Appendix C

Updated Biosis Archaeological Report

Limondale Sun Farm

Overland Sun Farming

Balranald sun farming project, NSW: Archaeological Report

FINAL REPORT

Prepared for Overland Sun Farming Company Pty Ltd

21 June 2017

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- Wakool Aboriginal Corporation
- Pappin Family Aboriginal Corporation
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- Mr John Jackson

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- Office of Environment and Heritage
- National Native Title Tribunal

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Glossary

ACHAR	Aboriginal Cultural Heritage Assessment Report
AHIMS	Aboriginal Heritage Information Management System
Consultation requirements	*Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a)
DA	Determining Authority
DECCW	Department of Environment, Climate Change and Water (now OEH)
DP	Deposited Plan
EPA	Environment Planning and Assessment
GDA	Geocentric Datum of Australia
GPS	Global Positioning System
GSV	Ground Surface Visibility
ICOMOS	International Council on Monuments and Sites
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MGA	Map Grid of Australia
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NTSCORP	Native Title Services Corporation
OEH	NSW Office of Environment and Heritage
PAD	Potential Archaeological Deposit
Study area	Bounded by Yanga Way to the east and surrounded by large farming properties
RAP	Registered Aboriginal Party
REF	Review of Environmental Factors
REP	Regional Environmental Plan
SEPP	State Environmental Planning Policy
The code	*Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010)

Summary

Biosis Pty Ltd was commissioned by Overland Sun Farming Company Pty Ltd to undertake an Aboriginal cultural heritage assessment of the Limondale Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated infrastructure in the Murray Darling Depression bioregion of south-western NSW (the project) (Figure 3). The site is located approximately 14 kilometres south of Balranald and approximately 160 kilometres east of the Mildura central business district (CBD).

There are 22 Aboriginal cultural heritage sites registered with the Aboriginal Heritage Information Management System (AHIMS) register, both within the site boundary as well as in the vicinity.

The Department of Planning and Environment is the consent authority and will assess the Environmental Impact Statement (EIS) to determine if the project is likely to have a significant effect on the environment, including Aboriginal cultural heritage.

The Aboriginal community was consulted regarding the heritage management of the project throughout its lifespan. Consultation has been undertaken as per the process outlined in the DECCW document, *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a) (consultation requirements).

The survey was conducted between 23 and 28 January 2017. The overall effectiveness of the survey for examining the ground for Aboriginal sites was deemed low. This was attributed to vegetation cover restricting ground surface visibility combined with a low amount of exposure.

Eleven previously unrecorded Aboriginal cultural heritage sites were identified during the field survey, including one with a Potential Archaeological Deposit (PAD). One historical site was also located during the survey.

There is potential for development activities to impact Aboriginal sites and the identified sites or areas of (archaeological) sensitivity.

Strategies have been developed based on the archaeological (significance) of cultural heritage relevant to the study area. The strategies also take into consideration:

- Predicted impacts to Aboriginal cultural heritage
- The planning approvals framework

Current best conservation practice, widely considered to include:

- Ethos of the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter
- The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*(DECCW 2010) (the code)

The recommendations that resulted from the consultation process are provided below.

Management recommendations

Prior to any development impacts occurring within the study area, the following is recommended:

Recommendation 1: Continued consultation with the registered Aboriginal parties

It is recommended that Overland Sun Farming continue to inform the RAPs about the management of Aboriginal cultural heritage sites within the site boundary throughout the construction of the project. This

recommendation is in keeping with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a).

Recommendation 2: Sites Limondale 1, 9 and 11 should be salvaged prior to development.

The development footprint is unable to avoid impacts to sites Limondale 1, 9 and 11. It is recommended that these sites undergo surface salvage prior to construction, with the exact details developed as part of a cultural heritage manage plan (CHMP).

Recommendation 3: Sites Limondale 2, 3, 4, 5, 6, 7, 8 and 12, and AHIMS sites 47-5-0008, 47-5-0604, 47-6-0603, are to be avoided from impact.

The development footprint avoids impact to sites Limondale 2, 4,5,6,7, 8 and 12, and AHIMS sites 47-5-0008, 47-6-0603, 47-5-0604 so further investigation is not required. However, in future if the development area changes and impact to these sites becomes likely further archaeological investigation in the form of sub-surface testing and would be required.

Recommendation 4: Further assessment required for AHIMS sites 47-6-0606 and 47-6-0605, or if further works are proposed outside of the current study area

The development footprint is unable to avoid impacts to AHIMS sites 47-6-0606 and 47-6-0605. It is recommended that further assessment, in the form of sub-surface testing, be undertaken at these sites.

If further disturbance is proposed in areas outside of the current study area, then additional survey may be required.

Recommendation 5: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and places are protected under the National Parks and Wildlife Act. It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the OEH and Aboriginal stakeholders to inform options for management of the objects.

Recommendation 6: Discovery of unanticipated historical relics

Relics are historical archaeological resources of local or State significance and are protected in NSW under the Heritage Act 1977. Relics cannot be disturbed except with a permit or exception/exemption notification. Should unanticipated relics be discovered during the course of the project, work in the vicinity must cease and an archaeologist contacted to make a preliminary assessment of the find. The Heritage Council will require notification if the find is assessed as a relic.

Recommendation 7: Discovery of Aboriginal ancestral remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains
2. Notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location
3. Not recommence work at that location unless authorised in writing by OEH.

Recommendation 8: Stop work provision for any potential discovery of human remains

If any suspected human remains are discovered during any activity works, all activity must cease immediately. The remains must be left in place and protected from harm or damage. The following contingency plan describes the immediate actions that must be taken in instances where human remains or suspected human remains are discovered. Any such discovery at the activity area must follow these steps:

1. Discovery: If suspected human remains are discovered all activity must stop to ensure minimal damage is caused to the remains; and the remains must be left in place, and protected from harm or damage.
2. Notification: Once suspected human skeletal remains have been found, the Coroners Office and the NSW Police must be notified immediately. Following this, and if the human remains are likely to be Aboriginal in origin, the find will be reported to the Aboriginal parties and DECCW NSW. If the find is likely to be non-Aboriginal in origin and more than 100 years in age, the Heritage Council of NSW will be notified of the find under s.146 of the *Heritage Act 1977*.

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Overland Sun Farming Company Pty Ltd to undertake an Aboriginal cultural heritage assessment of the Limondale Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated infrastructure in the Murray Darling Depression bioregion of south-western NSW (the project) (Figure 1). The assessment included a field survey and a review of background resources including soil landscapes, geology, hydrology and past reports and site records to inform predictive statements about the likelihood of Aboriginal heritages sites to occur within the study area.

An environmental impact statement (EIS) is a requirement of the approval process. This report details the investigation, consultation and assessment of Aboriginal cultural heritage undertaken for the project and forms part of the EIS.

1.2 Location of the study area

The study area is located approximately 14 kilometres south of Balranald within the Balranald Local Government Area (LGA), Parish of Balranald, County of Caira (see Figure 1). The study area encompasses 2,058 hectares of private land and the adjacent road reserves as shown in Figure 2. It is bounded by Yanga Way to the east and is surrounded by other large farming properties. The study area is zoned RU1 Primary Production with portions of the site identified as having high conservation values under the Balranald Local Environmental Plan 2010 (Balranald LEP).

The property description for the site is given in Table 1.

Table 1 Study area location

Lot number	Deposited plan (DP)
Lots 4, 12, 13, 15, 21 and 71	751179
Lots 11 and 12	751173
Lot 2	1017111
Lots 1 and 2	1190069

1.3 Planning approvals

The project is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). A development application for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning, or the Minister's delegate, is the consent authority.

Other relevant legislation and planning instruments that will inform the assessment include:

- *National Parks and Wildlife Act (NPW Act) 1974* (NSW)

- *National Parks and Wildlife Amendment Act 2010* (NSW)
- Balranald Local Environmental Plan 2010.

This report was prepared in accordance with the requirements of the NSW Department of Planning and Environment. These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 4 November 2016. The SEARs identify matters which must be addressed in the EIS. The SEARS state that the EIS must address:

- Heritage – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community

Further comments from OEH in regards to the SEARS also state that the EIS must:

- Identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the proposed Limondale Sun Farm and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the Guide to investigating. assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW, 2011) and consultation with OEH regional officers.
- Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.
- Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.

1.4 Objectives of the investigation

The objectives of the investigation can be summarised as follows:

- To identify and consult with any registered Aboriginal stakeholders and the Balranald Local Aboriginal Land Council.
- To conduct additional background research in order to recognise any identifiable trends in site distribution and location.
- To search statutory and non-statutory registers and planning instruments to identify listed Aboriginal cultural heritage sites within the study area.
- To highlight environmental information considered relevant to past Aboriginal occupation of the locality and associated land use and the identification and integrity/preservation of Aboriginal sites.
- To summarise past Aboriginal occupation in the locality of the study area using ethnohistory and the archaeological record.
- To formulate a model to broadly predict the type and character of Aboriginal sites likely to exist throughout the study area, their location, frequency and integrity.
- To conduct a field survey of the study area to locate unrecorded or previously recorded Aboriginal sites and to further assess the archaeological potential of the study area

- To assess the significance of any known Aboriginal sites in consultation with the Aboriginal community.
- To identify the impacts of the proposed development on any known or potential Aboriginal sites within the study area.
- To recommend strategies for the management of Aboriginal cultural heritage within the context of the proposed development.

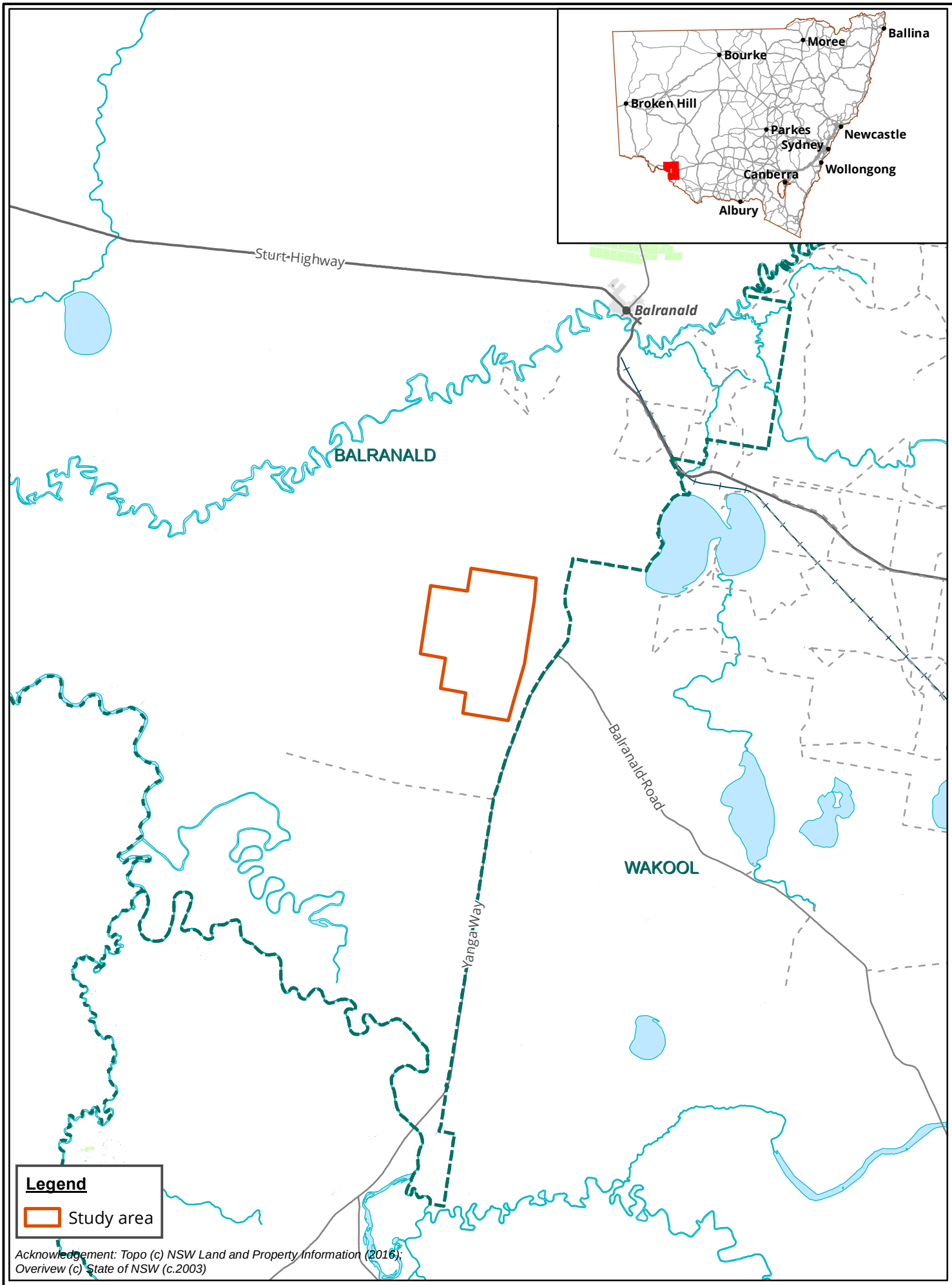
1.5 Investigators and contributors

The roles, previous experience and qualifications of the Biosis project team involved in the preparation of this archaeological report are described below in Table 2.

Table 2 Investigators and contributors

Name and qualifications	Experience summary	Project role
Amanda Atkinson BA (Hons)	Amanda has nine years archaeological consulting experience across south-eastern and western Australia. She is experienced in all aspects of heritage consulting with specialisation in Aboriginal archaeology. Amanda has extensive experience in the successful completion of Aboriginal and historical assessments, archaeological surveys, excavations, permits and management plans. She is accomplished in obtaining approvals under the NSW *National Parks and Wildlife Act 1974* and *NSW Heritage Act 1977*. Amanda has primarily undertaken projects in south-eastern Australia and the Pilbara region of Western Australia and has a detailed understanding of heritage values within the Sydney Basin, Cumberland Plain and Hunter Valley. Amanda specialises in the archaeology of central and far western New South Wales, with particular research interests in the Lachlan River valley.	• Lead cultural heritage advisor • Aboriginal community consultation • Field survey • Development of recommendations • Preparation of the report.
Rebecca Morris BA (Hons)	Rebecca recently graduated from the University of Sydney with First Class Honours in Archaeology and has experience with desktop assessments, archaeological field surveys, aboriginal and historical excavations, and the recording and analysis of cultural material. She also has skills in lithic analysis and project, administrative and client liaison experience. Most recently she has been involved in field survey, salvage and test excavation and archaeological report writing for Western Sydney, the NSW North Coast and the Southern Tablelands.	• Field survey • Preparation of the report
Lucy Sinclair BA (Hons)	Lucy Sinclair is a consultant archaeologist with the Biosis Pty Ltd Newcastle Office. Lucy has over ten years' experience working as a heritage consultant in Western Australia and	• Preparation of the report

Name and qualifications	Experience summary	Project role
	more recently in New South Wales. She has been involved in multiple surveys and excavations, with extensive experience in lithic analysis, rock art recording and Aboriginal consultation. She also plays a key role in the quality assurance of technical archaeology reports.	



Acknowledgement: Topo (c) NSW Land and Property Information (2016); Overivew (c) State of NSW (c.2003)

Figure 1: Location of the study area

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Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 23049
Date: 11 April 2017,
Checked by: MJS, Drawn by: LH, Last edited by: lharley
Location:P:\23000s\23049\Mapping\

0 2,000 4,000 6,000 8,000
Metres
N

Scale 1:200,000 @ A4, GDA 1994 MGA Zone 54

Legend

Study area

Acknowledgements: Topo (c) NSW Land and Planning Information

Figure 2: Location of the study area

0 240 480 720 960 1,200

Metres

Scale: 1:24,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

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Date: 11 April 2017,
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2 Proposed development

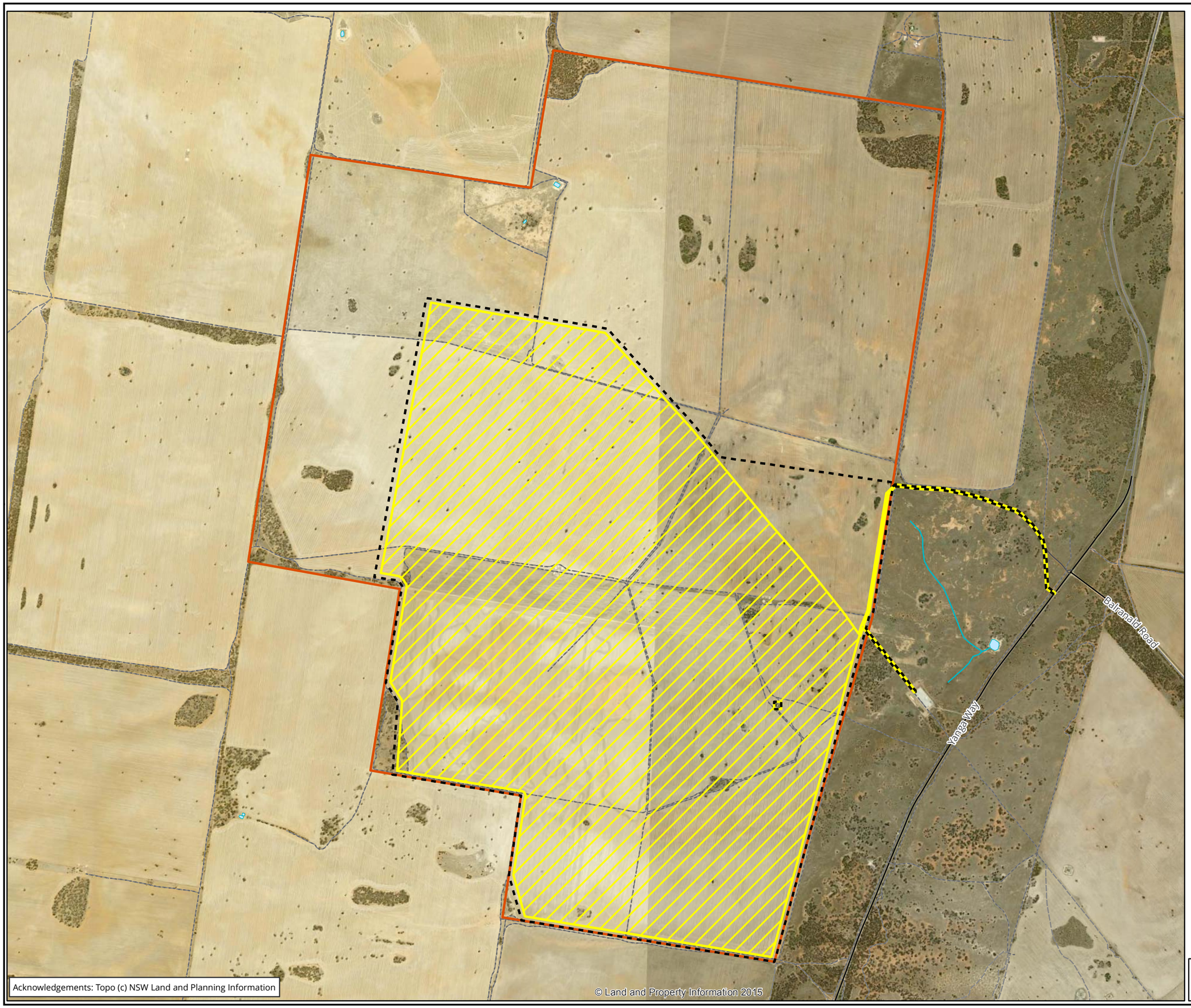
The project includes the development, construction and operation of a solar PV electricity generation facility, which comprises the installation of PV solar panels and associated infrastructure on the site.

The project will connect to the Transgrid 220 kV electricity distribution network that originates at the Balranald 220 kV Substation. The electricity and associated environmental products generated from the project will be sold to one or more of a registered energy retailing organisation, large energy users (governmental or private) or to the National Electricity Market that is managed by the Australian Energy Market Operator.

The project will have an estimated capacity in the order of 250 MW and comprises the following key components:

- a network of PV solar panel arrays
- electrical collection systems, switchyard and control room
- a management hub, including demountable offices and amenities and equipment sheds
- parking and internal access roads
- easement and connection infrastructure to the Balranald 220 kV Substation.

The development footprint is defined as the land area within the site where project infrastructure will be constructed and operate for the project life. The development footprint encompasses an area of 1532 ha, which has been refined through the project design process to avoid environmental constraints (primarily remnant vegetation and Aboriginal heritage). The conceptual infrastructure layout within the development footprint is presented in Figure 3.



Legend

- Study area
- Development footprint
- Infrastructure area

Figure 3: Proposed development

0 240 480 720 960 1,200

Metres

Scale: 1:24,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

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Biosis Pty Ltd

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3 Desktop assessment

A desktop assessment has been undertaken to review existing archaeological studies for the study area and surrounding region. This information has been synthesised to develop Aboriginal site prediction statements for the study area and identify known Aboriginal sites and/or Places recorded in the study area. This desktop assessment has been prepared in accordance with requirements 1 to 4 of the Code.

3.1 Landscape context

It is important to consider the local environment of the study area in any heritage assessment. The local environmental characteristics can influence human occupation and associated land use and consequently the distribution and character of cultural material. Environmental characteristics and geomorphological processes can affect the preservation of cultural heritage materials to varying degrees or even destroy them completely. Lastly, landscape features can contribute to the cultural significance that places can have for people.

3.2 Geology, soils and landforms

The study area is located in far south-west NSW, an area characterised by its ancient landscape and ancient lakes and waterways. The broader landscape formed over 60 million years when the area was covered by an inland sea. At this time marine sands were deposited and these sands are present in the current landscape. Subsequent draining of the sea led to periods of inundation by a giant fresh water lake and periods of deposition of clays and carbonates. The present landscape surface therefore represents the final phase of deposition, the youngest of which is approximately 36,000 years old (Porteners 1993).

The study area is located within the Murray Darling Depression bioregion. In NSW bioregions are characterised by broad areas which contain natural features and environments that influence the functions of entire ecosystems. The Murray Darling Depression bioregion is located in south-west New South Wales, extending into Victoria and South Australia. In total the Murray Darling Depression bioregion is 19,717,651 hectares, with 40.71 per cent lying within New South Wales (Eardley 1999, NPWS 2003). The Murray Darling Depression bioregion includes few towns; Ivanhoe is the major settlement in the bioregion with large pastoral stations including, Balranald, Manilla and Emmdale also located within this bioregion (NPWS 2003). The bioregion includes the four major river systems being the Murray, Murrumbidgee, Lachlan and Darling as well as three smaller systems of the Barwon, Yanda and Peacock Rivers.

The Murray Darling Depression bioregion is dominated by dunefields, sandplains and undulating plains of brown calcareous soils that are all of Tertiary and Quaternary age deposited from a shallow inland sea (Figure 3). Over time the sandy surface has been reworked into dunes and sandplains with the dunes in the study area being of a linear east-west orientation. All of the lakes and swamps in this bioregion have well-formed lunettes on their eastern margins. These lunettes have high potential to contain *in-situ* evidence of human occupation which could be of great antiquity (NPWS 2003). The climate in this bioregion is distinctly hot and dry with some areas being arid but that majority of the bioregion being semi-arid. The average temperature ranges from 3°C to 35°C and the mean annual rainfall is 210 to 400 millimetres (Stern *et al*. 2000).

Soil landscapes have distinct morphological and topological characteristics that result in specific archaeological potential (Figure 4). Because they are defined by a combination of soils, topography, vegetation and weathering conditions, soil landscapes are essentially terrain units that provide a useful way to summarise archaeological potential and exposure.

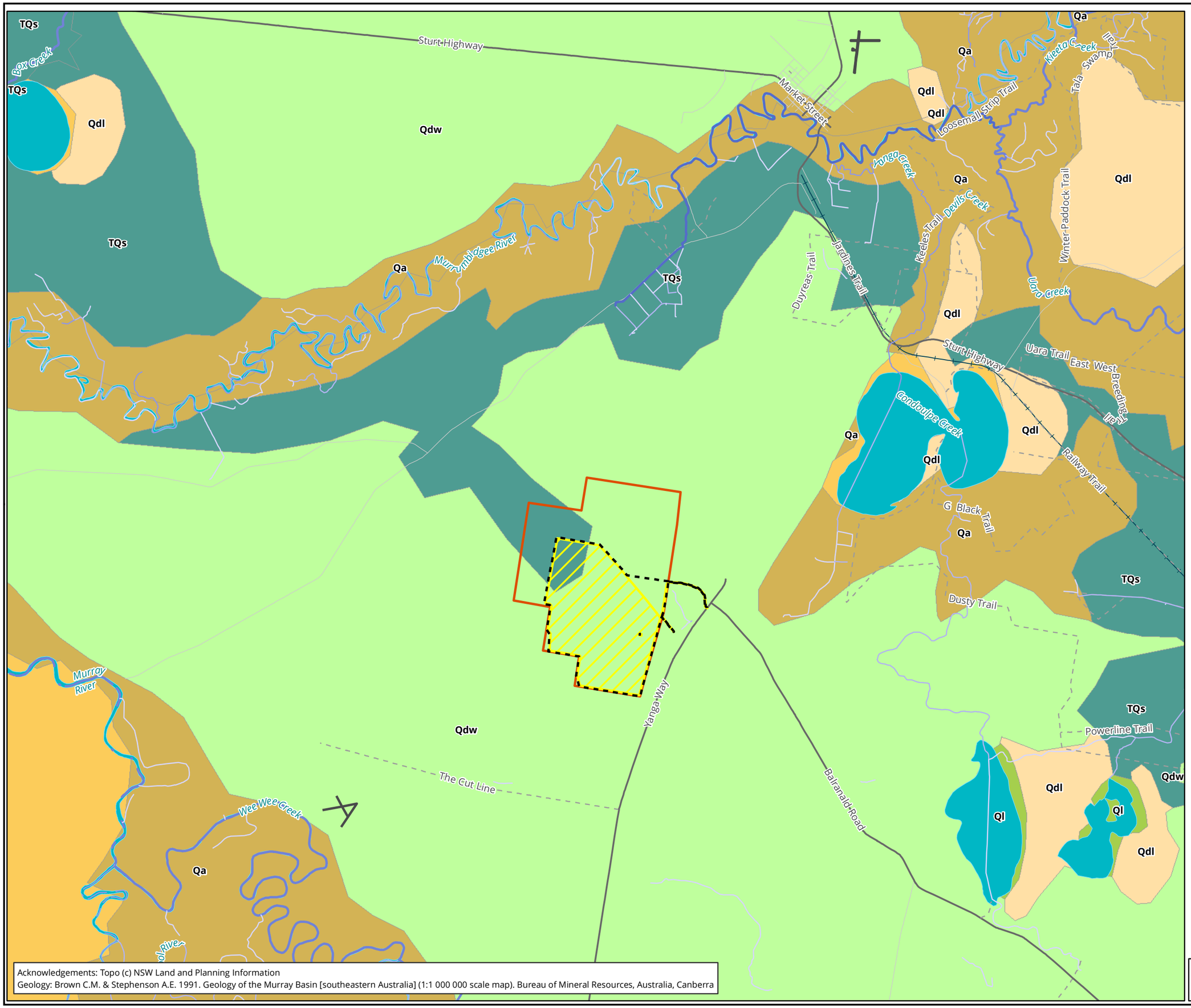
The Murrumbidgee scalded plains (Mbd) soil landscape is present within the study area. It is characterised as a flat alluvial landscape consisting of sediments of grey, brown and red cracking clays and red brown texture contrast soils. The Murrumbidgee depression plains (Mud) is characterised by alluvial plains with numerous circular depressions to a relief of 10 metres. The Mud soil landscape contains grey to brown clays and clay loams. The Mallee cliffs sandplains (Msc) contains numerous land systems; the land systems present within the study area were not mapped as part of this assessment. Generally, the Mcs soil landscape contains east-west oriented dunefields of quaternary Aeolian sands often with blowouts (see Table 3). These blowouts often contain evidence of previous human occupations.

Table 3 Soil landscape characteristics of soil landscapes in the study area (DECC 2002, pp. 101-105).

Soil material	Description
Mbd – Murrumbidgee scalded plains	Quaternary alluvium plains with extensive scalding interpreted as relic floodplains or terraces. Grey, brown and red cracking clays, red-brown texture contrast soils with scalds. Levees traces evident, relief generally <1 m up to 5 m on associated pans, swamps and lunettes. Low shrublands, grasslands and saltbush occur.
Mud – Murrumbidgee depression plains	Quaternary alluvial plains with numerous circular depressions interpreted as high floodplains or low terraces beyond the reach of average floodwaters with a relief to 10 m. Grey to brown clays and clay loams with a linear pattern from prior sandy streams. Now covered by extensive grasslands.
Msc - Mallee cliffs sandplains	Mallee cliffs sandplains landscape includes part of twelve land systems which include Ashmount, Bulgamurra, Frenchmans, Gulthal, Hatfield, Mulurulu, Overnewton, Quambi, Roo Roo, Trelega and Wilkura. The landscape is characterised by extensive and slightly undulating sandplains of quaternary Aeolian sands with east-west trending dunes, often with blowouts. It also contains partly scalded broad swales and small depressions with a relief of 6 to 10 m.

3.3 Flora and fauna

The area surrounding the study area supports natural and modified vegetation communities. The term modified is used to describe land where the original natural vegetation cover has been cleared and replaced with agricultural land uses. The state of vegetation in these modified areas varies considerably, from recently cropped areas to regenerating native vegetation. Although areas of natural vegetation cover the study area, most plant communities have been disturbed or degraded as a result of altered water regimes, physical disturbance from earthworks, livestock and pest animal grazing and weed invasion.



Legend

- Study area
- Development footprint
- Infrastructure area

Watercourse (strahler order)

- 1
- 2
- 3
- 4
- 5

Geological units (1:250,000)

- Unknown
- Qa
- Qdl
- Qdw
- Ql
- TQs

Figure 4: Geology/hydrology of study area

0 1,000 2,000 3,000 4,000 5,000

Metres

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

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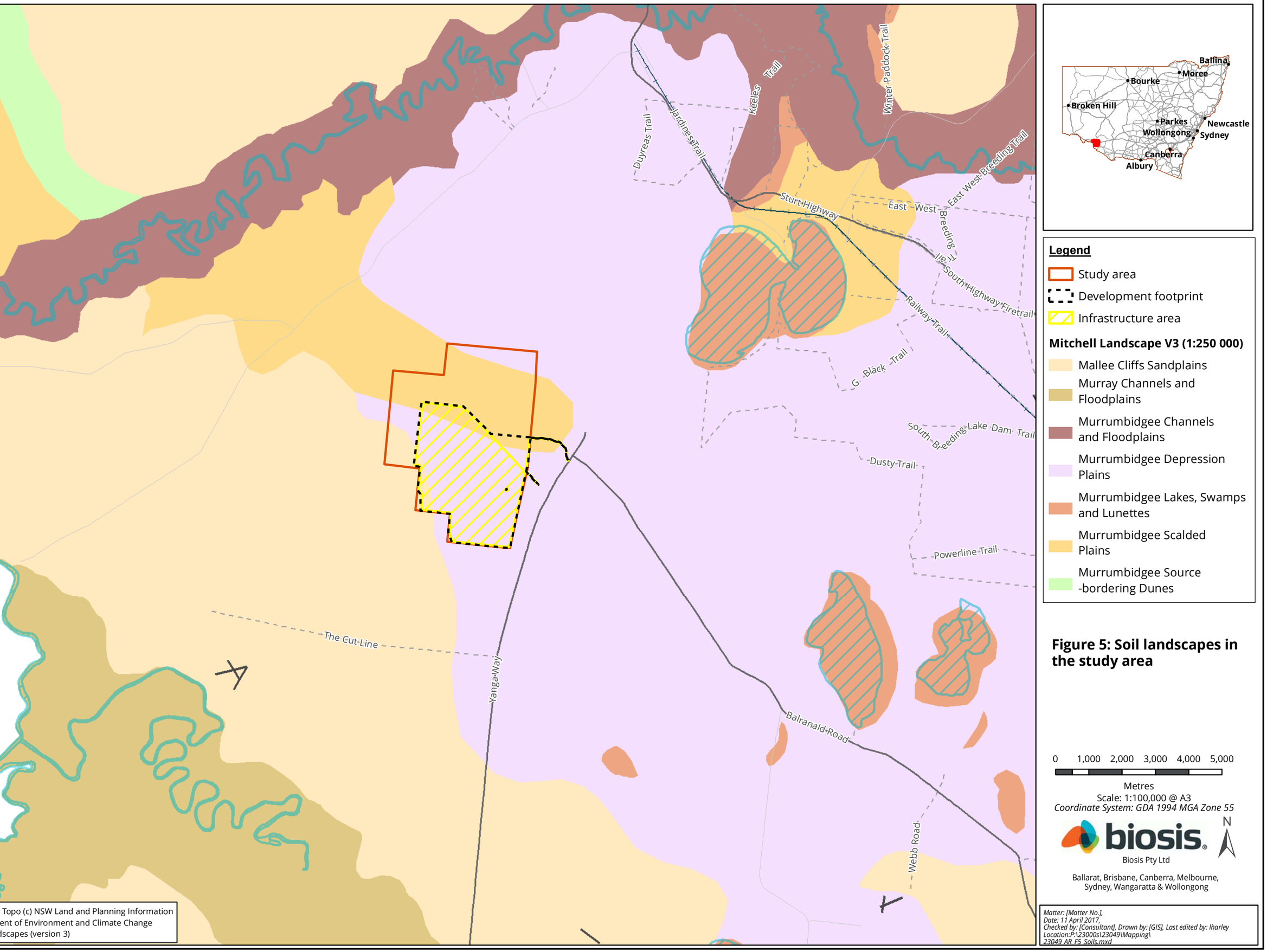
Acknowledgements: Topo (c) NSW Land and Planning Information

Geology: Brown C.M. & Stephenson A.E. 1991. Geology of the Murray Basin [southeastern Australia] (1:1 000 000 scale map). Bureau of Mineral Resources, Australia, Canberra

Matter: 23049,
Date: 11 April 2017,
Checked by: MJS, Drawn by: LH, Last edited by: lharley
Location:P:\23000s\23049\Mapping
23049_AR_F4_Geology.mxd



Legend

- Study area
- Development footprint
- Infrastructure area

Mitchell Landscape V3 (1:250 000)

- Mallee Cliffs Sandplains
- Murray Channels and Floodplains
- Murrumbidgee Channels and Floodplains
- Murrumbidgee Depression Plains
- Murrumbidgee Lakes, Swamps and Lunettes
- Murrumbidgee Scalded Plains
- Murrumbidgee Source -bordering Dunes

Figure 5: Soil landscapes in the study area

0 1,000 2,000 3,000 4,000 5,000

Metres
Scale: 1:100,000 @ A3
Coordinate System: GDA 1994 MGA Zone 55

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Acknowledgements: Topo (c) NSW Land and Planning Information
Soils: NSW Department of Environment and Climate Change (2008), Mitchell Landscapes (version 3)

Matter: [Matter No.],
Date: 11 April 2017,
Checked by: [Consultant], Drawn by: [GIS], Last edited by: lharley
Location:P:\23000s\23049\Mapping\23049_AR_F5_Soils.mxd

3.4 Resource statement

Resources in the vicinity of the study area would have provided adequate sources of nutrition for subsistence activities; however these resources would be largely tied to seasonal variations and the flow of the nearby Murrumbidgee River. In this respect, activities in and around the study area would resemble that elsewhere in Western New South Wales, with the Murrumbidgee finding parallels in the riverine environments surrounding the Murray and Darling River systems, and the semi-arid plain, with its ancestral lakes being similar to other semi-arid areas such as Willandra.

The activities of the Barkandji linguistic group in the Darling Basin, north-west of the current study area, have been well documented. Summer marked the period of highest productivity, with river flow being the strongest at this time. As a result of this, aquatic plants and animals were both abundant and nomadic avian species present to reproduce and feed. Cold conditions in winter coincided with lower flow of the river, leading to a marked decrease in available food resources, with fish and many crustaceans being either absent or in hibernation, and other sources, such as mussels, being present in decreased populations (Allen 1974 p. 311). Although the Murray Darling Basin is a winter-spring dominant system, in contrast to the Darling River which is summer dominant, a similar theory of seasonal use applies to the lower Murray Darling basin. This theory of seasonal use explains the high density of Aboriginal sites located away from the riverine and lacustrine environments in the semi-arid and arid plains.

In contrast, the surrounding arid and semi-arid plains provided greater opportunities to local groups in winter. Although Allen (1974, p. 311) observes that potential sources of food remain relatively stable throughout the year, these sources became more accessible during winter when the plains would become easier to traverse. During summer, high evaporation rates in these areas made water sources scare, sources which were generally more stable during winter, and allowed groups to traverse these arid regions in search of alternative food sources such as red kangaroo. As a result of this, Allen theorised that these groups would have stayed close to large water sources during summer, when sources of food were plentiful, and venturing into the surrounding arid and semi-arid areas in winter when these areas were more accessible, and the chances of obtaining food higher.

Descriptions are also available on resources available to groups around the Menindee Lakes as a part of Pardoe's (2003) study, which looked at how these resources and environments were used by groups in the area. Like the current study area and other examples described here, the Menindee Lakes area is characterised by a small number of permanent or semi-permanent water sources, which appear to supply a large portion of the landscape resources available to local groups, and arid or semi-arid plains surrounding these sources.

Pardoe noted ethnographic descriptions of Aboriginal resource use in the Menindee Lakes area, noting that different observers described drastically different situations there. Where Mitchell described large stretches of water, plentiful in waterfowl and fish (Mitchell 1839), Sturt in Pardoe described dried up lakes and local populations surviving almost entirely on roots (Sturt 1835). These descriptions give weight to the assertion made by both Pardoe and Allen that Aboriginal groups living in these environments would have employed both the riverine and arid/semi-arid environments.

A selection of resources common in the area has been compiled into Table 4 to give an indication of the resources available to local Aboriginal groups in and around the study area. Notably, the majority of the food sources mentioned in Table 3 are located within or in close proximity to rivers and lakes. This has partially to do with the greater availability of resources in these environments but it is also tied to early ethnographic observations made by explorers and surveyors such as Oxley, Mitchell, and Sturt.

These early explorers predominantly travelled close to the major rivers of the area, such as the Lachlan, Murrumbidgee, and Murray, and as a result of this, their observations mostly came as a result of interactions

with Aboriginal groups in these environments. Aboriginal activity is not well documented away from water sources, creating a bias in the information available.

Table 4 Landscape resources available to local Aboriginal groups.

Plant / animal	Aboriginal use
Bulrush / Cumbungi	Food source, fibres could be used to make twine (Mitchell 1835, Martin 2006, 2010)
Black Box	Wood used for boomerangs and other tools, bark used for canoes, dishes and shields, seeds as a food source, gum used as glue (Martin 2010)
Emus / emu eggs	Food source (Allen 1974), bones could be used for tools, the fat for medicine, and feathers as ornaments (Martin 2010)
Fish species	Food source, fat from these animals could also be used in medicine (Martin 2010)
Freshwater snail	Food source (Martin 2010)
Lignum	Food source – fresh shoots could be eaten raw (Martin 2010)
Marsh clubrush	Food source (Martin 2010)
Possum	Food source, skin could also be used to make cloaks (Martin 2010)
Red / grey kangaroo	Food source, also used to make bags to hold seeds or water (Allen 1974), bone was used for bone points, and the teeth for fish hooks (Martin 2010)
River mussel / lake mussel	Food source (Martin 2010)
River red-gum	Wood used for boomerangs and other tools, bark used for shields, dishes, and potentially boomerangs. (Martin 2010)
Rush	Used to make nets for hunting (Martin 2010)
Saltbush	Leaves used for medicinal wash, seeds ground and cooked (Martin 2010)
Snakes	Food source (Martin 2010)
Termites, termite larvae, and termite eggs	Food source, termite nests could also be used for a heat retainer over (Martin 2010)
Turtles	Food source, fat for medicine (Martin 2010)
Water ribbon	Food source – roots could be baked, and small fruits eaten (Martin 2006, 2010)
Waterfowl / other aquatic birds	Food source available in summer months in riverine environments (Allen 1974)
Yabby	Food source (Martin 2010)

3.5 Land use history

The study area initially formed part of the Yanga holding, before being subdivided and leased to brothers Joseph and H. T. Limon in the early 1890s, when the property was given the name of "Maffra" (NSW Parish Map, 1894). The land appears to have been used for grazing during this time and stayed in the hands of the Limon family into the 1920s (NSW Parish Map, 1924; Riverina Recorder, 1934).

3.6 Previous archaeological work

A number of Aboriginal cultural heritage investigations have been conducted for the areas surrounding Balranald and in the region. Models for predicting the location and type of Aboriginal sites with a general applicability to the region and thus relevant to the study area have also been formulated, some as part of these investigations and others from cultural heritage investigations for large developments. Looking at a wider area around Balranald, there are close links between it and other riverine/mallee environments within New South Wales, notably the Mungo, Willandra, and Menindee Lake systems, the Lachlan, and the Murray. These links become clearer when discussing the work of Allen (1974) and his discussion of the Bagundji (Barkindji) people in the Darling Basin. The links between the riverine and arid/semi-arid environments have clear parallels within the study area, with the Murrumbidgee situated nearby to the north and Yanga Lake system to the east of the study area.

3.6.1 Regional overview

Biosis (2016) undertook an assessment of a proposed water pipeline between Maude and Hay in NSW. The study area assessed a 65 kilometre pipeline route and located 21 Aboriginal heritage sites which included artefact scatters, hearths, earth mound and midden sites as well as a post contact site. Archaeological test excavation was undertaken at four locations within the study area and the subsurface assessment revealed archaeological deposits dating to 49,200 years BP.

Ironbark Heritage (2015) undertook a study of the Nimmie-Caira area for the Nimmie-Caira Enhanced Environmental Water Delivery Project. The project conducted 68 separate surveys in a 32 square kilometre area and identified 312 Aboriginal sites with 469 heritage features that included 40 burials, 46 modified trees, mounds, hearths, and artefacts.

Biosis (2015) undertook a desktop assessment for a soil sampling program being undertaken in the Nimmie-Caira. The study area was located on the lower Murrumbidgee River floodplain, near the town of Balranald and covered an area of 85,000 hectares. The assessment located 274 Aboriginal Heritage sites listed in the AHIMS along with the 312 Aboriginal sites located by Ironbark Heritage, three landforms considered to be of high potential and two geomorphological units of moderate potential were also predicted by the assessment.

Martin (2010) undertook a large scale assessment of aboriginal sites in the Lower Murrumbidgee and Lower Lachlan River wetlands and floodplains in NSW focusing on the links between the regional archaeology and wetland environments. Martin divided the Lower Murrumbidgee into four major landforms based on hydrological data these being the Murrumbidgee River, Nimmie-Caira Creeks, Redbank System to the north of the current study area, and Uara/Fiddlers Creek to the east of the study area. Martin conducted surveys within each of these landforms targeting areas that had not been the focus of previous cultural heritage surveys. Martin then used the results of these surveys to fill gaps in the archaeological record and develop predictive models for the Rivers Environmental Restoration Program (RERP).

Martin recorded a total of 1168 sites within the Lower Murrumbidgee and Lachlan River areas with 1306 features including mounds, ovens, middens, modified trees, burials, and artefacts being identified. As part of her surveys Martin also focused heavily on natural resources within the study areas, recording evidence of potential and utilized plant and faunal resources available in wetland regions.

Witter (2000) undertook a large scale assessment of Aboriginal sites in NSW, looking at regional variation on site types and distributions to develop a better understanding of how sites are preserved, and what natural processes impact on site preservation, with a particular focus on open camp sites. As a part of this study, Witter divided the state in to eight Archaeological regions, based on the pre-existing Interim Biogeographic Regionalisation for Australia. The current study area falls under the Riverine plains region (Witter 2004, p. 140).

The Riverine plains region is described as an area of alluvial plains cut by the Murray, Murrumbidgee, and Lachlan Rivers. It also contains a network of paleo channels and lake beds, containing deposits dating to the

late Holocene and early Pleistocene. Witter noted that owing to a lack of raw material in the region, stone artefacts are relatively scarce and small, although the presence of hearths can assist in identifying camp sites. Mounds are also a noted feature of this region, particularly on the Hay Plain, where they reach a larger size than elsewhere, and tend to contain larger numbers of stone artefacts. A summary of the archaeology present in the region is shown in Table 3.

Witter notes that in the past 200 years, a large part of the region had been cultivated, which has led to the destruction of archaeological traces through the flattening of mounds and ploughing of the ground surface. Witter describes the mound settlements as the most extraordinary features in Australian archaeology, as they suggest the region to be a major population centre of Aboriginal Australia (Witter 2004, p. 142).

It is concluded that that although the factors impacting on the preservation of open campsites in NSW vary, there are a number of main ones, including the erosion of soil profiles, hill slope erosion, gullying and rilling, blowouts, and clay pan expansion. He also notes that the introduction of domestic grazing animals has had a large impact on the archaeological record, as they accelerate the natural factors mentioned above (Witter 2004, p. 146).

Klaver (1987, 1995, 1998) has completed a number of studies focusing on the central Murrumbidgee and surrounds, primarily the area between Narrandera and Hay, to the east of the current study area. Klaver's work includes large scale survey to identify Aboriginal sites, and the excavation and dating of mound sites. As with Martin (2006, 2010), a major focus of Klaver's work was earth mounds.

The excavations conducted by Klaver identified the mounds as the result of the in situ use of baked clay heat retainer ovens. Dates obtained from the Cooey Point Lagoon excavations (around 100 k m east of the study area) identify a range of dates between 400 to 2660 BP. However Klaver noted that the date of 2660 BP comes from the 'core' of the mound, and that the overlying material was dated to 2000 years later.

Pardoe (1995) attempted to develop a regional model relating biological and cultural change in south-eastern Australia, with a focus on societies in the Murray-Darling River system. The biological discussion undertaken is closely linked with recovered skeletal remains, discussing the gradual changes seen in these remains and their potential links to changes in environment and cultural change. Explanations included a predator-prey model, stating the predator (human) size evolves alongside prey (animal) size, and that with the decrease in prey size after megafaunal extinction, predator size decreased too. A biocultural model is also put forward, relating skull size to various factors including warfare, famine, and disease.

Pardoe (2003) undertook a study of the Menindee Lakes, around 150 – 200 kilometre north-west of the current study area. The study involved an intensive archaeological survey aimed at identifying sites in areas which had been neglected by previous surveys. Pardoe used spatial analysis to identify areas of higher potential, focusing on environmental factors. The study area covered for this project was largely constricted to lake margins, river edges, floodplains, feeder creeks, and lakebeds, generally not extending more than 900 metres away from water sources.

As this study was centered on the Menindee Lakes, a part of it utilised spatial data to determine site distance from water source. It observed that that almost all sites were found within 1,500 metres of water, with the average distance being 368 metres from water. The study reported 90 per cent of sites were found within 500 metres of water, and 11per cent at water's edge. The predominant site types identified by Pardoe were oven (55%), and artefact (15%) sites, although there were a large number of site types identified throughout the course of the survey, with a total of 4,978 sites identified in 2,432 areas.

Fanning and Holdaway (2004) undertook a broad study of factors affecting surface artefact visibility in Western New South Wales. Their area of study took in a portion of 12 Mile Creek in the Sturt National Park, close to the border between NSW, Queensland, and South Australia. Although geographically quite far away

from the current study area, it does share a number of environmental characteristics, being located in an arid zone with discontinuous vegetation coverage.

The survey covered a variety of geographic units and surface types, seeking to compare exposures and artefact quantities present in each. The study did not find firm evidence to support increased or decreased artefact density in particular areas beyond general trends, for example, that there would be decreased visibility on sand and vegetation covered surfaces. It did note however that narrow survey transect were not ideal, as in many cases artefact visibility is highly dependent on very localised conditions, for example disturbance or visibility in one particular area. It concluded that generally speaking, artefact visibility was highest on erosional surfaces, and lowest on depositional ones, however the impacts of local variation in landscape are significant, and if a survey seeks to study relationships at a landscape level, this variation must be accounted for.

Fanning (1999) conducted a study of recent changes in the arid zone of Western NSW, looking at regional change in the nineteenth and twentieth centuries. Fanning argues that since European settlement of Australia, soil erosion rates have drastically increased, to around 145 times their 'natural' rate (Fanning 1999, p. 191). Fanning concludes that the introduction of domestic grazing animals, along with changes in land use and their associated effects (decreased vegetation cover, tree cutting etc.) has enhanced runoff in the arid zone. This has in turn increased the level of erosiveness this water flow has had on soils

3.6.2 Local overview

3.6.2.1 Identified Aboriginal archaeological sites – study area

An extensive search of the AHIMS database was conducted on 7 July 2016 (Client service ID: 233168). The search identified 113 Aboriginal archaeological sites within a 5 kilometre search area, centred on the proposed study area (Table 5). Five of those registered sites were located *within* the study area (Figure 6). The mapping coordinates recorded for these sites were checked for consistency with their descriptions and location on maps from Aboriginal heritage reports where available. These descriptions and maps were not relied on where notable discrepancies occurred.
The AHIMS site located within the study area include:

- 47-5-0008
- 47-6-0603
- 47-6-0604
- 47-5-0605
- 47-5-0606

It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area.

Table 5 AHIMS search results

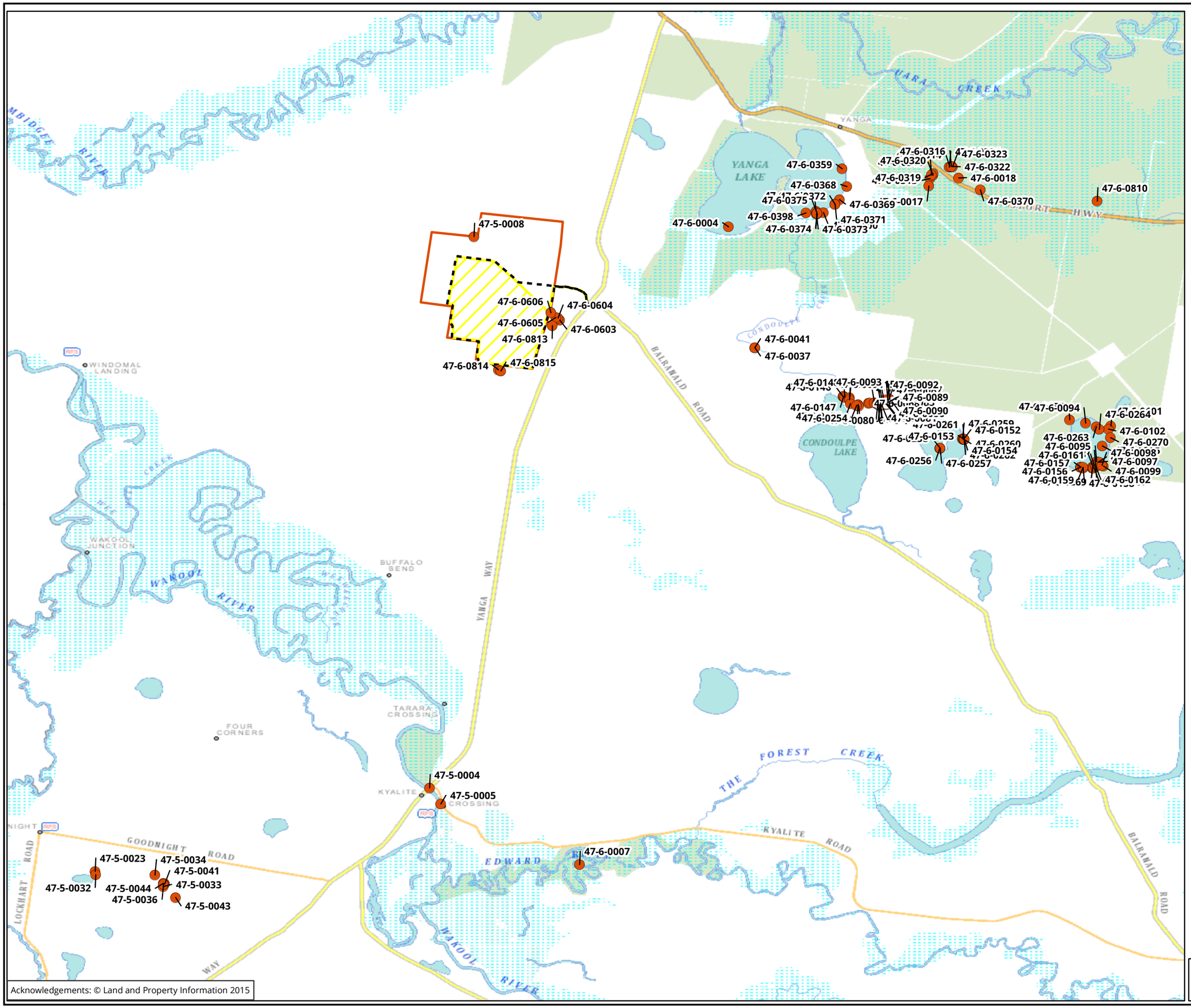
AHIMS site no	Site name	Site type
47-6-0004	Yanga Lake Burial Site	Burial
47-6-0007	Kyalite State Forest Scarred Trees;	Modified Tree (Carved or Scarred)
47-6-0041	Condoulpe Creek	Burial

AHIMS site no	Site name	Site type
47-6-0099	Lintot Lake 6	Artefact , Earth Mound, Hearth
47-6-0100	Lintot Lake 7	Earth Mound
47-6-0101	Lintot Lake 8	Earth Mound
47-6-0102	Lintot Lake 9	Artefact, Earth Mound, Shell
47-6-0253	Condoulpe Lake 24	Hearth
47-6-0255	Condoulpe Lake 26	Modified Tree (Carved or Scarred)
47-6-0256	South Dusty Lake 4	Modified Tree (Carved or Scarred)
47-6-0257	South Dusty Lake 5	Modified Tree (Carved or Scarred)
47-6-0258	South Dusty Lake 6	Modified Tree (Carved or Scarred)
47-6-0259	South Dusty Lake 7	Modified Tree (Carved or Scarred)
47-6-0260	South Dusty Lake 8	Modified Tree (Carved or Scarred)
47-6-0261	South Dusty Lake 9	Modified Tree (Carved or Scarred)
47-6-0262	South Dusty Lake 10	Modified Tree (Carved or Scarred)
47-6-0263	Lintot Lake 26	Artefact, Hearth, Potential Archaeological Deposit (PAD), Shell
47-6-0264	Lintot Lake 27	Artefact, Hearth, Shell
47-6-0265	Lintot Lake 28	Hearth, Potential Archaeological Deposit (PAD), Shell
47-6-0266	Lintot Lake 29	Hearth
47-6-0267	Lintot Lake 30	Hearth, Potential Archaeological Deposit (PAD),Shell
47-6-0268	Lintot Lake 31	Artefact, Hearth, Potential Archaeological Deposit (PAD), Shell
47-6-0269	Lintot Lake 32	Artefact , Hearth, Potential Archaeological Deposit (PAD), Shell
47-6-0270	Lintot Lake 33	Hearth
47-6-0313	South Breeding	Hearth
47-6-0314	East Breeding	Hearth
47-6-0318	South Breeding 2	Hearth
47-6-0319	South Breeding 3	Hearth
47-6-0320	South Breeding 1	Burial
47-6-0321	East Breeding 4	Burial
47-6-0322	East Breeding 3	Burial
47-6-0323	East Breeding2	Burial
47-6-0146	Condoulpe 18	Modified Tree (Carved or Scarred)

AHIMS site no	Site name	Site type
47-6-0147	Condoulpe 19	Modified Tree (Carved or Scarred)
47-6-0148	Condoulpe 20	Modified Tree (Carved or Scarred)
47-6-0149	Condoulpe 21	Modified Tree (Carved or Scarred)
47-6-0150	Condoulpe 22	Modified Tree (Carved or Scarred)
47-6-0151	Condoulpe 23	Modified Tree (Carved or Scarred)
47-6-0152	South Dusty Lake 1	Modified Tree (Carved or Scarred)
47-6-0153	South Dusty Lake 2	Modified Tree (Carved or Scarred)
47-6-0154	South Dusty Lake 3	Modified Tree (Carved or Scarred)
47-6-0155	Lintot Lake 10	Modified Tree (Carved or Scarred)
47-6-0156	Lintot Lake 11	Hearth, Shell
47-6-0157	Lintot Lake 12	Hearth, Shell
47-6-0158	Lintot Lake 13	Hearth
47-6-0159	Lintot Lake 14	Burial
47-6-0160	Lintot Lake 15	Earth Mound, Hearth
47-6-0161	Lintot Lake 16	Earth Mound, Hearth
47-6-0162	Lintot Lake 17	Hearth
47-6-0068	Condoulpe 1	Modified Tree (Carved or Scarred)
47-6-0069	Condoulpe 2	Modified Tree (Carved or Scarred)
47-6-0070	Condoulpe 3	Modified Tree (Carved or Scarred)
47-6-0071	Condoulpe 4	Modified Tree (Carved or Scarred)
47-6-0072	Condoulpe 5	Modified Tree (Carved or Scarred)
47-6-0073	Condoulpe 6	Modified Tree (Carved or Scarred)
47-6-0074	Condoulpe 7	Modified Tree (Carved or Scarred)
47-6-0075	Condoulpe 8	Modified Tree (Carved or Scarred)
47-6-0076	Condoulpe 9	Modified Tree (Carved or Scarred)
47-6-0077	Condoulpe 10	Modified Tree (Carved or Scarred)
47-6-0078	Condoulpe 11	Modified Tree (Carved or Scarred)
47-6-0079	Condoulpe 12	Modified Tree (Carved or Scarred)
47-6-0080	Condoulpe 13	Modified Tree (Carved or Scarred)
47-6-0081	Condoulpe 14	Modified Tree (Carved or Scarred)
47-6-0082	Condoulpe 15	Modified Tree (Carved or Scarred)
47-6-0083	Condoulpe 16	Modified Tree (Carved or Scarred)

AHIMS site no	Site name	Site type
47-6-0084	Condoulpe 17	Modified Tree (Carved or Scarred)
47-6-0085	North Dusty Lake-1	Modified Tree (Carved or Scarred)
47-6-0086	North Dusty Lake-2	Modified Tree (Carved or Scarred)
47-6-0087	North Dusty Lake-3	Modified Tree (Carved or Scarred)
47-6-0088	North Dusty Lake-4	Modified Tree (Carved or Scarred)
47-6-0089	North Dusty Lake-5	Modified Tree (Carved or Scarred)
47-6-0090	North Dusty Lake-6	Modified Tree (Carved or Scarred)
47-6-0091	hhims site	Artefact
47-6-0092	North Dusty Lake-7	Modified Tree (Carved or Scarred)
47-6-0093	North Dusty Lake-8	Artefact
47-6-0094	Lintot Lake 1	Earth Mound
47-6-0095	Lintot Lake 2	Earth Mound, Shell
47-6-0096	Lintot Lake 3	Earth Mound
47-6-0097	Lintot Lake 4	Earth Mound
47-6-0098	Lintot Lake 5	Earth Mound
47-6-0316	East Breeding 1	Hearth
47-6-0397	Yanga Lake 52	Modified Tree (Carved or Scarred)
47-6-0398	Yanga Lake 53	Modified Tree (Carved or Scarred)
47-6-0399	Yanga Lake 54	Modified Tree (Carved or Scarred)
47-6-0400	Yanga Lake 55	Modified Tree (Carved or Scarred)
47-6-0254	Condoulpe Lake 25	Modified Tree (Carved or Scarred)
47-6-0017	Holmdale 1;	Burial
47-6-0018	Holmdale 2;	Burial
47-5-0004	Kyalite Bridge Midden 1	Shell
47-5-0005	Kyalite Picnic Reserve Midden	Shell
47-6-0037	CONDOULPE	Burial-
47-6-0359	Yanga lake hearth 1	Hearth
47-6-0368	Yanga lake Midden 9	Shell
47-6-0369	Yanga Lake 44	Modified Tree (Carved or Scarred)
47-6-0370	Yanga Lake 45	Modified Tree (Carved or Scarred)
47-6-0371	Yanga Lake 46	Modified Tree (Carved or Scarred)
47-6-0372	Yanga Lake 47	Modified Tree (Carved or Scarred)

AHIMS site no	Site name	Site type
47-6-0373	Yanga Lake Pump Station Site 1	Modified Tree (Carved or Scarred)
47-6-0374	Yanga Lake Pump Station Site 2	Modified Tree (Carved or Scarred)
47-6-0375	Yanga Lake Pump Station Site 3	Modified Tree (Carved or Scarred)
47-6-0603	Transmission Line 3	Hearth
47-6-0604	Transmission Line 4	Hearth, Potential Archaeological Deposit (PAD)
47-6-0605	Transmission Line 5	Hearth, Potential Archaeological Deposit (PAD)
47-6-0606	Transmission Line 6	Hearth, Potential Archaeological Deposit (PAD)
47-5-0008	Transmission Line 7	Artefact, Earth Mound, Habitation Structure, Potential Archaeological Deposit (PAD)
47-5-0023	Tarcoola 9	Hearth
47-5-0032	Tarcoola 10	Artefact
47-5-0041	Tarcoola 19	Modified Tree (Carved or Scarred)
47-5-0043	Tarcoola 21	Modified Tree (Carved or Scarred)
47-5-0044	Tarcoola 20	Modified Tree (Carved or Scarred)
47-5-0033	Tarcoola 17	Modified Tree (Carved or Scarred)
47-5-0034	Tarcoola 16	Modified Tree (Carved or Scarred)
47-5-0036	Tarcoola 18	Modified Tree (Carved or Scarred)



Acknowledgements: © Land and Property Information 2015

Legend

- Study area
- Development footprint
- Infrastructure area
- AHIMS Records

Figure 6: AHIMS records near the study area

0 1,400 2,800 4,200 5,600 7,000

Metres
Scale: 1:140,000 @ A3
Coordinate System: GCS GDA 1994

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Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney,Wangaratta & Wollongong

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4 Predictive model

A model has been formulated to broadly predict the type and character of Aboriginal cultural heritage sites likely to exist throughout the study area and where they are more likely to be located.

This model is based on:

- Local and regional site distribution in relation to landform features identified within the study area.
- Consideration of site type, raw material types and site densities likely to be present within the study area.
- Findings of the ethnohistorical research on the potential for material traces to present within the study area.
- Potential Aboriginal use of natural resources present or once present within the study area.
- Consideration of the temporal and spatial relationships of sites within the study area and surrounding region.

Based on this information, a predictive model has been developed, indicating the site types most likely to be encountered during any survey and subsequent sub-surface investigations across the present study area (Table 10).

4.1 Analysis of Aboriginal occupation

The results of the regional AHIMS search exhibited a wide variety of sites common to the Balranald region. A search of sites registered within 5 kilometres of the study revealed the dominant site type recorded for the locality is culturally modified trees representing 54 per cent (n = 61) of the sites (Table 6). Hearths were the second most recorded site type occurring 12 per cent (n = 13) and burials the third with 9 per cent (n = 10) of the total local site types.

The dominance of modified trees in the results may reflect the individual recording and registration of these site types on the AHIMS database, while other site types such as artefacts and hearths are grouped and recorded as single site complexes. Given the results of previous studies in the area, and the Mitchells soil landscapes contained within it, these results should provide sufficient information to inform the predictive modelling.

Table 6 AHIMS sites within the vicinity of the study area

Site type	Occurrences	Frequency (%)
Artefact	3	2.65
Artefact/Earth Mound/Hearth	1	0.88
Artefact/Hearth/Potential Archaeological Deposit (Pad)/Shell	1	0.88
Artefact/Earth Mound/Habitation Structure/PAD	1	0.88
Artefact/Earth Mound/Shell	1	0.88
Artefact/Hearth/PAD	2	1.77
Artefact/Hearth/Shell	1	0.88

Site type	Occurrences	Frequency (%)
Burial	10	8.85
Earth Mound	6	5.31
Earth Mound/Hearth	2	1.77
Earth Mound/Shell	1	0.88
Hearth	13	11.50
Hearth/PAD	3	2.65
Hearth/PAD/Shell	2	1.77
Hearth/Shell	2	1.77
Modified Tree	61	53.98
Shell	3	2.65
Total	**113**	**100**

4.1.1 Local soils

A total of five soil landscapes are present in the vicinity of the study area and represented in the AHIMS results. These are dominated by the Murrumbidgee Lakes, Swamps and Lunettes and Murrumbidgee Depression Plains, but include the Mallee Cliffs Sandplains, Murray Channels and Floodplains and Murrumbidgee Scalded Plains soil landscapes (Table 7).

The widest variety of site types occur in the Murrumbidgee Lakes, Swamps and Lunettes soil landscape, with 73 sites identified across seven different site types (Figure 7). This landscape is typically large active freshwater lakes and swamps which are frequently flooded by the Murrumbidgee River and often nestled within larger relic Quarternary lake features. These lake beds and associated channels consist of grey cracking clay, beaches of brown to white sands, and lunettes of deep cemented yellow to white sands. The association between the soils and landforms within this landscape and the occurrence of site types associated with multiple occupation events suggests that occupation or camp sites are likely to be found within relic lake features on grey cracking clay, brown to white beaches and within lunettes. Sites containing shell are also most likely to occur within this soil landscape.

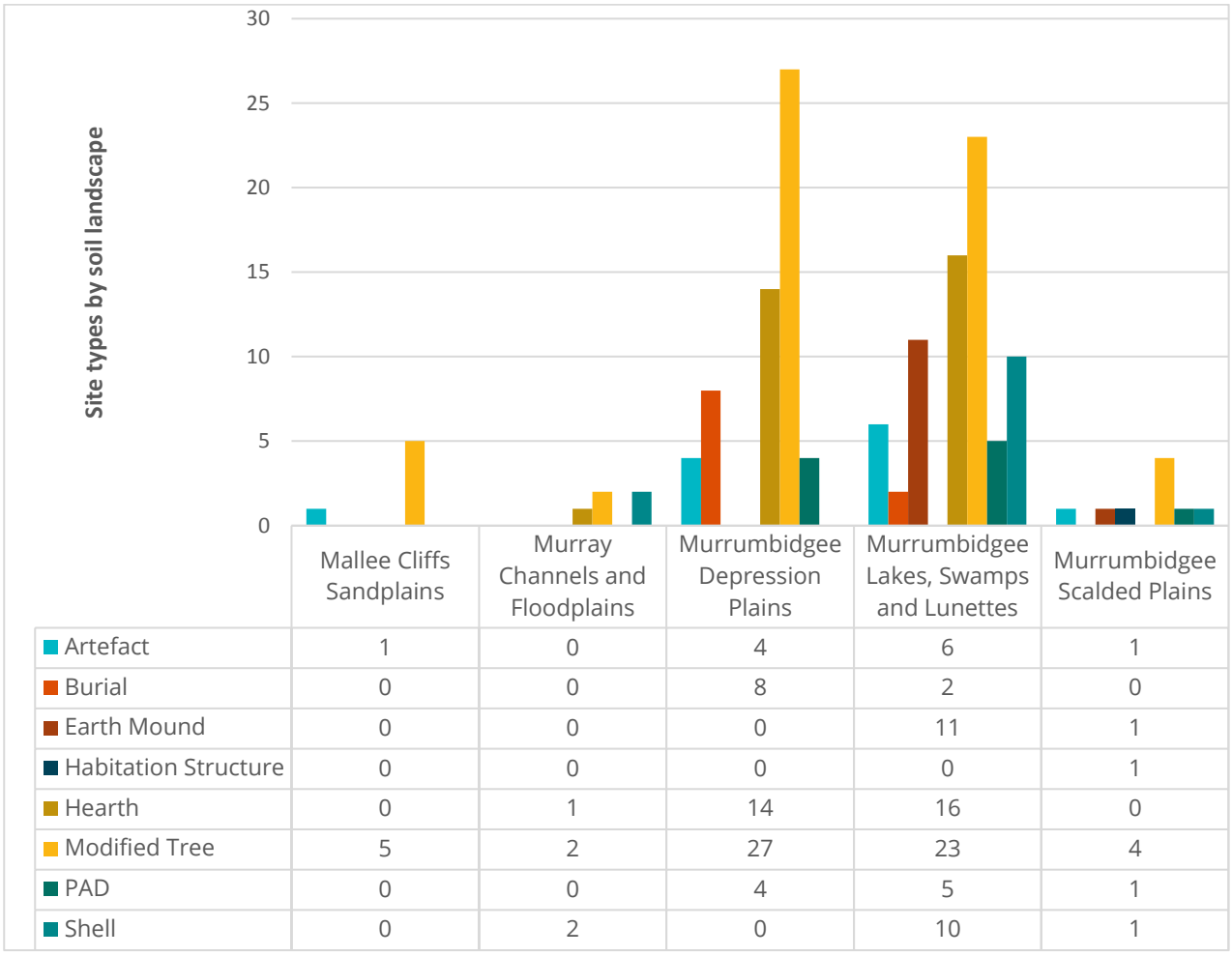
The second most varied soil landscape is the Murrumbidgee Depression Plains, with 57 sites identified across five different site types. The Murrumbidgee Depression Plains are characterised by numerous circular depressions with a relief of up to 10 metres. They display grey to brown clays and clay loams and are now commonly covered by extensive grasslands. Modified trees and burials are both most likely to occur within this landscape in association with reliefs of less than ten metres and grey to brown clays and clay loams. Large numbers of hearths have also been identified within this landscape.

Table 7 Soil landscapes in the vicinity of the study area

Soil landscape	Site type								
	Artefact	Burial	Earth Mound	Habitation Structure	Hearth	Modified Tree	PAD	Shell	Total
Mallee Cliffs Sandplains	1	-	-	-	-	5	-	-	6

Soil landscape	Site type								
	Artefact	Burial	Earth Mound	Habitation Structure	Hearth	Modified Tree	PAD	Shell	Total
Murray Channels and Floodplains	-	-	-	-	1	2	-	2	5
Murrumbidgee Depression Plains	4	8	-	-	14	27	4	-	57
Murrumbidgee Lakes, Swamps and Lunettes	6	2	11	-	16	23	5	10	73
Murrumbidgee Scalded Plains	1	-	1	1	-	4	1	1	9

Figure 7 Site types and number of recorded AHIMS sites located within soil landscapes in the local region



	Mallee Cliffs Sandplains	Murray Channels and Floodplains	Murrumbidgee Depression Plains	Murrumbidgee Lakes, Swamps and Lunettes	Murrumbidgee Scalded Plains
Artefact	1	0	4	6	1
Burial	0	0	8	2	0
Earth Mound	0	0	0	11	1
Habitation Structure	0	0	0	0	1
Hearth	0	1	14	16	0
Modified Tree	5	2	27	23	4
PAD	0	0	4	5	1
Shell	0	2	0	10	1

Table 8 shows the number of AHIMS sites identified in each soil landscape compared with the portion of the search area covered by that landscape. No sites were identified in the Murrumbidgee Channels and Floodplains landscape, which covered approximately 3.2% of the search area. There were notably low frequencies for sites within Mallee Cliffs Sandplains and Murray Channels and Floodplains, which make up approximately 34.84% and 14.24% of the study area respectively, suggesting these soil landscapes contain comparatively little archaeolgical potential. The frequencies of sites occuring within the Murrumbidgee Depression Plains and Murrumbidgee Scalded Plains landscapes roughly correlates with the percentage of sites identified within them. The Murrumbidgee Lakes, Swamps and Lunettes landscape, however, shows a markedly higher site frequency (48.67%) compared to the proportion of the search area it covers (4.35%).

Table 8 Search area covered by soil landscapes

Soil Landscape	Area covered (ha)	Area covered (%)	Aboriginal Sites (n)	Frequency (%)
Mallee Cliffs Sandplains	30986.61	34.84	6	4.00
Murray Channels and Floodplains	12665.33	14.24	5	3.33
Murrumbidgee Channels and Floodplains	2848.77	3.20	0	0.00

Soil Landscape	Area covered (ha)	Area covered (%)	Aboriginal Sites (n)	Frequency (%)
Murrumbidgee Depression Plains	36227.32	40.73	57	38.00
Murrumbidgee Lakes, Swamps and Lunettes	3864.72	4.35	73	48.67
Murrumbidgee Scalded Plains	2350.93	2.64	9	6.00
Total	88943.67	100.00	150	100.00

The data provided suggests that within the study area, sites are most likely to be identified within the Murrumbidgee Depression Plains and Murrumbidgee Scaled Plains landscapes, based on the proportion of sites in the vicinity located within them. Within this soil landscape, the AHIMS results suggest that modified trees and hearth sites are the most likely site types to be identified.

4.1.2 Local hydrology

Distance to water

Within the vicinity of the study area, AHIMS results indicate the vast majority of sites are located in closest proximity to ephemeral water sources. Of the 150 results analysed, only 3 were located closer to a permanent water course than an ephemeral one, so the sample size in relation to permanent water courses is extremely low. A further analysis of this information illustrates the distribution of site types within the landscape seems to bear little relation to their general relationship to modern water sources.

Table 9 Summary of the site types and their associated distances to water sources

Site type	Nearest ephemeral water source			Nearest permanent water source		
	Minimum (m)	Maximum (m)	Average (m)	Minimum (m)	Maximum (m)	Average (m)
Artefact	37.96	3569.92	904.74	-	-	-
Burial	71.95	3073.88	1506.46	-	-	-
Earth mound	220.54	3569.92	782.82	-	-	-
Habitation Structure	3569.92	3569.92	3569.92	-	-	-
Hearth	37.24	3005.24	914.82	-	-	-
Modified tree	8.92	1520.16	396.36	138.62	138.62	138.62
PAD	37.24	3569.92	763.63	-	-	-
Shell	49.66	1235.98	573.47	65.84	71.30	68.57

From the data shown, with the exception of shell, all site types are located on average closer to ephemeral water sources than permanent ones. Most site types are located on average between 500 and 1000 metres from the closest water source. The exceptions to this are modified trees, which are generally located closer to water sources, and burials and habitation structures which are on average located over 1000 metres from

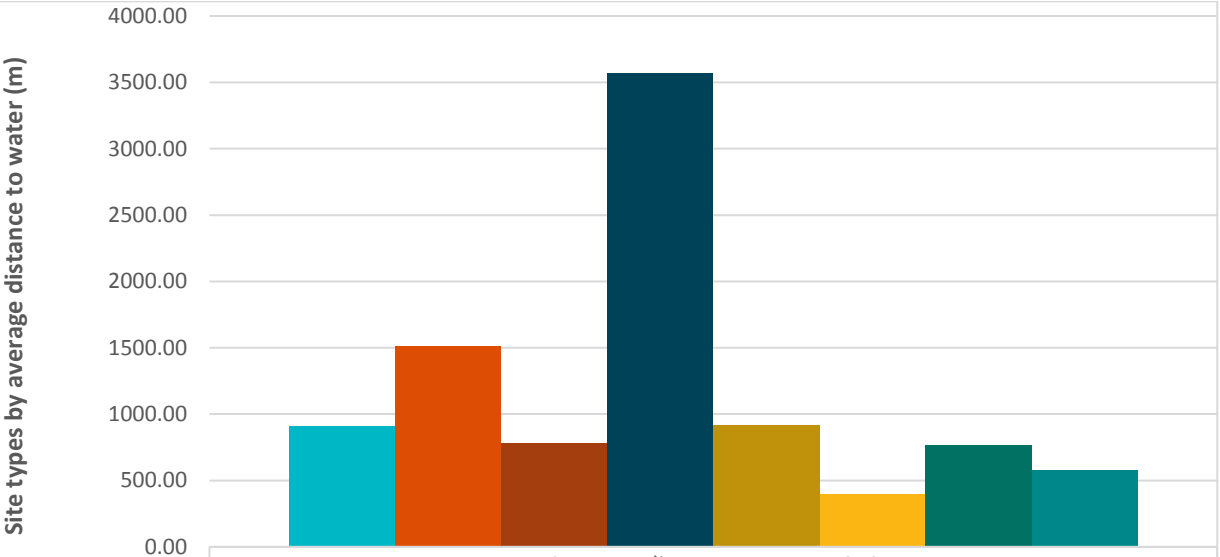
water sources. Only one example of a habitation structure was identified in the results and as such, this site type may be underrepresented and the data biased (Table 10and Figure 8). Burials occur in low frequency at varying distances from water sources and appear to bear little relationship with local hydrology.

The highest frequency of sites are located within 250 metres of ephemeral water courses (36%), although this is predominately made up of modified trees (n=35). The number of sites generally decreases with distance from water, although it is notable that sites continue to occur over 3000 metres from the closest water source, with an artefact, burial, earth mound, habitation structure, heath and PAD site all recorded at this distance (Table 10) The frequency of artefact, burial, earth mound, hearth and PAD site types appears to bear little correlation with the distance of these sites from water, with similar site frequencies evident up to 1000 metres from the closest water source.

Table 10 Distribution of sites types in relation to water sources

Distance (m)	Site type								
	Artefact	Burial	Earth Mound	Habitation Structure	Hearth	Modified Tree	PAD	Shell	Total
0 - 250	3	3	1		7	35	1	4	54
250 - 500	3		5		10	9	5	3	35
500 - 750	3	1	3		4	3	2	3	19
750 - 1000	1		2			3		1	7
1000 - 1250					2	10	1	2	15
1250 - 1500					1				1
1500 - 1750						1			1
1750 - 2000		2							2
2000 - 2250		2			2				2
2250 - 2500									0
2500 - 2750		1			2				3
2750 - 3000	1				2				
3000+	1	1	1	1	1		1		6

Figure 8 Recorded AHIMS site types by average distance to water sources



	Average distance to water (m)
Artefact	904.74
Burial	1506.46
Earth Mound	782.82
Habitation Structure	3569.92
Hearth	914.82
Modified Tree	396.36
PAD	763.63
Shell	573.47

These results show no clear trends regarding site types and their proximity to water. Modified trees do exhibit a slight tendency to be located closer to watercourses than other site types, but this likely reflects the survival of modified trees in areas where water remained available, rather than preferences in selection by Aboriginal groups. A possible explanation for the lack of trends lies in the hydrology of the area, which has been heavily modified by irrigation practices since the 19th century. The low relief of the area also leaves the courses of creek lines more susceptible to change. This suggests that the modern landscape and hydrology mapping does not accurately reflect the availability of water in the past and suitability of the land for sustaining multi-use sites, such as earth mounds and hearth complexes.

4.2 Aboriginal site prediction statements

The definitions of potential are described in Table 11. The results of this model will be influenced by previous survey patterns and the limited search area, which does not necessarily provide a representative sample of all site types, landforms, stream orders, geological formations or soil landscapes.

Table 11 Aboriginal site prediction statements

Site type	Site description	Potential
Scarred Trees	Trees with cultural modifications	High: Scarred trees are the most common site type within the vicinity of the study area. Due to extensive vegetation clearance only a small number of mature native trees have survived however these do have potential to be cultural modified.
Earth Mounds	Deposits of baked clay, charcoal, shell and bone which indicate multiple occurrences of occupation. Often contain human remains.	High: Earth mounds are commonly found near the Murray and Murrumbidgee rivers. Earth mounds can be found near the river banks as well as in the hinterland near less permanent water sources.
Hearths	Deposits of baked clay, charcoal, shell and bone which indicate a single use event.	High: Hearths are commonly found near the Murray and Murrumbidgee rivers. Earth mounds can be found near the river banks as well as in the hinterland near less permanent water sources.
Shell Middens	Deposits of shells accumulated over either singular large resource gathering events or over longer periods of time.	Moderate: Shell midden sites have been recorded near to the study area and are common in the riverine and lacustrine environments.
Quarries	Raw stone material procurement sites.	Low: There is no record of any quarries being within or surrounding the study area.
Potential Archaeological Deposits (PADs)	Potential sub surface deposits of cultural material.	Moderate: PADs have been previously recorded in the region across a wide range of landforms. PADs are likely to be present within areas adjacent to water courses or on high points in undisturbed landforms.
Flaked Stone Artefact Scatters and Isolated Artefacts	Artefact scatter sites can range from high-density concentrations of flaked stone and ground stone artefacts to sparse, low-density 'background' scatters and isolated finds.	High: Stone artefact sites have been previously recorded in the region on level, well-drained topographies in close proximity to reliable sources of fresh water. Due to disturbance of the site, the potential for locating stone artefacts is high.
Grinding Grooves	Grooves created in stone platforms through ground stone tool manufacture.	Low: Suitable horizontal sandstone rock outcrops do not occur in the study area.

Site type	Site description	Potential
Burials	Aboriginal burial sites.	Moderate: Aboriginal burial sites are generally situated within deep, soft sediments, caves or hollow trees. Areas of deep sandy deposits will have the potential for Aboriginal burials. The soil profiles associated with the study area are associated with burial sites. Burial sites have been recorded nearby.
Rock shelters with art and / or deposit	Rock shelter sites include rock overhangs, shelters or caves, and generally occur on, or next to, moderate to steeply sloping ground characterised by cliff lines and escarpments. These naturally formed features may contain rock art, stone artefacts or midden deposits and may also be associated with grinding grooves.	Low: The sites will only occur where suitable sandstone exposures or overhangs possessing sufficient sheltered space exist, which are not present in the study area.
Aboriginal Ceremony and Dreaming Sites	Such sites are often intangible places and features and are identified through oral histories, ethnohistoric data, or Aboriginal informants.	Moderate: There are currently no recorded mythological stories for the study area however they are known to occur in the region.
Post-Contact Sites	These are sites relating to the shared history of Aboriginal and non-Aboriginal people of an area and may include places such as missions, massacre sites, post-contact camp sites and buildings associated with post-contact Aboriginal use.	Moderate: There are no post-contact sites previously recorded in the study area however it is possible for post contact sites to occur in the region.
Aboriginal Places	Aboriginal places may not contain any "archaeological" indicators of a site, but are nonetheless important to Aboriginal people. They may be places of cultural, spiritual or historic significance. Often they are places tied to community history and may include natural features (such as swimming and fishing holes), places where Aboriginal political events commenced or particular buildings.	Low: There are currently no recorded Aboriginal historical associations for the study area.

5 Archaeological survey

A field survey of the study area was undertaken on 23, 24 and 25 January 2017. The field survey sampling strategy, methodology and a discussion of results are provided below.

5.1 Archaeological survey objectives

The objectives of the survey were to:

- Provide RAPs an opportunity to view the study area and to discuss previously identified Aboriginal object(s) and/or place(s) in or within close proximity to the study area.
- To undertake a systematic survey of the study area, while targeting areas with the potential for Aboriginal heritage.
- To inspect listed sites within the study area and to record their current condition.
- Identify and record Aboriginal archaeological sites visible on the ground surface.
- Identify and record areas of Potential Archaeological Deposits (PADs).

5.2 Archaeological survey methodology

The survey methods were intended to assess and understand the landforms and to determine whether any archaeological material from Aboriginal occupation or land use exists within the study Area.

5.2.1 Sampling strategy

The survey effort targeted all landforms within the study area and aimed to relocate AHIMS# 47-5-0008, 47-6-0603, 47-6-0604, 47-5-0605 and 47-5-0606, which have been previously identified within the study area.

5.2.2 Survey methods

The archaeological survey was conducted on foot with a field team of three members. Recording during the survey followed the archaeological survey requirements of the code and industry best practice methodology. Information that recorded during the survey included:

- Aboriginal objects or sites present in the study area during the survey.
- Survey coverage.
- Any resources that may have potentially have been exploited by Aboriginal people.
- Landform.
- Photographs of the site indicating landform.
- Evidence of disturbance.
- Aboriginal artefacts, culturally modified trees or any other Aboriginal sites.

Where possible, Identification of natural soil deposits within the study area was undertaken. Photographs and recording techniques were incorporated into the survey including representative photographs of survey units, landform, vegetation coverage, ground surface visibility and the recording of soil information for each survey unit were possible. Any potential Aboriginal objects observed during the survey were documented and photographed. The location of Aboriginal cultural heritage and points marking the boundary of the landform

elements were recorded using a hand-held Global Positioning System and the Map Grid of Australia (94) coordinate system.

5.3 Survey constraints

The overall effectiveness of the survey for examining the ground for Aboriginal sites was considered to be low due to poor ground surface visibility (GSV). The study area is comprised of fields of wheat and other crops which contained varying degrees of visibility between 50% to 80%. Opportunities to examine the ground surface primarily occurred along fence lines, dirt tracks, clay pans and occasional cleared patches within fields. Areas of exposure, within which visibility approached 100%, were targeted for their increased potential to contain visible Aboriginal cultural features. These majority of these exposure had been subject to and were created by substantial disturbance from clearing, ploughing and other farming activities (Plate 1).

Disturbance in the study area is associated with natural and human agents. Natural agents generally affect small areas and include the burrowing and scratching in soil by animals, such as foxes, rabbits and kangaroos, and sometimes exposure from slumping or scouring. The study area has been extensively disturbed by a long history of agricultural use which has seen the majority of the study area cleared and then extensively ploughed for the cultivation of wheat and other crops. Disturbances created by fencing, informal vehicle tracks and graded access roads also occur throughout the study area (Plate 2).

Plate 1 Ploughing and visibility within the southern portion of the study area. View north, 1 metre scale.

The ability to see more obtrusive potential cultural heritage features from a distance within the study area overall was considered to be high due to the very sparse tree cover. This allowed for the easy identification of landforms and areas of exposure. Small areas of undisturbed remnant mallee vegetation were present in a number of stands on the rises of dunes in the study area. The largest of these occurred along the western edge of the study area and these were targeted during the survey (Figure 9).

Plate 2 **General GSV within the study area, scale 1 m.**

5.4 Archaeological survey results

Archaeological survey was conducted over three days with a field team of three members. A total of eleven transects were walked across two landforms with the surveyors walking two metres apart (Figure 9). This follows the methodology set out in Burke and Smith (2004: 65) which states that a single person can only effectively visually survey an area of two linear metres. 12 Aboriginal sites, one with an associated PAD, were identified in the study area. All sites previously identified by Giles Hamm were relocated and assessed as still valid during the survey. The results from the field survey have been summarised in Table 12 and 13, and are discussed below (Figure 10).

Table 12 Survey coverage

Survey Unit	Landform	Survey unit area (m²)	Visibility (%)	Exposure (%)	Effective coverage area (m²)	Effective coverage (%)
1	Murrumbidgee scalded plain	33000	90	90	26730	81
2	Murrumbidgee scalded plain	280000	50	30	42000	15
3	Murrumbidgee scalded plain	210000	50	30	31500	15
4	Murrumbidgee scalded plain	50000	50	30	7500	15
5	Mallee cliff sandplain	120000	50	30	18000	15
6	Mallee cliff sandplain/white sand hill	60000	50	30	9000	15
7	Mallee cliff sandplain	80000	20	40	6400	8
8	Mallee cliff sandplain	80000	80	70	44800	56
9	Murrumbidgee scalded plain	105000	70	40	29400	28
10	Murrumbidgee scalded plain	69000	70	40	19320	28
11	Murrumbidgee scalded plain	880000	70	40	246400	28

Table 13 Landform summary

Landform	Landform area (m²)	Area effectively surveyed (m²)	Landform effectively surveyed (%)	No. of Aboriginal sites	No. of artefacts or features
Murrumbidgee scalded plain	11770000	1627000	14	9	At least 18
Mallee cliff sandplain	4000000	340000	8.5	2	8

During vehicle reconnaissance surveys of the study area one hearth with associated artefact scatter was identified in the centre of the study area.

Limondale 1

Limondale 1 is a hearth with associated artefact scatter located on a graded vehicle track within a Mallee cliff sandplain field (Plate 3, Plate 4).

The hearth consists of both burnt clay and termite mound heat retainers and shell fragments were visible within the centre of the hearth. Surrounding the hearth were six silcrete artefacts, all of which were recorded with the details provided in Table 14. The assemblage consisted of one single platform core fragment, two medial fragments, one complete flake, one third quadrant flake

fragment and one distal fragment. Scalar retouch was present on the distal margin of one complete flake.

The hearth has been degraded, with artefacts and some fragments of clay and termite mound displaced due to vehicle movement and grading, and its condition is considered to be poor.

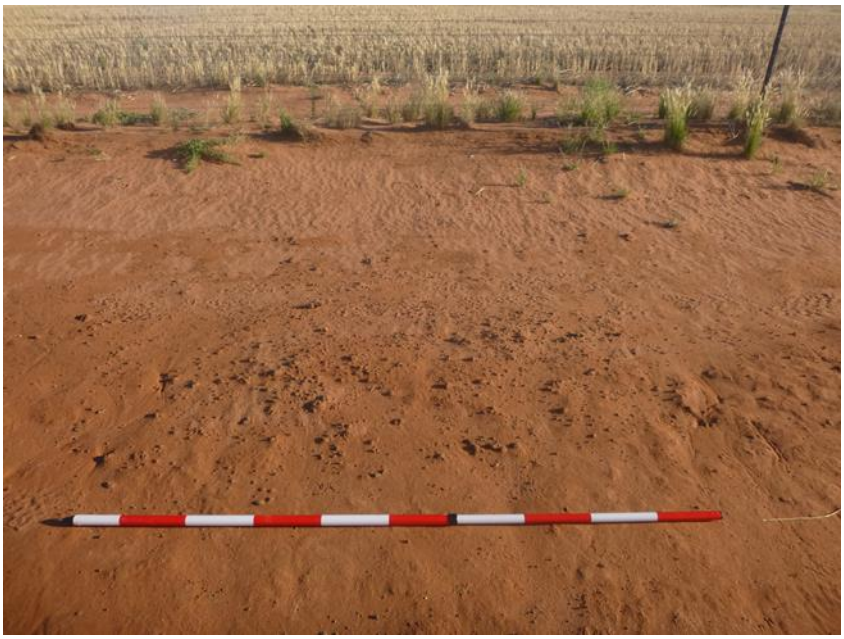


Plate 3 Limondale 1. View north, scale 2 m.

Plate 4 Limondale 1, scale 1 m.

Table 14 Details of artefact assemblage from Limondale 1.

ID	Type	Raw Material	Platform	Platform Length (mm)	Platform Width (mm)	Termination	Retouch	Retouch Location	Length (mm)	Width (mm)	Thickness (mm)	Flake Scars	Tool Type	Weight (g)
1	Distal Flake Fragment	Silcrete	N/A	N/A	N/A	Feather	N/A	N/A	7	9	3	N/A	N/A	0.19
2	Complete Flake	Silcrete	Flaked	11	4	Feather	Scalar	Distal Margin	11	21	6	1	Flat-edged Scrapers	2.44
3	Medial Flake Fragment	Silcrete	N/A	N/A	N/A	N/A	N/A	N/A	9	7	3	N/A	N/A	0.26
4	Single Platform Core Fragment	Silcrete	N/A	N/A	N/A	N/A	N/A	N/A	26	22	12	2, one complete 12x11.5 mm	N/A	4.83
5	Third Quadrant Break	Silcrete	N/A	12	5	Feather	N/A	N/A	19	16	6	N/A	N/A	1.63
6	Medial Flake Fragment	Silcrete	N/A	N/A	N/A	N/A	N/A	N/A	21	24	6	1	N/A	3.71

5.4.1 Transect 1

Transect 1 was surveyed on foot and consisted predominately of a red earth graded access road on a Murrumbidgee scalded plain (Plate 5). Visibility and exposure were both 90%. Some clay pans created by soil erosion were present along the edges of the access road in which visibility approached 100% and these were inspected for Aboriginal artefacts or features.

No Aboriginal objects or sites were identified during this portion of the survey.

Plate 5 Transect 1 View south-east, scale 1m.

5.4.2 Transect 2

Transect 2 was surveyed on foot and located within a cleared bean field on a Murrumbidgee scalded plain in the northern portion of the study area (Plate 6). The recent harvest meant general visibility throughout the transect was 50%, with exposure 30%. Areas of increased exposure were targeted during the survey and one large site complex of two associated earth mounds was identified.

Limondale 2

Limondale 2 is a disturbed site complex measuring 50 by 100 metres and consisting of two heavily disturbed earth mounds and a medial silcrete flake fragment on a Murrumbidgee scalded plain. The complex is located within a ploughed field but despite the poor condition of both earthmounds, the concentration of burnt clay and charcoal and the presence of a lithic artefact within the second mound argues for their attribution as cultural sites (Plate 7). The extensive ploughing made determining the original extent of the earth mounds difficult, as the burnt clay fragments appear to have been displaced by the plough and spread through the surrounding area. As such, the site condition was assessed as poor and an estimated maximum extent on the basis of this dispersal has been provided.

Both earth mounds contained burnt clay and charcoal and measured approximately 30 metres by 20 metres across. The silcrete flake displayed scalar retouch along one edge and measured 17 millimetres in length by 15 millimetres in width and 4 millimetres in thickness. It was located on the surface of the easternmost earth mound, having likely been displaced from within the mound by a plough.

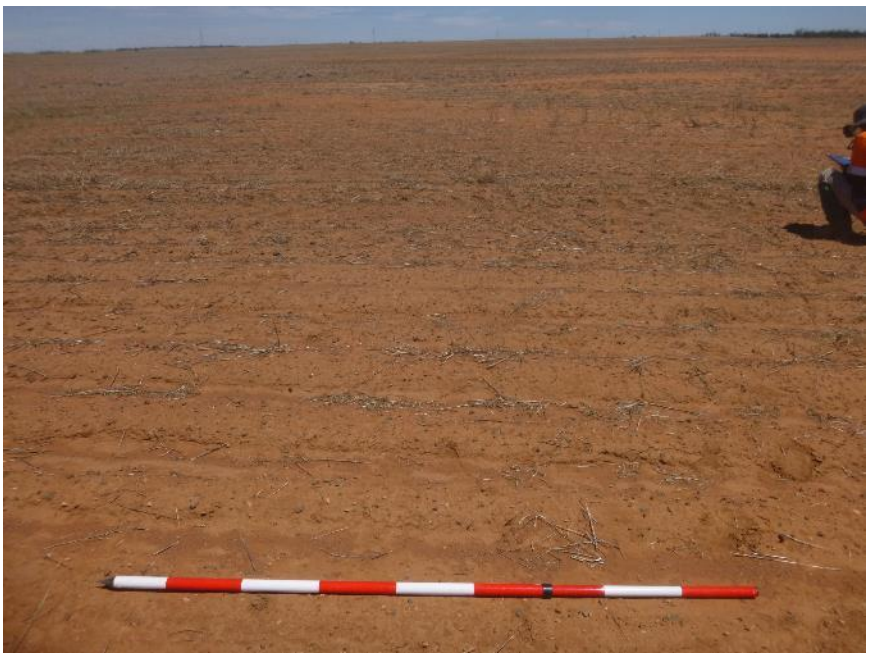


Plate 6 **Transect 2. View west, scale 1m.**

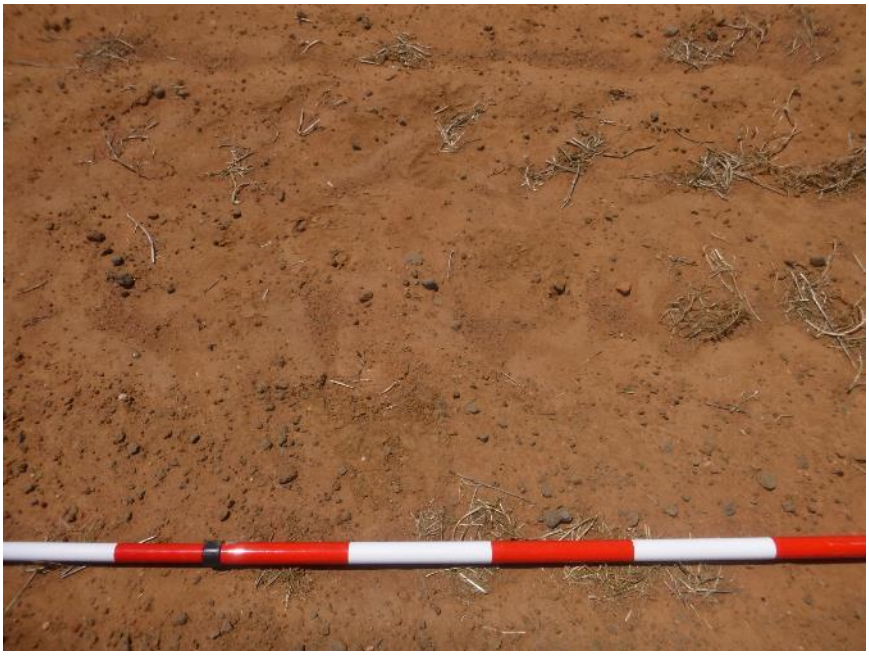


Plate 7 **Limondale 2. View north-east, scale 1m.**

5.4.3 Transect 3

Transect 3 was surveyed on foot and located within a cleared bean field on a Murrumbidgee scalded plain in the northern portion of the study area slightly south of transect 2 (Plate 8). The recent harvest meant general visibility along the transect was approximately 50%, with exposure 30%. Areas of increased exposure were targeted during the survey and three sites, one isolated hearth and two earth mounds, were identified.

Plate 8 **Transect 3. View west, scale 1m.**

Limondale 3

One isolated hearth feature, Limondale 3, was located in the northern portion of the study area within a ploughed field on Murrumbidgee scalded plain. It consists of burnt clay heat retainers and charcoal fragments.

The scattered hearth has been assessed as in poor condition as it has been subject to extensive ploughing and no in situ source of the burnt clay heat retainers was identified (Plate 9). The maximum extent of the hearth site was estimated to be 3 by 3 metres on the basis of the dispersal of these burnt clay fragments.

Plate 9 **Limondale 3, scale 1m.**

Limondale 4

Limondale 4 is a diffuse earth mound measuring approximately 30 by 30 metres on a Murrumbidgee scalded plain. The site was identified by the concentration of large amounts of burnt clay heat retainers and charcoal in an area of exposure on a slight rise within a cropped field (Plate 10). The extensive ploughing made determining the original extent of the earth mound difficult, as the burnt clay fragments appear to have been displaced by the plough and spread through the surrounding area. As such, the site condition was assessed as poor and an estimated maximum extent on the basis of this dispersal has been provided.

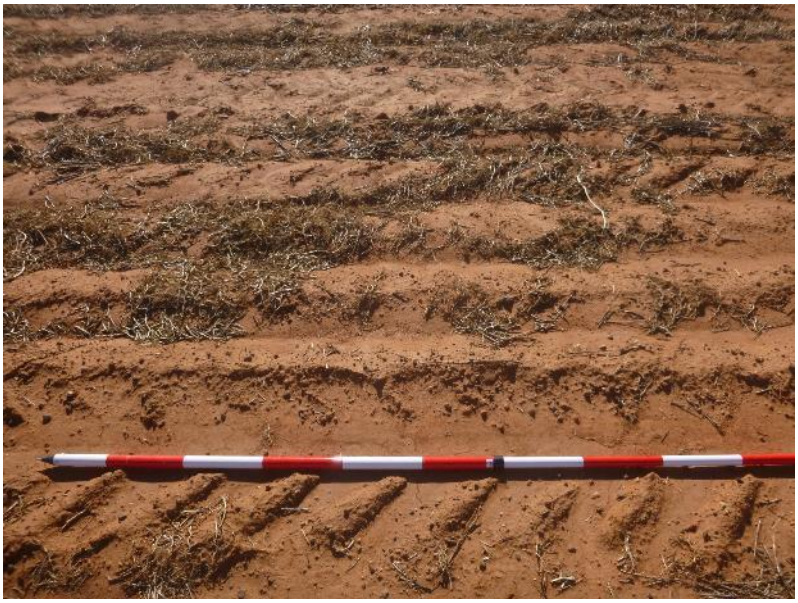


Plate 10 Limondale 4, scale 2 m

Limondale 5

Limondale 5 is a diffuse earth mound measuring approximately 20 by 30 metres on a Murrumbidgee scalded plain. The site was identified by the concentration of large amounts of burnt clay heat retainers and charcoal in an area of exposure on a slight rise within a cropped field (Plate 11). The extensive ploughing made determining the original extent of the earth mound difficult, as the burnt clay fragments appear to have been displaced by the plough and spread through the surrounding area. As such, the site condition was assessed as poor and an estimated maximum extent on the basis of this dispersal has been provided.

Plate 11 Limondale 5. View east, scale 2m.

5.4.4 Transect 4

Transect 3 was surveyed on foot and located within a cleared bean field on a Murrumbidgee scalded plain in the northern portion of the study area. The recent harvest meant general visibility throughout the transect was 50%, with exposure 30%. Areas of increased exposure and stands of remnant vegetation were targeted during the survey and three sites, one modified tree and two hearth complexes, were identified. Sites within transect 4 seemed to congregate on small rises within areas of red soil.

Limondale 6

Limondale 6 is a modified box tree measuring 2 metres in circumference with a small oval scar bearing four steel axe marks facing west on its lower trunk (Plate 12). The tree and scar are in good condition, with the scar located 80 centimetres from the ground and measuring 29 centimetres long by 12 centimetres wide and displaying 14 centimetres of regrowth.

Discussions with a representative from the local Aboriginal community indicated that steel axe marks in the centre of the scar may indicate the bark was removed for rabbit poisoning in the early 20th century, rather than in the production of Aboriginal objects. In this instance the use of the bark removal could not be determined with certainty and the scar has been recorded on the basis of its definite cultural attributes.

Plate 12 Limondale 6, scale 1m.

Limondale 7

Limondale 7 is a disturbed site complex measuring 600 by 20 metres and consisting of a series of heavily disturbed hearths with associated historic material on a Murrumbidgee scalded plain. The site was identified by the scattering of burnt clay heat retainers and charcoal across a slight rise of approximately 40 centimetre relief, but due to the extensive ploughing of the area no in situ sources of the burnt clay could be identified. No exact number of hearths could be identified, but the large number of clay fragments and their dispersal suggests multiple hearths were originally located on the rise. For this reason the site condition was assessed as poor. Within the same area fragments of glass, concrete and ceramics, along with animal bone were located, and it is likely these were associated with the hearths.

It is likely related to another disturbed site complex, Limondale 8, located within 500 metres and which also displays a mix of Aboriginal and historic cultural material.

Plate 13 Limondale 7. View south, scale 1 m.

Limondale 8

Limondale 8 is a disturbed site complex measuring 100 by 100 metres and consisting of a series of heavily disturbed hearths with associated historic material on a Murrumbidgee scalded plain (Plate 14). The site was identified by the scattering of burnt clay heat retainers and charcoal across a slight rise of approximately 40 centimetre relief, but due to the extensive ploughing of the area no in situ sources of the burnt clay could be identified. No exact number of hearths could be identified, but the large number of clay fragments and their dispersal suggests multiple hearths were originally located on the rise. For this reason the site condition was assessed as poor. Within the same area fragments of glass were located which were likely were associated with the hearths.

It is likely related to another disturbed site complex, Limondale 7, located with 500 metres and which also displays a mix of Aboriginal and historic cultural material.

Plate 14 Limondale 8. View west, scale 1m.

5.4.5 Transect 5

Transect 5 was surveyed on foot and was located within a wheat field on a cleared Mallee cliff sandplain overlooking the Murrumbidgee scalded plain to the east. The recent wheat harvest meant visibility was 50%, with exposure 30% (Plate 15). There we no large exposures identified on this landform during the survey.

No Aboriginal objects or sites were identified during this portion of the survey.

Plate 15 Visibility in transect 5, scale 1m.

5.4.6 Transect 6

Transect 6 was surveyed on foot and located within a wheat field on a white sand dune in the central portion of the study area. The recent wheat harvest meant visibility was 50%, with exposure 30%. There we no large exposures identified on this landform during the survey.

Limondale 9

Limondale 9 was an isolated find, a longitudinal silcrete flake fragment with a feather termination, found exposed in a ploughed area of white sand dune (Plate 16). As such, the site is considered to be in poor condition. The flake is likely associated with fragments of floodplain freshwater mussel shell visible throughout the surrounding dune and measures 20 millimetres in length by 13 millimetres in width and 5 millimetres in thickness.

Plate 16 Location of Limondale 9. View north, scale 1m.

5.4.7 Transect 7

Transect 7 was surveyed on foot and consisted of an area of remanent mallee scrub on a Mallee cliff sandplain along the western border of the study area. General visibility was 20% across this landform with 40% exposure. These exposures were predominantly located along an access track cutting running along the western edge of the study area.

No Aboriginal objects or sites were identified during this portion of the survey.

5.4.8 Transect 8

Transect 8 was surveyed on foot and was located on a Mallee cliff sandplain in the south-west corner of the study area. An access track and heavily ploughed area comprised the southern extent of this transect, creating large areas of exposure (Plate 17). General visibility was 80% across this landform with 70% exposure. These areas of exposure were inspected and, excepting the area of remnant vegetation, this transect was found to have been subject to extensive disturbance from agricultural activities and holds no potential to contain intact archaeological deposits.

No Aboriginal objects or sites were identified during this portion of the survey.

Plate 17 Ploughed area of exposure within transect 8. View south-east, scale 2 m

5.4.9 Transect 9

Transect 9 was located on a Murrumbidgee scalded plain within a wheat field and subject to vehicle survey to identify any areas of exposure. The landform had been subject to extensive disturbance from long term ploughing in its capacity as a wheat field.

Limondale 11

One isolated hearth feature, Limondale 11, was located on a flat between Mallee cliff sand dunes in the southern portion of the study area. The site consists of burnt calcrete heat retainers and is the only hearth of this type identified during the survey (Plate 18). Despite the presence of natural calcrete within the study area, the consistent large size of the cobbles and indicates they were deliberately collected as heat retainers for a campfire.

The scattered hearth has been assessed as in poor condition as it has been subject to extensive ploughing and no in situ source of the burnt calcrete heat retainers was identified. The maximum extent of the hearth site was estimated to be 10 by 10 metres on the basis of the dispersal of these cobbles.

Plate 18 Limondale 11, scale 1m.

5.4.10 Transect 10

Transect 10 was surveyed on foot and was located within a wheat field on a Murrumbidgee scalded plain in the southern portion of the study area. The recent wheat harvest meant visibility was 70%, with exposure 40%. There we no large exposures identified on this landform during the survey.

No Aboriginal objects or sites were identified during this portion of the survey.

Plate 19 Transect 10. View north, scale 1m.

5.4.11 Transect 11

Transect 11 was surveyed on foot and consisted of relatively undisturbed Murrumbidgee scalded plain. This area retained much of its native vegetation and had been subject to animal grazing, with subsequent erosion creating occasional large clay pans within which visibility approached 100%. These areas of exposure were inspected for cultural material. Overall, visibility in transect 11 was 70%, with exposure 40%.

All five sites previously recorded by Giles Hamm and registered within the study area, AHIMS# 47-5-0008, 47-6-0603, 47-6-0604, 47-5-0605 and 47-5-0606, were located within this transect. All of these sites were able to relocated and found to be in good condition.

Limondale 12

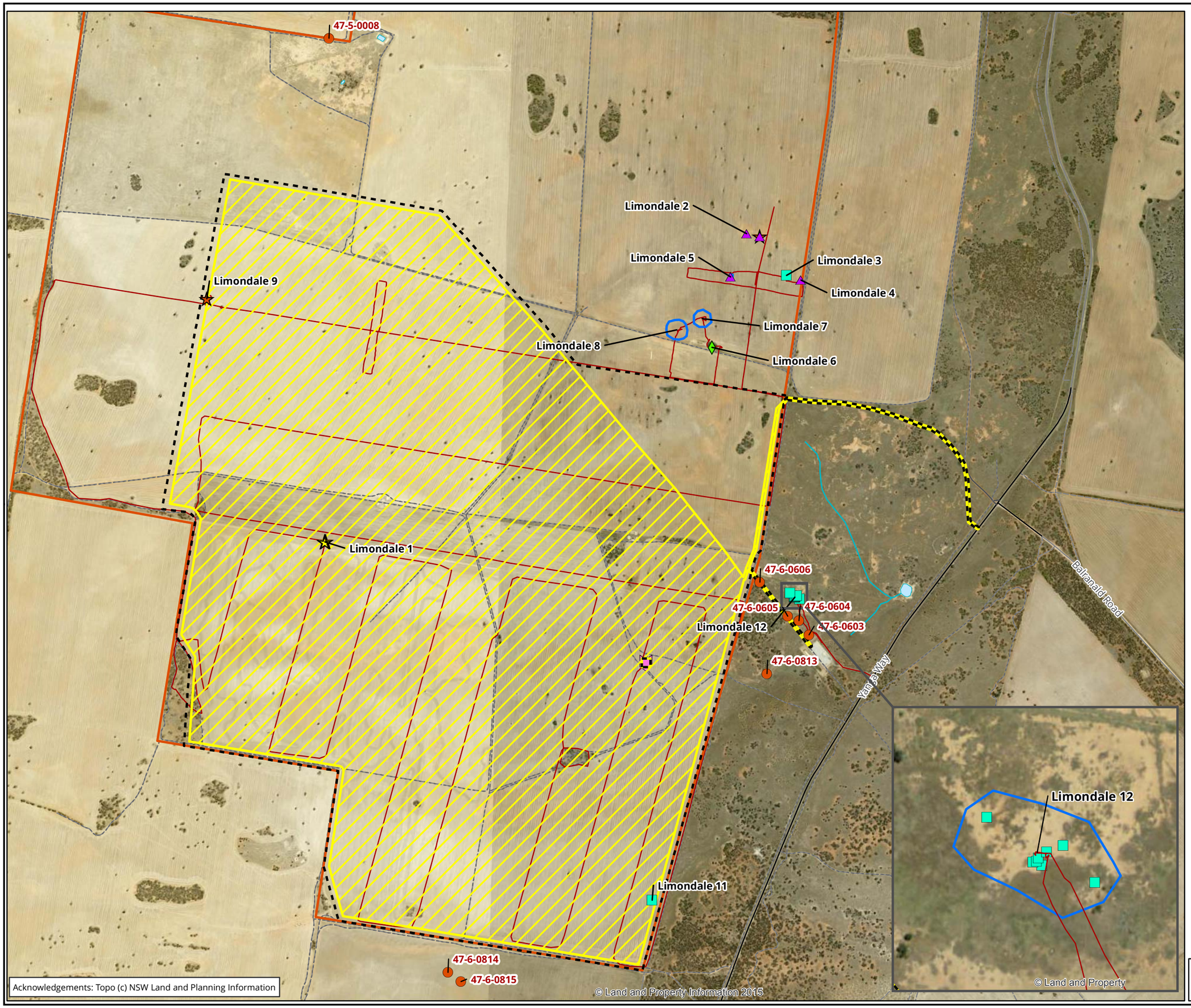
One site complex with an associated PAD, Limondale 12, was identified within these clay pans during the survey. It consisted of eight burnt clay heat retainer hearths, six of which also contained fragments of termite mound (Plate 20). One hearth was also found to contain burnt calcrete. All hearths associated with this complex were found to be intact and in good condition, with four still partially covered by residual soils and considered to hold the potential for intact subsurface deposits (Plate 21).

The hearths measured between 1 and 1.5 metres across and were surrounded on the clay pan by loose fragments of burnt clay and termite mound, dispersed during the erosion process. Individual hearths were identified by the clustering of in situ burnt clay, termite mound and charcoal into low mounds.

The closest modern water source to the site complex is an unnamed, non-perennial first order stream located approximately 450 metres to the east. Low depressions in the Murrumbidgee scalded plain were identified during the survey and the apparent density of occupation at the site suggests these depression may have held water in the past, accounting for the attraction of the location as a camp site.

Plate 20 Hearths within Limondale 12. View north-east, scale 1m.

Plate 21 Hearth partially covered by residual soil within Limondale 12. View east, scale 1m.



Legend

- Study area
- Development footprint
- Infrastructure area
- AHIMS Records
- Survey tracks
- Site extent
- House

Site Type

- Artefact Scatter with Hearth
- Earth Mound
- Hearth
- Modified Tree
- Surface Artefacts

Figure 9: Survey tracks

0 200 400 600 800 1,000

Metres

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 23049,
Date: 11 April 2017,
Checked by: ALA, Drawn by: SSK, Last edited by: lharley
Location:P:\23000s\23049\Mapping
23049_AR_F9_Survey_tracks.mxd

5.5 Discussion of archaeological survey results

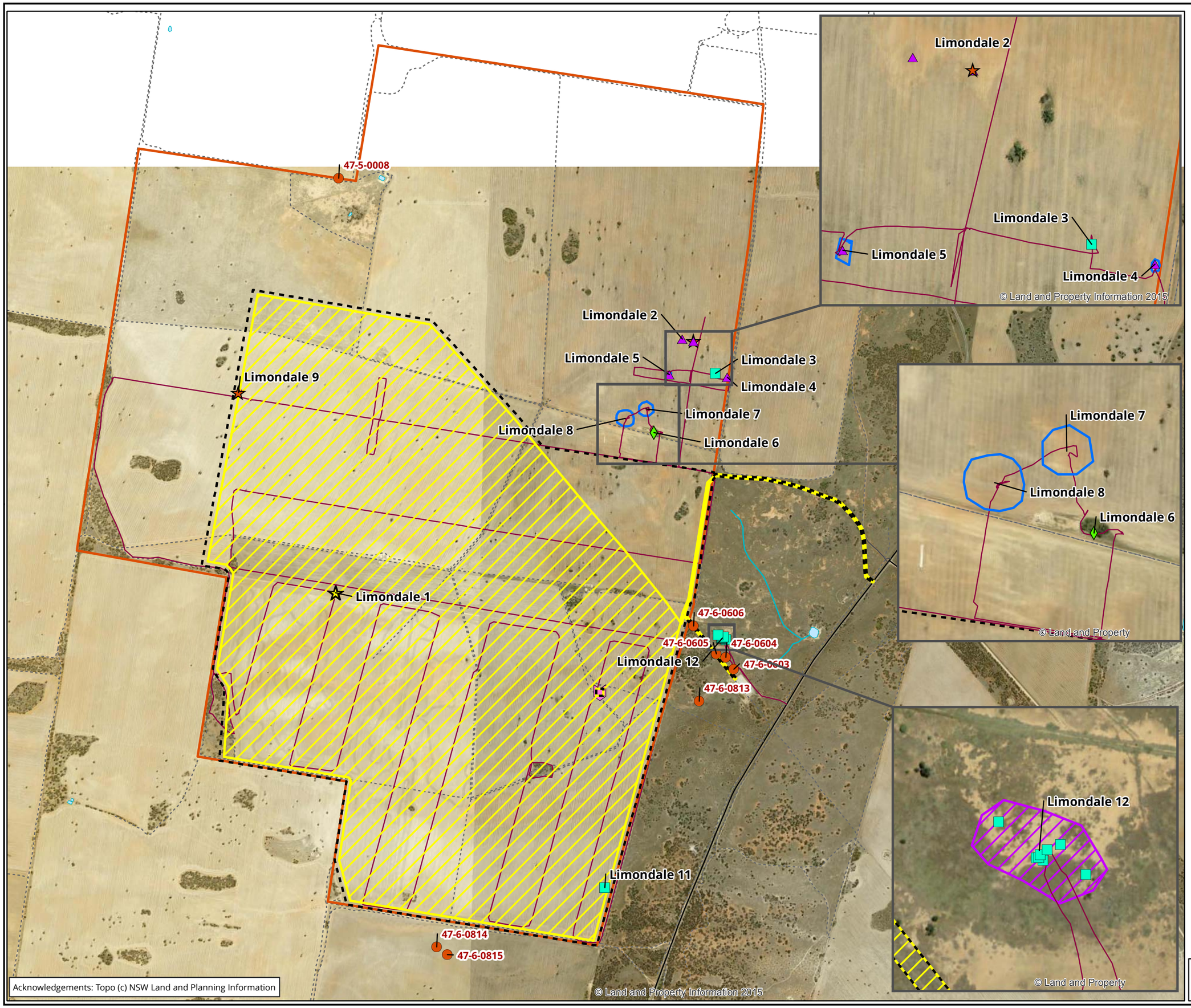
The survey effort relocated all previously identified sites in the study area in order to assess their current condition. It also identified 11 previously unrecorded aboriginal sites within the study area, one of which was associated with a new PAD.

The primary constraint to this survey was the lack of GSV within the study area, except for small areas of exposure created by erosion in clay pans, along vehicle access tracks, and occasional areas within ploughed fields. Where exposures were present they were usually associated with substantial ground disturbance from ploughing or the grading of vehicle tracks.

The majority of sites identified in the survey, particularly hearths and earth mounds complexes, were located on red earth within Murrumbidgee scalded plain land systems. Limondale 7 and 8 were located on very low relief rises within these plains, and it is likely that this was the case for most of the sites within the study area prior to the extensive ploughing of the land during the 20th century. The intensive agricultural use of the study area throughout the 20th century has significantly disturbed the shallow soil profiles within the study area, flattening the landscape and displacing cultural material.

One site, Limondale 11, was identified within the Mallee cliffs sandplains land system. This was a hearth with calcrete heat insulators which was itself unusual for the study area. A single artefact was located in association with freshwater mussel shell atop a white sand dune. Both sites located within sandplains indicated much lower intensity of use than those located within the Murrumbidgee scalded plains.

An analysis of these sites is presented in Section 5.



Legend

- Study area
- Development footprint
- Infrastructure area
- AHIMS Records
- Survey tracks
- PAD extent
- Site extent
- House

Site Type

- Artefact Scatter with Hearth
- Earth Mound
- Hearth
- Modified Tree
- Surface Artefacts

Figure 10 : Results Map

0 240 480 720 960 1,200

Metres
Scale: 1:24,300 @ A3
Coordinate System: GDA 1994 MGA Zone 54

N

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Sydney, Wangaratta & Wollongong

Matter: 23049,
Date: 11 April 2017,
Checked by: ALA, Drawn by: LH, Last edited by: lharley
Location:P:\23000s\23049\Mapping
23049_AR_F10_ResultsMap.mxd

6 Analysis and discussion

6.1 Previously identified sites

A total of five sites previously recorded on AHIMS were identified as falling within the study area. All of these sites were originally recorded by Giles Hamm and upon revisit were found to be in good condition.

All of these sites contained at least one baked clay heat retaining hearth, some with associated artefactual material and, when located in areas of remnant soil, PADs. The context of these sites was consistent with the newly identified hearth complex Limondale 12, and it is likely the sites are associated.

6.2 Newly identified sites

The types and locations of sites newly identified during the survey was largely consistent with the predictive model discussed in Section 4. The survey revealed that the current Mitchell's soils landscapes within the study area may not be accurate as no areas of Murrumbidgee Depression Plains were identified. Rather, the survey indicated that Murrumbidgee Scalded Plains was the dominant soil landscape within the study area, with areas of Mallee Cliffs, particularly through the western portion of the study area. With the exception of Limondale 9 and Limondale 11, all sites identified during this study were located on red earth Murrumbidgee Scalded Plain. This is in line with the predictive model, which identified areas of this landscape as the most likely to contain sites. Limondale 9, which consisted of a single stone artefact possibly associated with nearby fragments of freshwater mussel shell, was located on a white sand dune which was not consistent with either Mallee Cliff or Murrumbidgee Depression Plains soil landscapes.

The identification of only one site within the Mallee Cliff soil landscape was expected given the predictive model, which identified this landscape as holding the least archaeological potential. Notably, Limondale 11 was also the only hearth identified to contain only burnt calcrete heat retainers. While burnt calcrete cobbles were also identified within one hearth at Limondale 12, these formed part of a mixed hearth also containing burnt clay and termite mound heat retainers. The poor condition of Limondale 11 may account for the identification of only calcrete cobbles

The location of sites within the study area seems to bear little correlation with their relationship to modern water sources. There are no drainage or creek lines within the study area and the local area is generally water poor. None of the sites identified were located in close proximity to a source of water. This too is consistent with the predictive model, which saw little correlation between water availability and site location. This is likely the result of the movement of creek lines within the landscape and is potentially indicative of an early date for these sites, prior to natural or agricultural modifications to the landscape.

6.3 Analysis and discussion

Both previously and newly identified sites within study area were consistent with the predictive model and wider Balranald region. The identification of only one modified tree, Limondale 6, within the study area despite being the most common site type registered on AHIMS is likely a result of the extensive land clearing that occurred within the study area from the 19th century and during use of the land for grazing and, more recently, large scale cropping. The generally poor condition of sites within the study area is the result of this land use history.

All stone artefacts identified during the survey were silcrete, a common material for the area. To the south, a recent assessment carried out by NGH Environment for the Sunraysia Solar Farm identified a slightly more varied artefact assemblage, with chert, tuff and flaked petrified wood also present. The small size of the artefact assemblage identified during this study likely accounts for the dominance of silcrete, as well as the lack of patterns evident in the types of stone artefacts present in the assemblage. This does not allow for the development of any clear statements on the study area's Aboriginal occupation history on the basis of its lithic assemblage alone, although the low density of artefacts within the study area suggests only sporadic use.

The large number of hearth sites, as well as the presence of four earth mounds within the study area suggest it was likely used quite extensively by Aboriginal groups in the past. The presence of a mixed historical and Aboriginal feature at Limondale 7 and Limondale 8 indicates that the land continued to be used by Aboriginal people following the European settlement of the area.

7 Scientific values and significance assessment

The two main values addressed when assessing the significance of Aboriginal sites are cultural values to the Aboriginal community and archaeological (scientific) values. This report will assess scientific values while the Aboriginal Cultural Heritage Assessment Report will detail the cultural values of Aboriginal sites in the study area.

7.1 Introduction to the assessment process

Heritage assessment criteria in NSW fall broadly within the significance values outlined in the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter (Australia ICOMOS 1999). This approach to heritage has been adopted by cultural heritage managers and government agencies as the set of guidelines for best practice heritage management in Australia. These values are provided as background and include:

- **Historical significance** (evolution and association) refers to historic values and encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.
- **Aesthetic significance** (Scenic/architectural qualities, creative accomplishment) refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with social values and may include consideration of form, scale, colour, texture, and material of the fabric or landscape, and the smell and sounds associated with the place and its use.
- **Social significance** (contemporary community esteem) refers to the spiritual, traditional, historical or contemporary associations and attachment that the place or area has for the present-day community. Places of social significance have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events. Communities can experience a sense of loss should a place of social significance be damaged or destroyed. These aspects of heritage significance can only be determined through consultative processes with local communities.
- **Scientific significance** (Archaeological, industrial, educational, research potential and scientific significance values) refers to the importance of a landscape, area, place or object because of its archaeological and/or other technical aspects. Assessment of scientific value is often based on the likely research potential of the area, place or object and will consider the importance of the data involved, its rarity, quality or representativeness, and the degree to which it may contribute further substantial information.

The cultural and archaeological significance of Aboriginal and historic sites and places is assessed on the basis of the significance values outlined above. As well as the ICOMOS Burra Charter significance values guidelines, various government agencies have developed formal criteria and guidelines that have application when assessing the significance of heritage places within NSW. Of primary interest are guidelines prepared by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA), the OEH and the

Heritage Branch, NSW Department of Planning. The relevant sections of these guidelines are presented below.

These guidelines state that an area may contain evidence and associations which demonstrate one or any combination of the ICOMOS Burra Charter significance values outlined above in reference to Aboriginal heritage. Reference to each of the values should be made when evaluating archaeological and cultural significance for Aboriginal sites and places.

In addition to the previously outlined heritage values, the OEH Guidelines (DECC 2006) also specify the importance of considering cultural landscapes when determining and assessing Aboriginal heritage values. The principle behind a cultural landscape is that 'the significance of individual features is derived from their inter-relatedness within the cultural landscape'. This means that sites or places cannot be 'assessed in isolation' but must be considered as parts of the wider cultural landscape. Hence the site or place will possibly have values derived from its association with other sites and places. By investigating the associations between sites, places, and (for example) natural resources in the cultural landscape the stories behind the features can be told. The context of the cultural landscape can unlock 'better understanding of the cultural meaning and importance' of sites and places.

Although other values may be considered – such as educational or tourism values – the two principal values that are likely to be addressed in a consideration of Aboriginal sites and places are the cultural/social significance to Aboriginal people and their archaeological or scientific significance to archaeologists. The determinations of archaeological and cultural significance for sites and places should then be expressed as statements of significance that preface a concise discussion of the contributing factors to Aboriginal cultural heritage significance.

7.2 Archaeological (scientific significance) values

Archaeological significance (also called scientific significance, as per the ICOMOS Burra Charter) refers to the value of archaeological objects or sites as they relate to research questions that are of importance to the archaeological community, including indigenous communities, heritage managers and academic archaeologists. Generally the value of this type of significance is determined on the basis of the potential for sites and objects to provide information regarding the past life-ways of people (Burke and Smith 2004: 249, NPWS 1997b). For this reason, the NPWS (part of DECC) summarises the situation as 'while various criteria for archaeological significance assessment have been advanced over the years, most of them fall under the heading of archaeological research potential' (NPWS 1997b: 26). The NPWS criteria for archaeological significance assessment are based largely on the ICOMOS Burra Charter.

Research potential

Research potential is assessed by examining site content and site condition. Site content refers to all cultural materials and organic remains associated with human activity at a site. Site content also refers to the site structure – the size of the site, the patterning of cultural materials within the site, the presence of any stratified deposits and the rarity of particular artefact types. As the site contents criterion is not applicable to scarred trees, the assessment of scarred trees is outlined separately below. The site content ratings used for archaeological sites are provided in Table 15. Site condition refers to the degree of disturbance to the contents of a site at the time it was recorded. The site condition ratings used for archaeological sites are provided in Table 16.

Table 15 Site contents ratings used for archaeological sites.

Rating	Description
0	No cultural material remaining.
1	Site contains a small number (e.g. 0–10 artefacts) or limited range of cultural materials with no evident stratification.
2	Site contains a larger number, but limited range of cultural materials; and/or some intact stratified deposit remains; and/or are or unusual example(s) of a particular artefact type.
3	Site contains a large number and diverse range of cultural materials; and/or largely intact stratified deposit; and/or surface spatial patterning of cultural materials that still reflect the way in which the cultural materials were deposited.

Table 16 Site condition ratings used for archaeological sites.

Rating	Description
0	Site destroyed.
1	Site in a deteriorated condition with a high degree of disturbance; lack of stratified deposits; some cultural materials remaining.
2	Site in a fair to good condition, but with some disturbance.
3	Site in an excellent condition with little or no disturbance. For surface artefact scatters this may mean that the spatial patterning of cultural materials still reflects the way in which the cultural materials were laid down.

Pearson and Sullivan note that Aboriginal archaeological sites are generally of high research potential because 'they are the major source of information about Aboriginal prehistory' (1995, p.149). Indeed, the often great time depth of Aboriginal archaeological sites gives them research value from a global perspective, as they are an important record of humanity's history. Research potential can also refer to specific local circumstances in space and time – a site may have particular characteristics (well preserved samples for absolute dating, or a series of refitting artefacts, for example) that mean it can provide information about certain aspects of Aboriginal life in the past that other less or alternatively valuable sites may not (Burke and Smith 2004, p.247-8). When determining research potential value particular emphasis has been placed on the potential for absolute dating of sites.

The following sections provide statements of significance for the Aboriginal archaeological sites recorded during the surface survey for the assessment. The significance of each site follows the assessment process outlined above. This includes a statement of significance based on the categories defined in the Burra Charter. These categories include social, historic, scientific, aesthetic and cultural (in this case archaeological) landscape values. Nomination of the level of value—high, moderate, low or not applicable—for each relevant category is also proposed. Where suitable the determination of cultural (archaeological) landscape value is applied to both individual sites and places (to explore their associations) and also, to the Study Area as a whole. The nomination levels for the archaeological significance of each site are summarised below.

Representativeness

Representativeness refers to the regional distribution of a particular site type. Representativeness is assessed by whether the site is common, occasional, or rare in a given region. Assessments of representativeness are subjectively biased by current knowledge of the distribution and number of archaeological sites in a region. This varies from place to place depending on the extent of archaeological research. Consequently, a site that is assigned low significance values for contents and condition, but a high significance value for representativeness, can only be regarded as significant in terms of knowledge of the regional archaeology. Any such site should be subject to re-assessment as more archaeological research is undertaken.

Assessment of representativeness also takes into account the contents and condition of a site. For example, in any region there may only be a limited number of sites of any type that have suffered minimal disturbance. Such sites would therefore be given a high significance rating for representativeness, although they may occur commonly within the region. The representativeness ratings used for archaeological sites are provided in Table 17.

Table 17 Site representativeness ratings used for archaeological sites

Rating	Description
1	Common occurrence.
2	Occasional occurrence.
3	Rare occurrence.

Overall scientific significance ratings for sites, based on a cumulative score for site contents, site integrity and representativeness are provided in Table 18.

Table 18 Scientific significance ratings used for archaeological sites

Rating	Description
1-3	Low scientific significance.
4-6	Moderate scientific significance.
7-9	High scientific significance.

Each site is given a score on the basis of these criteria – the overall scientific significance is determined by the cumulative score. This scoring procedure has been applied to the Aboriginal archaeological sites identified during the survey. The results are in Table 19.

7.2.1 Statements of archaeological significance

The following archaeological significance assessment is based on Requirement 11 of the Code. Using the assessment criteria detailed in Scientific Values and Significance Assessment, an assessment of significance was determined and a rating for each site was determined. The results of the archaeological significance assessment are given in Table 20 below.

Table 19 Scientific significance assessment of Aboringinal archaeological sites recorded within the study area.

Site Name	Site Content	Site Condition	Representativeness	Scientific Significance
Limondale 1 (AHIMS # Pending)	2	2	1	Moderate
Limondale 2 (AHIMS # Pending)	2	1	1	Moderate
Limondale 3 (AHIMS # Pending)	1	1	1	Low
Limondale 4 (AHIMS # Pending)	2	1	1	Moderate
Limondale 5 (AHIMS # Pending)	2	1	1	Moderate
Limondale 6 (AHIMS # Pending)	1	3	3	High
Limondale 7 (AHIMS # Pending)	3	1	2	Moderate
Limondale 8 (AHIMS # Pending)	3	1	2	Moderate
Limondale 9 (AHIMS # Pending)	1	1	1	Low
Limondale 11 (AHIMS # Pending)	1	1	1	Low
Limondale 12 (AHIMS # Pending)	2	2	1	Moderate
Transmision line 5 (47-6-0605)	-	-	-	Moderate
Transmision line 5 (47-6-0606)	-	-	-	Moderate

Table 20 Statements of scientific significance for archaeological sites recorded within the study area.

Site Name	Statement of Significance
Limondale 1 (AHIMS # Pending)	Limondale 1 is a hearth with associated artefact scatter located on a graded track. The hearth is relatively intact and it appears to continue below the surface indicating some subsurface integrity may exist. The associated artefact scatter is in situ. This site type is common for the region and is in good condition so it is considered to have moderate significance.
Limondale 2 (AHIMS # Pending)	Limondale 2 is a complex of two disturbed earth mounds. Earth mounds are considered to have high scientific and cultural significance as they have potential to contain human remains however these earth mounds are highly disturbed and have been continuously ploughed. Some characteristics still exist so this site is considered to have moderate significance.
Limondale 3 (AHIMS # Pending)	Limondale 3 is a scattered hearth; there is no site integrity due to ongoing ploughing. The site type is common in the region and due to the disturbed nature it is considered to have low significance.
Limondale 4 (AHIMS # Pending)	Limondale 4 is a diffuse earth mound measuring approximately 30 by 30 metres on a Murrumbidgee scalded plain. Earth mounds are considered to have high scientific and cultural significance as they have potential to contain human remains however these earth mounds are highly disturbed and have been continuously ploughed. Some characteristics still exist so this site is considered to have moderate significance.
Limondale 5 (AHIMS # Pending)	Limondale 5 is a diffuse earth mound measuring approximately 20 by 30 metres on a Murrumbidgee scalded plain. Earth mounds are considered to have high scientific and cultural significance as they have potential to contain human remains however these earth mounds are highly disturbed and have been continuously ploughed. Some characteristics still exist so this site is considered to have moderate significance.
Limondale 6 (AHIMS # Pending)	Limondale 6 is a modified box tree measuring 2 metres in circumference with a small oval scar bearing four steel axe marks facing west on its lower trunk. Scar trees hold high significance to the local Aboriginal community. The scar is in good condition and is easy identifiable as being made by humans due to a number of steel axe marks. This site is of high scientific and cultural significance.
Limondale 7 (AHIMS # Pending)	Limondale 7 is a disturbed site complex measuring 50 by 100 metres and consisting of a series of heavily disturbed hearths with associated historic material on a Murrumbidgee scalded plain. The historic relics at this site add a degree of significance as it shows post-contact use of European items by Aboriginal people. Earth mounds are considered to have high scientific and cultural significance as they have potential to contain human remains however these earth mounds are highly disturbed and have been continuously ploughed. Some characteristics still exist so this site is considered to have moderate significance.
Limondale 8 (AHIMS #	Limondale 8 is a disturbed site complex measuring 100 by 100 metres and consisting of a series of heavily disturbed hearths with associated historic material on a

Pending)	Murrumbidgee scalded plain. The historic relics at this site add a degree of significance as it shows post-contact use of European items by Aboriginal people. Earth mounds are considered to have high scientific and cultural significance as they have potential to contain human remains however these earth mounds are highly disturbed and have been continuously ploughed. Some characteristics still exist so this site is considered to have moderate significance.
Limondale 9 (AHIMS # Pending)	Limondale 9 was an isolated find, a longitudinal silcrete flake fragment with a feather termination, found exposed in a ploughed area of white sand dune. Stone flakes are a common site type in the region and this site has been highly disturbed by ploughing. It has low scientific significance.
Limondale 11 (AHIMS # Pending)	One isolated hearth feature, Limondale 11, was located on a flat between Mallee cliff sand dunes in the southern portion of the study area. The site consists of burnt calcrete heat retainers and is the only hearth of this type identified during the survey. The site has been highly disturbed by ploughing and has low scientific significance.
Limondale 12 (AHIMS # Pending)	One site complex with an associated PAD, Limondale 12, was identified within these clay pans during the survey. It consisted of eight burnt clay heat retainer hearths, six of which also contained fragments of termite mound. The hearths are relatively intact and it appears to continue below the surface indicating some subsurface integrity may exist. This site has moderate scientific significance.
Transmission Line 5 (57-6-0605)	Hearth with Potential Archaeological Deposit. No report available on AHIMS. This site has moderate scientific significance.
Transmission Line 6 (57-6-0606)	Hearth with Potential Archaeological Deposit. No report available on AHIMS. This site has moderate scientific significance.

8 Impact assessment

8.1 Predicted physical impacts

The construction of the project includes disturbance to the ground surface within the development footprint. This construction has the potential to disturb Aboriginal heritage sites; however, through project design, Overland has redesigned the development footprint to avoid and minimize impacts to Aboriginal heritage sites as far as practicable.

A summary of impacts is provided below in Table 21.

Table 21 Summary of potential archaeological impacts

AHIMS site no.	Site name	Significance	Type of harm	Degree of harm	Consequence of harm
47-5-0045	Limondale 1	Moderate	Total	Total	Total loss of vale
47-6-0826	Limondale 2	Moderate	None	None	No loss of value
47-6-0827	Limondale 3	Low	None	None	No loss of value
47-6-0828	Limondale 4	Moderate	None	None	No loss of value
47-6-0829	Limondale 5	Moderate	None	None	No loss of value
47-6-0830	Limondale 6	High	None	None	No loss of value
47-6-0831	Limondale 7	Moderate	None	None	No loss of value
47-6-0834	Limondale 8	Moderate	None	None	No loss of value
47-5-0046	Limondale 9	Moderate	Direct	Total	Total loss of value
47-6-0833	Limondale 11	Low	Direct	Total	Total loss of value
47-6-0832	Limondale 12	Moderate	None	None	No loss of value
47-6-0605	Transmission Line 6	Moderate	Total	Total	Total loss of vale
47-6-0606	Transmission Line 5	Moderate	Total	Total	Total loss of vale

8.2 Management and mitigation measures

Ideally, heritage management involves conservation of sites through the preservation and conservation of fabric and context within a framework of "*doing as much as necessary, as little as possible*" (Marquis-Kyle and Walker 1994: 13). In cases where conservation is not practical, several options for management are available.

For sites, management often involves the salvage of features or artefacts, retrieval of information through excavation or collection (especially where impact cannot be avoided) and interpretation.

Overland has redesigned the development footprint to avoid harm to 8 of the 13 Aboriginal heritage sites in the study area. Impacts to Limondale 1, 9, and 11 cannot be avoided so salvage of these sites is recommended to retrieve as much information from them as possible. Impacts are also unavoidable for AHIMS sites 47-6-0606 and 47-6-0605 and further assessment in the form of sub-surface testing is recommended.

9 Recommendations

Strategies have been developed based on the archaeological (significance) of cultural heritage relevant to the study area and influenced by:

- Predicted impacts to Aboriginal cultural heritage;
- The planning approvals framework;
- Current best conservation practise, widely considered to include:
  - Ethos of the Australia ICOMOS Burra Charter
  - The Code.

Prior to any impacts occurring within the study area, the following is recommended:

Recommendation 1: Continued consultation with the registered Aboriginal parties

It is recommended that Overland Sun Farming continue to inform the RAPs about the management of Aboriginal cultural heritage sites within the site boundary throughout the construction of the project. This recommendation is in keeping with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a).

Recommendation 2: Sites Limondale 1, 9 and 11 should be salvaged prior to development.

The development footprint is unable to avoid impacts to sites Limondale 1, 9 and 11. It is recommended that these sites undergo surface salvage prior to construction, with the exact details developed as part of a cultural heritage manage plan (CHMP).

Recommendation 3: Sites Limondale 2, 3, 4, 5, 6, 7, 8 and 12, and AHIMS sites 47-5-0008, 47-5-0604, 47-6-0603, are to be avoided from impact.

The development footprint avoids impact to sites Limondale 2, 4,5,6,7, 8 and 12, and AHIMS sites 47-5-0008, 47-6-0603, 47-5-0604 so further investigation is not required. However, in future if the development area changes and impact to these sites becomes likely further archaeological investigation in the form of sub-surface testing and would be required.

Recommendation 4: Further assessment required for AHIMS sites 47-6-0606 and 47-6-0605, or if further works are proposed outside of the current study area

The development footprint is unable to avoid impacts to AHIMS sites 47-6-0606 and 47-6-0605. It is recommended that further assessment, in the form of sub-surface testing, be undertaken at these sites.

If further disturbance is proposed in areas outside of the current study area, then additional survey may be required.

Recommendation 5: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and places are protected under the National Parks and Wildlife Act. It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations.

These may include notifying the OEH and Aboriginal stakeholders to inform options for management of the objects.

Recommendation 6: Discovery of unanticipated historical relics

Relics are historical archaeological resources of local or State significance and are protected in NSW under the Heritage Act 1977. Relics cannot be disturbed except with a permit or exception/exemption notification. Should unanticipated relics be discovered during the course of the project, work in the vicinity must cease and an archaeologist contacted to make a preliminary assessment of the find. The Heritage Council will require notification if the find is assessed as a relic.

Recommendation 7: Discovery of Aboriginal ancestral remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains
2. Notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location
3. Not recommence work at that location unless authorised in writing by OEH.

Recommendation 8: Stop work provision for any potential discovery of human remains

If any suspected human remains are discovered during any activity works, all activity must cease immediately. The remains must be left in place and protected from harm or damage. The following contingency plan describes the immediate actions that must be taken in instances where human remains or suspected human remains are discovered. Any such discovery at the activity area must follow these steps:

1. Discovery: If suspected human remains are discovered all activity must stop to ensure minimal damage is caused to the remains; and the remains must be left in place, and protected from harm or damage.
2. Notification: Once suspected human skeletal remains have been found, the Coroners Office and the NSW Police must be notified immediately. Following this, and if the human remains are likely to be Aboriginal in origin, the find will be reported to the Aboriginal parties and DECCW NSW. If the find is likely to be non-Aboriginal in origin and more than 100 years in age, the Heritage Council of NSW will be notified of the find under s.146 of the *Heritage Act 1977*.

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Appendices

Appendix 1 AHIMS results

THE FOLLOWING APPENDIX IS NOT TO BE MADE PUBLIC