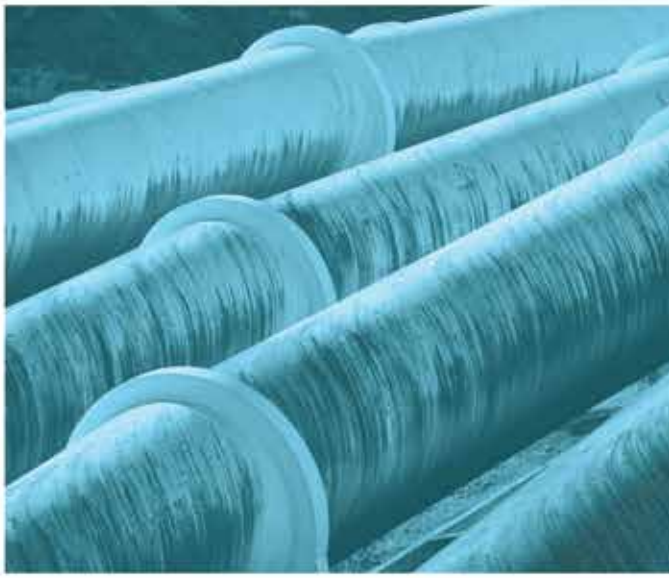



# Wongawilli Colliery Modification Report

PA 09_0161 MOD 2 - North West Mains Development
Volume 14 - Appendix N (Part 1)

**Prepared for Wollongong Coal Limited**
**December 2020**

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# Appendix N - Part 1

## Archaeological assessment

# Wongawilli Colliery
# North West Mains Modification:
# Archaeological Report

FINAL REPORT

Prepared for Wollongong Coal Ltd

9 November 2020

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# Glossary

| | |
|---|---|
| **ACHA** | Aboriginal Cultural Heritage Assessment |
| **AR** | Archaeological Report |
| **AHIMS** | Aboriginal Heritage Information Management System |
| **CBD** | Central business district |
| **Consultation requirements** | *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010a) |
| **DA** | Development Application |
| **DECCW** | Department of Environment, Climate Change and Water (now Heritage NSW) |
| **DP** | Deposited Plan |
| **EP&A Act** | *Environmental Planning and Assessment Act 1979* |
| **GPS** | Global Positioning System |
| **GSV** | Ground Surface Visibility |
| **Heritage NSW** | Heritage NSW, Department of Premier and Cabinet |
| **ICOMOS** | International Council on Monuments and Sites |
| **LALC** | Local Aboriginal Land Council |
| **LEP** | Local Environmental Plan |
| **LGA** | Local Government Area |
| **MGA** | Map Grid of Australia |
| **NPW Act** | *National Parks and Wildlife Act 1974* |
| **NPWS** | National Parks and Wildlife Service |
| **NSW** | New South Wales |
| **NWMD** | North West Mains Development |
| **PAD** | Potential Archaeological Deposit |
| **Study area** | See Figure 2 |
| **the Code** | *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) |
| **WCL** | Wollongong Coal Ltd |
| **WWC** | Wongawilli Colliery |

# Summary

Biosis Pty Ltd was commissioned by Wollongong Coal Ltd (WCL) to undertake an Aboriginal Cultural Heritage Assessment (ACHA) of the proposed North West Mains Development (NWMD) works at the Wongawilli Colliery (WWC) in the Southern Coalfields, NSW (the study area). This Archaeological Report (AR) documents the findings of the archaeological investigations 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.

WWC is an underground coal mine located approximately 14 kilometres south-west of the Wollongong central business district (CBD). Project approval was initially granted to Gujarat NRE Coking Coal Limited (the previous owners of WWC) on 2 November 2011, for mining operations within the WWC mining lease area until 31 December 2015. The project approval was granted a modification in 2015, which permitted mining operations to continue until 31 December 2020. WCL proposes a second modification to the existing project approval for extension of mining activities for a further five years.

To date, approximately 500 metres of the NWMD has been developed prior to the Colliery going into care and maintenance in July 2019. Furthermore, the modification largely seeks approval to extend the length of NWMD by approximately 2.9 kilometres to access the existing Wongawilli Ventilation Shaft 1 and construction of a new section of coal conveyor system, approximately 60 metres in length, at the Wongawilli Upper top pit. The NWMD would continue to be extracted via first workings mining method using two continuous miners. WCL committed in 2019 to no longer undertake mining via longwall extraction methods. As such no longwall mining is proposed as part of this modification application.

The study area is located approximately 9.5 kilometres west of Dapto and approximately 18 kilometres south-west of the Wollongong CBD, on the eastern edge of the Illawarra Escarpment. The study area is surrounded in all directions by the Illawarra escarpment and Upper Nepean Catchment area and straddles Lake Avon.

There are 87 Aboriginal cultural heritage sites registered with the Aboriginal Heritage Information Management System (AHIMS) register, within the vicinity of the study area. There are no Aboriginal cultural heritage sites located within the study area.

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

The survey was conducted between 31 August and 2 September 2020 by Samantha Keats (Consultant Archaeologist), Matthew Tetlaw (Research Assistant), Byron Dale (Field Assistant), James Davis (Wodi Wodi Traditional Owner), and Paul Cummins and Kayla Williamson (Woronora Plateau Gundangara Elders Council). 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 or areas of (archaeological) sensitivity were identified during the field investigation. As a result, the study area has been assessed as low archaeological potential to contain Aboriginal sites.

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

- Predicted impacts to Aboriginal cultural heritage.

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

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

**Management recommendations**

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

### Recommendation 1: No further archaeological assessment is required

No further archaeological work is required in the study area due to the entire study area being assessed as having low archaeological potential.

### Recommendation 2: 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 knowingly disturb an Aboriginal site without a consent permit issued by the 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 the Heritage NSW and Aboriginal stakeholders.

### Recommendation 3: 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.

### Recommendation 4: Continued consultation with the registered Aboriginal stakeholders

As per the consultation requirements, it is recommended that the proponent provides a copy of this final report to the Aboriginal stakeholders. The proponent should continue to inform these groups about the management of Aboriginal cultural heritage sites within the study area throughout the life of the project.

# 1 Introduction

## 1.1 Project background

Biosis Pty Ltd was commissioned by WCL to undertake an ACHA of the proposed NWMD works at the WWC in the Southern Coalfields, NSW (the study area). This AR documents the findings of the archaeological investigations conducted as part of the ACHA. The AR provides evidence about the material traces of Aboriginal land use to support the conclusions and management recommendations in the ACHA.

WWC is an underground coal mine located approximately 14 kilometres south-west of Wollongong. A project approval was initially granted to Gujarat NRE Coking Coal Limited (the previous owners of WWC) on 2 November 2011, for mining operations within the WWC mining lease area until 31 December 2015. The project approval authorised the following activities:

- Continued use of the surface infrastructure at the Wongawilli pit top as currently operated.
- Run of mine (ROM) coal production of up to 2 million tonnes per annum (Mtpa).
- Mining of six longwalls panels (N1 to N6) in the Nebo Project Area.
- Continued development and construction of the NWMD.
- Continued transportation of ROM coal from Wongawilli Colliery to Port Kembla Coal Terminal by rail.
- Rehabilitation of the site.

The project approval was granted a modification in 2015, which permitted mining operations to continue until 31 December 2020. The proposed modification is seeking to extend the life of the mine by 5 years to enable Wollongong Coal to continue development of the approved NWMD. To date, approximately 500 metres of the NWMD has been developed prior to the Colliery going into care and maintenance in July 2019. Furthermore, the modification largely seeks approval to extend the length of NWMD by approximately 2.9 kilometres to access the existing Wongawilli Ventilation Shaft 1 and construction of a new section of coal conveyor system, approximately 60 metres in length, at the Wongawilli Upper top pit. The NWMD would continue to be extracted via first workings mining method using two continuous miners. WCL committed in 2019 to no longer undertake mining via longwall extraction methods. As such no longwall mining is proposed as part of this modification application.

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 *Environmental Planning and Assessment Act 1979* (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 local LEP and are protected under the EP&A Act and *Heritage Act 1977.*

## 1.2 Study area

The study area is located approximately 9.5 kilometres west of Dapto and approximately 18 kilometres south-west of the Wollongong CBD (Figure 1), on the eastern edge of the Illawarra Escarpment. The study area is within the:

- Wollongong Local Government Area (LGA).
- Parish of Kembla.
- County of Camden.

The study area is surrounded in all directions by the Illawarra escarpment and Upper Nepean Catchment area and straddles Lake Avon. For this assessment, the study area is defined as the combined footprint of both the works at the Wongawilli Pit Top, and the Additional Driveage (Figure 2). Although no direct impacts resulting from subsidence are anticipated to occur (SCT Operations 2020), the Additional Driveage has been included in the study area due to the potential for indirect impacts to the surface as a result of the proposed underground mining.

## 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:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NPW Act.
- NSW *National Parks and Wildlife Amendment Act 2010.*
- Wollongong Local Environmental Plan 2009 (LEP).

## 1.4 Objectives of the investigation

The objectives of the investigation can be summarised as follows:

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

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

## 1.5 Investigators and contributors

The roles, previous experience and qualifications of the Biosis project team involved in the preparation of this archaeological report are described below in Table 1.

**Table 1 Investigators and contributors**

| Name and qualifications | Experience summary | Project role |
|---|---|---|
| **Amanda Markham**<br>**BA Hons (Anthropology/Sociology), PhD (Anthropology), Grad. Cert (Archaeology)** | Amanda Markham has over 20 years' experience in Anthropology and Archaeology throughout Australia, including extensively in remote areas. Her project experience includes working for Aboriginal representative bodies, mining and exploration companies, Commonwealth, state and territory government agencies, community groups and Indigenous stakeholder groups. Amanda's areas of expertise include cultural heritage management field work in remote areas with Aboriginal Traditional Owners, conducting heritage assessments under state and territory legislation, skeletal remains assessment and conducting archaeological and anthropological surveys and assessments. Amanda has proven staff and project management skills and ability to simultaneously oversee multiple large complex projects to deliver client outcomes within tight time frames and budget constraints. Amanda's excellent communication and negotiation skills have seen her easily managing and building relationships between Aboriginal people and senior government and corporate figures. | • Quality assurance |
| **Samantha Keats**<br>**BA (Hons)** | Samantha has over five years' 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 conducting desktop assessments, archaeological survey and Aboriginal and historical excavation as well as consulting with Traditional Owners. She has participated in a number of European historical excavations and monitoring programs in NSW and has authored several Statement of Heritage Impact reports and Heritage Assessments. Samantha has also authored multiple | • Project manager<br>• Field investigation<br>• Report author |

| Name and qualifications | Experience summary | Project role |
|---|---|---|
| | Aboriginal cultural heritage assessment report and participated in multiple Aboriginal archaeological excavations and survey. | |
| **Matthew Tetlaw**<br>**BA (Hons) Archaeology and History** | Matthew completed his Bachelor of Arts with honours in 2018 and joined Biosis in their Wollongong office in 2019. During his undergraduate years he participated in historical and Indigenous archaeological assessments in his home state of Western Australia as well as abroad. Primarily, these have included historical surveys of convict sites, an international excavation in Bulgaria and a desktop assessment of rock-art. 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. | • Aboriginal community consultation<br>• Background research |

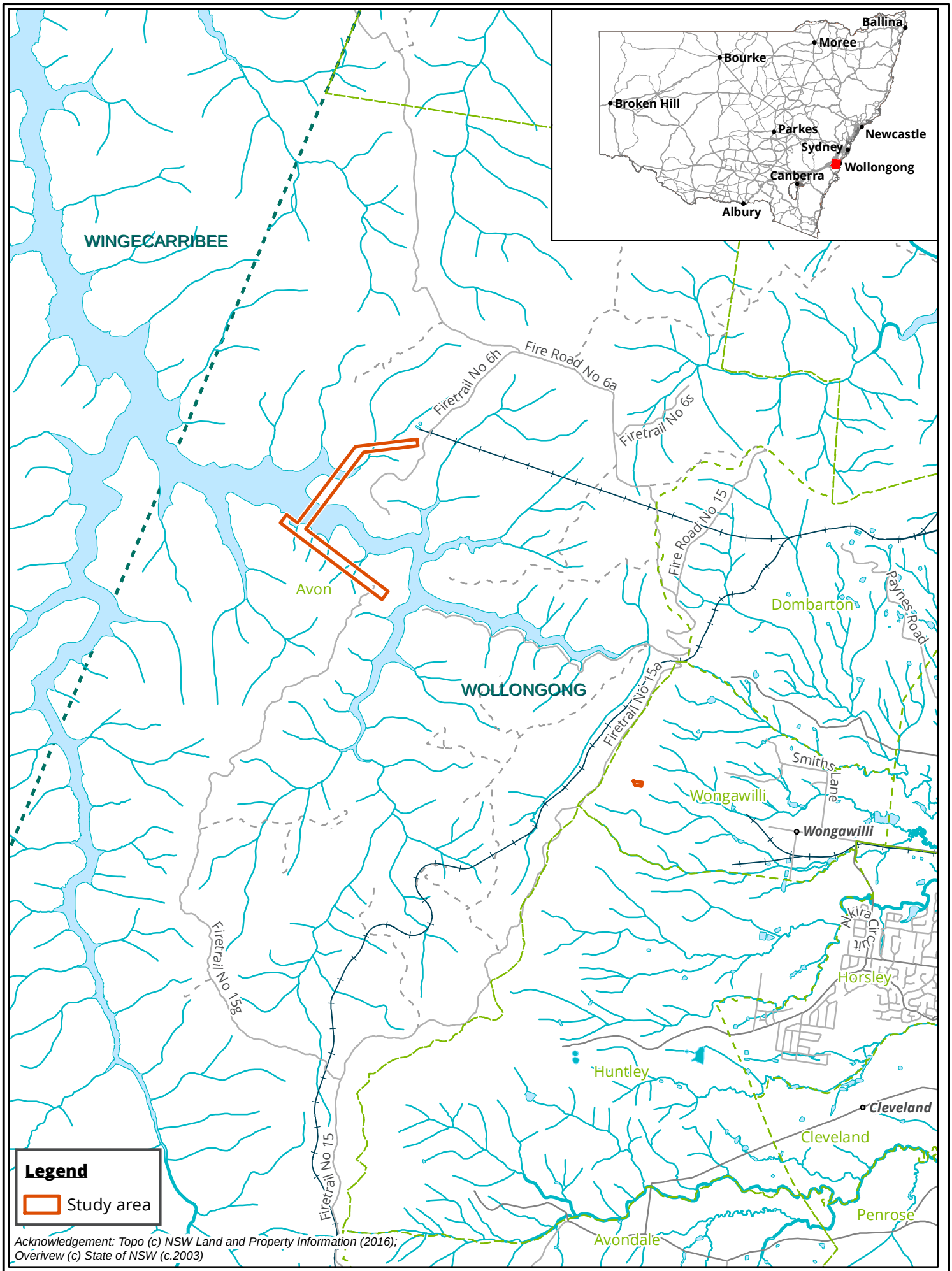


Figure 1 Location of the study area

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Date: 13 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location:P:\33200s\33219\Mapping\

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Kilometres
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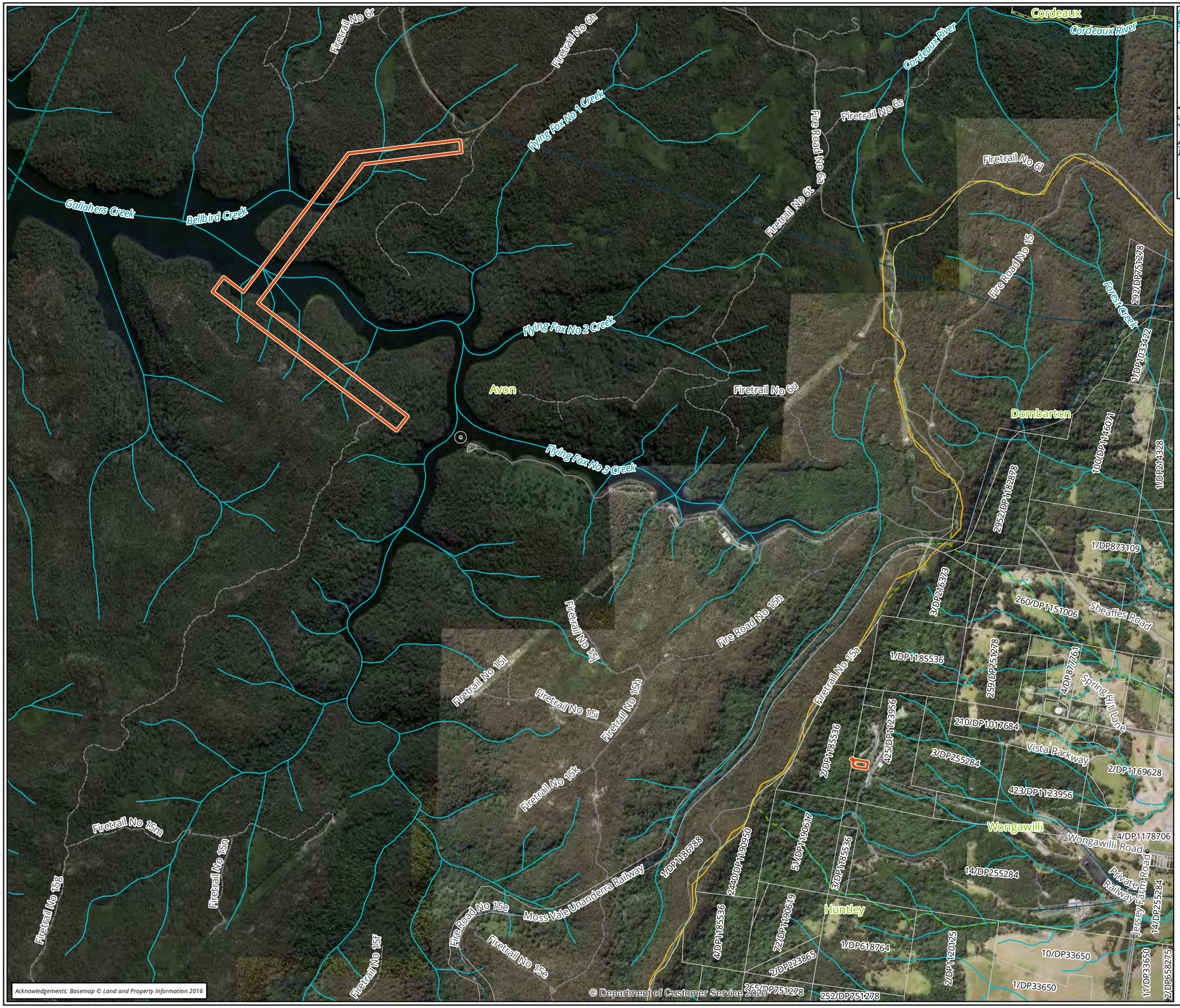
Scale 1:50,000 @ A4, GDA 1994 MGA Zone 56





**Legend**

- Study area
- Lot

**Figure 2 Study area detail**

0 200 400 600 800

Metres

Scale: 1:20,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

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Date: 13 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F2_StudyArea.mxd

# 2 Proposed development

The footprint of the NWMD development has been divided into two sections; the Wongawilli Pit Top, and the Additional Driveage (Figure 3). An overview of the proposed modification is outlined in the table below.

| Element | The Colliery (currently approved project) | MOD2 |
|---|---|---|
| **Operating hours** | 24 hours per day, seven days per week.<br>Unloading from coal handling / train loading infrastructure occurring during normal operational hours:<br>• 7am to 6pm Monday to Friday.<br>• 8am to 4 pm Saturday.<br>• no time on Sundays and public holidays. | Conveyance of coal from the Wongawilli upper pit top to the lower pit top to be restricted to normal operational hours. |
| **Coal seams** | Bulli and Wongawilli Coal Seams | No change |
| **Extraction rate** | 2 million tonnes per annum | No change |
| **Approval period ending** | 31 December 2020 | 31 December 2025 |
| **Mine life** | 9 years consisting of 4 years (original consent), plus 5 years (MOD1). | Coal extraction until 31 December 2025, representing an extension of the approved mine life by 5 years. |
| **Mining method** | Longwall and first workings mining methods. | First working mining methods only. |
| **Underground workings** | Four 5.5 m wide by 3.6 m high roadways<br>Access from existing portals. | Minor alignment changes to the western end of the approved NWMD. Additional first workings proposed to enable access to the existing Wongawilli Shaft 1. |
| **Mine infrastructure, coal stockpiles and product transport** | Wongawilli lower and upper pit top facilities and coal handling / load out infrastructure to rail. | No change to rail transport requirements.<br>No change to Wongawilli pit top administration and workshop facilities.<br>Additional access to the NWMD via existing Portals W9 and W10.<br>Relocation of crusher, sizer, and screen to underground.<br>Improvements to the coal conveyance network including the construction of a new section of coal conveyor, approximately 60 m in length and coal storage bin.<br>Extension of the Wongawilli lower pit top noise wall. |
| **Rail transport requirements** | No transport of coal by road.<br>Train movements restrictions:<br>• 8 train movements (calendar year average) a day | Maximum of 4 train movements a day.<br>No train movements at night. |

| Element | The Colliery (currently approved project) | MOD2 |
|---|---|---|
| | • 10 train movements (max. weekly rolling average) a day<br>• 3 train movements a night during normal operations<br>• 4 train movements a night during advertised campaigns, with a maximum of 10 such campaigns per year | |
| **Waste management** | Waste rock to be stored underground in two of the four Western Driveage roadways. Waste rock which does come to the surface to be utilised for ballast or fill underground or used on the surface for landscaping and rehabilitation. | Waste rock to be stored underground within existing and NWMD workings. Maintain approval for waste rock to be utilised on the surface for landscaping and rehabilitation purposes. |
| **Mine ventilation** | Mine portals and vent shafts including:<br>• Two portals for personnel and materials.<br>• One portal for coal extraction.<br>• Two portals into the NWMD.<br>• Wongawilli Shaft 1, Nebo Shaft 3 and 4.<br>Existing Nebo area portals (Wonga Belts and Wonga Track) and ventilation shafts (Vent Shaft 3 and 4) are proposed to be closed off and rehabilitated so will no longer be in use. | Revised NWMD will reduce future ventilation shaft requirements via relying on the existing Wongawilli 1 ventilation shaft.<br>Four portals into the NWMD. |
| **Workforce** | Approved for up to 300 FTEs and contract personnel. | Employment of up to 150 FTEs. |

### Wongawilli Pit Top

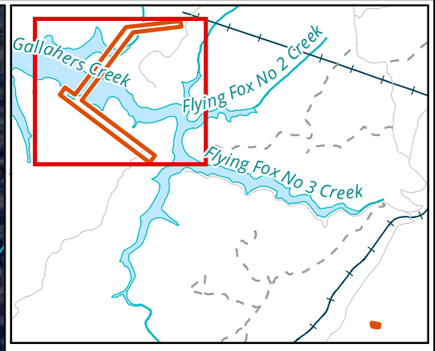
The Wongawilli Pit Top is located at the top of a private road north west of Jersey Farm Road, Wongawilli. It is bounded on the west by the Illawarra Escarpment State Conservation Area. Access to the driveage will be via two existing portal entries on the uppermost bench of the pit top, with one being used for the transport of people and materials, and one being used to convey coal from the mine. Wollongong Coal propose to largely utilise existing pit top surface infrastructure at the Wongawilli lower and upper pit top areas. The exception being the construction of a new section of coal conveyor system, approximately 60 m in length, and coal storage bin at the Wongawilli upperpit top and relocation of the coal preparation infrastructure including the crusher, sizer and screen which is to be located underground.

### Additional Driveage

The proposed additional driveage will consist of four underground roadways to be developed using first workings mining methods. This will involve the development of four 5.5 metre wide headings, drifts or roadways, and interconnecting cut-throughs with continuous miners. These will provide access to the coal resource, colliery ventilation and corridors for personnel and material movement within the seam and coal conveyor network. Works have commenced on the driveage, with approximately 500 metres developed within the Bulli Coal Seam. The modification largely seeks to extend the length of NWMD by approximately 2.9 kilometres to access the existing Wongawilli Ventilation Shaft 1 and construction of a new section of coal conveyor system, approximately 60 metres in length, at the Wongawilli Upper top pit.

As the driveage is being developed using the first workings mining method, no impacts are expected to the ground surface. The first workings method involves parallel tunnels known as 'headings' being driven into the coal seam from the mine entrance using remote controlled coal cutting. These form a series of self-supporting roadways, leaving behind a grid of pillars. The pillars are designed to provide stability to the void in the long term and support the roof strata above the seam. Where the pillars have been designed to be stable, the vertical subsidence is typically less than 20 millimetres.

Natural or seasonal variations in surface levels due to wetting and drying of soils are approximately 20 millimetres, and thus subsidence less than this can be considered no more than the variations occurring from natural processes, and should have negligible impacts on both natural and man-made surface infrastructure (CoA 2014, MSEC 2007, Hume Coal 2017). A geotechnical report provided by SCT Operations Pty Ltd (2020), confirmed this, with the geotechnical assessment concluding that there is no potential for any perceptible surface subsidence impacts as a result of the proposed additional Driveage.


**Legend**

Study area

**Development**

Approved

Proposed

**Figure 3 Proposed works**

**Additional driveage**

0 50 100 150 200

Metres

N

Scale: 1:6,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

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Matter: 33219,
Date: 10 September 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
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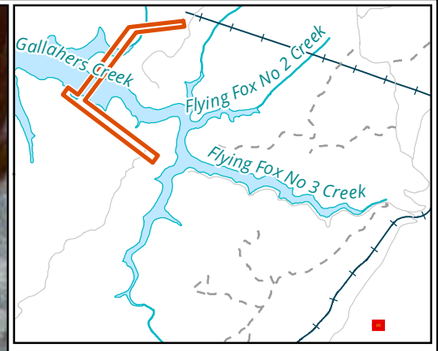


**Legend**

Study area

**Development**

Approved

Proposed



**Figure 3 Proposed works**

**Wongawilli Pit Top**

0 3 6 9 12

Metres

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Scale: 1:300 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

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# Desktop assessment

The desktop assessment involves researching and reviewing existing archaeological studies and reports relevant to the study area and Illawarra 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.

## 2.1 Landscape context

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

### 2.1.1 Topography and hydrology

The study area contains complex geology with two principal geological formations present: Hawkesbury Sandstone and the Narrabeen Group (Figure 4). Hawkesbury Sandstone consists of medium to coarse-grained quartz sandstone with minor shale and laminate lenses that is Mid Triassic in age (245-241 mya) (Hazelton & Tille 1990, p.45). The Narrabeen Group underlies the Hawkesbury Sandstone and is exposed only at the base of the coastal cliff lines. It consists of fine-grained lithic sandstone occasionally interbedded with thin shale lenses (Hazelton & Tille 1990, p.61) and is Early Triassic in age (251-245 mya). Both of these formations are underlain by the Illawarra Coal Measures of Late Permian in age (263-253 mya), which consists of shale sandstone, conglomerates, tuff, chert and coal.

The study area is located within the southern Woronora Plateau, an area typically characterised as 'level to rolling pattern of plains, rises and low hills standing above a cliff, scarp or escarpment that extends around a large part of its perimeter' (Speight 2009, p.69). It comprises deeply incised creek valleys resulting in steep, high sandstone cliffs and high ridgelines. Typical landform elements associated with plateau landform patterns described by Speight (2009) present within the study area include: cliff, hillcrest, hillslope and drainage depressions. Cliffs are very wide, steep to precipitous slopes that are eroded usually by gravity, water-aided mass movement or sheet wash. Rock flats are flat or bare consolidated rock eroded by sheet wash. Hillcrests and hillslopes are very gently to gently inclined slopes eroded mainly by sheet wash, creep or water-aided mass movement. Drainage depressions are level to gently inclined depressions rising to moderately inclined side slopes.

Stream order is recognised as a factor which assist the development of predictive modelling in Aboriginal archaeology. These predictive models have a tendency to favour high order streams as the locations of campsites and therefore archaeological remans. 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 Plate 1. As stream order increases, so does the likelihood that the stream would be a perennial source of water.

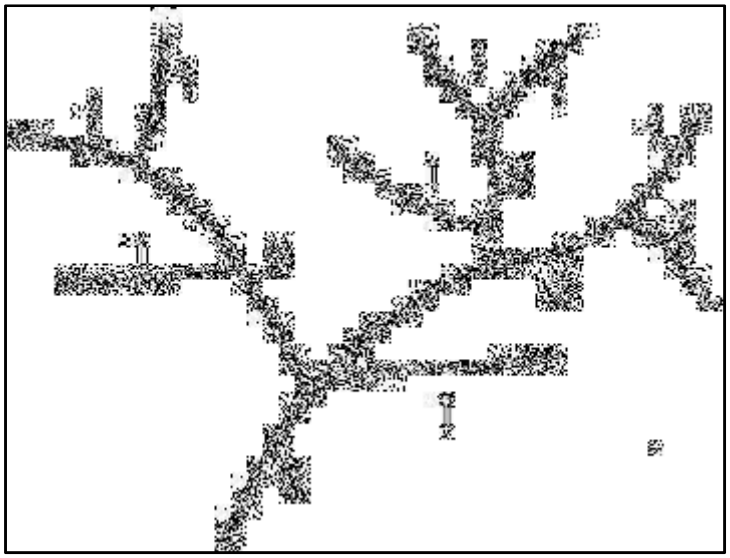


**Plate 1 Diagram showing Strahler stream order (Ritter et al. 1995, pp. 151)**

A number of water ways are located in and within close proximity to the study area, which include Gallahers Creek, Bellbird Creek, Flying Fox No. 1 Creek, Flying Fox No. 2 Creek and Flying Fox No. 3 Creek. Following the construction of Avon Dam, the water level is approximately 50 metres higher and the valley floor has been inundated, which has likely affected and modified these creek lines. Stream channels within the study area are typically erosional, closely spaced and drain into Avon River and Gallaher's Creek. They flow in narrow steep sided gullies which deepen and widen towards the confluence. Upland swamps or basins filled with waterlogged soils are not generally well developed at the heads of these minor creeks, with the exception of swamps present within the Bundeena Soil Landscape (Figure 5).

### 2.1.2 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.

Five soil landscapes are present within the study area: Warragamba, Bundeena, Hawkesbury, Illawarra Escarpment, and Lucas Heights (Figure 6). In general, soils in these areas are shallow, loose and sandy. There are three colluvial soil landscapes (Warragamba, Hawkesbury and Illawarra Escarpment) and two residual soil landscapes (Bundeena and Lucas Heights) in the study area. Colluvial soil landscapes are dominated by areas where mass movement is the principal agent of accumulation. Cliffs, scarps and steep slopes are examples of colluvial soil landscapes. Residual soil landscapes are characterised by areas where soils are derived from long-term, *in situ* weathering of parent materials. Examples of these types of soil landscapes are flats, plains and plateaus with poorly defined drainage lines (Hazelton & Tille 1990).

The Warragamba soil landscape covers the majority of the study area and is dominated by moderate to very steep slopes of 20-50% and a local relief of 50 to 150 metres. It has narrow convex crests and ridges and steep colluvial side slopes on Narrabeen Sandstone. Archaeological potential of the Warragamba soil landscape is deemed to be low due to very steep slopes that are not conducive to human occupation. In addition, at the junction of the Hawkesbury Sandstone and Narrabeen Group formations, overlying Hawkesbury sandstone generally forms large cliff lines that rarely have overhang development. In cases

where overhangs are present due to rock fall, they mostly have steep and wet floors without deposit. Soil material descriptions can be found in Table 2.

**Table 2 Warragamba soil landscape material (Hazelton & Tille 1990, p.61)**

| Soil landscape | Description |
|---|---|
| **Warragamba 1 (wg1) – Dark brown loamy sand** | Loose to friable single-grained loamy sand. Colour ranges from brown (10YR 2/2 to 5YR 3/1) to yellowish brown (10YR 5/6). The pH is extremely acid (pH 3.5). This material includes rock fragments (likely sandstone). Roots are abundant and charcoal is occasional present. This material occurs as topsoil. |
| **Warragamba 2 (wg2) – Very dark reddish brown clayey sand** | Loose clayey sand which is apedal single-grained. Colour ranges from very dark reddish brown (5YR 2/3) to yellowish brown (10YR 5/6). The pH is extremely acid (3.5). Stone fragments and roots are common and charcoal is sometimes present. This material occurs as subsoil. |
| **Warragamba 3 (wg3) – Pedal clay** | Clay loam to medium clay with texture increasing with depth. Colour is variable, most commonly dull brown (7.5YR 5/4), yellowish brown (10YR 5/6), orange (7.5YR 6/8) and reddish brown (5YR 4/6). Occasional yellow and red mottles are present. The pH level is 3.5-4. Rock fragments are present but roots and charcoal are absent. This material occurs as subsoil. |

The Bundeena soil landscape has very low undulating rises on exposed Hawkesbury sandstone plateau. This soil landscape is present within the south-eastern part of the study area. It has very broad ridges and crests, flat to moderate slopes and local relief is up to 80 metres. A large area of the land surface of this landscape has rock outcrop and small swamps, while seepage areas are common. Sandy shallow soils occur in areas where they can accumulate. This landscape is deemed to be archaeologically rich with the sandstone outcrop and swamps indicating a high potential for grinding groove sites and pictogram art sites. Soil material descriptions can be found in Table 3.

**Table 3 Bundeena soil landscape material (Hazelton & Tille 1990, pp. 31)**

| Soil landscape | Description |
|---|---|
| **Bundeena 1 (bu1) – Loose, stony dull yellowish brown sandy loam** | Stony, coarse loamy sand to sandy loam. Colour varies from yellowish brown (2.5YR 3/2) to dull yellowish brown (10YR 5/3). The pH is moderately acid (5.5). Sub-angular sandstone fragments are common, but roots are few. This material occurs as topsoil. |
| **Bundeena 2 (bu2) – Earthy, yellowish brown, light sandy clay loam** | Yellowish brown apedal massive sandy clay loam. Colour ranges from dull yellowish brown (10YR 5.3) to light grey (10YR 8/2). The pH is strongly acid (4.0) to moderately acid (5.5). Iron-coated gravel inclusions are common but roots are few. This material occurs as subsoil. |
| **Bundeena 3 (bu3) – Friable yellowish brown clayey sand** | Friable yellowish brown clayey sand. Colour is yellowish brown (2.5Y 5/3). The pH is moderately acid (5.0). Sandstone fragments and roots are usually absent. |

The Hawkesbury soil landscape is characterised by rugged sandstone escarpment and ridges with moderate to steep slopes and narrow, incised valleys of the Woronora Plateau. This soil landscape is present within the north-west and central part of the study area. Sandstone rock outcrops are very common and occur as boulders, benches and large blocks, often forming scarps up to 10 metres high. The soils in this landscape are

shallow, discontinuous and generally sandy. The Hawkesbury soil landscape is the most archaeologically sensitive landscape in the study area, as the blocks and weathered scarps provide overhangs with a suitable environment for rock art and in most cases the accumulation of cultural deposits. However, deposits with a potential for deep stratified occupational deposits are very limited. In addition, sandstone platforms close to water sources provide the potential for grinding grooves sites. Previous archaeological work within the region have demonstrated an abundance of rock art and grinding grooves associated with this landscape. Soil material descriptions can be found in Table 4.

**Table 4 Hawkesbury soil landscape material (Hazelton & Tille 1990, pp. 45)**

| Soil landscape | Description |
|---|---|
| **Hawkesbury 1 (ha1) – Loose, coarse quartz sand** | Sand to sandy loam with porous sandy fabric. Colour ranges from brownish black (10YR 2/2) where organic matter is present, otherwise material colour is dull yellowish brown (10YR 4/3). The pH is moderately acid (5.5); weathered sandstone fragments are present, and root and charcoal inclusions are common. This material occurs as topsoil. |
| **Hawkesbury 2 (ha2) – Yellowish brown sandy clay loam** | Clayey sand to sandy clay loam. This material's colour includes dull yellow orange (10YR 6/4), yellowish brown (10YR 5/6) and bright yellowish brown (10YR 6/6). The pH is moderately acid (4.5-5.5). Gravel, stones and ironstone-plated sandstone fragments are comments. Roots and charcoal are rare. This material occurs as subsoil, usually in association with bedrock. |
| **Hawkesbury 3 (ha3) – Pale, strongly pedal light clay** | Fine sandy clay loam to medium clay. Colour ranges from bright yellowish brown (10YR 6/6) to bright brown (5YR 5/6). Colours are often pale but vary with drainage characteristics. Orange and grey mottles are often present, as are stratified ironstone gravels. Roots and charcoal are either rare or absent. This material occurs as subsoil derived from shale lenses within the Hawkesbury sandstone. |

The Lucas Heights soil landscape can be described as having gently undulating crests, ridges and plateau surfaces, with local relief between 10 to 50 metres and slopes of less than10%. This soil type is confined to the ridge tops and gentle slopes within the northern part of the study area. The soils are generally yellowed to lateritic podsolic; however, this landscape is known for outcrops and limited deep soil bases. Limitations include stoniness, hard-setting surfaces and low soil fertility. Although this soil landscape consists of generally shallower soils, it is still considered to be of some Aboriginal archaeological potential. These site types are more likely to comprise isolated stone artefact occurrences situated on travel routes rather than campsites. Soil material descriptions can be found in Table 5.

**Table 5 Lucas Heights soil landscape material (Hazelton & Tille 1990, pp. 24)**

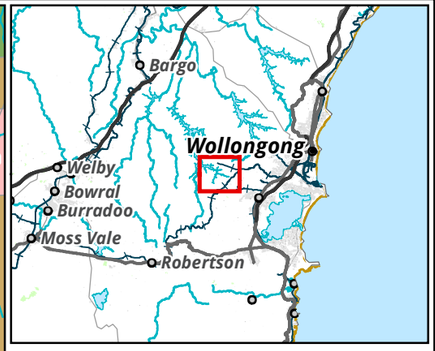
| Soil landscape | Description |
|---|---|
| **Lucas Heights 1 (lh1) – Loose, greyish brown fine sandy loam** | Loose sandy to sandy loam. Colour varies from greyish brown (7.5YR 5/2) to yellowish brown (10YR 5/6). The pH varies from 4.5 to 6.5. Common inclusions are iron-coated, platy fine sandstone fragments and charcoal fragments. Roots are also common. This material occurs as subsoil. |
| **Lucas Heights 2 (lh2) – Bleached, stony, hardsetting sandy clay loam** | Bleached, stony, sandy clay loam. Colour ranges from yellowish orange (10YR 8/6) to dull orange (6.4YR 4/3) and yellowish brown (10YR 7/6). Pale yellow are brown mottles are present, usually associated with bioturbation. The pH ranges from 4.0 to 6.0. Sandstone fragments and rounded iron nodules are common. Charcoal traces are present but roots are absent. This material occurs as topsoil. |

| Soil landscape | Description |
|---|---|
| **Lucas Heights 3 (lh3) – Earthy, yellowish brown sandy clay loam** | Yellowish brown sandy clay loam. Colour ranges from yellowish brown (2.5YR 5/6, 10YR 5.4) to dull yellow orange (10YR 7/2). Orange mottles occur with depth. The pH ranges from 4.5 to 6.0. Sandstone fragments are common, but charcoal and root inclusions are rare. This material occurs as subsoil. |
| **Lucas Heights 4 (lh4) – Pedal yellowish brown clay loam** | Yellowish brown sandy clay to heavy clay. Colour varies from dull yellowish orange (10YR 6/4) to dark reddish brown (5.0YR 3/6) to bright yellowish brown (10YR 7/6). Yellow, red and orange mottles are occasionally present; pH ranges between 4.0 and 5.0. Bands of sandstone fragments are common but charcoal and roots are rarely present. |

The Illawarra Escarpment soil landscape is present within a small part of the study area where the Wongawilli Pit Top is located. It is characterised by the upper slopes and benches of the Illawarra Escarpment with steep to very steep slopes, gradients of between 20% and 50% and a local relief of 100 to 300 metres. This soil landscape includes the cliffs of the escarpment. Large landslips are a very common feature and, below the escarpment, bedrock outcrop is absent. Archaeological potential of the Illawarra Escarpment soil landscape is deemed to be low due to very steep slopes and rock fall hazards, which are not conducive to human occupation. Soil material descriptions can be found in Table 6.

**Table 6 Illawarra Escarpment soil landscape material (Hazelton & Tille 1990, pp. 58,60)**

| Soil landscape | Description |
|---|---|
| **Illawarra Escarpment 1 (ie1) – Loose dark brown sand** | Loose sandy to weakly pedal loam. Colour varies from dark brown (10YR 3/3) to brownish black (7.5YR 3/1) to brownish grey (7.5YR 4/1). The pH ranges from 5.5 to 6.5. Sandstone fragments (2-200 millimetres in size) are very common. Roots are common. This material occurs as topsoil. |
| **Illawarra Escarpment 2 (ie2) – Moderately pedal sandy clay loam** | Moderately pedal sandy clay loam to fine sandy clay loam. Colour varies from dark reddish brown (2.5YR 3/6) to reddish brown (5YR 4/6) to dark brown (7.5YR 4/6). This material is often mottled with red, white or orange. The pH varies from 4.5 to 7.0. Sandstone fragments and boulders are abundant. This material occurs as subsoil. |
| **Illawarra Escarpment 3 (ie3) – Moderately pedal sandy clay** | Moderately pedal sandy clay to heavy clay. Colour varies from dark reddish brown (2.5YR 3/6) to reddish brown (5YR 4/6) to dark brown (7.5YR 4/6). As ie2, this material is often mottled with orange, white or red. The pH is 4.5 to 7.0. Sandstone fragments and boulders are abundant. |




**Legend**

Study area

**Geological Units**

- CZucx - Cordeaux Crinanite
- P__gm - Minnamurra Latite Member
- Pil - Illawarra Coal Measures
- Pshr - Broughton Formation
- Q_a - Alluvium
- Q_avf - Alluvial fan deposits
- Q_ct - Colluvial talus deposits
- Tna - Narrabeen Group
- Tnca - Scarborough Sandstone
- Tncc - Coal Cliff Sandstone
- Tnck - Kangaloon Sandstone
- Tnco - Wombarra Claystone
- Tuth - Hawkesbury Sandstone

**Figure 4 Geological units within the vicinity of the study area**

0 200 400 600 800

Metres

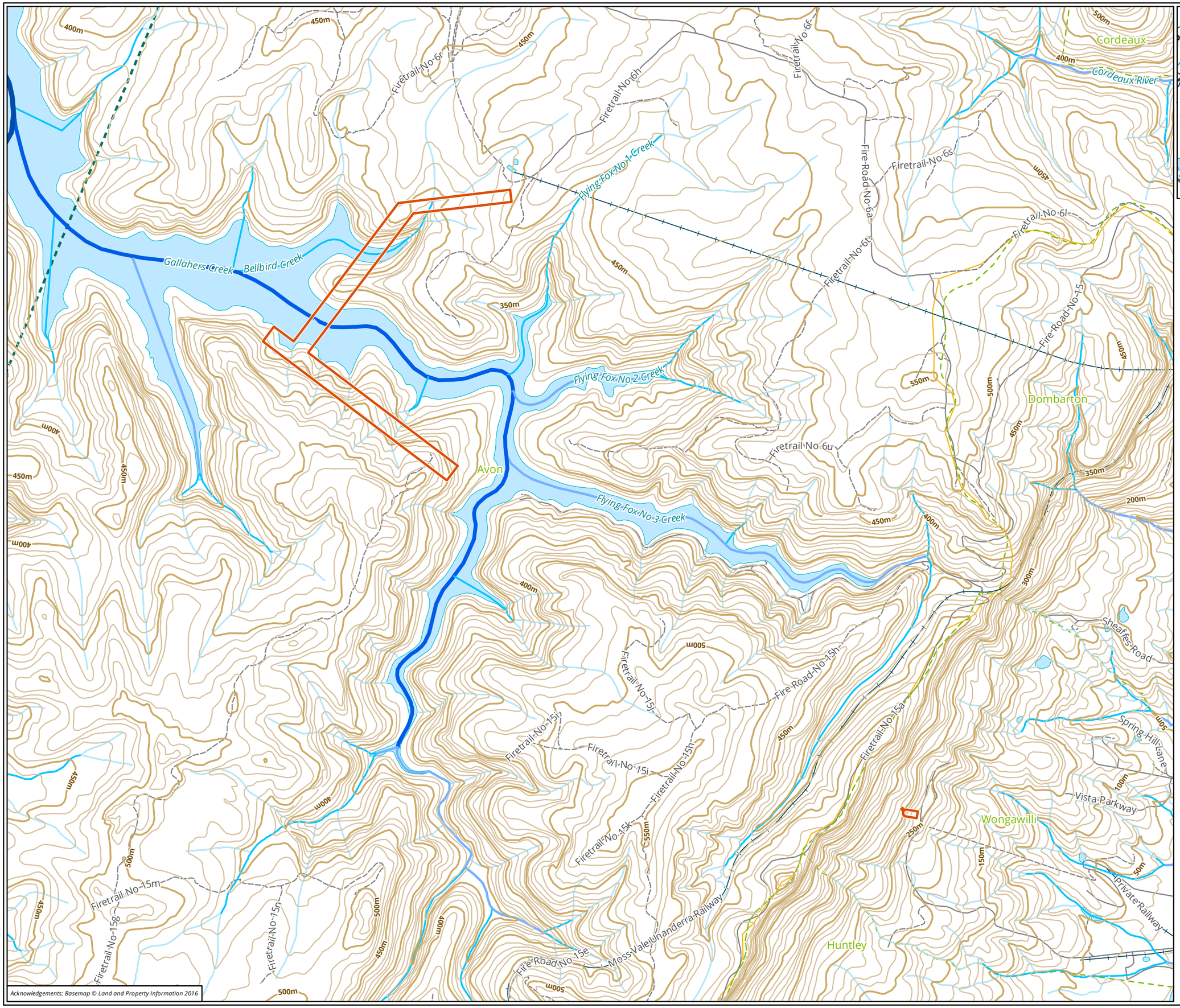
N

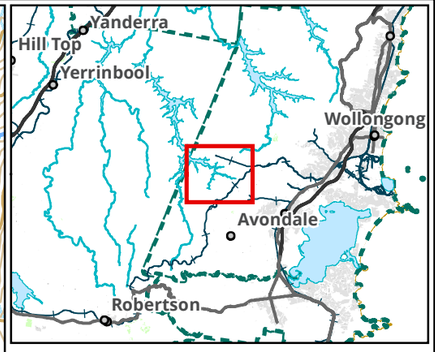
Scale: 1:20,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 25 June 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F4_Geology.mxd




**Legend**

- Study area
- Contour (10m)

**Strahler Order**

- 1
- 2
- 3
- 4
- 5

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

0 200 400 600 800

Metres

N

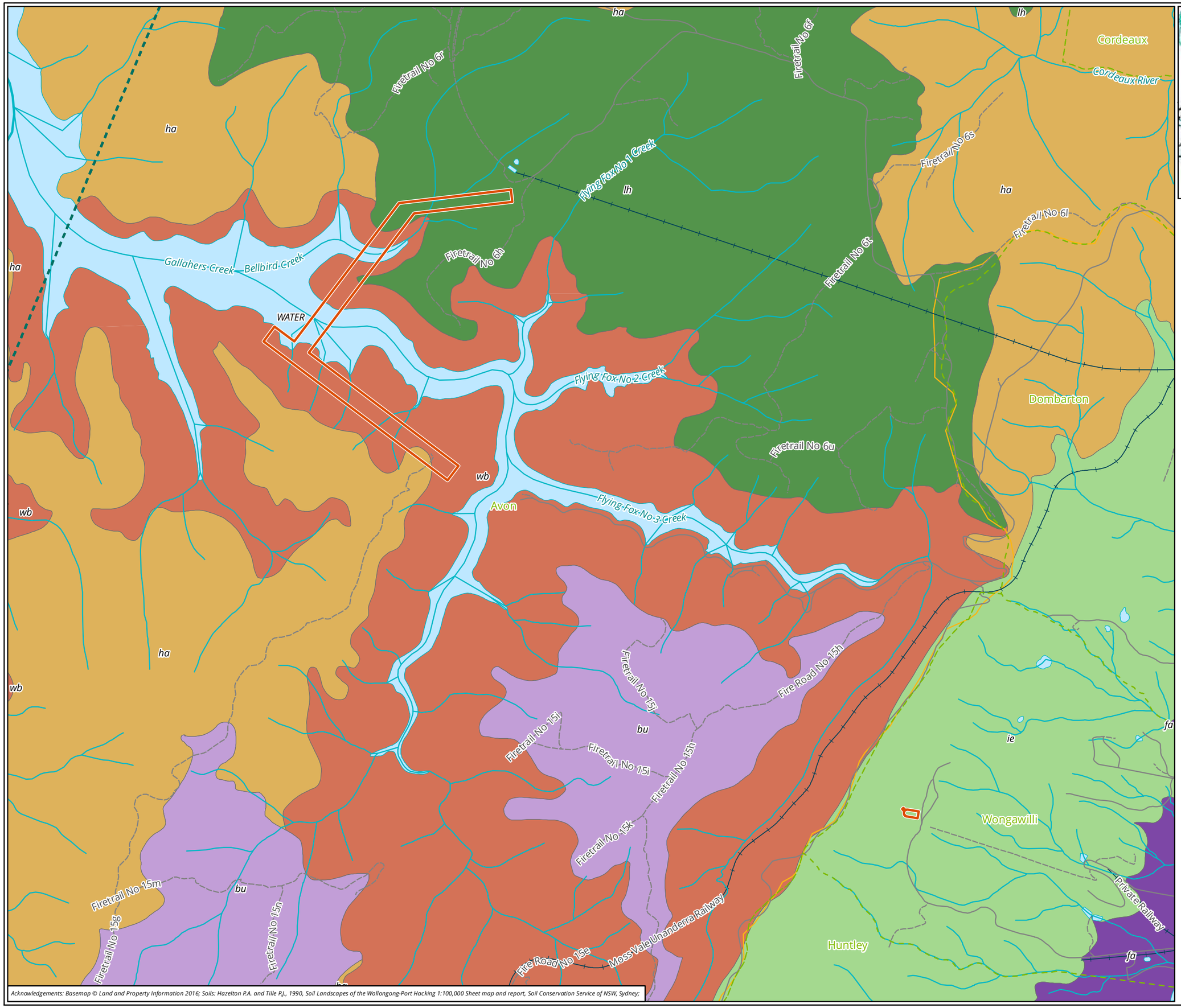
Scale: 1:20,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 25 June 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F5_Hydrology.mxd

*Acknowledgements: Basemap © Land and Property Information 2016*





**Legend**

Study area

**Soil Landscape units**

- bu - BUNDEENA
- fa - FAIRY MEADOW
- fb - FAULCONBRIDGE
- ha - HAWKESBURY
- ie - ILLAWARRA ESCARPMENT
- lh - LUCAS HEIGHTS
- WATER - WATER
- wb - WARRAGAMBA

**Figure 6 Soil landscapes 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: 33219
Date: 26 June 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F6_Soils.mxd

*Acknowledgements: Basemap © Land and Property Information 2016; Soils: Hazelton P.A. and Tille P.J., 1990, Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet map and report, Soil Conservation Service of NSW, Sydney;*

### 2.1.3 Landscape resources

The high rainfall and elevation of the study area encourage mesophilic vegetation on richer soils with cool temperate rainforest elements such as, Sassafras (*Doryphora sassafras*), Coachwood (*Ceratopetalum apetalum*), Cabbage-tree Palm (*Livistona australis*), Native Tamarind (*Diploglottis australis*), Cheese Tree (*Glochidion ferdinandi*), Lilly Pilly (*Acmena smithii*), Illawarra Flame Tree (*Brachychiton acerifolius*), with Water Gum (*Tristaniopsis laurina*) and Soft Tree-ferns (*Dicksonia antarctica*) and Rough Tree-ferns (*Cyathea australis*) in the gullies. Sydney Peppermint (*Eucalyptus piperita*), Turpentine (*Syncarpia glomulifera*), Grey Gum (*Eucalyptus punctata*), Smooth-barked Apple (*Angophora costata*) and Christmas Bush (*Ceratopetalum gummiferum*) dominate more exposed ridgelines (Mitchell 2002).

Many of the plants found within the study area were important to both Aboriginal people and European settlers inhabiting the area and could be used for numerous purposes. Food, tools, shelter and ceremonial items were derived from floral resources, with the locations of many campsites predicated on the seasonal availability of resources. 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).

The vegetation across the plateau would have supported a diverse range of fauna. These would have included koalas, quolls, rock wallabies, bandicoots as well as birds such as cockatoos, falcons and owls. Along the waterways there would have been frogs, platypus and within the waters there would have been numerous fish species, such as perch, eels and galaxias. These faunal species would have provided a range of resources for Aboriginal people. Terrestrial and avian resources were not only used for food, but also provided a significant contribution to the social and ceremonial aspects of Aboriginal life through their use as ritual implements or even simply through fashioning as personal adornments.

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. 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).

The geological landscapes would have provided various sources of stone material for Aboriginal people, from which a range of stone tools could be manufactured. Raw materials types would have included quartz and quartzite, silcrete, and harder stone such as basalt which could be located to the west. Locally, quartz would have been the main stone raw material type suitable for tool manufacture that would occur in the vicinity of the study area in any abundance. This would be in the form of pebbles derived from the Hawkesbury sandstone. Where outcrops or cobble beds occur, other potential raw materials for stone artefact making would have included tuff, mudstone, silcrete, chert, quartzite and basalt. Many of these materials occur well beyond the study area. Deposits of clays and ochres suitable for art, particularly stencil art are locally available in the vicinity of the study area and its adjacent land systems.

### 2.1.4 Land use history

The first recorded contact between Aboriginal and European peoples occurred in 1770, when Captain Cook sailed down the east coast of Australia in the Endeavour and observed cook fires and Aboriginal people carrying canoes along the coast (Organ 1990). The next recorded contact occurred in 1796, when Flinders and Bass travelled along the coast in the Tom Thumb. Organ (1993) also notes an expedition from Jervis Bay by George William Evans, in which the expedition met several groups of Aboriginal people on the way through the Wollongong area in 1812.

The first settlement in the Illawarra region was established by Charles Throsby Smith (C.T. Smith), who cut a cattle track from Glenfield to just behind South Beach, Wollongong, where he constructed a stockman's hut and cattle yard in 1815 (Osbourne 2000). Joe Wild was Throsby's stockman, and was also made constable of the district of Five Islands in 1815 (McDonald 1966). The following year, Surveyor-General John Oxley was sent to the Illawarra region to make a general survey of the area and to connect it to the known parts of the colony, as well as identify specific lands for prospective grantees (Osbourne 2000).

The early European history of the escarpment is dominated by the acquisition of natural resources. Cedar getters were said to be exploiting the cedar trees in the escarpment by 1805. So extensive was this exploitation that this supply was all but exhausted by the 1820s. The first coal mine constructed at mount Keira in 1849 and this industry spurred urban and industrial development during the 1880s (NPWS 2003, p.9).

Little further development took place within the study area after large portions of the escarpment were declared a state catchment area in 1880. The area was subsequently a conservation area and development was prohibited. A large state infrastructure project took place on the major lakes and rivers in the catchment, including on the Avon River, known as the upper Nepean Scheme (Water NSW 2015). This scheme sought to increase the state's water supply during the 1920s. Work on Avon Dam began in 1921 and finished in 1927 (Water NSW 2015). The resulting Lake has flooded surrounding tributaries and landforms. It has also raised the water level, possibly destroying or moving Aboriginal objects from their original locations.

Following the arrival of European settlers into the Illawarra, the movement of Aboriginal people began to become increasingly restricted. European expansion was swift and soon there had been considerable loss of land to agriculture. This led to violence and conflict between Europeans and Aboriginal people as both groups sought to compete for the same resources. At the same time diseases such as small pox were having a devastating effect on the Aboriginal population of the South Coast (Dowling 1997). Death, starvation and disease were some of the disrupting factors that led to a reorganization of the social practices of Aboriginal communities after European contact. The formation of new social groups and alliances were made as Aboriginal people sought to retain some semblance of their previous lifestyle.

## 2.2 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 majority of south coast Aboriginal sites date to the last 6,000 years when the sea-level stabilised following the end of the last Ice Age. Prior to this, sea levels were lower and the coast was located much further inland, about 14 kilometres to the east of its current position. Coastal sites older than 6,000 years are rare, as most would have been most likely inundated by the rising sea. Pleistocene-age Aboriginal sites on the south coast include a rock shelter at Burrill lake (located approximately 150 kilometres south of the study area) which has been dated to 20,830±810BP (ANU-138) (Lampert 1971, p.122) and a coastal midden at Bass Point dated to 17,010±650BP (ANU-536) (Bowdler 1970, p.254).

Previous archaeological work in the catchment areas of the Illawarra and Lower Sydney Basin regions began in the early 1960s, with the identification of a large shelter containing Aboriginal art and deposit by Fred McCarthy in 1961. This shelter site became known as 'Whale Cave' and has been discussed as part of academic investigations into regional variations of rock art and the prehistory of the Illawarra (Officer 1984, Sefton 1998, McDonald 1994). Very little archaeological excavation work has been undertaken in this region outside of coastal and estuarine areas. Those shelters that have been excavated within the inland plateau environment have yielded dates of 2220 + 70 BP, with evidence of the earliest occupation at Mill Creek 11

(Koettig 1985). Dating of the deposits at Mill Creek 11 and 14 in 1990 yielded similar dates. Biosis excavated Brennans Creek 2 and Brennans Creek 6 at West Cliff Colliery near Appin and recovered organic material in the deposits that yielded dates of 1791 + 40 BP (BC2) and 838 + 51 BP (BC6).

### 2.2.1 Regional overview

Regional studies relevant to the study area include an Honours study by Officer (1984) examining regional art variation in the Sydney basin region and Sefton's (1998) Master's thesis on regional Aboriginal site spatial patterning in the Woronora Plateau in 1998. The spatial patterning of Aboriginal sites in the Dendrobium area, which lies to the north of the study area in Avon and Cordeaux catchments, has been revisited by Biosis (2007) and Rich (1989) as part of environmental impact assessments.

Officer's (1984) Honours Thesis involved the formal analysis of 57 sandstone shelters and seven engraving sites in the Campbelltown region to explore and describe the formal variability within a local body of art, at a local and regional level. He identified strong localised ties between the coast and hinterland, despite a linguistic boundary and other evidence for cultural dichotomy.

McDonald (1994) completed a PhD thesis that focussed on prehistoric rock art within the Sydney region. The rock art that was examined included open sites comprising engravings or petroglyphs, and rock shelter sites, comprising rock art consisting of drawing, stencils, paintings and engravings. Information gathered from previous archaeological work throughout the Sydney Basin was used to define a model for cultural interaction which can describe this prehistoric art system, which was to be based on information exchange theory.

A number of major differences were identified in site type frequency and site component variations. Shelters with art south of the Georges River had a much lower association with deposit (7%), while to the north, almost one third (30%) contained both art and deposit components. Further, almost one third (28%) of shelter sites with deposit contained grinding grooves, whereas only 12 of 113 sites (10.6%) north of the river contained grinding grooves. It should be pointed out that it is highly probable that the number of shelters with art and deposit is much greater than recorded, due to observer bias, increasing the figures for pigment art and occupation deposit correlation. This is also the trend when looking at the presence of rock engraving sites. North of the Georges River, 155 of the 365 sites contain rock engravings, while south of the Georges River; only two out of 181 sites contain rock engravings.

An extremely large proportion of motifs (41%) recorded consist of unidentifiable motifs, which can be attributed to poor preservation from the great instability of the sandstone surfaces within the shelters. Of the identifiable motifs, hand stencils and hand variations predominate (49%). The other main motifs include macropods (9%), anthropomorphs (7%) and other land animals (5.5%). The majority of the art is depictive (66.1%), followed by stencilling (32.6%) and engraving (1.3%). Of these, most are created using dry pigments, such as charcoal. The remainder have been painted, and very few are a combination of both. Colours used in stencilling are dominated by red and white, while a small number of localised yellow and black stencils have also been recorded. Depictive motifs have been executed in outline and infill form.

McDonald noted that in comparing the two art forms, art within shelters and open art sites, it could be said that there are two synchronous art forms in the Sydney Basin. The comparison revealed two underlying similarities between the art forms, firstly that they are both relatively recent and, secondly that they are roughly contemporaneous.

There are significant variations in motif assemblages throughout the region. Motif classes that are present in the northern and southern areas are not present in the central area of the Sydney Basin. Similarities in Tharawal and southern Darug motifs, compared with northern Darug motifs, indicate that the proposed boundary between these two language groups was unimportant. Colour usage in the different language areas reveals definite stylistic preferences across the region. These findings can be used to conclude that

there are major variations in rock art technique and motif type between southern areas on the Woronora Plateau and the central and northern areas of the Sydney Basin.

Sefton (1998) completed postgraduate work that focussed on site and artefact patterns on the Woronora Plateau. The data used for this investigation was collected over a number of years (between 1970 and 1998) by the Illawarra Prehistory Group. The study area comprised a 351 square kilometre area stretching from the Illawarra Escarpment in the east, north to the Woronora River, west to Wallandoola River and the southern reaches of the Cataract Catchment. The results of field work completed over the last 20 years were used as the basis of analysis to identify patterns and determine the relationship between shelter distribution, archaeological content, and suitable environment, economic strategy and settlement patterns.

The major associations considered included patterned relationships between sites, the cultural material they contained, the drainage basin on the Woronora Plateau in which they are located and their coastal or inland location. One of the major limitations of Sefton's assessment for Aboriginal sites, was that the survey technique was not designed to systematically identify surface stone artefact scatters, but rather focussed on sandstone overhangs, open sandstone outcrops or platforms, and grinding grooves. The analysis of archaeological sites was solely focussed on grinding grooves, engravings, and shelter sites and the archaeological features that are associated with them.

Many archaeologists argue against the use of site frequency to determine population density and land use patterns as it does not take into consideration behavioural change and archaeological site visibility that bias the interpretation of the archaeological record (Attenbrow 1987, Vinnicombe 1980). However, Sefton argues that site density can be used as an indicator of spatial distribution or density of the Aboriginal population within the study area using multivariate analysis (Sefton 1998, p.62). She concludes that the high density of grinding grooves located within the Georges River Basin indicated a higher population density in this basin than that in the Cataract River Basin. Despite a correlation between the presence of rock engravings and grinding grooves at the same location, rock engravings are generally restricted to the coastal regions rather than inland regions with the overall distribution of shelters is markedly similar to the distribution of grinding grooves (Sefton 1998, p.120). Variations in distribution can be attributed to appropriate environmental requirements such as sandstone overhangs or sandstone platforms.

The analysis of shelter sites and attributes demonstrated clear patterns between shelters, shelter attributes, drainage basins on the Woronora Plateau and the inland/coastal associations of the shelter sites (Sefton 1998, p.166). The results indicated a difference in settlement patterns, population size and differential use of the study area. These differences corresponded with the ethnographic observations of a coastal/inland subdivision of the Tharawal population, and the concept of a drainage basin based territorial division within the study area.

Rich (1989) undertook a survey of proposed road upgrades for Fire Road no. 15 and Cordeaux Road near Mount Kembla partly along the Illawarra Escarpment and along American Creek. Rich provided a discussion of the likelihood of sites being located within her study area. She noted that the top of the Illawarra Escarpment is quite flat and would have been a good access route for travel between the coast and inland. Sites located on the escarpment would reflect temporary stop over camps with low density scatters representing maintenance and sharpening of tools rather than the manufacturing of tools. However, such low density of artefacts would be difficult to locate due to the poor visibility in the area, and within the road corridor study area, would probably have been damaged or destroyed by the development of the road. Along American Creek, which was within the road corridor, it is possible that open occupation sites may have been present and these would probably have been low density scatters reflecting local materials and utilised by small family groups (Rich 1989, p.12). During the survey no Aboriginal Archaeological sites were located within the road corridor, nor had any sites previously been recorded within the corridor. The survey corridor was very narrow up to 10 metres wide of the existing road, and it did not include any of the flat ground at the

top of the escarpment or along American creek. The corridor was very disturbed by road construction and ground visibility was very low due to grass cover, leaf litter and gravel and bitumen roads.

Biosis Research (2007) undertook an archaeological and cultural heritage assessment of Dendrobium Area 3 for proposed longwall mining activities by BHP Billiton Illawarra Coal. During this survey, 65 Aboriginal archaeological sites were re-assessed or newly identified. It was concluded that the most sensitive landforms associated with Aboriginal archaeological sites within the study area were those associated with the Hawkesbury Sandstone soil landscape. These landforms comprise drainage features which produce deeply incised, rocky gullies and valleys suitable for the formation of sandstone overhangs and shelters. Previous surveys either tended to focus on these more sensitive landforms by undertaking targeted contour and drainage surveys, or by employing opportunistic surveys that focused on areas of previous disturbance such as vehicle tracks or potential impact areas such as seismic lines. This was achieved by walking parallel to these characteristic topographic features and inspecting for suitable overhangs and open sandstone platforms. The results of this survey showed that the area contains archaeological sites typical of the Woronora Plateau, and observations from this assessment are generally consistent with previous major studies in the area (Navin Officer 2000, Sefton 1994, Sefton 1997). The area contains a diversity of shelter sites, art motifs and techniques consistent with the local region and it was concluded that the area presented a strong sample to accurately characterise Aboriginal site patterning.

Biosis Research (2012) conducted an archaeological survey for an Aboriginal cultural heritage assessment to accompany the AHIP application for Dendrobium 3B area for proposed mining activities by BHP Billiton Illawarra Coal. The survey targeted landforms predetermined to have a high potential for Aboriginal heritage and in order to relocate previously recorded sites. All 23 previously recorded sites were relocated during the survey. The majority of sites were shelters with art, which also include shelters with art and deposit, followed by shelters with deposit and stone artefact scatters. No grinding grooves or stone arrangements were identified. It was concluded that the frequency of Aboriginal site types as recorded on the Aboriginal Heritage Information Management System (AHIMS) register is roughly comparable to the site types identified within the Dendrobium 3B area. The lack of grinding grooves sites was considered unusual, but lack of stone arrangements was attributed to the relatively small number of this site type within the wider region. Out of the 23 Aboriginal sites, three were assessed as having high scientific significance.

### 2.2.2 Local overview

A number of Aboriginal cultural heritage investigations have been conducted within the vicinity of the study area. Most of these investigations were undertaken as part of determining impacts of mining activities and primarily included surface investigations. These investigations are summarised below.

Attenbrow (1983) surveyed the area for the proposed rail link between Maldon and Dombarton. The southern route of the proposed rail link runs along the northern reaches of Gallaher's Creek, approximately 3 kilometres north of the current study area. During the survey one shelter was identified in the Cordeaux Catchment along the proposed route. It was recommended that further archaeological testings and recordings are undertaken for all the sites that are identified along the proposed route, or the sites should be avoided by diverting the route.

Sefton (1990) completed archaeological survey of the Cordeaux and Woronora rivers as part of the Illawarra Prehistory Group with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. Surveys were undertaken of two areas: one in the Cordeaux Catchment area approximately eight kilometres north of the current study area, the other is in the Woronora Eastern Catchment area. During the survey a total of 87 archaeological sites were located within the Cordeaux Catchment study area. Sefton provides useful statistical data about site types and content based on the site information recorded during the survey. The most common site type were shelters (n=58), followed by 29 grinding sites, two rock engraving sites and two engraved groove channel sites. A total of 667 motifs are depicted within the shelters.

The most common art technique is charcoal drawing motifs (n=571), followed by 57 red drawings, 42 red stencil, 17 white stencil, 13 red painting, seven bichrome and four white drawings.

Sefton (1991) conducted an additional survey concentrating on the areas around Wongawilli Creek, a tributary of the Cordeaux River. Wongawilli Creek is located four kilometres north of the current study area. Sites recorded during this survey: Browns Road Site 8 (52-2-1623), Browns Road Site 11 (52-2-1626), Browns Road Site 12 (52-2-1627) and Browns Road Site 13 (52-2-1628). A comparative analysis of the site types and their frequencies within both the Woronora and Cordeaux Catchments led Sefton to conclude that due to higher numbers of grinding groove sites and shelters with artefacts in the Woronora Catchment, this area had sustained larger population than the Cordeaux Catchment area. From the analysis of art motifs and art techniques Sefton inferred that this increased artistic expression is related to more complex social and religious life.

Sefton (1994) undertook archaeological survey of the Avon River as part of the Illawarra Prehistory Group with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. The survey area is located in the Avon Catchment area, which includes part of the current study area. The majority of survey effort was centred on Hawkesbury Sandstone, and Sefton derived her methodology based on her knowledge of the geology and topography and the study of maps. She formed the following model that was used as her methodology:

- Stone arrangements and rock engravings were considered likely to occur on flat sandstone caps on ridge tops or in saddles.
- Grinding grooves were considered likely to occur on water pans at ridge top level or on sandstone associated with swamps.
- Engraved groove channels and rock engravings were likely to be associated with swamps.
- Under ridge top caps, sandstone overhangs may be present and may contain art, archaeological deposits and/or art, archaeological deposit and/or grinding grooves.
- On valley slopes, sandstone overhangs frequently occur and these may contain art, archaeological deposit and/or art, archaeological deposit and/or grinding grooves.
- Surface deposits in overhangs were searched for stone artefacts and shell.

The survey concentrated on sandstone outcrops and surface scatters were only looked for where walking tracks had exposed the ground. Within the area surveyed by Sefton, 53 shelters with art were located and 17 contained stone artefacts. Thirteen grinding grooves were located, two stone arrangements and one engraved groove channel.

Sefton (1997) undertook another archaeological survey of the Avon River as part of the Illawarra Prehistory Group. The study area includes the western section of the Avon River, between the Illawarra escarpment and the confluence with the Nepean River, as well as part of the current study area. During this survey, the same methodology was used as for her 1994 survey (see above). The survey located 104 shelters, with art found in the majority of shelters. Eighty-two shelters with art were located and most of the shelters contained a deposit. Grinding grooves were the most frequent sites type among open sites, 19 in total. Stone artefacts were found in 50 of the shelters, there were six stone arrangements and two engraved groove channel sites. Shell was found in one of the shelters.

Navin Officer (2000) completed a large-scale cultural heritage assessment for the Dendrobium Coal Project, an area that is located to the north of the study area. Other areas in the study included the Nebo Colliery, Kemira Colliery and the West Cliff Colliery emplacements. Sample areas selected for the field survey were within the zones of proposed impact, areas that were assessed as being archaeologically sensitive and areas that had gaps in the record. The survey methodology aimed to re-assess previously recorded sites and

identify new sites within impact zones. The field survey consisted of targeted surveys of two types, the first involving selected areas aimed at locating sandstone shelters and the second to focus on areas of exposure where there was potential for detection of open campsites. Any large trees spotted during survey were also targeted and inspected for cultural scarring.

Navin Officer provides a good discussion on considerations of visibility and site obtrusiveness on the Woronora Plateau and Illawarra Escarpment. The obtrusiveness of sandstone rock shelter and overhang sites, even in heavily vegetated areas is always high, so these sites are likely to be detected and inspected during survey. In comparison the obtrusiveness of surface sites, such as axe grinding grooves, engraved channels and motifs on sandstone platforms, or stone artefact scatters, which occur virtually anywhere, is low to very low because of the limited ground surface visibility described above. Sandstone shelves suitable for axe grinding grooves and channels are more often than not covered in leaf litter and moss from bushes that grow on trapped sediment. The concept of visibility is also applicable to the surface of shelter sites when considering archaeological potential or looking for artefacts exposed in drip lines. The Navin Officer survey relocated 19 previously recorded Aboriginal sites and identified 11 previously unrecorded sites, majority of which were shelters with art.

Biosis Research (2009) was commissioned by Gujarat NRE Minerals Limited (NRE) to undertake an archaeological and cultural heritage impact assessment for the proposed mining of Longwalls 11, 12, 15, 16, 19 and pillar extraction area 1 at Wongawilli Colliery, approximately 700 metres north of the current study area. Most of the study area had been subject to previous archaeological survey that focussed on sandstone outcrops and cliff lines, and creeks and drainage. The aim of the cultural heritage investigation was to identify, record and assess the value of Aboriginal or historical archaeological sites within the study area through landform survey and targeted site re-assessment. This information formed the basis of the subsidence impact assessment for the proposed longwalls and one pillar extraction area. A total of 28 Aboriginal archaeological sites are situated within the study area for Longwalls 11, 12, 15, 16, 19 and pillar extraction area 1. No historical archaeological sites were previously recorded within the study area, and no new historical sites were identified during the survey.

Based on subsidence predictions, it was unlikely that there would be impacts to the archaeological sites resulting from the proposed longwall mining. Aboriginal archaeological sites that have some potential to be impacted by the proposed longwall mining, were subjected to monitoring. This involved site inspections prior to extraction, during extraction, and three, six and 12 months following the completion of extraction of relevant Longwalls and one pillar extraction area for six sites. A Cultural Heritage Management Plan (CHMP) was also developed from this assessment.

ERM (2010b) was commissioned by Gujarat NRE FGCL Pty Ltd to undertake an Aboriginal heritage assessment of the Nebo mining area within the NRE Wongawilli Colliery, approximately five kilometres north-east of the current study area. A field survey was conducted on foot and targeted the location of previously recorded archaeological sites and creek lines. No new Aboriginal sites were located; however, one previously identified Aboriginal site (AHIMS 52-2-2247/Dendrobium 5) was relocated. Predictions made by SMEC (2010) indicated that Dendrobium 5 is located outside of the area of predicted impacts and that no subsidence, strain or tilt will occur; therefore, no management or monitoring was required.

Dibden (2011) analysed the rock art on the Woronora Plateau, west of Wollongong, as part of her PhD. Her research examined the diversity and spatial distribution of rock art across the land and changes over time. The current study area was included in her analysis. Dibden used two data sets for her research, which included data from 110 rock shelters recorded during 20 weeks of fieldwork and data from the Illawarra Prehistory Group database of 700 recorded open sites and rockshelters. The two different data sets were explored in accordance with their geographic and environmental location in order to gain an appreciation of the experience and engagement between Aboriginal people and the land in this part of the Sydney Basin. Dibden found that the rock art became increasingly diverse in a number of formal and material ways, and

also became geographically and environmentally common and widespread. She also developed a temporal rock art sequence based on colour and technique:

- Phase 1 – intaglio engraved motifs greater than 4000 years old.
- Phase 2 – red hand stencils and hand prints, and red pigment smears over large areas between 500 and 4000 years old.
- Phase 3 – recent production (less than 500 years ago) of white and cream stencils; pigment blobs and circles; scratched, pitted and subbed marks; charcoal drawn motifs; re-drawing of earlier red drawn motifs; and white painted and drawn motifs.

According to Dibden's sequence, the majority of rock shelters in close proximity to the current study area are Phase 2 and Phase 3 shelters. The results suggests that regional bodies of rock art are likely to have been produced in accordance with a diversity of motivations and functional purposes and that significant temporal changes can occur over relatively short time frames.

Biosis (2013) was commissioned by Gujarat NRE Wonga Pty Ltd to undertake an Aboriginal heritage constraints assessment for the proposed Longwalls 1-6 in the Avon Domain located in the Avon Catchment area, approximately 500 metres south-west of the current study area. A total of 15 Aboriginal cultural heritage sites have previously been registered within the study area AHIMS. A field survey was undertaken over 14 days to re-locate previously recorded sites and identify any additional Aboriginal heritage. A total of 13 previously recorded Aboriginal cultural heritage sites were re-located during the survey, with two sites observed to be the same site (AHIMS 52-2-1157 and 52-2-1971). Three sites previously recorded on AHIMS register could not be re-located. In addition, five new Aboriginal sites were identified. It was recommended that an ACHA be undertaken in consultation with Aboriginal stakeholders to ascertain the Aboriginal cultural values of the study area.

### 2.2.3 AHIMS site analysis

A search of the AHIMS database (Client Service ID: 511747) identified 87 Aboriginal archaeological sites within a 2 by 2 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 area. 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 upon where notable discrepancies occurred.

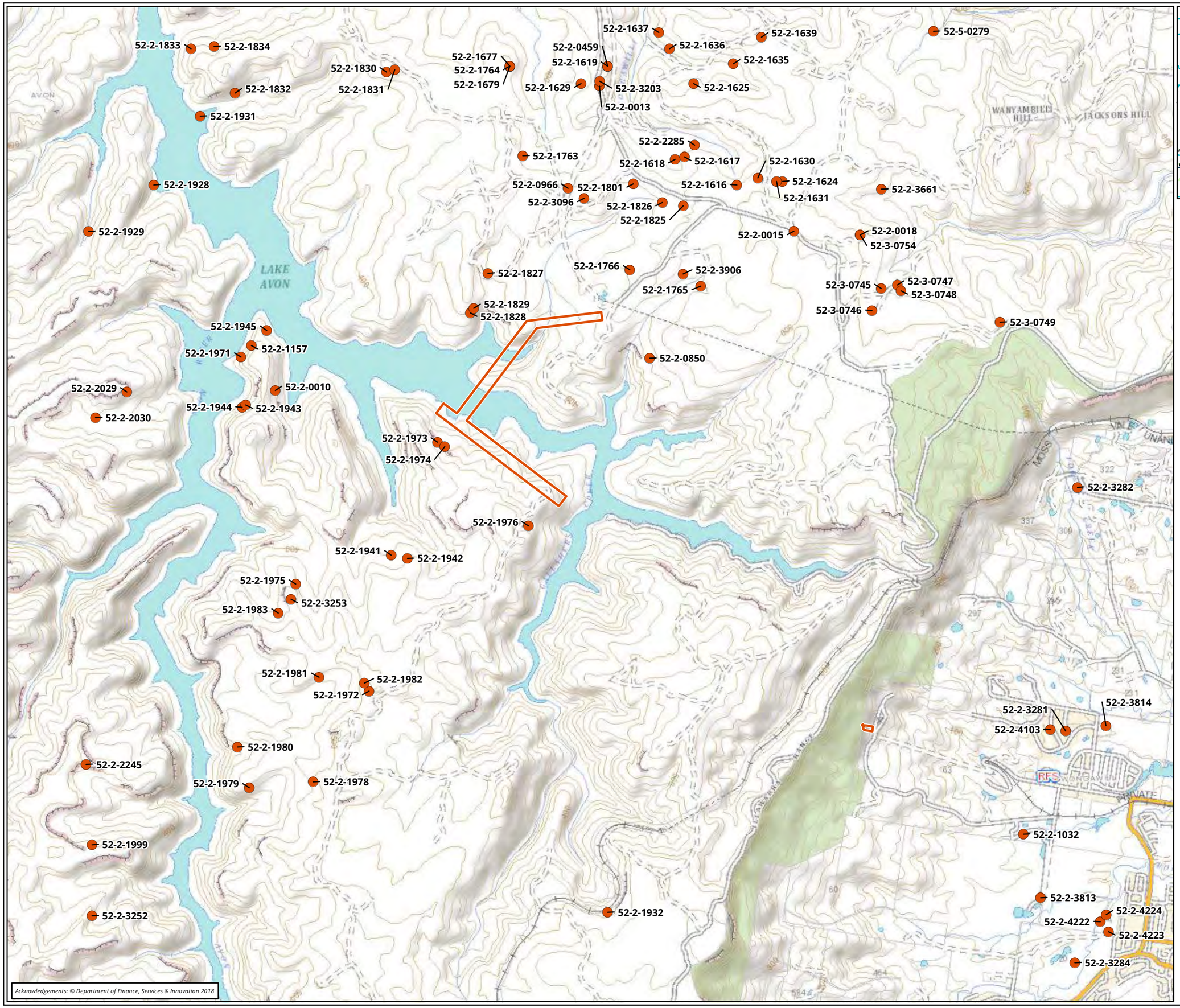
It should be noted that the AHIMS database reflects Aboriginal sites that have been officially recorded and included on the list. Large areas of NSW have not been subject to systematic, archaeological survey; hence AHIMS listings may reflect previous survey patterns and should not be considered a complete list of Aboriginal sites within a given area. Some recorded sites consist of more than one element, for example art and potential archaeological deposit (PAD); 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 104 results presented here, compared to the 87 sites identified in AHIMS.

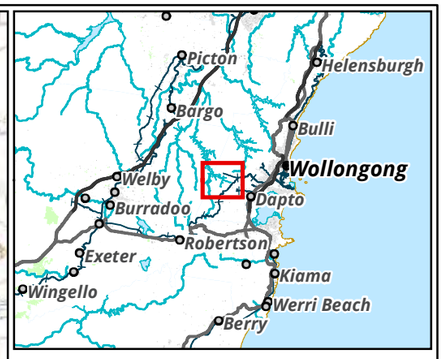
**Table 7 AHIMS site type frequency**

| Site type | Number of occurrences | Frequency (%) |
|---|---|---|
| **Art (pigment or engraved)** | 47 | 45.19 |
| **Artefact** | 25 | 24.04 |
| **Grinding groove** | 15 | 14.42 |

| Site type | Number of occurrences | Frequency (%) |
|---|---|---|
| **PAD** | 14 | 13.46 |
| **Stone arrangement** | 3 | 2.88 |
| **Total** | **104** | **100.00** |

A simple analysis of the Aboriginal cultural heritage sites registered within 2 kilometres of the study area indicates that the dominant site type is art (pigment or engraved), representing 45.19% (n=47), followed by artefact at 24.04% (n=25). Grinding grooves and PAD were represented by 14.42% (n=15) and 13.46% (n=14) respectively. Stone arrangements accounted for 2.88% (n=3). All the sites were located within close proximity to the reliable sources of water or within areas of relevant sandstone outcrops for grinding grooves and overhang development (shelters with art/deposit).




**Legend**

- Study area
- AHIMS record

**Figure 7 AHIMS sites in the vicinity of the study area**

0 250 500 750 1,000

Metres

N

Scale: 1:30,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 13 July 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F7_AHIMS.mxd

## 2.3 Discussion

The study area is located within the southern Woronora Plateau, an area with a landform pattern typically characterised as 'level to rolling pattern of plains, rises and low hills standing above a cliff, scarp or escarpment that extends around a large part of its perimeter' (Speight 2009, p.69). Typical landform elements that are associated with plateau landform pattern as defined by Speight (2009) are present within the study area: cliff, hillcrest, hillslope and drainage depressions.

Several water ways are located within or close to the study area, including Gallahers Creek, Bellbird Creek, Flying Fox No. 1 Creek, Flying Fox No. 2 Creek and Flying Fox No. 3 Creek. Stream channels within the study area are typically erosional, closely spaced and drain into Avon River and Gallaher's Creek.

The study area is located within five soil landscapes: Warragamba, Bundeena, Hawkesbury, Illawarra Escarpment, and Lucas Heights. In general, a mixture of colluvial and residual landscapes is beneficial to preserving archaeological material, in particular on level landforms without much gravitational movement. Deposits within shelters may also be preserved especially where residual landscapes are present because soil and associated archaeological material is unlikely to be moved once buried in-situ.

Minimal usage has occurred within the study area. After preliminary use for logging and initial mining activities it was quickly declared a conservation and catchment area in 1880. Little development has taken place within the study area during this time besides the construction of access and fire tracks. The construction of Avon Dam in 1927 may have disturbed some sites within the region and study area as the water level rose.

Regional and local archaeological studies have shown extensive use of the Woronora Plateau and Illawarra escarpment. A variety of archaeological evidence such as stone artefacts, grinding grooves, modified trees rock shelters with art and deposit as well as stone arrangements show complex social systems and use of the region. Local analysis has suggested a rock art sequence formally developed by Dibden (2011) which stipulates three phases. The potential rock of in the study area would likely be phase two or three.

## 2.4 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 |
|---|---|---|
| **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. | High: The sites will only occur where suitable sandstone exposures or overhangs possessing sufficient sheltered space exist, which are present in the study area, and associated with the Hawkesbury soil landscape. |
| **Axe grinding grooves** | Grooves created in stone platforms through ground stone tool manufacture. | High: Axe grinding grooves are relatively common in the local region and occur in association with the Bundeena and Hawkesbury soil landscapes. These sites are likely to occur on suitable horizontal sandstone rock outcrops in close proximity to water |
| **Stone arrangements** | Stone arrangements can include circles, mounds, lines and various other patterns, most commonly associated with ceremonial sites, mythological or sacred sites, such as bora grounds or rings. The vast majority of these sites are situated on ridgelines or higher elevations within the landscape where surface stone is available. | High**:** Three stone arrangements have been recorded within the vicinity of the study area. |
| **Potential archaeological deposits (PADs)** | Potential sub surface deposits of cultural material. | Moderate: PADs have been previously recorded in the region across a wide range of landforms including alluvial flats, slopes, ridgelines and crests. They have the potential to be present in undisturbed landforms within the study area. |
| **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. | Moderate: Stone artefact sites have been previously recorded in the region across a wide range of landforms including slopes, ridgelines and crests, particularly in association with the Lucas Heights soil landscape. They are unlikely to be identified due to poor ground surface visibility across the study area; however, they may occur in rock shelters where ground surface visibility is high. |
| **Aboriginal Ceremony and Dreaming Sites** | Such sites are often intangible places and features and are identified through oral histories, ethnohistoric data, or Aboriginal informants. | Moderate: There are currently no recorded mythological stories for the study area; however stone arrangements have been recorded in the vicinity of the study area and are commonly associated with ceremonial sites, mythological or sacred sites. |

| Site type | Site description | Potential |
|---|---|---|
| **Modified trees** | Trees with cultural modifications | Moderate: Appropriate tree species are known to occur within the study area. As the area is part of the Sydney Catchment it has been somewhat protected from timber cutting and clearance. However, preservation of dead trees and high intensity periodic bush fires will reduce the likelihood of these sites being present. As such, there is moderate potential for identifying scarred trees where these remnant tree species have survived. |
| **Rock engravings** | Rock engravings are created by repeatedly scraping or hammering soft, sedimentary rock surfaces, such as sandstone. These sites can include outlined or filled motifs of animals, human figures, pathways or dreaming/ceremonial symbols. Such sites are situated where open areas of suitable sandstone are present | Low: Very few of these sites have been previously recorded throughout the region surrounding the study area, despite there being numerous exposures of sandstone associated with the Bundeena soil landscape. This can be attributed to cultural differences between groups within the Sydney basin with such sites being situated north of the study area. Thus, it is considered unlikely that these sites will occur within the study area. |
| **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 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. |
| **Burials** | Aboriginal burial sites. | Low: Aboriginal burial sites are generally situated within deep, soft sediments, rock shelters 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 do occur within the study area: however, no burials have been recorded within rock shelters in the vicinity of 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 associated with post-contact Aboriginal use. | 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 |
|---|---|---|
| **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. |

# 3 Archaeological survey

A field survey of the study area was undertaken between 31 August and 2 September 2020 by Samantha Keats (Consultant Archaeologist), Matthew Tetlaw (Research Assistant), Byron Dale (Field Assistant), James Davis (Wodi Wodi Traditional Owner), and Paul Cummins and Kayla Williamson (Woronora Plateau Gundangara Elders Council). The field survey sampling strategy, methodology and a discussion of results are provided below.

## 3.1 Archaeological survey objectives

The objectives of the survey were to:

- Provide RAPs an opportunity to view the study area and to discuss previously identified Aboriginal object(s) and/or place(s) in or within close proximity to the study area.
- 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 PADs.

## 3.2 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.

### 3.2.1 Sampling strategy

Parts of the study area have been previously surveyed by Sefton (1997). Based on all previous archaeological work within the region, the survey methodology involved targeted survey of known landforms of archaeological sensitivity in order to re-locate previously recorded Aboriginal archaeological sites and to systematically survey the study area for new Aboriginal sites. Shelter sites are most likely present within moderate to steep sandstone slopes and ridgelines in the proximity to permanent water sources. Shelter sites occur rarely on slopes that are lower than 20-30 degrees gradients, and they have never been recorded on slopes greater than 40 degrees. Ridge tops with sandstone rock outcrops were also systematically surveyed as well as any sandstone platforms within the vicinity of permanent water.

### 3.2.2 Survey methods

The archaeological survey was conducted on foot with a field team of four 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 were possible. Any potential Aboriginal objects observed during the survey were documented and photographed. The location of Aboriginal cultural heritage and points marking the boundary of the landform elements were recorded using a hand-held Global Positioning System (GPS) and the Map Grid of Australia (MGA) (94) coordinate system.

## 3.3 Archaeological survey results

The survey was conducted across two landforms, steep hills and steep low hills. Due to dense vegetation across most of the study area and limited access to some cliff lines, the surveyors walked in single file where required. On fire trails or unsealed roads the survey team walked on either side of the track with a spacing of two metres. 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 or PADs were identified in the study area. The results from the field survey have been summarised in Table 9 below.

Generally, the survey was hampered by very poor ground surface visibility due to extremely thick vegetation and dead leaf and tree litter. Much of the ground was covered, obscuring the ground and making it almost impossible to identify site types such as artefact scatters, which may occur virtually anywhere across the landscape (Photo 1). On the other hand, the presence of site types such as shelters and rock platforms is high, and these sites were easily detected and inspected during the survey (Photo 2). Locating site types such as axe grinding grooves, engraved channels and motifs on sandstone platforms was low to moderate, and they were more often than not covered in moss and leaf litter that could hinder the identification of these sites (Photo 3). Many clifflines within the study area, particularly the ones that expand along the edges of Avon River, are extremely high and in many places impassable.

In some areas, due to safety concerns, very steep clifflines were not walked along or were walked from a fair distance from the edge. This is not considered to be a significant constraint to the targeted cliff survey given the uncommon occurrence of impenetrable vegetation and inaccessible cliffs, whilst the clifflines were inspected from both below and above. It should be noted that considering such unfavourable access to some of these areas and also the fact that majority of the very high clifflines do not have an overhang development and are within slopes greater than 40 degrees, they would have a low archaeological potential. These areas are within the Narrabeen geological formation and Warragamba soil landscape. Results of the survey showed that this soil landscape and geological formation have generally low archaeological potential.

Shelter sites were identified only in areas that have overhang development and moderate to steep slopes. Sandstone outcrops in the Hawkesbury soil landscape were very common with frequent well developed overhangs; however, this soil landscape was only present in a small part of the study area. Some of these cliffs are not easily accessible, mainly due to very thick vegetation (Photo 4). Shelters range in size from large overhangs or caverns, to small walls or sheltered areas formed by detached boulders.

There were minimal disturbance within the study area. Natural disturbances included burrowing and scratching in soil by animals, such as wombats and wallabies, and sometimes exposure from slumping or erosion. Disturbances associated with recent human action are relatively minor and are confined to access tracks, Wongawilli No. 1 vent shaft (Photo 5) and Wongawilli pit top (Photo 6).

**Photo 1 West facing photo showing the steep terrain and low visibility**

**Photo 2 South facing photo showing sandstone overhangs**

**Photo 3 North facing photo showing areas of exposure associated with rock platforms**

**Photo 4 East facing photo showing thick vegetation**

**Photo 5 South facing photo showing disturbances associated with Wongawilli Shaft 1**

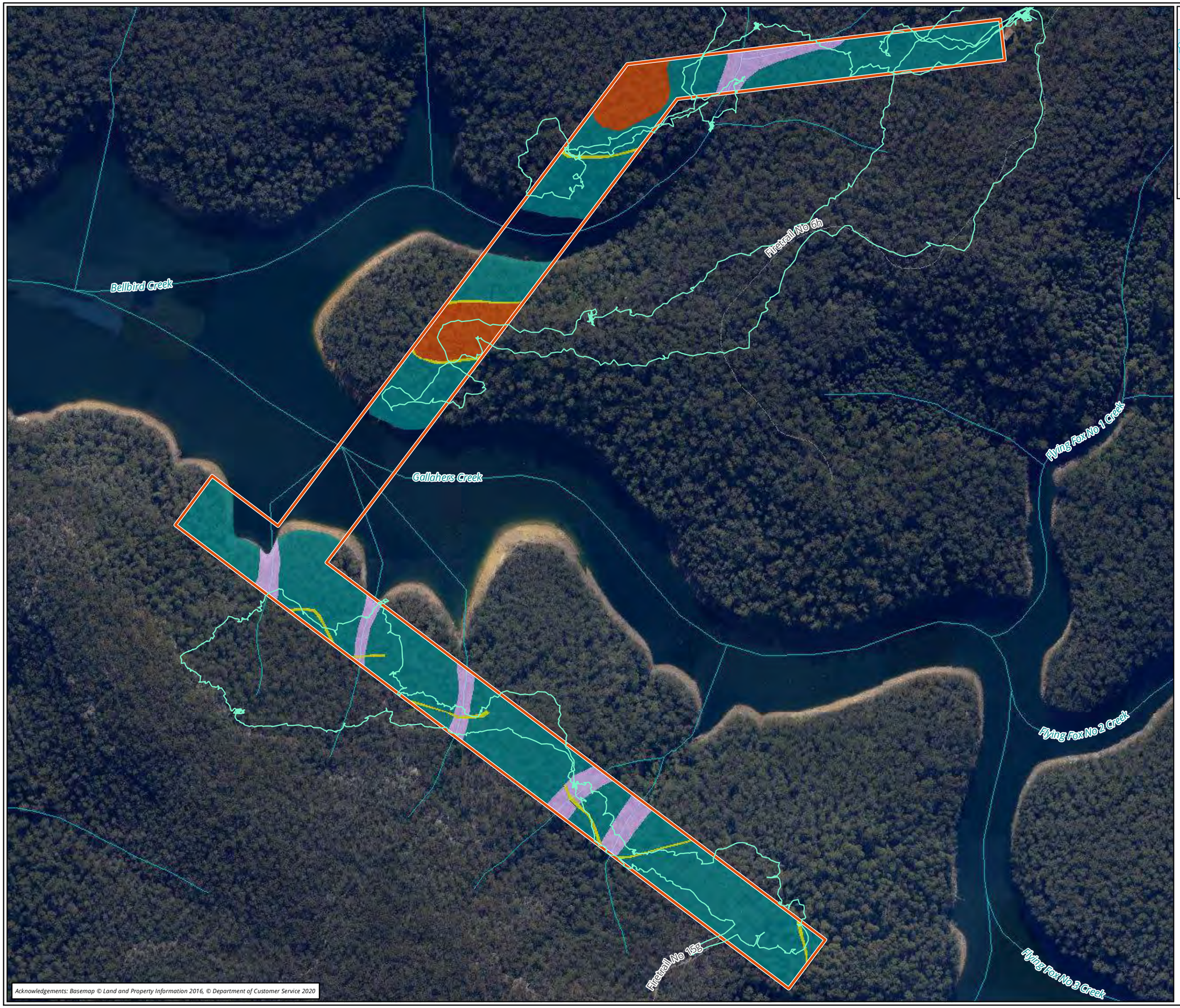
**Photo 6 West facing photo showing disturbances at the Wonagawilli pit top**

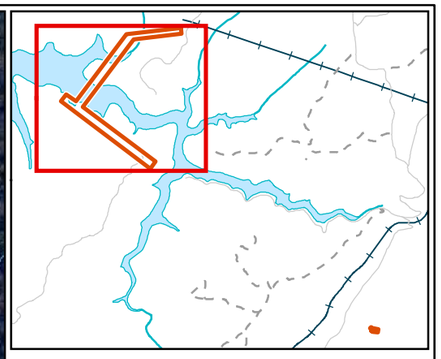
**Table 9 Survey coverage**

| Landform | Survey unit area (m²) | Visibility (%) | Exposure (%) | Effective coverage area (m²) | Effective coverage (%) |
|---|---|---|---|---|---|
| **Cliff** | 4,963 | 10 | 10 | 1,012 | 20.40 |
| **Crest** | 23,025 | 20 | 10 | 1,378 | 5.98 |
| **Drainage depression** | 23,446 | 10 | 10 | 2,371 | 10.1 |
| **Slope** | 194,750 | 10 | 10 | 19,089 | 9.80 |

**Table 10 Landform summary**

| Landform | Landform area (m²) | Area effectively surveyed (m²) | Landform effectively surveyed (%) | No. of Aboriginal sites | No. of artefacts or features |
|---|---|---|---|---|---|
| **Cliff** | 4,963 | 1,012 | 20.40 | 0 | 0 |
| **Crest** | 23,025 | 1,378 | 5.98 | 0 | 0 |
| **Drainage depression** | 23,446 | 2,371 | 10.1 | 0 | 0 |
| **Slope** | 194,750 | 19,089 | 9.80 | 0 | 0 |



**Legend**

- Study area
- Survey tracks

**Landform**

- Cliff
- Crest
- Drainage depression
- Slope

**Figure 8.1 Survey effort**

0 50 100 150 200

Metres

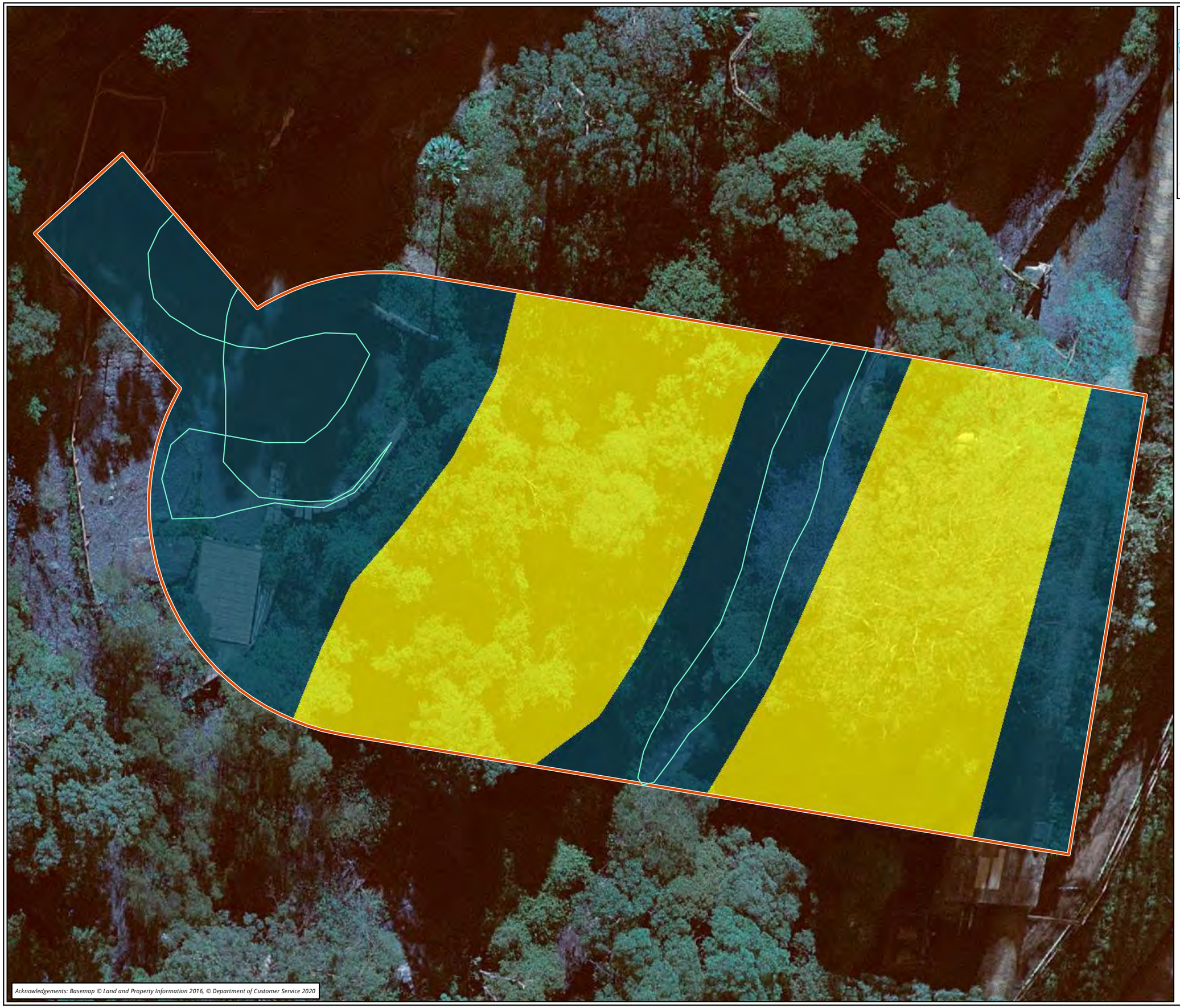
N

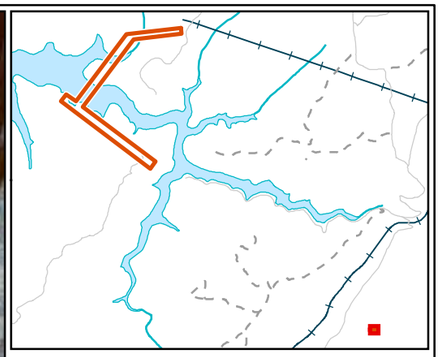
Scale: 1:6,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 15 September 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F8_SurveyEffort.mxd





**Legend**

- Study area
- Survey tracks

**Landform**

- Cliff
- Disturbed

**Figure 8.2 Survey effort**

0 3 6 9 12

Metres

N

Scale: 1:300 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 15 September 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F8_SurveyEffort.mxd

## 3.4 Discussion of archaeological survey results

The archaeological survey consisted of a meandering foot transect, which targeted all accessible parts of the study area. The results of the field survey are provided in Figure 9. The assessment for areas that have low, moderate or high 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, and results of the current survey.

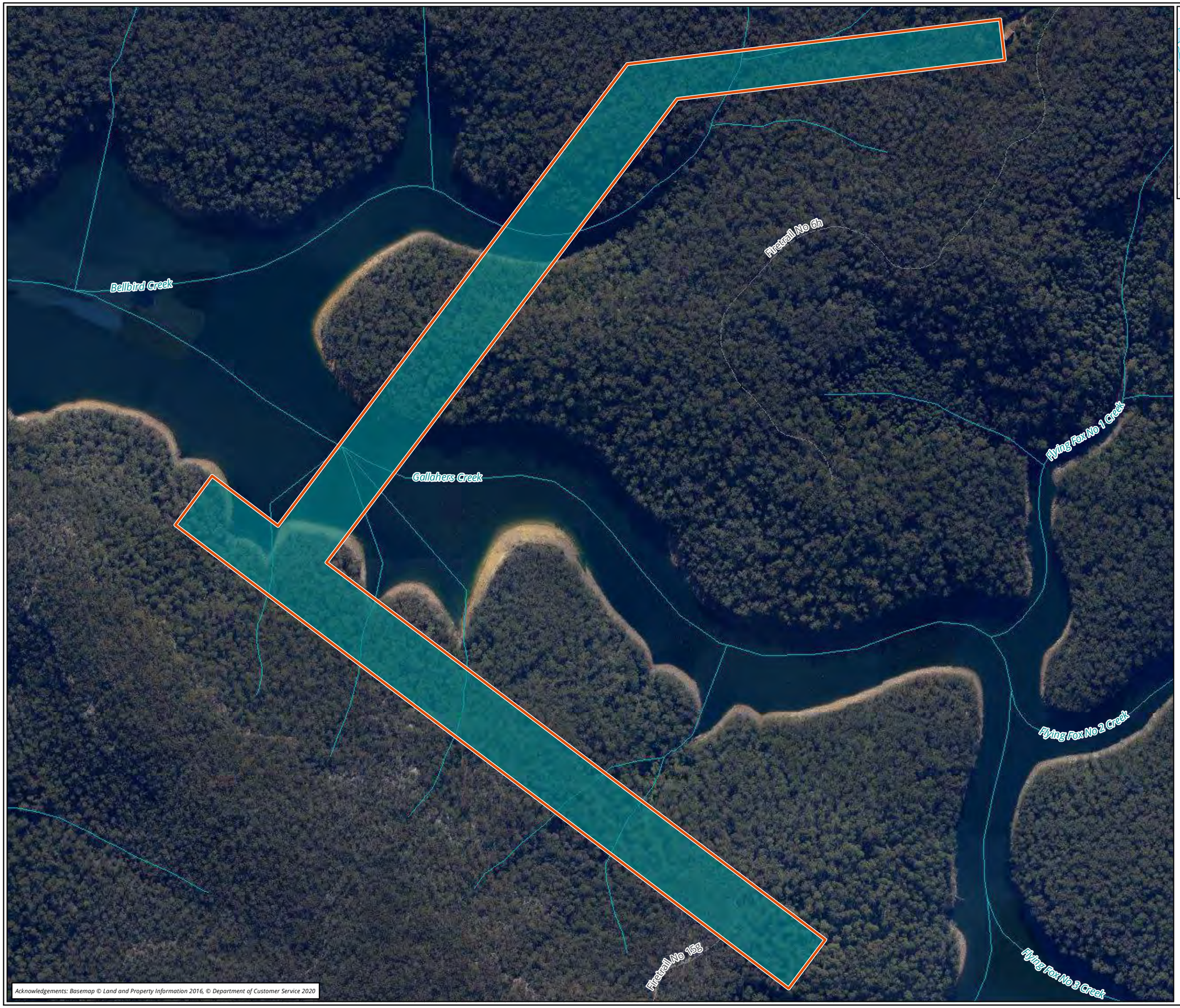
The review of recent Aboriginal heritage assessments conducted for the area have found that the type and distribution of Aboriginal sites is strongly correlated with landform features. The study area consists of rugged sandstone escarpment and cliffs with moderate to steep slopes and narrow, deeply incised valleys. These areas are most likely to contain significant sandstone overhangs that may have been used as shelters. The very high cliff lines present around the Avon River within the areas where two geological formations overlap, very rarely contain overhangs. These areas will have a limited number of shelter sites that will be determined by suitable sandstone overhangs. Stone arrangements have been previously recorded on sandstone outcrops on crests and ridgetops and it is possible that more stone arrangements may be located in these areas. On open plateaus, adjacent to swamps or creeks where open sandstone platforms occur, grinding groove sites are most likely to be present. Due to its ruggedness and later protection as a water catchment area, the study area has not been cleared of vegetation and there is a possibility that scarred trees and open stone artefact sites may also occur.

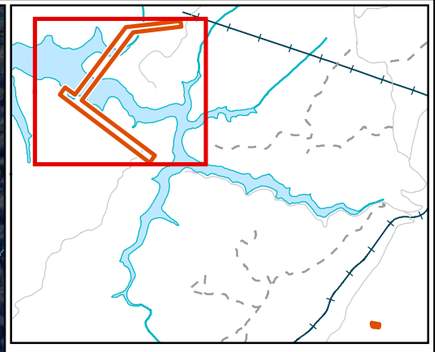
The field investigation revealed limited disturbances within the majority of the study area. The most suitable sandstone overhangs for Aboriginal occupation occur within the scarps and gorges of the Hawkesbury Sandstone usually associated with permanent water sources; however, this geological formation only occurs within a small part of the study area on the southern side of the Avon River. Any sandstone overhangs that were present within the study area were located at the junction of the Hawkesbury Sandstone and Narrabeen Group formations, overlying Hawkesbury sandstone. This junction forms large cliff lines with limited overhang development and where they were present, they had steep and wet floors without deposit.

There are five soil landscapes within the study area: Warragamba, Bundeena, Hawkesbury, Illawarra Escarpment, and Lucas Heights. The most archaeologically sensitive landscape is the Hawkesbury soil landscape as the blocks and weathered scarps provide overhangs with a suitable environment for rock art and in most cases the accumulation of cultural deposits. Likewise, the Bundeena soil landscape is deemed to be archaeologically rich with the sandstone outcrop and swamps indicating a high potential for grinding groove sites and pictogram art sites. Archaeological potential of the remaining three soil landscapes is deemed to be low due to either shallow or limited soil development or very steep slopes that are not conducive to human occupation.

There was only one previous systematic survey undertaken in the Avon Catchment area by Sefton (1994), who centred the survey effort on Hawkesbury Sandstone units. Within the area surveyed by Sefton, 53 shelters with art were located and 17 contained stone artefacts. Two of these sites, AHIMS 52-2-1973/Amber 23 and AHIMS 52-2-1974/Amber 22, are within 200 metres of the study area but were unable to be located during the current survey. They are recorded as rockshelters with art, one also with grinding grooves, and likely to be further to the west according to the site cards. The location of the sites as provided by the AHIMS register were confirmed not to be accurate. From the previous experience with relocating sites in the region, it is known that actual site locations can be up to 500 metres away from the registered site card coordinates.

The field investigation revealed that some parts of the study area had been subject to previous ground disturbance due to construction of the Wongawilli vent shaft and pit top. These areas would have displaced surface cultural material and disturbed deeper buried archaeological deposits, as previously assessed. Also, archaeological potential of the Illawarra Escarpment soil landscape, present within the Wongawilli Pit Top area, to be low due to very steep slopes and rock fall hazards, which are not conducive to human occupation.



**Legend**

Study area

**Archaeological potential**

Low potential

**Figure 9.1 Survey results**

0 50 100 150 200

Metres

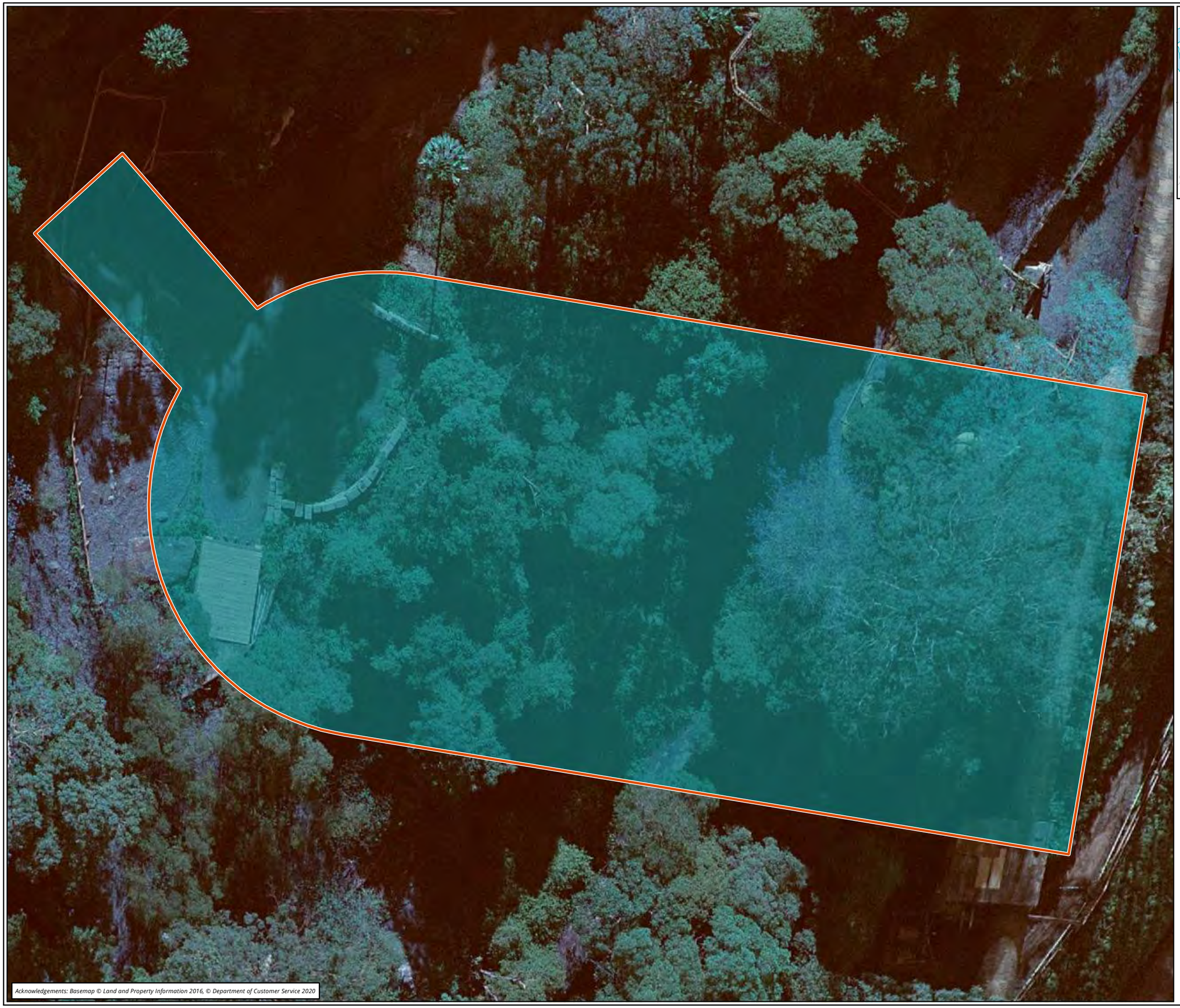
N

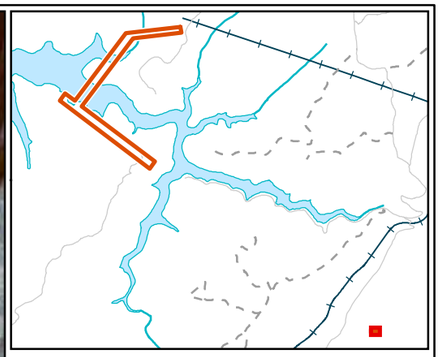
Scale: 1:6,000 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 16 September 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F9_SurveyResult.mxd





**Legend**

Study area

**Archaeological potential**

Low potential

**Figure 9.2 Survey results**

0 3 6 9 12

Metres

N

Scale: 1:300 @ A3

*Coordinate System: GDA 1994 MGA Zone 56*

biosis

Matter: 33219,
Date: 16 September 2020,
Checked by: SJK, Drawn by: AEDM, Last edited by: amurray
Location: P:\33200s\33219\Mapping\33219_F9_SurveyResult.mxd

# 4 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.

## 4.1 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, NSW Department of Planning, Industry and Environment. 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.

## 4.2 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 11, and the site condition ratings in Table 12.

**Table 11 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 12 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 following sections provide statements of significance for the Aboriginal archaeological sites recorded during the sub-surface testing for the assessment. The significance of each site follows the assessment process outlined above. This includes a statement of significance based on the categories defined in the Burra Charter. These categories include social, historic, scientific, aesthetic and cultural (in this case archaeological) landscape values. Nomination of the level of value—high, moderate, low or not applicable—for each relevant category is also proposed. Where suitable the determination of cultural (archaeological) landscape value is applied to both individual sites and places (to explore their associations) and also, to the Study Area as a whole. The nomination levels for the archaeological significance of each site are summarised below.

### Representativeness

Representativeness refers to the regional distribution of a particular site type. Representativeness is assessed by whether the site is common, occasional, or rare in a given region. Assessments of representativeness are subjectively biased by current knowledge of the distribution and number of archaeological sites in a region. This varies from place to place depending on the extent of archaeological research. Consequently, a site that is assigned low significance values for contents and condition, but a high significance value for

representativeness, can only be regarded as significant in terms of knowledge of the regional archaeology. Any such site should be subject to re-assessment as more archaeological research is undertaken.

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

The representativeness ratings used for archaeological sites are shown in Table 13.

**Table 13 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 14.

**Table 14 Scientific significance ratings**

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

The study area was given a score on the basis of these criteria – the overall scientific significance is determined by the cumulative score.

### 4.2.1 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. The results of the archaeological significance assessment are given in Table 15 below.

**Table 15 Scientific significance assessment for the study area**

| Site name | Site content | Site condition | Representativeness | Scientific significance |
|---|---|---|---|---|
| **Wongawilli Pit Top** | 0 | 1 | 1 | 2 – Low |
| **Additional Driveage** | 0 | 2 | 1 | 3 – Low |

**Table 16 Statements of scientific significance for the study area**

| Site name | Statement of significance |
|---|---|
| **Wongawilli Pit Top** | The Wongawilli Pit Top is located within the Illawarra Escarpment soil landscape, which is characterised by steep to very steep slopes and large landslips. Archaeological potential of the |

| Site name | Statement of significance |
|---|---|
| | Illawarra Escarpment soil landscape is deemed to be low due to very steep slopes and rock fall hazards, which are not conducive to human occupation. Furthermore, the significant ground disturbances associated with the Wongawilli Pit Top would have displaced surface cultural material and disturbed deeper buried archaeological deposits, if present. |
| **Additional Driveage** | The Additional Driveage area displayed minimal disturbances associated with burrowing and scratching in soil by animals, exposure from slumping or erosion, and the construction of access tracks. However, the Wongawilli vent shaft displayed significant ground disturbances that would have displaced surface cultural material and disturbed deeper buried archaeological deposits, as previously assessed. The most suitable sandstone overhangs for Aboriginal occupation occur within the scarps and gorges of the Hawkesbury Sandstone usually associated with permanent water sources; however, this geological formation only occurs within a small part of the Additional Driveage area. Any sandstone overhangs that were present within the study area were located at the junction of the Hawkesbury Sandstone and Narrabeen Group formations, overlying Hawkesbury sandstone. This junction forms large cliff lines with limited overhang development and where they were present, they had steep and wet floors without deposit. Archaeological potential of the study area is therefore deemed low due to either shallow or limited soil development or very steep slopes that are not conducive to human occupation. |

# 5 Impact assessment

As previously outlined, the project proposes to seek a modification to the existing project approval for extension of mining activities at WWC for a further 5 years. The modification largely seeks approval to extend the length of NWMD by approximately 2.9 kilometres to access the existing Wongawilli Ventilation Shaft 1 and construction of a new section of coal conveyor system, approximately 60 metres in length, at the Wongawilli Upper top pit.

## 5.1 Predicted physical impacts

The first workings mining method will be utilised for the driveage, which consists of parallel tunnels known as 'headings' being driven into the coal seam from the mine entrance using remote controlled coal cutting. These form a series of self-supporting roadways, leaving behind a grid of pillars, which are designed to provide stability to the void in the long term and support the roof strata above the seam.

Where the pillars have been designed to be stable, the vertical subsidence is typically less than 20 millimetres. However, natural seasonal variations in surface levels due to wetting and drying of soils are approximately 20 millimetres, and thus subsidence less than this can be considered no more than the variations occurring from natural processes. This should have negligible impacts on both natural and man-made surface infrastructure (CoA 2014, MSEC 2007, Hume Coal 2017). SCT Operations Pty Ltd (2020) have provided a geotechnical report for the project that concluded that there is no potential for any perceptible surface subsidence impacts as a result of the proposed Additional Driveage.

## 5.2 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.

Avoidance of impact to archaeological and cultural heritage sites through design of the development is the primary mitigation and management strategy, and should be implemented where practicable. Biosis has undertaken background research and a survey of the study area as part of the ACHA to identify and characterise any potential Aboriginal heritage constraints within the study area. No Aboriginal sites or areas of potential archaeological deposit were identified within the study area during the survey. As a result, the study area has been assessed as low archaeological potential to contain Aboriginal sites. No further archaeological investigation is recommended in the study area and it is recommended that the unexpected finds protocols set out in recommendations 2 and 3 are followed in order to mitigate potential impacts to unexpected Aboriginal sites if present.

# 6 Recommendations

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

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

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

### Recommendation 1: No further archaeological assessment is required

No further archaeological work is required in the study area due to the entire study area being assessed as having low archaeological potential.

### Recommendation 2: Discovery of unanticipated Aboriginal objects

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

### Recommendation 3: 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:

4. Immediately cease all work at that location and not further move or disturb the remains.
5. 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.
6. Not recommence work at that location unless authorised in writing by Heritage NSW.

### Recommendation 4: Continued consultation with the registered Aboriginal stakeholders

As per the consultation requirements, it is recommended that the proponent provides a copy of this final report to the Aboriginal stakeholders. The proponent should continue to inform these groups about the management of Aboriginal cultural heritage sites within the study area throughout the life of the project.

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# Appendices

# Appendix 1 AHIMS results

**THE FOLLOWING APPENDIX IS NOT TO BE MADE PUBLIC**