Prepared for Samsung C&T Renewable Energy Australia Samsung

# Soil Technical Report

## Mangoplah BESS

August 2025

Project Number: 240779

# Document verification

| | |
|---|---|
| Project Title: | Mangoplah BESS |
| Project Number: | 240779 |
| Project File Name: | 240779_Mangoplah_BESS_Soil Tech Report_2025025 |

| Revision | Date | Prepared by | Reviewed by | Approved by |
|---|---|---|---|---|
| Draft v1 | 13/05/2025 | A. Conley | Nicola Smith | Nicola Smith |
| Final v1 | 28/08/2025 | A. Conley | Nicola Smith | Nicola Smith |

NGH Pty Ltd prints all documents on environmentally sustainable paper including paper made from bagasse

# Table of Contents



## Figures

## Table

# Acronyms and Abbreviations

| | |
|---|---|
| ASL | Above sea level |
| ASS | Acid Sulfate Soils |
| AWS | Automatic weather station |
| BESS | Battery Energy Storage System |
| BH | Borehole |
| BOM | Australian Bureau of Meteorology |
| BSAL | Biophysical Strategic Agricultural Land |
| Ca | Calcium |
| CEC | Cation Exchange Capacity |
| CIC | Critical Industry Clusters |
| cmol (+)/kg | centimoles per kilogram – equates to milliequivalents per 100g (meq/100g) |
| ha | Hectares |
| K | Potassium |
| kg | Kilogram |
| km | Kilometres |
| LGA | Local government area |
| LSC | Land and Soil Capability |
| LSSEG | Large -Scale Solar Energy Guidelines |
| m | Metres |
| meq/100g | Milliequivalents per 100 grams |
| Mg | Magnesium |
| mg | milligram |
| mg/kg | Milligram per kilogram |
| mm | millimetre |

| | |
|---|---|
| MW | Megawatt |
| MWh | Megawatt hours |
| N | Nitrogen |
| NATA | National Association of Testing Authorities |
| NEM | National Electricity Market |
| NSW | New South Wales |
| P | Phosphorus |
| S | Sulphur |
| SEED | The Central Resource for Sharing and Enabling Environmental Data in NSW |
| SSAL | State Significant Agricultural Land |
| sol. | solution |
| TOC | Total Organic Carbon |
| µS/cm | Microsiemens per centimetre |
| Zn | Zinc |

# Terms used in this report

| Term used in this report | Definition |
|---|---|
| **Involved Lands** | All lots and easements involved in the Project |
| **Project Site** | All areas within the Involved Lands impacted by the Project. Area of investigation for this report. |

# 1. Introduction

## 1.1. Purpose

NGH Pty Ltd (NGH) was engaged to carry out a Soil Survey (the assessment) to address the Secretary's Environmental Assessment Requirements (SEARs) for the proposed Mangoplah Battery Energy Storage System (BESS) (the Project) State Significant Development (SSD-77521135). The SEARs requests "*a soil survey to determine the soil characteristics and consider the potential for salinity, acid sulphate soils and erosion to occur*".

This report describes the soil characteristics at the Project Site. The assessment identifies the potential for salinity, acid sulphate soils and erosion to occur during construction, operation and decommissioning, and provide a benchmark of soil condition for rehabilitation.

- The Project Site is located in New South Wales (NSW), 3.1 kilometres (km) east of the village of Mangoplah, 30.6 km south of Wagga Wagga within the Wagga Wagga Local Government Area (LGA) on a 13.5 hectare (ha) section of three privately owned lots, identified as Lot 222 DP 754557 (siting of the BESS infrastructure), Lot 225 DP 754557 and Lot 228 DP 754557(access track upgrades).

The Project would have an intended capacity of 100 megawatts (MW)/ 400 MW hour (MWh) (4 hours).

## 1.2. Key components of the Project

Details of the Project are provided in the Table 1-1.

Table 1-1 Site identification details of the Project

| Site Identification | Description |
|---|---|
| Address | 4178 Holbrook Road, Mangoplah NSW 2652 |
| Lot and Deposited Plan numbers | • Lot 222 DP 754557<br>• Lot 225 DP754557<br>• Lot 228 DP754557 |
| Centre co-ordinates | X: 525859<br>Y: 6083811 |
| Investigated area size (proposed site and proposed access) | 13.5 ha |
| Local Government Area (LGA) | Wagga Wagga |
| Current land use | Grazing and cropping |

The Project includes the construction, operation and decommissioning of a Battery Energy Storage System (BESS) with a capacity of up to 100 MW and 400 MWh which would supply electricity to the National Energy Market (NEM) during peak periods.

The Mangoplah BESS will comprise, but is not limited to, the following key components identified in Table 1-2.

Table 1-2 Project key components

| Feature | Description |
|---|---|
| **Infrastructure components** | |
| **Battery Energy Storage System (BESS)** | • 100MW / 400MWh<br>• 108 Tesla Megapack 2XL<br>• 27 4.6step-up transformers<br>• 5 ring main units<br>• 1 HV transformer |
| **Substation and switch yard** | • 33 kilovolt (kV) switch room<br>• Auxiliary low-voltage transformer<br>• 33/132kV Transformer |
| **Transmission line connections** | • 132kV alternating current (AC) overhead line |
| **Site access and intersection upgrades** | • Access and upgrade from existing site access off Holbrook Road |
| **Temporary works areas: Construction compound, and construction parking/laydown areas** | • Construction compound<br>• Construction laydown area<br>• Storage<br>• Bunding<br>• Drainage<br>• Carpark |
| **Water access** | • Riverina Water County Council managed standpipe |
| **Permanent ancillary infrastructure** | • Security fencing<br>• Water tank<br>• Pumpable sewage holding tank<br>• Control room<br>• Diesel generator<br>• Onsite car parking<br>• Internal access tracks<br>• Landscaping |
| **Development footprint (all areas that may be disturbed by the Project)** | • The Development Footprint covers a total area of 13.5 ha |

## 1.3. Assessment approach

In the absence of BESS specific guidelines, the soil assessment has been undertaken in accordance with the Large-Scale Solar Energy Guidelines (LSSEG) (NSW Government, 2022), which includes requirements to undertake a soil survey.

The soil sampling and classification was undertaken in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO, 2009) and the *Australian Soil Classification* (Isbell, 2021). The density for number of boreholes completed was undertaken in accordance with the *Guidelines for Surveying Soil and Land Resources* (CSIRO, 2008) for a moderately (semi-detailed) intensity level.

# 2. Regional context

## 2.1. Property zoning

The entirety of the Project Site is zoned Primary Production (RU1) under the *Wagga Wagga Local Environmental Plan 2010*.

## 2.2. Climate and rainfall

The climate and rainfall of Wagga Wagga is typical of a temperate region. The hottest and driest months are December through February, and the wettest months are during the spring months (September through November). Winter is characterised with cool nights with daytime average temperatures in the mid to late teens. Figure 2-1 shows the average monthly climate statistics for Wagga Wagga with data collected for the period 1942 to 2025 recorded at the Wagga Wagga Australian Meteorological Office site number 072150, located approximately 40 km away.

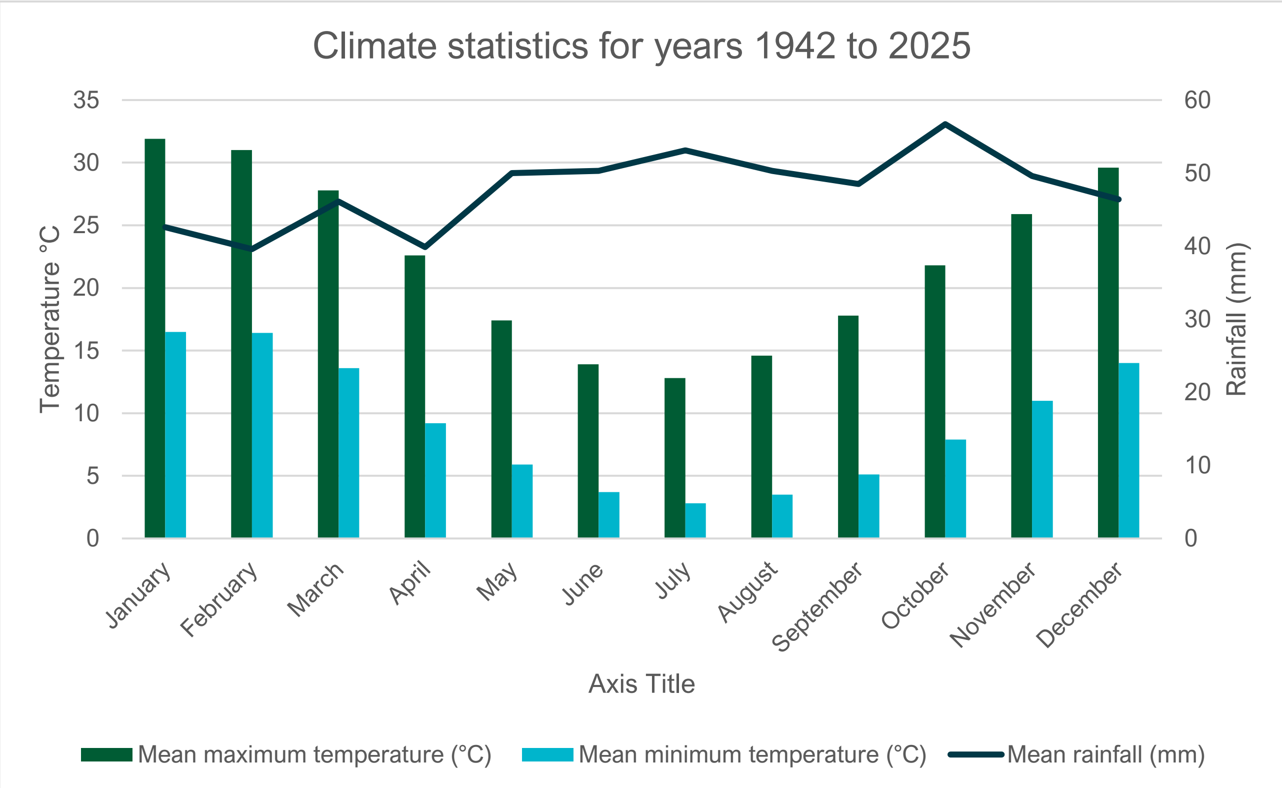



Figure 2-1 Climate Statistics 1997 to 2025 Wagga Wagga AMO site number 072150

## 2.3. Regional landform

### 2.3.1. Regional landform characteristics

The South Western Slopes Bioregion is a large area of foothills and ranges comprising the western fall of the Great Dividing Range to the edge of the Riverina Bioregion (NSW OEH, 2024). A very wide range of rock types is found across the bioregion, which is also affected by topographic and rainfall gradients that decrease toward the west.

These physical differences have an impact on the nature of the soils and vegetation found across the bioregion. Inland streams pass across the slopes in confined valleys with terraces and local areas of sedimentation. Geology, soils and vegetation are complex and diverse but typified by granites and meta-sediments, texture contrast soils and a variety of eucalypt woodlands, making this bioregion the southern equivalent of the Nandewar Bioregion. (NSW OEH, 2024).

### 2.3.2. Regional geology

The bioregion lies wholly in the eastern part of the Lachlan Fold Belt, which consists of a complex series of north to north-westerly trending folded bodies of Cambrian to Early Carboniferous sedimentary and volcanic rocks. Granites are common and mostly located in large scale upfolded bodies of rock (NSW OEH, 2024). Granite landscapes occur either as central basins surrounded by steep hills formed on contact metamorphic rocks, or as high blocky plateau features with rock outcrops and tors.

Hilly landscapes developed on sedimentary and volcanic rocks are controlled by structural features (bedding and faults) and typically form lines of hills extended along the strike of more resistant rocks such as quartzite (NSW OEH, 2024). The valleys between ranges are either in granite or generally softer rocks such as shale, phyllite or slate.

South Western Slopes region has limited areas of Tertiary basalt with underlying river gravels and sands. As the landscape becomes lower to the west and north, wide valleys filled with Quaternary alluvium and occasional lakes become the dominant landscape form (NSW OEH, 2024). At the western edge of the bioregion the alluvial fans of the Riverine Plain have largely buried bedrock forms. Remnants of earlier gravel deposition on these fans, indicative of higher river discharges than today, are found as terrace features in the valleys and as gravel outwash plains (NSW OEH, 2024).

Several limestone outcrops are known, all of which have developed karst topography and carry locally different vegetation. A narrow belt of serpentinite with chemically distinctive soil runs northwest from Tumut to Cootamundra. A very large number of mineral deposits have supported the mining industry over the past 150 years (NSW OEH, 2024).

# 3. Soil survey

## 3.1. Desktop assessment

### 3.1.1. Soils, topography and geology

A search of the Central Resource for Sharing and Enabling Environmental Data in NSW (SEED) database 01 May 2025 indicated that the subject land is mapped with the following features with a low data confidence.

- Land and Soil Capability (LSC); Class 3, Class 4 and Class 5 (refer Figure 3-1).
- Australian Soil Classification (ASC) of Sodosols, Chromosols, Kandosols and Kurosols (refer Figure 3-2).
- Great Soil Group of Red Podzolic soils, Red Podzolic soils – less fertile, non-calcic Brown soils, Sodolic Soils (refer Figure 3-3).
- Assessed as a combination of hydrologic soil group, access track is Very Slow, Slow and Moderate infiltration rates, with the Project Site (BESS infrastructure area) being Moderate infiltration and Slow infiltration.
- Moderate Soil Fertility and areas of Moderately low fertility (refer Figure 3-4).
- Gently undulating landscape.

The access track traverses a range of soil landscapes in addition to those captured by the area that will host the BESS infrastructure.

Soil landscapes (refer Table 3-1 and Figure 3-5) include:

- Pulletop
- Mangoplah
- Becks Lane
- O'briens Creek.

Table 3-1 Soil landscapes on site

| Soil Landscape | Features | Landscape Limitations |
|---|---|---|
| **Pulletop** | **Geology**<br><br>Shallow to moderately deep (40 – 100 cm) Mesotrophic Red Chromosols on crests, ridges and upper slopes; moderately deep (80 – 150 cm) bleached and Haplic Red Chromosols on mid to lower slopes, and moderately deep (80 – 150 cm) mottled Subnatric Brown Sodosols in drainage lines.<br><br>**Topography**<br><br>Undulating rises of Ordovician metasedimentary rocks. Local relief 15 – 40 m; slope gradients 3 – 10%. Broad crests and ridges, long, waning slopes and moderately broad drainage depressions. Extensively to completely cleared tall woodland. | Slight to moderate water erosion hazard, foundation hazard (localised), salinity (localised), strongly acid and locally shallow and stony soil. |

| Soil Landscape | Features | Landscape Limitations |
|---|---|---|
| **Mangoplah** | **Geology**<br>Soils are moderately deep (80 – 150 cm) Subnatric Red Sodosols.<br>**Topography**<br>Extensive level plains of Burkes Creek alluvial sediments. Local relief. | Low limitations. Streambank erosion (localised), acidity, locally hard setting soil. |
| **Becks Lane** | **Geology**<br>Thick (>2 m) slope-washed and alluvial-colluvial sands, clays and gravels, mostly derived from Ordovician metasedimentary rocks.<br>**Topography**<br>Very gently to gently inclined (2 – 4%), long (>300 m) foot slopes and piedmonts adjacent to hills and rises. Local relief is mostly 5 – 15 m within an elevation range of 200 – 300 m. Unidirectional (mostly parallel) drainage lines are shallow and narrow (<60m). | Moderate to high water erosion hazard. Foundation hazard (localised), acidity and locally hard setting soil. |
| **O'Briens Creek** | **Geology**<br>Soils are moderately deep (80 – 150 cm) Mottled Subnatric Red Sodosols and Mottled Mesonatric Brown Sodosols on plains; Mottled Subnatric Brown Sodosols near some channel zones.<br>**Topography**<br>Gently undulating plains of alluvial sediments. Local relief <10 m; slope gradients <3%. Extensive sloping plains adjacent to hillslopes, river channels and narrow drainage lines. | High to moderate water erosion hazard (localised) Foundation hazard (localised)<br>Streambank erosion (localised), waterlogging (localised), strong acidity, locally hard setting soil. |

## Land and Soil Capability mapping

Land capability is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources (NSW OEH, 2012). The NSW land and soil capability assessment scheme (NSW OEH, 2012) describes and maps eight land and soil capability classes. The classes range from 1 (best, highest capability land) and 8 (worst, lowest capability land). The classification is based on the biophysical features of the land and soil (including landform position, slope gradient, drainage, climate, soil type and soil characteristics) and susceptibility to hazards. Hazards include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement.

The BESS infrastructure would be located on Class 4 capability land. The existing access track traverses land mapped as Class 3, Class 4 and Class 5 capability land. The classes are described as:

- Class 3 – high capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
- Class 4 - Moderate capability land: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
- Class 5 - Moderate–low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.

Refer to Figure 3-1 for Land and Soil Capability (LSC) mapping across the Project site.

## Biophysical Strategic Agricultural Land

The 'NSW Government's Strategic Regional Land Use Policy' defines and identifies strategic agricultural land across NSW. Strategic agricultural land includes land with unique natural resource characteristic, known as biophysical strategic agricultural land (BSAL), and clusters of significant agricultural industries known as critical industry clusters (CICs). The Policy has been developed to achieve balanced land use outcomes, specifically between mining, coal seam gas and agriculture. The closest mapped BSAL is approximately 40 km north near Wagga Wagga NSW.

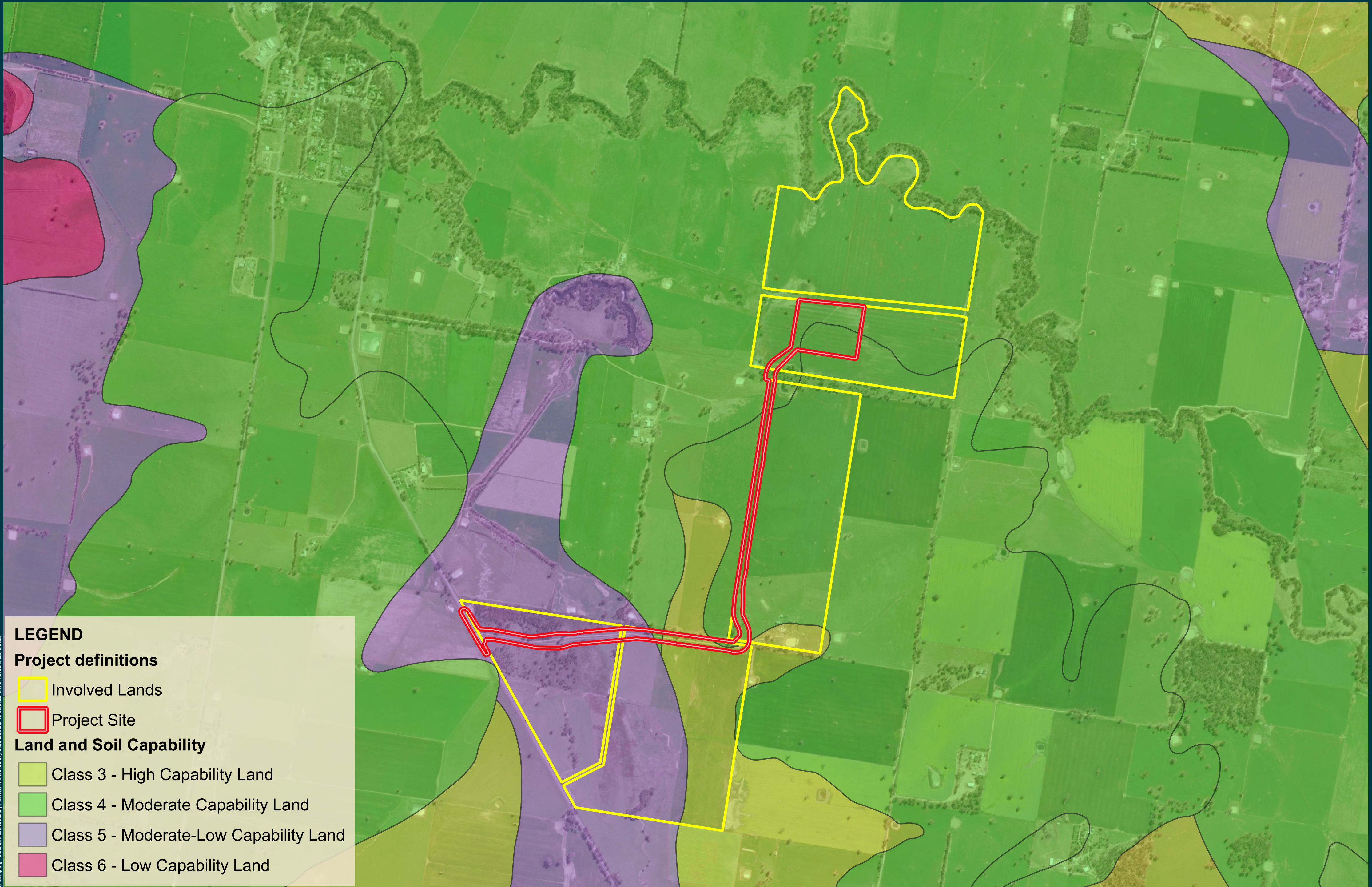
## State Significant Agricultural Land

The NSW Department of Primary Industries is undertaking a mapping program of State Significant Agricultural Land (SSAL). A map of SSAL is an essential component of agricultural land use planning, enabling clearer local planning with informed prioritisation of future land uses.

The Project is not located on the draft mapping for the SSAL and as such does not require further consideration for the Project.

## Acid Sulfate Soils

There is no land currently mapped on the Project Site as being impacted by Acid Sulfate Soils (ASS).



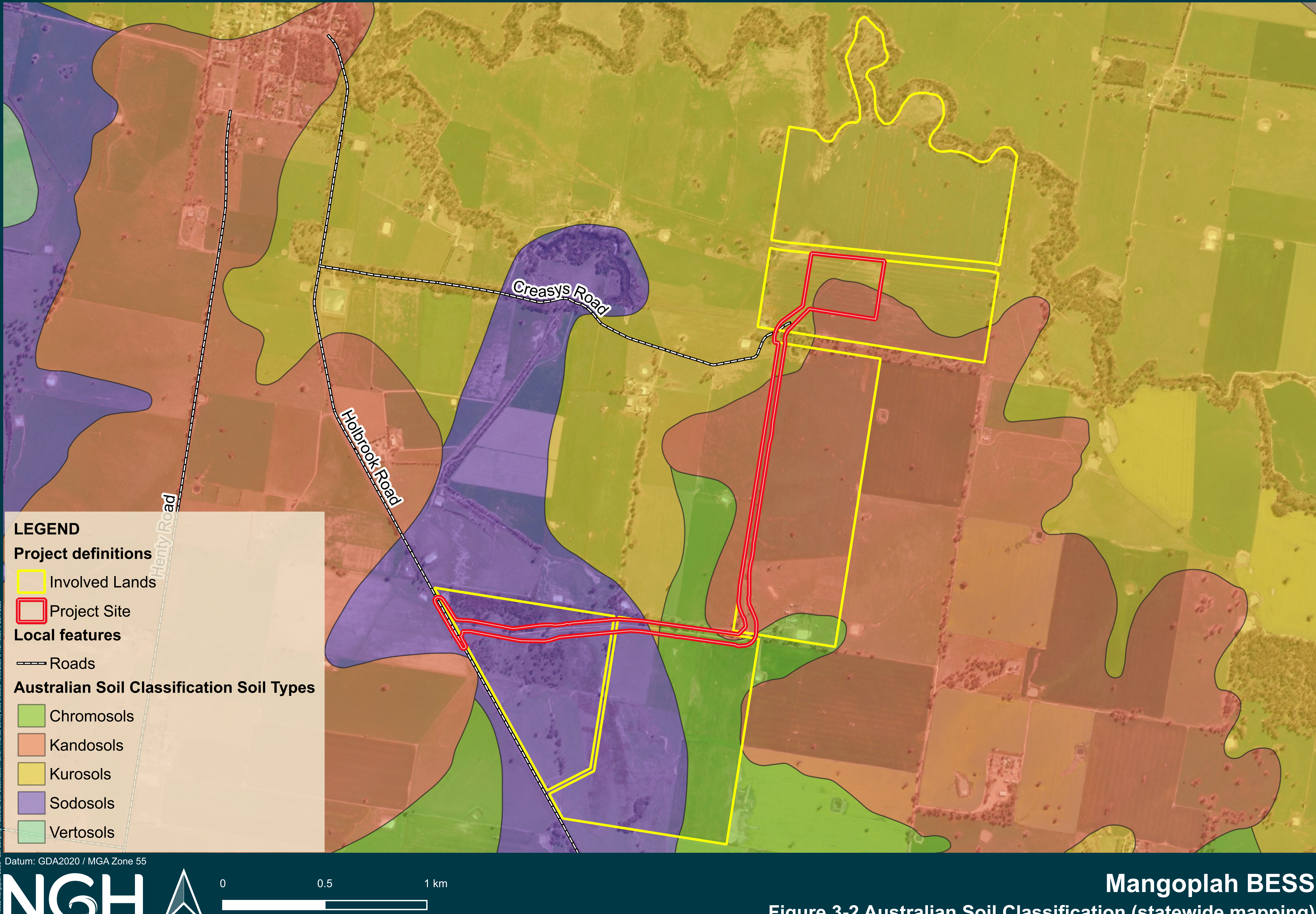

Datum: GDA2020 / MGA Zone 55

0 0.5 1 km

NGH

**Mangoplah BESS**

**Figure 3-1 Land and Soil Capability (statewide mapping)**

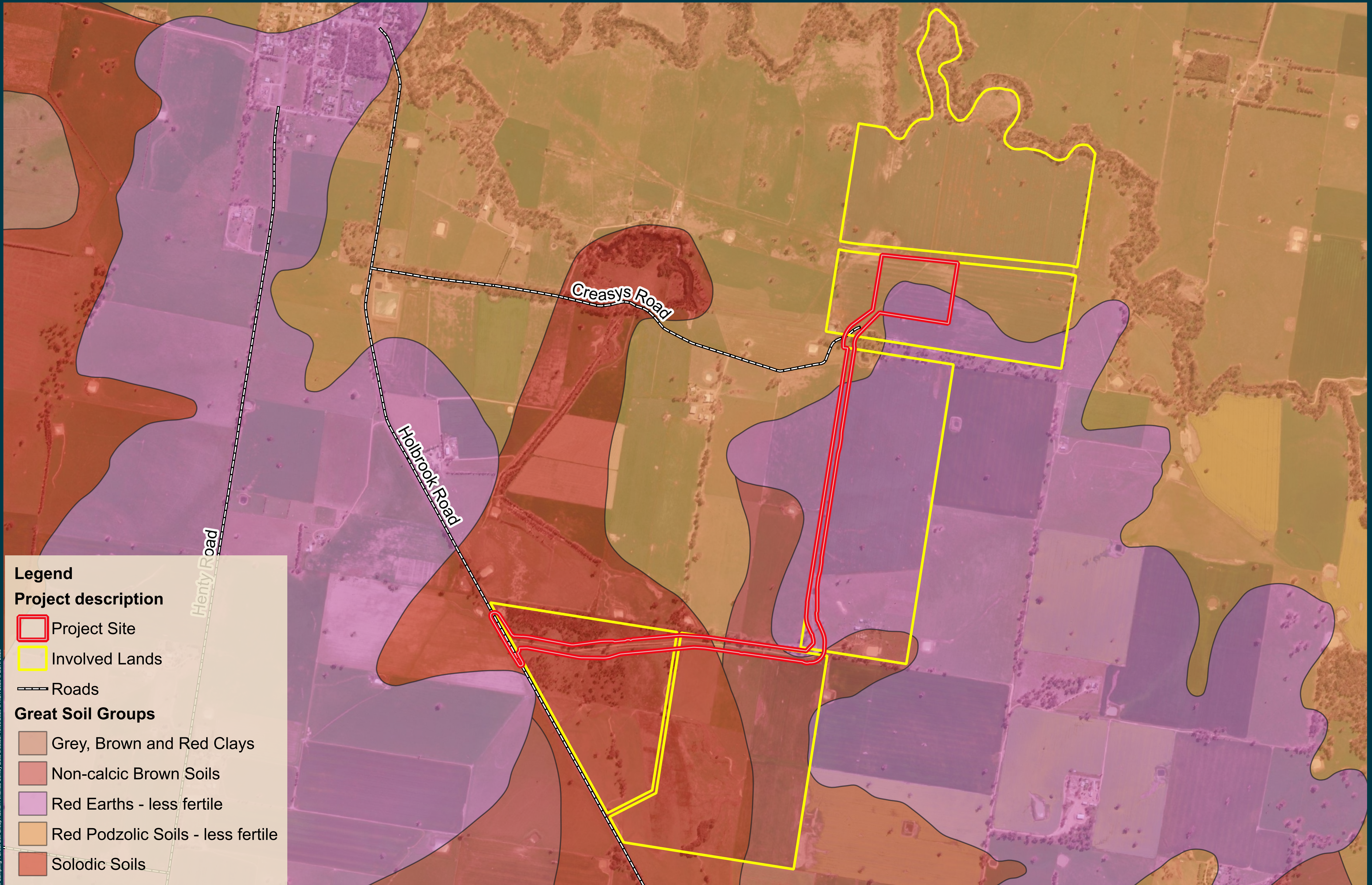



Ref: 240052 Mangoplah BESS - Soil Sampling | Australian Soil Classification Author: Amanda Conley Date created: 15.09.2025 © NGH 2025 © ESRI 2025

NGH

**Mangoplah BESS**

**Figure 3-2 Australian Soil Classification (statewide mapping)**

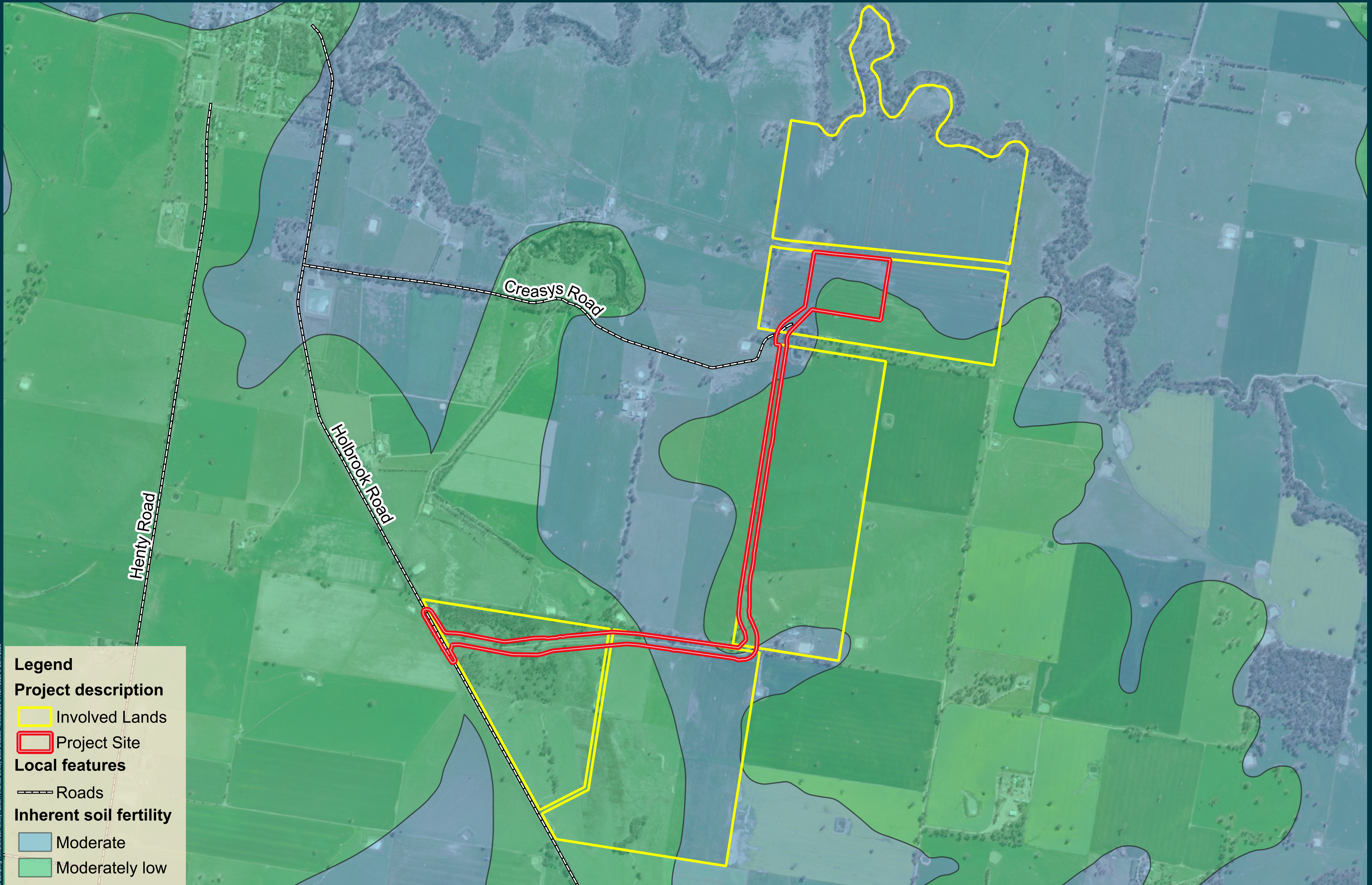



Datum: GDA2020 / MGA Zone 55

0 0.5 1 km

# Mangoplah BESS

## Figure 3-3 Great Soil Group (statewide mapping)

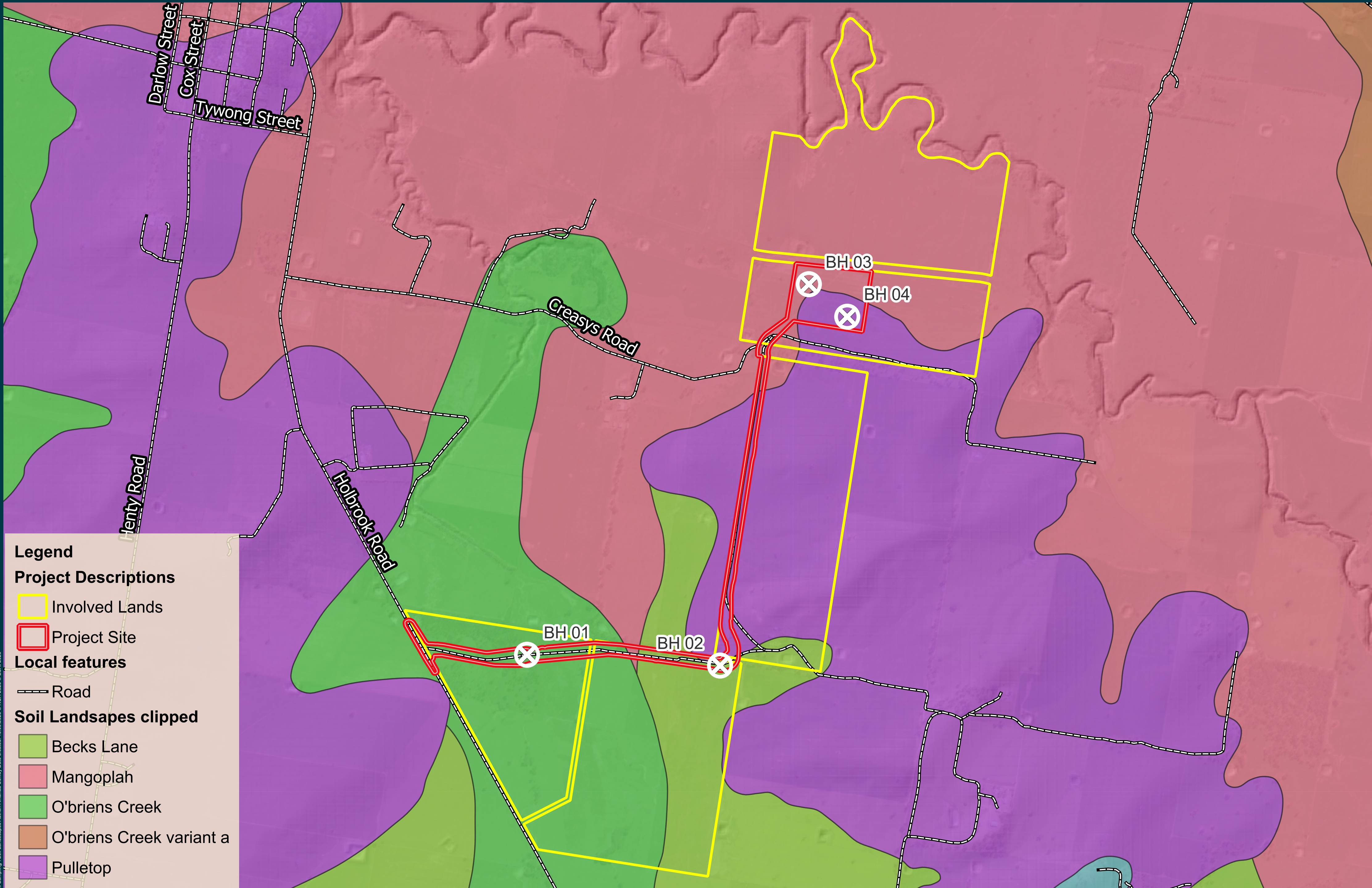



Datum: GDA2020 / MGA Zone 55

0 0.5 1 km

# Mangoplah BESS

## Figure 3-4 Inherent Soil Fertility (statewide mapping)




Datum: GDA2020 / MGA Zone 55

0 0.5 1 km

**Mangoplah BESS**

**Figure 3-5 Soil Landscapes**

## 3.2. Soil investigation, sampling and analysis

NGH executed an intrusive soil investigation comprised of a drilling program carried out in March 2025 using a 6.5 T S590 bobcat with an auger 450 millimetre (mm) wide to a depth of 1.5 metres below ground level (m bgl).

The soil sampling and classification was undertaken in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO, 2009) and the *Australian Soil Classification* (Isbell, 2021). The density for number of boreholes completed was undertaken in accordance with the *Guidelines for Surveying Soil and Land Resources* (CSIRO, 2008) for a moderately (semi-detailed) intensity level (refer Table 3-2)

Table 3-2 Recommended soil survey intensity

| Intensity level | Inspection density | Publication scale | Objectives |
|---|---|---|---|
| Moderately (semi-detailed) | 1 to 5 ha to 25 ha i.e. 4 to 20 per $km^2$ | 1:25 000 | Moderately intensive uses at 'field' level, detailed project planning |

The total number of four borehole locations was calculated as 1 per 6.39 ha. The boreholes (BH) were located within the Project Site including the existing access track, refer to Figure 3-6.


Ref: 240052 Mangoplah BESS - Soil Sampling \ Borehole location Author: Amanda Conley Date created: 15.09.2025 © NGH 2025 © ESRI 2025

NGH

**Mangoplah BESS**

**Figure 3-6 Borehole Locations**

## 3.3. Site Observations

The Project Site was observed to be gently undulating. The site is flat to gently rolling hills. The access track is devoid of plant growth, however, the edges of the track and the surrounding land have areas of dense native remnant vegetation of both grasses and overstory plant species. The Project site is predominantly covered in dense harvested crop with an opportunistic self-sown crop of canola emerging underneath. The land adjacent to the Project site on all sides has historically been used for dryland cropping and grazing enterprises.

Figure 3-7 Project Site is currently used for cropping, overstory vegetation is limited to fence lines

Surface conditions include:

- Vegetation covering up to 90% of the soil
- Cleared of tall standing native vegetation in the Project Site
- All boreholes were terminated at full depth of 1.5 m.

## 3.4. Laboratory results and analysis

### 3.4.1. Topsoil

Four topsoil samples were analysed by Southern Cross University Environmental Analysis Laboratory, a National Association of Testing Authorities (NATA) accredited laboratory.

The suite of analytes included:

- Potential of Hydrogen (pH) (1:5 CaCl2) (pH units) – appropriate for assessing conditions for plant growth (ideal 6.5-7.0)
- Electrical conductivity (EC) (1:5 water) (µS/cm)
- Chloride (mg/kg)
- Exchangeable Cations (Calcium, Magnesium, Sodium, Potassium) plus effective cation exchange capacity (CEC) (%)
- Exchangeable Sodium Percentage (ESP) (%) (ideal <1%)
- Nitrogen – Total Nitrogen as N (mg/kg)
- Nitrogen – Total Kjeldahl Nitrogen as N (mg/kg)
- Phosphorous – Total Phosphorus as P (mg/kg)
- Phosphorus – Extractable (Bray) (mg/kg)
- Phosphorus – Extractable (Olsen) (mg/kg) (ideal range 14-20 mg/kg)
- Sulfur – Total Sulfur as S (%)
- Total Organic Carbon (TOC) (%) (ideal <2%)
- Total Metals – Zinc (mg/kg).
- Emerson Aggregate Test (EAT)
- Particle Size Analysis (PSA).

The laboratory certificates are included in Appendix A.

### 3.4.2. Subsoil

Six subsoil samples were analysed from the 0.15 – 1.5 m depth by Southern Cross University Environmental Analysis Laboratory, a NATA accredited laboratory.

The suite of analytes included:

- pH (1:5 CaCl2) – appropriate for assessing conditions for plant growth (ideal 6.5-7.0)
- EC (1:5 water) (µS/cm)
- Chloride (mg/kg)
- Exchangeable Cations (Calcium, Magnesium, Sodium, Potassium) plus effective CEC (%)
- ESP (%) (ideal <1%)
- Phosphorous - Total Phosphorus as P (mg/kg)
- Phosphorus – Extractable (Bray) (mg/kg)
- Phosphorus – Extractable (Olsen) (mg/kg) (ideal range 14-20 mg/kg)
- Sulfur - Total Sulfur as S (%)
- Total Organic Carbon (TOC) (%) (ideal <2%)
- Total Metals – Zinc (mg/kg).
- EAT
- PSA.

The laboratory certificates are included in Appendix A.

### 3.4.3. Nutrient status

#### Soil CEC

The amount of positively charged cations a soil can hold is described as the CEC and is expressed in centimoles per kilogram (cmol(+)/kg). The larger this number, the more cations the soil can hold.

The soil CEC is an indicator of how big a soil is (the bigger the number), the bigger the soil the higher the clay content. Table 3-3 shows generalised classification of soil based on its CEC. Table 3-4 details the CEC ranges of the boreholes tested and reports on the classification range reporting from topsoil to samples at depth.

Table 3-3 CEC soil classification EAL Lismore 2025

| Heavy Soil – Clay | Medium Soil – Clay Loam | Light Soil – Loam | Sandy Soil – Loamy Sand |
|---|---|---|---|
| 20.1 | 14.3 | 7.8 | 3.3 |

Table 3-4 CEC values across boreholes and depths

| Borehole | CEC ($cmol_+$/kg) 0.0-0.20 | CEC ($cmol_+$/kg) 0.5-1.0 | Classification |
|---|---|---|---|
| BH01 | 5.7 | 16.5 | Loamy sand |
| BH02 | 3.7 | 8.3 | Sand |
| BH03 | 7.3 | 9.8 | Loam |
| BH04 | 5 | 11 | Loamy sand |

Overall, the soils are typical of a light/ small soil and are not likely to hold a high volume of nutrients in the topsoil.

#### pH

Soils can be classified according to their pH value (QLD Government, 2024):

- 6.5 to 7.5 – neutral
- Over 7.5 – alkaline
- Less than 6.5 – acidic
- Less than 5.5 – strongly acidic.

Table 3-5 details the pH results for all sample locations and all sample depths. Overall, the soils are neutral to acidic.

Table 3-5 pH results for BH locations and depths

| Borehole (m bgl) | pH | Rating |
|---|---|---|
| **BH01** 0.0-0.2 | 5.98 | Acidic |
| **BH01** 0.5-1.0 | 6.51 | Neutral |
| **BH02** 0.0-0.2 | 5.76 | Acidic |
| **BH02** 0.5-1.0 | 6.96 | Neutral |
| **BH03** 0.0-0.2 | 6.07 | Acidic |
| **BH03** 0.5-1.0 | 6.74 | Neutral |
| **BH04** 0.0-0.2 | 7.04 | Neutral |
| **BH04** 0.5-1.0 | 6.05 | Acidic |

## Exchangeable cations

**Calcium** is a necessary plant nutrient. It plays a key role in maintaining soil structure and is generally present in high concentrations in the soil solution — even at low pH (Agriculture Victoria, 2023).

Exchangeable calcium should be 5 to 10 meq/100g and in the range of 65 to 80% of the total cations present (Agriculture Victoria, 2023).

For all sample locations in the top 0.0-0.2 m bgl, the exchangeable calcium was considered to be low with all BH reporting values less than 5 meq/100g. Values reported for the subsoils (0.5-1.0 m bgl) for BH01 and BH02 are considered deficient, recording values less than 5 meq/100g. Whereas both sample depths tested for BH03 and BH04 are within the ideal range with both recording values between 5 and 10 meq/100g.

## Base Saturation (exchangeable cations %)

**Magnesium** is also a necessary plant nutrient. It is usually present in sufficient quantities to satisfy plant requirements (Agriculture Victoria, 2023).

- Exchangeable magnesium should be 1 to 3 meq/100g and in the range of 10 to 20% of the total cations present (Agriculture Victoria, 2023).
- If exchangeable magnesium is more than 20% of the sum of cations present, it may result in potassium deficiency in plants and animals (Agriculture Victoria, 2023).

All topsoil samples for all borehole locations recorded results are considered within the ideal range of 1-3 meq/100g.

The base saturation for the topsoils is recorded as 37% for BH01, which is considered excessive and 20% for BH03, which is at the high end of the ideal range. At 0.5-1.0 m bgl, BH02 is recorded a value of 14% and BH04 recorded a value of 19%.

Subsoil magnesium levels are considered excessive for BH01, BH02 and BH04. The base saturation for all subsoils are considered extremely excessive and unbalanced. The recorded values BH01 56%, BH02 48%, BH03 29% and BH04 42% are indicative of extremely unbalanced soils.

Excessive levels of magnesium will generally make the soils tighter (reduce the pore space) and less responsive to rainfall (limits movement of water through the soil profile). Balancing these soils with an appropriate application of lime will open (increase the pore space) up these soils to enable better movement of water from the surface down though the soil profile.

**Potassium** is an essential plant nutrient and is required in larger amounts (Agriculture Victoria, 2023).

- Exchangeable potassium should be 0.3 to 0.7 meq/100g and in the range of 3 to 8% of the total cations present (Agriculture Victoria, 2023). For the soil testing by EAL the upper limit is 0.6 meq/100g for the heaviest soil.
- If the exchangeable potassium level is more than 10% of the sum of cations, it may cause magnesium deficiency in plants and animals (Agriculture Victoria, 2023).

BH01, BH03, and BH04 all recorded values within the ideal range. BH02 recorded a value of 0.87 meq/100g, slightly above the upper end of the ideal range. All subsoils recorded values within the ideal range.
Base saturation results indicate that except for BH01 (6.2%), all topsoils are in excess of the ideal range with BH02 recording 24% of the cation sites are taken up by potassium.

**Sodium –** ideally exchangeable sodium should be <0.7 meq/100g and less than 1% of the total cations present (Agriculture Victoria, 2023).

If sodium makes up 6% or more of the total cations present, then the soil may be sodic and susceptible to dispersion, which is where a soil may lose structural integrity, compact and form surface crusts (Agriculture Victoria, 2023).

Table 3-6 describes the laboratory results for the plant available and exchangeable sodium percentage to evaluate sodicity potential.

Table 3-6 Consolidated plant available and exchangeable sodium percentage (ESP)

| BH (m bgl) | Sodium meq/100g | ESP (Base Saturation) | Sodic Y/N |
|---|---|---|---|
| **01** (0.0-0.2) | 0.24 | 4.3 | N |
| **01** (0.5-1.0) | 2.7 | 16 | Y |
| **02** (0.0-0.2) | 0.065 | 0.5 | N |
| **02** (0.5-1.0) | 0.25 | 0.3 | N |
| **03** (0.0-0.2) | 0.036 | 0.6 | N |
| **03** (0.5-1.0) | 0.036 | 0.6 | N |
| **04** (0.0-0.2) | 0.065 | 0.3 | N |
| **04** (0.5-1.0) | 0.25 | 2.3 | N |

BH 01 (0.5-1.0 m bgl) recorded sodium values above the ideal for both the exchangeable pool. The base saturation exchangeable sodium percent (ESP) was recorded at 16% and is considered extremely sodic and has the potential to be dispersive when wet. BH01 is associated with the access track and LSC 5 refer (Figure 3-1).

All other values recorded for all other sample locations and depths are considered low, non - sodic and do not have the potential to be dispersive when wet.

## Organic carbon

Organic carbon is a measure of the organic matter present in soil. Organic matter results from partly decayed plant and animal residues in various degrees of decomposition. It assists in maintaining:

- Soil structure
- The supply and retention of nutrients
- Air
- Water

If a soil is low in organic matter, the soil test will result in a low organic carbon level (Agriculture Victoria, 2023).

Generally, a minimum of 2% is ideal for a soil in low rainfall areas. BH02 recorded a value of 1.78% which is considered low, all other samples tested had less than 1% organic carbon, which is considered extremely low.

## Phosphorus

Phosphorus (P) is essential for plant growth and for early root formation. Bray P (refer Table 3-7) has been considered a test that measures the quantity of (potentially available) P. Topsoil results for P are generally extremely low and are considered deficient.

The current mapped land use for the Project Site is dryland and irrigated pastures. Table 3-8 displays the ideal phosphorus levels for the soil, Table 3-8 describes the laboratory topsoil results for each Borehole.

Table 3-7 Bray P levels (DPI, 2025).

| Land use | Bray P level (mg/kg) |
|---|---|
| **Dryland pasture** | 15-20 |
| **Irrigated and improved pasture** | 25-30 |
| **Tree crops** | 30-50 |
| **Vegetables** | >50 |

Table 3-8  Soil Phosphorus results (Bray 1)

| Borehole | P mg/kg | Soil test range |
|---|---|---|
| **BH01** | 2.4 | Extremely Low |
| **BH02** | 10 | Low |
| **BH03** | 2.5 | Extremely Low |
| **BH04** | 4.1 | Extremely Low |

## Potassium

Potassium (K) is essential to plant health, growth and development. The ideal level is >0.5 meq/100g (Agriculture Victoria, 2023). Both samples of BH01, and BH02 (0.5-1.0 m bgl), are below the ideal range. All other sites have recorded results above 0.5 meq/100g.

## Calcium:Magnesium ratio

Well-structured soils generally have twice the amount of exchangeable calcium to exchangeable magnesium. If the ratio is less than 2:1, this may indicate reduced soil stability (Agriculture Victoria, 2023).

Topsoils – BH01 has a value less than 2:1 and may indicate reduced soil stability. All other topsoils have recorded values above 3:1 and may indicate a stable soil structure.

Subsoils – BH01, BH02 and BH04 all have results recorded less than 2:1 and indicate poor structural stability in the subsoils. BH03 has a ratio of 2.2:1 and would be considered ideal.

## Total Nitrogen

Total nitrogen (%) for the topsoil samples fall within the noted range of low with all samples tested returning values between 0.08% (BH04) and 0.14% (BH02), refer Table 3-9.

Table 3-9  Total nitrogen values and ratings (Apal, 2023)

| Rating (% by weight) | Description |
|---|---|
| **<0.05** | Very Low |
| **0.05 - 0.15** | Low |
| **0.15 - 0.25** | Medium |
| **0.25 – 0.50** | High |

| Rating (% by weight) | Description |
|---|---|
| **0.50** | Very High |

### 3.4.4. Erosivity

Emerson Class analysis measures the tendency of the clay fraction of a soil to go into colloidal suspension in water, forming a cloud around the soil particle (Alliance, 2024), refer Table 3-10. The Emerson Aggregate Test classifies the behaviour of soil aggregates when immersed in water. The results are categorised 1 (extremely dispersive) to 8 (non-dispersive).

Table 3-10 Emerson class description

| Emmerson Class | Description | Potential for Erosion |
|---|---|---|
| **1** | Slaking with complete dispersion | High |
| **2** | Slaking with some dispersion | High |
| **3** | No dispersion from air dry. Full dispersion when remoulded and tested from field capacity moisture. | Moderate to High |
| **4** | Slaking with no dispersion, remoulded and immersed immediately in water no dispersion Carbonate or Gypsum present. | Low |

#### Dispersion risk

All sampled and tested soils are considered dispersive. All topsoils returned EAT values of 3 indicating they have a moderate to high risk for erosion.

BH02 (0.5-1.0 m bgl) returned an EAT value of 3 and has a moderate to high risk for erosion.

All other subsoils recorded EAT values of 2 which indicate that they have a high risk of erosion following disturbance events.

#### Sodicity

Soil sodicity is the accumulation of sodium salt relative to other types of cations, especially calcium. Sodic soils are characterised by poor soil structure, vulnerable to erosion, low infiltration rate and dispersion. Soils with six percent or more of sodium as a percentage of the total exchangeable cations are considered sodic and are at risk of dispersion. Soils with sandy topsoil and dense clay subsoil may have severe problems at depth without any surface signs (Table 3-11).

Except for BH01 (0.5-1.0 m bgl), which recorded an ESP of 16% and is considered highly sodic, all other topsoil and subsoil test locations recorded values less than 6% and are considered non-sodic.

Table 3-11 Sodicity rating adapted from W.A. Department of Primary Industries and regional development (Agriculture and Food) (2023))

| Rating | ESP |
|---|---|
| Non-Sodic | <6 |
| Slightly sodic | 6-10 |
| Moderately sodic | 6-10 |
| Highly sodic | >15 |

## Salinity

Soil salinity is a measure of the minerals and salts that can be dissolved in water. Increased soil salinity has progressive and profound effects on the structure, water movement, and microbial and plant diversity of soils. Soil salinity is measured using electrical conductivity measurements of a water saturated soil paste extract.

The electrical conductivity of a saturated soil extract ($EC_e$) is the most useful and reliable measure of salinity for comparison between soil types as it accounts for soil texture. Conventionally, saline soils are defined as those having and $EC_e$ >4 dS/m. All soils at all sample locations and all depths are considered non – saline. Table 3-12 describes the classification of soil based on the $EC_e$ values found in the soil.

Table 3-12 Salinity ratings for soil based on ECe

| Rating | $EC_e$ dS/m |
|---|---|
| Non – saline | <2 |
| Slightly saline | 2 – 4 |
| Moderately saline | 4 – 8 |
| Highly saline | 8 – 16 |
| Extremely saline | >16 |

All samples recorded for all boreholes returned values less than 2 dS/m and are considered non-saline.

# 4. Summary and recommendations

## 4.1. Desktop assessment

The desktop assessment indicates that the topsoil and subsoil of the proposed Project Site is a combination of:

- Class 3, Class 4 and Class 5 soils as per the Statewide mapping of Land and Soil Capability (LSC) (refer Figure 3-1)
- Australian Soil Classification (ASC) of Sodosols, Chromosols, Kandosols and Kurosols (refer Figure 3-2)
- Great Soil Group of Red Podzolic soils, Red Podzolic soils – less fertile, non-calcic Brown soils, Sodolic Soils (refer Figure 3-3)
- Moderate Soil Fertility and areas of Moderately low fertility (refer Figure 3-4)
- Assessed as a combination of hydrologic soil group, access track is Very Slow, Slow and Moderate infiltration rates, with the Project Site (BH03 and BH04) being Moderate infiltration and Slow infiltration.

Soil landscapes (refer Figure 3-5) include:

- Pulletop
- Mangoplah
- Becks Lane
- O'briens Creek.

Mapped soils in the Project Site are described below.

**Kandosols,** which lack a strong texture contrast, have a massive or only weakly structured B horizon and are not calcareous throughout and have the following features (Isbell, 2021):

- B2 horizons in which the major part has a grade of pedality that is massive or weak
- A maximum clay content in some part of the B2 horizon that exceeds 15%
- Do not have a clear or abrupt textural B horizon
- Are not calcareous through the solum or below the A1 horizon or to a depth of 0.2 m if the A1 horizon is only weakly developed.

BH04 is located within this soil type and conforms to this Australian Soil Classification soil description for Kandosols.

**Kurosols** have a strong texture contrast between A horizons and strongly acid B horizons. Many of these soils have some unusual subsoil chemical features (high magnesium, sodium and aluminium). These soils have a clear or abrupt textural B horizon in which is strongly acid (Isbell, 2021):

- pH levels closer to neutral, and moderate magnesium, low sodium and low aluminium levels.

BH03 is located within this ASC soil description, but the laboratory results and site observations indicate that the soils tested for BH03 do not conform to this ASC definition.

**Chromosols** have a strong texture contrast between A and B horizons. Strong texture contrast is referred to as a 'clear or abrupt textural B horizon' in the ASC (for a definition, see Isbell (1996) in Appendix 1):

- Their B2 horizons are not strongly acid, and are not sodic (ESP < 6) in their upper 0.2 m (or the major part of the B2 horizon if it is less than 0.2 m thick)
- Strongly acid soil, as defined in the ASC, has a pH less than 5.5 (1:5 soil : $H_2O$) in the fine earth soil material (< 2 mm), or less than 4.6 (1:5 soil : 0.01M $CaCl_2$) (DPI, 2024).

The laboratory results and site observations are consistent with this description of Chromosols with all BH02 samples being non-sodic in topsoil and subsoil and recorded pH above 5.5 ($H_2O$).

**Sodosols** are soils with a strong texture contrast between A horizons and sodic B horizons that are not strongly acid (Isbell, 2021): BH01 is located in this soil type and conforms with this description, with a sodic B horizon (16%).

**Land and soil capability** – the Project Site (siting of the BESS infrastructure) is mapped as Class 4 – moderate capability land, the access track is a mix of Class 3, Class 4 and Class 5.

## 4.2. Laboratory assessment

The results of topsoil laboratory analysis indicate:

- Topsoil pH values are generally acidic. As soils become more acidic, the soils become nutrient limiting, and some less ideal nutrients become more available (e.g. aluminium) and become toxic for most plants.
- The CEC in the topsoil ranges from 3.7 to 7.3 meq/100 g. CEC is the capacity of the soil to hold and exchange cations by electrical attraction and is a useful indicator of soil fertility. It demonstrates the ability of the soil to supply three big nutrients being calcium, magnesium and potassium. The CEC is low for all topsoils analysed. This means that the soil has more sand characteristics and higher levels of sand and a low capacity to hold onto these nutrients.
- Generally, the soils are deficient in plant available nitrogen.
- Topsoil phosphorus both total and available are deficient. The application of both a short-term P and a medium to long term P source would assist with site revegetation.
- All topsoils are considered non-sodic in the topsoil 0.0-0.20 m bgl
- Emerson aggregate test results indicate Class 3. The topsoils are considered dispersive with moderate to high risk of dispersion.
- The topsoil organic carbon content is considered low for the topsoil across the site.

The results of the subsoil laboratory analysis indicate:

- The pH of the subsoil is neutral.
- The CEC in the subsoil ranges from 8.3 to 16.5 meq/100g indicating these are light to medium clays.
- Subsoil results indicate that they are non- sodic except for BH01.
- Generally, the fertility of the soil is low.
- BH01 subsoil is highly dispersive. Management measures should be undertaken to minimise areas of disturbance and potential erosion during upgrade to the existing access track.

## 4.3. Summary and recommendations

Except for BH03, the results of the laboratory analysis indicate that the topsoil and subsoils are consistent with their allocated Australian Soil Classification. The transition between ASC classification could mean that BH03 is within the transitional zone between Kurosols and Kandosols.

All topsoils recorded electrical conductivity values of <6 indicating that they are not saline. BH01 was considered sodic and with a highly dispersive subsoil. All topsoils returned EAT values of 3 indicating they have a moderate to high risk for dispersion and moderate to high risk of erosion.

Dispersive soils are structurally unstable and breakdown or disperse into a slurry when exposed to fresh water (e.g. rain). These soils should not be worked when they are wet or powder dry. Once disturbed, they have the tendency to be hard setting and will make revegetation difficult. To overcome this, in areas that are to be revegetated, it is recommended that a high quality, nutrient balanced (site specific) certified humus compost be gently worked into the top 100 mm prior to reseeding.

Dispersive subsoils can lead to tunnel and gully erosion and would require amelioration using gypsum at a rate of 5 tonne per hectare if subsoils are to be disturbed or trenching activities are to be undertaken. Under the right conditions, adding lime or gypsum to dispersive soils decreases the ESP, reducing dispersion and increasing soil stability. Calcium ions displace some of the sodium ions on the surface of soil particles allowing the sodium ions to leach out (WA PIRD, 2025).

During construction, measures will be required to manage the dispersive nature of this soil while forming the access road to minimise dispersive behaviour and manage the structural integrity of the access track during the life of the Project. As part of the mitigation strategies a soil and water management plan with project erosion and sediment control plan would be prepared to manage soil and water during construction. Examples of measures might include erosion controls, staged disturbance, addition of a soil amendment, over compaction to prevent infiltration.

The results of this soil report should be used to inform rehabilitation following disturbance. Areas of ground disturbance should be rehabilitated as soon as practicable, and no longer than three months following completion of an area.

The soils sampled at this site have poor nutrient status and an unbalanced cation exchange capacity. It is important to rehabilitate the soil to support the growth of soil stabilising pasture species that will stabilise the soil for the life of the project (in areas not covered in hardstand, tracks or infrastructure), to prevent the loss of soil due to erosional processes and to rehabilitate the soil on decommissioning.

The levels of plant available P detected is considered extremely low in most surface soil tested. Amelioration would be required to restore this site to have the capacity to support pasture growth in the future (post operation).

In areas that are not hardstand or permanent infrastructure, organic matter could be improved by retaining plant cover and encouraging microbial activity to breakdown and fix organic carbon into the soil.

It is recommended that there is comprehensive topsoil sampling and analysis on decommissioning of the Project to verify and rehabilitate soil nutrient status to support future agricultural practices.

# 5. Safeguards and mitigation measures

<table>
<tr><th>Safeguard and mitigation measures</th><th>Timing</th></tr>
<tr><td>Progressive Erosion and Sediment Control Plans (ESCP) and Soil and Water Management Plan (SWMP) will be prepared for the Project in accordance with Landcom Soils and Construction: Managing Urban Stormwater (Landcom, 2004) and include, but not be limited to:<ul><li>Minimising the extent and duration of ground disturbance</li><li>Progressive rehabilitation of disturbed areas</li><li>Stockpile management of topsoil to prevent soil structural decline. Topsoil will be stripped and stockpiled separately. Stockpiles will be stabilised with a groundcover (i.e. geotextile or similar) if stockpiling is required for more than six weeks</li><li>Maintain at least 70% groundcover where applicable throughout the site during operation to reduce the risk of erosion.</li><li>Subsoil management should be included in the SWMP to manage subsoil disturbance in areas prone to dispersion (e.g. road formation, trenching activities).</li></ul></td><td>Construction;<br>Operation;<br>Decommissioning</td></tr>
<tr><td>A comprehensive agronomic nutrient soil survey sampling and analysis prior to construction to establish a baseline nutrient data set would be undertaken to:<ul><li>Support rehabilitation of the Project Site land to Class 4 Agricultural land on decommissioning.</li><li>Support preparation of the vegetative screening area (if relevant) to provide a growing environment which is conducive to achieving a successful vegetative screen.</li></ul></td><td>Pre-construction and decommissioning</td></tr>
<tr><td>The design, construction and decommissioning of the project should minimise the extent and duration of ground disturbance.</td><td>Construction;<br>Decommissioning</td></tr>
<tr><td>Progressively rehabilitate any area of the Project Site not under hardstand, road or infrastructure to reduce erosion impacts to disturbed soil.</td><td>Construction;<br>Decommissioning</td></tr>
<tr><td>A Revegetation and Rehabilitation Plan for decommissioning should be prepared and include stabilisation and topsoil amelioration (e.g., incorporation of organic matter to improve soil structure or gypsum to improve structure, reduce hard-setting surfaces and reduce soil dispersion).</td><td>Decommissioning</td></tr>
<tr><td>Avoid altering the groundwater and surface water regime to prevent mobilisation of any salt stores, however low, in the soil.</td><td>Construction</td></tr>
<tr><td>Reference the soil survey results (this document), Australian Soil and Land Survey Handbook (CSIRO, 2009), Guidelines for Surveying Soil and Land Resources (CSIRO, 2008) and the Land and Soil Capability Assessment Scheme: second approximation (NSW OEH, 2012) when returning the site to the BESS farmland capability.</td><td>Decommissioning</td></tr>
</table>

# 6. References

Agriculture Victoria. (2023). *Understanding soil tests for pastures.* Retrieved from Agriculture Victoria Farm management Soil: https://agriculture.vic.gov.au/farm-management/soil/understanding-soil-tests-for-pastures

Alliance. (2024). *Emmerson Class*. Retrieved from Allicance Geotechnical and environmental solutions: https://allgeo.com.au/testing/emerson-class/

Apal. (2023). Retrieved from Apal Agricultural Laboratory Soil test Interpretation Guide: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.hort360.com.au/wordpress/uploads/Nutrient/Decision/Soil_Test_Interpretation_Guide_1.pdf

CSIRO. (2008). *Guidelines for Surveying Soil and Land Resources.*

CSIRO. (2008). *Guidelines for Surveying Soil and Land Resources.* CSIRO.

CSIRO. (2009). *Australian Soil and Land Survey Field Handbook.* CSIRO.

CSIRO. (2009). *Australian Soil and Land Survey Field Handbook .*

DPE. (2024). *The Riverina Bioregion*. Retrieved from NSW Department of Planning and Environment: https://www.environment.nsw.gov.au/resources/nature/riverinaText.pdf

DPI. (2024). *Vegetable SOILpak*. Retrieved from SOILpak: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/127268/Red-brown-earths.pdf

DPI. (2025). *How to interpret your soil test.* https://www.dpi.nsw.gov.au/about-us/services/laboratory-services/soil-health/interpret.

DPIRD, W. (2023). *Identifying dispersice (sodic)soil.* Retrieved from Department of Primary Industries and Regional Development Agriculture and Food: https://www.agric.wa.gov.au/dispersive-and-sodic-soils/identifying-dispersive-sodic-soils

Isbell. (2021). *Australian Soil Classification .*

Landcom. (2004). *Managing Urban Stormwater.* NSW Government.

NGH. (2024). *Armidale East BESS Environmental Impact Statement.* NGH Pty Ltd.

NSW Government. (2022). *Large-Scale Energy Guideline.* State of New South Wales through Department of Planning and Environment.

NSW OEH. (2012). *The land and soil capability assessment scheme Second appoximation.* Retrieved from Environment NSW Government: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/land-soil-capability-assessment-scheme-120394.pdf

NSW OEH. (2012). *The land and soil capability assessment scheme: Second approximation.* Offie of Environment and Heritage.

NSW OEH. (2024). *Riverina Bioregion Chapter 10*. Retrieved from NSW Environment and Heritage bioregions of NSW: https://www.environment.nsw.gov.au/resources/nature/nswSouthWesternSlopes.pdf

QLD Government. (2024). *Soil pH*. Retrieved from Soil Properties: https://www.qld.gov.au/environment/land/management/soil/soil-properties/ph-levels

WA PIRD. (2025). *Manging Sodic Soils .*

# Appendix A Laboratory Certificate

# Certificate of Analysis E25-00-2385

| Client: | NGH Pty Ltd | Laboratory: | Environmental Analysis Laboratory |
|---|---|---|---|
| Contact: | [redacted] | Contact: | EAL Customer Service Team |
| Address: | [redacted] | Address: | Military Road, East Lismore NSW 2480, Australia |
| Telephone: | [redacted] | Telephone: | (02) 6620 3678 |
| Email: | [redacted] | Email: | eal@scu.edu.au |

| | | | |
|---|---|---|---|
| Customer reference: | 240779 Mangoplah BESS | Request ID: | EAL /E25-00-2385 |
| Number of samples: | 8 | Report ID: | E25-00-2385_EALP3_1 |
| Date samples received: | 04 March 2025 | Issue date: | 20 March 2025 |

| | |
|---|---|
| Authorised by: | Kris Saville |
| Position: | Technical Team Leader |

Accreditation No. 14960

Comments: EAL is a NATA accredited laboratory (14960), accredited for compliance with ISO/IEC 17025 - Testing.

Received on 26/02/2025

# Certificate of Analysis

Request ID: EAL/E25-00-2385 Report ID: E25-00-2385_EALP3_1 Issue date: 20 March 2025

| | | | Client Sample ID: | BH01 | BH01 | BH02 | BH02 | BH03 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Depth: | 0.0-0.2 | 0.5-1.0 | 0.0-0.2 | 0.5-1.0 | 0.0-0.2 |
| | | | Sample Date: | 19 February 2025 | 19 February 2025 | 19 February 2025 | 19 February 2025 | 19 February 2025 |
| | | | Your Client: | Mangoplah | Mangoplah | Mangoplah | Mangoplah | Mangoplah |
| | | | EAL Sample ID: | E25-00-2385-0001 | E25-00-2385-0002 | E25-00-2385-0003 | E25-00-2385-0004 | E25-00-2385-0005 |
| **Parameter** | **Unit** | **Method Reference** | **LOR** | --- | --- | --- | --- | --- |
| Phosphorus - Bray 1 | mg/kg | ** Rayment & Lyons 2011 - 9E2 | <1 | 2.4 | --- | 10 | --- | 2.5 |
| pH (H2O) | units | Rayment & Lyons 2011 - 4A1 | --- | 5.98 | 6.51 | 5.76 | 6.96 | 6.07 |
| Electrical Conductivity | dS/m | Rayment & Lyons 2011 - 3A1 | <0.005 | 0.030 | 0.229 | 0.115 | 0.037 | 0.021 |
| Calcium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.05 | 2.70 | 4.25 | 1.88 | 3.62 | 4.92 |
| Calcium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <22 | 1210 | 1910 | 842 | 1630 | 2210 |
| Calcium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <10 | 542 | 851 | 376 | 726 | 986 |
| Magnesium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.01 | 2.10 | 9.25 | 0.52 | 3.96 | 1.48 |
| Magnesium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <2 | 571 | 2520 | 142 | 1080 | 402 |
| Magnesium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <1 | 255 | 1120 | 63.3 | 482 | 179 |
| Potassium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.12 | 0.35 | 0.29 | 0.87 | 0.47 | 0.65 |
| Potassium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <112 | 311 | 253 | 759 | 414 | 567 |
| Potassium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <50 | 139 | 113 | 339 | 185 | 253 |
| Sodium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.065 | 0.24 | 2.70 | < 0.065 | 0.25 | < 0.065 |
| Sodium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <33 | 125 | 1390 | < 33 | 127 | < 33 |
| Sodium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <15 | 55.9 | 620 | < 15 | 56.5 | < 15 |
| Aluminium - Exchangeable | cmol+/kg | ** Inhouse S37 | <0.01 | 0.07 | 0.02 | 0.11 | 0.02 | 0.08 |
| Aluminium - Exchangeable | kg/ha | ** Inhouse S37 | <1 | 14 | 3.9 | 23 | 3.4 | 15 |
| Aluminium - Exchangeable | mg/kg | ** Inhouse S37 | <1 | 6.2 | 1.7 | 10 | 1.5 | 6.8 |
| Hydrogen - Exchangeable | cmol+/kg | ** Rayment & Lyons 2011 - 15G1 | <0.01 | 0.25 | < 0.01 | 0.29 | < 0.01 | 0.20 |
| Hydrogen - Exchangeable | kg/ha | ** Rayment & Lyons 2011 - 15G1 | <1 | 5.6 | < 1 | 6.5 | < 1 | 4.6 |
| Hydrogen - Exchangeable | mg/kg | ** Rayment & Lyons 2011 - 15G1 | <1 | 2.5 | < 1 | 2.9 | < 1 | 2.0 |
| Calcium - Base Saturation | % | ** Calculation | <0.1 | 47 | 26 | 51 | 44 | 67 |
| Magnesium - Base Saturation | % | ** Calculation | <0.1 | 37 | 56 | 14 | 48 | 20 |
| Potassium - Base Saturation | % | ** Calculation | <0.1 | 6.2 | 1.8 | 24 | 5.7 | 8.8 |
| Sodium - Base Saturation (ESP) | % | ** Calculation | <0.1 | 4.3 | 16 | 0.5 | 3.0 | 0.3 |
| Aluminium - Base Saturation | % | ** Calculation | <0.1 | 1.2 | 0.1 | 3.1 | 0.2 | 1.0 |
| Hydrogen - Base Saturation | % | ** Calculation | <0.1 | 4.4 | < 0.1 | 7.9 | < 0.1 | 2.8 |
| Calcium/Magnesium Ratio | --- | ** Calculation | <0.1 | 1.3 | 0.5 | 3.6 | 0.9 | 3.3 |
| Effective Cation Exchange Capacity | cmol+/kg | ** Calculation | --- | 5.7 | 16.5 | 3.7 | 8.3 | 7.3 |
| Carbon - Total | % | Inhouse S4a | <0.02 | 0.74 | --- | 1.23 | --- | 0.50 |
| Nitrogen - Total | % | Inhouse S4a | <0.02 | 0.11 | --- | 0.14 | --- | 0.10 |
| Carbon : Nitrogen Ratio | Ratio | Inhouse S4a | <1 | 6.6 | --- | 8.7 | --- | 5.0 |
| Estimated Organic Matter | % | Inhouse S4a | <0.04 | 1.30 | --- | 2.15 | --- | 0.87 |
| Basic Texture | --- | ** Inhouse S65 | --- | Clay Loam | --- | Clay Loam | --- | Clay Loam |
| Basic Colour | --- | ** Inhouse S65 | --- | Brownish | --- | Brownish | --- | Brownish |
| Moisture Content | % | Inhouse S2 (105°C) | <0.1 | 12.3 | 14.7 | 7.6 | 9.7 | 12.6 |
| Texture (ISSS Classification) | --- | ** Inhouse S30 | --- | Silty Loam | Silty Clay | Loam | Clay Loam | Clay Loam |
| Gravel > 2 mm fraction | % of whole sample | ** Inhouse S30 | <0.1 | 0.2 | < 0.1 | 2.3 | 2.7 | < 0.1 |
| Sand > 20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 42.1 | 17.5 | 69.3 | 51.0 | 58.4 |
| Silt 2–20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 33.5 | 25.0 | 17.9 | 21.0 | 9.2 |
| Clay < 2 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 24.4 | 57.5 | 12.8 | 28.0 | 32.3 |
| Emerson Aggregate Test - Class | --- | ** Inhouse S28 | --- | 3 | 2 | 3 | 3 | 3 |
| Chloride | mg/kg | ** Rayment & Lyons 2011 - 5A3a | <0.1 | 16.7 | 169 | 3.6 | 7.5 | 2.1 |
| Phosphorus | mg/kg | 1:3 Nitric:HCl - APHA 3125 ICPMS | <50 | 165 | 134 | 246 | 121 | 141 |

# Environmental Analysis Laboratory

ASPAC NATA Accreditation No. 14960

## Certificate of Analysis

Request ID: EAL/E25-00-2385 Report ID: E25-00-2385_EALP3_1 Issue date: 20 March 2025

| | | | Client Sample ID: | BH01 | BH01 | BH02 | BH02 | BH03 |
|---|---|---|---|---|---|---|---|---|
| | | | Sample Depth: | 0.0-0.2 | 0.5-1.0 | 0.0-0.2 | 0.5-1.0 | 0.0-0.2 |
| | | | Sample Date: | 19 February 2025 | 19 February 2025 | 19 February 2025 | 19 February 2025 | 19 February 2025 |
| | | | Your Client: | Mangoplah | Mangoplah | Mangoplah | Mangoplah | Mangoplah |
| | | | EAL Sample ID: | E25-00-2385-0001 | E25-00-2385-0002 | E25-00-2385-0003 | E25-00-2385-0004 | E25-00-2385-0005 |
| **Parameter** | **Unit** | **Method Reference** | **LOR** | --- | --- | --- | --- | --- |
| Phosphorus Buffer Index | --- | ** Rayment & Lyons 2011 - 9I2b | --- | 76 | 112 | 42 | 90 | 88 |
| Cation Exchange Capacity (Ca, Mg, K, Na) | cmol+/kg | ** Calculation | --- | --- | 16.5 | --- | 8.3 | --- |
| Total Cation Exchange Capacity | cmol+/kg | ** Calculation | --- | --- | 17.8 | --- | 8.5 | --- |

| | | | Client Sample ID: | BH03 | BH04 | BH04 |
|---|---|---|---|---|---|---|
| | | | Sample Depth: | 0.5-1.0 | 0.0-0.2 | 0.5-1.0 |
| | | | Sample Date: | 19 February 2025 | 19 February 2025 | 19 February 2025 |
| | | | Your Client: | Mangoplah | Mangoplah | Mangoplah |
| | | | EAL Sample ID: | E25-00-2385-0006 | E25-00-2385-0007 | E25-00-2385-0008 |
| **Parameter** | **Unit** | **Method Reference** | **LOR** | --- | --- | --- |
| Phosphorus - Bray 1 | mg/kg | ** Rayment & Lyons 2011 - 9E2 | <1 | --- | 4.1 | --- |
| pH (H2O) | units | Rayment & Lyons 2011 - 4A1 | --- | 6.74 | 6.05 | 7.04 |
| Electrical Conductivity | dS/m | Rayment & Lyons 2011 - 3A1 | <0.005 | 0.018 | 0.018 | 0.024 |
| Calcium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.05 | 6.27 | 3.17 | 5.33 |
| Calcium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <22 | 2810 | 1420 | 2390 |
| Calcium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <10 | 1260 | 636 | 1070 |
| Magnesium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.01 | 2.82 | 0.92 | 4.64 |
| Magnesium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <2 | 767 | 250 | 1260 |
| Magnesium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <1 | 342 | 112 | 564 |
| Potassium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.12 | 0.65 | 0.50 | 0.74 |
| Potassium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <112 | 567 | 440 | 644 |
| Potassium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <50 | 253 | 197 | 287 |
| Sodium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | <0.065 | < 0.065 | < 0.065 | 0.25 |
| Sodium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | <33 | < 33 | < 33 | 129 |
| Sodium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | <15 | < 15 | < 15 | 57.7 |
| Aluminium - Exchangeable | cmol+/kg | ** Inhouse S37 | <0.01 | 0.02 | 0.10 | 0.01 |
| Aluminium - Exchangeable | kg/ha | ** Inhouse S37 | <1 | 4.2 | 20 | 2.5 |
| Aluminium - Exchangeable | mg/kg | ** Inhouse S37 | <1 | 1.9 | 8.8 | 1.1 |
| Hydrogen - Exchangeable | cmol+/kg | ** Rayment & Lyons 2011 - 15G1 | <0.01 | < 0.01 | 0.24 | < 0.01 |
| Hydrogen - Exchangeable | kg/ha | ** Rayment & Lyons 2011 - 15G1 | <1 | < 1 | 5.3 | < 1 |
| Hydrogen - Exchangeable | mg/kg | ** Rayment & Lyons 2011 - 15G1 | <1 | < 1 | 2.4 | < 1 |
| Calcium - Base Saturation | % | ** Calculation | <0.1 | 64 | 64 | 49 |
| Magnesium - Base Saturation | % | ** Calculation | <0.1 | 29 | 19 | 42 |
| Potassium - Base Saturation | % | ** Calculation | <0.1 | 6.6 | 10 | 6.7 |
| Sodium - Base Saturation (ESP) | % | ** Calculation | <0.1 | 0.6 | 0.3 | 2.3 |
| Aluminium - Base Saturation | % | ** Calculation | <0.1 | 0.2 | 2.0 | 0.1 |
| Hydrogen - Base Saturation | % | ** Calculation | <0.1 | < 0.1 | 4.8 | < 0.1 |
| Calcium/Magnesium Ratio | --- | ** Calculation | <0.1 | 2.2 | 3.5 | 1.1 |
| Effective Cation Exchange Capacity | cmol+/kg | ** Calculation | --- | 9.8 | 5.0 | 11.0 |
| Carbon - Total | % | Inhouse S4a | <0.02 | --- | 0.58 | --- |
| Nitrogen - Total | % | Inhouse S4a | <0.02 | --- | 0.08 | --- |
| Carbon : Nitrogen Ratio | Ratio | Inhouse S4a | <1 | --- | 7.1 | --- |
| Estimated Organic Matter | % | Inhouse S4a | <0.04 | --- | 1.02 | --- |
| Basic Texture | --- | ** Inhouse S65 | --- | --- | Clay Loam | --- |
| Basic Colour | --- | ** Inhouse S65 | --- | --- | Brownish | --- |

Environmental Analysis Laboratory

ASPAC NATA Accreditation No. 14960

# Certificate of Analysis

Request ID: EAL/E25-00-2385 Report ID: E25-00-2385_EALP3_1 Issue date: 20 March 2025

| | | | Client Sample ID: | BH03 | BH04 | BH04 |
|---|---|---|---|---|---|---|
| | | | Sample Depth: | 0.5-1.0 | 0.0-0.2 | 0.5-1.0 |
| | | | Sample Date: | 19 February 2025 | 19 February 2025 | 19 February 2025 |
| | | | Your Client: | Mangoplah | Mangoplah | Mangoplah |
| | | | EAL Sample ID: | E25-00-2385-0006 | E25-00-2385-0007 | E25-00-2385-0008 |
| **Parameter** | **Unit** | **Method Reference** | **LOR** | --- | --- | --- |
| Moisture Content | % | Inhouse S2 (105°C) | <0.1 | 13.5 | 9.4 | 14.8 |
| Texture (ISSS Classification) | --- | ** Inhouse S30 | --- | Clay | Clay Loam | Clay |
| Gravel > 2 mm fraction | % of whole sample | ** Inhouse S30 | <0.1 | 2.8 | 1.5 | 1.3 |
| Sand > 20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 42.4 | 64.8 | 33.1 |
| Silt 2–20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 15.0 | 11.0 | 13.0 |
| Clay < 2 µm fraction | % < 2 mm fraction | ** Inhouse S30 | <0.1 | 42.6 | 24.3 | 53.9 |
| Emerson Aggregate Test - Class | --- | ** Inhouse S28 | --- | 2 | 3 | 2 |
| Chloride | mg/kg | ** Rayment & Lyons 2011 - 5A3a | <0.1 | 2.8 | 1.5 | 3.1 |
| Phosphorus | mg/kg | 1:3 Nitric:HCl - APHA 3125 ICPMS | <50 | 148 | 188 | 200 |
| Phosphorus Buffer Index | --- | ** Rayment & Lyons 2011 - 9I2b | --- | 124 | 65 | 196 |
| Cation Exchange Capacity (Ca, Mg, K, Na) | cmol+/kg | ** Calculation | --- | 9.8 | --- | 11.0 |
| Total Cation Exchange Capacity | cmol+/kg | ** Calculation | --- | 10.3 | --- | 11.0 |

| | | Guideline: | Heavy Soil Guidelines | Light Soil Guidelines | Medium Soil Guidelines | Sandy Soil Guidelines |
|---|---|---|---|---|---|---|
| **Parameter** | **Unit** | **Method Reference** | --- | --- | --- | --- |
| Phosphorus - Bray 1 | mg/kg | ** Rayment & Lyons 2011 - 9E2 | 45 | 24 | 30 | 20 |
| pH (H2O) | units | Rayment & Lyons 2011 - 4A1 | 6.5 | 6.3 | 6.5 | 6.3 |
| Electrical Conductivity | dS/m | Rayment & Lyons 2011 - 3A1 | 0.200 | 0.120 | 0.150 | 0.100 |
| Calcium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | 15.6 | 5.0 | 10.8 | 1.9 |
| Calcium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | 7000 | 2240 | 4816 | 840 |
| Calcium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | 3125 | 1000 | 2150 | 375 |
| Magnesium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | 2.4 | 1.2 | 1.7 | 0.60 |
| Magnesium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | 650 | 325 | 448 | 168 |
| Magnesium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | 290 | 145 | 200 | 75 |
| Potassium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | 0.60 | 0.40 | 0.50 | 0.30 |
| Potassium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | 526 | 336 | 426 | 224 |
| Potassium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | 235 | 150 | 190 | 100 |
| Sodium - Exchangeable | cmol+/kg | Rayment & Lyons 2011 - 15D3 | 0.3 | 0.22 | 0.26 | 0.11 |
| Sodium - Exchangeable | kg/ha | Rayment & Lyons 2011 - 15D3 | 155 | 113 | 134 | 57 |
| Sodium - Exchangeable | mg/kg | Rayment & Lyons 2011 - 15D3 | 69 | 51 | 60 | 25 |
| Aluminium - Exchangeable | cmol+/kg | ** Inhouse S37 | 0.6 | 0.4 | 0.5 | 0.2 |
| Aluminium - Exchangeable | kg/ha | ** Inhouse S37 | 121 | 73 | 101 | 30 |
| Aluminium - Exchangeable | mg/kg | ** Inhouse S37 | 54 | 32 | 45 | 14 |
| Hydrogen - Exchangeable | cmol+/kg | ** Rayment & Lyons 2011 - 15G1 | 0.6 | 0.4 | 0.5 | 0.2 |
| Hydrogen - Exchangeable | kg/ha | ** Rayment & Lyons 2011 - 15G1 | 13 | 8 | 11 | 3 |
| Hydrogen - Exchangeable | mg/kg | ** Rayment & Lyons 2011 - 15G1 | 6 | 4 | 5 | 2 |
| Calcium - Base Saturation | % | ** Calculation | 77.6 | 65.6 | 75.7 | 57.4 |
| Magnesium - Base Saturation | % | ** Calculation | 11.9 | 15.7 | 11.9 | 18.1 |
| Potassium - Base Saturation | % | ** Calculation | 3.0 | 5.2 | 3.5 | 9.1 |
| Sodium - Base Saturation (ESP) | % | ** Calculation | 1.5 | 2.9 | 1.8 | 3.3 |
| Aluminium - Base Saturation | % | ** Calculation | 3.0 | 5.2 | 3.5 | 6.0 |
| Hydrogen - Base Saturation | % | ** Calculation | 3.0 | 5.2 | 3.5 | 6.0 |
| Calcium/Magnesium Ratio | --- | ** Calculation | 6.5 | 4.2 | 6.4 | 3.2 |
| Effective Cation Exchange Capacity | cmol+/kg | ** Calculation | 20.1 | 7.8 | 14.3 | 3.3 |

EAL Environmental Analysis Laboratory

ASPAC NATA Accreditation No. 14960

# Certificate of Analysis

Request ID: EAL/E25-00-2385 Report ID: E25-00-2385_EALP3_1 Issue date: 20 March 2025

| | | Guideline: | Heavy Soil Guidelines | Light Soil Guidelines | Medium Soil Guidelines | Sandy Soil Guidelines |
|---|---|---|---|---|---|---|
| **Parameter** | **Unit** | **Method Reference** | --- | --- | --- | --- |
| Carbon - Total | % | Inhouse S4a | >3.1 | > 2.0 | > 2.6 | > 1.4 |
| Nitrogen - Total | % | Inhouse S4a | >0.30 | > 0.20 | > 0.25 | > 0.15 |
| Carbon : Nitrogen Ratio | Ratio | Inhouse S4a | 10-12 | 10-12 | 10-12 | 10-12 |
| Estimated Organic Matter | % | Inhouse S4a | >5.5 | > 3.5 | > 4.5 | > 2.5 |
| Basic Texture | --- | ** Inhouse S65 | --- | --- | --- | --- |
| Basic Colour | --- | ** Inhouse S65 | --- | --- | --- | --- |
| Moisture Content | % | Inhouse S2 (105°C) | --- | --- | --- | --- |
| Texture (ISSS Classification) | --- | ** Inhouse S30 | --- | --- | --- | --- |
| Gravel > 2 mm fraction | % of whole sample | ** Inhouse S30 | --- | --- | --- | --- |
| Sand > 20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | --- | --- | --- | --- |
| Silt 2–20 µm fraction | % < 2 mm fraction | ** Inhouse S30 | --- | --- | --- | --- |
| Clay < 2 µm fraction | % < 2 mm fraction | ** Inhouse S30 | --- | --- | --- | --- |
| Emerson Aggregate Test - Class | --- | ** Inhouse S28 | Class 3–8 | Class 3–8 | Class 3–8 | Class 3–8 |
| Chloride | mg/kg | ** Rayment & Lyons 2011 - 5A3a | --- | --- | --- | --- |
| Phosphorus | mg/kg | 1:3 Nitric:HCl - APHA 3125 ICPMS | 400–1500 | 400–1500 | 400–1500 | 400–1500 |
| Phosphorus Buffer Index | --- | ** Rayment & Lyons 2011 - 9I2b | <15 (extremely Low); 15–70 (Very Low); 71–140 (Low); 141–280 (Moderate); 280–840 (High); > 840 (Very High) | <15 (extremely Low); 15–70 (Very Low); 71–140 (Low); 141–280 (Moderate); 280–840 (High); > 840 (Very High) | <15 (extremely Low); 15–70 (Very Low); 71–140 (Low); 141–280 (Moderate); 280–840 (High); > 840 (Very High) | <15 (extremely Low); 15–70 (Very Low); 71–140 (Low); 141–280 (Moderate); 280–840 (High); > 840 (Very High) |

**Notes:**

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Conversions to kg/ha = mg/kg x 2.24.
- Soluble salts are included in exchangeable cation results. No pre-wash is carried out unless specifically requested.
- The chloride estimate result (Electrical Conductivity x 640) is considered an estimate, and is generally an over-estimate.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- LOR' means less than limit of reporting. 'ND' means not detected. 'NA' means not applicable. 'NR' means not requested.
- ** denotes NATA accreditation does not cover the performance of this service.
- .. denotes not requested, no data/information or no guidelines available.
- All analysis is on a dry weight basis.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (available on request or at scu.edu.au/eal).
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full.
- Results only relate to the item tested.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Guidelines for phosphorus have been reduced for Australian soils.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Methods from Rayment and Lyons, 2011. Soil Chemical Methods - Australasia. CSIRO Publishing, Collingwood.
- The Morgan 1 Extract is adapted from 'Science in Agriculture', 'Non-Toxic Farming', and 'LaMotte Soil Handbook'.
- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Moisture is based on supplied sample dried at 105 °C.
- DOC analysis is carried out on samples as they are supplied, with results corrected to 105°C oven dried basis.

# Certificate of Analysis

Request ID: EAL/E25-00-2385   Report ID: E25-00-2385_EALP3_1   Issue date: 20 March 2025

- Conversions for 1 cmol+/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm.
- ppm = mg/kg dried sample

**NGH Pty Ltd**

NSW • ACT • QLD • VIC

ABN 31 124 444 622   ACN 124 444 622

E: ngh@nghconsulting.com.au

**BEGA**

Suite 11, 89-91 Auckland Street
(PO Box 470)
Bega NSW 2550

T. (02) 6492 8333

**BRISBANE**

T3, Level 7, 348 Edward Street
Brisbane QLD 4000

T. (07) 3129 7633

**CANBERRA**

Unit 8, 27 Yallourn Street
(PO Box 62)
Fyshwick ACT 2609

T. (02) 6280 5053

**GOLD COAST**

2B 34 Tallebudgera Creek Road
Burleigh Heads QLD 4220

T. (07) 3129 7633

**MELBOURNE**

Level 14, 10-16 Queen Street
Melbourne VIC 3000

T: (03) 7031 9123

**NEWCASTLE - HUNTER & NORTH COAST**

2 Dick Street
Newcastle West  NSW  2302

T. (02) 4929 2301

**SUNSHINE COAST**

Building 1, 30 Chancellor Village Boulevard
Sippy Downs   QLD   4556

T:  13 54 93

**SYDNEY REGION**

Suite 9.01, Level 9, 28 Foveaux Street
Surry Hills NSW 2010

T. (02) 8202 8333

**TOWNSVILLE**

Level 4, 67-75 Denham Street
Townsville QLD 4810

T. (07) 4410 9000

**WAGGA WAGGA - RIVERINA & WESTERN NSW**

35 Kincaid Street (PO Box 5464)
Wagga Wagga NSW 2650

T. (02) 6971 9696

**WODONGA**

Unit 2, 83 Hume Street
(PO Box 506)
Wodonga VIC 3690

T. (02) 6067 2533