106-228 Aldington Road, Kemps Creek

Archaeological Report

DRAFT REPORT

Prepared for Stockland, on behalf of Fife Kemps Creek Pty Ltd

24 March 2021

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- Stockland.
- Ethos Urban.
- Registered Aboriginal Parties.

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- Anne Murray and Julian Turner for mapping.

Contents

Tables

Figures

Photos

Glossary

ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Biosis	Biosis Pty Ltd
BP	Before Present
CHMP	Cultural Heritage Management Plan
Consultation requirements	*Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*
DA	Determining Authority
DECCW	Department of Environment, Climate Change and Water (now Heritage NSW)
DP	Deposited Plan
DPC	Department of Premier and Cabinet
DPIE	Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ESD	Ecologically Sustainable Development
EP&A Act	*Environmental Planning and Assessment Act 1979*
GFA	Gross Floor Area
GPS	Global Positioning System
GSV	Ground Surface Visibility
Heritage NSW	Heritage NSW, Department of Premier and Cabinet
ICOMOS	International Council on Monuments and Sites
JMCHM	Jo McDonald Cultural Heritage Management
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MGA	Map Grid of Australia
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service

NSW	New South Wales
PAD	Potential Archaeological Deposit
RAP	Registered Aboriginal Party
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
study area	Lots 20-23 DP 255560 and Lots 30-32 DP 258949
the Code	*Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*

Summary

Biosis Pty Ltd (Biosis) was commissioned by Stockland, on behalf of Fife Kemps Creek Pty Ltd (Fife Kemps Creek), to undertake an Aboriginal Cultural Heritage Assessment (ACHA) of the proposed development of 106-228 Aldington Road, Kemps Creek New South Wales (NSW) (the study area). The project is to be assessed as a State Significant Development (SSD-10479) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Secretary's Environmental Assessment Requirements (SEARs) were issued for the proposed development in July 2020. The SEARs requested that an ACHA be undertaken to identify Aboriginal heritage values within the study area to determine whether the proposed development has the potential to impact upon these sites. This Archaeological Report (AR) documents the findings of the desktop assessment, archaeological survey, and test excavations conducted as part of the ACHA. As required under Section 2.3 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010a) (the Code), the AR provides evidence about the material traces of Aboriginal land use to support the conclusions and management recommendations in the ACHA.

The Department of Planning, Industry and Environment (DPIE) is the determining authority (DA) and will assess the Environmental Impact Statement (EIS) accompanying the application to help them determine if the proposed development is likely to have a significant effect on the environment, including Aboriginal cultural heritage.

The Aboriginal community has been consulted regarding the heritage management of the project throughout its lifespan. Consultation has been undertaken as per the process outlined in the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010b) (consultation requirements).

A search of the Aboriginal Heritage Information Management System (AHIMS) register conducted on 27 May 2020, identified 102 Aboriginal sites within a 4 by 4 kilometre search area centred over the study area. None of these registered sites were located within the study area.

An archaeological survey was conducted on 11 July 2020. 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 (GSV) combined with a low amount of exposures. No previously unrecorded Aboriginal cultural heritage sites were identified during the archaeological survey; however, three areas of moderate archaeological potential (Area 1, Area 2 and Area 3) were recorded.

Test excavations within Area 1, Area 2 and Area 3 were completed as part of this assessment. A total of 248 artefacts were recovered from Area 1 (n=19), Area 2 (n=28), and Area 3 (n=201). Soil deposits are considered to be intact as impacts from previous disturbances (including ploughing and grazing and vegetation clearance) do not extend further than approximately 200 millimetres in depth.

The presence of artefacts within spits 1 to 4 suggests that Area 3 demonstrates ongoing periodic occupation of the study area by Aboriginal people, based on the proximity to Ropes Creek and artefact types recovered throughout the PAD. The high density concentration in the northern portion of Area 3 indicates that the area was utilised heavily for artefact reduction purposes. The remainder of Area 3 comprises of low to moderate density artefact deposits tied to this event, or to frequent, periodic occupation of the area by Aboriginal people occupying the Kemps Creek area. The potential

for further intact archaeological deposits to be recovered within Area 3, specifically surrounding the high density artefact deposit, is considered high, particularly in undisturbed soils within 50-100 metres of Ropes Creek.

An assessment of impacts to Aboriginal heritage values through the proposed works has determined that Area 1, Area 2 and a portion of Area 3 will be impacted by the proposed development. The remaining portion of Area 3 contains a high density archaeological deposit that has been recommended for further salvage if impacts cannot be avoided.

The following recommendations have been developed based on the archaeological significance of cultural heritage relevant to the study area. Recommendations also take into consideration:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practice, widely considered to include:
  - The ethos of the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter.
  - the Code.

Management recommendations

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

Recommendation 1: Development of a CHMP

A CHMP should be developed to provide management and mitigation measures for cultural heritage values identified within the study area. The CHMP should be prepared to include the following recommendations, and will be developed in consultation with RAPs.

Recommendation 2: No further works within Area 1 and Area 2 and part of Area 3

Area 1 (AHIMS pending), Area 2 (AHIMS pending), and part of Area 3 (AHIMS pending) will be impacted by the proposed development. Further testing and salvage of these sites is not recommended. The proposed works may therefore proceed with caution in these areas in line with an approved CHMP.

Recommendation 3: Archaeological salvage of part of Area 3 if impacts cannot be avoided

This assessment has determined that part of Area 3 (AHIMS pending) will not be impacted by the proposed development. This portion of Area 3 consists of a high density, intact subsurface archaeological deposit that has the potential to contribute further knowledge regarding Aboriginal occupation within the local region.

It is recommend that if impacts cannot be avoided to the portion of Area 3 where high density intact archaeological deposits have been identified, then salvage excavations in accordance with a salvage methodology to be developed in consultation with RAPs as part of the CHMP will be required.

Salvage excavations will focus on the areas of highest artefact density (artefact densities >25 artefacts per square metre) within the recommended salvage area (Figure 14). It is recommended that (if applicable) an area of up to 100 square metre be salvaged to adequately investigate the extent of the high density deposit within Area 3. This will allow for a comparative assessment to be undertaken with similar excavations in the local area.

Recommendation 4: Fencing of part of Area 3

Prior to any works taking place, the portion of Area 3 (AHIMS pending) recommended for salvage should be clearly fenced, to ensure it will not be harmed by the proposed works. Fencing must remain in place over the lifespan of the proposed development.

Recommendation 5: Long term care agreement

The establishment of a long term care agreement in consultation with RAPs should be developed in order to ensure the artefacts identified as part of this assessment and any future salvage works are adequately cared for. Several management options are possible depending on the wishes of RAPs. Artefacts recovered from the salvage excavations can be given back to the Aboriginal community through a long term care agreement where they can then be used to teach subsequent generations about Aboriginal culture or can be reburied in a culturally appropriate place.

This approach considers the principles of Economically Sustainable Development (ESD) and intergenerational equity and more importantly ensures that recovered artefacts are managed according to the wishes of RAPs.

Recommendation 6: Heritage inductions

Heritage inductions for all site workers and contractors should be undertaken in order to prevent any unintentional harm to Aboriginal sites located within the study area and its surrounds. This includes the following items:

- Relevant legislation.
- Location of identified Aboriginal heritage sites, areas of archaeological potential, and areas of archaeological sensitivity.
- Basic identification skills for Aboriginal and non-Aboriginal artefacts and human remains.
- Procedure to follow in the event of an unexpected heritage item find during construction works.
- Procedure to follow in the event of discovery of human remains during construction works.
- Penalties and non-compliance.

Recommendation 7: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and Places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to disturb an Aboriginal object or site without a consent permit issued by Heritage NSW, Department of Premier and Cabinet (Heritage NSW). 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 Heritage NSW and Aboriginal stakeholders.

Recommendation 8: 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 Heritage NSW'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 Heritage NSW.

1 Introduction

1.1 Project background

Biosis was commissioned by Stockland, on behalf of Fife Kemp Creek, to undertake an ACHA for the proposed development of 106-228 Aldington Road, Kemps Creek NSW. The proposed development will be classified as a SSD (SSD-10479) under Part 4 of the EP&A Act.

SEARs were issued July 2020 for the proposed development (SSD-10497) requesting that an ACHA be undertaken to identify and describe Aboriginal cultural heritage values within the study area. This AR documents the findings of the desktop assessment, field investigation, and test excavations conducted as part of the ACHA and provides an assessment of impacts to Aboriginal heritage values identified by the assessment and mitigation measures. The AR provides evidence about the material traces of Aboriginal land use to support the conclusions and management recommendations in the ACHA.

This investigation has been carried out under Part 6 of the NPW Act. It has been undertaken in accordance with the Code. The Code has been developed to support the process of investigating and assessing Aboriginal cultural heritage by specifying the minimum standards for archaeological investigation undertaken in NSW under the NPW Act. The archaeological investigation must be undertaken in accordance with the requirements of the Code.

The EP&A Act includes provisions for local government authorities to consider environmental impacts in land-use planning and decision making. Each Local Government Area (LGA) is required to create and maintain a Local Environmental Plan (LEP) that includes Aboriginal and historical heritage items. Local Councils identify items that are of significance within their LGA, and these items are listed on heritage schedules in the LEP and are protected under the EP&A Act and *Heritage Act 1977*.

1.2 Study area

The study area is located approximately 12 kilometres south-east of Penrith and approximately 40 kilometres west of the Sydney CBD (Figure 1). It encompasses 72.08 hectares of private land and consists of Lots 20-23 DP 255560 and Lots 30-32 DP 258949.

The study area is within the:

- City of Penrith LGA.
- Parish of Melville.
- County of Cumberland.

The study area is bounded by Aldington Road to the west and pastoral properties to the north, east and south (Figure 2).

1.3 Planning approvals

The proposed development will be assessed against Part 4 of the EP&A Act. Other relevant legislation and planning instruments that will inform this assessment include:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- NPW Act.
- *National Parks and Wildlife Amendment Act 2010.*
- *Infrastructure State Environmental Planning Policy 2007* (SEPP).
- *Penrith Local Environmental Plan 2010 (LEP).*
- *State Environmental Planning Policy (Western Sydney Employment Area) 2009*.
- *Mamre Road Precinct Draft Development Control Plan 2020* (DCP).

1.4 Objectives of the investigation

The objectives of the investigation can be summarised as follows:

- To identify and consult with any RAPs and the Deerubbin Local Aboriginal Land Council (LALC).
- 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 investigation of the study area to locate unrecorded or previously recorded Aboriginal sites and to further assess the archaeological potential of the study area.
- To conduct test excavations in any areas of moderate potential, to establish the extent and nature of the PADs identified.
- 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 1.

Table 1 Investigators and contributors

Name and qualifications	Experience summary	Project role
Taryn Gooley BASc (Hons)	Taryn has over 10 years' experience in archaeological consulting and has successfully completed numerous projects throughout NSW. Taryn has extensive experience in undertaking Aboriginal archaeological assessments, archaeological surveys, and large scale archaeological testing and salvage excavation programs across NSW. Taryn has participated in and managed a number of long term archaeological programs under Part 4 and Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).	• Quality assurance
Ashleigh Keevers-Eastman BA (Hons)	Ashleigh is a Project Archaeologist with over three years' experience. Ashleigh has gained experience in conducting Aboriginal heritage assessments, field surveys, archaeological test excavations and salvage works across New South Wales. Ashleigh's strengths are in consulting with the Aboriginal community to build strong relationships that assist in the assessment of Aboriginal cultural heritage. Ashleigh possesses skills in lithic identification, technical report writing and project management.	• Project management • Field team • Report writing
Samantha Keats BA (Hons)	Samantha is a senior archaeologist with Biosis Wollongong office. Samantha has over five years of experience as an archaeologist, with a particular research focus on rock art assemblages and ochre in the north-west Kimberley region of Australia. Samantha has experience in the successful completion of ACHA's, archaeological surveys, test excavations, and salvage excavations, as well as Aboriginal community consultation. She is also accomplished in obtaining approvals under the NPW Act.	• Project management • Report writing
Ashley Bridge M ArchSci (Adv. with Hons) BA Archaeology	Ashley joined Biosis at the Sydney Office as a Research Assistant – Heritage in 2018. She completed her Masters in Archaeological Science in 2016, having written a thesis on forensic stature in Australian mass casualty scenarios. In the last year Ashley has undertaken fieldwork for Biosis throughout Sydney, Wollongong and Western NSW, with a focus in both Aboriginal and historical archaeology. This has allowed her to further develop her skills in Aboriginal and historical excavations in Australia, while also honing her skills in reporting and administrative tasks. She also has experience with desktop research and Aboriginal consultation practices	• Field team • Report writing

Name and qualifications	Experience summary	Project role
	in an Australian context.	
Anthea Vella B.Arch M.AHM	Anthea is an Archaeologist with two years' experience. Anthea has experience in conducting Aboriginal and historical heritage assessments, surveys and archaeological test excavations for a variety of projects throughout NSW. Anthea possesses specialist skills in analysing Ground Penetrating Radar data. Anthea also possesses skills in desktop research, project administration, and reporting.	• Field team • Data entry
Madeleine Lucas BA (Hons) BSC	Madeleine joined Biosis as a Research assistant in 2019. Madeleine possesses skills in zooarchaeological analysis and is experienced in the identification of faunal remains and taphonomic analysis. Since joining Biosis, Madeleine has further developed her skills in historical and Aboriginal background research, data entry, and report production. Madeleine is also experienced in undertaking Aboriginal community consultation.	• Background research • Aboriginal community consultation • Reporting
Matthew Tetlaw BA (Hons) Archaeology and History	Matthew completed his Bachelor of Arts with honours in 2018 and joined Biosis in their Wollongong office in 2019. Since employment at Biosis, Matthew has participated in a variety of Aboriginal and historic projects which has brought him in contact with test excavation, archaeological survey, artefact analysis, background research, legislative requirements. All of this experience has provided an opportunity to become proficient in archaeological assessment and report writing.	• Background research • Field team
James Shepherd BA Informatics (Hons)	James is a Senior GIS Officer working with Biosis since February 2011, with over ten years' professional experience in the use and application of GIS to various disciplines, particularly within the environmental and heritage consulting sectors. James is experienced in map production, spatial analysis and spatial data management and has applied these skills to work for a diverse range of clients across Australia. James is a qualified ESRI trainer in a number of official ESRI ArcGIS Desktop courses from beginner to advanced level. James has previously worked as an archaeological and heritage consultant both in NSW and Victoria including assisting with heritage and archaeological assessments and management plans. James has contributed to numerous consultant reports at Biosis for both the Natural and Cultural heritage teams in the form of figure production, field data preparation and management, spatial analysis,	• Map production • GIS analysis

Name and qualifications	Experience summary	Project role
	landscape interpretation and quantitative impact analysis (e.g. vegetation impacts calculations).	

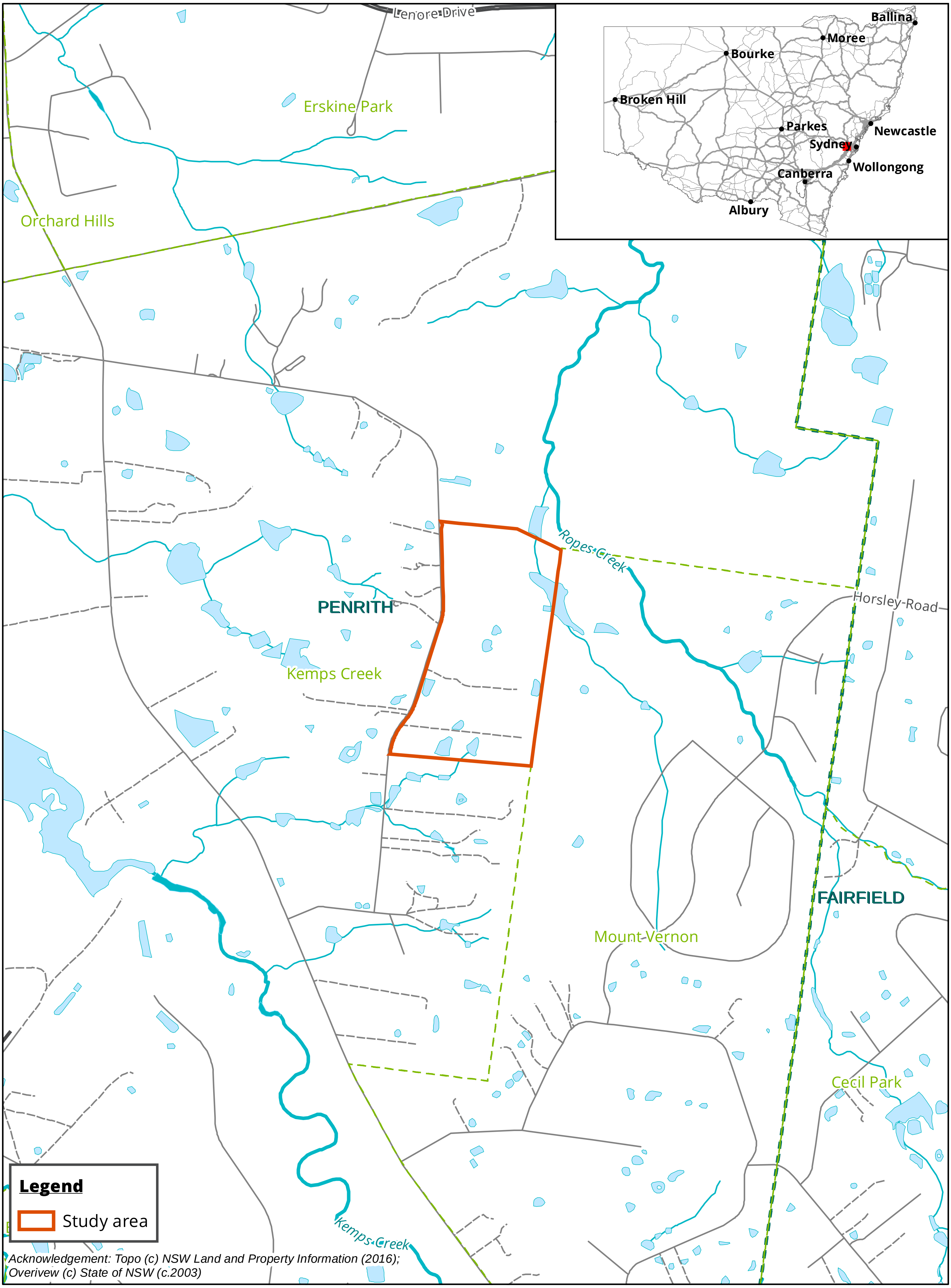

Figure 1 Location of the study area

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Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

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Checked by: AKE, Drawn by: AEDM, Last edited by: jturner
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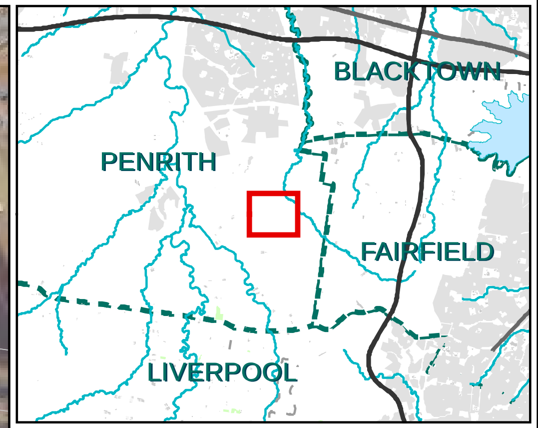
Metres
N
Scale 1:25,000 @ A4, GDA 1994 MGA Zone 56



Legend

Study area

Lot

Figure 2 Study area detail

0 50 100 150 200

Metres

N

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Date: 23 March 2021,
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2 Proposed development

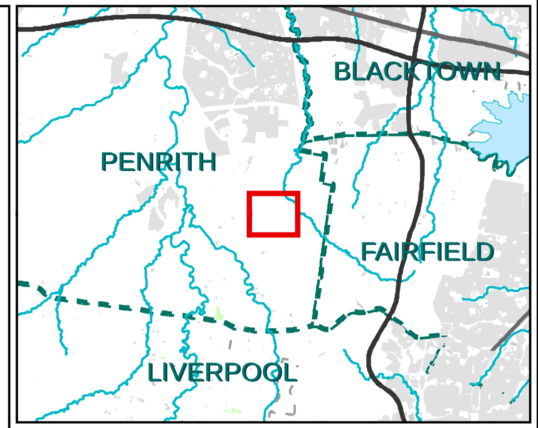
Fife Kemps Creek are proposing to develop 106 – 228 Aldington Road, Kemps Creek, NSW (Lots 30-32 DP258949 and Lots 20-23 DP255560) (Figure 2). The intent is to redevelop the site for industrial purposes in line with the desired future outcomes of the Mamre Road Precinct and recent amendments (which occurred in June 2020) to the SEPP (Western Sydney Employment Area) 2009.

The development comprises of a Concept State Significant Development Application (SSDA) for the site including proposed future development lots and building footprints, as well as detailed consent for Stage 1 works which will include construction of a 52,500 square metre warehouse building and associated infrastructure required to be constructed for the development to operate, including road intersections, internal road construction and other associated on-site utilities (Figure 3).

Specifically, the application seeks approval for the following development:

- A concept masterplan with an indicative total building area of 374, 630 square metres, comprising:
  - 356,660 square metres of warehouse floor space.
  - 17,770 square metre of ancillary office floor space.
  - 200 square metre of café floor space.
  - 13 individual development lots for warehouse buildings with associated hardstand areas.
  - Internal road layouts and road connections to Aldington Road.
  - Provision for 1700 car parking spaces.
  - Associated site landscaping.
- Detailed consent for site preparation, earthworks and infrastructure works (i.e. Stage 1 works) on the site include:
  - Demolition and clearing of all existing built form structures.
  - Drainage and infill of existing farm dams and any ground dewatering.
  - Clearing of all existing vegetation.
  - Construction of a warehouse building with a total of 52,500 square metres of Gross Floor Area (GFA), including.
    - 50,000 square metres of warehouse GFA.
    - 2,500 square metres of office GFA.
    - 230 car parking spaces.
- Bulk earthworks including 'cut and fill' to create flat development platforms for the warehouse buildings.
- Top soiling and grassing/site stabilization works.
- Roadworks and access infrastructure.
- Inter-allotment, road and boundary retaining walls.

- Storm water and drainage works including storm water basins, diversion of storm water lines, gross pollutant traps and associated swale works.
- Sewer and potable water reticulation.



Legend

Study area

Stage1 impact area

Lot D

Lot F

Lot L

Riparian works

Proposed new top of bank

Vegetated Riparian Zone (VRZ) using existing top of bank (7345m2)

Proposed new vegetated riparian zone (7687m2)

Figure 3 Proposed development

0 50 100 150 200

Metres

N

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Acknowledgements: Basemap © Land and Property Information 2016,

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3 Desktop assessment

The desktop assessment involves researching and reviewing existing archaeological studies and reports relevant to the study area and the Cumberland Plain region. This information is combined to develop an Aboriginal site prediction model for the study area, and to 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 of places.

3.1.1 Topography and hydrology

The study area is located within the Cumberland Lowlands physiographic region that consists of low lying, gently undulating plains and low hills, with a dense drainage net of predominantly northward flowing channels (Bannerman & Hazelton 1990, p.2). The study area itself is a series of undulating moderately inclined slopes and crests which gradually descends towards unnamed tributaries of Ropes Creek in the north-east and Kemps Creek in the south. This landscape is situated on the Bringelly Shale formation which is part of the Wianamatta group (Figure 4). Bringelly shale consists of shale, carbonaceous claystone, laminate, lithic sandstone and rare coal. Artefact scatters are common in this landscape, as are Potential Archaeological Deposits (PADs).

Stream order is recognised as a factor which assists the development of predictive modelling in Sydney Basin Aboriginal archaeology, and has seen extensive use in predictive modelling for the Sydney region, most notably by Jo McDonald Cultural Heritage management (Jo McDonald Cultural Heritage Management Pty Ltd 2000, Jo McDonald Cultural Heritage Management 2005a, Jo McDonald Cultural Heritage Management 2005b, Jo McDonald Cultural Heritage Management Pty Ltd 2008). These predictive models have a tendency to favour higher order streams as the locations of campsites and therefore archaeological deposits. Larger water sources would have been more likely to provide a stable source of water and by extension other resources which would have been used by Aboriginal groups.

The stream order system used for this assessment was originally developed by Strahler (1952). It functions by adding two streams of equal order at their confluence to form a higher order stream, as shown in Photo 1. As stream order increases, so does the likelihood that the stream would be a perennial source of water.

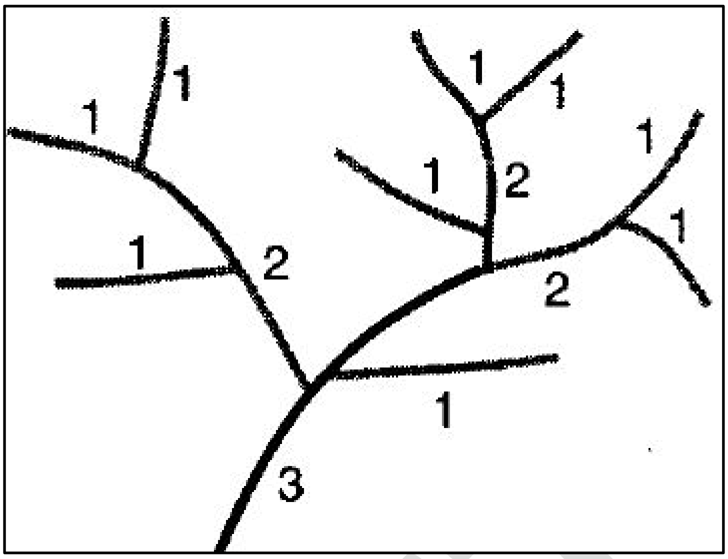


Photo 1 Diagram showing Strahler stream order (Ritter et al. 1995, pp. 151).

There are two creek lines within the study area. The first is an unnamed first order tributary of Ropes Creek that transects the north-east corner of the study area. Ropes Creek, a third order creek, is located 70 metres from the north-east corner of the study area. The second is in the south of the study area and is a first order tributary of Kemps Creek, which is located 1.2 kilometres to the south-east. These larger water bodies are located approximately 400 metres to the west for Ropes Creek and 3 kilometres east for Kemps Creek (Figure 5).

3.1.2 Soil landscapes

Soil landscapes have distinct morphological and topological characteristics that result in specific archaeological potential. 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 study area is located partly within the Blacktown soil landscape Figure 6). This landscape is characterised by its low reliefs and gentle slopes, and is generally associated with a landform pattern of gently undulating rises. The local relief is around 30 metres, with slopes 5% (Bannerman & Hazelton 1990, p.29). The soil characteristics of this landscape are described in Table 2 below.

Table 2 Blacktown soil landscape characteristics (Bannerman & Hazelton 1990, pp.29–30)

Soil material	Description
bt1—Friable brownish black loam	This is a friable brownish black loam to clay loam with moderately pedal subangular blocky (2 – 20 millimetres) structure and rough-faced porous ped fabric. This material occurs as topsoil (A horizon). Colour is brownish black (10YR 2/2) but can range from dark reddish brown (5YR 3/2) to dark yellowish brown (10YR 3/4). Rounded iron indurated fine gravel-sized shale fragments and charcoal fragments are sometimes present. Roots are common.

Soil material	Description
bt2—Hard setting brown clay loam	This is a brown clay loam to silty clay loam which is hard setting on exposure or when completely dried out. It occurs as an A2 horizon. This material is water repellent when extremely dry. Colour is dark brown (7.5YR 4/3) but can range from dark reddish brown (2.5YR 3/3) to dark brown (10YR 3/3). Platy, iron indurated gravel-sized shale fragments are common. Charcoal fragments and roots are rarely present.
bt3—Strongly pedal, mottled brown light clay	This is a brown light to medium clay with strongly pedal polyhedral or sub-angular to blocky structure and smooth-faced dense ped fabric. This material usually occurs as subsoil (B horizon). Colour is brown (7.5YR 4/6) but may range from reddish brown (2.5YR 4/6) to brown (10YR 4/6). Frequent red, yellow or grey mottles occur often becoming more numerous with depth. Fine to coarse gravel-sized shale fragments are common and often occur in stratified bands. Both roots and charcoal fragments are rare.
bt4—Light grey plastic mottled clay	This is a plastic light grey silty clay to heavy clay with moderately pedal polyhedral to subangular blocky structure and smooth faced dense ped fabric. This material usually occurs as deep subsoil above shale bedrock (B3 or C horizon). Colour is usually light grey (10YR 7/1) or, less commonly, greyish yellow (2.5YR 6/2). Red, yellow or grey mottles are common. Strongly weathered ironstone concretions and rock fragments are common. Gravel-sized shale fragments and roots are occasionally present. Charcoal fragments are rare.

The Blacktown soil landscape is a residual landscape which develops slowly, allowing geomorphic processes to preserve Aboriginal objects as they are deposited on the surface. Because of a lack of erosional forces, there is little lateral movement on the surface or below, and thus may preserve archaeological material *in situ*.

The Luddenham soil landscape is also represented within the study area (Figure 6). The topography of this soil type consists of low rolling to steep low hills with local reliefs of 50-120 metres, slopes of 5-20%, convex narrow ridges and hillcrests with moderately inclined slopes containing drainage lines (Bannerman & Hazelton 1990). The soil types that characterise the Luddenham soil landscape are summarised in Table 3.

The Luddenham soil landscape distribution patterns vary dependant on the landform type it is contained within, therefore altering the depths at which subsurface archaeological artefact deposits are found. The majority of the study area contains undulating slopes, with 50 centimetres of loamy sand overlaying >100 centimetres of sandy clay. Occasionally this overlays > 150 centimetres of mottled grey plastic clay (lu4). On average, soil depth is less than 200 centimetres.

Table 3 Luddenham soil landscape characteristics (Bannerman & Hazelton 1990, p.63)

Soil landscape	Description
lu1 - Friable dark brown loam	Dark brown, friable loam, silt loam or silty clay loam with moderate to strong structure and porous fabric. This material occurs as topsoil (A1 horizon). Surface condition is distinctly friable but may become hard setting when compacted and dry. Colour is dark brown (10YR 3/3, 7.5 YR 3/3) but can range from brownish black (5YR 3/1) to brown (10YR 4/4). This material is occasionally water repellent.

Soil landscape	Description
	The pH varies from moderately acidic (pH 5.0) to slightly acidic (pH 6.5). Roots are common to 10 centimetres becoming fewer with increasing depth. Charcoal fragments occur occasionally.
lu2 – Hard setting brown clay loam	This is a clay loam to fine sandy clay loam with an earthy or porous, rough faced fabric. This material occurs as an A2 horizon and is occasionally hard setting when exposed at the surface. Colour is brown (7.5YR 4/4) but can range between dull yellowish brown (10YR 5/4) and reddish brown (5YR 4/6). The pH varies between strongly acidic (pH 4.0) and slightly acidic (pH 6.5). Shale rock fragments, charcoal fragments and roots are present.
lu3 – Whole coloured, strongly pedal clay	This is a medium clay with strong structure and a smooth-faced, dense fabric. It occurs as subsoil (B horizon). Texture is commonly medium clay but can range from silty day to heavy clay. Colour is reddish brown (5YR 4/6- 8) and can range from bright reddish brown (2.5YR 4/8) to bright yellowish brown (10YR 6/6). The pH ranges from strongly acidic (pH 4.0) lo moderately acidic (pH 5.5). Shale rock fragments are common. Roots are rare and charcoal fragments are absent.
lu4 – Mottled grey plastic clay	A grey, mottled, medium clay with strongly pedal structure and dense, smooth fabric. It occurs as deep subsoil. Texture ranges to heavy clay. Colour is usually light grey (10YR 7/1) but ranges to light reddish grey (2.5YR 7/1). Yellow and red mottles are common. It is usually moist and is very plastic. The pH varies from strongly acidic (pH 4.0) to moderately acidic (pH 5.5). Shale rock fragments and gravel are common. Roots are rare, and other inclusions are absent.
lu5 – Apedal brown sandy clay	This is an apedal massive brown, sandy clay to light clay with a dense earthy fabric. It occurs as subsoil (B horizon). Occasionally weak sub angular blocky or polyhedral structure is evident. Colour is usually brown (7.5YR 4/4-6) but ranges from dull reddish brown (5YR 4/4) to dull yellowish brown (10YR 5/4). This material is moderately acidic (pH 5.0) to neutral (pH 7.0). Roots are common. Up to 10% of the volume may be small (2-6 millimetres) angular, well weathered shale fragments. Charcoal and other inclusions do not occur.

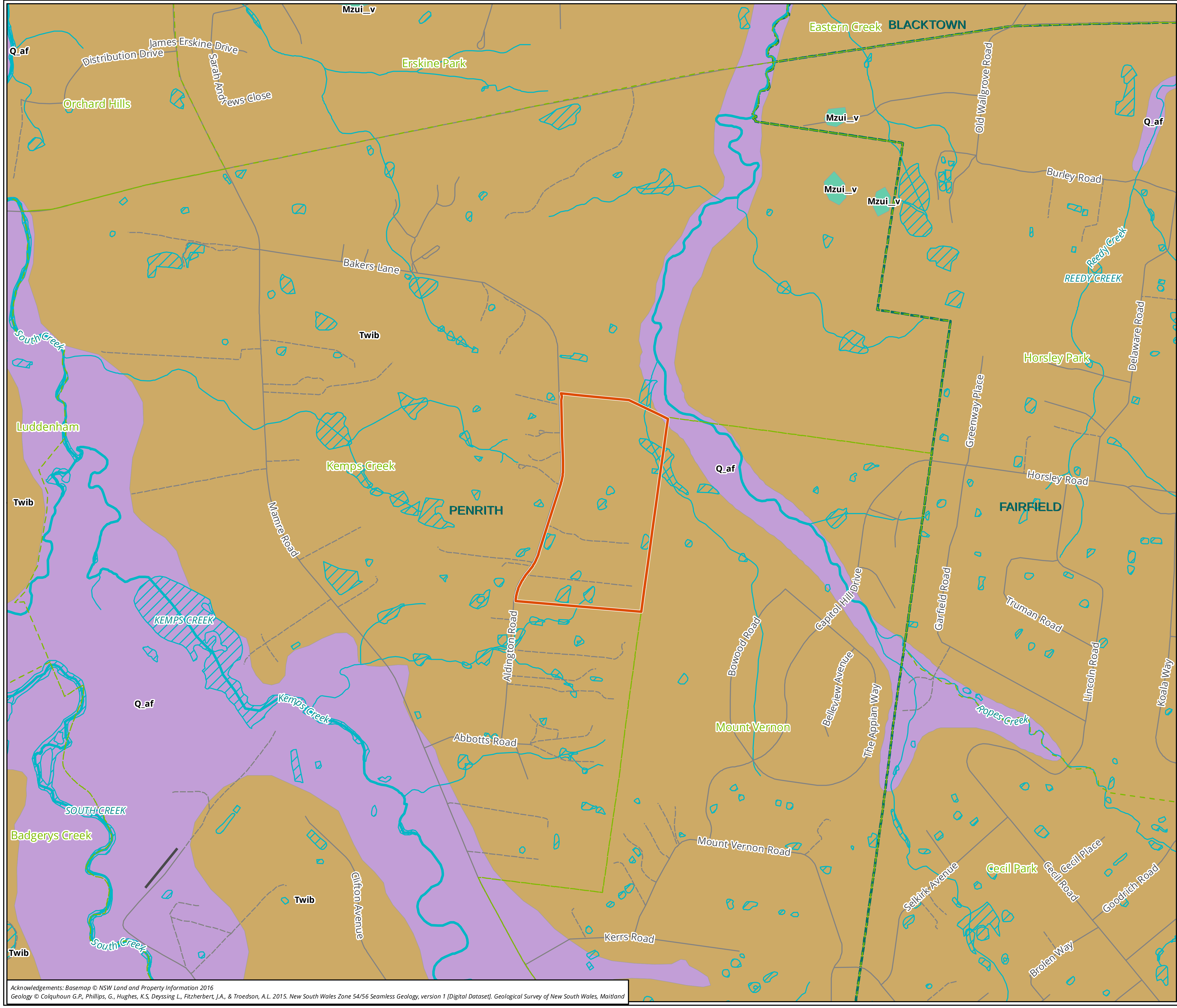
The Luddenham soil landscape is considered erosional, and because of lateral movement, especially on inclined landforms, is unlikely to preserve archaeological material on the surface or *in situ* as this material is removed by these forces.

The north-east corner of the study area is located within the South Creek soil landscape. These soils comprise the floodplains, valley flats and drainage lines of the Cumberland Plain. The South Creek soil landscape is a topology of flat to gently sloping alluvial plain with sporadic terracing and levees providing low relief. Slopes are less than 5% and the local relief is less than 10 metres. Geologically it is a quaternary alluvium derived from Wianmatta Group Shales and Hawkesbury Sandstone. This alluvium is dynamic, with multiple layers of erosion and deposition occurring simultaneously and sheet erosion is common. The soil material found in South Creek is described in Table 4 below.

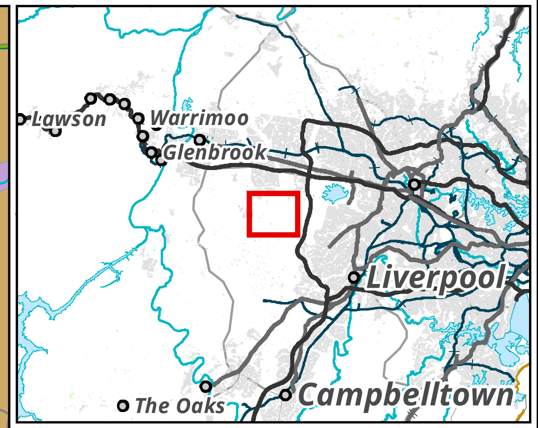
Table 4 South Creek Soil landscape characteristics (Bannerman & Hazelton 1990, p.68)

Soil landscape	Description
Sc1 – Brown apedal single-grained loam	A brown sandy loam to sandy clay loam with apedal, single-grained structure. Colour ranges from dull reddish brown (5YR 4/3) to dull yellowish brown (10YR 4/3). Sc1 is generally moderately acidic (pH 5.5) but may varying from pH 4.5 to pH 6.5. Small (2-6 millimetre) gravels may occur as inclusions and roots are abundant in the surface layer. Charcoal does not occur. This material occurs as top soil.
Sc2 – Dull brown clay loam	A hard setting clay loam to fine sandy clay loam with a porous, earthy fabric. Colour is usually dull brown (7.5YR 4/5) but can range from greyish brown (5YR 4/2) to yellowish brown (10yr 5/6). The pH level varies from 5.5 to 7.0 at this level. No inclusions are found at this level. It occurs as topsoil (A horizon)
Sc3 – Bright brown clay	This is a bright light to medium clay with strong pedal structure. Sometimes this material contains enough sand to become a sandy clay. The colour ranges from reddish brown (3YR 4/8) to bright yellowish brown (10YR 5/1). When occurring, mottles are yellow or grey and account for 15% of the material. The pH is variable, ranging from 3.0 to 7.0. Roots are present when this material occurs as top soil. Small (2-20 millimetres) may make up 50% of the volume. This material occurs as subsoil (B horizon).

The South Creek soil landscape within the study area is both near a creek channel and in some cases is a low terrace. Near channels, deposits comprise of 30-50 centimetres of friable and loose sandy loam (sc1) overlaying 15 centimetres of clay loam (sc2) and 70 centimetres of light clay (sc3). On low terraces, 2-50 centimetres of sandy clay loam (sc1) overlies 15 centimetres of clay loam (sc2) and 60-85 centimetres of whole coloured heavy clay (sc3). Alluvial deposits have great archaeological potential. Firstly, because they are located in the vicinity of water sources beneficial for Aboriginal people; and secondly, because of the many active layers of deposition increasing the chance of subsurface archaeological remains.



Acknowledgements: Basemap © NSW Land and Property Information 2016
Geology © Colquhoun G.P., Phillips, G., Hughes, K.S, Deyssing L., Fitzherbert, J.A., & Troedson, A.L. 2015. New South Wales Zone 54/56 Seamless Geology, version 1 [Digital Dataset]. Geological Survey of New South Wales, Maitland



Legend

Study area

Geological Units

- Mzui__v - Unnamed Mesozoic igneous
- Q_af - Alluvial floodplain deposits
- Twib - Bringelly Shale

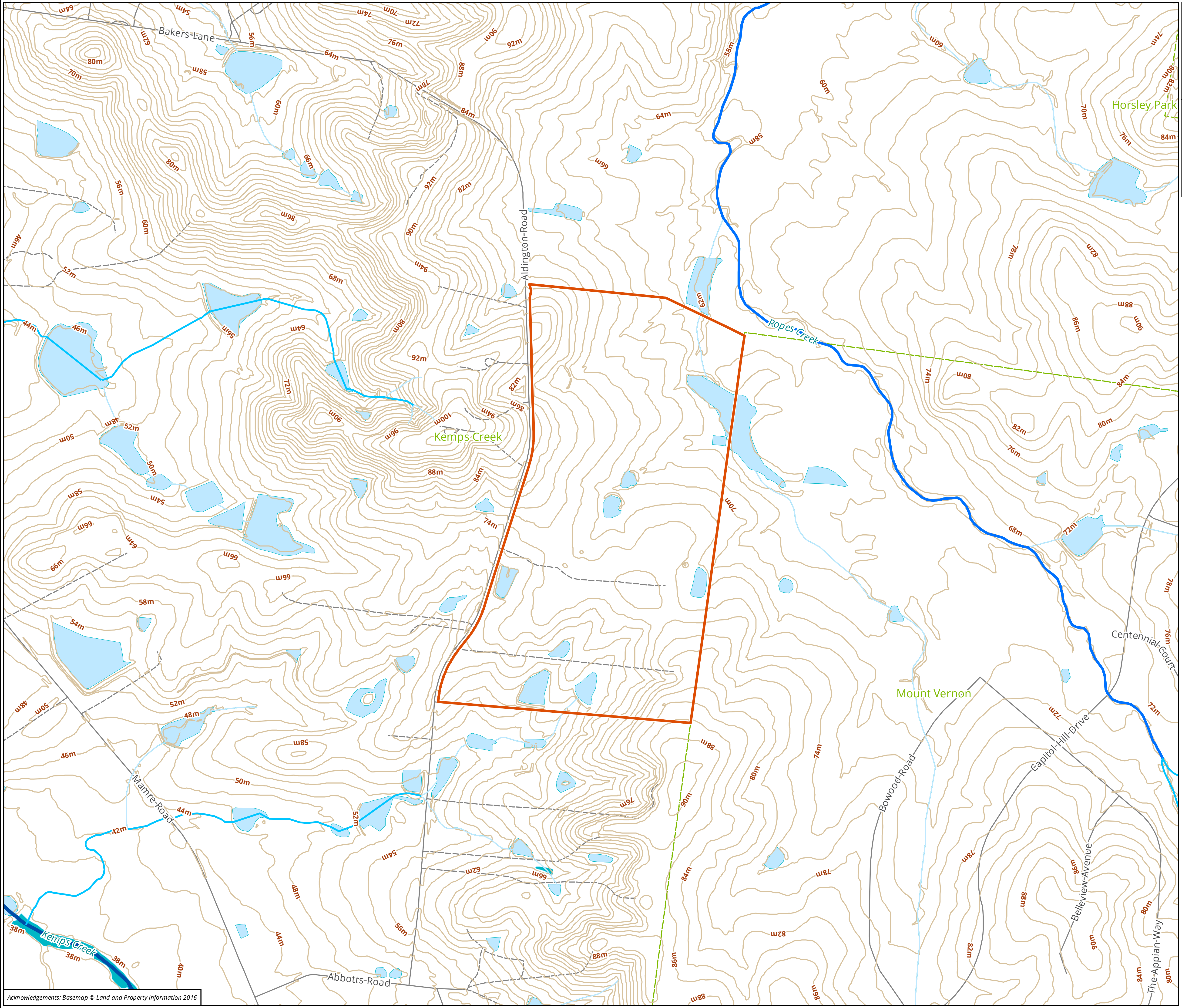
Figure 4 Geological units within the vicinity of the study area

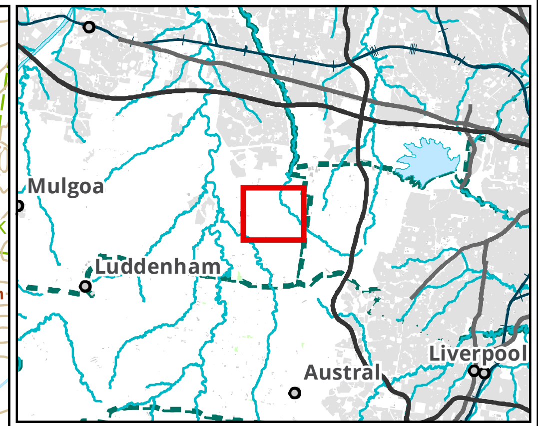
0 200 400 600 800
Metres
N

Scale: 1:20,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 03 June 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F4_Geology.mxd





Legend

Study area

Contour (2m)

Strahler Order

1

2

3

4

Figure 5 Hydrology and topography in the vicinity of the study area

0 100 200 300 400 500

Metres

N

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis.

Matter: 31837,
Date: 23 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F5_Hydrology.mxd

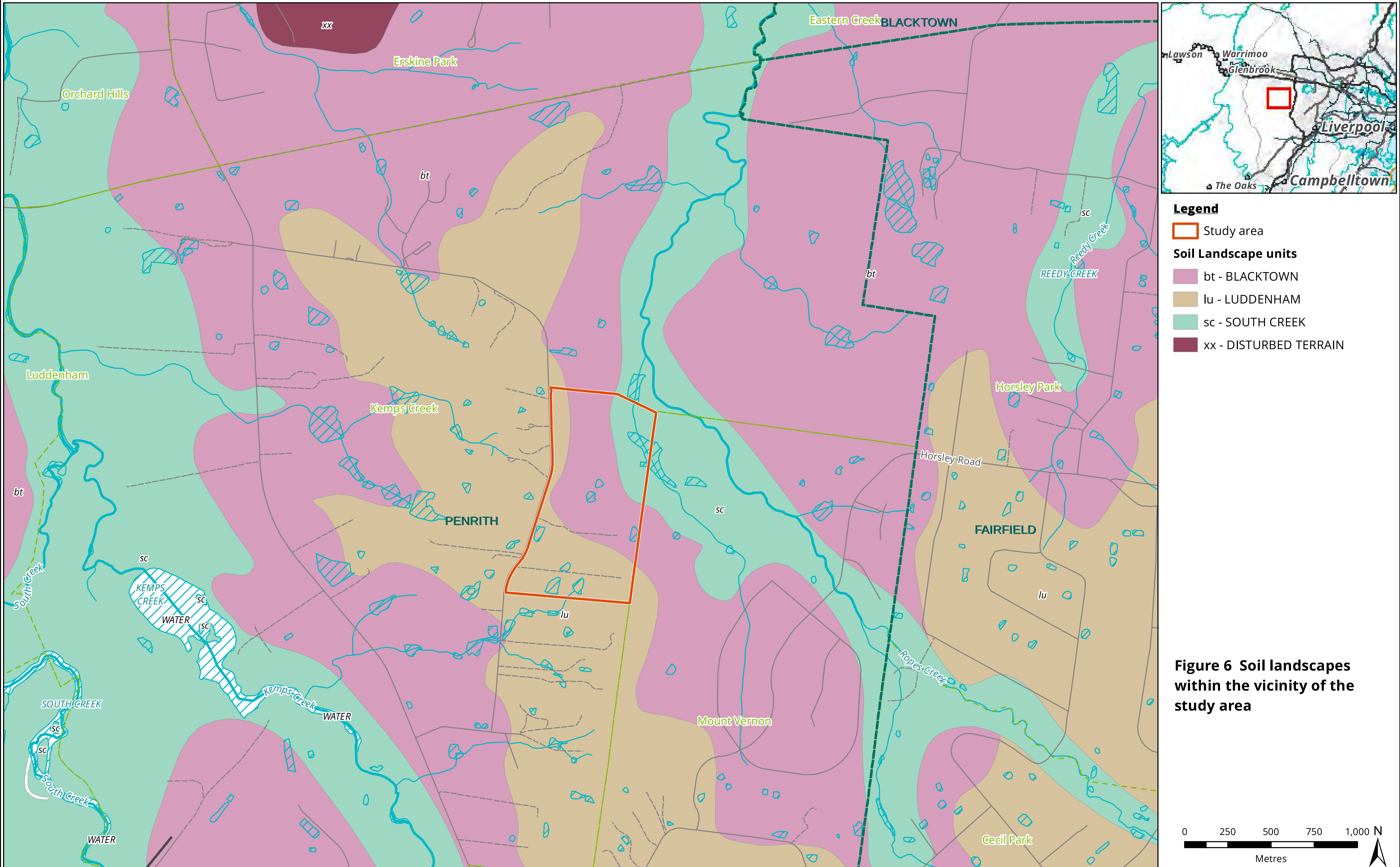


Figure 6 Soil landscapes within the vicinity of the study area

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Acknowledgements: Basemap © Land and Property Information 2016; Soils: Bannerman S.M. and Hazelton P.A., 1990, Soil Landscapes of the Penrith 1:100,000 Sheet map and report, Soil Conservation Service of NSW, Sydney;

Matter: 31837,
Date: 23 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F6_Soils.mxd

3.1.3 Landscape resources

Within the Cumberland subregion of the Sydney Basin Bioregion a variety of vegetation types are present, with Grey Box *Eucalyptus microcarpa*, Forest Red Gum *Eucalyptus tereticornis*, Narrow-leaved Ironbark *Eucalyptus. crebra* woodland, and Spotted Gum *Corymbia maculata* are present on shale hills. Hard-Leaved Scribbly Gum *Eucalyptus sclerophylla*, Rough-Barked Apple *Angophora floribunda*, and Old Man Banksia *Banksia serrata* are identified on alluvial sands and gravels. Broad-Leaved Apple *Angophora subvelutina*, Cabbage Gum *Eucalyptus amplifolia*, Forest Red Gum *Eucalyptus tereticornis*, and Swamp Oak *Casuarina glauca* are present on river flats. Tall Spike Rush *Eleocharis sphacelata*, and Juncus *Juncus effusus* with Parramatta Red Gum *Eucalyptus parramattensis* noted around lagoons and swamps (NPWS 2003, p.193).

The Blacktown soil landscape typically supports dry sclerophyll forest; predominantly species of eucalypt, including Forest Red Gum *Eucalyptus tereticornis*, Narrow Leaved Ironbark *Eucalyptus crebra*, and Grey Box *Eucalyptus moluccana* (Bannerman & Hazelton 1990, p.29). Broad Leaved Ironbark *Eucalyptus fibrosa* and White Stringy Bark *Eucalyptus globoidea* are also occasionally present.

The type of vegetation found within the Luddenham soil landscape includes extensively cleared open dry sclerophyll forest (Bannerman & Hazelton 1990, p.64). The dominant tree species include Spotted Gum *Eucalyptus maculata* and Grey Box *E. moluccana.* Broad-leaved Iron Bark *E. fibrosa,* Narrow Leaved Ironbark *E. crebra*, Forest Red Gum *E. lereticornis* and Woolybutt *E. longifolia* are also present. The understory shrub species include Blackthorn *Bursaria spinose*, Coffee Bush *Breynia oblongifolia*, Forest Oak *Alocasuarina torulosa*, Hickory *Acacia implexa* and *Clerodendrum tomenlosum*. While common grasses include Speargrass *Aristida vagans*, Bordered Panic Grass *Entolasia marginate* and Paddock Lovegrass *Theineda australis* (Bannerman & Hazelton 1990, p.64).

Common tree species include Broad-leaved Apple *Angophora subvelutina*, Cabbage Gum *Eucalyptus amplifolia* and Swamp Oak *Casuarina glauca.* On elevated stream banks a tall shrubland of Paperbark *Melaleuca spp.* and Tea Tree *Leptospernu spp.* may occur.

Native fauna that would have been present in the vicinity of the study area include: Australian Wood Duck *Chenonetta jubata*, White-Faced Heron *Egretta novaehollandiae*, Eastern Long-Necked Tortoise *Chelodina longicollis*, Eastern Water Skink *Eulamprus quoyii*, Garden Skink *Lampropholis guichenoti*, Welcome Swallow *Hirundo neoxena*, Western Swamphen *Porphyrio porphyrio*, as well as arboreal fauna including owls Strigiformes, Ringtailed Possum *Pseudocheirus peregrinus* and Brushtailed Possums *Trichosrus vulpecula*, and gliders Petauridae.

Aboriginal people used plant resources in a variety of ways. Fibres were twisted into string, which was used for many purposes, including the weaving of nets, baskets and fishing lines. String was also used for personal adornment. Bark was used in the provision of shelter; a large sheet of bark being propped against a stick to form a gunyah (Attenbrow 2002).

As well as being important food sources, animal products were also used for tool making and fashioning a myriad of utilitarian and ceremonial items. For example, tail sinews are known to have been used to make fastening cord, while 'bone points', which would have functioned as awls or piercers, are sometimes present as part of the archaeological record. Animals such as Brush-tailed Possums were highly prized for their fur, with possum skin cloaks worn fastened over one shoulder and under the other. Kangaroo teeth were incorporated into decorative items, such as head bands (Attenbrow 2002).

3.1.4 Land use history

The earliest exploration of the Penrith region was led by Captain Watkin Tench, an officer in the Marine Corps, accompanied by Mr Lowe (surgeon's mate of the Sirius), Mr Arndell (assistant surgeon to the Colony), two other marines, and a convict, in 1789. The group reached the Nepean River on 28 June (Oehm, A. 2006, Paul Davies Pty Ltd 2007a, p.11). Later that year, the Penrith Ford was crossed, and in 1791 the course of the Nepean had been explored from the ford to Grose River. By 1791, it had been confirmed that the Hawkesbury and Nepean rivers were the same watercourse; however, each of the names were kept, transitioning from one to the other at the junction with the Grose River (Thorpe 1986, p.12). From 1803, Charles Grimes and James Meehan surveyed areas of the eastern bank of the Nepean following the sanctioning of settlement in this area by Governor Philip Gidley King, likely in part for the fertile soils associated with the Nepean River floodplain. The portions of land ranged from 40 to 200 acres (approximately 16.2 to 81 hectares), with several of 1,000 acres (404.6 hectares) and above. These were granted to officials, free settlers and military staff (Paul Davies Pty Ltd 2007a, p.11, Thorpe 1986, p.12). Over time, around 1,699 Europeans had settled in the Nepean region, most of whom were of Irish and English heritage and were emancipists or convicts assigned to free settlers or those associated with the government or military (Paul Davies Pty Ltd 2007b). Until the establishment of the Great Western Road around 1815, there was no official passage to the Nepean area. In the same year, Governor Lachlan Macquarie conducted his inspection tour of the region (Thorpe 1986, p.12). The Great Western Road had developed into a main route for travel and communication for the Nepean region by 1817, and in this year the government town of Penrith was also established. Penrith remained a small, roadside settlement into the 1830s (Thorpe 1986, p.12).

A review of Melville Parish maps and crown plans for Aldington Road indicates that the study area was previously part of a 550 acre plot of land granted to Nicholas Bayly, an English Parliamentarian, in 1810, known as Bayly Park (Paul Davies Pty Ltd 2007a, pp.112–113). According to Paul Davies, a house was built by 1814 which was surrounded by gardens and cultivated grounds and in 1823 Bayly engaged government road gangs to undertake extensive clearing across his estate (Paul Davies Pty Ltd 2007b, p.114). Bayly Park was utilized by Bayly for grazing and agricultural activities.

Following Nicholas Bayly's death in 1823, Balyly park was then acquired by Richard Jones in 1826, and became known as Fleurs Estate (Paul Davies Pty Ltd 2007b, p.114). The homestead for Bayly Park/Fleurs Estate is not located within the study area.

In 1891, Thomas Morse acquired the Fleurs Estate, which still contained the study area (NSW Land Registry Services, Certificate of Title Volume 912 Folio 55). An attempt was made in 1895 to subdivide and sell off the Estate; the auction advertisement describes the land as suitable for farms, orchards and dairies; but no structures were recorded on the plan (Richardson & Wrench & McCarron, Stewart & Co & Chatfield & Brown 1895).

A historical aerial from the 1970s (Photo 2) shows the study area to be mostly cleared of vegetation. Despite this, few other developments have taken place within the study area. The tributary of Ropes creek in the north-east remains intact as does the creek line to the south.

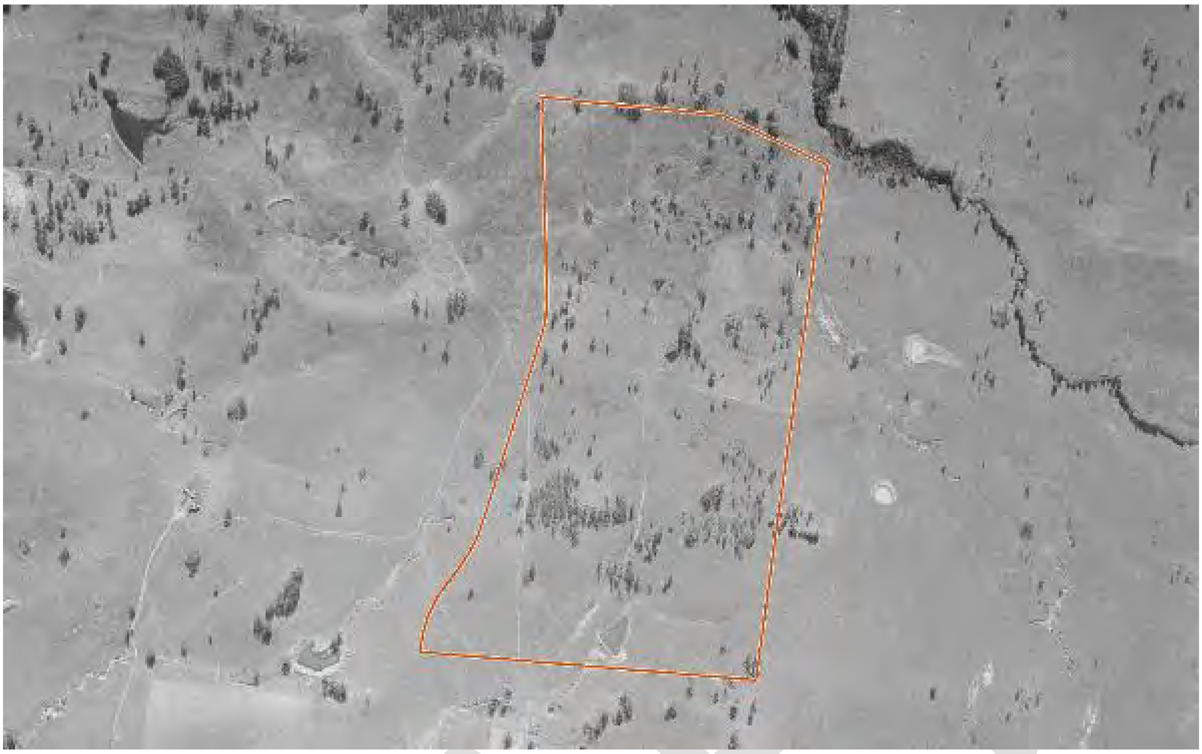


Photo 2 1970s aerial photograph of the study area (Source: NSW aerial imagery)

An aerial from 1989 (Photo 3) shows the study area to be somewhat disturbed. Aldington Road was constructed by this time as more intensive farming practices took place within the study area. This included the construction of dams, unpaved road construction and crop planting into some areas of the study area, most prominently in the north and south.

Photo 3 1989 aerial photograph of the study area (Source: NSW aerial imagery)

A later aerial taken in 1998 (Photo 4) shows crop farming practices have been intensified in the study area. This appears to be quite dynamic as crops visible in the 1989 aerial such as those in the north of the study area have been removed, replaced by crops in other areas. Aside from the heavy disturbance associated with the construction of the dam, it is likely that farming practices caused little disturbance to subsurface remains.

Photo 4 1998 aerial photograph of the study area (Source: NSW aerial imagery)

3.2 Previous archaeological work

A large number of cultural heritage surface (surveys) and sub-surface (excavations) investigations have been conducted throughout the region of NSW in the past 30 years. There has been an increasing focus on cultural heritage assessments in NSW due to ever increasing development, along with the legislative requirements for this work and greater cultural awareness of Aboriginal cultural heritage.

The timing for the human occupation of the Sydney Basin is still uncertain. While there is some possible evidence for occupation of the region around 40,000 years ago, the earliest known radiocarbon date for the Aboriginal occupation of the Sydney Basin is associated with a cultural / archaeological deposit at Parramatta, which was dated to 30,735 ± 407 BP (Jo McDonald Cultural Heritage Management Pty Ltd 2005a, Jo McDonald Cultural Heritage Management Pty Ltd 2005b).

Archaeological evidence of Aboriginal occupation of the Cumberland Plains indicates that the area was intensively occupied from approximately 4,000 years BP (Dallas 1982). Such 'young' dates are probably more a reflection of the conditions associated with the preservation of this evidence and the areas that have been subject to surface and sub-surface archaeological investigations, rather than actual evidence of Aboriginal occupation prior to this time.

3.2.1 Regional overview

A number of Aboriginal cultural heritage investigations have been conducted for the Cumberland region. Models for predicting the location and type of Aboriginal sites with a general applicability to the Cumberland lowlands region and thus relevant to the study area have also been formulated, some as a part of these investigations and others from cultural heritage investigations for relatively large developments.

Brayshaw McDonald (1994) completed the Liverpool Rural Lands Study which included a broad predictive study relating to Aboriginal sites in rural areas to the west of Liverpool, located south-east of the current study area. The report identified that the distribution of sites was mostly dependent on topography and the bedrock formation of the area, or geology. Background research supported predictive models 10 kilometres from the study area.

It identified that shelter sites, art sites, and grinding grooves were likely to occur on overlying sandstone formations where the appropriate topography was present. Sites over the remainder of the Cumberland Plain were likely to consist of open artefact scatters, quarries, modified trees, and stone arrangements. The report noted that occupation within the area was likely to be similar to the northern Cumberland Plain, as the landscape and geology were extremely similar. As such, predictive site modelling was summarised from an assessment which included test excavations completed by Rich and McDonald in 1993:

- *Most of the areas tested [either with sparse or no surface manifestations] contained subsurface archaeological deposits.*
- *Sites which are on permanent water are more complex [ie they represent foci for larger groups or are used repeatedly by smaller groups over a long period of time] than sites on ephemeral or temporary water lines. Major confluences are prime site locations. Sparse sites also occur on major creeklines and not all confluences are locations of prime sites.*
- *Alluvial terraces [and other depositional environments] contain the best potential for intact archaeological remains. Some hillslope zones may also be intact and have good potential. In areas where there is deep alluvium many sites also have intact material below the plough zone. These*

sites often have artefact bearing deposit to a depth of 70-90 centimetres; the plough zone is [max] 25 centimetres deep.

- *Temporary and minor gullies tend to have one-off or occasionally repeated Aboriginal visits in prehistory and hence low density sites.*
- *Few ridgetop sites were located by the testing programme mostly because the associated development was located close to the creeklines, but also because of the higher levels of destructive disturbance in the more elevated locations, e.g. housing and ploughing of shallower deposit.*
- *While much of the Rouse Hill study area had been severely disturbed over the last 200 years, the areas tested on the whole revealed intact patterns in the archaeological material.* (Brayshaw McDonald Pty Ltd 1994, pp.20–21).

Jo McDonald Cultural Heritage Management (1997) conducted an archaeological investigation of the Australian Defence Industries (ADI) Site, at Saint Marys, for ADI-Lend Lease Joint Venture. The investigation included the refinement of existing Aboriginal site predictive models, by developing a framework for assessing Aboriginal site representativeness (Jo McDonald Cultural Heritage Management 1997, pp.1–2). A model was presented for the ADI site that predicted the character of Aboriginal sites in relation to landscape features; particularly water permanence, lithic resources and landscape unit. The study concluded that the model is applicable to the Cumberland Plains region, and provides a framework for which the correlation between sites and permanent water can be tested. The model predicts the following (Jo McDonald Cultural Heritage Management 1997, pp.56–57):

- The frequency and density of Aboriginal sites located in the headwaters of upper tributaries (first order watercourse) is likely to be low, and such sites are likely to represent a background scatter.
- The frequency and density of Aboriginal sites located in the middle reaches of minor tributaries (second order watercourses) is likely to be low, and such sites are likely to represent single events, for example, one-off camping locations or knapping episodes.
- The frequency and density of Aboriginal sites located in the lower reaches of tributary creeks (third order watercourses) is likely to be greater, and such sites are likely to represent repeated occupation, knapping events and more concentrated activities.
- The frequency and density of Aboriginal sites located on major creek lines is likely to be greater, and such sites are likely to represent or more permanent occupation and consequently will be more complex.
- The junctions of creeks may have been a focus of Aboriginal activity.
- The frequency and density of Aboriginal sites located on ridge tops between drainage lines is likely to be low, and such sites are likely to represent single event.
- Outcrops of silcrete would have been exploited if known.
- The general size of stone artefacts is likely to decrease the further they are located from the quarry from which they were obtained. Similarly, the presence of cortex on artefacts is less likely to be present, or occur as smaller percentages that further artefacts are located from the quarry from which they were obtained due to the continued reduction sequence.
- Sandstone outcrops may have been the focus of camping and art production for sandstone overhangs as well as axe production/sharpening for sandstone platforms.

Kelleher Nightingale Consulting (2011) undertook an assessment of a 10 kilometre strip of Bringelly Road, approximately 12 kilometres south from the study area, in advance of a proposed upgrade (taking the road from two to four lanes in size). Predictive modelling employed by KNC suggested that artefact scatters and isolated finds were the site types most likely to be identified, where exposure and visibility were high. These sites were considered most likely to be identified in close proximity to water sources, on either flat or gently sloping landforms. A total of 44 sites were identified in the design corridor of the proposed upgrade, all of which were either artefact scatters or isolated finds.

Jo McDonald Cultural Heritage Management (JMCHM) (2001) undertook an assessment at West Hoxton, approximately 12 kilometres south from the study area, in aid of the South Hoxton Park Aerodrome Master Plan. The background research for the area suggested that artefact scatters would likely be associated with streams, with the size and number of sites increasing with stream order. It also noted that smaller scatters and isolated finds have the potential to be identified across a variety of landforms within the landscape, including hillslopes and ridges away from water (Jo McDonald Cultural Heritage Management Pty Ltd 2001, p.9).

Survey efforts were hampered by land access issues, as the majority of the land in the area studied was privately owned; however a total of two artefact scatters and nine PADs were identified by the investigation, with one previously identified site (also an artefact scatter) being relocated. The majority of the PADs were assessed as having low to moderate potential, with JMCHM noting that the true potential of sites was difficult to assess in the absence of test excavations.

AMBS (2012) conducted a wide ranging report, assessing the entirety of the Austral and Leppington North precincts. Although surveys were targeted at specific properties, which at the time represented accessible properties, the results of the survey were combined with the existing regional model and a review of studies within the local area in order to produce sensitivity mapping for the entirety of the Austral and Leppington North precincts.

Regionally, trends noted as influencing this sensitivity model include the following statements:

- Sites are most frequently located in close proximity to permanent water courses on creek banks, alluvial flats, or high ground.
- Large artefact scatters may be identified up to 200 – 250 metres away from water courses.
- Additional factors need to be considered than just the presence or absence of surface artefacts when characterising an archaeological site.

The predictive model employed by AMBS stated that the most common site type occurring in the area would be stone artefacts scatters, and that undisturbed alluvial soils have the potential to be associated with stratified archaeological deposits (AMBS 2012, p.56). The results of the survey largely confirmed this predictive model, with AMBS identifying seven new sites including six isolated finds and one artefact scatter/PAD.

GML (2016) conducted an archaeological excavation and assessment of Stockland's land in East Leppington approximately 12 kilometres south-east of the study area, prior to the development of the residential estate Willowdale. Predictive modeling of the area has shown that Aboriginal people occupied East Leppington for over 5,000 years. Areas along Bonds Creek were used as camping sites meanwhile areas of tool manufacture and procurement was resource specific. Both survey and hand excavation were used to understand the area. In total, 12 locations were excavated over a total of

487 square metres. Of these, 7,956 lithic artefacts and 21 features were identified. Features included eight ground ovens, hearths, clay extraction pits and modified trees. Dominant material types were silcrete, mudstone (IMSTC) and quartz, comprising 66%, 25% and 8% of finds respectively. Tool types included anvils, hammers and a possible grindstone fragment. Backing was visible in artefacts from all but two excavation areas (OA4 and OA11). A total of 253 cores and core fragments were also recovered, mostly of silcrete.

Overall, GML identified an area of domestic activity (associated with hearths and ovens), and an area of ceremonial activity associated with red paint pits, culturally modified trees and unusual stone arrangements. Pits at the base of these trees suggest evidence of landscape use unique to this particular area of the site.

White & McDonald (2010) undertook a review of previous work in the Rouse Hill development area, discussing lithic artefact distribution in previous excavations carried out by JMCHM. The study considered a number of factors including stream order, distance from water, landform, aspect, and distance to silcrete sources. As a result of the assessment, the following statements were made:

- Stream Order: water supply was a significant factor influencing Aboriginal land use and habitation in the area. There was a correlation between increasing stream order and larger numbers and higher densities of artefacts (from a comparison of first, second, and fourth order streams).
- Distance from water: the results showed that an assumption that sites would be clustered within 50 metres of water sources was not entirely correct from the data available. In first order stream landscapes, there was no significant correlation between artefact distribution and distance to water. In second order landscapes, artefact density was highest within 50 metres of water, and then declined with increasing distance. In fourth order landscapes, density was highest between 51-100 metres from water.
- Landform: Artefact density was considered to be lowest on upper slopes and ridgetops, with density increasing on mid and lower slopes. Density was highest in terrace landforms, and lower on creek flats, likely due to repeated flooding events and the erosion this caused.
- Distance to silcrete sources: the results of the study showed no significant difference between sites located closer to or further away from silcrete sources. However, 6 kilometres was the maximum tested distance from silcrete sources, so the sample is only representative of a limited area.
- Aspect: only appeared to have an influence on sites in the lower parts of valley. Locations may have been sited to take advantage of constant factors such as the rising/setting sun and wind direction. Sites in higher parts of valleys may have been influenced by weather and other factors.

The study concluded that landform and distance from water had an impact on site distribution, with artefacts becoming more numerous closer to creeks, and along higher order creeks. The study also found that although artefacts are found on all landforms, landform type influences artefact distribution, with the preference being for slightly elevated, well-drained areas in the lower parts of valleys.

3.2.2 Local overview

A number of Aboriginal cultural heritage investigations have been conducted within the region (within approximately 10 kilometres of the study area). Most of these investigations were undertaken as part of development applications and included surface and sub-surface investigations. These investigations are summarised below.

JMCHM (2000) undertook a survey in advance of a proposed light industrial subdivision, 3 kilometres west-east of the current study area. The predictive modelling undertaken primarily identified the potential for sites to be present in association with water sources, with the size and density increasing with stream order. It was also noted that creek junctions provide a focus for activity. Other locations such as ridgetops between drainage lines may provide evidence of occupation (JMCHM 2000 p. 19). The area surveyed contained first and second order creeks, and so it was predicted that background scatters of artefacts may be associated with first order creeks, and that higher density sites may be identified in association with the second order creek.

The survey identified nine sites, including six artefact scatters and three isolated finds. Six of the identified sites were located on lower hillslopes, two on creek bank/lower hillslopes, and one on a creek bank/floodplain. The majority of sites were identified between 50 and 200 metres from water sources. Subsequently, sensitivity mapping was developed and it was recommended that subsurface investigation take place in areas of higher sensitivity within the study area.

Excavations of the site were subsequently carried out by JMCHM (2008). These salvage excavations retrieved a total of 8,867 lithics from 298 square metres, indicating a density of 29.8 artefacts per square metre. It was identified that the pattern of artefact distribution within the Austral Land site was typical for the Cumberland Plain and was likely higher due to the presence of second and third order streams (which indicates a permanent or semi-permanent water source).

The area assessed in this report contains a number of similarities to the study area, namely its relatively low relief (around 10 metres (JMCHM 2008 p.7)), and a confluence of streams within the area. Although these streams are of a lower order than many identified in the current study area, they would have provided a semi-permanent source of water to Aboriginal groups in the area, with Kemps Creek and Ropes Creek being located nearby.

Based on the review of previous work undertaken, a number of predictive statements were formulated for the study area, including the following (JMCHM 2008 p.11-15):

- There may be evidence of long or short term occupation with sporadic use and re-use of locations.
- Occupation may date to the pre-Bondaian (30,000 – 9,000BP), but is more likely to date to the Bondaian (9,000 BP – European Contact).
- A variety of activities are likely to have been carried out within the study area and discrete knapping floors may have been present in association with both creeks and the area of their confluence.
- The proximity of the salvage locations adjacent to second order streams and the confluence of these creeks (where they become a third order stream) would have suggested that there would be evidence for sparse, but focussed activity and potentially repeated occupation by small groups, knapping floors and evidence for more concentrated activities.

In addition to these predictions, a number of more general statements about the Cumberland Plain were made, including that large scale patterning of sites is identifiable based on environmental patterns, particularly stream order, with permanent sources of water being associated with more complex sites than ephemeral sources. Most sites will be dated to the mid to late Holocene, as geomorphic conditions necessary for the preservation of earlier sites are not common on the Cumberland Plain, most areas contain subsurface deposits, regardless of the presence or absence of surface artefacts, and that where silcrete outcrops are present, there will be evidence for quarrying (JMCHM 2008 p.11-12).

The excavations consisted of testing followed by open area salvage at two locations, EP6+7/1 and EP6+7/2 (a total of 145 square metres and 153 square metres at each location). Both locations were located relatively close (within 100 metres) of creeklines in the study area.

Table 5 Lithologies from excavation conducted by JMCHM (2008 p.139)

Area	Silcrete	Silicified tuff	Quartz	S Wood	Fine-grained siliceous	Quartzite	Igneous	Unidentified	Total artefacts
Testing	863	107	53	9	1			2	1,035
A	390	24	3						417
B	2,482	194	40	7	6	11	1	5	2,746
C	2,302	130	125	5	1	1		2	2,566
D	1,750	177	426	4	14			3	2,374
Total	7,491	637	666	25	22	12	2	12	8,867

It is evident from the data presented in Table 5 that across all areas excavated that the dominant material type encountered is silcrete. It has been noted that silcrete outcrops have been identified in the vicinity of the study area, and this may be a contributing factor to the result.

Table 6 Artefact types from excavation conducted by JMCHM (2008 p.140)

Area	Multi cobble	Backed artefacts	Backing debitage	Tools & possible tools	Other retouched	Cores	Bipolar artefacts	Platform Debitage	FF/FP Debitage	Remnant flaked	Total artefacts
Testing		19	1	8	8	19	9	334	543	94	1,035
Area A		10		1	3	11		130	223	39	417
Area B		88	2	11	11	23	8	847	1,648	108	2,746
Area C	1	62	6	21	22	74	7	998	1,259	116	2,566
Area D		37	1	10	7	46	30	621	1,439	183	2,374
Total	1	211	9	51	50	166	58	2,831	4,958	535	8,867

Analysis on the artefacts conducted shows that the dominant artefact types recovered from excavations were flake fragments/flaked piece debitage followed by platform debitage (Table 6). It is notable that there are a large number of cores and other retouched and backed artefacts.

It was concluded that the site patterning in the area was typical of the Cumberland Plain, however artefact density was influenced by a number of landscape and resource features in the area, with it being noted that artefact density decreases with stream order and use of silcrete as a raw material decreases with increasing distance from silcrete sources. As a whole, the site displayed a higher than average artefact density, likely due to the presence of nearby sources of silcrete (JMCHM 2008 p. i).

Dominic Steele Consulting Archaeology (DSCA) (2003) undertook test excavation at Wallgrove Road, Eastern Creek approximately 4.7 kilometres east of the study area. The assessment built on a number of previous surveys conducted between 1980 and 2002 within the study area. The assessment included predictive statements determined by JMCHM study from (1997), which stated that surface artefacts were not an effective way to characterise archaeological sites, and that at the time of writing:

- 17 out of the 61 excavated sites on the Cumberland Plain had no artefacts present on the surface prior to excavation however, most areas with sparse or no surface manifestations contained considerable archaeological deposits.
- The ratio of recorded surface to excavated artefacts is 1:25 across the Cumberland Plain.
- None of the excavated sites could be properly characterised on the basis of their surface artefacts alone.
- Open campsites are located in all landscapes on the Cumberland Plain. The predominance of sites recorded along creek banks is likely to be indicative of surface visibility conditions and taphonomic factors, rather than the human distribution of artefacts across the landscape (DSCA 2003, pp.19–20).

This statement notes a number of issues with predictive models that base their assessment of subsurface potential based entirely on the presence or absence of surface artefacts. Steele also reviewed previous work carried out in the Rouse Hill area to create a predictive model for the nature and extent of subsurface deposits (DSCA 2003, pp.20–21). Some of the key factors noted include:

- Sites along permanent water courses tended to be more complex than those along ephemeral water courses, and the ideal site locations were at major confluences.
- Within the Rouse Hill area, alluvial areas along with intact hillslopes had the greatest potential to retain intact archaeology, with artefact deposits extending from 70 to 90 centimetres, while the typical plough zone extended to 30 centimetres.
- Hillslopes and ephemeral water courses which revealed sites typically showed evidence of limited occupation, with few producing artefact densities of greater than 20 artefacts per square metre.
- Sites located at the interface of sandstone and shale geologies tended to demonstrate evidence of single occupations by large groups, or multiple occupations by smaller groups.
- There is greater potential for complex archaeological sites to be located subsurface than is demonstrated by surface artefacts, with knapping floors, backed blade manufacturing sites, and other complex sites have been identified.
- There may be a correlation between artefact density and site function.

A total of twenty 1 by 1 metre squares were excavated using a backhoe, and sieved through nested 5 and 2.5 millimetre sieves. The deposit encountered tended to be relatively shallow, with most pits not exceeding 20 centimetres. A total of 38 artefacts were identified by surface survey and excavation, with a density characterised by Steele as extremely low. The area was interpreted as being visited sporadically, and not the site of any sort of knapping or camping, but rather a general background scatter.

The deposit consisted primarily of silcrete, with quartz, tuff, and volcanic rock present in much lesser quantity. The vast majority of the deposit was identified as manuport, with some flake and core fragments present, and one potential broken axe.

Navin Officer Heritage Consultants Pty Ltd (2005) conducted machine testing at the CSR lands, Erskine Park, approximately 2 kilometres to the north of the current study area. A total of 256 test pits were excavated, with 285 artefacts being identified across 88 of these pits. It is noted in (JMCHM 2008, p.14) that only a sample of the excavated deposit was sieved, and that this may be a contributing factor to the relatively low number of artefacts identified at the site relative to other excavations in the area.

The assemblage was primarily comprised of silcrete and silicified tuff, making up about 81% of the total assemblage, and contained a range of artefact types, including microblades, bondi points, and backed artefacts. Based on the results of this testing, Navin Officer characterised the site as having been used as a transient camp, or for peripheral activities in relation to a larger camping area, and stated that it had been subject to low intensity occupation (Navin Officer Heritage Consultants Pty Ltd 2005 p.ii).

Biosis (2017, 2018) completed an Aboriginal heritage assessment of the Mamre West Precinct located approximately 2 kilometres north-west of the study area. The initial assessment recorded a number of archaeological sites including MWP-AD3 which identified the highest density of artefacts. In total, 43 stone artefacts were recovered from 20 of the 39 test pits. The majority of these were recorded in the first 200 millimetres of the soil deposit, and were intermixed with European cultural material signalling disturbance of that level.

Biosis found that the dominance of material types differed to those of the surrounding region. At MWP-AD3, chert and mudstone artefacts were found in higher proportions to silcrete, which is seen in higher proportions other sites in the region.

Biosis (2019) carried out an ACHA as part of a two stage industrial development along Mamre Road, that incorporated Lots 210 – 215 DP 1013539, and Lots 1 and 2 DP 1233392 approximately 4 kilometres north-west of the study area. The ACHA included archaeological survey and test excavations in an area of high subsurface archaeological potential. The results of the test excavations identified one subsurface archaeological deposit (AHIMS #41-5-0016/MNPAD01) consisting of 14 artefacts dispersed across an area of 105 metres by 17 metres of a gently sloping plain landform.

3.2.3 AHIMS site analysis

A search of the AHIMS database (Client Service ID: 508437) identified 102 Aboriginal archaeological sites within a 4 by 4 kilometre search area, centred on the study area. None of these registered sites are located within the study area (Figure 7). AHIMS search results are provided in Appendix 1. Table 7 provides the frequencies of Aboriginal site types in the vicinity of the study. 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 relied where notable discrepancies occurred.

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. Some recorded sites consist of more than one element, for example artefacts and a modified tree, however for the purposes of this breakdown and the predictive modelling, all individual site types will be studied and compared. This explains why there are 108 results presented here, compared to the 102 sites identified in AHIMS.

Table 7 AHIMS site type frequency

Site type	Number of occurrences	Frequency (%)
Artefact	102	94.44
Potential archaeological deposit (PAD)	6	0.05
Total	**108**	**100**

A simple analysis of the Aboriginal cultural heritage sites registered within the 4 by 4 kilometre buffer of the study area indicates that artefact sites are the most dominant, representing 94.44% (n = 102) of the sites. PAD is the only other site type present and is represented significantly less as 0.05% (n=6).

The presence of large amounts of artefact sites is likely due to the landforms of the region. In particular the presence of elevated landforms such as crests and slopes in proximity to large perennial creek lines. The small amount of PAD and the absence of other site types is likely the result of both modern development in the area and a gap in archaeological recording. This modern development significantly alters the landscape often destroying or displacing Aboriginal objects. In the case of the study area, tree clearing activities by at least the 1960s may have destroyed other archaeological site types if they were present within the study area.

3.3 Mamre Road Precinct Draft Development Control Plan

The Mamre Road Precinct draft DCP aims to ensure that Aboriginal heritage values are managed appropriately in order to produce conservation outcomes. This includes archaeological and culturally significant areas. The draft DCP has mapped areas of high and moderate Aboriginal archaeological potential (Photo 5). The study area contains areas of high and moderate potential in the northern corner.

The DCP has a list of controls for completing assessments for Aboriginal heritage. For ground disturbing works this includes completing an Aboriginal Due Diligence Assessment for areas that have not yet been mapped or areas of low potential as a first step. If land is within or adjacent to land that contains a known Aboriginal cultural heritage site, assessments must consider and comply with the requirements of the NPW Act. The draft DCP determines that an ACHA is required as the study area contains an area of high and moderate Aboriginal archaeological potential. These areas will be impacted by the proposed development. The draft DCP also states that an Aboriginal Heritage Impact Permit (AHIP) will be required if impacts to Aboriginal heritage cannot be avoided. This project is a SSD and as such an AHIP will not be required. This is due the overall assessment of State significant projects that addresses all heritage issues. These projects do not require an AHIP under the NPW Act.

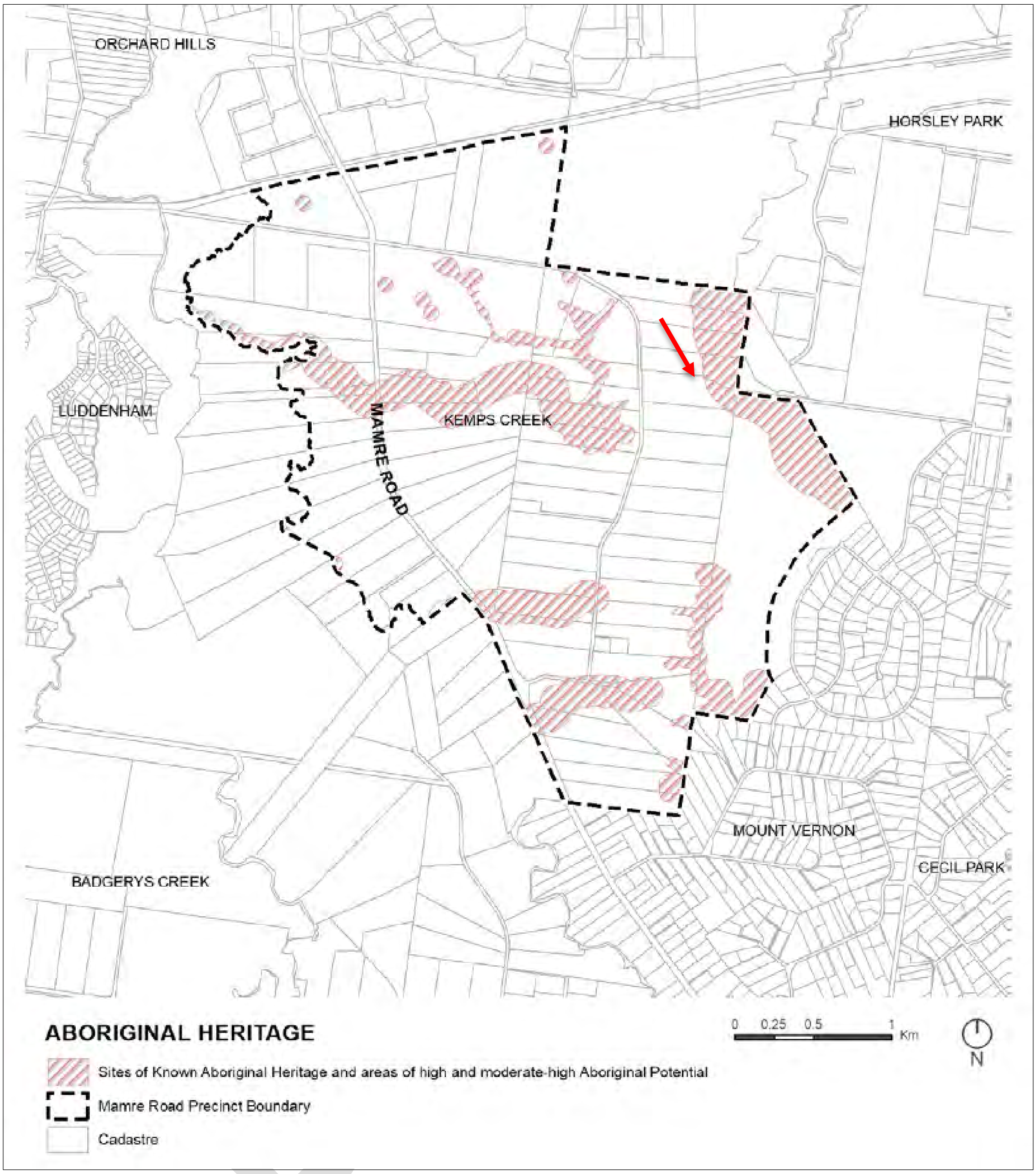


Photo 5 Areas of high and moderate Aboriginal archaeological potential with red arrow indicating approximate location of the study area (Source: Mamre Road Precinct draft DCP)

3.4 Discussion

The study area is situated within the Cumberland Lowlands which features undulating plains and low hills with dense drainage lines. The study area itself reflects this, possessing undulating moderately inclined slopes. This topology formed atop Bringelly shale, the presence of which precludes the appearance of rock shelters and grinding grooves, however artefact sites and PADS are common.

Streams located in proximity to the study area include two first order creek lines, one in the north-east and another in the south. More permanent water sources include Ropes Creek, 400 meters north-east and Kemps Creek three kilometers to the west. These water sources are good predictors of archaeological potential. The location of the study area in such close proximity to Ropes Creek and its elevated landforms may suggest Aboriginal occupation in the past.

The soil landscapes of the study area include the Blacktown soil landscape which features clayey loams with a local relief of around 30 centimetres; the Luddenham soil landscape, which consists of low rolling hills and also clayey loams, and the South Creek soil landscape which consists of floodplains, valley flats and depressions.

European history of the Kemps Creek region is largely one of rural development. Early exploration and movement into the region accompanied early land grants which were subdivided and sold, not often developed. Nicholas Bayly, the original owner of the land likely used for pastoral purposes, as did subsequent owners. More recent aerial images show this to be the case until the 1990s when agricultural practices such as cropping can be seen to increase within the study area. This land use history is likely to have disturbed any archaeological remains within the study area. Tree clearing would have removed any modified trees and disturbed the top layer of soil due to uprooting. The Mamre DCP has mapped areas of high and moderate Aboriginal archaeological potential. The northern portion of the study area containing this potential. Likewise, pastoral activities would have also disturbed the topsoil. Deeper deposits however may remain unaffected.

Regional and local archaeological analysis has shown that the size and extent of water sources within the Cumberland Plain is the greatest predictor of the types of archaeological sites within the region. Large archaeological assemblages indicative of open campsites have been found in relation to streams of second or third Strahler order (Jo McDonald Cultural Heritage Management Pty Ltd 2000, KNC 2011, AMBS 2012). Indeed, alluvial deposits (sediments moved via water) have also been found to contain archaeological deposits (Brayshaw McDonald Pty Ltd 1994). Past research has identified the character of archaeological sites on the Cumberland Plain as:

- Site complexity and size is dictated by proximity to water sources as well as the size of those water sources.
- Alluvial surfaces are also likely to contain high amounts of artefacts, although artefacts have been found on all landforms in the region, in particular on undisturbed crests and lower slopes near creek lines.
- Disturbance by ploughing only effects approximately the top 25 centimetres of sediment (Brayshaw McDonald Pty Ltd 1994).
- The presence of surface artefacts are not indicative of subsurface potential of an area.
- The most common raw materials are silcrete and quartz (Jo McDonald Cultural Heritage Management Pty Ltd 2008, Dominic Steele Consulting Archaeology 2003, Navin Officer Heritage Consultants Pty Ltd 2005).

Because the study area is located within 300 metres of Ropes Creek, a large third order creek line, there is a good possibility that Aboriginal habitation occurred within the study area. The intermittent moderate slopes and crests within the study area would have been attractive camp sites for people in the region. Despite the disturbance resulting from agricultural activities it may be the case that *in situ* archaeological material could be found below the 25 centimetre plough barrier established by Brayshaw Mcdonald (1994).

3.4.1 Predictive statements

A series of predictive statements have 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.

These statements are based on:

- Site distribution in relation to landscape descriptions 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.

Table 8 indicates the site types most likely to be encountered across the present study area. The definition of each site type is described firstly, followed by the predicted likelihood of this site type occurring within the study area.

Table 8 Aboriginal site prediction statements

Site type	Site description	Potential
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 across a wide range of landforms and a large amount have been recorded within 4 kilometres of the study area. Due to the relatively low disturbance of the study area and the presence of water sources, the potential for lithics to be present within the study area has been assessed as high.
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 including alluvial flats. They have the potential to be present in undisturbed landforms within the study area, likely within will drained elevated grounds nearby Ropes Creek.

Site type	Site description	Potential
Shell middens	Deposits of shells accumulated over either singular large resource gathering events or over longer periods of time.	Low: Shell midden sites have not been recorded within the study area. There is some potential for shell middens to be located in vicinity of permanent water sources which are not present within the study area. There have been no shell midden sites recorded within the vicinity of the study area.
Quarries	Raw stone material procurement sites.	Low: There is no record of any quarries being within or surrounding the study area.
Modified trees	Trees with cultural modifications	Low: Mass vegetation clearing has taken place within the study area, likely removing any modified trees that may have been present.
Axe grinding grooves	Grooves created in stone platforms through ground stone tool manufacture.	Low: The geology of the study area lacks suitable horizontal sandstone rock outcrops for axe-grinding grooves. Therefore there is low potential for axe grinding grooves to occur in the study area.
Burials	Aboriginal burial sites.	Low: 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 not commonly associated with burials.
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.	Low: There are currently no recorded mythological stories for the study area.
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	Low: There are no post-contact sites previously recorded in the study area and historical sources do not identify one.

Site type	Site description	Potential
	associated with post-contact Aboriginal use.	
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.

4 Archaeological survey

An archaeological survey of the study area was undertaken on 10 July 2020 by archaeologists Mathew Smith and Matthew Tetlaw, and Deerubbin LALC representative Steven Randall. The archaeological survey sampling strategy, methodology and a discussion of results are provided below.

4.1 Archaeological survey objectives

The objectives of the survey were to:

- Provide RAP representatives 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.
- Undertake a systematic survey of the study area targeting areas with the potential for Aboriginal heritage.
- Identify and record Aboriginal archaeological sites visible on the ground surface.
- Identify and record areas of archaeological sensitivity.

4.2 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.

4.2.1 Sampling strategy

The survey effort targeted archaeologically significant landforms and areas of archaeological potential. A traditional transect survey was attempted in areas of low disturbance and higher visibility, with all identified landforms surveyed at the time of the investigation. However, as the majority of the study area contained significant disturbances and tall grass coverage was prevalent across much of the site, it meant that ground visibility was very low at 0-20 %, and therefore only areas that were accessible were surveyed.

Those landforms targeted included any raised landforms like crests and slopes as well as those besides creek lines for there was higher archaeological potential in those areas.

4.2.2 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 (GSV) and the recording of soil information for each survey unit where 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 (GPS) and the Map Grid of Australia (MGA) (94) coordinate system.

4.3 Archaeological survey results

A single meandering transect was undertaken to survey the study area. In areas of lower disturbance and higher visibility, a total of two traditional transects were completed. These transects were walked across two landforms (flat and simple slope) with the three surveyors walking two metres apart. (Figure 8). This follows the methodology set out in Burke and Smith (2004, p.65) which states that a single person can only effectively visually survey an area of two linear metres. No Aboriginal sites and three areas of moderate archaeological potential were identified in the study area. The results from the archaeological survey have been summarised in Table 9 below.

Generally the survey was hampered by poor GSV in some areas due to dense vegetation and thick grass cover. This limited the potential of Aboriginal sites to be identified on the surface.

4.4 Constraints to the survey

With any archaeological survey there are several factors that influence the effectiveness (the likelihood of finding sites) of the survey. The factors that contributed most to the effectiveness of the survey within the study area were ground surface visibility (GSV). The study area had uneven GSV due to extensive grass coverage and infrastructure related to market gardening activities across the study area, as well as areas of exposure resulting from these activities and vehicle tracks. Furthermore, the survey was able to access all portions of the study area.

4.4.1 Visibility

In most archaeological reports and guidelines visibility refers to GSV, and is usually a percentage estimate of the ground surface that is visible and allowing for the detection of (usually stone) artefacts that may be present on the ground surface (DECCW 2010a). GSV across the study area was typically low (0-20%) due to extensive grass coverage and overgrown market gardens (Photo 6). Where market gardens were maintained, visibility rose from 30 % to 100 % due to ground clearing around vineyards, access tracks and other associated infrastructure (Photo 7, Photo 8). Areas of low GSV did not allow for the detection of surface sites such as stone artefacts. Areas of high GSV were associated with disturbance in the study area, which would have moved or destroyed any Aboriginal artefacts on the surface.

Photo 6 **East facing photo showing extensive grass coverage across the southern portion of study area, which reduced the ground surface visibility**

Photo 7 **South-west facing photo depicting short grass coverage albeit still at low GSV**

Photo 8 **West facing photo depicting area of high GSV resulting from modern disturbance**

4.4.2 Exposure

Exposure refers to the geomorphic conditions of the local landform being surveyed, and attempts to describe the relationship between those conditions and the likelihood that they provide for the exposure of (buried) archaeological materials. Whilst also usually expressed as a percentage estimate, exposure is different to visibility in that it is in part a summation of geomorphic processes, rather than a simple observation of the ground surface (Burke & Smith 2004, p.79, DECCW 2010a). Overall, areas of exposure accounted for less than 30 % of the study area due to extensive grass coverage and overgrown market gardens. Areas of exposure were located where market gardening activities were taking place (Photo 9), scours at the base of trees, and along access tracks (Photo 10).

Photo 9 **West facing photo showing areas of exposure from ongoing market gardening activity**

Photo 10 East facing photos showing areas of exposure beside tomato plantings

4.4.3 Disturbances

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 wombats, foxes, rabbits and wallabies, and sometimes exposure from slumping or scouring. Disturbances associated with recent human action are prevalent in the study area and cover large sections of the land surface. The agents include residential and commercial development such as landscaping and construction of buildings; farming practices, such as initial vegetation clearance for creation of paddocks, fencing and stock grazing.

The study area has been subjected to extensive vegetation clearance, which would have resulted in extensive topsoil disturbance. Additionally, the majority (approximately 70 %) of the study area has undergone extensive disturbance resulting from market gardening activities primarily in the southern half of the study area including the planting of orchards or, the construction of greenhouses, dam construction, access roads, and houses (Photo 11, Photo 12, Photo 13, Photo 14). In the north of the study area, grazing activity and tree clearing had taken place but these lots appeared to be less disturbed (Photo 16). The results of the visual inspection are outlined in Figure 8.

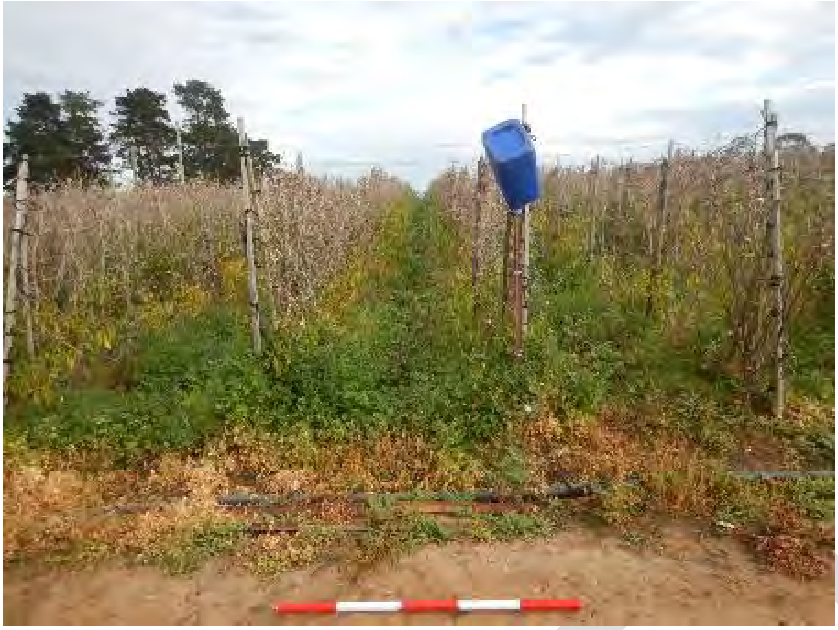


Photo 11 **Extensive disturbance of the ground survey resulting from crop planting**

Photo 12 **Modern construction within the study area. This photo shows a shed and adjacent electricity infrastructure**

Photo 13 **Further disturbance within the study area in the form of a dam used to aid market gardening activities**

Photo 14 **Vineyards in the north of the study area. Disturbance from market gardening can be seen throughout the study area**

Photo 15 Greenhouses constructed for horticultural purposes

Photo 16 North facing photo of creek line in northern portion of study area. This area of the study area was less disturbed

4.5 Areas of archaeological potential located the within the study area

Three areas of moderate archaeological potential (Area 1, Area 2, Area 3) were identified during the survey. Visibility during the survey was low as explained above, therefore these determinations were made through the observation of elevated landforms and proximity to local resources such as creek lines. The location of these areas are shown in Figure 8.

4.5.1 Area 1

Area 1 (Photo 17) is located on a crest landform in the eastern part of the study area within Lot 23 DP 255560. It consists of an elevated landform located approximately 300 metres west from a tributary of Ropes Creek. A 1998 aerial over the study area (Photo 4) shows Area 1 has been subject to some disturbance from vegetation removal and market gardening in the area. These activities may have only disturbed the top layers of sediment and so it is possible *in situ* archaeological deposits remain below that level. Area 1 is located in a mixture of the Blacktown and South Creek soil landscapes. Both of these soil landscapes have potential to contain and preserve subsurface archaeological remains.

Photo 17 A south facing photo of Area 1

4.5.2 Area 2

Area 2 (Photo 18) is located on a flat landform adjacent to a tributary of Ropes Creek in the north-east part of the study area within Lot 32 DP 255560. Area 2 was identified due to its location adjacent to a creek line, which would have provided ample resources for Aboriginal people. In addition, a number of AHIMS sites are located one kilometre north on the bank of Ropes Creek and may extend further south into the study area.

Little disturbance or development has taken place within Area 2. Aerials from 1970 and 1998 (Photo 2 and Photo 4) show that vegetation removal has occurred; however, the area was not used for market gardening. During the survey, it was observed that the boundaries of Area 2 roughly followed existing fencing consistent with the boundaries of the lot. Area 2 is located in the South Creek soil landscape which past archaeological research suggests may contain subsurface archaeological deposits.

Photo 18 South-west facing photo of Area 2

4.5.3 Area 3

Area 3 (Photo 19) is located on a crest and simple slope landform between two tributaries of Ropes Creek in the north-east part of the study area within Lot 32 DP 255560. This area has been identified as an area of moderate potential due to its elevated landform beside a resource zone, which may have been utilised by Aboriginal people in the past. As with Area 2, a number of AHIMS sites were identified north of the study area and may extend further south. As such, it is likely that Area 3 contains subsurface archaeological deposits.

It is considered likely that disturbances may have only affected the upper layers of soil within Area 3 and *in situ* archaeological material may exist below this. Area 3 is located within the South Creek soil landscape, which past archaeological research has suggested is likely to contain subsurface archaeological deposits.

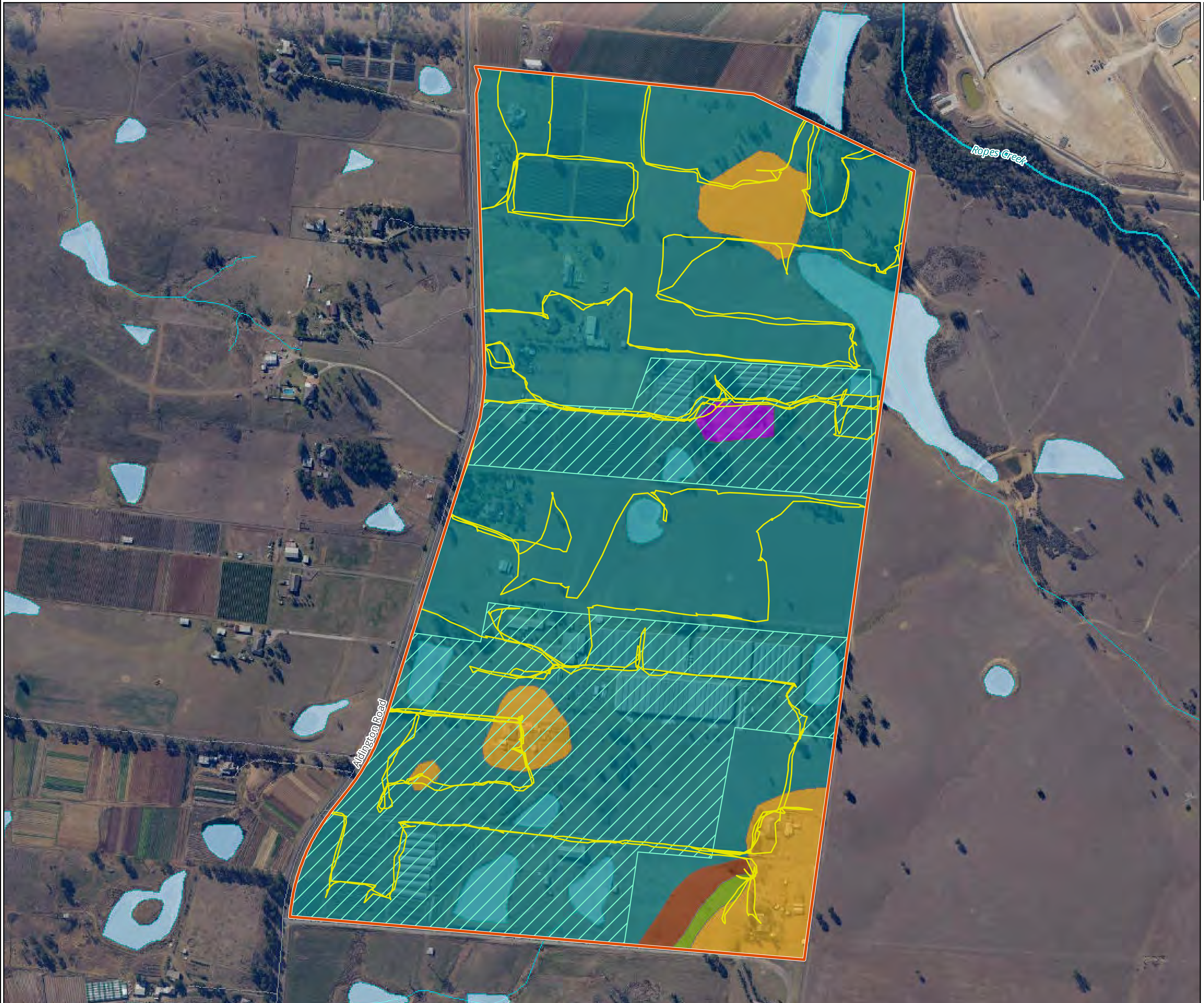
Photo 19 South facing photo of a portion of Area 3 atop the crest

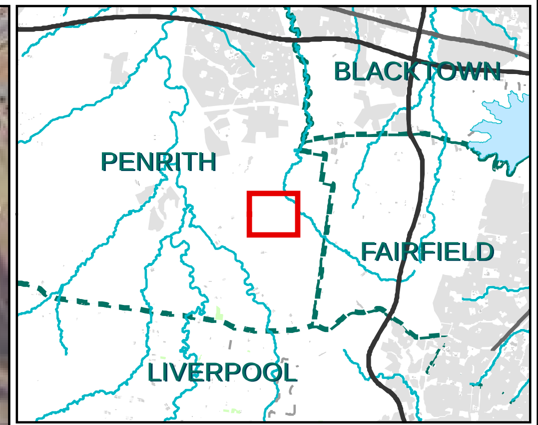
Table 9 Survey coverage

Survey unit	Landform	Survey unit area (m²)	Visibility (%)	Exposure (%)	Effective coverage area (m²)	Effective coverage (%)
1	Crests	54,404	5	0	32,590	11.98
2	Simple slope	5,186	10	0	649	12.52
3	Flat	6,888	20	5	142	2.06
4	Lower slope	2,970	0	0	368	12.41
5	Middle slope	65,1436	0	0	60,284	9.25

Table 10 Landform summary

Landform	Landform area (m²)	Area effectively surveyed (m²)	Landform effectively surveyed (%)	No. of Aboriginal sites	No. of artefacts or features
Crest	54,404	32,590	11.98	2	0
Flat	5,186	649	12.52	1	0
Lower slope	6,888	142	2.06	0	0
Middle slope	2,970	368	12.41	0	0
Simple slope	65,1436	60,284	9.25	0	0





Legend

- Study area
- Survey tracks
- Disturbance

Landforms

- Crest
- Flat
- Lower slope
- Middle slope
- Simple slope

Figure 8 Survey coverage

0 50 100 150 200

Metres

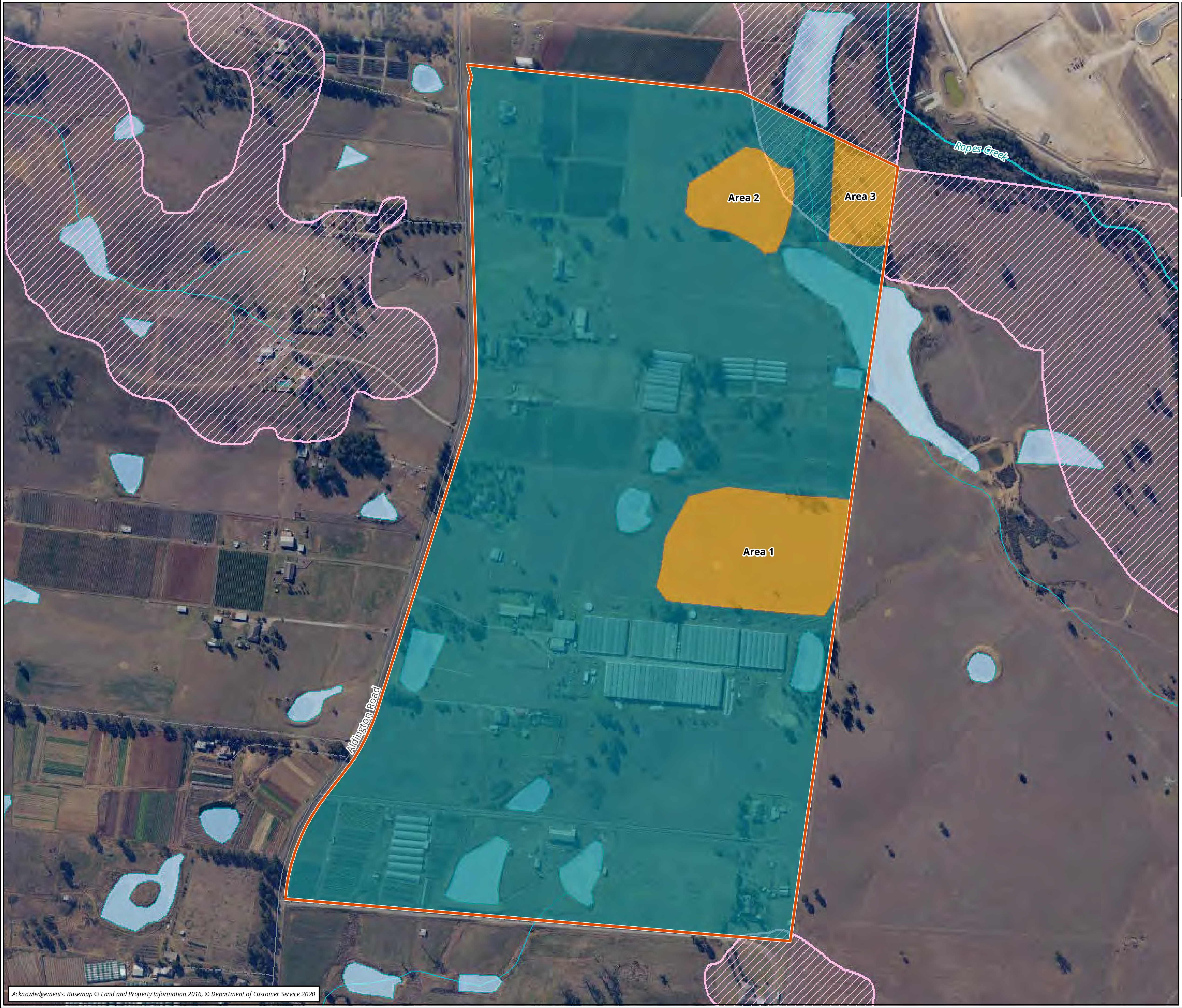
N

Scale: 1:5,000 @ A3

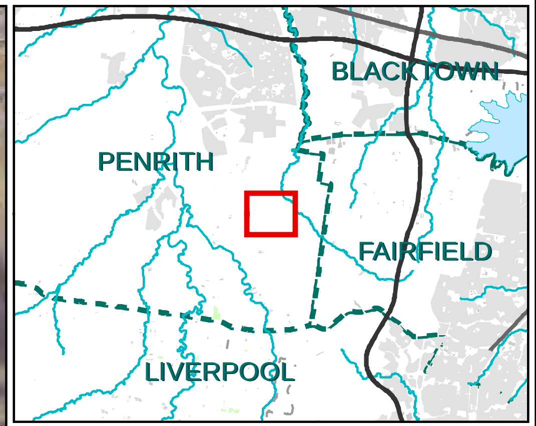
Coordinate System: GDA 1994 MGA Zone 56

Matter: 31837,
Date: 23 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F8_SurveyCoverage.mxd

Acknowledgements: Basemap © Land and Property Information 2016, © Department of Customer Service 2020



Acknowledgements: Basemap © Land and Property Information 2016, © Department of Customer Service 2020



Legend

Study area

Sites of known Aboriginal heritage and areas of high and moderate-high Aboriginal potential

Archaeological potential

Moderate potential

Low potential

Figure 9 Survey results

0 50 100 150 200

Metres

N

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 03 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F9_SurveyResults.mxd

4.6 Discussion of archaeological survey results

Though no Aboriginal sites were identified by this assessment, three areas of moderate archaeological potential were recorded as a result of the archaeological survey. The assessment of areas that have low and moderate archaeological potential within the study area is based on a number of factors, including environmental conditions, geomorphological processes, past land use activities, results of previous archaeological studies, surveys and test excavations, results of the current survey and site predictive modelling for the region.

The study area is located within a series of moderately undulating slopes, simple slopes and crests. The study area contains three soil landscapes; the Luddenham, Blacktown and South Creek soil landscapes, which all consist of loamy soils above mottled clays. Blacktown soils are residual and lack erosion, preventing the subsurface movement of archaeological material. South Creek soils are alluvial and have been shown to be a good predictor of archaeological material. In both soil landscapes, artefacts that are deposited on the surface may be kept *in situ*. The Luddenham soil landscape consists of loamy soils closer to the surface that transitions to clays as depth increases. The Luddenham soils are prone to erosion and these areas tend to have low archaeological potential (Bannerman & Hazelton 1990).

The study area is intersected by a substantial tributary of Ropes Creek in the north of the study area and several smaller tributaries of Kemps Creek in the south. The combined landforms and drainage lines create an area abundant with natural resources which Aboriginal people may have exploited.

The survey showed the study area to be extensively disturbed. Disturbances from ongoing market gardening activities were observed across the study area, which included crop and agricultural disturbance, construction of greenhouses and dams, and associated pumps and pipeline infrastructure. These major disturbances would have displaced any cultural material present at these locations. Additionally disturbance included vegetation clearing throughout the study area and exposures caused by animal use. These disturbances are relatively minor and in areas may only affect the upper soil levels with archaeological material being present below that.

Regional assessments of the area showed that the occurrence of subsurface deposits is not directly related to artefacts on the surface (Brayshaw McDonald Pty Ltd 1994, White & McDonald 2010). Alluvial sediments such as those associated with Area 2 and Area 3 were shown to be most promising in predicting subsurface deposits. Further archaeological work closer to the study area by Steele (2003) showed similarly that surface artefacts are not representative of *in situ* deposits. The Mamre DCP has mapped out the northern portion of the study area as containing high and moderate archaeological potential.

5 Test excavations

Following the results of the field survey a test excavation program was undertaken to characterise the extent, nature and archaeological (scientific) value of Aboriginal cultural heritage within identified Area 1, Area 2, and Area 3, as part of Stage 1 works. The test excavation program was conducted over September 2020 and February 2021. Excavations were conducted by Biosis archaeologists Mathew Smith, Ashleigh Keevers-Eastman, Ashley Bridge and Anthea Vella, with representatives from the Deerubbin LALC, Darug Custodian Aboriginal Corporation and Kamilaroi Yankuntjatjara Working Group also in attendance. The test excavations were conducted in accordance with Requirement 16a of the Code. The sampling strategy, methodology and results of the test excavation program are discussed below.

5.1 Test excavation objectives

The objectives of the sub-surface investigation are to identify and understand the nature, extent and significance of any areas of identified moderate or high archaeological potential within the study area.

The aims of the testing program were to:

- Determine whether sub-surface archaeological deposits exist within the study area and to establish the extent and nature of such deposits.
- Identify if the archaeological material occurs in an intact, undisturbed context, by examining the soil profile and stratigraphy.
- Analyse and interpret any archaeological finds (such as stone artefacts, hearths, etc.) recovered during the testing program.
- Inform current knowledge of Aboriginal occupation and land use models of the region.
- Provide management and mitigation measures for Aboriginal archaeological objects located during the subsurface testing program.
- Test the predictive model and answer the research questions developed as part of this assessment.

5.2 Research questions

Research questions provide a framework for undertaking sub-surface investigations and ensure that the information collected during the sub-surface testing program contributes to the knowledge of the sites and the broader archaeological record. Research questions include:

- *Do non-disturbed or minimally disturbed soil profiles exist within the area of moderate archaeological potential?*
- *How does proximity to Ropes Creek and landform type contribute to the extent and nature of any archaeological deposits (if present) within the areas of moderate potential?*
- *What are the extent and nature of any archaeological deposits (if present) within the area of moderate potential?*

- *How does the character of archaeological deposit within the study area (if present) inform the scientific understanding of Aboriginal occupation and land use models for the region?*

5.3 Test excavation methodology

Test excavations were conducted in accordance with requirement 16a of the Code and conformed to the below methodology:

- Test excavations will be conducted in 50 by 50 centimetre units.
- The test pits will be excavated by hand (inclusive of trowels, spades and other hand tools) along transects at intervals of between 10 and 20 metres or other justifiable and regular spacing (being no smaller than five metres).
- The first test pit within a site or PAD area will be excavated in five centimetre spits; the subsequent test pits conducted within the site or PAD area can then be excavated in either 10 centimetre spits or stratigraphic units (whichever is smaller) to the base of Aboriginal object-bearing units being the removal of the A-horizon soil deposit down to the sterile clay or bedrock layer (B-horizon).
- If the depth of deposit prevents reaching sterile deposits within the 50 by 50 centimetre test pit, additional 50 by 50 centimetre test pits may be excavated adjacent to the original test pit (for example expanding the test pit to 50 by 100 centimetres) to reach the sterile deposits.
- Test pits may be combined and excavated as necessary in 50 by 50 centimetre units for the purposes of further understanding site characteristics. Note that under the Code, the maximum area that can be excavated in any one continuous area is three metres squared (3 m^2).
- The Code dictates that the maximum surface area of all test excavation units must be no greater than 0.5% of the PAD or area being investigated.
- All excavated soil will be sieved in 5 millimetre sieves. Dry sieving will be attempted in the first instance, however wet sieving may be used if deposits cannot be dry sieved.
- All cultural material will be collected, bagged and clearly labelled. They will be temporarily stored in the Biosis office for analysis (at 14/17-27 Power Avenue, Alexandria NSW 2015).
- For each test pit that is excavated, the following documentation will be taken:
  - Unique test pit identification number.
  - GPS coordinate of each test pit.
  - Munsell soil colour and texture.
  - Amount and location of cultural material within the deposit.
  - Nature of disturbance where present.
  - Stratigraphy.
  - Archaeological features (if present).
  - Photographic records.
  - Spit records.
- Test excavation units will be backfilled as soon as practicable.

- An AHIMS Site Impact Recording form will be completed and submitted to the AHIMS Registrar for any sites impacted during test excavations.
- In the event that suspected human remains are identified works will immediately cease and the NSW Police and Heritage NSW will be notified.
- Test excavations will cease when enough information has been recovered to adequately characterise the objects present with regard to their nature and significance.*

5.4 Test excavation results

A total of 87 test pits were excavated throughout Areas 1, 2, and 3. Across Area 1 a total of 40 test pits were excavated across ten transects; Area 2 had 26 test pits over six transects; and Area 3 had 21 test pits across three transects in Area 3 (Figure 10 and Figure 11). Within Area 3 and Area 1, there were two areas that were expanded to identify PAD boundaries and site density. The maximum depths reached for these expansion areas was 400 millimetres at Area 3 and 180 millimetres at Area 1. Individual test pit and soil analysis results are provided in Appendix 2. Results are shown in Table 11 and a detailed discussion of results is provided below.

Table 11 Test excavation coverage and results

Area	Potential	Potential area (m^2)	Area tested (m^2)	Effectively tested (%)	No. of test pits	No. of artefacts
Area 1	Moderate	43,661	10	0.02	40	19
Area 2	Moderate	15,535	6.5	0.04	26	28
Area 3	Moderate	11,700	5.25	0.04	21	201

5.4.1 Area 1

Area 1 is an area of moderate archaeological potential located upon a crest landform within Lot 23 DP 255560. It consists of an elevated landform located approximately 300 metres west from a tributary of Ropes Creek. A total of 40 test pits were excavated at 20 metres intervals across ten transects in order to test the archaeological potential of Area 1.

Three contexts were present within Area 1 (Photo 21 to Photo 24). Context 1 ranged from a dark yellowish brown (10YR 4/2) to dark brown (7.5YR 3/2) silty loam of moderate compaction containing rootlets and reaching a depth of 90 millimetres. Disturbances caused by ploughing and bioturbation were also noted across Area 1. A total of 25% (n=10) of the test pits ended at Context 1. A clear horizon to Context 2 was present, which contained a dark yellowish brown (10YR 4/2) to dark reddish brown (5YR 3/3) silty loam of moderate compaction with rootlets and charcoal fleck inclusions, ranging 90 and 200 millimetres. Clay mottling was noted to increase with depth and rootlets were also present. A total of 60% (n=24) of the test pits ended at Context 2. A gradual horizon into Context 3 was also present. Context 3 comprised of a reddish brown (5YR 4/4) to red (5YR 4/6, 2.5YR 4/6) clay of moderate to hard compaction containing rootlets and

** *Enough information is defined by Heritage NSW as meaning "the sample of excavated material clearly and self-evidently demonstrates the deposit's nature and significance. This may include things like locally or regionally high object density: presence of rare or representative objects: presence of archaeological features: or locally or regionally significant deposits stratified or not."* (DECCW 2010a, p.28).

ironstone inclusions ending at a maximum depth of 290 millimetres. The overall pH within Area 1 varied between 5.5. and 7. A total of 15% (n=6) of the test pits ended on Context 3.

A total of 19 artefacts were recovered during test excavations from nine test pits, including one tool, a silcrete broken point. A total of twelve of the artefacts were recovered from spit 1, and seven from spit 2. No artefacts came from spit 3. Test pit 3 in transect 5 had the highest density of artefacts, and silcrete was the overall dominant raw material type. The results of the test excavations have identified Area 1 as a mod density artefact scatter.

Photo 20 Transect 1 Test Pit 1, photo facing north

Photo 21 Transect 5 Test Pit 3, photo facing north

Photo 22 **Transect 5 Test Pit 5, photo facing north**

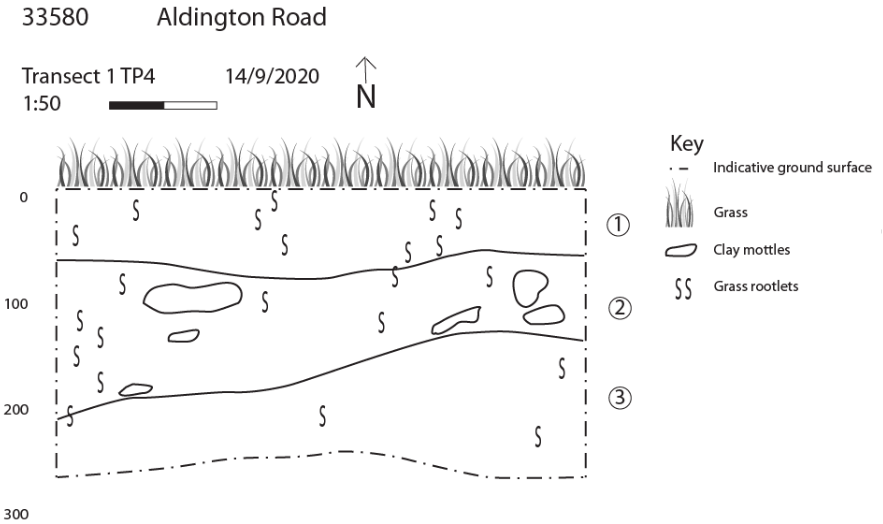


Photo 23 **Representative section drawing of stratigraphy across Area 1: Transect 1 Test Pit 4**

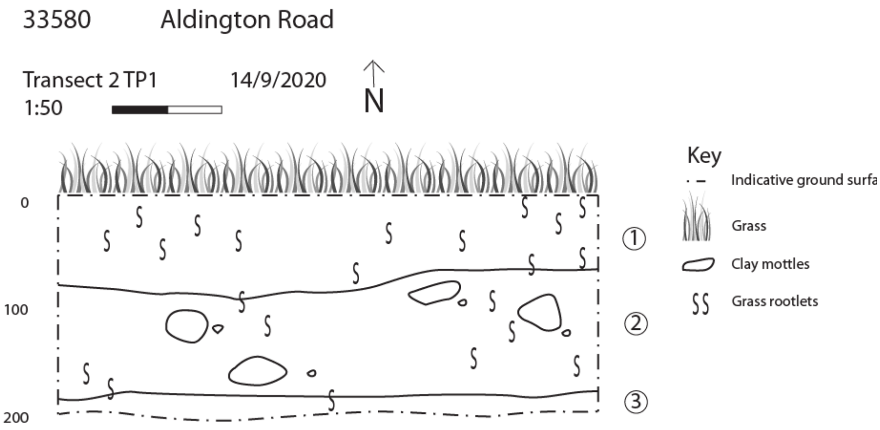


Photo 24 **Representative section drawing of stratigraphy across Area 1: Transect 2 Test Pit 1**

5.4.2 Area 2

Area 2 is an area of moderate archaeological potential located within Lot 32 DP 255560. It consists of a flat landform and is adjacent to a creek line. A total of 26 test pits were excavated at 20 metres intervals across six transects in order to test the archaeological potential of Area 2.

Three contexts were present within Area 2 (Photo 25 to Photo 30). Context 1 comprised of moderately to highly compacted dark brown (7.5YR 3/3) loamy clay. Rootlets, glass, and plastic were noted across Area 2. This context reached a depth ranging from 200 to 300 millimetres with a clear horizon. A total of 30.77% (n=8) of the test pits ended at Context 1. Context 2 consisted of moderately to highly compacted strong brown (7.5YR 4/6) to dark brown (7.5YR 3/3) loamy clay. This context increased in clay content with depth, and there was also some orange mottling present. This context ranged between 100 to 750 millimetres with a clear horizon. A total of 61.54% (n=16) of the test pits ended at Context 2. Context 3 consisted of highly compacted strong brown (7.5YR 4/6) silty clay to dry clay. This context ranged between 380 to 650 millimetres with a clear horizon. A total of 7.69% (n=2) of the test pits ended at Context 3. Overall pH ranged from 5 to 7 across Area 2.

A total of 28 artefacts were recovered during test excavations from six test pits predominantly comprised of broken flakes. The artefacts recovered were made up of silcrete, mudstone, chert and quartz material in the form of flakes, cores, and angular fragments, and were identified within spits 1 to 4. The results of the test excavations have identified Area 2 as a low density artefact scatter.

Photo 25 Transect 3 Test Pit 1, photo facing north east

Photo 26 **Transect 6 Test Pit 2, photo facing north east**

Photo 27 **Transect 4 Test Pit 5, photo facing north east**

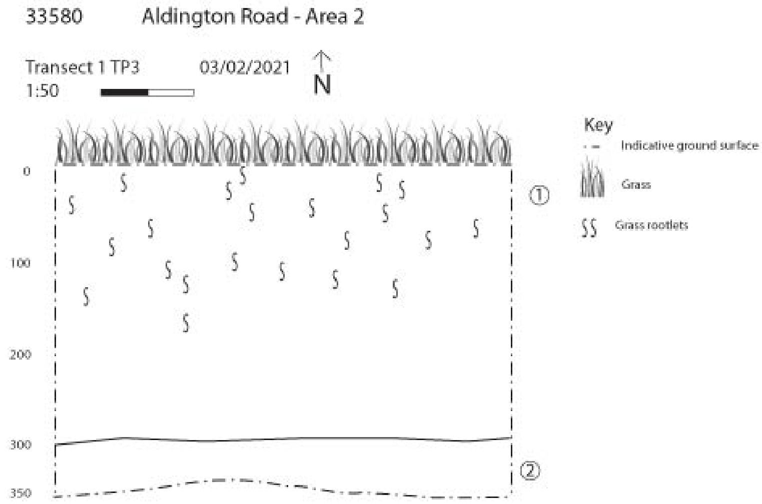


Photo 28 Representative section drawing of stratigraphy across Area 2: Transect 1 Test Pit 3

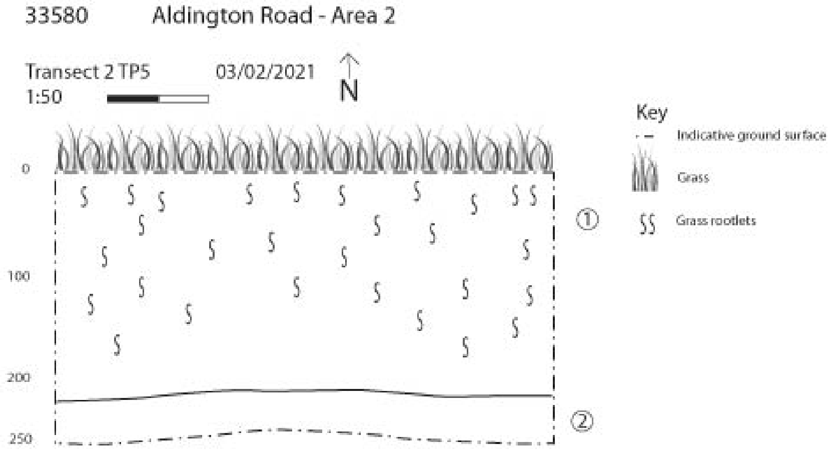


Photo 29 Representative section drawing of stratigraphy across Area 2: Transect 2 Test Pit 5

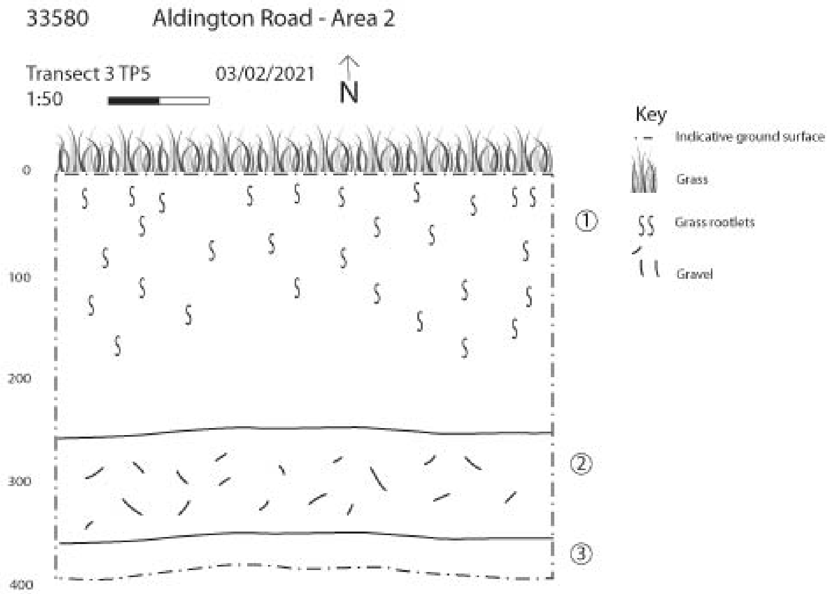


Photo 30 Representative section drawing of stratigraphy across Area 2: Transect 3 Test Pit 5

5.4.3 Area 3

Area 3 is an area of moderate archaeological potential located between two tributaries of Ropes within Lot 32 DP 255560. It consists of a crest and simple slope landform. A total of 21 test pits were excavated at 40 metres intervals across three transects in order to test the archaeological potential of Area 3.

Three contexts were present within Area 3 (Photo 31 - Photo 36). Context 1 comprised of a very dark brown (7.5YR 2.5/2) to black (7.5YR 2.5/1) silty sandy loam of moderate compaction and rootlets present. Disturbances from ploughing were also noted. This context reached a depth of 200 millimetres with a clear horizon. A total of 4.76% (n=1) of the test pits ended at Context 1. Context 2 contained a brown (7.5YR 5/4) to very dark brown (7.5YR 2.5/3) silty sand to silty clayey loam of moderate compaction and rootlets present. Disturbances caused by ploughing were also present causing the mixing and disturbance of soils between spits 1 and 2. This context ranged between 200 to 400 millimetres with a gradual horizon. A total of 47.61% (n=10) of the test pits ended at Context 2. Context 3 comprised of a yellowish brown to strong brown (7.5YR 5/6) soft sandy loam to sandy clay with rootlets present, reaching a depth of 400 millimetres. A total of 42.87% (n=94) of the test pits ended at Context 3. Context 4 featured a dark reddish brown (2.5YR 4/6) sandy clay, that increased in clay content with depth. A total of 4.76% (n=1) of the test pits ended at Context 4. This context ended on clay at 750 millimetres, and the pH ranged from 5 to 6.5 across Area 3.

A total of 201 artefacts were recovered during test excavations from thirteen test pits predominantly comprised of angular fragments. Transect 3 test pit 4 was expanded due to a high artefact density. An additional nine test pits were excavated, ranging from adjacent to test pit 4 (TP 4A, 4B, 4C, 4D and 4E), or 5-10 metres east, west and south of test pit 4. The artefacts recovered were made up of silcrete, quartz, chert and basalt material in the form of flakes, cores, blades and angular fragments, and were identified within spits 1 to 4. The results of the test excavations have identified Area 1 as a high density artefact scatter.

Photo 31 Transect 1 Test Pit 1, photo facing north

Photo 32 **Transect 1 Test Pit 3, photo facing north**

Photo 33 **Transect 3 Test Pit 4D and 4E, photo facing north**

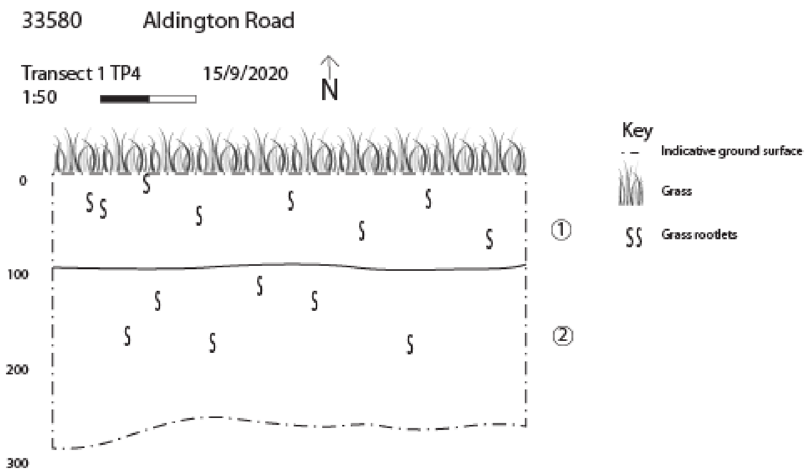


Photo 34 **Representative section drawing of stratigraphy across Area 3: Transect 1 Test Pit 4**

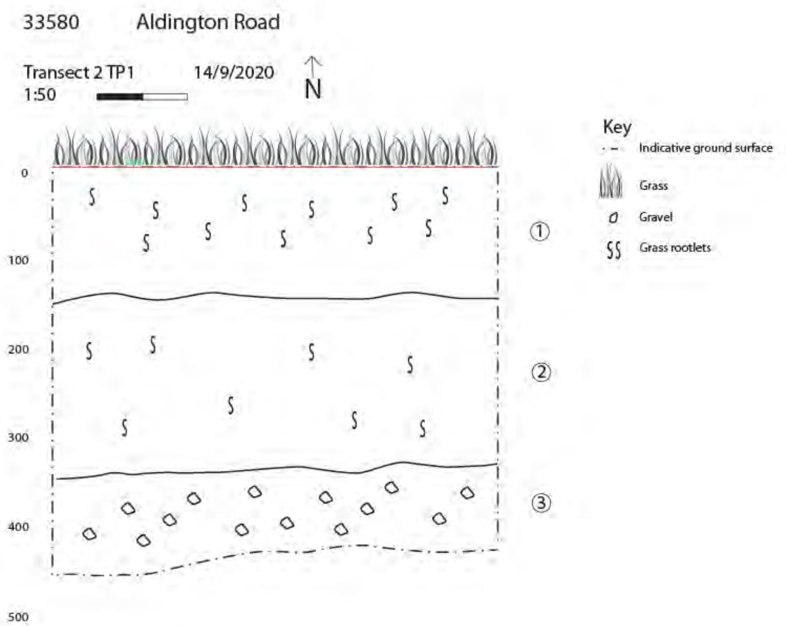


Photo 35 **Representative section drawing of stratigraphy across Area 3: Transect 2 Test Pit 1**

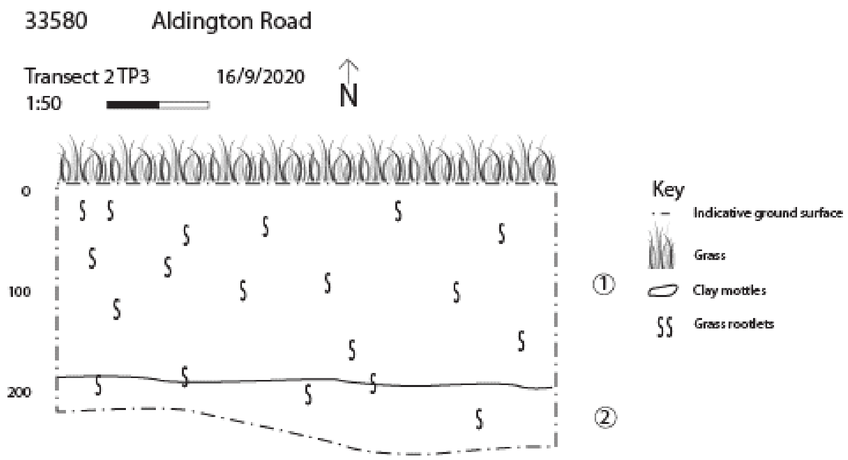


Photo 36 Representative section drawing of stratigraphy across Area 3: Transect 2 Test Pit 3

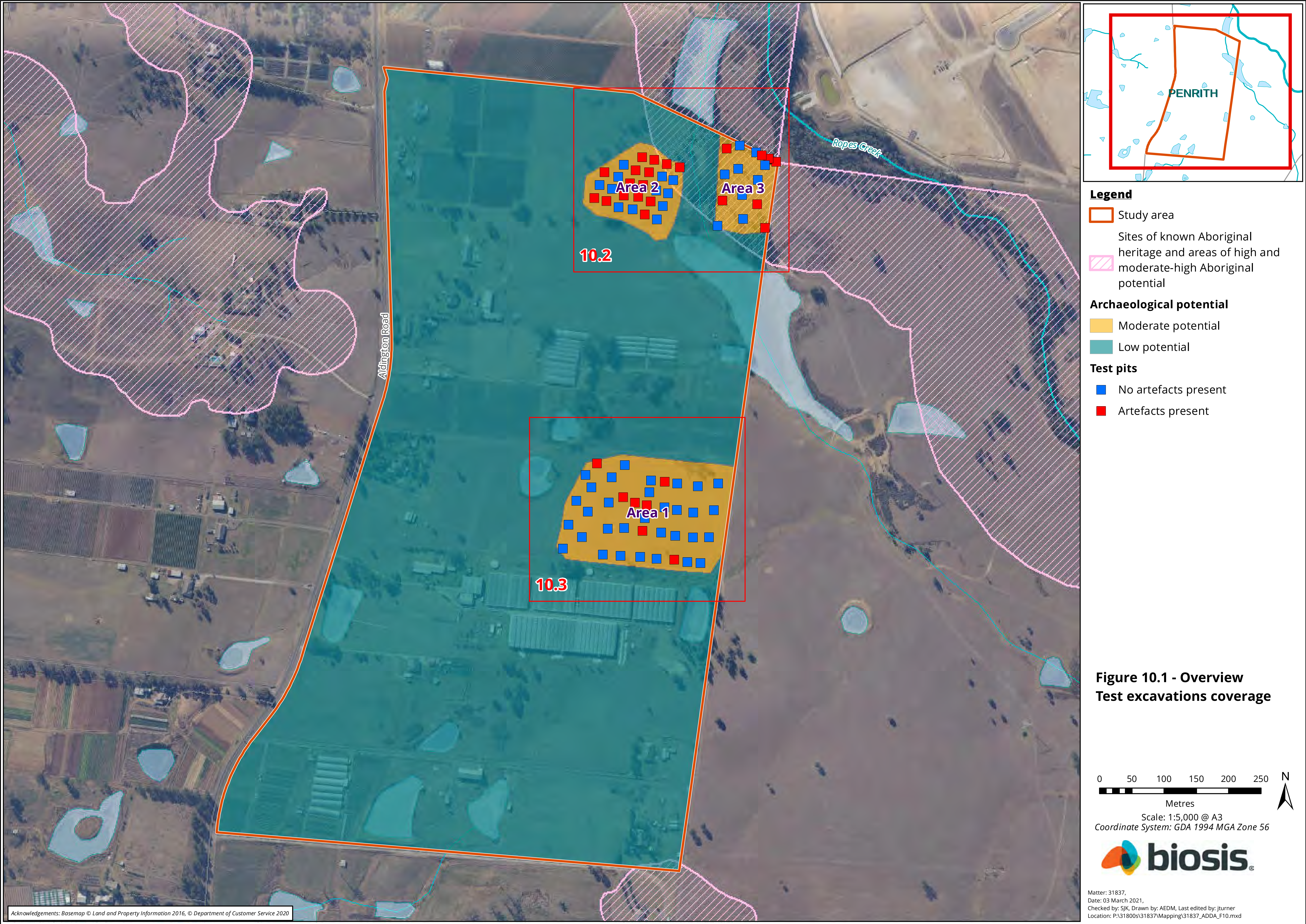
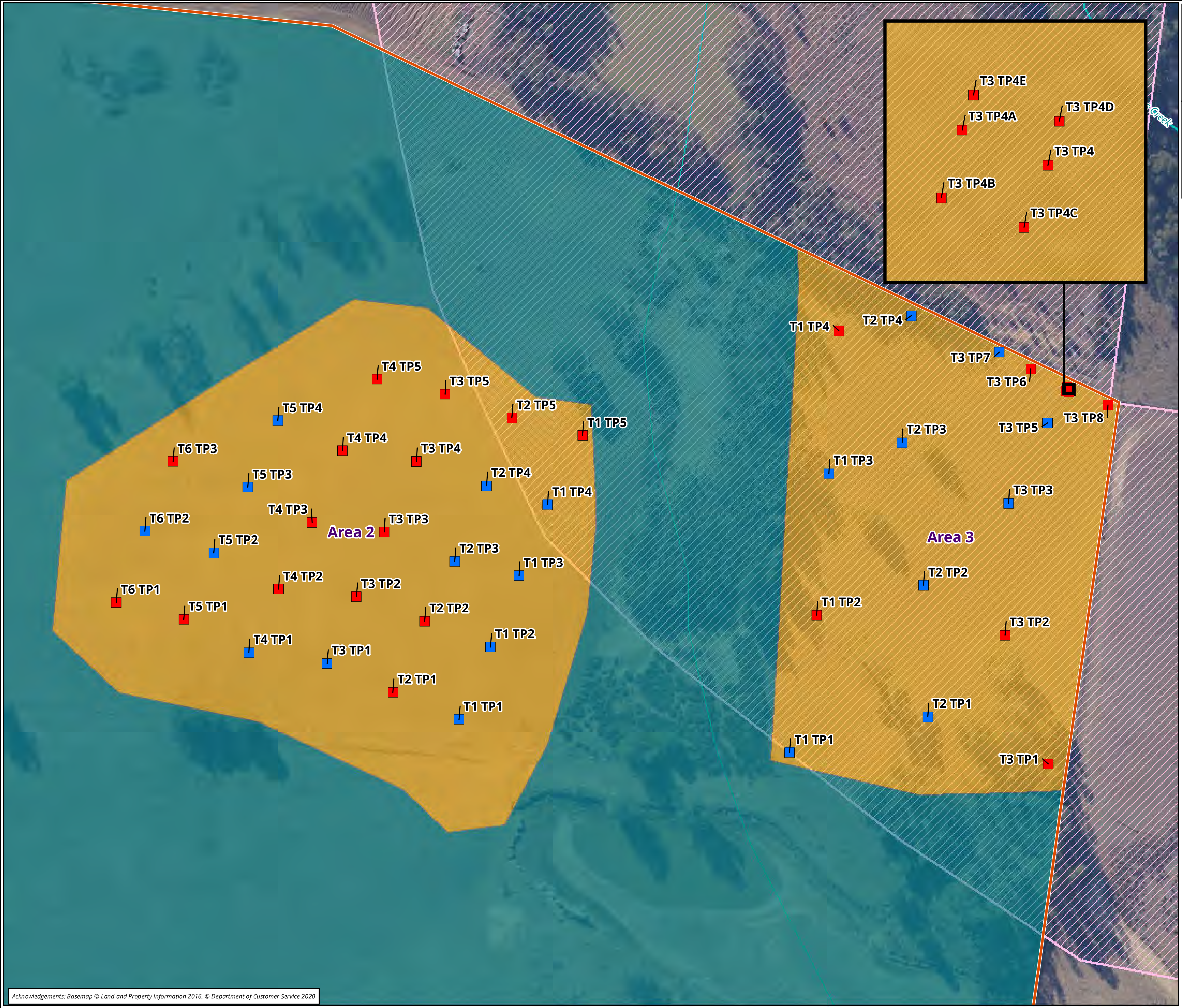
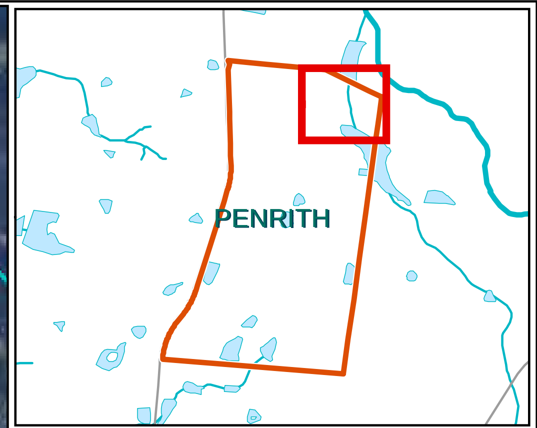


Figure 10.1 - Overview Test excavations coverage

Matter: 31837,
Date: 03 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F10.mxd





Legend

Study area

Sites of known Aboriginal heritage and areas of high and moderate-high Aboriginal potential

Archaeological potential

Moderate potential

Low potential

Test pits

No artefacts present

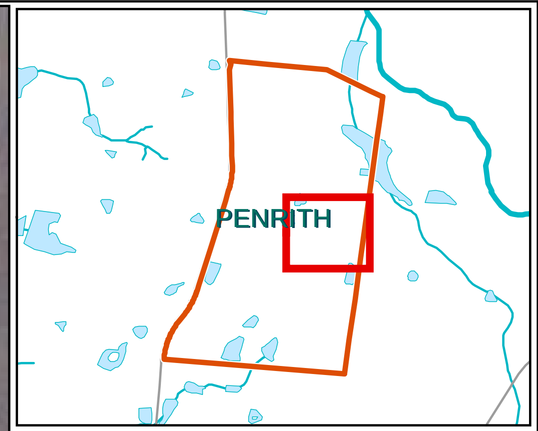
Artefacts present

Figure 10.2
Test excavations coverage

0 50
Metres
Scale: 1:1,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 03 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F11.mxd



Legend

Study area

Archaeological potential

Moderate potential

Low potential

Test pits

No artefacts present

Artefacts present

Figure 10.3
Test excavations coverage

0 50
Metres
N

Scale: 1:1,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 03 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F11.mxd

Figure 11.1 - Overview Number of artefacts in each test pit

Matter: 31837,
Date: 04 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F11_TestPitNos.mxd

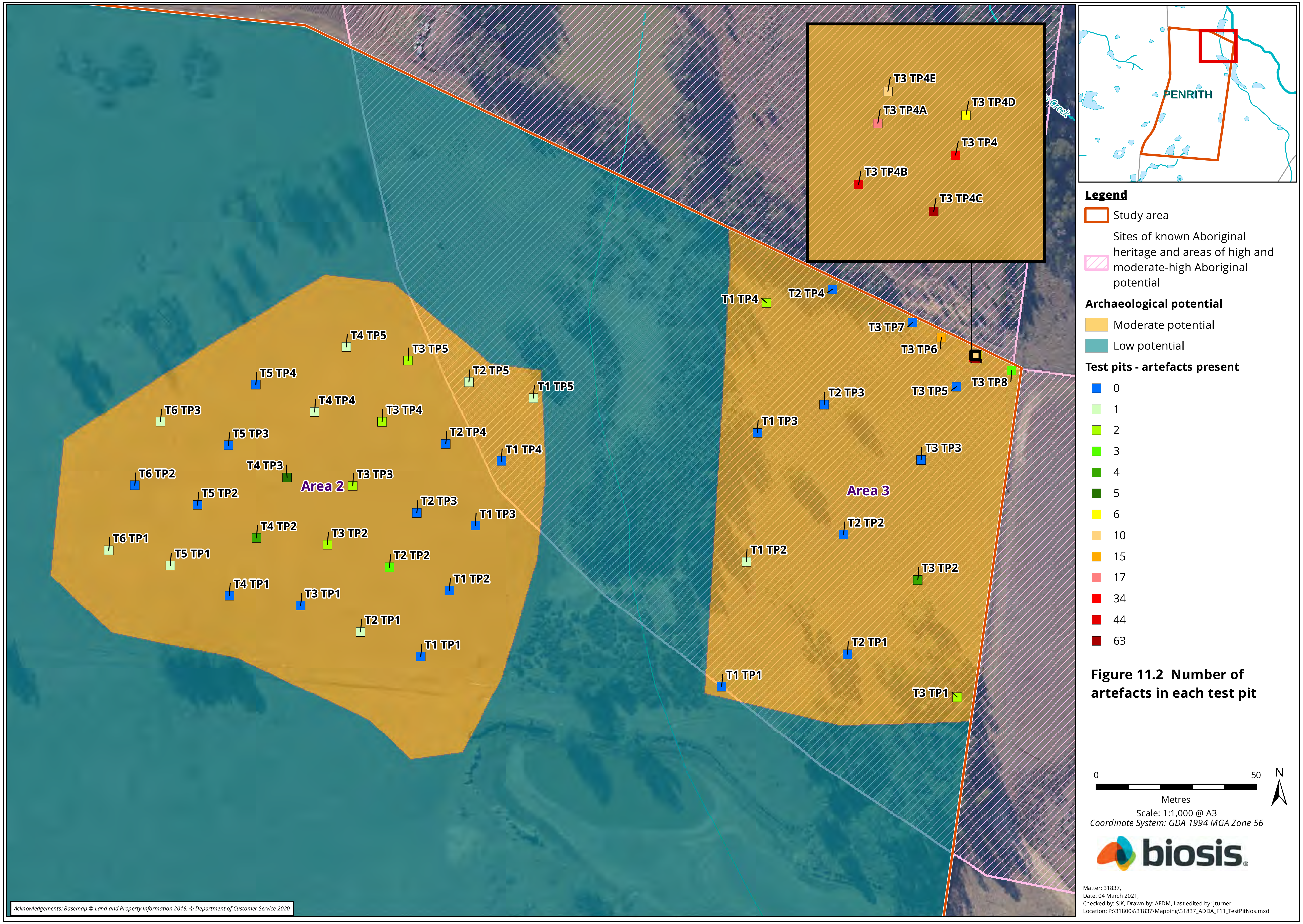
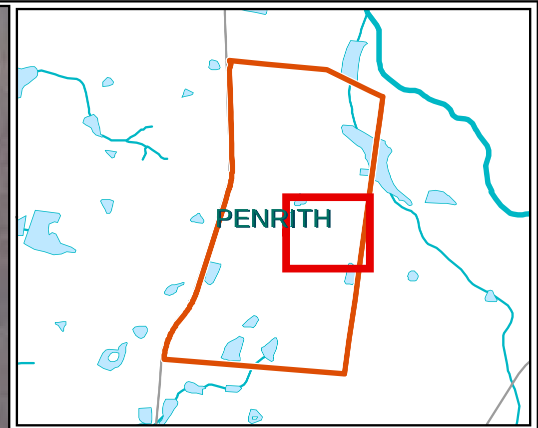


Figure 11.2 Number of artefacts in each test pit



Legend

Study area

Archaeological potential

Moderate potential

Low potential

Test pits - artefacts present

0

1

2

4

6

Figure 11.3 Number of artefacts in each test pit

0 50

Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 04 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F11_TestPitNos.mxd

6 Analysis and discussion

6.1 Archaeological analysis

The following analysis has been undertaken for the sub-surface assemblage excavated throughout Area 1, Area 2, and Area 3. A total of 248 artefacts were identified and recorded during the test excavations.

The artefact analysis addresses a series of themes including:

- Spatial distribution.
- Stone raw material procurement.
- Stone reduction technology.

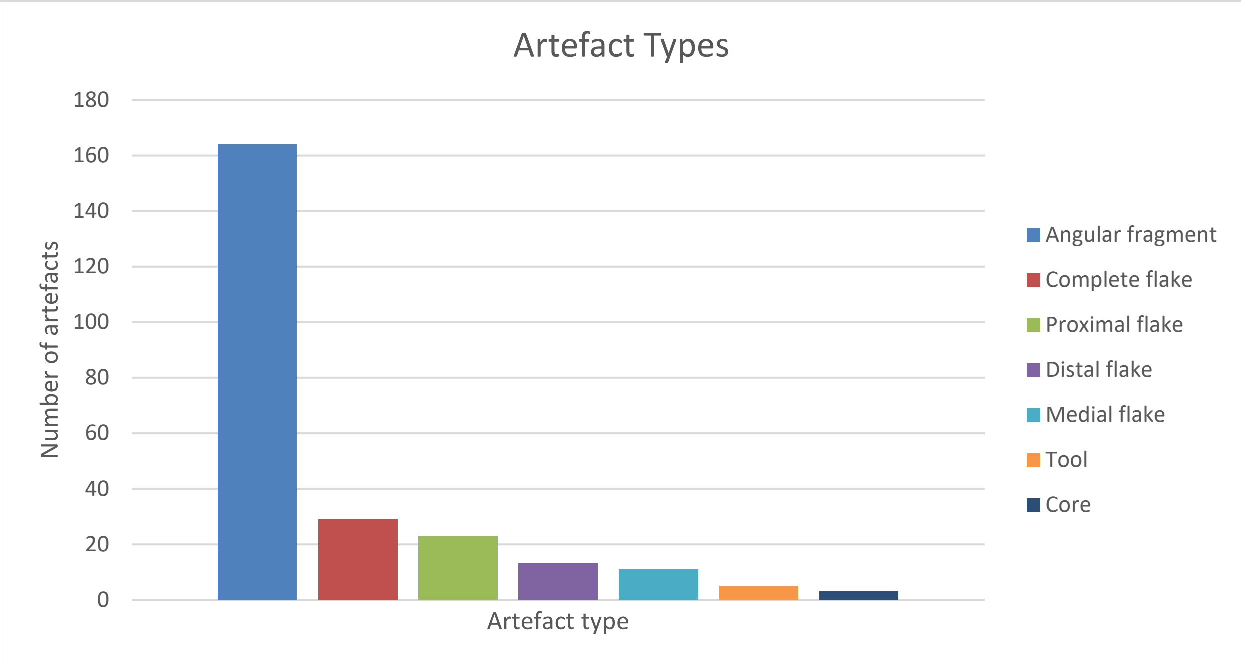
Stone artefacts collected from the excavations were labelled by spit and their test pit location recorded. The recording form utilised by Biosis prompts the user to record all relevant artefact attributes; this enabled a comprehensive typological, technological and metrical analysis of the assemblage to be undertaken. Analysis was undertaken using a standard set of digital Vernier calipers. All measurements were recorded in millimetres to two decimal places. Appendix 2 contains the detailed sub-surface lithics recordings. Collected artefacts were recorded at their temporary storage location at the Biosis office in Sydney (Unit 14/17-27 Power Avenue, Alexandria, NSW), as per the test excavation methodology in section 5.3 of this report.

6.1.1 Artefact types

The artefact assemblage is dominated by angular fragments which make up 66.13% (n=164) of the total assemblage. Complete flakes and proximal flake fragments accounted for 11.69% (n=29) and 9.27% (n=23) of the assemblage respectively, followed by distal flake fragments (5.24%, n=13) and medial flake fragments (4.44%, n=11) (Table 12). Five tools (2.02%, n=5) (one being a Bondi point) and three cores (1.21%, n=3) were also identified.

Table 12 Sub-surface assemblage artefact types

Artefact Type	Count (n)	Percentage (%)
Angular fragment	164	66.13
Complete flake	29	11.69
Proximal flake	23	9.27
Distal flake	13	5.24
Medial flake	11	4.44
Tool	5	2.02
Core	3	1.21
Total	**248**	**100.00**



Graph 1 Artefact types

6.1.2 Artefact distribution

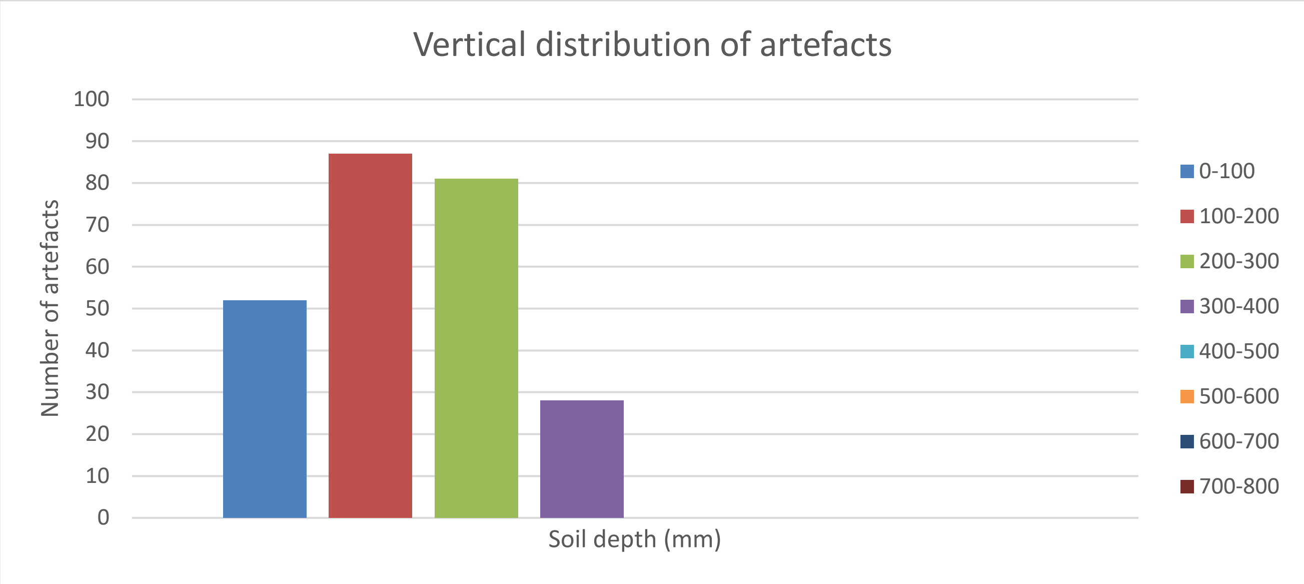
The vertical distribution of artefacts at a site can be a good indicator of occupation intensity as spits with higher artefact concentrations are likely to have seen longer or more intensive occupation than spits with smaller artefact concentrations. This analysis can also help identify variation in occupation over time, with multiple large and small clusters of artefacts at different depths indicating separate depositional periods and possibly indicating separate occupation events.

The results of artefact concentrations by spit depth shows the highest concentration of artefacts was found between 100 and 200 millimetres (35.08 %, n=87) (Graph 2 and Table 13). The next highest concentration of artefacts was found between 200 and 300 millimetres (32.66%, n=81). Spit 1 (0-100 millimetres), displayed an artefact concentration of 20.97% (n=52), while spit 4 recovered 11.29% (n=28). No artefacts were found between 400 and 800 millimetres. The concentrations of artefacts can also be tied to soil contexts. Artefacts were found most frequently in contexts 2 and 3, which consisted predominantly of silty, sandy loam or clayey loam with moderate compaction. Artefacts were also found in context 1, which consisted predominantly of silty loam with soft compaction. No artefacts were found throughout the sterile B horizon clay soils (context 4).

Table 13 Concentrations of artefacts by depth

Spit number	Count (n)	Percentage (%)
Spit 1 (0-100)	52	20.97
Spit 2 (100-200)	87	35.08
Spit 3 (200-300)	81	32.66
Spit 4 (300-400)	28	11.29

Spit number	Count (n)	Percentage (%)
Spit 5 (400-500)	0	0
Spit 6 (500-600)	0	0
Spit 7 (600-700)	0	0
Spit 8 (700-800)	0	0
Total	**248**	**100.00**



Graph 2 Vertical distribution of artefacts by spit depth

6.1.3 Artefact size

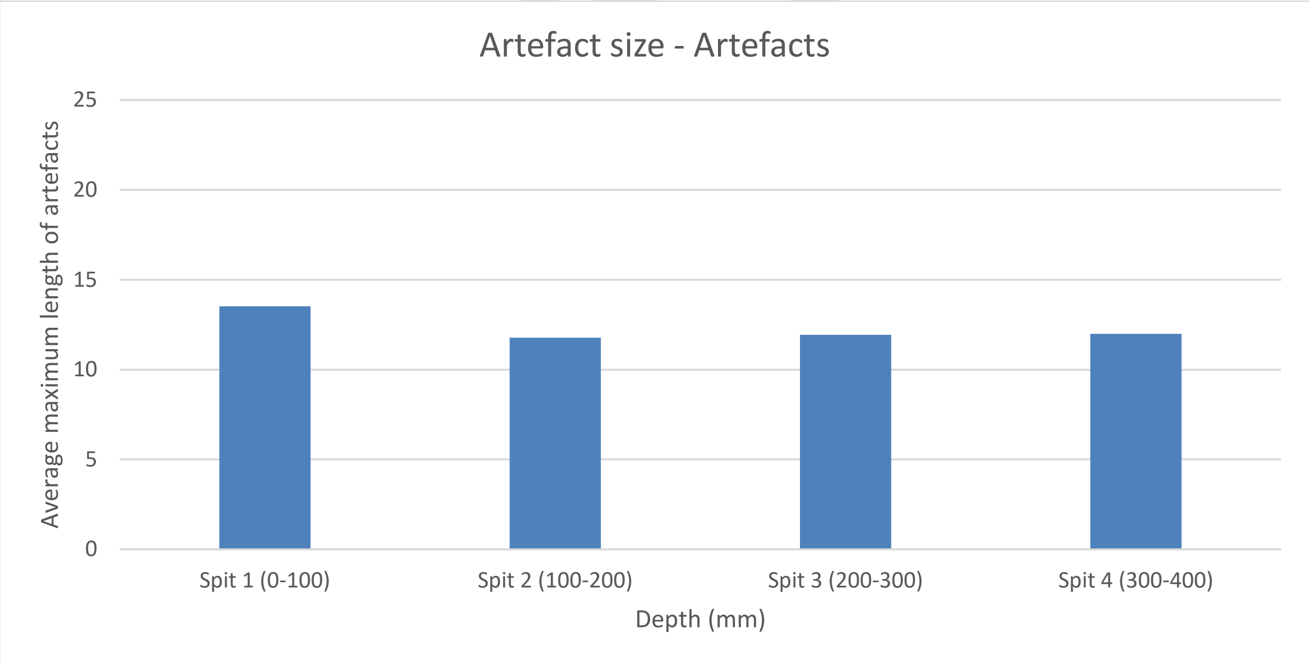
Artefact size in an assemblage can provide information about post-depositional processes, raw material procurement and stone reduction. A useful guide to determining post-depositional processes such as trampling, ploughing and bioturbation in a subsurface assemblage is the measurement of mean length by spit. If the mean length (i.e. the average size of the artefacts) decreases with depth, it is a good indicator that post-depositional processes have occurred and the stone artefacts have been displaced downwards in the soil (Richardson 1992). This is because small artefacts are more likely to be affected by size sorting and soil movement, resulting in higher numbers of smaller artefacts at the base of an excavation. Larger artefacts are less likely to move through the soil profile and will therefore represent the original depositional location of artefacts more accurately (Baker 1978).

The sizes of artefacts in the overall assemblage shows that the majority of artefacts have lengths averaging less than 14 millimetres, while the cores recovered had an average of 24.65 millimetres in length. The most common artefact size for angular fragments was between 5 and 10 millimetres (46.91%, n=76), followed by 10 and 15 millimetres (26.54%, n=43). Due to the lack of diagnostic features present on angular fragments, material was split into size class for analysis, rather than measuring maximum length (see section 6.1.6). The average artefact size for flakes and cores throughout the assemblage was 14.99 millimetres, with the average lengths across the entire assemblage for each spit all below 14 millimetres (Graph 3 and Table 14). This indicates that the artefacts in the assemblage are small and are likely a result of later stage reduction techniques, where core sizes are smaller and thus will limit flake sizes.

The results of the artefact analysis illustrates that all artefacts ranged between 11 to 14 millimetres throughout all spits, suggesting that size sorting is not present in the assemblage. Graph 3 and Table 14 demonstrate that while there is a small variation in size in spit 1 (0-100 millimetres), it is not sufficient to indicate a significant difference in comparison to the other spits. This could illustrate that although some post-depositional processes have occurred throughout Areas 1, 2, and 3 in the past, overall the assemblage has remained intact. As the artefact assemblage (excluding angular fragments) is quite small, it is difficult to accurately determine whether post-depositional processes affected the assemblage, causing some size sorting to occur, or whether the deposit remains intact.

Table 14 Average maximum length of artefacts by depth

Spit Number	Length (mm)
Spit 1 (0-100)	13.52
Spit 2 (100-200)	11.77
Spit 3 (200-300)	11.93
Spit 4 (300-400)	11.99



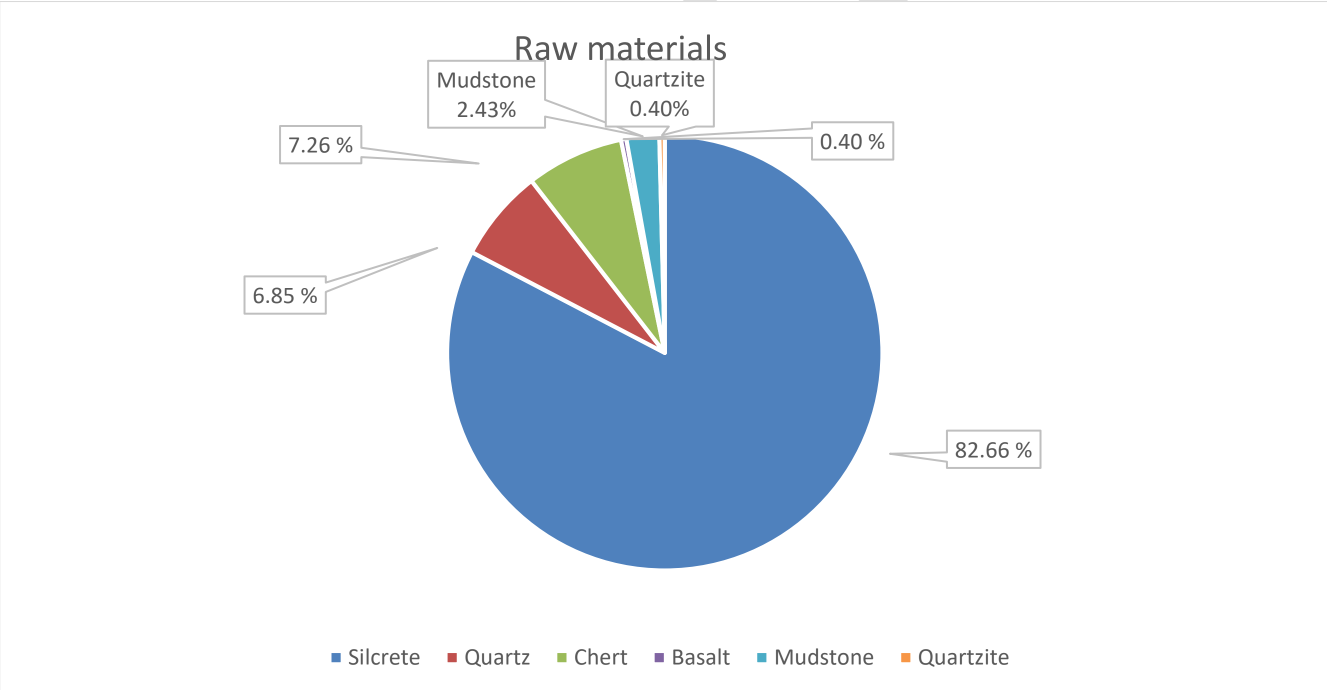
Graph 3 Average maximum length of artefacts by depth

6.1.4 Raw material procurement

Raw material types recorded highlight that silcrete was the most common material type within the assemblage representing 82.66% (n=205), followed by chert at 7.26% (n=18) (Table 15 and Graph 4). Quartz was the next most common material type with 6.85 % (n=17). Mudstone represented 2.43% (n=6), and basalt and quartzite both had 0.40% respectively (n=1).

Table 15 Raw material types in the assemblage

Raw material type	Count (n)	Percentage (%)
Silcrete	205	82.66
Chert	18	7.26
Quartz	17	6.85
Mudstone	6	2.43
Basalt	1	0.40
Quartzite	1	0.40
Total	**248**	**100.00**



Graph 4 Raw material types

The cortex (weathered exterior of a rock) provides information about the origin of stone sources. Artefacts with a rough cortex were acquired from a primary source, such as an *in situ* outcrop. Artefacts with a smooth or water-rolled cortex originate from a secondary source, such as a river cobble from a waterway. The amount of cortex on an artefact often indicates the distance artefacts were transported from the source (Hiscock & Mitchell 1993, pp.12–17). A high percentage of cortex on an artefact can indicate that the source of stone was nearby; while artefacts with less cortex or no cortex were transported further from the source. As cores are transported away from the source they are typically highly reduced and the flakes from these cores are smaller. The amount of cortex present in an assemblage also provides information on the potential uses of a site, as cores and flakes with high cortex are often found at sites were raw material extraction was occurring, whilst small flakes with lower percentages of cortex often dominate faunal and floral resource processing areas further from a raw material source (Odell et al. 2004). It should be noted, however, that recent assessments over the last 20 years within the Cumberland Plain, illustrate that while this theory is valid, the increasing number of new silcrete sources throughout the region has made the testing of the distance-decay model more difficult, suggesting that the model may be a poor mechanism for explaining raw material preferences in this area (Dallas & Witter 1983, JMCHM 2002, Jo McDonald Cultural Heritage Management Pty Ltd 2002).

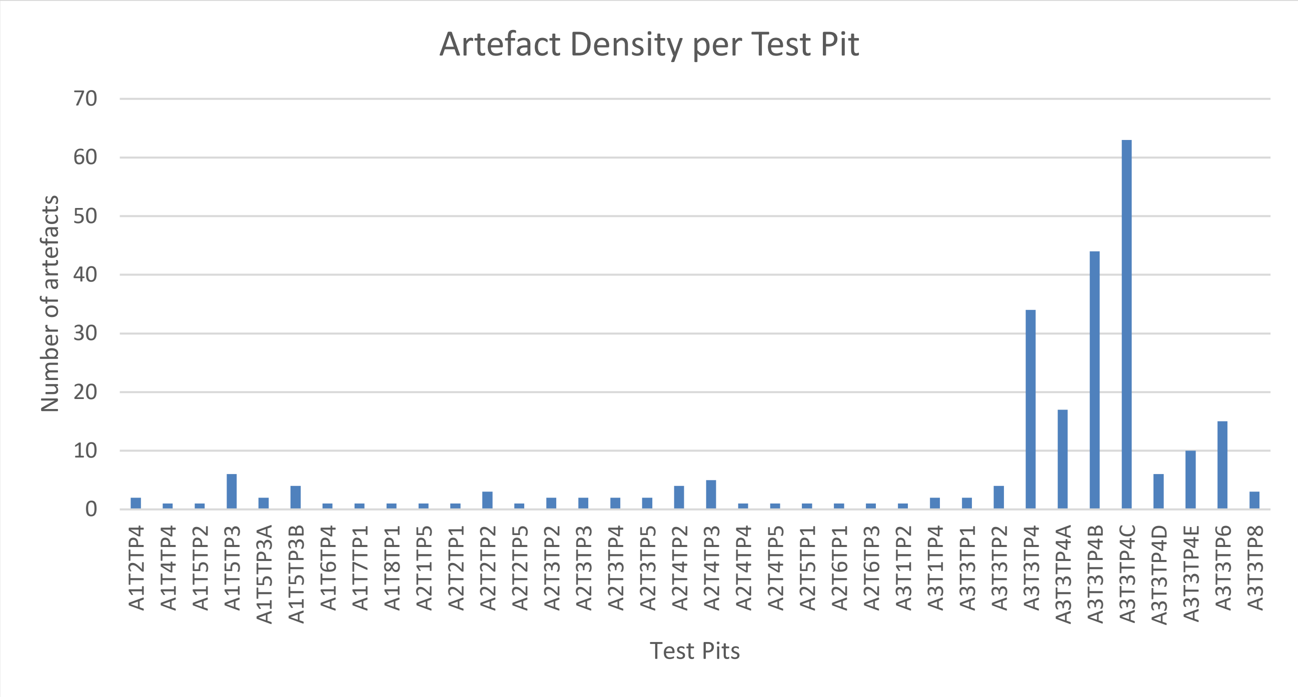
The analysis of the cortex on the recorded sub-surface artefacts clearly shows highly reduced artefacts and artefactual material, with the majority of artefacts presenting with no cortex (97.58 %, n=242). This indicates that artefact reduction was being undertaken within Areas 1, 2, and 3. However, given the close proximity of the site to silcrete resources (approximately 3-5 kilometres west and north of the study area), this analysis appears to support McDonald's theory that the distance-decay model is not a useful mechanism to determine raw material source preference for the Cumberland Plain region (Stephanie Garling Archaeological Consulting (SGAC) 2000, JMCHM 2002).

6.1.5 Artefact density

Artefact density can be an important factor to consider when looking at an assemblage and can be heavily influenced by the mobility of Aboriginal groups and abundance of raw materials present. Holdaway and Stern (2004, p.80) state that highly mobile groups typically accumulate artefact assemblages with a variety of raw materials, with assemblages usually comprising of durable, easily worked materials, reducing the risk of being without a particular tool at any given time. Conversely, less mobile groups made use of the local resources close by, with less malleable materials utilised as groups were more sedentary and distant stone sources were not as easily accessible. This process would in turn result in a higher degree of tool production, artefact reduction and an accumulation of waste (angular fragments). Less mobile groups also typically occupied areas within good proximity to local resources, including a perennial creek line and food, resulting in less risk or need to travel to obtain resources.

Artefact density across Area 1 and 2 consisted of a low density deposit, Area 1 had 7.66% (n=19), of the total artefacts and Area 2 had 11.29% (n=28) of the total artefacts. Area 3 contained 81.05% (n=201) of the total assemblage. Area 1 and 2 feature a widespread deposit, with a range of artefactual materials.

While the majority of the artefacts found throughout Area 3 contained a range of artefactual materials, the expansion test pits surrounding test pit 4 in Transect 3 (test pit 4A, 4B, 4C, 4D and 4E) contained the highest artefact concentration, comprising of 56.45% (n=140) of the total assemblage. This indicates that stone tool production activities were concentrated in the northern portion of this area, with Graph 5 illustrating the clustered density in comparison to the remainder of the site. The remainder of Area 3 comprised of moderate to low density artefact deposit radiating outwards from test pit 4. Densities were between 1 to 15 artefacts per test pit.

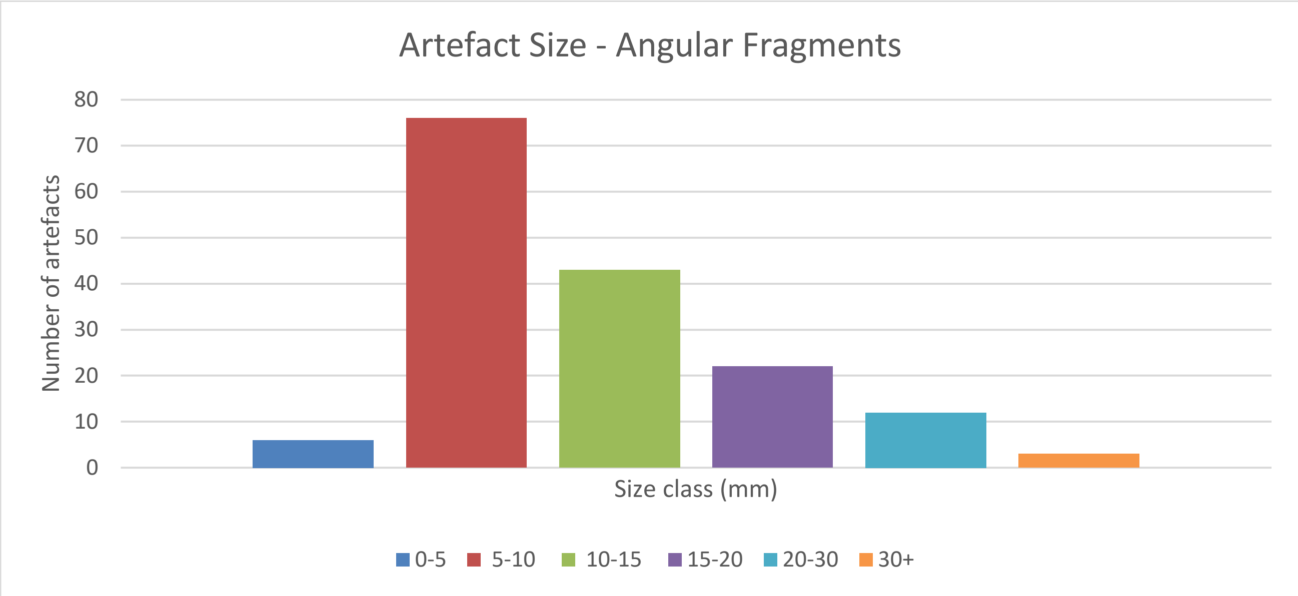


Graph 5 Artefact density per test pit

6.1.6 Angular fragment analysis

An angular fragment is a piece of material that cannot be classified as a proximal, medial, or distal fragment, but has been produced as a result of the knapping process (Holdaway & Stern 2004, p.114, Andrefsky 2001, p.xi). Angular fragments can provide a number of insights into the stone tool reduction process practiced at a site. The most common form of analysis applied to angular fragments is aggregate analysis. This involves separating the angular fragments into size classes and examining the size distribution. The size of an angular fragment is considered to be directly related to the parent piece (core), the size distribution of angular fragments within the artefact assemblage can therefore assist in determining levels of reduction present in the assemblage (Andrefsky 2001, p.2).

Angular fragments were the most common artefact type representing 66.13% (n=164) of the total assemblage. The majority of angular fragments identified fell within the 5-10 millimetres size class (46.91%, n=76) followed by the 10-15 millimetres size class (26.54%, n=43). The 15-20 millimetre size class made up 13.58% (n=22), the 20-30 millimetre size class made up 7.41% (n=12), the 0-5 millimetre size class made up 3.71% (n=6), and the 30+ millimetre size class accounted for 1.85% (n=3). This indicates that the stone tool assemblage at this site has been highly reduced resulting in smaller sized angular fragments (Graph 6).



Graph 6 Size classes for angular fragments

The manufacture of retouched tools can result in the production of very small (less than 2 millimetres) flakes and angular fragments, particularly in association with retouch events. While 6 angular fragments were recorded as measuring under 5 millimetres in length, none measured less than 2 millimetres. This suggests that retouched tool maintenance or manufacture may have been occurring in small levels at this location; however, the lack of small angular fragments could also be a reflection of the use of 3 millimetre sieves during the test excavations which will not typically capture such small debitage.

6.1.7 Platforms and terminations

The analysis of flake platform attributes can provide information about which stage of the reduction sequence a flake was removed. Flaked platforms were the most common platform type in the sub-surface assemblage, accounting for 83.64% (n=46) of the assemblage. This was followed by crushed platforms at 10.91% (n=6). Facetted comprised of 3.64% (n=2), and cortical with 1.81% (n=1). No abraded platforms were identified within the assemblage (Table 16). The presence of a cortical flake platforms within the assemblage suggests that the flakes were removed at an earlier stage of the reduction process (Holdaway & Stern 2004, p.119). Flaked platforms are formed via the removal of up to two flakes from the platform. The removal of a series of flakes from across the platform are considered an attempt to control the angle of the platform and the core during later stages of the reduction process (Holdaway & Stern 2004, p.119). Conversely, crushed platforms are typically indicative of flaked platforms that have been damaged to the point where the platform attributes are no longer discernible (Holdaway & Stern 2004, p.120). They can also be a good indication of the type of percussion instrument being used to create the flake, with crushed platforms typically utilising an anvil to create the artefacts; this could also explain why a small core was recovered in the assemblage, anvils are often used to assist knappers with flake production on small cores.

Table 16 Platform types in the assemblage

Platform type	Count (n)	Percentage (%)
Flaked	46	83.64
Crushed	6	10.91
Facetted	2	3.64
Cortical	1	1.81
Total	**55**	**100.00**

Terminations identified within the study area consisted primarily of feather terminations which made up 75.51% (n=37) of the assemblage. Hinge terminations were also recorded with 14.29% (n=7), and plunge and step terminations represented 4.08% (n=2) of the assemblage, respectively. Crushed terminations represented 2.04% (n=1) (Table 17).

Table 17 Termination types in the assemblage

Termination type	Count (n)	Percentage (%)
Feather	37	75.51
Hinge	7	14.29
Plunge	2	4.08
Step	2	4.08
Crushed	1	2.04
Total	**49**	**100.00**

6.1.8 Cores

Three core were identified from the test excavations, one from Area 3 and two from Area 2. One core had cortex, and two of the cores featured three or more platforms. The average length of the cores was 24.65 millimetres, indicating that they were largely reduced at the time of discard and are therefore representative of late stage reduction techniques.

6.1.9 Retouch and tool types

Tool analysis follows a typologically defined method of analysis where a tool type has been defined in such a way that the type is more than the sum of its attributes. This allows inferences to be made about technology, function and style of stone artefacts in an assemblage.

Recorded tools were identified by the presence of edges modified by retouch and placed into typological categories for ease of analysis. In total, there were five artefacts that featured retouch, and two of these artefacts featured heat treatment. There were two tools present within the assemblage, one of these tools is a Bondi point (Photo 37). Asymmetrical in shape, Bondi points are flakes that have been backed along one of its lateral margins, coming to a point at the distal end (Holdaway & Stern 2004, pp.261–262). They are made from blade or bladelets, with studies illustrating that manufacture and backing retouch processes were sometimes undertaken at different locations (Hiscock & Mitchell 1993). Bondi Points are generally considered to belong to the Australian small tool tradition and are commonly featured in mid-Holocene (7,000 - 4,000 BP) sites in the south eastern portions of Australia (Holdaway & Stern 2004, p.17, Flood 2004, p.224, Hiscock 1994, p.268).

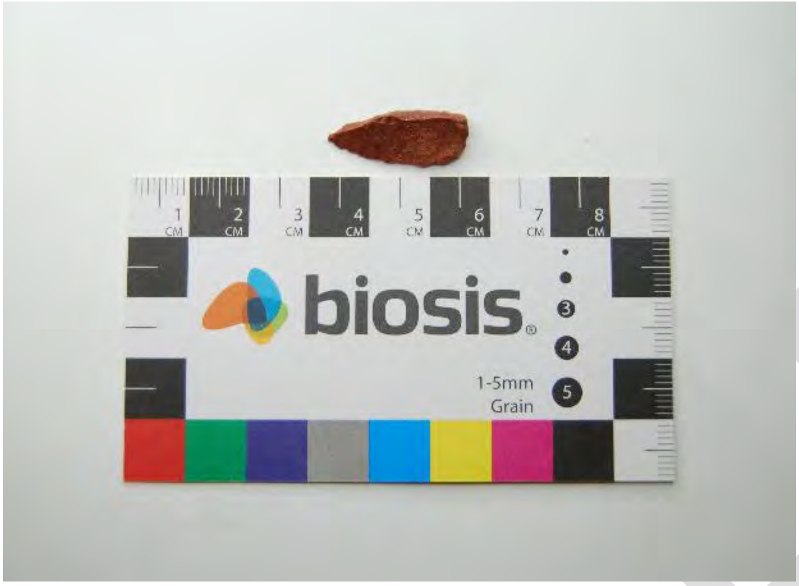


Photo 37 Area 3, Transect 3 Test Pit 6, Bondi point

6.2 Aboriginal sites identified

6.2.1 Area 1 (AHIMS Pending)

Site location

Area 1 is an area of moderate archaeological potential located at the rear of Lot 23 DP 255560, along Aldington Road, approximately 600 metres south-west of Ropes Creek (Table 18 and Figure 12).

Table 18 Grid reference site Area 1 (GDA94/MGA56) (approximate centre point of site)

Easting (mE)	Northing (mN)
296685	6252817

Site description

Area 1 consists of a low density subsurface archaeological deposit, located upon a gently sloping landform. It consists of a subsurface archaeological deposit containing 19 artefacts of predominantly silcrete material recovered from 9 test pits. Other raw material types recorded within this site include mudstone, chert, and quartzite.

The condition of the subsurface deposit is largely intact, with some bioturbation, and manmade disturbance to topsoils present, however this is confined to spit 1. Based on the test excavation results, artefacts are likely to be found within the first 200 millimetres of soil deposits across the entirety of the PAD. Soils within the extent of the deposit consisted of loosely to moderately compacted silty loam to loamy clay soils consistent with the Blacktown soil landscape. The vertical distribution of artefacts within Area 1 illustrate that the majority of the artefacts were identified within spits 1 and 2 (0-200 millimetres). No artefacts were identified in spit 3. As the average size of the artefacts from spit 1 to 2 (0-200 millimetres) does not change dramatically, and the soils present throughout the study area are typically stratified with little evidence of mixing or disturbance; it is likely that the artefacts have not been subject to extensive post-depositional processes and have remained largely intact.

Low levels of cortex across the assemblage also suggests that the assemblage is highly reduced, however known locations of silcrete quarries close by illustrate that artefact reduction on site was undertaken within 3 to 5 kilometres of the raw material sources. Broken flakes were the dominant artefact type. Other artefact types identified within this site extent include complete flakes, angular fragments, and a small tool. This indicates that the assemblage may date to the mid-Holocene period.

6.2.2 Area 2 (AHIMS Pending)

Site location

Area 2 is an area of moderate archaeological potential located within Lot 32 DP 255560. It consists of a flat landform and is adjacent to a creek line (Table 19 and Figure 12).

Table 19 Grid reference site Area 2 (GDA94/MGA56) (approximate centre point of site)

Easting (mE)	Northing (mN)
296768	6253309

Site description

Area 2 consists of a low density subsurface archaeological deposit, located upon a gently sloping landform. It consists of a subsurface archaeological deposit containing 28 artefacts of predominantly silcrete material recovered from 15 test pits. Other raw material types recorded within this site include mudstone, chert, and quartzite.

The condition of the subsurface deposit is largely intact, with some manmade disturbance to topsoils present; however, this is confined to spits 1and the lower spits containing high density deposits remain unaffected. Based on the test excavation results, artefacts are likely to be found within the first 400 millimetres of soil deposits across the entirety of the PAD. Soils within the extent of the deposit consisted of loosely to moderately compacted loamy clay soils consistent with the Blacktown and South Creek soil landscape. The vertical distribution of artefacts within Area 2 illustrate that the majority of the artefacts were identified within spits 2 and 3 (200-300 millimetres); however, artefact deposits were present in all stratigraphic contexts identified, suggesting repeated occupation of this site. As the average size of the artefacts from spit 1 to 4 (100-400 millimetres) does not change dramatically, and the soils present throughout the study area are typically stratified with little evidence of mixing or disturbance, it is likely that the artefacts have not been subject to extensive post-depositional processes and have remained largely intact.

Low levels of cortex across the assemblage also suggests that the assemblage is highly reduced; however, known locations of silcrete quarries close by illustrate that artefact reduction on site was undertaken within 3 to 5 kilometres of the raw material sources. Broken flakes were the dominant artefact type. Other artefact types identified within this site extent include complete flakes, cores, and angular fragments. This indicates that the assemblage may date to the mid-Holocene period.

6.2.3 Area 3 (AHIMS Pending)

Site location

Area 3 is located within Lot 32 DP 258949, along Aldington Road, approximately 70 metres south-west of Ropes Creek and 25 metres east of a tributary of Ropes Creek (Table 20 and Figure 12).

Table 20 Grid reference site Area 3 (GDA94/MGA56) (approximate centre point of site)

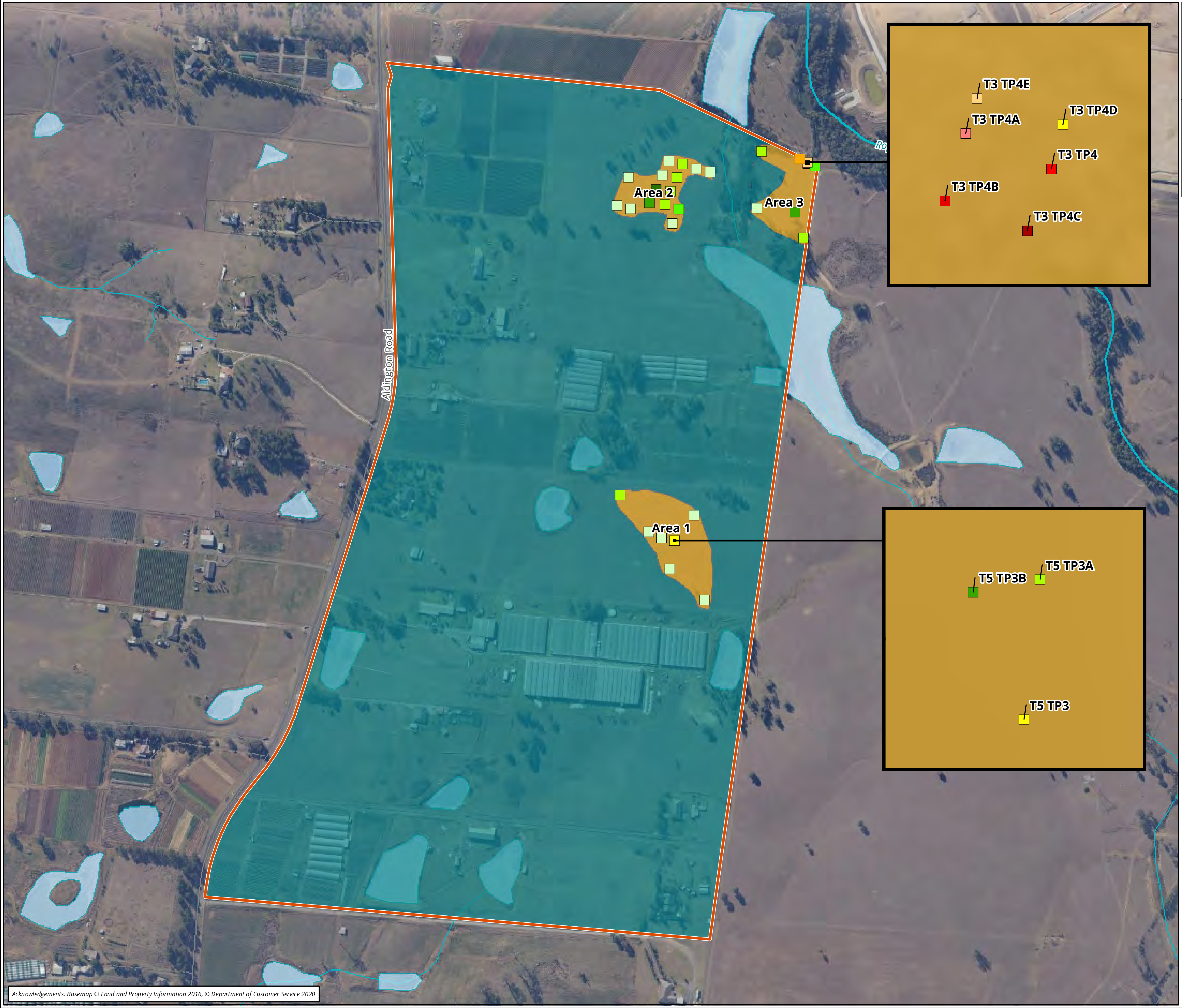
Easting (mE)	Northing (mN)
296932	6253304

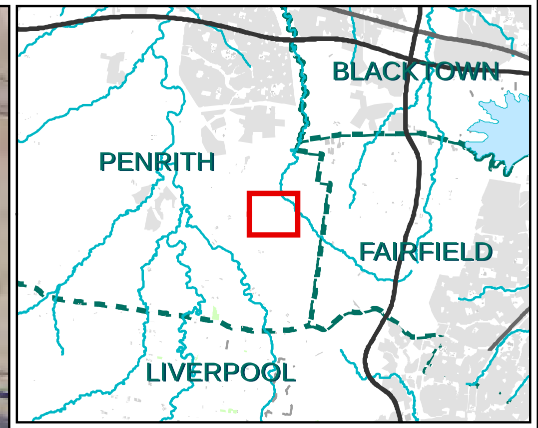
Site description

Area 3 consists of a high density subsurface archaeological deposit, located upon a gently sloping landform throughout the area, with a higher concentration of artefacts located in the northern portion of the PAD. It consists of a subsurface archaeological deposit containing 202 artefacts of predominately silcrete material recovered from 29 test pits. The site covers an area of approximately 105 by 120 metres, with raw material types including silcrete, chert, quartz and basalt.

The condition of the subsurface deposit is largely intact, with some bioturbation, and manmade disturbance to topsoils present; however, this is confined to spits 1 and 2 and the lower spits containing high density deposits remain unaffected. Based on the test excavation results, artefacts are likely to be found within the first 400 millimetres of soil deposits across the entirety of the PAD. Soils within the extent of the deposit consisted of loosely to moderately compacted sandy to clay loamy soils consistent with the South Creek soil landscape. The vertical distribution of artefacts within Area 3 illustrate that the majority of the artefacts were identified within spits 2 and 3 (100-300 millimetres), however, artefact deposits were present in all stratigraphic contexts identified, suggesting repeated occupation of this site. As the average size of the artefacts from spit 1 to 4 (100-400 millimetres) does not change dramatically, and the soils present throughout the study area are typically stratified with little evidence of mixing or disturbance, it is likely that the artefacts have not been subject to extensive post-depositional processes and have remained largely intact.

Low levels of cortex across the assemblage also suggests that the assemblage is highly reduced; however, known locations of silcrete quarries close by illustrate that artefact reduction on site was undertaken within 3 to 5 kilometres of the raw material sources. Angular fragments were the dominant artefact type. Other artefact types identified within this site extent include complete flakes, broken flakes, a core and a small tool. A single Bondi point was identified within the assemblage in spit 3 (200-300 millimetres). This indicates that the assemblage may date to the mid-Holocene period.





Legend

Study area

Archaeological potential

Moderate potential

Low potential

Test pits - artefacts present

1
2
3
4
5
6
10
15
17
34
44
63

Figure 12 Aboriginal sites within the study area

0 50 100 150 200

Metres

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 31837,
Date: 23 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F12_AboriginalSites.mxd

7 Discussion of results

7.1 Discussion of results

Information gathered during background research was analysed in order to formulate predictive modelling statements that were applicable to the landscape context of the study area. Predictive models for the study area were informed by a review of previous assessments undertaken by JMCHM (2002), Kelleher Nightingale Consulting (2010) and White & McDonald (2010). These assessments identified that regionally, Aboriginal sites frequently occur within close proximity to higher order streams, as these types of streams would have been more likely to provide a stable source of water and by extension, other resources which would have been used by Aboriginal groups. These areas of occupation tend to be found on elevated landforms or slopes within proximity to the associated creek line, as raised landforms have a lower likelihood of being inundated during flooding events. It is also stated that in these types of landscapes, artefact density was highest within 50-100 metres of the creek line, and then declined with increasing distance.

Predictive modelling indicated that the most likely site types to occur within the study area are artefact sites and PADs upon flats and slope landforms. Previous assessments undertaken by JMCHM (2000, 2008) and Biosis (2017, 2018), within 2-3 kilometres of the study area, have recovered moderate to high density artefact scatters as part of testing and salvage excavation programs. The excavations undertaken by JMCHM were located within 100 metres of a perennial creek line, with predictive modelling and subsequent results illustrating that it was more likely to recover artefacts closer to a perennial water source rather than an ephemeral one or in an area located further than 200 metres away (Jo McDonald Cultural Heritage Management Pty Ltd 2008). Test excavations undertaken by Biosis also illustrated how landforms played a role in artefact density, with the majority of sites recovered located throughout gently sloping plain landforms (Biosis 2017, Biosis 2018). The results from these assessments allows the postulation that the study area would also recover similar artefact densities in similar environmental contexts.

A field investigation of the study area was undertaken in July 2020 to assess levels of disturbance and archaeological sensitivity in line with the results of the predictive modelling. Three PADs were identified in the north-eastern corner and eastern portion of the study area within a gently sloping landform. It was determined that levels of disturbance across the areas of PAD were typically low, associated with ploughing and vegetation clearance.

Test excavations were undertaken within the study area in September 2020 and February 2021, within Areas 1, 2, and 3. These works identified a total of 248 artefacts across 28 of the 87 test pits excavated. Overall, soils across the extent of the study area were shallow to moderately deep, reaching an average of 300 millimetres, and a maximum of 750 millimetres.

In Area 1, soils consisted of loam to loamy clay deposits of moderate to high compaction, with little disturbance identified. Test excavations within this portion of the study area encountered a low density deposit, with 19 artefacts identified across nine test pits.

In Area 2, soils consisted of to loamy clay deposits of moderate to high compaction, with little disturbance identified. Test excavations within this portion of the study area encountered a low density deposit, with 28 artefacts identified across six test pits.

Area 3 provided the remainder of the artefacts recovered as part of the test excavation program. Soils consisted of loosely to moderately compacted sandy to clay loamy soils consistent with the South Creek soil landscape and supported the results of the predictive modelling, identifying one high density, intact subsurface archaeological deposit within 70 metres of Ropes Creek and 25 metres of a tributary of Ropes Creek. This area recovered a total of 201 artefacts. The highest density of artefacts occurred towards the northern boundary of the study area, surrounding transect 3 test pit 4. Minimal disturbances were observed in test pits throughout Area 3, with evidence of ploughing, vegetation clearance and bioturbation confined to spit 1 and small sections of spit 2. The remainder of the test pits contained low levels of post-depositional disturbances.

The results of the artefact analysis illustrate that the majority of the assemblage within all three areas was dominated by angular fragments (n=164). An analysis of these fragments determined that the bulk of the assemblage is within the 5-10 millimetres size class, and identified a handful of angular fragments measuring less than 5 millimetres (n=6). This suggests that retouched tool maintenance or manufacture may have been occurring in small levels at this location; however this is difficult to confirm due to the limited sample size of artefacts recovered. It was also determined that the most common raw material type was silcrete. The majority of artefactual material was identified within spits 2 and 3 (100-300 millimetres), with all artefacts found within the first 400 millimetres of excavation. This suggests that the site was repeatedly utilised over time. The presence of a Bondi point suggests that the site may have been used between 4,000 to 7,000 years ago, as these tool types are generally associated with mid-Holocene sites in south-eastern Australia (Holdaway & Stern 2004, p.17, Flood 2004, p.224, Hiscock 1994, p.268). However, it should be noted that the presence of Bondi points have been recovered throughout all phases of Aboriginal occupation, therefore salvage excavation works should be conducted to ascertain whether this time period is correct.

Results of the analysis for the remaining artefacts illustrate there is not any indication of size sorting present throughout the assemblage, signifying evidence of a lack of post-depositional processes disturbing subsurface deposits. The average size of artefacts from spits 1 to 4 ranged from 11 to 14 millimetres. While there is a slight variation and decrease in the size of artefacts when looking at vertical distribution, the similarities in size class for each spit suggests that post-depositional processes such as ploughing were minimal throughout this area and the archaeological deposit remains intact.

Artefact density throughout Area 3 illustrates that while the majority of the study area contained a range of artefactual materials, the expansion test pits surrounding test pit 4 in Transect 3 (test pit 4A, 4B, 4C, 4D and 4E) contained the highest artefact concentration, comprising of 56.45% (n=140) of the total assemblage. This indicates that stone tool production activities were concentrated in the northern portion of the study area. The remainder of Area 3 comprised of moderate to low density artefact deposit radiating outwards from test pit 4 (Graph 5). Densities were between 1 to 15 artefacts per test pit.

Cortex levels throughout the assemblage were noted to be very low, with 97.58% (n=242) of the assemblage containing no cortex. Previous assessments throughout the region use a 'distance-decay' model when looking at cortex retention and artefact reduction processes. Hiscock and Mitchell (1993) state that the amount of cortex on an artefact often indicates the distance artefacts were transported from the source (Hiscock & Mitchell 1993, pp.12–17), while White and McDonald (2010, p.34) state that increasing distance from stone sources can affect the attributes of lithic assemblages, as people would use various strategies to conserve available lithic supplies when further away from quarries. These strategies could include artefact reduction techniques, which would reduce the amount of cortex present on artefacts as they reused the material. If applying this model to the study area, it would suggest that the source of raw material was located some distance from the site location, resulting in a large volume of highly reduced artefactual material.

Although this model would explain the lack of cortex present and the artefact density throughout Areas 1, 2 and 3, the study area is located approximately 3.6 kilometres east from a known, naturally occurring, silcrete quarry (LEC12 CGD4) and approximately 4.8 kilometres south-east of a reported silcrete quarry (WSC) (White 2018). This proximity to natural stone resources, paired with the late stage reduction techniques and high concentration of artefacts and angular fragments, would suggest that the opposite trend is visible throughout the site. It is likely that the presence of a largely silcrete site indicates that less mobile groups may have utilised the area, making use of the abundant local resources close by (Holdaway & Stern 2004, p.80). These occupational behaviours resulted in a higher degree of tool production, artefact reduction and an accumulation of waste (angular fragments), as Aboriginal people occupied areas within close proximity to local resources more frequently.

This is corroborated by research undertaken by Jo McDonald in 2002 (pp.15–16), which states that based on the increasing number of new silcrete sources throughout the Cumberland Plain region, the distance-decay model becomes increasingly flawed, as there is less need or risk to travel distances to find resources for stone tool production. As there is a high quantity of natural silcrete sources within 3-5 kilometres of Areas 1, 2 and 3, this suggests that the assumptions made by McDonald are correct and this model is a poor mechanism for explaining raw material preferences around the Cumberland Plain.

Therefore, the results of the test excavations and subsequent artefact analysis suggest that it is likely Area 3 was utilised for ongoing periodic occupation during the mid-Holocene period, based on the proximity to Ropes Creek and artefact types recovered throughout the PAD. The high density concentration in the northern portion of the PAD demonstrates that the area was utilised heavily for artefact reduction purposes. The remainder of Area 3 comprises of low to moderate density artefact deposits tied to this event, or to frequent, periodic occupation of the area by Aboriginal people occupying the Kemps Creek area. The potential for further intact archaeological deposits to be recovered within Area 3, specifically surrounding the high density artefact deposit, is considered high, particularly within undisturbed soils within 50-100 metres of Ropes Creek.

Areas 1 and 2 both identified low density deposits that may indicate a sporadic use of the areas, as compared to Area 3. These areas may also represent a wider background scatter of the northern portion of Area 3.

7.2 Research questions

This section provides detailed responses to the research questions, based on the results above.

7.2.1 Do non-disturbed or minimally disturbed soil profiles exist within the area of moderate archaeological potential?

Within the areas of moderate potential, it had been previously determined that evidence of disturbance in the form of vegetation clearance and ploughing/grazing existed. The top soil (spit 1) present throughout Areas 1, 2, and 3 consistently comprised of a loam deposit, relating to these ploughing efforts and vegetation clearance. However, despite these disturbances, the remaining spits throughout Areas 1, 2, and 3 illustrated minimal subsurface disturbances, with the majority of artefacts located within spits 2 and 3 (200-300 millimetres) in minimally disturbed soil profiles. This demonstrates that while disturbances did occur and subsequently affected the higher spits in the assemblage, disruption to the majority of the lower spits is minimal.

7.2.2 How does proximity to Ropes Creek and landform type contribute to the extent and nature of any archaeological deposits (if present) within the areas of moderate potential?

Predictive models for the study area were informed by a review of previous assessments undertaken by Stephanie Garling Archaeological Consulting (SGAC) (2000), JMCHM (2002), Kelleher Nightingale Consulting (2010) and White & McDonald (2010). These assessments identified that regionally, Aboriginal sites frequently occur within close proximity to higher order streams, as these types of streams would have been more likely to provide a stable source of water and by extension, other resources which would have been used by

Aboriginal groups. These areas of occupation tend to be found on elevated landforms or slopes within close proximity to the associated creek line, as raised landforms have a lower likelihood of being inundated during flooding events. It is also stated that artefact density was highest within 50 -100 metres from water, and then declined with increasing distance.

Previous testing and salvage works undertaken by JMCHM (2000, 2008) and Biosis (2017, 2018), illustrate that moderate to high density deposits are typically recovered within 100 metres of Ropes Creek, with majority of artefact concentrations located within hillslopes or lower slopes. Areas 1, 2, and 3 are predominately contained within a gently sloping landform, with Area 3 located approximately 70 metres south-west of Ropes Creek and 25 metres east of a tributary of Ropes Creek. This provides extremely favourable conditions for Aboriginal groups to occupy, which is reflected through the high density concentration of artefacts found in the northern portion of the area. Conversely, Area 1 and 2, while both contain favourable landform conditions, is located approximately 600 metres south-west of Ropes Creek, with the closest tributary located approximately 315 metres north-east of the PAD. This distance from a perennial water source is a large factor in why minimal deposits were recovered, as there is a highly discernible decrease in artefact density the further south-west from the creek line you go. These findings align well with predictive modelling provided in previous assessments, confirming that the presence of lower slope and flat landforms in close proximity to Ropes Creek is a major contributing factor to the density and extent of archaeological deposits in the region, and also in Area 3.

7.2.3 What are the extent and nature of any archaeological deposits (if present) within the area of moderate potential?

Areas 1, 2 and 3 are contained within areas of moderate archaeological potential. Based on the density of the deposit located within Area 3, it is likely that the high density PAD extends outside of the northern boundary of the study area. It is also postulated that this extension would be intact, as minimal disturbances appear to have occurred outside of the boundary. Based on the test excavation program and the current artefact analysis, this indicates that stone tool production activities were concentrated in the northern portion of this area, with Graph 5 illustrating the clustered density in comparison to the remainder of the site. The remainder of the Area 3 comprised of moderate to low density artefact deposit radiating outwards from test pit 4. Densities were between 1 to 15 artefacts per test pit. This decrease in artefacts has indicated the extent of the deposit.

Areas 1 and 2 both identified low density deposits that may indicate a sporadic use of the areas, as compared to Area 3. These areas may also represent a wider background scatter of the northern portion of Area 3.

7.2.4 How does the character of archaeological deposit within the study area (if present) inform the scientific understanding of Aboriginal occupation and land use models for the region?

The archaeological deposit recovered throughout Area 3, contains many of the same results as previous assessments within the vicinity of the study area and Ropes Creek. The results of the test excavations and subsequent artefact analysis suggest that it is likely Area 3 was utilised for ongoing periodic occupation during the mid-Holocene period, based on the proximity to Ropes Creek and artefact types recovered throughout the PAD. The high density concentration in the northern portion of the PAD demonstrates that the area was utilised heavily for artefact reduction purposes. The remainder of the study area (Areas 1 and 2) comprises low density artefact deposits tied to this event, or to frequent, periodic occupation of the study area by Aboriginal people occupying the Kemps Creek area.

The site likely extends past the overall study area bounds, which provides an opportunity to recover an intact, high density deposit example of Aboriginal occupation and reduction techniques throughout the Kemps Creek region during the mid-Holocene period.

Test excavations at Area 3 have contributed to our understanding of Aboriginal occupational patterns in the Kemps Creek area. The test excavations have also provided further evidence to support the theory that the distance decay model is not a useful tool to determine raw material procurement in the north western Cumberland Plain region.

The results of the test excavations indicate that it is likely less mobile groups may have utilised the area, making use of the abundant local resources close by (Holdaway & Stern 2004, p.80). These occupational behaviours resulted in a higher degree of tool production, artefact reduction and an accumulation of waste (angular fragments), as Aboriginal people occupied areas within close proximity to local resources more frequently.

8 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 ACHA report will detail the cultural values of Aboriginal sites in the study area.

8.1 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 2013). 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 and Energy, Heritage NSW, DPIE. 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 Heritage NSW Guidelines (OEH 2011) 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.

8.2 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 & Smith 2004, p.249, NPWS 1997). For this reason, the NPWS 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 1997, p.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. Site condition refers to the degree of disturbance to the contents of a site at the time it was recorded. The site contents ratings used for archaeological sites are shown in Table 21, and the site condition ratings in Table 22.

Table 21 Site content ratings

Rating	Description
0	No cultural material remaining.

Rating	Description
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 22 Site condition ratings

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 (1995, p.149) note that Aboriginal archaeological sites are generally of high research potential because 'they are the major source of information about Aboriginal prehistory'. 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 & Smith 2004, pp.247–8). When determining research potential value particular emphasis has been placed on the potential for absolute dating of sites.

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 shown in Table 23.

Table 23 Site representativeness ratings

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 shown in Table 24.

Table 24 Scientific significance ratings

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.

8.2.1 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 25 below.

Table 25 Scientific significance assessment of areas of moderate archaeolgical potential within the study area

Site name	Site content	Site condition	Representativeness	Scientific significance
Area 1	1	2	1	4 - Moderate
Area 2	1	2	1	4 - Moderate
Area 3	2	2	2	6 - Moderate

Table 26 Statements of scientific significance for areas of moderate archaeological potential within the study area

Site name	Statement of significance
Area 1	Area 1 is located on a crest landform in the eastern part of the study area within Lot 23 DP 255560. It consists of an elevated landform located approximately 300 metres west from a tributary of Ropes Creek. Area 1 consists of a low density sub surface artefact scatter. This site consists of 19 artefacts and is a common site type in the region. This site has been assessed as moderate scientific significance.
Area 2	Area 2 is located on a flat landform adjacent to a tributary of Ropes Creek in the north-east part of the study area within Lot 32 DP 255560. Area 2 was identified due to its location adjacent to a creek line, which would have provided ample resources for Aboriginal people. In addition, a number of AHIMS sites are located one kilometre north on the bank of Ropes creek and may extend further south into the study area. Area 2 consists of a low density sub surface artefact scatter. This site consists of 28 artefacts and is a common site type in the region. This site has been assessed as moderate scientific significance.
Area 3	Area 3 consists of a high density subsurface deposit, located within a crest and simple slope landform between two tributaries of Ropes Creek in the north-east part of the study area within Lot 32 DP 255560. The area was identified as an area of moderate archaeological potential due to its elevated landform beside a resource zone, which may have been utilised by Aboriginal people in the past. A total of 202 artefacts were recovered from 21 test pits in an area measuring approximately 105 by 120 metres during test excavations. Soil deposits are considered to have remained intact as impacts from previous disturbances (including ploughing and grazing and vegetation clearance) do not extend further than approximately 200 millimetres in depth. The presence of artefacts within spits 1 to 4 suggests that Area 3 demonstrates ongoing periodic occupation of the study area by Aboriginal people. This region contains a variety of Aboriginal sites (including PAD and isolated artefacts), suggesting that the landform was utilised by Aboriginal people. The archaeological deposit recovered throughout Area 3 contains many of the same artefact types and materials as previous assessments with 3 kilometres of the study area and Ropes Creek; however, unlike other PAD sites identified in the local area, the archaeological deposit remains mostly intact and in-situ. This demonstrates that Area 3, and in particular the high density deposit to the north, remains in good condition with minimal disturbances, and contains moderate representativeness and scientific value for the Kemps Creek region. Therefore, the PAD has been assessed as having moderate archaeological significance for this region. There is potential for further information to be recovered from intact subsurface deposits within the site extent which would contribute to our understanding of Aboriginal archaeology in the Kemps Creek area.

9 Impact assessment

As previously outlined, the project proposes to develop 72.08 hectares of land at 106-228 Aldington Road, Kemps Creek NSW. This development will involve bulk earthworks and site infrastructure, and vegetation removal works as described in Section 2.

9.1 Predicted physical impacts

The proposed development activities outlined in Section 2 above, have the potential to impact Aboriginal sites through the removal of deposits during bulk earthworks, installation of infrastructure, construction of industrial buildings, dam infilling, hardstand areas, installation of services (inclusive, but not limited to, electricity, storm water and sewerage), the construction of roadways and landscaping (Figure 13). A summary of impacts is provided below in Table 27.

Table 27 Summary of potential archaeological impacts

AHIMS site no.	Site name	Significance	Type of harm	Degree of harm	Consequence of harm	Mitigation measures
Pending	Area 1	Moderate	Direct	Total	Total loss of value	CHMP
Pending	Area 2	Moderate	Direct	Total	Total loss of value	CHMP
Pending	Area 3	Moderate	Direct	Total	Total loss of value	CHMP, partial salvage (if required)

9.2 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 & Walker 1994, p.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.

Based on conversations with the client, it has been advised that total avoidance is not possible for Aboriginal sites identified by this assessment. Area 1, Area 2 and a portion of Area 3 will be impacted by the proposed development; therefore the following mitigation measures, which consider the principles of ESD and intergenerational equity in their design, are proposed.

9.2.1 Development of a CHMP

A CHMP should be developed to provide management and mitigation measures for cultural heritage values identified within the study area. The CHMP should be developed in consultation with RAPs, DPIE, and Heritage NSW. The CHMP should include the following mitigation and management measures.

9.2.2 No further archaeological work required for Area 1, Area 2, and part of Area 3

Areas 1, Area 2 and part of Area 3 will be impacted by the proposed development. Archaeological test excavations have determined that Areas 1 and 2 consist of a low density subsurface artefact scatter that has been assessed as containing moderate archaeological significance.

The portion of Area 3 which will be impacted by the proposed works also consists of a low density artefact scatter that has been assessed as containing moderate archaeological significance.

The artefacts recovered during the test excavations from Area 1, Area 2 and Area 3 have been catalogued and analysed which has further contributed to our current knowledge of Aboriginal archaeological site types and distributions within the study area and on the Cumberland Plain. Test excavations have increased our current understanding of Aboriginal occupation in the region and will contribute to the scientific and cultural information available to future generations. Further testing and salvage of these sites is therefore not recommended. The proposed works may therefore proceed with caution in these areas in line with an approved CHMP.

9.2.3 Salvage of part of Area 3

This assessment has determined that part of Area 3 (AHIMS pending) will not be impacted by the proposed development. This portion of Area 3 consists of a high density, intact subsurface archaeological deposit that has the potential to contribute further knowledge regarding Aboriginal occupation within the local region.

It is recommend that if impacts cannot be avoided to the portion of Area 3 where high density intact archaeological deposits have been identified, then salvage excavations in accordance with a salvage methodology to be developed in consultation with RAPs as part of the CHMP will be required.

Salvage excavations will focus on the areas of highest artefact density (artefact densities >25 artefacts per square metre) within the recommended salvage area (Figure 14). It is recommended that (if applicable) an area of up to 100 square metre be salvaged to adequately investigate the extent of the high density deposit within Area 3. This will allow for a comparative assessment to be undertaken with similar excavations in the local area. This not only increases current understanding of the site but increases our knowledge of Aboriginal occupation in the wider Kemps Creek region and ensures that any scientific and cultural information that we obtain can be accessed and used by future generations.

9.2.4 Fencing of part of Area 3 recommended for salvage

Prior to any works taking place, the portion of Area 3 (AHIMS pending) recommended for salvage (see Figure 14) should be clearly fenced, to ensure it will not be harmed by the proposed works. Fencing must remain in place over the over the lifespan of the proposed development.

9.2.5 Long term care agreement

The establishment of a long term care agreement in consultation with RAPs should be developed in order to ensure the artefacts are adequately cared for as part of the CHMP. Several management options are possible depending on the wishes of RAPs. Artefacts recovered from the salvage excavations can be given back to the Aboriginal community through a long term care agreement where they can then be used to teach subsequent generations about Aboriginal culture or can be reburied in a culturally appropriate place.

This approach considers the principles of ESD and intergenerational equity and, more importantly, ensures that recovered artefacts are managed according to the wishes of RAPs.

9.2.6 Heritage inductions

Heritage inductions for all site workers and contractors should be undertaken in order to prevent any unintentional harm to Aboriginal sites located within the study area and its surrounds. This includes the following items:

- Relevant legislation.
- Location of identified Aboriginal heritage sites, areas of archaeological potential, and areas of archaeological sensitivity.
- Basic identification skills for Aboriginal and non-Aboriginal artefacts and human remains.
- Procedure to follow in the event of an unexpected heritage item find during construction works.
- Procedure to follow in the event of discovery of human remains during construction works.
- Penalties and non-compliance.

Legend

Study area

Archaeological potential

Moderate potential

Low potential

Stage1 impact area

Lot D

Lot F

Lot L

Riparian works

Proposed new top of bank

Vegetated Riparian Zone (VRZ) using existing top of bank (7345m2)

Proposed new vegetated riparian zone (7687m2)

Figure 13 Impact assessment

0 50 100 150 200

Metres

N

Scale: 1:5,000 @ A3

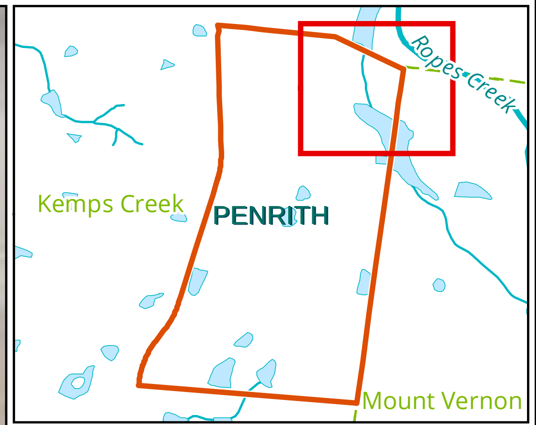
Coordinate System: GDA 1994 MGA Zone 56

biosis.

Acknowledgements: Basemap © Land and Property Information 2016,

Matter: 31837,
Date: 23 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location: P:\31800s\31837\Mapping\31837_ADDA_F13_ImpactAssessment.mxd

Acknowledgements: Basemap © Land and Property Information 2016, © Department of Customer Service 2020



Legend

- Study area
- Potential Archaeological Deposit (PAD)
- Low potential
- Test Pit
- Recommended salvage area

Figure 14 Recommended salvage area

0 10 20 30 40 50

Metres

Scale: 1:1,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 31837,
Date: 23 March 2021,
Checked by: SJK, Drawn by: AEDM, Last edited by: jturner
Location:

10 Recommendations

Recommendations have been developed based on the archaeological significance of cultural heritage relevant to the study area. Recommendations also take into consideration:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practice, widely considered to include:
  - The ethos of the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter.
  - the Code.

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

Recommendation 1: Development of a CHMP

A CHMP should be developed to provide management and mitigation measures for cultural heritage values identified within the study area. The CHMP should be prepared to include the following recommendations, and will be developed in consultation with RAPs.

Recommendation 2: No further works within Area 1 and Area 2 and part of Area 3

Area 1 (AHIMS pending), Area 2 (AHIMS pending), and part of Area 3 (AHIMS pending) will be impacted by the proposed development. Further testing and salvage of these sites is not recommended. The proposed works may therefore proceed with caution in these areas in line with an approved CHMP.

Recommendation 3: Archaeological salvage of part of Area 3 if impacts cannot be avoided

This assessment has determined that part of Area 3 (AHIMS pending) will not be impacted by the proposed development. This portion of Area 3 consists of a high density, intact subsurface archaeological deposit that has the potential to contribute further knowledge regarding Aboriginal occupation within the local region.

It is recommend that if impacts cannot be avoided to the portion of Area 3 where high density intact archaeological deposits have been identified, then salvage excavations in accordance with a salvage methodology to be developed in consultation with RAPs as part of the CHMP will be required.

Salvage excavations will focus on the areas of highest artefact density (artefact densities >25 artefacts per square metre) within the recommended salvage area (Figure 14). It is recommended that (if applicable) an area of up to 100 square metre be salvaged to adequately investigate the extent of the high density deposit within Area 3. This will allow for a comparative assessment to be undertaken with similar excavations in the local area.

Recommendation 4: Fencing of part of Area 3

Prior to any works taking place, the portion of Area 3 (AHIMS pending) recommended for salvage should be clearly fenced, to ensure it will not be harmed by the proposed works. Fencing must remain in place over the lifespan of the proposed development.

Recommendation 5: Long term care agreement

The establishment of a long term care agreement in consultation with RAPs should be developed in order to ensure the artefacts identified as part of this assessment and any future salvage works are adequately cared for. Several management options are possible depending on the wishes of RAPs. Artefacts recovered from the salvage excavations can be given back to the Aboriginal community through a long term care agreement where they can then be used to teach subsequent generations about Aboriginal culture or can be reburied in a culturally appropriate place.

This approach considers the principles of ESD and intergenerational equity and more importantly ensures that recovered artefacts are managed according to the wishes of RAPs.

Recommendation 6: Heritage inductions

Heritage inductions for all site workers and contractors should be undertaken in order to prevent any unintentional harm to Aboriginal sites located within the study area and its surrounds. This includes the following items:

- Relevant legislation.
- Location of identified Aboriginal heritage sites, areas of archaeological potential, and areas of archaeological sensitivity.
- Basic identification skills for Aboriginal and non-Aboriginal artefacts and human remains.
- Procedure to follow in the event of an unexpected heritage item find during construction works.
- Procedure to follow in the event of discovery of human remains during construction works.
- Penalties and non-compliance.

Recommendation 7: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and Places are protected under the NPW Act. It is an offence to disturb an Aboriginal object or site without a consent permit issued by Heritage NSW. 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 Heritage NSW and Aboriginal stakeholders.

Recommendation 8: 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 Heritage NSW'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 Heritage NSW.

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Appendices

Appendix 1 AHIMS results

THE FOLLOWING APPENDIX IS NOT TO BE MADE PUBLIC

Appendix 2 Test excavation results and artefact data

Transect	TP	Spit (numeral)	Depth (mm)	Raw Material	Primary Form	Size class	Cortex %	% of edge with retouch/ usewear (flakes, blades and angular fragments only)	Retouch height/intensity (t)	Flake thickness measuresed parallel to retouch height (T)	Retouch/usewear location	Flake Platform (complete and proximal flakes and blades only)	Flake Termination (complete, distal and longitudinal split flakes and blades only)	Number of complete scars (cores only)	Longest scar (axial mm) (cores only)	Number of platforms/core rotations (cores only)	Formal Tool/ Core Type (if any)	Secondary Modification (if any)	Length - axial for flakes and blades (mm)	Width - axial for flakes and blades (mm)	Thickness (mm)	Maximum Dimension (mm)	Platform width (mm)	Platform depth (mm)	Notes
Area 1																									
2	4	2	100-200	Silcrete	Angular frag	5-10																			
4	4	2	100-200	Silcrete	Flake - Medial		1-32%	33-66%	1-32%	1.44	Retouch on right lateral margin									13.94	7.8	22.17			heat treatment
5	2	2	100-200	Mudstone	Flake - Complete		None	1-32%			Usewear o	Flaked	Feather						14.5	9.87	4.55	14.5	5.46	1.55	
5	3	1	0-100	Chert	Angular frag	5-10																			
5	3	1	0-100	Silcrete	Blade - Complete		None	33-66%	1-32%	3.63	Retouch or	Flaked	Feather						26.99	15.22	7.01	28.76	4.01	1.86	heat treatment, geometric like in shape but not typical
5	3	1	0-100	Silcrete	Flake - Distal		None	None					Feather							10.64	2.63	12.82			
5	3	1	0-100	Silcrete	Flake - Medial		None	None												15.31	2.67	18.51			Breakage along left lateral margin, heat treatment
5	3	2	100-200	Silcrete	Flake - Complete		33-66%	None				Cortical	Feather						17.9	8.28	5.09	18.33	6.33	2.04	
5	3	2	100-200	Silcrete	Flake - Distal		None	None					Hinge							9.36	2.64	9.87			
5	3A	1	0-100	Silcrete	Flake - Medial		None	None												5.47	1.69	7.61			
5	3A	1	0-100	Silcrete	Flake - Proximal		None	None				Flaked	Feather						10.35	4.76	1.26	10.45	2.86	1.62	
5	3B	1	0-100	Silcrete	Flake - Complete		None					Flaked	Crushed						13.25	11.79	3.87	13.78	5.68	5.21	
5	3B	1	0-100	Silcrete	Flake - Medial		None													10.97	1.79	12.48			
5	3B	2	100-200	Quartzite	Angular frag	10-15																			
5	3B	2	100-200	Silcrete	Flake - Complete		None					Flaked	Hinge						11.72	5.8	3.22	12.93	4.07	0.8	Bending initiation
6	4	1	0-100	Silcrete	Angular frag	5-10																			
7	1	1	0-100	Silcrete	Flake - Proximal							Facetted								17.57	4.77	25.95	13.1	5.01	Lateral flakes scars on dorsal surface (4), heat treated and pots lid note
8	1	1	0-100	Silcrete	Angular frag	15-20																			
Area 2																									
1	5	2	100-200	Silcrete	Flake - Complete		33-66%	None				Flaked	Feather						25.41	29.44	8.51	28.94	11.1	3.1	
2	1	2	100-200	Silcrete	Flake - Proximal		None	None				Flaked	Feather							24.09	5.18	24.71	3.33	1.11	eurealiar scar
2	2	2	100-200	Silcrete	Flake - Complete		None	None				Facetted	Feather						10.38	15.26	5.14	15.23	6.12	2.6	
2	2	3	200-300	Silcrete	Flake - Distal		None	None					Feather							7.7	3.64	11.96			
2	2	3	200-300	Quartz	Flake - Proximal		None	None				Flaked	Feather							16.38	4.38	27.06	12.98	3.42	
2	5	2	100-200	Silcrete	Flake - Distal		None	None					Hinge							9.25	2.02	18.71			
3	2	3	200-300	Silcrete	Angular frag	20-30																			
3	2	3	200-300	Silcrete	Flake - Complete		None	None				Flaked	Step						17.81	13.77	2.63	18.66	8.39	2.81	
3	3	1	0-100	Silcrete	Angular frag	10-15																			
3	3	1	0-100	Silcrete	Angular frag	5-10																			
3	4	1	0-100	Chert	Flake - Complete		None	None				Flaked	Step						17.39	11.13	3.4	20.09	6.52	1.41	eurealiar scar, platform preparation on dorsal surface (step retouch)
3	4	3	200-300	Silcrete	Flake - Complete		None	None				Flaked	Hinge						34.04	15.7	6.17	34.41	10.81	6.8	Heat treated
3	5	3	200-300	Silcrete	Flake - Medial		1-32%	None												9.3	2.84	11.82			
3	5	4	300-400	Silcrete	Flake - Proximal		None	None				Flaked								5.41	2.36	8.37	3.36	1.37	
4	2	1	0-100	Mudstone	Angular frag	5-10																			
4	2	1	0-100	Mudstone	Flake - Medial		None	None												8.18	2.12	10.43			
4	2	2	100-200	Chert	Core - Unidirectional		33-66%							2	11.3	1				8.16	6.49	14.71			
4	2	2	100-200	Silcrete	Flake - Proximal		None	None				Flaked								12.63	3.21	16.53	9.67	3.28	
4	3	1	0-100	Chert	Angular frag	15-20																			
4	3	1	0-100	Silcrete	Angular frag	25-30																			
4	3	2	100-200	Silcrete	Angular frag	15-20																			
4	3	2	100-200	Mudstone	Flake - Distal		None	None					Feather							5.81	1.7	10.44			
4	3	2	100-200	Silcrete	Flake - Proximal		None	None				Crushed	Feather						12.35	8.41	3.92	14.07	6.65	3.08	
4	4	2	100-200	Mudstone	Flake - Complete		None	None				Flaked	Hinge						21.37	13.62	4.44	21.82	7.49	1.47	
4	5	3	200-300	Silcrete	Core - Multidirectional		None	None						6	17.41	5				12.05	10.52	32.93			Heat treated core
5	1	2	100-200	Silcrete	Flake - Medial		None	None												8.86	1.25	8.52			
6	1	2	100-200	Mudstone	Flake - Complete		None	1-32%			Usewear o	Flaked	Plunge						19.88	11.62	5.47	20.24	4.01	1.45	
6	3	1	0-100	Silcrete	Flake - Complete		None	None				Flaked	Feather						15.26	10.88	2.92	15.74	6.58	1.51	
Area 3																									
1	2	1	0-100	Silcrete	Angular frag	10-15																			
1	3	1	0-100	Quartz	Flake - Complete		None					Crushed	Feather						20.01	16.34	8.69	21.98			
1	4	1	0-100	Silcrete	Angular frag	20-30																			
1	4	1	0-100	Silcrete	Angular frag	20-30																			
3	1	2	100-200	Silcrete	Angular frag	10-15																			
3	1	3	200-300	Quartz	Angular frag	20-30																			
3	2	3	200-300	Silcrete	Angular frag	15-20																			
3	2	3	200-300	Silcrete	Angular frag	15-20																			
3	2	4	300-400	Silcrete	Angular frag	10-15																			
3	2	4	300-400	Silcrete	Flake - Distal		None						Feather							10.75	2.66	11.6			

Transect	TP	Spit (numeral)	Depth (mm)	Raw Material	Primary Form	Size class	Cortex %	% of edge with retouch/ usewear (flakes, blades and angular fragments only)	Retouch height/intensity (t)	Flake thickness measuresed parallel to retouch height (T)	Retouch/usewear location	Flake Platform (complete and proximal flakes and blades only)	Flake Termination (complete, distal and longitudinal split flakes and blades only)	Number of complete scars (cores only)	Longest scar (axial mm) (cores only)	Number of platforms/core rotations (cores only)	Formal Tool/ Core Type (if any)	Secondary Modification (if any)	Length - axial for flakes and blades (mm)	Width - axial for flakes and blades (mm)	Thickness (mm)	Maximum Dimension (mm)	Platform width (mm)	Platform depth (mm)	Notes
3	4	2	100-200	Chert	Angular frag	30+																			
3	4	2	100-200	Quartz	Angular frag	5-10																			
3	4	2	100-200	Silcrete	Angular frag	10-15																			
3	4	2	100-200	Silcrete	Angular frag	10-15																			
3	4	2	100-200	Silcrete	Angular frag	5-10																			
3	4	2	100-200	Silcrete	Angular frag	5-10																			
3	4	2	100-200	Silcrete	Angular frag	5-10																			
3	4	2	100-200	Quartz	Flake - Distal		None						Feather							11.26	4.38	15.03			
3	4	3	200-300	Silcrete	Angular frag	10-15																			
3	4	3	200-300	Silcrete	Angular frag	10-15																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	5-10																			
3	4	3	200-300	Silcrete	Angular frag	15-20																			
3	4	3	200-300	Silcrete	Angular frag	20-30																			
3	4	3	200-300	Silcrete	Flake - Complete		None					Crushed	Hinge						18.32	11.08	4.64	20.84			
3	4	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						5.34	11.89	2.56	11.98	5.14	1.71	
3	4	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						9.1	5.82	2.62	10.62	2.69	2.68	
3	4	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						12.33	4.95	1.48	12.52	3.17	1.77	
3	4	3	200-300	Quartz	Flake - Distal		None	None					Feather							6.68	2.31	9.68			
3	4	3	200-300	Quartz	Flake - Distal		None						Feather							8.03	3.12	10.24			
3	4	3	200-300	Chert	Flake - Proximal		None					Flaked								9.9	1.74	10.18	3.19	1.09	
3	4	3	200-300	Silcrete	Flake - Proximal		None					Flaked								9.51	1.08	9.54	5.63	1.59	
3	4	3	200-300	Silcrete	Flake - Proximal		None					Flaked								10.33	2.84	11.69	4.95	1.32	
3	4	3	200-300	Silcrete	Flake - Proximal		None					Flaked								12.98	5.85	25.94	5.98	3.53	
3	4	4	300-400	Silcrete	Angular frag	10-15																			
3	4	4	300-400	Silcrete	Angular frag	10-15																			
3	4	4	300-400	Silcrete	Angular frag	5-10																			
3	4	4	300-400	Silcrete	Angular frag	15-20																			
3	4	4	300-400	Silcrete	Flake - Complete		None					Flaked	Feather						7.9	9.84	1.81	11.93	6.99	1.83	
3	4	4	300-400	Silcrete	Flake - Complete		None					Flaked	Feather						8.03	10.95	2.79	13.58	10.62	2.03	
3	6	1	0-100	Chert	Angular frag	5-10																			
3	6	1	0-100	Chert	Angular frag	20-30																			
3	6	1	0-100	Silcrete	Angular frag	10-15																			
3	6	1	0-100	Silcrete	Angular frag	5-10																			
3	6	1	0-100	Silcrete	Angular frag	5-10																			
3	6	1	0-100	Silcrete	Angular frag	5-10																			
3	6	1	0-100	Silcrete	Angular frag	15-20																			
3	6	1	0-100	Silcrete	Blade - Medial		None													3.42	1.24	7.02			
3	6	1	0-100	Quartz	Flake - Distal		None						Feather							6.94	2.12	10.04			
3	6	1	0-100	Silcrete	Flake - Medial		None													5.69	5.65	9.98			
3	6	2	100-200	Silcrete	Angular frag	20-30																			
3	6	3	200-300	Silcrete	Angular frag	5-10																			
3	6	3	200-300	Silcrete	Angular frag	5-10																			
3	6	3	200-300	Silcrete	Angular frag	5-10																			
3	6	3	200-300	Silcrete	Blade - Complete		None					Flaked	Feather				Backed - Bondi Point		23.5	8.89	3.36	23.83	3.58	4.52	
3	8	1	0-100	Chert	Angular frag	5-10																			
3	8	1	0-100	Chert	Angular frag	5-10																			
3	8	2	100-200	Quartz	Angular frag	5-10																			
3	4A	1	0-100	Silcrete	Angular frag	5-10																			
3	4A	1	0-100	Silcrete	Angular frag	5-10																			
3	4A	1	0-100	Silcrete	Angular frag	5-10																			
3	4A	1	0-100	Silcrete	Angular frag	15-20																			
3	4A	2	100-200	Silcrete	Angular frag	10-15																			
3	4A	2	100-200	Silcrete	Angular frag	10-15																			
3	4A	2	100-200	Silcrete	Angular frag	5-10																			

Transect	TP	Spit (numeral)	Depth (mm)	Raw Material	Primary Form	Size class	Cortex %	% of edge with retouch/ usewear (flakes, blades and angular fragments only)	Retouch height/intensity (t)	Flake thickness measuresed parallel to retouch height (T)	Retouch/usewear location	Flake Platform (complete and proximal flakes and blades only)	Flake Termination (complete, distal and longitudinal split flakes and blades only)	Number of complete scars (cores only)	Longest scar (axial mm) (cores only)	Number of platforms/core rotations (cores only)	Formal Tool/ Core Type (if any)	Secondary Modification (if any)	Length - axial for flakes and blades (mm)	Width - axial for flakes and blades (mm)	Thickness (mm)	Maximum Dimension (mm)	Platform width (mm)	Platform depth (mm)	Notes
3	4A	2	100-200	Silcrete	Angular frag	5-10																			
3	4A	2	100-200	Silcrete	Angular frag	5-10																			
3	4A	2	100-200	Silcrete	Angular frag	5-10																			
3	4A	2	100-200	Silcrete	Angular frag	0-5																			
3	4A	2	100-200	Silcrete	Angular frag	15-20																			
3	4A	2	100-200	Silcrete	Angular frag	15-20																			
3	4A	2	100-200	Silcrete	Flake - Complete		None					Flaked	Feather						5.45	3.67	0.45	5.56	0.92	0.98	
3	4A	2	100-200	Silcrete	Flake - Proximal		None					Crushed								14.12	3.06	16.89			
3	4A	2	100-200	Silcrete	Flake - Proximal		None					Flaked								16.23	3.02	16.75	3.57	0.55	
3	4A	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	1	0-100	Silcrete	Angular frag	5-10																			
3	4B	1	0-100	Silcrete	Angular frag	15-20																			
3	4B	2	100-200	Chert	Angular frag	15-20																			
3	4B	2	100-200	Quartz	Angular frag	10-15																			
3	4B	2	100-200	Quartz	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	10-15																			
3	4B	2	100-200	Silcrete	Angular frag	10-15																			
3	4B	2	100-200	Silcrete	Angular frag	10-15																			
3	4B	2	100-200	Silcrete	Angular frag	10-15																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	5-10																			
3	4B	2	100-200	Silcrete	Angular frag	0-5																			
3	4B	2	100-200	Silcrete	Angular frag	15-20																			
3	4B	2	100-200	Silcrete	Core - Bidirectional		None							3	14.25	3					10.31	26.31			
3	4B	2	100-200	Quartz	Flake - Medial		None														1.82	10.7			
3	4B	2	100-200	Silcrete	Flake - Proximal		None					Crushed								7.31	1.36	7.98			
3	4B	3	200-300	Chert	Angular frag	5-10																			
3	4B	3	200-300	Chert	Angular frag	5-10																			
3	4B	3	200-300	Quartz	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	10-15																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	5-10																			
3	4B	3	200-300	Silcrete	Angular frag	0-5																			
3	4B	3	200-300	Silcrete	Angular frag	0-5																			
3	4B	3	200-300	Silcrete	Angular frag	20-30																			
3	4B	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						9.25	4.16	1.36	9.27	3.47	0.8	
3	4B	3	200-300	Chert	Flake - Proximal		None					Flaked								11	2.54	14.21	10.47	2.24	
3	4B	3	200-300	Chert	Flake - Proximal		None					Flaked								3.73	0.99	9.53	2.23	1.11	
3	4B	4	300-400	Silcrete	Angular frag	10-15																			
3	4B	4	300-400	Silcrete	Flake - Complete		None					Flaked	Plunge						3.58	8.63	2.05	8.91	8.48	2.13	
3	4B	4	300-400	Silcrete	Flake - Proximal		None					Flaked								8.79	3.64	12.04	9.42	3.23	
3	4C	1	0-100	Silcrete	Angular frag	5-10																			
3	4C	1	0-100	Silcrete	Angular frag	5-10																			
3	4C	1	0-100	Silcrete	Angular frag	0-5																			
3	4C	1	0-100	Silcrete	Blade - Distal		None						Feather							5.5	1.53	10.79			
3	4C	1	0-100	Silcrete	Blade - Proximal		None					Flaked								8.07	2.82	16.64	2.04	1.89	

Transect	TP	Spit (numeral)	Depth (mm)	Raw Material	Primary Form	Size class	Cortex %	% of edge with retouch/ usewear (flakes, blades and angular fragments only)	Retouch height/intensity (t)	Flake thickness measuresed parallel to retouch height (T)	Retouch/usewear location	Flake Platform (complete and proximal flakes and blades only)	Flake Termination (complete, distal and longitudinal split flakes and blades only)	Number of complete scars (cores only)	Longest scar (axial mm) (cores only)	Number of platforms/core rotations (cores only)	Formal Tool/ Core Type (if any)	Secondary Modification (if any)	Length - axial for flakes and blades (mm)	Width - axial for flakes and blades (mm)	Thickness (mm)	Maximum Dimension (mm)	Platform width (mm)	Platform depth (mm)	Notes
3	4C	2	100-200	Quartz	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	10-15																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	5-10																			
3	4C	2	100-200	Silcrete	Angular frag	0-5																			
3	4C	2	100-200	Silcrete	Angular frag	30+																			
3	4C	2	100-200	Silcrete	Angular frag	30+																			
3	4C	2	100-200	Basalt	Flake - Medial		None													5.4	2.24	11.45			
3	4C	2	100-200	Silcrete	Flake - Medial		None													4	1.23	6.08			
3	4C	2	100-200	Silcrete	Flake - Proximal		None					Flaked								11.08	4.22	15.18	5.45	3.61	
3	4C	2	100-200	Silcrete	Flake - Proximal		None					Flaked								8.21	2.12	12.11	4.71	1.26	
3	4C	2	100-200	Silcrete	Flake - Proximal		None					Flaked								5.72	1.22	5.72	4.26	1.37	
3	4C	3	200-300	Chert	Angular frag	15-20																			
3	4C	3	200-300	Quartz	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	10-15																			
3	4C	3	200-300	Silcrete	Angular frag	10-15																			
3	4C	3	200-300	Silcrete	Angular frag	10-15																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	5-10																			
3	4C	3	200-300	Silcrete	Angular frag	20-30																			
3	4C	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						13.27	8.32	2.55	16.4	5.21	1.28	
3	4C	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						14.46	10.51	3.54	15.04	4.39	4.43	
3	4C	3	200-300	Silcrete	Flake - Complete		None					Flaked	Hinge						11.29	9.83	3.42	11.9	5.01	1.64	
3	4C	3	200-300	Silcrete	Flake - Proximal		1-32%					Crushed								10.28	2.42	12.04			
3	4C	3	200-300	Silcrete	Flake - Proximal		None					Flaked								4.97	1.4	8.27	4.12	1.6	
3	4C	4	300-400	Silcrete	Angular frag	10-15																			
3	4C	4	300-400	Silcrete	Angular frag	10-15																			
3	4C	4	300-400	Silcrete	Angular frag	10-15																			
3	4C	4	300-400	Silcrete	Angular frag	5-10																			
3	4C	4	300-400	Silcrete	Angular frag	5-10																			
3	4C	4	300-400	Silcrete	Angular frag	5-10																			
3	4C	4	300-400	Silcrete	Angular frag	5-10																			
3	4C	4	300-400	Silcrete	Angular frag	5-10																			
3	4C	4	300-400	Silcrete	Angular frag	15-20																			
3	4C	4	300-400	Silcrete	Angular frag	15-20																			
3	4C	4	300-400	Silcrete	Angular frag	15-20																			
3	4C	4	300-400	Silcrete	Angular frag	20-30																			
3	4C	4	300-400	Silcrete	Flake - Complete		None					Flaked	Feather						11.44	7.07	1.5	11.68	2.06	0.77	
3	4C	4	300-400	Silcrete	Flake - Distal		None						Feather							6.52	1.84	8.82			
3	4D	1	0-100	Chert	Angular frag	20-30																			

Transect	TP	Spit (numeral)	Depth (mm)	Raw Material	Primary Form	Size class	Cortex %	% of edge with retouch/ usewear (flakes, blades and angular fragments only)	Retouch height/intensity (t)	Flake thickness measuresed parallel to retouch height (T)	Retouch/usewear location	Flake Platform (complete and proximal flakes and blades only)	Flake Termination (complete, distal and longitudinal split flakes and blades only)	Number of complete scars (cores only)	Longest scar (axial mm) (cores only)	Number of platforms/core rotations (cores only)	Formal Tool/ Core Type (if any)	Secondary Modification (if any)	Length - axial for flakes and blades (mm)	Width - axial for flakes and blades (mm)	Thickness (mm)	Maximum Dimension (mm)	Platform width (mm)	Platform depth (mm)	Notes
3	4D	1	0-100	Silcrete	Angular frag	5-10																			
3	4D	1	0-100	Silcrete	Angular frag	15-20																			
3	4D	1	0-100	Silcrete	Angular frag	15-20																			
3	4D	1	0-100	Quartz	Flake - Complete		None					Flaked	Feather						10.87	10.81	7.69	11.27	12.38	6.79	
3	4D	2	100-200	Chert	Flake - Complete		None					Flaked	Feather						15.9	13.59	6.99	18.52	9.11	5.81	
3	4E	1	0-100	Silcrete	Angular frag	15-20																			
3	4E	2	100-200	Silcrete	Flake - Proximal		None					Flaked							13.52	16.51	2.61	18.23	2.96	1.12	
3	4E	3	200-300	Silcrete	Angular frag	10-15																			
3	4E	3	200-300	Silcrete	Angular frag	10-15																			
3	4E	3	200-300	Silcrete	Angular frag	10-15																			
3	4E	3	200-300	Silcrete	Angular frag	5-10																			
3	4E	3	200-300	Silcrete	Flake - Complete		None					Flaked	Feather						15.88	29.1	11.05	29.21	22.18	9.57	
3	4E	3	200-300	Quartz	Flake - Distal		None						Feather							8.16	1.19	11.15			
3	4E	4	300-400	Silcrete	Angular frag	15-20																			
3	4E	4	300-400	Silcrete	Flake - Distal		None						Feather							18.57	6.02	18.63			

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
Area 1											
T1 TP1	1	0	90	10YR 4/2 dark yellowish brown	Moderate	Silty Loam			rootlets	6	Clear
	2	90	200	10YR 4/2 dark yellowish brown	Moderate	Silty Loam	ploughing and bioturbation		rootlets and charcoal flecks	6	Gradual
	3	200	220	5YR 4/4 reddish brown	Hard	Clay			rootlets and ironstone	6	Clear
T1 TP2	1	0	140	7.5 YR 3/2 dark brown	Soft	Silty Loam	ploughing throughout topsoil		rootlets	6	Gradual
	2	140	230	5YR 3/3 dark reddish brown	Moderate	Silty Loam		with clayey inclusions	clay mottling increasing with depth, sparse rootlets dispersed throughout	6	Gradual
	3	230	290	2.5 YR 4/6 red	Moderate	Clay			rootlets	6	Clear
T1 TP3	1	0	70	7.5YR 3/2 dark brown	Moderate		ploughing and grazing throughout		rootlets	6	Clear
	2	70	220	5YR 3/3 dark reddish brown	Moderate	Clayey Loam			rootlets and clay mottling throughout	6	Diffuse
	3	220	290	2.5YR 4/6 red	Moderate	Clay			rootlets	6	Gradual
T1 TP4	1	0	60	7.5YR 3/2 dark brown	Soft	Loam	ploughing		rootlets	6	Clear
	2	60	220	5 YR 3/3 dark reddish brown	Moderate	Clayey Loam			rootlets with increasing clay content with depth	6	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
	3	220	280	2.5YR 4/6 red	Moderate	Clay			rootlets and ironstone	6	Clear
T2 TP1	1	0	60	7.5YR 3/2 dark brown	Soft	Silty Loam	ploughing		rootlets	6	Clear
	2	60	190	7.5 YR 4/4 brown	Moderate	Clayey Loam			rootlets, clay mottling	6	Diffuse
	3	190	200	5YR 4/6 red	Hard	Clay			rootlets	6.5	Clear
T2 TP2	1	0	50	7.5YR 3/2 dark brown	Soft	Loam	ploughing		rootlets	6	Clear
	2	50	100	5YR 4/6 red	Moderate	Clay			rootlets	6.5	Sharp
T2 TP3	1	0	95	7.5YR 5/2 brown	Moderate	Silty sand	ploughing		rootlets and charcoal flecks	6	Clear
	2	95	200	5YR 4/6 red	Hard	Clay			rootlets	6	Clear
T2 TP4	1	0	60	7.5YR 5/2 brown	Moderate	Silty sand			rootlets and charcoal flecks and gravel	6	Clear
	2	60	130	5YR 4/6 red	Hard	Clay			rootlets	6	Clear
T3 TP1	1	0	100	7.5YR 3/2 to 10YR 5/3	Moderate	Loamy Clay	grassroots, ants	7.5YR 3/2 dark brown silty clay loam, to brown silty clay 10YR 5/3, finishing on yellow brown clay	charcoal flecks or fragments 1-4mm 2%	6	Clear
	1	0	100	10YR 3/4 to 7.5YR 4/3	Moderate	Silty Clay Loam	grass	10 YR 3/4 dark brown, onto 10 YR4/3 brown silty clay finishing on red brown clsy	charcoal flecks or fragments 2-5mm 1%	6.5	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T3 TP3	2	100	170	10YR 4/3	Moderate	Silty Clay	grassroots	10YR 4/3 silty clay finishing on orange brown clay	charcoal flecks or fragments 1-4 mm 2%, ironstone gravel 5%, claystone	6.5	Clear
T3 TP4	1	0	100	10YR 3/4 to 7.5YR 4/3	Moderate	Silty Clay Loam	grass and burnt tree roots	7.5YR 3/4 dark yellow brown silty clay loam, to brown silty clay to 7.5 R 4/3 brown silty clay , finishing on brown clay	charcoal flecks or fragments 5-10mm 5% - likely burnt tree roots, 1% red clay stones	6.5	Clear
T4 TP1	1	0	100	10YR3/4 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown silty loam to clayey silt	charcoal flecks 1-4mm 1%	6	Clear
	2	100	140	7.5 YR 3/4 dark brown	Moderate	Silty Clay	Grass roots	Moderately compacted dark brown silty clay finishing on orange brown clay	charcoal 1-4mm 2%	5.5	Clear
T4 TP2	1	0	100	10YR 4/3	Moderate	Loamy Silt	grassroots	10YR 4/3 brown loam silt, 10YR 4/3 silty clay	charcoal flecks or fragments 1mm 2%	6	Clear
	2	100	200	10YR 4/3	Moderate	Silty Clay	grassroots	10YR 4/3 brown loam silt, 10YR 4/3 silty clay, onto orange brown clay	charcoal flecks or fragments 1mm 2%	6	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T4 TP4	1	0	100	10YR 4/3	Moderate	Loamy Silt	grassroots	10YR 4/3 brown loam silt, 10YR 4/3 silty clay , finishing on bro	charcoal flecks or fragments 1mm 2%, ironstone gravel.	6	Clear
	2	0	100	10YR 4/3	Moderate	Silty Clay	grassroots	10YR 4/3 silty clay , finishing on yellow brown clay with orange brown clay	charcoal flecks or fragments 1mm 2%, ironstone gravel.	6.5	Clear
T4 TP5	1	0	100	10YR 4/3	Moderate	Loamy Silt	grassroots	10YR 4/3 brown loam silt, to10YR 4/3 silty clay , finishing on bro	charcoal flecks or fragments 1mm 2%, ironstone gravel 10%.	6	Clear
	2	100	140	10YR 4/3	Moderate	Silty Clay	grassroots	10YR 4/3 silty clay , finishing on orange brown clay	charcoal flecks or fragments 1mm 2%, ironstone gravel.	6.5	Clear
T5 TP1	1	0	100	10YR 3/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown l oamy silt with increasing clay content finishing on orange brown clay	charcoal flecks 1%1-2mm	6.5	Clear
T5 TP2	1	0	100	10YR 3/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown loamy silt with increasing clay content	charcoal flecks 1%1-4mm	6.5	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
	2	100	130	7.5YR 3/4 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown clay with orange mottles	charcoal flecks 1%1-4mm	7	Clear
T5 TP3	1	0	100	10YR 4/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt with increasing clay content	charcoal flecks 1%1-10mm	7	Clear
	2	100	160	7.5YR 4/4 brown	Moderate	Silty Clay	Grass roots, ants, burnt roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal flecks 2% 2-10mm	6	Clear
T5 TP4	1	0	100	10YR 4/3 dark brown to 7.5YR4/4 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay finishing on clay with orange mottles	charcoal flecks 2%1-5mm	7	Clear
T5 TP5	1	0	100	7.5YR 4/2 brown onto 7.5 YR4/4	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown loamy silt onto brown silty clay		6	Clear
	2	100	150	7.5YR 4/4 dark brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown silty clay finishing on orange brown clay	charcoal flecks 1%1-4mm	7	Clear
T5 TP6	1	0	100	10YR 3/3 dark brown to 7.5YR 3/4 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown loamy silt to dark brown silty clay finishing on dark brown clay with orange mottles	charcoal flecks 1%1-2mm	6	Clear
T5 TP3A	1	0	100	10YR 4/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt with increasing clay content	charcoal flecks 1%1-5mm	7	Clear
	2	100	140	7.5YR 4/4 brown	Moderate	Silty Clay	Grass roots, ants, burnt roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal flecks 1% 1-50mm	6	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T5 TP3B	1	0	100	10YR 4/3 dark brown	Moderate	Loamy Silt	Grass roots, ants	Moderately compacted brown loamy silt with increasing clay content	charcoal flecks 1%1-5mm	7	Clear
	2	100	160	7.5YR 4/4 brown	Moderate	Silty Clay	Grass roots, ants, burnt roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal flecks 1% 1-4mm	6	Clear
T5 TP3C	1	0	100	10YR 4/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt with increasing clay content	charcoal flecks 1% 2mm, clay stones 2% 10-30mm	7	Clear
	2	100	180	7.5YR 4/4 brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal flecks 1% 1-4mm, clay stones 5% 10 - 30mm	6	Clear
T6 TP1	1	0	100	7.5YR 3/4 dark brown to 7.5YR 3/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to silty clay finishing on orange brown clay	iron stone 1% 15mm	6	Clear
T6 TP2	1	0	100	7.5YR 3/4 dark brown to 7.5YR 3/3 dark brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to silty clay finishing on orange brown clay	charcoal flecks 1%1-2mm	6	Clear
T6 TP3	1	0	100	7.5YR 3/4 dark brown to 7.5YR 3/3 dark brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown loamy silt to silty clay	charcoal flecks 1%1-2mm, iron stone 20-100mm 5%	6	Clear
	2	100	130	7.5YR 3/3 dark brown	Moderate	Silty Clay	Grass roots	Moderately brown silty clay to dark brown clay with orange mottles	charcoal flecks 1%1-2mm, iron stone 20-100mm 5%	6.5	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T6 TP4	1	0	100	7.5YR 3/4 dark brown to 7.5YR 3/3 dark brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown loamy silt to silty clay	charcoal flecks 1%1-2mm, iron stone 20-150mm 5%	6	Clear
	2	100	170	7.5YR 3/3 dark brown	Moderate	Silty Clay	Grass roots	Moderately brown silty clay to dark brown clay with orange mottles	charcoal flecks 1%1-2mm, iron stone 20-150mm 5%	6.5	Clear
T7 TP1	1	0	100	7.5YR 4/2 brown onto 7.5 YR4/4	Moderate	Loamy Silt	Grass roots	Moderately compacted dark brown loamy silt with increasing clay content onto brown clay	charcoal flecks 1%1-4mm	6	Clear
T8 TP1	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay		6	Clear
	2	100	160	7.5YR 4/3 brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown loamy silt to brown silty clay		6	Clear
T8 TP2	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay finishing on brown clay with orange and red mottles		6	Clear
T8 TP3	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay finishing on brown clay with orange and red mottles	charcoal 1% 2-5mm	6	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T8 TP4	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay finishing on brown clay with orange mottles	charcoal 1% 2-5mm	6	Clear
T9 TP1	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay	charcoal flecks 2% 2-5mm	6	Clear
	2	100	140	7.5YR 4/3 brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown loamy silt to brown silty clay	charcoal flecks 1% 2-5mm	6	Clear
T9 TP2	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay	charcoal flecks 2-4mm 1%	6	Clear
	2	100	120	7.5YR 4/3 brown	Moderate	Clay	Grass roots	Moderately compacted brown clay orange and red mottles		6.5	Clear
T9 TP3	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay	charcoal flecks 5% 2--10mm, large chunk of yellow claim western wall	6	Clear
	2	100	130	7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal 1% 1-5mm	6.5	Clear
	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay	burnt clay fragments 2% 20-30mm	6	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T9 TP4	2	100	170	7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal 1% 10-80mm, by st clay fragments around burnt tree root 5% 10-40mm	6.5	Clear
T10 TP1	1	0	100	7.5YR 4/2 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt		6	Clear
	2	100	200	7.5YR 4/3 brown	Moderate	Clayey Silt	Grass roots	Moderately compacted brown silty clay	charcoal 1-4mm 2%	6	Clear
	3	200	260	7.5YR 4/3 brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal 2% 2-5mm	6.5	Clear
T10 TP2	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay to brown clay with orange and red mottles	charcoal 1-4mm 1%	6	Clear
	2	100	130	7.5YR 4/3 brown	Moderate	Silty Clay	Grass roots	Moderately compacted brown clay orange and red mottles	charcoal inclusions 10-40mm 2%	6.5	Clear
T10 TP3	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay to brown clay with orange and red mottles		6	Clear
	2	100	130	7.5YR 4/3 brown	Moderate	Clay	Grass roots	Moderately compacted brown clay orange and red mottles		6.5	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T10 TP4	1	0	100	7.5YR 4/2 brown to 7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown loamy silt to brown silty clay		6	Clear
	2	100	170	7.5YR 4/3 brown	Moderate	Loamy Silt	Grass roots	Moderately compacted brown silty clay finishing on brown clay with orange mottles	charcoal 2% 2-10mm	6.5	Clear
Area 2											
T1 TP1	1	0	250	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay, ending on clay, increasing compaction with depth	5% 1-2mm gravel	6	Clear
T1 TP2	1	0	350	7.5YR 3/3 Dark brown	Moderate	Loamy Clay	Rootlets, glass, plastic	Moderately to highly compacted loamy clay	Rootlets, glass, plastic, 5% 1-2mm gravel	5	Clear
	2	350	750	7.5YR 4/6 strong brown	Hard	Silty Clay	Rootlets	Highly compacted silty clay ending on clay at 450mm	Rootlets, glass, plastic, 20% 5-10mm gravel	6	Clear
T1 TP3	1	0	300	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets, glass, plastic	Moderately to highly compacted loamy clay	Rootlets, glass, plastic, 5% 1-2mm gravel	5	Clear
	2	300	350	7.5YR 3/3 dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay, increasing in clay content with depth, ending on clay at 350mm, some orange mottling in base of test pit	Rootlets, glass, plastic, 5% 1-2mm gravel	5	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T1 TP4	1	0	320	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets, glass, plastic	Moderately to highly compacted loamy clay	Rootlets, glass, plastic, 5% 1-2mm gravel	5	Clear
	2	320	350	7.5YR 3/3 dark brown	Moderate	Loamy Clay	Rootlets, glass, plastic	Moderately to highly compacted loamy clay, increasing in clay content with depth, ending on clay at 350mm, some orange mottling in base of test pit		5	Clear
T1 TP5	1	0	295	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets,	5	Clear
	2	295	350	7.5YR 3/3 dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay, increasing in clay content with depth, ending on clay at 350mm, some orange mottling in base of test pit		6	Clear
T2 TP1	1	0	270	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel	6	Clear
T2 TP2	1	0	280	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets, 5% 1-2mm gravel	6.5	Clear
	2	280	300	7.5YR 4/6 strong brown	Hard	Silty Clay	Rootlets	Highly compacted silty clay ending on clay at 300mm	Rootlets, glass, 20% 5-10mm gravel	6.5	Clear
T2 TP3	1	0	250	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets, 5% 1-2mm gravel	7	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
	2	250	260	5YR 4/6 yellowish red	Moderate	Clay	Rootlets	Moderately to highly compacted clay		7	Clear
T2 TP4	1	0	240	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets, 5% 1-2mm gravel	6.5	Clear
	2	240	250	10YR 4/3 dark yellowish brown	Moderate	Clay	Rootlets	Moderately to highly compacted clay		7	Clear
T2 TP5	1	0	220	7.5YR 3/2 Dark brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets, 5% 1-2mm gravel	5.5	Clear
	2	220	250	10YR 4/3 dark yellowish brown	Moderate	Clay	Rootlets	Moderately to highly compacted clay		6.5	Clear
T3 TP1	1	0	300	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel	7	Clear
	2	300	300	10YR 4/3 dark yellowish brown	Moderate	Clay	Rootlets	Moderately to highly compacted clay		7.5	Clear
T3 TP2	1	0	280	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel	7	Clear
T3 TP3	1	0	160	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel, black plastic at 90mm	7	Clear
	2	160	210	10YR 4/3 dark yellowish brown	Moderate	Clay	Rootlets	Moderately to highly compacted clay		7.5	Clear
T3 TP4	1	0	200	10YR 3/3 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel, black plastic at 100mm	6.5	Clear
	2	200	210	10YR 4/3 dark yellowish brown	Hard	Clay	Rootlets	highly compacted dry clay		7	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T3 TP5	1	0	250	10YR 3/4 Dark yellowish brown	Moderate	Loamy Clay	Rootlets	Moderately to highly compacted loamy clay	Rootlets,	5	Clear
	2	250	370	10YR 6/6 brownish yellow	Moderate	Silt	Rootlets	light highly compacted silt with 5% bravel		6	Clear
	3	380	400	7.5YR 4/6 strong brown	Hard	Clay	Rootlets	highly compacted dry clay		7	Clear
T4 TP1	1	0	300	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets, plastic	Moderately compacted loamy clay, ending on clay at 300mm, increasing compaction with depth, plastic throughout	5% 1-2mm gravel	6	Clear
T4 TP3	1	0	250	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel, black plastic 100mm	6.5	Clear
	2	250	280	5YR 4/6 yellowish red	Hard	Clay	Rootlets	highly compacted clay		7	Clear
T4 TP4	1	0	280	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel, black plastic spit 1	6.5	Clear
	2	280	300	5YR 4/6 yellowish red	Hard	Clay	Rootlets	highly compacted clay		7	Clear
T4 TP5	1	0	200	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel, black plastic at 100mm	6.5	Clear
	2	200	210	10YR 4/3 dark yellowish brown	Moderate	Clay	Rootlets	highly compacted clay		7	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T5 TP1	1	0	300	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets, plastic	Moderately compacted loamy clay, ending on clay at 300mm, increasing compaction with depth, plastic throughout	5% 1-2mm gravel	6	Clear
T5 TP2	1	0	300	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay, ending on clay at 300mm, increasing compaction with depth	5% 1-2mm gravel	6	Clear
T5 TP3	1	0	250	7.5YR 2.5/1 Black	Moderate	Loamy Clay	Rootlets	Moderately compacted clay loam		6	Clear
	2	250	450	7.5YR 7/1 slight grey	Hard	Silty Clay	Rootlets	Highly compacted silty clay, ending on clay at 450mm, 30% 2-5 mm gravel inclusions	30% 2-5 mm gravel inclusions	6	Clear
T5 TP4	1	0	300	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets	Moderately compacted loamy clay	5% 1-2mm gravel	6	Clear
T6 TP1	1	0	400	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets, plastic	Moderately compacted loamy clay, increasing compaction with depth, plastic throughout	5% 1-2mm gravel	6	Clear
	2	400	450	7.5YR 7/2 light grey	Hard	Silty Clay		Highly compacted silty clay, ending on clay at 450mm	30% 2-5mm gravel	6.5	Clear
T6 TP2	1	0	240	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets, plastic	Moderately compacted loamy clay, ending on clay at 240mm, increasing compaction with depth, plastic throughout	5% 1-2mm gravel	6	Clear
	1	0	100	7.5YR 3/2 dark brown	Moderate	Loamy Clay	Rootlets, plastic	Moderately compacted loamy clay	5% 1-2mm gravel	6	Clear

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T6 TP3	2	100	600	7.5YR 4/4 BROWN	Hard	Silty sand		Highly compacted silty sand, some charcoal		6	Clear
	3	600	650	7.5YR 4/6 Strong brown	Hard	Silty sand		Highly compacted silty sand to silty clay, some charcoal, ends on clay at 650mm.		6	Clear
Area 3											
T1TP1	1	0	150	2.5YR 3/4 dark reddish brown	Soft	Loamy Silt		dark reddish brown, loaym silt, 2-5mm gravel	rootlets, 2-5mm gravel	6	Gradual
	2	150	450	2.5YR 3/4 dark reddish brown	Soft	Sandy Silty Loam		dark reddish brown, sandy silty loam, 2-5mm gravel	rootlets, 2-5mm gravel	6	Gradual
	3	450	600	2.5YR 3/4 dark reddish brown	Soft	Sandy Loam		dark reddish brown, sandy loam, 5% clay content		6	Gradual
	4	600	750	2.5YR 4/6 red	Soft	Sandy Clay		dark reddish brown, sandy clay, increase in clay content with depth, ends on clay at 750mm		6	Gradual
T1TP2	1	0	100	7.5YR 2.5/3 very dark brown	Moderate	Silty Loam	roots	Very dark brown, moderate compaction, charcoal flecks	1-2mm charcoal flecks	5	Gradual
	2	100	330	7.5YR 2.5/2 very dark brown	Moderate	Loamy Clay	roots	Very dark brown, loamy clay to clay, ending on clay, moderate compaction, charcoal flecks and dried orange clay, some mottling in base of test pit.	1-2mm charcoal and dried orange clay	6	Gradual
	1	0	100	7.5YR 2.5/3 very dark brown	Moderate	Silty Loam	roots	Very dark brown, moderate compaction		5	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T1TP3	2	100	300	7.5YR 2.5/2 very dark brown	Moderate	Loamy Clay	roots	Very dark brown, loamy clay to clay, ending on clay, moderate compaction, increase in compaction with depth, some mottling in base of test pit.		6	Gradual
T1TP4	1	0	100	7.5YR 2.5/3 very dark brown	Moderate	Silty Loam	roots	Very dark brown, moderate compaction		5	Gradual
	2	100	300	7.5YR 2.5/2 very dark brown	Moderate	Loamy Clay	roots	Very dark brown, loamy clay to clay, ending on clay, moderate compaction, increase in compaction with depth, some mottling in base of test pit.	rootlets	6	Gradual
T2TP1	1	0	150	7.5YR 2.5/1 black	Moderate	Silty Loam	roots	Black, silty loam, moderate compaction, rootlets		6	Clear
	2	150	350	7.5YR 2.5/2 very dark brown	Moderate	Loamy Clay	roots	Roots			
	3	350	450	7.5YR 5/6 strong brown	Soft	Sandy Loam	roots	Strong brown, Sandy loam to clay, low compaction, 2-5mm gravel inclusions, increase in clay content with depth, clay mottling in base of test pit, ends on clay at 450mm.	2-5mm gravel	6.5	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T2 TP2	1	0	200	7.5YR 2.5/3 Very dark brown	Soft	Clayey Loam	ploughing		rootlets	6	Gradual
	2	200	330	7.5 YR5/6 Strong brown	Moderate	Clay			rootlets	6	Clear
T2 TP3	1	0	230	7.5YR 2.5/3 Very dark brown	Soft	Clayey Loam	ploughing and waterlogged		rootlets	6	Gradual
	2	230	270	7.5YR 2.5/1 black	Moderate	Clay			rootlets	6	Clear
T2TP4	1	0	100	7.5YR 2.5/3 very dark brown	Moderate	Silty Loam	roots	Very dark brown, moderate compaction		5	Gradual
	2	100	300	7.5YR 2.5/2 very dark brown	Moderate	Loamy Clay	roots	Very dark brown, loamy clay to clay, ending on clay, moderate compaction, increase in compaction with depth, some mottling in base of test pit.	rootlets	6	Gradual
T3 TP1	1	0	200	7.5YR 2.5/3 Very dark brown	Moderate	Silty Sandy Loam	ploughing	Very dark brown, silty Sandy loam, rootlets	rootlets	6	Clear
	2	200	400	7.5YR 5/4 brown	Moderate	Silty sand	ploughing	brown, silty sand, rootlets	rootlets	6	Gradual
	3	400	600	10YR 5/6 yellowish brown	Moderate	Sandy Clay	ploughing	Yellowish brown, sandy clay to clay, rootlets, tree roots, some oranvecmottling in base of test pit, ends on clay at 600mm.	rootlets	6	Gradual
T3 TP2	1	0	250	7.5YR 2.5/3 Very dark brown	Moderate	Silty Loam	ploughing	Very dark brown, silty loam, rootlets	rootlets	6	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T3 TP3	1	0	50	7.5 YR 2.5/3 very dark brown	Soft	Silty Loam	ploughing	topsoil	rootlets	6	Sharp
	2	50	200	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Sharp
	3	200	350	7.5YR 5/6 strong brown	Moderate	Clay	tree root	Strong brown clay, moderately compacted, tree root in base of test pit, 2-5mm gravel, test pit ends on clay at 350mm.	rootlets, 2-5mm gravel	6	Gradual
T3 TP4	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Gradual
T3 TP4A	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Gradual
T3 TP4B	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T3 TP4C	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Gradual
T3 TP4D	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay			rootlets	6	Gradual
T3 TP4E	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing		rootlets	6.5	Gradual
	2	50	350	7.5YR 2.5/3 Very dark brown	Moderate	Loam			rootlets, small ironstone flecks, dried yellow and orange clay mottled in northern wall,	6	Gradual
	3	350	390	7.5YR 5/6 strong brown	Moderate	Clay		test pit ends on clay at 390mm, with yellow and orange mottled.	rootlets	6	Gradual
	1	0	200	7.5YR 5/3 brown	Soft	Loamy Clay	potential ploughing	brown, moderately compacted, loamy clay, rootlets	rootlets	6.5	Gradual

Test Pit Number	Context Number	StartDepth_mm	EndDepth_mm	Colour (Munsell Code)	Compaction	Texture	Disturbance	Notes	Inclusions	PH	Horizon clarity
T3 TP5	2	200	250	7.5YR 5/6 strong brown	Moderate	Loamy Clay	potential ploughing	Strong brown, moderately compacted, loamy clay to clay, rootlets, ends on clay at 250mm	rootlets	6.5	Gradual
T3 TP6	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing	brown, silty loam, rootlets	rootlets	6.5	Gradual
T3 TP6	2	50	300	7.5YR 2.5/3 Very dark brown	Moderate	Loam		Very dark brown, moderately compacted,increase in compaction with depth, loam, ending on clay at 350mm	rootlets	6	Gradual
T3 TP7	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing	brown, silty loam, rootlets	rootlets	6.5	Gradual
T3 TP7	2	50	200	7.5YR 2.5/3 Very dark brown	Moderate	Loam		Very dark brown, moderately compacted,increase in compaction with depth, loam, ending on clay at 200mm	rootlets	6	Gradual
T3 TP8	1	0	50	7.5YR 5/3 brown	Soft	Silty Loam	potential ploughing	brown, silty loam, rootlets	rootlets	6.5	Gradual
T3 TP8	2	50	250	7.5YR 2.5/3 Very dark brown	Moderate	Loam		Very dark brown, moderately compacted, increase in clay content with depth, loam, ending on clay at 250mm, mottling in base of test pit	rootlets	6	Gradual