Environmental Approval & Compliance Solutions

15 Mile Irrigation Project Land Suitability Study

Flinders Shire Council

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8 March 2019

Flinders Shire Council
PO Box 274
Hughenden QLD 4821

Attention: Robyn Young, Rural Services Manager

Dear Robyn

RE: 15 Mile Irrigation Project Land Suitability Study - Final Report

Please find enclosed the final report for the 15 Mile Irrigation Project Land Suitability Study.

The report provides information on portions of land within the 15 Mile project area that have been assessed as suitable, in terms of topography, climate and soil attributes, for production of irrigated table grape, citrus and avocado crops. For all proposed land uses, the project area contains portions of land with suitability Class 3 (*Suitable land with moderate limitations*).

This report has been compiled by Dr Andrew Butler (NRA) who has graduate and post graduate qualifications in Soil Science and is a Certified Professional Soil Scientist (Accreditation No. S00422). The report has been prepared using field survey data and interpretation provided by Mr. Jon Burgess (Director of Soil Mapping and Monitoring Pty Ltd). Jon holds a BAgrSc (Hons) (majoring in Land Resource Science) and has demonstrated expertise in soil and landscape mapping, geomorphology and regolith characterisation, field based pedology, soil classification, analysis and interpretation, land suitability evaluation and Strategic Cropping Land assessment.

Please let me know if you require GIS data layers for the land suitability maps in this report or Excel spreadsheets of the limitation classes assigned to each unique mapping area (UMA) to assist with your development approvals.

If you have any questions regarding the enclosed document, please do not hesitate to contact me on (07) 4034 5300 or andrew@natres.com.au.

Yours sincerely
NRA Environmental Consultants

Andrew Butler
Principal Environmental Consultant

Encl: 15 Mile Irrigation Project Land Suitability Study – final report

Document Control Summary

NRA Environmental Consultants

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Report Summary	
Key Words	Land suitability, irrigation, Flinders Shire Council, FSC, 15 Mile, Impact Assessment Report
Abstract	This report details the findings of a soil survey and assessment of land suitability for production of irrigated table grape, citrus and avocado crops on the 15 Mile project area.

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Quality Assurance					
Author	**Technical Review**	**Editor**	**Document Version**	**Approved for Issue by QA Manager**	
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Glossary

This glossary includes a selection of terms used in this report that are uncommon or unfamiliar.

Backplain (BKP)	Large flat resulting from aggradation by over-bank stream flow at some distance from the stream channel often characterised by a high water table and the presence of swamps or lakes; part of a covered plain landform pattern.
Epipedal	A structured A (surface) horizon, commonly blocky or polyhedral structure, with a moderate to strong grade and no surface crust (*ie* not self-mulching).
Gilgai microrelief	A small, ephemeral pool formed from a depression in the soil surface in expanding clay soils. The pools are commonly a few metres wide and less than 30 cm deep; however, in some instances, they may be several metres deep and up to 100 m wide.
Land suitability	The fitness of a given area for a land utilisation type (usually crop specific), commonly expressed as a set of discrete classes numbered from Class 1 (completely suited) to Class 5 (completely unsuited). Land is classified on the basis of a specified land use and a rating of 'suitable' assumes production is optimal with minimal degradation to the land resource and the wider environment in the long-term. The land suitability classification depends on the severity of limitations associated with the land use being considered. These, in turn, are determined by the land use requirements of the crop, the inherent characteristics of the land, and the season of crop growth.
Scroll (SCR)	Long, curved very low ridge built up by channelled stream flow and left relict by channel migration. Part of a meander plain landform pattern.
Scroll plain (SRP)	Large flat resulting from aggradation by channelled stream flow as a stream migrates from side to side; the dominant element of a meander plain landform pattern. This landform element may include occurrences of scroll, swale and oxbow.
Self-mulching	Soil surface that, when dry, is composed of easily disturbed small aggregates resulting from extensive swelling and shrinking from wetting and drying. The aggregates naturally fall apart as the soil dries to form a loose surface mulch.
Terrace plain (TEP)	Large or very large flat aggraded by channelled or over-bank stream flow, standing above a scarp and no longer frequently inundated; part of a former flood plain.

Executive Summary

Background

Flinders Shire Council (FSC) has acquired the former reserve known as '15 Mile', a freehold property, which FSC intends to reconfigure into viable agricultural development blocks, obtain suitable water licences and promote to private investors. The 15 Mile project area is Lot 168 on Plan SP262319 (approximately 918 ha) and is approximately 12 km west-north-west of Hughenden in the upper Flinders River catchment.

As the development involves the clearing of native vegetation, FSC wishes to apply for a 'coordinated project involving clearing for agriculture'. Under the *State Development Assessment Provisions: State Code 16: Native vegetation clearing* (SDAP State Code 16), clearing for an agricultural coordinated project is only to be undertaken where the land is *suitable for agriculture having regard to topography, climate and soil attributes* (Performance Outcome 29 – SDAP State Code 16). The performance outcome can be met by demonstrating that the land is suitable for agriculture in accordance with the *Guidelines for Coordinated Projects involving Clearing for Agriculture* (DNRME 2018).

NRA Environmental Consultants (NRA) was commissioned by FSC to undertake a land suitability study of the 15 Mile project area to determine whether the project fulfils Performance Outcome 29 under SDAP State Code 16. NRA partnered with Soil Mapping and Monitoring Pty Ltd to undertake the soil survey and land suitability assessment for this project.

Proposed land use

The proposed land uses for the project area include irrigated table grapes, avocados and citrus crops (the Initial Advice Statement (IAS) indicated a preliminary area of 344 ha subject to the land suitability assessment presented in this report), farming infrastructure and low value crops (the IAS indicated a preliminary area of 101 ha with no target crops specified), water storage (25.5 ha), and the balance (447.5 ha) comprising environmental buffers for watercourses, wetlands and regulated vegetation.

Soil resource survey

Desktop review

As required by Part 5 (Scope) of the FSC request for tender dated 8 October 2018 and *Guidelines for Coordinated Projects involving Clearing for Agriculture,* version 1.00 effective as of 2 November 2018 (DNRME 2018), a desktop review of available relevant information was undertaken. The scale of the land resource and land evaluation assessments conducted to date is only suitable for regional scale planning at best. The information provides some indication of likely land quality and limitations and provides background information that can be used to inform more detailed surveys.

A reconnaissance survey was not considered necessary and the detailed field survey (at a scale of 1:25,000 or better) was considered the most appropriate means of assessing land suitability for regulatory assessment and project planning purposes.

Field survey

Approach

The field soil survey was undertaken by a team of qualified agricultural scientists, each with over 30 years' work experience in soil survey, soil resource assessment and soil management.

The survey methods and the data recorded were in accordance with guidelines, industry standards or reference texts including:

- *Guideline for Coordinated Projects Involving Clearing for Agriculture (Land Suitability Requirement)*, version 1
- *Guidelines for Surveying Soil and Land Resources,* Second Edition
- *Australian Soil and Land Survey Field Handbook*, Third Edition
- *The Australian Soil Classification,* Second Edition.

Soil investigations were undertaken in December 2018 using a vehicle-mounted hydraulic coring rig capable of capturing and extracting 75 mm intact soil cores to depths of 4.5 m. The type and nature of the soil and landscape data collected during the field survey were consistent with industry standards and the detailed requirements of the project scope of works and the *Guideline for Coordinated Projects Involving Clearing for Agriculture (Land Suitability Requirement)*.

Soil unit boundaries inferred from the desktop review were verified and adjusted during fieldwork, and final linework was scanned and digitised following the completion of the field investigation. Mapped polygons delineated during the study represent recognisable and repeatable combinations of landform, soil unit and associated vegetation.

Mapping scale and sampling intensity

The number of ground observations made during the survey (*ie* the sampling intensity) was guided by the *Guidelines for Surveying Soil and Land Resources*, Second Edition. A total of 135 ground observations were documented during the field survey. The number and type of observations made were sufficient to meet the minimum requirements to achieve a mapping scale of 1:25,000 (or better) as directed by the *Guideline for Coordinated Projects Involving Clearing for Agriculture (Land Suitability Requirement)*.

Soil sampling and analysis

Ten profiles (including 2 deep borings) were fully analysed as representative sites covering the major soil units identified in the project area. Due to the recognised regional salinity risk, a further 21 profiles (including a further 2 deep borings) were analysed for salinity. All soil analysis was undertaken by a suitably accredited laboratory that specialises in the analysis of agricultural soil samples.

Soil units

A total of 11 soil units were delineated across three soil landscapes (described in **Section 4.3**). The best quality soils on the site were in elevated positions on the alluvial terrace plain fronting the Flinders River. These were very deep, moderately well drained, non-saline, clay loamy surfaced, black or brown structured gradational earths. Very deep, salt affected cracking clays and scalded sodic non-cracking clays dominated the lower lying alluvial backplains. Very deep self-mulching cracking clays overlying Cretaceous sedimentary rocks were found on the higher ground to the far west of the project area.

Land suitability assessment

Approach

The suitability framework developed for this project is based on the five standard land suitability classes nominated in *Guidelines for Agricultural Land Evaluation in Queensland* and presented in the table below. Suitability outcomes decrease progressively from Class 1 to Class 5, and reflect increasing levels of production or environmental constraints. Land in Classes 1, 2 and 3 for a given land use is regarded as 'suitable' for this purpose.

Land suitability class	Definition	Description
1	Suitable land with negligible limitations	Highly productive land requiring only simple management practices to maintain sustainable production.
2	Suitable land with minor limitations	Land with minor limitations that either constrain production or require more than the simple management practices of Class 1 land to maintain sustainable production.
3	Suitable land with moderate limitations	Land with moderate limitations that further constrain production or require more than the management practices of Class 2 land to maintain sustainable production.
4	Unsuitable land with severe limitations	Currently unsuitable land with severe limitations that preclude successful or sustained use under existing conditions. Future changes in knowledge, economics or technology may alter this.
5	Unsuitable land with extreme limitations	Land with extreme limitations that preclude any possibility of successful or sustained use, either now or in the future.

The attributes used to characterise the land quality (and hence determine its suitability for a given land use) are called land use limitations (or simply 'limitations' *eg* degree of rockiness, soil wetness, frequency of frost). For this project, limitations and the decision rules used to apply a suitability classification to each limitation were selected from the following sources as directed by the officers from the Department of Natural Resources and Mines and Energy (DNRME):

- *Regional Land Suitability Frameworks for Queensland*
- *Flinders and Gilbert Agricultural Resource Assessment (FGARA)*
- *Northern Australia Water Resource Assessment (NAWRA)*
- *Inland Burdekin Regional Suitability Framework* (developed for the *Charters Towers Agricultural Precinct* (CTAP) project).

For each land use (irrigated table grapes, citrus and avocado), decision rules were developed for 18 limitations.

Land suitability outcomes

For each soil unit, the information on soil quality and land attributes collected through the field assessment and laboratory analysis were assessed against the decision rules for each of the 18 limitations selected for this project (**Appendix 10, Table 2**). This provides an assessment of the land suitability class value for each limitation and an overall suitability class value for each soil unit (based on the value for the most limiting attribute). This process was undertaken for each combination of soil unit and crop type.

Two of the 11 soil units described were found to be wholly or partly suitable, with moderate limitations, for irrigated table grapes and citrus production. One of the soil units described was found to be suitable, with moderate limitations, for irrigated avocado production. A full description of the limitations that apply to each land use is presented in **Section 5** of the report.

The outcome of the assessment for each soil unit is summarised below and presented in maps in **Section 5**.

Land Suitability Class	Table grapes (ha)	Citrus (ha)	Avocado (ha)
Class 1	0	0	0
Class 2	0	0	0
Class 3	370.4	370.4	311.0
Class 4	220.5	220.5	194.7
Class 5	297.3	297.3	382.4

Conclusion

The land suitability assessment found that:

- 370.4 ha of land in the 15 Mile project area was found to be suitable (*ie* Class 3) for irrigated table grapes production
- 370.4 ha of land in the 15 Mile project area was found to be suitable (*ie* Class 3) for irrigated citrus production
- 311.0 ha of land in the 15 Mile project area was found to be suitable (*ie* Class 3) for irrigated avocado production.

The land area found to be suitable for the selected irrigated horticultural crops is similar to that indicated in the IAS for the 15 Mile Irrigation Project (344 ha).

1. Introduction

1.1 Background

Flinders Shire Council (FSC) wishes to promote the shire as a centre for private sector investment in irrigated agricultural development by demonstrating that the shire possesses the principal elements of suitable land, climate and water supplies. Such developments are seen as crucial to improve the employment prospects for current and future residents and hopefully reverse the current rate of population decline.

FSC has acquired the former reserve known as '15 Mile', a freehold property that FSC intends to reconfigure into viable agricultural development blocks, obtain suitable water licences and promote to private investors.

Intensively grown, efficiently irrigated, low volume, high value, horticultural crops will result in a higher and more sustainable return than broad acre, low-return, high volume crops. These types of enterprises would also meet FSC's goals of providing employment prospects for residents and encouraging migration of skilled workers to the shire.

The development would involve the clearing of native vegetation. A party wanting to clear native vegetation is required by the Queensland *Planning Act* 2016 to apply to the relevant assessment manager. FSC wishes to apply for a 'coordinated project involving clearing for agriculture'. Under the *State Development Assessment Provisions: State Code 16: Native vegetation clearing* (SDAP State Code 16), clearing for an agricultural coordinated project is only to be undertaken where the land is *suitable for agriculture having regard to topography, climate and soil attributes* (Performance Outcome 29 – SDAP State Code 16). The performance outcome can be met by demonstrating that the land is suitable for agriculture in accordance with the *Guidelines for Coordinated Projects involving Clearing for Agriculture (Land Suitability Requirement)* (Version 1.00, effective as of 2 November 2018) (DNRME 2018).

NRA Environmental Consultants (NRA) was commissioned by FSC to undertake a land suitability study of the 15 Mile project area to determine whether the project fulfils Performance Outcome 29 under SDAP State Code 16. NRA partnered with Soil Mapping and Monitoring Pty Ltd to undertake the soil survey and land suitability assessment for this project.

1.2 Scope

The scope was provided in the request for tender dated 8 October 2018 (FSC 2018) and cross-referenced many of the requirements presented in *Guideline for Coordinated Projects involving Clearing for Agriculture (Land Suitability Requirement)* (Version 1.00) (DNRME 2018). The scope is reproduced in **Appendix 1**.

NRA's proposed approach was documented in a proposal dated 5 November 2018. NRA offered to prepare a preliminary report prior to the initiation of fieldwork based on the desktop component of the scope of works.

A preliminary desktop report was provided on 12 December 2018 (NRA 2018). The preliminary report provided:

- the desktop component of the land suitability assessment based on the framework documented in DNRME (2018) (now incorporated into this report)

- information on the approach to fieldwork and land suitability assessment
- initial advice to FSC on the quality of the land according to the outcomes of previous land resource surveys and land suitability assessments conducted at various scales.

2. Project Description and Physical Environment

2.1 Location

The 15 Mile project area is Lot 168 on Plan SP262319 (**Figure 1**). It is 918 ha and is approximately 12 km west-north-west of Hughenden. The project area is in the upper Flinders River catchment, and the property boundary straddles the alluvial plains of the main channel of the Flinders River and adjacent areas of Mitchell Grassland.

2.2 Existing land use

The following land use description is based on the *15 Mile Irrigated Agricultural Development Project Initial Advice Statement, August 2018* (GHD 2018).

Lot 168 on Plan SP262319 was previously part of the 15 Mile Reserve, which also included sections of the adjacent Lot 167 on Plan SP262319. The 15 Mile Reserve formed part of the Queensland Stock Route network prescribed under the Queensland *Stock Route Management Act* 2002 and was managed by FSC and the DNRME.

The 15 Mile Reserve has a Stock Route Watering Facility, which consists of a solar pump that fills two 38 kL tanks, a trough, and a dam at the southern end of the reserve. The reserve is agisted on a 1 month agistment permit basis.

FSC purchased the site from the Queensland Government in 2016. It is still currently used for cattle grazing.

It is understood that there is no history of irrigated agricultural development within the 15 Mile project area. Irrigated agricultural production has previously been attempted on the rolling downs landscape immediately to the south, and is in limited production on isolated land parcels on the Flinders River floodplain approximately 15 km to the north-west of the project area.

2.3 Proposed land use

The proposed land uses for the project area, confirmed by FSC, include production of irrigated table grapes, avocados and citrus crops (the Initial Advice Statement (IAS) indicated a preliminary area of 344 ha subject to the land suitability assessment), farming infrastructure and low value crops (IAS indicated a preliminary area of 101 ha with no target crops specified), water storage (25.5 ha), and the balance (447.5 ha) comprising environmental buffers for watercourses, wetlands and regulated vegetation.

It is understood that the target crops have been selected based on climatic adaptation, investor interest, market demand, niche harvest window and likely production potential.

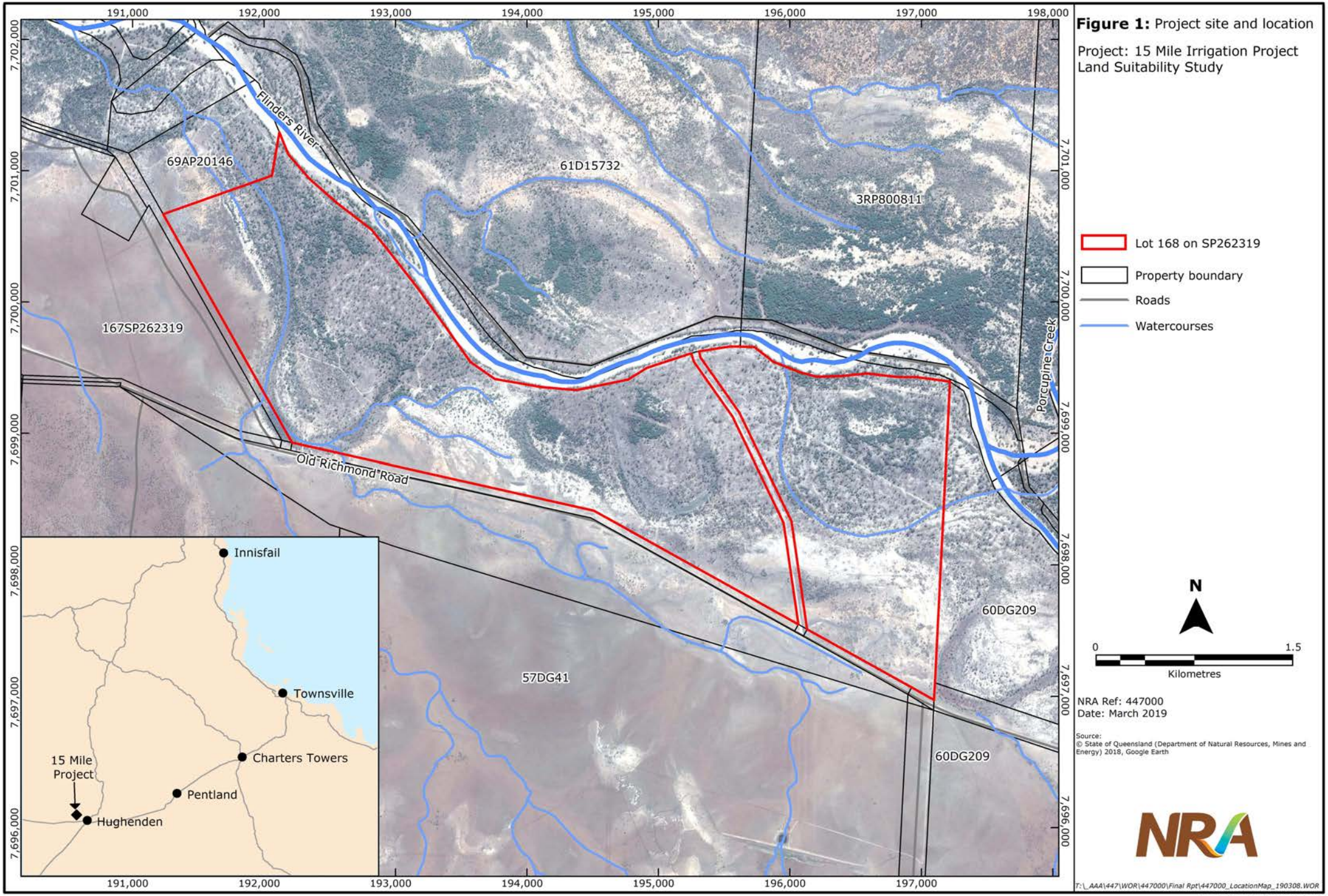

Figure 1: Project site and location

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Land Suitability Study

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While agricultural production in the region is currently limited, effort has been taken to identify suitable agricultural land as evidenced by the major studies covering the Flinders and neighbouring catchments (*eg The Flinders and Gilbert Agricultural Resource Assessment* (FGARA) and the *Land Suitability of the Fitzroy, Darwin and Mitchell catchments and part of the Northern Australia Water Resource Assessment* (NAWRA), both conducted by CSIRO). These studies have identified areas with agricultural potential that warrant further assessment at an appropriate scale.

2.4 Climate

The Flinders River catchment has a hot and dry semi-arid climate (Petheram *et al.* 2013). The climate is seasonal, with a wet season occurring between December and March and an extended dry season between April and November. The nearest active Bureau of Meteorology weather station is at the Hughenden Airport (station number 30022). Average annual rainfall for the station is 442 mm (2001 to 2018) with a range from 130 to 932 mm (BOM 2019a). In the Flinders River catchment, 88% of the rainfall occurs in the wet season (Petheram *et al.* 2013).

Summary climate statistics for the Hughenden Airport are presented in **Table 1**.

Table 1: Hughenden Airport summary climate statistics (2001 to 2018) (BOM 2019b)

Parameter	January	February	March	April	May	June	July	August	September	October	November	December
Mean max. temperature (°C)	35.8	35.2	34.5	32.2	28.8	26.0	26.1	28.1	32.3	35.3	36.6	37.4
Highest temperature (°C)	44.2	43.2	42.5	37.8	37.1	34.0	34.6	37.6	39.8	42.6	43.6	43.9
Mean no. days ≥40 °C	3.0	1.1	0.3	0	0	0	0	0	0	1.8	3.0	6.3
Mean min. temperature (°C)	23.7	22.7	21.6	18.2	13.7	10.7	9.6	10.4	15.4	19	21.9	23.5
Lowest temperature (°C)	16.3	12.8	12.0	6.0	1.9	0.2	-2.0	-0.5	4.0	6.1	12.6	13.0
Mean no. days ≤2 °C	0	0	0	0	0.1	0.8	2.1	0.7	0	0	0	0
Mean monthly rainfall (mm)	118.1	80.1	34.8	17.6	5.3	18.6	13.7	8.2	8.3	16.2	46.1	66.5
Median monthly rainfall (mm)	111.9	51.5	22.5	1.0	1.9	0.5	0.3	0	0.5	5.6	39	41.3

Turner and Hughes (1983) identify that in the upper Flinders River catchment, heat wave conditions are common, commencing in September and peaking in November and December, and frosts are generally light and infrequent.

The Scientific Information for Land Owners climate database (using the Data Drill climate data interpolation service) provided by the Queensland Government has been used to assess climatic limitations against the land suitability decision rules selected for the project. **Section 3.3** provides for further details of the method used.

2.5 Geology

Digital surface geology mapping (scale 1:100,000) on Queensland Globe (Queensland Government 2018) identifies two geological mapping units in the project area (the Lower Cretaceous Ranmoor Member and Quaternary alluvium), and three more in the vicinity (Toolebuc Formation, Allaru Mudstone, Quaternary colluvial and residual deposits).

Each of these units is described in **Table 2**. The spatial relationships of the geological units are shown on **Figure 2**.

Table 2: Surface geology mapping units

Mapped geology unit	Description
Qa-QLD	Clay, silt, sand and gravel; flood-plain alluvium*
Qr-QLD	Clay, silt, sand, gravel and soil; colluvial and residual deposits*
Ranmoor Member	Mudstone, in part carbonaceous, calcareous siltstone†
Toolebuc Formation	Limestone, calcareous bituminous shale, coquinite†
Allaru Mudstone	Primarily blue-grey mudstone (partly pyritic) and interbedded calcareous siltstone, cone-in-cone limestone and lesser sandstone†

Sources:
* Queensland Government (2018).
† Geoscience Australia (undated)

2.6 Topography and land systems

GHD (2018) describes the topography of the project area as sloping from approximately 300 m AHD (Australian Height Datum) in the south-east to approximately 290 m AHD in the north-west.

The variation in topography reflects the underlying geology and patterns of deposition and erosion within the Flinders River alluvial plain. A 1 m elevation contour map based on Shuttle Radar Topography Mission 1 arc-second digital elevation model (DEM) data for the project site is provided on **Figure 3**.

The DEM shows the transition between slightly higher elevations associated with the land on the Cretaceous sediments of the Rolling Downs (Mitchell Grass plains[1]) to the far south and west of the project site and the Quaternary alluvial deposits that comprise the bulk of the site. This aligns with the land systems mapping (CSIRO 1964; scale 1:1,000,000) that described two units in the project area: the Gregory and Julia land systems.

The Gregory land system is described as a constructional land surface of covered plains of fine and coarse-textured alluvia with Mitchell Grass pastures or arid sparse low woodland over arid short grasses with levees of lighter structured soils with frontage woodland over frontage grass. The Julia land system is described as a destructional land surface or eroding plains consisting of rolling Mitchell Grass plains that occupy most of the southern part of the Carpentaria and inland plains.

[1] The terms Mitchell Grass plains, Mitchell Grass Downs or Rolling Downs are used in the various published resources reviewed. They refer to the same landform unit (but reference either underlying geology or overlying vegetation cover) and are often used interchangeably.

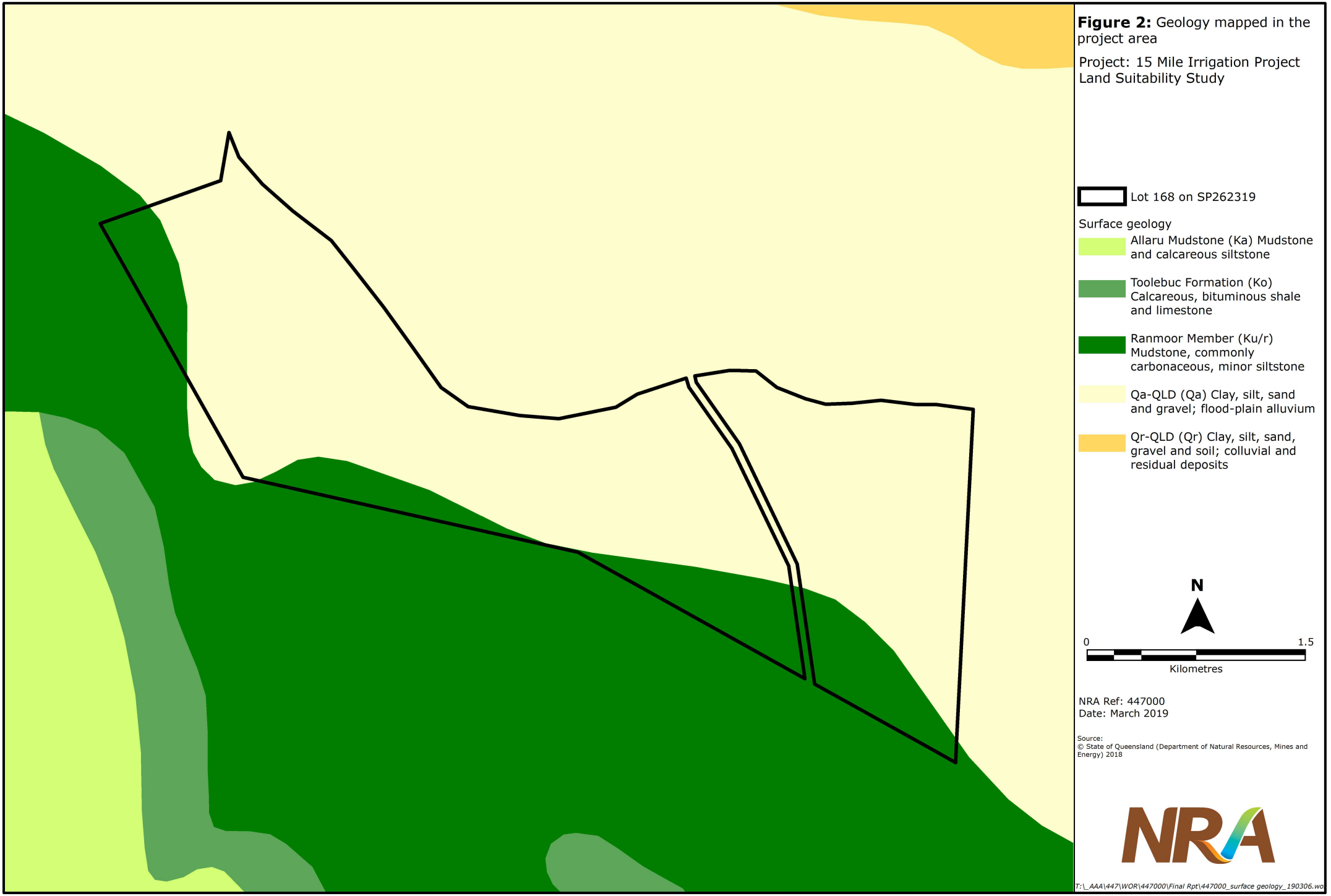

Figure 2: Geology mapped in the project area

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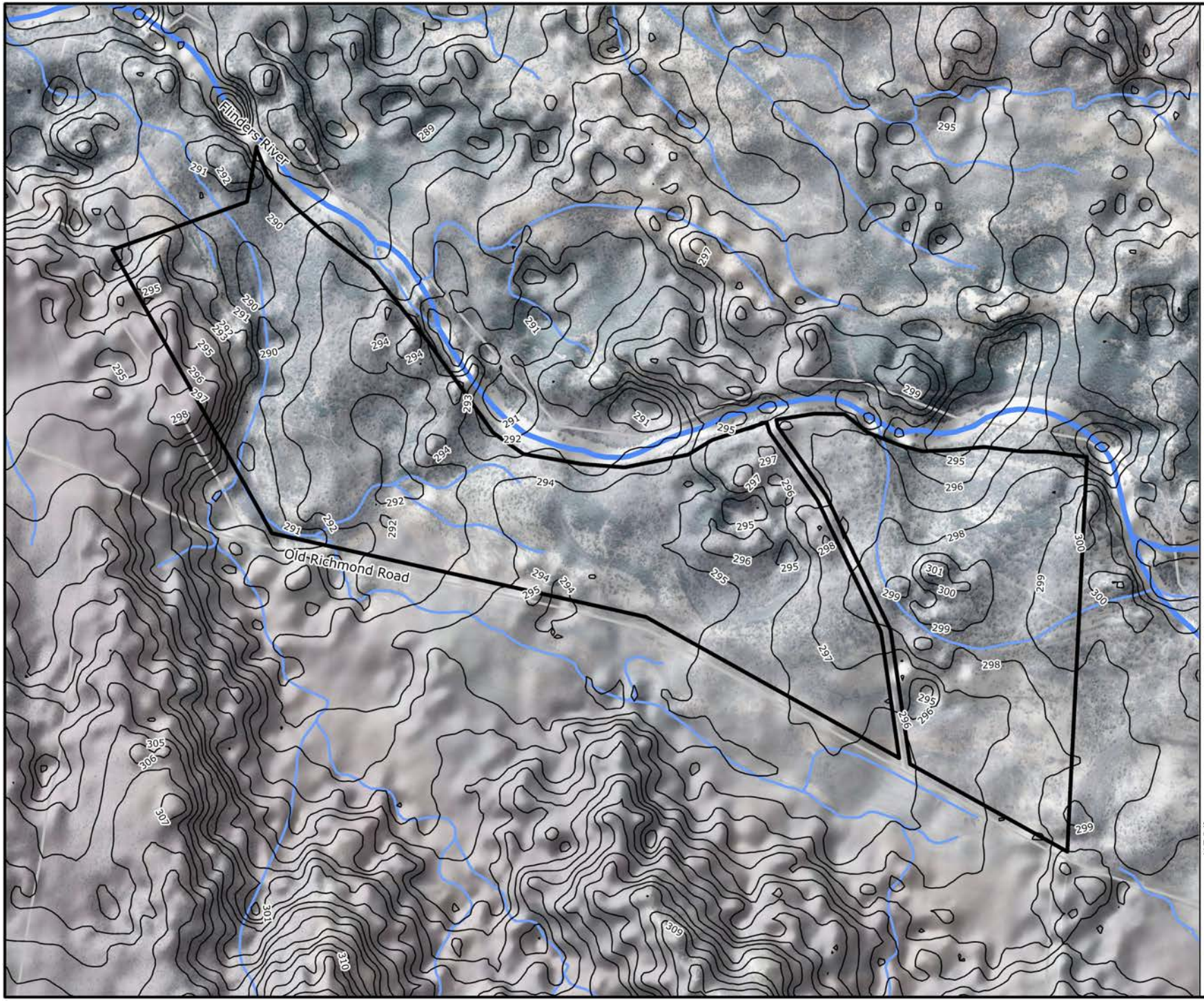

Figure 3: Topography of the project area

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Lot 168 on SP262319

1 m contours

Roads

Watercourses

N

0 1.5

Kilometres

NRA Ref: 447000
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Source:
© State of Queensland (Department of Natural Resources, Mines and Energy) 2018, © Commonwealth of Australia (Geoscience Australia) 2010, CSIRO Land & Water, Google Earth

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3. Methods

3.1 Desktop review

The approach to this desktop review is based on Part 5 (Scope) of the FSC request for tender dated 8 October 2018 (FSC 2018) and *Guidelines for Coordinated Projects involving Clearing for Agriculture* (DNRME 2018) (in particular Section 4.4).

The desktop review was used to:

- provide information to guide the field effort
- provide information on decision rules to guide the land suitability assessment
- identify preliminary mapping units and provide an indication on the soil type(s) present in the area to allow effective allocation of resources for the field survey stage
- provide preliminary indication of land quality and potential site constraints to guide the field sampling and analysis decisions
- determine the need for a reconnaissance and/or detailed field assessment
- identify any critical data gaps that can be targeted during the field survey.

The desktop review examined available information relevant to the project area including:

- geology mapping and reports
- topographic mapping
- remote sensing data
- aerial photographs and satellite imagery
- existing soils and land resource reports, maps and associated information.

3.1.1 Soil resources and land evaluation

The following resources were reviewed to provide information on soil distribution, land quality and likely constraints:

- *Atlas of Australian Soils*, scale 1:2,000,000 (NRIC 1991, Northcote *et al.* 1960-1968)
- *Upper Flinders River Irrigation Proposal*, scale 1:250,000 (Turner & Hughes 1983). This included soil mapping and land evaluation.
- *Flinders and Gilbert Agricultural Resource Assessment* undertaken by CSIRO (Bartley *et al.* 2013, Petheram *et al.* 2013).

Soil survey data collected in Queensland is stored in the Queensland Government Soil and Land Information (SALI) database. Site listing reports are available in SALI for Turner and Hughes (1983) (Survey code FLN) and Bartley *et al*. (2013) (Survey code LSGARA). The site listing reports provide soil profile and site descriptions with a range of associated physical and chemical data.

Of the reports available from the local area, one (FLN2) is from within the project area, and the remaining reports are from locally similar landforms or geology (*eg* Rolling Downs and alluvial plains) (**Figure 4**). The data was reviewed to provide information on the types of soils likely to be encountered during the field survey and range of properties and limitations that may be present.

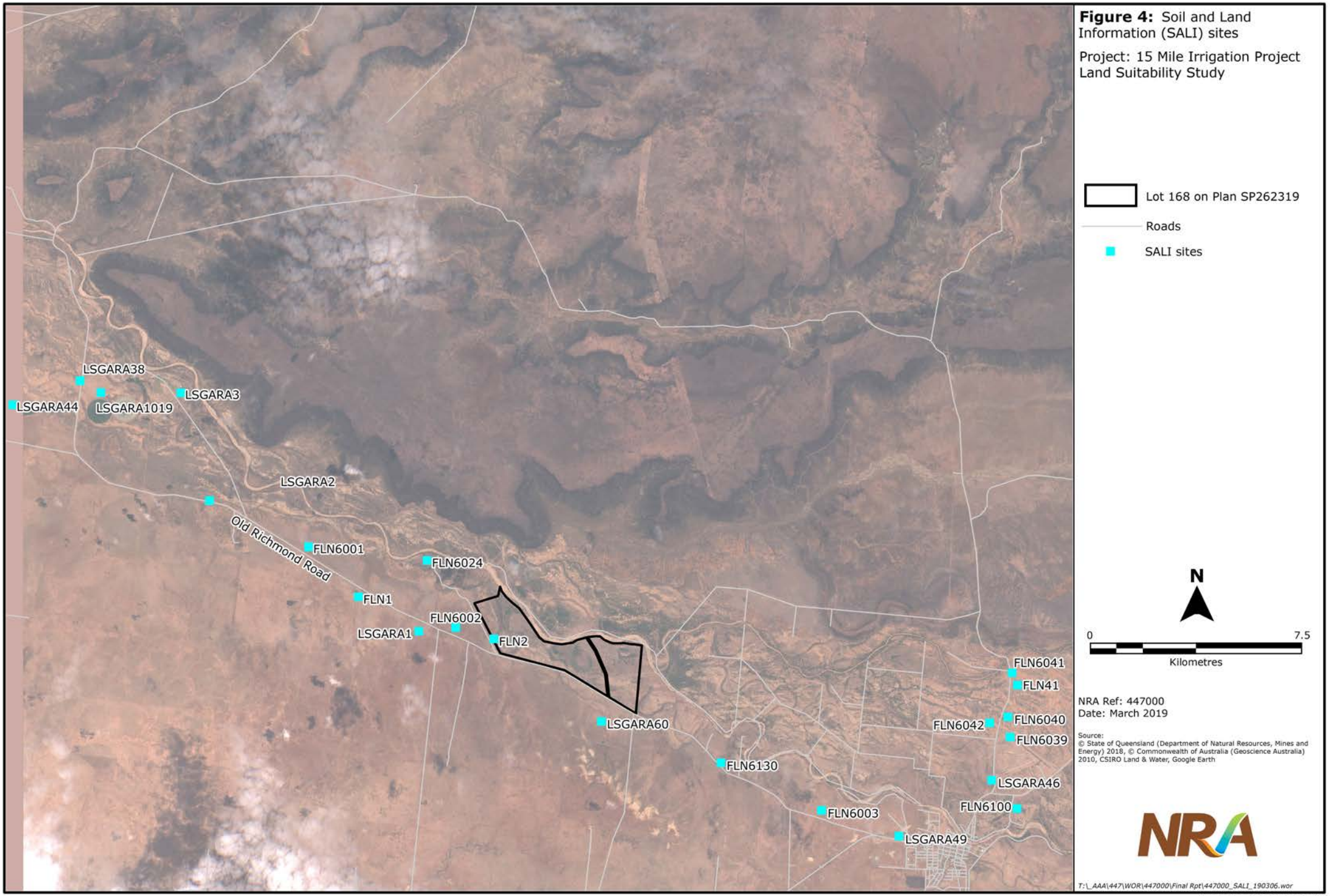

Figure 4: Soil and Land Information (SALI) sites

Project: 15 Mile Irrigation Project Land Suitability Study

Lot 168 on Plan SP262319

Roads

SALI sites

N

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Kilometres

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Date: March 2019

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3.1.2 Land suitability frameworks

After discussion with officers from DNRME (Neil Enderlin and Mellissa Spry, teleconference, 7 December 2018), the documents listed below were used to source appropriate decision rules for land suitability assessment for this project. The development of regional decision rules has evolved in recent years, and the various projects have used slightly different sets of attributes depending on the purpose of the project and the location.

- *Regional Land Suitability Frameworks for Queensland,* which includes decision rules for irrigated grapes, citrus and avocado crops for the Gulf Plains area that includes the project site (DNRM & DSITIA 2013)
- *Land Suitability: Technical Methods* used for the *Flinders and Gilbert Agricultural Resource Assessment* (FGARA) project and based on the Gulf Plains decision rules above (Bartley *et al.* 2013)
- *Land suitability of the Fitzroy, Darwin and Mitchell Catchments* prepared for the *Northern Australia Water Resource Assessment* (NAWRA) (Thomas *et al.* 2018). The decision rules for the Mitchell River catchment were reviewed as being most applicable to this project. This source does not include decision rules for grapes
- *Inland Burdekin Regional Suitability Framework* (developed for the Charters Towers Agricultural Precinct (CTAP) project) (DNRME (unpublished)). This is the most contemporary set of decision rules for irrigated horticultural crops for inland northern Queensland and was recommended as a primary source by Neil Enderlin, Natural Resource Management Officer, Land Resource Assessment, Planning Services North, DNRME. This source does not include decision rules for grapes.

The logic behind the selection of the rules applied for this project are presented in **Section 3.3**.

3.1.3 Desktop review outcomes

Soils and soil distribution

There is general consensus across the reviewed land resource and soil survey reports about the distribution of landform units and major soil types across the project area. The mapping is largely consistent with boundaries in surface geology and with features visible from satellite imagery and topography.

On the Rolling Downs landform units, the soils appear to be relatively uniform and well characterised by previous surveys *ie* deep to very deep self-mulching vertosols. The SALI database indicates that in the area surrounding the project, subsoils may be strongly sodic and saline below 0.5-0.9 m and often containing gypsum and carbonate segregations (typified by SALI profiles FLN1, FLN2, FLN6001, FLN6002, LSGARA1 and LSGARA60). Depending on the landscape position, this could indicate potential for salt mobilisation and redistribution down-gradient (secondary salinity potential).

Turner and Hughes (1983) confirmed high soil variability on the Flinders River alluvium. Only a small number of profiles in the SALI database are from the alluvial plains around the 15 Mile project area. From the selection of profiles available (LSGARA3, LSGARA38 and LSGARA1019), the soils range from deep clayey Orthic Tenosols (soils with very little profile development – usually recently formed) to deep clayey Brown Dermosols (non-cracking clay soils) to very deep Brown Vertosols (cracking clay soils). A common feature of the SALI profiles close to the project area is the presence of sodicity and salinity in the subsoil.

The review indicated that the detailed field survey should pay particular attention to the assessment of landscape complexity and soil heterogeneity, drainage status, sodicity and salinity.

Land evaluation and suitability for target crops

As the cracking clay soils in the Rolling Downs are largely unsuited to tree cropping, the soils formed on alluvium were highlighted as the soils with the greatest potential in the *15 Mile Irrigated Agricultural Development Project Initial Advice Statement* (GHD 2018).

Turner and Hughes (1983) considered the soils of the Flinders River Alluvium (a range of Sododols, Vertosols and Rudosols and/or Tenosols,) to be unsuited to irrigated cropping due to high soil variability (severe limitation for all soils), extensive scalding (surface soil condition - a moderate limitation for all soils) and impeded drainage (wetness - a severe limitation for the Sodosols and Rudosols/Tenosols).

The mapping produced by the FGARA project (Bartley *et al.* 2013) indicated that the majority of land within the 15 Mile project area may be:

- suitable with moderate limitations for trickle irrigated grape (land suitability class 3)
- suitable with moderate limitations for trickle irrigated citrus (land suitability class 3)
- marginal (presently considered unsuitable due to severe limitations) for trickle irrigated avocado (land suitability class 4).

The information available was conflicting, but what it did reveal was that:

- soil distribution may be complex and conditions could vary over a short distance
- some soils likely to be present may have limitations that could affect their suitability for irrigated tree crops (soil complexity, surface soil condition, wetness, effective rooting depth and salinity/sodicity)
- there is some potential for irrigated horticulture and further site-specific assessment is warranted.

Need for more detailed project-specific information

The *Upper Flinders Irrigation Proposal* (Turner & Hughes 1983) included a broad land capability assessment rather than a detailed crop suitability assessment, and no crop-specific decision rules were provided. The mapping was conducted at 1:250,000 scale, which is appropriate for regional planning or the identification of areas that warrant further detailed assessment.

The FGARA project (Bartley *et al.* 2013) included modelling of land suitability based on digital soil mapping data. For the four primary investigation areas targeted (including land around Hughenden), the aim was to reach a mapping scale equivalent to 1:100,000 in traditional soil mapping and for secondary areas a scale equivalent to 1:500,000 (CSIRO 2012). This scale is suitable for regional planning or pre-feasibility assessments.

The scale of the assessments conducted to date is only suitable for regional planning at best. The information provides some indication of likely land quality and limitations and provides background information that can be used to inform more detailed surveys.

A reconnaissance survey was not considered necessary and the detailed field survey (at a scale of 1:25,000 or better) was considered the most appropriate method to assess land suitability for regulatory assessment and project planning purposes.

3.2 Detailed field survey

3.2.1 Survey team

The detailed field survey and data interpretation was undertaken by Jon Burgess, Director of Soil Mapping and Monitoring Pty Ltd (SMM), who is a qualified agricultural scientist (land resources) with over 30 years' experience in soil and landscape assessment for agricultural and resource development in the Northern Territory and Queensland. Jon was assisted in the field by Bevan Emmerton, an agricultural scientist (land resources) with over 30 years' experience.

The survey team members:

- understand landscapes for the purpose of mapping and describing soils types, soil attributes and limitations
- are competent in the description of soils in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST 2009) and mapping them at a property scale in accordance with the *Guidelines for Surveying Soil and Land Resources* (McKenzie *et al*. 2008)
- are competent in undertaking agricultural land suitability assessments considering key soil attributes and land limitations in accordance with the *Guidelines for Agricultural Land Evaluation in Queensland* (DNRM & DSITI 2015).

3.2.2 Technical standards, guidelines and texts

Field survey methods and related technical assessments used for the 15 Mile investigation are in accordance with the industry standards, guidelines and texts presented in **Table 3**.

Table 3: Guidelines, industry standards and reference texts used during the 15 Mile investigation

Soil survey and sampling intensity
• DNRME 2018, *Guideline for Coordinated Projects involving Clearing for Agriculture (Land Suitability Requirement)*,Version 1
Soil, landscape and vegetation field assessment
• McKenzie *et al.* 2008, *Guidelines for Surveying Soil and Land Resources*, Second Edition • National Committee on Soil and Terrain (NCST) 2009, *Australian Soil and Land Survey Field Handbook,* Third Edition • Munsell Color 2010, *Munsell Soil-Color Charts: with genuine Munsell color chips*
Soil classification
• Isbell, RF and the National Committee on Soil and Terrain 2016, *The Australian Soil Classification*, Second Edition
Soil analytical methods, data interpretation and assessment
• Rayment, GE and Lyons, D 2011, *Soil Chemical Methods – Australasia* • Hazelton P and Murphy B, 2016. *Interpreting soil test results: what do all the numbers mean?* Third Edition • McKenzie *et al.* 2002, *Soil Physical Measurement and Interpretation for Land Evaluation*

3.2.3 Mapping scale and sampling intensity

Mapping of the 15 Mile project area was captured and presented at a scale of 1: 25 000 in accordance with the scope of works and the requirements documented in the *Guidelines for Coordinated Projects Involving Clearing for Agriculture (Land Suitability Requirement)* (DNRME 2018). This scale is also appropriate for the project area size and degree of landscape complexity.

Required ground observation densities

DNRME (2018) does not provide a minimum sampling intensity but directs applicants to the *Guidelines for Surveying Soil and Land Resources* (McKenzie *et al.* 2008). Schoknecht *et al.* (2008) (Chapter 14 of the *Guidelines for Surveying Soil and Land Resources*) provide a guide to sampling density for conventional mapping projects in landscapes of moderate complexity. For a survey at the 1:25 000 scale, they nominate a minimum acceptable density of between 1 observation per 25 ha and a recommended range of between 1 observation per 6.25 ha to 12.5 ha.

Adequate numbers of detailed soil profile sites are important to define modal soil and landscape characteristics, while carefully selected representative analytical sites provide quantification of physical and chemical characteristics important for agricultural development. Map boundary observations provide limited data (typically brief diagnostic notes or coded field map annotations), but are important to improve spatial reliability and mapping confidence.

Although DNRME (2018) provides minimum requirements for the types of observations to be made (see **Table 4**), it does not nominate how many of each observation type is required[2]. Schoknecht *et al.* (2008) recommend data collection comprising of a minimum of 10-30% detailed soil profile descriptions (for modal soil characteristics), 1-5% profiles for sampling (also referred to as representative or analysed sites), 1-5% deep borings (to investigate local hydrology) and 60-88% map boundary observations (to delineate soil changes and landscape variability on the ground).

Table 4: Ground observation types required by *Guidelines for Coordinated Projects involving Clearing for Agriculture (Land Suitability Requirement)* (DNRME 2018)

Observation type	Purpose and data collected
Detailed soil profile sites (S)	Landscape description, soil morphology, associated vegetation and some additional salinity analysis
Representative analysed sites (A)	Landscape description, soil morphology, full soil chemistry and physical data, associated vegetation
Deep borings (D)	Landscape description, soil morphology, salinity characteristics, associated vegetation
Semi-detailed check sites (C)	Cored field site with sufficient distinguishing soil and landscape data to verify the assigned soil unit
Map boundary observations (M)	Rapid check site or simple map boundary observation (information recorded)

Based on the recommendations of Schoknecht *et al.* (2008), mapping of the 918 ha[3] 15 Mile project area at a 1: 25 000 scale would require a minimum of 73 ground observations comprising 7-22 detailed field sites, 1-4 representative analytical sites, 1-4 deep cores and a further 43-64 map boundary observations. This was used as a guide for the field survey.

Details of the field methods use for each observation type are presented below.

[2] DNRME (2018) only states that each 'typical' soil requires at least one analysed site.

[3] The initial survey design was based on 918 ha as advised. The mapping extent of the two portions of the lot comprising the project area and the easement between the portions of the lot covers 888.6 ha.

3.2.4 Field survey

Initial landscape interpretation conducted during the desktop review stage incorporated geological mapping, digital elevation model (DEM) analysis, imagery patterns and observable landscape features to delineate preliminary soil units prior to field investigation. Proposed sampling locations were selected during this process to ensure full characterisation of the proposed units.

The field survey was undertaken in December 2018. Soil unit boundaries were verified and adjusted during fieldwork, and final linework was scanned and digitised following the completion of the field investigation. Mapped polygons delineated during the study represent recognisable and repeatable combinations of landform, soil units and associated vegetation.

Profile sampling methods

Soil investigations were undertaken using a vehicle-mounted hydraulic coring rig capable of capturing and extracting 75 mm intact soil cores to depths of 4.5 m. Profiles were extruded into sample trays in the field (with minimal core disruption) for immediate description and sampling (**Plate 1**).

Plate 1: Vehicle-mounted hydraulic corer and core extrusion into sample tray

Detailed field sites were drilled to a minimum depth of 1.5 m (or until refusal). In the soil units with the greatest potential suitability for the target crops, two deep boring were made to depths of 3.5 m (to loose gravelly sand) and 4.5 m.

In addition, the arisings from four water drillers boreholes to between 18 and 24 m deep (arranged as 1 m deep chip samples) were described and sampled to investigate salt loads within the regolith (basement recorded at between 14 and 18 m).

Detailed field description

All field descriptions were documented in accordance with standards outlined by the National Committee on Soil and Terrain (2009), Hnatiuk *et al.* (2009) and Isbell and NCST (2016). Field observations recorded included:

- datum/GPS coordinates (MGA), surveyor, date, observation class and method
- site photographs - landscape, vegetation, soil profile and soil surface
- Australian Soil Classification
- land use/disturbance
- geology/parent material, landform (pattern and element), slope, relief/modal slope class, substrate lithology

- site disturbance, erosion features, microrelief, surface coarse fragments, rock outcrop, surface condition, site drainage, permeability properties, vegetation characteristics
- detailed soil profile morphology – soil horizons, boundaries, texture, colour, mottling, bleaching, structure, cutans, consistence, gravel, segregations, substrate material (where present), sand fraction and field assessment of dispersive behaviour
- field tests for dispersion and slaking (**Plate 2**), fine earth $CaCO_3$ effervescence and manganese segregations.

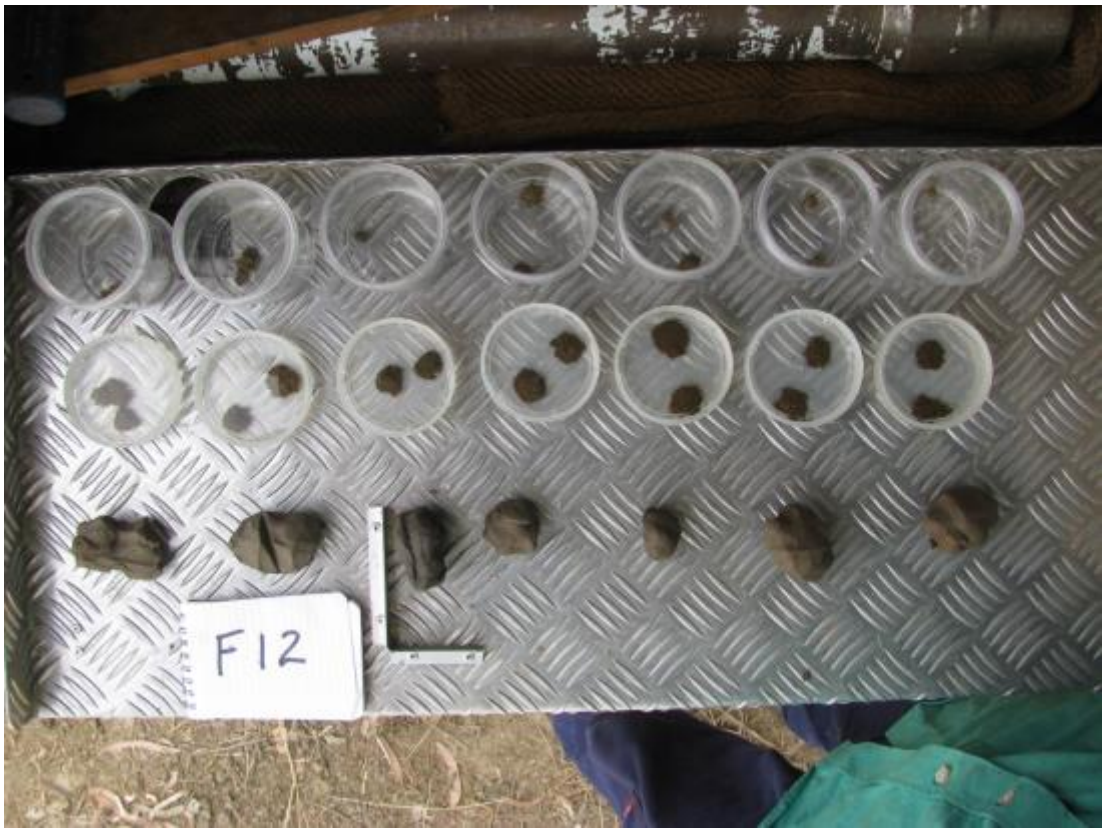

Plate 2: Slaking and dispersion field testing (intact soil aggregates at the top and reworked sample below)

Vegetation structural and floristic characteristics were recorded at each detailed field site, in accordance with the conventions and terminology in the *Australian Soil and Land Survey Handbook (*NCST 2009). Descriptions were in sufficient detail to convey useful information about the relationship between vegetation communities and each soil unit. The information is not intended to provide detailed vegetation data or mapping.

The field sheets from all detailed sites (inclusive of deep bores and semi-detailed check sites) are presented in **Appendix 2.**

Map boundary observations

Soil boundary site observations were made in sufficient detail to differentiate between recognised soil units. Details of the notes recorded are presented in **Appendix 3**.

3.2.5 Soil sampling and laboratory analysis

Sampling program

At all detailed field sites (including deep bores), samples of surface soil and subsoil materials were collected at standard 0.1 m intervals to 0.3 m and at 0.3 m depth intervals below 0.3 m (*ie* A1 surface depth, 0.1-0.2 m, 0.2-0.3 m, 0.5-0.6 m, 0.8-0.9 m, 1.1-1.2 m and 1.4-1.5 m)

plus selected intermediate depths, where required. At each site, sample depths were correlated with soil profile descriptions to ensure all soil horizons were captured, and horizon boundaries were not compromised (Baker & Eldershaw 1993).

In addition, for the two deep cores described in detail, samples were collected at 0.3 m intervals below 1.5 m to 3.3 m (*ie* 1.8 m, 2.1 m, 2.4 m, 2.7 m, 3.0 m and 3.3 m).

Samples from two of the four water driller's core chips were taken at 1 m intervals (bulk samples) to 14 m and analysed at 2 m intervals from 2 m to provide additional salinity data below the standard detailed profile depths.

Sample selection and laboratory analyses

The desktop review identified salinity as a potential significant constraint and this was considered in the selection of samples for analysis. The selection of sites for analysis and the nature of the analytical suite chosen were designed to ensure adequate spatial distribution and full characterisation of the expected range of soil properties in each significant soil unit identified.

A full description of the analyses performed and a summary of the number of samples analysed is presented in **Appendix 4**.

Laboratory pH, $EC_{1:5}$ and $Cl_{1:5}$ were measured at standard depths to 1.5 m (at intervals described above) at all detailed field sites[4] to provide a comprehensive dataset of profile salinity trends and leaching characteristics across the entire 15 Mile project area. Deep samples (>1.5 m depth) were also screened for salinity to improve the salinity hazard assessment.

Soil pH, $EC_{1:5}$ and $Cl_{1:5}$ results for all depths at all field sites are presented in **Appendix 5**, while mean pH, $EC_{1:5}$ and $Cl_{1:5}$ data, measured ranges (to highlight variability within the data) and calculated EC_e values are summarised for each soil unit in **Appendix 6**. Salinity findings are also presented graphically for each soil unit in **Section 4.3**.

Full laboratory analysis is necessary to characterise the chemistry and particle size characteristics of soil resources, and to quantify key soil attributes used in the assessment of agricultural land suitability including erosion hazard. Analytical sites were carefully selected to ensure coverage of all major soil units and their spatial extent to assess the severity and distribution of soil-based constraints likely to impact irrigated horticultural development.

Full profile physical and chemical analysis (including cation chemistry, sodicity and dispersion, particle size analysis and soil water retention characteristics) was carried out on samples at each standard depth to 1.5 m from representative soil unit profiles (also referred to as analysed sites) and surface soils from these profiles were analysed for inherent fertility.

For widely distributed larger soil units (A1 and A2), more than one analysed profile was selected. Minor soil units considered to have limited agricultural potential (A1e, A3 and B2g) were not included in the selection of analysed sites. However, salinity screening was carried out on samples from these soil units.

Analytical data for the 10 analysed sites are presented in **Appendix 7**. Further explanation and discussion of the data (including correlation with profile morphology and quantification

[4] All detailed field sites with the exception of water drillers bore sites 8 and 9.

of important physical and chemical characteristics) is presented in the modal soil profiles presented in the soil unit description pages in **Section 4.3**.

All laboratory analyses were undertaken by Agricultural Chemistry Pty Ltd., at their laboratory in Ipswich, Queensland. This is an Australasian Soil and Plant Analysis Council (ASPAC) accredited laboratory with extensive experience in agricultural soil and water testing for government and industry. The certificates of analysis (and quality control data) are presented in **Appendix 8**.

3.2.6 Data interpretation and calculated soil attributes

Assessment criteria used to interpret and rate analytical findings followed those defined by Bruce and Rayment (1982), Baker and Eldershaw (1993), Peverill *et al.* (1999), Burgess (2003a, b) and Hazelton and Murphy (2016).

Laboratory and field data have been used to estimate important soil attributes used in the assessment of land suitability including:

- effective rooting depth (ERD)
- plant available water capacity (PAWC to 1.0 m and 1.5 m)
- depth-weighted profile mean (WPM) saturated paste extract electrical conductivity (EC_e)
- soil erodibility (K factor).

The methods used to calculate these attributes are described in **Appendix 9** together with a summary of the outcomes for each soil unit.

3.3 Land suitability assessment for irrigated agriculture

Land suitability involves determining the potential of land for pre-defined land uses and identifying any associated production constraints that may require different degrees of management or resource inputs. A 'land use' is a combination of crop type (*eg* avocado) and management system (*eg* trickle irrigation).

The attributes used to characterise the land (and hence determine its suitability for a given land use) are called land use limitations (or simply 'limitations' *eg* degree of rockiness, wetness, frequency of frost). Land is considered less suitable as the severity of constraining limitations increases. Typically, this reflects either:

- reduced potential for production; and/or
- increased inputs to achieve acceptable production; and/or
- increased inputs to prepare the land successfully; and/or
- increased inputs to prevent land degradation.

3.3.1 Land suitability classes

The suitability framework developed for this project is land use specific and uses five standard land suitability classes (DNRM & DSITI 2015) to describe differing levels of potential agricultural success. Suitability outcomes decrease progressively from Class 1 to Class 5, and reflect increasing levels of production or environmental constraints. Suitable land is defined as land that can attain optimum, sustainable production with current technology, while minimising degradation to the land resource and environment in the short-, medium- and long-term.

Definitions for each land suitability class in DNRM and DSITIA (2015) are reproduced in **Table 5**.

Table 5: Definitions for land suitability classes 1-5 (DNRM & DSITIA 2015)

Class	Definition	Description
1	Suitable land with negligible limitations	Highly productive land requiring only simple management practices to maintain sustainable production.
2	Suitable land with minor limitations	Land with minor limitations that either constrain production or require more than the simple management practices of Class 1 land to maintain sustainable production.
3	Suitable land with moderate limitations	Land with moderate limitations that further constrain production or require more than the management practices of Class 2 land to maintain sustainable production.
4	Unsuitable land with severe limitations	Currently unsuitable land with severe limitations that preclude successful or sustained use under existing conditions. Future changes in knowledge, economics or technology may alter this.
5	Unsuitable land with extreme limitations	Land with extreme limitations that preclude any possibility of successful or sustained use, either now or in the future.

Classes 1, 2 and 3 are considered suitable for a specified land use, as the benefits from using the land outweigh the inputs required to initiate and maintain sustainable production in the long-term. Class 1 land is the most productive. The difference between Class 1 and Class 2 or 3 land reflects differences in the level of production constraints and the need for additional inputs to achieve a similar level of productivity.

Class 4 land is considered currently unsuitable for a specified land use, due to the severity of one or more limitations. The premise is that land use inputs and costs (economic and environmental) needed to achieve and maintain sustainable production, outweigh the benefits from using the land in the long-term. Although "currently unsuitable", it is possible that future agronomic or technological advances could enable some level of environmentally sustainable, economic production on these lands. However, significant improvements in the management of constraining limitations would be required before such production was realised.

Class 5 land is considered permanently unsuitable for a specified land use. It has limitations that singly or in aggregate are so extreme that any benefits from using the land could never justify the inputs and costs (economic and environmental) required to achieve and maintain sustainable production. Irrespective of future changes in climate, economics, agronomic knowledge, resource utilisation, technology or environmental management, it is unlikely that Class 5 land would ever be suited to agricultural development. Typical examples include land constrained by steep terrain, severe or frequent flooding, very rocky lands and strongly saline areas.

Each land use has a different set of land requirements and for each limitation, there is a threshold that determines if land is suitable or unsuitable for a specific land use.

3.3.2 Land suitability assessment framework - land use requirements and limitations

As noted in **Section 3.1.2**, the land suitability framework developed for this project has been based on a review of the limitations and decision rules nominated for other studies in the surrounding area. The decision rules applied to each land attribute/limitation for these studies were compared (**Appendix 10, Table 1**).

Following the review, eighteen potential soil and land limitations were identified as important for assessing the suitability of the area for irrigated horticultural production. These were:

- **climatic limitations** – climate stress - heat (Cs), frost (Cf), temperature - minimum (Ct)
- **landscape limitations** – wind erosion (A), water erosion (E), flooding (F), salinity (Sa), discharge potential (Ss), microrelief (Tm), wetness (W), soil complexity (Xs), topographic complexity (Xt)
- **soil profile limitations** – infiltration - soil profile recharge (Ir), soil water availability (M), soil depth to physical root barrier (Pd), rockiness (R)
- **soil physical limitations** - surface soil condition (Ps)
- **soil nutrient limitations** – nutrient balance - pH soil reaction trend (Nr).

Table 6 describes the desirable requirement associated with each potential limitation and the information used to assess the degree of potential limitation.

Table 6: Land use limitations considered during the assessment of land suitability for the 15 Mile project

Code	Limitation	Land use requirement(s)	Attributes used to assess
A	Wind erosion	Minimal soil loss or crop damage from wind erosion	Assessment based on surface soil texture characteristics, rainfall (<500 mm) and Sodosol presence or absence
Cf	Frost	Frost free (dry season April to October)	Days of potential frost (as defined by the Bureau of Meteorology) per year
Cs	Climate stress (heat)	Free of temperature extremes that could damage crops / productivity. Prolonged high temperatures	Days over 40^{o}C
Ct	Temperature (minimums)	Favourable year-round temperature conditions for crop production	Monthly mean minimum temperature during growing season
E	Water erosion	Minimal soil loss from water erosion	Estimated erosion hazard based on % slope and calculated soil erodibility (K factor) of the surface soil
F	Flooding	Minimal impact from damaging floods	Estimated average flood recurrence interval (ARI); based on local elevation, landscape position (particularly proximity to and size of nearby drainage systems and size of conforming catchment)
Ir	Infiltration - soil profile recharge	Permeability to irrigation infiltration	Whole soil profile permeability
M	Soil water availability	Adequate soil water storage to maintain plant growth and maximise irrigation efficiency	Estimated plant available water capacity (mm/1.0 m or 1.5 m) from particle size analyses summed over horizon thickness and effective rooting depth
Nr	Nutrient balance - soil reaction trend (pH)	Absence of induced deficiencies or toxicities caused by pH extremes	Soil pH
Pd	Soil depth to physical root barrier	Adequate soil depth for physical plant support and root crop harvesting	Depth to rock, hardpan, continuous gravel layer or other impenetrable feature
Ps	Physical restrictions (Soil surface	Minimal soil based restrictions to germination and seedbed	Surface soil condition, structure, texture and sand fraction; ESP of surface soil (and plough zone where relevant)

Code	Limitation	Land use requirement(s)	Attributes used to assess
	condition and soil texture/structure)	preparation	
R	Rockiness	Minimal impact from gravel, stone and rock at the soil surface	Surface coarse fragment size and abundance (%)
Sa	Salinity	Low levels of soluble salts in the soil profile	Mean profile soil salinity and landscape indicators; salt tolerant vegetation
Ss	Discharge potential	Minimal susceptibility to salinity impacts from irrigation	Landscape position, soil profile salinity, evidence of seepage or ”wicking”, depth to water table
Tm	Microrelief	Level land surface for tillage and crop production	Size of gilgai microrelief
W	Wetness	Adequate drainage for soil aeration and minimal waterlogging	Drainage class and profile permeability; indicators include depth to and degree of bleaching, mottling, Mn segregations, gley features, soil colour, texture, structure; vegetation characteristics; field evidence of water saturation; presence of impermeable layers
Xs	Soil complexity	Uniform production areas with managerially similar soils	soil variability; size and shape of mapped soil units and intensity of fragmentation
Xt	Topographic complexity	Minimal dissection of the soil landscape and short range slope variability	Distribution and density of watercourses gullies and dissected features

The decision rules adopted for each limitation and for each selected land use are presented in **Appendix 10, Table 2**. The combined framework describes the limitations, attribute values and subclass decision rules used to assess irrigated horticultural potential within the 15 Mile project area. For climate and flooding limitations, commentary is provided below.

Assessment of climate limitations

The climate data required to assess climate (climate stress (Cs), frost (Cf), temperature - minimum (Ct)) and wind erosion (A) limitations (which considered annual rainfall) was obtained from the Scientific Information for Land Owners (SILO) climate database. SILO datasets are constructed from observational records provided by the Bureau of Meteorology. SILO interpolates the raw data, which may contain missing values, to derive datasets that are both spatially and temporally complete (DES 2016). This provides a continuous daily time series of data (starting from 1889) at either recording stations or grid points across Australia. A 100 year dataset (01/01/1918 – 31/12/2017) of point data from grid point -20.80N 144.05E was obtained. The datasets used, the decision rules applied and the review outcomes are shown in **Table 7**.

Table 7: Data review and outcomes of assessment of land suitability limitations related to climate and wind erosion

Limitation	Basis for decision rule	Data set used	Value	Resulting limitation class for each land use		
				Table grapes	Citrus	Avocado
Climate stress (Cs)	Average number of days per year with daily maximum temperatures >40^{o}C	Daily maximum temperature data	10 days (5-20 days/year)	3	3	3
Frost (Cf)	Average number of days per year with daily minimum temperatures <2^{o}C	Daily minimum temperature data	1 day (<2 days/year)	2	2	2
Temperature - minimum (Ct)	Average number of months per year with mean monthly minimum temperatures of <15^{o}C	Monthly minimum temperature data	4.3 months (>4 months)	1	1	2
Wind erosion (A)	Average annual rainfall above or below 500 mm	Annualised monthly rainfall data	458 mm (<500 mm)	NA Also dependent on surface soil texture	NA Also dependent on surface soil texture	NA Also dependent on surface soil texture

Assessment of flooding limitations

FSC does not have flood mapping for the project area (Robyn Young, FSC, *pers. comm*. 13 December 2018). According to GHD (2018), although the lower Flinders River catchment is known to be prone to flooding, the project area has not been identified as having a significant history of flooding (for 2000 to 2010) and is not susceptible to long periods of inundation. Field observations indicated that the swales and backplains receive regular inundation. This was supported by anecdotal evidence collected by the survey team from neighbouring landholders in December 2018, who indicated that the river frontage area had not been flooded in living memory (approximately 50 years) but that overflows from the Flinders River did affect the back of the property. With local relief approximately 5-6 m above the incised channel, the river frontage area would be above the major flood level (set at a river height 4.0 m at Hughenden). Adjacent scroll plains at slightly lower elevation are likely to be within the major flood level. Data from the Bureau of Meteorology (BOM 2018) for flooding at Hughenden indicates that flood peak has reached major flood level (4 m) on six occasions in the last 70 years and reached over 5 m on three of these occasions.

During the 2019 floods, Robyn Young from FSC (*pers. comm.* 14 February 2019) advised that the area drained well after the initial rain. However, when the whole of the upstream catchment drained, due to flooding downstream, water backed-up in the Flinders River and

the whole of the project area was inundated. However, Robyn Young reported that the inundation on higher ground did not last more than a day.

In the absence of detailed flood hazard data, flood height records at Hughenden, site observations of flooding or inundation evidence and localised changes in elevation together with local knowledge about flood occurrence and severity have been used to inform the assessment of flooding limitations.

4. Soil and Land Resources

4.1 Completed ground observation densities and validation of survey scale

Completed survey statistics for the 15 Mile project area are presented in **Table 8**. The total number of observations was 135, that is 184% of the minimum recommended by Schoknecht *et al.* (2008) or equivalent to the minimum recommended number of observations for mapping at a scale of approximately 1:15,000. The proportion of each observation type made was within the range recommended by Schoknecht *et al.* (2008) with the exception of the proportion of analysed sites, which was greater (better) than that recommended. The survey statistics in **Table 8** confirm that the sampling intensity and proportion of different observation types is consistent with the requirements for 1:25 000 scale mapping and provides an appropriate level of data capture to support the project's aims to meet guideline requirements.

Table 8: Comparison of completed survey statistics with minimum recommendations for 1: 25 000 scale mapping

	Total	Detailed field sites	Analytical sites	Deep cores	Semi-detailed check sites	Map boundary observations
Minimum recommended number	73	7-22	1-4	1-4	NA	43-64
Proportion of observations	-	10-30%	1-5%	1-5%	NA	60-88%
Completed ground observations	**135**	**29[#]**	**10^**	**4[*]**	**8[*]**	**96**
Proportion of observations	**-**	**23%**	**7%**	**3%**	**6%**	**71%**

[#] This includes all fully described detailed sites, analysed sites and detailed deep borings sites.

^ This includes two detailed deep cores that were analysed as per standard profiles.

[*]Two detailed deep borings were made and a further four sites described from water driller's bore chips. The two detailed deep bore sites were fully analysed and two of the drillers bore were analysed for salinity characteristics to depth and were included in the deep bore sample counts. The remaining two water driller's bore chip descriptions have been counted as semi-detailed check sites.

The locations of the ground observations are provided on **Figure 5** together with the boundaries of the soil units described in **Section 4.3**.

4.2 Soil landscape framework

Field observations confirmed the presence of land systems described by CSIRO (1964). Three major landscape units have been identified, each with a distinct set of associated soils and vegetation communities. A brief description of the landscape units and their distribution is provided below.

The nature of the soils and associated vegetation communities that have developed within these landscapes is described in **Table 9**. Soil unit codes used in **Table 9** comprise a primary letter code denoting lithologic landscape, a second number code that signifies a recognised combination of soil and vegetation. Additional letter codes indicate specific variants and phases (*eg* g – gilgaied, e – eroded).

Figure 5: Locations of ground observations and soil unit boundaries

Project: 15 Mile Irrigation Project Land Suitability Study

Lot 168 on SP262319
Roads
Watercourses
A1 UMA polygon boundaries
Detailed sites
Representative analytical sites
Semi-detailed check sites
Deep cores
Map boundary observations

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Kilometres

NRA Ref: 447001
Date: March 2019

Source:
Soil Mapping and Monitoring PL, © Commonwealth of Australia (Geoscience Australia) 2010, CSIRO Land & Water, Google Earth

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Table 9: Soil landscape framework for the 15 Mile project area

Unit	Soil landscape description	Dominant Vegetation	Sites	Area (ha)
Landscape A: Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa)				
Elevated, level terrace plains; local relief 5-6 m above the incised river channel and 2-3 m above the clay backplains; slopes ≤ 0.5%				
A1	Very deep (>1.5 m), hardsetting to firm, clay loamy surfaced, black or brown structured gradational earth with moderate to strong blocky structure (5-20 mm) in the upper subsoil (CLS-LMC, fine to medium sand fraction); over buried micaceous alluvial sand and/or gravel and/or and clay deposits from or below 0.5-1.0 m. (Black or Brown Dermosol, occasional Black or Brown Chromosol).	Ghost Gum, large-fruited Bloodwood and Bauhinia with occasional River Red Gum and/or Coolibah	1, 2, 3, 7, 8, 9, 10, 15, 17, 19, 22, 23, 24, 32	311.0
Eroded terrace plain margins (adjacent to incised swales or oxbows); local relief 1-2 m below the elevated terrace plains; slopes mostly 3-10%				
A1e	**A1 eroded variant** – As for Soil A1; but with variably developed A horizons that have been partially or completely stripped; moderately to severely sheet eroded, but with minimal rill or gully development. (Black Dermosol).	Bauhinia with shrubby *Eremophila sp.* (Butterbush)	31	12.5
Less elevated, level to very gently undulating scroll plains; local relief 1-2 m below the elevated terrace plains and 1-2 m above the clay backplains; slopes ≤ 1.0%				
A2	Very deep (>1.5 m), hardsetting to firm pedal, black or grey non-cracking to cracking clay with moderate to strong blocky (or occasionally lenticular) (5-20 mm) structure throughout the subsoil (LMC-MHC, often fine sandy); buried micaceous alluvial sand and/or gravel and/or and clay deposits not encountered before 1.5 m. (Black Dermosol, less commonly Black Vertosol).	Coolibah with occasional Bauhinia; less commonly Coolibah- Bauhinia scrub	12, 18, 21, 25, 29, 33, 37	140.8
Low channel benches and incised terrace swales and oxbows; local relief 2-3m below the elevated terrace plains; slopes mostly ≤ 3.0%, up to 20% on incised sideslopes				
A3	Very deep (>1.5 m), hardsetting, clay loamy surfaced, brown structured gradational earth with weak to moderate blocky structure (10-20 mm) in the upper subsoil (CL-LC, fine sandy); over buried micaceous alluvial sand and/or gravel and/or and clay deposits from or below 0.5 m. (Brown Dermosol).	River Red Gum	11	33.3
A4	Very deep (>1.5 m), moderately to strongly self-mulching, black cracking clay with a moderately thick to thick (0.02-0.05 m), coarse granular (2-5 mm) surface (MC-MHC), over a coarse blocky (20-100 mm) upper subsoil (HC) and strong lenticular (5-100 mm) lower subsoil (HC); over buried micaceous alluvial sand and/or gravel and/or and clay deposits below 1.5 m. (Self-mulching Aquic Vertosol).	Coolibah or Coolibah - River Red Gum	16, 30	58.0

Unit	Soil landscape description	Dominant Vegetation	Sites	Area (ha)
Landscape B: Flinders River backplain alluvium – locally sourced, non-micaceous clayey alluvium overlying older regionally provenanced micaceous deposits (Qa)				
Locally inundated, level clay backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%				
B1	Very deep (>1.5 m), weakly to strongly self-mulching, grey or brown cracking clay with a thin to moderately thick (0.02-0.03 m), fine granular (<2 mm) surface (LC-MC, often silty/fine sandy), over a strong blocky (5-20 mm) upper subsoil (MC) and strong lenticular (5-50 mm) lower subsoil (MC-MHC); over buried micaceous sandy clay deposits (CLS-SLMC) from or below 0.9->1.5 m. (Epipedal/Self-mulching Grey or Brown Vertosol).	Mitchell Grass open downs	6, 35	55.1
B2	Very deep (>1.5 m), hardsetting, firm pedal or weakly self-mulching, black or brown cracking clay with an inconsistent, thin (0.02 m), fine granular (<2 mm) to blocky (2-20 mm) surface (LC –LMC fine sandy), over a strong blocky (5-20 mm) upper subsoil (LMC fine sandy) and moderate to strong blocky/lenticular (5-50 mm) lower subsoil (MC-MHC fine sandy); over buried micaceous sandy clay deposits (SCL-SLC medium/coarse sand fraction) from or below 0.7->1.5 m. (Epipedal Black or Brown Vertosol).	Sparse Boree scrub with associated Coolibah and Bauhinia	14, 36, 38, 39	98.5
B2g	**B2 gilgaied phase** – Very deep (>1.5 m), gilgaied (lattice or shallow melonhole VI 0.3 m, HI 15 m), moderately to strongly self-mulching, grey or black cracking clay with a moderately thick (0.03 m), fine granular (<2 mm) surface (MC), over a strong blocky to lenticular (10-20 mm) upper subsoil (MHC) and strong lenticular (5-100 mm) lower subsoil (MHC); over buried micaceous sandy clay deposits (MC fine sand fraction) from or below 1.3->1.5 m. (Self-mulching Black or Grey Vertosol).	Boree scrub with associated Coolibah and Bauhinia	5	21.4
Locally inundated, scalded backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%				
B3	Very deep (>1.5 m), severely scalded, hardsetting and often crusted, black (or occasionally brown) sodic non-cracking clay (or sodic texture contrast soil where residual A horizons remain intact) with moderate to strong blocky structure (5-20 mm) throughout the subsoil (LMC - MHC); buried horizons (where present) are >1.5 m. (Black (or occasionally Brown) Dermosol/Sodosol).	Severely scalded and un-vegetated; or with isolated Boree, Coolibah and Bauhinia	4, 13, 20, 28, 34	106.8
Landscape C: Fine-grained Cretaceous sedimentary rocks (labile mudstone, minor siltstone) (Kur)				
Gently undulating, elevated plains and low rises; local relief 5-10 m above the Flinders River alluvium; slopes 0.5-2.0%				
C1	Very deep (>1.5 m), weakly gilgaied (linear VI <0.15 m, HI 6 m), strongly self-mulching, red or brown cracking clay (MC-HC subsoil), with a thick (>0.06 m), fine granular (<2 mm) surface (MC), over a strong blocky to lenticular (2-20 mm) upper subsoil (MC-MHC), and strong lenticular (5-100 mm) lower subsoil (HC); over in-situ Cretaceous mudstone from 1.6 m. (Self-mulching Red or Brown Vertosol).	Mitchell Grass open downs	26	20.6

Unit	Soil landscape description	Dominant Vegetation	Sites	Area (ha)
Footslopes of the gently undulating, elevated plains and low rises (Soil C1); local relief 3-8 m above the Flinders River alluvium; slopes 2.0-5.0%				
C2	Very deep (>1.5 m), gravelly (2-20% rounded quartz), hardsetting, firm pedal or moderately to strongly self-mulching, brown cracking clay (subsoil - MC-MHC), with an inconsistent, thin to moderately thick (≤ 0.04 m), fine granular (<2 mm) to fine blocky (2-5 mm) surface (FSLC), over a strong blocky (5-20 mm) upper subsoil (MC), and strong lenticular (2-200 mm) lower subsoil (MC-MHC). (Epipedal or Self-mulching Brown Vertosol).	Boree scrub	27	30.0

Blue highlight = Full representative analytical profile; includes deep core profiles 12 and 24 which have additional pH, EC Cl data at standard depths to 3.3 m.
No highlight = detailed site with pH, EC Cl data at standard depths.
Yellow highlight = deep cores with pH, EC Cl data at 2 m depth intervals to 14 m.
Yellow highlight = deep cores described to 14 m+ but without salinity data.
Green highlight = semi-detailed check sites with indicative morphological data but no analytical data.

Two landscape units occur on the Quaternary Alluvium (Qa). Landscape A occurs on regionally provenanced, micaceous terrace alluvium deposited by overbank flow from the Flinders River. This landscape consists of landscape elements built up by overland flow from the Flinders River channel and the past migration of the meander bends within the flood plain. There are large areas of level elevated terrace plain (TEP) on the river frontage standing high above the incised Flinders River channel that are unlikely to be frequently flooded (**Plate 3**). There are also large areas of level to very gently undulating scroll plains (visible on the aerial imagery in the north-east and centre of the project area (**Plate 4**). This landscape is incised with prior stream channels and isolated or ephemeral oxbows (**Plate 5**).

Plate 3: Typical topography of the elevated alluvial terrace on Quaternary Alluvium

Plate 4: Very gently undulating scroll plains on Quaternary Alluvium

Plate 5: Incised terrace swale on Quaternary Alluvium

Landscape B occurs on locally sourced, non-micaceous clayey backplain alluvium overlying older regionally provenanced micaceous deposits. The area is flat with local relief 2-3 m below the TEP and is locally inundated **(Plate 6**). This backplain (BKP) landscape generally occurs further away from the channel behind the TEP and covers a large portion of the southern part of the project area. The area is dominated by cracking clay soils and has extensive scaled areas devoid of vegetation particularly through the centre of the site. In places, there is no groundcover and topsoil has been removed by wind and/or water erosion (**Plate 6**). There are better drained areas on the margins of Landscape B backplains closer to the river that have soils that also occur in Landscape A (Soil Unit A2). Although morphologically similar to the soils on the TEP, these soils are affected by subsoil salinity indicative of impeded landscape drainage and active salinity accession within the backplains (due to discharge from the adjacent rolling downs) (see soil unit pages in **Section 4.3** for more detail).

Plate 6: Level backplain on Quaternary Alluvium with Mitchell Grass on the left and severe scalds on the right

Landscape C is the Rolling Downs country on mudstones of the Cretaceous sediments and is isolated to the north-west section of the project area and extends to the south outside of the project boundary. This area is also dominated by cracking clay soils (**Plate 7**).

Plate 7: Gently undulating, elevated plains of the Rolling Downs on Cretaceous sediments

4.3 Soil unit descriptions

The following section provides a summary of field descriptions, analytical data and interpreted attributes for soil units described in the project area. Soil unit nomenclature is split according to landscape age (youngest to oldest) and landscape position and further sub-divided on the basis of soil unit and vegetation characteristics.

Information presented for each soil unit includes landscape description, detailed soil profile morphology, dominant vegetation, soil chemistry, physical soil attributes (based on data in **Appendices 5, 6, 7 and 9**), limitations to agricultural development and land suitability outcomes for irrigated horticulture (for the crops selected) (see descriptions of the data presented in **Table 10**). Data interpretation uses ratings and classes defined by Bruce and Rayment (1982), Baker and Eldershaw (1993), Peverill *et al.* (1999), Hazelton and Murphy (2016) and Burgess (2003a, b).

The distribution of soil units is shown in **Figure 6**.

Table 10: Soil and landscape attribute definitions

Soil or landscape attribute	Description
Geological landscape	Geological formation, dominant lithology and weathering status of the parent material.
Landform	Dominant relief/modal slope class, landform pattern and typical slope range.
Soil concept	A conceptual soil description summarising distinguishing profile features and parent material.
Soil classification	Australian Soil Classification – Suborder/Soil Order (Isbell & NCST 2016).
Runoff, permeability and drainage	Estimates as defined by the National Committee on Soil and Terrain (NCST) (2009).
Surface features	Surface condition as defined by the NCST (2009).
	Presence or absence of microrelief (type, degree of development, size and dominance of components).
	Estimates of gravel and rock as defined by the NCST (2009).
Dominant vegetation	Summary of the dominant mid/upper stratum species and structure

Soil or landscape attribute	Description
Modal soil profile description	Descriptions of the depth, horizon designation, dominant colour, mottling, texture, structure, segregations, gravel and field pH of the major soil horizons and underlying substrate as defined by the NCST (2009): estimates of the effective rooting depth (ERD), plant available water capacity (PAWC) and surface soil erodibility (K factor).
Root zone salinity	Assessment of the severity and distribution of soluble salt loads and effective rooting depth (ERD) of the soil.
Soil analytical summary	Summary of the fertility status and ratings for organic carbon, total nitrogen and available phosphorus, potassium, calcium, minor elements, sulfur and micronutrients.
	Important soil chemistry attributes of the surface soil and subsoil including pH, electrical conductivity, soluble chloride, cation exchange capacity, exchangeable cations, cation dominance, ESP, sodicity and dispersive behaviour (R1).
	Important physical soil characteristics including clay content, sand fraction, clay mineralogy and dispersion.
Limitations to horticultural development	Inherent climatic, landscape or soil based factors that affect or potentially limit irrigated horticultural development, such as surface rock, salinity and drainage.
Land suitability outcomes	Land suitability findings for irrigated avocados, citrus and table grapes.

Figure 6: Distribution of soil units

Project: 15 Mile Irrigation Project Land Suitability Study

Lot 168 on SP262319
Roads
Watercourses
Unique Mapping Areas (UMA)
Labels indicate soil unit and UMA number
Detailed sites
Representative analytical sites
Semi-detailed check sites
Deep cores

Unit	Soil landscape description	Vegetation
Landscape A: Flinders River terrace alluvium (Qa)		
Elevated, level terrace plains		
A1	Clay loamy surfaced Black/Brown Dermosol over buried alluvial layers from 0.5-0.8 m.	Ghost gum, bloodwood ± bauhinia
Eroded terrace plain margins		
A1e	As for Soil A1 but partially or completely sheet eroded.	Bauhinia ± *Eremophila sp.*
Less elevated, level to very gently undulating scroll plains		
A2	Clay loamy surfaced Black Dermosol to Epipedal Black Vertosol over buried alluvial layers below 1.5 m.	Coolibah with bauhinia
Low channel benches, terrace swales and oxbows		
A3	Clay loamy surfaced Brown Dermosol over buried alluvial layers from 0.5 m.	River red gum
A4	Self-mulching Black Vertosol over buried alluvial layers below 1.5 m.	Coolibah ± river red gum
Landscape B: Flinders River backplain alluvium (Qa)		
Locally inundated, level clay backplains		
B1	Epipedal or Self-mulching Grey/Brown Vertosol over buried sandy clay deposits from 0.9->1.5 m.	Mitchell grass open downs
B2	Clayey surfaced Black/Brown Dermosol to Epipedal Black/Brown Vertosol over buried sandy clay deposits from 0.7->1.5 m.	Sparse boree scrub ± coolibah and bauhinia
B2g	Gilgaied Self-mulching Black/Grey Vertosol over buried sandy clay deposits from 1.3->1.5 m.	Boree scrub ± coolibah and bauhinia
B3	Severely scalded, sandy to clayey surfaced Black/Brown Dermosol (or Sodosol/Chromosol).	Un-vegetated; or isolated boree, coolibah and bauhinia
Landscape C: Labile Cretaceous sedimentary rocks (Kur)		
Gently undulating, elevated plains and low rises		
C1	Self-mulching Red/Brown Vertosol over weathered calcareous mudstone from 1.3->1.5 m.	Mitchell grass open downs
Footslopes of the elevated plains and low rises		
C2	Epipedal or Self-mulching Brown Vertosol over weathered calcareous mudstone from 1.2->1.5 m.	Boree scrub

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NRA Ref: 447001
Date: March 2019

Source:
Soil Mapping and Monitoring PL, © State of Queensland (Department of Natural Resources, Mines and Energy) 2019.

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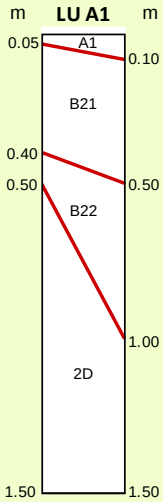
Recommended print size: A3

Soil Unit A1	Bloodwood terrace plains
Geological landscape:	Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa).
Landform:	Elevated, level terrace plains; local relief 5-6 m above the incised river channel and 2-3 m above the clay backplains; slopes ≤ 0.5%.
Soil concept:	Very deep (>1.5 m), hardsetting to firm, clay loamy surfaced, black or brown structured gradational earth with moderate to strong blocky structure (5-20 mm) in the upper subsoil (CLS-LMC, fine to medium sand fraction); over buried micaceous alluvial sand and/or gravel and/or and clay deposits from or below 0.5-1.0 m.
Aust. Soil Classification:	Black or Brown Dermosol, occasional Black or Brown Chromosol.
Runoff, perm., drainage:	Slow runoff; moderately permeable (occ. slowly permeable); moderately well-drained.
Surface features:	Hardsetting, occ. firm; non-cracking; non-gilgaied; non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Ghost gum, large-fruited bloodwood and bauhinia with occasional river red gum and/or coolabah.
Investigation area:	Total area mapped: 311.0 ha No. of Field sites: 14 Analysed sites: 2, 24

Typical bloodwood - ghost gum vegetation on the terrace plain (Site 22)

Hardsetting sandy clay loamy surface (Site 24).

Modal Soil Profile Description



The **surface soil** (A1) is a black (10YR 2/1, 3/2) or brown (3/3, 4/3), sandy clay loam to clay loam sandy (fine sand), with massive to weak subangular blocky (5-20 mm) structure; non-gravelly; few to common very fine (<1 mm diameter) roots; field pH 6.5-8.5. Lower depth 0.05- 0.1 m. Abrupt to clear change.

The **upper subsoil** (B21) is a black (10YR 2/2, 3/1-2) or brown (10YR 3/3), clay loam sandy to light medium clay (fine to medium sand), with moderate to strong angular blocky (5-20 mm) structure; non-gravelly; few to common very fine (<1 mm diameter) roots; field pH 6.5-8.5. Lower depth 0.4-0.5 m. Clear to gradual change.

The **lower subsoil** (B22) is a black (10YR 3/2) or brown (10YR 3/3, 4/3), sandy clay loam to clay loam sandy (fine to medium sand), with weak to strong angular blocky (5-20 mm) structure; occasional <2-20% <2 mm calcareous soft segregations; few to common very fine (<1 mm diameter) roots; field pH 6.0-8.5. Lower depth 0.5-1.0 m. Clear to gradual change.

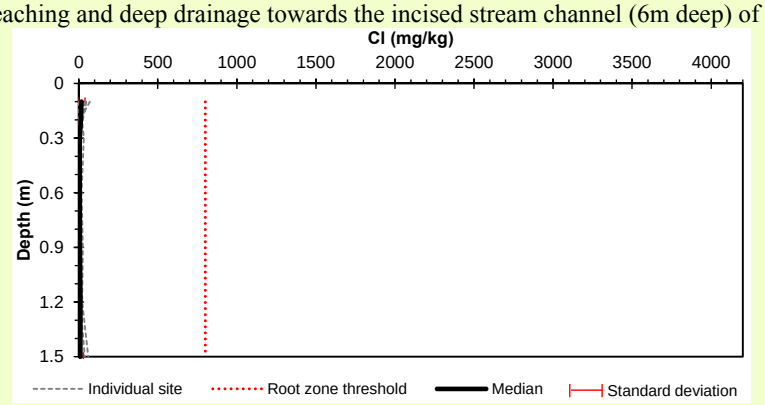
Buried horizons (2D) are brown (10YR 3/3-4, 4/3-4, 5/3) or yellow (10YR 6/4), sand to sandy loam grading coarser and sandier with depth; with massive structure and sandy or earthy fabric; non-gravelly; roots absent or few very fine (<1 mm diameter) roots; field pH 7.0-9.0. Buried layers (including coarse gravel beds and clay lenses) are randomly distributed stratigraphically and spatially, and were laid down by stream channel movements during scroll plain development. They vary enormously in terms of thickness and sequencing. Deposits can be shallow (0.5 m), but are most common below 0.8-1.0 m. All deposits (including clay layers) have a consistent visible micaceous sand fraction.

PAWC to 1.0 m:	PAWC to 1.5 m:	K factor:
63-71 mm	100-110 mm	0.040-0.043 (high)

Soil Unit A1 Bloodwood terrace plains

Root zone salinity

Median salinity levels are very low (Cl <50 mg/kg) throughout, and effective rooting depth (ERD) >1.5 m. Salinity curves lack a recognizable equilibrium "salt bulge", and salinity characteristics confirm the landscape is subject to regular leaching and deep drainage towards the incised stream channel (6m deep) of the Flinders River.



Soil analytical summary

The soil has a beneficial organic fraction with low to moderate organic carbon, and moderate to high total nitrogen levels. Inorganic nutrients are above sufficiency levels with high to very high phosphorous and potassium, moderate to high calcium, and moderate micronutrients levels (copper and zinc). The only exception is sulfate which is low to very low. Soil pH values are neutral to alkaline (range 6.4-8.7) in the upper profile (0-0.6 m), and strongly alkaline (range 7.8-8.9) at depth (0.9-1.5 m). CEC values are low to moderate (range 6-19 cmol/kg) in both surface and subsoil horizons, but vary significantly in buried layers. CEC/clay ratios are moderate to high throughout (range 0.5-0.9), and suggest the clay fraction is of mixed mineralogy with moderate to high activity. Profiles are non-saline (EC_e <2 dS/m, Cl<50mg/kg), non-sodic (ESP <1%), moderately well-drained and moderately permeable.

Clay content is low to moderate (range 9-21%) in surface horizons, and gradually increases to moderate levels (range 16-28%) in the subsoil. Buried horizons are highly variable (range <10-37%). The surface soil is massive to weakly structured, with an elevated fine sand/ silt fraction (51-64%); and will be prone to slaking and pulverescent behaviour following aggressive tillage. The subsoil has similar fine sand/ silt characteristics, but is moderately to strongly structured (blocky). Buried layers to 1.5 m are predominantly massive and sandy. Profiles are rigid throughout and lack sodicity and salinity constraints. Laboratory measured dispersion is moderate to high in the surface soil (R1 0.74-0.89), high in the subsoil (0.82-0.87) and highly variable in buried layers (0.6-0.99). Values reflect inherent instability within the fine sand/silt fraction (rather than a dispersive clay fraction).

Limitations to horticultural development

Identified constraints are either minor or moderate and include heat stress(Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), flooding (F), infiltration/recharge (Ir), soil water storage to 1.0m (M) (citrus and table grapes only), nutrient balance (Nr) (citrus only), surface soil condition (Ps) and soil wetness (W).

Land suitability outcomes

Soil Unit A1 is suitable with moderate limitations (Class 3) for irrigated table grapes, citrus and avocado production. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

Profile at Site 1 with loose sand from 0.8m

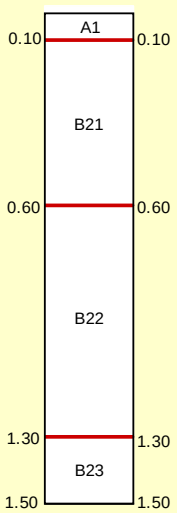
Driller's core to 24m at Site 8; soil first 2-3m (far right)

Soil Unit A1e	**Eroded terrace plain margins**
Geological landscape:	Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa).
Landform:	Eroded terrace plain margins (adjacent to incised swales or oxbows); local relief 1-2 m below the elevated terrace plains; slopes mostly 3-10%.
Soil concept:	As for Soil A1; but with variably developed A horizons that have been partially or completely stripped by moderate to severe sheet erosion and limited rill and gully development.
Aust. Soil Classification:	Black Dermosol.
Runoff, perm., drainage:	Moderately rapid runoff; slowly permeable; moderately well-drained.
Surface features:	Firm or hardsetting; non-cracking; non-gilgaied; non-gravelly; no outcrop.
Dominant vegetation:	Bauhinia with shrubby *Eremophila* sp.
Investigation area:	Total area mapped: 12.5 ha No. of Field sites: 1 Analysed site:– NA

Severely sheet eroded terrace margins with bauhinia and shrubby butterbush at Site 31

Rill formation and localised sheet wash on terrace sideslopes at Site 31

Modal Soil Profile Description



The **surface soil** (A1) is a black (10YR 3/2), sandy clay loam (medium to coarse sand), with weak subangular blocky (10-20 mm) structure; non-gravelly; common very fine (<1 mm diameter) roots; field pH 6.5-7.0. Lower depth 0.1 m. Gradual change.

The **upper subsoil** (B21) is a black (10YR 3/2), clay loam sandy (medium to coarse sand), with moderate angular blocky (5-10 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 6.5-7.5. Lower depth 0.6 m. Diffuse change.

The **lower subsoil** (B22, B23) is a brown (10YR 3/3, 4/3), light medium clay grading to sandy light clay at depth (fine to medium sand), with moderate to strong angular blocky to prismatic (10-50 mm) structure; <2-10% <2 mm calcareous nodules and soft segregations; 2-10% faint yellow mottles at depth; few very fine (<1 mm diameter) roots; field pH 8.0-8.5. Profile is typically deeper than 1.5 m.

Buried horizons (2D) were not observed but are likely and would have similar characteristics to those described for Soil A1.

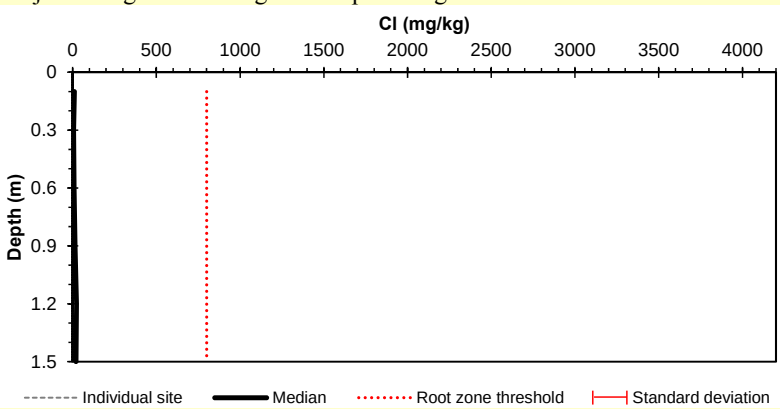
PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
63 mm [#]	100 mm [#]	0.043 (high) [#]

[#] PAWC and K factor data are based on data from Soil A1 – Site 2

Soil Unit A1e **Eroded terrace plain margins**

Root zone salinity

Median salinity levels are very low (Cl <50 mg/kg) throughout, and effective rooting depth (ERD) >1.5 m. Salinity curves lack a recognizable equilibrium "salt bulge", and salinity characteristics confirm the landscape is subject to regular leaching and deep drainage towards the incised oxbow feature that sits adjacent.



Soil analytical summary

Salinity analyses confirm Soil A1e and Soil A1 have similar leaching profiles and are developed from the same alluvium. Erosion features on Soil A1e are the product of overgrazing and higher gradients (3-10%) around terrace margins, and not different physical or chemical soil attributes. Soil analytical data and interpretations from Soil A1 (Site 24) provided below can be applied equally to Soil A1e.

The soil has a modest organic fraction with low organic carbon, and moderate total nitrogen levels. Inorganic nutrients are above sufficiency levels with high phosphorous and potassium, moderate calcium, and moderate micronutrients levels (copper and zinc). The only exception is sulfate which is very low. Soil pH values are neutral to slightly alkaline (range 6.7-7.7) in the upper profile (0-0.6 m), and alkaline (range 8.0-8.3) below. CEC values are low (range 6-9 cmol/kg) in both surface and subsoil horizons. CEC/clay ratios are moderate throughout (range 0.5-0.7), and suggest the clay fraction is of mixed mineralogy with moderate activity. Profiles are non-saline (EC_e <2 dS/m, Cl<50mg/kg), non-sodic (ESP <1%), moderately well-drained and slowly permeable.

Clay content is low (range 9-18%) throughout the profile. The surface soil is weakly structured, with an elevated fine sand/ silt fraction (51-53%); and will be prone to slaking and pulverescent behaviour following aggressive tillage. The subsoil has similar fine sand/ silt characteristics, but is moderately to strongly structured (blocky to prismatic). Profiles are rigid throughout and lack sodicity and salinity constraints. Laboratory measured dispersion is high in the surface soil (R1 0.81-0.89) and high in the subsoil (0.86-0.87). Values reflect inherent instability within the fine sand/silt fraction (rather than a dispersive clay fraction).

Limitations to horticultural development

Identified constraints range from minor or extreme and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding(F), infiltration/recharge (Ir), soil water storage to 1.0m (M) (citrus and table grapes only), nutrient balance (Nr) (citrus only), surface soil condition (Ps), discharge potential (Ss), soil wetness (W) and topographic complexity (Xt).

Land suitability outcomes

Soil Unit A1e is unsuitable (Class 5) for irrigated table grapes, citrus and avocado production. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

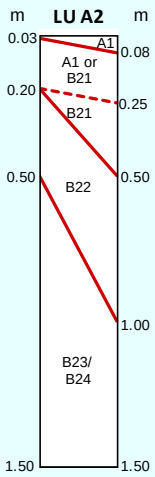
Soil Unit A2	Coolibah scroll plains
Geological landscape:	Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa).
Landform:	Less elevated, level to very gently undulating scroll plains; local relief 1-2 m below the elevated terrace plains and 1-2 m above the clay backplains; slopes ≤ 1.0%.
Soil concept:	Very deep (>1.5 m), hardsetting to firm pedal, black or grey non-cracking to cracking clay with moderate to strong blocky (or occasionally lenticular) (5-20 mm) structure throughout the subsoil (LMC-MHC, often fine sandy); buried micaceous alluvial sand and/or gravel and/or and clay deposits not encountered before 1.5 m.
ASCSoil Classification:	Black Dermosol, less commonly Black Vertosol.
Runoff, perm., drainage:	Very slow to slow runoff; slowly permeable; moderately well-drained or occasionally imperfectly drained.
Surface features:	Hardsetting to firm pedal; non-cracking, less commonly cracking; non-gilgaied, rarely minor lattice gilgai (VI 0.2 m HI 25 m); non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Coolibah with occasional bauhinia; less commonly coolibah- bauhinia scrub.
Investigation area:	Total area mapped: 140.8 ha No. of Field sites: 7 Analysed sites:12, 25

Typical coolibah scroll plain at Site 12

Deep core to 3.5m at Site 12 - black Vertosol over river sand (from 2.4m)

Blocky surface structure at Site 25

Modal Soil Profile Description



The **surface soil** (A1) is a black (10YR 3/2) or grey (10YR 4/2), rarely mottled (10-20% <5 mm distinct orange mottles), clay loam sandy to light medium clay (with fine sand), with weak to strong granular (<2 mm) to subangular blocky (2-20 mm) structure; non-gravelly; few to common very fine (<1 mm diameter) roots; field pH 6.5-7.5. Lower depth typically 0.03-0.08 m, occasionally thicker (0.2-0.25 m). Abrupt to clear change.

The **upper subsoil** (B21) is a black (10YR 3/1, 3/2) or grey (10YR 4/1), rarely mottled (2-10% <5 mm faint brown mottles), light medium to medium clay (with fine to medium sand), with moderate to strong angular blocky (5-20 mm) structure; non-gravelly; few to common very fine to fine (<1-2 mm diameter) roots; field pH 6.5-8.5. Lower depth 0.2-0.5 m. Gradual to diffuse change.

The **lower subsoil** (B22, B23, B24) is a black (10YR 3/1, 3/2) or brown (7.5YR, 10YR 3/3, 4/3, 4/4), rarely mottled (2-20% <5-15 mm distinct brown or orange mottles), light clay to medium heavy clay (with fine to medium sand), with moderate to strong angular blocky to lenticular (5-100 mm) structure; common <2-10% <2-6 mm calcareous nodules and soft segregations and rare <2% <2 mm gypsum crystals; often few to common very fine to fine (<1-2 mm diameter) roots; field pH 7.5-9.0. Profiles are typically deeper than 1.5 m.

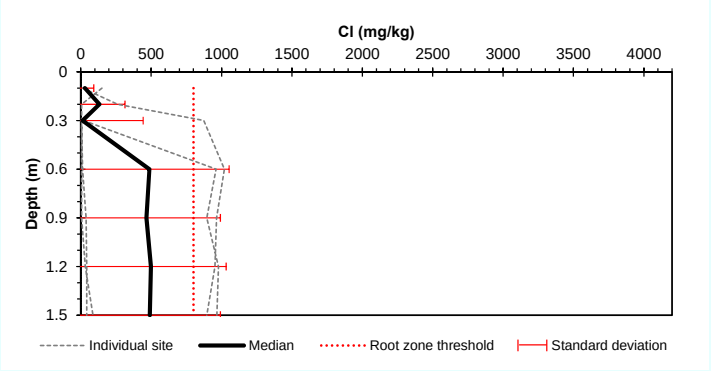
Buried horizons (2D) occur below 1.5m, and are similar to deposits beneath Soils A1 and A1e; brown (10YR 3/3-4, 4/3-4, 5/3) or yellow (10YR 6/4), sand to sandy loam grading coarser and sandier with depth; with massive structure and sandy or earthy fabric; non-gravelly; roots absent or few very fine (<1 mm diameter) roots; field pH 7.0-9.0. Buried layers (including coarse gravel beds and clay lenses) were laid down by stream channel movements during scroll plain development and vary enormously in terms of thickness and sequencing. Deposits typically have a visible consistent micaceous sand fraction.

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
37-104 mm (ERD 0.3->1.5 m)	37-133 mm (ERD 0.3->1.5 m)	0.057-0.071 (high to very high)

Soil Unit A2 **Coolibah scroll plains**

Root zone salinity

Two groups with differing salinity characteristics are recognised within the A2 soil. The first group have non-saline profiles and are associated with the elevated terrace plains (Sites 12, 18 – A2 TEP), while the second group have significant subsoil salinity, and lie adjacent to or form part of the low lying backplain landscape (Sites 21, 25 – A2 BKP). Salinity levels for the elevated A2 TEP group are very low (Cl <50 mg/kg) throughout, and the effective rooting depth (ERD) is >1.5 m. Salinity curves for this group lack a recognizable equilibrium "salt bulge", and salinity characteristics confirm the landscape is subject to leaching and deep drainage towards the incised stream channel (6m deep) of the Flinders River. Subsoil salinity levels for the less elevated A2 BKP group are moderate to high (Cl 800-1000 mg/kg) below 0.3-0.5m, and have a recognizable equilibrium "salt bulge" (i.e. the "salt bulge" remains constant) below this depth. The start of the "salt bulge" marks the long-term wetting front and effective rooting depth for this group, and is indicative of impeded landscape drainage and active salinity accession within the backplains (due to discharge from the adjacent rolling downs).



Soil analytical summary

Organic carbon levels are moderate and total nitrogen levels are high to very high and confirm the soil has a significant organic fraction. Macronutrient levels are elevated with high to very high levels of calcium, phosphorous and potassium and moderate levels of sulfate, while micronutrients (copper and zinc) levels are moderate. Soil pH values indicate soil profiles are neutral at the surface (6.7-7.3), slightly alkaline to alkaline (7.5-8.5) in the upper profile (to 0.6m) and alkaline to strongly alkaline (8.1-9.0) at depth. CEC values (range 21-31 cmol/kg) are moderate to high and CEC/clay ratios (range 0.5-1.0) are moderate to very high, suggesting the clay fraction is of mixed mineralogy with moderate to high activity.

Clay content for the dominant non-cracking clays (Dermosols) is moderate (range 21-37%) in the surface and upper subsoil to 0.3 m, and increasing to high levels (range 43-48%) in the subsoil. The surface soil is weakly to strongly structured (blocky), with an elevated fine sand/ silt fraction (74-79%); and will be prone to slaking and pulverescent behaviour following aggressive tillage. The subsoil has similar fine sand/ silt characteristics, but is better structured (mod. to strong blocky). Clay content for the cracking clays (Vertosols) is moderately high to high (39-49%) throughout, with more structured surface soil but similar subsoil materials.

Salinity, sodicity and dispersion characteristics relate to landscape position (see root zone salinity comments). Profiles in the A2 TEP group are non-saline, non-sodic and have moderate surface dispersion (R1 0.64) and low subsoil dispersion (R1 0.52-0.57). Profiles in the A2 backplain group, have significant subsoil salinity (Cl >800-1000 ppm) and strong to extreme sodicity (ESP 19-38%) from 0.3-0.5 m. Laboratory measured dispersion is moderate to high in the surface soil (R1 0.63-0.65) and high to extreme in the subsoil (0.80-0.98).

Limitations to horticultural development

Identified constraints range from minor to severe but vary from between individual UMAs. This summary provided only general information about constraints. A more complete analysis is provided in **Appendices 11 and 12**. Constraints include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), salinity (Sa), discharge potential (Ss), soil wetness (W) and topographic complexity (Xt).

Land suitability outcomes

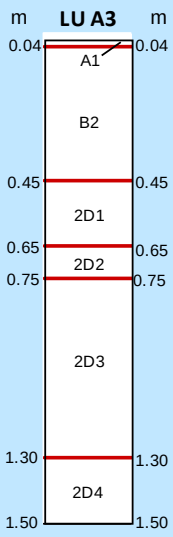
Most UMAs on soils in the A2 TEP group are suitable (Class 3) for irrigated citrus and table grapes with negligible to moderate limitations, but unsuitable for avocados because of severe constraints. UMAs on soils in the A2 BKP group are unsuitable (Class 4) for all selected crops because of severe constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

Soil Unit A3	River red gum channels benches and swales
Geological landscape:	Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa).
Landform:	Low channel benches and incised terrace swales; local relief 2-3m below the elevated terrace plains; slopes mostly ≤ 3.0%, up to 20% on incised sideslopes.
Soil concept:	Very deep (>1.5 m), hardsetting, clay loamy surfaced, brown structured gradational earth with weak to moderate blocky structure (10-20 mm) in the upper subsoil (CL-LC, fine sandy); over buried micaceous alluvial sand and/or gravel and/or and clay deposits from or below 0.5 m.
Aust. Soil Classification:	Brown Dermosol.
Runoff, perm., & drainage:	Very slow runoff; moderately permeable; moderately well-drained.
Surface features:	Hardsetting; non-cracking; non-gilgaied; non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	River red gum.
Investigation area:	Total area mapped: 33.3 ha No. of Field sites: 1 Analysed site – NA

Elongated swale (channelled and incised) with river red gum (Site 11)

Brown Dermosol within an incised terrace swale at Site 11; buried alluvial sand from 0.5m

Modal Soil Profile Description



The **surface soil** (A1) is a brown (10YR 4/3), sandy clay loam (fine sand), with massive to weak subangular blocky to platy (5-10 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 7.0-7.5. Lower depth 0.04 m. Clear change.

The **subsoil** (B2) is a brown (10YR 4/4), clay loam sandy to light clay (fine sand), with weak to moderate subangular blocky (10-20 mm) structure; non-gravelly; common very fine (<1 mm diameter) roots; field pH 8.0-8.5. Lower depth 0.45 m. Clear to gradual change.

Buried horizons:

2D1 - brown (10YR 5/3), sand (medium to coarse sand), with massive structure and sandy fabric; non-gravelly; few very fine (<1 mm diameter) roots; field pH 8.0-8.5. Lower depth 0.65 m. Clear change.

2D2 - brown (10YR 4/3), clay loam sandy (fine sand), with massive structure and earthy fabric; non-gravelly; common very fine (<1 mm diameter) roots; field pH 7.5-8.0. Lower depth 0.75 m. Clear change.

2D3 - brown (10YR 5/3), sand (medium to coarse sand), with massive structure and sandy fabric; non-gravelly; few very fine (<1 mm diameter) roots; field pH 7.5-8.5. Lower depth 1.3 m. Gradual change.

2D4 - loamy sand (medium to coarse sand), with massive structure and earthy fabric; non-gravelly; common very fine (<1 mm diameter) roots; field pH 8.0-8.5. Profiles are deeper than 1.5 m.

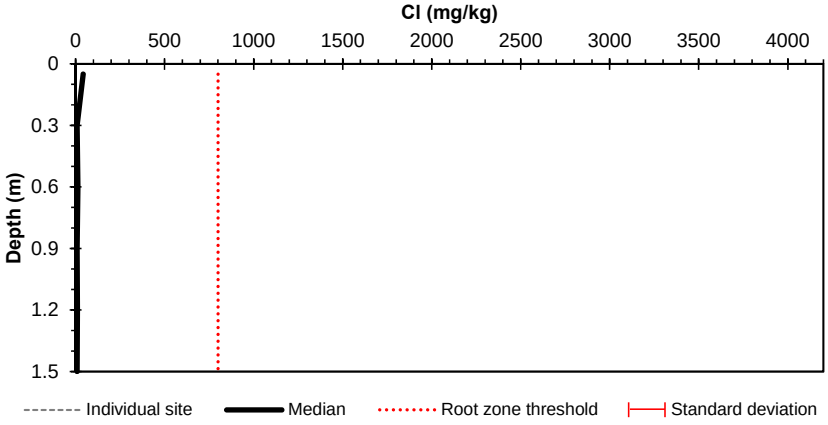
PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
71 mm #	110 mm #	0.040 (high) #

PAWC and K factor data are based on data from Soil A1 – Site 2

Soil Unit A3 River red gum channels benches and swales

Root zone salinity

Median salinity levels are very low (Cl <50 mg/kg) throughout, and effective rooting depth (ERD) is >1.5 m. Salinity curves lack a recognizable equilibrium "salt bulge", and salinity characteristics confirm the landscape is subject to regular leaching and deep drainage from inundation events and more generally towards the stream channel (6m deep) of the Flinders River.



Soil analytical summary

Salinity analyses confirm Soil A3 and Soil A1 have similar leaching profiles and are developed from the same alluvium. Soil analytical data and interpretations as described below from Soil A1 (Site 2) apply equally to Soil A3.

The soil has a beneficial organic fraction with moderate organic carbon, and high total nitrogen levels. Inorganic nutrients are above sufficiency levels with very high phosphorous and potassium, high calcium, and moderate micronutrients levels (copper and zinc). The only exception is sulfate which is low. Soil pH values are neutral at the surface (7.3), alkaline in the upper profile (8.5) and strongly alkaline (8.7) below. CEC values are moderate (range 17-19 cmol/kg) in both surface and subsoil horizons, but vary significantly in buried layers. CEC/clay ratios are moderate to high throughout (range 0.6-0.9), and suggest the clay fraction is of mixed mineralogy with moderate to high activity. Profiles are non-saline (EC_e <2 dS/m, Cl<50mg/kg), non-sodic (ESP <1%), moderately well-drained and moderately permeable.

Clay content is moderate (range 21-28%) throughout the profile, while buried horizons are highly variable (range 15-37%). The surface soil is massive to weakly structured, with an elevated fine sand/ silt fraction (64%); and will be prone to slaking and pulverescent behaviour following aggressive tillage. The subsoil has similar fine sand/ silt characteristics, but is weakly to moderately structured (blocky). Buried layers to 1.5 m are predominantly massive and sandy. Profiles are rigid throughout and lack sodicity and salinity constraints. Laboratory measured dispersion is moderate in the surface soil (R1 0.74), high in the subsoil (0.82) and highly variable in buried layers (0.6-0.91). Values reflect inherent instability within the fine sand/silt fraction (rather than a dispersive clay fraction).

Limitations to horticultural development

Identified constraints range from heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding (F), infiltration/recharge (Ir), soil water storage to 1.0 m (M) (citrus and table grapes only), nutrient balance (Nr), surface soil condition (Ps), discharge potential (Ss), soil wetness (W) and topographic complexity (Xt).

Land suitability outcomes

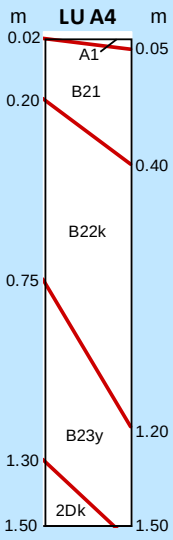
Soil Unit A3 is unsuitable (Class 4) for irrigated citrus, table grapes and avocados because of severe constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

Soil Unit A4	Coolibah oxbows
Geological landscape:	Flinders River terrace alluvium – regionally provenanced micaceous alluvium deposited by overbank flow from the Flinders River (Qa).
Landform:	Low-lying, incised oxbows; local relief 2-3m below the elevated terrace plains; slopes mostly ≤ 3.0%, up to 20% on incised sideslopes.
Soil concept:	Very deep (>1.5 m), moderately to strongly self-mulching, black cracking clay with a moderately thick to thick (0.02-0.05 m), coarse granular (2-5 mm) surface (MC-MHC), over a coarse blocky (20-100 mm) upper subsoil (HC) and strong lenticular (5-100 mm) lower subsoil (HC); over buried micaceous alluvial sand and/or gravel and/or and clay deposits below 1.5 m.
Aust. Soil Classification:	Self-mulching Aquic Vertosol.
Runoff, perm. & drainage:	No runoff; very slowly permeable; poorly drained.
Surface features:	Moderately to strongly self-mulching; cracking; non-gilgaied; non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Coolibah or coolibah – river red gum
Investigation area:	Total area mapped: 58.0 ha No. of Field sites: 2 Analysed site: 16

Coolibah – river red gum woodland in an oxbow feature at Site 30

Coolibah open woodland, surface cracking and typical black Aquic Vertosol profile at Site 16

Modal Soil Profile Description



The **surface soil** (A1) is a black (10YR 3/2) or grey (10YR 4/2), commonly mottled (20-50% <5 mm distinct orange mottles), medium clay to medium heavy clay, with strong coarse granular (2-5 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 6.5-7.5. Lower depth 0.02-0.05 m. Abrupt to clear change.

The **upper subsoil:**

B21 - black (2.5Y, 10YR 3/1, 3/2), commonly mottled (20-50% <5 mm distinct orange mottles), heavy clay, with moderate to strong angular blocky to lenticular (5-100 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 7.0-8.0. Lower depth 0.2-0.4 m. Gradual change.

B22k - black (2.5Y 3/1), heavy clay, with strong lenticular (5-100 mm) structure; <2% <2 mm calcareous nodules; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 0.75-1.2 m. Diffuse change.

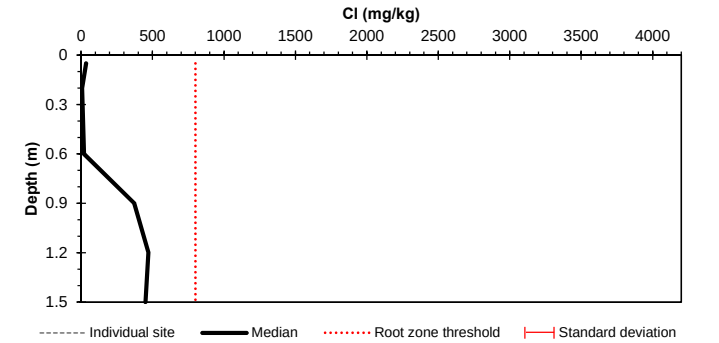
The **lower subsoil** (B23y) is a black (10YR 3/2), commonly mottled (30-70% <5-15 mm distinct brown and orange mottles), heavy clay, with moderate to strong angular blocky to lenticular (10-20 mm) structure; 2-10% <2 mm gypsum crystals; roots absent; field pH 8.0-9.0. Profiles are typically deeper than 1.5 m.

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
117 mm (ERD 0.8 m)	117 mm (ERD 0.8 m)	0.046 (high)

Soil Unit A4 Coolibah oxbows

Root zone salinity

Subsoil salinity levels are moderate (Cl 370-470 mg/kg) below 0.8m, and have a recognizable equilibrium "salt bulge" (i.e. the "salt bulge" remains constant) below this depth. The start of the "salt bulge" marks the long-term wetting front and effective rooting depth (0.8 m) for this soil, and corresponds to the depth at which ESP values >15% occur. Salinity characteristics are a compromise between impeded landscape drainage, regular flushing and salinity accession from adjacent backplains.



Soil analytical summary

The soil has a modest organic fraction with low organic carbon and moderate total nitrogen levels. Macronutrient levels are very high (calcium, phosphorous, potassium and sulfate), while micronutrients (copper and zinc) levels are moderate. Soil pH values indicate soil profiles are neutral (6.8-7.1) in the surface soil to 0.2 m, and slightly to strongly alkaline in both the upper (0.2-0.6 m) (range 7.8-8.7) and lower subsoil (0.9-1.5 m) (range 7.9-8.7). CEC levels (33-37 cmol/kg) are high throughout. Moderate CEC/clay ratios (0.6) and the presence of cracking and lenticular structure suggest the clay fraction is of mixed mineralogy (with a high proportion of smectites), is highly reactive and has significant shrink-swell characteristics.

Clay content is very high and relatively uniform (60-62%) throughout the profile. Structure within the plough zone to 0.3 will be coarse, blocky and difficult to breakdown (high strength) even though the immediate surface soil is self-mulching (coarse granular 2-5 mm). Surface and upper subsoil material will be prone to significant compaction if subject to heavy traffic or aggressive tillage when moist or wet. The surface soil and upper subsoil to 0.4 m are non-saline (Cl <50 ppm) and non-sodic (ESP 1-2%), with low to moderate dispersion (R1 0.49-0.65). The lower subsoil below 0.4 m has increasing salinity (moderate Cl 21-451 ppm) and sodicity (moderate to very high ESP 10-24%), high dispersion (R1 0.80-0.91) and coarse macro lenticular structure, that together limit effective rooting depth (ERD 0.8 m). Profiles are characterised by Calcium (Ca) dominant cation chemistry throughout (high Ca/Mg ratios).

Limitations to horticultural development

Identified constraints range from minor to extreme and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding (F), infiltration/recharge (Ir), nutrient balance (Nr), surface soil condition (Ps), discharge potential (Ss), soil wetness (W) and topographic complexity (Xt).

Land suitability outcomes

Soil Unit A4 is unsuitable (Class 5) for irrigated for irrigated citrus, table grapes and avocados because of severe constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

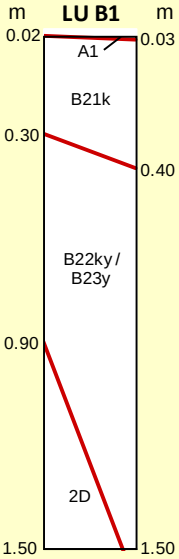
Flood height marks to 2.5m and recent flood sediment at Site 30

Soil Unit B1	Mitchell grass backplains
Geological landscape:	Flinders River backplain alluvium – locally sourced, non-micaceous clayey alluvium overlying older regionally provenanced micaceous deposits (Qa)
Landform:	Locally inundated, level clay backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%.
Soil concept:	Very deep (>1.5 m), weakly to strongly self-mulching, grey or brown cracking clay with a thin to moderately thick (0.02-0.03 m), fine granular (<2 mm) surface (LC-MC, often silty/fine sandy), over a strong blocky (5-20 mm) upper subsoil (MC) and strong lenticular (5-50 mm) lower subsoil (MC-MHC); over buried micaceous sandy clay deposits (CLS-SLMC) from or below 0.9->1.5 m.
Aust. Soil Classification:	Epipedal/Self-mulching Grey or Brown Vertosol.
Runoff, perm., & drainage:	Very slow runoff; very slowly permeable; moderately well-drained.
Surface features:	Weakly to strongly self-mulching; surface flake and fine sandy wash; cracking; non-gilgaied; non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Mitchell grass open downs.
Investigation area:	Total area mapped: 55.1 ha No. of Field sites: 2 Analysed site: 6

Level backplains with Mitchell Grass at Site 6

Severe cracking and thin to moderately thick self-mulch at Site 6

Modal Soil Profile Description



The **surface** soil (A1) is a grey (10YR 4/2) or brown (10YR 3/3), light clay to medium clay (often silty/fine sandy), with moderate to strong granular (<2 mm) to subangular blocky (2-5 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 6.5-8.5. Lower depth 0.02-0.03 m. Clear change.

The **upper subsoil** (B21k) is a grey (10YR 4/2) or brown (10YR 3/3), medium clay, with moderate to strong angular blocky (5-20 mm) structure; <2% <2 mm calcareous nodules; few very fine (<1 mm diameter) roots; field pH 8.0-9.0. Lower depth 0.3-0.4 m, common slight effervescence. Gradual change.

The **lower subsoil** (B22ky/B23y) is a grey (10YR 4/2) or brown (10YR 3/3), medium clay to medium heavy clay, with moderate to strong lenticular (5-50 mm) structure; <2% <2 mm calcareous nodules and <2-10% <2 mm gypsum crystals; roots absent or few very fine (<1 mm diameter) roots; field pH 8.5- 9.0. Lower depth 0.9->1.5 m, common slight effervescence. Clear change.

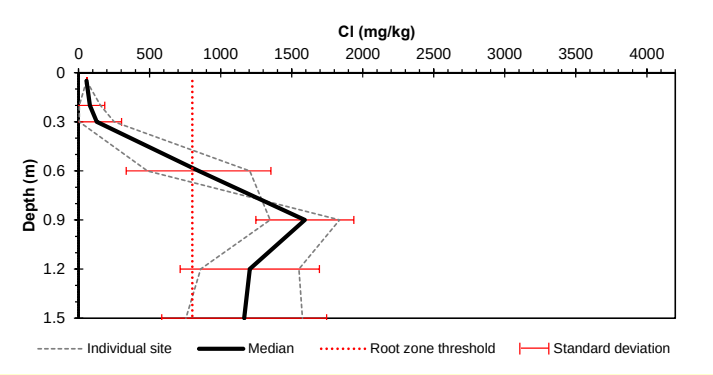
Buried horizons (2D) are brown (7.5YR, 10YR 4/4), mottled (<2-10% 5- 15 mm faint orange mottles), clay loam to light medium clay (often sandy and micaceous) with massive or weak to moderate angular blocky/polyhedral (10-20 mm) structure; 2-10% <2- 6 mm gypsum crystals; roots absent; field pH 8.5- 9.0. Profiles are deeper than 1.5 m.

PAWC to 1.0 m:	PAWC to 1.5 m:	K factor:
59 mm (ERD 0.4 m)	59 mm (ERD 0.4 m)	0.050 (high)

Soil Unit B1 Mitchell grass backplains

Root zone salinity

Subsoil salinity levels are high to very high (Cl ≥ 800-1800 mg/kg) below 0.5-0.7m, and exhibit a recognizable equilibrium "salt bulge" (i.e. the "salt bulge" remains relatively constant with depth). The "salt bulge" marks the long-term wetting front and effective rooting depth of the soil, and is indicative of indicative of impeded landscape drainage and active salinity accession within the backplains (due to discharge from the adjacent rolling downs).



Soil analytical summary

The soil has a modest organic fraction with low organic carbon and moderate total nitrogen levels. Macronutrient levels are high to very high (calcium, phosphorous, potassium and sulfate), while micronutrients (copper and zinc) levels are moderate. Soil pH values indicate soil profiles are alkaline (7.9-8.2) in the surface soil to 0.1 m, strongly alkaline in the upper subsoil (0.1-0.6 m) (range 8.3-9.0) and variable at depth (0.9-1.5 m) (range 7.7-9.1). CEC levels (20-27 cmol/kg) are moderate to high throughout. Moderate CEC/clay ratios (0.5-0.6) and the presence of cracking and strong lenticular structure suggest the clay fraction is of mixed mineralogy (with a high proportion of smectites), is highly reactive and has significant shrink-swell characteristics.

Clay content is moderately high to high (43-50%) in the upper profile, decreasing to moderate levels (33-37%) in buried horizons from or below 0.9 m. The plough zone to 0.3 m is moderately to strongly structured and likely to be friable with tillage, but may be subject to crusting behaviour because of elevated silt levels. Surface and upper subsoil material will be prone to significant compaction if subject to heavy traffic or aggressive tillage when moist or wet. The surface soil and upper subsoil to 0.4 m are non-saline (Cl <50 ppm) and non-sodic to moderately sodic (ESP 2-8%), with low to moderate dispersion (R1 0.43-0.65). The lower subsoil below 0.4 m has moderate to very high salinity (Cl 480 ppm increasing rapidly to >1500 ppm), very high sodicity (ESP 27-30%), moderate dispersion (R1 0.66-0.74) and coarse macro lenticular structure, that together limit effective rooting depth (ERD 0.4 m). Profiles are characterised by Calcium (Ca) dominant cation chemistry throughout (high Ca/Mg ratios).

Limitations to horticultural development

Identified constraints range from minor to severe (for citrus and table grapes) or extreme (for avocado) and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), salinity (Sa), discharge potential (Ss), soil wetness (W) and soil complexity (Xs).

Land suitability outcomes

Soil Unit B1 is unsuitable (Class 4 or 5) for irrigated for irrigated citrus, table grapes and avocados because of severe or extreme constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11.**

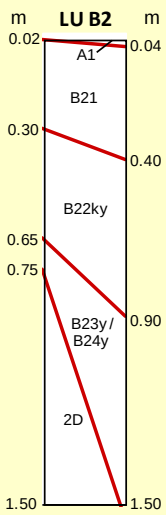
Self-mulch layer (0.03 m) and strong flake at Site

Soil Unit B2	Boree backplains
Geological landscape:	Flinders River backplain alluvium – locally sourced, non-micaceous clayey alluvium overlying older regionally provenanced micaceous deposits (Qa)
Landform:	Locally inundated, level clay backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%.
Soil concept:	Very deep (>1.5 m), hardsetting, firm pedal or weakly self-mulching, black or brown cracking clay with an inconsistent, thin (0.02 m), fine granular (<2 mm) to blocky (2-20 mm) surface (LC –LMC fine sandy), over a strong blocky (5-20 mm) upper subsoil (LMC fine sandy) and moderate to strong blocky/lenticular (5-50 mm) lower subsoil (MC-MHC fine sandy); over buried micaceous sandy clay deposits (SCL-SLC medium/coarse sand fraction) from or below 0.7->1.5 m.
Aust. Soil Classification:	Epipedal Black or Brown Vertosol.
Runoff, perm., & drainage:	Very slow to slow runoff; very slowly permeable; moderately well-drained.
Surface features:	Hardsetting, firm pedal or weakly self-mulching; occasional surface flake; cracking; non-gilgaied; no outcrop; no termitaria.
Dominant vegetation:	Sparse boree scrub with associated coolibah and bauhinia.
Investigation area:	Total area mapped: 98.5 ha; No. of Field sites: 4; Analysed site: 38

Sparse boree scrub on level backplains at Site 38

Surface cracking, epipedal condition (hardsetting to weakly self-mulching) and typical profile features at Site 38

Modal Soil Profile Description



The **surface soil** (A1) is a brown (7.5YR, 10YR 3/3, 3/4, 4/3), light clay to light medium clay (with fine sand), with weak to strong granular (<2 mm) to subangular blocky (2-20 mm) structure; non-gravelly; few very fine (<1 mm) roots; field pH 7.0-8.5, slight effervescence. Lower depth 0.02-0.04 m. Abrupt to clear change.

The **upper subsoil**:

B21 - black (10YR 3/2) or brown (7.5YR, 10YR 3/4, 4/3), light medium clay (with fine sand), with strong angular blocky (5-20 mm) structure; occasional <2% <2 mm calcareous soft segregations; few very fine (<1 mm) roots; field pH 8.0-9.5, common moderate effervescence. Lower depth 0.3-0.4 m. Clear to gradual change.

B22ky - black (10YR 3/2) or brown (10YR 3/4), light medium clay to medium clay (with fine sand), with moderate to strong angular blocky to lenticular (5-20 mm) structure; <2% <2 mm calcareous nodules and <2-10% <2 mm gypsum crystals; roots absent; field pH 8.5-9.5, common moderate effervescence. Lower depth 0.65-0.9 m. Gradual to diffuse change.

The **lower subsoil** (B23y/B24y) where present is a brown (10YR 3/3, 4/4) or grey (10YR 4/2), medium clay to medium heavy clay (with fine sand), with moderate to strong angular blocky or lenticular (5-50 mm) structure; 2- 20% 2-6 mm gypsum crystals; roots absent; field pH 8.5-9.0, common slight effervescence. Lower depth >1.5 m.

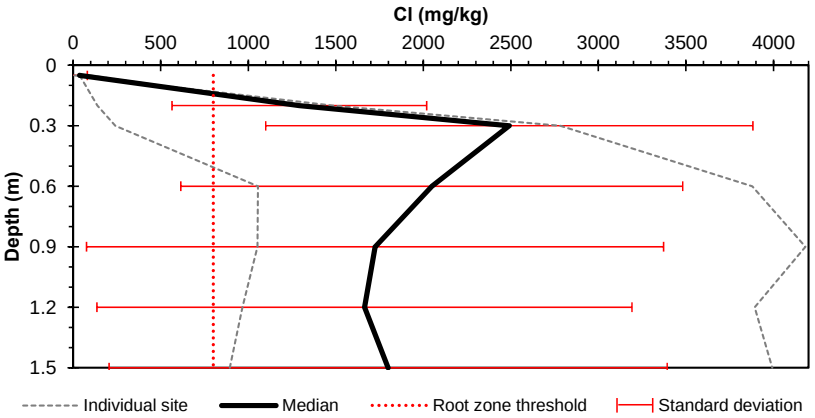
Buried horizons (2D) where present before 1.5 m are brown (10YR 4/4, 4/6), sandy clay loam to sandy light clay (with medium/coarse sand), with weak to moderate angular blocky (10-20 mm) structure; common <2% <2 mm calcareous soft segregations and <2% <2 mm gypsum crystals; roots absent; field pH 8.0- 8.5. Profiles are typically deeper than 1.5 m.

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
15 mm (ERD 0.1 m)	15 mm (ERD 0.1 m)	0.070 (very high)

Soil Unit B2 Boree backplains

Root zone salinity

Soil salinity levels are high to extreme (Cl ≥ 900-4000 mg/kg) below about 0.1 m, and define the long-term wetting front and effective rooting depth of this soil. Salinity levels below this depth exhibit a significant shallow "salt bulge", and are indicative of episodic evaporative "wicking" and surface salinity expression. Salinity characteristics indicate severely impeded landscape drainage and active salinity accession are occurring within the backplains (due to discharge from the adjacent rolling downs).



Soil analytical summary

The soil has a modest organic fraction with low organic carbon and moderate total nitrogen levels. Macronutrients are variable with high to very high levels of phosphorous, potassium and calcium, low levels of sulfate and moderate micronutrient levels (copper and zinc). Soil pH Values indicate soil profiles are neutral to alkaline (7.2-8.5) in the surface soil to 0.1 m, strongly alkaline in the upper subsoil (0.1-0.6 m) (range 8.5-9.2) and alkaline to strongly alkaline at depth (0.9-1.5 m) (range 8.1-9.1). CEC levels are moderate (17-23 cmol/kg) in the upper profile to 0.6 m and increase to high levels at depth (26-31 cmol/kg). Moderate CEC/clay ratios (0.5-0.6), surface cracking and lenticular structure at depth suggest the clay fraction is of mixed mineralogy (with a high proportion of smectites), with moderate to high activity and significant shrink-swell characteristics.

Clay content is moderate (28-36%) in the surface and upper subsoil to 0.3 m, and gradually increases to high or very high levels (45-61%) at depth. The plough zone to 0.3 m is moderately to strongly structured and likely to be friable with tillage, but may be subject to crusting behaviour because of elevated silt levels. Surface and upper subsoil material will be prone to significant compaction if subject to heavy traffic or aggressive tillage when moist or wet. Immediate surface horizons to about 0.1 m have low levels of salinity and sodicity (Cl <250 ppm, ESP <6%) and only moderate dispersion values ((R1 0.73). Subsoil materials below 0.1 m are extremely saline (Cl ≥ 900-4000 mg/kg), extremely sodic (ESP 36-76%), and have high to very high dispersion (R1 0.82-0.99). Profiles are characterised by Sodium (Na) dominant cation chemistry below 0.1 m.

Limitations to horticultural development

Identified constraints range from minor to extreme and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), salinity (Sa), discharge potential (Ss), soil wetness (W) and soil complexity (Xs).

Land suitability outcomes

Soil Unit B2 is unsuitable (Class 5) for irrigated for irrigated citrus, table grapes and avocados because of extreme constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11.**

Boree scrub and epipedal surface with significant cracking at Site14

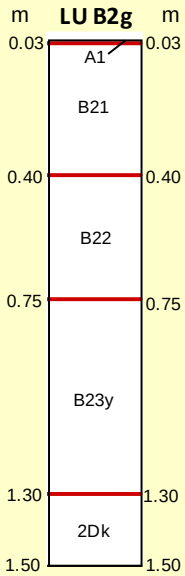
Drill samples to 24m at Site 39

Soil Unit B2g	Gilgaied backplains
Geological landscape:	Flinders River backplain alluvium – locally sourced, non-micaceous clayey alluvium overlying older regionally provenanced micaceous deposits (Qa)
Landform:	Locally inundated, level clay backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%.
Soil concept:	Very deep (>1.5 m), gilgaied (lattice or shallow melonhole VI 0.3 m, HI 15 m), moderately to strongly self-mulching, grey or black cracking clay with a moderately thick (0.03 m), fine granular (<2 mm) surface (MC), over a strong blocky to lenticular (10-20 mm) upper subsoil (MHC) and strong lenticular (5-100 mm) lower subsoil (MHC); over buried micaceous sandy clay deposits (MC fine sand fraction) from or below 1.3->1.5 m.
Aust. Soil Classification:	Self- mulching Grey or Black Vertosol.
Runoff, perm., & drainage:	Very slow runoff; very slowly permeable; imperfectly drained.
Surface features:	Moderately to strongly self-mulching; weak surface flake; cracking; lattice or shallow melonhole gilgai (VI 0.3 m, HI 15 m); non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Boree scrub with associated coolibah and bauhinia.
Investigation area:	Total area mapped: 21.4 ha No. of field sites: 1 Analysed site: NA

Gilgaied B2g backplain unit with boree scrub and lattice/melonhole gilgai to 0.3m VI at Site 5

Typical profile features of the gilgaied self-mulching grey Vertosol at Site 5

Modal Soil Profile Description



The **surface soil** (A1) is a grey (10YR 4/2), medium clay, with strong granular (<2 mm) structure; non-gravelly; field pH 7.0-7.5, slight effervescence. Lower depth 0.03 m. Clear change.

The **upper subsoil**:

B21 - grey (10YR 4/2), medium heavy clay, with strong angular blocky to lenticular (10-20 mm) structure; <2% <2 mm calcareous nodules; field pH 8.0-9.0, slight effervescence. Lower depth 0.4 m. Gradual change.

B22 - black (10YR 3/2), medium heavy clay, with strong lenticular (5-100 mm) structure; <2% <2 mm calcareous nodules and <2% <2 mm gypsum crystals; field pH 8.5-9.0, slight to moderate effervescence. Lower depth 0.75 m. Gradual change.

The **lower subsoil** (B23y) where present is a black (10YR 3/2), medium heavy clay, with strong lenticular (5-100 mm) structure; <2% <2 mm calcareous nodules and 2-10% <2 mm gypsum crystals; field pH 8.5, slight to moderate effervescence. Lower depth 1.3 m. Diffuse change.

Buried horizons (2Dk) where present are brown (7.5YR, 10YR 4/4), mottled (2-10% <5 mm distinct orange mottles), medium clay, with moderate angular blocky to lenticular (10-20 mm) structure; 2-10% <2 mm calcareous nodules; field pH 8.5, slight to moderate effervescence. Profiles are typically deeper than 1.5 m.

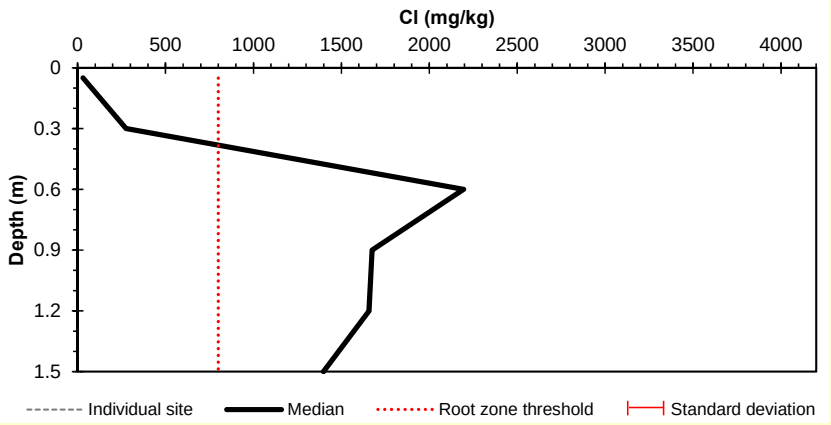
PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
59 mm (ERD 0.4 m) #	59 mm (ERD 0.4 m) #	0.050 (high) #

PAWC and K factor data are based on data from Soil B1 – Site 6

Soil Unit B2g **Gilgaied backplains**

Root zone salinity

Soil salinity levels are high to extreme (Cl ≥ 1400-2200 mg/kg) below about 0.4 m, and define the long-term wetting front and effective rooting depth of this soil. Salinity levels below this depth exhibit a significant shallow "salt bulge", and are indicative of episodic evaporative "wicking" and surface salinity expression. Salinity characteristics indicate severely impeded landscape drainage and active salinity accession are occurring within the backplains (due to discharge from the adjacent rolling downs).



Soil analytical summary (based on analytical data from Land Unit B1)

Soil analytical data for soil B2g is limited to pH and salinity data from Site 5. Analytical data from soil B1 Site 6 (which lies immediately adjacent to Site 5 and has equivalent soil profile characteristics) is presented and interpreted here. Clay content and clay activity are likely to be greater for the weakly gilgaied B2g soil (Site 5) when compared with the B2 soil (Site 6).

The soil is likely to have similar fertility characteristics to Site 6, with a modest organic fraction, low organic carbon and moderate total nitrogen levels. Macronutrient levels will be high to very high (calcium, phosphorous, potassium and sulfate), while micronutrients (copper and zinc) levels will be moderate. pH analyses from Site 5 indicate soil profiles are slightly alkaline (7.7) in the surface soil to about 0.1 m, alkaline to strongly alkaline in the upper subsoil (0.1-0.6 m) (range 8.3-8.9) and alkaline at depth (0.9-1.5 m) (range 8.0-8.3). CEC levels are likely to be moderate to high throughout (20-27 cmol/kg). Moderate CEC/clay ratios (0.5-0.6) and the presence of gilgai, cracking and strong lenticular structure suggest the clay fraction is of mixed mineralogy (with a high proportion of smectites), is highly reactive and has significant shrink-swell characteristics.

Field texture correlation (between Sites 5 and 6) suggest clay content is similar at Sites 5 and 6, and is moderately high to high (43-50%) throughout; including in buried horizons. The plough zone to 0.3 m is strongly structured and likely to be friable with tillage. Surface and upper subsoil material will be prone to significant compaction if subject to heavy traffic or aggressive tillage when moist or wet. The surface horizons and upper subsoil to 0.4 m have low levels of salinity and sodicity (Cl <280 ppm, ESP <8%) and low to moderate dispersion values (R1 0.43-0.65). Subsoil materials below 0.4 m have very high salinity levels (Cl ≥ 1400-2200 mg/kg) and are extremely sodic (ESP >25%).

Limitations to horticultural development

Identified constraints range from minor to extreme and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), salinity (Sa), discharge potential (Ss), microrelief (Tm) and soil wetness (W).

Land suitability outcomes

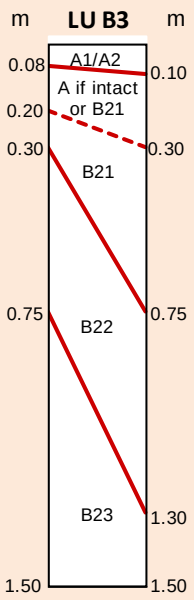
Soil Unit B2g is unsuitable (Class 5) for irrigated for irrigated citrus, table grapes and avocados because of extreme constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

Soil Unit B3	Scalded backplains
Geological landscape:	Flinders River backplain alluvium – locally sourced, non-micaceous clayey alluvium overlying older regionally provenanced micaceous deposits (Qa)
Landform:	Locally inundated, scalded backplains; local relief 2-3 m below the elevated terrace plains; slopes ≤ 0.5%.
Soil concept:	Very deep (>1.5 m), severely scalded, hardsetting and often crusted, black (or occasionally brown) sodic non-cracking clay (or sodic texture contrast soil where residual A horizons remain intact) with moderate to strong blocky structure (5-20 mm) throughout the subsoil (LMC - MHC); buried horizons (where present) are >1.5 m.
Aust. Soil Classification:	Black (or occasionally Brown) Dermosol/Sodosol.
Runoff, perm., & drainage:	Very slow to slow runoff; very slowly permeable; imperfectly drained.
Surface features:	Hardsetting; crusted (often with a fine sandy veneer) where topsoil has been removed; non-cracking; non-gilgaied; non-gravelly; no outcrop; no termitaria.
Dominant vegetation:	Either severely scalded and un-vegetated; or very isolated boree, coolibah and bauhinia.
Investigation area:	Total area mapped: 106.8 ha; No. of Field sites: 5; Analysed site: 20

Scalded B3 backplain at Site 20

Surface crusting at Site 20, and topsoil erosion terracettes at Site 13

Modal Soil Profile Description



The **surface soil** (A1/A2) is highly variable and includes residual sandy or loamy topsoil (where intact) and exposed, crusted subsoil materials; typically it comprises a black (10YR 3/2), brown (10YR 3/3, 4/3, 5/3) or grey (10YR 4/2), fine sandy loam to fine sandy light clay, with massive (where topsoil) to strong platy or blocky (5-20 mm) structure (where subsoil material); non-gravelly; roots absent or few to common very fine (<1 mm diameter) roots; field pH 6.0-9.0. Lower depth 0.08-0.10 m, occ. thicker (0.2-0.3 m) where residual A horizons remain intact. Abrupt to clear change.

The **upper subsoil:**

B21 - black (10YR 3/2) or occasionally brown (10YR 3/3), light clay to light medium clay, with moderate to strong angular blocky (5-20 mm) structure; occasional 2-10% <2 mm calcareous nodules; roots absent or few very fine (<1 mm diameter) roots; field pH 6.5-9.0, occasional high effervescence. Lower depth 0.3-0.75 m. Clear to gradual change.

B22 - black (10YR 3/2) or brown (10YR 3/3, 4/3), light medium clay to medium heavy clay, with moderate to strong angular blocky (5-20 mm) structure; common <2-10% <2 mm calcareous soft segregations and frequent <2-20% <2 mm gypsum crystals; roots absent; field pH 8.5-9.5, moderate effervescence. Lower depth 0.75-1.3 m. Gradual to diffuse change.

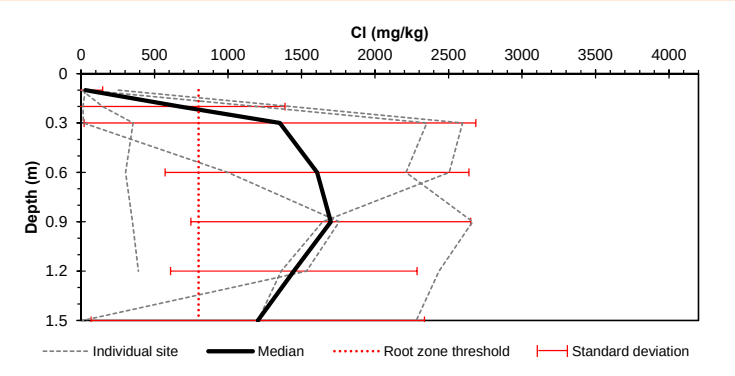
The **lower subsoil** (B23) is a brown (7.5YR, 10YR 3/3, 3/4, 4/3), frequently mottled (2-10% <5-15 mm faint to distinct dark, brown or red mottles), light medium clay to medium heavy clay, with weak coarse lenticular (>50 mm) parting to moderate or strong angular blocky (5-20 mm) structure; common 2-10% <2 mm calcareous nodules or soft segregations and 2-20% <2-6 mm gypsum crystals; roots absent; field pH 8.5-9.5, slight effervescence. Profiles are typically deeper than 1.5 m.

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
1.6-16 mm (ERD 0.01-0.1 m)	1.6-16 mm (ERD 0.01-0.1 m)	0.051 (high)

Soil Unit B3 Scalded backplains

Root zone salinity

Soil salinity levels are high to extreme (Cl ≥ 900->2900 mg/kg) below 0.01-0.1m (depending on depth of intact A horizon material), and define the long-term wetting front and effective rooting depth of this soil. Salinity levels below this depth exhibit a significant shallow "salt bulge", and are indicative of episodic evaporative "wicking" and surface salinity expression. Salinity characteristics indicate severely impeded landscape drainage and active salinity accession are occurring within the backplains (due to discharge from the adjacent rolling downs).



Soil analytical summary

Organic carbon and total nitrogen levels are very low to low, and confirm the soil has a limited organic fraction. Macronutrient levels are moderate to high (calcium, phosphorous, potassium and sulfate), while micronutrient levels are moderate (copper and zinc). Soil pH values indicate soil profiles are acidic to alkaline (6.1-8.3) in the surface soil to 0.1 m, neutral to strongly alkaline in the upper subsoil (0.1-0.6 m) (range 6.5-8.9) and strongly alkaline at depth (0.9-1.5 m) (range 8.4-9.3). CEC levels (18-27 cmol/kg) are moderate to high throughout. CEC/clay ratios are moderate (range 0.4-0.6), and suggest the clay fraction is of mixed mineralogy with moderate to high activity.

Clay content is moderate (range 33-43%) in the surface soil and upper subsoil (to 0.6 m), and increases to high or very high levels (50-57%) at depth. Immediate surface horizons to 0.01-0.1 m have low levels of salinity and sodicity (Cl <250 ppm, ESP <15%), while subsoil materials below this depth are extremely saline (Cl ≥ 900->2900 mg/kg), extremely sodic (ESP 42-111%), and moderately to extremely dispersive (R1 0.52-0.99). Profiles are characterised by Sodium (Na) dominant cation chemistry below 0.1 m. This landscape is very fragile and disturbance should be avoided. Scalded surfaces are typically crusted, very hardsetting, extremely impermeable and highly susceptible to sheet and wind erosion. Surface layers have an elevated fine sand/ silt fraction (60-64%); and will be prone to slaking and pulverescent behaviour following disturbance.

Limitations to horticultural development

Identified constraints range from minor to extreme and include wind erosion (A) (some UMAs), heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), salinity (Sa), discharge potential (Ss), soil wetness (W) and soil complexity (Xs).

Land suitability outcomes

Soil Unit B3 is unsuitable (Class 5) for irrigated for irrigated citrus, table grapes and avocados because of extreme constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11.**

Subsoil dispersion at Site 13

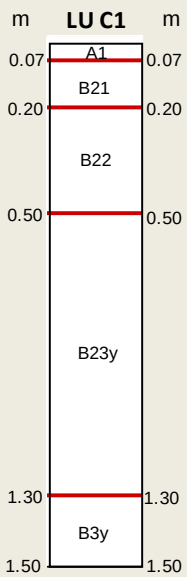
Soil profile from a severe scald at Site 20

Soil Unit C1	**Rolling downs**
Geological landscape:	Fine-grained Cretaceous sedimentary rocks (labile mudstone, minor siltstone) (Kur).
Landform:	Gently undulating, elevated plains and low rises; local relief 5-10 m above the Flinders River alluvium; slopes 0.5-2.0%.
Soil concept:	Very deep (>1.5 m), weakly gilgaied (linear VI <0.15 m, HI 6 m), strongly self-mulching, red or brown cracking clay (MC-HC subsoil), with a thick (>0.06 m), fine granular (<2 mm) surface (MC), over a strong blocky to lenticular (2-20 mm) upper subsoil (MC-MHC), and strong lenticular (5-100 mm) lower subsoil (HC); over in-situ Cretaceous mudstone from 1.6 m.
Aust. Soil Classification:	Self-mulching Red or Brown Vertosol.
Runoff, perm., & drainage:	Slow runoff; very slowly permeable; moderately well-drained.
Surface features:	Strongly self-mulching; weak surface flake; cracking; linear gilgai (VI 0.15 m HI 6 m); <2% 6- 20 mm quartz gravels; no outcrop; no termitaria.
Dominant vegetation:	Mitchell grass open downs.
Investigation area:	Total area mapped: 20.6 ha No. of Field sites: 1 Analysed site: 26

Elevated Mitchell grass plains at Site 26

Thick fine self-mulch and typical profile features over in-situ mudstone (from 1.6m) at Site 26

Modal Soil Profile Description



The **surface soil** (A1) is a brown (7.5YR 3/4), medium clay, with strong granular (<2 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 0.07 m. Clear change.

The **upper subsoil:**

B21 - brown (7.5YR 3/4), medium clay, with strong angular blocky to lenticular (5-10 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 0.2 m. Gradual change.

B22 - red (5YR 3/3), medium heavy clay, with strong lenticular (2-20 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 0.5 m. Gradual change.

The **lower subsoil** (B23y) is a red (5YR 3/3), heavy clay, with strong lenticular (5-100 mm) structure; <2% <2 mm calcareous soft segregations and 2-10% 2-6 mm gypsum crystals; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 1.3 m. Gradual change.

The **transition to substrate** (B3y) is a red (5YR 5/6), mottled (2-10% 5- 15 mm distinct yellow substrate mottles), medium clay (with fine sand), with moderate lenticular (10-100 mm) structure; 10-20% 6-20 mm mudstone fragments, <2% <2 mm calcareous soft segregations and 20-50% 2-6 mm gypsum crystals; roots absent; field pH 8.5-9.0. Lower depth 1.6 m. Gradual change.

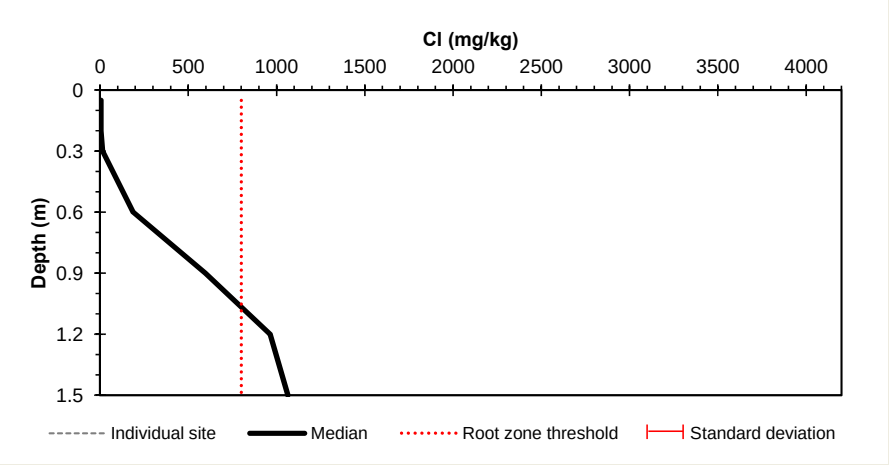
The **underlying substrate** (C) comprises brown to yellow (10YR 5/6, 6/6), mottled (20-50% 5-15 mm distinct red substrate mottles), massive, clayey weathered fines (<30%) within a matrix of in-situ mudstone (70-100%).

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
104 mm (ERD 0.8 m)	104 mm (ERD 0.8 m)	0.037 (moderate)

Soil Unit C1 Rolling downs

Root zone salinity

Subsoil salinity levels are moderate (Cl ≥ 350-800 mg/kg) from 0.7-1.0 m, and high (Cl ≥ 800-1060 mg/kg) below 1.0 m. They develop a recognizable equilibrium "salt bulge" (i.e. the "salt bulge" remains relatively constant with depth) at about 1.2-1.3 m at the transition to weathered substrate. The "salt bulge" marks the long-term wetting front and effective rooting depth of the soil.



Soil analytical summary

The soil has a modest organic fraction with low organic carbon and moderate total nitrogen levels. Macronutrient levels are variable with high to very high levels of phosphorous, calcium and potassium, low levels of sulfate, and low to moderate levels of micronutrients (copper and zinc). Soil pH values indicate soil profiles are slightly alkaline to alkaline (range 7.7-8.1) throughout. CEC levels (38-49 cmol/kg) are high to very high throughout. High to very high CEC/clay ratios (0.8-3.2) and the presence of gilgai, cracking and strong lenticular structure suggest the clay fraction is predominantly montmorillonitic/smectitic, is highly reactive and has significant shrink-swell characteristics.

Clay content is very high (55-63%) in the surface and upper subsoil to 0.5 m, but decreases significantly (12-34%) below this depth due to an increasing silt fraction (44-66%) from the weathering of the underlying mudstone. The plough zone to 0.3 m is strongly structured and likely to be friable with tillage. Surface and upper subsoil material will be prone to significant compaction if subjected to heavy traffic or aggressive tillage when moist or wet. The surface soil and upper subsoil to 0.5 m is non-saline (Cl <50 ppm) and non-sodic (ESP <2%), with very low dispersion (R1 0.15-0.38). The subsoil below 0.5 m has moderate to very high salinity (Cl 600 ppm increasing gradually to >950 ppm), moderate to very high sodicity (ESP 10% increasing to 32%) and coarse macro lenticular structure, that together limit ERD to about 0.8 m. Profiles are characterised by Calcium (Ca) dominant cation chemistry (high Ca/Mg ratios), and dispersion remains very low to low throughout (R1 0.21-0.56).

Limitations to horticultural development

Identified constraints range from minor to severe and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), infiltration/recharge (Ir), nutrient balance (Nr) (citrus only), surface soil condition (Ps), salinity (Sa) (avocados only), microrelief (Tm) and soil wetness (W).

Land suitability outcomes

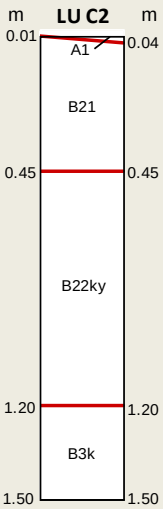
Soil Unit C1 is unsuitable (Class 4) for irrigated for irrigated citrus, table grapes and avocados because of severe constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

Soil Unit C2	Boree footslopes
Geological landscape:	Fine-grained Cretaceous sedimentary rocks (labile mudstone, minor siltstone) (Kur).
Landform:	Footslopes of the gently undulating, elevated plains and low rises (Soil C1); local relief 3-8 m above the Flinders River alluvium; slopes 2.0-5.0%.
Soil concept:	Very deep (>1.5 m), gravelly (2-20% rounded quartz), hardsetting, firm pedal or moderately to strongly self-mulching, brown cracking clay (subsoil - MC-MHC), with an inconsistent, thin to moderately thick (≤ 0.04 m), fine granular (<2 mm) to fine blocky (2-5 mm) surface (FSLC), over a strong blocky (5-20 mm) upper subsoil (MC), and strong lenticular (2-200 mm) lower subsoil (MC-MHC).
Aust. Soil Classification:	Epipedal or Self-mulching Brown Vertosol.
Runoff, perm., & drainage:	Moderately rapid runoff; very slowly permeable; moderately well-drained.
Surface features:	Hardsetting, firm pedal or moderately to strongly self-mulching; cracking; non-gilgaied; 2- 20% 20-60 mm quartz gravels; no outcrop; no termitaria.
Dominant vegetation:	Boree scrub.
Investigation area:	Total area mapped: 30.0 ha No. of Field sites: 1 Analysed site: 27

Boree scrub on footslopes of the rolling downs at Site 27

Variable surface condition (hardsetting, epipedal or thin self-mulch) and typical profile features at Site 27

Modal Soil Profile Description



The **surface soil** (A1) is a brown (7.5YR 4/3), light clay (with fine sand), with moderate to strong granular (<2 mm) to subangular blocky (2-5 mm) structure; <2% 20-60 mm quartz gravels; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth ≤ 0.04 m. Clear change.

The **upper subsoil** (B21) is a brown (10YR 3/3, 4/3), medium clay (with fine sand), with strong angular blocky (5-20 mm) structure; non-gravelly; few very fine (<1 mm diameter) roots; field pH 8.5-9.0. Lower depth 0.45 m. Diffuse change.

The **lower subsoil** (B22ky) is a brown (10YR 4/6), mottled (4-20% 5-15 mm faint brown and grey substrate mottles), medium clay (with medium sand), weak to moderate angular blocky to lenticular (10-50 mm) structure; 2-10% <2 mm calcareous nodules and 10-20% <2 mm gypsum crystals; roots absent; field pH 8.5-9.0. Lower depth 1.2 m. Diffuse change.

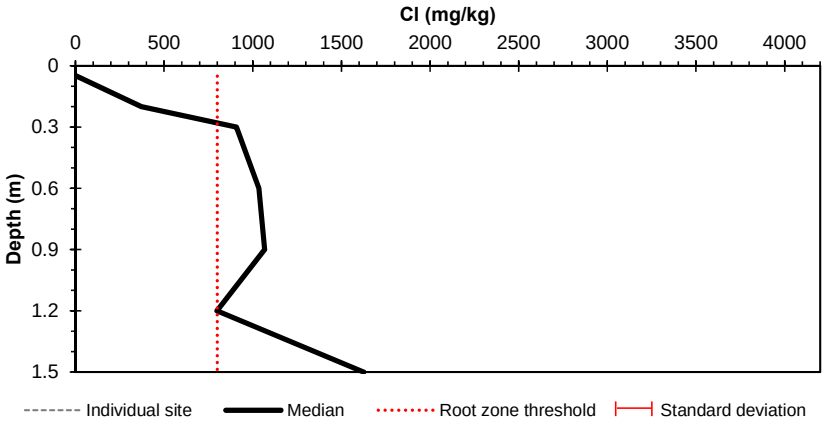
The **transition to substrate** (B3k) is a brown (7.5YR 4/6), mottled (50% 5- 15 mm distinct yellow and prominent grey substrate mottles), medium heavy clay (with fine sand), with strong lenticular (2-200 mm) structure; 20-50% 6- 20 mm mudstone fragments, 2-10% <2 mm calcareous nodules and 2-10% <2 mm manganiferous nodules; roots absent; field pH 8.5-9.0. Profiles are typically deeper than 1.5 m.

PAWC to 1.0 m:	**PAWC to 1.5 m:**	**K factor:**
30 mm (ERD 0.2 m)	30 mm (ERD 0.2 m)	0.031 (moderate)

Soil Unit C2 Boree footslopes

Root zone salinity

Subsoil salinity levels are high to very high (Cl ≥ 900-1630 mg/kg) below 0.2m, and exhibit a recognizable equilibrium "salt bulge" (i.e. the "salt bulge" remains relatively constant with depth). The "salt bulge" marks the long-term wetting front and effective rooting depth of the soil, and is indicative of episodic landscape drainage and/or shallow groundwater discharge and salinity accession from the adjacent elevated rolling downs.



Soil analytical summary

The soil has a modest organic fraction with low organic carbon and total nitrogen levels. Macronutrients are variable with high to very high levels of phosphorous, calcium and potassium, very low levels of sulfate and low to moderate levels of micronutrients (copper and zinc). Soil pH values indicate soil profiles are alkaline to strongly alkaline (range 8.3-9.2) throughout, with moderate to high CEC levels (16-31 cmol/kg). Moderate CEC/clay ratios (0.50-0.6) and the presence of cracking and strong lenticular structure suggest the clay fraction is reactive, has significant shrink-swell characteristics and is of mixed mineralogy with a high proportion of smectites.

Clay content is moderate to high and relatively uniform (29-48%) and increases to very high (62%) below 1.3 m due to the influence of weathering mudstone. The plough zone to 0.3 m is moderately to strongly structured and likely to be friable with tillage. Surface and upper subsoil material will be prone to significant compaction if subjected to heavy traffic or aggressive tillage when moist or wet. The surface soil and upper subsoil to 0.2 m has low to moderate salinity (Cl <400 ppm), low to moderate sodicity (ESP 1-13%) and moderate dispersion (R1 0.62-0.72). The subsoil below 0.2 m has high to very salinity (Cl 800-1650 ppm), high to very high sodicity (ESP 23-34%) and high to very high dispersion (R1 0.80-0.99). Profiles are characterised by Calcium (Ca) dominant cation chemistry throughout.

Limitations to horticultural development

Identified constraints range from minor to severe (for citrus and table grapes) or extreme (for avocado) and include heat stress (Cs), frost (Cf), temperature (minimum) (Ct) (avocados only), water erosion (E), flooding (F), infiltration/recharge (Ir), soil water storage (M), nutrient balance (Nr), surface soil condition (Ps), rockiness (R), salinity (Sa), discharge potential (Ss), soil wetness (W) and soil complexity (Xs).

Land suitability outcomes

Soil Unit C2 is unsuitable (Class 4 or 5) for irrigated for irrigated citrus, table grapes and avocados because of sever or extreme constraints. Land suitability criteria and suitability assessment are presented in **Appendices 10 and 11**.

5. Land Suitability Assessment

For each soil unit, the information on soil quality and land attributes, presented in **Section 4** and **Appendices 5, 6, 7** and **9**, has been assessed against the land suitability decision rules for each of the 18 limitations selected for this project (**Appendix 10, Table 2)**. This provides an assessment of the land suitability class value for each limitation and an overall suitability class value for each soil unit (based on the value for the most limiting attribute). This process was undertaken for each combination of soil unit and crop type.

The outcome of the assessment for each soil type and land use combination is presented in **Appendix 11** and summarised in **Table 11** below. The land suitability assessment outcomes for each land use using the documented decision rules and data reported in this study are discussed in more detail in **Sections 5.1, 5.2** and **5.3**.

Figures 7, 8 and **9** show the distribution of land in regard to each suitability class for irrigated table grapes, citrus and avocado respectively.

A summary of land areas suitable for each land use is provided in **Table 12** in **Section 5.4**.

Table 11: Land suitability classes and constraining limitations for the 15 Mile project area

Soil unit	Suitability class and limiting factors (and limitation class) for each selected land use[#]		
	Table Grapes	Citrus	Avocado
A1	**3** Cs(3), Cf(2), F(2), Ir(2), M1(2), Ps(2), W(2)	**3** Cs(3), Cf(2), F(2), Ir(2), M1(2), Nr1(2), Nr2(2),Ps(2), W(2)	**3** Cs(3), W(3), Cf(2), Ct(2), F(2), Ir(2), Ps(2)
A1e	**5** Xt(5), E(4), F(4) Cs(3), Ss(3), W(3), Cf(2), Ir(2), M1(2), Ps(2)	**5** Xt(5), E(4), F(4) Cs(3), Ss(3), W(3), Cf(2), Ir(2), M1(2), Nr1(2), Nr2(2),Ps(2)	**5** Xt(5), E(4), F(4), W(4) Cs(3), Ss(3), Cf(2), Ct(2), Ir(2), Ps(2)
A2*	**3-4** F(3-4), M1(1-4), Ss(3-4), Xt(1-4) Cs(3), Sa(1-3), W(3), Cf(2), E(2), Ir(2), Nr2(1-2),Ps(2)	**3-4** F(3-4), M1(1-4), Ss(3-4), Xt(1-4) Cs(3), Nr2(2-3),Sa(1-3), W(3), Cf(2), E(2), Ir(2), Nr1(2), Ps(2)	**4** F(3-4), M2(1-4), Sa(1-4), Ss(3-4), W(4), Xt(1-4) Cs(3), Cf(2), Ct(2), E(2), Nr2(1-2), Ir(2), Ps(2)
A3	**4** F(4), Xt(4) Cs(3), E(3), Nr1(3), Nr2(3), Ss(3), Cf(2), Ir(2), M1(2), Ps(2), W(2)	**4** F(4), Xt(4) Cs(3), E(3), Nr1(3), Nr2(3), Ss(3), Cf(2), Ir(2), M1(2), Ps(2), W(2)	**4** F(4), Xt(4) Cs(3), E(3), Nr1(3), Nr2(3), Ss(3), W(3), Cf(2), Ct(2), Ir(2), Ps(2)
A4	**5** W(5), F(4), Ss(4), Xt(4) Cs(3), E(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Cf(2)	**5** W(5), F(4), Ss(4), Xt(4) Cs(3), E(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Cf(2)	**5** W(5), F(4), Ss(4), Xt(4) Cs(3), E(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Cf(2), Ct(2)
B1	**4** F(4), Sa(4), Ss(4), W(4) Cs(3), Ir(3), M1(3), Nr1(3), Ps(3), Xs(3), Cf(2)	**4** F(4), Sa(4), Ss(4), W(4) Cs(3), Ir(3), M1(3), Nr1(3), Ps(3), Xs(3), Cf(2), Nr2(2)	**5** Sa(5), F(4), Ss(4), W(4), Cs(3), Ir(3), M2(3), Nr1(3), Ps(3), Xs(3), Cf(2), Ct(2)
B2*	**5** Sa(5), F(3-4), M1(4), Ps(4), Ss(3-4), W(4) Cs(3), Ir(3), Nr1(3), Nr2(3), Xs(1-3), Cf(2), E(2)	**5** Sa(5), F(3-4), M1(4), Ps(4), Ss(3-4), W(4) Cs(3), Ir(3), Nr1(3), Nr2(3), Xs(1-3), Cf(2), E(2)	**5** Sa(5), F(3-4), M2(4), Ps(4), Ss(3-4), W(4) Cs(3), Ir(3), Nr1(3), Nr2(3), Xs(1-3), Cf(2), Ct(2), E(2)
B2g*	**5** Sa(5), W(5), F(3-4), Ss(3-4) Cs(3), Ir(3), M1(3), Nr1(3), Ps(3), Tm(3), Cf(2)	**5** Sa(5), W(5), F(3-4), Ss(3-4) Cs(3), Ir(3), M1(3), Nr1(3), Ps(3), Tm(3), Cf(2), Nr2(2)	**5** Sa(5), W(5), F(3-4), Ss(3-4) Cs(3), Ir(3), M2(3), Nr1(3), Ps(3), Tm(3), Cf(2), Ct(2)
B3*	**5** Sa(5), W(5), F(3-4), M1(4), Ps(4) Ss(3-4) A(1-3), Cs(3), Ir(3), Nr2(3), Xs(1-3), Cf(2)	**5** Sa(5), W(5), F(3-4), M1(4), Ps(4) Ss(3-4) A(1-3), Cs(3), Ir(3), Nr2(3), Xs(1-3), Cf(2), Nr1(2)	**5** Sa(5), W(5), F(3-4), M2(4), Ps(4) Ss(3-4) A(1-3), Cs(3), Ir(3), Nr2(3), Xs(1-3), Cf(2), Ct(2)

Soil unit	Suitability class and limiting factors (and limitation class) for each selected land use[#]		
	Table Grapes	**Citrus**	**Avocado**
C1	**4**	**4**	**4**
	W(4), Cs(3), Ir(3), Ps(3), Cf(2), E(2), Tm(2)	W(4) Cs(3), Ir(3), Ps(3), Cf(2), E(2), Nr1(2), Nr2(2), Tm(2)	W(4) Cs(3), Ir(3), Ps(3), Cf(2), Ct(2), Sa(2), E(2), Tm(2)
C2	**4**	**4**	**5**
	M1(4), Sa(4), Ss(4), W(4) Cs(3), F(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Xs(3), Cf(2), E(2), R(2)	M1(4), Sa(4), Ss(4), W(4) Cs(3), F(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Xs(3), Cf(2), E(2), R(2)	Sa(5), M2(4), Ss(4), W(4) Cs(3), F(3), Ir(3), Nr1(3), Nr2(3), Ps(3), Xs(3), Cf(2), Ct(2), E(2), R(2)

Limitations placed in order of severity, with severe and extreme limitations listed separately from minor and moderate limitations. Limitation codes are described in **Table 6.**

***** Variations in either landscape position and/or subsoil salinity and/or surface texture resulted in individual mapped polygons being allocated different limitation class scores. See **Appendix 12** for details.

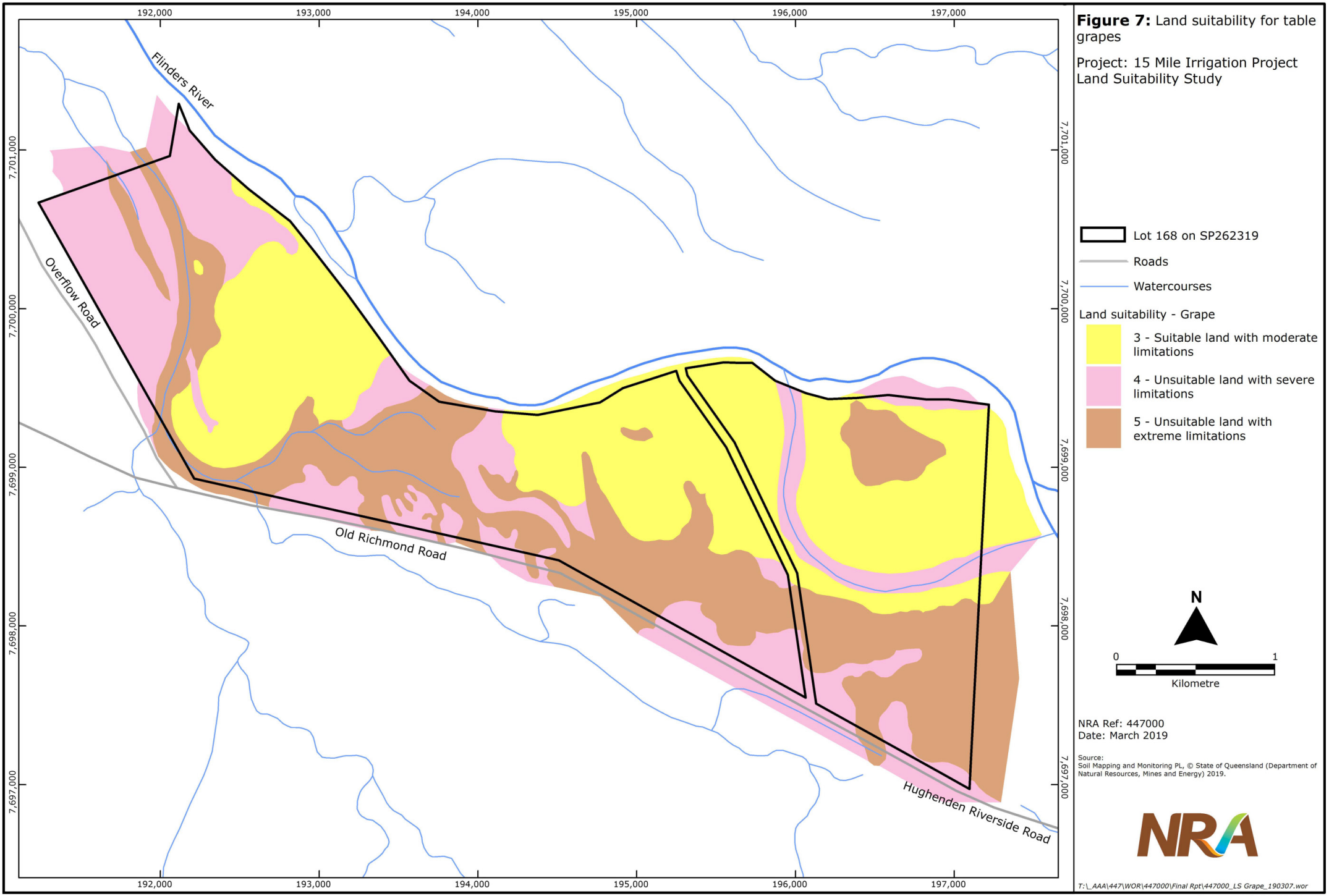


Figure 7: Land suitability for table grapes

Project: 15 Mile Irrigation Project
Land Suitability Study

Lot 168 on SP262319
Roads
Watercourses

Land suitability - Grape

- 3 - Suitable land with moderate limitations
- 4 - Unsuitable land with severe limitations
- 5 - Unsuitable land with extreme limitations

N

0 1
Kilometre

NRA Ref: 447000
Date: March 2019

Source:
Soil Mapping and Monitoring PL, © State of Queensland (Department of Natural Resources, Mines and Energy) 2019.

NRA

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Recommended print size: A4

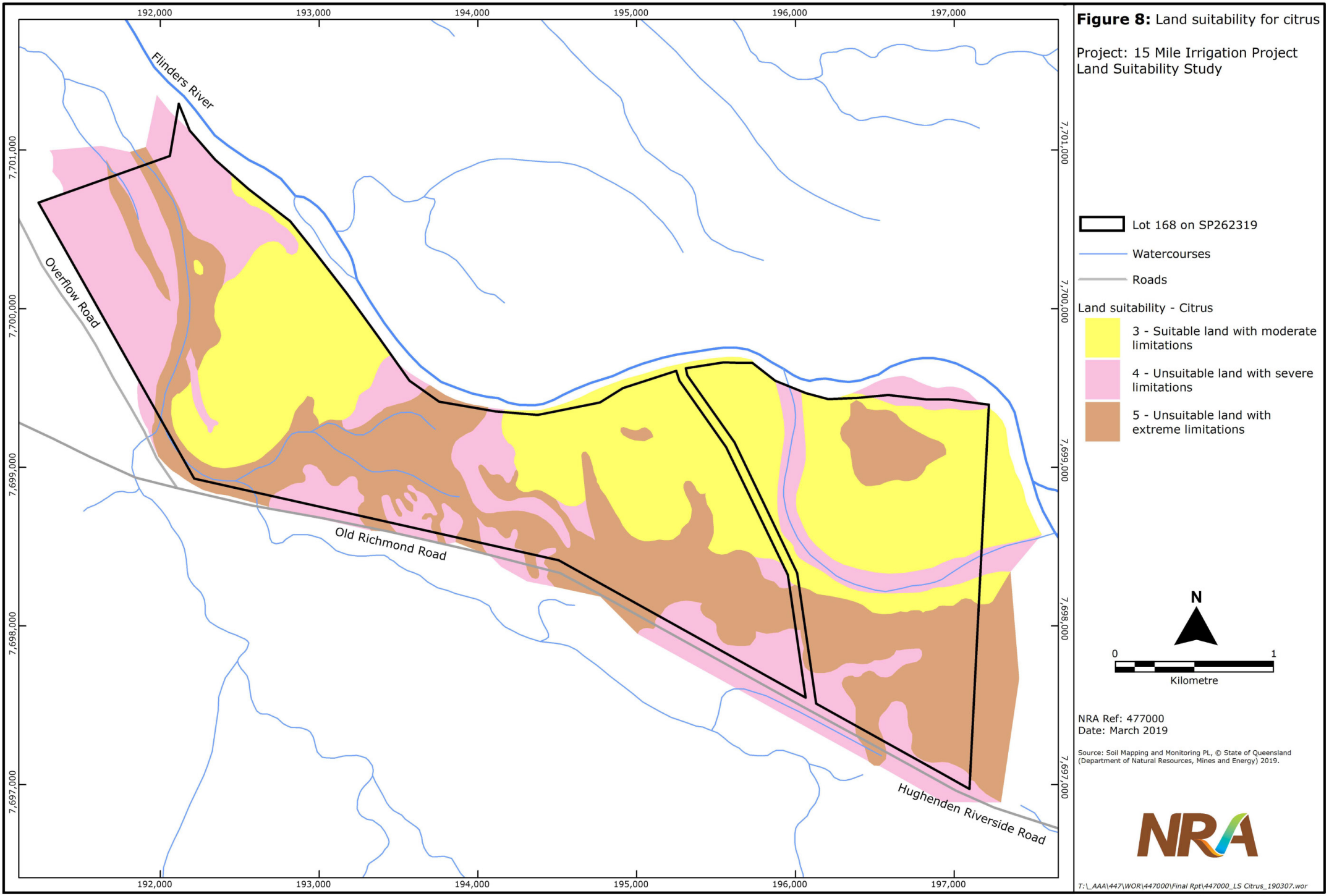

Figure 8: Land suitability for citrus

Project: 15 Mile Irrigation Project
Land Suitability Study

Lot 168 on SP262319

Watercourses

Roads

Land suitability - Citrus

3 - Suitable land with moderate limitations

4 - Unsuitable land with severe limitations

5 - Unsuitable land with extreme limitations

N

0 1

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Date: March 2019

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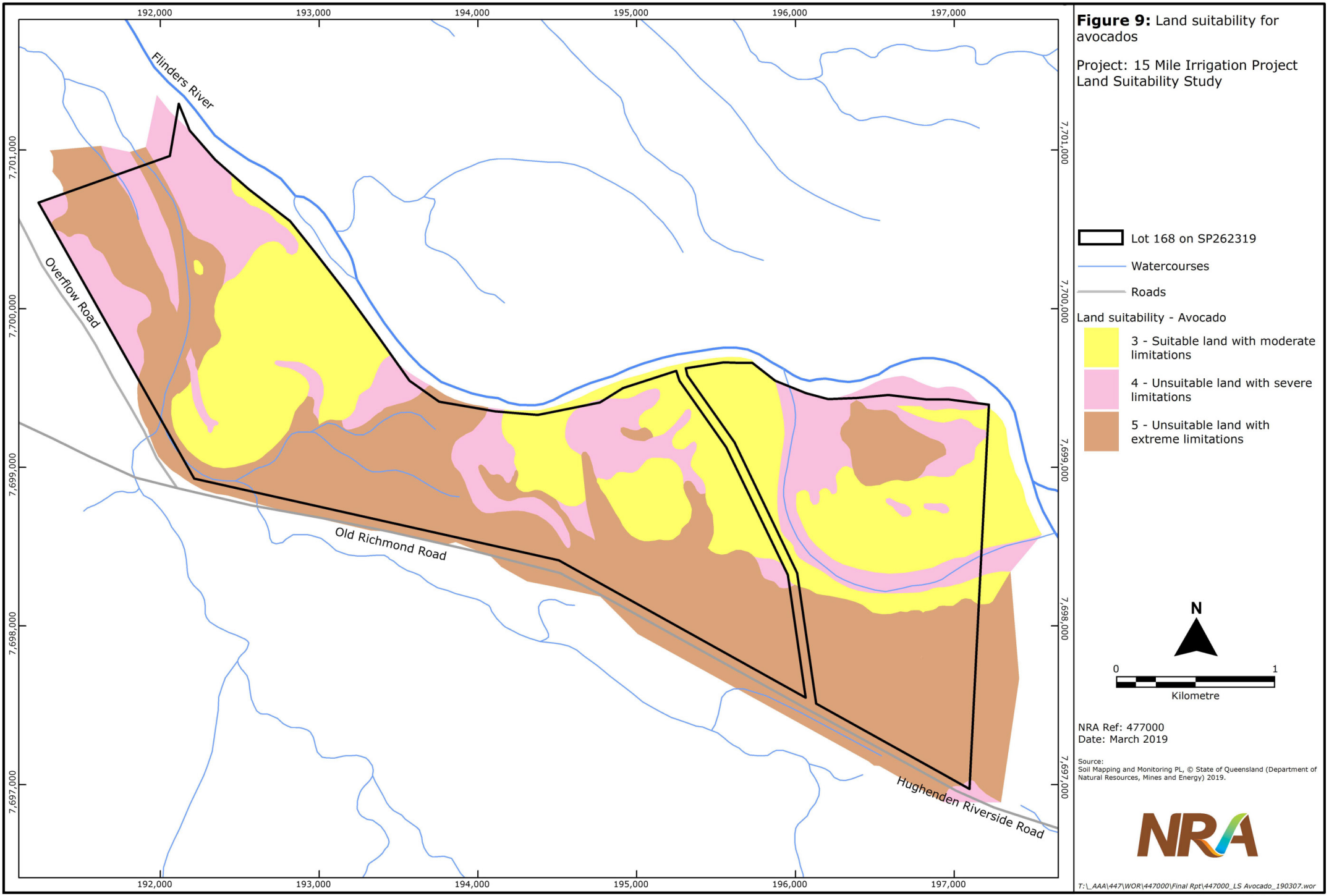

Figure 9: Land suitability for avocados

Project: 15 Mile Irrigation Project
Land Suitability Study

Lot 168 on SP262319

Watercourses

Roads

Land suitability - Avocado

3 - Suitable land with moderate limitations

4 - Unsuitable land with severe limitations

5 - Unsuitable land with extreme limitations

N

0 1

Kilometre

NRA Ref: 477000
Date: March 2019

Source:
Soil Mapping and Monitoring PL, © State of Queensland (Department of Natural Resources, Mines and Energy) 2019.

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Recommended print size: A4

5.1 Land suitability for table grapes

Production of table grapes is not constrained by unsuitable climatic conditions (severe heat stress, frequent frost or insufficient or excessive chill factor windows) in the local Hughenden area, although heat stress is a moderate limitation.

Of the 11 soil units mapped, only Soil Unit A1 and elevated occurrences of Soil Unit A2 have soil and land characteristics suitable for table grape agronomy and production.

These soils occupy 41.7% (370.4 ha) of the project area (888.6 ha[5]).

These soils are deep, rarely flooded, non-saline, rock free and moderately well drained, with negligible to moderate subsoil constraints. Variation in the suitability of Soil Unit A2 as a growing medium for table grapes relates to differences in location and landscape position. Where Soil Unit A2 occurs centrally within the elevated terrace plains (dominated by Soil Unit A1), it is free of severe constraints. Lower elevation occurrences such as at the rear of the terrace plains however, have severe flooding, salinity and similar sodicity constraints (and commensurate suitability outcomes) to the adjacent saline backplains (Soil Units B1, B2 and B3).

Constraining soil and land limitations for table grape production on Soil Units A1 and A2 (elevated) include flooding, water erosion (elevated Soil Unit A2 only), infiltration, PAWC (Soil Unit A1 only), soil surface condition, discharge potential (elevated Soil Unit A2 only) and wetness (drainage).

Table grape production on all other soils (low-lying areas of Soil Unit A2 and Soil Units A3, A4, B1, B2, B2g, B3, C1 and C2) is constrained by a number of severe or extreme limitations (Class 4/5). These include regular flooding, salinity and sodicity constraints (and associated limited effective rooting depth/soil water availability), soil or topographic complexity and worsening soil wetness.

5.2 Land suitability for citrus

Production of citrus crops is not constrained by unsuitable climatic conditions (severe heat stress, frequent frost or insufficient or excessive chill factor windows) in the local Hughenden area, although heat stress is a moderate limitation.

Of the 11 soil units mapped, only Soil Unit A1 and elevated occurrences of Soil Unit A2 have soil and land characteristics suitable for citrus agronomy and production.

These soils occupy 41.7% (370.4 ha) of the project area (888.6 ha[5]).

These soils are deep, rarely flooded, non-saline, rock-free and moderately well drained, with negligible to moderate subsoil constraints. Variation in the suitability of Soil Unit A2 as a growing medium for citrus production relates to differences in location and landscape position. Where Soil Unit A2 occurs centrally within the elevated terrace plains (dominated by Soil Unit A1), it is free of severe constraints. Lower elevation occurrences such as at the rear of the terrace plains however, have severe flooding, salinity and similar sodicity constraints (and commensurate suitability outcomes) to the adjacent saline backplains (Soil Units B1, B2 and B3).

[5] This is the extent of the two portions of the lot comprising the project area and the easement in between the two portions of the lot.

Constraining soil and land limitations for citrus production on Soil Units A1 and A2 (elevated) include flooding, water erosion (elevated Soil Unit A2 only), infiltration, PAWC (Soil Unit A1 only), nutrient balance (pH trend), soil surface condition, discharge potential (elevated Soil Unit A2 only) and wetness (drainage).

Citrus production on all other soil units (low-lying areas of Soil Unit A2 and Soil Units A3, A4, B1, B2, B2g, B3, C1 and C2) is constrained by a number of severe or extreme limitations (Class 4/5). These include regular flooding, salinity and sodicity constraints (and associated limited effective rooting depth/soil water availability), soil or topographic complexity and worsening soil wetness.

5.3 Land suitability for avocados

Production of avocados is not constrained by unsuitable climatic conditions (severe heat stress, frequent frost or insufficient or excessive chill factor windows) in the local Hughenden area, although heat stress is a moderate limitation and would be expected to affect fruit set and harvest of the crop (*pers. comm*. Marie Piccone, Managing Director Manbulloo Mangoes). Heat stress can be managed by using above tree lines and misting sprinklers, but such infrastructure would be costly to install and run, use valuable water supply and potentially contribute to increased disease risk within the crop.

Of the 11 soils mapped, only Soil Unit A1 has edaphic characteristics suitable for avocado agronomy.

These soils occupy 35.0% (311.0 ha) of the project area (888.6 ha).

These soils are deep, non-saline, rarely flooded, rock-free and moderately well drained, with negligible to moderate subsoil constraints.

Constraining soil and land limitations for avocado production on Soil Unit A1 include flooding, infiltration, soil surface condition and wetness (drainage).

Avocado production on all other soils (Soil Units A2 (all areas), A3, A4, B1, B2, B2g, B3, C1 and C2) is constrained by a number of severe or extreme limitations (Class 4/5). These include regular flooding, salinity and sodicity constraints (and associated limited effective rooting depth/soil water availability), soil or topographic complexity and worsening soil wetness.

5.4 Summary of land suitability outcomes

Land suitability outcomes for the 15 Mile project area are summarised in **Table 12** and shown in **Figures 7, 8** and **9**.

Table 12: Summary of the extent (ha) of suitable (Classes 1, 2 and 3) and unsuitable land (Classes 4 and 5) within the 15 Mile project area*

Land Suitability Class	Table grapes (ha)	Citrus (ha)	Avocado (ha)
Class 1	0	0	0
Class 2	0	0	0
Class 3	370.4	370.4	311.0
Class 4	220.5	220.5	194.7
Class 5	297.3	297.3	382.4

* Area figures include the land in the easement between the lots.

This study found that the land area that is suitable for the selected irrigated horticultural crops is similar to that indicated in the IAS (GHD 2018) of 344 ha.

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Appendix 1:
Project Scope

Part 5 – Scope

Flinders Shire Council wishes to promote the Shire as a centre for private sector investment in irrigated agricultural development by demonstrating that the Shire possesses the principal elements of suitable land, climate and water supplies. Such developments are seen as crucial to improve the employment prospects for current and future residents and hopefully reverse the current rate of population decline.

Council has acquired the former Reserve known as "15 Mile"; being Lot168 on SP262319 of 918 hectares in area with the intention of reconfiguring the freehold property into viable agricultural development blocks, obtain suitable water licences and promote such blocks to private investors.

It is considered that intensively grown, efficiently irrigated, low volume, high value, horticultural crops will result in a better, sustainable return than broad acre, low-return, high volume crops. These types of enterprises would also meet Council's goals of providing employment prospects for residents as well as encouraging migration of skilled workers to the Shire.

The successful tenderer will be required to provide a detailed report that demonstrates that the land is suitable for the proposed crop (Performance outcome on the Land suitability of the site to be included in an IAR for the Co-ordinated project Under the State Development Assessment Provisions: State Code 16 (SDAP State Code 16) applicants must demonstrate that the land is suitable for the proposed crop (Performance Outcome 29 – SDAP State Code 16), using the following Guidelines:

The land suitability assessment will be undertaken by a person who has skills and experience in soil and land resource science. This includes;

1. Understanding landscapes for the purpose of mapping and describing of soil types, toil attributes and limitations;
2. Describing soils in accordance with the Australian Soil and Land Survey Field Handbook (NCST 2009) and map them at a property scale in accordance with the Guidelines for Surveying soils and Land Resources (McKenzie et al. 2008); and
3. Undertaking agricultural land suitability assessments considering key soil attributes and land limitations in accordance with the Guidelines for Agricutlural Land Evaluation in Queensland (DSITI & DNRM 2015)

All soil and landform site data, and the crop suitability evaluation, will need to be collected and compiled strictly in accordance with the Australian Soil and Land Survey Field Handbook (NCST 2009), Guidelines for surveying Soil and Land Resources (McKenzie et al 2008) and the Queensland Guideline for Agricultural Land Evaluation (DSITI & DNRM, 2015).

Soil and land resource mapping into unique map areas and resultant land suitability assessments for clearing for agriculture must be conducted at a property level scale. In general, property scale assessments will range from 1:5 000 to 1:25 000 scale. At times (e.g. if more than 10 000 ha was proposed to be cleared), then 1:50 000 may be considered appropriate, if the soils and landscapes can be proven not to be complex. At scales of 1:50 000 or coarser, insufficient information is collected and presented to allow an adequate assessment of the land suitability, compliance with the POs and assessment of off-site impacts. The mapping scale chosen must suit the circumstance – the cropping proposed and its area, and more importantly the complexity of the soil and landform. Chapter 14, and Table 14.1 (see McKenzie et al. 2008) provides further information about scale. It is recommended that applicants using survey or mapping scales coarser than 1:25 000 discuss the supporting information required with a DNRME Land Resources Officer. Further information about survey intensity and cartographic scale is included in Appendix 3—Land Suitability Report.

The initial development of the block will be for table grapes, avocadoes and citrus crops, it is unlikely that all of the available, suitable land will be developed for permanent tree or vine crops. It is considered more likely, given the critical importance of reliable water supplies for these high-value orchards, that some of this land may support seasonal horticultural crops or niche crops such as specialty grains. These short-duration crops will have far lower annual water requirements and may be planted only when water is available; most likely from on-farm storage.

Minimum Information Required for Each Site

Information required for each site

The following provides an example of the type and standard information and data that should be collected for each detailed site, deep boring, analysed site and check site, and presented on a coherent basis in or as an appendix to the report supporting the application:

Table A1 Minimum data for land resource survey site observations (modified from DES & DNRME 2018)

Attributes	Detailed soil profile description, deep borings and analysed sites	Check sites	Reference in *Australian Soil and Land Survey Field Handbook* (YB)	Example
Location				
Datum/projection, coordinates, method, accuracy	▲	▲	YB p7-11, BB Ch16 p246-251	605 900 mE 7 380 000 mN, Zone 55S, UTM WGS84 or -23.687366°, 148.038652°, GDA94
General				
Unique, meaningful site identification code				D/08 for site 8 in project XYZ
Described by	▲	▲	YB p13	
Date (time optional)	▲	▲	YB p13	
Site type	▲	▲	YB p13	
Observation class	▲	▲		
Observation method	▲	▲	BB* Ch16 p252, YB p147-148	Soil pit, auger, pit
Reason for lower investigation depth	▲			Auger refusal due to bedrock
Geology: unit, map sheet, year	▲	☼	BB Ch4	
Australian Soil Classification	▲	☼ (Sub order)	ASC, BB Ch19, YB p225-227	Haplic Mesotrophic Red Dermosol
Photos: profile, landscape, fieldsheet	▲	☼	BB Ch16 p256-257	
Landform				
Landform: element, pattern, RMS	▲	▲	YB p15-55	Levee on Floodplain, Level Plain
Slope: method, % slope, slope class, MT	▲	☼	YB p18-26	
Site/land surface				
Land use	▲	▲		

Part 5 – Scope

Disturbance	▲	▲	YB p128	Cultivated; rainfed
Microrelief	▲	▲	YB p 129-133	Including element sampled
Erosion	▲	▲	YB p133-138	
Surface coarse fragments	▲	▲	YB p139-143	
Rock outcrop	▲	▲	YB p143-144	
Surface condition	▲	▲	YB p189-191	Hardsetting
Runoff	▲		YB p144-145	
Vegetation associations	▲	☼	YB p 73-125	
Permeability	▲		YB p200-202	
Drainage	▲		YB p202-204	
Depth to free water	▲			
Soil profile				
Horizon notation	▲	☼	YB p148-159	A1, A2
Horizon depths	▲	☼	YB p156	
Horizon boundaries	▲	☼	YB p199-200	Clear, Diffuse
Soil matrix colour	▲	☼	YB p159	10YR32
Mottles	▲	☼	YB p159-161	<2%, 1-15mm, prominent, orange
Field texture	▲	☼	YB p161-169	Sandy clay loam
Coarse fragments	▲		YB p170-171	2_10%, 20-60mm, subangular, quartz
Structure	▲	☼	YB p171-181	moderate, <2mm, subangular blocky
Cutans (slickensides)	☼			
Segregations	▲	☼	YB p195-198	10-20% calcareous concretions, 2-6mm
Depth to R horizon, strongly cemented pan	▲	☼	YB p156-159	
Pans	▲			
Permeability and drainage (horizon)	☼			
Sample depths, number	▲ (sampled sites)		BB Ch17 p265	
Substrate			YB p205-224	
Type of observation	▲			
Confidence	▲			
Depth	▲	☼		
Lithological type	▲	☼		
Grain size, texture, structure, mineral composition, strength, alteration, distance	☼			

Field tests				
pH: method, value (surface 0.1m and for each horizon or every 0.3m)	▲	☼	YB p198, GB* p46	
Electrical conductivity (surface 0.1m and for each horizon or every 0.3 m)	▲			
Dispersion/slaking class (SCL or heavier)	☼	☼		
Effervescence of fine earth ($CaCO_3$) or segregations (Mn)	☼			

Note:

- YB refers to the Australian Soil and Land Survey Field Handbook (NCST, 2009)
- BB refers to the "Blue Book", Guidelines for Surveying Soil and Land Resources (MacKenzie et al 2008); and
- ASC refers to the Australian Soils Classification (CSIRO, 2016)
- GB refers to the Soil Chemical Methods– Australasia (Rayment and Lyons, 2011)

At least two clearly labelled photographs are required showing:

- the nature of the general environs and soil surface at the site
- the attributes of the exposed soil profile, including a scalar reference, such as a tape, surveying staff or calibrated sample tray.

An example of suitable photographs is include in Figure A1.1, and a sample field sheet is included as Figure A1.2.

The soil profile shall be described (dug or exposed) to a minimum depth of 1.2m, or 1.5m if irrigation is proposed, or to a shallower depth of refusal by hardpan or bedrock.

Exposure will be by either or a combination of (in order of reliability) – excavation/pit, relatively undisturbed core, jarret hand auger as used in soil survey. Post hole diggers are not reliable due to contamination of the soil profile horizons, and are not considered to be a jarret hand auger. Any deviations from the above should be discussed with DNRME.

Detailed Sites

Figure A1.1 An example for a detailed site of the basic format and the required level of detail for site and soil descriptions as well as the use of photographs to support those descriptions:

Project: CAPEVILLE Site: 13

Location: GDA 94 zone 56, 300 000 mE 7 000 000 mN
Described by: Bill Smith
Date: 17-Jan-18

Site description

Geology: Qa - alluvium
Landform Pattern: alluvial plain
Element: levee
Permeability: moderately permeable
Microrelief: zero or none
Microrelief Component: no record
Drainage: imperfectly drained
Slope: 1 %
Rock Outcrops: no bedrock exposed
Surface Coarse Fragments: few 2-10%, small pebbles 2-6 mm, ironstone
Surface Condition: hard setting
Disturbances: cultivation – rain-fed

ASC Classification: Brown Dermosol

Profile Morphology

Horizon	Depth (m)	Description
A1	0.0 to 0.005	Dark greyish brown (10YR4/2) moist; fine sandy clay loam; very few <2% rounded siltstone small pebbles 2-6 mm ferruginised; massive structure; few 2-10% medium 2-6 mm ferruginous nodules; clear to
2A1b	0.05 to 0.3	Very dark grey (10YR3/1) moist; fine sandy clay loam; very few <2% rounded siltstone small pebbles 2-6 mm ferruginised; massive structure; very few <2% medium 2-6 mm ferruginous nodules; clear to
2A2eb	0.3 to 0.4	Brown (10YR4/3) moist; pale brown (10YR63) dry; fine sandy clay loam; very few <2% sub-rounded siltstone small pebbles 2-6 mm ferruginised; massive structure; very few <2% medium 2-6 mm ferruginous nodules; clear to
2B21b	0.4 to 0.75	Brown (10YR5/3) moist; very few <2% fine <5 mm faint orange (7.5YR6/6) mottles; light clay; very few <2% sub-rounded siltstone small pebbles 2-6 mm ferruginised; platy moderate 5-10 mm structure; very few <2% medium 2-6 mm ferruginous nodules; clear to
2B22b	0.75 to 1.5	Light yellowish brown (2.5Y6/4) moist; very few <2% fine <5 mm distinct orange (5YR7/6) mottles, very few <2% fine <5 mm prominent red (2.5YR5/6) mottles; light clay; very few <2% sub-rounded siltstone small pebbles 2-6 mm ferruginised; platy moderate 5-10 mm structure; very few <2% medium 2-6 mm ferruginous nodules; very few <2% medium 2-6mm manganiferous laminae

Analysed sites

Guidance for soil sampling provided by McKenzie & Ryan (2008) suggests that for the purposes of a general soil survey, the maximum sampling interval should be 100 mm in the upper 300 mm of the soil profile. Likewise below that depth the maximum sampling interval should be 300 mm. These generic recommendations should be considered when sampling analysed sites for a land suitability determination.

Other matters applicants need to consider in deciding on a suitable sampling regime include:

- what limitations and soil attributes are the analyses looking to verify, and what analytical tests are involved.
- how many samples are to be taken and analysed, and the likely costs of those analyses.
- whether sampling is to be of individual soil horizons (e.g. A1 horizon, A2 horizon, B2 horizon, etc.) or based on standardised profile depth intervals (e.g. 0–0.1 m, 0.2–0.3 mm, 0.5–0.6 m, 0.8–0.9 m, 1.1–1.2mm; and 1.4-1.5 for deep rooted crops and irrigated assessments).
- are the soils uniform, gradational or texture contrast soils, and are the horizon boundaries gradual or diffuse.
- what are the risks of too great a sample interval diluting material from a narrow non-compliant layer of soil, or of too small a sample interval missing a non-compliant layer of soil.
- Irrespective of whether sampling is horizon or depth interval based, all samples should be taken within single soil horizons (i.e. depth interval samples should not cross major soil horizon boundaries).

All samples are to be analysed at a NATA accredited or ASPAC accredited laboratory. See Appendix 4 for further information.

Collect and provide the same site and soil profile information for each analysed site as set out in the detailed site section above.

Check sites

Where the defining attributes of the characteristic soil in a map unit can be readily identified by obvious superficial features (e.g. surface soil colour, surface soil texture, surface condition, presence of gilgai, etc.), check sites can provide a quick and reliable means of identifying the areal extent of the unique mapping area (i.e. map unit.).

On the other hand, where the soil attributes confirming whether the check site is within a homogeneous soil unit require the exposure of part or all of the soil profile, the check site will effectively become another detailed site. In this latter case, provided the total number of detailed sites is increased accordingly, there may be no need to have observation sites that are designated as check sites.

Those attributes that confirm that a check site belongs to a particular soil type or unique map area need to be recorded for each check site, along with the unique identification (e.g. C16 for check site 16). The GPS coordinates of the check site and the applicable spatial datum (e.g. 605 900 mE 7 380 000 mN, Zone 55S, UTM WGS84) must also be recorded and submitted. However, simply submitting a site identification and some location coordinates for a check site, without any evidence of the confirmatory site or soil attributes observed, does not provide sufficient information for a determination of land suitability and is liable to be discounted or disregarded in that assessment. Hence the nature

of the confirmatory evidence obtained at check sites needs also to be stated (e.g. self-mulching, surface cracking, black clay surface soil).

Figure A1.2 Example of Field Sheet

Site #		Slope		Permeability		Erosion	
Desc. By		Element		Drainage		Surface Coarse Fragments	
Date							
Datum		Pattern		Microrelief		Rock Outcrop	
Zone							
Easting/Lat		Northing/Long					
Notes:							

Horizon Name	Depth	Texture	Moisture Status	Colour	Mottles	Coarse Frags	Segregations	Structure	Test Depth	pH	EC	Sample Depth

Landscape drawings are commonly completed on the reverse of the field sheet.

Preparing Information

Desktop assessment

In most instances a desktop assessment of all available sources of relevant information should be considered prior to undertaking further work such as a reconnaissance survey or an intensive field survey. The aims of the desktop assessment should be to:

- identify unique map areas or map units and provide an indication on the soil type/s present in the area.
- identify the survey area and the number and location of observation sites for further field investigation based on the likely number of soil types represented, the nature of those soils and their likely distribution across the area of interest. This may be larger than the land the subject of the application to include areas of potential off site impact.
- pinpoint any obvious or critical data gaps.

Suitable sources of information for the desktop assessment might include:

- geology mapping and reports.
- topographic mapping.
- remote sensing data (e.g. land use mapping, digital elevation models, etc.).
- aerial photographs and satellite imagery.
- existing soils and land resource reports, maps and associated information.

There is a substantial body of published soil and land resource reports and mapping that have been produced by various federal and state government agencies that are likely to be relevant to land suitability assessments. This material comes in a range of scales and is generally freely available or available at minimal cost.

In many coastal areas, as well as some inland areas of Queensland, detailed mapping at a scale of 1:25 000 to 1:100 000 is available and may include soil attribute data. In the majority of inland areas only broadscale ‘land system’ or ‘land resource area’ mapping is available at scales of 1:250 000 or 1:500 000. Soil, land system and land resource mapping at all the above scales are often complemented by detailed reports.

The scales applicable to published maps will normally need to be refined by a field survey covering the area of interest to an applicant. However, there are certain areas which have been subject to very intensive soil surveys by government agencies and those surveys could potentially yield information and data suitable for forming the sole or principal basis of an application.

Existing soils data, whether taken directly from government agency data bases or publications, or other privately collected data, may not fully satisfy the requirements for demonstrating the suitability of the land for the specific crops. This is frequently due to the data being originally collected for a purpose other than property scale land suitability assessments.

Some common examples of where existing data would not be suitable to use in assessing property scale assessment include:

- mottle colours not being reported using the required colour chip notation.
- EC1:5 values, but not chloride values.
- analytical methods applied in older studies being the currently preferred or acceptable method.

Electronic copies of existing government soil reports and maps, and GIS spatial data for the associated mapping, can be accessed through the following websites:

- the Department of Environment and Science and Natural Resources Mines and Energy library (PDF versions of reports and maps), https://www.qld.gov.au/environment/library
- the Queensland Government (GIS spatial data), https://data.qld.gov.au/dataset/land-resource-areas-series

Applicants are encouraged to discuss all results of the desktop survey with DNRME before commencing further detailed assessments.

Reconnaissance survey

In some cases a desktop assessment of available soil mapping and data might be sufficient to demonstrate compliance with the requirements for a land suitability assessment, depending on the scale of the published data, and complexity of the soil and landscape. Where more detail is required, a reconnaissance survey, can be a cost effective step that complements the desktop assessment.

A competent soil scientist, armed with some basic equipment (e.g. a hand auger, corer or similar, GPS), and the knowledge gained from the desktop assessment, should be able to quickly survey a parcel of land and, if necessary, review or refine the survey area for a subsequent, more detailed field survey.

Information gained in the reconnaissance survey can provide significant benefits in planning any subsequent, detailed field survey, including:

- providing guidance on the validity of the concepts developed (in the desktop assessment) on the likely distribution and nature of the survey area.
- focusing resources to the areas of the landscape that contain the most complex soils and landforms.
- allowing more accurate costing and budgeting for the field survey.

If done correctly, the information and data gained in the reconnaissance survey should potentially reduce the amount of information and data that needs to be collected in the subsequent, more detailed field survey.

Detailed field survey

The critical aspect of a field survey is the identification and characterisation of sufficient ‘observation sites’ to be examined, documented and evaluated.

There are four types of observation sites that can be used to map the unique map areas and determine land suitability, including:

- detailed soil profile description;
- deep borings;
- analysed sites;
- check sites.

Table A2.1 Classes of observations

Observation Type	Description	When is it required?
Detailed soil profile description	Detailed morphological and site descriptions to characterise the main soil and landforms, and the specific soil attributes required in land suitability assessments. Soils are described to minimum of 1.2 m or 1.5 m (if irrigation or deep rooted crops are proposed), or an impermeable layer such as bedrock.	Used to identify the different soil types and characterise the dominant soil in a unique mapping area, essential for characterising the soil attributes and limitations used in land suitability assessment.
Deep borings	Deep borings examine the material below the normal depth and are important when subsolum and substrate properties influence land use. Deep borings allows consideration of factors such as deep impermeable layers, salt accumulation, groundwater depth and salinity. Full soil profile morphology including pH and electrical conductivity, measured from the surface and at 0.3 m increments. Lower soil depth for these borings should be discussed with DNRME to ensure adequate assessment of deep drainage.	Essential if irrigation is proposed, particularly to assess the off-site impacts associated with deep drainage, water logging and salinity.
Analysed sites	Profiles where samples are taken for laboratory analysis. Sampling is usually conducted to characterise each 'typical soil' in the area being investigated, or to target selected soil attributes such as fertility, sodicity or salinity. Physical and chemical analyses are expensive and must be well targeted and clearly specified. Minimum required includes pH, EC, Cl, particle size distribution, air dry moisture content, dispersion ratio, cations, trace elements and fertility suite.	These are used to evaluate sites and unique map areas within the area to be cleared, to characterise off site impacts and to confirm field textures, soil permeability and field tests, which are required to assess limitations such as wetness, soil water availability and erosion. Each 'typical' soil requires at least one analysed site. More may be required for larger applications, particularly if irrigation is proposed (up to 3 analysed sites per unique map area if polygons exceed 10 ha).
Check sites	Check sites are brief observations to confirm mapping boundaries, soil type distributions or other characteristics being mapped in the survey area. They must be in sufficient detail to allocate the site to a specific soil type and unique map area or mapping unit.	Used to accurately delineate the location of the boundaries of unique map areas or to ascertain the degree of variability within a map unit.

Note: soil site density and mapping scale should be produced at the property scale and determined by the area to be cleared, crop type and complexity of the soils and landscape. Mapping scale needs to be discussed during prelodgement, for proposed scales coarser than 1:25 000.

Land Suitability Report

Your land suitability report should be completed in accordance with the Guidelines for Agricultural Land Evaluation in Queensland (available at Guidelines for Agricultural Land Evaluation in Queensland) and should include the following:

1. Signed statement by Technical Expert
    a. Qualifications and experience in soil and land resource science;
    b. Statement of land suitability for the proposed crops.
2. Site location/description and proposed activity
    a. Lot number and registered plan number;
    b. Current site plan with scale bar, showing north, lot on plan boundaries and location of soil sampling sites (including GPS coordinates and the applicable spatial datum coordinates of detailed sites, deep borings, analysed sites, and check sites);
    c. Proposed crop(s) to be grown;
    d. Management practices for growing/harvesting crops to ensure limitations are considered when determining land suitability i.e. irrigation method.
3. Assessment and Findings
    a. Address information requirements specific to level/option.
    b. Identify the assessment methodology in accordance with the required standards (Guidelines for Agricultural Land Evaluation in Qld; Australian Soil and Land Survey Field Handbook) (include: location of all sites; soil profile descriptions (see Appendix 1)); soil map at property scale with a description of each soil type and limitations for each of the unique mapping areas—this may include collated information (present in excel spreadsheet) from published land resource/land suitability studies used in the assessment (including a discussion of each limitation used in that particular land suitability assessment).
    c. Include a description of the proposed crop requirements in terms of climate and seasonal variability, and link this to the climatic and seasonal conditions at the site location.
    d. Include a description of the landscape element, landscape pattern, slope, drainage, permeability, surface rockiness (abundance, size, and lithology), rock outcrop (abundance and lithology) and microrelief of each site sampled.
    e. Include a description of each soil horizon at each site, including the minimum standards specified in Table A1.1 of this guideline (e.g soil texture, colour, structure, coarse fragments, segregations, field pH, upper/lower depths of horizons etc).
    f. provide data on the pH and Electrical Conductivity at each site at 0.3 m increments to maximum depth of 1.5 m.
    g. provide photographic evidence of the general environs and soil surface at each site, and the attributes of each exposed soil profile to the required depth.
    h. Clearly identify any links or correlation between the sites sampled to the soil unique map areas and how the soil attributes relate to the limitations and overall land suitability.
    i. For irrigated cropping, include a daily water balance model to make an assessment of deep drainage, water logging and off-site impacts on salinity.
    j. Findings.
    k. Include all digital copies of spatial data (e.g. ArcGIS shapefiles) used for assessment including unique map areas, final suitability, and LiDAR if available.
    l. include digital copy of excel spreadsheet listing unique mapping areas and limitations used for suitability calculations.

Part 5 – Scope

4. Conclusions and recommendations
    a. Statement that the subject is/is not suitable for the identified crop(s) or crop group.
    b. Identification of any limitations and constraints on the use of the site where applicable.
    c. Land suitability mapping.
5. Attachments
    a. Laboratory results from an accredited laboratory (e.g. NATA, ASPAC).

Laboratories for soil analysis

Under normal circumstances the laboratories performing the analysis of soil samples required to determine whether land suitability will need to:

- comply with the Australian Standard (AS) AS ISO/IEC 17025-2005: General requirements for the competence of testing and calibration laboratories; and
- have the technical expertise for the specific analytical methods.

Accreditation provided by the National Association of Testing Authorities (NATA) can provide evidence of compliance to this standard.

Preferably, analytical laboratories should also participate in Australasian Soil and Plant Analysis Council (ASPAC) proficiency trials, and maintain certification for the relevant methods. The ASPAC website (www.aspac-australasia.com.au) lists participating laboratories.

In the cases of both NATA and ASPAC, the respective accreditation or certification is for specific analytical tests or methodologies (e.g. method 15C1 in Rayment & Lyons, 2011), and is not a generic accreditation for all analyses undertaken at a laboratory. Therefore before submitting soil samples for analysis, it is important to check that the laboratory is accredited and/or holds certification for all of the required tests.

While the use of sample handling and preservation focused quality assurance measures, such as chain-of-custody documentation, analysis of field and trip blanks, spiked and duplicate samples, is not to be discouraged, if site selection and sample collection are not of a suitable quality, post sampling quality assurance measures are of no value and will not overcome sampling or procedural deficiencies.

Where analytical testing of soil samples is undertaken outside of an accredited facility, the agency assessing a verification application might require evidence that:

- the equipment used has been calibrated or recalibrated by the equipment supplier, or another entity with suitable expertise, and that the calibration is current;
- the calibration of the equipment is routinely checked when the equipment is operating;
- a recognised analytical methodology has been followed;
- a documented set of suitable quality assurance procedures is in place to cover all aspects of the testing, from sample receipt to the provision of the results;
- the persons undertaking the tests have the competencies necessary to prepare the samples, operate the testing equipment, record the results, and identify quality assurance non-conformities and any anomalous results.

1. Irrespective of the accreditation or certification held by a laboratory, copies of all analysis certificates provided by the analytical laboratories or other providers must be submitted for assessment by the government.

Appendix 2:
Soil Survey Field Sheets

Photos – Escape/veg 1-7
– Soil 8-15
– Drillers log 25-31 (near Site 2)

Slope range <0.5-1.0%. Level to Very gently slope LEV/TEP – 5m above modern FR STC

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	Slope MT	Slope Ind	Landform Element Type	Landform Element Loc	Landform Element Height	Landform Element Width	Landform Element Length	Landform Pattern Pattern	Landform Pattern Class	Landform Pattern Modal	Landform Pattern RMS	Land Use LU1	Land Use Mgt1	Land Use Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	1.0		S		LEV					ALP			LP				BURT	10/2/18	FSC 15M	01		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Air Photos Run No	Air Photos Frame No
C	M	4	1	2	3	4	–	X	999							

Substrate: buried sand deposits

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F.	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	0		080							UC						

Location Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition
M	55	195020 (5?)	6994494 AGD94	3	D	E	A	E	Y	Y	C	D	A	Silcrete very deep. Because buried layers are unconsolidated.	—	1	H

Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Outcrop Lith
Z						0						0	

Profile Diagram: A1 0-0.05; B21 0.05-0.30; B22 0.30-0.60; D1 0.60-1.30; D2/D3 1.30-1.60

Erosion

Type	State	Deg	GD
S	P	1	

Vegetation Community

No	Ref No	Name
1		Very open woodland of coolibah, bloodwood and occ River red gum = 10-30-12
2		
3		

ghost gum

Vegetation Community Details

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V	14		EUCCOOLA		CORDALLA		EUCAMAL	
M	T	6	V	8		LYSGILVU		GREVSTRIA		CORPLENA	
L	S	4	V	<2		VACFARNE		ACAYICTO		ACASALIC	

AH? EO? V? Gindablue CARLASIA CARLANCE

<15%

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dsct	Bound Shape	Field Texture	Field Texture Qual	Perm	Drain	Book	Colour Hue	Colour V	Colour C	Colour Moist	Mottles Type	Mottles Abun	Mottles Size	Mottles Contr	Mottles Col	Coarse Fragments Abun	Coarse Fragments Size	Coarse Fragments Shape	Coarse Fragments Lith	Coarse Fragments Str	Structure Grade	Structure Size	Structure Type	Structure Cmpd	Segregations Abun	Segregations Nat	Segregations Form	Segregations Size	Segregations Str	Cracks	Strgth SWS	Strgth Cons	Cutans Fabric	Cutans Kind	Cutans Abund	Cutans Distinct	Pans Type	Pans Cmnt	Pans Cont	Pans Str	Roots Size	Roots Abun	Samples (m)
1	A1	000	005	C		FSCL	+	3	4		10YR	43	M	5/4/D		0				0					W/V	3	SB		0						D	3					–						0-0.05
2	B21	005	030	G		FSLC		3	4		10YR	22	M			0				0					M	4	AB	1	0						D	4	5				–						0.05-0.1 / 0.1-0.2 / 0.2-0.3
																									M	3	AB	2																			
3	B22	030	060	C/G		SCL	F-M	3	4		10YR	32	M			0				0					W	5	SB		0						D	3/4					–						0.5-0.6
4	2D1	060	130	C		S	M-K	4	4		10YR	34	M			0				0					V/G				0						D	2	G				–						0.8-0.9 / 1.1-1.2
5	2D2	130	160	C		SL		M	4	4		10YR	43	M		0				0					V/E				0						D	2	E				–						1.4-1.5
6	2D3	160	170			S	M-K	4	4		10YR	43	M			0				0					V/G				0						D	1	G				–						–
7																																															

Alluvial layering

Field Tests	Meth	0-02	0.20	0.40	0.60	0.90	1.20	1.50
pH-RP	1	6.5	7.0	7.8	8.2	7.8	7.8	8.2
pH-1:5	4							
EC-1:5	1							
Slaking	1	0	1	2	2	2	2	2
Dispersion	1	0/2# N	0/0-1# N	0/0-1# N	0/2# N	0/0-1# N	0/2# N	0/2# N
Efferv fin. earth								

after remoulding

NOTES:

Front levee dyspan adjoins indistinct Scroll plain to south

SRP (indistinct)

- Level to very gently sloping LEV/TEP deposit immediately adjacent to incised Flinders River STC; incision approx 5-6m below ALP/ indistinct SRP (scroll plain)
- See note over

Site 1 photographs

Soil profile photograph

Landscape photograph

Photos - Lscape/veg 16-19
- Soil 20-24

SITE DESCRIPTION

slope range <0.5%. indistinct TEP/SRP - 5m above incised FR STC

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		SRP / TEP					ALP			LP				BURJ	19/12/18	FSC15M	02		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4	—		999								C	0		0.4							UC						

Substrate: alluvial layers

Location: AGD94

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Gr2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	195734	7699220	3	DE (CH?)	AE	YY	CD	A	E	M	O	X	—	—	1	H	Z						0						0	

Australian Soil Classification note: given variable PPF because buried layers are not constrained.

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
S	S	P		1		Very open woodland bloodwood, ghost gum & bauhinia = 10.3.12 + shrubs & Mesquite (AH? EO?)	T	T	7	V (U?)	13		COR PLENA		CORDALLA	occ	LYSGILVU	
				2			M	5	5	V	3		VAC FARNE		ACASALIC	occ	ERE sp (mitchelli??)	
				3			L	—					PRO PALLI					

Profile Diagram: A1 0.06; B21 0.45; 2D1 0.60; 3B2 1.00; 4D2 1.20; 5B2 1.70

Number	Horizon	Depth Upper (m)	Depth Lower (m)	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles	Coarse Fragments Abun	Structure Grade	Size	Type	Cmpd	Segregations Abun	Strgth SWS	Cons	Pans	Samples (m)
1	A1	000	006	G		FSCL		3	4	10YR	3	3	M	0	0	W / V	3	SB		0	D	3	—	0-0.05; 0.05-0.1
2	B21	006	045	C		FSLMC+		2	4	10YR	3	2	M	0	0	M / M	4 / 3	AB / AB	1 / 2	0	D	4/5		0.1-0.2; 0.2-0.3
3	2D1	045	060	C		S	M-K	4	4	10YR	3	3	M	0	0	V/E				0	D	2		0.5-0.6
4	3B2	060	100	C		LMC		2	4	10YR	4	3	M	0	0	M / M	4 / 3	AB / AB	1 / 2	0	D	5		0.8-0.9
5	4D2	100	120	G		S	M-K	4	4	10YR	3	3	M	0	0	V/G				0	D	2		1.1-1.2
6	5B2	120	170			LC		3	4	10YR	4	3	M	0	0	M / M	5 / 3	PR / AB	1 / 2	0	D	4/5		1.4-1.5
7																								

Field Tests	Meth	0.02	0.20	0.55	0.85	1.15	1.45
pH-RP	1	7.0	7.5	7.8	8.2	8.2	>8.5
pH-1:5	4						
EC-1:5	1						
Slaking	1	0	1	2	2	2	2
Dispersion	1	0/2#	0/2#	0/2#	1/0-1#	1/0-1#	1/0-1#
Efferv fin. earth		N	N	N	N	N	N

after remoulding

NOTES:

- Buried sand layers @ 0.45-0.6m & 1.0-1.2m; structured clayey subsoil is similar above & below these horizons; sand layers possibly relict/buried A1?
- Level TEP/indistinct SRP (scroll plain) of Flinders River ALP.
- Sand fraction - fine to medium & micaceous; coarser in sand lenses & large mica flakes

Site 2 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 32–34
– soil 35–38

but adjacent to prior STC + potentially relict LEV dep

SITE DESCRIPTION

Slope range <0.5 Back TEP component

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0-2		F		LEV? relict TEP					ALP			LP				BURJ	11 12 18	FSC15M	F03		

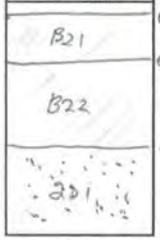
Substrate: Alluvial sand deposit – buried

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Film No	Run No	Frame No	Substrate: OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	3	4			999								C			1.05							UC						

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Gr2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	195 994 (5?)	7698 384	3	DE	AB	YY (AH?)	CD	A	E	M	M	X (W?)	K (alluvial layers are unconstrained)	–	–	1 (H)	HF	Z						0						0	

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
S	P	1		1		Very open woodland of ghost gum, C. plena	T	T	7	V	15	<10	CORDALLA		CORPLENA			
				2		with – 10.3.12 (but	M	T	5	V	4		LYSGILVU		ERESP?		ACASALIC	
				3		+ shrubs + Mesquite mapped as 10.3.26)	L						PROPALLI		(MITCH)?			

Profile Diagram

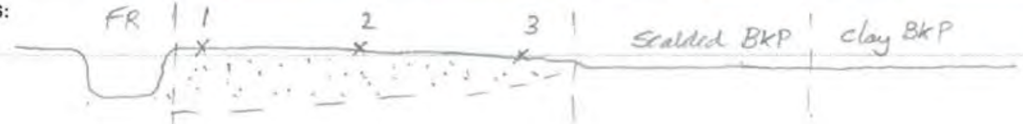


Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Hue	V	C	Moist	Mottles	Coarse Fragments Abun	Structure Grade	Size	Type	Segregations Abun	Cracks	SWS	Cons	Fabric	Cutans	Pans	Roots Size	Roots Abun	Samples (m)
1	A1	000	005	C		SCL	M–	3	4	10YR	3 / 5	3 / 3	M / D	0	0'	W / V	4	SB	0		D	2/3	R		–	1	1	0–0.05; 0.05–0.1
2	B21	005	045	G		CLS	M	3	4	10YR	3	3	M	0	0 (Str W)	M	4	AB	0		D	4	R?		–	1	1	0.1–0.2; 0.2–0.3
3	B22	045	105	G		CLS	M+	3	4	10YR	4	3	M	0	0	W / M	5 / 4	AB / AB	0		D	4/5	R?		–	1	1	0.5–0.6; 0.8–0.9
4	2D1	105	170			LS ↓ SL	M+ / –	4	4	10YR	4	3	M	0	0	V			0		D	2	E		–	1	1	1.1–1.2; 1.4–1.5
5																												
6						Medium sand fraction – visible grains – obvious mica flakes																						
7																												

Field Tests	Meth	0.02	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.8	6.8	7.8	8.2	8.0	8.5
pH-1:5	4						
EC-1:5	1						
Slaking	1	0	1	1	2	2	2
Dispersion	1	0/2#	0/2#	0/0-1#	0/0-1#	0/0-1#	0/0-1#
Efferv fin. earth		N	N	N	N	N	N

after remoulding

NOTES:



- Site located @ back end of broad TEP adjacent to FR
- To compare with sites 1 + 2; equivalent to site 1 which suggests areas adjacent to former streams may act like contemporary LEV

Site 3 photographs

Soil profile photograph

Landscape photograph

Soil mass has mica flakes throughout matrix to 1.5m & confirms Qa sourced from Flinders River (provenanced from metamorphics in upper catchment).

Photos - Lscape/veg 39-41
- Soil 42-46.

SITE DESCRIPTION

Slope range 0-0.5% Scalded BKP drainage area of Flinders River alluvium / transitioning to rolling downs lscape.

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0-2		F		BKP SCD					FLO			LP				BURJ	1/12/18	FSC15M	F04		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	1	1	3			999								C										ND						

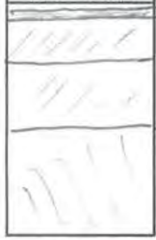
Substrate: Not described.

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	ASC Ord	Sub Ord	Gr Or2	SG SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	196029	7698109	3	DE	AE	YY	EX	A	E	M	O	X	—	—	1	HYX	Z	.					0						0	

Australian Soil Classification annotations: SO? AH? EO?; ← <20% clay difference @ C/A boundary = DE + occ cracking. Surface condition: OccG.

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
C	A	3	—	1		No vegetation - completely bare scald.	T								
				2			M								
				3		Mapped as 4.3.20 ✓	L								

Profile Diagram



Number	Horizon	Depth Upper	Depth Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans	Pans	Roots Size	Abun	Samples (m)
1	A1	000	004	C		FSCL	+	1	3	10YR	3 / 5	3 / 3	M / D	0					0					W / V	4	PL		0						D	3				1	1	0-0.04
2	A2j	004	008	C	A	CLFS		1	3	10YR	4 / 6	2 / 3	M / D	0					0					W	3	SB		0						D	4				1	1	0.04-0.08
3	B21	008	030	G		LMC	+	1	3	10YR	3	2	M	0					0					M / M	5 / 3	AB / AB	1 / 2	0						D	5/6				1	1	0.1-0.2 / 0.2-0.3
4	B22	030	075	D		MC		1	3	10YR	3	2	M	0					0					M	4	AB	.	0						D	6				—		0.5-0.6
5	B23K	075	130			MC		1	3	10YR	3 / 3	3 / 4	M / M	M	2	2	F	R	0					W / M	6 / 4	LE / AB	1 / 2	2	K	N	1			D	6/7				—		0.8-0.9 / 1.1-1.2
6	Stopped by very dense hard clay - stopped rig									↑ appears to pond water																															
7																																									

Field Tests	Meth							
Depth		0.02	0.10	0.25	0.55	0.85	1.15	
pH-RP	1	6.5	—	6.8	8.5	9.0	9.0-9.5	
pH-1:5	4							
EC-1:5	1	0.04	—	0.13	0.24	0.36	—	
Slaking	1	2	2	1	2	2	2	
Dispersion	1	1/3#	0/3#	0/2#	0/<0-1#	0/<0-1#	0/<0-1#	# after remoulding
Efferv fin. earth								

NOTES:
- Severely scalded + non vegetated.
- Depositional BKP influenced both by local lscape drainage / flooding + Flinders River overflow; very hard + impermeable + subject to ponding + scalding behaviour; definitely subject to wind erosion; advice from Ed McIntosh - only get plant growth where surface raised from dead timber etc.

Site 4 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 47–51
– Soil 52–56

Locally provenanced Qa from adjacent "rolling Dacons" Lscape

weakly channelled <0.5m, shallow vales / BKP of Flinders River FLO + receives local drainage from rolling dacons to south.

SITE DESCRIPTION

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	d-2		F		BKP					FLO			LP				BURJ	11/2/18	FSC15M	FØ5		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	1	3				999							

Substrate — Not described.

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND.						

Location — 4.–3 based on landscape position

Datum	Zone	Easting / Latitude	Northing / Longitude
M	55	196204	7697788

Australian Soil Classification

Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5
3	VE	AD	E	I	GB	E	R	R	X

PPF	GSG: aff	Disturb	Surface Condition
—	—	1	GM

Microrelief

Type	Agent	Cmpt	Prop	VI	HI
A		M	B	ϕ·3	15

Surface Coarse Fragments

Abun	Size	Shape	Lith	Str	Alt
Ø					

Outcrop

Abun	Lith
Ø	

Profile Diagram: A1 0.03 / B21 0.40 / B22 0.75 / B23 1.30. / B24/D

Erosion

Type	State	Deg	GD
X			

Vegetation Community

No	Ref No	Name
1		Mid-dense Boree scrub on alluvium
2		Mapped as 4.3.3/10-35; both incorrect
3		

W? – bottom horizon no more constrained than B22/B23.

Vegetation Community Details

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	6	M	10		ACATEPHR	∞	EUCCOOLA			
M											

Number	Horizon	Depth (m) Upper	Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str
1	A1	ϕϕϕ	ϕϕ3	C		MC	–	4	?	1	ϕ YR	4	2	M	ϕ					ϕ				
2	B21	ϕϕ3	ϕ4ϕ	G		MHC		1/2	4	?	1 ϕ YR	4	2	M	ϕ					ϕ				
3	B22	ϕ4ϕ	ϕ75	G		MHC		1/2	4	?	1ϕ YR	3	2	M	ϕ					ϕ				
4	B23 Ky	ϕ75	13ϕ	D		MHC		1/2	3	?	1 ϕ YR	3	2	M	ϕ					ϕ				
5	2DK	13ϕ	16ϕ			MC		1/2	3		1ϕ YR 7.5YR	4	4		M	2	1	D	D	ϕ				
6	micaceous clay = relict alluvium																							
7																								

Number	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	S	1	GR.		ϕ								S				–						0·03
																							0·03–0·1
2	S	4	AB LE	1	1	K	N	1					S				–						0·1–0·2
																							0·2–0·3
3	S	6	LE	1	1	K	N	1					S	K	2	D	–						0·5–0·6
	S	3	LE	2	1	Y	X	1	?														
4	S	6	LE	1	1	K	N	1					S				–						0·8–0·9
	S	3	LE	2	2	Y	X	1															1·1–1·2
5	M	4	LE AB		2	K	N	1					S				–						1·4–1·5
6																							
7																							

"Black soil" provenanced from rising dacons

buried alluvial

Field Tests	Meth	0·03	0·10	0·25	0·55	0·65	1·15	1·45
pH-RP	1	7·5	8·2	9·0	8·5	8·5	8·5	8·5
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	2	2	2	2	2	2
Dispersion	1	ϕ/<0–1 # 5	ϕ/<0–1 # 5	ϕ/<0–1 # 5	2/1 # S/M	3/2 # S/M	2/2 # S/M	1/2 # S/M
Efferv fin. earth								

after remoulding

NOTES:

- Mod thick, mod to strongly SM (S1-2GR) + weak flake.

Site 5 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 57–59
– soil surface 60–62
– profile 63–67

Locally provenanced "Black Soil" Qa

SITE DESCRIPTION

Slope range <0–0.5% Similar Lscape to FØ5 – open grassland (FØ5 = Sedgee)

Geology	Slope Eval	Percent	Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern (Local)	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	Ø-2		F		BKP					FLO			LP				BURJ	1/12/18	FSC15M	FØ6		

(flowing westwards)

Substrate: micaceous clay seds below 0.9m

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Code	Map Unit Type	Code	Air Photos Film No	Run No	Frame No	OT	Distance	Conf	Depth	Gr S	Str	Sl	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	1	1	3			999								C			Ø.9Ø								UC						

Location 4? – based on low-lying lscape position

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	195831	7697777	3	VE	AD	GS	GB?	A	E	ØØ	X		–	–		1	GXF M	Z						Ø						Ø	

Vegetation Community: EI? – predominantly weakly SM

Erosion Type	State	Deg	GD	No	Ref No	Name
X				1		Mitchell grass on local alluvial FLO
				2		provenanced from adjacent "rolling downs"
				3		Mapped as 4-3-14 ✓

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T											
M											
L	G	3	S	1.Ø		AST SQUAR		AST LAPPA??			

Profile Diagram:

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Frag Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	ØØØ	ØØ2	C	A	FSLC	+	2	4?	1Ø YR	4	2	M		Ø				Ø					M	2	SB	1	Ø						D	2	S				–				1	1	Ø–Ø.Ø2
																								M/S	1	GR	2																			Ø.Ø2–0.1
2	B21 K	ØØ2	Ø4Ø	G		MC		2	4?	1Ø YR	4	2	M		Ø				Ø					M	5	AB	1	1	K	N	1			D	6	S				–				1	1	0.1–0.2
																								S	4	AB	2																			0.2–0.3
3	B22 Ky	Ø4Ø	Ø9Ø	C		MC		1/2	3?	1Ø YR	4	2	M		Ø				Ø					M	5	LE	1	1	K	N	1			D/4	4	S				–				1	1	0.5–0.6
																								M	3	LE	2	1	Y	X	1															0.8–0.9
4	2 Dy	Ø9Ø	16Ø			FSLMC		1/2	3	1Ø YR	4	4	M	M	2	2	F	O	Ø					M	4	AB		2	Y	X	1			T	3/4	S				–					Ø	1.1–1.2
										7.5YR	4	4	M													PO		1	Y	X	2															1.4–1.5
5																																														
6																																														
7																																														

Field Tests	Meth	Ø.Ø2	Ø.1Ø	Ø.25	Ø.55	Ø.85	1.15	1.45
pH-RP	1	8.2	8.Ø	9.Ø	9.Ø	9.Ø	9.Ø	9.Ø
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	2	2	2	2	2	2
Dispersion	1	Ø/<Ø-1#	Ø/<Ø-1#	Ø/2#	3/2#	1/1#	1/1#	1/1#
Efferv fin. earth		N	S	S	S	S	N	N

after remoulding

NOTES:

- Thin weakly SM (to firm pedal in patches) surface with well developed flake & sandy wash – not micaceous.
- Open mitchell grass downs on level FLO
- Fine sandy wash across surface & formation of significant flake; firm pedal to weakly SM (epipedal)

Site 6 photographs

Soil profile photograph

Landscape photograph

Summary Recent dep = 0–6m <45% clay + gravel beds.
Older dep = 6–18m. >45% clay + gravel beds

- Drillers core near site FQ2
- Sampled for pH, EC, Cl to 14m @ 1.0m intervals
- Photos – core samples 68–71 (0-0.1, 0.1-0.2, 0.2-0.3 etc bulk samples)
  – 1 scape 72–73

SITE DESCRIPTION

Slope range 0–0.5%

Geology	Slope: Eval	Percent	Class	MT	Ind	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		TEP					ALP			LP				BURJ	121218	FSC15M	FQ7		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	2	2	2	4			18.0							

Substrate#: unconsol gravel/clay sed to 18m

IOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen 1	Text	Mass Str	MDS	MC1	MC2
C			5.0							GV						
			18.0							MU						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	195739	7699191	3	DE	AB	—							—	—	1	H

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						0						0	

Profile Diagram: 4.0m; 6.0m; MHC-HC clay; 14.0; 18.0; = Mudstone

Erosion: Type	State	Deg	GD
S	S	P	

Vegetation Community: No	Ref No	Name
1		Very open woodland bloodwood, ghost gum + bauhinia + Mesquite. V = 10.3.12
2		
3		

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T						See site FQ2 for description (same site area).					
M											
L											

Number	Horizon	Depth (m) Upper	Lower	Bound Dact	Shape	Field Texture	Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund.	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1		0	1.0			1 0 YR33M		3	4											FSLC																												Bulked samples 0–4.0
						1 0 YR43M																																										
2		1.0	2.0			1 0 YR43M		2	3 4											FSLMC																													
3		2.0	3.0			1 0 YR43M		3	4											SLC																												
4		3.0	4.0			1 0 YR43M		3	4											FSLC																												
5		4.0	5.0			– rounded river gravel		4	6											–																											4.0–6.0
6		5.0	6.0			– rounded river gravel		4	6											–																											
		6.0	10.0			1 0 YR 5/6														MHC (checked @ 1.0m intervals)																											6.0–10.0
7		10.0	14.0			1 0 YR 4/6 – 10 YR 5/6 throughout 13														MHC-HC (checked @ 1.0m intervals).																											10.0–14.0
		14.0	18.0	=		GV Sands.				46																																	14.0–18.0

Field Tests	Meth
pH-RP	1
pH-1:5	4
EC-1:5	1
Slaking	1
Dispersion	1
Efferv fin. earth	

18.0 + MU

- No slaking or dispersion testing
- Sampled for PSA analysis – bulked core equivalent – see sample depths above. 1.0m intervals (as above)
- Sampled for pH EC Cl every 1.0m to 14.0m where 2nd GV beds starts.

See site FQ2 for equivalent soil description to 1.5m

NOTES:

- Core log – sampled each 1.0m interval + laid out as core chip piles
  – KU mudstone @ 18m = basement
  – 3–4 m coarse gravel above the mudstone 14–18m = confined aquifer

2nd shallower gravel bed @ 5–6m; coarse gravel + no fines = @ depth of incised

Site 7 photographs

Soil profile photograph

Landscape photograph

Summary Recent dep = 0–5m
Older dep = GV – 6–17
= clay – 17–19
= mudstone 19+

Slope range 0–0.5%

• Drillers Core on TEP of Flinders River on Cobumbundy
• Sampled for pH, EC, Cl to 19 m @ 1.0 m intervals
• Photos – Core samples 74–77
– Iscape 78–80

(0-1.0, 1.0-2.0, 2.0-3.0 etc bulk samples)

SITE DESCRIPTION

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	Φ·2		F		TEP					ALP			LP				BURJ	12 12 18	FSC15M	FΦ8		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No	Substrate: IOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Att	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	L4	2	2	3	4			19·Φ								C			3·Φ							GV					

Substrate uncon gravel, sand & clay subs to 19m

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition	Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	197132	7698936	3	DE	AB	—						—	—		1	H	Z						Φ					Φ		

Erosion: Type	State	Deg	GD	Vegetation Community: No	Ref No	Name	Vegetation Community Details: Stratum	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Dcc Species 3	Prop
S	P	1		1		Very open woodland of ghost gum, bloodwood & lesser coolabah. = 10.3.12. (mapped on 4.3.3/4.3.1)	T	T	7	V			CORDALLA		COR PLENA		EUCCOOLA	
				2			M											
				3			L											

Profile Diagram

Number	Horizon	Depth (m) Upper	Lower	Bound: Dist	Shape	Field Texture	Qual	Perm	Drain	Colour: Book	Hue	V	C	Moist	Mottles: Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	Soil	Φ	1·Φ			CLFS		3	4		10YR	3	2		3	4																												
		1·Φ	2·Φ			SLC		3	4		10YR	3	3		3	4																												
2		2·Φ	3·Φ			CLS		3	4		10YR	4	3		3	4																												
		3·Φ	4·Φ			50% gravel / CLS					10YR	4	3		4	4																												
3	↓ 4–5m	4·Φ	5·Φ			50% gravel / CLS					10YR	4	3		4	4																												
	Gravel	5·Φ	6·Φ			Coarse river gravel					—				4	6																												
4		6·Φ	10·Φ			Coarse river gravel					—				4	6																												
		10·0	11·0			KSL					7.5YR	5	6		4	4																												
5	↓ 17m	11·0	17·0			Coarse river gravel					—				4	6																												
	clay 19m ↓	17·0	19·0			LMC									5	3																												
6	Mudstone basement	19·Φ	→			dark mudstone					10YR	5	4		—																												
7																																												

Field Tests	Meth
pH-RP	1
pH-1:5	4
EC-1:5	1
Slaking	1
Dispersion	1
Efferv fin. earth	

• No slaking or dispersion testing

Similar Iscape position to FΦ2. + soil + veg

NOTES: Core log – sampled by drillers @ 1.0m intervals & laid out as core dip samples.
– KU mudstone @ 19m = basement
– coarse gravel dominates from 5.0m ; thin confining clay base 17–19m ; mudstone from 19m.

Site 8 photographs

Soil profile photograph

Landscape photograph

SITE DESCRIPTION

- Drillers Core on TEP near "swamp"/prior STC
- Sampled for pH, EC, Cl to 18m @ 1.0m intervals. (0-1.0, 1.0-2.0, 2.0-3.0 etc)
- Photos – core samples 84–88 – Lscape 81–83
- built sample

Slope range 0–0.5 on TEP. sideslopes to prior STC = 3–5%.

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		TEP					ALP			LP				BURT	12/12/18	FSC TSM	F09		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	2	2	2	4			18.0							

Substrate: uncon alluvial clay seds/gravel to 18m

IOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			3.0							UC						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Cont	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	195179	7699001	3	DE	AB								–	–	1	H

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Abun	Surface Coarse Fragments: Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						0						0	

18.0 MU

Erosion: Type	State	Deg	GD
S	P	1	

Vegetation Community: No	Ref No	Name
1		• Very open woodland ghost gum bloodwood ± bauhinia on elevated TEP
2		• bloodbark in prior STC
3		

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V			CORDALLA		COR PLENA		LYSGILVU	
M	S	4	V			ACASALIC		± PRO PALLI			
L											

Profile Diagram

Number	Horizon	Depth (m) Upper	Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Colour Book	Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans: Fabric	Kind	Abund	Distnct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	Soil	0	1.0			CLFS		3	4		10YR	3	2																																		0–3.0
	↓	1.0	2.0			FSLC		3	4		10YR	3	3																																		
2	↓	2.0	3.0			FSLC		3	4		10YR	4	3																																		
Sandy	clayey seds	3.0	4.0			SCL	–	3	4		10YR	5	3																																		3.0–6.0
3	↓	4.0	5.0			CLS		3	4		10YR	5	3																																
	↓	5.0	6.0			FSCL		3	4		10YR	5	4																																
4	Gravel bed	6.0	7.0			Gravel		4	6		–																																		6.0–7.0
	clay	7.0	9.0			LMC		2	3		10YR	5	4																																7.0–9.0
5	clay	9.0	12.0			MHC		1	3		10YR	5	6	+	10YR 5/2																														9.0–12.0
	clay	12.0	18.0	+		MC		1	3		10YR	5	4																																12.0–18.0
6	Mudstone	18.0	24.0	+		dark mudstone					2.5Y	3	1																																Bulked sample for PSA analysis.
7	basement																																												

Field Tests	Meth	
pH-RP	1	–
pH-1:5	4	
EC-1:5	1	
Slaking	1	–
Dispersion	1	–
Efferv fin. earth		

• No slaking or dispersion testing.

Similar soil & TEP Lscape to site F02.

NOTES: Core log – sampled by drillers @ 1.0m intervals & laid out in 6m length core chip samples.
– KU mudstone @ 18m = basement
– clay dominates – gravel captured to 6.0–7.0m; clay from 7–18m; mudstone from 18m.

Site 9 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 89–91, 92 = truck/rig
– soil 93–97

Flinders River alluvium

Slope range – 0-0.5

Typical TEP deposit / equivalent lscape position to site FØ3.

SITE DESCRIPTION

Geology	Slope				Landform Element				Landform Pattern				Land Use			Described By	Date (ddmmyy)	Project	Site	Obs	S Type
	Eval	Percent	Class	MT	Type	Loc	Height	Width	Length	Pattern	Class	Modal	RMS	LU1	Mgt1	Mgt2						
Qa	A	Ø·2		F	TEP					ALP			LP				BURJ	121218	FSC15M	FIØ		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz
C	M	4	1	2	3	4			999

Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Air Photos Run No	Air Photos Frame No

Substrate: buried alluvial sand @ 0-75m

OT	Distance	Conf	Depth	Gr St	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			Ø·75							UC						

Location Datum	Zone	Easting / Latitude	Northing / Longitude
M	55	196527	7698587

Australian Soil Classification Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5
Borderline DE 3	CH	AE	yy	CD	A	E	M	O	X

PPF: buried horizons are unconstrained = very deep

GSG: — aff

Disturb	Surface Condition
1	H

Microrelief Type	Agent	Cmpt	Prop	Vl	Hl
Z					

Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt
Ø					

Outcrop Abun	Lith
Ø	

Profile Diagram: A1 0·05; B21 0·40; B22 0·75; 2D1

Erosion Type	State	Deg	GD
SP	1		

Vegetation Community No	Ref No	Name
1		Very open woodland of bloodwood, ghost gum + occ River Red gum + significant mature Mesquite
2		
3		

AH? V?

Vegetation Community Details Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Occ	Species 3	Prop
T	T	7	V			CORPLENA		CORDALLA			EUCCAMAL	
M	T	5	S			PROPALLI						
L												

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dect	Bound Shape	Field Texture	Field Texture Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str
1	A1	Ø	Ø·05	A		CLFS	FM	3	4		10YR	3	3	M	Ø					Ø				
											10YR	6	3	D										
2	B21	Ø·05	Ø·40	G		SLMC	FM	3	4		10YR	3	1		Ø					Ø				
3	B22	Ø·40	Ø·75	C/A		CLS	M	3	4		10YR	3	3		Ø					Ø				
4	2D1	Ø·75	1·5Ø			LS / S	M-K / M-K	4	4		10YR	4	3		Ø					Ø				
5																								
6																								
7																								

buried alluvial sand dep

Number	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund.	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Roots Abun	Samples (m)
1	W	3	SB	1	Ø						D	3	R				—				1	1	Ø–Ø·05
	V			2																			0·05–0·1
2	M	5	AB	1	Ø						D	4	S				—				1	1	0·1–0·2
	S	3	AB	2																			0·2–0·3
3	M	5	AB		Ø						D	4	S				—				1	2	0·5–0·6
4	V				Ø						D	2	G				—				1	1	0·8–0·9
																							1·1–1·2
5																							1·4–1·5
6																							
7																							

Field Tests	Meth	Ø·Ø2	Ø·1Ø	Ø·25	Ø·55	Ø·85	1·15	1·45
pH-RP	1	6·8	6·6	7·Ø	6·Ø	7·5	7·5	8·Ø
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	1	2	2	2	2	2
Dispersion	1	Ø/3#	Ø/3#	Ø/2#	Ø/2Ø-1#	Ø/1#	Ø/1#	Ø/1#
Efferv fin. earth		N	N	N	N	N	N	N

after remoulding

NOTES:
- Located on slightly elevated (1-2m) TEP; back terrace position but adjacent to major prior stream & likely to have been influenced by LEV type deposition.
- Exactly same soil/lscape/veg as Sites FØ1, FØ2 & FØ3. ✓ = dominant soil unit on extensive TEP

Site 10 photographs

Soil profile photograph

Landscape photograph

10.3.12a. Photos – Lscape/veg 98 – 103
– soil 104 – 107

SITE DESCRIPTION

Slope range 0.5–5% within swale; 5–20% on sideslope banks.

Geology	Slope Eval	Slope Percent	Slope Class	Slope MT	Slope Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	1.0		R		SRP SWL					ALP			UP				BURJ	12/12/18	FSC15M	F11		

Substrate: buried alluvial sand @ 0.45m

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	1	3	4			999								C			0.45							UC						

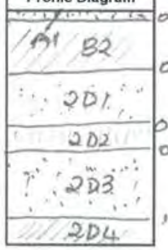
Location / Australian Soil Classification: because of adjacent incised STC; PPF: larger subsid. & unconstrained.

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	196121	7698441	3	DE	AB	YY	CD	A	E	M	O	X	—	—	1	H	Z						0						0	

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name (KA? AH?)	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Tall open forest of River Redgum	T	T	6	M	12 (10–14 range)		EUCCAMAL					
				2		+ Mesquite understorey	M	S	5	5	5		PROPALLI					
				3		Mapped as 10-3.12a	L											

Vegetation community notes: U? H

Profile Diagram:



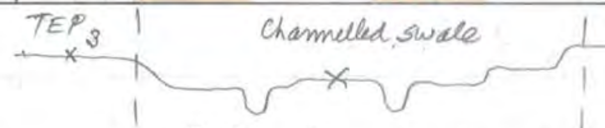
Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Hue	V	C	Moist	Mottles Abun	Coarse Fragments Abun	Structure Grade	Size	Type	Segregations Abun	Strgth SWS	Cons	Fabric	Pans	Roots Size	Abun	Samples (m)
1	A1	000	004	C		FSCL		3	4	10YR	4	3	M	0	0	W/V	3	SB/PL	0	D	3	R	—	1	1	0–0.04; 0.04–0.1
2	B21	004	045	C/G		CLFS ↓ FSLC	+	3	4	10YR	4	4	M	0	0	W/M	4	SB	0	D	4	R	—	1	2	0.1–0.2; 0.2–0.3
3	2D1	045	065	C		S	m-k	4	4	10YR	5	3	M	0	0	V			0			G	—	1	1	0.5–0.6
4	2D2	065	075	C		CLFS		3	4	10YR	4	3	M	0	0	V			0			E	—	1	2	—
5	2D3	075	130	G		S	m-k	4	4	10YR	5	3	M	0	0	V			0			G	—	1	1	0.8–0.9; 1.1–1.2
6	2D4	130	150			LS	m-k	4	4	10YR	4	3	M	0	0	V			0			E	—	1	2	1.4–1.5
7																										

Soil ↓ — buried alluvial layers ↓

Field Tests	Meth	0.01	0.1	0.25	0.55	0.85	1.15	1.45
pH-RP	1	7.5	—	8.5	8.0	7.8	8.2	8.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	0	0	0	1	1	2	2
Dispersion	1	0/<0-1 #	0/<0-1 #	0/<0-1 #	0/1 #	0/1 #	0/1 #	0/<0-1 #
Efferv fin. earth								

after remoulding

NOTES:



• relatively level slightly elevated "ridge" between 2 or 3 channels within prior stream complex

Prior stream complex within TEP of Flinders River ALP.

Site 11 photographs

Soil profile photograph

Landscape photograph

✓ = Very well structured subsoil – unconstrained physically + excellent blocky structure

• check salinity constraint? (Seems unlikely.)

Photos → Lscape/veg 108, 112, 113 → soil 114 – 117 → drill rig 109, 110, 111 slaking tests → 118 – 120

SITE DESCRIPTION

Slope range 0 – 0.5 %. Small less elevated BKP adjacent to swale of Prior stream / Flinders River STC

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	ϕ.2		F		BKP					ALP			LP				BURJ	13 12 18	FSC15M	F12		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	2	1	2	4			999							

Substrate: buried alluvial sand layers from 1.9m

IOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			1.9ϕ							UC						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	196203	7699258	3	VE	AE	GS	CD	A	E	O	O	X	–	–	1	HFG

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						ϕ						ϕ	

Profile Diagram: A1 0–0.03; B21 0.03–0.20; B22 0.20–0.50; B23 0.50–1.30; B24 1.30–

Erosion: Type	State	Deg	GD	No	Ref No	Vegetation Community: Name
N				1		Open woodland of coolibah ✓ with Mesquite understory = 433 Mapped as 433/443.1 ✓
				2		
				3		

Vegetation Community Details (10–12m)

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V	12		EUCCOOLA		LYSGILVU occ			
M	S	S	S			PROPALLI occ		ERE sp occ		VACFARNE	
L											

Number	Horizon	Depth (m): Upper	Lower	Bound: Dsct	Shape	Field Texture	Qual	Perm	Drain	Book	Colour: Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str
1	A1	ϕϕϕ	ϕϕ3	C		LMC		2	4		10YR	4	2	M	ϕ					ϕ				
2	B21	ϕϕ3	ϕ2ϕ	G		MC		2	4		10YR	4	1	M	ϕ					ϕ				
3	B22	ϕ2ϕ	ϕ5ϕ	G		MHC	1/	2	4		10YR	3	1	M	ϕ					ϕ				
4	B23	ϕ5ϕ	13ϕ	G		MC ↓ LMC ↓		2	4		10YR	3	2	M	ϕ					ϕ				
5	B24	13ϕ	19ϕ	G		LMC	(TS)	2	4		10YR	3	1	M	ϕ					ϕ				
6		# See over for deep core to 3–5m.																						
7																								

Number	Segregations: Grade	Size	Type	Cmpd	Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	W	3	PL	1	ϕ						D	3					–				1	1	0–0.03
	M	2	SB	2																			0.03–0.1
2	S	5	AB	1	ϕ						D	4					–				1	1	0.1–0.2
	S	3	AB	2																			0.2–
3	M	5	LE	1	ϕ						D	4	5				–				2	1	0.2–0.3
	M/S	3	LE	2																			0.5–0.6
4	M/S	4	AB		ϕ						D	4					–				1	2	0.8–0.9
	M/S	3	AB																				1.1–1.2
5	M/S	4	AB		ϕ						D	4					–				1	1	1.4–1.5
	M/S	2	AB																				1.7–1.8
6																							
7																							

Field Tests	Meth	1	2	3	4	5	6	7
pH-RP	1	ϕ.ϕ2 7.5	ϕ.1ϕ 7.5	ϕ.25 7.5	ϕ.55 8.ϕ	ϕ.65 8.5	1.15 8.8	1.45 8.8	1.75
pH-1:5	4								
EC-1:5	1								
Slaking	1	ϕ/1#	ϕ/<0–1#	ϕ/<0–1#	ϕ/<0–1#	ϕ/<0–1#	ϕ/<0–1#	ϕ/<0–1#	–
Dispersion	1	N	N	N	N	N	N	N	– # after remoulding
Efferv fin. earth									–

NOTES:

Lower elevation than TEP by 1–2m; slightly channelled; channels mark extent; located adjacent to FR STC but acting as a BKP area because of proximity to large swale of Prior stream to west.

Page 2
Continuation of deep core – F12

Photos – Dup coring 412 – 420
– profile below 1.5m. 421 – 427

Duplicate @ F12 continued

SITE DESCRIPTION

Slope range – 0-0.5%.

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MT	Slope: Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	ϕ2		F		BKP					ALP			LP				BURJ	191218	FSCISM	F12		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Run No	Frame No
C	M	4	2	1	2	4			999							

Substrate

OT	Distance	Conf	Depth	Gr S	Str	Pol	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			1.9ϕ							UC						

Location

Datum	Zone	Easting / Latitude	Northing / Longitude
	55	196 2ϕ3	7699 258

Australian Soil Classification

Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5
3	VE	AE	GS	CD	AE	06	X		

PPF	GSG: aff	Disturb	Surface Condition
–	–	1	HFG

Microrelief

Type	Agent	Cmpt	Prop	VI	HI
Z					

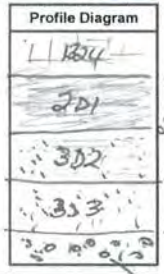
Surface Coarse Fragments

Abun	Size	Shape	Lith	Str	Alt
ϕ					

Outcrop

Abun	Lith
ϕ	

Profile Diagram



Erosion

Type	State	Deg	GD
Z			

Vegetation Community

No	Ref No	Name
1		Open woodland of coolibah with mesquite understorey
2		
3		

Vegetation Community Details (10-12 m)

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V	12		EUC COOLA		LYS GI LVU			
M	S	5	S			PRO PALLI	occ	ERE sp.	occ	VACFARNE	
L											

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dist	Bound Shape	Field Texture	Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	2D1	19ϕ	24ϕ	C/A		FSCL		3	4		1ϕ YR	3	3	M	ϕ					ϕ					V				ϕ						D	3	E				+				ϕ		2.0 – 2.1
																																															2.3 – 2.4
2	3D2	24ϕ	27ϕ	C		LS	M-K	4	4		1ϕ YR	4	3	M	ϕ					12		R	Qz	VS	V				ϕ						D	1/2	G/E				+				ϕ		2.6 – 2.7
																																															2.9 – 3.0
3	3D3	27ϕ	33ϕ	C/A		S	M-K	4	4		1ϕ YR	6	4	M	ϕ					ϕ					V				ϕ						D	ϕ	G				+				ϕ		3.2 – 3.3
												7	3	D																																	
4	4D4	33ϕ	35ϕ			S	M-K	4	3		1ϕ YR	7	4	M	ϕ					42		U	Qz	VS	V				ϕ						D	ϕ	G				+				ϕ		3.3 – 3.5
												6	3	D								R	Gv	VS																							
5											# Pale river sand below 2.7m → not pedogenic bleaching.																																						
6																																																
7																																															

loamy sand
coarse sand
gravelly sand

river gravels.

Field Tests	Meth
pH-RP	1
pH-1:5	4
EC-1:5	1
Slaking	1
Dispersion	1
Efferv fin. earth	

pH + EC not done in field below 1.5m – see lab data.
Slaking + dispersion not done below 1.5m

NOTES: • pH, EC, & emplid every 0.1 to 1.5m; and every 0.3m to 3.5m. ✓

Site 12 photographs

Soil profile photograph

Landscape photograph

- Site located in intact topsoil area (effectively not scalded - cf site 4 = scalded).
- Very soft to core ~ saline?
- Photos → Lscape / veg · 121 – 123
  → soil 131 – 134
  → rig coring 124 – 130
  dargey

SITE DESCRIPTION

Slope range – 0-0.5%. Slightly elevated deposit within main TEP + surrounded by lower lying SkP + Mesquite scrub.

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
9a	A	0.2		F		PLA					ALP			LP				BURJ	131218	FSCISM	F13		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	H	4	1	2	3				999							

Substrate: OT C; Distance; Conf; Depth; Gr S; Str; Por; Sp F; Alt; Str; Lith: ND (Not described); Gen T; Text; Mass Str; MDS; MC1; MC2

Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	196554	7699061	3	50	AE	ES	CV	A	E	K	O	X	—	—	1	HYFZ

Microrelief: Type; Agent; Cmpt; Prop; VI; HI

Surface Coarse Fragments: Abun; Size; Shape; Lith; Str; Alt

Outcrop: Abun; Lith

Erosion: Type	State	Deg	GD	No	Vegetation Community: Ref No	Name
C	A	3		1		Severely scalded with isolated Boree + mature Mesquite
S	A	1/2		2		
				3		

DP?

Vegetation Community Details: Stratum	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	I			ACATEPHR					
M	T	6	V			PROPALLI					
L											

Profile Diagram: A1 / B21 / B22y / B23y; 0.08; 0.40; 1.00

Number	Horizon	Depth (m): Upper	Lower	Bound: Dist	Shape	Field Texture	Qual	Perm	Drain	Colour: Book	Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	A1	0	0.08	C	A	LS (M)		4	4		10	YR	4	3 M D	0					0					V				0								G	E			—				1	1	0-0.08
2	B21	0.08	0.40	C		LMC	1	2	4		10	YR	3	2 M	0					0					S	4	AB		0								S				—				1	1	0.1-0.2 0.2-0.3
3	B22y	0.40	1.20	G	D	LMC +	1	2	4		10	YR	3	3 M	0					0					S	3	AB		3	Y	x	1					S				—				0		0.5-0.6 0.8-0.9
4	B23y	1.20	1.70			MC	1	2	3		10	YR	3	3 M	22	D	D			0					M M	5 5	PR 3	1 AB	2	Y	x	2					S	K	1	D	—				0		1.1-1.2 1.4-1.5
5						(texture hade FS but not enough to record in texture code)														10YR 2/2 M							LE																					
6																																																
7																																																

Field Tests	Meth	0.02	0.1	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.2	7.8	8.2	8.5	9.0	9.0	9.0
pH-1:5	4							
EC-1:5	1		# after remoulding					
Slaking	1	2	1	1	2	2	2	2
Dispersion	1	0/2#	0/2#	1/2#	1/1#	1/2#	1/1#	1/1#
Efferv fin. earth								

Slaking photos 135 – 138 (13½ 0.1 remould; 13½ 0.85 remould)

NOTES:

- Severe wind/sheet erosion + resultant scalding across site – 25% with intact A1 horizons, exposure of upper subsoil loss through active water based sheet erosion post accession loss; 75 severely scalded.
- Effectively same unit + soil landscape as BKP scalding behind the TEP; suggest site 13 + site 4 are older material & largely relict & younger micaceous sods have built up around them.
- Definitely not mottled – seems unusual! (See site A)

Site 13 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 139 – 142
– soil surface 143 – 144
– profile 145 – 148

SITE DESCRIPTION

Slope range 0–0.5%. Stripped ALP – slightly lower elevation than young micaceous seds

Geology	Slope Eval	Slope Percent	Slope Class	MT	Ind	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2				PLA					ALP			LP				BURJ	13 12 18	FSC 15M	F14		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4			999								C										ND						

Substrate: Not described.

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	196526	7699263	3	VE	AE	GS	FM ? (GB?)	A	E	O	O	X	—	—	1	GHF	Z						0						0	

Profile Diagram:

Erosion Type	State	Deg	GD	No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1	Low stunted Boree scrub on Qa	T	T	6	M			ACATEPHR		LYSGILVU			
C	A	1		2	+ shrubby Eremophila, Bauhinia +	M	S	S	S			ERE SP.? (mitchelli?)		PRO PALLI.			
				3	Mesquite.	L											

DCC Scalding where cleared.

No	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles	Coarse Fragments	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Strgth SWS	Cons	Pans	Roots Size	Abun	Samples (m)
1	A1	000	004	C		FSLMC		2	4	10YR	3	3	M	0	0	W	4	PL	1	0				D	3/4	—	1	1	0.00–0.04
											5	3	D			W	4	SB	2										0.04–0.1
2	B21k	004	030	C	G	LMC ↓ MC		2	4	10YR	3	2	M	0	0	S	3	AB		1	K	S	1	D	5	—	1	1	0.1–0.2
																													0.2–0.3
3	B22ky	030	090	D		MC	+	2	4	10YR	3	2	M	0	0	S	4	AB ↓ LE		1	K	S	1	T	5	—	0		0.5–0.6
																				2	Y	X	1						0.8–0.9
4	B23y	090	160			MHC		2	4	10YR	4	2	M	0	0	S	5	LE	1	2	Y	X	2	T	5	—	0		1.1–1.2
																M/S	3	LE	2										1.4–1.5
5																													
6																													
7																													

Field Tests	Meth	0.02	0.1	0.25	0.55	0.85	1.15	1.45
pH-RP	1	7.5	8.8	9.5	9.5	9.5	9.5	9.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	2	2	2	2	2	2
Dispersion	1	0/3#	0/2#	1/1#	1/1#	1/<0-1#	1/<0-1#	1/<0-1#
Efferv fin. earth		N	M	M	M	M	S	S

after remoulding

NOTES:

- Hardsetting, dark/brown cracking clay on "relict" alluvium; characterized by gidgee scrub + scalding; similar to BKP scalded lscape.
- Assume "relict" older lscape that has been infilled around by more recent deposition (micaceous alluvium) of the Flinders River.
- Very fine sand fraction + non micaceous — cf with younger Qa of FR

Site 14 photographs

Soil profile photograph

Landscape photograph

< 0.5% 1.5% 1.5% ?

1.5% on sides of low broad ridge

SITE DESCRIPTION

Slope range 0–1.5%

Very slightly elevated component with TEP; occ. undulations associated with scroll plain features.

Geology	Slope Eval	Slope Percent	Slope Class	MT	Ind	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.5		R		TEP (SRP)					ALP			LP				BURT	131218	FSC15M	F15		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	3	4			999								C			0.80							UC						

Substrate: uncon micaceous sand deposits from 0.8m

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	196617	7698867	3	DE	AE (AH)	VY	CD	AE	M	O	X		— (Layer subsoil unconfirmed)	—		1	H	Z						0						0	

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Open woodland of bloodwood,	T	T	7	V			CORPLENA		EUCCOOLA		LYSGILVU	
				2		coolibah & bauhinia with understory	M	S	5	V			PROPALLI					
				3		of Mesquite	L											

Profile Diagram: 0.08, 0.30, 0.80

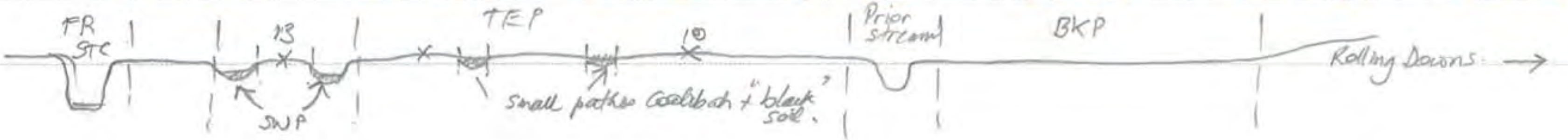
Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	000	008	C	A	CLFS		3	4	10YR	3	3	M	0					0					W / V	4	SB	1 / 2	0						D	3/4	R				—				1	1	0.05
2	B21	008	030	G		LMC	F-M	3	4	10YR	3	2	M	0					0					M / S	4 / 3	AB / AB	1 / 2	0						D	4	S				—				2	1	0-1 + every 0.1
3	B22	030	080	D		SCL	M-K	3	4	10YR	3	3	M	0					0					M	4	AB		0						D	4	S				—				2 / 1	1 / 2	to 1.5m
4	2D1	080	160			LS	M-K	4	4	10YR	4	3	M	0					0					V				0						D	2/3	E				—				1	1	
5																																														
6																																														
7																																														

Samples for pH EC

Horizon 4: uncon micaceous sand = buried alluvial

Field Tests	Meth							
pH-RP	1	0.05	0.10	0.25	0.55	0.85	1.15	1.45
pH-1:5	4	7.5	7.5	7.5	7.8	8.2	8.0	8.0
EC-1:5	1							
Slaking	1	No slaking or dispersion; not sampled for lab						
Dispersion	1							
Efferv fin. earth								

NOTES:



Site 15 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 162–164
– soil 158–161
– cracking 165–166

Sideslopes = <3.0%. Compare with more relict SWL @ site

SITE DESCRIPTION

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	ϕ·2		F		OXB					ALP			LP				BURT	14 12 18	FSCISM	F16		

Water filled @ easting end = contemporary feature

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	0	2	2			999							

Substrate: Not described.

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	194901	7698519	3	VE	A	E	E	I	A	E	0	X	—	—	1	GM

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						ϕ						ϕ	

Profile Diagram: 0·02 / 0·4 / 1·1·0

Erosion: Type	State	Deg	GD
Z			

Vegetation Community: No	Ref No	Name
1		Open forbland with isolated Coolibah.
2		
3		

Vegetation Community Details (8–10m)

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	6	I			EUCCOOLA					
M	F	1	M			ATRIPLEX sp ?		(widespread forb cover – all same species)			
L											

Number	Horizon	Depth (m): Upper	Lower	Bound: Dact	Shape	Field Texture	Qual	Perm	Drain	Colour: Book	Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str
1	A1	ϕϕϕ	ϕϕ2	A		MHC		2	2		10YR	3	2	M		ϕ				ϕ				
2	B21	ϕϕ2	ϕ4ϕ	G		HC		2			2·5Y	3	1	M		ϕ				ϕ				
3	B22K	ϕ4ϕ	12ϕ	D		HC		2			2·5Y	3	1	M		ϕ				ϕ				
4	B23y	12ϕ	15ϕ			HC		2			10YR	3	2	M	4 2 3 1	D D	B O			ϕ				H
5																								
6																								
7																								

Number	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	S	2	GR		ϕ						D	2					—				1	1	0–0.02
																							0.02–0.1
2	M	5	AB		ϕ						D	5	K	I	D		—				M	1	0.1–0.2
	S	3	LE																				0.2–0.3
3	S	6	LE		1	K	S	1			T	4	K	2	D		—				1	1	0.5–0.6
	S	3	LE																				0.8–0.9
4	S	4	LE	1	2	y	X	1			T	4	K	I	D		—				ϕ		1.1–1.2
	S	4	AB	↓																			1.4–1.5
5																							
6																							
7																							

10YR 4/4

7.5YR 5/6

blocd on Lscape position

Field Tests	Meth																							
		ϕ·ϕ2			ϕ·1ϕ			ϕ·25			0·55			ϕ·85			1·15			1·45				
pH-RP	1	8·2			7·ϕ			7·ϕ			8·8			9·ϕ			9·ϕ			9·ϕ				
pH-1:5	4																							
EC-1:5	1																							
Slaking	1																							
Dispersion	1	ϕ/ϕ 2 # N			ϕ/ϕ 1 # N			ϕ/1 1 # N			2/3 2 # S			1/3 2 # S/M			1/3 2 # M			ϕ/2 2 # N			# after remoulding.	
Efferv fin. earth																								

NOTES:

- Very strongly cracked with large hexagonal blocks
- Self mulching with a thin <0.02 (to mod thick 0.03m in pedis) coarse SM (S2GR).
- Variable wit mostly moderately to strongly SM

Site 16 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 167 – 171
– Soil profile 172 – 175
– Soil surface 176 – 178

SITE DESCRIPTION

Slope range 0–1%

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.5		F		TEP					ALP			LP				BURJ	14 12 18	FSC15M	F17		

Substrate: Buried alluvial sand from 0.8 m.

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	3	4			999								C			0.8							UC						

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	195089	7698756	3	CH	AB	BD	CD	A	E	L	O	X	(lacw' subsoil unconstrained)	–		1		Z						0						0	

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name (DE?)	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Very open woodland of bloodwood, ghostgum & occ leafwood with	T	T	7	I	14		CORPLENA		CORDALLA		OCC GRESTRIA	
				2		shrubby understory of sally wattle	M	S	5	5	4		ACASALIC		ERE SP? (Mitchellii?)			
				3			L											

Profile Diagram:

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Coarse Fragments Abun	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Strgth SWS	Cons	Fabric	Pans Type	Roots Size	Roots Abun	Samples (m)
1	A1	000	007	C		SL M	–	4	4	10YR	3	2	M	0	0	W / V	4	PL	1 / 2	0			D	3	E	—	1	1	0 – 0.07
2	B21	007	030	G		SLC M	+	3	4	10YR	3	3	M	0	0	S / M/S	4 / 3	AB	1 / 2	0					R	—	1	1	0.1 – 0.2; 0.2 – 0.3
3	B22K	030	080	G		SCL M	+	3	4	10YR	4	3	M	0	0	W/M	4	AB		2	K	S	1		R	—	1	1	0.5 – 0.6
4	2D1	080	130	C		SL M-K		4	4	10YR	4	3		0	0	V				1	K	S	1		E	—	1	1	0.8 – 0.9; 1.1 – 1.2
5	2D2	130	160			S M-K		4	4	10YR	4	3		0	0	V				0					G	—	1	1	1.4 – 1.5
6																													
7																													

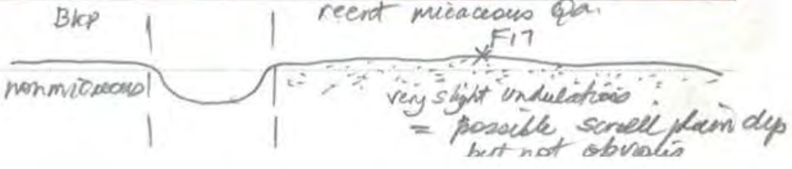
Margin: ? (beside B22K); buried alluvial dep ↓ (beside horizons 4–5)

Field Tests	Meth	0.05	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.8	7.0	7.5	8.0	9.0	9.0	9.0
pH-1:5	4							
EC-1:5	1							
Slaking	1	0	1	1	1	2	2	2
Dispersion	1	0/2#	0/3#	0/<0-1#	0/<0-1#	0/<0-1#	0/<0-1#	0/1#
Efferv fin. earth		N	N		M	H	H	H

after remoulding

NOTES:

- Same as sites 1, 2, 3 & 10; micaceous sand evident throughout.
- Typical TEP landscape enclosed by oxbow & relict scroll/prior stream.



Site 17 photographs

Soil profile photograph

Landscape photograph

- Field tests suggest no salt, no dispersion & very well structured
- Profile completely dry & fractured – suggests no salt & complete water uptake & usage by scrub.

Photos – Lscape/veg 179 – 181
– soil 182 – 185
– surface 186 – 187

Slope range – <0.5m

Slightly lower elevation than TEP but above Swale/Oxbow depression & BKP levels.

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	MT	Ind	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		PLA					ALP			LP				BURJ	141218	FSC15M	F18		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4			999								C										ND						

Substrate: Not described

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	194891	7699137	3	DE	AE	BD	DK	A	E	M	O	X	–	–	1	HF	Z						0						0	

Profile Diagram: A1 0.04 / B21 0.35 / B22 0.90 / B23 1.30 / B24

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Bauhinia, whitewood ± Boree Scrub	T	T	7	M	10–12m		LYSGILVU		ATAHEMIG		ACATEPHR	
				2		with thick understorey of Mesquite	M	S	6	M			PROPALLI				PROPALLI	
				3			L											

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	000	004	C	A	CLFS	+	3	4	10YR	3	2	M	0					0				W	M	2	SB	1	0						D	3					–				1	1	0 – 0.04
																								M	1	GR	2																			0.04 – 0.10
2	B21	004	035	G		FSLC	+	3	4	10YR	3	1	M	0					0					S	4	AB	1	0						D	4					–				2	1	0.1 – 0.2
																								S	3	AB	2																			0.2 – 0.3
3	B22K	035	090	D		LMC		2	4	10YR	3	2	M	0					0					S	4	AB	1	1	K	S	1			D	4/5					–				2	1	0.5 – 0.6
																								S	3	AB	2																			0.8 – 0.9
4	B23k	090	130	D		LMC		2	4	10YR	3	3	M	2	2	D	B		0				M	S	5	PR	1	2	K	S	1			D	4/5					–				1	1	1.1 – 1.2
																								S	3	AB	2	1	K	N	1															
5	B24k	130	160			FSLC		3	4	10YR	4	3	M	2	1	F	O		0					M	5	PR	1	2	K	S	2			D	4/5					–				0		1.4 – 1.5
																								S	3	AB	2	1	K	N	1															
																										PO	2																			
6																																														
7																																														

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.5	7.8	8.5	9.0	9.0	9.0	9.0
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	1	2	2	2	2	2
Dispersion	1	0/1#	0/<0-1#	0/<0-1#	0/<0-1#	0/<0-1#	0/<0-1#	0/<0-1#
Efferv fin. earth		N	N	N	M	M	H	H

after remoulding

NOTES:

- Landscape summary – 2 broad landscapes – "younger" micaceous sandy alluvium – sits over original surface. – "older" Cretaceous + alluvial dissected original surface.
- Within "younger" micaceous seds – 3 levels – elevated TEP (1,2,3,10,17), intermediate PLA (Sites 12, 18) + lowlying depressions, Swale/oxbow features (Sites 11, 16).

Site 18 photographs

Soil profile photograph

Landscape photograph

Photos – lscape/veg 188–191
– soil 192–195
– surface 196–197

– appears to have much darker surface signal.

SITE DESCRIPTION

Slope range – <0.5%. Elevated TEP – localized lower area within TEP (very slight only)

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		TEP					ALP			LP				BURT	14/2/18	FSCISM	F19		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	2	2	4			999							

Substrate: alluvial sand from 1.3m (micaceous)

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			1.3							UC						

Location: Datum M; Zone 55; Easting / Latitude 194499; Northing / Longitude 6991144

Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition
3	D	E	A	E	C	V	C	D	A	E	M	O	X	—	—		1	H

layer subsoil/2D unconstrained

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						Ø						Ø	

Profile Diagram: A1 0.07; B21 0.30; B22 0.65; B23 ?.30; 2D

Erosion: Type	State	Deg	GD
2			

Vegetation Community: No	Ref No	Name
1		• Area stick-raked for Mesquite. ✓
2		• Very open woodland of bauhinia, ghost gum + occ coolibah.
3		

W?

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V			LYSGILVJ		CORDALLA		EUCCOOLA	
M	S	4	V			CAPLASIA		ERE. sp.?? (mitchellii?)		LYSGILVJ	
L											

Number	Horizon	Depth (m) Upper	Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Cont	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	Ø	0.07	C	A	CLFS		3	4	10	YR	2	1	M	Ø				Ø					W	3	SB	1	Ø					D2/3	R				—			1	1	0.0–0.07
																								V			2																	
2	B21	0.07	0.30	G		SLC (F-M)	+	3	4	10	YR	3	1	M	Ø				Ø					S	4	AB	1	Ø					D4/5	S				—			1	2	0.1–0.2
																								S	3	AB	2																	0.2–0.3
3	B22	0.30	0.65	G		SLMC (M)		2	4	10	YR	3	2	M	Ø				Ø					M	4	AB	1	Ø					D4/5	S				—			1	2	0.5–0.6
																								S	3	AB	2																	
4	B23K	0.65	1.30	G		CLS (M)		3	4	10	YR	3	3	M	Ø				Ø					M	4	AB		1	K	S	1		D4	S				—			1	1	0.8–0.9
																																													1.1–1.2
5	2DK	1.30	1.60			LS (M-K)		4	4	10	YR	4	3	M	Ø				Ø					V				Ø					D2/3	E				—			1	1	1.4–1.5
6																																														
7																																														

2D1?
2D2?
buried alluvial layers

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	7.8	7.2	7.2	7.8	8.5	8.5	8.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	1	1	1	2	2	2
Dispersion	1	Ø/2# N	Ø/3# N	Ø/3# N	Ø/1# N	Ø/<0-1# H	Ø/<0-1# H	Ø/#1# H
Efferv fin. earth								

after remoulding

NOTES:

- Micaceous flakes/sand particles – evident throughout profile
- Typical TEP lscape + veg – but with more bauhinia + slightly lower lying lscape position = represents poorly defined former swale areas between scrolls etc.

TEP. 2or 10+17 | 19 |

Site 19 photographs

Soil profile photograph

Landscape photograph

Typical scalded landscape = analytical site

Photos — Lscape/veg 198 - 201
— soil 202 — 205
— surface 206 — 210. scalding & crust.

SITE DESCRIPTION

Slope range - 0-0.5 % Scalded BKP on older Flinders River fa + locally proximal

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		BkP SCD					FLO			LP				BURT	15/12/18	ESC 15M	F20.		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	1	1	3			999							

Substrate — Not described

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	193581	7699159	3	DE	AE	BD	EO	A	E	M	O	X	—	—	1	HCV

Microrelief: thin FS veneer over scald

Surface Coarse Fragments: Type	Agent	Cmpt	Prop	Vl	Hl	Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						Ø						Ø	

Profile Diagram: 0.01 / 0.08 / 0.40 / 1.00 / 1.60

Erosion: Type	State	Deg	GD	No	Ref No	Vegetation Community: Name
C				1		Very open woodland of Mesquite + occ coolibah + Boree; Severely scalded >80% land surface
				2		
				3		

Vegetation Community Details — 6-8m

Stratum	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	6	V	8		PRD PALLI		Occ Aca sutherlandii			
M	S	5	I	3		ERE sp ?? (Mitchellii?)		Occ EUCCOOLA		Occ ACATEPHR	
L											

Number	Horizon	Depth (m) Upper	Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Colour Book	Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A11	Ø	Ø.1	A		FSCL	1/2	3		10YR	5	3	M	Ø					Ø					S	3	PL	Ø						D	4					—				Ø		0-0.01
	A12	Ø.1	Ø.8	C		FSLC	1/2	3		10YR	4	3	M	Ø					Ø					S	3	AB	Ø						D	4											0.01-0.08
2	B21K	Ø.8	Ø.40	G		LC ↓ LMC		2	3	10YR	3	2	M	Ø					Ø					S	4	AB	1	2	K	S	1		D	5					—				Ø		0.1-0.2
																								S	3	AB	2																		0.2-0.3
3	B22YK	Ø.40	1.00	D		MHC		1	3	10YR	3	3	M	Ø					Ø					S	4	AB	1	3	Y	X	1		D	5					—				Ø		0.5-0.6
																								S	3	AB	2	2	K	S	1														0.8-0.9
4	B23YK	1.00	1.60			MHC		1	3	7.5YR	4	3	M	M	2	1	F	B	Ø					W	S	LE	3	Y	X	2		T	D	5					—				Ø		1.1-1.2
																								M	S	4	AB	2	K	S	1														1.4-1.5
5																																														
6																																														
7																																														

Field Tests	Meth	Ø.01	Ø.02	Ø.10	Ø.25	Ø.55	Ø.65	1.15	1.45
pH-RP	1	8.8	8.8	8.8	9.Ø	9.5	9.5	9.5	9.5
pH-1:5	4								
EC-1:5	1								
Slaking	1	1 3/3# N	2 1/3# N	1/2# H	2 1/Ø# H	2 Ø/Lo-1# M	2 1/1# M	2 2/1# S	2 2/1# S
Dispersion	1								
Efferv fin. earth									

after remoulding

NOTES:

- Severely scalded lscape — very high pH >9.0 throughout, suggests GAB influenced; severely prone to wind erosion.
  - well dredged 1-2cm crust — layered & sorted with accumulation/resizing of FS in immediate surface.
  - indicative of much older material & significant chemistry development. (Sodium Bicarb)

Site 20 photographs

Soil profile photograph

Landscape photograph

* Imperfectly to poorly drained Codibah FLO/SWP

Photos – Soil 211–215
– Lscape/veg 216–218
– Surface cracking 219–220

SITE DESCRIPTION

Slope range 0-0.5%

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0-2		F		BKP					SWP			LP				BURJ	15 12 18	FSC 15M	F21		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
CM	4	1		1	2	3			999							

Substrate

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location

Datum	Zone	Easting / Latitude	Northing / Longitude
M	55	193 000	6 990 070

Australian Soil Classification

Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5
B	V	EA	EG	SF	Z	ER	R	X	-

PPF: —

GSG: aff —

Disturb: 1

Surface Condition: M GHF

Microrelief

Type	Agent	Cmpt	Prop	VI	HI
A	M	A	0-2	25	

Surface Coarse Fragments

Abun	Size	Shape	Lith	Str	Alt

Outcrop

Abun	Lith

Profile Diagram: 0.03, 0.50, 1.00, 1.5

Erosion

Type	State	Deg	GD
N			

Vegetation Community — EI?

No	Ref No	Name
1		Open woodland of Codibah with understorey of Mesquite
2		
3		

Vegetation Community Details — 8-10m

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	6	V			EUCCOOLA					
M	S	5	S			PROPALLI					
L											

Number	Horizon	Depth (m) Upper	Lower	Bound Dist	Shape	Field Texture	Qual	Perm	Drain	Colour Book	Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	0	0.03	C	A	MC		2	3		10YR	4	2	M	M	3	1	D	O	0					M	2	SB	1	0						D	3	S				—				1	1	0–0.03
															S	1	GR	2																														0.03–0.1
2	B21	0.03	0.50	G		MC	+	2	3		10YR	3	2	M	M	2	1	F	B	0					S	4	AB/LE		0						D	5/6	S				—				1	1	0.1–0.2
															M	B	2	LE																													0.2–0.3
3	B22 Ky	0.50	1.00	D		MHC		2	3		10YR	3	3	M	M	3	2	D	B	0					M	6	LE		1	K	S	1		D	5/6	S	K	I	D	—				0	1	0.5–0.6
															M	S	3	LE										1	Y	X	1															0.6–0.9
4	B23 Ky	1.00	1.50	D		FSMC		2	3		7.5YR	4	3	M	M	3	2	D	O	0					S	6	LE		1	K	S	1		D	5/6	S	K	I	D	—				0	1	1.1–1.2
																2	2	D	D						M	6	LE		2	Y	X	1															1.4–1.5
5	B24 K	1.50	1.60			SLMC (FM)		3	4		7.5YR	4	4	M		0				0					M	3	LE		3	K	S	1			D	4	S				—				0	1	
6																																															
7																																															

2D?

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.8	6.5	7.2	8.5	6.2	8.2	8.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	2	2	2	2	2	2
Dispersion	1	0/0 #	0/2 #	1/2 #	2/1 #	2/1 #	2/2 #	2/2 #
Efferv fin. earth		N	N	N	M	M	M	H

after remoulding

NOTES:

* Similar to site 12 = younger FLO alluvium – 2 codibah FLO units – both younger & less elevated than TEP (but heavier more swampy) but not older BKP alluvium.
* Soil cracks variable but predominately thin (<0.03) mostly 0.02 to mod – in parts. 1 limit to weak LSM: hardset in parts – 2 units – heavy cracked vertosol, unit 2 blocky dermosol. unit 1

Site 21 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape 221 – 225
– Soil 226 – 233
– pit 234 – 235

distinct high point within TEP Lscape

Slope range = 0-1%. Gentle Sandy ridge within elevated TEP

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	MT	Ind	Landform Element Type	Loc	Height	Width	Length	Landform Pattern Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.5		R		PST					ALP			LP (GP?)				BURJ	15/2/18	FSC15M	F22		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	3	5			999								C			0.50							KS / UC						

Substrate: Coarse river bed sand below 0.8 m

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	ASC Ord	Sub Ord	GG/Gr2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	192713	7700028	3	DE (KA?)	AB	YY (AH)	CD	A	E	M (L)	M	X (V?)	— (Lower subsoil is unconstrained)	—	1	HF	Z						0					0		

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Very open woodland of bloodwood, ghost gum, and river red gum (no understorey) Mapped as 10.3.12a	T	T	7	Y			CORPLENA		CORPALLA		EUCCAMAL	
				2			M											
				3			L											

Profile Diagram:

Horizon	Lower depth
A11	0.06
A12	0.20
B2	0.50
2D1	1.00
2D2	

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Coarse Fragments Abun	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Cracks	Strgth SWS	Cons	Pans Type	Roots Size	Roots Abun	Samples (m)
1	A11	000	006	C		SCL M-K	−	3	5	10YR	3	3	M		0	0		W / V	4	PL	1 / 2	0		D	3	—	1	1	0–0.06
2	A12	006	020	C/G		SL MK	+	4	5	10YR / 10YR	3 / 4	2 / 3	M / D		0	0		W / V	4	SB	1 / 2	0		D	3/4	—	1	1	0.1–0.2
3	B2	020	050	C/A		CLS M-K		3	5	10YR	3	3	M		0	0	W/	M	4	AB		0		D	3/4	—	1	1	0.2–0.3
4	2D1	050	100	D		KS		4	5	10YR / 10YR	4 / 5	3 / 3	M / D		0	0		V				0		D	0	—	1	1	0.5–0.6; 0.8–0.9
5	2D2	100	150			KS		4	5	10YR / 10YR	5 / 7	3 / 3	M / D		0	0		V				0		D	0	—		0	1.0–1.5
6																													
7																													

buried river sand (horizons 4–5)

white river sand (not a bleached layer = pure Qtz)

bulked loose sand.

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.5	6.5	7.0	7.5	7.2	7.5	7.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	2	1	1	2	2	2
Dispersion	1	0/2 #	0/2 #	0/2 0-1 #	0/1 ? #	0/1 ? #	0/—	1?/—
Efferv fin. earth		N	N	N	N	N	N	N

after remoulding

NOTES:

- Very dry coarse sand below 1.0m; difficult to retrieve either by core or auger; sample retrieved with 1" core; coarse sand to 1.5m.
- Profiles are dominated by micaceous sand & mica flakes throughout – obvious indicator of recent Flinders River alluvium.

Site 22 photographs

Soil profile photograph

Landscape photograph

Soil core - bdaos 1.2m; pure sand
- minimal resistance to core to 1.8m but metered irretrievable by core or auger. = pure river sand to 1.8m. ✓

Slope range - 0-1% very slight undulations - <0.5m; no apparent soil differences & not oil/gas related.

Photos - Lscape 236-239
- Soil 240-243
- Surface 244-246

SITE DESCRIPTION

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.5		F		SRP					ALP			LP				BURJ	16/2/18	FSC15M	F23		

= relict scroll surface undulations

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	2	3	4			999							

Substrate: Coarse river sand 0.8-1.5m.

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			0.75							UC						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	192877	7699840	3	DE	AB	yy	DK	A	E	M	O	X	—	—		1	HF	Z						Ø						Ø	

lower subsoil unconsolidated

Profile Diagram: A1 0.1; B21 0.3; B22 0.7; 2D1

Erosion: Type	State	Deg	GD
N			

Vegetation Community: No	Ref No	Name
1		Very open woodland of river red gum, and bloodwood + nb understorey
2		
3		

AE?

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	5	13		EUCCAMAL		CORPLENA			
M											
L											

Crowns clearly separated = 10-50%

Number	Horizon	Depth (m) Upper	Lower	Bound Dict	Shape	Field Texture	Qual	Perm	Drain	Book	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	Ø	0.1Ø	C		CLFS		3	4		10YR	3	2	M	Ø					Ø					M	4	SB	1	Ø						D	3	E				—				1	2	0-0.1m
																									M	3	SB	2																			
2	B21	0.1Ø	Ø.3Ø	G		FSLC		3	4		10YR	3	2	M	Ø					Ø					M	4	AB		Ø						D	4					—				1	2	0.1-0.2
																																															0.2-0.3
3	B22	Ø.3Ø	Ø.75	A		CLFS	+	3	4		10YR	3	3	M	Ø					Ø					W	3	AB		Ø						D	3/4					—				1	2	0.5-0.6
																									V																						
4	2D1	Ø.75	1.5Ø			KS		4	4		10YR	6	4	M	Ø					Ø					V				Ø						D	Ø	G				—				1	1	0.8-0.9
												7	3	D																																	1.1-1.2
5						# Micaceous sand abrasive throughout profile including riverbed sand bdaos 0-8m.									pale "fresh" riverbed sand (not bleached from pedogenic processes) = "pure river sand"																																			—	
6																																																1.4-1.5 not retrievable
7																																																

coarse river sand deposit ↓

Field Tests	Meth																																															
		Ø.Ø2				Ø.1Ø				Ø.25				Ø.55				Ø.85				1.15				—																						
pH-RP	1	8.5				8.5				8.2				8.Ø				7.5				7.Ø																										
pH-1:5	4																																															
EC-1:5	1																																															
Slaking	1	Ø				Ø				1				1				2				2																										
Dispersion	1	Ø/<0-1 # N				Ø/<0-1 # N				1/<0-1 # N				1/<0-1 # N				- N				- N				# after remoulding.																						
Efferv fin. earth																																															

NOTES:

- Relative lower plain/flat within elevated TEP developed on micaceous Qa of the Flinders River.
- Represents lower component within western TEP.
- very gentle low ridges & slight depressions - very minimal but evidence of relict scroll activity when laid down.

Site 23 photographs

Soil profile photograph

Landscape photograph

‣ Deep Core – western development block ⌒ # Core to 4·5m; unable to retrieve loose riverbed sand below 3·5m; confirmed no constraints to 4·5m. ⌒ # Photos – Lscape/veg 247 – 251; – Soil 252 – 261; – surface. 262 – 264
• Compare with sites – 7, 8 + 9 eastern development block

SITE DESCRIPTION

Slope range 0–1%. Very gently undulating SRP

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0·2		F		SRP					ALP			LP				BURJ	16 12 18	FSC 15M	F24		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No	Substrate: OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Lith	Conf	Text	Mass Str	MOS	MC1	MC2
C	M	4	2	2	3	4			999								C			1·05						UC						

Substrate: Coarse riverbed load sand from 1·05m – 4·5m

Borderline DE (Australian Soil Classification); PPF: Loam subsoil unconstrained

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	192628	7699339	3	DE	AB	YY	CD	A	E	M (L)	M	X (W?)		—		1	H	Z						0						0	

Erosion: Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
N				1		Very open woodland of bauhinia + Mesquite with isolated bloodwood, ghost gum emergents.	T	T	7	5	10		LYSGILVU		PROPALLI			
				2			M	T	6	5	6		PROPALLI		ACAVICTO		LYSGILVU	
				3			L											

Vegetation Community Details: 8–10m (+ Very occ Cor plena, Cor dalla to 14m; isolated emergents)

Profile Diagram: 0.20, 0.65, 1.05, 1.60, 2.00, 2.40, 4.50

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1 (Modern soil)	A1	0.00	0.20	C		SCL / SL	M– / M+	4	4	10YR	3	2	M	0					0					W / V	3	SB	1 / 2	0						D	2/3	E				—				1	1	0–0.1; 0.1–0.2
2	B21	0.20	0.65	G		SCL / CLS	M / M	3	4	10YR	3	3	M	0					0				W	M	4	AB		0						D	4/5	R				—				1	2	0.2–0.3; 0.5–0.6
3	B22	0.65	1.05	G		CLS	M	3	4	10YR	4	3	M	0					0				W	M	3	AB		0						D	4/5	R				—				1	2	0.8–0.9; 1.1–1.2
4 (alluvial dep)	2D1	1.05	1.60	C	A	LS	M–K	4	4	10YR	4	4	M	0					0					V				0						D	2	E				—				1	2	1.4–1.5
5	2D2 K / 2D3 K	1.60 / 2.00	2.00 / 2.40	C / G		SCL / KS	M–K+ / K	3 / 4	4 / 4	10YR / 10YR	4 / 4	4 / 3	M / M	0 / 0					0 / 0					V / V				1 / 1	K / K	S / S	1 / 1			D / D	2/3 / 0	E / G				— / —				1 / 1	1 / 1	1.7–1.8; 2.0–2.1
6	3D4 / 3D5	2.40 / 2.75	2.75 / 3.00	C / C	/ A	SCL / LS	F–M– / F–M+	4 / 4	4 / 4	10YR / 10YR	4 / 4	4 / 3	M / M	0 / 0					0 / 0					V / V				0 / 0						D / D	3/4 / 3	E / E				— / —					0 / 0	2.3–2.4; 2.6–2.7
7	4D6	3.00 / 3.50	3.50 / 4.50			KS	K	4	4	10YR	6	4	M	0					0					V				0						D	0	G				—					0	2.9–3.0; 3.2–3.3

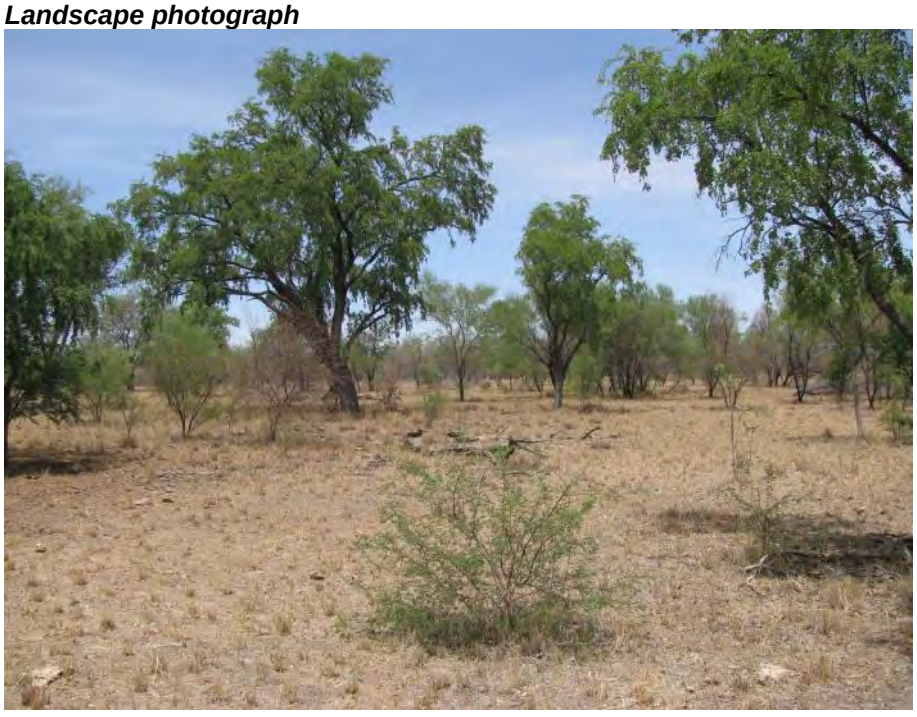
Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45	
pH-RP	1	6.5	6.8	7.0	7.5	7.8	9.0	9.0	
pH-1:5	4								
EC-1:5	1								
Slaking	1	1	1	2	2	2	2	2	
Dispersion	1	0/2 #	0/2 #	0/2 #	0/2 #	0/<0–1 #	0/<0–1 #	0/<0–1 #	# after remoulding
Efferv fin. earth		N	N	N	N	N	S	S	Highly calc 1.6–2.4m

NOTES:
• KS @ base of profile 10YR 7/3 D; but not pedogenic bleaching – washed clean riverbed load sand. (pure Qtz) + micas.
• pH, EC, Cl sampled every 0.1 m to 1.5 m, & every 0.3 m to 3.5 m.

Site 24 photographs

Soil profile photograph

Landscape photograph



Photos – 265-267 Lscape/veg
– 268-271 soil profile
– 272-273 surface.

SITE DESCRIPTION

Slope range – mostly 0-1%; up to 4% near indistinct drainage deps/swales that run through the unit.

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	Ø.5		F		PLA					ALP			LP				BURJ	161218	FSC15M	F25		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4			999								C										ND (Not described)						

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	192132	77ØØ924	3	DE	AE	BD	CD	A	E	M	O	X	–	–	1	HF (Occ cracking)	Z						Ø						Ø	

Profile diagram depths: 0.1, 0.2, 0.65, 1.05

EO ? see analyses

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height (10-12 range)	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Coolibah woodland/OF with occ bauhinia & significant Mesquite	T	T	7	M	12		EUCCOOLA		occ LYSGILVU		PROPALLI	
				2			M	S	5	V	4		PROPALLI					
				3			L											

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A11	ØØØ	Ø1Ø	G		CLFS		3	4	1ØYR	3	3	M		Ø				Ø					M	4	SB	1	Ø						D	3					–				1	2	0-0.1
																								M	3	SB	2																			0.1-0.2
2	A12	Ø1Ø	Ø27	G		CLFS	+	3	4	1ØYR	3	2	M		Ø				Ø					M	3	SB		Ø						D	3					–				1	2	0.2-0.3
3	B21	Ø27	Ø65	D		FSLMC		2	4	1ØYR	3	2	M		Ø				Ø					S	3	AB		Ø						D	5					–				2	1	0.3-0.4
																																														0.5-0.6
4	B22Ky	Ø65	1Ø5	D		LMC		2	4	1ØYR	3	1	M		Ø				Ø					M	5	PR	1	1	K	S	1			D	5					–				2	1	0.8-0.9
																								M/S	4	AB	2	2	Y	X	1															
5	B23Ky	1Ø5	16Ø			LMC		2	4	1ØYR	3	1	M		Ø				Ø					S	4	AB		3	K	S	2			D	4/5					–				1	1	1.1-1.2
																												2	Y	X	1															1.4-1.5
6	# Sand fraction is micaceous throughout																																													
7																																														

Field Tests	Meth	Ø.02	Ø.1Ø	Ø.25	Ø.55	Ø.85	1.15	1.45
pH-RP	1	6.2	7Ø	7.5	8.2	9.Ø	9.Ø	9Ø
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	1	2	2	2	2	2
Dispersion	1	Ø/1 #	Ø/2 #	Ø/2 #	1/2 #	1/2 #	1/2 #	2/2 #
Efferv fin. earth		N	N	N	N	S/M	H	H

after remoulding

NOTES:
- Lower elevation Coolibah ALP/FD dominated on recent micaceous Flinders River small plain alluvium.
- Same as site 12 exactly.

Site 25 photographs

Soil profile photograph

Landscape photograph

Photos – LS cape/veg 274–276
– soil 283–286.
– surface 277–282

– eroded gently undulating plain/LRS.

SITE DESCRIPTION

Slope range 0–1%. Local relief – 6–8m above ALP = 100m rise.

Geology	Slope					Landform Element					Landform Pattern				Land Use		Described By	Date (ddmmyy)	Project	Site	Obs	S Type
	Eval	Percent	Class	MT	Incl	Type	Loc	Height	Width	Length	Pattern	Class	Modal	RMS	LU1	Mgt1 Mgt2					
Ku/r	A	0.5		U		HSL					PLA			LP			BURS	16/12/18	FSC15M	F26		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Air Photos Run No	Air Photos Frame No
C	M	4	1	2	2	4			999							

Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C		A	1.60						VW	MU						

Location Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5
M	55	191561	7700235	3	VE	AA	EIB2		E	R	S	X	–

weathered MU @ PPF 1.6m

GSG aff	Disturb	Surface Condition
–	1	GMX

Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
L	MA			0.15	6	1	2	5	Q2	VS		0	

Profile Diagram: 0.07 / 0.20 / 0.50 / 1.30

Erosion Type	State	Deg	GD
Z			

Vegetation Community No	Ref No	Name
1		Mitchell grass grassland. – dried off & heavily grazed (no seed heads)
2		
3		

Mitchell Grass downs

Vegetation Community Details: weak surface flake.

Stratum	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T											
M											
L	G	2	5	0.4	3	AST sp.					

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dist	Bound Shape	Field Texture	Field Texture Qual	Perm	Drain	Book	Colour Hue	Colour V	Colour C	Colour Moist	Mottles Type	Mottles Abun	Mottles Size	Mottles Contr	Mottles Col
1	A1	0.00	0.07	C		MC		2	4		7.5YR	3	4			0			
2	B21	0.07	0.20	G		MC	+	2	4		7.5YR	3	4			0			
3	B22	0.20	0.50	G		MHC		2	4		5.0YR	3	3			0			
4	B23 y	0.50	1.30	G		HC		2	4		5.0YR	3	3			0			
5	B3 y	1.30	1.60	G		FSMC	+	2	4		5.0YR	5	6		Z	2	2	D	Y
6	C	1.60	1.65			–		2	3		10YR	5	6	M	Z	4	2	D	R
												6	6	M					B
7																			

weathered MU

– soil material in MU matrix

Number	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Strgth Cons	Cutans Fabric	Cutans Kind	Cutans Abund	Cutans Distinct	Pans Type	Pans Cmnt	Pans Cont	Pans Str	Roots Size	Roots Abun	Samples (m)
1	0					5	1	GR		0						D	1	5	0			–				1	1	0–0.07
2	0					5	3	AB LE	↓	0						D	4/5	5	0			–				1	1	0.1–0.2
3	0					5	4	LE	1	0						D	5	5	K	1	D	–				1	1	0.2–0.3
						5	2	LE	2																			
4	0					5	6	LE	1	2	Y	X	2	?		T	4/5	5	K	2	D	–				1	1	0.5–0.6
						5	3	LE	2	1	K	S	1	?														0.8–0.9
5	0					M	6	LE	1	4	Y	X	2			T	4	5	K	2	D	–				0	1	1.1–1.2
						M	4	LE	2	1	K	S	1	?														1.4–1.5
6	0					√				0						T	4	–	0			–				0	–	–
7																												

– soil material in MU matrix

– insitu cretaceous mudstone

Field Tests	Meth	0.02	0.10	0.25	0.55	0.65	1.15	1.45
pH-RP	1	8.8	8.8	8.8	8.8	8.8	8.8	8.8
pH-1:5	4							
EC-1:5	1							
Slaking	1	0	0	0	0	1	1	1
Dispersion	1	2/<0-1 #	1/<0-1 #	1/<0-1 #	1/<0-1 #	1/<0-1 #	2/<0-1 #	2/<0-1 #
Efferv fin. earth		–	–	–	–	–	–	–

after remoulding

NOTES: # Effervescence not done – run out of acid

Red-brown strongly SM vertosol on weathered Cretaceous MU – upland rolling downs landscape; not related to + local dodged linear gilgai

Flinders River alluvium.

Site 26 photographs

Soil profile photograph

Landscape photograph

Photos – Lscape/veg 287 – 289
– soil 295 – 298
– surface 290 – 100

Local relief – 6-8 m total; midslope 3-4 m above adjacent Qa.
Slope range – 2-5%. Sideslope to elevated plain/rise with rolling downs.

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Ku/r	A	3.5		M		HSL					RIS PLA			GP				BURS	17 12 18	FSC 15M	F27		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	3	2	4			999								C			1.20						VW	MU						

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	191 680	7700 426	3	VE	AB	EI	GM	F	Q	R	X	–	–	–		1	FH GM	Z						2	3	UR	QZ	VS		∅	

Australian Soil Classification note: Sometimes Gr – H
Surface Coarse Fragments note: 2 – 20% range.

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
S	A	2		1		Fringing Boree Scrub on sideslope to rolling downs unit	T	T	6	5	6 (5-8)		ACATEPHR					
R	A	2	1	2			M											
				3			L											

Vegetation Community Details notes: SM in parts; but variable + sheet eroded;
= thin to mod thick 0.02 – 0.05 m where SM
= otherwise firm pedal to HS
= best as Vertosol – definitely cracking in parts

Profile Diagram: 0.04 – 0.45 – 1.20

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans	Pans	Roots Size	Roots Abun	Samples (m)
1	A1	000	004	C		FSLC	(F)	2	4	7.5YR	4	3	M	∅					1	3	R	QZ	VS	M/S	2	SB	1	∅						D	2			–	1	1	0-0.04
																								S	1	GR	2														0.04-0.1
2	B21	004	045	D		FSMC	(F)	2	4	10YR	3	3	M	∅					∅					S	4	AB	1	∅						D	4/5			–	1	1	0.1-0.2
										↓	4	3	M											S	3	AB	2														0.2-0.3
3	B22 Ky	045	120	D		SMC	(M)	2	4	10YR	4	6	M	Z	2	2	F	B	∅					W	5	LE	1	2	K	N	1			T	4			–	∅		0.5-0.6
														Z	2	2	F	G						M	4	AB	2	3	Y	X	1										0.8-0.9
4	B3K	120	160			MHC	(F)	1	3	7.5YR	4	6		Z	4	2	D	Y	4	2	SP	MU	VW	S	7	LE	1	2	M	N	1			T	4			–	∅		1.1-1.2
														Z	3	2	P	G						S	2/3	LE	2	2	K	N	1										1.4-1.5
5																																									
6																																									
7																																									

Margin note beside horizon 4: insitu. Cretaceous mudstone ↓

Mottles notes: associated with weathered MU; yellow 10YR 6/4; grey 2.5Y 7/1

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	8.5	9.0	9.0	9.0	9.0	9.0	8.5
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	1	1	2	2	2	2
Dispersion	1	∅/<0-1 #	∅/<0-1 #	∅/1 #	∅/<0-1 #	1?/<0-1 #	1?/2 #	∅/2 #
Efferv fin. earth		–	–	–	–	–	–	–

after remoulding

NOTES:

- Sideslope to rolling downs unit with gidgee scrub.
- Characterized by rounded river gravels (predominantly QZ) – assume interbedded in Cretaceous mudstone substrate

Site 27 photographs

Soil profile photograph

Landscape photograph

Semi-detailed check site to verify mapping unit

Photos – Lscape/veg 299 – 300
– Soil 301 – 302

SITE DESCRIPTION

Slope range – 2 – 0.5%

scalded BKP/FLO associated with "older" locally proximal Qa @ back of TRP Lscape.

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MT	Slope: Incl	Landform Element: Type	Landform Element: Loc	Landform Element: Height	Landform Element: Width	Landform Element: Length	Landform Pattern: Pattern	Landform Pattern: Class	Landform Pattern: Modal	Landform Pattern: RMS	Land Use: LU1	Land Use: Mgt1	Land Use: Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	φ-2		F		BKP / SCD					FLO			LP				BURJ	171218	FSC15M	F28		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Air Photos: Run No	Air Photos: Frame No
C	M	4	1C	1	1	3			–							

Substrate — Not described

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	191867	77φ468	3	DE	AE								–	–	1	HC

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						φ						φ	

Profile Diagram

Erosion: Type	State	Deg	GD
C	A	3/4	

Vegetation Community: No	Ref No	Name
1		Scalded Boree Scrub Unit – very variable canopy cover
2		
3		

Vegetation Community Details — 6–8 m

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	6	5	6		ACATEPHR		PROPALLI		LYSGILVU	
M	S	5	5	3		PROPALLI		ERE sp?? (mitchellii?)			
L											

Number	Horizon	Depth (m): Upper	Depth (m): Lower	Bound: Dect	Bound: Shape	Field Texture	Field Texture: Qual	Perm	Drain	Colour: Book	Colour: Hue	Colour: V	Colour: C	Colour: Moist	Mottles: Type	Mottles: Abun	Mottles: Size	Mottles: Contr	Mottles: Col	Coarse Fragments: Abun	Coarse Fragments: Size	Coarse Fragments: Shape	Coarse Fragments: Lith	Coarse Fragments: Str	Structure: Grade	Structure: Size	Structure: Type	Structure: Cmpd	Segregations: Abun	Segregations: Nat	Segregations: Form	Segregations: Size	Segregations: Str	Cracks	Strgth: SWS	Strgth: Cons	Cutans: Fabric	Cutans: Kind	Cutans: Abund	Cutans: Distinct	Pans: Type	Pans: Cmnt	Pans: Cont	Pans: Str	Roots: Size	Roots: Abun	Samples (m)
1	A11 (crust)	φ	φ1	A		FSLC	+	1	3		10YR	3	2	M	φ					φ					S	3	PL		φ						D	3/4					–				φ		Not sampled
2	A12?	φ1	φ.1φ			LMC		1	3		10YR	3	2	M	φ					φ					S	4	AB		φ						D	4/5					–				φ		
3		φ.10	+																																												
4		↓																																													
5																																														
6																																														
7																																														

B2? depending on erosion loss & stripping

Field Tests	Meth	φ.φ1	φ.1φ
pH-RP	1	7.5	8.5
pH-1:5	4		
EC-1:5	1	–	–
Slaking	1	–	–
Dispersion	1	–	–
Efferv fin. earth			

No slaking or dispersion testing / not sampled

NOTES:

- Scalded gidgee unit on older BKP alluvium.
- Semi detailed check site to verify scalding, vegetation & surface horizon & scalding.
- See Site 20 for detailed description
- Securely crusted surface – 1 cm + hardened & intact.

Site 28 photographs

Soil profile photograph

Landscape photograph

Semi-detailed checksite to verify mapping unit

Photos – Lscape/veg 303–304
– soil 305–308

Micaceous sediments / = younger FR alluvium

slope range ~ <0.5

SITE DESCRIPTION

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MT	Slope: Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	ϕ·2		F		PLA					ALP			LP				BURJ	17/2/18	FSC ISA	F29		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Run No	Frame No
C	M	4	1C	2	2	4			999							

Substrate: Not described

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	192013	7770468	3	DE	AB	yy	–	A	E	D	O	X	–	–	1	HF

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						ϕ						ϕ	

Profile Diagram

Erosion: Type	State	Deg	GD
N			

Vegetation Community: No	Ref No	Name
1		Very open woodland of coolibah and bauhinia; significant Mesquite
2		
3		

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V			EUC COOLA		LYS GILVU		PRO PALLI	
M	S	5	5/M			PRO PALLI		ERE sp.?? (MitchelliI?)			
L											

Number	Horizon	Depth (m): Upper	Depth (m): Lower	Bound: Dist	Bound: Shape	Field Texture	Field Texture: Qual	Perm	Drain	Book	Colour: Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str
1	A1	ϕ	ϕ6	C		SLC (FM)	2	3	4		1ϕ YR	3	2	M	ϕ					ϕ				W
2	B21	ϕ6	ϕ35	G		SLMC (M)	2	4			1ϕ YR	3	3	M	ϕ					ϕ				S
3	B22	ϕ35	ϕ70			SLC	–	3	4		1ϕ YR	4	3	M	ϕ					ϕ				M/S
4	↓	0·70	+			↑ micaceous sand/flakes throughout																		
5		↓																						
6																								
7																								

Number	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	M	4	SB	1	ϕ						D3						–				1	1	–
	W	3	SB	2																			
2	S	4	AB	1	ϕ						D4/5						–				1	1	–
	M/S	3	AB	2																			
3	M/S	3	AB		ϕ						D3/4						–				1	1	–
4																							
5																							
6																							
7																							

Not sampled

Field Tests	Meth																						
pH-RP	1	ϕ·ϕ2	6·8		ϕ·1ϕ	8·ϕ		ϕ·25	8·ϕ		ϕ·55	8·8											
pH-1:5	4																						
EC-1:5	1	—			—			—			—												
Slaking	1	—			—			—			—												
Dispersion	1	—			—			—			—												
Efferv fin. earth																							

No slaking or dispersion testing / not sampled

NOTES:

- Younger, lower elevation component of TEP landscape – developed on micaceous Flinders River alluvium
- Same lscape, prjdle + mapping unit as Sites D+25. ✓

Site 29 photographs

Soil profile photograph

Landscape photograph

Semi detailed check site to verify mapping unit

Photos – Lscape/veg 316 – 318
– soil cracking + surface mulch 309–315
– flood marks @ 2.5m 319–323

SITE DESCRIPTION

Slope range – <0.5 in base, sideslopes – 3-10%

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		OXB					ALP			LP				BURT	171218	FSCISM	F30		

Tax Unit: Reddish brown recent sediment deposition.

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	IC	0?	2	2		1	—								C										ND						

Substrate: Not described

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	192189	7700227	3	VE	AE	EI	–	E	R	S	X	–	—	—	1	GM	Z						0						0	

Profile Diagram

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Open woodland/forest of coolibah	T	T	7	5	14		EUCCOOLA (12m)		EUCCAMAL (15m)			
				2		+ River Red Gum.	M	No understorey										
				3			L											

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	000	005	C		MC	+	2	2	10YR	4	2	M	M	4	1	D	O	0					S	2	GR		0						D	2					—				1	1	
2	B21	005	020			HC	1/	2	2	10YR	3	2	M	M	4	1	D	O	0				M/S	S / S	6 / 4	AB / AB	1 / 2							D	5					—				1	1	
3		020 +																																												
4																																														
5																																															
6																																														
7																																														

strong coarse SM → (horizon 1)

Mottle colour = 5.0YR4/6

2.5m of inundation; period + freq unknown but potentially poorly drained – wet > 2-3 months.

Self mulching – strongly SM
thick loose coarse SM layer 2-5mm GR + some blocky
+ very strongly cracked – large hexagonal blocks.

Field Tests	Meth	0.02	0.10
pH-RP	1	6.5	7.5
pH-1:5	4		
EC-1:5	1	—	—
Slaking	1	—	—
Dispersion	1	—	—
Efferv fin. earth			

No slaking or dispersion testing / not sampled

NOTES:
- Distinct, active, ephemeral oxbow on young Flinders River alluvium
- Inundation + flood marks evident @ 2.5m; floods regularly.
- Red brown recently aggraded sediment = pH 8.5-9.5 (cf with surface pH grey clay material @ site) → sourced from rolling downs + adjacent downs
- See site 16 for detailed core description + analyses – exactly same as.

Site 30 photographs

Soil photograph

Landscape photograph

Detailed site to characterise eroded TEP margins. – same soil as TEP surface but @ slopes 2-10%, @ incision points.
Slope range = 2-8%

Local relief – 2-4m; includes sideslopes to intermediate + oxbow features + river incision
Eroded margins of elevated TEP

Photos – Lscape/veg 324 – 329
– Surface 330 – 334
– profile 335 – 338

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	5.0		M G		HSL (TEP margin sideslopes)					TEP margins.			GP				BURJ	18 12 18	FSC 15M	F31		

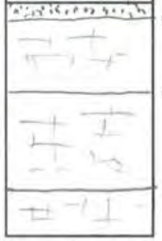
TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	3	2	4			999								C										ND						

Substrate: Not described

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	192324	7700076	3	DE	AE	CV	CD	A	E	M	O	X	—	—	1	HF	Z						0						0	

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
S	A	3		1		Scrubby woodland of bauhinia +	T	T	6 (8m)	V			LYSGILVU		PROPALLI			
R	A	1		2		butterbush ± mesquite	M	S	S	S			ERE sp? (Mitchellii)?		PROPALLI			
				3			L											

Profile Diagram: 0.10, 0.60, 1.30



Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A1	000	010	G		SCL	M-K	3	4	10YR	3	2	M		0				0					W	4	SB	1	0						D	3					—				1	2	
																								V			2																			
2	B21	010	060	D		CLS	M-K	3	4	10YR	3	2	M		0				0					M	3	AB		0						D	4					—				1	1	
3	B22k	060	130	D		LMC	F-M	2	4	10YR	3	3	M		0				0					M	5	PR	1	1	K	S	1			D	5					—				1	1	
																								S	4	AB	2																			
4	B23k	130	150			SLC	F-M	3	4	10YR	4	3	M	M	2	2	F	Y	0					M	5	PR	1	1	K	S	1			D	5					—				1	1	
																								M/S	4	AB	2	1	K	N	1															
5																																														
6																																														
7																																														

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45	
pH-RP	1	6.8	6.5	6.5	7.2	8.2	8.2	8.2	
pH-1:5	4								
EC-1:5	1								
Slaking	1	1	1	2	2	2	2	2	
Dispersion	1	0/2#	0/2#	0/3#	0/<0-1#	0/<0-1#	0/<0-1#	0/<0-1#	# after remoulding
Efferv fin. earth									

NOTES: • Sampled in area of sheet-wash – very variable surface texture + thickness depending on local stripping + redeposition.

Site 31 photographs

Soil profile photograph

Landscape photograph

Photos - Lscape/veg 339 - 340
- soil 341 - 344
- surface 345 - 347

SITE DESCRIPTION

Slope range 0 - 0.5%

Geology	Slope Eval	Slope Percent	Slope Class	Slope MT	Slope Incl	Landform Element Type	Landform Element Loc	Landform Element Height	Landform Element Width	Landform Element Length	Landform Pattern Pattern	Landform Pattern Class	Landform Pattern Modal	Landform Pattern RMS	Land Use LU1	Land Use Mgt1	Land Use Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		TEP					ALP			LP				BURJ	18/2/18	FSCISM	F32		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Air Photos Run No	Air Photos Frame No
C	M	4	1	2	2	4			999							

Substrate (Not described)

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C										ND						

Location Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG aff	Disturb	Surface Condition
M	55	193190	7699631	3	DE	AB	BD	DK	A	E	M	O	X	—	—	1	FH

Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
Z						Ø						Ø	

Profile Diagram

Erosion Type	State	Deg	GD
Z			

Vegetation Community

No	Ref No	Name
1		Very open woodland ghostgum, bloodwood + river red gum + mesquite
2		
3		

Vegetation Community Details

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V	14		CORPLENA		CORDALLA		EUCCAMAL	
M	S	5	5	4		PROPALLI					
L											

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dist	Bound Shape	Field Texture Field Texture	Field Texture Qual	Perm	Drain	Colour Book	Colour Hue	Colour V	Colour C	Colour Moist	Mottles Type	Mottles Abun	Mottles Size	Mottles Contr	Mottles Col	Coarse Fragments Abun	Coarse Fragments Size	Coarse Fragments Shape	Coarse Fragments Lith	Coarse Fragments Str	Structure Grade	Structure Size	Structure Type	Structure Cmpd	Segregations Abun	Segregations Nat	Segregations Form	Segregations Size	Segregations Str	Cracks	Strgth SWS	Strgth Cons	Cutans Fabric	Cutans Kind	Cutans Abund	Cutans Distinct	Pans Type	Pans Cmnt	Pans Cont	Pans Str	Roots Size	Roots Abun	Samples (m)
1	A1	0	0.1	C		CLFS		3	4	10	YR	3	2	M	Ø					Ø					M	3	SB	1	Ø						D	3					—				1	2	
2	B21	0.1	0.3	G		FSLMC (FM)		2	4	10	YR	3	2	M	Ø					Ø					S	4	AB	1	Ø						D	S					—				1	2	
																									S	3	AB	2																		
3	B22	0.3	0.7	D		FSLC (FM) +		3	4	10	YR	3	3	M	Ø					Ø				M/S	4	AB		Ø						D	T	4				—				1	2	
4	B23	0.7	1.0			FSLC (FM)		3	4	10	YR	4	3	M	Ø					Ø				M/S	4	AB		3	K	S	1			D	T	4				—				1	2	
5																																															
6																																															
7																																															

Field Tests	Meth	0.02	0.1	0.25	0.55	0.85
pH-RP	1	6.8	7.0	7.0	7.5	8.5
pH-1:5	4					
EC-1:5	1	—	—	—	—	—
Slaking	1	—	—	—	—	—
Dispersion	1	—	—	—	—	—
Efferv fin. earth						

No slaking or dispersion testing / not sampled

NOTES:

- Core to 1.0m confirms typical TEP alluvial domosol; characterised by minor sand/clay deposition. ✓

Site 32 photographs

Soil profile photograph

Landscape photograph

✓

Photos – Lscape/veg 352 – 353
– Soil 348 – 351
– Surface 354 – 356

• Same as sites 12 + 25. – conforms "intermediate" level coolibah unit developed on micaceous FR Qa.

Micaceous FR alluvium) slope range – 0–0.5%

SITE DESCRIPTION

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		PLA					ALP			LP				BURJ	18/2/18	FSCISM	F33		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4			999								C										ND						

Substrate: Not described

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith	Profile Diagram
M	55	193438	7699539	3	DE	AE	BD	DK	A	E	0	0	X	—	—	1	HF	Z						0						0		

Vegetation Community: Dominated by bauhinia + coolibah

Erosion Type	State	Deg	GD	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Open clumped woodland of bauhinia +	T	T	7	5	12		LYSGILVU		EUCCOOLA		EUCCAMAL	
				2		coolibah ± occ river red gum, bloodwood ?	M	S	5	V			ERE.Sp? (Mitchellii?)		ACASALIC		PROPALLI	
				3		& ghost gum	L											

I occ Cor plena, Cor dalla

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Book	Hue	V	C	Moist	Mottles	Coarse Fragments	CF Str	Structure Grade	Size	Type	Cmpd	Segregations	Cracks	SWS	Cons	Fabric	Cutans	Pans	Roots Size	Roots Abun	Samples (m)
1	A1	000	020	C		FSLC		3	4		10YR	3	2	M	0	0	M/	S	3	SB		0		D	4			—	1	1	Not sampled.
2	B21	020	050	D		LMC		2	4		10YR	3	1	M	0	0		S	4	AB		0		D	5			—	1	1	
3	B22	050	100			MC	+	2	4		10YR	3	1	M	0	0		S / S	4 / 3	AB / AB	1 / 2	2KS2 / 2KN2		D	5			—	1	1	
4																															
5																															
6																															
7																															

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85
pH-RP	1	6.5	6.5	7.5	8.8	8.8
pH-1:5	4					
EC-1:5	1	—	—	—	—	—
Slaking	1	—	—	—	—	—
Dispersion	1	—	—	—	—	—
Efferv fin. earth						

No slaking or dispersion testing / not sampled

NOTES:

• Typical non cracking clay / Dermosol associated with intermediate level Coolibah – bauhinia unit that sits @ slightly lower elevation than adjacent more elevated TEP surface.

Site 33 photographs

Soil profile photograph

Landscape photograph

Micaceous seds throughout — but lower material indicative of older Qa landscape = scalding

Photos – Lscape/veg 357 – 359
– soil 360 – 363
– surface 364 – 365

SITE DESCRIPTION

Slope range – 0–0.5%

Geology	Slope Eval	Slope Percent	Slope Class	MT	Incl	Landform Element Type	Loc	Height	Width	Length	Landform Pattern	Class	Modal	RMS	Land Use LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		PLA					ALP			LP				BURJ	181218	FSC15M	F34		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit Type	Tax Unit Code	Map Unit Type	Map Unit Code	Air Photos Film No	Run No	Frame No	Substrate OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C	M	4	1	2	2	4			999								C										ND						

Substrate: Not described

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	SO Ord (?)	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition	Microrelief Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments Abun	Size	Shape	Lith	Str	Alt	Outcrop Abun	Lith
M	55	193898	7699340	3	CH	AB	CV	EO	BE	LO	X			—	—		1	H	Z						0						0	

Profile Diagram:

0.10
0.27
0.75
1.30

Erosion Type	State	Deg	GO	No	Ref No	Vegetation Community Name	Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Sparse stunted Boree scrub.	T	T	6	V			ACATEPHR					
				2		+ severely scalded adjacent.	M	S	4	V			ERE sp? (Mitchellii?).		PROPALLI			
				3			L											

Vegetation Community: CD? — Sparse Boree scrub

Number	Horizon	Depth Upper	Depth Lower	Bound Dsct	Shape	Field Texture	Qual	Perm	Drain	Colour Hue	V	C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Fabric	Cutans Kind	Abund	Dstnct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
1	A11	000	010	C		FSCL	—	3	4	10YR	4	3	M	0					0					V				0						D	3	E				—				1	2	0–0.10
2	A12	010	027	C/A		FSL		3	4	10YR	3	3	M	0					0					M	3	SB		0						D	4	R				—				1	1	0.1–0.20 0.20–0.27
3	B21	027	075	G		FSLC		2	4	10YR	3	3	M	0					0					M M/S	4 3	AB AB	1 2	0						D	5	S				—				1	1	0.3–0.4 0.5–0.6
4	B22	075	130	D		FSLMC		2	4	10YR	4	3	M	0					0					W/M	4	AB		1 1	K Y	S X	1 1			D	5	S				—				0		0.8–0.9 1.1–1.2
5	B23y	130	170			FSLMC		2	4	7.5YR	4	3	M	0					0					M/S	3	AB		2	Y	X	1			D	5	S				—				0		1.4–1.5
6																																														
7																																														

clay seds indicative of BKP soils eg scalded areas.

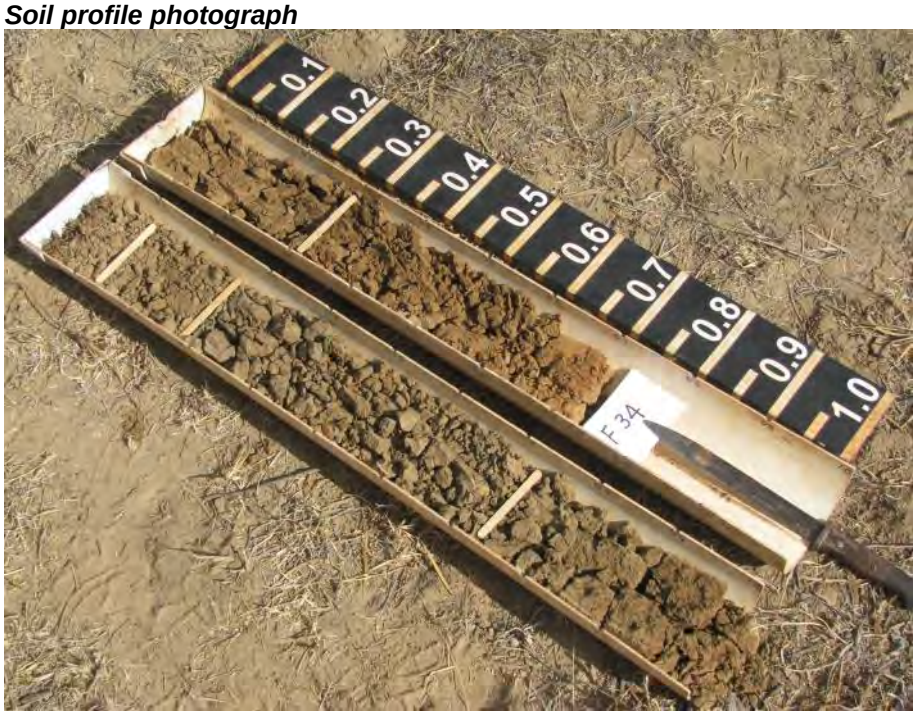
Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	5.8	6.5	8.0	8.8	8.6	8.5	8.5
pH-1:5	4							
EC-1:5	1			0.03	0.55	1.86		
Slaking	1	1	1	1	2	2	2	2
Dispersion	1	0/2#	0/2#	0/3#	1/3#	1/2#	1/2#	1/2#
Efferv fin. earth								

after remoulding

NOTES:
- Front Levee / TEP position but @ the intermediate elevation level – same elevation surface as coolibah unit.
- Dominated by micaceous seds but boree vegetation + severely scalded just in from front LEV/TEP position. cf site 20.

Site 34 photographs

Soil profile photograph



Landscape photograph

Definite reddish brown micaceous seds from 1.0m; some as seen @ 4, 5 & 6.
→ minor mica also apparent in "Black soil"

Photos – Lscape/veg 366 – 367
– soil 374 – 377
– surface 368 – 373

Slope range 0–0.5%

SITE DESCRIPTION

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MT	Slope: Ind	Landform Element: Type	Landform Element: Loc	Landform Element: Height	Landform Element: Width	Landform Element: Length	Landform Pattern: Local Pattern	Landform Pattern: Class	Landform Pattern: Modal	Landform Pattern: RMS	Land Use: LU1	Land Use: Mgt1	Land Use: Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		BKP					FLO			LP				BURJ	19/12/18	FSC 15M	F35		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Air Photos: Run No	Air Photos: Frame No
C	M	4	1	1	2	4			999							

Substrate: Buried alluvial deposit from 1.0m

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			1.0							UC						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/Or2	SG/SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	192998	7698433	3	VE	AB	E	I	G	B	E	R	R	W	—	—	1	GMX

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
2						0						0	

Profile Diagram: B01 (0.03) / B22 (0.30) / B23 (0.60) / 2D1 (1.00)

Erosion: Type	State	Deg	GD
2			

Vegetation Community: No	Ref No	Name
1		Open mitchell grass alluvial plain
2		
3		

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T											
M						Very overgrazed.					
L	G	2	V			AST SQUAR		occ Forbs (hayed off)			

Number	Horizon	Depth (m): Upper	Depth (m): Lower	Bound: Dect	Bound: Shape	Field Texture: Field Texture	Field Texture: Qual	Perm	Drain	Colour: Book	Colour: Hue	Colour: V	Colour: C	Colour: Moist	Mottles: Type	Mottles: Abun	Mottles: Size	Mottles: Contr	Mottles: Col	Coarse Fragments: Abun	Coarse Fragments: Size	Coarse Fragments: Shape	Coarse Fragments: Lith	Coarse Fragments: Str	Structure: Grade	Structure: Size	Structure: Type	Structure: Cmpd	Segregations: Abun	Segregations: Nat	Segregations: Form	Segregations: Size	Segregations: Str	Cracks	Strgth: SWS	Strgth: Cons	Cutans: Fabric	Cutans: Kind	Cutans: Abund	Cutans: Distinct	Pans: Type	Pans: Cmnt	Pans: Cont	Pans: Str	Roots: Size	Roots: Abun	Samples (m)
1	A1	0	0.03	C		MC		2	4		10YR	3	3	M		0				0					5	1	GR		0						D	1					—				1	1	0–0.03
																																															0.03–0.1
2	B21K	0.03	0.30	G		MC	+	2	4		10YR	3	3	M		0				0					5	3	AB LE	1	1	K	N	1		D	5					—				1	1	0.1–0.2
																																															0.2–0.3
3	B22K	0.30	0.60	D		MHC		2	4		10YR	3	3	M		0				0					5	4	LE		1 2	K Y	N X	1 1		D	5					—				1	1	0.5–0.6
4	B23	0.60	1.00	C		MHC		2	4		10YR	3	3	M		0				0					M 5	S 4	LE LE	1 2	2	Y	X	1		D	5/6					—				0	0	0.8–0.9
prior alluvial deposition ↓	2D1	1.00	1.50		↓	SLC CLS	M-K	3	4		7.5YR	4	4	M	1	2	F	O		0					W M N	4	AB	1 2	2	Y	X	1		D	4					—				0	0	1.1–1.2
																																														1.4–1.5
6																																															
7																																															

Similar to substrate / uncon seds = micaceous ✓
seen below sites 5 & 6; varys in texture.

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	6.5	8.0	8.8	8.6	8.8	9.0	9.0
pH-1:5	4							
EC-1:5	1							
Slaking	1	1	2	2	2	2	2	2
Dispersion	1	0/<0-1 #	0/<0-1 #	1/<0-1 #	1/2 #	1/2 #	1/2 #	1/2 #
Efferv fin. earth								

after remoulding

NOTES:

- Lower subsoil confirms micaceous alluvial deposition seen in the BKP "lower zone"/"older" FR stratigraphic deposit that underlies whole
- Mod thick (0.02–0.03m), strong fine SM (SIGR) with well developed surface flake + fine sandy wash. ↑ FR ALP/BKP system.

Site 35 photographs

Soil profile photograph

Landscape photograph

• Confirms FR micaceous alluvium underlies whole ALP – 3 zones

Concepts = 1. Intact TEP – "softer" loamy overlie
2. Scalded zone – stripped of softer loamy + dispersive materials exposed

Photos – landscape/veg 378 – 379
– soil 383 – 386
– soil surface 380 – 382

SITE DESCRIPTION

Slope range – 0–0.5%

3. BKP landscape – underlain by dispersive materials; "black soil" alluvium from Riding Downs

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2			F	BKP					ALP							BURJ	19 12 18	FSC 15M	F36		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No
C	M	4	1	1	2	4			999							

Substrate: buried micaceous alluvial dep from 0.7

LOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			0.7							UC						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	Disturb	Surface Condition: occ	Microrelief: Type	Agent	Cmpt	Prop	Vl	Hl	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	193 333	7698 730	3	VE	AB	GS	GM	E	Q	R	X		–	–	1	GF	X	Z					1	3	R	Qz	VS		Ø	

lower subsoil buried PPF referred but unconstrained

Profile Diagram: A1 0.02 – B21 0.30 – B22 0.70 – 2D1 1.10 – 2D2

Erosion: Type	State	Deg	GD
C	P	1	

Vegetation Community: No	Ref No	Name
1		
2		
3		

Vegetation Community Details

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T						No trees – occ. Mesquite					
M											
L	G	I	V			Grazed to ground level & unidentifiable					

Number	Horizon	Depth (m): Upper	Lower	Bound: Dact	Shape	Field Texture	Qual	Perm	Drain	Colour: Book	Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distinct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	A1	0	0.2	A		FSLC		3	4		7.5YR	3	4	M	Ø					Ø					M	2	SB	1	Ø						D	3					–				1	1	0–0.02
																									S	1	GR	2																			0.02–0.
2	B21	0.2	0.3	G		FSLMC (F–M)	+	2	4		7.5YR	3	4	M	Ø					Ø					S	4	AB	1	Ø						D	4					+				1	1	0.1–0.2
																									S	3	AB	2																			0.2–0.3
3	B22 Ky	0.3	0.7	D		FSLMC (F–M)	+	2	4		10YR	3	4	M	Ø					Ø					M	4	AB LE	1 ↓	1 1	K Y	S x	1 1			D	4/5					+				Ø		0.5–0.6
4	2D1	0.7	1.1	D		SLC	M–K	3	4		10YR	4	4	M	Ø					Ø					M	4	AB		1 1	K Y	S x	1 1			D	4/5					–				Ø		0.8–0.9
5	2D2	1.1	1.5			SCL	M–K	+	3	4	10YR	4	6	M	Ø					Ø					W/M	4	AB		Ø						D	4/5					+				Ø		1.1–1.2
																																															1.4–1.5
6																																															
7																																															

Alluvial dep

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	7.0	7.0	7.8	8.5	8.5	8.2	8.0
pH-1:5	4							
EC-1:5	1							
Slaking	1	0/3 (2) #	0/3 (2) #	0/3 (2) #	0/1 (2) #	1/1 (2) #	1/2 (2) #	1/2 (2) #
Dispersion	1							
Efferv fin. earth								

after remoulding

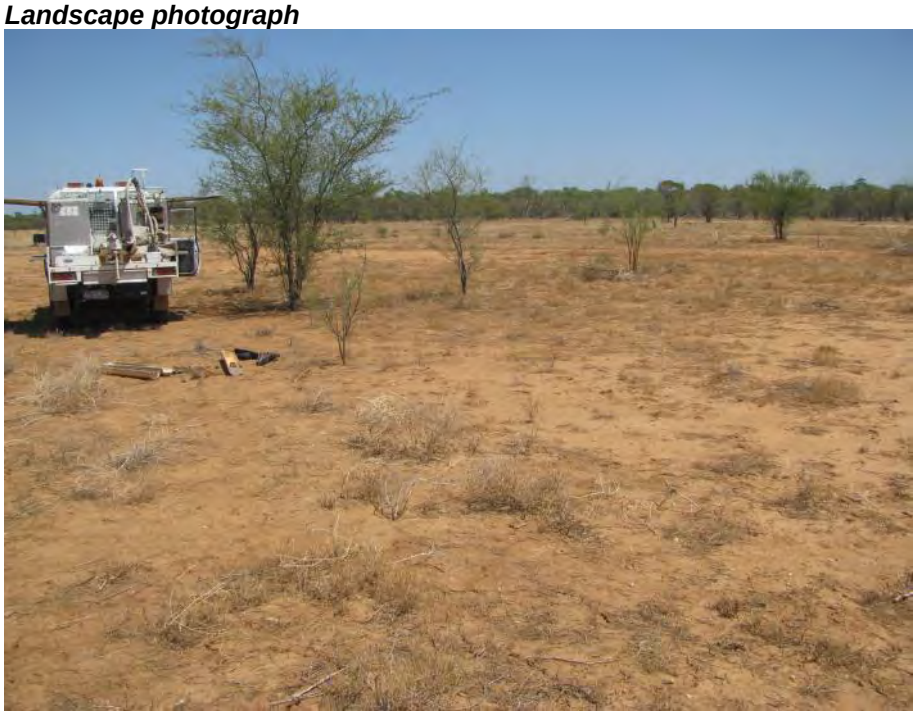
NOTES:

- Site located in minor red-brown clay unit within alluvial BKP; adjacent to "black soil" of site F35.
- Micaceous throughout
- Borderline DE/VE – occ cracking & weak thin SM + surface flake → suggest VE but not real LE observed

Site 36 photographs

Soil profile photograph

Landscape photograph



Photos – Lscape/veg 387 - 388
– Soil 390 - 389 - 392

SITE DESCRIPTION

Slope range - 0-0.5%.

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MMT	Slope: Incl	Landform Element: Type	Landform Element: Loc	Landform Element: Height	Landform Element: Width	Landform Element: Length	Landform Pattern: Pattern	Landform Pattern: Class	Landform Pattern: Modal	Landform Pattern: RMS	Land Use: LU1	Land Use: Mgt1	Land Use: Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		PLA					ALP			LP				BURJ	191218	FSC15M	F37		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Air Photos: Run No	Air Photos: Frame No
CM	4	1	1	1	2	4			999							

Substrate: Not described

DOT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
L										ND						

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG	aff	Disturb	Surface Condition
M	55	194105	7699075	3	DE	AE	CV	DK	A	EM	O		X	–	–		1	HF

assumed 7-5. PPF

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						Ø						Ø	

Profile Diagram: 0.08 / 0.35 / 1.00

Erosion: Type	State	Deg	GD	No	Vegetation Community: Ref No	Name
Z				1		Bauhinia Scrub with thick mesquite
				2		
				3		

AB?

Vegetation Community Details

Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	I	12		LYSGILVU					
M	T	6	D	7		LYSGILVU		PROPALLI			
L											

Number	Horizon	Depth (m): Upper	Depth (m): Lower	Bound: Dist	Bound: Shape	Field Texture: Field Texture	Field Texture: Qual	Perm	Drain	Colour: Book	Colour: Hue	Colour: V	Colour: C	Colour: Moist	Mottles: Type	Mottles: Abun	Mottles: Size	Mottles: Contr	Mottles: Col	Coarse Fragments: Abun	Coarse Fragments: Size	Coarse Fragments: Shape	Coarse Fragments: Lith	Coarse Fragments: Str	Structure: Grade	Structure: Size	Structure: Type	Structure: Cmpd	Segregations: Abun	Segregations: Nat	Segregations: Form	Segregations: Size	Segregations: Str	Cracks	Strgth: SWS	Strgth: Cons	Cutans: Fabric	Cutans: Kind	Cutans: Abund	Cutans: Distinct	Pans: Type	Pans: Cmnt	Pans: Cont	Pans: Str	Roots: Size	Roots: Abun	Samples (m)
1	A1	Ø	0.08	C		CLFS	+	3	4		10YR	3	2	M		Ø				Ø					M	5	SB		Ø					D	3	4					–				1	2	
2	B21	0.08	0.35	D		FSLMC		2	4		10YR	3	1	M		Ø				Ø					S	4	AB	1	Ø						D	4	5					–				1	2	
																									S	3	AB	2																			
3	B22K	0.35	1.00			MC (F)		2	4		10YR	3	3	M		Ø				Ø					S	3	AB			I	K	S	1		D	4	5					–				1	2	
4																																																
5																																																
6																																																
7																																																

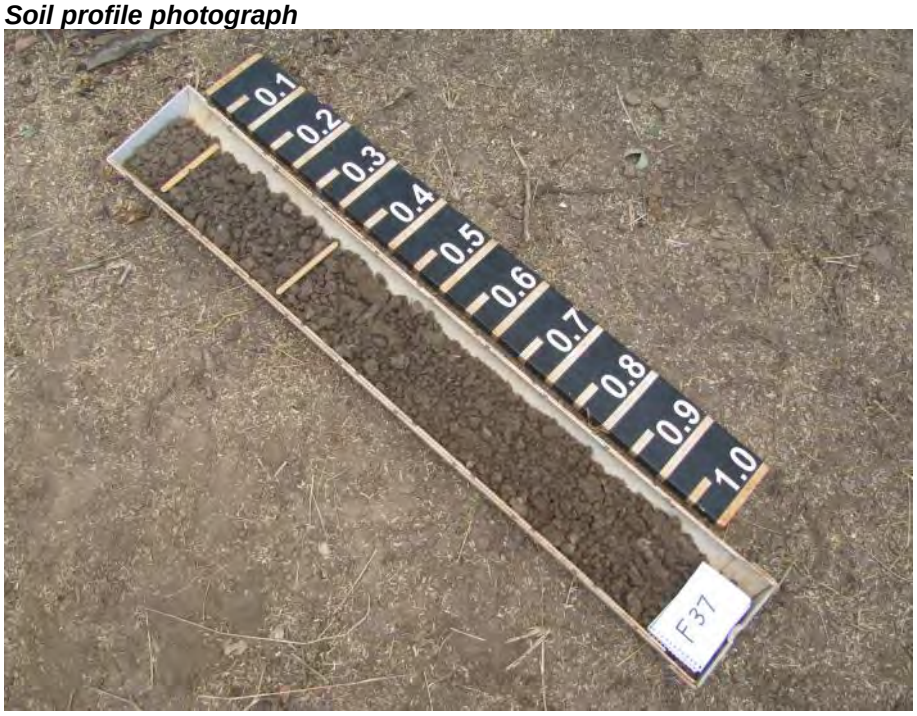
Field Tests	Meth	0.02	0.10	0.25	0.55	0.65
pH-RP	1	7.5	7.5	7.5	8.5	8.5
pH-1:5	4					
EC-1:5	1	–	–	–	–	–
Slaking	1	–	–	–	–	–
Dispersion	1	–	–	–	–	–
Efferv fin. earth						

No slaking or dispersion testing / not sampled.

NOTES:
- Micaceous throughout
- Same as site 18 exactly ✓

Site 37 photographs

Soil profile photograph



Landscape photograph

Easy to core – definite macetine in clay subsoil below 0.4m. suggests extremely saline
– possible cracking & salinity fluoc layer in upper profile 0–0.4m

Photos – Lscape/veg 393–397
– soil 404–411
– surface 398–403

slope range 0–<0.5%.

SITE DESCRIPTION

Geology	Slope: Eval	Percent	Class	MT	Incl	Landform Element: Type	Loc	Height	Width	Length	Landform Pattern: Pattern	Class	Modal	RMS	Land Use: LU1	Mgt1	Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	0.2		F		BKP					FLO			LP				BURJ	191218	FSCISM	F38		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Code	Map Unit: Type	Code	Air Photos: Film No	Run No	Frame No	Substrate: OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
CM	4	I	1	2	4				999								C										ND						

Not described

Location: Datum	Zone	Easting / Latitude	Northing / Longitude	Australian Soil Classification: Conf	Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition	Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
M	55	196896	7697396	3	VE	AB	GS	PM	E	Q	R	X	-	—	—	1	GHF	Z						Ø						Ø	

Profile Diagram: 0.02, 0.35, 0.65, 1.00

Erosion: Type	State	Deg	GD	Vegetation Community: No	Ref No	Name	Vegetation Community Details: Stratum	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
Z				1		Very open/sparse Boree scrub. ± occ bauhinia & mesquite shrubs.	T	T	6	5			ACATEPHR	occ.	LYSGILVU			
				2			M											
				3			L											

Borderline EI?

HS/firmpedal to weak/mod, thin SM.

Number	Horizon	Depth (m): Upper	Lower	Bound: Dist	Shape	Field Texture: Field Texture	Qual	Perm	Drain	Colour: Book	Hue	V	C	Moist	Mottles: Type	Abun	Size	Contr	Col	Coarse Fragments: Abun	Size	Shape	Lith	Str	Structure: Grade	Size	Type	Cmpd	Segregations: Abun	Nat	Form	Size	Str	Cracks	Strgth: SWS	Cons	Cutans: Fabric	Kind	Abund	Distnct	Pans: Type	Cmnt	Cont	Str	Roots: Size	Abun	Samples (m)
1	A1	0	0.03	C		FS LC	2	3	4		10YR	4	3	M		0				0					M	5	3	SB	1	0					D						—				1	1	0–0.02
																									A	5	1	GR	2																		0.02–0.1
2	B21	0.03	0.35	C		FS LMC		2	4		10YR	4	3	M		0				0					S	4	AB	1	0					D						—				1	1	0.1–0.2
																									S	3	AB	2																		0.2–0.3
3	B2 Ky	0.35	0.65	G		LMC (F)	+	2	4		10YR	3	2	M		0				0					S	3	AB	1	1	K	5	1		D	T	4				—				0		0.5–0.6
																									S	2	AB	2	2	y	x	1														
4	B23 y	0.65	1.00	D		MC (F)		2	4		10YR	3	3	M		0				0					M	5	4	AB		3	Y	X	2			T	4			—				0		0.8–0.9
5	B24 y	1.00	1.50			MHC (F)		2	4		10YR	4	4	M		0				0					M	5	4	AB		2	Y	X	2			T	4			—				0		1.1–1.2
											7.5YR	4	4	M													PO																		1.4–1.5
6																																															
7																																															

Field Tests	Meth	0.02	0.10	0.25	0.55	0.85	1.15	1.45
pH-RP	1	8.5	7.9	>7.9	>7.9	>7.9	>7.9	>7.9
pH-1:5	4							
EC-1:5	1							
Slaking	1	2	2	2	2	2	2	2
Dispersion	1	0/3#	0/0#	2/0#	1/0#	1/2#	1/2#	1/2#
Efferv fin. earth		—	—	—	—	—	—	—

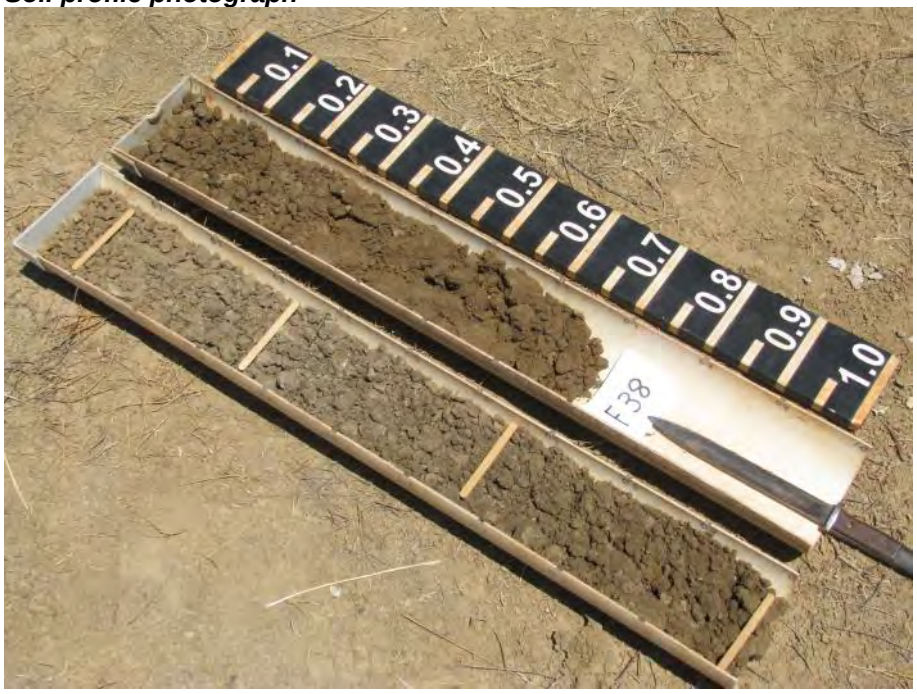
after remoulding

NOTES:

- Variable surface condition – hardsetting/firmpedal to thin (0.02m), weak to mod SM. (SIGR) –0.03m
- Compare with heavier gilgaied Boree scrub @ site 5; dominant unit is hardset to weakly SM unit – sites 14, 34, 38

Site 38 photographs

Soil profile photograph



Landscape photograph

SITE DESCRIPTION

- Drillers core log on southern boundary of TEP + BKP 1 local
- Sampled for pH, EC, Cl to 18m @ 1.0m intervals (0-0.1, 0.1-0.2, 0.2-0.3 etc, bulk samples)
- Photos — Lscape
  — core samples

Slope range — 2.0-5.1 TEP to BKP transition zone — adjacent to scalded lscape.

Geology	Slope: Eval	Slope: Percent	Slope: Class	Slope: MT	Slope: Incl	Landform Element: Type	Landform Element: Loc	Landform Element: Height	Landform Element: Width	Landform Element: Length	Landform Pattern: Pattern	Landform Pattern: Class	Landform Pattern: Modal	Landform Pattern: RMS	Land Use: LU1	Land Use: Mgt1	Land Use: Mgt2	Described By	Date (ddmmyy)	Project	Site	Obs	S Type
Qa	A	9.2				BKP					ALP			LP				BURJ	19/2/18	FSC 15M	F39		

TSO	M Type	L Meas	Obs Reas	Runoff	Perm	Drainage	M Samp	Aggredn	Depth R Horiz	Tax Unit: Type	Tax Unit: Code	Map Unit: Type	Map Unit: Code	Air Photos: Film No	Air Photos: Run No	Air Photos: Frame No
C	M	4	2	1	1	3			19							

Uncon clay seds over Substrate weathered 3cm 15-19m. fresh MU @ 19m

OT	Distance	Conf	Depth	Gr S	Str	Por	Sp F	Alt	Str	Lith	Gen T	Text	Mass Str	MDS	MC1	MC2
C			3.0							UC						
			18.0													

Location

Datum	Zone	Easting / Latitude	Northing / Longitude	Conf	Australian Soil Classification: Ord	Sub Ord	GG/ Or2	SG/ SO2	F1	F2	F3	F4	F5	PPF	GSG: aff	Disturb	Surface Condition
M	55	195773	6982582	3	DE	AB	—	—	—	—	—	—	—	—	—	1	H

Microrelief: Type	Agent	Cmpt	Prop	VI	HI	Surface Coarse Fragments: Abun	Size	Shape	Lith	Str	Alt	Outcrop: Abun	Lith
Z						Ø						Ø	

Profile Diagram

Erosion: Type	State	Deg	GD
Z			

Vegetation Community: No	Ref No	Name
1		Coolibah - Bare open woodland with shrubby Eremophila U/S.
2		
3		

10-12

Vegetation Community Details: Strata	Form	Ht Cl	Cov Cl	Height	Cover	Species 1	Prop	Species 2	Prop	Species 3	Prop
T	T	7	V			EUCCOOLA		ACATEPHR			
M	S	5	5			ERESp?? (Mitchellii?)		ACATEPHR			
L											

Number	Horizon	Depth (m) Upper	Depth (m) Lower	Bound Dect	Bound Shape	Field Texture	Qual	Perm	Drain	Colour Book	Colour Hue	Colour V	Colour C	Moist	Mottles Type	Abun	Size	Contr	Col	Coarse Fragments Abun	Size	Shape	Lith	Str	Structure Grade	Size	Type	Cmpd	Segregations Abun	Nat	Form	Size	Str	Cracks	Strgth SWS	Cons	Cutans Fabric	Kind	Abund	Distinct	Pans Type	Cmnt	Cont	Str	Roots Size	Abun	Samples (m)
Micaceous Soil material	1	Soil	0.0	1.0			CLFS		34		10YR	33																																			0 - 3.0
			1.0	2.0			FSLC		34		10YR	43																																			
	2		2.0	3.0			FSLMC		24		10YR	43																																			
Micaceous clayey Seds	3	Layer 1	3.0	8.0			LMC	+	24		7.5YR	54																																			3.0-8.0
	4	Layer 2	8.0	12.0			MHC		123		10YR	56																																			8.0-12.0
	5	Layer 3	12.0	18.0			HC		13		10YR	53																																			12.0-18.0
weathered MU	6	C weathered MU	18.0	19.0			—		—		10YR	52																																	→	Bulked Samples for PSA Analysis
fresh MU	7	R mudstone basement	19.0	24.0			—		—		2.5Y	21																																			

Field Tests	Meth
pH-RP	1
pH-1:5	4
EC-1:5	1
Slaking	1
Dispersion	1
Efferv fin. earth	

- No slaking or dispersion testing

NOTES: Core samples/log — Sampled by drillers @ 1.0m intervals ✓ laid out in 6m length core chip-samples.

- KU mudstone @ 18m = basement
- clay dominates throughout @ rear of TEP/BKP transition — no gravel or sand beds; clay continuous from 3.0m to 18m. (PPP mud stone) in situ

Site 39 photographs

Soil profile photograph

Landscape photograph

Appendix 3:
Soil Map Boundary Observation Notes

Appendix 3 Soil map boundary observation notes

Observation site (M) reference number	Mapping observation comment
M1	Small patch of elevated open downs marks boundary between Cretaceous landscape and backplain alluvium (BKP), same as site 26 = C1 unit
M2	Confirms Mitchell Grass cracking clay on BKP alluvium, marks boundary between Cretaceous landscape and BKP alluvium, same as site 6 = B1 unit
M3	Marks boundary between open downs and Boree scrub on BKP alluvium, same as site 38 = B2 unit
M4	Marks boundary between BKP alluvium Boree scrub unit and incised oxbow to the east, same as site 38 = B2 unit
M5	Severely scalded, unvegetated, BKP alluvium unit, same as site 4 = B3 unit
M6	Confirms sparse Boree scrub and hardsetting to firm brown cracking clay, same as site 38 = B2 unit
M7	Narrow band of "black soil" with Mitchell Grass on BKP alluvium, confirms boundary with adjacent Boree scrub, same as site 6 = B1 unit
M8	Marks boundary between gilgaied self-mulching clay and Boree scrub and BKP with Mitchell Grass, same as site 5 = B2g unit, also confirms scalded BKP alluvium to north
M9	Confirms BKP Boree scrub unit, same as site 38 = B2 unit
M10	Confirms BKP Boree scrub unit, same as site 38 = B2 unit
M11	Narrow band of "black soil" with Mitchell Grass on BKP alluvium, confirms boundary with adjacent Boree scrub, same as site 6 = B1 unit
M12	Confirms BKP Mitchell Grass open downs unit, same as site 6 = B1 unit
M13	Confirms BKP Mitchell Grass open downs unit, same as site 6 = B1 unit
M14	Confirms BKP Boree scrub unit, same as site 38 = B2 unit, marks change from scalded BKP B3 unit moving north
M15	Marks boundary change from clay BKP alluvium to elevated terrace plain (TEP), same as site 3 = A1 unit
M16	Confirms incised River Red Gum swale unit, same as site 11 = A3 unit
M17	Marks boundary between incised swale and elevated TEP, same as site 10 = A1 unit
M18	Confirms typical elevated TEP with Ghost Gum/Bloodwood, same as site 10 = A1 unit
M19	Confirms boundary change to small patch of less elevated TEP surface, lower lying and Coolibah, old swale remnant from old scroll plain, same as site 12 = A2 unit
M20	Confirms boundary change to small patch of less elevated TEP surface, lower lying and Coolibah, old swale remnant from old scroll plain, same as site 12 = A2 unit
M21	Confirms and marks boundary of eastern/southern extent, narrow swamp located on southern side of scalded remnant, weakly gilgaied and heavy cracking clay/self-mulching and Boree scrub and Coolibah, same as site 5 = B2g unit
M22	Marks boundary between scalded B3 unit and B2 Boree scrub unit on BKP alluvium within the eastern TEP, same as site 14 = B2 unit
M23	Confirms boundary between elevated and less elevated TEP and confirms Coolibah and epipedal vertosol at eastern end of A2 unit
M24	Confirms boundary between elevated and less elevated TEP and confirms Coolibah and epipedal vertosol at eastern end of A2 unit
M25	Marks change from less elevated to fully elevated TEP, same as site 15 = A1 unit
M26	Confirms elevated levee/terrace adjacent to river channel, same as site 1 = A1 unit
M27	Low lying channel bank immediately adjacent to Flinders River, same as site 11 = River Red Gum, flooded and channelized = A3 unit

Observation site (M) reference number	Mapping observation comment
M28	Confirms and marks boundary of western/northern extent, narrow swamp located on southern side of scalded remnant, weakly gilgaied and heavy cracking clay/self-mulching and Boree scrub and Coolibah, same as site 5 = B2g unit
M29	Marks boundary between less elevated and fully elevated TEP, same as site 10 = A1 unit
M30	Small patch of A1 unit within larger A2 unit, too small to map, same as site 10 = A1 unit
M31	Marks boundary between elevated TEP = A1 unit and incised River Red Gum swale of site 11 = A3 unit
M32	Marks boundary between elevated TEP = A1 unit and incised River Red Gum swale of site 11 = A3 unit
M33	Confirms incised River Red Gum swale unit, same as site 11 = A3 unit
M34	Incised swale of site 11, at northern end adjacent to Flinders River, same as site 11
M35	Typical TEP and Ghost Gum/Bloodwood, same as sites 1 and 2 = A1 unit
M36	Confirms elevated front TEP with Ghost Gum and Bloodwood, same as site 2 = A1 unit
M37	Lower area within terrace and weak channelling and Coolibah, same as site 12 = A2 unit
M38	Boundary check site to confirm narrow neck of A2 unit, same as site 12
M39	Confirms less elevated, Coolibah and A2 unit and marks division between areas of elevated TEP/A1 unit to east and west
M40	Confirms less elevated, Coolibah and A2 unit and marks division between areas of elevated TEP/A1 unit to east and west
M41	At boundary between A2 unit and A4 unit, change to oxbow Coolibah and self-mulching vertosol, same as site 16 = A4 unit
M42	At boundary of elevated TEP and transition to BKP, also close to drop off to nearby oxbow (A4 unit), same as site 3 = A1 unit
M43	Small patch of A2 unit at transition between elevated TEP and B2 unit BKP alluvium, incidence of localised seepage, minor channelling, same as site 12 = A2 unit
M44	Confirms sparse Boree scrub on BKP, B2 unit, same as site 14 and 38 and marks boundary to TEP and adjacent incised oxbow
M45	Confirms sparse Boree scrub on BKP, B2 unit, same as site 14 and 38 and marks boundary to TEP and adjacent incised oxbow but not close to TEP boundary
M46	Marks boundary change from B2 unit to scalded BKP B3 unit
M47	Confirms Boree scrub/unit B2 on BKP, marks boundary with incised oxbow
M48	Same as sites 14 and 38, confirms Boree BKP unit = B2 unit
M49	Same as sites 14 and 38, confirms Boree BKP unit = B2 unit
M50	Marks distinct change from sparse Boree scrub B2 unit to open Mitchell Grass, same as site 6 = B1 unit
M51	Marks boundary changes to patch of heavy, really gilgaied self-mulching vertosol and Boree scrub and Coolibah swamp, same as site 5 = B2g unit
M52	Marks boundary changes to patch of heavy, really gilgaied self-mulching vertosol and Boree scrub and Coolibah swamp, same as site 5 = B2g unit
M53	Non-cracking clay and Coolibah at transition to BKP and adjacent to incised oxbow, same as site 12 exactly = A2 unit
M54	Severely scalded and occasional Boree scrub/Bauhinia, same as site 20= B3 unit
M55	Scrubby Coolibah and distinct drainage feature, same as site 21 = A2 unit
M56	Severely scalded, same as site 20 = B3 unit
M57	Ghost Gum, Bloodwood ± Bauhinia, at boundary between elevated TEP and transition to BKP, exactly the same as site 19 = A1 unit

Observation site (M) reference number	Mapping observation comment
M58	Confirms typical elevated TEP/A1 unit, same as site 19
M59	Marks boundary between A1 unit/TEP and A2 unit to east
M60	Marks boundary change from A4 unit to A2 unit at northern end of oxbow, self-mulching vertosol and Coolibah and swamp feature at M60, distinct change just north to A2 unit
M61	Confirms A2 unit and marks the finish of the oxbow and start of A2 unit
M62	Marks boundary between small patch of Boree scrub and minor scalding (change from A2 unit to B2 unit), weakly channelled A2 unit to the north and B2 unit to the south, also marks boundary to elevated TEP just to the east
M63	Marks boundary between A2 unit and A1 unit near front of TEP
M64	Marks boundary change from less elevated Coolibah, non-cracking clay to elevated TEP to west, same as site 12 = A2 unit
M65	Confirms elevated TEP and Ghost Gum/Bloodwood noted in map boundary observation at M64, same as site 19 = A1 unit
M66	Marks boundary change from elevated TEP with A1 unit to less elevated Coolibah non-cracking clay = A2 unit, same as site 19 at M66 and M67 = A1 unit
M67	Marks boundary change from elevated TEP with A1 unit to less elevated Coolibah non-cracking clay = A2 unit, same as site 19 at M66 and M67 = A1 unit
M68	Confirms less elevated Coolibah and non-cracking clay, same as site 12 = A2 unit
M69	Severely scalded and very sparse Boree scrub, effectively same as site 13 and 20 = B3 unit
M70	Marks boundary change from scalded B3 unit to A2 unit, with Coolibah and Bauhinia = A2 unit
M71	Confirms BKP Boree scrub unit, same as site 36 = B2 unit
M72	Confirms “black soil” with Mitchell Grass on BKP alluvium, confirms B1 unit, same as site 35
M73	Confirms “black soil” with Mitchell Grass on BKP alluvium, confirms B1 unit, same as site 35
M74	Confirms BKP Boree scrub unit, same as site 36 = B2 unit
M75	Confirms “black soil” with Mitchell Grass on BKP alluvium, confirms B1 unit, same as site 35
M76	Confirms BKP Boree B2 unit, borderline brown dermosol/vertosol with occasional Boree and shrubs
M77	Confirms eastern arm of incised oxbow, actively flooded, self-mulching cracking clay and Coolibah, same as sites 30 and 16 = A4 unit
M78	Marks boundary between elevated TEP and incised oxbow, same as site 24 = A1 unit
M79	Marks boundary between elevated TEP and incised oxbow, same as site 24 = A1 unit
M80	Narrow drainage area within elevated TEP, shrubby Coolibah confirms unit A2, same as site 29
M81	Small patch of sheet eroded A1e unit between narrow terrace swale and incised oxbow, same as site 31 = A1e unit
M82	Confirms incised, active oxbow, flood marks apparent SM clay and Coolibah, same as site 30 = A4 unit
M83	Confirms self-mulching clay on sideslope to elevated rolling downs landscape and Boree scrub, same as site 27 = C2 unit, slope measured at 10%
M84	Confirms extent of eroded TEP margins, extensively sheet eroded but minimal rill or gully erosion, same as site 31 = A1e unit

Observation site (M) reference number	Mapping observation comment
M85	Confirms extent of eroded TEP margins, extensively sheet eroded but minimal rill or gully erosion, same as site 31 = A1e unit
M86	Marks boundary between elevated intact TEP/A1 unit and eroded margins characterised by site 31, same as site 23/24
M87	Marks boundary between elevated TEP/A1 unit and less elevated Coolibah country of A2 unit, same as site 23/24
M88	Confirms Coolibah and non-cracking clay on less elevated TE, same as site 25 = A2 unit
M89	Confirms Coolibah and non-cracking clay on less elevated TE, same as site 25 = A2 unit
M90	Confirms Coolibah and non-cracking clay on less elevated TE, same as site 25 = A2 unit
M91	Narrow front levee associated with elevated TEP and A1 unit, same as site 1
M92	Marks boundary between end of narrow levee/A1 unit and start of less elevated A2 unit with Coolibah
M93	Small patch of intact elevated TEP/A1 unit within larger polygon mapped as A1e unit (eroded margins), same as site 24
M94	Boree scrub on rolling downs footslope, same as site 27 = C2 unit
M95	Boree scrub on rolling downs footslope, very gravelly epipedal cracking to non-cracking clay/dermosol, not self-mulching clay, effectively same as site 27 = C2 unit
M96	Confirms extension of A2 unit westwards outside the study area boundary, same as site 12/25

Appendix 4:
Soil Analytical Methods and Testing Program

Appendix 4 Soil analytical methods and testing program

The following suites of soil analyses were performed on samples from the 15 Mile Project depending on the site type and sample depth. For detailed profiles (with the exception of water drillers bore sites 8 and 9), a full profile salinity screen (analytical suite 1 **Table 1**) was performed. Full profile physical and chemical analysis (analytical suite 2 **Table 2**) was performed on all soil unit representative profiles (also referred to as analysed sites) and surface soils from these profiles were analysed for inherent fertility (analytical suite 3 **Table 3**).

All samples were air dried at 40°C, and ground and sieved to <2 mm prior to analysis and were analysed according to procedures described by Rayment and Lyons (2011), McKenzie *et al*. (2002), Richards (1965) and Day (1965).

Table 4 provides a summary of the number of samples analysed for each analytical suite.

Table 1: Salinity screening (Suite 1)

Laboratory analysis and units	Use and interpretation of data	Method[1]
pH (1:5 soil/water)	Measure of the acidity or alkalinity of soil material	4A1
Electrical conductivity (EC 1:5 soil/water)	Screening test to assess potential salinity hazard	3A1
Soluble chloride (Cl mg/kg)	Measure of the level of soluble Cl in the soil solution; provides a direct estimate of the soluble NaCl salt concentration and aids in the interpretation of EC1:5 soil/water results (particularly in soils containing gypsum)	5A2

1 Method codes are from Rayment and Lyons (2011) unless otherwise stated.

Table 2: Profile physical and chemical analysis (Suite 2)

Laboratory analysis and units	Use and interpretation of data	Method[1]
Cation chemistry		
Cation exchange capacity (CEC/ECEC cmol/kg)	CEC is a measure of a soils capacity to retain cations based on the surface area and charge density of soil constituents (particularly clay and organic matter fractions). CEC influences physical and chemical properties particularly in clay rich materials	15I3 / 15J1
Exchangeable calcium (cmol/kg)	Measure of the amount of Ca on the cation exchange complex	15C1 / 15A1
Exchangeable magnesium (cmol/kg)	Measure of the amount of Mg on the cation exchange complex	15C1 / 15A1
Exchangeable sodium (cmol/kg)	Measure of the amount of Na on the cation exchange complex	15C1 / 15A1
Exchangeable potassium (cmol/kg)	Measure of the amount of K on the cation exchange complex	15C1 / 15A1
Exchangeable acidity (Al and H) (cmol/kg)	Measure of the amount of Al and H on the cation exchange complex	15G1
Sodicity and dispersion		
Exchangeable sodium % (ESP)	Measure of soil sodicity, which affects the physical behaviour (permeability/density/strength) and clay dispersion. ESP measures the relative abundance of Na on the cation exchange complex	15N1
Dispersion ratio (R1)	Measure of soil dispersion potential based on the ratio of silt and clay dispersed during testing to total silt and clay content expressed as a percentage	NA

Laboratory analysis and units	Use and interpretation of data	Method[1]
Particle size analysis (PSA)		
% coarse sand (0.2 – 2 mm)	Visible sand range, open pore spaces, friable, permeable	Day (1965)
% fine sand (0.02 – 0.2 mm)	Non-visible sand; causes packing and increased density, "bulldusty", intractable, hardsetting conditions. A high proportion causes poor soil cohesion and high erodibility.	Day (1965)
% silt (0.002 - 0.02 mm)	Causes maximum packing and density, dilatancy, surface sealing, "bulldusty", intractable, hardsetting conditions. , highly erosive fraction. A high proportion causes poor soil cohesion and high erodibility.	Day (1965)
% clay (<0.002 mm)	Colloidal fraction, determines CEC, moisture holding capacity, shrink-swell characteristics, soil structure and cracking behaviour	Day (1965)
Moisture retention (used to calculate PAWC)		
Air dry moisture content (ADMC %)	Used to convert test data from an air dry basis to standardised oven dry basis	2A1
15 bar (pressure plate/gravimetric)	Estimate of moisture retention at approximate wilting point; calculated gravimetrically as moisture retained after 15 bar pressure plate losses	Richards (1965)

1 Method codes are from Rayment and Lyons (2011) unless otherwise stated.

Table 3: Surface (A1) soil fertility analysis (Suite 3)

Laboratory analysis and units	Use and interpretation of data	Method[1]
Total organic carbon (%C)	Provides an estimate of the total carbon store (%C) in the soil; used to estimate organic matter (OM %) content	8B1
Total (Kjeldahl) nitrogen (%N)	Provides an estimate of the total store of nitrogen (%N) in the soil that can potentially be mineralised	7A2
Bicarbonate extractable phosphorus (mg/kg P)	Provides a reliable and consistent estimate of plant available phosphorus (P) in the soil across a range of pH conditions	9B2
Extractable sulfate sulfur (mg/kg)	Provides a reliable and consistent estimate of plant available sulfate sulfur (S) in the soil	10B3
Extractable trace elements - Cu, Fe, Mn, Zn (ppm)	Provides a reliable and consistent estimate of plant available copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) in the soil	12A1

1 Method codes are from Rayment and Lyons (2011) unless otherwise stated.

Table 4: Analytical regime

Observation type	Soil Unit and site numbers	Analytical suites	Nominal sample depths *	Number of profiles	Final number of samples analysed
Analysed sites (Soil Unit representative profiles) including 2 deep cores	A1 (2 and deep core 24) A2 (25 and deep core 12) A4(16) B1(6) B2 (38) B3 (20) C1 (26) C2 (27)	Suite 1	Standard cores to 1.5 m A1 or 0-0.1, 0.1-0.2, 0.2-0.3, 0.5-0.6, 0.8-0.9, 1.1-1.2, 1.4-1.5 m	8	69
			Deep cores to ≥ 3.5 m 1.7-1.8, 2.0-2.1, 2.3-2.4, 2.6-2.7, 2.9-3.0, 3.1-3.3 m	2	12
		Suite 2	A1 or 0-0.1, 0.1-0.2, 0.2-0.3, 0.5-0.6, 0.8-0.9, 1.1-1.2, 1.4-1.5 m	10	69
		Suite 3	A1 or 0-0.1 m	10	10
Remaining detailed sites	A1 (1, 3, 10, 15, 17, 17, 19, 22, 23) A1e (31) A2 (18, 21) A3 (11) B1 (35) B2(14, 36) B2g (5) B3 (4, 13, 34)	Suite 1	A1 or 0-0.1, 0.1-0.2, 0.2-0.3, 0.5-0.6, 0.8-0.9, 1.1-1.2, 1.4-1.5 m	19	108
Deep cores (water drillers chip samples) [#]	A1 (7) B2 (39)	Suite 1	2, 4, 6, 8, 10, 12, 14 m	2	14

* Actual sampling depths collated will vary to reflect soil horizonation (see complete record of analysed samples in certificates of analysis in **Appendix 8**).

[#] Deep water drillers cores 8 and 9 (in Soil Unit A1) were not analysed.

Appendix 5:
Salinity Screening Data from Detailed Site Profiles

Appendix 5 Salinity screening data from detailed site profiles

Soil Unit	Site No	Horizon	Depth (m)	pH 1:5	EC1:5 (dS/m)	Cl (mg/kg)
A1	1	A1	0-0.05	7.2	0.126	48
		B21	0.3	7.5	0.043	<5
		B22	0.6	7.9	0.031	<5
		2D1	0.9	8.1	0.030	<5
		2D1	1.2	8.2	0.025	<5
		2D2	1.5	8.2	0.034	8.2
A1	2	A1	0-0.06	7.0	0.166	71
		B21	0.2	7.5	0.047	6.1
		B21	0.3	7.7	0.034	6.2
		2D1	0.6	7.7	0.026	9.6
		3B2	0.9	8.1	0.032	8.1
		4D2	1.2	8.3	0.044	18
		5B2	1.5	8.1	0.032	8.4
A1	3	A1	0-0.05	7.3	0.089	40
		B21	0.3	7.4	0.029	7.5
		B22	0.6	7.9	0.048	11
		B22	0.9	8.4	0.053	11
		2D1	1.2	7.9	0.504	11
		2D1	1.5	8.1	1.285	38
A1	7	FSLMC	2.0	8.2	0.458	31
		FSLC	4.0	8.2	0.178	14
		gravel	6.0	8.0	0.039	8
		MHC	8.0	7.7	2.19	4.2
		MHC	10.0	9.3	0.547	37
		MHC	12.0	9.3	0.513	4.7
		MHC	14.0	9.1	0.291	3.4
A1	10	A1	0-0.05	7.3	0.088	21
		B21	0.3	7.3	0.030	9.2
		B22	0.6	7.3	0.034	12
		2D1	0.9	7.8	0.023	11
		2D1	1.2	7.9	0.021	8.6
		2D1	1.5	8.2	0.030	11
A1	15	A1	0-0.08	7.3	0.096	25
		B21	0.3	7.9	0.039	8.4
		B22	0.6	8.3	0.055	7.4
		2D1	0.9	8.4	0.041	5.8
		2D1	1.2	8.3	0.040	7.2
		2D1	1.5	8.3	0.047	11
A1	17	A1	0-0.07	6.4	0.067	5.7
		B21	0.3	7.7	0.071	33
		B22k	0.6	8.7	0.110	18
		2D1	0.9	8.8	0.126	27
		2D1	1.2	8.8	0.128	21
		2D2	1.5	8.9	0.092	8.5
A1	19	A1	0-0.07	7.0	0.199	13
		B21	0.3	7.6	0.049	6.3
		B22	0.6	8.0	0.053	5.5
		B23k	0.9	8.6	0.108	9.0
		B23k	1.2	8.6	0.209	21
		2Dk	1.5	8.6	0.343	61
A1	22	A11	0-0.06	6.7	0.046	<5
		A12	0.2	7.2	0.022	<5
		B2	0.3	7.4	0.025	<5
		2D1	0.6	8.2	0.026	<5
		2D1	0.9	8.1	0.037	<5
A1	23	A1	0-0.1	8.2	0.110	<5
		B21	0.3	8.2	0.066	<5
		B22	0.6	8.3	0.073	<5
		2D1	0.9	8.8	0.038	<5
A1	24	A1	0-0.1	7.1	0.058	<5
		A1	0.2	6.9	0.032	<5
		B21	0.3	7.2	0.027	<5
		B21	0.6	7.5	0.027	<5
		B22	0.9	7.8	0.035	<5
		2D1	1.2	8.6	0.083	<5
		2D1	1.5	8.9	0.075	<5
		2D2k	1.8	8.0	2.83	1416
		2D3k	2.1	9.0	0.065	12
		2D3k	2.4	8.9	0.078	12
		3D4	2.7	8.8	0.130	21
		3D5	3.0	8.9	0.110	20
		4D6	3.3	8.4	0.022	9
A1e	31	A1	0-0.1	6.7	0.071	10
		B21	0.3	7.2	0.026	5.7
		B21	0.6	7.7	0.050	8.1
		B22k	0.9	8.0	0.075	15
		B22k	1.2	8.1	0.095	23
		B23k	1.5	8.3	0.100	20
A2	12	A1	0-0.03	7.3	0.241	151
		B21	0.2	7.5	0.037	<5
		B22	0.3	7.5	0.033	<5
		B23	0.6	7.9	0.041	<5
		B23	0.9	8.2	0.065	<5
		B23	1.2	8.2	0.133	33
		B24	1.5	8.2	0.200	87
		B24	1.8	8.2	0.178	50
		2D1	2.1	8.3	0.108	32
		2D1	2.4	8.2	0.068	20
		3D2	2.7	8.2	0.037	14
		3D3	3.0	7.8	0.031	14
		3D3	3.3	8.1	0.271	29

Soil Unit	Site No	Horizon	Depth (m)	pH 1:5	EC1:5 (dS/m)	Cl (mg/kg)
A2	18	A1	0-0.04	6.7	0.201	35
		B21	0.3	8.1	0.116	6.0
		B22k	0.6	8.4	0.181	14
		B22k	0.9	8.5	0.209	38
		B23k	1.2	8.5	0.193	42
		B24k	1.5	8.7	0.191	43
A2	21	A1	0-0.03	6.7	0.117	23
		B21	0.3	8.0	0.124	19
		B22ky	0.6	8.1	1.610	960
		B22ky	0.9	8.0	1.409	895
		B23ky	1.2	8.8	1.164	979
		B23ky	1.5	8.9	1.239	966
A2	25	A11	0-0.1	7.0	0.139	15
		A12	0.2	7.7	0.253	261
		B21	0.4	8.2	0.802	873
		B21	0.6	8.5	1.261	1020
		B22ky	0.9	8.9	1.336	965
		B23ky	1.2	9.0	1.595	953
		B23ky	1.5	8.5	2.82	895
A3	11	A1	0-0.04	7.3	0.105	42
		B21	0.3	8.5	0.107	9
		2D1	0.6	8.7	0.067	14
		2D3	0.9	8.7	0.064	8
		2D3	1.2	8.7	0.064	11
		2D4	1.5	8.7	0.083	8
A4	16	A1	0-0.02	6.8	0.234	35
		B21	0.2	7.1	0.060	7.2
		B21	0.3	7.8	0.073	9.9
		B22k	0.6	8.7	0.176	21
		B22k	0.9	8.7	0.589	372
		B22k	1.2	8.6	0.770	471
		B23y	1.5	7.9	2.29	451

Soil Unit	Site No	Horizon	Depth (m)	pH 1:5	EC1:5 (dS/m)	Cl (mg/kg)
B1	6	A1	0-0.02	7.9	0.288	56
		B21k	0.2	8.3	0.070	<5
		B21k	0.3	8.9	0.111	<5
		B22ky	0.6	9.0	0.578	484
		B22ky	0.9	8.0	3.66	1837
		2Dy	1.2	7.8	4.35	1551
		2Dy	1.5	7.7	4.15	1576
B1	35	A1	0-0.03	8.2	0.160	56
		B21k	0.3	8.6	0.325	252
		B22ky	0.6	8.4	1.07	1205
		B23y	0.9	8.7	1.296	1349
		2D1y	1.2	8.2	2.86	858
		2D1y	1.5	9.1	0.746	755
B2	14	A1	0-0.04	7.2	0.196	93
		B21k	0.3	8.8	2.77	2491
		B22ky	0.6	9.0	2.43	2048
		B22ky	0.9	8.6	3.76	1725
		B23y	1.2	8.9	3.07	1664
		B23y	1.5	9.1	2.53	1799
B2	36	A1	0-0.02	7.2	0.084	37
		B21	0.3	8.5	0.255	241
		B22ky	0.6	8.5	0.921	1055
		2D1	0.9	8.4	0.890	1053
		2D2	1.2	8.4	0.800	967
		2D2	1.5	8.1	0.726	895
B2	38	A1	0-0.03	8.5	0.183	<5
		B21	0.2	9.2	1.271	1485
		B21	0.3	8.9	2.89	2783
		B22ky	0.6	8.5	5.84	3880
		B23y	0.9	8.5	6.11	4182
		B24y	1.2	8.6	6.24	3892
		B24y	1.5	8.9	4.38	3994

Soil Unit	Site No	Horizon	Depth (m)	pH 1:5	EC1:5 (dS/m)	Cl (mg/kg)
B2	39	FSLC	2.0	8.6	0.647	151
		LMC	4.0	8.0	2.84	194
		LMC	6.0	8.2	3.72	142
		LMC	8.0	8.5	4.51	777
		MHC	10.0	8.4	5.54	899
		MHC	12.0	7.9	4.99	556
		HC	14.0	8.7	1.717	537
B2g	5	A1	0-0.03	7.7	0.148	31
		B21	0.3	8.9	0.393	277
		B22	0.6	8.3	2.075	2195
		B23ky	0.9	8.0	2.61	1675
		B23ky	1.2	8.1	1.719	1656
		2Dk	1.5	8.2	1.965	1399
B3	4	A1	0-0.04	6.8	0.041	<5
		B21	0.2	6.5	0.164	146
		B21	0.3	6.7	0.309	355
		B22	0.6	8.2	0.294	303
		B23k	0.9	8.8	0.413	351
		B23k	1.2	8.9	0.471	391
B3	13	A1	0-0.08	7.2	0.057	34
		B21	0.3	8.3	1.852	2352
		B22y	0.6	8.2	2.56	2211
		B22y	0.9	9.1	2.55	2664
		B22y	1.2	8.8	2.92	2436
		B23y	1.5	8.4	4.63	2281
B3	20	A12	0.01-0.08	8.3	0.731	914
		B21k	0.2	8.8	2.33	2857
		B21k	0.3	8.9	5.89	2595
		B22yk	0.6	8.8	7.6	2505
		B22yk	0.9	8.7	6.84	1643
		B23yk	1.2	8.6	6.27	1362
		B23yk	1.5	9.3	2.85	1203

Soil Unit	Site No	Horizon	Depth (m)	pH $_{1:5}$	$EC_{1:5}$ (dS/m)	Cl (mg/kg)
B3	34	A11	0-0.1	6.1	0.161	29
		A12	0.2	6.6	0.055	14
		B21	0.3	7.2	0.079	15
		B21	0.6	8.8	0.833	999
		B22	0.9	8.7	1.647	1757
		B22	1.2	8.8	1.401	1534
		B23y	1.5	8.8	0.095	13
C1	26	A1	0-0.07	8.1	0.130	<5
		B21	0.2	7.7	1.536	<5
		B22	0.3	7.7	2.40	14
		B23y	0.6	7.8	2.99	187
		B23y	0.9	7.8	3.85	597
		B23y	1.2	7.9	4.38	964
		B3y	1.5	8.0	4.32	1064
C2	27	A1	0-0.04	8.8	0.100	6.5
		B21	0.2	9.2	0.395	371
		B21	0.3	9.0	0.912	908
		B22ky	0.6	8.4	2.60	1035
		B22ky	0.9	8.3	3.38	1068
		B22ky	1.2	9.2	0.945	798
		B3k	1.5	8.9	1.516	1627

Appendix 6:
Mean Soil Unit Salinity Data

Appendix 6 Mean soil unit salinity data

Calculation of EC_{Cl}, and EC_e values

Assessment of soil salinity characteristics within the 15 Mile project area uses Soluble Chloride ($Cl_{1:5}$ mg/kg) measurements rather than $EC_{1:5}$ (dS/m) data because of the presence of crystalline gypsum throughout many of the soil profiles. Naturally occurring crystalline gypsum causes artificially elevated $EC_{1:5}$ readings following standard 1:5 laboratory dilutions, and such data is often difficult to interpret. Soluble $Cl_{1:5}$ measurements are not affected in this way and provide a more consistent and reliable assessment of soil salinity. To ensure the salinity dataset across the entire project area is both consistent and comparable, Soluble $Cl_{1:5}$ data has been converted firstly to EC_{Cl} and then to EC_e using the following equations and conversion factors:

1. $\%Cl_{1:5} = Cl_{1:5}$ (mg/kg) x 10^{-4}
2. EC_{Cl} (dS/m) = 6.64 x $\%Cl_{1:5}$ (per weight of soil)
3. EC_e (dS/m) = EC_{Cl} (dS/m) x multiplier factor

The multiplier factor used in the conversion of EC_{Cl} to EC_e in Equation 3 is necessary to account for differences in the moisture holding properties of soils, and uses soil texture and estimated clay % in its approximation. Multiplier factors used in the calculations are presented in the table below (Hazelton & Murphy 2016).

Soil texture	Multiplier factor
Sand, loamy sand, clayey sand	23
Sandy loam, fine sandy loam, light sandy clay loam	14
Loam, fine sandy loam, silty loam, sandy clay loam	9.5
Clay loam, silty clay loam, fine sandy clay loam, sandy clay, silty clay, light clay	8.6
Light medium clay	8.6
Medium clay	7.5
Medium heavy clay, heavy clay	5.8

The mean pH, EC 1:5, soluble Cl, calculated ECe and calculated weighed profile mean (WPM) EC_e for all soil units is presented in **Table 1**.

Table 1: Mean pH, EC $_{1:5}$, soluble Cl, calculated ECe and calculated WPM ECe for all soil units

Soil Unit	Depth (m)	Mean $pH_{1:5}$	$pH_{1:5}$ range	Mean $EC_{1:5}$	$EC_{1:5}$ range	Mean Cl (mg/kg)	Cl range (mg/kg)	Calc. EC_{Cl} (dS/m)	Calc. ECe (dS/m)
A1	0.1	7.17	6.4-8.2	0.10	0.05-0.20	24	5-71	0.02	0.15
	0.2	7.16	6.9-7.5	0.04	0.03-0.05	6	5-6	0.00	0.04
	0.3	7.59	7.2-8.2	0.04	0.03-0.07	9	5-33	0.01	0.05
	0.6	7.97	7.3-8.7	0.05	0.03-0.11	8	5-18	0.01	0.06
	0.9	8.28	7.8-8.8	0.05	0.02-0.13	9	5-27	0.01	0.09
	1.2	8.32	7.9-8.8	0.13	0.02-0.50	12	5-21	0.01	0.14
	1.5	8.40	8.1-8.9	0.24	0.03-1.29	19	5-61	0.01	0.24
								ECe (WPM) to 1.2 m:	**0.09**
A1e	0.1	6.72	-	0.07	-	10.4	-	0.01	0.07
	0.3	7.23	-	0.03	-	5.7	-	0.00	0.03
	0.6	7.73	-	0.05	-	8.1	-	0.01	0.05
	0.9	8.02	-	0.08	-	14.8	-	0.01	0.08
	1.2	8.07	-	0.10	-	23.1	-	0.02	0.13
	1.5	8.34	-	0.10	-	19.8	-	0.01	0.11
								ECe (WPM) to 1.2 m:	**0.07**
A2*	0.1	7.01	6.7-7.3	0.22	0.20-0.24	93	35-151	0.06	0.53
	0.2	7.49	-	0.04	-	5	-	<0.01	0.02
	0.3	7.80	7.5-8.1	0.07	0.03-0.12	5	5-6	<0.01	0.03
	0.6	8.16	7.9-8.4	0.11	0.04-0.18	9	5-14	0.01	0.05
	0.9	8.35	8.2-8.5	0.14	0.07-0.21	22	5-38	0.01	0.12
	1.2	8.37	8.2-8.5	0.16	0.13-0.19	37	33-42	0.02	0.21
	1.5	8.47	8.2-8.7	0.20	0.19-0.20	65	43-87	0.04	0.37
							ECe (WPM) to 1.2 m for elevated terrace plains (TEP sites 12 and 18):		**0.13**
A2*	0.1	6.83	6.7-7.0	0.13	0.12-0.14	19	15-23	0.01	0.10
	0.2	7.71	-	0.25	-	261	-	0.17	1.49
	0.3	8.08	8.0-8.2	0.46	0.12-0.80	446	19-873	0.30	2.54
	0.6	8.29	8.1-8.5	1.44	1.26-1.61	990	960-1020	0.66	5.30
	0.9	8.46	8.0-8.9	1.37	1.34-1.41	930	895-965	0.62	4.99
	1.2	8.86	8.8-9.0	1.38	1.16-1.60	966	953-979	0.64	5.16
	1.5	8.71	8.5-8.9	2.03	1.24-2.82	931	895-966	0.62	4.96
							ECe (WPM) to 1.2 m for low-lying backplains (BKP sites 21 and 25):		**3.99**
A3	0.04	7.29	-	0.11	-	42	-	0.03	0.27
	0.3	8.52	-	0.11	-	9	-	0.01	0.05
	0.6	8.69	-	0.07	-	14	-	0.01	0.09
	0.9	8.71	-	0.06	-	8	-	0.01	0.13
	1.2	8.73	-	0.06	-	11	-	0.01	0.16
	1.5	8.65	-	0.08	-	8	-	0.01	0.13
								ECe (WPM) to 1.2 m:	**0.12**
A4	0.02	6.83	-	0.23	-	35	-	0.02	0.18
	0.2	7.14	-	0.06	-	7	-	0.00	0.03
	0.3	7.80	-	0.07	-	10	-	0.01	0.04
	0.6	8.71	-	0.18	-	21	-	0.01	0.08
	0.9	8.74	-	0.59	-	372	-	0.25	1.43
	1.2	8.56	-	0.77	-	471	-	0.31	1.81
	1.5	7.91	-	2.29	-	451	-	0.30	1.74
								ECe (WPM) to 1.2 m:	**0.70**

Soil Unit	Depth (m)	Mean $pH_{1:5}$	$pH_{1:5}$ range	Mean $EC_{1:5}$	$EC_{1:5}$ range	Mean Cl (mg/kg)	Cl range (mg/kg)	Calc. EC_{Cl} (dS/m)	Calc. ECe (dS/m)
B1	0.03	8.24	7.9-8.6	0.26	0.16-0.33	121	56-252	0.08	0.62
	0.2	8.31	-	0.07	-	5	-	0.00	0.03
	0.3	8.77	8.6-8.9	0.22	0.11-0.33	128	5-252	0.09	0.64
	0.6	8.69	8.4-9.0	0.82	0.58-1.07	845	484-1205	0.56	4.21
	0.9	8.36	8.0-8.7	2.48	1.30-3.66	1593	1349-1837	1.06	7.93
	1.2	7.98	7.8-8.2	3.61	2.86-4.35	1205	858-1551	0.80	6.88
	1.5	8.38	7.7-9.1	2.45	0.75-4.15	1166	755-1576	0.77	6.66
							ECe (WPM) to 1.2 m:		**4.34**
B2	0.03	7.62	7.2-8.5	0.15	0.08-0.20	45	5-93	0.03	0.26
	0.2	9.20	-	1.27	-	1485	-	0.99	8.48
	0.3	8.73	8.5-8.9	1.97	0.26-2.89	1838	241-2783	1.22	9.89
	0.6	8.65	8.5-9.0	3.06	0.92-5.84	2328	1055-3880	1.55	12.79
	0.9	8.52	8.4-8.6	3.59	0.89-6.11	2320	1053-4182	1.54	11.81
	1.2	8.59	8.4-8.9	3.37	0.80-6.24	2174	967-3892	1.44	11.26
	1.5	8.69	8.1-9.1	2.55	0.73-4.38	2229	895-3994	1.48	11.50
							ECe (WPM) to 1.2 m:		**10.40**
B2g	0.03	7.74	-	0.15	-	31	-	0.02	0.15
	0.3	8.88	-	0.39	-	277	-	0.18	1.38
	0.6	8.31	-	2.08	-	2195	-	1.46	10.93
	0.9	8.02	-	2.61	-	1675	-	1.11	8.34
	1.2	8.11	-	1.72	-	1656	-	1.10	8.25
	1.5	8.22	-	1.97	-	1399	-	0.93	6.97
							ECe (WPM) to 1.2 m:		**6.55**
B3	0.1	7.15	6.1-8.5	0.13	0.04-0.26	80	5-254	0.58	0.58
	0.2	6.53	6.5-6.6	0.11	0.06-0.16	80	14-146	0.05	0.48
	0.3	7.78	6.7-8.9	2.03	0.08-5.89	1329	15-2595	0.88	7.60
	0.6	8.52	8.2-8.8	2.82	0.29-7.60	1505	303-2505	1.00	8.08
	0.9	8.81	8.7-9.1	2.86	0.41-6.84	1604	351-2664	1.06	8.79
	1.2	8.78	8.6-8.9	2.77	0.47-6.27	1431	391-2436	0.95	7.85
	1.5	8.82	8.4-9.3	2.53	0.10-4.63	1165	13-2281	0.77	5.81
							ECe (WPM) to 1.2 m:		**6.88**
C1	0.07	8.09	-	0.13	-	5	-	0.00	0.02
	0.2	7.73	-	1.54	-	5	-	0.00	0.02
	0.3	7.72	-	2.40	-	14	-	0.01	0.07
	0.6	7.78	-	2.99	-	187	-	0.12	0.72
	0.9	7.82	-	3.85	-	597	-	0.40	2.30
	1.2	7.88	-	4.38	-	964	-	0.64	3.71
	1.5	7.97	-	4.32	-	1064	-	0.71	5.30
							ECe (WPM) to 1.2 m:		**1.39**
C2	0.04	8.8	-	0.100	-	6.5	-	0.00	0.04
	0.2	9.2	-	0.395	-	371	-	0.25	1.85
	0.3	9.0	-	0.912	-	908	-	0.60	4.52
	0.6	8.4	-	2.60	-	1035	-	0.69	5.16
	0.9	8.3	-	3.38	-	1068	-	0.71	5.32
	1.2	9.2	-	0.945	-	798	-	0.53	3.97
	1.5	8.9	-	1.516	-	1627	-	1.08	8.10
							ECe (WPM) to 1.2 m:		**4.19**

***** For Soil Unit A2, there is a material difference between subsoil EC between soils formed on elevated terrace plains (TEP) and on low-lying backplains (BKP) and they have been split on this limitation for suitability assessment.

Appendix 7:
Analytical Data and Soil Profile Descriptions for Representative (Analysed) Sites

Appendix 7 Analytical data and soil profile descriptions for representative (analysed) sites

Land Unit A1 **Representative Site 2** **Australian Soil Classification: Eutrophic Black Dermosol** **DEAEAHCDAEMOX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting; non-cracking; non-gravelly
0-0.06	A1	Brown (10YR 3/3); sandy clay loam (fine sand); massive to weak subangular blocky (5-10 mm) structure; non-gravelly; field pH 7.0
0.06-0.45	B2	Black (10YR 3/2); light medium clay (with fine sand); moderate angular blocky (5- 20 mm) structure; non-gravelly; field pH 7.5
0.45-0.60	2D1	Brown (10YR 3/3); sand (medium to coarse sand); massive structure and earthy fabric; non-gravelly; field pH 7.8
0.60-1.00	3B2	Brown (10YR 4/3); light medium clay; moderate angular blocky (5- 20 mm) structure; non-gravelly; field pH 8.2
1.00-1.20	4D2	Brown (10YR 3/3); sand (medium to coarse sand); massive structure and sandy fabric; non-gravelly; field pH 8.2
1.20-1.70	5B2	Brown (10YR 4/3); light clay; moderate angular blocky to prismatic (5- 50 mm) structure; non-gravelly; field pH 8.5

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.06	2.35	0.142	73	7	0.68	3.6	41.9	14.9

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.06	15	42	22	21	0.9
0.10-0.20	14	40	19	27	0.6
0.20-0.30	20	37	17	28	0.6
0.50-0.60	46	32	6	15	0.6
0.80-0.90	19	45	12	25	0.6
1.10-1.20	29	50	7	15	0.9
1.40-1.50	7	35	24	37	0.7

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.06	7.0	0.166	71	1.6	12.6	4.7	2.10	0.12	19[#]	1	2.7	13	0.74
0.10-0.20	7.5	0.047	6.1	1.5	12.4	4.0	1.47	0.04	17	<1	3.1	12	0.82
0.20-0.30	7.7	0.034	6.2	1.6	13.5	4.0	1.18	0.05	17	<1	3.4	12	0.82
0.50-0.60	7.7	0.026	9.6	0.9	7.3	2.2	0.60	0.01	9	<1	3.3	6	0.91
0.80-0.90	8.1	0.032	8.1	1.4	13.1	4.0	0.64	0.05	15	<1	3.3	11	0.74
1.10-1.20	8.1	0.032	8.4	1.2	11.0	3.1	0.30	0.05	13	<1	3.5	7	0.76
1.40-1.50	8.3	0.044	18	2.8	19.7	6.3	0.53	0.16	25	1	3.1	16	0.60

[#] ECEC values measured instead of CEC where $pH_{1:5}$ is <7.3

Land Unit A1 | **Representative Site 24** | **Australian Soil Classification: Eutrophic Brown Dermosol** | **DEABAHCDBELMX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting; non-cracking; non-gravelly
0-0.20	A1	Black (10YR 3/2); sandy loam (medium sand); massive to weak subangular blocky (5-10 mm) structure; non-gravelly; few very fine roots; field pH 6.5
0.20-0.65	B21	Brown (10YR 3/3); sandy clay loam to clay loam sandy (medium sand); weak to moderate angular blocky (10- 20 mm) structure; non-gravelly; common very fine roots; field pH 6.8-7.5
0.65-1.05	B22	Brown (10YR 4/3); clay loam sandy (medium sand); weak to moderate angular blocky (5-10 mm) structure; non-gravelly; common very fine roots; field pH 7.8
1.05-1.60 1.60-4.50	2D1 2D2-4D6	Buried alluvial layer; brown (10YR 4/4); loamy sand (medium to coarse); non-gravelly Buried river sand deposits; brown or greyish (10YR 4/3, 4/4, 6/4); loose sand (medium to coarse), with thin sandy clay loam interbeds; gravel beds and clay lenses not encountered; field pH 8.5-9.0

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.10	1.06	0.055	39	2	0.33	0.9	14.9	11.2

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.10	39	47	6	9	0.7
0.10-0.20	39	45	6	12	0.5
0.20-0.30	38	41	7	16	0.6
0.50-0.60	33	45	7	18	0.5
0.80-0.90	35	44	7	16	0.6
1.10-1.20	53	31	4	13	0.5
1.40-1.50	59	25	3	10	0.5

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.10	7.1	0.058	<5	0.6	3.2	1.05	1.14	0.01	6	<1	3.1	4	0.81
0.10-0.20	6.9	0.032	<5	0.5	4.2	1.3	0.65	0.06	6#	1	3.4	5	0.89
0.20-0.30	7.2	0.027	<5	0.8	6.3	1.8	0.755	0.08	9#	1	3.5	6	0.86
0.50-0.60	7.5	0.027	<5	1.0	7.4	2.1	0.49	0.04	9	<1	3.5	7	0.86
0.80-0.90	7.8	0.035	<5	0.8	7.4	1.89	0.36	0.02	9	<1	3.9	7	0.87
1.10-1.20	8.6	0.083	<5	0.6	6.0	1.37	0.55	0.02	7	<1	4.4	5	0.91
1.40-1.50	8.9	0.075	<5	0.6	5.1	1.11	0.24	0.04	5	1	4.6	4	0.99

ECEC values measured instead of CEC where $pH_{1:5}$ is <7.3

Land Unit A2 | **Representative Site 12** | **Australian Soil Classification: Epipedal Black Vertosol** | **VEAEGSCDEQRX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting to firm pedal; cracking; non-gravelly
0-0.03	A1	Grey (10YR 4/2); light medium clay; weak to moderate subangular blocky to platy (2-10 mm) structure; non-gravelly; few very fine roots; field pH 7.5
0.03-0.20	B21	Grey (10YR 4/1); medium clay; strong angular blocky (5- 50 mm) structure; non- gravelly; few very fine roots; field pH 7.5
0.20-0.50	B22	Black (10YR 3/1); medium heavy clay; moderate to strong lenticular (5-50 mm) structure; non-gravelly; few fine roots; field pH 7.5
0.50-1.30	B23	Black (10YR 3/2); medium clay; moderate to strong angular blocky (5-20 mm) structure; non-gravelly; common very fine roots; field pH 8.0-8.8
1.30-1.90	B24	Black (10YR 3/1); light medium clay; moderate to strong lenticular (2-20 mm) structure; non-gravelly; few very fine roots; field pH 8.8
1.90-2.40 2.40-3.50	2D1 3D2-4D4	Brown (10YR 3/3); sandy clay loam (fine sand); massive; non-gravelly Buried river sand deposits; brown or grey (10YR 4/3, 6/4, 7/4); loose sand (medium to coarse); with gravel beds; clay lenses not encountered; field pH 7.8-8.2

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.03	2.01	0.161	118	11	1.50	1.9	91.6	14.4

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.03	2	19	41	39	0.8
0.10-0.20	1	13	37	49	0.6
0.20-0.30	2	13	37	48	0.6
0.50-0.60	2	24	30	44	0.7
0.80-0.90	2	21	34	43	0.7
1.10-1.20	2	21	37	43	0.7
1.40-1.50	3	12	39	45	0.7

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.03	7.3	0.241	151	3.1	18.3	8.4	2.91	0.25	30[#]	1	2.2	21	0.64
0.10-0.20	7.5	0.037	<5	3.8	23.4	7.0	1.24	0.06	31	<1	3.3	23	0.57
0.20-0.30	7.5	0.033	<5	3.6	23.6	6.7	1.08	0.06	31	<1	3.5	22	0.54
0.50-0.60	7.9	0.041	<5	3.6	20.9	7.3	0.79	0.11	29	<1	2.9	20	0.52
0.80-0.90	8.2	0.065	<5	3.4	23.4	8.2	0.70	0.05	29	<1	2.9	20	0.53
1.10-1.20	8.2	0.133	33	2.4	23.9	8.9	0.57	0.29	30	1	2.7	20	0.53
1.40-1.50	8.2	0.200	87	2.5	23.3	9.1	0.57	0.53	31	2	2.6	22	0.55

[#] ECEC values measured instead of CEC where $pH_{1:5}$ is <7.3

Land Unit A2 | **Representative Site 25** | **Australian Soil Classification: Calcic Black Dermosol** | **DEAEBDEOBEMOX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting to firm pedal; non-cracking; non-gravelly
0-0.10	A11	Brown (10YR 3/3); clay loam sandy (fine sand); moderate subangular blocky (5- 20 mm) structure; non-gravelly; common very fine roots; field pH 6.2
0.10-0.27	A12	Black (10YR 3/2); heavy clay loam sandy (fine sand); moderate subangular blocky (5- 10 mm) structure; non-gravelly; common very fine roots; field pH 7.0-7.5
0.27-0.65	B21	Black (10YR 3/2); light medium clay (with fine sand); strong angular blocky (5- 10 mm) structure; non-gravelly; few fine roots; field pH 8.2
0.65-1.05	B22ky	Black (10YR 3/1); light medium clay; moderate to strong angular blocky to prismatic (10-50 mm) structure; <2% <2 mm calcareous soft segregations and 2-10% <2 mm gypsum crystals; few fine roots; field pH 9.0
1.05->1.50	B23ky	Black (10YR 3/1); light medium clay; strong angular blocky (10-20 mm) structure; 10-20% 2-6 mm calcareous soft segregations and 2-10% <2 mm gypsum crystals; few very fine roots; field pH 8.8

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.10	1.98	0.127	102	11	1.03	2.0	40.1	22.4

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.10	2	53	26	21	1.0
0.10-0.20	2	53	21	26	0.8
0.30-0.40	2	45	18	37	0.0
0.50-0.60	4	35	19	43	0.6
0.80-0.90	6	27	20	48	0.5
1.10-1.20	4	33	17	47	0.5
1.40-1.50	4	32	19	47	0.6

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.10	7.0	0.139	15	1.8	13.7	5.6	1.38	0.25	21#	1	2.4	14	0.65
0.10-0.20	7.7	0.253	261	2.4	15.1	6.1	0.82	1.08	21	5	2.5	14	0.63
0.30-0.40	8.2	0.802	873	2.6	12.5	7.0	0.60	4.4	23	19	1.8	18	0.80
0.50-0.60	8.5	1.261	1020	3.4	13.5	9.1	0.67	5.8	25	23	1.5	20	0.89
0.80-0.90	8.9	1.336	965	3.5	12.2	9.9	0.91	7.4	25	30	1.2	22	0.96
1.10-1.20	9.0	1.595	953	3.3	12.1	10.8	0.87	8.9	25	36	1.1	22	0.94
1.40-1.50	8.5	2.82	895	3.4	12.1	11.6	0.88	9.9	26	38	1.0	23	0.98

ECEC values measured instead of CEC where $pH_{1:5}$ is <7.3

Land Unit A4 | **Representative Site 16** | **Australian Soil Classification: Self-mulching Black Vertosol** | **VEAEEIGMESSX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Moderately to strongly self-mulching; cracking; non-gravelly
0-0.02	A1	Black (10YR 3/2); medium heavy clay; strong granular (2-5 mm) structure; non- gravelly; few very fine roots; field pH 8.2
0.02-0.40	B21	Black (2.5Y 3/1); heavy clay; moderate to strong angular blocky to lenticular (5- 50 mm) structure; non-gravelly; few very fine roots; field pH 7.0
0.40-1.20	B22k	Black (2.5Y 3/1); heavy clay; strong lenticular (5-100 mm) structure; <2% <2 mm calcareous soft segregations; few fine roots; field pH 8.8-9.0
1.20->1.50	B23y	Black (10YR 3/2), mottled (30-70% <5-15 mm distinct brown 10YR4/4 and orange 7.5YR5/6 mottles); heavy clay; moderate to strong angular blocky to lenticular (10-20 mm) structure; 2-10% <2 mm gypsum crystals; roots absent; field pH 9.0

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.02	1.33	0.084	205	73	4.21	2.0	100.1	117.8

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.02	1	11	28	60	0.6
0.10-0.20	1	11	27	62	0.6
0.20-0.30	1	11	27	62	0.6
0.50-0.60	1	10	29	62	0.6
0.80-0.90	1	10	29	62	0.6
1.10-1.20	1	10	29	61	0.6
1.40-1.50	1	10	29	61	0.6

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.02	6.8	0.234	35	4.6	23.0	7.9	1.90	0.52	33#	2	2.9	25	0.49
0.10-0.20	7.1	0.060	7.2	5.1	24.6	9.0	1.65	0.50	36#	1	2.7	25	0.50
0.20-0.30	7.8	0.073	9.9	5.0	26.2	8.9	1.86	0.74	36	2	2.9	25	0.65
0.50-0.60	8.7	0.176	21	4.7	25.4	9.1	1.46	3.5	35	10	2.8	26	0.80
0.80-0.90	8.7	0.589	372	4.8	22.9	7.4	1.16	6.0	35	17	3.1	28	0.89
1.10-1.20	8.6	0.770	471	4.4	19.6	11.6	0.90	8.5	36	24	1.7	27	0.91
1.40-1.50	7.9	2.29	451	4.3	19.7	12.8	1.42	8.7	37	24	1.5	26	0.81

ECEC values measured instead of CEC where $pH_{1:5}$ is <7.3

Land Unit B1 | **Representative Site 6** | **Australian Soil Classification: Epipedal Grey Vertosol** | **VEADGSGBEQRX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Weakly to moderately self-mulching; cracking; non-gravelly
0-0.02	A1	Grey (10YR 4/2); light clay (with fine sand); moderate to strong granular (<2 mm) to subangular blocky (2-5 mm) structure; non-gravelly; few very fine roots; field pH 8.2
0.02-0.40	B21k	Grey (10YR 4/2); medium clay; moderate to strong angular blocky (10-50 mm) structure; <2% <2 mm calcareous nodules; few very fine roots; field pH 8.0-9.0
0.40-0.90	B22ky	Grey (10YR 4/2); medium clay; moderate lenticular (5-50 mm) structure; <2% <2 mm calcareous nodules and <2% <2 mm gypsum crystals; few very fine roots; field pH 9.0
0.90->1.50	2Dy	Brown (10YR 4/4); light medium clay (with fine sand); moderate angular blocky to polyhedral (10-20 mm) structure; 3-10% <2-6 mm gypsum crystals; roots absent; field pH 9.0

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.02	1.25	0.072	92	31	1.95	0.9	63.4	18.6

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.02	3	35	21	43	0.6
0.10-0.20	2	32	18	49	0.5
0.20-0.30	2	34	19	47	0.6
0.50-0.60	2	31	20	48	0.5
0.80-0.90	2	26	24	50	0.5
1.10-1.20	1	39	24	37	0.6
1.40-1.50	1	47	21	33	0.6

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.02	7.9	0.288	56	2.5	18.1	6.9	1.96	0.59	25	2	2.6	16	0.43
0.10-0.20	8.3	0.070	<5	3.4	19.3	7.5	0.81	0.71	26	3	2.6	17	0.46
0.20-0.30	8.9	0.111	<5	3.3	17.9	7.2	0.61	2.2	26	8	2.5	18	0.65
0.50-0.60	9.0	0.578	484	3.3	13.4	8.6	0.71	7.1	26	27	1.6	19	0.66
0.80-0.90	8.0	3.66	1837	3.6	13.0	9.7	0.71	8.8	27	33	1.3	19	0.66
1.10-1.20	7.8	4.35	1551	3.8	14.0	7.7	0.45	6.3	21	30	1.8	16	0.69
1.40-1.50	7.7	4.15	1576	3.2	12.6	7.5	0.37	5.9	20	30	1.7	15	0.74

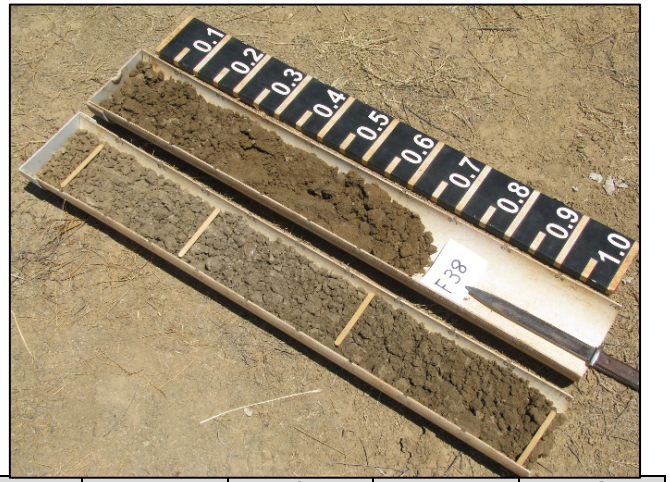
Land Unit B2 **Representative Site 38** **Australian Soil Classification: Epipedal Brown Vertosol** **VEABGSGHEQRX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting to firm pedal (occ. weak self-mulching); cracking; non-gravelly
0-0.03	A1	Brown (10YR 4/3); light clay (with fine sand); moderate to strong granular (<2 mm) to subangular blocky (5-10 mm) structure; non-gravelly; few very fine roots; field pH 8.5
0.03-0.35	B21	Brown (10YR 4/3); light medium clay (with fine sand); strong angular blocky (5- 20 mm) structure; non-gravelly; few very fine roots; field pH 9.0
0.35-0.65	B22ky	Black (10YR 3/2); light medium clay (with fine sand); strong angular blocky (2- 10 mm) structure; <2% <2 mm calcareous soft segregations and 2-10% <2 mm gypsum crystals; roots absent; field pH 9.0
0.65-1.00	B23y	Brown (10YR 3/3); medium clay (with fine sand); moderate to strong angular blocky (10-20 mm) structure; 10-20% 2-6 mm gypsum crystals; roots absent; field pH 9.0
1.00->1.50	B24y	Brown (10YR 4/4); medium heavy clay (with fine sand); moderate to strong angular blocky to polyhedral (10-20 mm) structure; 2-10% 2-6 mm gypsum crystals; roots absent; field pH 9.0

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.03	0.94	0.072	38	5	1.36	0.6	16.8	11.5



Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.03	7	48	18	28	0.6
0.10-0.20	5	46	15	36	0.5
0.20-0.30	5	47	14	36	0.5
0.50-0.60	5	37	15	45	0.5
0.80-0.90	4	26	18	53	0.5
1.10-1.20	3	22	19	58	0.5
1.40-1.50	2	21	18	61	0.5

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.03	8.5	0.183	<5	1.7	13.1	3.8	1.13	0.997	17	6	3.5	14	0.73
0.10-0.20	9.2	1.271	1485	2.5	12.1	3.4	0.47	6.8	19	36	3.6	15	0.82
0.20-0.30	8.9	2.89	2783	2.6	9.5	3.1	0.78	11.9	19	63	3.0	15	0.98
0.50-0.60	8.5	5.84	3880	3.5	10.9	4.8	1.08	15.5	23	67	2.3	19	0.96
0.80-0.90	8.5	6.11	4182	4.4	8.5	6.1	0.61	19.4	26	75	1.4	23	0.99
1.10-1.20	8.6	6.24	3892	4.8	10.2	6.9	0.69	21.2	28	76	1.5	25	0.99
1.40-1.50	8.9	4.38	3994	4.3	6.6	7.3	1.01	22.4	31	72	0.9	26	0.99

Land Unit B3 | **Representative Site 20** | **Australian Soil Classification: Calcic Black Dermosol** | **DEAEBDEOAEMOX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Hardsetting with surface crust and sandy veneer; non-cracking; non-gravelly
0-0.01	A11	Brown (10YR 5/3); sandy clay loam (fine sand); strong platy (5-10 mm) structure; non-gravelly; roots absent; field pH 8.8
0.01-0.08	A12	Grey (10YR 4/3); light clay (with fine sand); strong angular blocky (5- 10 mm) structure; non-gravelly; roots absent; field pH 8.8
0.08-0.40	B21k	Black (10YR 3/2); light medium clay; strong angular blocky (5-20 mm) structure; 2- 10% <2 mm calcareous nodules; roots absent; field pH 8.8-9.0
0.40-1.00	B22ky	Brown (10YR 3/3); medium heavy clay; strong angular blocky (5-20 mm) structure; 2- 10% <2 mm calcareous nodules and 10-20% <2 mm gypsum crystals; roots absent; field pH 9.5
1.00->1.50	B23ky	Brown (7.5YR 4/3), mottled (2-10% <5 mm faint brown mottles); medium heavy clay; weak to moderate angular blocky to lenticular (10-50 mm) structure; 2-10% <2 mm calcareous nodules and 10-20% 2-6 mm gypsum crystals; roots absent; field pH 9.5

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0.01-0.08	0.44	0.050	29	11	1.10	1.0	18.2	22.0

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0.01-0.08	5	44	20	33	0.6
0.10-0.20	3	40	20	39	0.5
0.20-0.30	4	39	18	41	0.5
0.50-0.60	4	35	19	43	0.4
0.80-0.90	4	29	15	53	0.4
1.10-1.20	4	24	23	50	0.5
1.40-1.50	4	23	17	57	0.5

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0.01-0.08	8.3	0.731	914	2.3	11.3	4.5	0.77	4.5	19	24	2.5	14	0.72
0.10-0.20	8.8	2.33	2857	2.3	10.5	5.5	0.45	8.3	20	42	1.9	15	0.66
0.20-0.30	8.9	5.89	2595	2.2	10.7	4.5	0.85	14.9	20	75	2.4	16	0.52
0.50-0.60	8.8	7.6	2505	3.5	9.0	3.4	0.56	20.0	18	111	2.7	21	0.99
0.80-0.90	8.7	6.84	1643	3.7	9.7	4.2	0.62	19.7	21	94	2.3	22	0.99
1.10-1.20	8.6	6.27	1362	4.6	10.7	4.2	0.63	22.3	25	89	2.6	24	0.99
1.40-1.50	9.3	2.85	1203	3.6	4.6	4.4	0.68	24.6	27	91	1.0	25	0.99

Land Unit C1 **Representative Site 26** **Australian Soil Classification: Self-mulching Red Vertosol** **VEAAEIBZERSX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Strongly self-mulching; cracking; <2% 2-10 mm quartz gravels
0-0.07	A1	Brown (7.5YR 3/4); medium clay; strong granular (<2 mm) structure; non-gravelly; few very fine roots; field pH 8.8
0.07-0.20	B21	Brown (7.5YR 3/4); medium clay; strong angular blocky to lenticular (5- 10 mm) structure; non- gravelly; few very fine roots; field pH 8.8
0.20-0.50	B22	Red (5YR 3/3); medium heavy clay; strong lenticular (2-20 mm) structure; non-gravelly; few very fine roots; field pH 8.8
0.50-1.30	B23y	Red (5YR 3/3); heavy clay; strong lenticular (5-100 mm) structure; <2% <2 mm calcareous soft segregations and 2-10% 2-6 mm gypsum crystals; few very fine roots; field pH 8.8
1.30->1.50	B3y	Red (5YR 5/6), mottled (2-10% 5-15 mm distinct yellow substrate mottles); medium clay (with fine sand); moderate lenticular (10-100 mm) structure; 10-20% 2- 6 mm mudstone gravels, <2% <2 mm calcareous soft segregations and 20-50% 2- 6 mm gypsum crystals; roots absent; field pH 8.8

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.07	1.05	0.060	19	8	1.81	0.4	11.4	6.3

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.07	7	20	18	55	0.9
0.10-0.20	7	19	14	61	0.8
0.20-0.30	6	18	14	63	0.8
0.50-0.60	6	17	44	34	1.4
0.80-0.90	5	17	57	23	2.0
1.10-1.20	4	16	57	25	1.8
1.40-1.50	6	17	66	12	3.2

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.07	8.1	0.130	<5	4.4	45.5	2.6	1.08	0.054	48	<1	17.7	28	0.38
0.10-0.20	7.7	1.536	<5	5.1	49.6	1.6	0.48	0.245	49	1	31.0	25	0.18
0.20-0.30	7.7	2.40	14	6.7	53.1	2.1	0.37	0.842	49	2	25.8	25	0.15
0.50-0.60	7.8	2.99	187	7.0	47.0	4.0	0.43	4.55	47	10	11.8	27	0.21
0.80-0.90	7.8	3.85	597	7.1	41.7	4.9	0.66	10.1	47	21	8.5	28	0.34
1.10-1.20	7.9	4.38	964	7.0	37.9	4.9	1.13	12.7	46	28	7.7	29	0.49
1.40-1.50	8.0	4.32	1064	7.2	35.2	4.2	0.65	12.1	38	32	8.4	27	0.56

Land Unit C2 **Representative Site 27** **Australian Soil Classification: Self-mulching Brown Vertosol** **VEABEIGOFQRX**

Soil Profile Description

Depth m	Horizon	Description
Surface	-	Epipedal and/or moderately to strongly self-mulching (variable); cracking; 2-20% 20-60 mm quartz gravels
0-0.04	A1	Brown (7.5YR 4/3); light clay (with fine sand); moderate to strong granular (<2 mm) to subangular blocky (2-5 mm) structure; non-gravelly; few very fine roots; field pH 7.5
0.04-0.45	B21	Brown (10YR 3/3-4/3); medium clay (with fine sand); strong angular blocky (5- 20 mm) structure; non-gravelly; few very fine roots; field pH 7.5
0.45-1.20	B22ky	Brown (10YR 4/6); medium clay (with fine sand); weak to moderate angular blocky to lenticular (10-50 mm) structure; 2-10% <2 mm calcareous nodules and 10-20% <2 mm gypsum crystals; roots absent; field pH 7.5
1.20->1.50	B3k	Brown (7.5YR 4/6); medium heavy clay (with fine sand); strong lenticular (2- 200 mm) structure; 2-10% <2 mm calcareous nodules and 2-10% manganiferous nodules; roots absent; field pH 8.8

Analytical Data

Depth m	OC %	Total N %	Available P Bicarb mg/kg	Sulfate S mg/kg	Extr. Micronutrients mg/kg			
					Cu	Zn	Mn	Fe
0-0.04	0.92	0.044	21	3	0.96	0.2	7.0	4.5

Depth m	Coarse Sand %	Fine Sand %	Silt %	Clay %	CEC/clay ratio
0-0.04	36	29	7	29	0.6
0.10-0.20	31	21	12	37	0.6
0.20-0.30	32	19	11	39	0.5
0.50-0.60	27	18	12	43	0.6
0.80-0.90	28	14	11	48	0.5
1.10-1.20	50	12	8	31	0.5
1.40-1.50	18	9	11	62	0.5

Depth m	$pH_{1:5}$ H_2O	$EC_{1:5}$ H_2O dS/m	$Cl_{1:5}$ mg/kg	ADMC %	Exchangeable Cations cmol/kg				CEC cmol/kg	ESP %	Ca/Mg Ratio	15 Bar %	R1 Disp. Ratio
					Ca	Mg	K	Na					
0-0.04	8.8	0.100	6.5	1.6	19.2	1.3	0.63	0.177	16	1	14.3	9	0.62
0.10-0.20	9.2	0.395	371	1.7	21.9	2.2	0.44	3.2	24	13	9.8	15	0.72
0.20-0.30	9.0	0.912	908	1.5	18.9	2.4	0.48	4.8	21	23	8.1	16	0.80
0.50-0.60	8.4	2.60	1035	2.4	20.3	3.0	0.36	7.4	25	30	6.8	17	0.86
0.80-0.90	8.3	3.38	1068	2.9	19.6	3.3	0.34	7.9	25	32	5.9	18	0.87
1.10-1.20	9.2	0.945	798	1.4	12.0	2.4	0.28	5.4	17	32	4.9	12	0.99
1.40-1.50	8.9	1.516	1627	2.7	20.4	4.5	0.44	10.5	31	34	4.5	22	0.93

Appendix 8:
Laboratory Certificates of Analysis

Agricultural Chemistry Pty Ltd

72 Cothill Rd
Silkstone 4304

Phone: 0409 494 288
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Date Received: 2/01/2019
Date Completed: 9/2/2019

FINAL REPORT

Project:

Flinders Shire Council 15 Mile Agricultural Development Project

All results in this report relate only to the items tested. Results are expressed on an "as received basis".

Client Name: Soil Mapping & Monitoring

Contact: Jon Burgess

Sample Type: soil

Number of samples: 252

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
9	A1	**1**	A1	0-0.05m	7.2	0.126	48
10			B21	0.1m			
11			B21	0.2m			
12			B21	0.3m	7.5	0.043	<5
13			B22	0.6m	7.9	0.031	<5
14			2D1	0.9m	8.1	0.030	<5
15			2D1	1.2m	8.2	0.025	<5
16			2D2	1.5m	8.2	0.034	8.2
17		**3**	A1	0-0.05m	7.3	0.089	40
18			B21	0.1m			
19			B21	0.2m			
20			B21	0.3m	7.4	0.029	7.5
21			B22	0.6m	7.9	0.048	11
22			B22	0.9m	8.4	0.053	11
23			2D1	1.2m	7.9	0.504	11
24			2D1	1.5m	8.1	1.285	38
25		**10**	A1	0-0.05m	7.3	0.088	21
26			B21	0.1m			
27			B21	0.2m			
28			B21	0.3m	7.3	0.030	9.2
29			B22	0.6m	7.3	0.034	12
30			2D1	0.9m	7.8	0.023	11
31			2D1	1.2m	7.9	0.021	8.6
32			2D1	1.5m	8.2	0.030	11
33		**15**	A1	0-0.08m	7.3	0.096	25
34			B21	0.1m			
35			B21	0.2m			
36			B21	0.3m	7.9	0.039	8.4
37			B22	0.6m	8.3	0.055	7.4
38			2D1	0.9m	8.4	0.041	5.8
39			2D1	1.2m	8.3	0.040	7.2
40			2D1	1.5m	8.3	0.047	11
41		**17**	A1	0-0.07m	6.4	0.067	5.7
42			B21	0.1m			
43			B21	0.2m			
44			B21	0.3m	7.7	0.071	33
45			B22k	0.6m	8.7	0.110	18
46			2D1	0.9m	8.8	0.126	27
47			2D1	1.2m	8.8	0.128	21
48			2D2	1.5m	8.9	0.092	8.5
49		**19**	A1	0-0.07m	7.0	0.199	13
50			B21	0.1m			
51			B21	0.2m			
52			B21	0.3m	7.6	0.049	6.3
53			B22	0.6m	8.0	0.053	5.5
54			B23k	0.9m	8.6	0.108	9.0
55			B23k	1.2m	8.6	0.209	21
56			2Dk	1.5m	8.6	0.343	61

Not Analysed
NSR No Sample Received

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
57		**22**	A11	0-0.06m	6.7	0.046	<5
58			A12	0.1m			
59			A12	0.2m	7.2	0.022	<5
60			B2	0.3m	7.4	0.025	<5
61			2D1	0.6m	8.2	0.026	<5
62			2D1	0.9m	8.1	0.037	<5
63			2D2	1.2m	NSR		
64			2D2	1.5m	NSR		
65		**23**	A1	0.1m	8.2	0.110	<5
66			B21	0.2m			
67			B21	0.3m	8.2	0.066	<5
68			B22	0.6m	8.3	0.073	<5
69			2D1	0.9m	8.8	0.038	<5
70			2D1	1.2m	NSR		
71			2D1	1.5m	NSR		
72	**A1e**	**31**	A1	0.1m	6.7	0.071	10
73			B21	0.2m			
74			B21	0.3m	7.2	0.026	5.7
75			B21	0.6m	7.7	0.050	8.1
76			B22k	0.9m	8.0	0.075	15
77			B22k	1.2m	8.1	0.095	23
78			B23k	1.5m	8.3	0.100	20
79	**A2**	**18**	A1	0-0.04m	6.7	0.201	35
80			B21	0.1m			
81			B21	0.2m			
82			B21	0.3m	8.1	0.116	6.0
83			B22k	0.6m	8.4	0.181	14
84			B22k	0.9m	8.5	0.209	38
85			B23k	1.2m	8.5	0.193	42
86			B24k	1.5m	8.7	0.191	43
87		**21**	A1	0-0.03m	6.7	0.117	23
88			B21	0.1m			
89			B21	0.2m			
90			B21	0.3m	8.0	0.124	19
91			B22ky	0.6m	8.1	1.610	960
92			B22ky	0.9m	8.0	1.409	895
93			B23ky	1.2m	8.8	1.164	979
94			B23ky	1.5m	8.9	1.239	966
95	**A3**	**11**	A1	0-0.04m	7.3	0.105	42
96			B21	0.1m			
97			B21	0.2m			
98			B21	0.3m	8.5	0.107	9
99			2D1	0.6m	8.7	0.067	14
100			2D3	0.9m	8.7	0.064	8
101			2D3	1.2m	8.7	0.064	11
102			2D4	1.5m	8.7	0.083	8
103	**B2g**	**5**	A1	0-0.03m	7.7	0.148	31
104			B21	0.1m			
105			B21	0.2m			
106			B21	0.3m	8.9	0.393	277
107			B22	0.6m	8.3	2.075	2195
108			B23ky	0.9m	8.0	2.61	1675
109			B23ky	1.2m	8.1	1.719	1656
110			2Dk	1.5m	8.2	1.965	1399

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
111	**B1**	**35**	A1	0-0.03m	8.2	0.160	56
112			B21k	0.1m			
113			B21k	0.2m			
114			B21k	0.3m	8.6	0.325	252
115			B22ky	0.6m	8.4	1.07	1205
116			B23y	0.9m	8.7	1.296	1349
117			2D1y	1.2m	8.2	2.86	858
118			2D1y	1.5m	9.1	0.746	755
119	**B2**	**14**	A1	0-0.04m	7.2	0.196	93
120			B21k	0.1m			
121			B21k	0.2m			
122			B21k	0.3m	8.8	2.77	2491
123			B22ky	0.6m	9.0	2.43	2048
124			B22ky	0.9m	8.6	3.76	1725
125			B23y	1.2m	8.9	3.07	1664
126			B23y	1.5m	9.1	2.53	1799
127		**36**	A1	0-0.02m	7.2	0.084	37
128			B21	0.1m			
129			B21	0.2m			
130			B21	0.3m	8.5	0.255	241
131			B22ky	0.6m	8.5	0.921	1055
132			2D1	0.9m	8.4	0.890	1053
133			2D2	1.2m	8.4	0.800	967
134			2D2	1.5m	8.1	0.726	895
135	**B3**	**13**	A1	0-0.08m	7.2	0.057	34
136			B21	0.1m			
137			B21	0.2m			
138			B21	0.3m	8.3	1.852	2352
139			B22y	0.6m	8.2	2.56	2211
140			B22y	0.9m	9.1	2.55	2664
141			B22y	1.2m	8.8	2.92	2436
142			B23y	1.5m	8.4	4.63	2281
143		**4**	A1	0-0.04m	6.8	0.041	<5
144			A2j	0.04-0.08m			
145			B21	0.1-0.2m	6.5	0.164	146
146			B21	0.2-0.3m	6.7	0.309	355
147			B22	0.5-0.6m	8.2	0.294	303
148			B23k	0.8-0.9m	8.8	0.413	351
149			B23k	1.1-1.2m	8.9	0.471	391
150					NSR		
151		**34**	A11	0.1m	6.1	0.161	29
152			A12	0.2m	6.6	0.055	14
153			B21	0.3m	7.2	0.079	15
154			B21	0.6m	8.8	0.833	999
155			B22	0.9m	8.7	1.647	1757
156			B22	1.2m	8.8	1.401	1534
157			B23y	1.5m	8.8	0.095	13

Agricultural Chemistry Pty Ltd

Soil Analysis Report

Batch Number: 19/04

Date Received: 2/1/2019

Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
158	**A1**	**24**	2D2k	1.8m	8.0	2.83	1416
159			2D3k	2.1m	9.0	0.065	12
160			2D3k	2.4m	8.9	0.078	12
161			3D4	2.7m	8.8	0.130	21
162			3D5	3.0m	8.9	0.110	20
163			4D6	3.3m	8.4	0.022	9
164	**A2**	**12**	B24	1.8m	8.2	0.178	50
165			2D1	2.1m	8.3	0.108	32
166			2D1	2.4m	8.2	0.068	20
167			3D2	2.7m	8.2	0.037	14
168			3D3	3.0m	7.8	0.031	14
169			3D3	3.3m	8.1	0.271	29
170	**A1**	**7**	FSLMC	2.0m	8.2	0.458	31
171			FSLC	4.0m	8.2	0.178	14
172			gravel	6.0m	8.0	0.039	8
173			MHC	8.0m	7.7	2.19	4.2
174			MHC	10.0m	9.3	0.547	37
175			MHC	12.0m	9.3	0.513	4.7
176			MHC	14.0m	9.1	0.291	3.4
177	**B2**	**39**	FSLC	2.0m	8.6	0.647	151
178			LMC	4.0m	8.0	2.84	194
179			LMC	6.0m	8.2	3.72	142
180			LMC	8.0m	8.5	4.51	777
181			MHC	10.0m	8.4	5.54	899
182			MHC	12.0m	7.9	4.99	556
183			HC	14.0m	8.7	1.717	537

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
184	**A1 (east)**	**2**	A1	0-0.06m	7.0	0.166	71
185			B21	0.06-0.1m			
186			B21	0.1-0.2m	7.5	0.047	6.1
187			B21	0.2-0.3m	7.7	0.034	6.2
188			2D1	0.5-0.6m	7.7	0.026	9.6
189			3B2	0.8-0.9m	8.1	0.032	8.1
190			4D2	1.1-1.2m	8.3	0.044	18
191			5B2	1.4-1.5m	8.1	0.032	8.4
192	**A1 (west)**	**24**	A1	0-0.1m	7.1	0.058	<5
193			A1	0.1-0.2m	6.9	0.032	<5
194			B21	0.2-0.3m	7.2	0.027	<5
195			B21	0.5-0.6m	7.5	0.027	<5
196			B22	0.8-0.9m	7.8	0.035	<5
197			2D1	1.1-1.2m	8.6	0.083	<5
198			2D1	1.4-1.5m	8.9	0.075	<5
199	**A2 (east)**	**12**	A1	0-0.03m	7.3	0.241	151
200			B21	0.03-0.1m			
201			B21	0.1-0.2m	7.5	0.037	<5
202			B22	0.2-0.3m	7.5	0.033	<5
203			B23	0.5-0.6m	7.9	0.041	<5
204			B23	0.8-0.9m	8.2	0.065	<5
205			B23	1.1-1.2m	8.2	0.133	33
206			B24	1.4-1.5m	8.2	0.200	87
207	A2 (west)	**25**	A11	0-0.1m	7.0	0.139	15
208			A12	0.1-0.2m	7.7	0.253	261
209			A12	0.2-0.27m			
210			B21	0.3-0.4m	8.2	0.802	873
211			B21	0.5-0.6m	8.5	1.261	1020
212			B22ky	0.8-0.9m	8.9	1.336	965
213			B23ky	1.1-1.2m	9.0	1.595	953
214			B23ky	1.4-1.5m	8.5	2.82	895
215	**A4**	**16**	A1	0-0.02m	6.8	0.234	35
216			B21	0.02-0.1m			
217			B21	0.1-0.2m	7.1	0.060	7.2
218			B21	0.2-0.3m	7.8	0.073	9.9
219			B22k	0.5-0.6m	8.7	0.176	21
220			B22k	0.8-0.9m	8.7	0.589	372
221			B22k	1.1-1.2m	8.6	0.770	471
222			B23y	1.4-1.5m	7.9	2.29	451
223	**B1**	**6**	A1	0-0.02m	7.9	0.288	56
224			B21k	0.02-0.1m			
225			B21k	0.1-0.2m	8.3	0.070	<5
226			B21k	0.2-0.3m	8.9	0.111	<5
227			B22ky	0.5-0.6m	9.0	0.578	484
228			B22ky	0.8-0.9m	8.0	3.66	1837
229			2Dy	1.1-1.2m	7.8	4.35	1551
230			2Dy	1.4-1.5m	7.7	4.15	1576

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl
				m		mS/cm	mg/kg
231	**B2**	**38**	A1	0-0.03m	8.5	0.183	<5
232			B21	0.03-0.1m			
233			B21	0.1-0.2m	9.2	1.271	1485
234			B21	0.2-0.3m	8.9	2.89	2783
235			B22ky	0.5-0.6m	8.5	5.84	3880
236			B23y	0.8-0.9m	8.5	6.11	4182
237			B24y	1.1-1.2m	8.6	6.24	3892
238			B24y	1.4-1.5m	8.9	4.38	3994
239	**B3**	**4**	A1	0-0.04m	6.8	0.041	<5
240			A2j	0.04-0.08m			
241			B21	0.1-0.2m	6.5	0.164	146
242			B21	0.2-0.3m	6.7	0.309	355
243			B22	0.5-0.6m	8.2	0.294	303
244			B23k	0.8-0.9m	8.8	0.413	351
245			B23k	1.1-1.2m	8.9	0.471	391
246	**C1**	**26**	A1	0-0.07m	8.1	0.130	<5
247			B21	0.1-0.2m	7.7	1.536	<5
248			B22	0.2-0.3m	7.7	2.40	14
249			B23y	0.5-0.6m	7.8	2.99	187
250			B23y	0.8-0.9m	7.8	3.85	597
251			B23y	1.1-1.2m	7.9	4.38	964
252			B3y	1.4-1.5m	8.0	4.32	1064
253	**C2**	**27**	A1	0-0.04m	8.8	0.100	6.5
254			B21	0.04-0.1m			
255			B21	0.1-0.2m	9.2	0.395	371
256			B21	0.2-0.3m	9.0	0.912	908
257			B22ky	0.5-0.6m	8.4	2.60	1035
258			B22ky	0.8-0.9m	8.3	3.38	1068
259			B22ky	1.1-1.2m	9.2	0.945	798
260			B3k	1.4-1.5m	8.9	1.516	1627

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl	Pbic	OC	SO4-S	Ca	Mg	K	Na	CEC	ECEC	ESP
				m		mS/cm	mg/kg	mg/kg	%	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%
184	**A1 (east)**	**2**	A1	0-0.06m	7.0	0.166	71	73	2.35	7	12.6	4.7	2.10	0.12		19	1
185			B21	0.06-0.1m													
186			B21	0.1-0.2m	7.5	0.047	6.1				12.4	4.0	1.47	0.04	17		<1
187			B21	0.2-0.3m	7.7	0.034	6.2				13.5	4.0	1.18	0.05	17		<1
188			2D1	0.5-0.6m	7.7	0.026	9.6				7.3	2.2	0.60	0.01	9		<1
189			3B2	0.8-0.9m	8.1	0.032	8.1				13.1	4.0	0.64	0.05	15		<1
190			4D2	1.1-1.2m	8.1	0.032	8.4				11.0	3.1	0.30	0.05	13		<1
191			5B2	1.4-1.5m	8.3	0.044	18				19.7	6.3	0.53	0.16	25		1
192	**A1 (west)**	**24**	A1	0-0.1m	7.1	0.058	<5	39	1.06	2	3.2	1.05	1.14	0.01	6		<1
193			A1	0.1-0.2m	6.9	0.032	<5				4.2	1.3	0.65	0.06		6	1
194			B21	0.2-0.3m	7.2	0.027	<5				6.3	1.8	0.755	0.08		9	1
195			B21	0.5-0.6m	7.5	0.027	<5				7.4	2.1	0.49	0.04	9		<1
196			B22	0.8-0.9m	7.8	0.035	<5				7.4	1.89	0.36	0.02	9		<1
197			2D1	1.1-1.2m	8.6	0.083	<5				6.0	1.37	0.55	0.02	7		<1
198			2D1	1.4-1.5m	8.9	0.075	<5				5.1	1.11	0.24	0.04	5		1

Lab No	Soil Type	Site No	Horizon	Depth	Cu	Zn	Mn	Fe	Total-N	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	R1	15 Bar	ADMC
				m	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%		%	%
184	**A1 (east)**	**2**	A1	0-0.06m	0.681	3.61	41.88	14.88	0.142	15	42	22	21	0.74	13	1.6
185			B21	0.06-0.1m												
186			B21	0.1-0.2m						14	40	19	27	0.82	12	1.5
187			B21	0.2-0.3m						20	37	17	28	0.82	12	1.6
188			2D1	0.5-0.6m						46	32	6	15	0.91	6	0.9
189			3B2	0.8-0.9m						19	45	12	25	0.74	11	1.4
190			4D2	1.1-1.2m						29	50	7	15	0.76	7	1.2
191			5B2	1.4-1.5m						7	35	24	37	0.60	16	2.8
192	**A1 (west)**	**24**	A1	0-0.1m	0.327	0.862	14.94	11.23	0.055	39	47	6	9	0.81	4	0.6
193			A1	0.1-0.2m						39	45	6	12	0.89	5	0.5
194			B21	0.2-0.3m						38	41	7	16	0.86	6	0.8
195			B21	0.5-0.6m						33	45	7	18	0.86	7	1.0
196			B22	0.8-0.9m						35	44	7	16	0.87	7	0.8
197			2D1	1.1-1.2m						53	31	4	13	0.91	5	0.6
198			2D1	1.4-1.5m						59	25	3	10	0.99	4	0.6

Not Analysed

All results for particle size analysis and R1 are reported on oven dry basis (no pretreatment applied to test samples)

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl	Pbic	OC	SO4-S	Ca	Mg	K	Na	CEC	ECEC	ESP
				m		mS/cm	mg/kg	mg/kg	%	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%
199	**A2 (east)**	**12**	A1	0-0.03m	7.3	0.241	151	118	2.01	11	18.3	8.4	2.91	0.25		30	1
200			B21	0.03-0.1m													
201			B21	0.1-0.2m	7.5	0.037	<5				23.4	7.0	1.24	0.06	31		<1
202			B22	0.2-0.3m	7.5	0.033	<5				23.6	6.7	1.08	0.06	31		<1
203			B23	0.5-0.6m	7.9	0.041	<5				20.9	7.3	0.79	0.11	29		<1
204			B23	0.8-0.9m	8.2	0.065	<5				23.4	8.2	0.70	0.05	29		<1
205			B23	1.1-1.2m	8.2	0.133	33				23.9	8.9	0.57	0.29	30		1
206			B24	1.4-1.5m	8.2	0.200	87				23.3	9.1	0.57	0.53	31		2
207	A2 (west)	**25**	A11	0-0.1m	7.0	0.139	15	102	1.98	11	13.7	5.6	1.38	0.25		21	1
208			A12	0.1-0.2m	7.7	0.253	261				15.1	6.1	0.82	1.08	21		5
209			A12	0.2-0.27m													
210			B21	0.3-0.4m	8.2	0.802	873				12.5	7.0	0.60	4.4	23		19
211			B21	0.5-0.6m	8.5	1.261	1020				13.5	9.1	0.67	5.8	25		23
212			B22ky	0.8-0.9m	8.9	1.336	965				12.2	9.9	0.91	7.4	25		30
213			B23ky	1.1-1.2m	9.0	1.595	953				12.1	10.8	0.87	8.9	25		36
214			B23ky	1.4-1.5m	8.5	2.82	895				12.1	11.6	0.88	9.9	26		38

Lab No	Soil Type	Site No	Horizon	Depth	Cu	Zn	Mn	Fe	Total-N	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	R1	15 Bar	ADMC
				m	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%		%	%
199	**A2 (east)**	**12**	A1	0-0.03m	1.499	1.885	91.57	14.38	0.161	2	19	41	39	0.64	21	3.1
200			B21	0.03-0.1m												
201			B21	0.1-0.2m						1	13	37	49	0.57	23	3.8
202			B22	0.2-0.3m						2	13	37	48	0.54	22	3.6
203			B23	0.5-0.6m						2	24	30	44	0.52	20	3.6
204			B23	0.8-0.9m						2	21	34	43	0.53	20	3.4
205			B23	1.1-1.2m						2	21	37	43	0.53	20	2.4
206			B24	1.4-1.5m						3	12	39	45	0.55	22	2.5
207	A2 (west)	**25**	A11	0-0.1m	1.025	1.986	40.12	22.42	0.127	2	53	26	21	0.65	14	1.8
208			A12	0.1-0.2m						2	53	21	26	0.63	14	2.4
209			A12	0.2-0.27m												
210			B21	0.3-0.4m						2	45	18	37	0.80	18	2.6
211			B21	0.5-0.6m						4	35	19	43	0.89	20	3.4
212			B22ky	0.8-0.9m						6	27	20	48	0.96	22	3.5
213			B23ky	1.1-1.2m						4	33	17	47	0.94	22	3.3
214			B23ky	1.4-1.5m						4	32	19	47	0.98*	23	3.4

Not Analysed

All results for particle size analysis and R1 are reported on oven dry basis (no pretreatment applied to test samples)

* Partially Flocculated

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl	Pbic	OC	SO4-S	Ca	Mg	K	Na	CEC	ECEC	ESP
				m		mS/cm	mg/kg	mg/kg	%	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%
215	**A4**	**16**	A1	0-0.02m	6.8	0.234	35	205	1.33	73	23.0	7.9	1.90	0.52		33	2
216			B21	0.02-0.1m													
217			B21	0.1-0.2m	7.1	0.060	7.2				24.6	9.0	1.65	0.50		36	1
218			B21	0.2-0.3m	7.8	0.073	9.9				26.2	8.9	1.86	0.74	36		2
219			B22k	0.5-0.6m	8.7	0.176	21				25.4	9.1	1.46	3.5	35		10
220			B22k	0.8-0.9m	8.7	0.589	372				22.9	7.4	1.16	6.0	35		17
221			B22k	1.1-1.2m	8.6	0.770	471				19.6	11.6	0.90	8.5	36		24
222			B23y	1.4-1.5m	7.9	2.29	451				19.7	12.8	1.42	8.7	37		24
223	**B1**	**6**	A1	0-0.02m	7.9	0.288	56	92	1.25	31	18.1	6.9	1.96	0.59	25		2
224			B21k	0.02-0.1m													
225			B21k	0.1-0.2m	8.3	0.070	<5				19.3	7.5	0.81	0.71	26		3
226			B21k	0.2-0.3m	8.9	0.111	<5				17.9	7.2	0.61	2.2	26		8
227			B22ky	0.5-0.6m	9.0	0.578	484				13.4	8.6	0.71	7.1	26		27
228			B22ky	0.8-0.9m	8.0	3.66	1837				13.0	9.7	0.71	8.8	27		33
229			2Dy	1.1-1.2m	7.8	4.35	1551				14.0	7.7	0.45	6.3	21		30
230			2Dy	1.4-1.5m	7.7	4.15	1576				12.6	7.5	0.37	5.9	20		30

Lab No	Soil Type	Site No	Horizon	Depth	Cu	Zn	Mn	Fe	Total-N	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	R1	15 Bar	ADMC
				m	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%		%	%
215	**A4**	**16**	A1	0-0.02m	4.212	2.034	100.06	117.81	0.084	1	11	28	60	0.49	25	4.6
216			B21	0.02-0.1m												
217			B21	0.1-0.2m						1	11	27	62	0.50	25	5.1
218			B21	0.2-0.3m						1	11	27	62	0.65	25	5.0
219			B22k	0.5-0.6m						1	10	29	62	0.80	26	4.7
220			B22k	0.8-0.9m						1	10	29	62	0.89	28	4.8
221			B22k	1.1-1.2m						1	10	29	61	0.91	27	4.4
222			B23y	1.4-1.5m						1	10	29	61	0.81	26	4.3
223	**B1**	**6**	A1	0-0.02m	1.952	0.892	63.36	18.59	0.072	3	35	21	43	0.43	16	2.5
224			B21k	0.02-0.1m												
225			B21k	0.1-0.2m						2	32	18	49	0.46	17	3.4
226			B21k	0.2-0.3m						2	34	19	47	0.65	18	3.3
227			B22ky	0.5-0.6m						2	31	20	48	0.66	19	3.3
228			B22ky	0.8-0.9m						2	26	24	50	0.66*	19	3.6
229			2Dy	1.1-1.2m						1	39	24	37	0.69*	16	3.8
230			2Dy	1.4-1.5m						1	47	21	33	0.74*	15	3.2

Not Analysed

All results for particle size analysis and R1 are reported on oven dry basis (no pretreatment applied to test samples)

* Partially Flocculated

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl	Pbic	OC	SO4-S	Ca	Mg	K	Na	CEC	ECEC	ESP
				m		mS/cm	mg/kg	mg/kg	%	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%
231	**B2**	**38**	A1	0-0.03m	8.5	0.183	<5	38	0.94	5	13.1	3.8	1.13	0.997	17		6
232			B21	0.03-0.1m													
233			B21	0.1-0.2m	9.2	1.271	1485				12.1	3.4	0.47	6.8	19		36
234			B21	0.2-0.3m	8.9	2.89	2783				9.5	3.1	0.78	11.9	19		63
235			B22ky	0.5-0.6m	8.5	5.84	3880				10.9	4.8	1.08	15.5	23		67
236			B23y	0.8-0.9m	8.5	6.11	4182				8.5	6.1	0.61	19.4	26		75
237			B24y	1.1-1.2m	8.6	6.24	3892				10.2	6.9	0.69	21.2	28		76
238			B24y	1.4-1.5m	8.9	4.38	3994				6.6	7.3	1.01	22.4	31		72
239	**B3**	**20**	A12	0.01-0.08m	8.3	0.731	914	29	0.44	11	11.3	4.5	0.77	4.5	19		24
240			B21k	0.2m	8.8	2.33	2857				10.5	5.5	0.45	8.3	20		42
241			B21k	0.3m	8.9	5.89	2595				10.7	4.5	0.85	14.9	20		75
242			B22yk	0.6m	8.8	7.6	2505				9.0	3.4	0.56	20.0	18		111
243			B22yk	0.9m	8.7	6.84	1643				9.7	4.2	0.62	19.7	21		94
244			B23yk	1.2m	8.6	6.27	1362				10.7	4.2	0.63	22.3	25		89
245			B23yk	1.5m	9.3	2.85	1203				4.6	4.4	0.68	24.6	27		91

Lab No	Soil Type	Site No	Horizon	Depth	Cu	Zn	Mn	Fe	Total-N	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	R1	15 Bar	ADMC
				m	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%		%	%
231	**B2**	**38**	A1	0-0.03m	1.364	0.623	16.83	11.46	0.072	7	48	18	28	0.73	14	1.7
232			B21	0.03-0.1m												
233			B21	0.1-0.2m						5	46	15	36	0.82	15	2.5
234			B21	0.2-0.3m						5	47	14	36	0.98	15	2.6
235			B22ky	0.5-0.6m						5	37	15	45	0.96*	19	3.5
236			B23y	0.8-0.9m						4	26	18	53	0.99*	23	4.4
237			B24y	1.1-1.2m						3	22	19	58	0.99*	25	4.8
238			B24y	1.4-1.5m						2	21	18	61	0.99	26	4.3
239	**B3**	**20**	A12	0.01-0.08m	1.097	1.017	18.16	22.01	0.050	5	44	20	33	0.72	14	2.3
240			B21k	0.2m						3	40	20	39	0.66	15	2.3
241			B21k	0.3m						4	39	18	41	0.52	16	2.2
242			B22yk	0.6m						4	35	19	43	0.99*	21	3.5
243			B22yk	0.9m						4	29	15	53	0.99*	22	3.7
244			B23yk	1.2m						4	24	23	50	0.99*	24	4.6
245			B23yk	1.5m						4	23	17	57	0.99	25	3.6

Not Analysed

All results for particle size analysis and R1 are reported on oven dry basis (no pretreatment applied to test samples)

* Partially Flocculated

Agricultural Chemistry Pty Ltd

Soil Analysis Report
Batch Number: 19/04

Date Received: 2/1/2019
Date Completed: 9/2/2019

Client: Soil Mapping & Monitoring

Lab No	Soil Type	Site No	Horizon	Depth	pH	EC	Cl	Pbic	OC	SO4-S	Ca	Mg	K	Na	CEC	ECEC	ESP
				m		mS/cm	mg/kg	mg/kg	%	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	%
246	**C1**	**26**	A1	0-0.07m	8.1	0.130	<5	19	1.05	8	45.5	2.6	1.08	0.054	48		<1
247			B21	0.1-0.2m	7.7	1.536	<5				49.6	1.6	0.48	0.245	49		1
248			B22	0.2-0.3m	7.7	2.40	14				53.1	2.1	0.37	0.842	49		2
249			B23y	0.5-0.6m	7.8	2.99	187				47.0	4.0	0.43	4.55	47		10
250			B23y	0.8-0.9m	7.8	3.85	597				41.7	4.9	0.66	10.1	47		21
251			B23y	1.1-1.2m	7.9	4.38	964				37.9	4.9	1.13	12.7	46		28
252			B3y	1.4-1.5m	8.0	4.32	1064				35.2	4.2	0.65	12.1	38		32
253	**C2**	**27**	A1	0-0.04m	8.8	0.100	6.5	21	0.92	3	19.2	1.3	0.63	0.177	16		1
254			B21	0.04-0.1m													
255			B21	0.1-0.2m	9.2	0.395	371				21.9	2.2	0.44	3.2	24		13
256			B21	0.2-0.3m	9.0	0.912	908				18.9	2.4	0.48	4.8	21		23
257			B22ky	0.5-0.6m	8.4	2.60	1035				20.3	3.0	0.36	7.4	25		30
258			B22ky	0.8-0.9m	8.3	3.38	1068				19.6	3.3	0.34	7.9	25		32
259			B22ky	1.1-1.2m	9.2	0.945	798				12.0	2.4	0.28	5.4	17		32
260			B3k	1.4-1.5m	8.9	1.516	1627				20.4	4.5	0.44	10.5	31		34

Lab No	Soil Type	Site No	Horizon	Depth	Cu	Zn	Mn	Fe	Total-N	PSA-CS	PSA-FS	PSA-Silt	PSA-Clay	R1	15 Bar	ADMC
				m	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%		%	%
246	**C1**	**26**	A1	0-0.07m	1.811	0.376	11.4	6.27	0.060	7	20	18	55	0.38	28	4.4
247			B21	0.1-0.2m						7	19	14	61	0.18*	25	5.1
248			B22	0.2-0.3m						6	18	14	63	0.15*	25	6.7
249			B23y	0.5-0.6m						6	17	44	34*	0.21*	27	7.0
250			B23y	0.8-0.9m						5	17	57	23*	0.34*	28	7.1
251			B23y	1.1-1.2m						4	16	57	25*	0.49*	29	7.0
252			B3y	1.4-1.5m						6	17	66	12*	0.56*	27	7.2
253	**C2**	**27**	A1	0-0.04m	0.959	0.237	6.95	4.51	0.044	36	29	7	29	0.62	9	1.6
254			B21	0.04-0.1m												
255			B21	0.1-0.2m						31	21	12	37	0.72	15	1.7
256			B21	0.2-0.3m						32	19	11	39	0.80	16	1.5
257			B22ky	0.5-0.6m						27	18	12	43	0.86*	17	2.4
258			B22ky	0.8-0.9m						28	14	11	48	0.87*	18	2.9
259			B22ky	1.1-1.2m						50	12	8	31	0.99	12	1.4
260			B3k	1.4-1.5m						18	9	11	62	0.93	22	2.7

Not Analysed

All results for particle size analysis and R1 are reported on oven dry basis (no pretreatment applied to test samples)

* Partially Flocculated

Agricultural Chemistry Pty Ltd

METHOD I

Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit
pH	4A1	1.1	0.1	pH
EC	3A1	5.4	0.01	dS/m
Cl	5A2	10.0	5.0	mg/kg
NO3-N	7C2	6.7	0.5	mg/kg
NH4-N	7C2	7.8	0.6	mg/kg
Bicarb.P	9B2	16.8	1.0	mg/kg
TN	7A2	12.9	0.01	%
OC	8B1	9.7	0.02	%
Ca (Neut)	15A1	10.3	0.10	meq/100g
Mg (Neut)	15A1	6.6	0.10	meq/100g
Na (Neut)	15A1	7.3	0.03	meq/100g
K (Neut)	15A1	3.9	0.02	meq/100g
ECEC	15J1	5.0	1	meq/100g
ESP	15N1	5.0	3	%
Ext. K	18B1	3.5	7	mg/kg
Sand	no ref	22.1	1.0	%
Silt	no ref	16.6	1.0	%
Clay	no ref	12.7	1.0	%

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

Agricultural Chemistry Pty Ltd

METHOD I

Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit
Ca (Alc)	15C1	7.2	0.18	meq/100g
Mg (Alc)	15C1	4.7	0.31	meq/100g
Na (Alc)	15C1	9.6	0.09	meq/100g
K (Alc)	15C1	4.8	0.02	meq/100g
CEC	15I3	5.7	1.0	meq/100g
DTPA-Cu	12A1	17.1	0.26	mg/kg
DTPA-Zn	12A1	16.4	0.10	mg/kg
DTPA-Mn	12A1	9.0	0.32	mg/kg
DTPA-Fe	12A1	13.0	0.23	mg/kg
ADMC	2A1	11.9	0.4	%
R1	NA	20.2	NA	
SO4-S	10B3	11.5	0.6	mg/kg
Al	15G1	NA	NA	meq/100g
H+	15G1	NA	NA	meq/100g
15 Bar		NA	NA	
1/3 Bar		NA	NA	

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

DESCRIPTIONS

Soil

Reference: 19/04

Name	Method Description
pH	1:5 water extr, pH meter
Electrical conductivity	1:5 water extr, EC meter
Chloride	1:5 water extr, (AA) colorimetric
Nitrate-nitrogen	1:5 water extr, (AA) colorimetric
Ammonium-nitrogen	1M KCl extr, (AA) colorimetric
Bicarb.ext.phosphorus	0.5M NaHCO3 @ pH 8.5, (AA) colorimetric
Total Kjeldahl Nitrogen	Sulphuric acid digest, (AA) colorimetric
Organic Carbon	Walkley & Black, (H2SO4/K2Cr2O7), titr.
Exchangeable calcium	1M NH4Cl @ pH 7.0 shake, AAS
Exchangeable magnesium	1M NH4Cl @ pH 7.0 shake, AAS
Exchangeable sodium	1M NH4Cl @ pH 7.0 shake, AAS
Exchangeable potassium	1M NH4Cl @ pH 7.0 shake, AAS
Effective cation ex.capacity	Sum of exchangeable cations
Exchangeable Na%	(Exchangeable Na/sum of exch.cations)%
Extractable potassium	0.05M HCl shake, AAS
Particle size, sand	Hydrometer, gravimetric
Particle size, silt	Hydrometer, gravimetric
Particle size, clay	Hydrometer, gravimetric

For Manager
Analytical Services: _____

DESCRIPTIONS

Soil

Reference: 19/04

Name	Method Description
Exchangeable calcium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Exchangeable magnesium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Exchangeable sodium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Exchangeable potassium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Cation Exchange Capacity	KNO3 + Ca(NO3)2 extr, (AA) colorimetric
DTPA ext. copper	DTPA extraction, AAS
DTPA ext. zinc	DTPA extraction, AAS
DTPA ext. manganese	DTPA extraction, AAS
DTPA ext. iron	DTPA extraction, AAS
Air Dried Moisture Content	Gravimetric oven dry @ 105C
Dispersion Ratio	Ratio [Aqueous dispersible (Silt + Clay):Total (Silt + Clay)]
Sulfate sulfur	Ca(H2PO4)2 @ pH 4.0 extractable sulfate-sulfur, ICPOES
Exchangeable Aluminium	Exch. Hydrogen and Aluminium by 1M KCl
Exchangeable Acidity	Exch. Hydrogen and Aluminium by 1M KCl
15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C
15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C

For Manager
Analytical Services: _____

Agricultural Chemistry Pty Ltd

QUALITY CONTROL DATA

Soil

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

Test Method	Units		Actual Value	Acceptance Criteria [Range]
pH	pH	MB	7.9, 7.9, 7.9, 7.9, 7.9	7.5 - 8.1
EC	dS/m	MB	.369, .369, .370, .358	.320 - .380
Cl	mg/kg	MB	250, 252, 249, 249, 251	230 - 260
NO3-N	mg/kg	MB		15 - 23
NH4-N	mg/kg	MB		
Colwell P	mg/kg	1703-3	50, 51	35.5 - 55.3
BSES P	mg/kg	MB		73 - 87
Total N	%	1806-4	.172, .172, .178	.134 - .256
Total P	%	1806-4		0.02 - 0.04
Organic Carbon	%	1706-1	2.25, 2.32	1.86 - 2.72
Ca (Exch. cations)pH7	meq/100g	KAL	18.1, 17.3, 18.3	17.2 - 20.9
Mg (Exch. cations)pH7	meq/100g	KAL	11.4, 11.2, 11.3	9.6 - 11.5
Na (Exch. cations)pH7	meq/100g	KAL	1.121, 1.168, 1.19	1.01 - 1.33
K (Exch. cations)pH7	meq/100g	KAL	.484, .494, .49	.455 - .721
Exch. Acidity	meq/100g			NA
ECEC	meq/100g			NA
CEC	meq/100g	S12	58, 59, 60, 58	56 - 70
ESP	%			NA
Coarse sand	%	RD	31, 32, 32, 33, 33, 33	29 -33
Fine Sand	%	RD	31, 32, 31, 30, 32, 31	27 - 32
Silt	%	RD	11, 11, 8, 9,	8 - 15
Clay	%	RD	28, 28, 29, 29, 29, 29	21 - 30
R1		RD	.50, .50, .47, .44, .49, .53	.38 - .57

Test Method	Units	Test Soil	Actual Value	Acceptance Criteria [Range]
DTPA-Cu	mg/kg	KAL	2.1, 2.08	1.55 - 2.10
DTPA-Zn	mg/kg	KAL	.196, .197	.15 - .43
DTPA-Mn	mg/kg	KAL	89.9, 91.6	44.5 - 95.2
DTPA-Fe	mg/kg	KAL	33.3, 35.5	28.1 - 46.3
Suflate-sulfur	mg/kg	PM	65	58 - 73
ADMC	%			NA
15 Bar	%	G	29, 29, 30, 29, 31, 31	23 - 32
0.33 Bar	%	G		32 - 51
Ca (Exch. cations)pH8.5	meq/100g	S12	33.8, 34.9, 34.2, 33.5	27.7 - 37.4
Mg (Exch. cations)pH8.5	meq/100g	S12	23.7, 24.3, 24.5, 24.6	22.88 - 26.5
Na (Exch. cations)pH8.5	meq/100g	S12	1.94, 1.81	1.80 - 2.28
K (Exch. cations)pH8.5	meq/100g	S12	1.73, 1.72, 1.81	1.64 - 2.09

Appendix 9:
Calculated Attribute Data Methods and Results

Appendix 9 Calculated attribute data methods and results

Laboratory and field data have been used to estimate soil attributes used in the assessment of land suitability including:

- effective rooting depth (ERD)
- plant available water capacity (PAWC to 1.0 m and 1.5 m)
- soil erodibility (K factor).

The methods used are described below.

Assessment of Effective Rooting Depth

Effective rooting depth (ERD) is defined as the depth to which approximately 90% of plant roots will extract water. It is normally limited by the presence of underlying rock or other hard materials, or by chemical or physical constraints within the soil that restrict root growth. ERD for soil units within the 15 Mile project area was determined using analytical data from relevant representative analytical profiles (A2, A6, A12, A16, A20, A24, A25, A26, A27, A38) and the following commonly accepted criteria (Burgess 2003b):

1. $Cl_{1:5} > 800$ ppm;
2. ESP > 15%;
3. Lab pH < 5.5; and/or
4. Depth to C or R horizons (or other impenetrable hard pans or gravel layers).

Calculated PAWC

PAWC values were calculated for the ERD using SALFcalc software based on inputs from analytical data collected for soil unit representative profiles (analysed sites).

K factor assessment and method

Method

Soil erodibility and observed modal slope (%) is used to characterise the potential erosion hazard of a soil unit (or mapping unit) and this is used to determine the water erosion limitation class for land evaluation purposes (see **Section 3** of the main report). Surface soil erodibility has been estimated using calculated K factor values from the Revised Universal Soil Loss Equation (RUSLE) method of Rosewell and Loch (2002).

Rosewell and Loch (2002) suggest K factor values estimated from the soil erodibility nomograph of Wischmeier and Smith (1978), using dispersed particle size data (Bowman & Hutka 2002), are appropriate where soils are unstructured, non-vertic and have a combined silt (Si) and very fine sand (vfs) fraction less than 68%. Loch and Rosewell (1992); however, had shown previously that such an approach significantly underestimates K factor values in aggregated clay soils. In such cases, Rosewell and Loch (2002) recommend the use of non-dispersed particle size data (Method 516.01 - Rosewell 2002) in conjunction with a modified approach (Method 528.01 - Rosewell & Loch 2002) to more accurately predict values.

In situations where only dispersed particle size data is available, Loch and Rosewell (1992) report considerable improvement in the prediction of K factor values when the wet density of eroded sediment is taken into account. In such cases, these authors recommend adjustment of traditionally derived K factor values through the incorporation of wet density estimates, to better reflect expected erosive behaviour. The suggested approach calculates a modified K factor value (K_m) for aggregated clay soils, based on an assumption that eroded aggregates from the initial soil erodibility study of Wischmeier *et al*. (1971) had wet densities (d_i) close to 2.0 mg/m^3 (*pers. comm.* R Loch 2018).

Modified K factor values are calculated using the equation (Loch & Rosewell 1992):

$$K_m = K_{nomograph} (d_i - 1) / (d_s - 1)$$

where K_m is the modified K factor value, d_i is the wet density and d_s is the wet sediment density of the soil material. When the density of water is subtracted from both sediment density terms, the equation simplifies to:

$$K_m = K_{nomograph} / (d_s - 1)$$

For aggregated clay soils, wet sediment density (d_s) is calculated as:

$$d_s = 1.462 + 0.048 (1.03259^X)$$

where X is the sand percentage >0.02 mm from dispersed particle size data.

Aggregated clay soils are widespread in the Hughenden region, and the adoption of the modified K factor approach of Loch and Rosewell (1992) has ensured calculated estimates of inherent erodibility are realistic and meaningful. The method is particularly useful for soil survey situations where budgetary constraints and spatial extent limit the applicability of; complex paddock-scale field measurements or non-routine non-dispersed particle size analyses.

For the purposes of land evaluation, the K factor only characterises the inherent erodibility of the in-situ soil resource as a means of determining generic erosion hazard. Other factors such as contributing catchment area, rainfall erosivity, slope length, or soil surface management (cultivation and groundcover provision) will affect the rate of erosion. Assessment of potential erosion rates is beyond the scope of the land suitability assessment.

K factor data inputs, assumptions and decision rules

Initial nomograph based K factor calculations (prior to modification) require measures or estimates of the following:

- organic matter (OM %) in the surface soil (0-0.10 m) (Rayment & Lyons 2011)
- dispersed particle size data (PSA) in the surface soil (0-0.10 m) (Bowman & Hutka 2002)
- field estimates of surface soil structure (A1 horizon) (NCST 2009)
- field estimates of profile permeability (least permeable soil horizon) (NCST 2009)
- field estimates of profile gravel content based on modal land unit data (NCST 2009).

Profile morphology and laboratory data used in the estimation of K factor values, are presented in **Appendix 7**. All calculations and assumptions (listed below) are in accordance with the method and rationale of Rosewell and Loch (2002).

- The dispersed PSA fine sand fraction (0.02-0.2 mm) (Bowman & Hutka 2002) was partitioned into arbitrary very fine sand (vfs – 0.02-0.1 mm) and fine sand (fs – 0.1-0.2 mm) sub-fractions. K factor calculations assume 70% of the laboratory measured fine sand fraction (0.02-0.2 mm) is attributable to the very fine sand range (0.02 0.1 mm) (Rosewell & Loch 2002).
- Estimates of organic matter (OM %) were derived from laboratory measured organic carbon (OC %) data using a standard conversion ratio of 1.72 (*ie* organic C % multiplied by 1.72) (Rayment & Lyons 2011).
- A surface structure (SS) value has been assigned to all land units based on field assessments of surface structural characteristics.

- Estimation of profile permeability (PP) required conversion of the standard 4 class modal field permeability values defined by NCST (2009), to a 6 class profile permeability (PP) framework defined by Rosewell and Loch (2002). Conversion from the 4 class system to the 6 class system considered field permeability characteristics (particularly texture and sand fraction) and dispersed PSA data from the least permeable soil horizon in its determination. Final input values were adjusted or moderated using the decision rules listed in **Table 1**. Clay soils are largely unaffected by the conversion. However for Kandosols and Dermosols with a field permeability value of 3 (NCST 2009), final profile permeability class has been split between PP Class 3 and PP Class 4, depending on texture range and dominant sand fraction within the upper 1.0 m of the profile. In most cases, profiles dominated by coarse sand have been assigned to PP Class 3, while profiles dominated by fine sand have been assigned to PP Class 4. Soils with a coarse sand fraction are considered more permeable, and have been separated on this basis.
- Adjustment of final PP class for gravelly soils follows the recommendations of Rosewell and Loch (2002). Gravel has been assessed on a whole of profile basis (excluding C horizons), and considers the maximum gravel content recorded at each analysed site and adjusted based on modal soil unit estimates.

Table 1: Decision rules to convert modal field permeability values (NCST 2009) to the 6 class profile permeability (PP) categories defined by Rosewell and Loch (2002)

Field permeability class (NCST 2009)			RUSLE profile permeability (Rosewell & Loch 2002)			
Class	**Rating**	**mm/day**	**Field perm Class 3 rule**	**Class**	**Rating**	**mm/day**
-	-	-	-	PP Class 1	rapid	>3120
Class 4	high	>500	-	PP Class 2	moderate to rapid	1440-3120
Class 3	moderate	50-500	coarse sand > fine sand	PP Class 3	moderate	480-1440
			coarse sand < fine sand	PP Class 4	slow to moderate	120-480
Class 2	slow	5-50	-	PP Class 5	slow	1-5
Class 1	very slow	<5	-	PP Class 6	very slow	<1

K factor interpretation

The land suitability limitation classes for water erosion are adapted from the five class system described by Rosewell and Loch (2002). **Table 2** shows the relationship between the two class systems and different terminology used.

Table 2: Soil erodibility classes adopted for the 15 Mile project compared to those of Rosewell and Loch (2002)

Soil erodibility class (Rosewell & Loch 2002)	K factor	Soil erodibility class used for land evaluation
Very low	<0.01	Very stable soils
Low	0.01-0.02	
Moderate	0.02-0.04	Stable soils
High	0.04-0.06	Unstable soils
Very high	>0.06	Very unstable soils

A summary of laboratory derived soil attribute data is provided in **Table 4** and this data has been used in evaluating soil suitability for irrigated tree cropping (see **Sections 3** and **5** of the main report).

Table 3: Summary of laboratory derived soil attribute data

Soil Unit[1]	Depth to 800 ppm	Depth to ESP 15%	ERD depth value	Primary ERD constraint	PAWC 1.0 m	PAWC 1.5 m	EC_e WPM[1]	Salinity rating	K factor[@]	Erodibility rating
A1	-	-	>1.5 m	-	63-71 mm	100-110 mm	0.09 dS/m	Non-saline	0.040-0.043	High
A1e	-	- [#]	>1.5 m	-	63 mm [#]	100 mm [#]	0.07 dS/m	Non-saline	0.043 [#]	High
A2 TEP	>1.5 m	>1.5 m	>1.5 m	-	104 mm	133 mm	0.13 dS/m*	Non-saline	0.057 (DE)-0.071 (VE)	High Very high
A2 BKP	0.3 m	0.3 m	0.3 m	Salinity and sodicity	37 mm	37 mm	3.99 dS/m*	Slightly saline	0.057 (DE)-0.071 (VE)	High Very high
A3	-	- ^	>1.5 m	-	71 mm ^	110 mm ^	0.12 dS/m	Non-saline	0.040 ^	High
A4	-	0.8 m	0.8 m	Sodicity	117 mm	117 mm	0.70 dS/m	Non-saline	0.046	High
B1	0.4-0.7 m	0.4 m	0.4 m	Salinity and sodicity	59 mm	59 mm	4.34 dS/m	Moderately saline	0.050	High
B2	0.1 m	0.1 m	0.1 m	Salinity and sodicity	15 mm	15 mm	10.40 dS/m	Highly saline	0.070	Very high
B2g	0.4 m	0.4 m [+]	0.4 m	Salinity and sodicity	59 mm [+]	59 mm [+]	6.55 dS/m	Moderately saline	0.050 [+]	High
B3	0.1 m	0.1 m	0.1 m	Salinity and sodicity	16 mm	16 mm	6.88 dS/m	Moderately saline	0.051	High
C1	1.1 m	0.8 m	0.8 m	Sodicity	104 mm	104 mm	1.39 dS/m	Non-saline	0.037	Moderate
C2	0.2 m	0.2 m	0.2 m	Salinity and sodicity	30 mm	30 mm	4.19 dS/m	Moderately saline	0.031	Moderate

* For Soil Unit A2, there is a material difference in subsoil EC between soils formed on elevated terrace plains (TEP) and on low-lying backplains (BKP) and they have been split on this limitation for suitability assessment.

[#] ESP, PAWC and K factor estimated from data from Estimated from data from closest Soil Unit A1 representative site (24)

^ ESP, PAWC and K factor estimated from data from Soil Unit A1 representative site 2

\+ ESP, PAWC and K factor estimated from data from Soil Unit B1 representative site 6

[@] DE= Dermosol and VE= Vertosol. Rating uses Rosewell and Loch (2002) and were converted to soil stability classes .

Appendix 10:
Land Suitability Framework Review and Adopted Decision Rules

Table 1. Review of decision rules from available land suitability frameworks and comments on the rules chosen for the 15 Mile project

Attribute	Attribute definition	CODE	Citrus				Avacado				Grape				Comment about source selection
			GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	
Extreme heat	Low heat stress (<5 40°C days)	Cs1	1	1	ND	ND	1	1	ND	ND	1	1	ND	ND	GPARF, FGARA rules available for all selected crop types and applied for consistency across land uses
	Moderate heat stress (5-20 40°C days)	Cs2	3	3	ND	ND	3	3	ND	ND	3	3	ND	ND	
	Severe heat stress (>20 40°C days)	Cs3	4	4	ND	ND	4	4	ND	ND	4	4	ND	ND	
Extreme heat	Low heat stress (<5 35°C days) - Wet-season	Ch4	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Moderate heat stress (5-50 35°C days) - Wet-season	Ch5	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	ND	
	Severe heat stress (>50 35°C days) - Wet-season	Ch6	ND	ND	4	3	ND	ND	4	3	ND	ND	ND	ND	
Frost	Frost free	Cf1	1	1	1	ND	1	1	1	ND	1	1	ND	ND	No CTAP rules. GPARF, FGARA, NAWRA (Mitchell) rules consistent and can be adopted
	Occasional frost (<2 days)	Cf2	2	2	2	ND	2	2	2	ND	2	2	ND	ND	
	Regular light frosts (>=2 days)	Cf3	3	3	3	ND	3	3	3	ND	3	3	ND	ND	
Temperature	Mean min. monthly temperature <15°C for 4 months or more	Ct1	1	1	1	ND	2	2	2	ND	1	1	ND	ND	
	Mean min. monthly temperature <15°C for 3 months or less	Ct2	2	2	2	ND	1	1	1	ND	2	2	ND	ND	
Wind Erosion	No restriction: annual rainfall >= 500mm OR surface texture not sandy	A1	1	1	ND	ND	1	1	ND	ND	1	1	ND	ND	No CTAP rules. GPARF, FGARA rules consistent and can be adopted with minor wording modifications
	Annual rainfall <500mm AND surface texture class 1 (sandy)	A2	2	2	ND	ND	2	2	ND	ND	2	2	ND	ND	
	Annual rainfall <500mm AND surface texture class 1 (sandy) AND Soil Grp 8 (Sodosols)	A3	3	3	ND	ND	3	3	ND	ND	3	3	ND	ND	
PWAC to 1.0 m	PAWC >150mm*	M7	1	1	ND	ND	ND	ND	ND	ND	1	1	ND	ND	CTAP rules have inconsistent size classes acrosss PAWC (1.0 m) and PAWC (1.5 m) with rules for both depths for the slected crops making calculation and interprwetation more complex. Simple rules, with uniform class intervals available for all selected crop types in GPARF, FGARA rules and applied for consistency across land uses.
	PAWC 100 - 150mm	M8	1	1	ND	ND	ND	ND	ND	ND	1	1	ND	ND	
	PAWC 75 - 100mm	M9	2	2	ND	ND	ND	ND	ND	ND	2	2	ND	ND	
	PAWC 60 - 75mm	M10	2	2	ND	ND	ND	ND	ND	ND	2	2	ND	ND	
	PAWC 40- 60 mm	M11	3	3	ND	ND	ND	ND	ND	ND	3	3	ND	ND	
	PAWC <40mm	M12	4	4	ND	ND	ND	ND	ND	ND	4	4	ND	ND	
PWAC to 1.5 m	PAWC >150mm*	M1	ND	ND	ND	ND	1	1	ND	ND	ND	ND	ND	ND	
	PAWC 100 - 150mm	M2	ND	ND	ND	ND	1	1	ND	ND	ND	ND	ND	ND	
	PAWC 75 - 100mm	M3	ND	ND	ND	ND	1	1	ND	ND	ND	ND	ND	ND	
	PAWC 60 - 75mm	M4	ND	ND	ND	ND	2	2	ND	ND	ND	ND	ND	ND	
	PAWC 40- 60 mm	M5	ND	ND	ND	ND	3	3	ND	ND	ND	ND	ND	ND	
	PAWC <40mm	M6	ND	ND	ND	ND	4	4	ND	ND	ND	ND	ND	ND	
PWAC to 1.0 m	PAWC 125 - 150mm	M4-1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 100 - 125mm	M4-2	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 75 - 100mm	M4-3	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 50 - 75mm	M4-4	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 30 - 50mm	M4-5	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	PAWC 20 - 30mm	M4-6	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	PAWC <20mm	M4-7	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
PWAC to 1.5 m	PAWC >150mm	M5-1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 125 - 150mm	M5-2	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 100 - 125mm	M5-3	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 75 - 100mm	M5-4	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 50 - 75mm	M5-5	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	PAWC 30 - 50mm	M5-6	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
PWAC to 1.5 m	PAWC >150mm	M1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	PAWC 125 - 150mm	M2	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	PAWC 100 - 125mm	M3	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	PAWC 75 - 100mm	M4	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	PAWC 50 - 75mm	M5	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	PAWC 30 - 50mm	M6	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	
	PAWC <30mm	M7	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	ND	
Soil pH	pH 5.5-7.0	Nr1	1	1	1	ND	1	1	1	ND	1	1	ND	ND	CTAP rules more detailed to account for pH trends and adopted
	pH 7.0-8.5	Nr2	1	1	2	ND	1	1	1	ND	1	1	ND	ND	
	pH <5.5	Nr3	2	2	2	ND	2	2	2	ND	2	2	ND	ND	
	pH>8.5	Nr4	3	3	3	ND	3	3	3	ND	3	3	ND	ND	
pH (0.0-0.6m) (Nr1)	pH 5.5-7.0	Nr1-1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	pH 7.0-8.5	Nr1-2	ND	ND	ND	2	ND	ND	ND	1	ND	ND	ND	ND	
	pH <5.5	Nr1-3	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	pH>8.5	Nr1-4	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
pH (0.6-1.2m) (Nr2)	pH 5.5-7.0	Nr2-1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	pH 7.0-8.5	Nr2-2	ND	ND	ND	2	ND	ND	ND	1	ND	ND	ND	ND	
	pH <5.5	Nr2-3	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	pH>8.5	Nr2-4	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
Physical restrictions	No restriction: surface condition loose	Ps1	1	1	ND	ND	1	1	ND	ND	1	1	ND	ND	Inconsistency across differenrt rule sets. After clarification of classes with DNRME, CTAP rules (with wording clarified) adoopted.
	Surface condition firm/hardsetting, light texture: sands and loams	Ps2	2	2	ND	ND	2	2	ND	ND	2	2	ND	ND	
	Surface condition firm/hardsetting, heavy texture of clay	Ps3	2	2	ND	ND	3	3	ND	ND	2	2	ND	ND	
	Cracking clay soils - fine structure	Ps4	3	3	ND	ND	3	3	ND	ND	3	3	ND	ND	
	Cracking clay soils - coarse structure	Ps5	3	3	ND	ND	3	3	ND	ND	3	3	ND	ND	
	ESP>6 or surface condition firm/hardsetting and silty surface texture	Ps6	3	3	ND	ND	3	3	ND	ND	3	3	ND	ND	
	Depth of A horizon <=0.2m AND Generic soil group - "Sand or Loam over intractable clay subsoils"	Ps7	3	3	ND	ND	4	4	ND	ND	3	3	ND	ND	
Physical restrictions	No restriction: surface condition class 2	Ps1	ND	ND	ND	1	ND	ND	ND	1	ND	1	ND	ND	
	Firm/hardsetting - light texture sandy to sandy loam (S to SL)	Ps2	ND	ND	ND	1	ND	ND	ND	2	ND	ND	ND	ND	
	Firm/hardsetting - heavy texture: Clay loamy (SCL to CL)	Ps3	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	Cracking clay soils - fine structure: surface condition 1; soil structure 3	Ps4	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Cracking clay soils - coarse structure: surface condition 1; soil structure 4	Ps5	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Hardsetting - silty surface (ZL-ZCL) >0.1 m	Ps6	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Strongly sodic, intractable clay B horizon <0.3 m	Ps7	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Physical restrictions	Surface condition loose or soft (sandy or loamy surface texture)	Ps1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Surface condition firm/hard setting or crusting and sandy or loamy surface texture	Ps2	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Surface texture silty	Ps3	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Clayey surface texture and single grain surface structure	Ps4	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Clayey surface texture and fine surface structure	Ps5	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Clayey surface texture and cloddy (massive) surface structure	Ps6	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	
	Clayey surface texture and coarse surface structure	Ps7	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	
Physical restrictions	Sandy or loamy surface texture	Pa1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Clayey or silty surface texture and non-cracking surface condition	Pa2	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	clayey surface texture and self mulching surface condition	Pa3	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	ND	
	Clayey surface texture and ONLY cracking surface condition	Pa4	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	ND	
	Soils with sodic subsoils and A horizon thickness < 20 cm	Pa5	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	ND	

Attribute	Attribute definition	CODE	Citrus				Avacado				Grape				Comment about source selection
			GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	
Soil depth	Very deep (>1.5m)	Pd1	1	1	1	1	1	1	1	1	1	1	ND	ND	CTAP rules dopted for Avocardo as thi seems to be the most recent view. Citrus and grapes rules consistent across GPARF, FGARA, NAWRA (Mitchell) and adopted.
	Deep (1.0 - 1.5m)	Pd2	1	1	1	1	2	2	2	2	1	1	ND	ND	
	Moderate (0.5 - 1.0m)	Pd3	2	2	2	2	4	4	4	4	3	3	ND	ND	
	Shallow (0.25 - 0.5m)	Pd4	4	4	4	4	4	4	5	5	4	4	ND	ND	
	Very shallow (<0.25m)	Pd5	5	5	5	5	5	5	5	5	5	5	ND	ND	
Low erodibility (K factor <0.02)	slope <0.5%	E1	ND	ND	1	1	ND	ND	1	1	ND	ND	ND	ND	Inconsistency across differenrt rule sets. CTAP rules are the most recent State based rules nad have been adopted.
	slope 0.5-1.0%	E2	ND	ND	1	1	ND	ND	1	1	ND	ND	ND	ND	
	slope 1-2%	E3	ND	ND	2	1	ND	ND	2	1	ND	ND	ND	ND	
	slope 2-3%	E4	ND	ND	2	2	ND	ND	2	2	ND	ND	ND	ND	
	slope 3-5%	E5	ND	ND	3	2	ND	ND	3	2	ND	ND	ND	ND	
	slope 5-8%	E6	ND	ND	3	3	ND	ND	3	3	ND	ND	ND	ND	
	slope 8-12%	E7	ND	ND	4	3	ND	ND	4	3	ND	ND	ND	ND	
	slope 12-15%	E8	ND	ND	4	4	ND	ND	4	4	ND	ND	ND	ND	
	slope 15-20%	E9	ND	ND	5	4	ND	ND	5	4	ND	ND	ND	ND	
	slope >20%	E10	ND	ND	5	5	ND	ND	5	5	ND	ND	ND	ND	
Stable Soils (K factor 0.02 - 0.04)	slope <0.5%	E11	1	1	1	1	1	1	1	1	1	1	ND	ND	
	slope 0.5-1.0%	E12	1	1	2	1	1	1	2	1	1	1	ND	ND	
	slope 1-2%	E13	1	1	2	2	1	1	2	2	1	1	ND	ND	
	slope 2-3%	E14	1	1	3	2	1	1	3	2	1	1	ND	ND	
	slope 3-5%	E15	2	2	3	3	2	2	3	3	2	2	ND	ND	
	slope 5-8%	E16	2	2	4	3	2	2	4	3	2	2	ND	ND	
	slope 8-12%	E17	3	3	4	4	3	3	4	4	3	3	ND	ND	
	slope 12-15%	E18	3	3	5	4	3	3	5	4	3	3	ND	ND	
	slope 15-20%	E19	4	4	5	5	4	4	5	5	4	4	ND	ND	
	slope >20%	E20	5	5	5	5	5	5	5	5	5	5	ND	ND	
Unstable Soils (K factor 0.04 - 0.06)	slope <0.5%	E21	1	1	2	1	1	1	2	1	1	1	ND	ND	
	slope 0.5-1.0%	E22	1	1	2	2	1	1	2	2	1	1	ND	ND	
	slope 1-2%	E23	1	1	3	2	1	1	3	2	1	1	ND	ND	
	slope 2-3%	E24	2	2	3	3	2	2	3	3	2	2	ND	ND	
	slope 3-5%	E25	2	2	4	3	2	2	4	3	2	2	ND	ND	
	slope 5-8%	E26	3	3	4	4	3	3	4	4	3	3	ND	ND	
	slope 8-12%	E27	3	3	5	4	3	3	5	4	3	3	ND	ND	
	slope 12-15%	E28	4	4	5	5	4	4	5	5	4	4	ND	ND	
	slope 15-20%	E29	5	5	5	5	5	5	5	5	5	5	ND	ND	
	slope >20%	E30	5	5	5	5	5	5	5	5	5	5	ND	ND	
Very unstable Soils (K factor >0.06)	slope <0.5%	E31	1	1	2	2	1	1	2	2	1	1	ND	ND	
	slope 0.5-1.0%	E32	2	2	3	2	2	2	3	2	2	2	ND	ND	
	slope 1-2%	E33	2	2	3	3	2	2	3	3	2	2	ND	ND	
	slope 2-3%	E34	2	2	4	3	2	2	4	3	2	2	ND	ND	
	slope 3-5%	E35	2	2	4	4	2	2	4	4	2	2	ND	ND	
	slope 5-8%	E36	3	3	5	4	3	3	5	4	3	3	ND	ND	
	slope 8-12%	E37	4	4	5	5	4	4	5	5	4	4	ND	ND	
	slope 12-15%	E38	4	4	5	5	4	4	5	5	4	4	ND	ND	
	slope 15-20%	E39	5	5	5	5	5	5	5	5	5	5	ND	ND	
	slope >20%	E40	5	5	5	5	5	5	5	5	5	5	ND	ND	

Attribute	Attribute definition	CODE	Citrus				Avacado				Grape				Comment about source selection
			GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	
Soil wetness	Rapidly drained - Drainage class 6	W1	1	1	1	ND	1	1	1	ND	1	1	ND	ND	CTAP rules appear incomplete (no class for Well drained - Drainage class 5, permeability class 2) and there seems unecessary differentation in poorly drained classes (whihc are class 5 for the crops selected ie the differentiation does not assit in rejecting marginal soils). NAWRA (Mitchell) rules to be adopted with Citrus rules applied to grapes.
	Well drained - Drainage class 5, permeability class 4	W2	1	1	1	ND	1	1	1	ND	1	1	ND	ND	
	Well drained - Drainage class 5, permeability class 3	W3	1	1	1	ND	1	1	1	ND	1	1	ND	ND	
	Well drained - Drainage class 5, permeability class 2	W4	1	1	2	ND	2	2	2	ND	1	1	ND	ND	
	Well drained - Drainage class 5, permeability class 1	W5	3	3	3	ND	4	4	3	ND	3	3	ND	ND	
	Moderately well drained - Drainage class 4, permeability class 4	W6	1	1	1	ND	3	3	2	ND	3	3	ND	ND	
	Moderately well drained - Drainage class 4, permeability class 3	W7	2	2	2	ND	3	3	3	ND	3	3	ND	ND	
	Moderately well drained - Drainage class 4, permeability class 2	W8	3	3	3	ND	4	4	4	ND	3	3	ND	ND	
	Moderately well drained - Drainage class 4, permeability class 1	W9	4	4	4	ND	4	4	4	ND	4	4	ND	ND	
	Imperfectly drained - Drainage class 3, permeability class 4	W10	4	4	3	ND	4	4	4	ND	4	4	ND	ND	
	Imperfectly drained - Drainage class 3, permeability class 3	W11	4	4	4	ND	4	4	4	ND	4	4	ND	ND	
	Imperfectly drained - Drainage class 3, permeability class 2	W12	4	4	4	ND	5	5	5	ND	4	4	ND	ND	
	Imperfectly drained - Drainage class 3, permeability class 1	W13	5	5	5	ND	5	5	5	ND	5	5	ND	ND	
	Poorly drained - Drainage class 2, permeability class 3 or 4	W14	5	5	5	ND	5	5	5	ND	5	5	ND	ND	
	Poorly drained - Drainage class 2, permeability class 1 or 2	W15	5	5	5	ND	5	5	5	ND	5	5	ND	ND	
	Very poorly drained - Drainage class 1	W16	5	5	5	ND	5	5	5	ND	5	5	ND	ND	
Soil wetness	Rapidly drained - Drainage class 6	W1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	Well drain - Drainage class 5, permeability class 4	W2	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	Well drain - Drainage class 5, permeability class 3	W3	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	Well drain, very slow permability	W4	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Moderately well drain - Drainage class 4, permeability class 4	W5	ND	ND	ND	1	ND	ND	ND	2	ND	ND	ND	ND	
	Moderately well drain - Drainage class 4, permeability class 3	W6	ND	ND	ND	2	ND	ND	ND	3	ND	ND	ND	ND	
	Moderately well drain - Drainage class 4, permeability class 2	W7	ND	ND	ND	3	ND	ND	ND	4	ND	ND	ND	ND	
	Moderately well drain - Drainage class 4, permeability class 1	W8	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	Imperfectly drain - Drainage class 3, permeability class 4	W9	ND	ND	ND	3	ND	ND	ND	4	ND	ND	ND	ND	
	Imperfectly drain - Drainage class 3, permeability class 3	W10	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	Imperfectly drain - Drainage class 3, permeability class 2	W11	ND	ND	ND	4	ND	ND	ND	5	ND	ND	ND	ND	
	Imperfectly drain - Drainage class 3, permeability class 1	W12	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Poorly drain - Drainage class 2, permeability class 3 or 4	W13	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Poorly drain - Drainage class 2, permeability class 2	W14	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Poor drain, very slow permeability	W15	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Very poorly drained - Drainage class 1	W16	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Rockiness	None	R0	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP rules more comprehensive that other rule sets (which have only two classes) and cthus adopted.
Rockiness <2%	2-20mm	R1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	20-60mm	R2	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	60-200mm	R3	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	200-600mm	R4	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	>600mm	R5	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
Rockiness 2-10%	2-20mm	R6	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	20-60mm	R7	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	60-200mm	R8	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	200-600mm	R9	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	>600mm	R10	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
Rockiness 10-20%	2-20mm	R11	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	20-60mm	R12	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	60-200mm	R13	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	200-600mm	R14	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	>600mm	R15	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Rockiness 20-50%	2-20mm	R16	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	
	20-60mm	R17	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	60-200mm	R18	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	200-600mm	R19	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	>600mm	R20	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Rockiness >50%	2-20mm	R21	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	20-60mm	R22	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	60-200mm	R23	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	200-600mm	R24	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	>600mm	R25	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Rockiness >90%	2-20mm	R26	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	20-60mm	R27	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	60-200mm	R28	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	200-600mm	R29	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	>600mm	R30	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Rockiness	Not rocky or significantly rocky	R1	1	1	1	ND	1	1	1	ND	1	1	ND	ND	
	Rocky	R2	4	4	4	ND	4	4	4	ND	4	4	ND	ND	

Attribute	Attribute definition	CODE	Citrus				Avacado				Grape				Comment about source selection
			GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	GPARF	FGARA	NAWRA (Mitchell)	CTAP	
Gilgai (microrelief)	Gilgai with vertical interval <0.1m	Tm1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP rules more comprehensive that other rule sets (which have only two classes) and cthus adopted.
	Gilgai with vertical interval 0.1-0.3m	Tm2	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	Gilgai with vertical interval 0.3-0.5m	Tm3	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Gilgai with vertical interval >0.5m	Tm4	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Gilgai (microrelief)	No gilgai or vertcal interval <0.3m	Tm1	1	1	1	ND	1	1	1	ND	1	1	ND	ND	
	Vertical interval >0.3m	Tm2	4	4	4	ND	4	4	4	ND	4	4	ND	ND	
Flooding	Flood free	F1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP only rules available and adopted.
	Flood frequency exceeds 1:50; <1:10 years (10-50 years)	F2	ND	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	
	Flood frequency exceeds 1:10; <1:5 years (5-10 years)	F3	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Flood frequency exceeds 1:5; <1:1 years (1-5 years)	F4	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	EROSIVE flooding annually or almost annually (<1 year)	F5	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Salinity	Ecse<1dS/m	Sa1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP rules adopted for citrus and avocado. As grape and citrus (orange, lemon and grapefuit) have similar salinity threshold and 10% yield reduction values, citrus rules to be adopted for grapes
	Ecse 1-2 dS/m	Sa2	ND	ND	ND	1	ND	ND	ND	2	ND	ND	ND	ND	
	Ecse 2-3 dS/m	Sa3	ND	ND	ND	2	ND	ND	ND	3	ND	ND	ND	ND	
	Ecse 3-4 dS/m	Sa4	ND	ND	ND	3	ND	ND	ND	4	ND	ND	ND	ND	
	Ecse 4-5 dS/m	Sa5	ND	ND	ND	4	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 5-6 dS/m	Sa6	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 6-7 dS/m	Sa7	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 7-8 dS/m	Sa8	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 8-9 dS/m	Sa9	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 9-10 dS/m	Sa10	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 10-11 dS/m	Sa11	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 11-12 dS/m	Sa12	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse 12-13 dS/m	Sa13	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
	Ecse >13 dS/m	Sa14	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Surface salinity	No evidence of salinity	Sa1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Existing salinty	Sa2	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	ND	
Secondary salinity	No potential outflow	Ss1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP only rules available and adopted (with minor wording modification)
	Some potential outflow	Ss2	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Mod-high potential outflow	Ss3	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Soil complexity	Minimal soil complexity	Xs1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP rules adopted
	Moderate soil complexity	Xs2	ND	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	
	Severe soil complexity	Xs3	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
Topographic complexity	Not topgraphically complex	Xt1	ND	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	CTAP rules adopted
	Long/narrow shape	Xt2	ND	ND	ND	4	ND	ND	ND	4	ND	ND	ND	ND	
	Hills/gullies/watercourse	Xt3	ND	ND	ND	5	ND	ND	ND	5	ND	ND	ND	ND	
Irrigation efficiency	Rapidly permeable soils - Permeability class 5-7 (WA only)	Ir1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	NAWRA)Mitchell) rules adpoted, but limitation descriptor changed to reflect intent and numbering changed to reflect exclsuion of Ir1
	Highly permeable soils - Permeability class 4	Ir2	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	
	Moderately permeable soils - Permeability class 3	Ir3	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	
	Slowly permeable soils - Permeability class 2	Ir4	ND	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	
	Very slowly permeable soils - Permeability class 1	Ir5	ND	ND	3	ND	ND	ND	3	ND	ND	ND	ND	ND	
Surface infiltration	Silty surface texture or surface ESP >=6	Pi1	ND	ND	2	ND	ND	ND	3	ND	ND	ND	ND	ND	Duplication with Ps and not considered necessary
	All other soils	Pi2	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND	ND	

*** FGARA does not include this description value, it does however have suitability subclass values for this field. The description value was taken from the GPARF in this instance.**

Table 2. Land suitability limitation class decision rules applied to the 15 Mile Project

Limitation	Source	Definition	CODE	Grapes	Citrus	Avocado
Wind erosion (A)	**GPARF, FGARA**	No restriction: annual rainfall >= 500mm OR surface texture not sandy	**A1**	1	1	1
		Annual rainfall <500mm AND surface texture sand or sandy loam	**A2**	2	2	2
		Annual rainfall <500mm AND surface texture sand or sandy loam AND Soil classified as Sodosol	**A3**	3	3	3
Frost (Cf)	**GPARF, FGARA, NAWRA (Mitchell)**	Frost free	**Cf1**	1	1	1
		Occasional frost (<2 days)	**Cf2**	2	2	2
		Regular light frosts (>=2 days)	**Cf3**	3	3	3
Climate stress (heat) (Cs)	**GPARF, FGARA**	Low heat stress (<5 40°C days)	**Cs1**	1	1	1
		Moderate heat stress (5-20 40°C days)	**Cs2**	3	3	3
		Severe heat stress (>20 40°C days)	**Cs3**	4	4	4
Temperature (minimums) (Ct)	**GPARF, FGARA, NAWRA (Mitchell)**	Mean min. monthly temperature <15°C for 4 months or more	**Ct1**	1	1	2
		Mean min. monthly temperature <15°C for 3 months or less	**Ct2**	2	2	1
Water erosion (E) Very stable soils (K factor <0.02)	**CTAP**	slope <0.5%	**E1**	1	1	1
		slope 0.5-1.0%	**E2**	1	1	1
		slope 1-2%	**E3**	1	1	1
		slope 2-3%	**E4**	2	2	2
		slope 3-5%	**E5**	2	2	2
		slope 5-8%	**E6**	3	3	3
		slope 8-12%	**E7**	3	3	3
		slope 12-15%	**E8**	4	4	4
		slope 15-20%	**E9**	4	4	4
		slope >20%	**E10**	5	5	5
Water erosion (E) Stable soils (K factor 0.02-0.04)	**CTAP**	slope <0.5%	**E11**	1	1	1
		slope 0.5-1.0%	**E12**	1	1	1
		slope 1-2%	**E13**	2	2	2
		slope 2-3%	**E14**	2	2	2
		slope 3-5%	**E15**	3	3	3
		slope 5-8%	**E16**	3	3	3
		slope 8-12%	**E17**	4	4	4
		slope 12-15%	**E18**	4	4	4
		slope 15-20%	**E19**	5	5	5
		slope >20%	**E20**	5	5	5

Limitation	Source	Definition	CODE	Grapes	Citrus	Avocado
Water erosion (E) Unstable Soils (K factor 0.04 - 0.06)	**CTAP**	slope <0.5%	**E21**	1	1	1
		slope 0.5-1.0%	**E22**	2	2	2
		slope 1-2%	**E23**	2	2	2
		slope 2-3%	**E24**	3	3	3
		slope 3-5%	**E25**	3	3	3
		slope 5-8%	**E26**	4	4	4
		slope 8-12%	**E27**	4	4	4
		slope 12-15%	**E28**	5	5	5
		slope 15-20%	**E29**	5	5	5
		slope >20%	**E30**	5	5	5
Water erosion (E) Very unstable Soils (K factor >0.06)	**CTAP**	slope <0.5%	**E31**	2	2	2
		slope 0.5-1.0%	**E32**	2	2	2
		slope 1-2%	**E33**	3	3	3
		slope 2-3%	**E34**	3	3	3
		slope 3-5%	**E35**	4	4	4
		slope 5-8%	**E36**	4	4	4
		slope 8-12%	**E37**	5	5	5
		slope 12-15%	**E38**	5	5	5
		slope 15-20%	**E39**	5	5	5
		slope >20%	**E40**	5	5	5
Flooding (F)	**CTAP**	Flood free or flood frequency less than once in 50 years	**F1**	1	1	1
		Flood frequency once every10-50 years	**F2**	2	2	2
		Flood frequency once every 5-10 years	**F3**	3	3	3
		Flood frequency once every 1-5 years	**F4**	4	4	4
		EROSIVE flooding annually or almost annually	**F5**	5	5	5
Infiltration - soil profile recharge (Ir)	**NAWRA (Mitchell)**	Highly permeable soils - Permeability class 4	**Ir1**	1	1	1
		Moderately permeable soils - Permeability class 3	**Ir2**	2	2	2
		Slowly permeable soils - Permeability class 2	**Ir3**	2	2	2
		Very slowly permeable soils - Permeability class 1	**Ir4**	3	3	3
PWAC to 1.5 m (M)	**GPARF, FGARA**	PAWC >150mm*	**M1**	ND	ND	1
		PAWC 100 - 150mm	**M2**	ND	ND	1
		PAWC 75 - 100mm	**M3**	ND	ND	1
		PAWC 60 - 75mm	**M4**	ND	ND	2
		PAWC 40- 60 mm	**M5**	ND	ND	3
		PAWC <40mm	**M6**	ND	ND	4

Limitation	Source	Definition	CODE	Grapes	Citrus	Avocado
PWAC to 1.0 m (M)	**GPARF, FGARA**	PAWC >150mm*	**M7**	1	1	ND
		PAWC 100 - 150mm	**M8**	1	1	ND
		PAWC 75 - 100mm	**M9**	2	2	ND
		PAWC 60 - 75mm	**M10**	2	2	ND
		PAWC 40- 60 mm	**M11**	3	3	ND
		PAWC <40mm	**M12**	4	4	ND
Nutrient balance (Nr1) Upper profile pH (0.0-0.6m)	**CTAP**	pH 5.5-7.0	**Nr1-1**	1	1	1
		pH 7.0-8.5	**Nr1-2**	1	2	1
		pH <5.5	**Nr1-3**	2	2	2
		pH>8.5	**Nr1-4**	3	3	3
Nutrient balance (Nr2) Lower profile pH (0.6-1.2m)	**CTAP**	pH 5.5-7.0	**Nr2-1**	1	1	1
		pH 7.0-8.5	**Nr2-2**	1	2	1
		pH <5.5	**Nr2-3**	2	2	2
		pH>8.5	**Nr2-4**	3	3	3
Physical restrictions (Soil surface condition and soil texture/structure) (Ps)	**CTAP**	No restriction: Surface (Class) Condition 2 – Loose and or Soft	**Ps1**	1	1	1
		Firm/hardsetting - light texture sandy to sandy loam (S to SL)	**Ps2**	1	1	2
		Firm/hardsetting - heavy texture: Clay loamy (SCL to CL)	**Ps3**	2	2	2
		Surface (Class) Condition 1 – Cracking and /or Self mulching and Soil Structure Class 3 – Moderate/Strong and fine (peds <=10 mm)	**Ps4**	3	3	3
		Surface (Class) Condition 1 – Cracking and /or Self mulching and Soil Structure Class 4 – Moderate/Strong and coarse (peds >10 mm)	**Ps5**	3	3	3
		Hardsetting - silty surface (ZL-ZCL) >0.1 m	**Ps6**	3	3	3
		Surface ESP >6% and strongly sodic (>15%), intractable clay B horizon <0.3 m (within plough zone)	**Ps7**	4	4	4
Soil depth to physical root barrier (Pd)	**GPARF, FGARA, NAWRA (Mitchell), CTAP**	Very deep (>1.5m)	**Pd1**	1	1	1
		Deep (1.0 - 1.5m)	**Pd2**	1	1	2
		Moderate (0.5 - 1.0m)	**Pd3**	2	2	4
		Shallow (0.25 - 0.5m)	**Pd4**	4	4	5
		Very shallow (<0.25m)	**Pd5**	5	5	5
Rockiness (R) Abundance 0%	**CTAP**	Size	**R0**	1	1	1
Rockiness (R) Abundance <2%	**CTAP**	2-20mm	**R1**	1	1	1
		20-60mm	**R2**	1	1	1
		60-200mm	**R3**	1	1	1
		200-600mm	**R4**	2	2	2
		>600mm	**R5**	2	2	2
Rockiness (R) Abundance 2-10%	**CTAP**	2-20mm	**R6**	1	1	1
		20-60mm	**R7**	1	1	1
		60-200mm	**R8**	1	1	1
		200-600mm	**R9**	2	2	2
		>600mm	**R10**	3	3	3

Limitation	Source	Definition	CODE	Grapes	Citrus	Avocado
Rockiness (R) Abundance 10-20%	**CTAP**	2-20mm	**R11**	1	1	1
		20-60mm	**R12**	2	2	2
		60-200mm	**R13**	2	2	2
		200-600mm	**R14**	3	3	3
		>600mm	**R15**	4	4	4
Rockiness (R) Abundance 20-50%	**CTAP**	2-20mm	**R16**	1	1	1
		20-60mm	**R17**	2	2	2
		60-200mm	**R18**	3	3	3
		200-600mm	**R19**	4	4	4
		>600mm	**R20**	4	4	4
Rockiness (R) Abundance >50%	**CTAP**	2-20mm	**R21**	2	2	2
		20-60mm	**R22**	3	3	3
		60-200mm	**R23**	4	4	4
		200-600mm	**R24**	5	5	5
		>600mm	**R25**	5	5	5
Rockiness (R) Abundance >90%	**CTAP**	2-20mm	**R26**	3	3	3
		20-60mm	**R27**	4	4	4
		60-200mm	**R28**	5	5	5
		200-600mm	**R29**	5	5	5
		>600mm	**R30**	5	5	5
Salinity (Sa)	**CTAP**	Ecse<1dS/m	**Sa1**	1	1	1
		Ecse 1-2 dS/m	**Sa2**	1	1	2
		Ecse 2-3 dS/m	**Sa3**	2	2	3
		Ecse 3-4 dS/m	**Sa4**	3	3	4
		Ecse 4-5 dS/m	**Sa5**	4	4	5
		Ecse 5-6 dS/m	**Sa6**	5	5	5
		Ecse 6-7 dS/m	**Sa7**	5	5	5
		Ecse 7-8 dS/m	**Sa8**	5	5	5
		Ecse 8-9 dS/m	**Sa9**	5	5	5
		Ecse 9-10 dS/m	**Sa10**	5	5	5
		Ecse 10-11 dS/m	**Sa11**	5	5	5
		Ecse 11-12 dS/m	**Sa12**	5	5	5
		Ecse 12-13 dS/m	**Sa13**	5	5	5
		Ecse >13 dS/m	**Sa14**	5	5	5
Discharge potential (Ss)	**CTAP**	No potential outflow	**Ss1**	1	1	1
		Minor potential outflow	**Ss2**	3	3	3
		Mod-high potential outflow	**Ss3**	4	4	4
Microrelief (Tm)	**CTAP**	Gilgai with vertical interval <0.1m	**Tm1**	1	1	1
		Gilgai with vertical interval 0.1-0.3m	**Tm2**	2	2	2
		Gilgai with vertical interval 0.3-0.5m	**Tm3**	3	3	3
		Gilgai with vertical interval >0.5m	**Tm4**	4	4	4

Limitation	Source	Definition	CODE	Grapes	Citrus	Avocado
Wetness (W)	NAWRA (Mitchell)	Rapidly drained - Drainage class 6	W1	1	1	1
		Well drained - Drainage class 5, permeability class 4	W2	1	1	1
		Well drained - Drainage class 5, permeability class 3	W3	1	1	1
		Well drained - Drainage class 5, permeability class 2	W4	2	2	2
		Well drained - Drainage class 5, permeability class 1	W5	3	3	3
		Moderately well drained - Drainage class 4, permeability class 4	W6	1	1	2
		Moderately well drained - Drainage class 4, permeability class 3	W7	2	2	3
		Moderately well drained - Drainage class 4, permeability class 2	W8	3	3	4
		Moderately well drained - Drainage class 4, permeability class 1	W9	4	4	4
		Imperfectly drained - Drainage class 3, permeability class 4	W10	3	3	4
		Imperfectly drained - Drainage class 3, permeability class 3	W11	4	4	4
		Imperfectly drained - Drainage class 3, permeability class 2	W12	4	4	5
		Imperfectly drained - Drainage class 3, permeability class 1	W13	5	5	5
		Poorly drained - Drainage class 2, permeability class 3 or 4	W14	5	5	5
		Poorly drained - Drainage class 2, permeability class 1 or 2	W15	5	5	5
		Very poorly drained - Drainage class 1	W16	5	5	5
Soil complexity (Xs)	CTAP	Minimal soil complexity	Xs1	1	1	1
		Moderate soil complexity	Xs2	3	3	3
		Severe soil complexity	Xs3	4	4	4
Topographic complexity (Xt)	CTAP	Not topgraphically complex	Xt1	1	1	1
		Long/narrow shape	Xt2	4	4	4
		Hills/gullies/watercourse	Xt3	5	5	5

Appendix 11:
Land Suitability Assessment Results for Each Soil Unit

Appendix 11 Land suitability assessment results for each Soil Unit

The following tables list the inherent climate, soil and landscape attributes relevant to each soil unit. Limitation subclass values (which are used to determine final suitability class) for each crop – soil unit scenario were assessed using the decision rules defined within **Appendix 10**. Final land suitability classes for each crop by unique mapping area (UMA) are presented in **Appendix 12**.

Irrigated horticultural suitability assessment - Soil Unit A1					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.040-0.043 and slope ≤ 0.5%	1	1	1
F	**Flooding**	Flood frequency once every 10-50 years	2	2	2
Ir	**Infiltration/ soil profile recharge**	Moderately permeable (3)	2	2	2
M1	**PAWC to 1.0 m**	PAWC: 63-71 mm	2	2	-
M2	**PAWC to 1.5 m**	PAWC: 100-110 mm	-	-	1
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	Mean pH 7.2-8.0	1	2	1
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	Mean pH 8.3	1	2	1
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Firm/hardsetting - heavy texture (non-cracking)	2	2	2
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 0.09 dS/m	1	1	1
Ss	**Discharge potential**	No potential outflow	1	1	1
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), moderately permeable (3)	2	2	3
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**3**	**3**	**3**

Irrigated horticultural suitability assessment - Soil Unit A1e					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.043 * and slope: up to 10%	4	4	4
F	**Flooding**	Flood frequency once every 1-5 years	4	4	4
Ir	**Infiltration/ soil profile recharge**	Slowly permeable (2)	2	2	2
M1	**PAWC to 1.0 m**	PAWC: 63 mm *	2	2	-
M2	**PAWC to 1.5 m**	PAWC: 100 mm *	-	-	1
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 6.7-7.7	1	2	1
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.0-8.3	1	2	1
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Firm/hardsetting - heavy texture (non-cracking)	2	2	2
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 0.07 dS/m	1	1	1
Ss	**Discharge potential**	Minor potential outflow	3	3	3
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), slowly permeable (2)	3	3	4
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Topography dissected	5	5	5
Overall assessment rating			**5**	**5**	**5**

***** Estimated from data from closest Soil Unit A1 representative site (24).

Irrigated horticultural suitability assessment - Soil Unit A2					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.057 for UMAs dominated by Dermosols -0.071 and slope: ≤ 1.0% (UMAs 1, 5, 10, 21, 23)	2	2	2
		K factor: 0.071 for UMAs dominated by Vertosols slope: ≤ 1.0% (UMAs 9, 18, 37, 38, 43)	2	2	2
F	**Flooding**	Flood frequency once every 5-10 years for TEP UMAs *	3	3	3
		Flood frequency once every 1-5 years for BKP UMAs *	4	4	4
Ir	**Infiltration/ soil profile recharge**	Slowly permeable (2)	2	2	2
M1	**PAWC to 1.0 m**	PAWC: 104 mm for TEP UMAs *	1	1	-
		PAWC: 37 mm for BKP UMAs *	4	4	-
M2	**PAWC to 1.5 m**	PAWC: 133 mm for TEP UMAs *	-	-	1
		PAWC: 37 mm for BKP UMAs *	-	-	4
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 7.0-8.2 for TEP UMAs *	1	2	1
		pH 6.8-8.3 for BKP UMAs *	1	2	1
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.2-8.4 for TEP UMAs *	1	2	1
		pH 8.5-8.9 for BKP UMAs *	2	3	2
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Firm/hardsetting - heavy texture (non-cracking)	2	2	2
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 0.13 dS/m for TEP UMAs *	1	1	1
		ECe (WPM): 3.99 dS/m for BKP UMAs *	3	3	4
Ss	**Discharge potential**	Minor potential outflow for TEP UMAs *	3	3	3
		Mod-high potential outflow for BKP UMAs *	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), slowly permeable (2)	3	3	4
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Not topographically complex (UMAs 1, 9, 10, 21, 37, 38, 43)	1	1	1
		Small isolated or long/ narrow shape (UMAs 3, 5, 18, 23, 25)	4	4	4
Overall assessment rating			**3-4***	**3-4***	**4**

* Soil Unit A2 split into elevated terrace plains (TEP) and low-lying backplains (BKP) UMAs for assessment and the soil unit overall rating reflects differences in suitability between UMAs.

Irrigated horticultural suitability assessment - Soil Unit A3					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.040 * and slope: up to 3.0%	3	3	3
F	**Flooding**	Flood frequency once every 1-5 years	4	4	4
Ir	**Infiltration/ soil profile recharge**	Moderately permeable (3)	2	2	2
M1	**PAWC to 1.0 m**	PAWC: 71 mm *	2	2	-
M2	**PAWC to 1.5 m**	PAWC: 110 mm *	-	-	1
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 7.3-8.7	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.7	3	3	3
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Firm/hardsetting - heavy texture (non-cracking)	2	2	2
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 0.12 dS/m	1	1	1
Ss	**Discharge potential**	Minor potential outflow	3	3	3
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), moderately permeable (3)	2	2	3
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Long/ narrow shape	4	4	4
Overall assessment rating			**4**	**4**	**4**

***** Estimated from data from closest Soil Unit A1 representative profile (2).

Irrigated horticultural suitability assessment - Soil Unit A4					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.046 and slope up to 3.0%	3	3	3
F	**Flooding**	Flood frequency once every 1-5 years	4	4	4
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 117 mm	1	1	-
M2	**PAWC to 1.5 m**	PAWC: 117 mm	-	-	1
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 6.8-8.7	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.6-8.7	3	3	3
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Cracking clay with moderate/strong and fine structure (peds ≤10 mm)	3	3	3
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 0.70 dS/m	1	1	1
Ss	**Discharge potential**	Mod-high potential outflow	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Poorly drained (2), very slowly permeable (1)	5	5	5
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Long/ narrow watercourse	4	4	4
Overall assessment rating			**5**	**5**	**5**

Irrigated horticultural suitability assessment - Soil Unit B1					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.05 and slope ≤ 0.5%	1	1	1
F	**Flooding**	Flood frequency once every 1-5 years	4	4	4
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 59 mm	3	3	-
M2	**PAWC to 1.5 m**	PAWC: 59 mm	-	-	3
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 8.2-8.7	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8-8.4	1	2	1
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Cracking clay with moderate/strong and fine structure (peds ≤10 mm)	3	3	3
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 4.34 dS/m	4	4	5
Ss	**Discharge potential**	Mod-high potential outflow	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), very slowly permeable (1)	4	4	4
Xs	**Soil complexity**	Moderate soil complexity	3	3	3
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**4**	**4**	**5**

Irrigated horticultural suitability assessment - Soil Unit B2					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.070 and slope ≤ 0.5%	2	2	2
F	**Flooding**	Flood frequency once every 5-10 years for TEP UMAs *	3	3	3
		Flood frequency once every 1-5 years for BKP UMAs *	4	4	4
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 15 mm	4	4	-
M2	**PAWC to 1.5 m**	PAWC: 15 mm	-	-	4
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 7.2-9.2	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.5-8.7	3	3	3
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Sodic (ESP >6%) surface and strongly sodic (ESP >15%) clay subsoil	4	4	4
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 10.4 dS/m	5	5	5
Ss	**Discharge potential**	Minor potential outflow for TEP UMAs *	3	3	3
		Mod-high potential outflow for BKP UMAs *	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), very slowly permeable (1)	4	4	4
Xs	**Soil complexity**	Minimal soil complexity for TEP UMAs *	1	1	1
		Moderate soil complexity for BKP UMAs *	3	3	3
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**5**	**5**	**5**

***** Soil Unit B2 split into elevated terrace plains (TEP) UMAs and low-lying backplains (BKP) UMAs for suitability assessment.

Irrigated horticultural suitability assessment - Soil Unit B2g					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.050 +and slope ≤ 0.5%	1	1	1
F	**Flooding**	Flood frequency once every 5-10 years for TEP UMAs *	3	3	3
		Flood frequency once every 1-5 years for BKP UMAs *	4	4	4
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 59 mm +	3	3	-
M2	**PAWC to 1.5 m**	PAWC: 59 mm +	-	-	3
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 7.7-8.9	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.0-8.1	1	2	1
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Cracking clay with moderate/strong and fine structure (peds ≤10 mm)	3	3	3
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 6.55 dS/m	5	5	5
Ss	**Discharge potential**	Minor potential outflow for TEP UMAs *	3	3	3
		Mod-high potential outflow for BKP UMAs *	4	4	4
Tm	**Microrelief**	Gilgaied (VI 0.3-0.5 m)	3	3	3
W	**Wetness**	Imperfectly drained (3), very slowly permeable (1)	5	5	5
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**5**	**5**	**5**

***** Soil Unit B2g split into elevated terrace plains (TEP) UMAs and low-lying backplains (BKP) UMAs for suitability assessment.

+ Estimated from data from representative profile for soil unit B1 (6) with similar texture and ERD restrictions.

Irrigated horticultural suitability assessment - Soil Unit B3					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500mm AND surface texture sand or sandy loam AND Soil classified as Sodosol for TEP UMAs	3	3	3
		Annual rainfall <500 mm and surface texture not sandy for BKP UMAs	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.051 and slope ≤ 0.5%	1	1	1
F	**Flooding**	Flood frequency once every 5-10 years for TEP UMAs *	3	3	3
		Flood frequency once every 1-5 years for BKP UMAs *	4	4	4
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 1.6-16 mm	4	4	-
M2	**PAWC to 1.5 m**	PAWC: 1.6-16 mm	-	-	4
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 6.5-8.5	1	2	1
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.8	3	3	3
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Sodic (ESP >6%) surface and strongly sodic (ESP >15%) clay subsoil	4	4	4
R	**Rockiness**	None	1	1	1
Sa	**Salinity**	ECe (WPM): 6.88 dS/m	5	5	5
Ss	**Discharge potential**	Minor potential outflow for TEP UMAs *	3	3	3
		Mod-high potential outflow for BKP UMAs *	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Imperfectly drained (3), very slowly permeable (1)	5	5	5
Xs	**Soil complexity**	Minimal soil complexity for TEP UMAs *	1	1	1
		Moderate soil complexity for BKP UMAs *	3	3	3
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**5**	**5**	**5**

* Soil Unit B3 split into elevated terrace plains (TEP) UMAs and low-lying backplains (BKP) UMAs for suitability assessment.

Irrigated horticultural suitability assessment - Soil Unit C1					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.037 and slope up to 2.0%	2	2	2
F	**Flooding**	Flood free or flood frequency less than once in 50 years	1	1	1
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 104 mm	1	1	-
M2	**PAWC to 1.5 m**	PAWC: 104 mm	-	-	1
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 7.8-8.1	1	2	1
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 7.8-7.9	1	2	1
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Cracking clay with moderate/strong and fine structure (peds ≤10 mm)	3	3	3
R	**Rockiness**	<2% 6-20 mm gravels	1	1	1
Sa	**Salinity**	ECe (WPM): 1.39 dS/m	1	1	2
Ss	**Discharge potential**	No potential outflow	1	1	1
Tm	**Microrelief**	Gilgaied (VI 0.15 m)	2	2	2
W	**Wetness**	Moderately well-drained (4), very slowly permeable (1)	4	4	4
Xs	**Soil complexity**	Minimal soil complexity	1	1	1
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**4**	**4**	**4**

Irrigated horticultural suitability assessment - Soil Unit C2					
Limitation		**Attribute value**	**Table grapes**	**Citrus**	**Avocado**
A	**Wind erosion**	Annual rainfall <500 mm and surface texture not sandy	1	1	1
Cf	**Frost**	Occasional frost (<2 days/year)	2	2	2
Cs	**Climate stress (heat)**	Moderate heat stress (5- 20 days >40˚C days)	3	3	3
Ct	**Temperature (minimum)**	Mean min. monthly temperature <15˚C for 4 months or more	1	1	2
E	**Water erosion**	K factor: 0.031 and slope up to 2.0%	2	2	2
F	**Flooding**	Flood frequency once every 5-10 years	3	3	3
Ir	**Infiltration/ soil profile recharge**	Very slowly permeable (1)	3	3	3
M1	**PAWC to 1.0 m**	PAWC: 30 mm	4	4	-
M2	**PAWC to 1.5 m**	PAWC: 30 mm	-	-	4
Nr1	**Nutrient balance/ pH (upper profile <0.6 m)**	pH 8.4-9.2	3	3	3
Nr2	**Nutrient balance/ pH (lower profile 0.6-1.2 m)**	pH 8.3-9.2	3	3	3
Pd	**Soil depth to physical root barriers**	>1.5 m	1	1	1
Ps	**Soil surface condition**	Cracking clay with moderate/strong and fine structure (peds ≤10 mm)	3	3	3
R	**Rockiness**	Up to 20% 20-60 mm gravels	2	2	2
Sa	**Salinity**	ECe (WPM): 4.19 dS/m	4	4	5
Ss	**Discharge potential**	Mod-high potential outflow	4	4	4
Tm	**Microrelief**	Non-gilgaied	1	1	1
W	**Wetness**	Moderately well-drained (4), very slowly permeable (1)	4	4	4
Xs	**Soil complexity**	Moderate soil complexity	3	3	3
Xt	**Topographic complexity**	Not topographically complex	1	1	1
Overall assessment rating			**4**	**4**	**5**

Appendix 12:
Land Suitability Assessment Results for Each UMA (Mapping Polygon)

Land Suitability Assessment Results for each UMA
Crop type **Table Grapes**

			Wind erosion	Frost	Climate stress (heat)	Temperature (minimum)	Water erosion	Flooding	Infiltration/ soil profile recharge	PAWC to 1.0 m	PAWC to 1.5 m	Nutrient balance/ pH (upper profile <0.6 m)	Nutrient balance/ pH (lower profile 0.6-1.2 m)	Soil depth to physical root barriers	Soil surface condition	Rockiness	Salinity	Discharge potential	Microrelief	Wetness	Soil complexity	Topographic complexity	XX Overall assessment rating
Poly No.	**Soil Unit**	**Lands pos**	**A**	**Cf**	**Cs**	**Ct**	**E**	**F**	**Ir**	**M1**	**M2**	**Nr1**	**Nr2**	**Pd**	**Ps**	**R**	**Sa**	**Ss**	**Tm**	**W**	**Xs**	**Xt**	
11	A1		1	2	3	1	1	2	2	2	-	1	1	1	2	1	1	1	1	2	1	1	3
20	A1		1	2	3	1	1	2	2	2	-	1	1	1	2	1	1	1	1	2	1	1	3
22	A1		1	2	3	1	1	2	2	2	-	1	1	1	2	1	1	1	1	2	1	1	3
39	A1		1	2	3	1	1	2	2	2	-	1	1	1	2	1	1	1	1	2	1	1	3
46	A1		1	2	3	1	1	2	2	2	-	1	1	1	2	1	1	1	1	2	1	1	3
4	A1e		1	2	3	1	4	4	2	2	-	1	1	1	2	1	1	3	1	3	1	5	5
47	A1e		1	2	3	1	4	4	2	2	-	1	1	1	2	1	1	3	1	3	1	5	5
3	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	4	4
9	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	1	3
21	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	1	3
37	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	1	3
38	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	1	3
43	A2	TEP	1	2	3	1	2	3	2	1	-	1	1	1	2	1	1	3	1	3	1	1	3
1	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	1	4
5	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	4	4
10	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	1	4
18	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	4	4
23	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	4	4
25	A2	BKP	1	2	3	1	2	4	2	4	-	1	2	1	2	1	3	4	1	3	1	4	4
36	A3		1	2	3	1	3	4	2	2	-	3	3	1	2	1	1	3	1	2	1	4	4
45	A3		1	2	3	1	3	4	2	2	-	3	3	1	2	1	1	3	1	2	1	4	4
2	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
24	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
33	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
12	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
13	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
14	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
16	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
28	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
32	B1		1	2	3	1	1	4	3	3	-	3	1	1	3	1	4	4	1	4	3	1	4
19	B2	TEP	1	2	3	1	2	3	3	4	-	3	3	1	4	1	5	3	1	4	1	1	5
40	B2	TEP	1	2	3	1	2	3	3	4	-	3	3	1	4	1	5	3	1	4	1	1	5
15	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
26	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
31	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
35	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
42	B2g	TEP	1	2	3	1	1	3	3	3	-	3	1	1	3	1	5	3	3	5	1	1	5
27	B2g	BKP	1	2	3	1	1	4	3	3	-	3	1	1	3	1	5	4	3	5	1	1	5
29	B2g	BKP	1	2	3	1	1	4	3	3	-	3	1	1	3	1	5	4	3	5	1	1	5
41	B3	TEP	3	2	3	1	1	3	3	4	-	1	3	1	4	1	5	3	1	5	1	1	5
6	B3	BKP	1	2	3	1	1	4	3	4	-	1	3	1	4	1	5	4	1	5	3	1	5
17	B3	BKP	1	2	3	1	1	4	3	4	-	1	3	1	4	1	5	4	1	5	3	1	5
30	B3	BKP	1	2	3	1	1	4	3	4	-	1	3	1	4	1	5	4	1	5	3	1	5
44	B3	BKP	1	2	3	1	1	4	3	4	-	1	3	1	4	1	5	4	1	5	3	1	5
8	C1		1	2	3	1	2	1	3	1	-	1	1	1	3	1	1	1	2	4	1	1	4
34	C1		1	2	3	1	2	1	3	1	-	1	1	1	3	1	1	1	2	4	1	1	4
7	C2		1	2	3	1	2	3	3	4	-	3	3	1	3	2	4	4	1	4	3	1	4

Land Suitability Assessment Results for each UMA
Crop type **Citrus**

			Wind erosion	Frost	Climate stress (heat)	Temperature (minimum)	Water erosion	Flooding	Infiltration/ soil profile recharge	PAWC to 1.0 m	PAWC to 1.5 m	Nutrient balance/ pH (upper profile <0.6 m)	Nutrient balance/ pH (lower profile 0.6-1.2 m)	Soil depth to physical root barriers	Soil surface condition	Rockiness	Salinity	Discharge potential	Microrelief	Wetness	Soil complexity	Topographic complexity	XX Overall assessment rating
Poly No.	**Soil Unit**	**Lands pos**	**A**	**Cf**	**Cs**	**Ct**	**E**	**F**	**Ir**	**M1**	**M2**	**Nr1**	**Nr2**	**Pd**	**Ps**	**R**	**Sa**	**Ss**	**Tm**	**W**	**Xs**	**Xt**	
11	A1		1	2	3	1	1	2	2	2	-	2	2	1	2	1	1	1	1	2	1	1	3
20	A1		1	2	3	1	1	2	2	2	-	2	2	1	2	1	1	1	1	2	1	1	3
22	A1		1	2	3	1	1	2	2	2	-	2	2	1	2	1	1	1	1	2	1	1	3
39	A1		1	2	3	1	1	2	2	2	-	2	2	1	2	1	1	1	1	2	1	1	3
46	A1		1	2	3	1	1	2	2	2	-	2	2	1	2	1	1	1	1	2	1	1	3
4	A1e		1	2	3	1	4	4	2	2	-	2	2	1	2	1	1	3	1	3	1	5	5
47	A1e		1	2	3	1	4	4	2	2	-	2	2	1	2	1	1	3	1	3	1	5	5
3	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	4	4
9	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	1	3
21	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	1	3
37	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	1	3
38	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	1	3
43	A2	TEP	1	2	3	1	2	3	2	1	-	2	2	1	2	1	1	3	1	3	1	1	3
1	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	1	4
5	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	4	4
10	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	1	4
18	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	4	4
23	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	4	4
25	A2	BKP	1	2	3	1	2	4	2	4	-	2	3	1	2	1	3	4	1	3	1	4	4
36	A3		1	2	3	1	3	4	2	2	-	3	3	1	2	1	1	3	1	2	1	4	4
45	A3		1	2	3	1	3	4	2	2	-	3	3	1	2	1	1	3	1	2	1	4	4
2	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
24	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
33	A4		1	2	3	1	3	4	3	1	-	3	3	1	3	1	1	4	1	5	1	4	5
12	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
13	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
14	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
16	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
28	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
32	B1		1	2	3	1	1	4	3	3	-	3	2	1	3	1	4	4	1	4	3	1	4
19	B2	TEP	1	2	3	1	2	3	3	4	-	3	3	1	4	1	5	3	1	4	1	1	5
40	B2	TEP	1	2	3	1	2	3	3	4	-	3	3	1	4	1	5	3	1	4	1	1	5
15	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
26	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
31	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
35	B2	BKP	1	2	3	1	2	4	3	4	-	3	3	1	4	1	5	4	1	4	3	1	5
42	B2g	TEP	1	2	3	1	1	3	3	3	-	3	2	1	3	1	5	3	3	5	1	1	5
27	B2g	BKP	1	2	3	1	1	4	3	3	-	3	2	1	3	1	5	4	3	5	1	1	5
29	B2g	BKP	1	2	3	1	1	4	3	3	-	3	2	1	3	1	5	4	3	5	1	1	5
41	B3	TEP	3	2	3	1	1	3	3	4	-	2	3	1	4	1	5	3	1	5	1	1	5
6	B3	BKP	1	2	3	1	1	4	3	4	-	2	3	1	4	1	5	4	1	5	3	1	5
17	B3	BKP	1	2	3	1	1	4	3	4	-	2	3	1	4	1	5	4	1	5	3	1	5
30	B3	BKP	1	2	3	1	1	4	3	4	-	2	3	1	4	1	5	4	1	5	3	1	5
44	B3	BKP	1	2	3	1	1	4	3	4	-	2	3	1	4	1	5	4	1	5	3	1	5
8	C1		1	2	3	1	2	1	3	1	-	2	2	1	3	1	1	1	2	4	1	1	4
34	C1		1	2	3	1	2	1	3	1	-	2	2	1	3	1	1	1	2	4	1	1	4
7	C2		1	2	3	1	2	3	3	4	-	3	3	1	3	2	4	4	1	4	3	1	4

Land Suitability Assessment Results for each UMA
Crop type **Avocado**

			Wind erosion	Frost	Climate stress (heat)	Temperature (minimum)	Water erosion	Flooding	Infiltration/ soil profile recharge	PAWC to 1.0 m	PAWC to 1.5 m	Nutrient balance/ pH (upper profile <0.6 m)	Nutrient balance/ pH (lower profile 0.6-1.2 m)	Soil depth to physical root barriers	Soil surface condition	Rockiness	Salinity	Discharge potential	Microrelief	Wetness	Soil complexity	Topographic complexity	XX Overall assessment rating
Poly No.	**Soil Unit**	**Lands pos**	**A**	**Cf**	**Cs**	**Ct**	**E**	**F**	**Ir**	**M1**	**M2**	**Nr1**	**Nr2**	**Pd**	**Ps**	**R**	**Sa**	**Ss**	**Tm**	**W**	**Xs**	**Xt**	
11	A1		1	2	3	2	1	2	2	-	1	1	1	1	2	1	1	1	1	3	1	1	3
20	A1		1	2	3	2	1	2	2	-	1	1	1	1	2	1	1	1	1	3	1	1	3
22	A1		1	2	3	2	1	2	2	-	1	1	1	1	2	1	1	1	1	3	1	1	3
39	A1		1	2	3	2	1	2	2	-	1	1	1	1	2	1	1	1	1	3	1	1	3
46	A1		1	2	3	2	1	2	2	-	1	1	1	1	2	1	1	1	1	3	1	1	3
4	A1e		1	2	3	2	4	4	2	-	1	1	1	1	2	1	1	3	1	4	1	5	5
47	A1e		1	2	3	2	4	4	2	-	1	1	1	1	2	1	1	3	1	4	1	5	5
3	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	4	4
9	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	1	4
21	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	1	4
37	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	1	4
38	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	1	4
43	A2	TEP	1	2	3	2	2	3	2	-	1	1	1	1	2	1	1	3	1	4	1	1	4
1	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	1	4
5	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	4	4
10	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	1	4
18	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	4	4
23	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	4	4
25	A2	BKP	1	2	3	2	2	4	2	-	4	1	2	1	2	1	4	4	1	4	1	4	4
36	A3		1	2	3	2	3	4	2	-	1	3	3	1	2	1	1	3	1	3	1	4	4
45	A3		1	2	3	2	3	4	2	-	1	3	3	1	2	1	1	3	1	3	1	4	4
2	A4		1	2	3	2	3	4	3	-	1	3	3	1	3	1	1	4	1	5	1	4	5
24	A4		1	2	3	2	3	4	3	-	1	3	3	1	3	1	1	4	1	5	1	4	5
33	A4		1	2	3	2	3	4	3	-	1	3	3	1	3	1	1	4	1	5	1	4	5
12	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
13	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
14	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
16	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
28	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
32	B1		1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	1	4	3	1	5
19	B2	TEP	1	2	3	2	2	3	3	-	4	3	3	1	4	1	5	3	1	4	1	1	5
40	B2	TEP	1	2	3	2	2	3	3	-	4	3	3	1	4	1	5	3	1	4	1	1	5
15	B2	BKP	1	2	3	2	2	4	3	-	4	3	3	1	4	1	5	4	1	4	3	1	5
26	B2	BKP	1	2	3	2	2	4	3	-	4	3	3	1	4	1	5	4	1	4	3	1	5
31	B2	BKP	1	2	3	2	2	4	3	-	4	3	3	1	4	1	5	4	1	4	3	1	5
35	B2	BKP	1	2	3	2	2	4	3	-	4	3	3	1	4	1	5	4	1	4	3	1	5
42	B2g	TEP	1	2	3	2	1	3	3	-	3	3	1	1	3	1	5	3	3	5	1	1	5
27	B2g	BKP	1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	3	5	1	1	5
29	B2g	BKP	1	2	3	2	1	4	3	-	3	3	1	1	3	1	5	4	3	5	1	1	5
41	B3	TEP	3	2	3	2	1	3	3	-	4	1	3	1	4	1	5	3	1	5	1	1	5
6	B3	BKP	1	2	3	2	1	4	3	-	4	1	3	1	4	1	5	4	1	5	3	1	5
17	B3	BKP	1	2	3	2	1	4	3	-	4	1	3	1	4	1	5	4	1	5	3	1	5
30	B3	BKP	1	2	3	2	1	4	3	-	4	1	3	1	4	1	5	4	1	5	3	1	5
44	B3	BKP	1	2	3	2	1	4	3	-	4	1	3	1	4	1	5	4	1	5	3	1	5
8	C1		1	2	3	2	2	1	3	-	1	1	1	1	3	1	2	1	2	4	1	1	4
34	C1		1	2	3	2	2	1	3	-	1	1	1	1	3	1	2	1	2	4	1	1	4
7	C2		1	2	3	2	2	3	3	-	4	3	3	1	3	2	5	4	1	4	3	1	5

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