

# WILTON COAL PROJECT

## Soil and Strategic Cropping Land Assessment

**Prepared for:**

Wilton Coking Coal Pty Ltd

SLR Ref: 623.17170-R01  
Version No: -v0.5  
July 2019



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## BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Wilton Coking Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

## DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
623.17170-R01-v0.5	23 July 2019	C Traill	R Masters	D Taylor

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## EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) was commissioned to prepare this report to support a development application for the Wilton Coal Project (the Project). This report will support an application for a regional interests development approval (RIDA) under the *Regional Planning Interests Act 2014* (RPI Act).

The north of the Project area has not been previously assessed and includes mapped strategic cropping land in areas where the mine pit and associated infrastructure are proposed. As such, additional survey work was required to assess the remainder of the mapped strategic cropping land on the Project site. The Study area for this report includes the previous, unreported data from the [NRC \(2017\)](#) field survey and the additional field assessment conducted over the area that had not been assessed in the north of the Project site.

As a soil and SCL assessment report, this report identifies, describes and maps the soil units and assesses their current suitability for agricultural production across the Study area through a detailed and rigorous desktop, field and laboratory assessment process. The results of the soil assessment identified the majority of the Study area is dominated by the Australian Soil Classification (ASC) types Vertosol (cracking clay) and Dermosol (non-cracking clay) on the geological units known as Burngrove Formation and Emerald Formation.

Through identification of the physical and chemical attributes and limitations of the overall landscape features and soil units, assessment of all observation sites against the SCL criteria was undertaken. The results of the assessment proved that every observation site within the two primary mapped soil units (Vertosols and Dermosols) have at least one limitation to being verified as SCL. As such, we concluded and recommended the SCL mapped areas within the Study area be removed from the State SCL mapping.

Construction and operation of the coal mine and associated infrastructure will have significant impacts on the current landform. Through implementation of the soil management measures specified in this report, however, this impact can be minimised and the land assets protected, maintained and ameliorated for rehabilitation following completion of mining. Implementation of these soil management measures should, therefore, facilitate reinstatement of the current land suitability and good quality agricultural land classifications post mining operations.

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## Signed Statement by Suitably Qualified Person to Approve this Assessment Report

This assessment report references previous soil and land assessment reports prepared by others for the Wilton Coal Project and surrounding landscape. These assessments were based on desktop assessments, field observations and soil profile descriptions and sampling, and laboratory analysis by laboratories with NATA accreditation for most analyses performed. The assessment report has been approved by Rodney Masters, Technical Director – Soil Science, SLR Consulting.

Rodney Masters, CPSS 3

A handwritten signature in black ink, appearing to read 'R Masters', is displayed on a light gray background.

**Technical Leader – Soil Science**  
**SLR Consulting**

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## Signed Statement by Suitably Qualified Person to Review this Assessment Report

This assessment report references previous soil and land assessment reports prepared by others for the Wilton Coal Project and surrounding landscape. These assessments were based on desktop assessments, field observations and soil profile descriptions and sampling, and laboratory analysis by laboratories with NATA accreditation for most analyses performed. The assessment report has been prepared by Cameron Traill, Principal – Soil Science, SLR Consulting.

### Qualifications and Experience

I am a soil scientist and water manager with a Bachelor of Applied Science Degree (Soil and Water Management) from The University of Queensland, Gatton Campus, that I graduated with in 1992. I have 28 years' experience in a diverse range of natural resource management projects, including a concentration of high intensity soil science projects over the last eight years.

I have considerable recent experience in undertaking soil surveys for the preparation of soil and land investigation reports, soil assessment and management plans, construction soil management plans, and erosion and sediment control plans for projects in a range of industry sectors, including the natural resource/ integrated catchment management, agricultural/horticultural, energy, transport infrastructure and extractive sectors. I am a member of Soil Science Australia (SSA), the Agricultural Institute of Australia (AIA), and the International Erosion Control Association (IECA) and am a trained and practising (but not yet certified) professional in erosion and sediment control.

After graduating from The University of Queensland, I had various roles in private, local and state government organisations associated with natural resource/integrated catchment management from 1992 to 2002 that developed and relied on my qualifications and, progressively expanding, experience in soil and water management. From 2002 to 2012, I was mostly employed in the private consulting sector providing general environmental science and management planning consulting services across climate and weather patterns; geology, topography and soils, including acid sulfate soils, erosion and sediment control, landscape design and contaminated land; terrestrial and aquatic (freshwater) flora and fauna, including regional ecosystems, macro-vertebrates, macro-invertebrates, macrophytes and blue-green algae; and water quality and quantity.

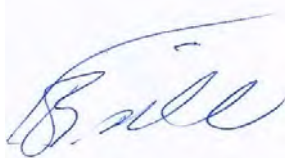
Towards the end of this period (2012), I graduated with a Graduate Certificate in Business Administration from the University of the Sunshine Coast. Since then, I have project managed and/or co-ordinated and/or technically led more than 30 detailed soil and land survey projects, the majority of which were for coal seam gas projects. These included broad-scale (gas field-wide or main pipeline long) and fine-scale (individual property) soil assessments to prepare more than 100 soil or land investigation reports, soil assessment and management plans, construction soil management plans, erosion and sediment control plans and contaminated land investigation reports.

Selected project experience includes:

- Preparing a soil and land suitability assessment report for the Cracow gold mine second tailings storage facility project for Evolution Mining Limited. The assessment included desktop assessment of historical soil and land resource assessment reports, previous NRC report for the project and GIS data, review of geotechnical field survey data including full representative profile description, laboratory analytical data assessment, and report drafting;

- Preparing a soil and land suitability assessment report for the Fairhill Coking Coal project for Fairhill Coking Coal Pty Ltd. The assessment included desktop assessment of historical soil and land resource assessment reports, previous NRC report for the project and GIS data, field survey including full representative profile description, sample collection for laboratory analysis and check sites, laboratory data assessment, and report drafting;
- Technically reviewing the Desktop Soil Assessment & Rehabilitation Strategy for the New Acland Stage 2 Extension for New Hope Corporation Limited's New Acland Mine. The review included incorporating historical soil and land assessment information from the Central Darling Downs Land Management Manual, both the Resource Information Book and Field Manual, cross-referencing previous soil and land assessments conducted for the New Acland Mine by other consultants to correlate soil profiles with mapped soil units, and expanding on the rehabilitation plan prepared in accordance with the Guideline: Rehabilitation requirements for mining resource activities (DES, 2014)
- Preparing a soil assessment and management plan (SAMP) for the Meteor Downs South (MDS) Loading Facility for Sojitz Coal Mining Ltd & Endocoal Limited. The soil assessment was based on a literature review of historical soil and land resource assessment reports by CSIRO and QDPI as well as desktop assessment of recent GIS data and geotechnical investigation bore logs for the project. Two soil units were mapped across the project site and informed the management plan, which provided specific soil management measures and practices for the short, medium and long-term protection of mapped agricultural lands, including strategic cropping land;
- Project managing and technically co-ordinating and leading an investigation into 'sink hole' formation on two properties in the Chinchilla area for Origin Energy on the APLNG Upstream Project. The project was to identify the physical, chemical and/or biological factors causing the 'sink holes'. The study confirmed the 'sink holes' were in fact tunnel erosion resulting from degrading soil physical, chemical and biological properties. Works included a detailed literature review and landholder consultation, field planning, desktop and field assessment, assessment of laboratory analytical data, and report drafting;
- Project managing and technically co-ordinating and leading the two packages of work to undertake soil surveys on 18 properties across three gas fields for Origin Energy on the APLNG Upstream Project. The project was to prepare 24 construction soil management plans and erosion and sediment control plans. Works included field planning, desktop and field soil and landscape assessment, assessment of laboratory analytical data, and report drafting; and
- Project co-ordination and field work for a proportion of the 21 soil assessment and management plans prepared for Origin Energy on the APLNG Upstream Project. These plans were spread across the Condabri, Combabula and Talinga-Orana gas fields, interconnecting gas and water trunk mains, main pipeline from Miles to Gladstone and associated infrastructure, such as laydowns and camps. Works included field planning, desktop and field soil and landscape assessment, assessment of laboratory analytical data, and report drafting.

Cameron Traill



**Principal – Soil Science**  
**SLR Consulting**

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# 1 Introduction

SLR Consulting Australia Pty Ltd (SLR) was commissioned to prepare this report to support a development application for the Wilton Coal Project (the Project). This report will support an application for a regional interests development approval (RIDA) under the *Regional Planning Interests Act 2014* (RPI Act).

The north of the Project area has not been previously assessed and includes mapped strategic cropping land in areas where the mine pit and associated infrastructure are proposed. As such, additional survey work was required to assess the remainder of the mapped strategic cropping land on the Project site. The Study area for this report includes the previous, unreported data from the [NRC \(2017\)](#) field survey and the additional field assessment conducted over the area that had not been assessed in the north of the Project site.

This report presents the information and data from the [NRC \(2017\)](#) field survey and additional survey work to assess the soils and validate the strategic cropping land (SCL) mapping applicable to the Project site.

## 1.1 Project Description

The Project is a proposed coal mine in central Queensland by Wilton Coking Coal Pty Ltd (WCC), which is wholly owned by Futura Resources Ltd. WCC will be a pilot project, with an annual production rate of up to 1.7 Mt, focussing only on the Burngrove coal measures. The Project is designed to test the viability of this coal product on the current market, trialling surface mining methodology in conjunction with excavators to strip-mine the coal from the layers in which it occurs.

There will be no on-site processing for the Project. Instead, WCC is seeking agreement from nearby owner operators of coal washing infrastructure to ship raw coal product to nearby operations and utilise existing CHPP and tailings infrastructure under agreement.

## 1.2 Purpose

The purpose of this report is to present an assessment of the soils across the mapped strategic cropping land within the Project site and validate the SCL mapping.

## 1.3 Scope

The scope of works to undertake the soil and land suitability assessment to prepare this report includes:

- Desktop assessment of:
  - Historical soil and landscape assessment reports prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) ([Story et al. 1967](#)) and Queensland Department of Primary Industries (DPI) ([Bourne & Tuck, 1993a](#); [Bourne & Tuck, 1993b](#));
  - Previous soil and strategic cropping land assessment report prepared by [NRC \(2017\)](#), including incorporation of relevant data from the field work for that report; and
  - Geographic information system (GIS) data, including aerial photography, digital terrain modelling, existing surface geology, topography, soils, and agricultural land assessments;
- Field assessment of the soil and land surface through a field survey to identify, describe through representative profiles and other check and exclusion sites, and sample the soils in the Study area;

- Laboratory analysis of selected representative profile samples to describe the physical and chemical properties of the soils in the Study area; and
- Prepare this soil and SCL assessment report analysing all the above data to describe the identified soil units and evaluate and validate their suitability to be mapped as SCL within the Study area.

## 1.4 Goal

The goal of this report is to validate the strategic cropping land mapping across the Study area through a detailed and rigorous desktop, field and laboratory assessment process.

# 2 Regulatory Framework

## 2.1 Regional Planning Interests Act 2014

The Wilton Coal Project (WCP) was originally assessed under the *Strategic Cropping Land Act 2011* (SCL Act) in the 'Soil and Land Suitability Assessment: Wilton Coal Project' report (EES Qld, 2012).

Since finalisation of the above report, the SCL Act was repealed by the *Regional Planning Interests Act 2014* (RPI Act). As such, the north-east section of Wilton South within the WCP was then assessed by Northern Resource Consultants (NRC) under the RPI Act.

The RPI Act provides for the protection of areas in Queensland that are of regional interest. The RPI Act aims to achieve a balance between protecting land uses and delivering diverse and prosperous economic future. The RPI Act requires resource companies to apply for a regional interests development approval (RIDA) to undertake resource activities in areas of regional interest if an exemption does not apply.

## 2.2 State Planning Policies and Guidelines

There are several State Planning Policies (SPPs) and guidelines that are applicable to the land resource assessment of the WCP. Some of these have either lapsed, been repealed or replaced. The SPP 1/92 Development and Conservation of Agricultural Land, and associated Planning Guideline 1: The Identification of Good Quality Agricultural Land, lapsed on 18th December 2012. Despite the lapse of SPP 1/92, the current Queensland SPP (April 2016) refers to the protection of Agricultural Land Classification (ALC) Class A and Class B. Therefore, consideration must still be given to this planning guideline.

Identification and description of environmental values is to be undertaken with reference to identified information sources and reference material. This includes those listed below:

- RPI Act statutory guideline 11/16: *Regional Planning Interests Act 2014* (RPI Act) companion guide ([DILGP, 2017b](#));
- Guidelines for Surveying Soil and Land Resources ([McKenzie, et al., 2008](#));
- Australian Soil and Land Survey Field Handbook ([NCST, 2009](#));
- Munsell Soil Color Charts ([Munsell Color, 2009](#))
- Soil Chemical Methods – Australasia ([Rayment & Lyons, 2011](#));
- Measuring soil cation exchange capacity and exchangeable cations ([SSA, 2013](#))

- Interpreting Soil Test Results – What Do All The Numbers Mean? ([Hazelton and Murphy, 2004](#)); and
- Australian Soil Classification (ASC) system ([Isbell & NCST, 2016](#)).

Assessment of the identified and described soils to validate strategic cropping land designation is then made against the following guidelines:

- Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques ([DME, 1995](#));
- Planning Guidelines: The Identification of Good Quality Agricultural Land ([DPI & DHLGP, 1993](#)); and
- RPI Act Statutory Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land ([DILGP, 2017a](#)).

### 3 Project Site Description

The Project site is located in central Queensland approximately 45 km northeast of Emerald, 40 km northwest of Blackwater, and approximately 280 km northwest of Gladstone, in Queensland's Bowen Basin (refer to **Figure 1**).

The Project site is situated on land within exploration permit for coal (EPC) 1235, which is approximately 12,644 ha. Within EPC 1235 are mining leases (ML) 700028 (617.09 ha) and 700029 (179.11 ha), which comprise the Project site and are also known as 'Wilton South' (refer to **Figure 2**). Wilton South is approximately 796.2 ha. The Project site is located on land identified as Lot 2 on SP254309.

The Project disturbance footprint is anticipated to include an open cut pit (including in pit dump) and other infrastructure comprising an out of pit overburden dump, administration and workshop, mine affected water storages, and run of mine, totalling a disturbance footprint of approximately 240 ha.

The Study area comprises a combined area of approximately 351 ha, 119 ha for the SLR field investigation area and 232 ha for the [NRC \(2017\)](#) report field investigation area, as shown in **Figure 2**, over which approximately 196 ha is mapped as strategic cropping land (refer to **Figure 12**). The mine footprint only directly impacts approximately 98.2 ha of the 196 ha of SCL within the Study area.





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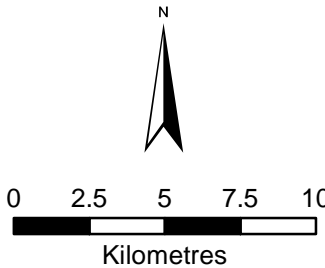
## WILTON

FIGURE 1  
REGIONAL LOCATION

### Legend

- Town
- Highway
- Major Road
- Major Watercourse
- Mining Lease (Application)

Data Sources:  
Town, Transportation, Mining Lease (Application), and Watercourse datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Imagery Source: 2.5m Q3 2017 Planet Labs Satellite Imagery: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019. Includes material © Planet Labs Netherlands B.V. 2017, reproduced under licence from Planet and Geoplex, all rights reserved. Data acquired under the Spatial Imagery Subscription Plan (SISP) and QSat initiative.  
Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 19/07/2019



Scale: 1:250,000 at A3





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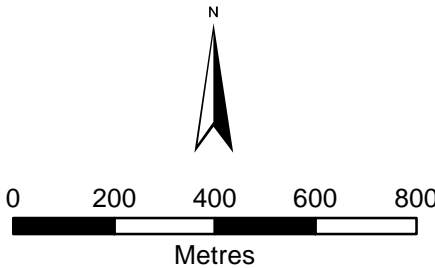
WILTON

FIGURE 2  
SITE OVERVIEW

Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area
- NRC Investigation Area
- Proposed Site Disturbance
- Base Cadastre

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





## 3.1 Climate

The Project site is located within the subtropics with warm, wet summers and cool, dry winters. The nearest Bureau of Meteorology (BOM) weather station is located at Emerald Airport (Station ID: 035264), approximately 45 km south-west of the Project.

According to the [BOM \(2017\)](#), the regional climate is characterised with:

- Mean maximum and minimum temperatures for summer months are approximately 34.1 °C and 20.1 °C, respectively;
- Mean maximum and minimum temperatures for winter months are approximately 23.9 °C and 9.8 °C, respectively; and
- Mean summer and winter rainfall is approximately 259 mm and 72.4 mm, respectively.

## 3.2 Geology

Surface geology, according to the Queensland Globe ([QG, 2019](#)), within and immediately surrounding the Project site (refer to **Figure 3**) includes:

- Burngrove Formation (Pwg);
- Emerald Formation (Te(w)); and
- Tertiary duricrusted palaeosols (Td).

### 3.2.1 Burngrove Formation (Pwg)

The Burngrove Formation outcrops across the northern part of the Project site, along part of the eastern boundary, and to a very small extent in the south-eastern corner. Approximately half the Study area is mapped on this formation. This formation is a late Permian age stratified unit, including volcanic and metamorphic arenite mudrock, comprising mudstone, siltstone, sandstone, coal, and tuff.

### 3.2.2 Emerald Formation (Te(w))

The Emerald Formation outcrops across the majority of the Project site covering the eastern boundary, through the centre of the Project site to the southern-eastern boundary, and eastern side of the southern boundary. Approximately half the Study area is mapped on this formation. This formation overlies the Burngrove Formation and is likely an Eocene age stratified unit, including volcanic and metamorphic sedimentary rock, comprising deeply weathered fluvial and lacustrine claystone and siltstone, quartzose sandstone, pebbly sandstone, gravel, lignite, oil shale, interbedded basalt (possibly a correlative of the Daringa Formation).

### 3.2.3 Tertiary Duricrusted Palaeosols (Td)

The Tertiary duricrusted palaeosols outcrop in the south of the Project site and extend to the southern boundary. None of the Study area is mapped on this formation. This formation overlies the Emerald Formation and is a Tertiary age stratified unit, including volcanic and metamorphic ferricrete, comprising duricrusted palaeosols at the top of deep weathering profiles, including ferricrete and silcrete; duricrusted old land surfaces.



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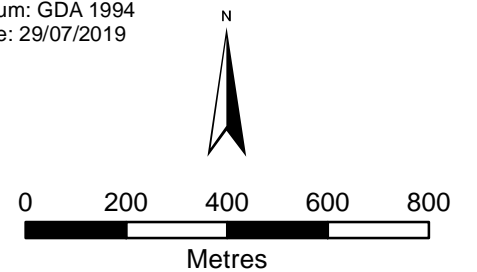
## WILTON

FIGURE 3  
SURFACE GEOLOGY

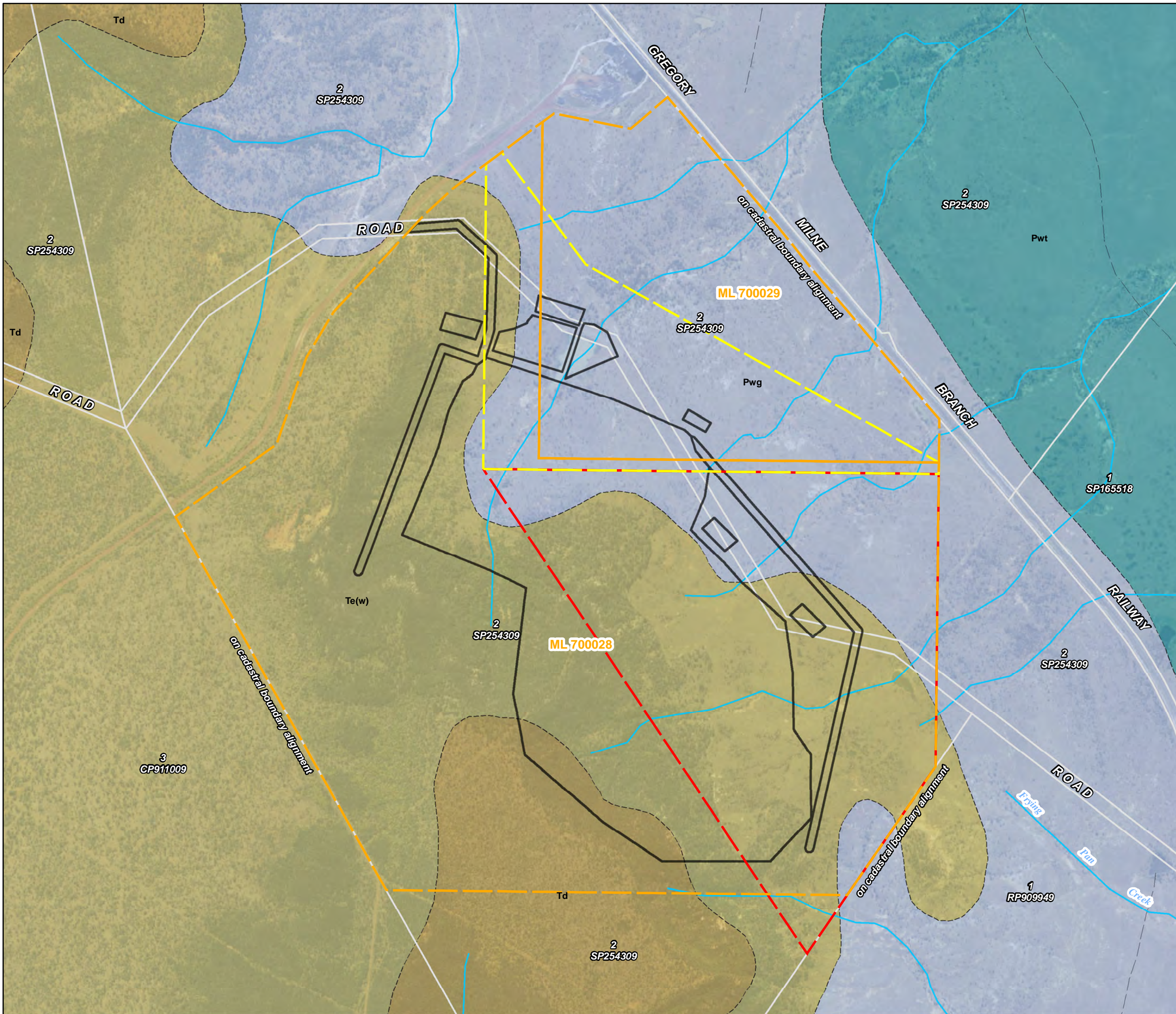
### Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre
- Detailed Geological Structures**
  - Geological boundary (conformable) approximate
  - Geological boundary (stratigraphic) approximate
  - Geological boundary (unconformable) approximate
  - Trend line
- Detailed Surface Geology**
  - Burngrove Formation
  - Emerald Formation(w)
  - Fair Hill Formation
  - Td-QLD

Data Sources:  
Mining Lease (Application), Watercourse, Detailed Surface Geology, Detailed Geological Structures, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





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### 3.3 Topography

The Project site is located on the north-eastern edge of a long plateau ridge running north-south through the regional landscape (refer to **Figure 4**).

The Burngrove Formation occupies the lower, shallower slopes to the north-east with a small section in the south-eastern corner. The land is gently undulating hills and slopes, incised with ephemeral drainage depressions. The desktop study indicates elevation ranges from 200 to 240 m Australian height datum (AHD) ([NRC, 2017](#)) and slopes range from <1 to 17% on this geological unit.

The Emerald Formation occupies the higher, steeper slopes through the middle of the Project site (western boundary to south-eastern corner). The land is undulating low hills and moderately steep slopes, incised with ephemeral gullies. The desktop study indicates elevation ranges from 212 to 299 m AHD and slopes range from <1 to 30% on this geological unit.

The Tertiary duricrusted palaeosols occupy the highest parts of the landscape, which occur on the southern boundary of the Project site. The landform is a plateau that is level on top but gradually increasing to steep as the landform drops off the plateau with ephemeral drainage depressions grading to incised gullies. The desktop study indicates elevation ranges from 262 to 306 m AHD and slopes range from 0 to 40% on this geological unit.

The relief is described as steep low hills.

### 3.4 Vegetation

Through a search of the Queensland Government's regional ecosystems database ([DES, 2019a](#)), the Project site is mapped, based on pre-clearing broad vegetation groups, as being dominated by the communities shown in **Figure 5** and listed and described ([DES, 2019b](#)) in **Table 1**. This data provides background to the likely types and distribution of soil units across the Project site and is referenced through the identification, description and mapping of the soil units.



WILTON COKING  
COAL PTY LTD

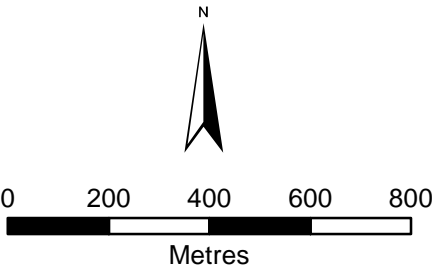
WILTON

FIGURE 4  
SITE TOPOGRAPHY

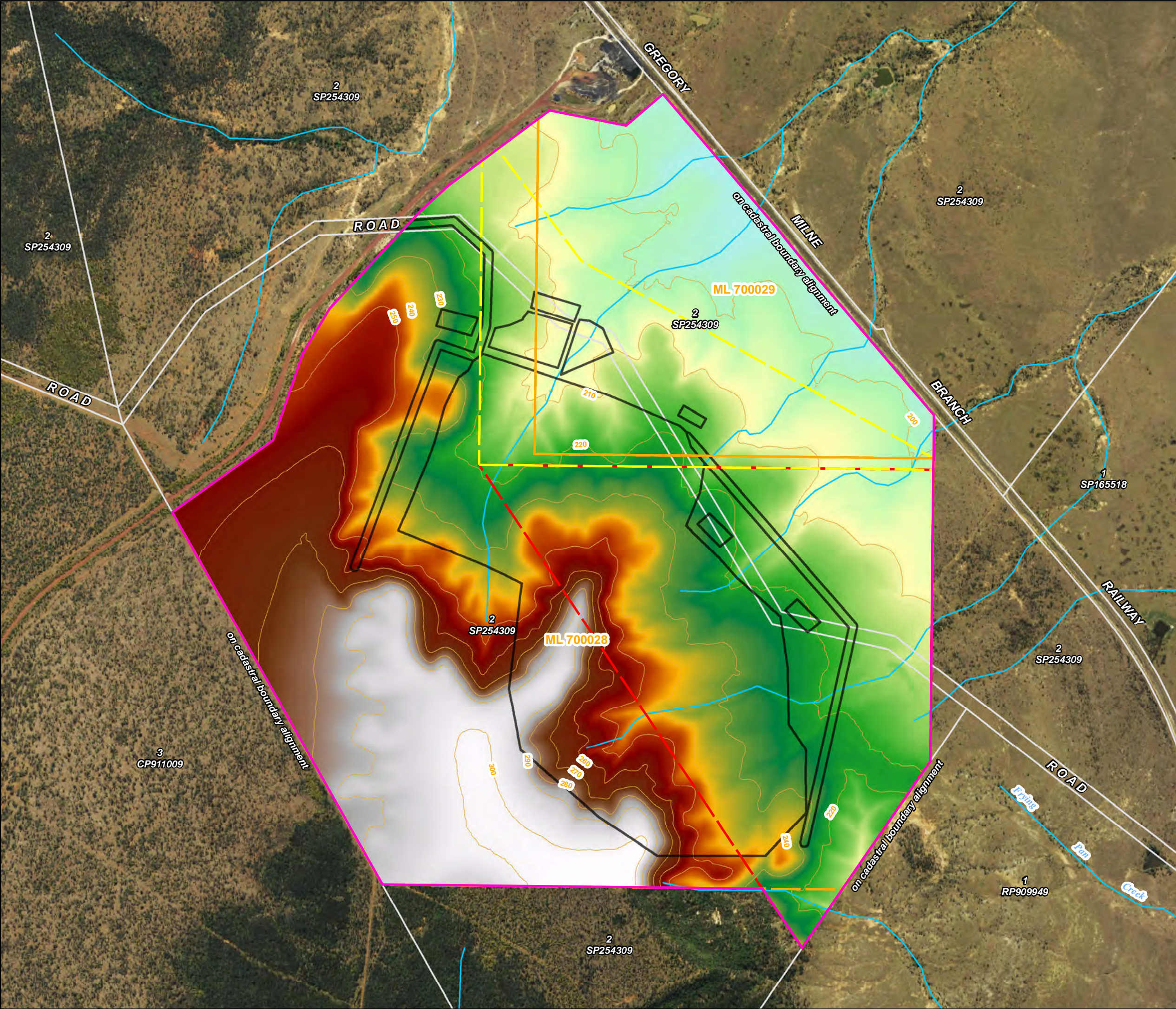
Legend

- Minor Watercourse
- Contour (mAHD)
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre
- Elevation (mAHD)
  - High : 304.3
  - Low : 192.4

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, SLR Investigation Area, 10m Contour (mAHD), and 10m resolution Digital Elevation Model datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





**Table 1 Pre-clearing vegetation communities mapped across the Project site**

RE code	Proportion (%)	RE Short description	Detailed description	Mapped geological units
11.9.1	100	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> woodland to open forest on fine-grained sedimentary rocks.	Open forest to woodland of <i>Eucalyptus cambageana</i> or <i>E. thozetiana</i> and <i>Acacia harpophylla</i> . <i>Eucalyptus cambageana</i> is commonly codominant with <i>Acacia harpophylla</i> in the open forest, or the open forest may be dominated by <i>A. harpophylla</i> and have scattered emergent <i>Eucalyptus cambageana</i> or <i>E. thozetiana</i> trees. The <i>A. harpophylla</i> trees range from about 12 m to 14 m in height and the eucalypts 15-18 m high. In central western areas the <i>Acacia harpophylla</i> may form tall shrubland c. 4 m high with emergent <i>Eucalyptus cambageana</i> trees 10-12 m high. The community has a moderately dense to dense lower tree/tall shrub layer dominated by species such as <i>Eremophila mitchellii</i> , <i>Carissa ovata</i> and <i>Geijera parviflora</i> , with <i>Terminalia oblongata</i> often present in the north. The ground layer is frequently sparse. Associated with slopes and crests of undulating plains and below low ridges and escarpments formed from Cainozoic to Proterozoic consolidated, fine-grained sediments. Texture contrast soils predominate, often with surface stone or gravel in sub-surface horizons, but other soils such as clays, sandy clay loams and cracking clays may also be present.	Emerald Formation (Te(w)), Burngrove Formation (Pwg)
11.9.2	100	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks.	<i>Eucalyptus melanophloia</i> and/or <i>E. orgadophila</i> grassy woodland to open woodland. Other tree species occasionally present as subdominants include <i>Corymbia erythrophloia</i> , <i>Eucalyptus populnea</i> or <i>Corymbia dallachiana</i> . Occurs on rises on undulating plains with cracking clay or texture contrast soils.	Emerald Formation (Te(w)), Burngrove Formation (Pwg)
11.9.2/ 11.9.1	80/ 20	As above for RE codes 11.9.1 and 11.9.2.		Emerald Formation (Te(w))
11.3.3/ 11.3.25 /11.9.1	60/ 20/ 20	11.3.3 <i>Eucalyptus coolabah</i> woodland on alluvial plains.	<i>Eucalyptus coolabah</i> woodland to open woodland with a grassy understorey. A mid layer is often absent but scattered tree or shrub species, such as <i>E. populnea</i> , <i>Melaleuca bracteata</i> , <i>Acacia stenophylla</i> , <i>Alectryon oleifolius</i> , <i>Terminalia oblongata</i> (in the north) and <i>Acacia pendula</i> , <i>A. cambagei</i> , and occasionally <i>Duma florulenta</i> may be present. The ground layer is dominated by a range of grass and forb species depending on season, soil and management conditions. Can include small areas of grassland with scattered trees. Occurs on Cainozoic alluvial plains or levees with clay or sometimes texture contrast soils.	Burngrove Formation (Pwg)

RE code	Proportion (%)	RE Short description	Detailed description	Mapped geological units
		11.3.25 <i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines.	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open forest. Other tree species such as <i>Casuarina cunninghamiana</i> , <i>E. coolabah</i> , <i>Melaleuca bracteata</i> , <i>Melaleuca viminalis</i> , <i>Livistona</i> spp. (in north), <i>Melaleuca</i> spp. and <i>Angophora floribunda</i> are commonly present and may be locally dominant. An open to sparse, tall shrub layer is frequently present dominated by species including <i>Acacia salicina</i> , <i>A. stenophylla</i> or <i>Lysiphyllum carronii</i> . Low shrubs are present, but rarely form a conspicuous layer. The ground layer is open to sparse and dominated by perennial grasses, sedges or forbs such as <i>Imperata cylindrica</i> , <i>Bothriochloa bladhii</i> , <i>B. ewartiana</i> , <i>Chrysopogon fallax</i> , <i>Cyperus dactyloides</i> , <i>C. difformis</i> , <i>C. exaltatus</i> , <i>C. gracilis</i> , <i>C. iria</i> , <i>C. rigidellus</i> , <i>C. victoriensis</i> , <i>Dichanthium sericeum</i> , <i>Leptochloa digitata</i> , <i>Lomandra longifolia</i> or <i>Panicum</i> spp. Occurs on fringing levees and banks of major rivers and drainage lines of alluvial plains throughout the region. Soils are very deep, alluvial, grey and brown cracking clays with or without some texture contrast. These are usually moderately deep to deep, soft or firm, acid, neutral or alkaline brown sands, loams or black cracking or non-cracking clays, and may be sodic at depth.	
		As above for RE code 11.9.1.		
11.7.2	100	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Monospecific stands of <i>Acacia</i> spp. forest/woodland on Cainozoic lateritic duricrusts. <i>Acacia shirleyi</i> and/or <i>Acacia catenulata</i> usually predominate the woodland to low woodland to low open forest tree canopy (7-12 m high). Other <i>Acacia</i> spp. that commonly occur and occasionally dominate the tree layer include <i>A. rhodoxylon</i> , <i>A. burrowii</i> , <i>A. sparsiflora</i> , <i>A. crassa</i> and <i>A. blakei</i> . Emergent eucalypt species such as <i>Eucalyptus thozetiana</i> , <i>E. crebra</i> , <i>E. decorticans</i> and <i>E. exserta</i> may be present. A low shrub layer is sometimes present and dominated by species such as <i>Acalypha eremorum</i> , <i>Croton phebaloides</i> and <i>Carissa ovata</i> . The ground layer is extremely sparse and dominated by grasses such as <i>Aristida caput-medusae</i> , <i>Paspalidium rarum</i> , <i>Urochloa foliosa</i> . Forbs are usually rare although <i>Sida</i> sp. (Musselbrook M.B.Thomas+ MRS437) may be conspicuous. Occurs on scarps and adjacent tops and slopes of dissected tablelands, mesas and buttes formed from chemically altered sediments and duricrusts. The soils are shallow to very shallow lithosols with surface stone and boulders. The vegetation is often growing in pockets of shallow lithosol soil between bare rock.	Emerald Formation (Te(w)), Ferricrete (Td-QLD)



RE code	Proportion (%)	RE Short description	Detailed description	Mapped geological units
11.7.1/ 11.7.2	50/ 50	11.7.1 <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> and <i>Eucalyptus thozetiana</i> or <i>E. microcarpa</i> woodland on lower scarp slopes on Cainozoic lateritic duricrust.	<i>Eucalyptus thozetiana</i> predominates forming a distinct but discontinuous canopy (13-21 m high) although localised areas may be dominated by a wide range of species. Occasionally scattered <i>E. microcarpa</i> or <i>Casuarina cristata</i> or <i>Acacia harpophylla</i> and sometimes <i>E. cambageana</i> (12-13 m emergents) are present in the canopy or locally dominant. On the deeper soils of the lower slopes, there is a moderately dense low tree layer of <i>C. cristata</i> and/or <i>Acacia harpophylla</i> . <i>Acacia catenulata</i> and <i>A. microperma</i> may be present towards crests. <i>Cadellia pentastylis</i> is sometimes present and may be locally dominant. A tall shrub layer of <i>Geijera parviflora</i> and less frequently, <i>Eremophila mitchellii</i> is usually developed, and a low shrub layer is often developed. The ground layer is sparse and usually dominated by forbs. Occurs on the slopes and scarps of rocky residual ranges with Cainozoic lateritic duricrust. The soils are shallow, gravelly, acidic loams and clays on the upper slopes, with deep (70-105 cm deep), uniform, brown clays with surface gravel on the lower slopes.	Emerald Formation (Te(w))
		As above for RE code 11.7.2.		
11.5.9b	100	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains and/or remnant surfaces.	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland. Other tree species that may be present and locally dominant include <i>Corymbia citriodora</i> or <i>C. clarksoniana</i> sometimes in association with <i>C. intermedia</i> , <i>C. dallachiana</i> , <i>C. lamprophylla</i> , <i>E. tenuipes</i> , <i>E. exserta</i> , <i>E. cloeziana</i> , <i>E. acmenoides</i> . The mid layer ranges from absent to a sparse to dense shrubland typically dominated by <i>Acacia</i> spp. (such as <i>A. excelsa</i> , <i>A. leiocalyx</i> ), <i>Petalostigma pubescens</i> , <i>Lysicarpus angustifolius</i> , <i>Alphitonia excelsa</i> and occasionally <i>Melaleuca nervosa</i> (on texture contrast soils). Occurs on plateaus and broad crests of hills and ranges which are formed by Cainozoic sandplains. Soils are generally deep red earths.	Emerald Formation (Te(w)), Ferricrete (Td-QLD)



# WILTON COKING COAL PTY LTD

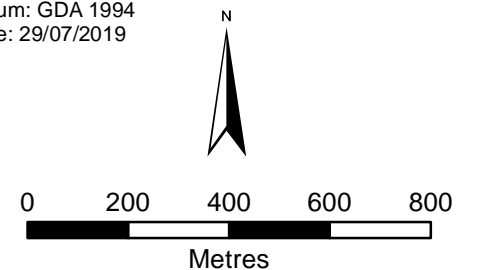
## WILTON

FIGURE 5  
PRE-CLEARING  
REGIONAL ECOSYSTEMS

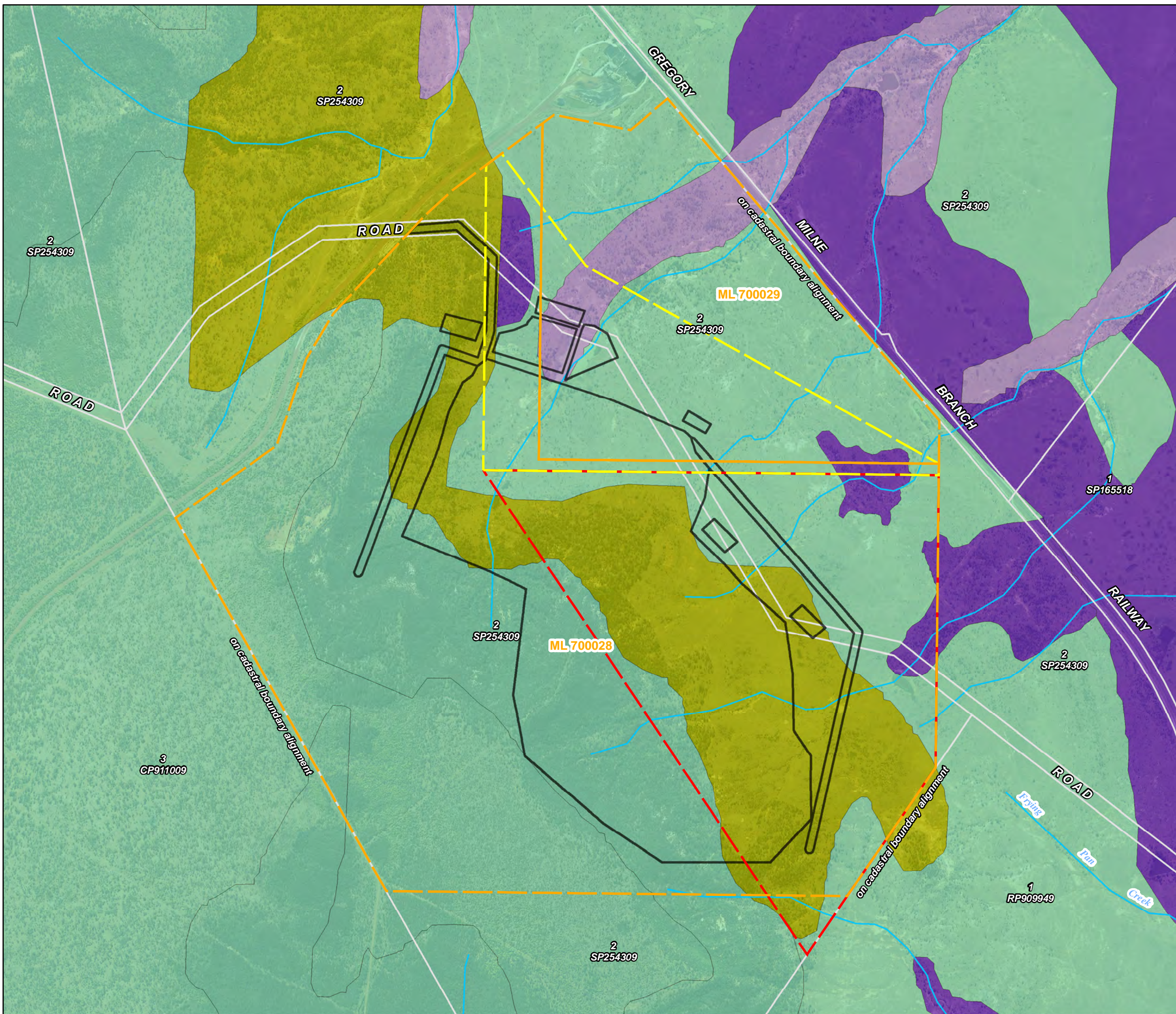
### Legend

- Minor Watercourse
  - Mining Lease (Application)
  - SLR Investigation Area (2019)
  - NRC Investigation Area (2017)
  - Proposed Site Disturbance
  - Base Cadastre
- Pre-Clearing Regional Ecosystems (Version 11)**
- Endangered - Dominant
  - Endangered - Sub-dominant
  - Of Concern - Dominant
  - No concern at present

Data Sources:  
Mining Lease (Application), Pre-Clearing Regional Ecosystems (Version 11), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





## 3.5 Soils

### 3.5.1 Land Systems

[Story et al. \(1967\)](#) conducted a survey of the soil and land resources of the Isaac-Comet region on behalf of the Queensland Government to identify, describe and map the land systems. The Project site is located across the Girrah, Durrandella and Monteagle land systems; however, only the Girrah and Durrandella land systems occur within the Study area. These are described below.

#### 3.5.1.1 Girrah Land System

The Girrah land system is characterised by lowlands with downs and brigalow and cracking clay soils on unweathered Permian shale and lithic sandstone in the north and centre ([Story et al. 1967](#)). Land forms within this land system include lowlands and low rises; lowlands and plains on shales and detrital clay; and alluvial flats.

Terrain, soils and vegetation associations with this land system include the following by land form:

- Lowlands and low rises (area 30%, widespread distribution) – local relief 3 to 33 m, slopes 2 to 5 %, mainly clay on shales but some stony patches on sandstone; mainly cracking clay soils ([Bruce](#)), minor shallow texture contrast soils ([Southernwood](#)); open savannah woodland of *Eucalyptus orgadophila*, *E. populnea*, *E. dichromophloia*, *E. papuana*, narrow-leaved ironbark or *E. melanophloia* over dense ground cover of *Dichanthium*, *Bothriochloa* spp., *Themeda* p., *Heteropogon* spp., *Iseilema* spp., *Cmopogon* spp., *Astida latifolia*, and *Enneapogon* spp.;
- Lowlands and plains on shales and detrital clay – slopes 0 to 5%:
  - Mostly cracking clay soils ([Teviot](#)) (area 45%, widespread distribution), commonly with linear gilgai, minor dark brown and grey-brown soils ([Cheshire](#)); downs, dense grass flora as per lowlands and rises above;
  - Some texture contrast soils mainly with thin sandy surface horizons and strongly alkaline sub-soils ([Taurus](#), minor [Wyesby](#)) (area 5%, distribution limited); open savannah woodland mainly of *E. populnea*, some *E. melanophloia* and *E. orgadophila*, ground cover as per lowlands and rises above (mainly near Girrah land system);
  - Texture contrast soils ([Taurus](#)) and cracking clay soils ([Rolleston](#)) (area 20%, widespread distribution); brigalow with varied associates (*Carissa* spp., *Eremopha* spp., *Terminalia* spp., *Denhamia obscura*, *Acalypha eremorum*, *Brachychiton* spp., *Canthium vacciniifolium*, *Croton phabalioides*, *Erythroxylum australe*), fair to scanty cover of *Paspalidium* spp., *Aristida* spp., *Chloris* spp., *Enneapogon* spp., *Cheilanthes hirsuta*, and mosses (widespread); and
- Alluvial flats (area <5%, widespread distribution) – up to 800 m wide, mainly clay, probably flooded in parts, both single and braided channels; **no soil families specified but assumed to be mainly texture contrast soils**; savannah woodland of *E. tessellaris* and *E. tereticornis* or *E. populnea*, ground cover of *Heteropogon* spp..

#### 3.5.1.2 Durrandella Land System

The Durrandella land system is characterised by hills with lancewood and narrow-leaved ironbark on weathered Tertiary and Permian rocks in the north-west, centre, and south-east; shallow rocky soils ([Story et al. 1967](#)). Land forms within this land system include mesa tops; tabular hills, benched slopes with rocky bluffs and narrow rocky valleys; breakaways and low stony hills; foot slopes; lower foot slopes; and alluvial flats.

Terrain, soils and vegetation associations with this land system include the following by land form:

- Mesa tops (area 20%, widespread distribution) – undulating up to 1.6 km across, slopes generally less than 3%, sandy surface, sheet erosion active in steeper margins; loamy red and yellow earths ([Dunrobin](#) and [Struan](#)) and some uniform coarse-textured soils ([Petrona](#)); savannah woodland of narrow-leaved ironbark, bloodwood, *Acacia cunninghamii*, and *Alphitonia* spp., fair groundcover of *Heteropogon* spp., *Briochloa* spp., *Themeda* spp., *Aristida* spp., and occasional *Triodia*, some lancewood and bendee over *Aristida* spp.;
- Tabular hills, benched slopes with rocky bluffs and narrow rocky valleys (area 25%, Cherwell Range) – local relief 17 to 66 m, slopes 5 to 50%; mainly shallow rock soils ([Shotover](#)), minor shallow red earths ([Gregory](#)) and shallow texture-contrast soils ([Southernwood](#)); lancewood or bendee with *E. exserta*, sparse ground cover (*Aristida* spp., *Ancistrachne* spp., *Calyptochloa gracillima*, *Triodia* spp., *Lomandra* spp.) or savannah woodland of narrow-leaved ironbark and bloodwood, sometime with *Acacia cunninghamii*, *Erythroxylum austral*, *Alphitonia* spp., and *Petalostigma* spp., ground cover of *Heteropogon* spp., *Themeda* spp., *Aristida* spp., *Chloris* spp., *Chrysopogon* spp., and *Eragrostis* spp.;
- Breakaways and low stony hills (area 35%, widespread distribution) – local relief 17 to 66 m, slopes up to 100%, much outcrop, rapid sheet erosion and gullying; shallow rocky soils ([Rugby](#) and [Shotover](#)), some dark brown and grey brown soils ([Bullaroo](#)); lancewood or bendee with *E. exserta* and *E. thozetiana* sparse ground cover (*Aristida* spp., *Ancistrachne* spp., *Calyptochloa gracillima*, *Triodia* spp., and *Lomandra* spp.);
- Foot slopes (area 15%, widespread distribution) – undulating up to 1.6 km long but usually less than 400 m, upper parts stony with slopes up to 10%, lower parts sandy or locally clayey with slopes up to 3%; texture contrast soils ([Luxor](#) and [Wyseby](#)); variable vegetation, mainly mixed scrub woodland or *E. populnea*, *Eremophila* spp., and *Carissa* spp., or savannah woodland of *E. populnea* or *E. melanophloia*, ground cover *Aristida* spp., *Chloris* spp., *Chrysopogon* spp., *Themeda* spp., *Eragrostis* spp., *Enneapogon* spp., and *Cymbopogon* spp., occasional “scalds”;
- Lower foot slopes (area <5%, sporadic distribution) – gently undulating to level, up to 400 m long, slopes up to 2 %, weathered shale and clay; texture contrast soils ([Broadmeadow](#) and [Taurus](#)); brigalow, *E. thozetiana* and *E. cambageana* with scanty ground cover of *Aristida* spp., *Chloris* spp., and *Paspalidium* spp.; and
- Alluvial flats (area <5%, widespread distribution) – usually sandy with single meandering channels up to 3 m deep, **no soil families specified but assumed to be mostly texture contrast soils**; savannah woodland of narrow-leaved ironbark and *E. citriodora*, or *E. populnea*, or *E. melanophloia*, ground cover fair of *Themeda* spp., *Heteropogon* spp., and *Chrysopogon* spp., channels of *E. tereticornis* and *E. tessellaris* over the same grasses, some brigalow and *E. cambageana* over *Aristida* spp..

### 3.5.1.3 Soils of the Girrah and Durrandella Land Systems

The soils of the Girrah and Durrandella land systems, as identified and described by [Story et al. \(1967\)](#), are briefly described in **Table 2**.

**Table 2 Soil families of the Girrah and Durrandella land systems from [Story et al. \(1967\)](#) and equivalent ASCs**

Major Group	Family	Brief Description	Appropriate or Approximate Equivalent Names	Principal Profile Form ( <a href="#">Northcote, 1965</a> )	Australian Soil Classification (ASC) ( <a href="#">Isbell &amp; NCST, 2016</a> )
Cracking clay soils	Rolleston	Tertiary weathered zone parent material: Deep clay soils – not gilgaied	Grey and brown soils of heavy texture ( <a href="#">Stephens, 1962</a> )	Ug5.16, 5.38	Grey and Brown Vertosols
	Teviot	Sedentary on various sedimentary rocks: Dark brown to very dark grey clay soils, moderately deep to deep	Black earth	Ug5.12, 5.15	Black, Brown and Grey Vertosols
	Bruce	Shallow clay soils on various materials: Shallow clay soils (<60 cm)	Grey and brown soils of heavy texture	Ug5.12, 5.37	Grey and Brown Vertosols
Dark, brown and grey-brown soils	Cheshire	Dark brown, medium-textured surface soils grading to fine-textured alkaline subsoils		Gn4.13, 4.15, 3.93	Black and Brown Ferrosols and Dermosols
	Bullaroo	Dark grey-brown, coarse-textured surface soils grading to brown, acid, medium- to fine-textured subsoils		Gn4.31	Black and Brown Ferrosols and Dermosols
Red and yellow earths	Dunrobin	Loamy red earths – sandy loam to sandy clay loam surface soils grading to light clay subsoils	Lateritic red earths ( <a href="#">Stephens, 1962</a> )	Gn2.12	Red Kandosols
	Struan	Loamy yellow earths – sandy loam to sandy clay loam surface soils grading to light clay subsoils	Yellow earths ( <a href="#">Stewart, 1959</a> ; <a href="#">Stephens, 1962</a> )	Gn2.22	Yellow Kandosols
	Gregory	Shallow red and yellow earths (<60 cm)		Gn2.11	Red and Yellow Kandosols

Major Group	Family	Brief Description	Appropriate or Approximate Equivalent Names	Principal Profile Form ( <a href="#">Northcote, 1965</a> )	Australian Soil Classification (ASC) ( <a href="#">Isbell &amp; NCST, 2016</a> )
Texture-contrast soils	Southernwood	Shallow soils (<60 cm): Sandy or loamy surface soils, acid to mildly alkaline subsoils	Solodic ( <a href="#">Stephens, 1962</a> )	Dr2.12	Black, Brown, Grey and Red Sodosols
	Luxor	Deep soils (>90 cm) with thick sandy surface soils (>35 cm): Acid to mildly alkaline subsoils	Sandy solodic soils ( <a href="#">Downes and Sleeman, 1955</a> ), sandy solodic ( <a href="#">Isbell, 1957</a> )	Dy3.21, 3.42, 5.21	Yellow Sodosols
	Broadmeadow	Deep soils (>90 cm) with thick sandy surface soils (>35 cm): Strongly alkaline subsoils, generally mottled	Solodized solonetz and solodic ( <a href="#">Isbell, 1957</a> )	Dr2.13, Db1.23, Dy3.23	Red, Brown and Yellow Sodosols
	Taurus	Thin sandy surface soils (<35 cm): Strongly alkaline subsoils	Solodized solonetz and solodic	Db1.23, Dy2.43, Dd1.23	Brown, Yellow and Black Sodosols
	Wyseby	Loamy surface soils (generally <35 cm): Acid to mildly alkaline subsoils	Solodic	Dr2.31, Db1.12	Red and Brown Sodosols
Uniform coarse-textured soils	Petrona	Moderately shallow, uniform, coarse-textured soils (<90 cm)		Uc1.21	Tenosols and Rudosols
Shallow rock soils	Rugby	Shallow, uniform, medium- to fine-textured soils	Skeletal soils ( <a href="#">Stephens, 1962</a> )	Um1	Tenosols and Rudosols
	Shotover	Shallow, uniform, coarse-textured soils	Skeletal soils ( <a href="#">Stephens, 1962</a> )	Uc1.2	Tenosols and Rudosols

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### 3.5.2 Land Resource Areas

The Queensland Department of Primary Industries (DPI) undertook a soil and landscape assessment to prepare a resource information report ([Bourne & Tuck, 1993b](#)) and field manual ([Bourne & Tuck, 1993a](#)). The report and manual were prepared for understanding and managing soils in the Central Highlands of Queensland as part of the State-wide land management manual project.

The MLA is located within the former Peak Downs local government area across land resource areas (LRAs) identified as Undulating Downs (LRA 4) and Ranges (LRA 6). These LRAs are described in the following sections.

Each LRA comprises various agricultural management units (AMUs), which are broad landscape units made up of groups of different soils developed from related geological units with recurring patterns of topography and vegetation. The major and minor AMUs of each LRA include those identified and described by [Bourne and Tuck \(1993b\)](#) based on their primary soil characteristics and landform, which are presented in **Table 3** along with their current equivalent Australian Soil Classification (ASC).

#### 3.5.2.1 Undulating Downs LRA

According to [Bourne and Tuck \(1993b\)](#), the Undulating Downs land resource area (LRA 4) “includes the heavy clay soils formed in situ on basalt and fine-grained sedimentary rocks. Depth to parent rock and lithology are the major diagnostic AMU attributes.” There are two major and three minor AMUs.

#### 3.5.2.2 Ranges LRA

According to [Bourne and Tuck \(1993b\)](#), the Ranges land resource area (LRA 6) “includes the range of shallow soils associated with mountains, hills, ridge lines and dissected plateaus, which have been included within a single AMU.” There are one major and two minor AMUs.

## 3.6 Current Land Use

The current land use on the Project site and immediate surrounds is primarily grazing on fairly extensively cleared lands and coal mining. Some areas under grazing may have also been cultivated and/or sown to improved pasture further to the east.

**Table 3 Major and minor AMUs for each LRA**

LRA	AMU	Soil classification - Great Soil Group - Northcote	Colour	Texture profile; depth	Other profile features	Landform	Equivalent ASC ( <a href="#">Isbell &amp; NCST, 2016</a> )
<b>Major:</b> LRA 4	Orion	- Black earth, grey clay - Ug 5.12, 5.22	Grey-brown to dark throughout	Uniform medium to heavy clay; 0.45 m to 1.2 m to bedrock	Coarse to moderate self-mulching surface; neutral to alkaline; surface stone can occur; alkaline and strongly structured subsoils	Gently undulating to undulating plains and rises	Black and Grey Vertosols
<b>Major:</b> LRA 4	Jimbaroo	- Black earth and non-cracking clay - Ug 5.12, Uf 63.2	Dark to reddish brown over dark to reddish brown subsoil	Light to medium clay over medium to medium heavy clay; <0.45 m to bedrock	Neutral to alkaline self-mulching to hard setting surface; often stony throughout	Crests and upper slopes of rises	Black to Brown Vertosols and Ferrosols
<b>Minor:</b> LRA 4	Kia-Ora	- Black earth - Ug 5.11, 5.15	Dark olive-grey to brownish black over dark brown to olive-grey subsoil	Uniform heavy clay; >0.60 m	Fine to medium self-mulching surface over strongly structured alkaline subsoil	Undulating to gently undulating	Black Vertosols
<b>Minor:</b> LRA 4, 6	Glen Idol	- Red-brown duplex and associated non-cracking clay - Dr 4.13, Uf 6.3	Red to reddish brown surface over red to reddish brown subsoils	Clay loam to sandy clay loam over medium to medium heavy clay; generally >0.9 m	Generally hard setting surface and no bleach; moderate prismatic structured subsoil; alkaline subsoils; carbonate often present	Undulating to gently undulating plains	Red and Brown Chromosols and Dermosols
<b>Minor:</b> LRA 4	Moramana	- Grey, brown and red clay - Ug 5.34, 5.24, 5.38	Brown to red over brown, dark or red subsoil	Medium clay over medium heavy clay; >1.5 m	Strongly self-mulching surface over alkaline strongly structured subsoil; often forms a gilgai complex	Level alluvial plains	Grey, Brown and Red Vertosols



LRA	AMU	Soil classification - Great Soil Group - Northcote	Colour	Texture profile; depth	Other profile features	Landform	Equivalent ASC ( <a href="#">Isbell &amp; NCST, 2016</a> )
<b>Major:</b> LRA 6	Highlands	- Shallow lithosols - Uc 1.23	Reddish brown to yellowish brown over rock	Variable; generally shallow, rocky sandy clay loam to loamy sand; > 0.1 m to bedrock	Neutral reaction trend; massive structure	Mountains, hills, plateaus and rises	Brown Tenosols and Rudosols
<b>Minor:</b> LRA 6	Lascelles	- Solodic and solodized solonetz - Dy 3.43, 2.33, 2.43	Dark brown to yellowish brown over mottled yellowish grey to brown subsoil	Sandy loam surface from 0.2 to 0.5 m; abruptly changes to medium heavy clay subsoil; > 1.2 m	Hard setting surface, often bleached, over coarse columnar structured and alkaline subsoils	Gently undulating to undulating plains	Grey and Brown Sodosols



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FIGURE 6  
LAND RESOURCE  
AREAS

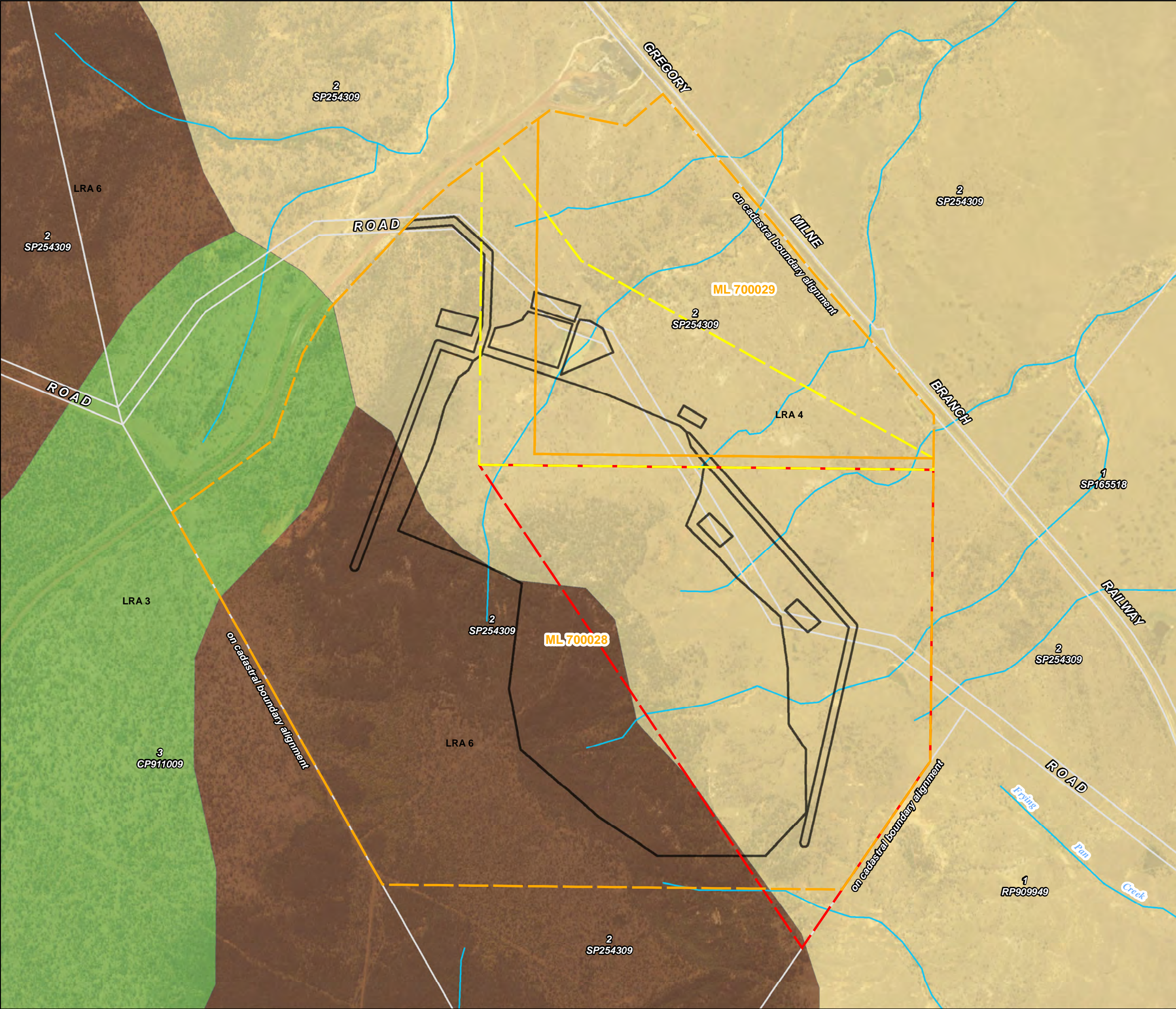
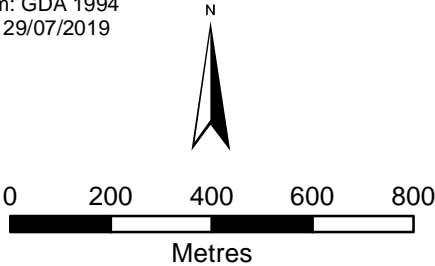
**Legend**

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre

**Land Resource Areas**

- Eucalypt Duplex Plains (LRA 3)
- Undulating Downs (LRA 4)
- Ranges (LRA 6)

Data Sources:  
Mining Lease (Application), Land Resource Areas (derived from Land Systems of the Isaac-Comet Area (ZDK3)), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019





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## 4 Soil Assessment

### 4.1 Methodology

Identification and description of soil units and their distribution across the Project site was undertaken based on:

- A desktop review of historical and more recent soil and land resource assessment reports and digital geographic information;
- Field soil and land surveying across the Project site; and
- Laboratory analysis of soil samples collected from described representative profiles.

The details associated with each of these aspects of the methodology are presented in the following sections.

#### 4.1.1 Desktop Assessment

Preliminary identification and description of soils and their distribution across the Project site was undertaken based on a desktop review of historical and more recent soil and land resource assessment reports and online information sources, including the:

- Information Resource for Understanding and Managing soils in the Central Highlands ([Bourne & Tuck, 1993b](#));
- Field Manual for Understanding and Managing soils in the Central Highlands ([Bourne & Tuck, 1993a](#));
- Lands of the Isaac-Comte Area, Queensland ([Story et al. 1967](#));
- Queensland Globe spatial data portal ([QG, 2019](#)); and
- Wilton Coal Project: Soils and Strategic Cropping Land Assessment ([NRC, 2017](#)).

Additionally, recent digital geographic information was also reviewed using GIS software. GIS data reviewed included:

- Aerial photography;
- Digital terrain modelling from which contours were generated;
- Existing surface geology;
- Existing soil mapping;
- Cadastre;
- Watercourses;
- Regional ecosystems;
- Exploration permits for coal mapping;
- Mining lease area mapping; and
- Proposed pit shell and associated infrastructure layout.

#### 4.1.2 Field Assessment

Based on the desktop assessment, broad soil classes were identified and a field sampling plan formulated that included check sites and detailed profile description and sampling to confirm the likely soil units and their physical and chemical characteristics.

The field sampling plan was developed in accordance with the following standards and guidelines:

- RPI Act Statutory Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land ([DILGP, 2017a](#)); and
- Guidelines for Surveying Soil and Land Resources ([McKenzie, et al., 2008](#)).

Based on these guidelines and with consideration for the previously DES-accepted NRC (2018) report for the WCC project, which used a mapping scale of 1:50,000, a mapping scale of 1:25,000 was adopted for this new report. At 1:25,000 scale, according to [McKenzie, et al. \(2008\)](#), the number of observations required for the study area, which was 311 ha, is shown in **Table 4**. The completed field sampling plan is also shown in **Table 4**, including consideration for previous observations made by [NRC \(2018\)](#) that were considered directly relevant to the SCL study area.

**Table 4 Number of field survey observations required at 1:25,000 scale according to McKenzie, et al. (2008) and completed field sampling plan**

Scale	Intensity	Area /site	Obs /ha	Size	Total		Detailed profile descriptions		Profiles for analysis		Mapping observations	
		(ha/obs)		(ha)	%	#	%	#	%	#	%	#
Required at 1:25,000 scale according to <a href="#">McKenzie, et al. (2008)</a>												
Moderate intensity (1:25,000)	Upper	3.25	0.16	351	100%	56	35	20	5	6	60	31
	Lower	12.5	0.08			28		10		3		15
	Minimum	25	0.04			14		5		1		8
Sample sites by NRC applicable and relevant to the Project site						23		9		9		14
Required at 1:25,000 scale for field sampling plan												
Moderate intensity (1:25,000)	Upper	3.25	0.16	351	100%	33	35	11	5	0	60	17
	Lower	12.5	0.08			5		1		0		1
	Minimum	25	0.04			0		0		0		0
Completed for the additional investigation area						13		7		7		6
Total completed for the report						36		16		16		20

In comparison, the RPI Act Statutory Guideline 08/14 ([DILGP, 2017a](#)) requires the number of observations to meet the requirements shown in **Table 5**. Based on the SCL assessment for each observation site (refer to **Figure 14**), the number of observations completed against each observation type required is as shown in **Table 5**.

**Table 5 Number of field survey observations required for the Western Cropping Zone according to DILGP (2017a) and completed field sampling plan**

Mapped Soil Unit	ASC	Area (ha)	Observation Type	Observation Site ID	Number of Observations	
					Completed	Required
Dermosols	Black, Grey, Brown and Red Dermosols	142	Detailed	<a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>	6	3
			Analysed	<a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>	6	3
			Check	<a href="#">O5C</a> , <a href="#">O6C</a> , <a href="#">O14C</a> , <a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>	9	≥6
			Exclusion	<a href="#">O2E</a> , <a href="#">O3E</a> , <a href="#">O7E</a> , <a href="#">O8E</a> , <a href="#">O9E</a> , <a href="#">S3</a> , <a href="#">O5C</a> , <a href="#">O6C</a> , <a href="#">O14C</a>	10	3
Vertosols	Black, Grey and Brown Vertosols	174	Detailed	<a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>	10	4
			Analysed	<a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>	10	4
			Check	<a href="#">OB03</a> , <a href="#">OB09</a> , <a href="#">OB10</a> , <a href="#">OB11</a> , <a href="#">OB12</a> , <a href="#">OB13</a> , <a href="#">O10C</a> , <a href="#">O11C</a> , <a href="#">O12C</a> , <a href="#">O13C</a> , <a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>	20	≥8
			Exclusion	<a href="#">O1E</a> , <a href="#">O4E</a> , <a href="#">OB02</a> , <a href="#">OB03</a> , <a href="#">OB04</a> , <a href="#">OB07</a> , <a href="#">OB09</a> , <a href="#">OB10</a> , <a href="#">OB11</a> , <a href="#">OB12</a> , <a href="#">OB13</a> , <a href="#">O11C</a> , <a href="#">O13C</a>	13	3
Total		316			36	27
Mapped SCL area (ha)						196
SCL site density (sites/ha)						1 site/5.4 ha

The number of observations completed for the new report is slightly more than the lower intensity required by [McKenzie, et al. \(2008\)](#) and more than the intensity required by [DILGP \(2017a\)](#) demonstrating compliance with the relevant standards and guidelines.

Field assessment to identify and verify soil units across the Project site were described in detail through various types of observation sites. Observation sites included surface check/exclusion sites, shallow subsurface check/exclusion sites and full soil profile descriptions to 1.2 m or refusal, whichever came first, with some soil profiles sampled and analysed. Observation data was recorded in accordance with the following standards and guidelines using the standard “green sheet” by SLR and an alternative log sheet by NRC (copies of original field sheets are provided in **Appendix C**):

- RPI Act Statutory Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land ([DILGP, 2017a](#)); and
- Australian Soil and Land Survey Field Handbook ([NCST, 2009](#));
- Munsell Soil Color Charts ([Munsell Color, 2009](#)); and

- Australian Soil Classification (ASC) system ([Isbell & NCST, 2016](#)).

Subsurface observations were made using an 82 mm diameter hand auger (refer to **Photo 1**).



**Photo 1** Hand auger used for representative soil profile and shallow subsurface observations



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FIGURE 7  
SOIL OBSERVATIONS

### Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre

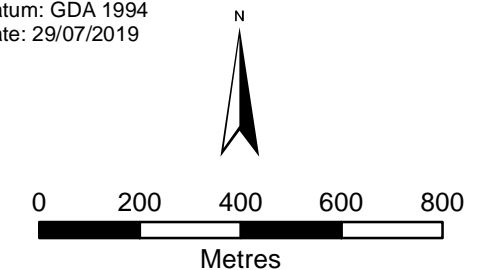
### SLR Soil Observations

- Profile Exclusion Site
- Exclusion Site
- Analysed Profile Site

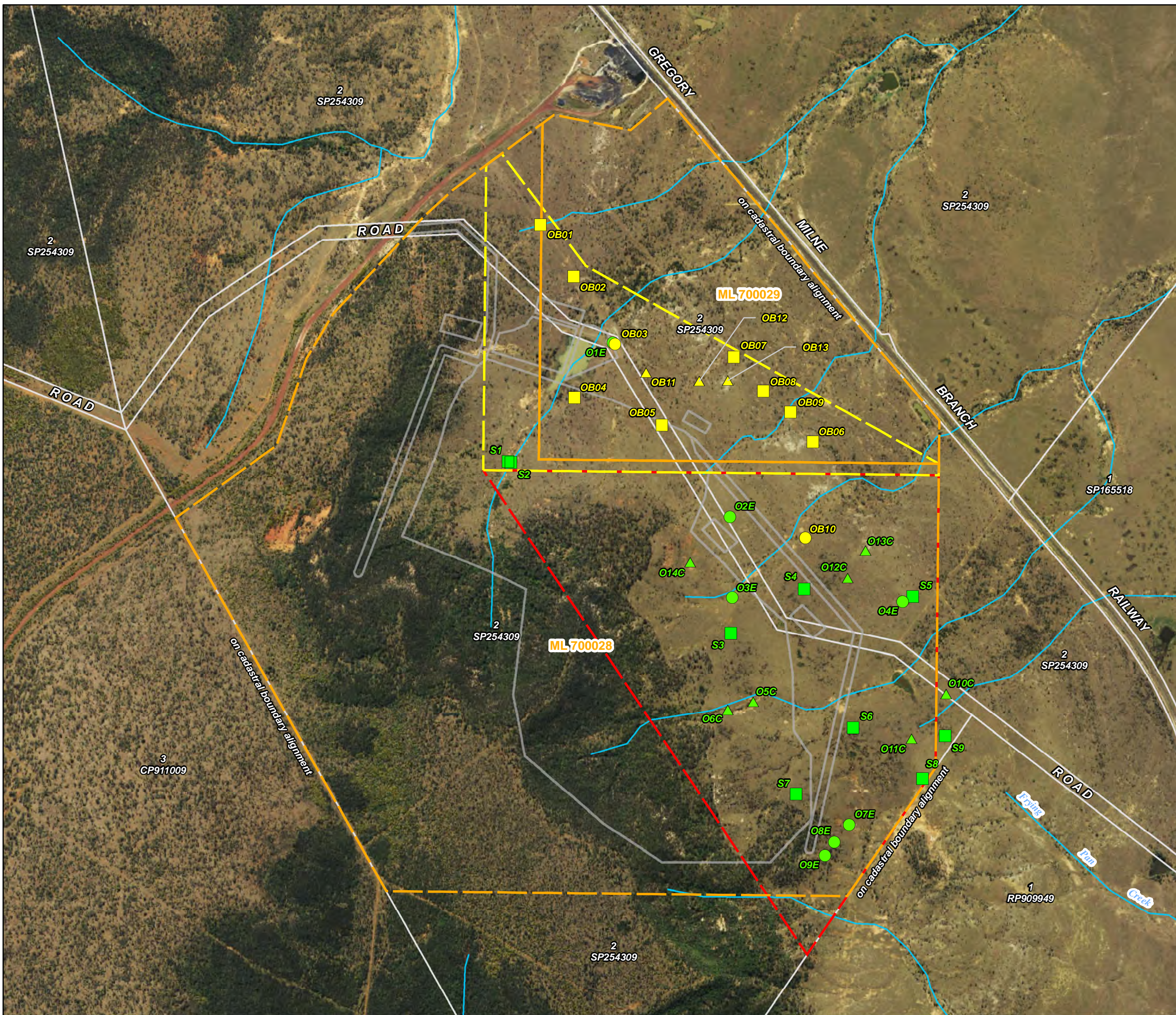
### NRC Soil Observations

- Exclusion Site
- Check Site
- Analysed Profile Site

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Soil Observations, and NRC Investigation Area datasets: Northern Resource Consultants (2017); Proposed Site Disturbance, SLR Soil Observations, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





### 4.1.3 Soil Sampling Methods

Field sampling procedures conformed to SLR's quality assurance/quality control (QA/QC) protocols to minimise the potential for cross contamination and preserve sample integrity. A summary of the soil sampling activities is outlined in **Table 6**.

**Table 6 Soil sampling activities**

Activity	Details
Soil profile locations	Navigation to soil core locations was undertaken using a Garmin Oregon 550 global positioning system (GPS) with an accuracy of +/- 3 m. The exact sample locations were recorded from this unit.
Soil profile excavations	82 mm diameter hand auger was used to core soil profiles. The soil core was augered to between 1.2 m BGL or refusal, whichever occurred first.
Abandonment	Soil cores were backfilled to the existing natural ground level using soil retrieved during augering.
Decontamination	The auger was cleaned at each new core by scraping and brushing soil material from the auger.
Soil logging	Soil characteristics were recorded and profiles classified in accordance with the Australian Soil and Land Survey Field Handbook ( <a href="#">NCST, 2009</a> ). In addition to soil descriptions, associated landscape features, including terrain, land use, areas of degradation, slopes and vegetation were recorded and photographed. Original field soil profile logs, "green sheets", are provided in <b>Appendix C</b> .
Soil sampling	Soil samples, at least 750 g in volume, were obtained directly from the augered profile at nominal depths of 0-10, 10-20, 20-30, 50-60, 80-90 and 110-120 cm BGL; however, these were adjusted depending on soil profile depth and locations of horizon boundaries. Discrete soil samples were collected and placed into resealable plastic bags and stored in cool boxes for dispatch to the laboratory.
Labelling	Sample bags were labelled with the project reference, sampler, site location and depth. For instance, a sample collected at PR01 at a depth of 0.0-0.1 m BGL was labelled as follows: Wilton Coking Coal CT OB01 / 0.0-0.1 m 26/05/2019 / 11:30am
Dispatch	Samples were stored in cool boxes out of the sun and couriered by road for analysis at Australian Laboratory Services (ALS) under chain of custody documentation.

### 4.1.4 Laboratory Analysis

For agronomic soil physical and chemical characteristics, laboratory analyses were primarily selected from the following resources:

- Soil Chemical Methods – Australasia ([Rayment & Lyons, 2011](#));
- Measuring soil cation exchange capacity and exchangeable cations ([SSA, 2013](#))



A total of 74 soil samples were analysed from 16 sampled profiles. These data were used to characterise the distribution of soils across the Project site and identify the soil mapping units.

Descriptions of the 16 soil profiles, based on field logs and laboratory results, are provided in **Appendix A**, while chain of custody forms and laboratory certificates for the 74 samples analysed are provided in **Appendix D**. Original field soil profile description and check site green sheet logs by SLR and other logs sheets by NRC are provided in **Appendix C**.

The 16 soil profile analyses undertaken for this assessment were performed by ALS Environmental and SGS, both laboratories with National Association of Testing Authorities (NATA) accreditation for most of the laboratory analyses required for this soil assessment. The soil profile analyses undertaken for this assessment included:

- pH<sub>1:5 H2O</sub>;
- Electrical conductivity (EC<sub>1:5 H2O</sub>);
- Acid neutralising capacity on SLR samples only;
- Moisture content (air dry);
- Emerson aggregate test, including colour, texture (on SLR samples only) and Emerson class number;
- Particle size analysis (<2 µm (clay), 2-20 µm (silt), 0.02-0.2 mm (fine sand), 0.2-2.0 mm (coarse sand) and >2 mm (gravel));
- Soil particle density on SLR samples only;
- Exchangeable cations (Al<sup>3+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>) and cation exchange capacity plus exchangeable sodium percentage (ESP) and calcium/magnesium ratio (Ca:Mg);
- Total sulfur (S) on SLR samples only;
- Chloride (Cl<sup>-</sup>);
- Trace elements (boron (B), copper, (Cu), iron (Fe), manganese (Mn), and zinc (Zn)) on SLR samples only;
- Nitrogen (N) as nitrite, nitrate, total Kjeldahl nitrogen (TKN) and total N on SLR samples only and nitrate and TKN on NRC samples;
- Phosphorus (P) as bicarbonate extractable P and total P on SLR samples only and total P on NRC samples; and
- Organic matter content (Walkley-Black) and total organic carbon by calculation.

## 4.2 Soil Units

Based on the desktop (refer to **Section 3**), field (refer to **Appendix A**) and laboratory assessment results (**Appendix B**), the soil units identified across the Study area are summarised in **Table 7** and shown in **Figure 8**. Laboratory data in **Appendix B** is presented in two tables as follows for ease of interpretation:

- First table comprises all laboratory data by sample site
- Second table comprises selected laboratory data organised by ASC/texture, pH, and salinity and chloride.

Example full representative profiles for the Dermosol and Vertosol soil units are provided following **Figure 8**.

**Table 7 Soil units identified across the Study area by adjusted surface geological unit based on field observations**

Surface Geology	Soil Unit (ASC)	Soil Unit Description	Observation Type	Site ID	Inferred Land System, Terrain and Soil	Inferred Land Resource Area and AMU	Mapped Soil Units	Area (ha)
Emerald Formation (Te(w))	Black, Grey, Brown and Red Dermosols	Shallow to deep, black, grey, brown and red non-cracking clays on level to moderately inclined slopes; soft to firm, some surface crusting, sometimes gravelly, silty loam to light clay surface horizons; overlying light to medium clay, some mottling, subsoil horizons, overlying weathered sandstone	Detailed	<a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>	Durrandella, foot slopes and lower foot slopes terrain, no suitable soil family	LRA 4, no suitable AMU	Dermosols	142
			Analysed	<a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>				
			Check	<a href="#">O5C</a> , <a href="#">O6C</a> , <a href="#">O14C</a> , <a href="#">S1</a> , <a href="#">S2</a> , <a href="#">S3</a> , <a href="#">S6</a> , <a href="#">S7</a> , <a href="#">S8</a>				
			Exclusion	<a href="#">O2E</a> , <a href="#">O3E</a> , <a href="#">O7E</a> , <a href="#">O8E</a> , <a href="#">O9E</a> , <a href="#">S3</a> , <a href="#">S7</a> , <a href="#">S8</a> , <a href="#">O5C</a> , <a href="#">O6C</a>				
Burngrove Formation (Pwg)	Black, Grey and Brown Vertosols	Shallow to deep black, grey and brown cracking clays; firm to hard, surface flake to crust, some self-mulching, gravelly, loamy to medium clay, some fine sandy, surface horizons; overlying light to medium clay, some fine sandy subsoil horizons; overlying weathered sandstone	Detailed	<a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>	Girrah, lowlands and low rises terrain, <a href="#">Bruce</a>	LRA 4, <a href="#">Kia-Ora</a>	Vertosols	174
			Analysed	<a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>				
			Check	<a href="#">OB09</a> , <a href="#">OB10</a> , <a href="#">OB11</a> , <a href="#">OB12</a> , <a href="#">OB13</a> , <a href="#">O10C</a> , <a href="#">O11C</a> , <a href="#">O12C</a> , <a href="#">O13C</a> , <a href="#">OB01</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB05</a> , <a href="#">OB06</a> , <a href="#">OB07</a> , <a href="#">OB08</a> , <a href="#">S4</a> , <a href="#">S5</a> , <a href="#">S9</a>				

Surface Geology	Soil Unit (ASC)	Soil Unit Description	Observation Type	Site ID	Inferred Land System, Terrain and Soil	Inferred Land Resource Area and AMU	Mapped Soil Units	Area (ha)
			Exclusion	<a href="#">O4E</a> , <a href="#">OB02</a> , <a href="#">OB04</a> , <a href="#">OB07</a> , <a href="#">OB09</a> , <a href="#">OB10</a> , <a href="#">OB11</a> , <a href="#">OB12</a> , <a href="#">OB13</a> , <a href="#">O11C</a> , <a href="#">O13C</a>				
	Black-Orthic Tenosol	Shallow, black, poorly developed (highly disturbed) soil; firm to hard, gravelly, clay loam, sandy, surface horizon; overlying weathered mudstone with medium clay in spaces between mudstone cobbles; grading to mudstone	Detailed	-	Girrah, lowlands and low rises terrain, degraded <a href="#">Bruce</a>	LRA 4, minor within <a href="#">Kia-Ora</a>	Minor within Vertosols	
			Analysed	-				
			Check	<a href="#">OB03</a>				
			Exclusion	<a href="#">OB03</a> , <a href="#">O1E</a>				
	Brown Dermosol	Shallow, brown, non-cracking clay in drainage depressions; firm, surface flake to crust, cobbly, clay loam, sandy, surface horizon; overlying fine sandy light medium to medium clay subsoil horizon; overlying sandstone	Detailed	<a href="#">OB02</a>	Girrah, lowlands and low rises terrain, no suitable soil family (minor within Bruce)	LRA 4, minor within <a href="#">Kia-Ora</a>	Minor within Vertosols	
			Analysed	<a href="#">OB02</a>				
			Check	<a href="#">OB02</a>				
			Exclusion	<a href="#">OB02</a>				
	Brown Sodosol	Texture contrast soil with buried soils in drainage depressions; loose to firm, surface flake to crust, coarse sandy loam surface horizon; overlying clay loam, coarse sandy, to medium clay, mottled, subsoil horizon; overlying weathered sandstone	Detailed	<a href="#">OB01</a>	Girrah, lowlands and low rises terrain, no suitable soil family (minor within Bruce)	LRA 4, minor within <a href="#">Kia-Ora</a>	Minor within Vertosols	
			Analysed	<a href="#">OB01</a>				
			Check	<a href="#">OB01</a>				
			Exclusion	-				



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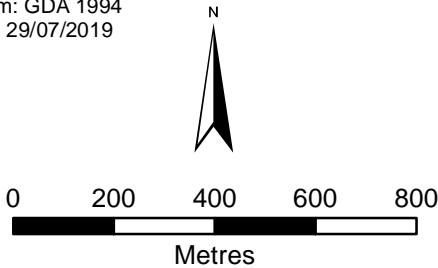
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FIGURE 8  
SOIL UNITS

Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area
- NRC Investigation Area
- Proposed Site Disturbance
- Base Cadastre
- SLR Mapped Soil Units**
  - Dermosols
  - Tenosols and Rudosols
  - Vertosols
- SLR Soil Observations**
  - Profile Exclusion Site
  - Exclusion Site
  - Analysed Profile Site
- NRC Soil Observations**
  - Exclusion Site
  - Check Site
  - Analysed Profile Site

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB  
datasets: © State of Queensland (Department of  
Natural Resources, Mines, and Energy) 2019; NRC  
Investigation Area dataset: Northern Resource  
Consultants (2017); Proposed Site Disturbance, SLR  
Mapped Soil Units, and SLR Investigation Area  
datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban  
2012 Orthophoto Image Service: © State of  
Queensland (Department of Natural Resources, Mines,  
and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3



#### 4.2.1 Representative Profile for the Dermosol Mapped Soil Unit

SITE DESCRIPTION		ASC Soil Order:		Red Dermosol			Site #:	S3
Coordinates:	Easting:	661083	Northing:	7416296	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee			Elevation:	228 m AHD	

#### LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)

Slope:	Gently inclined (4.3%)	Runoff:	Moderately rapid
Morphological type:	Mid slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Imperfectly drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Geology:	Emerald Formation (Te(w))	Rock outcrop:	Nil
Surface condition:	Not stated on field log, appears firm, surface crusting based on close-up of 3 <sup>rd</sup> photo below		
Coarse fragments:	Appears to be many (20-50%), coarse, metamorphic gravels (20-60 mm) based on close-up of bottom left photo		
Erosion:	Minor, active sheet erosion and minor, active gully erosion (<1.5 m deep) (see centre of top right photo)		
Vegetation:	Brigalow, buffel grass		



Site S3 landscape, looking upslope



Site S3 landscape, looking downslope



Site S3 surface condition



Site S3 surface condition

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S3 profile, 1.5 m deep**



**Site S3 profile, 0.0-0.25 m deep**



**Site S3 profile, 0.6-0.8 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Reddish brown (5YR 4/3) (moist); weak, 2-5 mm, angular blocky structure, weak consistence; light clay; many, coarse, metamorphic gravels; few, fine, ferruginous concretions; pH 7.0; clear change to -
B22	0.2-0.5	Reddish brown (5YR 4/3) (moist); few, fine, distinct, yellow mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; medium clay; few, fine, ferruginous concretions; pH 8.5; gradual change to -
B23	0.5-0.8	Strong brown (7.5YR 4/6) (moist); few, distinct, yellow-orange mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; medium clay; few, fine, ferruginous concretions; pH 7.5; clear change to -
B24	0.8+	Strong brown (7.5YR 5/6) (moist); many, distinct orange mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; few, fine, ferruginous concretions

SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	6.7	960	0.9	1,100	0.110	2.70	1.60
0.1-0.2	7.9	550	1.2	1,100	0.110	1.70	1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio	
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>					CEC
0.0-0.1	39	8	54	24	6.7	90	VL	76	-	-	-	4.3	6.6	0.9	0.70	14.0	5.1	NS	1.0	0.8
0.1-0.2	56	6	36	5	7.9	570	H	620	-	-	-	4.2	19.0	0.7	5.00	32.0	15.5	SS	1.0	0.4
0.2-0.3	57	10	36	4	8.2	690	H	780	-	-	-	8.3	20.0	0.74	5.70	35.0	16.4	SS	1.0	0.4
0.3-0.5	56	9	39	5	8.0	1,100	VH	1,200	-	-	-	6.4	21.0	0.7	7.30	35.0	20.5	SS	1.0	0.3
0.5-0.6	59	10	33	6	7.5	1,300	VH	1,700	-	-	-	4.3	23.0	0.74	8.70	36.0	23.9	SS	2.3	0.2
0.6-0.8	51	9	39	6	7.1	1,400	VH	1,800	-	-	-	4.2	25.0	0.8	9.50	39.0	24.4	SS	2.2	0.2
0.8-0.9	59	12	30	8	7.0	1,300	VH	1,700	-	-	-	4.0	23.0	0.8	9.00	37.0	24.2	SS	1.0	0.2





**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



#### 4.2.2 Representative Profile for the Vertosol Mapped Soil Unit

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB06
Coordinates:	Easting:	661432	Northing:	7417111	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		209 m AHD	

LANDFORM			
Slope:	Very gently inclined (2.7%)	Runoff:	Moderately rapid
Morphological type:	Upper slope	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, historically cultivated to south
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Sub-angular tabular, metamorphic fragments: many (20-50%), medium pebbles (6-20 mm) and common (10-20%), large pebbles (20-60 mm), and few (2-10%), cobbles (60-200 mm) pebbles		
Erosion:	Severe, active, sheet erosion and severe, active, gully erosion (1.5-3.0 m deep)		
Vegetation:	Caesalpinia, wilga, carissa, buffel grass, native grasses		
			
Site OB06 landscape		Site OB06 landscape, active sheet and gully erosion	
			
Site OB06 surface condition		Site OB06 surface condition	



## LANDFORM



Site OB06 profile, 0.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.40	Black (10YR 2/1) (moist); strong, 10-20 mm, sub-angular blocky structure; medium clay; very few, small, sub-angular tabular, metamorphic gravels; very few, fine, moderately calcareous nodules; pH 8.0; gradual change to -
B/C	0.4-0.6	Very dark grey (10YR 3/1) (moist); strong, 2-5 mm, sub-angular blocky structure; light medium clay; abundant, angular platy, metamorphic cobbles; few, fine, weakly calcareous laminae; pH 8.5; gradual change to -
C	0.6+	Refusal on rock

SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	8.1	8	1,160	0.116	2.6	1.5	<0.2	<1.00	10.3	22.0	<1.00
0.1-0.2	9.0	<5	1,290	0.129	2.4	1.4	0.4	<1.00	6.4	5.73	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	36	27	36	4	8.1	172	L	110	<0.01	-	-	11.6	3.8	0.8	1.5	17.8	8.4	S	-	3.0
0.1-0.2	60	25	15	3	9.0	482	M	570	0.05	-	-	17.3	6.2	1.0	4.0	28.5	13.9	S	3	2.8
0.2-0.3	59	23	18	4	9.0	606	H	1,100	0.02	-	-	17.5	6.9	0.9	5.1	30.4	16.8	SS	3	2.5
0.3-0.4	63	23	18	4	9.0	687	M	940	<0.01	-	-	18.2	7.4	0.9	5.9	32.5	18.2	SS	3	2.4
0.4-0.5	58	22	20	9	9.0	678	H	900	0.02	-	-	17.8	7.4	0.9	6.2	32.3	19.3	SS	3	2.4
0.5-0.6	48	23	29	31	9.1	613	H	770	<0.01	-	-	17.9	7.6	0.8	6.6	32.8	20.0	SS	3	2.4

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2–20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

## 4.3 Agricultural Lands

### 4.3.1 Land Suitability

The suitability of the Project site for agricultural production systems is based on an evaluation of the soils against the Land Suitability Assessment Techniques guideline (DME, 1995), referred to from hereon as the DME guideline. The agricultural production systems include rainfed broadacre cropping and beef cattle grazing. Land suitability classes are defined in the DME guideline and are presented in **Table 8**.

**Table 8 Land suitability classes**

Class	Definition
1	Suitable land with negligible limitations. Land is well suited to a proposed use.
2	Suitable land with minor limitations. Land is suited to a proposed use but which may require minor changes in management to sustain the use.
3	Suitable land with moderate limitations. Land is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use.
4	Marginally suitable land. Land is marginally suited for a proposed use and would require major inputs to ensure sustainability. These inputs may not just be the benefits to be obtained in using the land for the particular purpose and is hence considered presently unsuited.
5	Unsuitable land with extreme limitations. Land is unsuited and cannot be sustainably used for a proposed use.

Evaluation of the Project site soils against the classes in **Table 8** for the different agricultural production systems is made based on interpretation of the physical, chemical and nutritional characteristics of each soil type. The following sections present the criteria for evaluation in relation to each production system and the results of the assessment against those criteria.

#### 4.3.1.1 Land Suitability Criteria for Rainfed Broadacre Cropping and Beef Cattle Grazing

The criteria used to assess land suitability for rainfed broadacre cropping and beef cattle grazing on the Project site include those identified in **Table 9**.

**Table 9 Land suitability criteria for rainfed broadacre cropping and beef cattle grazing**

Land Suitability Criteria	Rainfed Broadacre Cropping	Beef Cattle Grazing
Water availability	✓	✓
Nutrient deficiency	✓	✓
Soil physical factors	✓	✓
Soil workability	✓	✗
Salinity	✓	✓
Rockiness	✓	✓
Micro relief	✓	✓
Soil pH	✗	✓

Land Suitability Criteria	Rainfed Broadacre Cropping	Beef Cattle Grazing
Soil ESP	✗	✓
Wetness	✓	✓
Topography	✓	✓
Water erosion	✓	✓
Flooding	✓	✓
Vegetation regrowth	✗	✓

The definitions for each of the DME guideline criteria used to assess the limitations associated with each soil type for both rainfed broadacre cropping and beef cattle grazing are discussed in **Section 4.3.1.2**.

#### 4.3.1.2 Land Suitability Assessment

##### 4.3.1.2.1 Water Availability

Plant available water capacity (PAWC) for the soil types on the Project site have been estimated by reference to Table 2.3 of the DME guideline. PAWC cut-off levels for each of the land suitability classes for both rainfed broadacre cropping and beef cattle grazing are as listed in **Table 10**.

**Table 10 PAWC cut-off levels for each land suitability class (LSC)**

PAWC Cut-off Levels	Rainfed Broadacre Cropping	Beef Cattle Grazing
>150 mm	Class 1	-
125-150 mm	Class 2	Class 1
100-125 mm	Class 3	Class 2
75-100 mm	Class 4	Class 3
<75 mm	Class 5	Class 4
<50 mm	-	Class 5

##### 4.3.1.2.2 All Other Land Suitability Criteria

All other land suitability criteria for the soil types on the Project site have been assessed against Table 2.1 of the DME guideline.

##### 4.3.1.3 Land Suitability Assessment for Rainfed Broadacre Cropping

The land suitability assessment and overall class for each soil type within the Project site are presented in **Table 11**. The overall class for each soil type is shown in **Figure 9**.

Table 11 Land suitability classes for rainfed broadacre cropping

Mapped Soil Unit (area)	Water Availability			Nutrient Deficiency		Soil Physical Factors		Soil Workability		Salinity		Rockiness		Micro Relief		Wetness		Topography		Water Erosion		Flooding		Overall Rating
	Limiting Features	PAWC (mm)	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	
Dermosols (142 ha)	Rigid soils (sodic) – soils with a sodic subsoil (ESP 6-14) becoming strongly sodic (ESP≥15) within 60-90 cm of surface	50-100	4-5	Exch. K>0.3 meq%	2	Rigid soils with loose, soft or firm surface when dry	1	Rigid soils with loose, soft or firm surface when dry	1	Rootzone EC <0.15 mS/cm and Cl <300 ppm to rootzone Cl 900-1500 ppm	1-4	<10% coarse surface gravel (>6 cm diam.) and rock outcrop to 20-50% surface cobble (6-20 cm diam.)	1-3	No melon-holes	1	Undulating terrain or elevated plains	1	No [natural] gully dissection to many deep gullies reduce arable area by <33%	1-3	Slopes 1-2% on sodic rigid soils to slopes >3% on sodic rigid soils	3-5	No flooding	1	4-5
Vertosols (174 ha)	Cracking clays: alkaline pH throughout and 40-60 cm depth to weathered or hard rock	75-100	4	Exch. K>0.3 meq%	2	Cracking clays with fine self-mulch (peds 2-10 mm)	2	Firm cracking clays (indicated by fine self-mulch)	2	Rootzone EC 0.15-0.3 mS/cm and Cl 300-600 ppm	2	20-50% surface cobble (6-20 cm diam.)	3	No melon-holes	1	Undulating terrain or elevated plains	1	Occasional deep gullies impede cultivation slightly	2	Slopes 1-3% on cracking clays without melonholes	2	No flooding	1	4



WILTON COKING  
COAL PTY LTD

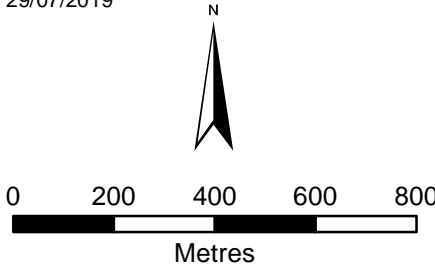
WILTON

FIGURE 9  
LAND SUITABILITY  
FOR RAINFED  
BROADACRE CROPPING

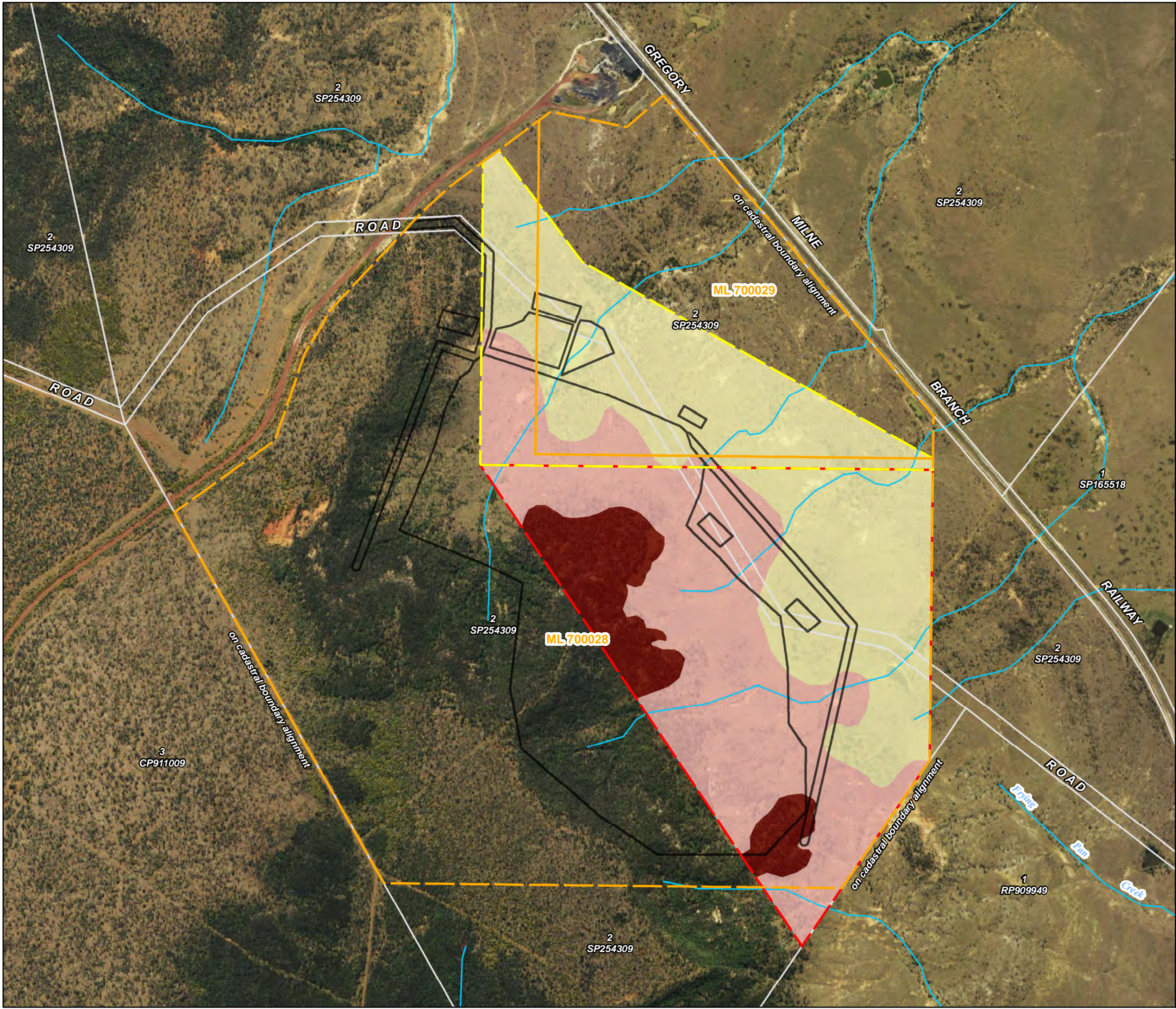
Legend

- Minor Watercourse
  - Mining Lease (Application)
  - SLR Investigation Area (2019)
  - NRC Investigation Area (2017)
  - Proposed Site Disturbance
  - Base Cadastre
- Land Suitability for Rainfed Broadacre Cropping**
- Land Suitability Class 4
  - Land Suitability Class 4-5
  - Not Classified

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Land Suitability, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





#### 4.3.1.4 Land Suitability Assessment for Beef Cattle Grazing

The land suitability assessment and overall class for each soil type within the Project site are presented in **Table 12**. The overall class for each soil type is shown in **Figure 10**.

Table 12 Land suitability classes for beef cattle grazing

Mapped Soil Unit (area)	Water Availability			Nutrient Deficiency		Soil Physical Factors		Salinity		Rockiness		Micro Relief		Soil pH		Soil ESP		Wetness		Topography		Water Erosion		Flooding		Vegetation Regrowth		Overall Rating
	Limiting Features	PAWC (mm)	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	Limiting Features	LSC	
Dermosols (142 ha)	Rigid soils (sodic) – subsoil becoming sodic (ESP 6-14) within 60 cm of surface but not strongly sodic (ESP≥15) within 90 cm to soils with a sodic subsoil (ESP 6-14) becoming strongly sodic (ESP≥15) within 60 cm of surface	50-100	3-4	Eucalypt vegetation and downs	2	Rigid soils with loose, soft or firm surface when dry	1	Rootzone EC <0.15 mS/cm and Cl <300 ppm to rootzone Cl 900-1500 ppm	1-4	<10% coarse surface gravel (>6 cm diam.) and rock outcrop to 20-50% surface cobble (6-20 cm diam.)	1-3	No melon-holes	1	5.6-6.6 and 6.6-8.0 to 6.6-8.0 and 8.0-9.0	1-3	<5 to 10-15	1-3	Undulating terrain or elevated plains	1	No [natural] gully dissection to many deep gullies reduce arable area by <33%	1-3	Slopes 1-2% on sodic rigid soils to slopes >3% on sodic rigid soils	3-5	No flooding	1	Mountain coolabah, bloodwood and ironbark woodlands	1	4-5
Vertosols (174 ha)	Cracking clays: alkaline pH throughout and 40-60 cm depth to weathered or hard rock	75-100	3	Eucalypt vegetation and downs	2	Cracking clays with fine self-mulch (peds 2-10 mm)	2	Rootzone EC 0.15-0.3 mS/cm and Cl 300-600 ppm	2	20-50% surface cobble (6-20 cm diam.)	3	No melon-holes	1	6.6-8.0 and 8.0-9.0	2-3	<5 to 10-15	1-3	Undulating terrain or elevated plains	1	Occasional deep gullies impede cultivation slightly	2	Slopes 1-3% on cracking clays without melon-holes	2	No flooding	1	Mountain coolabah, bloodwood and ironbark woodlands	1	3



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COAL PTY LTD

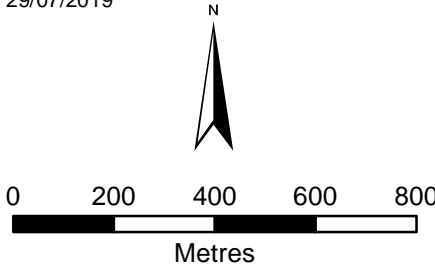
WILTON

FIGURE 10  
LAND SUITABILITY  
FOR BEEF  
CATTLE GRAZING

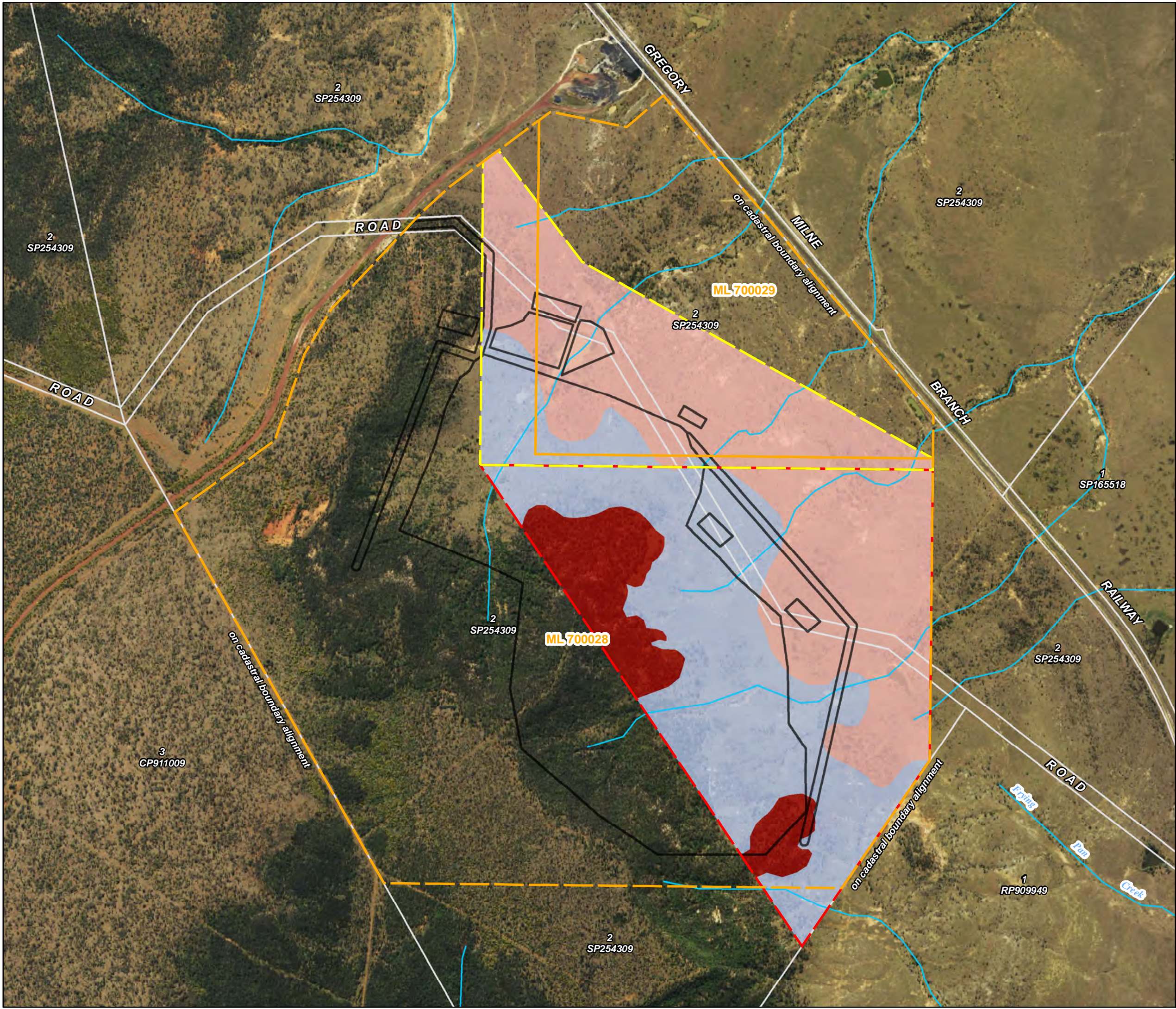
Legend

- Minor Watercourse
  - Mining Lease (Application)
  - SLR Investigation Area (2019)
  - NRC Investigation Area (2017)
  - Proposed Site Disturbance
  - Base Cadastre
- Land Suitability for Beef Cattle Grazing**
- Land Suitability Class 3
  - Land Suitability Class 4-5
  - Not Classified

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Land Suitability, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





#### 4.3.2 Good Quality Agricultural Land

Assessment to determine the class of land for agricultural purposes is made against the Planning Guidelines: The Identification of Good Quality Agricultural Land ([DPI & DHLGP, 1993](#)) hereon referred to as the GQAL guideline. This assessment provides for designation of the land into one of four classes. The agricultural classes are outlined in **Table 13**.

**Table 13 Good quality agricultural land classes**

Class	Description
A	<b>Crop land</b> – land that is suitable for current and potential crops with limitations production that range from none to moderate levels
B	<b>Limited crop land</b> – land that is marginal for current and potential crops due to severe limitations; and suitable for improved pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping
C	<b>Pasture land</b> – land that is suitable only for improved or native pastures due to limitations that preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment
D	<b>Non-agricultural land</b> – land not suitable for agricultural uses due to extreme limitations. This may be disturbed land significant habitat, conservation and/or catchment values or land that may be unstable because of very steep slopes, shallow soils, rock outcrop or poor drainage

A direct correlation between land suitability and GQAL classes can be made to classify the soil units on the Project site into the appropriate GQAL class. This correlation is presented in **Table 14** and the resultant GQAL Classes mapped on **Figure 11**.

**Table 14 Correlation between land suitability and GQAL classes to classify the Project site soil units into GQAL classes**

GQAL Class	Land Suitability		Description	Mapped Soil Unit (area)	
	Cropping	Grazing		Cropping	Grazing
<b>A</b>			<b>Crop land</b> – land that is suitable for current and potential crops with limitations production that range from none to moderate levels		
A1	1-3	1-3	Land that is suitable for a wide range of current and potential broadacre and horticultural crops with limitations to production that range from none to moderate levels		
A2	1-3	1-3	Land that is suitable for a wide range of current and potential horticultural crops only, with limitations to production that range from none to moderate levels		
<b>B</b>	4	1-3	<b>Limited crop land</b> – land that is marginal for current and potential crops due to severe limitations; and suitable for improved pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping	Vertosols (174 ha) and some Dermosols (small % of 142 ha)	
<b>C</b>			<b>Pasture land</b> – land that is suitable only for improved or native pastures due to limitations that preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment		
C1	5	1-2	Suitable for grazing sown pastures (with ground disturbance for establishment) or native pastures on higher fertility soils	Most Dermosols (large % of 142 ha)	
C2	5	3	Suitable for grazing native pastures with or without the introduction of pasture species and are lower fertility soils than C1		Vertosols (174 ha)
C3	5	4	Suitable for light grazing of native pastures in accessible areas, and includes steep land more suited to forestry or catchment protection		Some Dermosols (small % of 142 ha)
<b>D</b>	5	5	<b>Non-agricultural land</b> – land not suitable for agricultural uses due to extreme limitations. This may be disturbed land significant habitat, conservation and/or catchment values or land that may be unstable because of very steep slopes, shallow soils, rock outcrop or poor drainage		Most Dermosols (large % of 142 ha)



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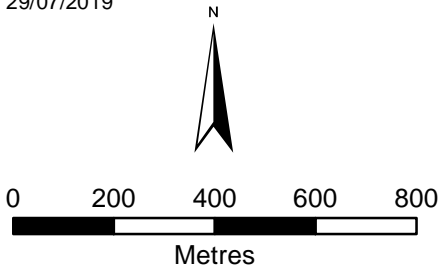
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FIGURE 11  
GOOD QUALITY  
AGRICULTURAL LAND

Legend

- Minor Watercourse
  - Mining Lease (Application)
  - SLR Investigation Area (2019)
  - NRC Investigation Area (2017)
  - Proposed Site Disturbance
  - Base Cadastre
- Good Quality Agricultural Land Classification**
- Land Suitability Class B-C2
  - Land Suitability Class B-D
  - Not Classified

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Land Suitability, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3



### 4.3.3 Strategic Cropping Land

The Study area is currently mapped with approximately 196 ha of strategic cropping land (SCL) under the Queensland Government's SCL mapping, as shown in **Figure 12**, although it is expected that only approximately 98 ha will be directly impacted by the mine pit and infrastructure. As such, an assessment against the SCL criteria is required for a regional interests development approval (RIDA) under the *Regional Planning Interests Act 2014* (RPI Act).

The SCL assessment is based on an evaluation of the soils against the RPI Act Statutory Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land ([DILGP, 2017a](#)), referred to from hereon as the RPI guideline.

With reference to the RPI guideline, the Project site is located within the Western Cropping Zone. As such, the criteria for assessment of the Study area soils to be mapped as SCL are as shown in **Table 15**. Assessment of the soils across the Study area against the criteria in **Table 15** is made with reference to the breakdown of SCL criteria within the RPI guideline. Data sources for the assessment of each observation site are also outlined in **Table 15**.

**Table 15 RPI guideline criteria for the Western Cropping Zone and data sources for the SCL assessment**

Criteria	Thresholds for Western Cropping Zone	Data Sources
Slope	Equal to or less than 3%	Clinometer and/or digital elevation model (refer to <b>Figure 13</b> and <b>Figure 14</b> for slope assessment)
Rockiness	Equal to or less than 20% for rocks greater than 60 mm in diameter	Individual site observation descriptions (refer to <b>Appendix A</b> )
Gilgai	Less than 50% of land surface being gilgai of greater than 500 mm in depth	Individual site observation descriptions (refer to <b>Appendix A</b> )
Soil depth	Equal to or greater than 600 mm	Individual site observation descriptions (refer to <b>Appendix A</b> )
Soil wetness	Has favourable drainage	Individual site observation descriptions (refer to <b>Appendix A</b> )
Soil pH	For rigid soils, the soil at 300 mm and 600 mm soil depth must be within the range of pH <sub>(1:5)</sub> 5.1 to pH <sub>(1:5)</sub> 8.9 inclusive For non-rigid soils, the soil at 300 mm and 600 mm soil depth must be greater than pH <sub>(1:5)</sub> 5.0	Individual site observation laboratory data (refer to <b>Appendix A</b> and <b>Appendix B</b> )
Salinity	Chloride content is less than 800 mg/kg at 600 mm soil depth	Individual site observation laboratory data (refer to <b>Appendix A</b> and <b>Appendix B</b> )
Soil water storage (SWS)	Equal to or greater than 100 mm to a soil depth or physico-chemical limitation of equal to or less than 1000 mm	Individual site observation laboratory data (refer to <b>Appendix B</b> , soil water storage lookup table calculations)

Assessment of observation sites is shown in **Table 16**, grouped according to mapped soil units, and **Figure 15**.



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COAL PTY LTD

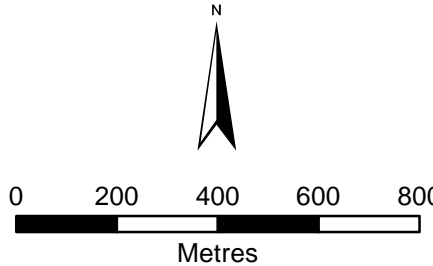
WILTON

FIGURE 12  
MAPPED STRATEGIC  
CROPPING LAND

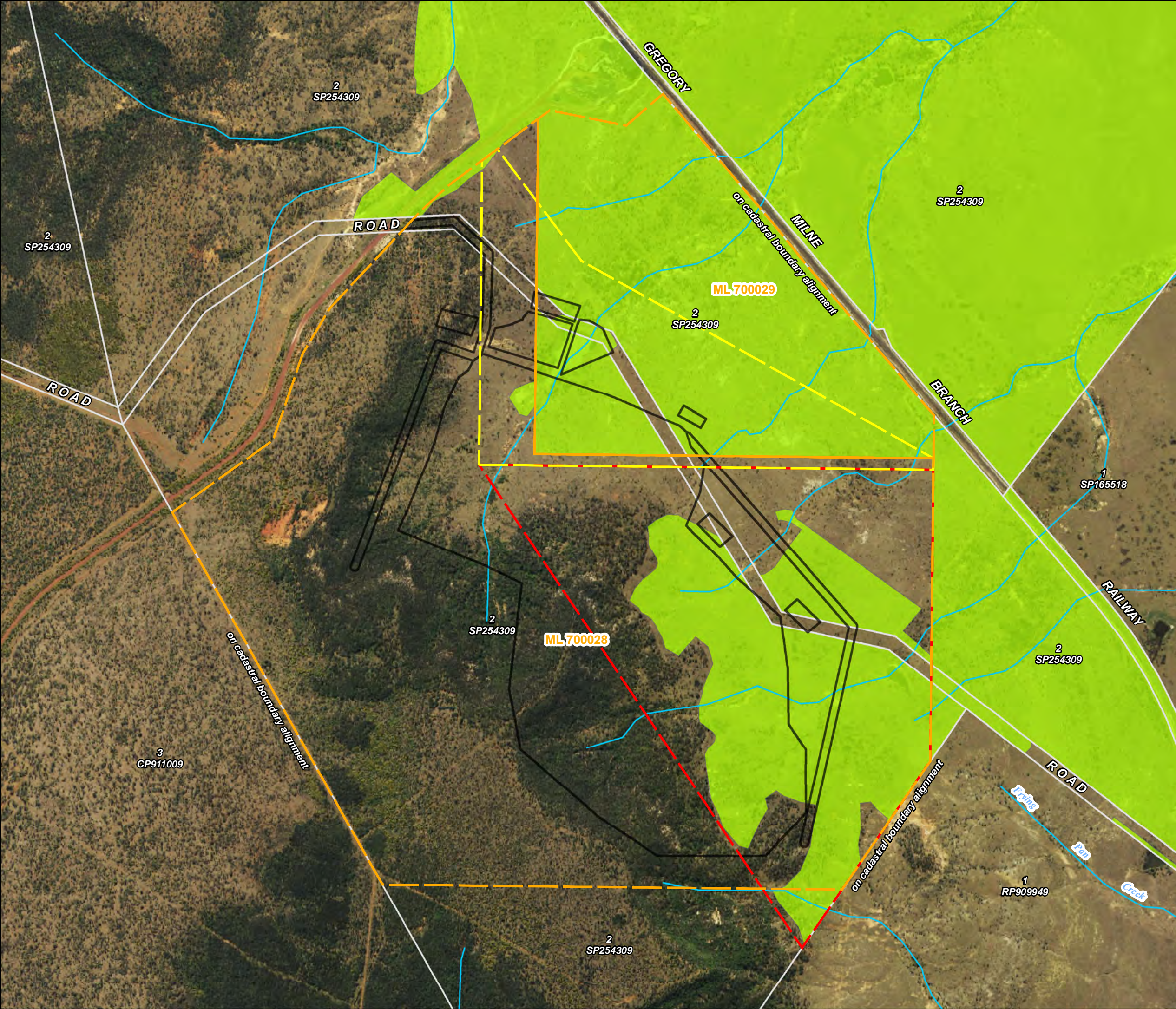
Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Strategic Cropping Land
- Proposed Site Disturbance
- Base Cadastre

Data Sources:  
Mining Lease (Application), Watercourse, Strategic Cropping Land, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
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Scale: 1:15,000 at A3





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COAL PTY LTD

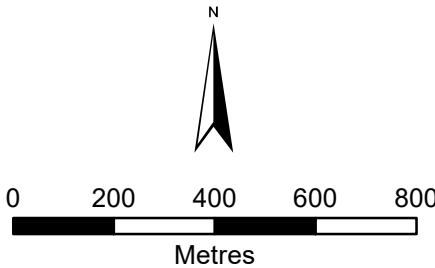
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FIGURE 13  
STRATEGIC  
CROPPING LAND  
SLOPE ASSESSMENT

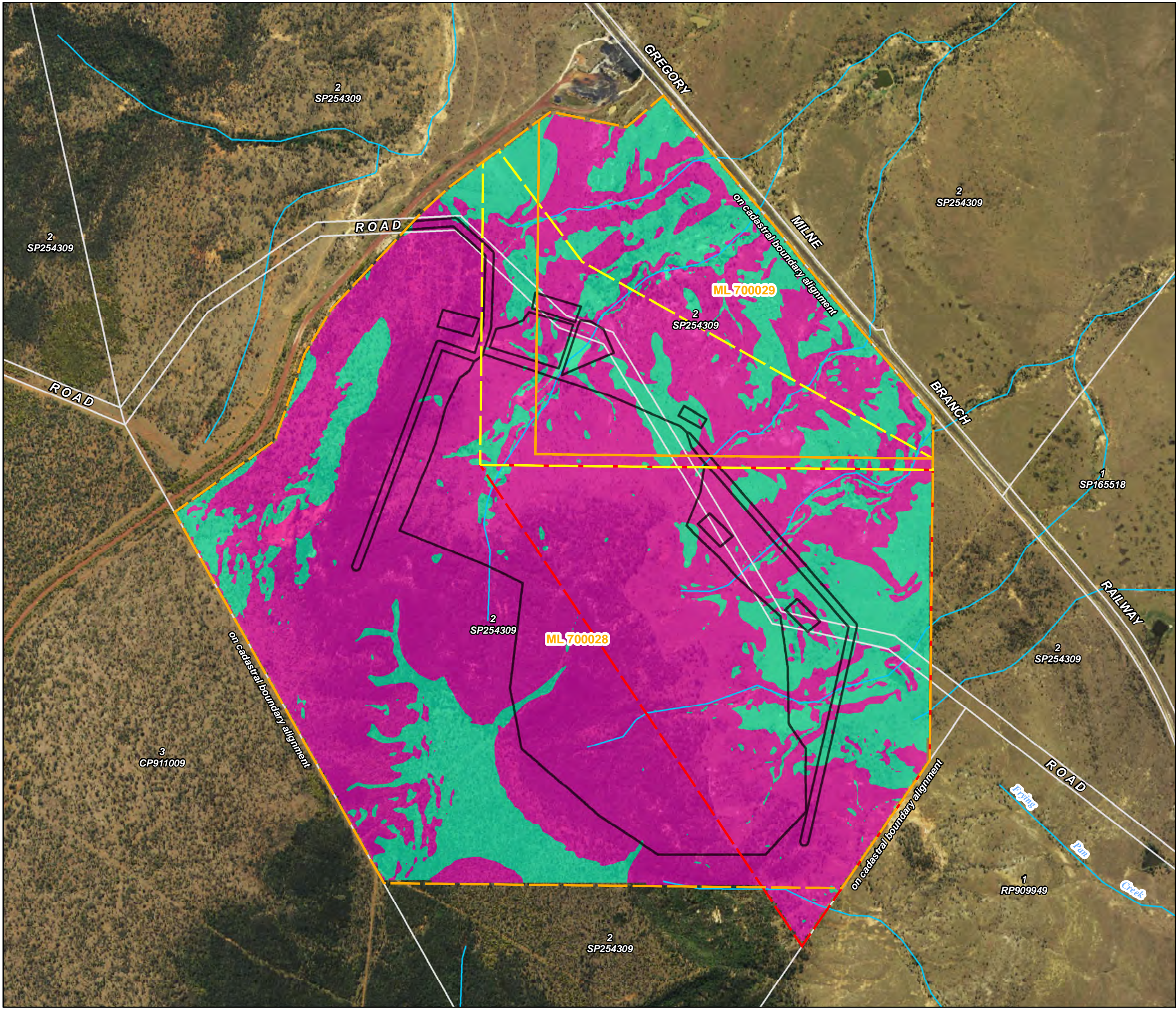
Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre
- Site Slope (%)
  - $\leq 3$
  - $> 3$

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Site Slope (%), and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





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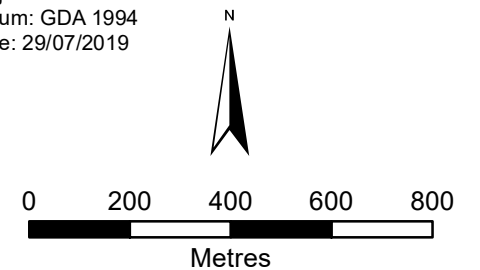
## WILTON

FIGURE 14  
STRATEGIC  
CROPPING LAND  
SLOPE ASSESSMENT  
AND SOIL OBSERVATIONS

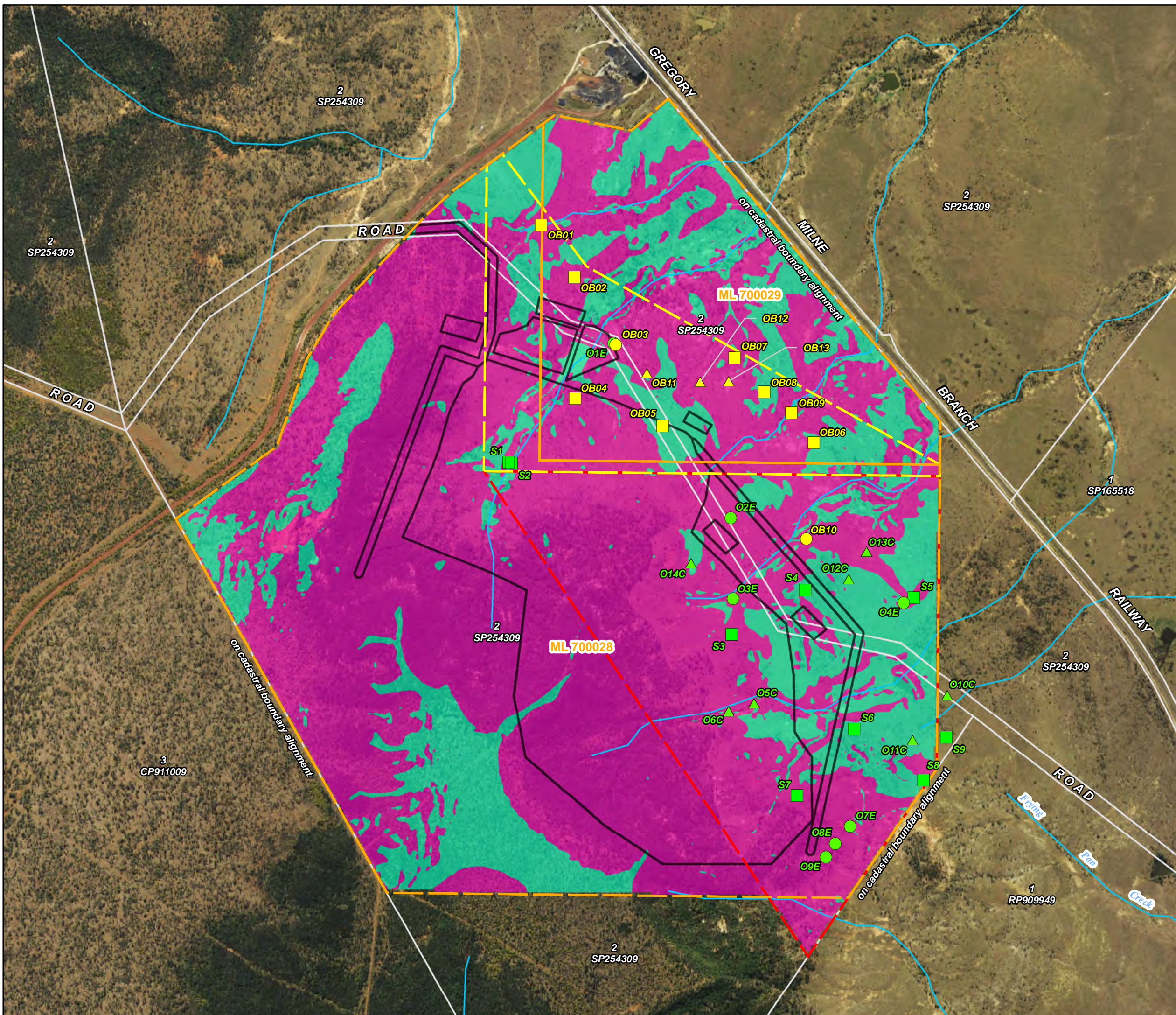
### Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Site Disturbance
- Base Cadastre
- SLR Soil Observations**
  - Profile Exclusion Site
  - Exclusion Site
  - Analysed Profile Site
- NRC Soil Observations**
  - Exclusion Site
  - Check Site
  - Analysed Profile Site
- Site Slope (%)**
  - $\leq 3$
  - $> 3$

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB  
datasets: © State of Queensland (Department of  
Natural Resources, Mines, and Energy) 2019; NRC  
Investigation Area, and NRC Soil Observations  
datasets: Northern Resource Consultants (2017);  
Proposed Site Disturbance, Site Slope (%), SLR Soil  
Observations, and SLR Investigation Area datasets:  
SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban  
2012 Orthophoto Image Service: © State of  
Queensland (Department of Natural Resources, Mines,  
and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





**Table 16 Strategic cropping land assessment for the Study area**

Soil Unit			Strategic Cropping Land Assessment Criteria								SCL?
MSU	Site #	Site Type	Slope	Rockiness	Gilgai	Depth	Wetness	pH	Salinity	SWS	
Dermosols (142 ha)	<a href="#">S1</a>	A, P, C	✓	✓	✓	✓	✗	✓	✓	✗	✗
	<a href="#">S2</a>	A, P, C	✓	✓	✓	✓	✗	✓	✓	✗	✗
	<a href="#">S3</a>	A, P, C, E	✗	✓	✓	✓	✓	✓	✗	✗	✗
	<a href="#">S6</a>	A, P, C	✓	✓	✓	NR	NR	✓	NR	ND	✗ Based on correlation with S8
	<a href="#">S7</a>	A, P, C, E	✗	✓	✓	✓	✓	✓	✗	✗	✗
	<a href="#">S8</a>	A, P, C, E	✗	✓	✓	✗	✓	✓	ND	✗	✗
	<a href="#">Q5C</a>	C, E	✗	✗	✓	✓	NR	NR	NR	NR	✗
	<a href="#">Q6C</a>	C, E	✗	✓	✓	NR	NR	NR	NR	NR	✗
	<a href="#">Q14C</a>	C	✓	✓	✓	NR	NR	NR	NR	NR	✗ Based on correlation with S3
	<a href="#">Q2E</a>	E	✗	✗	✓	NR	NR	NR	NR	NR	✗
	<a href="#">Q3E</a>	E	✗	✗	✓	NR	NR	NR	NR	NR	✗
	<a href="#">Q7E</a>	E	✗	✗	✓	NR	NR	NR	NR	NR	✗
	<a href="#">Q8E</a>	E	✗	✓	✓	NR	NR	NR	NR	NR	✗
	<a href="#">Q9E</a>	E	✗	✓	✓	NR	NR	NR	NR	NR	✗
Vertosols (174 ha)	<a href="#">OB01</a>	A, P, C	✓	✓	✓	✓	✓	✓	✓	✗	✗
	<a href="#">OB02</a>	A, P, C, E	✗	✓	✓	✓	✓	✓	✓	✗	✗
	<a href="#">OB04</a>	A, P, C, E	✗	✗	✓	✗	✓	✓	ND	✗	✗
	<a href="#">OB05</a>	A, P, C	✓	✓	✓	✗	✓	✗	ND	✗	✗



Soil Unit			Strategic Cropping Land Assessment Criteria								SCL?
MSU	Site #	Site Type	Slope	Rockiness	Gilgai	Depth	Wetness	pH	Salinity	SWS	
	<a href="#">OB06</a>	A, P, C	✓	✓	✓	✓	✓	✗	✗	✗	✗
	<a href="#">OB07</a>	A, P, C, E	✗	✓	✓	✗	✓	✗	ND	✗	✗
	<a href="#">OB08</a>	A, P, C	✓	✓	✓	✗	✓	✗	ND	✗	✗
	<a href="#">S4</a>	A, P, C	✓	✓	✓	✗	✓	✓	ND	✗	✗
	<a href="#">S5</a>	A, P, C	✓	✓	✓	✗	✓	✓	ND	✗	✗
	<a href="#">S9</a>	A, P, C	✓	✓	✓	✓	✓	✓	✓	✗	✗
	<a href="#">OB09</a>	C, E	✗	✓	✓	✓	✓	✗	NA	NA	✗
	<a href="#">OB10</a>	C, E	✗	✗	✓	✓	✓	✓	NA	NA	✗
	<a href="#">OB11</a>	C, E	✗	✗	✓	NR	NR	NA	NA	NA	✗
	<a href="#">OB12</a>	C, E	✗	✗	✓	NR	NR	NA	NA	NA	✗
	<a href="#">OB13</a>	C, E	✗	✗	✓	NR	NR	NA	NA	NA	✗
	<a href="#">O10C</a>	C	✓	✓	✓	NR	NR	NA	NA	NA	✗ Based on correlation with S4 & S9
	<a href="#">O11C</a>	C, E	✓	✗	✓	NR	NR	NA	NA	NA	✗
	<a href="#">O12C</a>	C	✓	✓	✓	NR	NR	NA	NA	NA	✗ Based on correlation with S4
	<a href="#">O13C</a>	C, E	✗	✗	✗	NR	NR	NA	NA	NA	✗
	<a href="#">OB03</a>	C,E	✗	✓	✓	✗	NR	NA	NA	NA	✗
	<a href="#">O1E</a>	E	✗	✓	✓	✗	NR	NA	NA	NA	✗
	<a href="#">O4E</a>	E	✗	✗	✓	NR	NR	NA	NA	NA	✗

**Notes:** A – Analysed profile site, P – Detailed profile site, C – Check site, E – Exclusion site, NA – Not Analysed, ND – Not Deep Enough (<60 cm), NR – Not Recorded, ID – Insufficient Data



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COAL PTY LTD

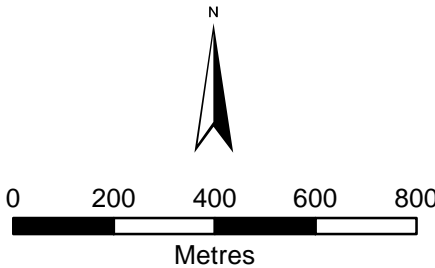
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FIGURE 15  
STRATEGIC  
CROPPING LAND  
LIMITATIONS

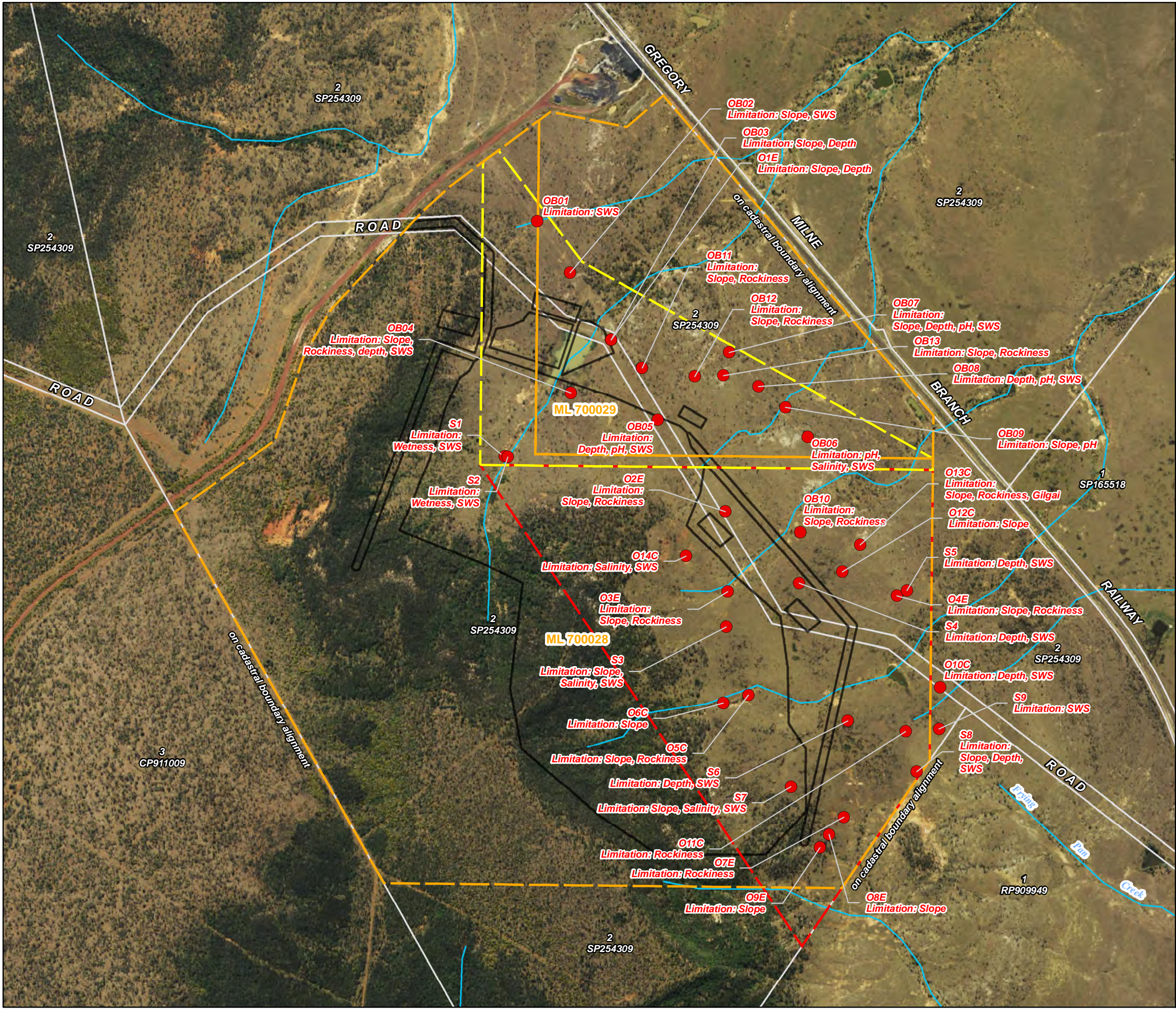
Legend

- Soil Sample Site
- Minor Watercourse
- ▭ Mining Lease (Application)
- ▭ SLR Investigation Area (2019)
- ▭ NRC Investigation Area (2017)
- ▭ Proposed Site Disturbance
- ▭ Base Cadastre

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Soil Sample Site, and SLR Investigation Area datasets: SLR Consulting (2019).  
Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





#### 4.3.3.1 SCL Assessment Results

Based on the assessment results in **Table 16** and evidence provided, both of the mapped soil units are verified as not SCL. The total mapped SCL area of approximately 196 ha can, therefore, be removed from the SCL Trigger Map, as shown in **Figure 16**.



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COAL PTY LTD

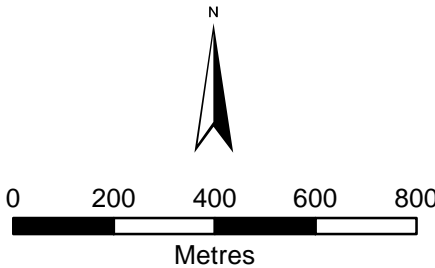
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FIGURE 16  
PROPOSED MAPPED  
STRATEGIC CROPPING  
LAND

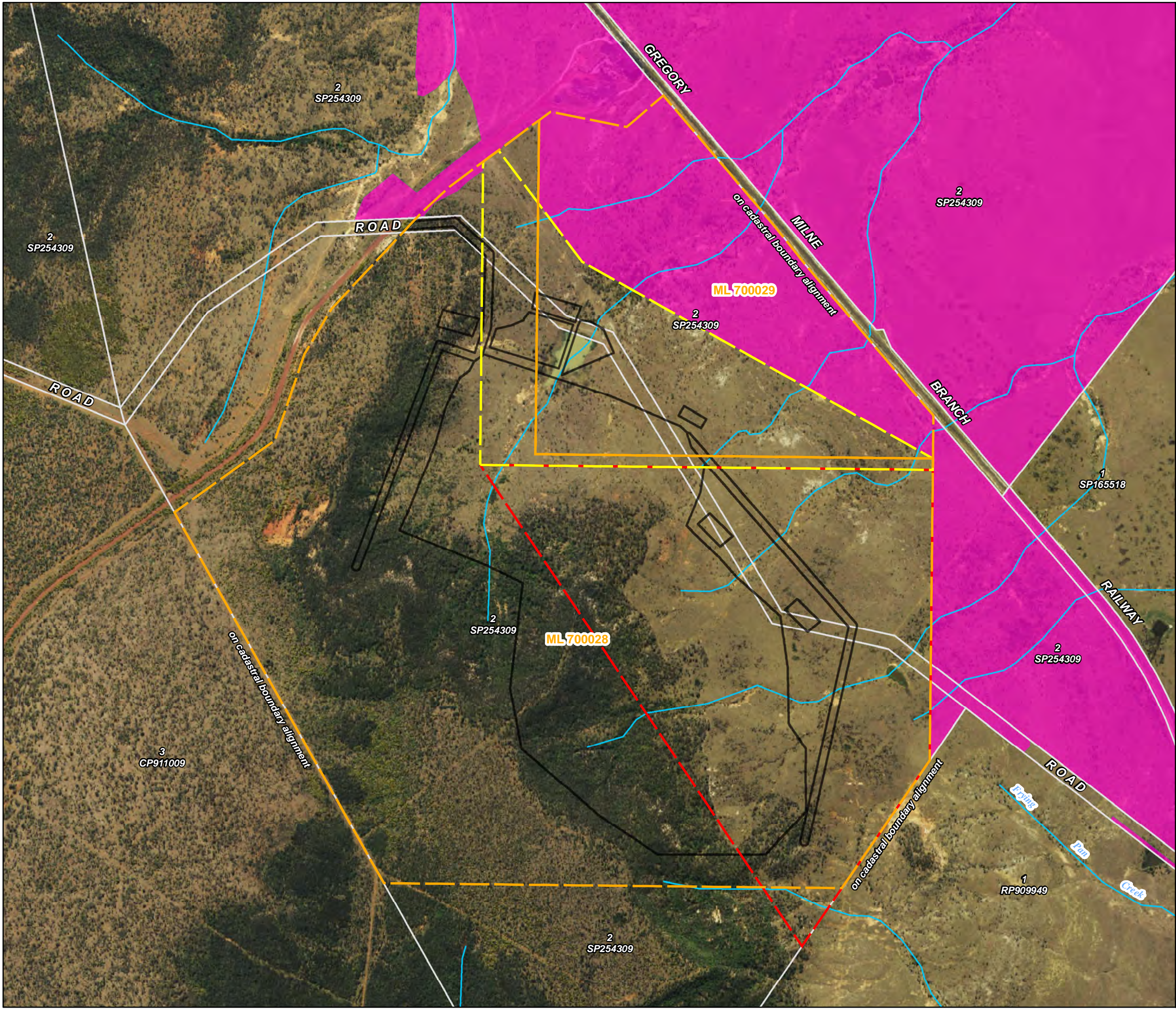
Legend

- Minor Watercourse
- Mining Lease (Application)
- SLR Investigation Area (2019)
- NRC Investigation Area (2017)
- Proposed Mapped Strategic Cropping Land
- Proposed Site Disturbance
- Base Cadastre

Data Sources:  
Mining Lease (Application), Watercourse, and DCDB datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019; NRC Investigation Area dataset: Northern Resource Consultants (2017); Proposed Site Disturbance, Proposed Mapped Strategic Cropping Land, and SLR Investigation Area datasets: SLR Consulting (2019). Imagery Source: 70cm Bowen Basin SISP PeriUrban 2012 Orthophoto Image Service: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2019.  
Coordinate System: GDA 1994 MGA Zone 55  
Projection: Transverse Mercator  
Datum: GDA 1994  
Date: 29/07/2019



Scale: 1:15,000 at A3





## 5 Soil Management Measures

The soil management measures proposed in **Table 17** have been formulated for the long-term protection and management of the soils on the Project Site thereby ensuring the soils are reinstated to their pre-disturbance productive capability post-disturbance.

**Table 17 Soil Management Measures for the Protection and Management of Soils on the Project Site**

Aspect	Acceptable Management Measures/Practices
Area of disturbance	<ul style="list-style-type: none"> <li>To minimise the extent of impact to the soils and their inherent agricultural capability, the disturbance footprint to construct, operate and deconstruct the rail loop and associated infrastructure will be minimised/confined to the greatest extent practicable. The only exception to this is the re-spreading of left-over topsoil at completion of construction. Management of this is outlined under topsoil stockpiling /windrowing.</li> <li>This will be achieved by installing suitable fencing to contain construction, operations and decommissioning activities.</li> <li>Signage will be installed to clearly identify no-go zones for construction, operation and decommissioning facilities, machinery and associated equipment.</li> <li>Monitoring will be conducted weekly to ensure there are no breaches of these requirements.</li> <li>Should there be any breaches, an incident will be recorded, investigations undertaken and actions taken to prevent re-occurrence and immediately rectify any damage caused.</li> </ul>
Erosion and sediment control	<ul style="list-style-type: none"> <li>An erosion and sediment control plan will be prepared, updated and maintained current during construction, operations and decommissioning phases in accordance with the Best Practice Erosion and Sediment Control guidelines (<a href="#">IECA, 2008</a>).</li> <li>Clean water will be diverted around construction and decommissioning areas and managed to prevent increased scour resulting in sheet, rill or gully erosion.</li> <li>Clean water will be reinstated to natural or as near as natural sheet flow and concentrated flow paths as practicably possible during operations through appropriate infrastructure layout design and following decommissioning to reinstate the natural landform.</li> <li>Exposed soil surfaces will be covered and protected or reinstated and seeded/hydrmulched as soon as reasonably practicable following earthworks and immediately prior to rainfall events likely to produce runoff.</li> <li>Sediment control devices will be designed and installed to remove sediment from dirty water generated from within the disturbance footprint to the greatest extent practicable prior to discharge from the Project Site.</li> <li>Sediment control devices will be installed around and immediately adjacent to stockpiles/windrows to capture sediment from each stockpile/windrow at the source to prevent mixing and contamination as far as reasonably practicable.</li> </ul>
Depth of disturbance	<ul style="list-style-type: none"> <li>The depth of disturbance will be restricted to the design depths specified on the approved construction plans.</li> </ul>



Aspect	Acceptable Management Measures/Practices
	<ul style="list-style-type: none"> <li>On the surface of the natural soil or regolith material remaining after scraping or excavating to the required depth, geofabric or some other suitable lining material is to be placed to clearly demarcate the boundary between infrastructure materials and the natural ground.</li> <li>On decommissioning, the infrastructure to be removed will be removed down to and including the geofabric or other lining material so that the original regolith can be reinstated to restore the soil profile to its original form.</li> <li>Final 'as constructed' design drawings are to be retained for the life of the infrastructure so that decommissioning operations are informed of the final design details for removal planning.</li> </ul>
Topsoil stripping	<ul style="list-style-type: none"> <li>Prior to stripping, topsoil from the Dermosol MSU should be treated with gypsum at a rate of at least 3 t/ha/100 mm of soil depth.</li> <li>Prior to stripping, topsoil from the Vertosol MSU should be treated with gypsum at a rate of at least 4 t/ha/100 mm of soil depth.</li> <li>Topsoil in each MSU will be stripped/excavated between 250-300 mm or to the extent practicable above the weathered parent rock (noted by general change from dark, heavy clay to paler, rockier material).</li> </ul>
Topsoil stockpiling /windrowing	<ul style="list-style-type: none"> <li>Topsoil from each MSU will be stockpiled/windrowed separately from all the other MSUs, clearly signed, and the respective location mapped and confirmed using GPS for future reference and to avoid incorrect use.</li> <li>Topsoil from all MSUs will also be stockpiled/windrowed separately from their respective subsoils.</li> <li>All MSU topsoil stockpiles/windrows will be placed upslope from their respective subsoil and unweathered parent material stockpiles/windrows to prevent contamination and degradation from their subsoils and unweathered parent material.</li> <li>Topsoil stockpiles/windrows will be no more than 2.0 m high to avoid degrading the topsoil and maintain fertility.</li> <li>Topsoil fertility of short-term (&lt;3 months) topsoil stockpiles/windrows will be maintained by a protective layer of mulch and the stockpile/windrow turned over and mulch thoroughly mixed through the soil on re-spreading the topsoil at rehabilitation.</li> <li>Topsoil fertility of medium-term (&gt;3 to &lt;6 months) to long-term (&gt;6 months) topsoil stockpiles/windrows will be maintained by repeated oversowing with sterile grasses (hydromulched), as required, until reuse and then the stockpile turned over and mixed prior to replacement.</li> <li>Where possible, all remaining topsoil should be re-spread to the greatest extent practicable across the remaining undisturbed and reinstated areas applicable for each MSU post infrastructure establishment.</li> </ul>



Aspect	Acceptable Management Measures/Practices
	<ul style="list-style-type: none"> <li>The details of topsoil volumes and GPS locations/extents will be recorded for decommissioning reference to recover the topsoil for reinstatement once the infrastructure is removed or with progressive pit rehabilitation. Spreading the topsoil in this manner for the duration of operations will better preserve the topsoil than long-term/indefinite stockpiling/windrowing and will require considerably less on-going maintenance to preserve the topsoil fertility.</li> </ul>
Subsoil stripping	<ul style="list-style-type: none"> <li>Subsoil in all MSUs will be stripped/excavated from 250-300 down to 1,500 mm or weathered parent material, where required.</li> </ul>
Subsoil stockpiling /windrowing	<ul style="list-style-type: none"> <li>Subsoil from all MSUs will be stockpiled/windrowed separately from all other MSUs, clearly signed, and their respective locations mapped and confirmed using GPS for future reference and to avoid incorrect use.</li> <li>Subsoil from all MSUs will also be stockpiled/windrowed separately from their respective topsoil and unweathered parent material.</li> <li>All MSU subsoil stockpiles/windrows will be placed downslope from their respective topsoil and upslope of their respective unweathered parent material stockpiles/windrows to prevent contamination and degradation of their subsoils.</li> </ul>
Unweathered parent material	<ul style="list-style-type: none"> <li>Unweathered parent material in all MSUs will be stripped/excavated from 1,500 mm or from below weathered parent material, where required.</li> </ul>
Unweathered parent material stockpiling /windrowing	<ul style="list-style-type: none"> <li>Unweathered parent material from all MSUs will be stockpiled/windrowed separately from all other MSUs, clearly signed, and their respective locations mapped and confirmed using GPS for future reference and to avoid incorrect use.</li> <li>Unweathered parent material from all MSUs will also be stockpiled/windrowed separately from their respective topsoils and subsoils.</li> <li>All MSU unweathered parent material stockpiles/windrows will be placed downslope from their respective topsoil and subsoil stockpiles/windrows to prevent contamination and degradation of their respective topsoils and subsoils.</li> </ul>
<i>In situ</i> soils	<ul style="list-style-type: none"> <li>Following construction and decommissioning, undisturbed and compacted in situ subsoils from machinery traffic, equipment and beneath removed infrastructure (including geofabric or some other lining material used), will have a suitable ameliorant applied (e.g., gypsum or lime (composition and concentration to be determined by laboratory analysis). The subsoil and ameliorant will be cultivated by ripping or scarifying to decompact and remove any potential hard pans and incorporate the ameliorant prior to backfilling on top with applicable MSU topsoil, as applicable to the area, to reinstate the original landform to the extent practicable.</li> <li>Following construction and decommissioning, undisturbed and compacted in situ topsoils from machinery traffic, equipment and beneath removed infrastructure (including geofabric or some other lining material used), will have suitable ameliorants applied (e.g., gypsum or lime and/or organic matter/humus and/or fertiliser (composition and concentration to be determined by laboratory analysis for major and trace elements). The topsoil and ameliorants will be cultivated by ripping or scarifying to decompact and remove any potential hard pans and incorporate the ameliorants prior to hydromulching or oversowing with a suitable cover crop (e.g., pasture grasses).</li> </ul>



Aspect	Acceptable Management Measures/Practices
	<ul style="list-style-type: none"> <li>At decommissioning, areas where topsoil was re-spread over undisturbed areas, to remove the need to manage stockpiles/windrows for the life of the coal mine, will need to be scraped off to the depth they were spread and stockpiled in accordance with topsoil stockpiling/windrowing practices outlined above. This material will be required for rehabilitating areas where no topsoil has been since construction and operation of the coal mine and associated infrastructure.</li> </ul>
Subsoil reinstatement	<ul style="list-style-type: none"> <li>Following construction, completion of extraction in an area of the pit and decommissioning works, disturbed subsoils from stockpiles/windrows will be spread evenly to reinstate the original landform where land disturbance can be reinstated. The subsoil will then have a suitable ameliorant applied (e.g., gypsum or lime (composition and concentration to be determined by laboratory analysis). It will then be cultivated by ripping or scarifying to decompact the subsoil from machinery traffic respreading activities and prepare it for topdressing with topsoil.</li> </ul>
Topsoil reinstatement	<ul style="list-style-type: none"> <li>Following construction, completion of extraction in an area of the pit and decommissioning, disturbed topsoils from stockpiles/windrows will be spread evenly to reinstate the original landform where land disturbance can be reinstated. The topsoil will then have suitable ameliorants applied (e.g., gypsum or lime and/or organic matter/humus and/or fertiliser (composition and concentration to be determined by laboratory analysis for major and trace elements). It will then be cultivated by ripping or scarifying to decompact the topsoil from machinery traffic respreading activities and prepare it for hydromulching or oversowing with a suitable cover crop (e.g., pasture grasses).</li> </ul>

## 6 Conclusions

The soil assessment conducted for this report primarily targeted soils within the mapped SCL areas to identify, describe and map their distribution, assess their suitability for agricultural production (land suitability and GQAL) and assess their suitability for being mapped as SCL.

The soil assessment identified that the Study area and mapped SCL area are largely dominated by two Australian Soil Classification soils, Vertosols (cracking clays) and Dermosols (non-cracking clays).

Assessment of the characteristics of these soil units against the land suitability and GQAL guidelines confirmed these soil units have moderate to considerable limitations for agricultural production resulting in land suitability classifications of 4 (Vertosols) and 4-5 (Dermosols) for rainfed broadacre cropping and 3 (Vertosols) and 4-5 (Dermosols) for beef cattle grazing. Converting these results to GQAL, cropping is Class B (Vertosols) and Class B-C1 (Dermosols) while grazing is Class C2 (Vertosols) and Class C3-D (Dermosols).

Assessment of the characteristics of these soil units, as presented by every observation site, against the SCL criteria has shown that every observation site within the two primary mapped soil units (Vertosols and Dermosols) has at least one limitation to being verified as SCL. That being the case, we conclude and recommend the SCL mapped areas within the Study area be removed from the State SCL mapping.



Although the mining operation will have a substantial impact on the soil and land values of the Study area, effective implementation of the management measures presented in this report should preserve, maintain and reinstate their physical and chemical characteristics such that they can be reinstated to achieve their current land suitability and GQAL classifications post mining operations.

## 7 Abbreviations and Definitions of Terms

The abbreviations and terms used in this report are detailed in the following sections.

### 7.1 Abbreviations

Abbreviations used in this report are defined in **Table 18**.

**Table 18** Abbreviations used in this report

Abbreviation	Definition
AHD	Australian height datum
AMU	Agricultural management unit
ASC	Australian Soil Classification
BoM	Bureau of Meteorology
CLR	Contaminated Land Register
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DES	Queensland Department of Environment and Science
DILGP	Department of Infrastructure, Local Government and Planning
DNRME	Queensland Department of Natural Resources, Mines and Energy
DPI	Queensland Department of Primary Industries
EA	Environmental authority
EES	Environmental Earth Sciences
EMR	Environmental Management Register
EP Act	Queensland <i>Environmental Protection Act 1994</i>
EPC	Exploration permit for coal
EP Reg	Queensland <i>Environmental Protection Regulation 2008</i>
ERA	Environmentally relevant activity
Futura	Futura Resources Pty Ltd
GIS	Geographic information systems
LRA	Land resource area
LS	Land system
LSC	Land suitability class
ML	Mining lease



Abbreviation	Definition
NRC	Northern Resource Consultants
RFI	Request for information notice
SLR	SLR Consulting Australia Pty Ltd or SLR Consulting
WCC	Wilton Coking Coal Pty Ltd

## 7.2 Definitions of Terms

Definitions of terms used within this report are provided in **Table 19**.

**Table 19 Definitions of Terms**

Term	Definition
A1 horizon	Mineral horizon at or near the surface with some accumulation of humified organic matter, usually darker in colour than underlying horizons and with maximum biological activity for any given soil profile (NCST, 2009)
A2 horizon	Mineral horizon having either, alone or in combination, less organic matter, sesquioxides or silicate clay than immediately adjacent horizons. It is usually differentiated from the A1 horizon by its paler colour (NCST, 2009)
Acid soil	Soil with a pH of less than 6.5 ( <a href="#">Rayment and Lyons, 2011</a> )
Alkaline soil	Soil with a pH greater than 7.4 ( <a href="#">Rayment and Lyons, 2011</a> )
API	Aerial photograph interpretation
Australian Soil Classification (ASC)	This is a multi-category scheme with classes defined on the basis of diagnostic horizons or materials and their arrangement in vertical sequence as seen in an exposed soil profile (Isbell and NCST, 2016)
B horizon	Horizons consisting of one or more mineral soil layers characterised by one or more of the following: a concentration of silicate clay, iron, aluminium, organic material or several of these; a structure and/or consistence unlike that of the A horizons above or of any horizons below; stronger colours, usually expressed as higher chroma and/or redder hue, than those of the A horizons above or of those horizons below ( <a href="#">NCST, 2009</a> )
Bicarb & acid extr. P	A measure of available soil phosphorus using a bicarbonate extract or acid extract
C horizon	Layers below the solum (AB profile) of consolidated or unconsolidated material, usually partially weathered, little affected by pedogenic processes, and either like or unlike the material from which the solum presumably formed
Ca:Mg	Ratios of exchangeable calcium (Ca) to exchangeable magnesium (Mg) are used to support assessments of subsoil dispersibility where Ca:Mg <0.1 are often associated with highly dispersive subsoils.



Term	Definition																														
	<div>Ca:Mg ratings</div> <table><tr><th>Ratio</th><th>Rating</th></tr><tr><td>&lt; 0.1</td><td>Very low</td></tr><tr><td>0.1 - 1</td><td>Low</td></tr><tr><td>1 - 2</td><td>Medium</td></tr><tr><td>&gt; 2</td><td>High</td></tr></table>	Ratio	Rating	< 0.1	Very low	0.1 - 1	Low	1 - 2	Medium	> 2	High																				
Ratio	Rating																														
< 0.1	Very low																														
0.1 - 1	Low																														
1 - 2	Medium																														
> 2	High																														
Cation exchange capacity	<div>CEC is a measure of a soils capacity to hold and exchange cations influenced by factors such as organic matter, clay percentage and clay type and pH.</div> <div>CEC ratings</div> <div>Exchangeable cations classification (<a href="#">Hazelton and Murphy, 2007</a>)</div> <table><tr><th>Cations</th><th>Very low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very high</th></tr><tr><td>Ca (meq/100g)</td><td>0 – 2</td><td>2 – 5</td><td>5 -10</td><td>10 – 20</td><td>&gt; 20</td></tr><tr><td>Mg (meq/100g)</td><td>0 – 0.3</td><td>0.3 – 1.0</td><td>1 - 3</td><td>3 - 8</td><td>&gt; 8</td></tr><tr><td>K (meq/100g)</td><td>0 – 0.2</td><td>0.2 – 0.3</td><td>0.3 – 0.7</td><td>0.7 – 2.0</td><td>&gt; 2</td></tr><tr><td>Na (meq/100g)</td><td>0 – 0.1</td><td>0.1 – 0.3</td><td>0.3 – 0.7</td><td>0.7 – 2.0</td><td>&gt; 2</td></tr></table>	Cations	Very low	Low	Moderate	High	Very high	Ca (meq/100g)	0 – 2	2 – 5	5 -10	10 – 20	> 20	Mg (meq/100g)	0 – 0.3	0.3 – 1.0	1 - 3	3 - 8	> 8	K (meq/100g)	0 – 0.2	0.2 – 0.3	0.3 – 0.7	0.7 – 2.0	> 2	Na (meq/100g)	0 – 0.1	0.1 – 0.3	0.3 – 0.7	0.7 – 2.0	> 2
Cations	Very low	Low	Moderate	High	Very high																										
Ca (meq/100g)	0 – 2	2 – 5	5 -10	10 – 20	> 20																										
Mg (meq/100g)	0 – 0.3	0.3 – 1.0	1 - 3	3 - 8	> 8																										
K (meq/100g)	0 – 0.2	0.2 – 0.3	0.3 – 0.7	0.7 – 2.0	> 2																										
Na (meq/100g)	0 – 0.1	0.1 – 0.3	0.3 – 0.7	0.7 – 2.0	> 2																										
Cultivated	Turning and/or breaking soil into smaller aggregates and aerating it prior to planting crops or pastures using implements such as disc ploughs and tynes																														
Dermosols	ASC Soil Order classification – Soils with structured B2 horizons and lacking strong texture contrast between A and B horizons ( <a href="#">Isbell &amp; NCST, 2016</a> )																														
Electrical conductivity	Measure of concentration of electrically charged water soluble salts (in a 1:5) soil water suspension. Used to quantify soil salinity																														
Emerson aggregate (class) test (EAT)	<div>Clay dispersion is semi-quantitatively measured using the Emerson aggregate test. This test measures the instability of soil structure when immersed in water.</div> <div>Definition of Emerson class (AS1289.3.8.1—2006)</div> <table><tr><th>Emerson class</th><th>Definition</th></tr><tr><td>Class 1</td><td>Air-dried crumbs of soil show a strong dispersing reaction, i.e. a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 min. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay</td></tr><tr><td>Class 2</td><td>Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs</td></tr><tr><td>Class 3</td><td>The soil remoulded at the plastic limit disperses in water</td></tr><tr><td>Class 4</td><td>The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present</td></tr><tr><td>Class 5</td><td>The remoulded soil does not disperse in water and the 1:5 soil / water suspension remains dispersed after 5 min</td></tr></table>	Emerson class	Definition	Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e. a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 min. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay	Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs	Class 3	The soil remoulded at the plastic limit disperses in water	Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present	Class 5	The remoulded soil does not disperse in water and the 1:5 soil / water suspension remains dispersed after 5 min																		
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Term	Definition																								
	<table><tr><td>Class 6</td><td>The remoulded soil does not disperse in water and the 1:5 soil / water suspension begins to flocculate within 5 min</td></tr><tr><td>Class 7</td><td>The air-dried crumbs of soil remain coherent (do not disperse) in water and swells</td></tr><tr><td>Class 8</td><td>The air-dried crumbs of soil remain coherent (do not disperse) in water and do not swell</td></tr></table>	Class 6	The remoulded soil does not disperse in water and the 1:5 soil / water suspension begins to flocculate within 5 min	Class 7	The air-dried crumbs of soil remain coherent (do not disperse) in water and swells	Class 8	The air-dried crumbs of soil remain coherent (do not disperse) in water and do not swell																		
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Class 8	The air-dried crumbs of soil remain coherent (do not disperse) in water and do not swell																								
Fertility	<p>Soil fertility (the capacity of the soil to support plant growth in a given climatic regime) is a function of the physical, chemical and biological characteristics of the soil. Indices used include Organic Carbon, Cation Exchange Capacity (CEC), exchangeable cations, Total Kjeldahl nitrogen (TKN) and available phosphorus (P).</p> <p>Some soil nutrient level ratings from <a href="#">Rayment and Lyons (2011)</a> include:</p> <table><tr><th>Analyte</th><th>Very low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very high</th></tr><tr><td>TKN (%)</td><td>&lt; 0.05</td><td>0.05 – 0.15</td><td>0.15 – 0.25</td><td>0.25 – 0.5</td><td>&gt; 0.5</td></tr><tr><td>Bicarb &amp; acid extr. P (mg/kg)</td><td>&lt; 10</td><td>10 - 20</td><td>&gt; 20 – 40</td><td>&gt; 40 - 100</td><td>&gt; 100</td></tr><tr><td>Organic Carbon (%)</td><td>&lt; 0.5</td><td>0.5 - 1.5</td><td>&gt; 1.5 - 2.5</td><td>&gt; 2.5 - 5.0</td><td>&gt; 5.0</td></tr></table>	Analyte	Very low	Low	Moderate	High	Very high	TKN (%)	< 0.05	0.05 – 0.15	0.15 – 0.25	0.25 – 0.5	> 0.5	Bicarb & acid extr. P (mg/kg)	< 10	10 - 20	> 20 – 40	> 40 - 100	> 100	Organic Carbon (%)	< 0.5	0.5 - 1.5	> 1.5 - 2.5	> 2.5 - 5.0	> 5.0
Analyte	Very low	Low	Moderate	High	Very high																				
TKN (%)	< 0.05	0.05 – 0.15	0.15 – 0.25	0.25 – 0.5	> 0.5																				
Bicarb & acid extr. P (mg/kg)	< 10	10 - 20	> 20 – 40	> 40 - 100	> 100																				
Organic Carbon (%)	< 0.5	0.5 - 1.5	> 1.5 - 2.5	> 2.5 - 5.0	> 5.0																				
Good quality agricultural land (GQAL)	<p>There are four agricultural land classes as described by <a href="#">DPI/DHLGP (1993)</a>:</p> <table><tr><th>Class</th><th>Description</th></tr><tr><td>A</td><td><p>Crop land</p><p>Land that is suitable for current and potential crops with limitations to production, ranging from none to moderate levels. There are two sub-classes of crop land:</p><p>A1 – Crop land suitable for rain-fed cropping</p><p>A2 – Crop land suitable for horticulture</p><p>All crop land is considered to be GQAL.</p></td></tr><tr><td>B</td><td><p>Limited crop land</p><p>Land that is marginal for current and potential crops due to severe limitations, and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.</p><p>Land marginal for particular crops of local significance is considered to be GQAL.</p></td></tr><tr><td>C</td><td><p>Pasture land</p><p>Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production, but some areas may tolerate a short period of ground disturbance for pasture establishment.</p><p>In areas where pastoral industries are the major primary industry, land suitable for improved or high-quality native pastures may be considered to be GQAL. There are three sub-classes of pasture land:</p><p>C1 – Land suitable for sown pastures with moderate limitations</p><p>C2 – Land suitable for sown pastures with severe limitations</p><p>C3 – Land suitable for light grazing for native pastures in inaccessible areas</p></td></tr></table>	Class	Description	A	<p>Crop land</p> <p>Land that is suitable for current and potential crops with limitations to production, ranging from none to moderate levels. There are two sub-classes of crop land:</p> <p>A1 – Crop land suitable for rain-fed cropping</p> <p>A2 – Crop land suitable for horticulture</p> <p>All crop land is considered to be GQAL.</p>	B	<p>Limited crop land</p> <p>Land that is marginal for current and potential crops due to severe limitations, and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.</p> <p>Land marginal for particular crops of local significance is considered to be GQAL.</p>	C	<p>Pasture land</p> <p>Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production, but some areas may tolerate a short period of ground disturbance for pasture establishment.</p> <p>In areas where pastoral industries are the major primary industry, land suitable for improved or high-quality native pastures may be considered to be GQAL. There are three sub-classes of pasture land:</p> <p>C1 – Land suitable for sown pastures with moderate limitations</p> <p>C2 – Land suitable for sown pastures with severe limitations</p> <p>C3 – Land suitable for light grazing for native pastures in inaccessible areas</p>																
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C	<p>Pasture land</p> <p>Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production, but some areas may tolerate a short period of ground disturbance for pasture establishment.</p> <p>In areas where pastoral industries are the major primary industry, land suitable for improved or high-quality native pastures may be considered to be GQAL. There are three sub-classes of pasture land:</p> <p>C1 – Land suitable for sown pastures with moderate limitations</p> <p>C2 – Land suitable for sown pastures with severe limitations</p> <p>C3 – Land suitable for light grazing for native pastures in inaccessible areas</p>																								



Term	Definition																																							
	<div>D</div> <div>Non-agricultural land</div> <div>Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage. These limitations preclude any interference with land or biological resources for the production of agricultural goods.</div>																																							
Gravel	Soil particles in the size range >2.0-60 mm ( <a href="#">NCST, 2009</a> )																																							
Gully erosion	A wide and deep incision into topsoil and subsoil layers resulting from erosion by expansion of rill erosion and/or collapse of tunnel erosion																																							
Horizon	A layer within the soil profile with morphological characteristics and properties different from layers below and /or above it																																							
Mottles	The presence of more than one soil colour in the same soil horizon, not including segregations or cutan colours																																							
Ped	An individual natural soil aggregate consisting of a cluster of primary particles. Ped faces may have limited to much accommodation to the faces of surrounding peds																																							
Permian	Period of geological time that spans 47 million years from the end of he Carboniferous Period 298.9 million years ago (Mya) to the beginning of the Triassic period 251.902 Mya																																							
Project site	The Project disturbance footprint, including an open cut pit (including in pit dump) of approximately 185 ha and other infrastructure comprising an out of pit overburden dump (20 ha), administration and workshop (6 ha), mine affected water storages (6 ha), and run of mine (1.2 ha) within mining leases (MLs) 700028 and 700029, which is also known as ‘Wilton’ located on Lot 2 on SP254309																																							
Quaternary	Period of geological time including the Holocene and Pleistocene; up to approx. 2 million years BP																																							
Rill erosion	A narrow and shallow incision into topsoil layers resulting from erosion by overland flow or surface runoff																																							
Ripping	Deep cultivation with a tyned implement to a depth of > 300 mm																																							
Scarifying	Shallow cultivation usually with a tyned implement to a depth of < 300 mm																																							
Sheet erosion	The removal of a thin layer of soil by raindrop splash and runoff																																							
Silt	Fine soil particles in the size range 0.02 - 0.002 mm ( <a href="#">NCST, 2009</a> )																																							
Salinity	<div>Salinity is the presence of soluble salts in soils, mainly Ca2+, Mg2+, Na+, Cl-, SO42- and HCO3. Salinity ratings (<a href="#">Rayment and Lyons, 2011</a>)</div> <table><tr><th rowspan="2">Soil salinity rating</th><th colspan="4">EC1:5 (dSm-1)</th></tr><tr><th>10 - 20% clay</th><th>20 - 40% clay</th><th>40 - 60% clay</th><th>60 - 80% clay</th></tr><tr><td>Very low</td><td>&lt; 0.07</td><td>&lt; 0.09</td><td>&lt; 0.12</td><td>&lt; 0.15</td></tr><tr><td>Low</td><td>0.07 - 0.15</td><td>0.09 - 0.19</td><td>0.12 - 0.24</td><td>0.15 - 0.3</td></tr><tr><td>Medium</td><td>0.15 - 0.34</td><td>0.19 - 0.45</td><td>0.24 - 0.56</td><td>0.3 - 0.7</td></tr><tr><td>High</td><td>0.34 - 0.63</td><td>0.45 - 0.76</td><td>0.56 - 0.96</td><td>0.7 - 1.18</td></tr><tr><td>Very high</td><td>0.63 - 0.93</td><td>0.76 - 1.21</td><td>0.96 - 1.53</td><td>1.18 - 1.87</td></tr><tr><td>Extreme</td><td>&gt; 0.93</td><td>&gt; 1.21</td><td>&gt; 1.53</td><td>&gt; 1.87</td></tr></table>	Soil salinity rating	EC1:5 (dSm-1)				10 - 20% clay	20 - 40% clay	40 - 60% clay	60 - 80% clay	Very low	< 0.07	< 0.09	< 0.12	< 0.15	Low	0.07 - 0.15	0.09 - 0.19	0.12 - 0.24	0.15 - 0.3	Medium	0.15 - 0.34	0.19 - 0.45	0.24 - 0.56	0.3 - 0.7	High	0.34 - 0.63	0.45 - 0.76	0.56 - 0.96	0.7 - 1.18	Very high	0.63 - 0.93	0.76 - 1.21	0.96 - 1.53	1.18 - 1.87	Extreme	> 0.93	> 1.21	> 1.53	> 1.87
Soil salinity rating	EC1:5 (dSm-1)																																							
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Extreme	> 0.93	> 1.21	> 1.53	> 1.87																																				



Term	Definition																				
Sand	Fine soil particles in the size range 0.02-2.0 mm, where fine sand ranges from 0.02-0.2 mm and coarse sand ranges from 0.2-2.0 mm ( <a href="#">NCST, 2009</a> )																				
Sodic soil/sodicity	<p>Sodicity is a measure of exchangeable sodium (Na) in proportion to other exchangeable cations. Fine earth material with an ESP of 6 or greater is defined as sodic.</p> <p>Sodicity / ESP ratings (Northcote and Skene, 1972)</p> <table> <tr> <th>Sodicity rating</th><th>ESPs proposed for Australian soils (%)</th></tr> <tr> <td>Non-sodic</td><td>0 – 6</td></tr> <tr> <td>Sodic</td><td>6 – 15</td></tr> <tr> <td>Strongly sodic</td><td>&gt; 15</td></tr> </table>	Sodicity rating	ESPs proposed for Australian soils (%)	Non-sodic	0 – 6	Sodic	6 – 15	Strongly sodic	> 15												
Sodicity rating	ESPs proposed for Australian soils (%)																				
Non-sodic	0 – 6																				
Sodic	6 – 15																				
Strongly sodic	> 15																				
Sodosols	ASC Soil Order – Soils with strong texture contrast between A horizons and sodic B horizons, which are not strongly acid ( <a href="#">Isbell &amp; NCST, 2002</a> )																				
Soil horizon	A soil horizon is a layer of soil, approximately parallel to the surface, with morphological properties different from layers below and/or above it																				
Soil pH	<p>Soil pH can be used as an indicator of the chemical processes that occur in a soil – that is, can indicate certain nutrient deficiencies and toxic effects, which may have implications for soil management and rehabilitation measures.</p> <p>pH classification (<a href="#">Rayment and Lyons, 2011</a>)</p> <table> <tr> <th>pH</th><th>Rating</th></tr> <tr> <td>&gt; 9.0</td><td>Very strongly alkaline</td></tr> <tr> <td>9.0 – 8.5</td><td>Strongly alkaline</td></tr> <tr> <td>8.4 – 7.9</td><td>Moderately alkaline</td></tr> <tr> <td>7.8 – 7.4</td><td>Mildly alkaline</td></tr> <tr> <td>7.3 – 6.6</td><td>Neutral</td></tr> <tr> <td>6.5 – 6.1</td><td>Slightly acid</td></tr> <tr> <td>6.0 – 5.6</td><td>Moderately acid</td></tr> <tr> <td>5.5 – 5.1</td><td>Strongly acid</td></tr> <tr> <td>5.0 – 4.5</td><td>Very strongly acid</td></tr> </table>	pH	Rating	> 9.0	Very strongly alkaline	9.0 – 8.5	Strongly alkaline	8.4 – 7.9	Moderately alkaline	7.8 – 7.4	Mildly alkaline	7.3 – 6.6	Neutral	6.5 – 6.1	Slightly acid	6.0 – 5.6	Moderately acid	5.5 – 5.1	Strongly acid	5.0 – 4.5	Very strongly acid
pH	Rating																				
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7.8 – 7.4	Mildly alkaline																				
7.3 – 6.6	Neutral																				
6.5 – 6.1	Slightly acid																				
6.0 – 5.6	Moderately acid																				
5.5 – 5.1	Strongly acid																				
5.0 – 4.5	Very strongly acid																				
Soil structure	Soil structure refers to the distinctness, size and shape of natural soil aggregates																				
Soil texture (field)	The size distribution of particles finer than 2 mm as reflected in the behaviour of a small handful of soil when moistened and kneaded into a ball																				
Subsoil	Subsoil is a commonly used term used to identify soil material below the topsoil (A horizons) and is usually comprised of B horizons																				
Tenosols	ASC Soil Order – Soils with generally only weak pedologic organisation apart from the A horizons ( <a href="#">Isbell &amp; NCST, 2002</a> )																				
Tertiary	Geological period approx. 65 – 2.0 Mya																				
Topsoil	Topsoil is a commonly used term to identify soil horizons designated as A horizon(s). It is described as the mineral horizon at or near the soil surface with some accumulation of humified organic matter. It is usually darker in colour than underlying horizons with maximum biologic activity for any given soil																				



Term	Definition										
	<p>profile. For the purposes of this document, topsoil is defined as that proportion of the soil profile that is suitable for stockpiling and rehabilitation.</p> <p>Topsoil thickness classification (Maher, 1996)</p> <table> <tr> <th>Horizon thickness (mm)</th><th>A horizon thickness rating</th></tr> <tr> <td>&lt; 150</td><td>Thin</td></tr> <tr> <td>150 - 300</td><td>Medium</td></tr> <tr> <td>300 - 600</td><td>Thick</td></tr> <tr> <td>&gt; 600</td><td>Very thick</td></tr> </table>	Horizon thickness (mm)	A horizon thickness rating	< 150	Thin	150 - 300	Medium	300 - 600	Thick	> 600	Very thick
Horizon thickness (mm)	A horizon thickness rating										
< 150	Thin										
150 - 300	Medium										
300 - 600	Thick										
> 600	Very thick										
Vertosols	ASC Soil Order – Clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates ( <a href="#">Isbell &amp; NCST, 2002</a> )										

## 8 References

- Bourne, GF and Tuck, GA 1993a, Field Manual in RN Thwaites and JM Maher (eds.) *Understanding and Managing Soils in the Central Highlands*, Department of Primary Industries, Training Series QE93002, Brisbane, Qld.
- Bourne, GF and Tuck, GA 1993b, Field Manual in RN Thwaites and JM Maher (eds.) *Understanding and Managing Soils in the Central Highlands*, Department of Primary Industries, Training Series QE93002, Brisbane, Qld.
- Bureau of Meteorology (BOM) 2017, *Climate statistics for Australian Locations – Emerald Airport (Station ID 035264)*, [http://www.bom.gov.au/climate/averages/tables/cw\\_035264.shtml](http://www.bom.gov.au/climate/averages/tables/cw_035264.shtml).
- Department of Environment and Science (DES) 2017, *Guideline: Application requirements for activities with impacts to land*, ESR/2015/1839, Version 4.01, DES, Brisbane, Qld.
- Department of Environment and Science (DES) 2019a, *Request a map of Biodiversity Status (Version 11) or Broad Vegetation Group (Version 4.0)*, DES, Brisbane, Qld.
- Department of Environment and Science (DES) 2019b, *Search regional ecosystems descriptions, Version 11*, DES, Brisbane, Qld.
- Department of Infrastructure, Local Government and Planning (DILGP) 2017a, *RPI Act Statutory Guideline 08/14: How to demonstrate that land in the strategic cropping area does not meet the criteria for strategic cropping land*, Queensland Government, Brisbane, Qld.
- Department of Infrastructure, Local Government and Planning (DILGP) 2017b, *RPI Act Statutory Guideline 11/16: Regional Planning Interests Act 2014 (RPI Act)*, Queensland Government, Brisbane, Qld.
- Department of Mines and Energy (DME) 1995, *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques*, DME, Brisbane, Qld.

- 
- Department of Primary Industries (DPI) and Department of Housing, Local Government and Planning (DHLGP) 1993, *Planning Guidelines: The Identification of Good Quality Agricultural Land*, Queensland Government, Brisbane, Qld.
- Downes, RG and Sleeman, JR 1955, *The soils of the Macquarie region, New South Wales*, CSIRO Aust. Soil Publ. No. 4, CSIRO, Melbourne, VIC.
- Environmental Earth Sciences (EES) 2012, *Soil and Land Suitability Assessment: Wilton Coal Project*, Newstead, Qld.
- Hazelton, P and Murphy, B 2007, *Interpreting Soil Test Results – What Do All The Numbers Mean?*, CSIRO Publishing, Collingwood, VIC.
- Isbell, RF 1957, *The soils of the Ingelwood-Talwood-Tara-Glenmorgan region, Queensland*, Qld. Bur. Invest. Tech. Bull. No. 5, Department of Public Lands, Brisbane, Qld.
- Isbell, RF and National Committee on Soil and Terrain (NCST) 2016, *The Australian Soil Classification*, 2nd Ed, CSIRO Publ., Collingwood, VIC.
- McKenzie, NJ *et al.* 2008, *Guidelines for Surveying Soil and Land Resources*, 2nd Ed, CSIRO Publ., Collingwood, VIC.
- Munsell Color 2009, *Munsell Soil Color Charts*, Munsell Color, Grand Rapids, Minnesota.
- NCST 2009, *Australian Soil and Land Survey Field Handbook*, 3rd Ed, CSIRO Publishing, Collingwood, VIC.
- Northcote, KH 1965, *A factual key for the recognition of Australian soils*, 2<sup>nd</sup> Ed., CSIRO Aust. Div. Soils div1 Rep. No. 2/65.
- Northern Resource Consultants (NRC) 2017, *Wilton Coal Project: Soils and Strategic Cropping Land Technical Assessment*, NRC, Townsville, Qld.
- Queensland Government (QG) 2019, *Queensland Globe*, <https://qldglobe.information.qld.gov.au/>.
- Rayment, GE and Lyons, DJ 2011, *Soil Chemical Methods – Australasia*, CSIRO Publishing, Collingwood, VIC.
- Soil Science Australia (SSA) 2013, *Measuring soil cation exchange capacity and exchangeable cations*, Soil Science Australia, Queensland Branch, Brisbane, QLD.
- Stephens, CG 1962, *A manual of Australian soils*, 3<sup>rd</sup> Ed., CSIRO Aust., Melbourne, Vic.
- Stewart, GA 1959, *Some aspects of soil ecology* in “Biogeography and Ecology in Australia”, Monographiae Biol., Vol. 8, pp. 303-14, Springer, Dordrecht.
- Story, R, Galloway, RW, Gunn, RH, and Fitzpatrick, EA (Story, *et al.*) 1967, *Land of the Isaac-Comte Area, Queensland*, Land Research Series No. 19, CSIRO, Melbourne, Vic.



# APPENDIX A

Representative Soil Profiles, Check Sites and Exclusion Sites

### Black, Grey, Brown and Red Dermosols on Emerald Formation (Te(w))

SITE DESCRIPTION		ASC Soil Order:		Brown or Red Dermosol			Site #:	S1
Coordinates:	Easting:	660134	Northing:	7417028	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee		Elevation:	218 m AHD		

#### LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)

Slope:	Level (2.4%)	Runoff:	Slow
Morphological type:	Lower slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Imperfectly drained
Landform pattern:	Hills	Surface condition:	Firm
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Microrelief:	Nil	Rock outcrop:	Nil
Geology:	Mapped as Burngrove Formation (Pwg) but more consistent with Emerald Formation (Te(w))		
Coarse fragments:	Nil		
Erosion:	Severe, active sheet, severe, active gully (1.5-3.0 m deep), and active tunnel erosion		
Vegetation:	Brigalow, ironbark, buffel grass, native grasses		



Site S1 landscape, looking upslope (south) to head of active gully erosion



Site S1 landscape, looking east-north-east down active gully erosion to farm dam in centre background



Site S1 surface condition, tunnel erosion



Site S1 gully erosion



**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S1 surface condition**



**Site S1 profile, 1.5 m deep**

**SOIL DESCRIPTION**

Horizon	Depth (m)	Description
Field log sheet lost. Likely similar to S2, except redder		

SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	7.2	510	1.1	740	0.074	2.0	1.1
0.1-0.2	7.1	590	3.5	640	0.064	1.4	0.83

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	29	8	62	2	7.2	30	VL	<5	-	-	-	6.6	0.9	0.7	0.03	8.3	0.4	NS	2.1	7.0
0.1-0.2	24	5	69	2	7.1	40	VL	>5	-	-	-	6.3	1.6	0.7	0.05	8.7	0.5	NS	2.1	3.9
0.2-0.3	39	11	50	2	6.9	40	VL	<5	-	-	-	6.5	2.1	0.88	0.08	9.6	0.8	NS	2.1	3.1
0.4-0.7	44	6	48	1	7.0	50	VL	19	-	-	-	6.6	2.4	0.5	0.23	9.7	2.4	NS	3.4	2.8
0.7-0.9	45	9	44	7	7.2	60	VL	36	-	-	-	7.2	2.5	0.5	0.25	10.0	2.4	NS	3.3	2.9
0.9-1.1	27	1	71	23	6.4	240	M	270	-	-	-	6.4	2.4	0.5	0.52	9.8	5.3	NS	3.3	2.7

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Black Dermosol			Site #:	S2
Coordinates:	Easting:	660146	Northing:	7417024	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee		Elevation:	218 m AHD		

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Level (2.4%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Lower slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Imperfectly drained
<b>Landform pattern:</b>	Hills	<b>Surface condition:</b>	Firm
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Geology:</b>	Burngrove Formation (Pwg)	<b>Rock outcrop:</b>	Nil
<b>Microrelief:</b>	Nil		
<b>Coarse fragments:</b>	Nil		
<b>Erosion:</b>	Severe, active, sheet erosion and severe, active, gully erosion (1.5-3.0 m deep)		
<b>Vegetation:</b>	Brigalow, ironbark, buffel grass, native grasses		



Site S2 landscape, looking east-north-east across active gully erosion



Site S2 landscape, looking east across active gully erosion, immediately upslope of previous photo



Site S2 profile of gully erosion

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S2 profile, 1.5 m deep**



**Site S2 profile, 0.0-0.3 m deep**



**Site S2 profile, 0.6-0.9 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.3	Dark brown (7.5YR 3/2) (moist); weak, 5-10 mm, sub-angular blocky, earthy structure, weak consistence; light clay; pH 7.0; diffuse change to -
B22	0.3-0.5	Very dark grey (7.5YR 3/1) (moist); weak, 5-10 mm, sub-angular blocky, earthy structure, weak consistence; light clay; pH 6.5; clear change to -
B23	0.5-1.2	Very dark greyish brown (10YR 3/2) (moist); many, distinct mottles; moderate, 20-30 mm, sub-angular blocky, smooth structure, strong consistence; medium clay; pH 6.0; clear change to -
C	1.2+	Very dark greyish brown (10YR 3/2) (moist); many, distinct mottles; moderate, 20-30 mm, sub-angular blocky, smooth structure, strong consistence; medium clay; fragments of siltstone, ironstone conglomerate; pH 6.0; grading to weathered siltstone



SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	6.5	750	4.9	1,500	0.150	4.9	2.8
0.1-0.2	6.4	810	2.2	1,400	0.140	4.2	2.4

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	29	9	60	0	6.5	40	VL	<5	-	-	-	15.0	2.8	0.5	0.10	19.0	0.6	NS	2.1	5.6
0.1-0.2	34	32	32	0	6.4	40	VL	<5	-	-	-	13.0	2.8	0.6	0.10	17.0	0.6	NS	2.1	4.6
0.2-0.3	40	23	38	0	6.2	30	VL	<5	-	-	-	9.6	3.0	0.56	0.11	13.0	0.9	NS	2.1	3.2
0.3-0.5	36	14	50	2	5.9	40	VL	12	-	-	-	5.9	2.8	0.4	0.53	9.5	5.6	NS	2.2	2.1
0.5-0.6	39	16	44	0	5.9	50	VL	18	-	-	-	5.8	2.9	0.41	0.60	9.8	6.1	S	2.2	2.0
0.6-0.9	44	13	42	1	5.9	100	VL	79	-	-	-	7.1	3.1	0.3	0.97	12.0	8.4	S	2.1	2.3
0.9-1.1	35	13	51	0	5.6	410	M	570	-	-	-	8.3	4.3	0.3	2.50	18.0	13.9	S	2.1	2.5
1.1-1.3	33	7	57	3	6.0	310	M	420	-	-	-	6.4	3.5	0.3	1.90	14.0	13.2	S	2.2	2.4

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Red Dermosol			Site #:	S3
Coordinates:	Easting:	661083	Northing:	7416296	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	228 m AHD	

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Gently inclined (4.3%)	Runoff:	Moderately rapid
Morphological type:	Mid slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Imperfectly drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Geology:	Emerald Formation (Te(w))	Rock outcrop:	Nil
Surface condition:	Not stated on field log, appears firm, surface crusting based on close-up of 3 <sup>rd</sup> photo below		
Coarse fragments:	Appears to be many (20-50%), coarse, metamorphic gravels (20-60 mm) based on close-up of bottom left photo		
Erosion:	Minor, active sheet erosion and minor, active gully erosion (<1.5 m deep) (see centre of top right photo)		
Vegetation:	Brigalow, buffel grass		



Site S3 landscape, looking upslope



Site S3 landscape, looking downslope



Site S3 surface condition



Site S3 surface condition



**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S3 profile, 1.5 m deep**



**Site S3 profile, 0.0-0.25 m deep**



**Site S3 profile, 0.6-0.8 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Reddish brown (5YR 4/3) (moist); weak, 2-5 mm, angular blocky structure, weak consistence; light clay; many, coarse, metamorphic gravels; few, fine, ferruginous concretions; pH 7.0; clear change to -
B22	0.2-0.5	Reddish brown (5YR 4/3) (moist); few, fine, distinct, yellow mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; medium clay; few, fine, ferruginous concretions; pH 8.5; gradual change to -
B23	0.5-0.8	Strong brown (7.5YR 4/6) (moist); few, distinct, yellow-orange mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; medium clay; few, fine, ferruginous concretions; pH 7.5; clear change to -
B24	0.8+	Strong brown (7.5YR 5/6) (moist); many, distinct orange mottles; moderate, 10-20 mm, angular blocky structure, moderate consistence; few, fine, ferruginous concretions

SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	6.7	960	0.9	1,100	0.110	2.70	1.60
0.1-0.2	7.9	550	1.2	1,100	0.110	1.70	1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	39	8	54	24	6.7	90	VL	76	-	-	-	4.3	6.6	0.9	0.70	14.0	5.1	NS	1.0	0.8
0.1-0.2	56	6	36	5	7.9	570	H	620	-	-	-	4.2	19.0	0.7	5.00	32.0	15.5	SS	1.0	0.4
0.2-0.3	57	10	36	4	8.2	690	H	780	-	-	-	8.3	20.0	0.74	5.70	35.0	16.4	SS	1.0	0.4
0.3-0.5	56	9	39	5	8.0	1,100	VH	1,200	-	-	-	6.4	21.0	0.7	7.30	35.0	20.5	SS	1.0	0.3
0.5-0.6	59	10	33	6	7.5	1,300	VH	1,700	-	-	-	4.3	23.0	0.74	8.70	36.0	23.9	SS	2.3	0.2
0.6-0.8	51	9	39	6	7.1	1,400	VH	1,800	-	-	-	4.2	25.0	0.8	9.50	39.0	24.4	SS	2.2	0.2
0.8-0.9	59	12	30	8	7.0	1,300	VH	1,700	-	-	-	4.0	23.0	0.8	9.00	37.0	24.2	SS	1.0	0.2

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Red Dermosol			Site #:	S6
Coordinates:	Easting:	661604	Northing:	7415893	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	220 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

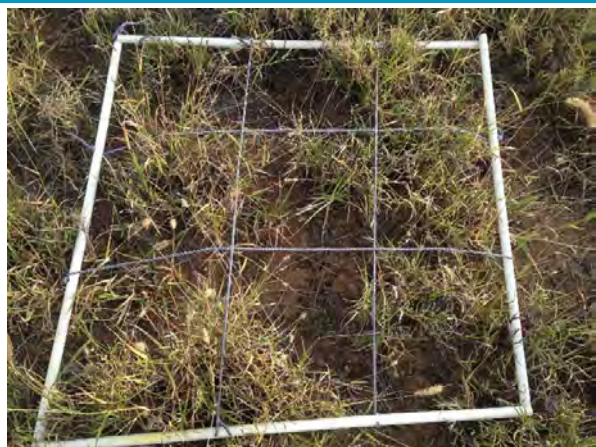
<b>Slope:</b>	Gently inclined (2.4%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Geology:</b>	Emerald Formation (Te(w))	<b>Rock outcrop:</b>	Nil
<b>Surface condition:</b>	Firm, likely surface crusting based on close-up of bottom left photo		
<b>Coarse fragments:</b>	Appears to be many (20-50%), medium, metamorphic gravels 6-20 mm) and few (2-10%), metamorphic cobbles (60-200 mm) based on close-up inspection of bottom left photo		
<b>Erosion:</b>	Minor, active sheet erosion and minor, active gully erosion (<1.5 m deep) (see centre of 2 <sup>nd</sup> photo below)		
<b>Vegetation:</b>	Brigalow, buffel grass		



Site S6 landscape, looking north-west, across slope



Site S6 landscape, looking south, across ridge



Site S6 surface condition

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S6 profile, 0.3 m deep**



**Site S6 profile, 0.0-0.23 m deep**



**Site S6 profile, 0.19-0.3 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Brown (5YR 4/3) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; silty loam; few, small, metamorphic pebbles; common, medium, ferruginous concretions; pH 7.0




SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	7.0	690	0.7	950	0.095	2.00	1.10
0.1-0.2	7.4	640	0.6	770	0.077	1.50	0.85

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	29	7	64	8	7.0	40	VL	<5	-	-	-	6.6	2.5	0.3	0.45	9.8	4.6	NS	2.1	2.6
0.1-0.2	29	7	64	10	7.4	40	VL	<5	-	-	-	7.7	3.2	0.3	0.72	12.0	6.0	S	2.2	2.4

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Red Dermosol			Site #:	S7
Coordinates:	Easting:	661360	Northing:	7415612	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee		Elevation:	230 m AHD		

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Very gently inclined (4.2%)	Runoff:	Slow
Morphological type:	Upper slope	Permeability:	Moderately permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Geology:	Emerald Formation (Te(w))	Rock outcrop:	Nil
Surface condition:	Firm		
Coarse fragments:	Many (20-50%), medium, metamorphic pebbles (6-20 mm) and common (10-20%), large metamorphic pebbles (20-60 mm)		
Erosion:	Minor, active sheet erosion near gully		
Vegetation:	Eucalyptus sp., brigalow		
			
Site S7 landscape, looking south, upslope			



**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S7 profile, 0.7 m deep**



**Site S7 profile, 0.0-0.3 m deep**



**Site S7 profile, 0.5-0.7 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.1	Reddish brown (5YR 4/3) (moist); weak, 2-5 mm, earthy, sub-angular blocky structure, weak consistence; light clay; abundant, large, metamorphic pebbles; pH 6.0; clear change to -
B22	0.1-0.3	Reddish brown (5YR 5/4) (moist); moderate, 20-50 mm, earthy, polyhedral structure, moderate consistence; medium clay; many, large metamorphic pebbles; few, medium, ferruginous concretions; pH 7.5; gradual change to -
B23	0.3-0.6	Reddish brown (5YR 5/4) (moist); moderate, 20-50 mm, earthy, polyhedral structure, moderate consistence; medium clay; few, medium, ferruginous concretions; pH 7.5; clear change to -
C	0.6-0.7	Reddish yellow (7.5YR 6/6) (moist); weak, 20-50 mm, earthy, polyhedral structure, moderate consistence; medium clay; few, medium, shale gravels; pH 6.5

SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	5.7	840	9.4	270	0.027	0.72	0.42
0.1-0.2	6.1	720	6.8	650	0.065	1.20	0.69

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	30	4	64	30	5.7	220	M	280	-	-	-	1.6	3.8	0.3	0.70	6.5	10.8	S	3.4	0.4
0.1-0.2	46	4	53	43	6.1	700	H	960	-	-	-	3.0	13.0	0.4	3.00	19.0	15.8	SS	2.3	0.2
0.2-0.3	43	5	51	26	6.5	660	H	910	-	-	-	3.1	17.0	0.37	4.60	25.0	18.6	SS	2.3	0.2
0.3-0.5	59	4	34	9	6.7	770	H	1,100	-	-	-	2.4	19.0	0.4	6.10	28.0	22.0	SS	1.0	0.1
0.5-0.6	64	11	22	1	5.8	750	H	1,000	-	-	-	1.4	19.0	0.52	7.30	28.0	26.2	SS	1.0	<0.1
0.6-0.7	70	11	19	16	5.7	730	H	1,100	-	-	-	4.7	18.0	0.6	7.50	28.0	27.1	SS	1.0	<0.1

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	S8
Coordinates:	Easting:	661899	Northing:	7415676	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	220 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Level (3.8%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Geology:</b>	Emerald Formation (Te(w))	<b>Rock outcrop:</b>	Nil
<b>Surface condition:</b>	Firm		
<b>Coarse fragments:</b>	Many (20-50%), large, metamorphic pebbles (20-60 mm)		
<b>Erosion:</b>	Minor, active sheet erosion		
<b>Vegetation:</b>	Brigalow, buffel grass		



Site S8 landscape, looking south, upslope



Site S8 landscape, looking north, downslope



Site S8 surface condition



Site S8 surface condition

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**



**Site S8 profile, 0.5 m deep**



**Site S8 profile, 0.0-0.25 m deep**



**Site S8 profile, 0.2-0.45 m deep**

**SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)**

Horizon	Depth (m)	Description
A1/B21	0.0-0.1	Dark brown (7.5YR 3/2) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; abundant, large, metamorphic pebbles; pH 6.5; clear change to -
B22	0.1-0.3	Dark yellowish brown (10YR 4/4) (moist); moderate, 20-50 mm, earthy, sub-angular blocky structure, moderate consistence; medium clay; many, medium metamorphic pebbles; few, medium, ferruginous concretions; pH 7.5; diffuse change to -
C	0.3-0.5	Light yellowish brown (10YR 6/5) (moist); moderate, 20-50 mm, sandy, angular blocky structure, weak consistence; sand; few, medium, sandstone pebbles; pH 8.5



SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	7.2	1000	0.8	770	0.077	2.40	1.40
0.1-0.2	7.6	810	1.0	720	0.072	1.80	1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	29	8	63	28	7.2	50	VL	7	-	-	-	65.4	3.4	0.6	0.86	14.0	6.1	S	2.2	2.7
0.1-0.2	37	4	61	29	7.6	90	VL	10	-	-	-	66.4	4.2	0.6	1.40	18.0	7.4	S	2.3	2.9
0.2-0.3	44	5	50	16	8.7	270	M	50	-	-	-	75.8	6.5	0.5	2.70	40.0	6.6	S	2.3	4.6
0.3-0.4	27	4	67	9	8.9	280	M	80	-	-	-	29.0	5.6	0.4	2.50	37.0	6.9	S	3.4	5.1

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Red Dermosol			Site #:	O2E
Coordinates:	Easting:	661079	Northing:	7416790	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee		Elevation:	222 m AHD		

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Gently inclined (3.4%)	<b>Runoff:</b>	Moderately rapid
<b>Morphological type:</b>	Ridge	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillcrest	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Surface condition:</b>	Firm	<b>Rock outcrop:</b>	Slightly rocky
<b>Geology:</b>	Mapped as Burngrove Formation (Pwg) but likely Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Many (20-50%), large, metamorphic stones (200-600 mm)		
<b>Erosion:</b>	Gully head, severe, active rill erosion		
<b>Vegetation:</b>	Ironbark, bloodwood, brigalow, buffel grass		



Site O2E landscape, looking south, upslope



Site O2E landscape, looking north, downslope



Site O2E surface condition



Site O2E surface condition



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	O3E
Coordinates:	Easting:	661089	Northing:	7416448	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	222 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Gently inclined (4.9%)	<b>Runoff:</b>	Moderately rapid
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Surface condition:</b>	Firm	<b>Rock outcrop:</b>	Slightly rocky
<b>Geology:</b>	Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Many (20-50%), large, metamorphic stones (200-600 mm)		
<b>Erosion:</b>	Gully head, severe, active, gully (<1.5 m deep), sheet and rill erosion		
<b>Vegetation:</b>	Brigalow, buffel grass, chenopod		



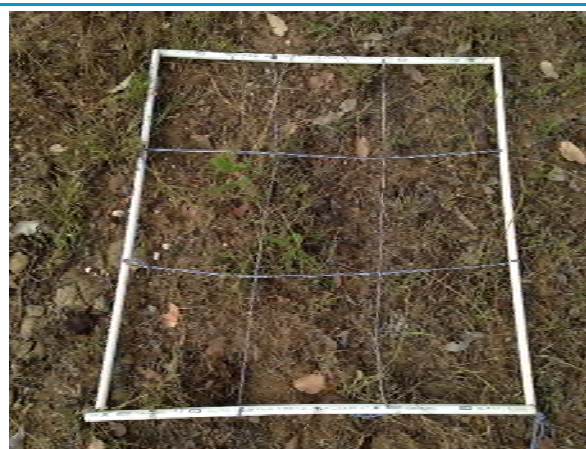
Site S8 landscape, looking south-west, upslope



Site S8 landscape, looking north-east, downslope







Site S8 surface condition and soil profile of gully



Site S8 surface condition

SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol (similar to <a href="#">S1</a> )			Site #:	O5C
Coordinates:	Easting:	661178	Northing:	7416004	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:		228 m AHD

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Very gently inclined (6.2%)	Runoff:	Moderately rapid
Morphological type:	Mid slope	Permeability:	Moderately permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Surface condition:	Firm	Rock outcrop:	Nil
Geology:	Emerald Formation (Te(w))		
Coarse fragments:	Many (20-50%), large, metamorphic stones (200-600 mm)		
Erosion:	Gully head, severe, active, gully (<1.5 m deep), sheet and rill erosion		
Vegetation:	Brigalow, buffel grass, chenopod		
			
Site O5C landscape, looking west, upslope, across gully erosion		Site O5C landscape, looking east-north-east, downslope with gully	
			
Site O5C surface condition		Site O5C gully soil profile	



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol (similar to <a href="#">S3</a> )			Site #:	O6C
Coordinates:	Easting:	661069	Northing:	7415970	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:		231 m AHD

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Gently inclined (4.7%)	<b>Runoff:</b>	Moderately rapid
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Surface condition:</b>	Firm	<b>Rock outcrop:</b>	Nil
<b>Geology:</b>	Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Abundant (50-90%), large, metamorphic pebbles (20-60 mm)		
<b>Erosion:</b>	Gully head, severe, active, gully (<1.5 m deep), sheet and rill erosion		
<b>Vegetation:</b>	Brigalow, buffel grass, chenopod		



Site O6C landscape, looking south, upslope, out of gully



Site O6C landscape, looking north, upslope, out of gully, exposed soil profile



Site O6C looking upslope, towards gully head



Site O6C exposed bed rock within gully

SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol (similar to <a href="#">S8</a> )			Site #:	O7E
Coordinates:	Easting:	661587	Northing:	7415481	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:		218 m AHD

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Very gently inclined (6.7%)	<b>Runoff:</b>	Moderately rapid
<b>Morphological type:</b>	Lower slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Surface condition:</b>	Firm	<b>Rock outcrop:</b>	Slightly rocky, exposed lignite
<b>Geology:</b>	Mapped as Burngrove Formation (Pwg) but likely Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Abundant (50-90%), large, metamorphic pebbles (20-60 mm)		
<b>Erosion:</b>	Gully head, severe, active, gully (1.5-3.0 m deep), sheet and rill erosion		
<b>Vegetation:</b>	Brigalow		



Site O7E landscape, looking west, upslope towards head of gully



Site O7E landscape, looking south, downslope towards drainage line



Site O7E exposed lignite



Site O7E soil profile



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	O8E
Coordinates:	Easting:	661523	Northing:	7415407	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	221 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Gently inclined (5.6%)	<b>Runoff:</b>	Rapid
<b>Morphological type:</b>	Upper slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared, some regrowth
<b>Surface condition:</b>	Soft	<b>Rock outcrop:</b>	Nil
<b>Geology:</b>	Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Many (20-50%), medium, metamorphic pebbles (6-20 mm)		
<b>Erosion:</b>	Minor, active, sheet erosion		
<b>Vegetation:</b>	Open eucalypt forest		



Site O8E landscape, looking north-west, upslope towards ridgeline, gravelly surface in foreground



Site O8E landscape, looking north-east, downslope towards gully erosion (site [O7E](#))



Site O8E landscape, looking south, across slope through open eucalypt forest



Site O8E surface condition



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	O9E
Coordinates:	Easting:	661483	Northing:	7415350	Zone:	55	Datum:	GDA94
Location:	Wilton	Describer:	NRC unnamed employee		Elevation:	223 m AHD		

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Gently inclined (7.6%)	<b>Runoff:</b>	Rapid
<b>Morphological type:</b>	Upper slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared, some regrowth
<b>Surface condition:</b>	Soft	<b>Rock outcrop:</b>	Nil, although exposed in gully
<b>Geology:</b>	Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Abundant (50-90%), large, metamorphic pebbles (20-60 mm) and few (2-10%), metamorphic cobbles (60-200 mm)		
<b>Erosion:</b>	Severe, active, sheet and moderate, active, gully (<1.5 m deep) erosion		
<b>Vegetation:</b>	Open eucalypt forest		



Site O9E landscape, looking south, across slope through open eucalypt forest, active sheet erosion in foreground



Site O9E landscape, looking west-north-west, up gully




Site O9E gully erosion and exposed lignite



Site O9E surface condition



SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	O14C
Coordinates:	Easting:	660910	Northing:	7416601	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	228 m AHD	

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Gently inclined (2.5%)	Runoff:	Rapid
Morphological type:	Mid slope	Permeability:	Moderately permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Surface condition:	Firm	Rock outcrop:	Nil
Geology:	Emerald Formation (Te(w))		
Coarse fragments:	Abundant (50-90%), large, metamorphic pebbles (20-60 mm)		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Open eucalypt forest		
			
Site O14E landscape, looking north-west, upslope		Site O14E landscape, looking south-east, downslope	
			
Site O14E surface condition		Site O14E soil profile, 0.0-0.1 m deep	

SOIL DESCRIPTION		
Horizon	Depth (m)	Description
A1/B21	0.0-0.1	Dark brown (7.5YR 3/2) (moist); weak, 5-10 mm, sub-angular blocky structure, earthy consistence; light clay; many, large, metamorphic pebbles; pH 6.0

### Black, Grey and Brown Vertosols on Burngrove Formation (Pwg)

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB04
Coordinates:	Easting:	660417	Northing:	7417298	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		211 m AHD	

LANDFORM			
Slope:	Gently inclined (4.3%)	Runoff:	Moderately rapid
Morphological type:	Ridge	Permeability:	Slowly permeable
Landform element:	Residual crest	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, improved pasture
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Many (20-50%), sub-angular platy, metamorphic cobbles (60-200 mm)		
Erosion:	Moderate, active, sheet erosion		
Vegetation:	<i>Eucalyptus</i> sp., silver-leaved ironbark, buffel grass, native grasses		



Site OB04 landscape



Site OB04 surface condition



Site OB04 surface condition



Site OB04 surface condition



## LANDFORM



Site OB04 profile, 0.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.25	Very dark brown (10YR 2/2) (moist); strong, 10-20 mm, sub-angular blocky structure; medium clay; common, medium sub-angular platy, metamorphic gravels; common, medium ferromanganiferous concretions; pH 7.0; abrupt change to -
B/C	0.25-0.3	Very dark greyish brown (10YR 3/2) (moist); common, coarse, distinct, brown mottles; moderate, 5-10 mm, sub-angular blocky structure; light medium clay; common, medium, sub-angular tabular, metamorphic pebbles; very few, fine, ferromanganiferous concretions; pH 7.0; gradual change to -
C	0.3+	Dark grey (10YR 4/1) (moist); weak, <2 mm, sub-angular blocky structure; light medium clay; abundant, sub-rounded tabular, metamorphic cobbles; pH 7.0; refusal on rock

SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	7.6	13	1,940	0.194	3.0	1.7	0.3	1.59	10.1	9.94	<1.00
0.1-0.2	7.8	<5	1,440	0.144	2.7	1.6	<0.2	1.34	9.19	10.4	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	57	29	14	21	7.6	35	VL	<10	<0.01	-	-	19.5	4.9	1.6	<0.2	25.9	<0.2	NS	-	4.0
0.1-0.2	59	25	16	17	7.8	39	VL	<10	<0.01	-	-	21.4	5.3	1.6	0.2	28.6	0.9	NS	4	4.0
0.2-0.3	50	18	32	34	7.7	38	VL	<10	<0.01	-	-	21.8	5.5	1.4	0.4	29.1	1.5	NS	3	4.0

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB05
Coordinates:	Easting:	660789	Northing:	7417183	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		219 m AHD	

LANDFORM			
Slope:	Very gently inclined (2.6%)	Runoff:	Moderately rapid
Morphological type:	Upper slope	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm to hard, surface crust
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, historically cultivated
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Abundant (50-90%), large, sub-angular platy, metamorphic pebbles (20-60 mm) and few (2-10%), sub-angular tabular, metamorphic stones (200-600 mm)		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, buffel grass, native grasses		



Site OB05 landscape



Site OB05 surface condition



Site OB05 surface condition



Site OB05 surface condition



## LANDFORM



Site OB05 profile, 0.4 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.10	Dark brown (10YR 3/3) (moist); moderate, 5-10 mm, sub-angular blocky structure; light medium clay; few, medium, angular platy, metamorphic gravels; pH 7.0; clear change to -
B22	0.10-0.25	Very dark brown (10YR 2/2) (moist); moderate, 10-20 mm, sub-angular blocky structure; medium clay; common, medium, angular platy, metamorphic pebbles; few, medium, ferromanganiferous concretions; pH 7.5; clear change to -
B/C	0.25-0.4	Very dark grey (10YR 3/1) (moist); weak, 2-5 mm, sub-angular blocky structure; light medium clay; abundant, angular platy, metamorphic cobbles; few, fine, moderately calcareous laminae; pH 8.5; clear change to -
C	0.4+	Refusal on rock



SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	7.1	8	960	0.096	1.6	0.9	0.3	1.92	14.5	11.9	<1.00
0.1-0.2	7.9	<5	1,160	0.116	2.4	1.4	0.5	2.41	10.7	12.2	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	70	14	16	14	7.1	105	VL	60	0.05	-	-	10.2	4.2	0.9	2.1	17.4	12.3	S	-	2.4
0.1-0.2	69	18	14	4	7.9	130	VL	100	0.02	-	-	8.2	3.0	0.4	1.8	13.4	13.6	S	2	2.7
0.3-0.4	62	20	18	15	9.0	256	L	60	<0.01	-	-	10.7	4.3	0.5	2.5	18.0	14.1	S	3	2.5

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB06
Coordinates:	Easting:	661432	Northing:	7417111	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		209 m AHD	

LANDFORM			
Slope:	Very gently inclined (1.4%)	Runoff:	Moderately rapid
Morphological type:	Upper slope	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, historically cultivated to south
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Sub-angular tabular, metamorphic fragments: many (20-50%), medium pebbles (6-20 mm) and common (10-20%), large pebbles (20-60 mm), and few (2-10%), cobbles (60-200 mm) pebbles		
Erosion:	Severe, active, sheet erosion and severe, active, gully erosion (1.5-3.0 m deep)		
Vegetation:	Caesalpinia, wilga, carissa, buffel grass, native grasses		



Site OB06 landscape



Site OB06 landscape, active sheet and gully erosion



Site OB06 surface condition



Site OB06 surface condition



## LANDFORM



Site OB06 profile, 0.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.40	Black (10YR 2/1) (moist); strong, 10-20 mm, sub-angular blocky structure; medium clay; very few, small, sub-angular tabular, metamorphic gravels; very few, fine, moderately calcareous nodules; pH 8.0; gradual change to -
B/C	0.4-0.6	Very dark grey (10YR 3/1) (moist); strong, 2-5 mm, sub-angular blocky structure; light medium clay; abundant, angular platy, metamorphic cobbles; few, fine, weakly calcareous laminae; pH 8.5; gradual change to -
C	0.6+	Refusal on rock

SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	8.1	8	1,160	0.116	2.6	1.5	<0.2	<1.00	10.3	22.0	<1.00
0.1-0.2	9.0	<5	1,290	0.129	2.4	1.4	0.4	<1.00	6.4	5.73	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emer- son class	Ca:Mg ratio	
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>					CEC
0.0-0.1	36	27	36	4	8.1	172	L	110	<0.01	-	-	11.6	3.8	0.8	1.5	17.8	8.4	S	-	3.0
0.1-0.2	60	25	15	3	9.0	482	M	570	0.05	-	-	17.3	6.2	1.0	4.0	28.5	13.9	S	3	2.8
0.2-0.3	59	23	18	4	9.0	606	H	1,100	0.02	-	-	17.5	6.9	0.9	5.1	30.4	16.8	SS	3	2.5
0.3-0.4	63	23	18	4	9.0	687	M	940	<0.01	-	-	18.2	7.4	0.9	5.9	32.5	18.2	SS	3	2.4
0.4-0.5	58	22	20	9	9.0	678	H	900	0.02	-	-	17.8	7.4	0.9	6.2	32.3	19.3	SS	3	2.4
0.5-0.6	48	23	29	31	9.1	613	H	770	<0.01	-	-	17.9	7.6	0.8	6.6	32.8	20.0	SS	3	2.4

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Grey Vertosol			Site #:	OB07
Coordinates:	Easting:	661095	Northing:	7417473	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		207 m AHD	

LANDFORM			
Slope:	Very gently inclined (4.2%)	Runoff:	Moderately rapid
Morphological type:	Lower slope	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Sub-angular tabular, metamorphic fragments: many (20-50%), medium pebbles (6-20 mm) and common (10-20%), large pebbles (20-60 mm), and few (2-10%), cobbles (60-200 mm) pebbles		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, carissa, buffel grass, native grasses		



Site OB07 landscape, active sheet erosion



Site OB07 landscape, active sheet erosion



Site OB07 surface condition



Site OB07 surface condition



## LANDFORM



Site OB07 profile, 0.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.3	Black (10YR 2/1) (moist); moderate, 10-20 mm, sub-angular blocky structure; fine sandy light medium clay; common, medium, sub-angular tabular, metamorphic gravels; few, fine, highly calcareous soft segregations; pH 7.5; gradual change to -
B/C	0.3-0.4	Dark grey (10YR 4/1) (moist); weak, <2 mm, granular structure; fine sandy light medium clay; abundant, angular platy, metamorphic cobbles; few, fine, moderately calcareous laminae; pH 8.0; gradual change to -
C	0.4+	Refusal on rock



SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	7.3	17	2,360	0.236	2.3	1.3	<0.2	<1.00	19.2	24.1	<1.00
0.1-0.2	8.7	<5	1,300	0.130	2.0	1.1	0.6	<1.00	10.6	6.28	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	13	23	65	12	7.3	50	VL	20	0.02	-	-	9.2	5.3	1.0	0.9	16.5	5.7	NS	-	1.7
0.1-0.2	26	26	47	9	8.7	154	L	60	0.02	-	-	13.8	6.3	1.1	2.6	23.9	11.0	S	3	2.2
0.2-0.3	30	26	44	12	9.2	279	M	130	<0.01	-	-	15.5	7.6	1	3.3	27.3	12.0	S	3	2.0
0.3-0.4	21	23	58	20	9.3	296	M	120	0.02	-	-	13.7	7.0	0.8	3.1	24.7	12.6	S	3	2.0

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB08
Coordinates:	Easting:	661221	Northing:	7417326	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		208 m AHD	

LANDFORM			
Slope:	Very gently inclined (2.3%)	Runoff:	Moderately rapid
Morphological type:	Ridge	Permeability:	Slowly permeable
Landform element:	Residual crest	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, historically cultivated
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Sub-angular tabular, metamorphic fragments: many (20-50%), medium pebbles (6-20 mm) and common (10-20%), large pebbles (20-60 mm), and few (2-10%), cobbles (60-200 mm) pebbles		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, wilga, caesalpinina, Moreton Bay ash, buffel grass, native grasses		



Site OB08 landscape, active sheet erosion



Site OB08 landscape, active sheet erosion



Site OB08 surface condition



Site OB08 surface condition



## LANDFORM



Site OB08 profile, 0.3 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Very dark greyish brown (10YR 3/2) (moist); strong, 20-50 mm, sub-angular blocky structure; medium clay; few, large, sub-angular platy, metamorphic pebbles; few, fine, ferruginous concretions; common, medium, moderately calcareous soft segregations; pH 9.0; clear change to -
B/C	0.2-0.3	Black (10YR 2/1) (moist); strong, 10-20 mm, sub-angular blocky structure; light medium clay; many, large, sub-angular platy, metamorphic pebbles; few, fine, ferruginous concretions; few, fine, moderately calcareous laminae; pH 8.5; clear change to -
C	0.3+	Refusal on rock

SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	7.3	17	2,360	0.236	2.3	1.3	<0.2	<1.00	19.2	24.1	<1.00
0.1-0.2	8.7	<5	1,300	0.130	2.0	1.1	0.6	<1.00	10.6	6.28	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	13	23	65	12	7.3	50	VL	20	0.02	-	-	9.2	5.3	1.0	0.9	16.5	5.7	NS	-	1.7
0.1-0.2	26	26	47	9	8.7	154	L	60	0.02	-	-	13.8	6.3	1.1	2.6	23.9	11.0	S	3	2.2
0.2-0.3	30	26	44	12	9.2	279	M	130	<0.01	-	-	15.5	7.6	1	3.3	27.3	12.0	S	3	2.0
0.3-0.4	21	23	58	20	9.3	296	M	120	0.02	-	-	13.7	7.0	0.8	3.1	24.7	12.6	S	3	2.0

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB09
Coordinates:	Easting:	661337	Northing:	7417237	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		206 m AHD	

LANDFORM			
Slope:	Very gently inclined (3.3%)	Runoff:	Moderately rapid
Morphological type:	Open depression	Permeability:	Slowly permeable
Landform element:	Bank	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Angular tabular, metamorphic fragments: many (20-50%), medium pebbles (6-20 mm), common (10-20%), large pebbles (20-60 mm) and few (2-10%), cobbles (60-200 mm)		
Erosion:	Severe, active, sheet erosion and severe, active, gully erosion (1.5-3.0 m deep)		
Vegetation:	River red gum, carissa, wilga, eremophila, buffel grass, native grasses		



Site OB09 landscape, active sheet and gully erosion



Site OB09 landscape, active sheet and gully erosion



Site OB09 surface condition of drainage line bed and bank



Site OB09 surface condition of drainage line bed

## LANDFORM



Site OB09 profile, 1.0 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.4	Very dark greyish brown (10YR 3/2) (moist); moderate, 10-20 mm, sub-angular blocky structure; light medium clay; many, medium, sub-angular platy, metamorphic pebbles; common, fine, ferruginous concretions; pH 9.0; gradual change to -
B/C	0.4-1.0	Dark brown (10YR 3/3) (moist); many, medium, distinct, pale mottles; moderate, 10-20 mm, sub-angular blocky structure; sandy light medium clay; abundant, sub-angular platy, metamorphic stones; common, fine, ferruginous concretions; pH 8.5; clear change to -
C	1.0+	Weathered parent material



SITE DESCRIPTION		ASC Soil Order:		Brown Vertosol			Site #:	OB10
Coordinates:	Easting:	661400	Northing:	74167014	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		213 m AHD	

LANDFORM			
Slope:	Gently inclined (10.3%)	Runoff:	Moderately rapid
Morphological type:	Open depression	Permeability:	Slowly permeable
Landform element:	Bank	Drainage:	Moderately well-drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Many (20-50%), angular tabular, metamorphic stones (200-600 mm)		
Erosion:	Severe, active, sheet erosion and active, stream bank erosion		
Vegetation:	Silver-leaved ironbark, wilga, brigalow, carissa, <i>Corymbia</i> sp., buffel grass, native grasses		



Site OB10 landscape, active sheet and stream bank erosion



Site OB10 landscape, active sheet erosion



Site OB10 surface condition



Site OB10 surface condition

## LANDFORM



Site OB10 profile, 1.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1/B21	0.0-0.15	Very dark brown (10YR 2/2) (moist); moderate, 5-10 mm, sub-angular blocky structure; light clay; abundant, angular tabular, metamorphic stones; pH 5.5; gradual change to -
B22	0.15-0.4	Dark brown (7.5YR 3/4) (moist); moderate, 20-50 mm, sub-angular blocky structure; medium clay; many, angular tabular, metamorphic cobbles; very few, fine, manganiferous concretions; pH 6.0; gradual change to -
B23	0.4-1.2	Dark yellowish brown (10YR 3/4) (moist); common, fine, faint, dark mottles; moderate, 20-50 mm, sub-angular blocky structure; medium clay; many, large, angular tabular, metamorphic pebbles; very few, fine, manganiferous concretions; pH 8.0; gradual change to -
B/C	1.2-1.6	Very dark brown (10YR 3/3) (moist); common, medium, prominent, orange mottles; moderate, 20-50 mm, sub-angular blocky structure; light medium clay; many, large, angular tabular, metamorphic pebbles; few, fine, ferromanganiferous concretions; pH 8.0; gradual change to -
C	1.6+	Weathered parent material



SITE DESCRIPTION		ASC Soil Order:		Brown Vertosol			Site #:	OB11
Coordinates:	Easting:	660722	Northing:	7417407	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		212 m AHD	

LANDFORM			
Slope:	Gently inclined (7.3%)	Runoff:	Rapid
Morphological type:	Open depression	Permeability:	Slowly permeable
Landform element:	Drainage depression	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Surface crust, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Very slightly rocky
Microrelief:	Nil		
Coarse fragments:	Angular tabular, metamorphic fragments: abundant (50-90%), medium pebbles (6-20 mm) and many (20-50%), stones (200-600 mm)		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, bloodwood, carissa, buffel grass, native grasses		



Site OB11 landscape, active sheet erosion



Site OB11 landscape, active sheet erosion



Site OB11 surface condition



Site OB11 surface condition

LANDFORM



Site OB11 drainage depression gully head



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB12
Coordinates:	Easting:	660948	Northing:	7417370	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		211 m AHD	

LANDFORM			
Slope:	Gently inclined (7.1%)	Runoff:	Moderately rapid
Morphological type:	Upper slopes	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Moderately well-drained
Landform pattern:	Rises	Surface condition:	Firm, surface flake
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, historical cropping to south
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Many (20-50%), angular tabular, metamorphic cobbles (60-200 mm)		
Erosion:	Severe, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, carissa, buffel grass, native grasses		



Site OB12 landscape, active sheet erosion



Site OB12 landscape, active sheet erosion



Site OB12 surface condition



Site OB12 surface condition

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	OB13
Coordinates:	Easting:	661070	Northing:	7417374	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		209 m AHD	

LANDFORM			
Slope:	Very gently inclined (4.3%)	Runoff:	Moderately rapid
Morphological type:	Simple slope	Permeability:	Moderately permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crusting, cracking
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared
Geology:	Burngrove Formation (Pwg)	Microrelief:	Nil
Rock outcrop:	Nil but exposed weathered sandstone in gully erosion		
Coarse fragments:	Many (20-50%), angular tabular, metamorphic cobbles (60-200 mm)		
Erosion:	Severe, active, sheet erosion and severe, active, gully erosion (<1.5 m deep)		
Vegetation:	Silver-leaved ironbark, bloodwood, carissa, buffel grass, native grasses		



Site OB13 landscape, active sheet and gully erosion



Site OB13 landscape, active sheet and gully erosion



Site OB13 surface condition



Site OB13 exposed parent material in gully erosion



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	S4
Coordinates:	Easting:	661394	Northing:	7416484	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	219 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Very gently inclined (2.5%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Erosion:</b>	Minor, active, sheet erosion	<b>Rock outcrop:</b>	Nil
<b>Surface condition:</b>	Varies from self-mulching, cracking (bottom left photo) to firm, surface crusting (bottom right photo)		
<b>Coarse fragments:</b>	Metamorphic fragments: abundant (50-90%), medium pebbles (6-20 mm), many (20-50%), large pebbles (20-60 mm) and few (2-10%), cobbles (60-200 mm)		
<b>Geology:</b>	Mapped as Emerald Formation (Te(w)) but likely Burngrove Formation (Pwg)		
<b>Vegetation:</b>	Brigalow, buffel grass		



Site S4 landscape, looking west, across slope



Site S4 landscape, looking east, downslope



Site S4 surface condition



Site S4 surface condition

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)



Site S4 profile, 0.5 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)

Horizon	Depth (m)	Description
A1/B21	0.0-0.1	Very dark grey (10YR 3/1) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; clay; pH 6.5; gradual change to -
B22	0.1-0.3	Very dark greyish brown (10YR 3/2) (moist); moderate, 10-20 mm, earthy, sub-angular blocky structure, moderate consistence; clay; few, fine, ferruginous concretions; few, fine, soft calcareous segregations; pH 6.5; clear change to -
B23	0.3-0.5	Very dark greyish brown (10YR 3/2) (moist); moderate, 20-50 mm, earthy, sub-angular blocky structure, moderate consistence; clay; very few, fine, ferruginous concretions; many, very coarse, soft calcareous segregations; pH 7.0; clear change to -
R	0.5+	Refusal on rock



SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	6.7	410	1.2	1,300	0.130	3.70	2.10
0.1-0.2	6.8	340	0.5	970	0.097	2.70	1.60

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	45	7	46	2	6.7	70	VL	10	-	-	-	16.0	10.0	1.1	1.30	28.0	4.6	NS	2.1	1.5
0.1-0.2	54	6	40	1	6.8	80	VL	18	-	-	-	17.0	11.0	0.9	1.70	30.0	5.7	NS	2.3	1.5
0.2-0.3	54	12	38	6	6.8	150	L	120	-	-	-	18.0	11.0	0.8	3.00	33.0	9.0	S	1.0	1.6
0.3-0.5	67	10	20	10	7.0	270	L	300	-	-	-	18.0	12.0	0.7	4.20	35.0	11.8	S	1.0	1.6

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	S5
Coordinates:	Easting:	661858	Northing:	7416452	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	210 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Very gently inclined (2.9%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Lower slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Erosion:</b>	Moderate, active, rill erosion	<b>Rock outcrop:</b>	Nil
<b>Surface condition:</b>	Firm, likely surface crusting (bottom left photo)		
<b>Coarse fragments:</b>	Common (10-20%), metamorphic cobbles (60-200 mm)		
<b>Geology:</b>	Burngrove Formation (Pwg)		
<b>Vegetation:</b>	Bloodwood, buffel grass		



Site S5 landscape, looking west, across slope



Site S5 landscape, looking east, downslope



Site S5 surface condition



LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)



Site S5 profile, 0.45 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)

Horizon	Depth (m)	Description
A1/B21	0.0-0.1	Very dark greyish brown (10YR 3/2) (moist); moderate, 10-20 mm, earthy, sub-angular blocky structure, moderate consistence; loamy clay; many, metamorphic stones; pH 7.5; clear change to -
B22?j	0.1-0.2	Very dark greyish brown (10YR 3/2) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; clay; many, metamorphic stones; pH 7.5; clear change to -
B23	0.3-0.5	Very dark greyish brown (10YR 3/2) (moist); moderate, 20-30 mm, smooth, sub-angular blocky structure, moderate consistence; medium clay; many, fine, metamorphic pebbles; pH 7.5; abrupt change to -
C	0.5+	Refusal on weathered sandstone

SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	7.5	1100	1.6	2,300	0.230	1.40	0.81
0.1-0.2	7.6	530	0.7	340	0.034	0.76	0.44

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	21	8	73	27	7.5	50	VL	6	-	-	-	9.2	2.1	0.8	0.49	13.0	3.9	NS	2.1	4.4
0.1-0.2	18	3	78	23	7.6	40	VL	8	-	-	-	7.4	2.0	0.4	0.56	10.0	5.4	NS	2.2	3.7
0.2-0.3	27	4	69	10	8.1	70	VL	10	-	-	-	15.0	4.2	0.38	2.00	22.0	9.0	S	2.1	3.7
0.3-0.4	38	4	54	9	8.8	280	M	24	-	-	-	35.0	7.3	0.5	3.30	46.0	7.1	S	3.1	4.8

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	S9
Coordinates:	Easting:	661995	Northing:	7415860	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	217 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Very gently inclined (2.2%)	<b>Runoff:</b>	Slow
<b>Morphological type:</b>	Lower slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Erosion:</b>	Minor, active, sheet erosion	<b>Rock outcrop:</b>	Nil
<b>Surface condition:</b>	Surface crusting, cracking		
<b>Coarse fragments:</b>	Few (2-10%), metamorphic cobbles (60-200 mm)		
<b>Geology:</b>	Mapped as Emerald Formation (Te(w)) but likely Burngrove Formation (Pwg)		
<b>Vegetation:</b>	Brigalow, buffel grass		



Site S9 landscape, looking south, upslope



Site S9 landscape, looking west, across slope



Site S9 surface condition

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)



Site S9 profile, 065 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)

Horizon	Depth (m)	Description
A1/B21	0.0-0.15	Very dark grey (7.5YR 3/1) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; common, medium, metamorphic pebbles; pH 6.5; clear change to -
B22	0.15-0.4	Brown (7.5YR 4/2) (moist); moderate, 20-50 mm, earthy, polyhedral structure, moderate consistence; light clay; few, fine, ferruginous concretions; 7.0; gradual change to -
B23	0.4-0.65	Dark grey (7.5YR 4/1) (moist); strong, 20-30 mm, smooth, polyhedral structure, firm consistence; medium clay; common, fine, ferruginous concretions; pH 7.5



SURFACE CHEMISTRY DATA							
Depth (m)	pH (H <sub>2</sub> O)	Total P (mg/kg)	Nitrate (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)
				(mg/kg)	(%)		
0.0-0.1	6.9	510	3.3	1,300	0.130	3.10	1.80
0.1-0.2	7.1	300	2.1	1,000	0.100	2.30	1.40

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Approximated and adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	31	13	57	2	6.9	70	VL	7	-	-	-	14.0	4.3	1.3	0.65	20.0	3.3	NS	2.3	3.1
0.2-0.3	47	5	48	0	7.1	240	L	260	-	-	-	20.0	8.3	1.1	3.10	33.0	9.5	S	2.2	2.4
0.3-0.5	49	6	34	1	7.8	370	M	430	-	-	-	22.0	8.8	0.97	4.00	36.0	11.2	S	2.3	2.5
0.5-0.6	54	9	38	1	8.2	490	M	550	-	-	-	24.0	9.4	0.9	4.90	39.0	12.7	S	1.0	2.5

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

SITE DESCRIPTION		ASC Soil Order:		Brown Vertosol			Site #:	O4E
Coordinates:	Easting:	661814	Northing:	7416430	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	211 m AHD	

**LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)**

<b>Slope:</b>	Very gently inclined (3.3%)	<b>Runoff:</b>	Moderately rapid
<b>Morphological type:</b>	Mid slope	<b>Permeability:</b>	Moderately permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Microrelief:</b>	Nil
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Surface condition:</b>	Firm	<b>Rock outcrop:</b>	Slightly rocky
<b>Geology:</b>	Emerald Formation (Te(w))		
<b>Coarse fragments:</b>	Many (20-50%), metamorphic stones (200-600 mm)		
<b>Erosion:</b>	Gully head, severe, active, gully (<1.5 m deep), sheet and rill erosion		
<b>Vegetation:</b>	Ironbark, brigalow, <i>Aristida</i> sp.		



Site O4E landscape, looking north-west, across slope to gully head



Site O4E landscape, looking east, downslope within gully



Site O4E landscape, looking south-west, upslope to gully head



Site O4E surface condition



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	O10C
Coordinates:	Easting:	662000	Northing:	7416038	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	213 m AHD	

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Very gently inclined (2.1%)	Runoff:	Slow
Morphological type:	Lower slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Microrelief:	Nil
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Erosion:	Minor, active, sheet erosion, stable	Rock outcrop:	Nil
Surface condition:	Loose to firm, surface crusting		
Coarse fragments:	Few (2-10%), metamorphic cobbles (60-200 mm)		
Geology:	Mapped as Emerald Formation (Te(w)) but likely Burngrove Formation (Pwg)		
Vegetation:	Brigalow, buffel grass		



Site S9 landscape, looking west, upslope



Site S9 landscape, looking south-east to crescent ridge



Site O10C surface condition



Site O10C soil profile, 0.0-0.3 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)		
Horizon	Depth (m)	Description
A1/B21	0.0-0.15	Brown (7.5YR 4/2) (moist); weak, 5-10 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; many, medium, metamorphic pebbles; pH 7.5; clear change to -
B22	0.15-0.3	Dark brown (7.5YR 3/2) (moist); moderate, 20-50 mm, earthy, polyhedral structure, moderate consistence; light clay; few, small, metamorphic pebbles; common, medium, ferruginous concretions; 9.0



SITE DESCRIPTION		ASC Soil Order:		Grey Vertosol			Site #:	O11C
Coordinates:	Easting:	661852	Northing:	7415848	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	218 m AHD	

LANDFORM (interpreted from NRC log sheets, site photographs and GIS data)			
Slope:	Very gently inclined (2.7%)	Runoff:	Slow
Morphological type:	Upper slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Surface condition:	Firm
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Erosion:	Minor, active, sheet erosion	Rock outcrop:	Nil
Coarse fragments:	Many (20-50), metamorphic cobbles (60-200 mm)		
Microrelief:	Crabhole gilgai, 10 m wide, 0.2 m deep, 10% of landscape		
Geology:	Mapped as Emerald Formation (Te(w))) but likely Burngrove Formation (Pwg)		
Vegetation:	Brigalow, buffel grass		



Site O11C landscape, looking south-east, upslope



Site O11C landscape, looking north-east



Site O11C surface condition



Site O11C soil profile, 0.0-0.3 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)		
Horizon	Depth (m)	Description
A1/B21	0.0-0.15	Very dark grey (7.5YR 3/1) (moist); weak, 2-5 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; many, medium, metamorphic pebbles; pH 8.0; sharp change to -
B22	0.15+	Brown (7.5YR 4/2) (moist); moderate, 20-50 mm, smooth, polyhedral structure, moderate consistence; clay; few, fine, ferruginous concretions; 8.5



SITE DESCRIPTION		ASC Soil Order:		Black Vertosol			Site #:	O12C
Coordinates:	Easting:	661580	Northing:	7416533	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	215 m AHD	

**LANDFORM (interpreted from NRC log sheets and GIS data, no site photographs available)**

Slope:	Gently inclined (2.0%)	Runoff:	Moderately rapid
Morphological type:	Mid slope	Permeability:	Slowly permeable
Landform element:	Hillslope	Drainage:	Moderately well-drained
Landform pattern:	Hills	Surface condition:	Firm
Relief Modal Class:	Rolling hills	Disturbance:	Cleared
Erosion:	Minor, active, sheet erosion	Rock outcrop:	Nil
Coarse fragments:	Many (20-50%), large, metamorphic cobbles (20-60 mm)		
Microrelief:	Nil		
Geology:	Burngrove Formation (Pwg)		
Vegetation:	Brigalow, buffel grass		



Site O12C landscape, looking west, upslope



Site O12C landscape, looking north-east



Site O12C surface condition



Site O12C soil profile, 0.0-0.3 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)		
Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Very dark grey (5YR 3/1) [more like very dark grey (7.5 YR 3/1)] (moist); weak, 10-20 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; many, medium, metamorphic pebbles; pH 6.0; clear change to -
B22	0.2+	Brown (5YR 4/2) [more like black (7.5YR 2.5/1)] (moist); moderate, 20-50 mm, earthy, sub-angular blocky structure, moderate consistence; medium clay; few, medium, metamorphic pebbles; common, medium, ferruginous concretions; pH 7.5



SITE DESCRIPTION		ASC Soil Order:		Grey Vertosol			Site #:	O13C
Coordinates:	Easting:	661656	Northing:	7416648	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	NRC unnamed employee		Elevation:	210 m AHD	

**LANDFORM (interpreted from NRC log sheets and GIS data, no site photographs available)**

<b>Slope:</b>	Gently inclined (5.4%)	<b>Runoff:</b>	Slowly
<b>Morphological type:</b>	Lower slope	<b>Permeability:</b>	Slowly permeable
<b>Landform element:</b>	Hillslope	<b>Drainage:</b>	Moderately well-drained
<b>Landform pattern:</b>	Hills	<b>Surface condition:</b>	Soft
<b>Relief Modal Class:</b>	Rolling hills	<b>Disturbance:</b>	Cleared
<b>Geology:</b>	Burngrove Formation (Pwg)	<b>Microrelief:</b>	Nil
<b>Coarse fragments:</b>	Common (10-20%), metamorphic cobbles (60-200 mm)		
<b>Erosion:</b>	Severe, active, rill erosion leading to severe, active, gully erosion (<1.5 m deep)		
<b>Rock outcrop:</b>	Nil recorded but exposed weathered sandstone is evident in top right photo and soil depth is <600 mm as evidenced by geological pick in bottom right photo		
<b>Vegetation:</b>	<i>Eucalyptus</i> sp., bloodwood, buffel grass		



Site O13C landscape, looking south-west, upslope



Site O13C landscape, looking north-east, downslope, down erosion gully



Site O13C surface condition







Site O13C soil profile, 0.0-0.3 m deep

SOIL DESCRIPTION (interpreted from NRC log sheets and site photographs)		
Horizon	Depth (m)	Description
A1/B21	0.0-0.2	Very dark grey (10YR 3/1) (moist); weak, 10-20 mm, earthy, sub-angular blocky structure, weak consistence; loamy clay; common, medium, metamorphic pebbles; pH 7.0; clear change to -
B22	0.2+	Dark grey (10YR 4/1) (moist); moderate, 20-50 mm, earthy, sub-angular blocky structure, moderate consistence; light clay; few, fine, metamorphic pebbles; common, fine, ferruginous concretions; 7.0



### Black-Orthic Tenosols on Burngrove Formation (Pwg)

SITE DESCRIPTION		ASC Soil Order:	Black-Orthic Tenosol			Site #:	OB03 (NRC <b>O1E</b> )	
Coordinates:	Easting:	660590	Northing:	7417527	Zone:	55	Datum:	GDA94
Location:	Wiston		Describer:	C Traill	Elevation:		209 m AHD	

LANDFORM			
Slope:	Very gently inclined (5.4%)	Runoff:	Moderately rapid
Morphological type:	Simple slope	Permeability:	Slowly permeable
Landform element:	Riseslope	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm to hard
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, land surface modified for dam
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Many (20-50%), large, sub-angular platy, metamorphic pebbles (20-60 mm)		
Erosion:	Moderate, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, bloodwood, buffel grass, native grasses		
			
Site OB03 landscape		Site OB03 surface condition	
			
Site OB03 surface condition		Site OB03 surface condition	

## LANDFORM



Site OB03 profile, 0.35 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.0-0.15	Very dark greyish brown (10YR 3/2) (moist); weak, <2 mm, sub-angular blocky structure; clay loam, sandy; common, angular platy, metamorphic cobbles; pH 5.5; abrupt change to -
2B/C	0.15-0.35	Very dark grey (10YR 3/1) (moist); moderate, 2-5 mm, sub-angular blocky structure; medium clay; many, angular platy, mudstone cobbles; few, fine, ferromanganiferous concretions; pH 6.0; gradual change to -
C	0.35+	Refusal on rock



### Brown Dermosols on Burngrove Formation (Pwg)

SITE DESCRIPTION		ASC Soil Order:		Brown Dermosol			Site #:	OB02
Coordinates:	Easting:	660413	Northing:	7417814	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		208 m AHD	

LANDFORM			
Slope:	Very gently inclined (3.1%)	Runoff:	Moderately rapid
Morphological type:	Open depression	Permeability:	Moderately permeable
Landform element:	Drainage depression	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Firm, surface crust, flake
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, improved pasture
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Few (2-5%), sub-rounded tabular, metamorphic cobbles (60-200 mm)		
Erosion:	Moderate, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, buffel grass, native grasses		



Site OB02 landscape



Site OB02 surface condition



Site OB02 surface condition



Site OB02 surface condition

## LANDFORM



Site OB02 profile, 0.6 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.0-0.1	Dark yellowish brown (10YR 3/4) (moist); weak, 2-5 mm, sub-angular blocky structure; clay loam, sandy; pH 6.0; clear change to -
A2e	0.1-0.23	Dark greyish brown (10YR 4/2) (moist), grey (10YR 6/1) (dry); weak, 2-5 mm, sub-angular blocky structure; clay loam, sandy; pH 6.0; abrupt change to -
B21	0.23-0.5	Very dark greyish brown (10YR 3/2) (moist); few, fine, distinct, orange mottles; moderate, 5-10 mm, sub-angular blocky structure; fine sandy medium clay; very few, coarse, angular tabular, metamorphic pebbles; few, medium, ferromanganiferous concretions; pH 7.5; clear change to -
B/C	0.5-0.6	Dark grey (10YR 4/1) (moist); few, fine, distinct, orange mottles; weak, 2-5 mm, sub-angular blocky structure; fine sandy light medium clay; very few, coarse, angular tabular, metamorphic pebbles; few, fine, ferromanganiferous concretions; pH 8.0; gradual change to -
C	0.6+	Refusal on rock



SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	6.4	15	960	0.096	1.8	1.0	<0.2	<1.00	41.2	30.9	<1.00
0.1-0.2	6.8	<5	640	0.064	0.9	0.5	<0.2	<1.00	20.2	12.3	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)						ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio	
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>					CEC
0.0-0.1	36	27	38	10	6.4	15	VL	<10	0.02	-	-	5.2	4.7	1.2	2.0	11.3	1.8	NS	-	1.1
0.1-0.2	24	35	40	6	6.8	13	VL	<10	<0.01	-	-	3.4	4.2	0.6	0.9	9.2	10.0	S	3	0.8
0.3-0.4	47	30	23	9	7.7	144	L	160	<0.01	-	-	2.3	3.2	0.8	1.9	8.1	23.4	SS	2	0.7
0.4-0.5	48	24	27	9	8.4	280	M	360	<0.01	-	-	2.6	4.5	0.5	2.9	10.6	27.7	SS	2	0.6
0.5-0.6	49	28	23	2	8.7	402	M	530	<0.01	-	-	2.0	3.8	0.4	2.6	8.9	29.2	SS	2	0.5

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable

### Brown Sodosols on Burngrove Formation (Pwg)

SITE DESCRIPTION		ASC Soil Order:		Brown Sodosol			Site #:	OB01
Coordinates:	Easting:	660272	Northing:	7418034	Zone:	55	Datum:	GDA94
Location:	Wilton		Describer:	C Traill	Elevation:		209 m AHD	

LANDFORM			
Slope:	Very gently inclined (2.6%)	Runoff:	Moderately rapid
Morphological type:	Open depression	Permeability:	Moderately permeable
Landform element:	Drainage depression	Drainage:	Imperfectly drained
Landform pattern:	Rises	Surface condition:	Loose to firm, surface flake to crust
Relief Modal Class:	Gently undulating rises	Disturbance:	Cleared, improved pasture
Geology:	Burngrove Formation (Pwg)	Rock outcrop:	Nil
Microrelief:	Nil		
Coarse fragments:	Very few (<2%), medium, sub-angular tabular, metamorphic pebbles (6-20 mm)		
Erosion:	Moderate, active, sheet erosion		
Vegetation:	Silver-leaved ironbark, carissa, buffel grass, native grasses		



Site OB01 landscape



Site OB01 surface condition



Site OB01 surface condition



Site OB01 surface condition



## LANDFORM



Site OB01 profile, 0.8 m deep

## SOIL DESCRIPTION

Horizon	Depth (m)	Description
A1	0.0-0.2	Dark brown (10YR 3/3) (moist); massive, <2 mm, granular structure; coarse sandy loam; common, small, rounded, quartz pebbles; pH 6.5; clear change to -
2A2	0.2-0.3	Dark brown (7.5YR 3/3) (moist); weak, 2-5 mm, sub-angular blocky structure; clay loam, coarse sandy; few, medium, angular platy, metamorphic pebbles; pH 6.0; clear change to -
3A3	0.3-0.6	Brown (7.5YR 4/4) (moist); few, fine, faint, orange mottles; weak, 2-5 mm, sub-angular blocky structure; clay loam, coarse sandy; few, large, angular tabular, metamorphic pebbles; few, fine, ferromanganiferous concretions; pH 5.5; abrupt change to -
3B21	0.6-0.8	Yellowish brown (10YR 5/6) (moist); common, coarse, distinct, grey mottles, few, fine, faint, orange mottles; strong, 5-10 mm, sub-angular blocky structure; medium clay; very few, medium, angular tabular, metamorphic pebbles; few, fine, ferromanganiferous concretions; pH 7.0; clear change to -
C	0.8+	Refusal on rock

SURFACE CHEMISTRY DATA											
Depth (m)	pH (H <sub>2</sub> O)	Bicarbonate extr. P (Colwell) (mg/kg)	Total Kheldal nitrogen		Organic matter (%)	Total organic carbon (%)	Boron (mg/kg)	Trace Elements			
			(mg/kg)	(%)				Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
0.0-0.1	7.0	<5	60	0.006	0.6	<0.5	<0.2	<1.00	17.4	11.1	<1.00
0.1-0.2	7.0	<5	160	0.016	0.6	<0.5	<0.2	<1.00	28.4	12.8	<1.00

SOIL PROFILE CHEMISTRY DATA																				
Depth (m)	Adjusted particle size to remove gravel (%)*				pH (H <sub>2</sub> O)	EC (uS/cm)	EC rating (VL, L, M, H, VH, E)	Cl- (mg/kg)	Total Sulfur (%)	Exchangeable cations (meq/100 g)							ESP (%)	Sodicity (NS, S, SS)	Emerson class	Ca:Mg ratio
	Clay	Silt	Sand	Gravel						H <sup>+</sup>	Al <sup>3+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	CEC				
0.0-0.1	15	4	80	9	7.0	18	VL	<10	0.04	-	-	1.0	0.7	0.1	<0.1	1.9	2.2	NS	-	1.4
0.1-0.2	18	9	73	7	7.0	18	VL	<10	0.02	-	-	2.2	1.8	0.2	0.2	4.4	4.1	NS	3	1.2
0.2-0.3	20	7	73	11	6.8	25	VL	20	0.02	-	-	2.0	1.6	0.2	0.3	4.2	8.4	S	3	1.2
0.4-0.5	24	11	65	18	6.5	20	VL	20	0.02	-	-	1.1	1.1	0.2	0.4	2.8	16.1	SS	3	1.0
0.7-0.8	60	13	27	1	7.4	93	VL	90	<0.01	-	-	2.7	3.4	<0.2	1.9	8.2	23.6	SS	2	0.8

**Notes:**

\* Gravel (>2 mm), Sand (0.02–2 mm), Silt (2-20 µm), Clay (<2 µm); VL – Very Low, L – Low, M – Moderate, H – High, VH – Very High, E – Extreme; NS – Non-Sodic, S – Sodic, SS – Strongly Sodic; ID – Indeterminable



## APPENDIX B

### Summary of Laboratory Data by Representative Profile

Sample site	ASC	Land system, facet & soil (CSIRO)	AMU (DPI)	Depth (m)	Approximated and adjusted particle size to remove gravel (%)				Soil Water Storage			pH (H <sub>2</sub> O)	EC (uS/cm)	Salinity rating	Cl <sup>-</sup> (mg/kg)	Total Sulfur (%)	Emerson aggregate test			
					Clay	Silt	Sand SUM	Gravel	Soil Texture	Lookup Table mm/100 mm	Total mm/ 1000 mm	pH units					Munsell colour		Texture	Emerson Class
																	Code	Colour		
OB01	Brown Sodosol	Girrah, lowlands and low rises terrain, no suitable soil family (minor within Bruce)	4, minor part of Kia-Ora	0.0-0.1	15	4	80	9	Sandy Loam	5	74	7.0	18	VL	<10	0.04	-	-	-	-
				0.1-0.2	18	9	73	7	Sandy Loam	5		7.0	18	VL	<10	0.02	10YR 4/2	Dark Greyish Brown	CLS	3
				0.2-0.3	20	7	73	11	Sandy Clay Loam	6		6.8	25	VL	20	0.02	10YR 4/2	Dark Greyish Brown	LS	3
				0.4-0.5	24	11	65	18	Clay Loam	8		6.5	20	VL	20	0.02	10YR4/4	Dark Yellowish Brown	LS	3
				0.7-0.8	60	13	27	1	Clay	12		7.4	93	VL	90	<0.01	10YR 5/3	Brown	MC	2
OB02	Brown Dermosol	Girrah, lowlands and low rises terrain, no suitable soil family (minor within Bruce)	4, minor part of Kia-Ora	0.0-0.1	36	27	38	10	Silty Clay Loam	8	46	6.4	15	VL	<10	0.02	-	-	-	-
				0.1-0.2	24	35	40	6	Silty Loam	6		6.8	13	VL	<10	<0.01	10YR 3/1	Very Dark Grey	SCL	3
				0.3-0.4	47	30	23	9	Silty Clay	10		7.7	144	L	160	<0.01	10YR 3/1	Very Dark Grey	CLS	2
				0.4-0.5	48	24	27	9	Clay	12		8.4	280	M	360	<0.01	10YR 3/1	Very Dark Grey	SCL	2
				0.5-0.6	49	28	23	2	Silty Clay	10		8.7	402	M	530	<0.01	2.5Y 3/1	Very Dark Grey	SCL	2
OB04	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	57	29	14	21	Silty Clay	10	34	7.6	35	VL	<10	<0.01	-	-	-	-
				0.1-0.2	59	25	16	17	Clay	12		7.8	39	VL	<10	<0.01	2.5Y 3/1	Very Dark Grey	SC	4
				0.2-0.3	50	18	32	34	Clay	12		7.7	38	VL	<10	<0.01	2.5Y 4/1	Dark Grey	SC	3
OB05	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	70	14	16	14	Clay	12	36	7.1	105	VL	60	0.05	-	-	-	-
				0.1-0.2	69	18	14	4	Clay	12		7.9	130	VL	100	0.02	10YR 2/2	Very Dark Brown	SC	2
				0.3-0.4	62	20	18	15	Clay	12		9.0	256	L	60	<0.01	2.5Y 2.5/3	Very Dark Grey	SCL	3
OB06	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	36	27	36	4	Silty Clay Loam	8	68	8.1	172	L	110	<0.01	-	-	-	-
				0.1-0.2	60	25	15	3	Clay	12		9.0	482	M	570	0.05	5Y 2.5/1	Black	MC	3
				0.2-0.3	59	23	18	4	Clay	12		9.0	606	H	1,100	0.02	5Y 2.5/1	Black	MC	3
				0.3-0.4	63	23	18	4	Clay	12		9.0	687	M	940	<0.01	5Y 2.5/1	Black	MC	3
				0.4-0.5	58	22	20	9	Clay	12		9.0	678	H	900	0.02	5Y 2.5/1	Black	MC	3
				0.5-0.6	48	23	29	31	Clay	12		9.1	613	H	770	<0.01	5Y 2.5/1	Black	MSC	3
OB07	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	13	23	65	12	Loam	6	28	7.3	50	VL	20	0.02	-	-	-	-
				0.1-0.2	26	26	47	9	Silty Clay Loam	8		8.7	154	L	60	0.02	2.5Y 2.5/1	Black	MC	3
				0.2-0.3	30	26	44	12	Silty Clay Loam	8		9.2	279	M	130	<0.01	5Y 2.5/1	Black	SC	3
				0.3-0.4	21	23	58	20	Loam	6		9.3	296	M	120	0.02	2.5Y 5/1	Grey	SC	3
OB08	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	47	15	37	3	Clay	12	36	8.3	119	VL	30	<0.1	-	-	-	-
				0.1-0.2	64	20	15	16	Clay	12		8.9	223	L	80	<0.1	5YR 2.5/1	Black	SC	3
				0.2-0.3	57	21	22	23	Clay	12		9.0	322	M	160	<0.1	5YR 2.5/1	Black	SC	3
S1	Black Dermosol	Durrandella, lower foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	8	62	2	Clay Loam	8	94	7.2	30	VL	<5	-	-	-	-	2.1
				0.1-0.2	24	5	69	2	Sandy Clay Loam	6		7.1	40	VL	>5	-	-	-	-	2.1
				0.2-0.3	39	11	50	2	Clay	10		6.9	40	VL	<5	-	-	-	-	2.1
				0.4-0.7	44	6	48	1	Clay	10		7.0	50	VL	19	-	-	-	-	3.4
				0.7-0.9	45	9	44	7	Clay	12		7.2	60	VL	36	-	-	-	-	3.3
				0.9-1.1	27	1	71	23	Sandy Clay	8		6.4	240	M	270	-	-	-	-	3.3



Sample site	ASC	Land system, facet & soil (CSIRO)	AMU (DPI)	Depth (m)	Approximated and adjusted particle size to remove gravel (%)				Soil Water Storage			pH (H <sub>2</sub> O)	EC (uS/cm)	Salinity rating	Cl <sup>-</sup> (mg/kg)	Total Sulfur (%)	Emerson aggregate test			
					Clay	Silt	Sand SUM	Gravel	Soil Texture	Lookup Table mm/100 mm	Total mm/1000 mm	pH units					Munsell colour		Texture	Emerson Class
																	Code	Colour		
S2	Black Dermosol	Durrandella, lower foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	9	60	0	Clay Loam	8	96	6.5	40	VL	<5	-	-	-	-	2.1
				0.1-0.2	34	32	32	0	Silty Clay Loam	8		6.4	40	VL	<5	-	-	-	-	2.1
				0.2-0.3	40	23	38	0	Clay	10		6.2	30	VL	<5	-	-	-	-	2.1
				0.3-0.5	36	14	50	2	Clay	10		5.9	40	VL	12	-	-	-	-	2.2
				0.5-0.6	39	16	44	0	Clay	10		5.9	50	VL	18	-	-	-	-	2.2
				0.6-0.9	44	13	42	1	Clay	10		5.9	100	VL	79	-	-	-	-	2.1
				0.9-1.1	35	13	51	0	Clay	10		5.6	410	M	570	-	-	-	-	2.1
				1.1-1.3	33	7	57	3	Clay	10		6.0	310	M	420	-	-	-	-	2.2
S3	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	39	8	54	24	Clay	10	94	6.7	90	VL	76	-	-	-	-	1.0
				0.1-0.2	56	6	36	5	Clay	12		7.9	570	H	620	-	-	-	-	1.0
				0.2-0.3	57	10	36	4	Clay	12		8.2	690	H	780	-	-	-	-	1.0
				0.3-0.5	56	9	39	5	Clay	12		8.0	1,100	VH	1,200	-	-	-	-	1.0
				0.5-0.6	59	10	33	6	Clay	12		7.5	1,300	VH	1,700	-	-	-	-	2.3
				0.6-0.8	51	9	39	6	Clay	12		7.1	1,400	VH	1,800	-	-	-	-	2.2
				0.8-0.9	59	12	30	8	Clay	12		7.0	1,300	VH	1,700	-	-	-	-	1.0
S4	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	45	7	46	2	Clay	10	58	6.7	70	VL	10	-	-	-	-	2.1
				0.1-0.2	54	6	40	1	Clay	12		6.8	80	VL	18	-	-	-	-	2.3
				0.2-0.3	54	12	38	6	Clay	12		6.8	150	L	120	-	-	-	-	1.0
				0.3-0.5	67	10	20	10	Clay	12		7.0	270	L	300	-	-	-	-	1.0
S5	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	21	8	73	27	Sandy Clay Loam	6	27	7.5	50	VL	6	-	-	-	-	2.1
				0.1-0.2	18	3	78	23	Sandy Loam	5		7.6	40	VL	8	-	-	-	-	2.2
				0.2-0.3	27	4	69	10	Sandy Clay Loam	6		8.1	70	VL	10	-	-	-	-	2.1
				0.3-0.4	38	4	54	9	Clay	10		8.8	280	M	24	-	-	-	-	3.1
S6	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	7	64	8	Sandy Clay Loam	6	12	7.0	40	VL	<5	-	-	-	-	2.1
				0.1-0.2	29	7	64	10	Sandy Clay Loam	6		7.4	40	VL	<5	-	-	-	-	2.2
S7	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	30	4	64	30	Sandy Clay	8	78	5.7	220	M	280	-	-	-	-	3.4
				0.1-0.2	46	4	53	43	Clay	12		6.1	700	H	960	-	-	-	-	2.3
				0.2-0.3	43	5	51	26	Clay	10		6.5	660	H	910	-	-	-	-	2.3
				0.3-0.5	59	4	34	9	Clay	12		6.7	770	H	1,100	-	-	-	-	1.0
				0.5-0.6	64	11	22	1	Clay	12		5.8	750	H	1,000	-	-	-	-	1.0
				0.6-0.7	70	11	19	16	Clay	12		5.7	730	H	1,100	-	-	-	-	1.0
S8	Brown Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	8	63	28	Clay Loam	8	32	7.2	50	VL	7	-	-	-	-	2.2
				0.1-0.2	37	4	61	29	Sandy Clay	8		7.6	90	VL	10	-	-	-	-	2.3
				0.2-0.3	44	5	50	16	Clay	10		8.7	270	M	50	-	-	-	-	2.3
				0.3-0.4	27	4	67	9	Sandy Clay Loam	6		8.9	280	M	80	-	-	-	-	3.4
S9	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	31	13	57	2	Clay Loam	8	66	6.9	70	VL	7	-	-	-	-	2.3
				0.2-0.3	47	5	48	0	Clay	12		7.1	240	L	260	-	-	-	-	2.2
				0.3-0.5	49	6	34	1	Clay	12		7.8	370	M	430	-	-	-	-	2.3
				0.5-0.6	54	9	38	1	Clay	12		8.2	490	M	550	-	-	-	-	1.0

Sample site	ASC	Exchangeable cations (meq/100 g)					ESP (%)	Sodicity rating	Ca:Mg ratio	Mg:K ratio	Est. gypsum rate (t/ha)	Acid neutralising capacity (1:5)			Phosphorus			Nitrogen			Organic matter (%)	Total organic carbon (%)	TOC rating	Boron (mg/kg)	Trace Elements			
		Ca	Mg	K	Na	CEC						Kg H <sub>2</sub> SO <sub>4</sub> equ/t	%CaCO <sub>3</sub>	Fizz rating	Bicarb. extr. P (Colwell)		Total (mg/kg)	Nitrate (mg/kg)	TKN (mg/kg)	TKN (%)					Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
															(mg/kg)	Rating												
OB01	Brown Sodosol	1.0	0.7	0.1	<0.1	1.9	2.2	NS	1.4	4.8	0	-	-	-	<5	VL	144	0.3	60	0.006	0.6	<0.5	EL	<0.2	<1.00	17.4	11.1	<1.00
		2.2	1.8	0.2	0.2	4.4	4.1	NS	1.2	10.0	0	2.6	0.3	0	<5	VL	184	0.3	160	0.016	0.6	<0.5	EL	<0.2	<1.00	28.4	12.8	<1.00
		2.0	1.6	0.2	0.3	4.2	8.4	S	1.2	6.9	0	1.8	0.2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1.1	1.1	0.2	0.4	2.8	16.1	SS	1.0	5.2	0	2.9	0.3	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2.7	3.4	<0.2	1.9	8.2	23.6	SS	0.8	ID	3	5.9	0.6	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OB02	Brown Dermosol	5.2	4.7	1.2	2.0	11.3	1.8	NS	1.1	3.8	2	-	-	-	15	L	343	0.7	960	0.096	1.8	1.0	M1	<0.2	<1.00	41.2	30.9	<1.00
		3.4	4.2	0.6	0.9	9.2	10.0	S	0.8	7.4	1	5.1	0.5	1	<5	VL	219	0.6	640	0.064	0.9	0.5	VL	<0.2	<1.00	20.2	12.3	<1.00
		2.3	3.2	0.8	1.9	8.1	23.4	SS	0.7	4.2	3	5.2	0.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
		2.6	4.5	0.5	2.9	10.6	27.7	SS	0.6	8.7	5	6.8	0.7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
		2.0	3.8	0.4	2.6	8.9	29.2	SS	0.5	8.8	4	9.9	1.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
OB04	Black Vertosol	19.5	4.9	1.6	<0.2	25.9	<0.2	NS	4.0	3.1	0	-	-	-	13	L	385	3.4	1,940	0.194	3.0	1.7	H1	0.3	1.59	10.1	9.94	<1.00
		21.4	5.3	1.6	0.2	28.6	0.9	NS	4.0	3.3	0	13.2	1.3	1	<5	VL	345	3.8	1,440	0.144	2.7	1.6	H1	<0.2	1.34	9.19	10.4	<1.00
		21.8	5.5	1.4	0.4	29.1	1.5	NS	4.0	3.9	0	8.3	0.8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	
OB05	Black Vertosol	10.2	4.2	0.9	2.1	17.4	12.3	S	2.4	4.8	2	-	-	-	8	VL	265	9.7	960	0.096	1.6	0.9	L2	0.3	1.92	14.5	11.9	<1.00
		8.2	3.0	0.4	1.8	13.4	13.6	S	2.7	7.3	2	13.0	1.3	1	<5	VL	207	7.3	1,160	0.116	2.4	1.4	M3	0.5	2.41	10.7	12.2	<1.00
		10.7	4.3	0.5	2.5	18.0	14.1	S	2.5	9.2	3	98.3	10.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
OB06	Black Vertosol	11.6	3.8	0.8	1.5	17.8	8.4	S	3.0	4.6	1	12.9	1.3	1	8	VL	128	1.5	1,160	0.116	2.6	1.5	M3	<0.2	<1.00	10.3	22.0	<1.00
		17.3	6.2	1.0	4.0	28.5	13.9	S	2.8	6.4	5	84.7	8.6	2	<5	VL	131	2.2	1,290	0.129	2.4	1.4	M3	0.4	<1.00	6.4	5.73	<1.00
		17.5	6.9	0.9	5.1	30.4	16.8	SS	2.5	7.8	7	57.5	5.9	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
		18.2	7.4	0.9	5.9	32.5	18.2	SS	2.4	8.1	9	53.8	5.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
		17.8	7.4	0.9	6.2	32.3	19.3	SS	2.4	8.4	10	50.3	5.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
OB07	Black Vertosol	9.2	5.3	1.0	0.9	16.5	5.7	NS	1.7	5.4	0	-	-	-	17	L	228	3.4	2,360	0.236	2.3	1.3	M2	<0.2	<1.00	19.2	24.1	<1.00
		13.8	6.3	1.1	2.6	23.9	11.0	S	2.2	5.6	3	13.8	1.4	1	<5	VL	153	1.4	1,300	0.130	2.0	1.1	M1	0.6	<1.00	10.6	6.28	<1.00
		15.5	7.6	1	3.3	27.3	12.0	S	2.0	7.3	3	44.6	4.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
		13.7	7.0	0.8	3.1	24.7	12.6	S	2.0	8.4	3	63.0	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
OB08	Black Vertosol	16.5	3.4	1.8	1.5	23.2	6.4	S	4.8	1.8	1	-	-	-	6	VL	257	1.2	1,880	0.188	3.3	1.9	H2	<0.2	<1.00	8.46	8.93	<1.00
		23.2	4.6	1.3	3.0	32.2	9.5	S	5.0	3.6	3	82.3	8.4	2	<5	VL	170	0.5	1,340	0.134	2.1	1.2	M2	<0.2	<1.00	7.04	2.05	<1.00
		19.5	4.8	1.0	3.3	28.7	11.7	S	4.1	4.5	4	170.0	17.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	
S1	Black Dermosol	6.6	0.9	0.7	0.03	8.3	0.4	NS	7.0	1.3	0	-	-	-	-	-	510	1.1	740	0.074	2.0	1.1	M1	-	-	-	-	-
		6.3	1.6	0.7	0.05	8.7	0.5	NS	3.9	2.2	0	-	-	-	-	-	590	3.5	640	0.064	1.4	0.83	L2	-	-	-	-	-
		6.5	2.1	0.88	0.08	9.6	0.8	NS	3.1	2.4	0	-	-	-	-	-	660	3.0	660	0.066	1.4	0.82	L2	-	-	-	-	-
		6.6	2.4	0.5	0.23	9.7	2.4	NS	2.8	5.2	0	-	-	-	-	-	560	5.3	440	0.044	0.73	0.43	VL	-	-	-	-	-
		7.2	2.5	0.5	0.25	10.0	2.4	NS	2.9	5.6	0	-	-	-	-	-	480	4.6	390	0.039	0.73	0.43	VL	-	-	-	-	-
		6.4	2.4	0.5	0.52	9.8	5.3	NS	2.7	4.9	0	-	-	-	-	-	980	14.0	340	0.034	0.38	0.22	EL	-	-	-	-	-



Sample site	ASC	Exchangeable cations (meq/100 g)					ESP (%)	Sodicity rating	Ca:Mg ratio	Mg:K ratio	Est. gypsum rate (t/ha)	Acid neutralising capacity (1:5)			Phosphorus			Nitrogen			Organic matter (%)	Total organic carbon (%)	TOC rating	Boron (mg/kg)	Trace Elements			
		Ca	Mg	K	Na	CEC						Kg H <sub>2</sub> SO <sub>4</sub> equ/t	%CaCO <sub>3</sub>	Fizz rating	Bicarb. extr. P (Colwell)		Total (mg/kg)	Nitrate (mg/kg)	TKN (mg/kg)	TKN (%)					Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
															(mg/kg)	Rating												
S2	Black Dermosol	15.0	2.8	0.5	0.10	19.0	0.6	NS	5.6	5.5	0	-	-	-	-	-	750	4.9	1,500	0.150	4.9	2.8	VH4	-	-	-	-	-
		13.0	2.8	0.6	0.10	17.0	0.6	NS	4.6	4.4	0	-	-	-	-	-	810	2.2	1,400	0.140	4.2	2.4	VH3	-	-	-	-	-
		9.6	3.0	0.56	0.11	13.0	0.9	NS	3.2	5.4	0	-	-	-	-	-	780	1.1	1100	0.110	3.2	1.9	H2	-	-	-	-	-
		5.9	2.8	0.4	0.53	9.5	5.6	NS	2.1	8.0	0	-	-	-	-	-	660	2.5	770	0.077	2.1	1.2	M2	-	-	-	-	-
		5.8	2.9	0.41	0.60	9.8	6.1	S	2.0	7.1	0	-	-	-	-	-	600	1.1	700	0.070	1.9	1.1	M1	-	-	-	-	-
		7.1	3.1	0.3	0.97	12.0	8.4	S	2.3	10.0	1	-	-	-	-	-	540	5.1	650	0.065	2.1	1.2	M2	-	-	-	-	-
		8.3	4.3	0.3	2.50	18.0	13.9	S	2.5	16.5	4	-	-	-	-	-	560	4.9	770	0.077	2.90	1.70	H1	-	-	-	-	-
		6.4	3.5	0.3	1.90	14.0	13.2	S	2.4	10.9	3	-	-	-	-	-	510	1.9	460	0.046	1.40	0.82	L2	-	-	-	-	-
S3	Red Dermosol	4.3	6.6	0.9	0.70	14.0	5.1	NS	0.8	7.5	0	-	-	-	-	-	960	0.9	1,100	0.110	2.70	1.60	H1	-	-	-	-	-
		4.2	19.0	0.7	5.00	32.0	15.5	SS	0.4	27.5	7	-	-	-	-	-	550	1.2	1,100	0.110	1.70	1.00	M1	-	-	-	-	-
		8.3	20.0	0.74	5.70	35.0	16.4	SS	0.4	27.0	8	-	-	-	-	-	560	1.1	1100	0.110	1.70	0.99	L2	-	-	-	-	-
		6.4	21.0	0.7	7.30	35.0	20.5	SS	0.3	28.8	12	-	-	-	-	-	490	0.8	910	0.091	1.30	0.76	L1	-	-	-	-	-
		4.3	23.0	0.74	8.70	36.0	23.9	SS	0.2	31.1	15	-	-	-	-	-	380	0.6	670	0.067	0.70	0.41	VL	-	-	-	-	-
		4.2	25.0	0.8	9.50	39.0	24.4	SS	0.2	30.9	17	-	-	-	-	-	380	0.8	700	0.070	0.53	0.31	EL	-	-	-	-	-
		4.0	23.0	0.8	9.00	37.0	24.2	SS	0.2	29.1	17	-	-	-	-	-	420	0.8	740	0.074	0.67	0.39	EL	-	-	-	-	-
S4	Black Vertosol	16.0	10.0	1.1	1.30	28.0	4.6	NS	1.5	9.1	0	-	-	-	-	-	410	1.2	1,300	0.130	3.70	2.10	VH1	-	-	-	-	-
		17.0	11.0	0.9	1.70	30.0	5.7	NS	1.5	11.7	0	-	-	-	-	-	340	0.5	970	0.097	2.70	1.60	H1	-	-	-	-	-
		18.0	11.0	0.8	3.00	33.0	9.0	S	1.6	13.8	3	-	-	-	-	-	300	0.3	790	0.079	2.10	1.20	M2	-	-	-	-	-
		18.0	12.0	0.7	4.20	35.0	11.8	S	1.6	16.7	5	-	-	-	-	-	320	0.2	710	0.071	1.50	0.90	L2	-	-	-	-	-
S5	Black Vertosol	9.2	2.1	0.8	0.49	13.0	3.9	NS	4.4	2.8	0	-	-	-	-	-	1100	1.6	2,300	0.230	1.40	0.81	L2	-	-	-	-	-
		7.4	2.0	0.4	0.56	10.0	5.4	NS	3.7	5.1	0	-	-	-	-	-	530	0.7	340	0.034	0.76	0.44	VL	-	-	-	-	-
		15.0	4.2	0.38	2.00	22.0	9.0	S	3.7	11.1	2	-	-	-	-	-	300	0.3	580	0.058	1.60	0.91	L2	-	-	-	-	-
		35.0	7.3	0.5	3.30	46.0	7.1	S	4.8	13.5	2	-	-	-	-	-	220	1.6	580	0.058	1.10	0.64	L1	-	-	-	-	-
S6	Red Dermosol	6.6	2.5	0.3	0.45	9.8	4.6	NS	2.6	7.6	0	-	-	-	-	-	690	0.7	950	0.095	2.00	1.10	M1	-	-	-	-	-
		7.7	3.2	0.3	0.72	12.0	6.0	S	2.4	12.8	0	-	-	-	-	-	640	0.6	770	0.077	1.50	0.85	L2	-	-	-	-	-
S7	Red Dermosol	1.6	3.8	0.3	0.70	6.5	10.8	S	0.4	13.1	1	-	-	-	-	-	840	9.4	270	0.027	0.72	0.42	VL	-	-	-	-	-
		3.0	13.0	0.4	3.00	19.0	15.8	SS	0.2	31.7	4	-	-	-	-	-	720	6.8	650	0.065	1.20	0.69	L1	-	-	-	-	-
		3.1	17.0	0.37	4.60	25.0	18.6	SS	0.2	45.9	6	-	-	-	-	-	650	3.8	780	0.078	1.40	0.81	L2	-	-	-	-	-
		2.4	19.0	0.4	6.10	28.0	22.0	SS	0.1	50.0	9	-	-	-	-	-	470	1.7	690	0.069	0.99	0.57	VL	-	-	-	-	-
		1.4	19.0	0.52	7.30	28.0	26.2	SS	<0.1	36.5	13	-	-	-	-	-	390	0.8	590	0.059	0.77	0.42	VL	-	-	-	-	-
		4.7	18.0	0.6	7.50	28.0	27.1	SS	<0.1	32.7	13	-	-	-	-	-	540	0.7	540	0.054	0.66	0.39	EL	-	-	-	-	-
S8	Brown Dermosol	65.4	3.4	0.6	0.86	14.0	6.1	S	2.7	5.5	0	-	-	-	-	-	1000	0.8	770	0.077	2.40	1.40	M3	-	-	-	-	-
		66.4	4.2	0.6	1.40	18.0	7.4	S	2.9	6.8	1	-	-	-	-	-	810	1.0	720	0.072	1.80	1.00	M1	-	-	-	-	-
		75.8	6.5	0.5	2.70	40.0	6.6	S	4.6	13.0	1	-	-	-	-	-	830	0.5	660	0.066	1.10	0.66	L1	-	-	-	-	-
		29.0	5.6	0.4	2.50	37.0	6.9	S	5.1	12.7	1	-	-	-	-	-	940	0.3	470	0.047	0.75	0.43	VL	-	-	-	-	-
S9	Black Vertosol	14.0	4.3	1.3	0.65	20.0	3.3	NS	3.1	3.3	0	-	-	-	-	-	510	3.3	1,300	0.130	3.10	1.80	H2	-	-	-	-	-
		20.0	8.3	1.1	3.10	33.0	9.5	S	2.4	7.5	3	-	-	-	-	-	300	2.1	1,000	0.100	2.30	1.40	M3	-	-	-	-	-
		22.0	8.8	0.97	4.00	36.0	11.2	S	2.5	9.1	4	-	-	-	-	-	230	1.2	900	0.090	1.90	1.10	M1	-	-	-	-	-
		24.0	9.4	0.9	4.90	39.0	12.7	S	2.5	10.0	6	-	-	-	-	-	240	0.8	760	0.076	1.70	0.98	L2	-	-	-	-	-

Sample site	Geological unit	ASC	Land system, facet & soil family (CSIRO)	LRA and AMU (DPI)	Depth (m)	Approximated and adjusted particle size to remove gravel (%)				pH (H2O)	EC (uS/cm)	Salinity rating	Cl- (mg/kg)	Exchangeable cations (meq/100 g)					ECP (%)	EMP (%)	EKP (%)	ESP (%)	Sodicity rating	Ca:Mg ratio	Mg:K ratio
						Clay	Silt	Sand SUM	Gravel	pH units				Ca	Mg	K	Na	CEC							
S1	Emerald Formation (Te(w))	Black Dermosol	Durrandella, lower foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	8	62	2	7.2	30	VL	<5	6.6	0.9	0.7	0.03	8.3	79.7	11.4	8.6	0.4	NS	7.0	1.3
					0.1-0.2	24	5	69	2	7.1	40	VL	>5	6.3	1.6	0.7	0.05	8.7	72.6	18.5	8.4	0.5	NS	3.9	2.2
					0.2-0.3	39	11	50	2	6.9	40	VL	<5	6.5	2.1	0.88	0.08	9.6	68.2	21.8	9.2	0.8	NS	3.1	2.4
					0.4-0.7	44	6	48	1	7.0	50	VL	19	6.6	2.4	0.5	0.23	9.7	68.1	24.7	4.8	2.4	NS	2.8	5.2
					0.7-0.9	45	9	44	7	7.2	60	VL	36	7.2	2.5	0.5	0.25	10.0	69.4	24.0	4.3	2.4	NS	2.9	5.6
					0.9-1.1	27	1	71	23	6.4	240	M	270	6.4	2.4	0.5	0.52	9.8	65.7	24.0	5.0	5.3	NS	2.7	4.9
S2	Emerald Formation (Te(w))	Black Dermosol	Durrandella, lower foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	9	60	0	6.5	40	VL	<5	15.0	2.8	0.5	0.10	19.0	82.0	14.7	2.7	0.6	NS	5.6	5.5
					0.1-0.2	34	32	32	0	6.4	40	VL	<5	13.0	2.8	0.6	0.10	17.0	78.5	17.1	3.9	0.6	NS	4.6	4.4
					0.2-0.3	40	23	38	0	6.2	30	VL	<5	9.6	3.0	0.56	0.11	13.0	72.5	22.4	4.2	0.9	NS	3.2	5.4
					0.3-0.5	36	14	50	2	5.9	40	VL	12	5.9	2.8	0.4	0.53	9.5	61.7	28.9	3.7	5.6	NS	2.1	8.0
					0.5-0.6	39	16	44	0	5.9	50	VL	18	5.8	2.9	0.41	0.60	9.8	59.8	29.9	4.2	6.1	S	2.0	7.1
					0.6-0.9	44	13	42	1	5.9	100	VL	79	7.1	3.1	0.3	0.97	12.0	61.6	27.2	2.7	8.4	S	2.3	10.0
					0.9-1.1	35	13	51	0	5.6	410	M	570	8.3	4.3	0.3	2.50	18.0	60.7	23.9	1.4	13.9	S	2.5	16.5
1.1-1.3	33	7	57	3	6.0	310	M	420	6.4	3.5	0.3	1.90	14.0	59.7	24.8	2.2	13.2	S	2.4	10.9					
S7	Emerald Formation (Te(w))	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	30	4	64	30	5.7	220	M	280	1.6	3.8	0.3	0.70	6.5	25.2	59.5	4.5	10.8	S	0.4	13.1
					0.1-0.2	46	4	53	43	6.1	700	H	960	3.0	13.0	0.4	3.00	19.0	15.7	66.4	2.2	15.8	SS	0.2	31.7
					0.2-0.3	43	5	51	26	6.5	660	H	910	3.1	17.0	0.37	4.60	25.0	12.4	67.5	1.5	18.6	SS	0.2	45.9
					0.3-0.5	59	4	34	9	6.7	770	H	1,100	2.4	19.0	0.4	6.10	28.0	8.8	67.9	1.4	22.0	SS	0.1	50.0
					0.5-0.6	64	11	22	1	5.8	750	H	1,000	1.4	19.0	0.52	7.30	28.0	5.1	66.7	1.9	26.2	SS	<0.1	36.5
					0.6-0.7	70	11	19	16	5.7	730	H	1,100	4.7	18.0	0.6	7.50	28.0	4.7	66.3	2.0	27.1	SS	<0.1	32.7
S6	Emerald Formation (Te(w))	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	7	64	8	7.0	40	VL	<5	6.6	2.5	0.3	0.45	9.8	66.8	25.3	3.4	4.6	NS	2.6	7.6
					0.1-0.2	29	7	64	10	7.4	40	VL	<5	7.7	3.2	0.3	0.72	12.0	64.7	27.2	2.1	6.0	S	2.4	12.8
S8	Emerald Formation (Te(w))	Brown Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	29	8	63	28	7.2	50	VL	7	65.4	3.4	0.6	0.86	14.0	65.4	24.1	4.4	6.1	S	2.7	5.5
					0.1-0.2	37	4	61	29	7.6	90	VL	10	66.4	4.2	0.6	1.40	18.0	66.4	22.9	3.3	7.4	S	2.9	6.8
					0.2-0.3	44	5	50	16	8.7	270	M	50	75.8	6.5	0.5	2.70	40.0	75.8	16.3	1.3	6.6	S	4.6	13.0
					0.3-0.4	27	4	67	9	8.9	280	M	80	29.0	5.6	0.4	2.50	37.0	76.9	15.0	1.2	6.9	S	5.1	12.7
S3	Emerald Formation (Te(w))	Red Dermosol	Durrandella, foot slopes terrain, no suitable soil family	4, no suitable AMU	0.0-0.1	39	8	54	24	6.7	90	VL	76	4.3	6.6	0.9	0.70	14.0	40.5	48.1	6.4	5.1	NS	0.8	7.5
					0.1-0.2	56	6	36	5	7.9	570	H	620	4.2	19.0	0.7	5.00	32.0	24.4	57.9	2.1	15.5	SS	0.4	27.5
					0.2-0.3	57	10	36	4	8.2	690	H	780	8.3	20.0	0.74	5.70	35.0	23.6	57.9	2.1	16.4	SS	0.4	27.0
					0.3-0.5	56	9	39	5	8.0	1,100	VH	1,200	6.4	21.0	0.7	7.30	35.0	18.0	59.4	2.1	20.5	SS	0.3	28.8
					0.5-0.6	59	10	33	6	7.5	1,300	VH	1,700	4.3	23.0	0.74	8.70	36.0	11.8	62.2	2.0	23.9	SS	0.2	31.1
					0.6-0.8	51	9	39	6	7.1	1,400	VH	1,800	4.2	25.0	0.8	9.50	39.0	10.7	62.8	2.1	24.4	SS	0.2	30.9
					0.8-0.9	59	12	30	8	7.0	1,300	VH	1,700	4.0	23.0	0.8	9.00	37.0	10.8	62.8	2.1	24.2	SS	0.2	29.1
OB04	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	57	29	14	21	7.6	35	VL	<10	19.5	4.9	1.6	<0.2	25.9	75.3	18.9	6.2	<0.2	NS	4.0	3.1
					0.1-0.2	59	25	16	17	7.8	39	VL	<10	21.4	5.3	1.6	0.2	28.6	74.8	18.5	5.6	0.9	NS	4.0	3.3
					0.2-0.3	50	18	32	34	7.7	38	VL	<10	21.8	5.5	1.4	0.4	29.1	74.9	18.9	4.8	1.5	NS	4.0	3.9
OB05	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	70	14	16	14	7.1	105	VL	60	10.2	4.2	0.9	2.1	17.4	58.6	24.1	5.2	12.3	S	2.4	4.8
					0.1-0.2	69	18	14	4	7.9	130	VL	100	8.2	3.0	0.4	1.8	13.4	61.2	22.4	3.0	13.6	S	2.7	7.3
					0.3-0.4	62	20	18	15	9.0	256	L	60	10.7	4.3	0.5	2.5	18.0	59.4	23.9	2.8	14.1	S	2.5	9.2
OB07	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	13	23	65	12	7.3	50	VL	20	9.2	5.3	1.0	0.9	16.5	55.8	32.1	6.1	5.7	NS	1.7	5.4
					0.1-0.2	26	26	47	9	8.7	154	L	60	13.8	6.3	1.1	2.6	23.9	57.7	26.4	4.6	11.0	S	2.2	5.6
					0.2-0.3	30	26	44	12	9.2	279	M	130	15.5	7.6	1	3.3	27.3	56.8	27.8	3.7	12.0	S	2.0	7.3
					0.3-0.4	21	23	58	20	9.3	296	M	120	13.7	7.0	0.8	3.1	24.7	55.5	28.3	3.2	12.6	S	2.0	8.4
OB08	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	47	15	37	3	8.3	119	VL	30	16.5	3.4	1.8	1.5	23.2	71.1	14.7	7.8	6.4	S	4.8	1.8
					0.1-0.2	64	20	15	16	8.9	223	L	80	23.2	4.6	1.3	3.0	32.2	72.0	14.3	4.0	9.5	S	5.0	3.6
					0.2-0.3	57	21	22	23	9.0	322	M	160	19.5	4.8	1.0	3.3	28.7	67.9	16.7	3.5	11.7	S	4.1	4.5
S4	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	45	7	46	2	6.7	70	VL	10	16.0	10.0	1.1	1.30	28.0	55.5	36.1	3.8	4.6	NS	1.5	9.1
					0.1-0.2	54	6	40	1	6.8	80	VL	18	17.0	11.0	0.9	1.70	30.0	55.3	35.8	3.1	5.7	NS	1.5	11.7
					0.2-0.3	54	12	38	6	6.8	150	L	120	18.0	11.0	0.8	3.00	33.0	54.3	34.3	2.4	9.0	S	1.6	13.8
					0.3-0.5	67	10	20	10	7.0	270	L	300	18.0	12.0	0.7	4.20	35.0	52.5	33.7	2.1	11.8	S	1.6	16.7
S5	Burngrove Formation (Pwg)	Black Vertosol	Girrah, lowlands and low rises terrain, Bruce	4, Kia-Ora	0.0-0.1	21	8	73	27	7.5	50	VL	6	9.2	2.1	0.8	0.49								



## APPENDIX C

Copies of SLR Field Green Sheets and NRC Soil Logs

Appendix C contents here



## APPENDIX D

### Chain of Custody and Laboratory Certificates

Appendix D contents here



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