Excellence in your environment

niche
Environment and Heritage

Aboriginal Cultural Heritage Assessment Report
Longwall 19
Dendrobium Area 3A

LGA: Wollongong City Council

Prepared for South32 -Illawarra Metallurgical Coal

Prepared by Niche Environment and Heritage | 30 October 2020

niche-eh.com

Excellence in your environment

Document control

Project number	Client	Project manager	LGA
5548	South32 – Illawarra Metallurgical Coal	Layne Holloway	Wollongong City Council

Version	Author	Review	Status	Date
D3	Layne Holloway and Renée Regal	Renée Regal	DraftREV01	18 May 2020
D4	Layne Holloway and Renée Regal	Renée Regal	DraftREV02	2 June 2020
F1	Layne Holloway and Renée Regal	Renée Regal	Final01	11 August 2020
F2	Layne Holloway and Renée Regal	Yolanda Pavincich	Final02	30 October 2020

Enquiries should be addressed to:

Sydney Head Office
Niche Environment and Heritage
02 9630 5658
info@niche-eh.com
PO Box 2443 North Parramatta
NSW 1750 Australia

Executive summary

This report presents the Aboriginal Cultural Heritage Assessment (ACHA) for the Longwall 19 Subsidence Management Plan (SMP) application; that is being sort by South32-Illawarra Metallurgical Coal (IMC) in accordance with Schedule 3 Condition 7 of the Dendrobium Mine Development Consent 60-03-2001. The Dendrobium Mine (the 'Subject Area') is located approximately 13 kilometres (km) to the north west of the Wollongong Central Business District, within the WaterNSW Metropolitan Special Catchment Area. The Subject Area is defined by the 600 metre (m) boundary around the extent of the proposed Longwall 19.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by IMC to complete an ACHA and subsequent Aboriginal Heritage Impact Permit (AHIP). To complete this assessment Niche has used the following regulation and guidelines:

- *The National Parks and Wildlife Regulation 2009* (NPW Regulation)
- *Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW Department of Environment, Climate Change and Water* [DECCW]2010a)
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South* Wales (DECCW 2010b)
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (Office of Environment and Heritage [OEH] 2011) and;
- *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance* (Australia International Council on Monuments and Sites [ICOMOS] 2013).

A total of 11 separate Aboriginal stakeholders (including groups and individuals) have identified themselves as Registered Aboriginal Parties (RAPs) through the consultation process following the *Aboriginal cultural heritage consultation requirements for proponents 2010* (Section 3). Consultation with RAPs has been ongoing through the development of this ACHA and subsequent AHIP application.

In addition to the comprehensive reassessment of the Aboriginal Heritage Information Management System (AHIMS) registered sites that fall within the Subject Area, this ACHA has included a review of the previous surveys and assessments from within the Dendrobium 3A Area and surrounds. Biosis Research's previous assessment *Dendrobium Area 3 Archaeological and Cultural Heritage Assessment* (Biosis Research 2007) was sourced as a foundation for this assessment as a previous AHIP (ID# 1098243) had been approved within the existing Subject Area (Appendix E). This AHIP expired on 27 March 2017, as a result IMC are required to apply for a new AHIP.

A total of eight (8) Aboriginal cultural heritage sites fall within the Subject Area. The majority of the sites (5 of 8) have a low scientific (archaeological) significance. One site is of moderate scientific (archaeological) significance and two (2) are of high scientific (archaeological) significance. The RAPs have advised that all sites have a high cultural significance.

Summary of Impacts

The extraction of coal by longwall mining will result in vertical and horizontal subsidence at the surface, which can result in impacts to the natural and built environments (the Project). Subsidence predictions detailed by Mine Subsidence Engineering Consultants ([MSEC] 2020:55) suggest that four (4) Aboriginal cultural heritage sites located above the proposed Longwall 19 have the potential to experience direct impacts from the extraction of Longwall 19. These sites include:

- DM 13 (AHIMS ID#48-2-0056)
- DM 15 (AHIMS ID#52-2-3639)
- DM 20 (AHIMS ID# 52-2-3644)
- Sandy Creek Road 21 (AHIMS ID#52-5-0273)

Four (4) Aboriginal cultural heritage sites within the Subject Area are not predicted to experience subsidence related effects (MSEC 2020:55). These Aboriginal cultural heritage sites include:

- Browns Road Site 31 (AHIMS ID#52-2-1645)
- Browns Road Site 32 (AHIMS ID#52-2-1646)
- DM 16 (AHIMS ID#52-2-3640)
- DM 17 (AHIMS ID #52-2-3641)

Regulatory requirements and recommendations

Aboriginal objects and cultural heritage sites are protected under the *National Parks and Wildlife Act 1974*. In order to undertake the proposed works and potentially impact DM 13 (AHIMS ID#48-2-0056), DM 15 (AHIMS ID#52-2-3639), DM 20 (AHIMS ID# 52-2-3644) and Sandy Creek Road 21 (AHIMS ID#52-5-0273). An AHIP must be obtained under Section 90 of the *National Parks and Wildlife Act 1974.*

The following recommendations have been made by Niche in consultation with the RAPs:

Recommendations	
	Aboriginal Heritage Impact Permit
1.	IMC should continue to consult with the Aboriginal community for the life of the Project in accordance with the consultation guidelines.
2.	An application for an AHIP will be required to undertake the proposed activity as it may result in harm to the following Aboriginal cultural heritage sites: • DM 13 (AHIMS ID#48-2-0056); • DM 15 (AHIMS ID#52-2-3639); • DM 20 (AHIMS ID# 52-2-3644); and • Sandy Creek Road 21 (AHIMS ID#52-5-0273).
3.	The following Aboriginal cultural heritage site cards should be updated on the AHIMS: • Sandy Creek Road 21 (AHIMS ID#52-5-0273); • Browns Road Site 32 (AHIMS ID#52-2-1646); • DM 13 (AHIMS ID#48-2-0056); and • DM 15 (AHIMS ID#52-2-3639).
4.	A subsidence monitoring program is to be implemented progressively over the life of the Project. The subsidence monitoring program should include monitoring of all Aboriginal sandstone shelter sites located within the angle of draw of the Project. The program should include (but not be limited to) the following: • Details on how the Aboriginal community will be consulted with for subsidence monitoring. • A schedule for undertaking the subsidence monitoring at the nominated sites. • An impact TARP specific to each of the sites being monitored.
5.	The Aboriginal Heritage Plan for Dendrobium Area 3A should be revised to include provisions and recommended management strategies determined by the outcomes of this assessment, and any further recommendations provided by the terms of the AHIP approval, provided by Heritage NSW.
	General

Recommendations	
6.	All workers should have cultural awareness training, so they are made aware of their obligations under the NPW Act and any conditions of any future AHIP prior, during and after construction activities.
7.	In the unlikely event that suspected human remains are encountered during construction, all work in the area that may cause further impact, must cease immediately and: • The location, including a 20 m curtilage, should be secured using barrier fencing to avoid further harm. • The NSW Police must be contacted immediately. • No further action is to be undertaken until the NSW Police provide written notification to IMC. • If the skeletal remains are identified as Aboriginal, then IMC or their agent must contact: ▪ The Heritage NSW, of DPC Enviroline on 131 555; and representatives of the RAPs. ▪ No works are to continue until Heritage NSW provides written notification to the proponent or their Agent.

Glossary and list of abbreviations

Term or abbreviation	Definition
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, legends and places) cultural practices and traditions associated with past and present-day Aboriginal communities.
ACHA	Aboriginal Cultural Heritage Assessment.
Aboriginal object(s)	The legal definition for material Aboriginal cultural heritage under the NSW *National Parks and Wildlife Act 1974.*
Aboriginal stakeholders	Members of a local Aboriginal land council, registered holders of Native Title, Aboriginal groups or other Aboriginal people who may have an interest in the Project.
AHIP	Aboriginal Heritage Impact Permit.
Angle of draw	This is a subsidence engineering term used to define the limits of the subsidence movements in a landscape caused by mine workings, that leads to vertical displacement on the surface. The angle of draw is determined through a series of geometric parameters in which the angle between two lines drawn from the edge of the mine workings. One being a vertical line, and the other a line to the limit of vertical displacement on the surface. Because surface movements can also be caused by natural effects such as seasonal variations or drought leading to swelling or shrinkage of near-surface soil and sediment, it can be very difficult to identify where vertical movement due to mining ceases. Therefore, it is standard practice to specify a limiting value for vertical displacement which might be attributable to mining. In New South Wales, this value is usually 20 mm of vertical subsidence. It should be noted that, in some environments, up to 50 mm or more of vertical movement may occur due to seasonal climatic changes.
Archaeology	The scientific study of material traces of human history, particularly the relics and cultural remains of past human activities.
Archaeological deposit	A layer of soil material containing archaeological objects and/or human remains.
Archaeological investigation	The process of assessing the archaeological potential of an impact area by a qualified archaeologist.
Archaeological site	An area that contains surface or sub-surface material evidence of past human activity in which material evidence (artefacts) of past activity is preserved.
Artefact	An object made by human agency (e.g. stone artefacts).
Assemblage	A group of artefacts found in close association with one another. Any group of items designated for analysis that exist in spatial and/or vertical context – without any assumptions of chronological or spatial relatedness.
Avoidance	A management strategy which protects Aboriginal sites within an impact area by avoiding them totally in development.
BCD	the Biodiversity Conservation Division of the Department of Planning, Industry and Environment, previously known as the Office of Environment and Heritage.
Code of Practice	*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.*

Term or abbreviation	Definition
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
DECCW	The Department of Conservation, Climate Change and Water, now the Office of Environment and Heritage.
DA	Development Application.
DCP	Development Control Plan
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979.*
Flake	A piece of stone detached from a core, displaying a bulb of percussion and striking platform.
Harm	With regard to Aboriginal objects this has the same meaning as the NSW *National Parks and Wildlife Act 1974*.
Heritage NSW	Heritage NSW of the Department of Premier and Cabinet, previously known as the Biodiversity Conservation Division.
ILALC	Illawarra Local Aboriginal Land Council
IMC	The proponent South32-Illawarra Metallurgical Coal
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Impact area	An area that requires archaeological investigation and management assessment.
In situ	Latin words meaning 'on the spot, undisturbed'.
Isolated artefact / find	A single artefact found in an isolated context.
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features.
Landform	Any one of the various features that make up the surface of the earth.
LEP	Local Environmental Plan.
Management plans	Conservation plans which identify short- and long-term management strategies for all known sites recorded within a (usually approved) Subject Area.
Methodology	The procedures used to undertake an archaeological investigation.
Mitigation	To address the problem of conflict between land use and site conservation.
NPW Act	National Parks and Wildlife Act 1974.
NPW Regulation	National Parks and Wildlife Regulation 2009.
Open camp site	An archaeological site situated within an open space (e.g. archaeological material located on a creek bank, in a forest, on a hill, etc.).
PAD	Potential Archaeological Deposit. A location considered to have a potential for subsurface archaeological material.
RAP	Registered Aboriginal Party.
SHI	State Heritage Inventory
Statutory controls	control or regulation provided for by legislation

Term or abbreviation	Definition
Site recording	The systematic process of collecting archaeological data for an archaeological investigation.
Site	A place where past human activity is identifiable.
SMP	Subsidence Management Plan
Spit	A unit of archaeological excavation with an arbitrary assigned measurement of depth and extent.
Survey coverage	A graphic and statistical representation of how much of an impact area was surveyed and therefore assessed.
TARP	Trigger Action Response Plan

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 Project background and aims

Illawarra Metallurgical Coal (IMC), a wholly owned subsidiary of South32 Limited (South32), has proposed to extract Longwall 19 (The Project) within Area 3A of the Dendrobium Mine, as part of Consolidated Coal Lease (CCL) 768 under the Development Consent 60-03-2001 (DA 60-03-2001). The Subject Area is defined by the 600 metre (m) boundary around the proposed Longwall 19 which forms this Project (Figure 1 and Figure 2).

This report presents an Aboriginal Cultural Heritage Assessment (ACHA) to accompany the Longwall 19 Subsidence Management Plan (SMP) application and is necessary to satisfy the requirement to manage Aboriginal cultural heritage sites and objects under the *National Parks and Wildlife Act 1974* (NPW Act) and *Environmental Planning and Assessment Act 1979* (EP&A Act) as part of the proposed development. This assessment will inform the SMP for Longwall 19. IMC has engaged Niche Environment and Heritage (Niche) to assist with the development of an ACHA that:

- Determines the cultural significance of Aboriginal objects and /or places relevant to the Subject Area.
- Prepares an impact assessment and provides appropriate management recommendations for any identified Aboriginal objects that might be identified during the process.
- Details the community consultation process and any Aboriginal cultural heritage values identified, in compliance with the *Aboriginal cultural heritage consultation requirements for proponents 2010.*
- Following the development of the ACHA, an Aboriginal Heritage Impact Permit (AHIP) will be required from Heritage NSW of the Department of Premier and Cabinet (DPC), in order to undertake the proposed works.

1.2 Proposed activity

Longwall 19 is located within Dendrobium Mine Area 3A (here after referred as the "Subject Area") Dendrobium Mine is an existing underground coal mine located in the Southern Coalfield NSW within the WaterNSW managed Sydney Metropolitan water catchment area within Lot 14 / DP 1233164. IMC have previously completed longwall mining in Dendrobium Areas 1 and 2 and are currently mining Longwall 16 within the Dendrobium Area 3B domain.

The following Aboriginal Heritage Information Management System (AHIMS) registered sites listed in Table 1 are located within the Subject Area.

Table 1 AHIMS registered sites are located within the Subject Area

Site Name	AHIMS ID
Shelters with Art	
Browns Road Site 31	52-2-1645
Browns Road Site 32	52-2-1646
DM 15	52-2-3639
DM 16	52-2-3640
Shelter with Art and Deposit	
Sandy Creek Road 21	52-5-0273
Shelter with Deposit	

Site Name	AHIMS ID
DM 13	48-2-0056
DM 17	52-2-3641
Shelter with Art and Potential Archaeological Deposit (PAD)	
DM 20	52-2-3644

1.3 Statutory Controls

Dendrobium Mine was approved in 2001 and longwall mining has been in operation since 2005. The previous operator of this mine was BHP Billiton- Illawarra Coal. A number of changes to planning, development and mining legislation has occurred during this period. As a result, the consents and approvals in place for IMC to operate the Dendrobium Mine are numerous.

All subsidence related impacts are managed in accordance to the approved SMP and the *Dendrobium Coal Mine – Area 3A Aboriginal Heritage Plan* (Biosis Research, 2010).

The initial Development Application (DA 60-03-2001) for Dendrobium was assessed and determined under the EP&A Act in 2001 (Appendix F).

The previous ACHA for Dendrobium Area 3 (Biosis Research, 2007) was produced to modify the Dendrobium Mine DA-60-03-2001 to incorporate a revised Area 3 footprint and longwall layout pursuant to section 75W of the EP&A Act, as well as inform the broader environmental assessment documents required to support the SMP application process for Aboriginal cultural heritage sites that were to be impacted by longwall mining.

The approved AHIP (ID# 1098243) for Dendrobium Area 3A expired on the 27 March 2017. As a result, IMC are required to apply for an AHIP in order to extract Longwall 19; which is located within the original assessment area of Dendrobium Area 3A. Longwall 19 extraction has the potential to cause adverse impacts to Aboriginal cultural heritage sites due to subsidence and subsidence induced movements at the ground surface, which could subsequently cause harm to four of Aboriginal cultural heritage sites outlined in this ACHA. This report is designed to support an AHIP application under the NPW Act for the project to manage and mitigate harm to Aboriginal objects and cultural heritage values during the proposed Project works. The assessment requirements and objectives for the ACHA are provided in Table 2.

1.4 Objectives

This ACHA is designed to support an AHIP application under the NPW Act for the project to manage and mitigate harm to Aboriginal objects and cultural heritage values during the proposed Project works.

This assessment has been prepared to identify the Aboriginal cultural heritage values and provide recommendations for the Subject Area in accordance with the following regulations and guidelines:

- *The National Parks and Wildlife Regulation 2009*
- *Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW Department of Environment, Climate Change and Water* [DECW]2010a)
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South* Wales (DECCW 2010b)
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011)
- *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance* (Australia International Council on Monuments and Sites [ICOMOS] 2013)

The assessment requirements and objectives for the ACHA are provided in the Table 2.

Table 2: Assessment requirements and objectives

Objectives:	Addressed in:
• Identify whether Aboriginal objects could be present within the Subject Area.	Appendix A
• Undertake further investigation within areas identified as having potential high sensitivity.	Appendix A
• Provide a description of the Aboriginal objects and declared Aboriginal places located within the area of the proposed activity.	Section 2, and Appendix A
• Provide a description of the cultural heritage values, including the significance of the Aboriginal objects and any declared Aboriginal places, that exist across the whole area that will be affected by the proposed activity and the significance of these values for the Aboriginal people who have a cultural association with the land.	Section 5, Section 6, Appendix A and Appendix E
• Demonstrate how the requirements for consultation with Aboriginal people have been met (as specified in clause 80c of the NPW Regulation).	Section 3, Appendix B and Appendix E
• Present the views of those Aboriginal people regarding the likely impact of the proposed activity on their cultural heritage (if any submissions have been received as a part of the consultation requirements, the report must include a copy of each submission and response).	Section 3, Appendix A, Appendix B and Appendix E
• Provide an assessment of actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified.	Section 6
• Provide any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places and any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm or, if this is not possible, to manage (minimise) harm.	Section 7, Section 8, Appendix A

1.5 Authorship and acknowledgments

This report has been written by Layne Holloway (Heritage Consultant, Niche) and Renée Regal (NSW Heritage Team Leader, Niche). Original data sourced from Biosis Research (2007) contributed to the outcomes of this assessment. Figures included in this report have been prepared by Greg Tobin (GIS Consultant). Unless otherwise attributed, images used in this report are produced by Niche.

2. Description of the area

2.1 Location

The Subject Area is located within Dendrobium Mine Area 3A, within the Wollongong Local Government Area and Parish of Camden. Dendrobium Mine is an existing underground coal mine located in the Southern Coalfield of NSW within the WaterNSW managed Sydney Metropolitan Water Catchment Area. The area included in the mining operations encompasses 437.6 hectares (Ha) area to the south west of Lake Cordeaux, to the south of the previously approved, and extracted area of Longwall 8. The Subject Area is approximately 8 km west of Wollongong (Figure 1 and Figure 2).

2.2 Description of land where Aboriginal cultural heritage sites are proposed to be harmed

Longwall 19 is a continuation of mining that extends into the Dendrobium Mine Area 3A. The area that will be affected by mining related impacts includes:

- Longwall 19 void;
- 600 m Boundary; and
- 35-degree Angle of Draw.

Table 3 details the Aboriginal cultural heritage sites identified within the Subject Area and the proposed harm expected from the proposed works.

Table 3: Details of the Aboriginal objects identified by this ACHA

Estimated harm	AHIMS ID#	Site Name	Site Features	Easting (GDA 56)	Northing (GDA 56)
Direct harm. Subsidence movements at the ground surface will cause impacts.	48-2-0056	DM 13	Shelter with Deposit	293219	6192609
None. Will not be impacted by proposed works	52-2-1645	Browns Road Site 31	Shelter with Art	291340	6191650
None. Will not be impacted by proposed works	52-2-1646	Browns Road Site 32	Shelter with Art	291378	6192162
Direct harm. Subsidence movements at the ground surface will cause impacts.	52-2-3639	DM 15	Shelter with Art	291447	6192467
None. Will not be impacted by proposed works	52-2-3640	DM 16	Shelter with Art	290799	6192048

Estimated harm	AHIMS ID#	Site Name	Site Features	Easting (GDA 56)	Northing (GDA 56)
None. Will not be impacted by proposed works	52-2-3641	DM 17	Shelter with Deposit	290809	6192529
Direct harm. Subsidence movements at the ground surface will cause impacts.	52-2-3644	DM 20	Shelter with Art and Potential Archaeological Deposit (PAD)	292308	6192471
Direct harm. Subsidence movements at the ground surface will cause impacts.	52-5-0273	Sandy Creek Road 21	Shelter with Art and Deposit	292226	6192218

* AHIMS sites in Table 3 highlighted in dark grey have potential to be impacted by the extraction of Longwall 19 and will require an AHIP.

2.3 Environmental context

Understanding the past and present environmental contexts of an area is requisite in any Aboriginal archaeological and cultural heritage investigation (DECCW 2010a). The nature and distribution of Aboriginal archaeological sites are closely related to the environmental context. This section provides a broad overview of the environmental setting of the Subject Area.

Analysis of soil landscapes are a useful tool in identifying environmental proxies for the likely preservation and burial of Aboriginal objects within a landscape. Such analysis provides insight into resources that may have been available by Aboriginal people in the past; such as the presence of rock outcrops to provide surfaces for Art or to sharpen and prepare implements, stone for the manufacture of stone tools and plant species.

Broadly the Subject Area is located within the Upper Nepean Catchment of the southern Woronora Plateau. The Plateau is deeply incised by the Wongawilli and Sandy Creek's; which are second order tributaries of Cordeaux Dam.

Valley slopes that surround these water bodies are generally narrow and steep and frequently cliff lined (Plate 1 and Plate 2). The terrain of the Subject Area is characterised by middle Triassic Hawkesbury Sandstone that comprises overlapping beds of quartz-rich sandstone. The Hawksbury Sandstone soil landscape within the Subject Area is an eroding landscape that is highly vulnerable to natural weathering and granular loss. Active erosion has led to the development and collapse of sandstone overhangs and shelter formations with sandy deposits (Figure 3). The subsurface sandstone formations and substrates comprise of deep Permian Coal Measures that consist of shale sandstone, conglomerates, tuff, chert and coal (Branagan and Packhan 2000).

Plate 1: An example of the valley slopes within the Subject Area

Plate 2: An example of the sandstone formations within the Subject Area

2.4 Aboriginal occupation of the Upper Nepean Catchment

A search of the AHIMS of the Subject Area was conducted by Layne Holloway on 17 December 2019 (AHIMS Client ID# 473225). A total of 109 registered Aboriginal cultural heritage sites were identified within an 8 km² search area (Appendix A). There were no Aboriginal Places identified.

A search of the State Heritage Inventory (SHI) was also completed. Cordeaux Dam (SHR ID# 01360) is a built heritage item listed on the State Heritage Inventory and is located 400 m to the north west of the Subject Area the proposed project will not impact this heritage item. A detailed description of previous archaeological assessment in the region is provided in Appendix A.

The Subject Area is the traditional country of the Dharawal people. Tindale (1974) has identified the Dharawal boundaries extend from the south side of Botany Bay to north of the Shoalhaven River to the south, running inland to the Campbelltown and Camden area (Attenbrow 2010: 34; SA Museum 2010). Attenbrow (2010:35) points out that such boundary mapping, undertaken as it was in the nineteenth century is indicative at best, however, there appears to be reasonably strong agreement between those who have mapped language boundaries that the area is Dharawal country. The Wodi Wodi were also Dharawal speakers, and they inhabited the coastal plains and escarpment around Wollongong. Dharawal people distinguished themselves as Fresh Water, Bitter Water or Saltwater depending on where in the wider language boundary their traditional lands were – the inland hills and valleys, the plateaus' and swamps or the coastal plain respectively (DECC 2005: 6).

The records and histories of the Dharawal and their country at the time of contact with Europeans are subject to bias and are generally fragmented, providing misunderstood accounts of the way Aboriginal people were living prior to European interference. Nevertheless, it is understood that the Dharawal

regularly communicated, moved, traded and participated in ceremonies between their country and neighbouring areas. It is most likely family or tribal groups would 'intermingle and interact along both physical and social boundaries' rather than be strictly confined to the 'tribal' borders that were to be artificially imposed by European anthropologists (Organ 1990: xliii).

It is generally accepted that Aboriginal occupation of Australia dates back at least 50,000 years (Allen and O'Connell 2003). The result of this extensive and continued occupation of the Sydney Basin of which the Lake Illawarra region is a part has left a vast amount of accumulated depositional evidence. The oldest date generally considered to be reliable for the earliest occupation around the region comes from excavations at Parramatta where archaeological material has been dated to 30,735 ± 407 BP (McDonald et al 2005). The site of Bass Point at Shellharbour has been dated to 17,101+/- BP (Flood 1999). Within closer proximity to the current Subject Area on the Woronora Plateau the oldest date for Aboriginal occupation is at Curracurrang 1 Sandstone Shelter at 7,450 +/- 180 BP (Dibden 2019:38). Previous assessment (McDonald 1994: 348) considers that a dramatic population density occurred at approximately 3,000 BP, and that this and associated social pressures provided the impetus for the development of 'social mechanisms to control interaction and to make such interaction less stressful'. Others have noted that population growth within this period is not easily demonstrated using qualitative evidence (Hiscock 2008:158).

The arrival of the First Fleet in Sydney Cove in 1788 was followed the next year by a smallpox epidemic, which spread to the neighbouring regions and, although the exact effects are not known, killed over half the Aboriginal population of the areas effected (Organ 1990: 5).

Up until 1880, majority of the Upper Nepean Area was alienated crownland, avoided by graziers due to the rugged terrain and sterile soils. Historical records do not clearly suggest that Aboriginal use of this land continued during the early colonial period. However, Dibden (2019) suggest that there is evidence that indicates Aboriginal people did retreat to the Woronora Plateau to recover from introduced disease. The presence of permanent water sources in the forms of major rivers, upland swamps (also known as dells) had the potential to be resourced as a long-term water source during drought periods (Young 1985). The presence of water availability in the Upper Nepean region would have acted as a favourable landscape to host occupation of Aboriginal people.

As land grants were passed out and graziers and farmers started to occupy areas of Appin, clashes between the local Aboriginal people and colonisers became frequent. A number of attacks were recorded in the area, such as the massacre of 14 Aboriginal people that were killed in a single event during 1816 (Whittaker 2005).

Despite the massive changes that were so quickly brought to the Aboriginal people of the region, they maintained a sense of community, traditional customs and practices, cultural knowledge and continued to care for significant sites and the land in general. Today there are many thousands of Aboriginal people living in the Wollongong and Wollondilly LGA's surrounding the upper Nepean Catchment. They continue to be custodians of the land, whilst traditional owners maintain cultural knowledge (DEC 2005).

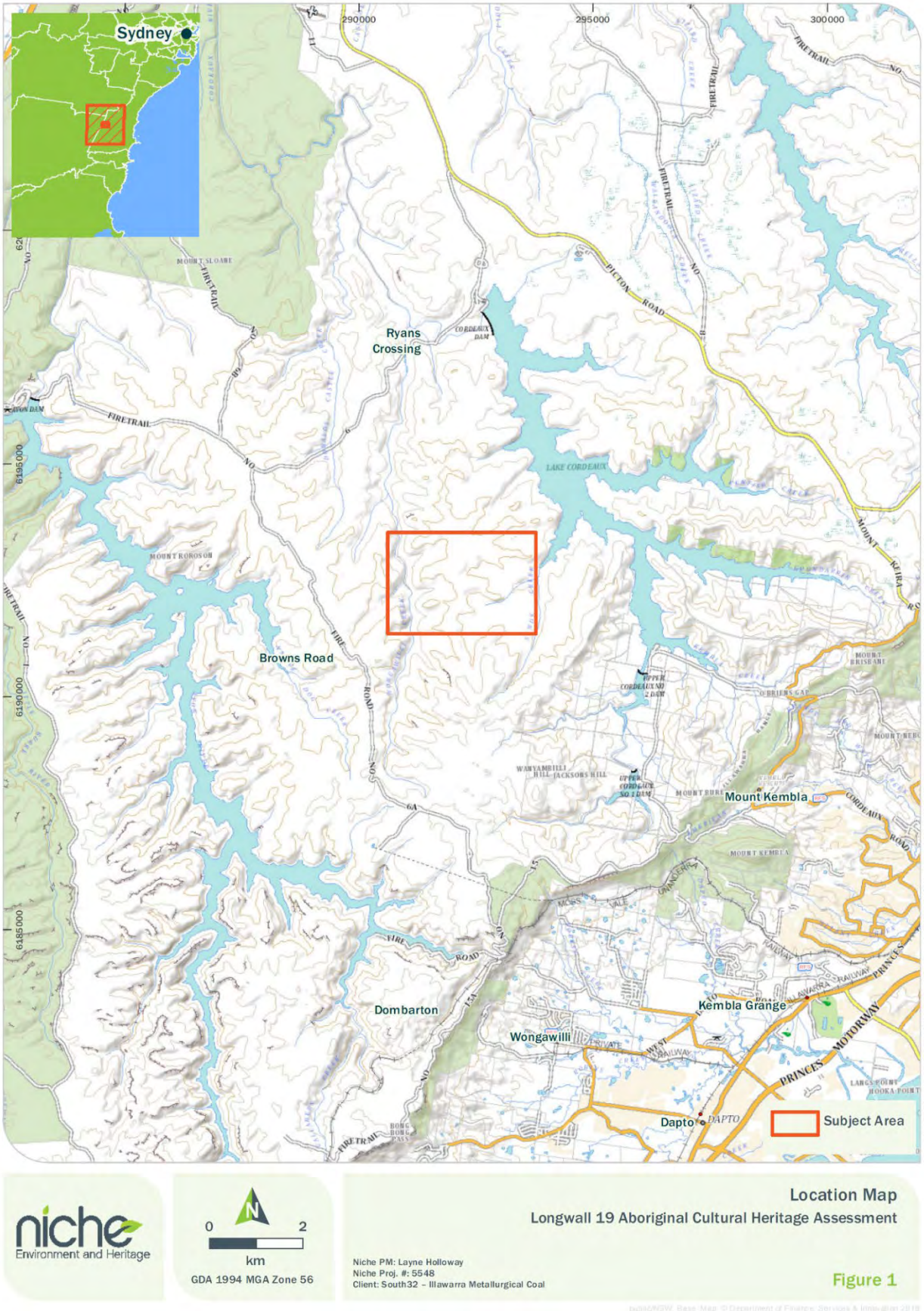

Figure 1: Location of Subject Area within regional context (Source: IMC, LPI and Niche)

Figure 2: Subject Area (Source: IMC, LPI and Niche)

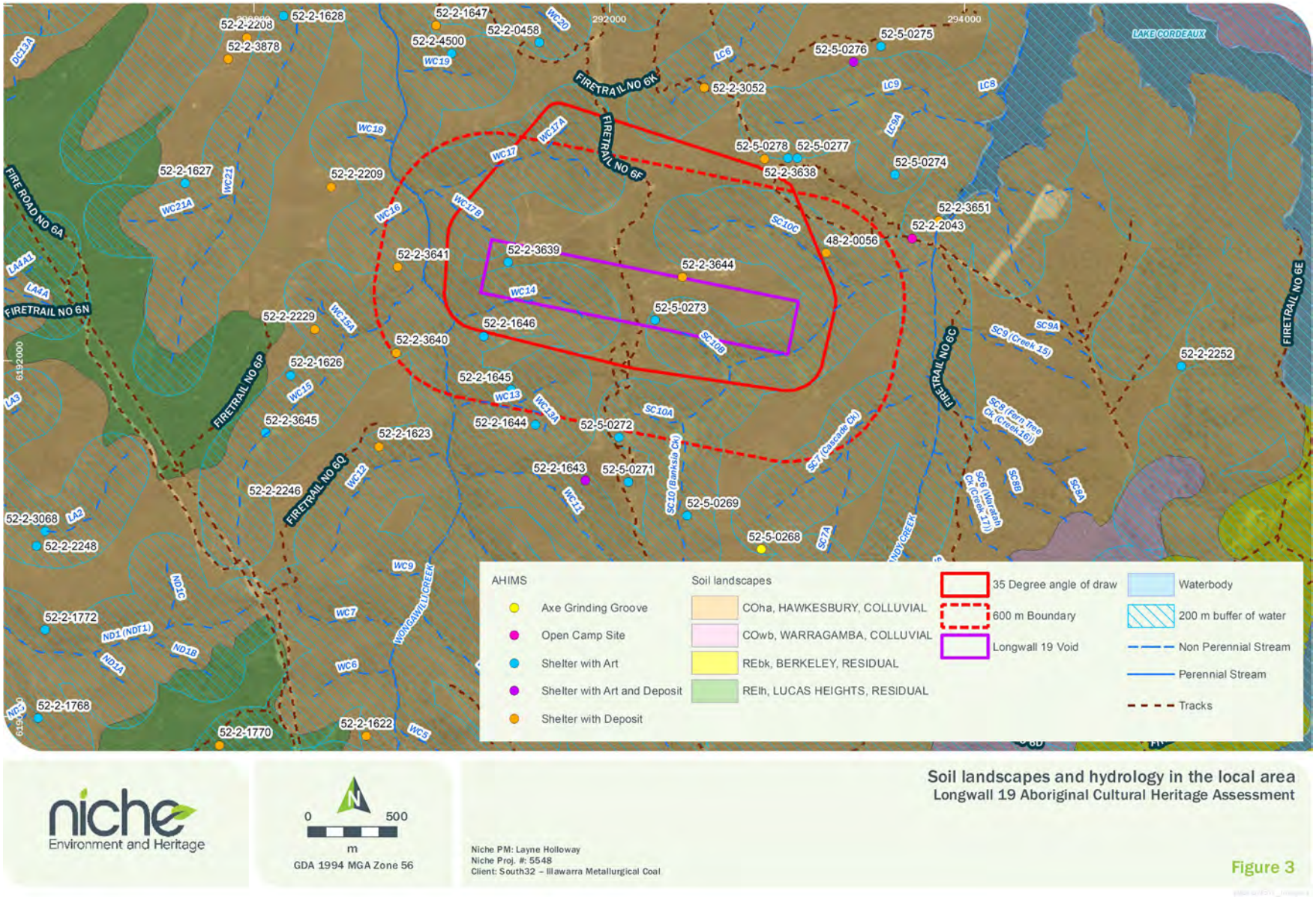

Figure 3: Soils and hydrology (Source: Heritage NSW and Niche)

3. The consultation process

In administering its statutory functions under Part 6 of the NPW Act, Heritage NSW requires that proponents consult with Aboriginal people about the Aboriginal cultural heritage values (cultural significance) of Aboriginal objects and/or places within any given development area, in accordance with Clause 80c of *NSW National Parks and Wildlife Regulation 2009.*

The Heritage NSW maintains that the objective of consultation with Aboriginal communities about the cultural heritage values of Aboriginal objects and places is to ensure that Aboriginal people have the opportunity to improve ACHA outcomes (DECCW 2010a). This is ensured by:

- Providing relevant information about the cultural significance and values of Aboriginal objects and /or places;
- Informing the design of the methodology to assess cultural and significance of Aboriginal objects and/or places;
- Actively contributing to the development of cultural heritage management options and recommendations for any Aboriginal objects and/or places within the proposed Subject Area; and
- Commenting on draft assessment reports before they are submitted by the Proponent to the Heritage NSW.

Consultation in the form outlined in the Aboriginal Cultural Heritage Consultation Requirements for proponents 2010(DECCW 2010a) is a formal requirement in cases where a proponent is aware that their development activity has the potential to harm Aboriginal objects or places. The Heritage NSW also recommends that these requirements be used when the certainty of harm is not yet established but a proponent has, through some formal development mechanism, been required to undertake a cultural heritage assessment to establish the potential harm their proposal may have on Aboriginal objects and/or places.

The Consultation Requirements outline a four-stage consultation process that includes detailed step-by-step guidance as to the aim of the stage, how it should proceed, and what actions are necessary for it to be considered successfully completed. The four stages area:

- Stage 1 – Notification of project proposal and registration of interest.
- Stage 2 – Presentation of information about the proposed project.
- Stage 3 – Gathering information about the cultural significance of the project area.
- Stage 4 – Review of the draft ACHA report.

The Consultation Requirements also outline the roles and responsibilities of the Heritage NSW, RAPs including Local and State Aboriginal Land Councils, and proponents throughout the consultation process.

To meet the requirements of consultation it is expected that the Proponent will:

- Bring the RAPs (or their nominated representatives) together and be responsible for ensuring appropriate administration and management of the consultation process.
- Consider the cultural perspectives, views, knowledge and advice of the RAPs involved in the consultation process when they assess cultural significance and work together to develop any heritage management outcomes for Aboriginal abject(s) and/or place(s).

- Provide evidence to the Heritage NSW of consultation by including information such as cultural perspectives, views, knowledge and advice provided by the RAPs.
- Accurately record and clearly articulate all consultation findings in the final cultural heritage assessment report; and
- Provide copies of their final ACHA report to the RAPs who have been consulted.

The consultation process undertaken to seek active involvement from appropriate Aboriginal representatives for the project followed the current NSW statutory guidelines – the Consultation Requirements. Section 1.3 of the Consultation Requirements describes the guiding principles of the document, which have been derived directly from the principles section of the Australian Heritage Commission's *Ask First: A guide to respecting Indigenous heritage places and values* (Australian Heritage Commission, 2002). Both documents share the aim of creating a system where advice can be sought from the Aboriginal community.

The following sections outline the process and results of the consultation conducted during this assessment to ascertain and reflect the Aboriginal cultural heritage values of the Subject Area. Further detail in regard to the Aboriginal community consultation process is outlined in Appendix B.

3.1 Stage 1 – Notification of project proposal and registration of interest

3.1.1 Notification of agencies

Notification was initiated on 13 December 2019 to all relevant organisations named under Section 4.1.2 of DECCW (2010a). This is done to identify Aboriginal people who may have cultural knowledge relevant to the Subject Area and whom may have an interest in the proposed project. Table 4 below and a copy of the notification letter is provided in Appendix B.

Table 4: List of contacted organisations

Name of Organisation	Date of notification sent	Date of response received
Wollongong City Council	12 December 2020	23 December 2019
NTS Corp	12 December 2020	No response
ILALC	12 December 2019	No response
Heritage NSW - Illawarra	12 December 2019	8 January 2020
Native Title Tribunal	12 December 2019	16 December 2019
Office of the Registrar	12 December 2019	No response
South East Local Land Services	12 December 2019	No response

3.1.2 Advertisement

In accordance with Section 4.1.3 of DECCW 2010a, a newspaper advertisement was placed in The Advertiser and the Illawarra Mercury on 13 January 2020 with a close date of 5 pm on the 27 January 2020 (14 days) to provide additional opportunity for Aboriginal people who may be interested in the project to come forward. A copy of the advertisement is included in Appendix B.

3.1.3 Notification of potential stakeholders

A list of potential cultural knowledge holders was compiled from submissions and information collected during the notification and registration periods:

Table 5: List of potential stakeholders

Badu (Murrin Clan/Peoples)	Barraby Cultural Services	Bellambi Indigenous Corporation Gandangara Traditional Owners
Biamanga (Murrin Clan/Peoples)	Bilinga (Murrin Clan/Peoples)	Coomaditchie United Aboriginal Corporation
Cullendulla (Murrin Clan/Peoples)	Darug Land Observations	Darryl Caines – Individual
Dharug (Murrin Clan/Peoples)	Duncan Falk Consultancy	Gadhu Dreaming
Garrara Aboriginal Corporation	Gary Caines (Individual)	Goobah Development PTY LTD (Murrin Clan/Peoples)
Gumaraa	Gundungurra Tribal Technical Services	Gunyuu (Murrin Clan/Peoples)
Illawarra Aboriginal Corporation	Jerringong (Murrin Clan/Peoples)	Korewal Elouera Jerrungurah Tribal Elders Council
Kullila Site Consultants and Koori Site Management	La Perouse Botany Bay Corporation	Leanne Tungai (Individual)
Minnamunnung	Munyunga (Murrin Clan/Peoples)	Mura Indigenous Corporation
Murramarang (Murrin Clan/Peoples)	Murra Bidgee Mullangari Aboriginal Corporation	Murrumbul (Murrin Clan/Peoples)
NIAC	Nundagurri (Murrin Clan/Peoples)	Norma Simms (Individual)
Pemulwuy (Murrin Clan/Peoples)	Raymond Garbutt (Individual)	Richard Campbell (Individual)
South Coast NSW Aboriginal Elders Incorporated	South West Rocks Corporation	South Coast Native Title Claimants
Three Ducks Dreaming Surveying and Consulting	Thoorga Nura	Tungai Tonghi
The Wadi Wadi Coomaditchie Aboriginal Corporation	Walbunja (Murrin Clan/Peoples)	Walgalu (Murrin Clan/Peoples)
Warra Bingi Nunda Gurri	The Wodi Wodi Elders Corporation	Woronora Plateau Gundungara Elders Council
Wullung (Murrin Clan/Peoples)	Yerramurra (Murrin Clan/Peoples)	Yurrandaali Cultural Services
Muragadi Heritage Indigenous Corporation	Merrigarn	

A copy of the notification letter that was sent to the above organisations and individuals is included in Appendix B.

3.1.4 Registered Aboriginal Parties

As a result of the Stage 1 enquiries, the following organisations and/or individuals have become RAPs for this assessment (Table 6), and a consultation log of all correspondence is included in Appendix C.

Table 6: RAP organisations and contacts

Organisation	Contact Name
Gumaraa	Richard Campbell, Jodie Edwards and Lisa Bazzano
Korewal Elouera Jerrungurah Tribal Elders Council	Uncle Rueben / George Villaflor
Illawarra Local Aboriginal Land Council	Paul Knight / Donna Hiscox
Merrigarn	Shaun Carroll
Murra Bidgee Mullangari	Ryan Johnson
Murramarang (Murrin Clan/Peoples)	Roxanne Smith
Muragadi Heritage Indigenous Corporation	Jesse Johnson
Three Ducks Dreaming	Leonard Wright
Warra Bingi Nunda Gurr	Nathanial Kennedy
Wodi Wodi Traditional Owner	James Davis
Woronora Plateau Gundangara Elders Council	Kayla Williamson
South Coast Native Title Claimants	Sandy Chalmers

3.1.5 Notification of Heritage NSW and LALC

Notification of RAPs to Heritage NSW and Illawarra Local Aboriginal Land Council (ILALC), as per Section 4.1.6 of DECCW 2010a was sent via email on the 10 February 2020 included in Appendix B.

3.2 Stage 2 - Presentation of project information

Project information was emailed and posted to the RAPs on 28 January 2020. A copy is provided in Appendix B.

3.3 Stage 3 - Gathering information about the cultural significance of the Subject Area

3.3.1 Assessment methodology

The RAPs were provided with a letter outlining information about the project and an assessment methodology in accordance with the Consultation Requirements (DECCW, 2010a) and the Code of Practice (DECCW, 2010b).

The purpose of the provided documents was to:

- Describe the project, outline the project scope, timeframe and proposed works.
- Describe the environment of the Subject Area and information relevant to the ACHA process.
- Provide an opportunity for the RAPs to understand the process and comment on the proposed methodology.
- Set a time frame for providing feedback and comments on the methodology and project information.

The draft methodology was submitted to the RAPs on 28 January 2020 and the closing date for comments was at 5 pm, 25 February 2020 (28 days). A copy of the cover letter and methodology is included in Appendix B.

One RAP provided feedback on the project information and assessment methodology. Their comments and/or review are outlined in Table 6, and copies of all submissions made are included in Appendix B.

Table 7: RAP responses to the draft methodology

Registered Aboriginal Party	Stakeholder	Comment made	Response from Niche
Murra Bidgee Mullangari	Ryan Johnson	I have read the project methodology for the project; I endorse the recommendations made.	Thank you, Ryan.

3.3.2 Cultural heritage survey

A notice for the survey was presented to all RAPs on the 27 February to invite participation in the two-day site survey planned for the 12 and 13 of March 2020. Due to weather restrictions, the site inspection was postponed to 24 and 31 Mach 2020. An extra field day was required on the 1 April 2020. Those who participated are provided in Table 7. A copy of the site inspection notice is included in Appendix B.

Table 8: Cultural heritage survey participants

Organisation	Representative	Contribution	Attendance
Merrigarn	Shaun Carroll	Site Officer	24/03/2020, 31/03/2020 and 01/04/2020
Murra Bidgee Mullangari	Gareth Conyard and Sam Lovttit	Site Officer	Gareth Conyard 24/03/2020 Sam Lovttit 31/03/2020 and 01/04/2020
Muragadi Heritage Indigenous Corporation	Jackson and Erin Turnbull	Site Officer	Jackson 24/03/2020 Erin Turnbull 31/03/2020 and 01/04/2020
Murramarang	Roxanne Smith	Cultural Heritage Advice	Could not attend due to COVID-19 self-isolation
Woronora Plateau Gundungara Elders Council	Kayla Williamson	Site Officer	24/03/2020, 31/03/2020 and 01/04/2020
Wodi Wodi Traditional Owner	Joel Tubbs and Paul Bell	Site Officer	Joel Tubbs 24/03/2020 Paul Bell 31/03/2020 and 01/04/2020

Any feedback regarding the cultural values of the Subject Area during the survey is presented in Table 9 below.

Table 9: Details of RAP feedback during the survey

Registered Aboriginal Party	Stakeholder	Comment made	Response from Niche
Wodi Wodi Traditional Owner	Paul Bell	My elder Denzel Bell fished from Hill 60 and had Irish heritage as well as Aboriginal. I have been told that tribal men from use to come down and visit them. They came from the west, I think. Probably from up here (assumed meaning the Upper Nepean area).	Thank you for sharing part of your family's story. The relationship between Aboriginal groups from the coastal plateau and the beyond the escapement has been noted in historical text and journals.

3.4 Stage 4 – Review of draft Aboriginal cultural heritage assessment report

A draft of this report was provided to the RAPs for their review and comment in accordance with DECCW, (2010a). A statutory timeframe of a minimum of 28 days for responses was provided to all RAPs, with a request for comments to be provided by 5 pm.

As of this time, 17 August 2020, the following responses have been received from the RAPs. Table 12 details the comments made, as well as Niche's response, and copies of all submissions made are included in Appendix B.

Table 10: Details of RAP feedback on the draft Aboriginal cultural heritage assessment report

Registered Aboriginal Party	Stakeholder	Comment made	Response from Niche
ILALC	Paul Knight	Thank you for your reminder. I am in the process of providing a formal response, however conflicting priorities may cause a delay in the response. I would therefore like it noted and strongly asserted that the LALC is concerned by the lack of accountability for damage that may occur. The report suggests that monitoring will occur, however it does not detail thresholds for damage or what will trigger a complete stop to the activities causing damage. The Land Council takes the view that is simply not good enough that the sites are only assessed through monitoring. This would indicate that over-time that it would be ok to fully destroy a site with no consideration for the impact on the Aboriginal community. It is the responsibility of all parties to determine thresholds in our view and clearly articulate the management process that will be attached to this.	Thank you for providing your feedback. I acknowledge your responsibility to conserve and manage your heritage. As part of this consultation process, we hope to provide Aboriginal parties with an opportunity to participate in the decision making regarding management strategies and cultural significance of Aboriginal cultural heritage sites located within the Subject Area. I hope to receive your formal response before the closure of this consultation period at 5pm July 15th 2020.
Gumaraa	Richard Campbell	Hope all is well with you I have no problem with the report.	Thanks so much for taking the time to review the report. Thank you for your support. If you have any further comments to contribute prior to the 15th July 2020, please do not hesitate in contacting me.
Murra Bidgee Mullangari Aboriginal Corporation	Ryan Johnson	I have read the project information and ACHA and archaeological report for the above project, I endorse the recommendations made.	Thanks so much for taking the time to review the report. Thank you for your support. If you have any further comments to contribute prior to the 15th July 2020, please do not hesitate in contacting me.

Registered Aboriginal Party	Stakeholder	Comment made	Response from Niche
Korewal Elouera Jerrungurah Tribal Elders Council	George Villaflor	Uncle has been in hospital over the past two weeks. I am of course unable to seek his final views. However, that should not be a problem in progressing your involvement. If when he is able to be spoken to about this, he has concerns or other comments, all I can reiterate his early comments to me that his lawful rights over this project are maintained & continues.	I am sorry to hear that Uncle Rueben is still battling with his health. Thank you again for offering your services to assist in this consultation. We will continue to consult with Uncle Rueben and yourself, as per his lawful right.

4. Summary and analysis of background information

4.1 Site Distribution

Site distribution within the Subject Area follows the same pattern that has previously been outlined by Biosis Research (2007) predictive modelling. Analysis of Aboriginal cultural heritage site distribution within Dendrobium Area 3 categorised by slope gradient identifies that shelter sites are common between slopes 20- and 30-degree gradients. Shelter sites rarely occur within gradients less than 20 degrees and never occur in gradients over 40 degrees (Biosis 2007). Analysis of site location based on slope set gradient identify that shelter sites with archaeological evidence of Aboriginal occupation are typically located within the moderate to steep slope set. A number of Aboriginal cultural heritage sites are also present on the gently inclined slopes that move towards open water ways and large open sandstone platforms that may be suitable for Axe Grinding Grooves. Typical features that form the Hawkesbury Sandstone landscape within the Upper Nepean catchment area have influenced and limited human movement throughout the region (Dibden 2019). It is evident that distribution of Aboriginal cultural heritage sites is dependent on environmental variables with identifiable landscape signatures for past Aboriginal occupation of the Subject Area.

4.2 Sandstone Shelter Sites

Of the eight (8) Aboriginal cultural heritage sites, all comprise of sandstone shelter sites that have either one or a combination of deposit and/or art. As outlined in Section 2.4, the Hawkesbury sandstone of the Subject Area lends itself to this site type to be used by past Aboriginal peoples for artistic expression, occupation and transient use. These site types are significant to the local Aboriginal community as they evidence the past occupation of the area and can be used as an educational tool for younger generations.

4.2.1 Sandstone Shelter with Art

The Subject Area contains five (5) shelter with Art sites that's art panels comprise of a mixture of pigmented mediums of charcoal and/or ochre. As identified in previous assessments, the most common type of expression is charcoal outline/infill (Biosis 2007 and Biosis 2009). Red and white ochre is used at Browns Road Site 32 (AHIMS ID#52-2-1646) DM 16 (AHIMS ID#52-2-3640). There are notable examples of the use of ochre Art with patterns scratched into the surface; or of stencils of hands, feet or material culture such as boomerangs or axes. Such sites have been previously been identified within the areas surrounding Tahmoor (Niche 2019), Dendrobium Area 3B (Biosis Research, 2007) and Helensburgh (Kayandel Archaeological Services 2008, Niche 2016b and Niche 2016c). Analysis of each Aboriginal cultural heritage site located within the Subject Area has been further discussed in section 2.4 of the Appendix A.

Whilst the Subject Area is not large enough to detect major trends in motif types, a number of the motif types have previously been observed during assessment within the adjoining Dendrobium mining lease areas. Sefton (1988) suggests that in the area surrounding Avon and Cordeaux Dams, human motifs are relatively more frequent than in the remainder of the region. This trend is representative of the sample reflected in the Subject Area. Examples of human figures within the current Subject Area were assessed at DM 15 (AHIMS ID#52-2-3639). As outlined in Annex 1 of Appendix A. There are several other motif types represented including macropods and other indeterminate motifs.

4.2.2 Sandstone Shelter with Deposit

There are (3) three Shelter with Deposit sites located within the Subject Area. A Shelter with Deposit describes a naturally formed sandstone overhang with stone artefacts located within the rock ledges or shallow sandy floor deposit areas. Stone artefacts commonly found within the Upper Nepean catchment

and are reflective of the available stone resources such as quartz, petrified wood and other materials traded from distant locations such as chert and silcrete.

4.3 Axe Grinding Groove Sites

The Subject Area does not contain Axe Grinding Groove sites; however, seven Axe Grinding Groove sites are located within the wider regional area and are a common site type within the broader region of the Woronora Plateau. This can be attributed to the landforms within the Hawkesbury Sandstone landscape that commonly feature large areas of sandstone plateau and large rivers and creeks with sandstone beds suitable for use for the making and sharpening of stone tools through the process of grinding. These sites hold significance to the local Aboriginal community as evidence of past occupation and use of the Subject Area as well as an educational tool for younger generations.

4.4 Open Camp Sites or Isolated Artefacts

Open Camp Sites or Isolated Artefact sites are stone tool sites located in an open context. The Subject Area does not contain Open Campsites or Isolated Artefacts; however, two Open Camp sites and one Isolated Artefact are in the boarder regional area. This low representation in the archeological record can be attributed to the landforms within the Hawkesbury sandstone formation and the vegetation coverage across the underground investigation area having limited exposure and poor stone resources. Whilst exposed areas, such as Fire Trail 6 has high exposure, the area has been heavily disturbed from grading and additional of sandstone road base, giving such areas a low potential for further subsurface archaeological deposits and Open Camp Sites.

4.5 Summary

The Subject Area contains a representative sample of regional archaeological and cultural site trends found in the broader Upper Nepean catchment area which provide information about past Aboriginal land use and settlement of the area. The types and locations of sites can be interpreted to provide an insight into what events took place in the past, and how the landscape was used in the past.

The Aboriginal cultural heritage sites within the Subject Area represent a range of activities and events, such as living places, expression through charcoal outline/infill and red ochre, stone artefact manufacture, and the use of flaked stone artefacts.

The location of the Aboriginal cultural heritage sites in the Subject Area are dependant in many cases on the natural environment –sandstone shelters only occur in areas where there are suitable rock formations, which generally occur on moderate and steeply inclined slopes (Biosis Research 2007). However, within this framework of the landscape Aboriginal people will have used the land in different ways, at different times and for different purposes – dictated by both utilitarian and non-utilitarian influences and objectives. Resource rich areas such as creeks and rivers may have been a focus of occupation when resources were abundant or readily available, and hence we expect to find more archaeological sites in association with these landforms. On the other hand, the nature and timing of occupation may have been dictated by non-utilitarian objectives such as ceremonies, rituals and gatherings and a shift in habitable areas due to colonisation pressures.

In conclusion, the archaeological and cultural values work that has been undertaken for the Project provides an insight into past Aboriginal land use within the Subject Area and the wider region. Some of the largest archaeological sites are located in close proximity to the Cordeaux River (now Cordeaux Dam), which would have provided abundant and reliable resources.

5. Cultural heritage values and statements of significance

5.1 Methods for assessing heritage significance

Heritage significance is assessed by considering each cultural, or archaeological site, against the significance criteria set out in the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011).

In all cases the assessment of significance detailed below is informed by the RAPs, which is documented in this report. To date there have been no culturally sensitive values identified during this assessment, should any be identified they would be dealt with as per sensitive information protocols outlined in section 5.1.1 of the Appendix A.

5.2 Assessment framework

The Burra Charter (Australia ICOMOS 2013) defines the basic principles and procedures to be observed in the conservation of places of importance. It provides the primary framework within which decisions about the management of heritage sites in Australia should be made.

5.3 Identifying values

The information collected during the background review of this assessment can be used to identify social, historical, scientific and aesthetic values. The review of background information and consultation with RAPs provides an understanding of past events. These include how the landscape was used and why the identified Aboriginal objects are in this location, along with contemporary uses of the land.

Information gaps are not uncommon and should be acknowledged. They may require further investigation to adequately identify the values present across the Subject Area. It may be helpful to prepare a preliminary values map that identifies, to the extent of information available the:

- Known places of social spiritual, cultural value, including natural resources of significance;
- Known historic places;
- Known Aboriginal objects and/or declared Aboriginal places; and
- Potential places/ areas of social, spiritual, cultural value, including natural resources, historic or archaeological significance.

Places of potential value that are not fully identified or defined should be included as 'sensitive' areas to target further investigation.

5.3.1 Significance as defined by the Burra Charter

The Burra Charter defines cultural significance as being derived from the following values: aesthetic value, historic value, scientific value and social value. However, more precise categories may be developed as an understanding of a particular place or site increases. The values are outlined below in Table 11.

Table 11: Values from which cultural significance is derived

Value type	Description
Aesthetic Value	Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.
Historic Value	Historic value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section.

Value type	Description
	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 setting is substantially intact, rather than where it has been changed or evidence does not survive. However, some events or association may be so important that the place retains significance regardless of subsequent treatment.
Scientific Value	The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness (conservation value), and on the degree to which the place may contribute further substantial information.
Social Value	Social or cultural value refers to the spiritual, traditional, historical or contemporary associations and attachments the place or area has for Aboriginal people. Social or cultural value is how people express their connection with a place and the meaning that place has for them. Places of social or cultural value have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events. Communities and individuals can experience a sense of loss should a place of social or cultural value be damaged or destroyed.

5.4 Assessing values and significance

This stage is used to assess and discuss the cultural significance of the values identified during the assessment of cultural significance by consulting with RAPs and to prepare a statement of significance. The assessment of values is a discussion of what is significant and why. An assessment of values is more than simply restating the evidence collected during the background review and identification of this information within various stages of the project. Rather, the assessment should lead to a statement of significance that sets out succinct and salient values that have been identified.

The assessment and justification in the statement of significance must discuss whether any value meets the following criteria (NSW Heritage Office, 2001):

- Does the Subject Area have a strong or special association with a particular community or cultural group or social, cultural or spiritual reasons? - Social Value.
- Is the Subject Area important to the cultural or natural history of the local area and/ or region and/ or state? - Historic Value.
- Does the Subject Area have potential to yield information that would contribute to an understanding of the cultural or natural history of the local area and/or region and/ or state? - Scientific (archaeological) Value.
- Is the Subject Area important in demonstrating aesthetic characteristic in the local area and/or region and/ or state? - Aesthetic Value.

Assessment of each of the criteria (above) should be graded in terms that allow the significance to be described and compared; for example, as high, moderate, or low. In applying these criteria, consideration should be given to:

- Research potential: does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state's natural and cultural history?
- Representativeness: how much variability (outside and/or inside the Subject Area) exists, what is already conserved, how much connectivity is there?

- Rarity: is the Subject Area important in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?
- Educational potential: does the Subject Area contain teaching sites that might have teaching potential?

Thus, the statement of significance is a succinct summary of the salient values drawn from the identification of values.

5.4.1 Grading scientific (Archaeological) values

The following gradations, where a site or zone satisfies at least one criterion, have been applied to provide a measure of the values/significance for Aboriginal cultural heritage sites identified within the Subject Area, and to provide an overall assessment of the significance of each of the zones used that define the Subject Area are included in Table 12 below.

Table 12: Criteria for grading scientific values

Gradation	Description
Low	The site or object contains only a single or limited number of features and has no potential to meaningfully inform our understanding of the past beyond what it contributes through its current recording (i.e. no or low research potential). The site or object is a representative but unexceptional example of the most common class of sites or objects in the region. Many more similar examples can be confidently predicted to occur within the Subject Area, and in the region.
Moderate	The site or object derives value because it contains features, both archaeological and contextual, which through further investigation may contribute to our understanding of the past. These features include but are not limited to the relationship with landscape features or other Aboriginal cultural heritage sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology. The presence of a diverse assemblage of archaeological features, connectedness with landscape and other notable values provide relatively higher representative and rarity values than sites of low significance.
High	The site or object has value because it contains archaeological and/or contextual features which through further investigation may significantly contribute to our understanding of the past, both locally and on a regional scale. These features include but are not limited to: Aboriginal ancestral remains; the site's relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a very large assemblage of stone artefacts associated with other features such as oven remains or shell midden. Such sites will be relatively rare and will be representative of a limited number of similar sites that make up this class; hence they derive high representative and rarity values.

5.5 Significance assessment

Table 13 provides an assessment of significance and summarises identified heritage values for individual Aboriginal cultural heritage sites within the Subject Area. Significance assessments for all sites within the Subject Area were previously completed as part of the Dendrobium Area 3 Aboriginal Cultural Heritage Assessment (Biosis Research 2007). Additional notes regarding the scientific (archaeological) significance have been included below in Table 13.

Table 13: Significance Assessment – individual sites

AHIMS ID	Site Name	Site Type	Aesthetic value	Historic value	Scientific (archaeological) value	Social or cultural value
48-2-0056	DM 13	Shelter with Deposit	Low – The shelter with deposit is in reasonably well-preserved condition with no outstanding features.	None – this site does not contain any historic values.	Low - This shelter is an example of a common shelter with deposit site. Additional comment from Niche notes the deposit holds a small collection of artefacts made from a range of materials that may have been sourced from local area, such as quartz, and petrified wood, with other materials that were not present within the Subject Area and were likely sourced from distant regions, such as chert and silcrete. The deposit containing the artefacts has been partially disturbed from animal burrowing.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.
52-2-1645	Browns Road Site 31	Shelter with Art	Low – the art in this shelter is poorly preserved and has been impacted by chemical erosion.	None – this site does not contain any historic values.	Low – the three charcoal motifs within this Shelter with Art site are poorly preserved and a common site type within the regional area. Additional comment from Niche notes that the two charcoal indeterminates and one kangaroo motif located on the roof of the sandstone shelter site is representative of motif types of the region.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.

52-2-1646	Browns Road Site 32	Shelter with Art	High – a large number of stencils and motifs that are in good condition and contribute to a strong sense of place.	None – this site does not contain any historic values.	High – This shelter provides a diversity of Art motifs with varying pigment types. Additional comment from Niche notes the art depicted in this shelter features a variety of inland native terrestrial and aquatic animal species that would have been present as food resources within the Woronora Plateau. This shelter also presents several red ochre handprints and stencils which are densely layered over charcoal Art. Ochre handprints are a rare motif type for the Dendrobium Area. The density and layering of the handprints over the charcoal art indicated that the site was visited a number of times by the Aboriginal community in the past.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.
52-2-3639	DM 15	Shelter with Art	Low – The Shelter with Art of this site is reasonably well-preserved condition with no outstanding features.	None – this site does not contain any historic values.	Low – this shelter is an example of the most common type motif in Shelter with Art site types within the region, being a male frontal anthropomorphic figure. The Art is in a good condition from case hardening preservation.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.
52-2-3640	DM 16	Shelter with Art	High – this shelter contains a number of well-preserved diverse motifs with uncommon drawing techniques.	None – this site does not contain any historic values.	High - this site contains a high density of charcoal motifs with bi-chrome infill. The diversity of art and technique is rare. Additional comment from Niche notes that bi-chrome infill is a rare art feature for this region, with only two	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.

					other examples previously registered within the region. These sites being Upper Avon 47 (AHIMS ID #52-2-1752) located in Dendrobium Area 5 and Flat Rock Creek 305 (AHIMS ID# 52-3-3497) located within the Woronora dam catchment area.	
52-2-3641	DM 17	Shelter with Deposit	Low – The deposit of this site is undisturbed with no outstanding features.	None – this site does not contain any historic values.	Low – This Shelter with Deposit contained a singular artefact, a common site type in the region.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.
52-2-3644	DM 20	Shelter with Art and Potential Archaeological Deposit (PAD)	Low – The Art featured at this site is in poor condition.	None – this site does not contain any historic values	Low – This shelter features a row of charcoal motifs that are in a poor condition. This site is a common site type within the region. And contains no outstanding characteristics. Additional comment from Niche notes that the combination of charcoal motifs a partial anthropomorphic figure is a representative of common Art motifs within the Subject Area.	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.
52-5-0273	Sandy Creek Road 21	Shelter with Art and Deposit	Moderate – This site contains Art of abnormal art in a moderate state of preservation.	None – this site does not contain any historic values.	Moderate- This Shelter with Art and Deposit contains notable irregular motifs. The Art is in moderate condition and the deposit has potential to inform of archaeological assemblages. Additional comment from Niche notes this site has a combination of	High – Aboriginal cultural heritage sites within the Woronora Plateau remain in relatively undisturbed environment with a relativity high density of sites, many being a highly visual cultural resource which creates a strong sense of place and cultural identity.

					indeterminate and anthropomorphic motifs of interest, being a charcoal frontal male figure with large eyes, and small scatter of artefacts representative of materials that were not present within the Subject Area and were likely sourced from distant regions, such as chert and silcrete.	

6. The proposed activity

The Subject Area is part of the traditional land of the Tharawal / Dharawal people (Tindale 1940, 1974). Since the arrival of colonisers, the area has changed through the development of Lake Cordeaux and Lake Avon, through the damming of each respective rivers to make the Metropolitan Special Water Catchment Area and the development of underground longwall mining of coal.

6.1 Longwall Mining

The proposed activity involves the extraction of coal using longwall mining methods. This assessment will inform a SMP for Longwall 19. The proposed longwalls are located between 280 m and 450 m below the ground surface, in an area between the Wongawilli Creek to the west and Sandy Creek to the east (MSEC 2020:3) (Figure 1).

Longwall mining involves the extraction of a rectangular section of coal from between supported underground roadways by cutting a wide, continuously retreating panel of coal (the longwall). The roof of the mine is temporarily held up by hydraulic jacks which are continuously moved behind the retreating face where coal is extracted by longwall shears. When the hydraulic jacks retreat the roof collapses into the void left behind, referred to as the goaf (NSW Minerals Council 2013). This process results in the subsidence impacts is then used to describe the physical changes to the ground and its surface caused by the removal of coal subsurface. These impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and subsidence but also include subsidence depressions or troughs. The environmental consequences of these impacts include cracking in rock strata, rock falls, and change of surface water flows which can subsequently result in harm to Aboriginal cultural heritage sites that are located in predicted subsidence zones (NSW Department of Planning 2008). Further description of subsidence movements is outlined in Section 12.1 of Archaeological Report1.1.1.1.1Appendix A.

6.2 Previous AHIP

An AHIP was previously granted to BHP Billiton Illawarra Coal for the consent to harm the following Aboriginal Cultural Heritage sites located within Dendrobium Area 3A (Appendix E):

Table 14 AHIMS sites in AHIP (ID# 1098243)

Name	AHIMS ID	Location
DM 13	48-2-0056	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
DM 15	52-2-3639	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
DM 20	52-2-3644	Located outside of the current Longwall 19 extraction zone and the projects Subject Area.
DM 23	52-2-3651	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
West Cordeaux Browns Road Site 33	52-2-0458	Located outside of the current Longwall 19 extraction zone and the projects Subject Area

Name	AHIMS ID	Location
Browns Road Site 32	52-2-1646	Located within the Subject Area.
Sandy Creek Road 21	52-2-0273	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
Sandy Creek Road 22	52-2-0274	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
Sandy Creek Road 25	52-2-0277	Located outside of the current Longwall 19 extraction zone and the projects Subject Area
Sandy Creek Road 25	52-2-0278	Located outside of the current Longwall 19 extraction zone and the projects Subject Area.

The AHIP (ID# 1098243) for the impacts related to the mining of Dendrobium Area 3A was approved on the 27 March 2009 and expired after an eight-year period on the 27 March 2017. During the valid period of the AHIP (ID# 1098243), three out of the four longwalls within Dendrobium Area 3A were extracted. Mining activities ceased in Dendrobium Area 3A in 2012. IMC plan to recommence mining of the fourth longwall - Longwall 19 in 2023. Hence, a new AHIP application is required for the harm to Aboriginal cultural heritage sites as a result of subsidence related movements from the proposed mining of Longwall 19.

Aboriginal cultural heritage site, Browns Road Site 32 (AHIMS ID # 52-2-1646) is the only site within the current Subject Area to be included within the previous AHIP (ID# 1098243), and is highlighted a shade darker in Table 14 . Biosis Research (2007) summarise Browns Road Site 32 (AHIMS ID # 52-2-1646) as predicted to experience low systematic tensile strains and a low likelihood of fracturing of strata and sheer movements. The predicted mining subsidence data model (MSEC 2020) used for the purpose of impact assessment for this report has calculated that Browns Road Site 32 (AHIMS ID # 52-2-1646) will not be harmed by the proposed works, and therefore will not be required to be included within the AHIP application for this project.

6.3 Dendrobium Area 3A Aboriginal Heritage Plan

Following the AHIP approval of AHIP (ID# 1098243) for the impacts associated with longwall mining in Dendrobium Area 3A, BHP Billiton Illawarra Coal (now IMC) prepared an Aboriginal Heritage Plan (AHP) (Appendix F) in accordance with the conditions of consent to the modification application of DA 60-03-2001 (Appendix G). The aim of the AHP is to describe protocols for ongoing Aboriginal community engagement, establish suitable methods for baseline recording, establish and conduct a monitoring program to detect and measure any changes at sites due to subsidence and a process schedule for impact and risk management.

This document provides site specific descriptions, reference for monitoring, a list of Registered Aboriginal Parties and monitoring regime specific for subsidence effects for Aboriginal cultural heritage shelter sites by Sefton (2000) and amended by Biosis Research (2010). The monitoring regime is intended to establish recording procedures that are up to date with current technologies and practices to capture and record rock art in its current context. As a result of this assessment, it is evident that the AHP for Dendrobium Area 3A will require a revision to include updates to RAPs, baseline recordings and references to regulatory bodies.

7. Avoiding and/or mitigating harm

7.1 Conservation Principles and Management Framework

The two founding principles behind the Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011:12) are ecologically sustainable development and intergenerational equity. These principles hold that "the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations".

The strong emphasis, as in the Burra Charter, is to quantify and understand the heritage values of a place, a site, or an object and exhaust avenues of avoiding harm to those values. If harm cannot be avoided, then there must be consideration and implementation of strategies to minimise harm (OEH 2011:13).

It follows that the hierarchy for consideration in regard to management strategies available for surface stone artefacts and subsurface stone artefacts and areas of archaeological potential, fall into four general categories, in order of preference from a conservation perspective:

- avoidance and in-situ conservation;
- partial avoidance and partial in-situ conservation (includes partial harm);
- harm caused with mitigating circumstances such as collection or salvage; and
- unmitigated harm.

The four general categories (described above) have been considered in the following subsections with regard to both direct impacts (e.g. surface disturbance) and indirect impacts (e.g. monitoring activities).

The management and mitigation measures have been prepared in consideration of comments received from the RAPs during the consultation process. These comments include those related to cultural considerations surrounding salvage works and the handling of artefactual materials, as well as the cultural significance of all sites. All comments received from the RAPs are considered in Section 3.4.

Where possible, harm to sites will be avoided and sites will be retained in situ.

7.2 Designing to avoid

During the design process of the proposed Longwall 19, as outlined in Section 6, a number of mining layout options were considered based of a range multidisciplinary factors. These options aimed to reduce the potential for impacts to surface features in order to achieve a balanced outcome.

This approach is consistent with the Heritage NSW requirements of ecologically sustainable development and intergenerational equity.

7.3 Mitigating harm

Management measures are warranted to mitigate the loss of values to the site that would result from the proposed activity. Management and mitigation measures are also warranted to ensure continued compliance with the NPW Act. Several management and mitigation measures have been considered for this project and are presented in Table 15.

Table 15: Consideration of management and mitigation strategies

Management Risk / Impacted Value	Strategies considered	Response
Management Risk - Compliance	AHIP	• An AHIP will be required to undertake the proposed activity as it will have the potential to in harm to Aboriginal objects.
Management Risk – Compliance and Unexpected Finds (excluding human remains)	Communication to employees, site visitors, contractors and landowners	• All workers should be inducted into the Subject Area, so they are made aware of their obligations under the NPW Act and any conditions of any future AHIP prior and during and after construction activities.
Management Risk – Unexpected Finds – human remains	Stop work and follow procedure for discovery of suspected human remains	• The location, including a 20 m curtilage, should be secured using barrier fencing to avoid further harm. • The NSW Police must be contacted immediately. • No further action is to be undertaken until the NSW Police provide written notification to IMC. • If the skeletal remains are identified as Aboriginal, then IMC or their agent must contact: ▪ The Heritage NSW, of the DPC Enviroline on 131 555; and representatives of the RAPs. • No works are to continue until the Heritage NSW provides written notification to the proponent or their Agent.
Impacted Conservation value – threatened resource	Avoiding or minimising harm	This strategy has been considered and taken into account by IMC during the planning phase of the Area 3A mining domain. The proposed Longwall 19 is considered to have a low likelihood to cause harm to Aboriginal objects within the Subject Area.
	Subsidence monitoring	Subsidence monitoring prior to and after longwall mining should be implemented for Aboriginal heritage sites within the underground investigation area subject to impacts from mining induced subsidence. The subsidence monitoring program should be in accordance with the relevant approved SMP and subsequent Aboriginal Heritage Plan. Monitoring should be undertaken by a suitably qualified archaeologist and representatives of the RAPs.
	Mitigating harm through providing educational value	This strategy should be considered. Possible avenues include: • Providing cultural heritage awareness for employees. • Providing public resource material detailing the archaeological significance of the Subject Area. • Updating the AHP for Dendrobium Area 3A to ensure harm mitigation is managed during project initiation.

Management Risk / Impacted Value	Strategies considered	Response
Impacted Rarity value – threatened resource	Mitigating harm through future management of the coastal dune vegetation	This strategy should be considered. Possible avenues include: • Continued consideration of impacts to Aboriginal heritage within the Upper Nepean Catchment region through the EP&A Act. • Consideration of minimising impacts during future longwall approval stage.

7.4 Consideration of ecological sustainable development

Section 5(vii) of the *EP&A Act* requires proponents to consider the key principles of Ecologically Sustainable Development (ESD) in the design of their projects. The principles of ESD are defined within the *Protection of the Environment Administration Act 1991*. This Act defines the precautionary principle and the principles of inter-generational equity, conservation of biological diversity and ecological integrity. The precautionary principle is defined as:

"*If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

EDS for the proposed Longwall 19 should consider intergenerational equity, which is fundamental to Aboriginal culture and identity into the future. Although DM13 (AHIMS ID#48-2-0056) , DM 15 (AHIMS # 52-2-3639), DM 20 (AHIMS ID#52-2-3644) and Sandy Creek Road 21 (AHIMS ID #52-5-0273) are all significant sites to the Aboriginal community, the other identified values of these sites are representative but are an unexceptional example of the common features of Aboriginal cultural heritage sites in the region. Many more valuable examples occur within the Subject Area, and in the wider region.

Table 16 considers the key principles of ESD with respect to the results of the literature review, Aboriginal heritage survey results and scientific (archaeological) significance assessment contained within this report.

Table 16: Assessment of ESD

Principles of the EIA and ESD Guidelines	ESD Assessment
A fundamental consideration for conservation of biological diversity and ecological integrity	IMC has undertaken an ACHA in consultation with the RAPs and determined that there are four sites (Table 3) present with the Subject Area that may result in irreversible and direct harm, which may also effect biological diversity and ecological integrity and generational equity to the local Aboriginal community.
Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment	
Consideration of intergenerational equity	
Where risk of serious or irreversible harm and lack of scientific knowledge of the nature of environmental harm combine, the precautionary principle applies. Where there is risk of serious or irreversible harm, it is necessary to establish whether there is adequate scientific knowledge of the subject to evaluate the perceived threat.	This assessment has considered a review of all Aboriginal heritage items and their associated scientific report identified in heritage searches of an 8 km radius of the Subject Area. The assessment identified eight Aboriginal cultural heritage sites with values of high cultural significance, four of which may be impacted by the proposed activity. IMC should consider ESD in regard to the Aboriginal cultural heritage sites identified as part of this assessment, including aspects of intergenerational equity; this is fundamental to identifying Aboriginal culture and identity into the future. Though the sites are significant to the Aboriginal community, they are subject to ongoing erosional disturbance and any harm suffered at this site as a result of subsidence will not cause significant harm to the Aboriginal communities' connection to country or cultural development within the community.
An assessment of the risk-weighted consequences of various options	Consideration of mitigation strategies is provided in Section 7.2

8. Recommendations

Niche was commissioned by IMC to complete an ACHA and subsequent AHIP application for the extraction of Longwall 19 within Dendrobium Area 3A.

The ACHA was carried out in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (*OEH, 2011). It included consultation with RAPs in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a) (details of which are in Appendices 2 and 3).

An assessment of the potential impact of the proposed works and associated ground disturbance indicates that AHIMS registered sites DM 13 (AHIMS ID #48-5-0056), DM 15(AHIMS ID #52-2-3639), DM 20 (AHIMS ID#52-2-3644) and Sandy Creek Road 21 (AHIMS ID#52-5-0273) have the potential to be impacted by the proposed works.

This assessment has determined that the proposed works ***do not*** have the potential to impact AHIMS registered sites Browns Road Site 31 (AHIMS ID#52-2-1645), Browns Road Site 32 (AHIMS ID#52-2-1646), DM 16 (AHIMS ID#52-2-3640) and DM 17 (AHIMS ID#52-2-3641).

Based on community consultation to date with the RAPs for the Project, and with the completion of this ACHA by Niche, the following recommendations have been made:

Table 17:Recommendations

Recommendations	
	Aboriginal Heritage Impact Permit
1.	IMC should continue to consult with the Aboriginal community for the life of the Project in accordance with the consultation guidelines.
2.	An application for an AHIP will be required to undertake the proposed activity as it may result in harm to the following Aboriginal cultural heritage sites: • DM 13 (AHIMS ID#48-2-0056); • DM 15 (AHIMS ID#52-2-3639); • DM 20 (AHIMS ID# 52-2-3644); and • Sandy Creek Road 21 (AHIMS ID#52-5-0273).
3.	The following Aboriginal cultural heritage site cards should be updated on the AHIMS: • Sandy Creek Road 21 (AHIMS ID#52-5-0273); • Browns Road Site 32 (AHIMS ID#52-2-1646); • DM 13 (AHIMS ID#48-2-0056); and • DM 15 (AHIMS ID#52-2-3639).
4.	A subsidence monitoring program is to be implemented progressively over the life of the Project. The subsidence monitoring program should include monitoring of all Aboriginal sandstone shelter sites located within the angle of draw of the Project. The program should include (but not be limited to) the following: • Details on how the Aboriginal community will be consulted with for subsidence monitoring. • A schedule for undertaking the subsidence monitoring at the nominated sites. • An impact TARP specific to each of the sites being monitored.

Recommendations	
5.	The Aboriginal Heritage Plan for Dendrobium Area 3A should be revised to include provisions and recommended management strategies determined by the outcomes of this assessment, and any further recommendations provided by the terms of the AHIP approval, provided by Heritage NSW.
	General
6.	All workers should have cultural awareness training so they are made aware of their obligations under the NPW Act and any conditions of any future AHIP prior and during and after construction activities.
7.	In the unlikely event that suspected human remains are encountered during construction, all work in the area that may cause further impact, must cease immediately and: • The location, including a 20 m curtilage, should be secured using barrier fencing to avoid further harm. • The NSW Police must be contacted immediately. • No further action is to be undertaken until the NSW Police provide written notification to IMC. • If the skeletal remains are identified as Aboriginal, then IMC or their agent must contact: ▪ The Heritage NSW, of DPIE Enviroline on 131 555; and representatives of the RAPs. ▪ No works are to continue until the Heritage NSW provides written notification to the proponent or their Agent.

References

Attenbrow, V 2010 *Sydney's Aboriginal Past: Investigating the archaeological and historical records.* University of New South Wales Press, Sydney.

Australian Government, 1992. *National Strategy for Ecologically Sustainable Development.* Ecologically Sustainable Development Steering Committee. ISBN 0 644 27253 8.

Australia ICOMOS, International Council on Monuments and Sites, 2013. *The Burra Charter: the Australia ICOMOS charter for places of cultural significance.*

Biosis Research 2007 *Dendrobium Area 3 Archaeological and Cultural Heritage Assessment*. An unpublished report for BHP Billiton-Illawarra Coal.

Biosis Research, 2010. *Dendrobium Coal Mine- Area 3 Aboriginal Heritage Plan*. An unpublished report for BHP Billiton-Illawarra Coal

Biosis 2012. *Bulli Seam Operations Aboriginal Cultural Heritage Assessment*. An unpublished report for BHP Billiton Illawarra Coal.

Department of Environment and Conservation, NSW,2005. *A History of Aboriginal People of the Illawarra 1770 to 1970,* Hurstville, NSW, Department of Environment and Conservation (NSW).

Department of Environment and Conservation, 2010a *Aboriginal Cultural heritage consultation requirements for proponents 2010.* Hurstville, NSW, Department of Environment and Conservation (NSW).

Department of Environment and Conservation, 2010b. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* New South Wales Department of Environment, Climate Change and Water, Sydney.

Dibden, J. 2019. *Drawing in the land-. Rock Art of the Upper Nepean, Sydney Basin New South Wales*. Terra Australis. Australian National University Press

Hazelton, P. A. and Tille, P.J. 1990. *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet Soil Conservation Service NSW,* Sydney.

Kayandel Archaeological Services 2008 *Aboriginal Cultural Heritage Assessment, Metropolitan Coal Project, Metropolitan Colliery, Helensburgh, NSW*. An unpublished report for Helensburgh Coal Pty Ltd.

Mine Subsidence Engineering Consultants 2020. *Subsidence predictions and impact assessments. Dendrobium – Longwall 19*. Unpublished reports for Illawarra Metallurgical Coal.

McDonald 1994. *Dreamtime Superhighway: An analysis of Sydney Basin Rock Art and Prehistoric Information Exchange.* An unpublished thesis, Australian National University.

New South Wales Heritage Office, 2001. *Assessing Heritage Significance (NSW Heritage Manual update).* DUAP.

New South Wales Department of Planning, 2008. *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield - Strategic Review.* Niche Environment and Heritage 2013a *West Cliff Longwall 35 End of Panel Heritage Assessment*. An unpublished report prepared for BHP Billiton Illawarra Coal.

Niche Environment and Heritage 2016 *Metropolitan Coal Longwall 25: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2017a *Metropolitan Coal Longwall 26: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2017b Tahmoor South Project: Historical Heritage Assessment. An unpublished report for Tahmoor Coal Pty Ltd

Niche Environment and Heritage, 2017c*. Dendrobium Mine – Plan for the future: Coal for Steelmaking*. Aboriginal Cultural Heritage Assessment. Prepared for South32 Illawarra Coal

Office of Environment and Heritage ,2011.*Guide to investigating, assessing and reporting on Aboriginal Cultural heritage in NSW: Part 6 National Parks and Wildlife Act 1974*, Office of Environment and Heritage, Sydney South, N.S.W.

Organ, Michael ,1990. *Illawarra and South Coast Aborigines 1770-1850,* University of Wollongong, Wollongong, Aboriginal Education Unit.

Mining Subsidence Engineering Consultants 2020 *Subsidence Predictions and Impact Assessments for Longwall 19 Dendrobium Area 3A.* An unpublished report prepared for Illawarra Coal

NSW Minerals Council 2013. Mining Methods. Available at http://www.nswmining.com.au/industry/mining-methods Accessed 26 Feburay 2020.

Sefton, C. 1988 *Prehistory of the Illawarra*. Unpublished MA Thesis, University of Sydney, Sydney.

Tindale, N. 1974 *Aboriginal Tribes of Australia*. Australian National University, Canberra

Wesson 2009. *Murni Dhunhang Kirrar: Living in the Illawarra*.

Young A 1982. *Upland Swamps (Dells) of the Woronora Plateau, NSW.* Unpublished PhD thesis. University of Wollongong.

Appendix A Archaeological Report

Excellence in your environment

niche Environment and Heritage

Appendix A: Archaeological Report
Longwall 19: Dendrobium Area 3A

Lake Cordeaux Catchment LGA: Wollongong City Council

Prepared for South32 – Illawarra Metallurgical Coal
Prepared by Niche Environment and Heritage 30 October 2020

niche-eh.com

Excellence in your environment

Document control

Project number	Client	Project manager	LGA
5548	South32 – Illawarra Metallurgical Coal	Renée Regal	Wollongong City Council

Version	Author	Review	Status	Date
D3	Layne Holloway and Renée Regal	Renée Regal	DraftREV02	3 June2020
F1	Layne Holloway and Renée Regal	Renée Regal	FINAL01	11 August 2020
F2	Layne Holloway and Renée Regal	Yolanda Pavincich	FINAL02	30 October 2020

Important information about your Report

Your Report has been written for a specific purpose: The Report has been developed for a specific purpose as agreed by us with you and applies only for that purpose. Unless otherwise stated in the Report, this Report cannot be applied or used when the nature of the specific purpose changes from that agreed. **Report for the sole benefit of Niche's client:** This Report has been prepared by Niche for you, as Niche's client, in accordance with our agreed purpose, scope, schedule and budget. This Report should not be applied for any purpose other than that stated in the Report. Unless otherwise agreed in writing between us, the Report has been prepared for your benefit and no other party. Other parties should not and cannot rely upon the Report or the accuracy or completeness of any recommendation. **Limitations of the Report:** The work was conducted, and the Report has been prepared, in response to an agreed purpose and scope, within respective time and budget constraints, and possibly in reliance on certain data and information made available to Niche. The analyses, assessments, opinions, recommendations, and conclusions presented in this Report are based on that purpose and scope, requirements, data, or information, and they could change if such requirements or data are inaccurate or incomplete. **No responsibility to others:** Niche assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with, or conclusions expressed in the Report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with, or conclusions expressed in the Report.

Niche Environment and Heritage Pty Ltd (ACN 137 111 721)
Enquiries should be addressed to Niche Environment and Heritage
PO Box 2443, Parramatta NSW 1750, Australia
Email: info@niche-eh.com

Executive Summary

Project Outline

This report presents the Archaeological Report (AR) for the Longwall 19 Subsidence Management Plan (SMP) application; that is being sort by South32-Illawarra Metallurgical Coal (IMC) in accordance with Schedule 3 Condition 7 of the Dendrobium Mine Area 3A mining lease (approved under Development Consent 60-03-2001, Consolidated Mining Lease 768). The Subject Area is located approximately 13 kilometres (km) to the north west of the Wollongong Central Business district, within the WaterNSW Metropolitan Special Catchment Area. The Subject Area is defined by the 600 metre (m) boundary around the extent of the proposed Longwall 19.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by IMC to complete an ACHA and subsequent Aboriginal Heritage Impact Permit (AHIP). To complete this assessment Niche has used the following regulation and guidelines:

- *The National Parks and Wildlife Regulation 2009* (NPW Regulation);
- *Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW Department of Environment, Climate Change and Water* [DECW]2010a);
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South* Wales (DECCW 2010b);
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011); and
- *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance* (Australia International Council on Monuments and Sites [ICOMOS] 2013).

A total of 11 separate Aboriginal stakeholders (including groups and individuals have identified themselves as Registered Aboriginal Parties (RAPs) through the consultation process following the *Aboriginal cultural heritage consultation requirements for proponents 2010* (Section 3). Consultation with all these parties has been ongoing through the development of this ACHA and subsequent AHIP application.

In addition to the comprehensive reassessment of the Aboriginal Heritage Information Management System (AHIMS) registered sites that fall within the Subject Area, this AR has included a review of the previous surveys and assessments from within the Dendrobium 3A Area and surrounds. Biosis Research's previous assessment *Dendrobium Area 3 Archaeological and Cultural Heritage Assessment* (Biosis Research 2007) has been used as a foundation for this assessment as a previous AHIP (ID# 1098243) has been approved within the exiting Subject Area (Appendix E of the ACHA). This AHIP expired on 27 March 2017, as a result IMC are required to apply for a new AHIP.

A total of eight (8) Aboriginal cultural heritage sites fall within the proposed Longwall 19 Subject Area. The majority of the sites (5 of 8) have a low scientific (archaeological) significance. One site is of moderate scientific (archaeological) significance and two (2) are of high scientific (archaeological) significance. The RAPs have advised that all sites have a high cultural significance.

Summary of Impacts

The extraction of coal by longwall mining likely result in vertical and horizontal subsidence at the surface which has impacts to the natural and built environments. It has been predicted by Mine Subsidence Engineering Consultants (MSEC 2020) that four (4) Aboriginal cultural heritage sites located within the

Subject Area have been identified that will experience direct impacts from the extraction of Longwall 19. These sites include:

- DM 13 (AHIMS ID#48-2-0056)
- DM 15 (AHIMS ID#52-2-3639)
- DM 20 (AHIMS ID# 52-2-3644)
- Sandy Creek Road 21 (AHIMS ID#52-5-0273)

Four (4) Aboriginal cultural heritage sites within the Subject Area are not predicted to experience subsidence related effects (MSEC 2020:55). These Aboriginal cultural heritage sites include:

- Browns Road Site 31 (AHIMS ID#52-2-1645)
- Browns Road Site 32 (AHIMS ID#52-2-1646)
- DM 16 (AHIMS ID#52-2-3640)
- DM 17 (AHIMS ID #52-2-3641)

Regulatory requirements and recommendations

Aboriginal objects and sites are protected under the *National Parks and Wildlife Act 1974*. In order to undertake the proposed works and potentially impact DM 13 (AHIMS ID#48-2-0056), DM 15 (AHIMS ID#52-2-3639), DM 20 (AHIMS ID# 52-2-3644) and Sandy Creek Road 21 (AHIMS ID#52-5-0273), an AHIP must be obtained under Section 90 of the *National Parks and Wildlife Act 1974.*

The following recommendations have been made by Niche and the RAPs:

Recommendations	
	Aboriginal Heritage Impact Permit
1.	IMC should continue to consult with the Aboriginal community for the life of the Project in accordance with the consultation guidelines.
2.	An application for an AHIP will be required to undertake the proposed activity as it may result in harm to the following Aboriginal cultural heritage sites: • DM 13 (AHIMS ID#48-2-0056); • DM 15 (AHIMS ID#52-2-3639); • DM 20 (AHIMS ID# 52-2-3644); and • Sandy Creek Road 21 (AHIMS ID#52-5-0273).
3.	The following Aboriginal cultural heritage site cards should be updated on the AHIMS: • Sandy Creek Road 21 (AHIMS ID#52-5-0273); • Browns Road Site 32 (AHIMS ID#52-2-1646); • DM 13 (AHIMS ID#48-2-0056); and • DM 15 (AHIMS ID#52-2-3639).
4.	A subsidence monitoring program is to be implemented progressively over the life of the Project. The subsidence monitoring program should include monitoring of all Aboriginal Sandstone Shelter sites located within the angle of draw of the Project. The program should include (but not be limited to) the following: • Details on how the Aboriginal community will be consulted with for subsidence monitoring. • A schedule for undertaking the subsidence monitoring at the nominated sites. • An impact Trigger Action Response Plan (TARP) specific to each of the sites being monitored.

Recommendations	
5.	The Aboriginal Heritage Plan for Dendrobium Area 3A should be revised to include provisions and recommended management strategies determined by the outcomes of this assessment, and any further recommendations provided by the terms of the AHIP approval, provided by Heritage NSW.
	General
6.	All workers should have cultural awareness training, so they are made aware of their obligations under the *National Parks and Wildlife Act 1974* and any conditions of any future AHIP prior and during and after construction activities.
7.	In the unlikely event that suspected human remains are encountered during construction, all work in the area that may cause further impact, must cease immediately and: • The location, including a 20 m curtilage, should be secured using barrier fencing to avoid further harm. • The NSW Police must be contacted immediately. • No further action is to be undertaken until the NSW Police provide written notification to IMC. • If the skeletal remains are identified as Aboriginal, then IMC or their agent must contact: ▪ The Heritage NSW of the Department of Premier and Cabinet (DPC) Enviroline on 131 555; and representatives of the RAPs. ▪ No works are to continue until the Heritage NSW provides written notification to the proponent or their Agent.

Table of Contents

List of Figures

List of Plates

List of Tables

1. Introduction

1.1 Project background and aims

This report presents the findings of archaeological investigations of the proposed extraction of Longwall 19 within Area 3A of the Dendrobium Mine within Consolidated Coal Lease (CCL) 768, under the Development Consent 60-03-2001 (DA 60-03-2001). Dendrobium Mine is an existing underground coal mine located in the Southern Coalfield NSW within the Sydney Metropolitan Water Catchment Area (Figure 1 and Figure 2; hereafter referred to as the 'Subject Area'). Niche Environment and Heritage (Niche) was commissioned by South32-Illawarra Metallurgical Coal (IMC) to produce this Archaeological Report (AR) to inform an Aboriginal Cultural Heritage Assessment (ACHA).

The Subject Area encompasses 437.5 hectares (ha) area within Lot 14 / DP 1233164 to the south west of Lake Cordeaux, located within the Local Government Area (LGA) of Wollongong and the Illawarra Local Aboriginal Land Council (ILALC) as outlined in Figure 1 and Figure 2.

Niche has prepared this AR in accordance with the following guidelines:

- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (Department of Environment, Climate Change and Water NSW, 2010)*

The objectives of this report are as follows:

- To identify if Aboriginal cultural heritage sites within the Subject Area predicted to be impacted by the proposed works;
- Assess the cultural significance of Aboriginal Cultural Heritage sites via consultation with Registered Aboriginal Parties (RAPs);
- Provide appropriated mitigation and management recommendations in accordance with the *National Parks and Wildlife Act 1974*; and
- To meet the approval requirements, in accordance with the Subsidence Management Plan (SMP).

2. Investigators and Contributors

The contributors to this AR and their project roles are listed in Table 1.

Table 1: Contributors, affiliations and contributions

Contributor	Affiliation	Contribution	Qualification	Years' experience
Renée Regal	Niche- Team Leader- Aboriginal Heritage	Project Director, Field Archaeologist, Author and Internal Document Review	BA (Hons)	15
Layne Holloway	Niche- Heritage Consultant	Author, Field Archaeologist and Aboriginal community consultation	BSc	2
Greg Tobin	Niche	GIS, Mapping	Assoc. Dip. Eng.	10
Dr Matt Harris	Niche	GIS, Mapping	BA (Hons), PhD, GDip (GIS)	3
Gary Brassington	IMC – Manager Mining Approvals	Document Review		
Cody Brady	IMC - Principal Mining Approvals	Document Review		
Dr James Barbato	MSEC	Mine Subsidence Engineering Consultant		
Paul Knight (CEO)	Illawarra Local Aboriginal Land Council	Registered Aboriginal Party, document review.		
George Villaflor	Korewal Elouera Jerrungurah Tribal Elders Council	Document Review		
Shaun Carroll	Merrigarn	Registered Aboriginal Party and survey assistant.		
Gareth Conyard	Murra Bidgee Mullangari	Registered Aboriginal Party and survey assistant.		
Sam Lottit	Murra Bidgee Mullangari	Registered Aboriginal Party and survey assistant.		
Roxanne Smith	Murramarang	Document Review		
Jesse Johnson	Muragadi Heritage Indigenous Corporation	Document Review		
Jackson Turnbull	Muragadi Heritage Indigenous Corporation	Registered Aboriginal Party and survey assistant.		
Erin Turnbull	Muragadi Heritage Indigenous Corporation	Registered Aboriginal Party and survey assistant.		

Contributor	Affiliation	Contribution	Qualification	Years' experience
Leonard Wright	Three Ducks Dreaming	Document Review		
Nathanial Kennedy	Warra Bingi Nunda Gurr	Document Review		
Paul Bell	Wodi Wodi Traditional Owner	Registered Aboriginal Party and survey assistant.		
Joel Tubbs	Wodi Wodi Traditional Owner	Registered Aboriginal Party and survey assistant.		
Kayla Williamson	Woronora Plateau Gundungara Elders Council	Registered Aboriginal Party and survey assistant.		
Sandy Chalmers	South Coast Native Title Claimants	Document Review		

3. Description of development proposal

Dendrobium Mine is an existing underground coal mine located in the Southern Coalfield NSW. Dendrobium Mine Area 3A is within Consolidated Coal Lease 768 and is approved under DA 60-03-2001. IMC has prepared a SMP application in accordance with Schedule 3 Condition 7 of DA60-03-2001 for the proposed extraction of Longwall 19 (Appendix G of the ACHA).

The location of the proposed project includes 437.5 Ha, within the area to the south west of Lake Cordeaux, below the previously approved, and extracted area of Longwall 8. The Subject Area is approximately 8 km west of Wollongong, NSW.

The works proposed by IMC includes the longwall mining of the Wongawilli Seam. The proposed longwall mining activities will occur approximately 280 m to 450 m subsurface. The activity that has the potential to harm Aboriginal cultural heritage sites is the extraction of coal below the ground surface, which will result in mining induced ground movements (subsidence) at the surface (further explained in Section 12.2). Longwall 19 is a continuation of mining that extends into the Dendrobium Mine Area 3A. The area that may be affected by mining related impacts includes:

- Longwall 19 void;
- 600 m Boundary; and
- 35-degree angle of draw.

The following previous assessments within the Subject Area have been used to develop this report:

- Dendrobium Area 3 Archaeological and Cultural Heritage Assessment (Biosis Research, 2007) (Appendix E of the ACHA);
- Dendrobium Coal Mine- Area 3A Aboriginal Heritage Plan. (Biosis Research, 2009) (Appendix E of the ACHA);
- Subsidence predictions and impact assessments. Dendrobium – Longwall 19 (Mine Subsidence Engineering Consultants 2020) (Appendix D of the ACHA)

Through this review process it has been determined that the extraction of Longwall 19 may have the potential impact the following Aboriginal cultural heritage sites (Table 2) registered on the Aboriginal Heritage Information Management System (AHIMS).

Table 2: AHIMS registered sites are located within the Subject Area

Site Name	AHIMS ID
Shelters with Art	
Browns Road Site 31	52-2-1645
Browns Road Site 32	52-2-1646
DM 15	52-2-3639
DM 16	52-2-3640
Shelter with Art and Deposit	
Sandy Creek Road 21	52-5-0273
Shelter with Deposit	
DM 13	48-2-0056

Site Name	AHIMS ID
DM 17	52-2-3641
Shelter with Art and Potential Archaeological Deposit (PAD)	
DM 20	52-2-3644

The proposed activity will likely cause impacts from the extraction of Longwall 19 MSEC (2020). These impacts may take the form of block fall, exfoliation, cracking, opening and/or closing of existing faults and fissures (Biosis Research 2009 and MSEC 2020).

An AHIP is required to progress with the proposed works as the activity may impact DM 13 (AHIMS ID #48-2-0056), DM 15 (AHIMS ID #52-2-3639), DM 20 (AHIMS ID#52-2-3644) and Sandy Creek Road 21 and (AHIMS ID#52-5-0273). This AHIP will be determined by Heritage NSW.

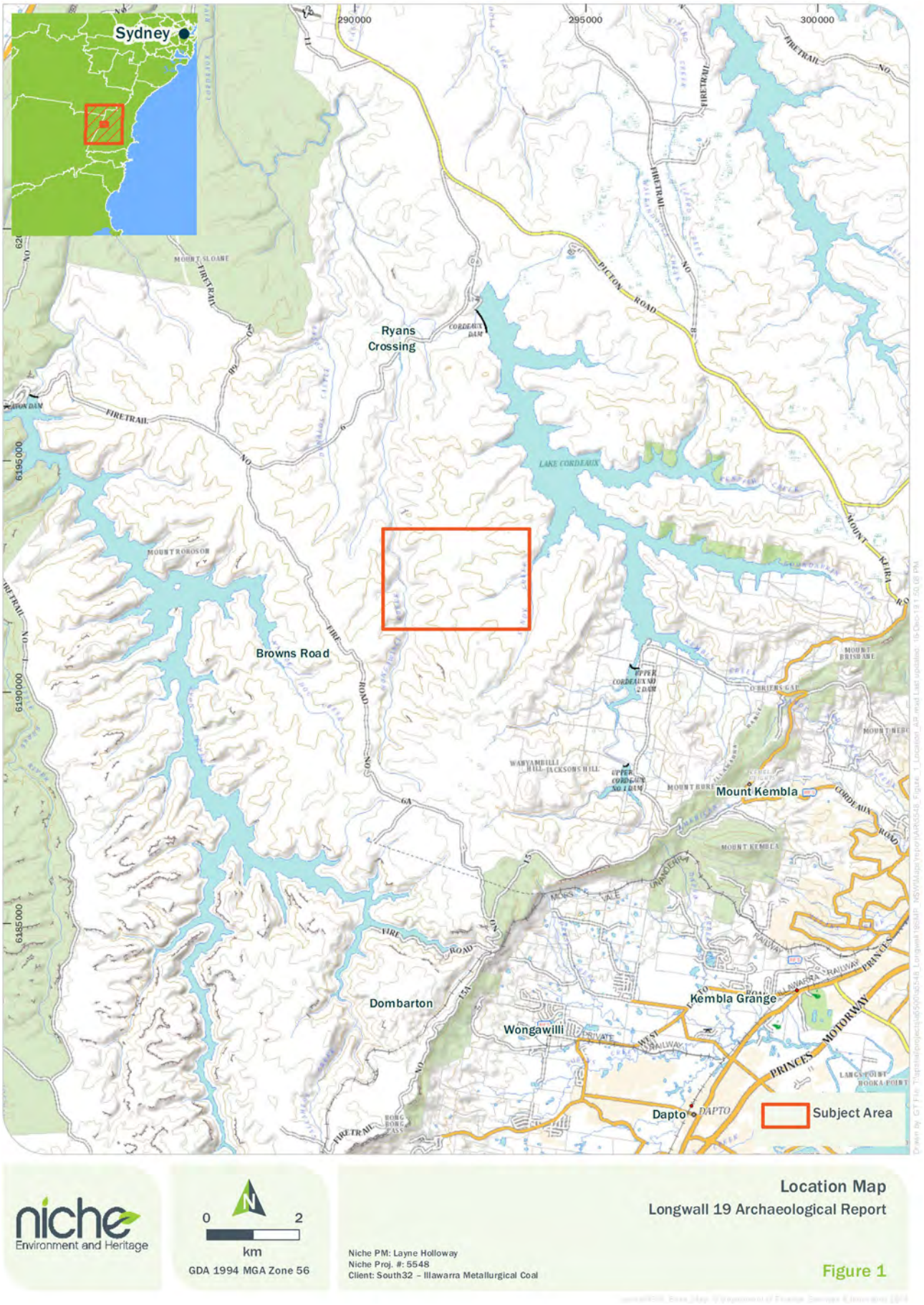

Figure 1: Location of Subject Area within regional context (Source: IMC, LPI and Niche)

Figure 2: Subject Area (Source: IMC, LPI and Niche)

4. Previous archaeological work

4.1 Aboriginal Heritage Information Management System (AHIMS)

A search of the AHIMS of the Subject Area was conducted by Layne Holloway on 17 December 2019 (AHIMS Client ID# 473225). A total of 109 Aboriginal cultural heritage sites and no Aboriginal Places were identified within an 8 km² search area (Figure 4).

The frequencies of site types within the search area are consistent with regional trends identified during previous studies that encompass the wider region (Sefton 1990, Biosis Research 2007, Biosis Research 2009, Navin Officer 1996, Niche 2011, Niche 2019, and Dibden 2019) Sandstone outcropped ridgelines and deeply incised creek lines landforms dominate the Subject Area which as shaped occupation within the region over time. Ridgetops act as vantage points and sandstone ridgelines and outcropping in proximity to creeks and swamps are noteworthy locations for shelter sites, which Aboriginal archaeological objects and occupation and resource sites are identified within the regional area.

The majority of the Aboriginal cultural heritage sites within the Subject Area were originally recorded by the Illawarra Prehistory Group (IPG) between 1980 and1990 during their systematic surveys of the Cordeaux and Avon catchment areas, which included Sandy Creek and Wongawilli Creek and their associated tributaries. Many sites were reassessed by Navin Officer (2000) and more recently Biosis Research (2007) for the completion of the original AHIP application for. The eight (8) Aboriginal cultural heritage sites recorded within the Subject Area have all been reassessed as part of this assessment. A summary of each of the site's details are outlined in Table 3 below. The complete site recordings are outlined in Annex 2 of this assessment.

Table 3: Description of Aboriginal cultural heritage sites located within the Subject Area

Site Name	AHIMS ID	Site description
DM 13	48-2-0056	This Shelter with deposit was recorded by Biosis Research in 2007. The site is situated at the ridgeline on the northern side of Sandy Creek, 150 m from the channel. The shelter is situated in the centre of a large, high sandstone cliff line, 150 m from the Sandy Creek channel. The cliff line is large and continuous and has been formed by block fall. The deposit within the living area consist of yellow brown sand that is course in texture. The deposit is estimated to be 30 – 40 cm deep across the living floor (Plate 3). The floor deposit has been partial disturbed by a wombat burrowing as evidenced by the burrow situated the centre base of the cliff line. A small number of stone artefacts were exposed on the spoil from the wombat whole. These include: • one silcrete scraper; • two chert flakes; • one silcrete flake; • one petrified wood flake; • one quartz core; • one fined grained siliceous flake; and • two pieces of quartz and silcrete debitage.
Browns Road Site 31	52-2-1645	This Shelter with Art was recorded by the IPG in 1991. The site is located under the second ridgeline up from the eastern tributary to Wongawilli Creek on the northern side, approximately 150 m north of a junction of two smaller tributaries. The sandstone overhang area of the sandstone shelter has a living area of 3 x 1 m. The floor deposit comprises of a grey loamy sand,

Site Name	AHIMS ID	Site description
		approximately 20 cm deep that has formed from the weathering sandstone of the shelter and slope wash. This recording identified: • one charcoal outline and infill of a macropod; and • two charcoal indeterminates. The Art is in a poor condition. During the previous site inspection conducted by Biosis Research (2007) natural exfoliation was observed, with part of the art being fragmented and flaked of the shelter wall.
Browns Road Site 32	52-2-1646	This Shelter with Art was recorded by the IPG in 1991. The site is located on the mid slopes of a ridge line 200 m south east of the junction of Wongawilli Creek and the WC 14 tributary. The Sandstone overhang living areas 8 x 2 m. The site was formed by block fall and cavernous weathering. The floor deposit is yellow orangey loamy sand approximately 10 cm deep in sections although most of the floor is rocky and the deposit is less than 2 to 3 cm. No artefacts were located within the deposit. A total of 30 Art motifs were located within the shelter. These include: • ten red ochre handprints, • one red ochre hand stencil, • three charcoal outlines of macropods, • seven charcoal indeterminates, • three charcoal outlines of reptiles, one with infill, • two charcoal outlines of bats, • two charcoal partial frontal human anthropomorphs, • two charcoal outlines of fish (Plate 4). Within art panel two, the charcoal motifs are overlapping the ochre red handprints.
DM 15	52-2-3639	This Shelter with Art was recorded by Biosis Research in 2007. The site is situated on the mid slopes of a ridge line above a major tributary of Wongawilli Creek. The small sandstone shelter is located in a sandstone outcrop and has been formed by blockfall and cavernous weathering. The shelter faces south, approximately 150 m from Wongawilli Creek. The floor area measures 2 x 2 m. The shelter deposit consists of medium yellow grey brown sand estimated to be 40 cm deep. No artefacts were identified. The art comprises of a single outline with infill charcoal male anthropomorphic figure. It is situated on a small panel on the eastern end of the shelter and has been well preserved by case hardening.
DM 16	52-2-3640	This Shelter with Art was recorded by Biosis Research in 2007. The site is situated on the mid upper valley slopes of a ridgeline that extends east to Wongawilli Creek. It is a large sandstone overhang that has been formed through cavernous weathering and block fall. Over 20 Art motifs were identified by the previous Biosis (2007) survey, although are barely distinguishable. The Art comprises of: • eight charcoal outlines with red bichrome infill; • one white ochre hand stencil; • four charcoal indeterminates; • one red ochre outline and infill indeterminate; and • one charcoal outline and red ochre infill indeterminate. The floor deposit consists of undisturbed medium yellow sand between 5 and 30 cm deep. No stone artefacts were identified.

Site Name	AHIMS ID	Site description
DM 17	52-2-3641	This Shelter with Deposit was recorded by Biosis Research in 2007. The site is situated on the upper sandstone cliff line of the Wongawilli Creek valley. It is a moderate overhang along a large, continues cliff line that has been formed by block fall and cavernous weathering, above a very steep drop off to the nearby creek. The floor area is approximately 9 x 2 m. The deposit consists of fine yellow grey sand, estimated to between 10 and 15 cm deep. No disturbance was evident across the floor of the shelter. One quartz core was recovered from the centre of the living floor. No Art was identified within the shelter.
DM 20	52-2-3644	This Shelter with Art and PAD was recorded by Biosis Research in 2007. The site is situated on the mid slopes of a moderate ridgeline 300 m east of Fire Trail 6C and 200 m north of an unnamed drainage line. The small sandstone overhang has been formed by block fall and cavernous weathering and is situated in a small continuous cliff line. The shelter faces north towards Sandy Creek and has a floor area of 3 x 2 m. There were no artefacts identified at this site the Art identified comprises of: • three charcoal outline and infill indeterminate motifs; and • one partial anthropomorphic figure. The motifs were in poor condition due to the excessive water seepage, leeching and micro- vegetal growth. The small cavern living area of the shelter was subject to continuous weathering resulting in exfoliation.
Sandy Creek Road 21	52-5-0273	This Shelter with Art and Deposit was originally recorded by the IPG in 1991. The site is located on a long narrow sandstone cliff line east of Fire Trail 6F. This shelter has formed through block fall and cavernous weathering; and is situated on the eastern facing overhang on the upper ridge cliff line and located 150 m south east of Sandy Creek. The deposit in the shelter comprises of a dark grey brown sandy loam. A total of seven artefacts were recorded of one which was in the drip line of the shelter: • one silcrete flake • one silcrete core fragment • one broken quartz flake • one chert flake • one petrified wood flake • one silcrete flake; and • one chert core (Plate 8). The Art consists of: • one outline and infilled partial human anthropomorph with large eyes • one charcoal outline and infill indeterminate; and • one charcoal outline indeterminate. The Art is slightly faded, and some surface exfoliation has occurred.

All recorded AHIMS sites within the Subject Area are situated within locality of Upper Nepean catchment area, part of the Woronora Plateau. The most common site type surrounding the immediate Subject Area are Shelter with Art (n= 5) and Shelter with Deposit (n=2) See (Table 4) for further details of site types within the region.

Within the wider local area, Shelter with Art (n=61), Shelter with Deposit (n=23) and Shelter with Art and Deposit (n=11) were the most common Aboriginal site types recorded on the AHIMS register (outlined in Table 4 and Figure 3). The closest sites were predominantly associated with the Wongawilli and Sandy Creeks, which has historically been suitable for Aboriginal occupation and transient use. It must be noted that care should be taken when using the AHIMS database to reach conclusions about site prevalence or distribution. The distribution of registered sites does not reflect patterns of occupation, but rather is often indicative of survey coverage and conditions.

Table 4: Summary of AHIMS site features within 8 km² of the Subject Area

Site features	Total
Shelter with Art	60
Shelter with Deposit	23
Shelter with Art and Deposit	12
Axe Grinding Groove	7
Open Camp Site	2
Shelter with Art, Deposit and Axe Grinding Groove	1
Shelter with Art and Axe Grinding Groove	1
Isolated Artefact	1
Stone Arrangement	1
Total	**109**

4.1 Assessment of robustness AHIMS data

The broader region surrounding the Subject Area has been subjected to extensive archaeological study over the last two decades. Most of the archaeological work has been initiated by impact assessments for various infrastructure, environmental engineering and academic research projects. Archaeological studies provide material evidence of Aboriginal use of the landscape at times both before and after written history and complements the oral histories and cultural knowledge held by the Aboriginal community. As noted in Section 4.2, several archaeological investigations have been undertaken in the Subject Area, including the following:

- a series of surveys undertaken by the IPG
- research assessments undertaken by Dibden, McDonald and Sefton
- due diligence assessments for mining related exploration activities undertaken within the Subject Area by Biosis Research Navin Officer, Niche and Sefton; and Aboriginal cultural heritage assessments contributing to mining approval processes and post mining monitoring competed by Niche Environment and heritage, Biosis Research and Navin Officer.

To date, the analysis within these studies has been to do with the presence, absence and disturbance of sites over time, and broad characterisation of where the sites occur in the landscape.

4.1.1 Other registers

Searches of the Australian World Heritage Database, the Commonwealth Heritage List, National Heritage List, State Heritage Register, State Heritage Inventory, the Wollongong City Local Environmental Plan (LEP)

(2009) and Wollondilly LEP (2011) and the Wollongong City and Development Control Plan's (DCP) were conducted on the 13 December 2019.

The Wollongong City DCP triggers the requirement of an ACHA, which this report satisfies.

Table 5: Listed heritage items in proximity to the Subject Area

Heritage Register	Items within the Subject Area	Items within close proximity to the Subject Area
Australian World Heritage Database	None	None
Commonwealth Heritage List	None	None
National Heritage List	None	None
State Heritage Register	None	Cordeaux Dam (SHR ID# 5051470)
State Heritage Inventory	None	None
Schedule 5 of the LEP	Timber Bridge (ID# DHS1)	Cordeaux Dam (ID # I56)
Development Control Plan; Wollongong City	ACHA assessment should be completed for all known sites containing either Aboriginal objects and / or places of Aboriginal cultural heritage significance.	All known sites containing either Aboriginal objects and / or places of Aboriginal cultural heritage significance.

4.2 Previous heritage assessments of the Subject Area

Due to the environmental and cultural significance and ongoing mining activity within the Upper Nepean Catchment of the Woronora Plateau, several heritage assessments have been undertaken within the Subject Area. This has built a collection of local knowledge of the cultural heritage values of the Subject Area. The eight Aboriginal cultural heritage sites that have been identified have had minimal disturbance as they are located within the WaterNSW Managed Metropolitan Special Catchment Area.

Table 6: Review of previous heritage assessments within the Subject Area

Author and Year	Title and Description
Sefton 1990 1989-1990	**Archaeological Survey of the Avon River by the Illawarra Prehistory Group** An assessment of the Cordeaux and Woronora Rivers was completed with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. A total of 89 Aboriginal cultural heritage sites were identified during this assessment. Sefton provided useful statistical data about the site types and art techniques within the Upper Nepean region.
McDonald 1994	**Dreamtime Superhighway: An analysis of Sydney Basin Rock Art and Prehistoric Information Exchange** McDonald completed a PhD thesis on the prehistoric rock art within the Sydney region. This thesis highlighted that Shelter with Art site types have greater visibility to a broader section of the community and had the potential to function in a different fashion to the engraved art of the region, which is not associated with habitation debris (McDonald 1994: 124). The thesis highlights the motif types present within the region and observes that within inland areas, land animals make up a high percentage of motifs used.

Author and Year	Title and Description
	In conclusion, McDonald demonstrates that there are also several major variations in art techniques and motif type between the southern areas of the Woronora Plateau and the eastern and northern areas of the Sydney Basin.
Sefton 1994 1993-1994	**Archaeological Survey of the Avon River by the Illawarra Prehistory Group** Sefton received a further grant from the Australian Institute of Aboriginal and Torres Strait Islander Studies to complete an assessment of the Avon River. The surveys focused on sandstone outcrops and formed a model of site types that would be present within the Subject Area, which is of the same typography as the current Subject Area for the Project. Site types that were highlighted were Stone Arrangements, Axe Grinding Grooves, Groove Channels, Rock Engravings, and Shelter with Art and/or Deposit site types. During this assessment, 53 Shelter sites, 13 Axe Grinding Groove Sites, two Stone Arrangements and one Engraved Channel were assessed.
Sefton 1998a	**Site and Artefact Patterns on the Woronora Plateau** Sefton completed a post graduate thesis that focused on the artefact and Aboriginal archaeological site patterns of the Woronora Plateau. The data used for this assessment had been collected by the Illawarra Prehistory Group between 1970 and 1998. The associations considered by Sefton included the relationship between sites, the material evidence remaining and their location within the landscape. This assessment focussed on Shelter with Art and/or Deposit, Axe Grinding Grooves and Rock Engravings site types. During her assessment, Sefton argues that site density within the Woronora Plateau area can be used to indicate the spatial distribution or density of the Aboriginal population within the study area using multivariate analysis (Sefton 1998a:62). In analysing the shelter sites with their attributes, clear patterns form between shelters, their attributes and the drainage basins of the Woronora Plateau and the inland/coastal associations of the shelter sites (Sefton 1998a:166). According to Sefton, these changes indicate a difference in settlement patterns across the Woronora Plateau.
Sefton 2000	**Overview of the monitoring of sandstone overhangs for the effects of mining subsidence in the Illawarra Coal Measures** Sefton completed an overview of the monitoring of sandstone overhangs for the effects of mining subsidence for Illawarra Coal. The purpose of this assessment was to develop a monitoring program to gauge the effects of subsidence on sandstone overhangs and to relate these effects to the following parameters: ▪ Topographic location; ▪ Overhang shape and size and overhang formation process; ▪ The presence of jointing in bedding planes; ▪ Mining subsidence; ▪ Comprehensive and tensile strains and tilts; and ▪ Overhang location relative to longwalls and geological anomalies. This assessment has been used as a template for Aboriginal archaeological site monitoring programs within the Southern Coalfield and the principles outlined for site recording will be used during this assessment.
Sefton 2002	**Archaeological Survey of longwall 9 and 10 Application Elouera Colliery**. Sefton was commissioned to complete an assessment of previously identified sites for IMC to comment on their archaeological significance and to provide management strategies.
Biosis Research 2004	**Dendrobium Area 3 Lake Cordeaux foreshore seismic testing REF: Archaeological survey** Biosis Research were commissioned to complete a Review of Environmental Factors (REF) for the proposed seismic testing of part of Dendrobium Mine Area 3 and the Lake Cordeaux foreshore. This REF included Aboriginal and European heritage. This assessment was used to assist with the development of the predictive modelling and survey methodology for the

Author and Year	Title and Description
	Project, as the Subject Area used for the previously completed assessment was also located within a similar landscape area.
Biosis Research 2007a	**Dendrobium Area 3 Aboriginal Cultural Heritage Assessment.** In 2007 Biosis Research was commissioned by BHP Billiton to complete an assessment of Dendrobium Mine Area 3 for Aboriginal and European heritage. During this assessment, a total of 65 Aboriginal cultural heritage sites were identified. Of these 65 sites, 14 were located within Dendrobium Mine Area 3A, the remaining 24 were located within Dendrobium Mine Area 3B and 18 were located within Dendrobium Mine Area 3C. Similar to Navin Officer (2000) and the current study, the site types identified comprised of Shelter with Art and/or Deposit, Isolated Artefacts, Axe Grinding Grooves and a suspected Stone Arrangement. As a result of this assessment, it was recommended that an AHIP to be applied for 14 Aboriginal cultural heritage sites.
Biosis Research 2010	**Dendrobium Area 3A Aboriginal Management Plan** This document was completed to satisfy the condition consent conditions for the Dendrobium mine project. The aim of this Management Plan is to describe protocols for ongoing Aboriginal community engagement, establish suitable methods for baseline recording, establish and conduct a monitoring program to detect and measure any changes at sites due to subsidence.
Biosis Research 2013	**Longwall 8 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 8 located in Dendrobium Area 3A, directly above the current Subject Area. A visual inspection of DM 13 (AHIMS ID #48-2-0056) and DM 20 (AHIMS ID #52-2-3639) was undertaken during mining to determine any subsidence impacts as a result of the longwall extraction. No Impacts were observed for any Aboriginal cultural heritage sites.

4.3 Previous heritage assessments and ethnographic sources of the region

The broader region of the Woronora Plateau would have been relatively rich and diverse resource area for Aboriginal people in the past, but modifications such as farming and residential developments are likely to have disturbed large areas containing archaeological materials. The preservation of the Upper Nepean catchment areas for water storage has conserved the natural environment from major modification, resulting in the preservation of many Aboriginal cultural heritage sites.

The region surrounding the Subject Area has been subject to intensive archaeological survey over the last two decades (Biosis Research 2004, 2007a 2007b, 2009a; McDonald 1994; Navin Officer 2000; Niche Environment and Heritage 2009-2017, 2017-2019 and Sefton 1990, 1994, 1998a, 2000 and2002). The main issues that have been dealt with by these studies have been questions of presence or absence of sites, broad characterisation of where the sites occur in the landscape, and the monitoring of sites for subsidence.

A description of these past archaeological assessments within the wider surrounds is provided in below in Table 7. The antiquity of Aboriginal occupation in the region is demonstrated through several archaeological excavations that have been undertaken in the region surrounding the Subject Area (Sefton 1990, 1994, 1998a, 2000 and 2002; McDonald 1994 and Biosis Research 2007a and 2009a). The oldest date generally considered to be reliable for the earliest occupation around the region comes from excavations at Parramatta where archaeological material has been dated to 30,735 ± 407 BP (McDonald et al 2005). The

site of Bass Point at Shellharbour has been dated to 17,101+/- BP (Flood 1999). Within closer proximity to the current Subject Area on the Woronora Plateau the oldest date for Aboriginal occupation is at Curracurrang 1 Sandstone Shelter at 7,450 +/- 180 BP (Dibden 2019:38).

Table 7: Regional heritage assessments considered

Author and Year	Title and relevance to the Subject Area
Organ 1990	**A History of Aboriginal People of the Illawarra 1770 to 1970 (DEC, NSW 2005), Illawarra and South Coast Aborigines 1770-1850** Provides an overview of historical and ethnographic sources for the Illawarra region. This resource provides a depth of information of tribal boundaries, language and occupation of Aboriginal people within the Illawarra.
Sefton 1990 1989-1990	**Archaeological survey of the Cordeaux River and Woronora River by the Illawarra** An assessment of the Cordeaux and Woronora Rivers was completed with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. A total of 89 archaeological sites were identified during this assessment. Sefton provided useful statistical data about the site types and art techniques.
Navin Officer 2000	**Dendrobium Coal Project: Cultural Heritage Assessment** In 2000, Navin Officer completed a cultural heritage assessment for the Dendrobium Coal Project, which included Longwalls 1 to 3 within Dendrobium Mine Area 1; which is to the south-east of the current Subject Area. The survey sample for this assessment was confined to areas that were proposed to have impacts associated with them. Like this current assessment, sites that were registered on AHIMS were reassessed. Large trees were assessed for scarring and ridgelines and open sandstone platforms were surveyed. During this assessment, 19 AHIMS accessioned sites were assessed and 11 previously unrecorded sites were identified. These site types comprised of Shelters with Art and/or Deposit and Potential Archaeological Deposit, Open Camp Sites, and a Stone Arrangement.
Department of Environment and Conservation, NSW, 2004	**Aboriginal Women's Heritage: Wollongong** This resource is a collection of Dharawal Women's oral history from local Elders that have recalled lore, cultural practices, resource gathering and a struggle for land and civil rights within the Illawarra. This resource supports archaeological finds and can be used as a basis for predictive modelling.
Biosis Research 2004	**Mine Area 3 Lake Cordeaux foreshore seismic testing REF: Archaeological survey** Biosis Research were commissioned to complete a Review of Environmental Factors (REF) for the proposed seismic testing of part of Dendrobium Mine Area 3 and the Lake Cordeaux foreshore. This REF included assessment of Aboriginal and European heritage sites.
Biosis Research 2007b	**West Cliff Colliery Stage 3 Coal Wash Emplacement Archaeological and Cultural Heritage Assessment** This assessment was completed in 2004 as part of the proposed Stage 3 West Cliff Colliery Coal Wash Emplacement works. This assessment was used to assist with the development of the predictive modelling and survey methodology for the project, as the Subject Area used for the previously completed assessment was also located within a similar landscape area.
Biosis Research 2009a	**Bulli Seam Operations Aboriginal Cultural Heritage Assessment** Biosis Research was commissioned by BHP Billiton-Illawarra Coal to conduct an ACHA for the proposed Bulli Seam Operations Project. During this assessment a total of 646 previously recorded and 45 newly identified sites were surveyed. The survey methodology

Author and Year	Title and relevance to the Subject Area
	for this assessment included targeted survey of previously recorded AHIMS sites and associated ridgelines.
Niche Environment and Heritage 2014b	**Longwall 9 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 9 located in Dendrobium Area 3B. It was concluded that minor cracking occurred at Dendrobium 1 (AHIMS ID#52-2-2208) in result of subsidence related movements. The four remaining sites within the Subject Area had not been impacted by subsidence related movements.
Biosis 2015	**Longwall 10 End of Panel Monitoring Assessment** The assessment of cultural heritage and archaeological sites potentially impacted by Longwall 10 was conducted by Biosis. Two (2) Shelter with Deposit sites were inspected as part of the assessment. Visual Inspections for Dendrobium 1 (AHIMS ID # 52-2-2208) and DM2 (AHIMS ID # 52-2-3878) concluded that no changes have occurred to DM2 (AHIMS ID # 52-2-3878), however Dendrobium 1 (AHIMS ID # 52-2-2208) had minor expansion and extension of vertical cracking in horizontal bedding plane during Longwall 9 extraction, however no impacts from the mining of longwall 10.
Biosis 2016	**Longwall 11 End of Panel Monitoring Assessment** An inspection of Aboriginal cultural heritage sites as part of the impact assessment within 400 m of Longwall 11. A visual inspection of Browns Road Site 12 (AHIMS ID #52-2-1627) and Dendrobium 2 (AHIMS ID #52-2-2209) was undertaken to determine any subsidence impacts as a result of the longwall extraction. No Impacts were observed for any Aboriginal cultural heritage sites.
Niche Environment and Heritage 2009-2017	**Dendrobium Exploration Review of Environmental Factors (REF): Aboriginal Cultural Heritage Due Diligence Assessments.** On behalf of IMC, Niche has completed several exploration REF's. These exploration works comprise seismic line and exploration borehole works. These assessments have been carried out within Dendrobium Mine Areas 3B, 3C, 4 and 5. The assessment for these works included assessing all ridgelines and creek beds within close proximity to the proposed works and relocating works within 100 m of AHIMS registered Aboriginal sites. Throughout these investigations, there have been no previously unregistered AHIMS sites located.
Niche Environment and Heritage 2017c	**Longwall 12 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 12 at Dendrobium Colliery. It was concluded that none of the five Aboriginal cultural heritage sites had not been impacted by subsidence related movements.
Niche Environment and Heritage 2018d	**Longwall 13 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 13 at Dendrobium Colliery. It was concluded that none of the five Aboriginal cultural heritage sites had were impacted by subsidence related movements.
Niche Environment and Heritage 2019b	**Longwall 14 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 14 at Dendrobium Colliery.

Author and Year	Title and relevance to the Subject Area
	This assessment concluded that Browns Road Site 11 (AHIMS ID# 52-2-1626) and Site 1 DB 1 (AHIMS ID #52-2-2229) had been impacted by subsidence related movements caused by mining. Three other Aboriginal cultural heritage sites located within the area of assessment had not been impacted.
Niche Environment and Heritage 2020	**Longwall 15 End of Panel Monitoring Assessment** A site assessment and review of the predicted and observed impacts on Aboriginal cultural heritage sites and their associated values resulting from the extraction of coal at Longwall 15 within Dendrobium Colliery Area 3B. This assessment concluded that DM 21 (AHIMS ID #52-2-2229) had been impacted by subsidence related movements caused by mining and Browns Road Site 11 (AHIMS ID# 52-2-1626) experienced further impacts from those identified during the Longwall 14 monitoring.
Niche Environment and Heritage 2017-2019	**Dendrobium Next Domain: Steelmaking for the Future** Niche were engaged to undertake a systematic survey of the creeks and ridgelines that have potential for Aboriginal cultural heritage within the proposed Dendrobium Mine Area 5 and 6 domains. A total of 37 Aboriginal cultural heritage sites were identified within the Subject Area, including five newly recorded sites and 32 previously recorded sites. The locations of three sites identified on AHIMS could not be confirmed during the assessment. All 37 sites are located within the proposed Dendrobium Mine Area 5 and Area 6 underground mining investigation areas, with one site located in close proximity to a proposed ventilation shaft investigation area.
Niche 2019	**Dendrobium Area 3B, Longwalls 20 – 21 Aboriginal Cultural Heritage Assessment** Niche were engaged to complete an ACHA with community consultation to assess the Aboriginal cultural heritage sites in the area above Longwalls 20 -21 in Area 3B. Eight Aboriginal cultural heritage sites were located within the Subject Area and are predicted by MSEC to experience nil to low levels of tilt and strain related to longwall extraction.
Dibden 2019	**Drawing in the land: Rock Art of the Upper Nepean, Sydney Basin New South Wales** Dibden's study offers a board analysis of rock art in the Nepean region. The text examines the landscape in connection with the material archaeology and insight to the philosophy in attempt to understand the habitual mode that has led to the Shelter with Art dominated archaeological record.

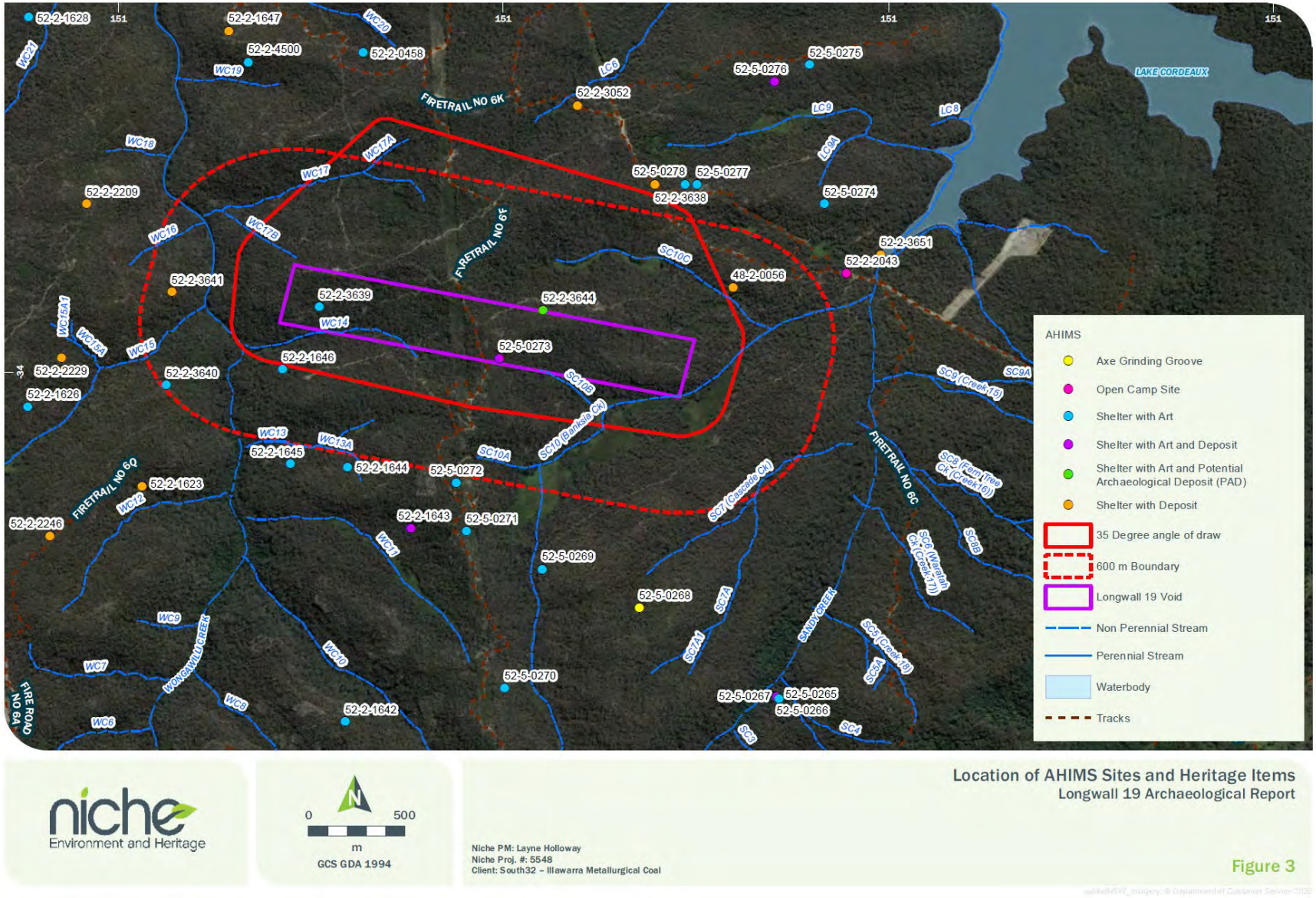

Figure 3: Regional AHIMS results (Source: Heritage NSW and Niche

5. Landscape context

5.1 Preamble

Understanding the past and present environmental contexts of a Subject Area is requisite in any Aboriginal archaeological and cultural heritage investigation (DECCW 2010a). This gives an understanding of what activities would have taken place there in the past and the likelihood any trace of them would remain below the surface.

The following section provides details of the environmental characteristics of the Subject Area. The section concludes by considering how the environmental character of the Subject Area affects the way in which the area would have been occupied by Aboriginal people in the past, and how Aboriginal archaeological sites will be distributed across the landscape. It is important to note that the environmental context for inhabitants of the Illawarra region in times past is different to current climates. The major impact of this change in climate was a change in sea-level on the coast which would have had ramifications for the inland river systems.

Consideration of the landscape is essential to define and interpret past Aboriginal land use across a landscape and is a requirement of any Aboriginal archaeological and cultural heritage investigation (DECCW 2010a: 8). The landscape may provide insight as to areas of land that may have been more intensively used by Aboriginal people in the past due to the presence of resources such as water, stone, plants and animals and other raw materials or landscape features associated with sustenance, shelter, tool manufacture and cultural activities. The landscape provides the context within which the material remains of past Aboriginal occupation may be preserved and detectable due to the movement of soil through geomorphic processes such as erosion or its removal from the landscape through past land use and disturbance (DECCW 2010a: 8). By considering these factors, an Aboriginal cultural heritage investigation may develop a sampling strategy for identifying any tangible Aboriginal heritage values within the Subject Area.

The Subject Area has experienced little change since colonisation. The sandstone landscape and sterile soils deterred settlers from colonising the area. During the late 1800's the land was gazetted as part of the Sydney Water Metropolitan Catchment Area which has restricted public access and has led to the damming of Avon, Cataract, Cordeaux, Nepean waterbodies (WaterNSW 2019). The consequences from damming and restricted access to continue traditional indigenous burning practices has likely altered streamflow and vegetational communities within the Subject Area (Dibden 2019: 31).

Despite the landscape changes the Subject Area may have faced since colonisation, the restricted access of this area has led the preservation to the native biodiversity and Aboriginal cultural heritage.

Plate 1: General photograph of a sandstone ridgeline within the Subject Area

Plate 2: General photograph sandy deposit in which artefacts are typically located within the Subject Area

5.1.1 Geology, soils and geomorphology

Broadly the Subject Area is located on the southern Woronora Plateau within the Cordeaux and Avon Dam catchment areas (Figure 5). The Project is located within the southern portion of the Permo-Triassic Sydney Basin. The terrain of the Subject Area is characterised by Middle Triassic Hawkesbury Sandstone, which is comprised of overlapping beds of quartz-rich sandstone. Under the sandstone formations the substrates comprise of deep Permian Coal Measures that consist of shale sandstone, conglomerates, tuff, chert and coal (Branagan and Packhan 2000). These formations are divided into colluvial and residual landscapes.

In colluvial landscapes the dominant form of landscape formation is mass movement (rock fall) hazard with steep sloped, rock outcrops with shallow stony high permeable soil (Hazelton and Tille 1990:45). The Hawkesbury sandstone soil landscape ranges from rolling and rugged hills to very steep sandstone escarpment and ridges. Within this landscape sandstone outcrops are very common and often occur as horizontal benches and broken scarps up to 10 m high. Rock outcrops and surface boulders and cobbles make up to half of the ground surface (Hazelton and Tille 1990:45-46). This outcropping is evident around Wongawilli Creek and Cordeaux Dam within the Subject Area (Plate 1). The soils comprise of shallow sandy lenses; up to 30 centimetres (cm) deep (Plate 2). The topsoil of colluvial landscapes has low erodibility, consisting of permeable, loose, coarse sands and organic matter. The Hawkesbury soil landscape is highly susceptible to concentrated flow erosion. This landscape is the most archaeologically sensitive within the Subject Area, as the blocks and weathered scarps provide suitable overhangs to be used for shelter. Within these overhangs there is often suitable surfaces for Art, as well as floor space for the accumulation of archaeological deposit. There is, however, limited space for a deep accumulation of stratified subsurface deposits due to the size of many of the overhangs, as evidenced by the number of shelter sites recorded. The distribution of Aboriginal cultural heritage sites within the Subject Area is associated with landforms suitable for overhangs for shelter and art surfaces.

5.1.2 Ecology

The vegetation within this landscape comprises of woodland and open forest with some areas of tall open forest, and rainforest within the sheltered gullies. On the open crests and ridges, woodland and open forest contains red bloodwood (*Corymbia gummifera*), narrow leaved stringy bark (*Eucalyptus globoidea*), Scribbly Gum (*Eucalyptus racemosa*), Blue Mountains Mallee (*Eucalyptus stricta*), Old-Man Banksia (*Banksia serrata*). Sheltered side slopes of the landscape are characterised by open forest containing Sydney Peppermint (*Eucalyptus piperita*), Smooth-Barked Apple (*Angophora costata*) and Black She-Oak (*Allocasuarina littoralis*) with an understorey of *Epacridaceae* spp., *Myrtaceae* spp., *Fabaceae* spp. and

Proteaceae spp. (Hazelton and Tille 1990: 46). These communities supported a range of resources that would have been utilised by Aboriginal peoples along with those coastal resources that would have been available, both for food as well as to fulfil social and cultural needs.

Table 8: Flora and fauna species that would have been utilised by the Aboriginal people of the Illawarra region. As described by Stewart and Percival (1997).

Resource Species	Traditional Uses
Silicified wood, mudstone, quartz, quartzite and Ochre	Such stone sources were used to craft flaked tools, grindstones, hammerstones and resources for art media.
Red Bloodwood (*Corymbia gummifera*)	The sap from this tree can be used for toothache and mouth wash, or used for mixing with paints to stain artefacts and rock art. It is also used to tan fishing ropes and nets.
Grey Ironbark (*Eucalyptus paniculata*)	The bark is mixed with Bloodwood Gum to tan fishing nets.
Thin-leaved Stringybark (*Eucalyptus globoidea*)	Bark was removed using various tool types, such as ground edge axes, and was used for a range of purposes such as coolamons, canoes and shields.
Yellow Stringybark (*Eucalyptus muellerana*)	Bark was removed using various tool types, such as ground edge axes, and was used for a range of purposes such as coolamons, canoes and shields.
Banksia species (*proteaceae*)	Sweet nectar can be sucked out of the flowers or shaken onto hand and licked off. The flower spikes can also be soaked in water for a 'sweet tea.' Banksias were also used to carry fire as the smouldering cones could be carried long distances.
Grass Tree (*Xanthorrhora*)	Roots are edible and flower stem is nectar rich which can be extracted to make a sweet drink or can be used as a hunting tool to attract birds. The tree sap can be used for resin.

5.1.3 Climate

The climate within the suburb of Cordeaux consists of mild summers with an average maximum of 28.5 degrees Celsius and minimum of 16.6 degrees Celsius in February, and cold, wet winters with an average minimum of 1.7 degrees Celsius and a maximum of 11.1 degrees Celsius in July (Bureau of Meteorology 2019, based on records taken between 1907-1975 from (Picton Council Depot station).

Recorded rainfall readings indicate an average annual rainfall of 800 millimetres (Bureau of Meteorology 2019, based on records taken at Picton council depot). Whilst conditions and temperatures are wide ranging, the conditions in the region of the Subject Area can be summarised as being mild and highly suitable for year-round hunter-gatherer occupation of all parts of the region.

5.1.4 Land use and disturbance

The landscape has been subject to limited impacts over time, owing to the area being part of WaterNSW Metropolitan Catchment area. Access within the Metropolitan Catchment Area is limited to the public and is restricted by Water NSW. Land use impacts include:

- Creation of the Avon and Cordeaux dams;
- Installation of services (power lines, pipes, roads); and
- Exploration drilling and seismic activities.

Each of the above land uses and activities impacts the preservation and visibility of the archaeological record within the Subject Area. However, the majority of the Subject Area has been subject to very limited modification and disturbance.

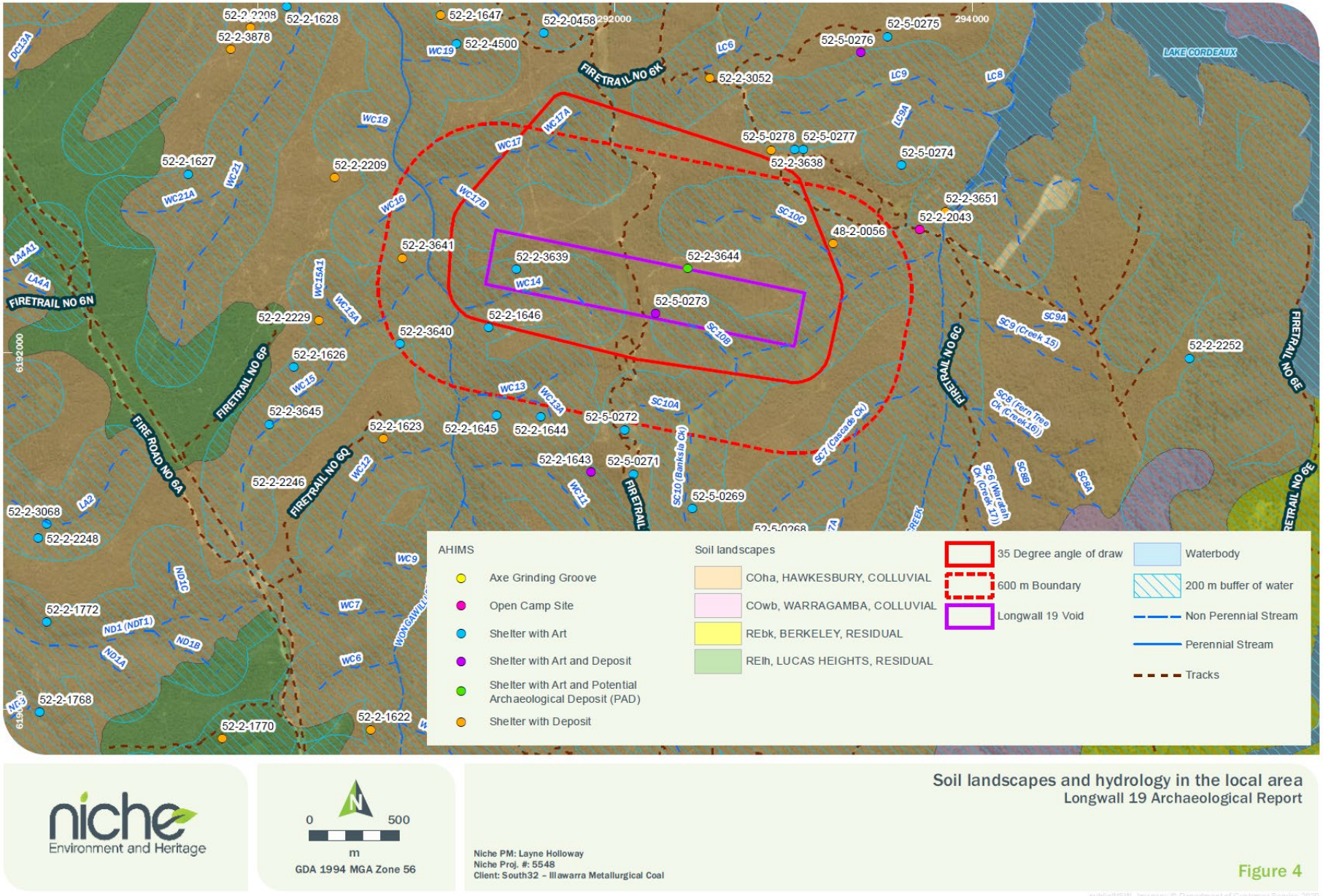

Figure 4: Soil and Hydrology landscapes located within the Subject Area (Source: LPI and Niche)

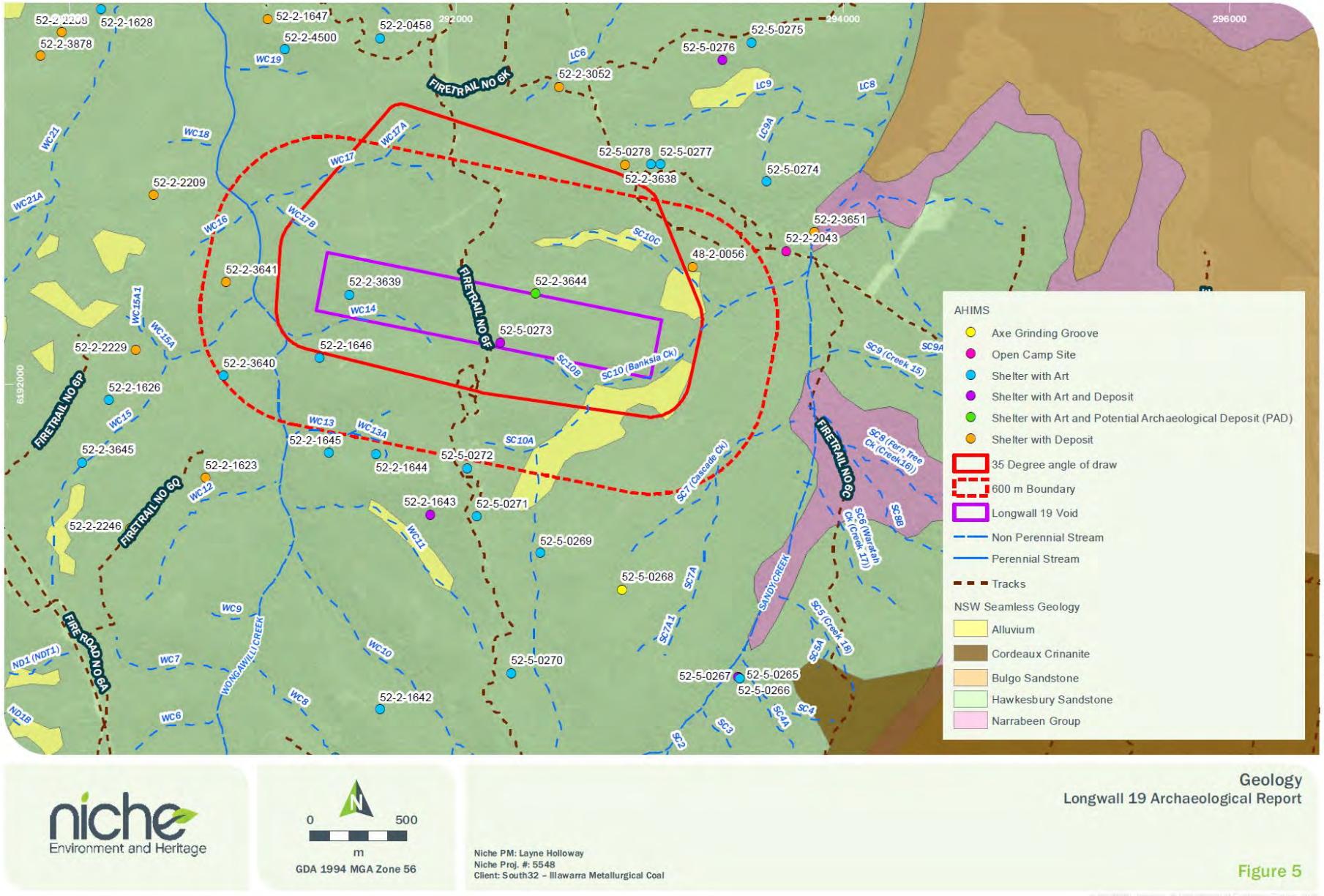

Figure 5: Geology within a regional context (Source: LPI and Niche)

6. Regional potential

6.1 Past Aboriginal land use in the Subject Area

The Subject Area is located on the traditional country of the Dharawal nation. Tindale (1974) has identified the Dharawal boundaries extend from the south side of Botany Bay to north of the Shoalhaven River to the south, running inland to the Campbelltown and Camden area (Attenbrow 2010: 34; SA Museum 2010).

The coastal plains and escarpment around Wollongong were inhabited by the Wadi Wadi, a tribe/sub-group of Dharawal-speakers (Tindale 1940:194-195, Tindale 1975:199-201). Other named groups of the Dharawal language group are thought to include the Gweagal, Norongerraga, Illawarra, Tagary, Wandeandega, Wodi Wodi and Ory-ang-ora (Tindale 1974). Attenbrow (Attenbrow 2010:35) points out that such boundary mapping, undertaken as it was in the nineteenth century, is indicative at best, however, there appears to be reasonably strong agreement between those who have mapped language boundaries that the area is Dharawal country. Dharawal people distinguished themselves as Fresh Water, Bitter Water or Saltwater depending on where in the wider language boundary their traditional lands were – the inland hills and valleys, the plateaus and swamps or the coastal plain respectively (DEC, NSW, 2005:6)

Past Aboriginal land use of the Subject Area can be re-traced using previously recorded archaeological resources, historical observations of early settlers and surveyors (though the inherent bias present in historical European observations must be recognised), and contemporary comments from Aboriginal people and consideration of art motifs represented within the Subject Area.

7. Predictions

The predictive model developed for the Subject Area is taken from Biosis Research 2007 and 2009 as these assessments were both undertaken within the current Subject Area for the application of AHIP # 1098243. These predictive models included the consideration of previous archaeological surveys and assessments in the local area and wider surrounds, the distribution and patterning of known sites within the Subject Area and surrounds, the landform units and landscape context of the Subject Area, and the previous known land uses in the area. Due to the rugged nature of the Hawkesbury Sandstone landscape, many of the sites suitable for Aboriginal occupation and transient use comprise of sandstone overhangs; as outlined in Section 5.1.1.

A summary of the known Aboriginal cultural heritage sites listed in the AHIMS database are provided in Section 4 and the complete AHIMS search results are listed within Attachment B of the ACHA.

The predictive model developed for the Subject Area is as follows:

- Sandstone shelters or rock overhangs with archaeological deposits, Art, and / or Artefacts will be the most common site type identified within the Subject Area. This is due to the steep slopes and ridgelines present along the Cordeaux Dam, Wongawilli Creek, as well as Sandy Creek and their associated tributaries. Of the sites identified within the Subject Area, 40% are sandstone shelter sites.
    - Art mediums will most likely consist of charcoal with red and white ochre being less common likely due to restrictions of the resource.
    - Art motifs are likely to reflect a representation the utilisation of inland resources, such as eels, fish and macropods.
- Axe Grinding Groove sites are a common site type within the Subject Area:
    - Axe Grinding Groove will most likely occur on sandstone outcrops associated with drainage lines, swamps, creek lines and riverbeds.
    - The bulk of axe grinding groove sites will contain fewer than 50 grinding grooves.
    - Grooves will generally be between 25 cm and 50 cm in length, 5 cm to 8 cm in width and between 2 cm and 5 cm in depth and represent the sharpening or preparing of ground-edge hatchets or fire-hardened points.
    - Axe Grinding Grooves are often located on large sandstone platforms within creek beds and swamp.
- Stone artefact scatters and isolated stone artefacts within an open context will be a less common class of site type or feature within the Subject Area:
    - The identification of this type of site depends on ground surface visibility, as site extent and artefact numbers are only visible on the surface. Due to the vegetation cover of the Subject Area this site type is difficult to relocate. Areas of open ground surface will be assessed for such site types.
    - The majority of these open context artefact sites on level to gently inclined alluvial plains, floodplains, terraces, foot slopes and simple slopes which are rarely present within the Subject Area.
    - The majority of sites will occur within 200 m of temporary or permanent water sources utilised for resource exploitation, with the average distance between a site and water being 70 m.
    - The majority of sites will occur on alluvial and transferral soil landscapes, neither of which are present within the Subject Area.
- Culturally modified trees will be the least represented class of site type in the Subject Area:

- Culturally modified trees are a site type that is formed from the removal of bark from a tree for use in the manufacture of canoes, shields, shelters and containers for sorting or carrying items.
- Whilst the area has been protected from large scale timber felling operations, due to public access restrictions, the area is frequently subject to intense bushfires that would significantly reduce this site type's survival.

- Burials, an uncommon site type, are present within soft alluvial sediments, caves or hollow trees. Such sites are more commonly located within the sand dunes of the coast region. It is highly unlikely that this site type will occur within the Subject Area.
- Stone arrangements, a rare although, may be located within the Subject Area. This type of site can include mounds of rocks for burial, or markers, mythological sites or areas of spiritual connection. There are no stone arrangements previously identified within the Subject Area.
- The bulk of archaeological sites within the Subject Area will relate to the last 2,000 years of occupation and the late Holocene period.
- Older archaeological deposits may be present in rock shelters or buried archaeological deposits associated with the infill of drainage lines, swamps and in areas with multiple depositional layers.

8. Sampling Strategy and Field Methods

8.1 Sampling Strategy

The following methods were used to identify heritage values and significant cultural themes for the Subject Area:

- Aboriginal community input – this was sought via the consultation process and correspondence and is documented in the ACHAR and Appendix B.
- Reassessment of Aboriginal cultural heritage sites previously identified during the surveys completed by Biosis Research during their 2007 and 2009 assessments.
- Additional gaps analysis through research and literature review of more recent assessments within the Subject Are and region.

The above methods and activities have been ongoing throughout the assessment project and have continuously fed back and informed each other.

8.2 Field methods

Survey participants in accordance with the methodology were generally spaced 5 m apart and targeted areas with ground surface visibility such as sandstone outcrops landforms, and shelter sites. The survey methodology is outlined below:

- A handheld GPS unit was used to record all tracks and appropriate site data for the survey.
- Representative photographs were taken of the recorded sandstone shelter sites, different visibility levels, exposures and disturbed areas.
- Different types and levels of exposure was recorded, defined as an estimate of the area which has a likelihood of revealing archaeological evidence on the surface of the ground, i.e. visibility refers to what conceals (Burke and Smith 2004:78-80).
- Aboriginal cultural heritage sites that were located within the angle of draw of the longwall or are predicted to be impacted by the extraction of Longwall 19 were revisited and surveyed.
- Revised section and plan recordings were completed on sites located during this assessment.
- The previous (Biosis 2007) survey methods utilised a 'contour surveying' strategy which involved walking parallel to characteristic topographic features and inspection for suitable sandstone shelters and platforms. This strategy was aimed to target landforms identified for having high archaeological potential based on the formed predictive model.

8.3 Sensitive cultural information - management protocol

During the consultation process IMC and Niche provided the opportunity for the RAPs to provide cultural information, including a statement of the value of identified sites and other matters. The input points were listed within the survey methodology that has been included in Appendix B of the ACHA, information will be accepted at any point during the project prior to the finalisation of the ACHA and AR.

RAPs were made aware that IMC and Niche staff would seek cultural information and supporting evidence in regard to matters of cultural value.

In the event that a stakeholder had sensitive or restricted public access information it was proposed that the proponent and Niche would manage this information (if provided by the Aboriginal community) in accordance with a sensitive cultural information management protocol. It is anticipated that the protocol will include making note of and managing the material in accordance with the following key limitations, as advised by Aboriginal people at the time of the information being provided:

- any restrictions on access to the material;
- any restrictions on communication of the material (confidentiality);
- any restrictions on the location/storage of the material;
- any cultural recommendations on handling the material;
- any names and contact details of persons authorised within the relevant Aboriginal stakeholder to make decisions concerning the Aboriginal material and the degree of authorisation;
- any details of any consent given in accordance with customary law; and
- any access and use by the registered Aboriginal stakeholders of the cultural information in the material.

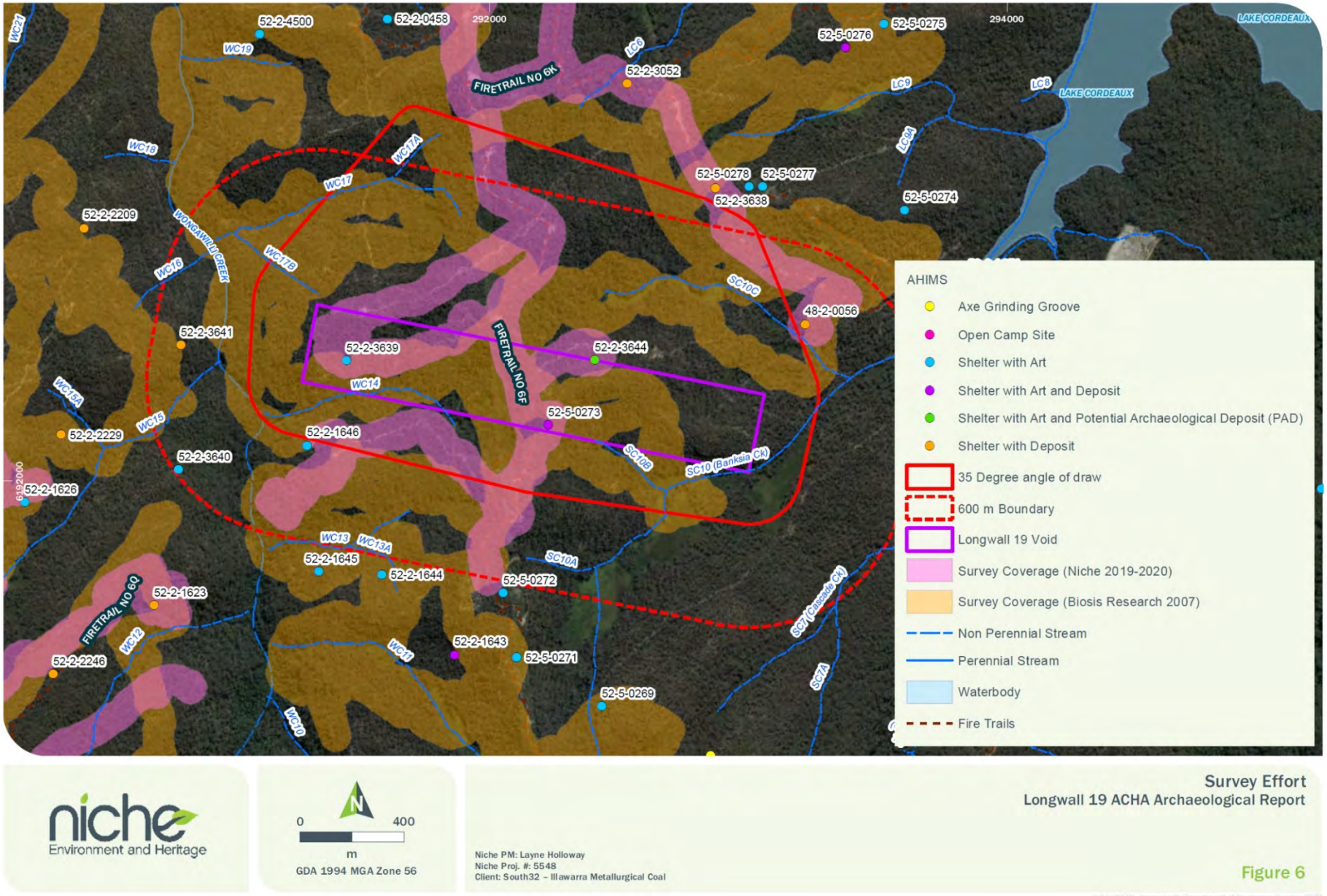

Figure 6: Survey effort (Source: Biosis 2007 and Niche 2020

8.3.1 Survey coverage results

The previous survey that was completed by Biosis Research (2007) involved a targeted survey of archaeologically sensitive landforms and a transect survey of predetermined areas. The survey was conducted over two weeks with Representatives from the ILALC, Korewal Elouera Jerrungarugh and Cubbitch Barta Native Title Claimants in attendance. All of the Aboriginal cultural heritage sites located within the current Subject Area were assessed during the Biosis Research survey.

This assessment revealed that the most suitable sandstone overhangs for Aboriginal occupation occurred within sandstone overhangs of the Hawkesbury soil landscape, usually associated with the Wongawilli Creek and its immediate tributaries. The Hawkesbury soil landscape features incised creeks and drainage lines, thin ridgelines and occasional steep hills. Sandstone outcrop is very frequent, with high cliffs, scarps, slopes and boulders being present. In some places, cliff lines and scraps are not safely accessible on foot. Despite the steep terrain, Dendrobium Area 3 is one of the most intensively surveyed locations on the Woronora Plateau. This provides confidence that the nature and character of the archaeological record of the Subject Area has been robustly determined.

Table 9: Surface survey coverage as completed by Biosis Research 2007 and the current assessment

Survey Unit	Survey unit area (Ha)	Landform	Visibility %	Exposure %	Effective Survey coverage area (Ha)	Effective coverage %
Biosis Survey 2007	214	Sandstone slopes, ridgelines and drainage lines of the Hawksbury soil landscape	10%	20%	437.6	48.90
Niche Survey	84.7	Targeted sites located within Sandstone slopes, ridgelines and drainage lines of the Hawksbury soil landscape	10%	20%	437.6	19.35

The Biosis Research survey showed empirically that shelter sites are common and generally occur on slopes between 20- and 30-degree gradients. Shelter sites rarely occur on slope ranges less than 20 degrees and never occur on slope gradients greater than 40 degrees. Overall, a lack of ground surface viability within the Hawksbury Sandstone environment results has factored in the lack of recorded open artefact sites. The targeted Niche survey completed as part of this assessment was successful in relocating all five shelter sites targeted (Table 10). No new sites were located; however, artefacts were located within the dripline of Sandy Creek 21(AHIMS ID# 52-5-0273) (Plate 8), resulting in the site details being updated on AHIMS and within this report to Shelter with Art and Deposit.

Table 10: AHIMS sites visited as part of this assessment

AHIMS ID	Site Name	Site Features	Survey Unit	Landform
48-2-0056	DM 13	Shelter with Deposit	Biosis and Niche surveys	Sandstone ridgeline of the Hawksbury soil landscape.
52-2-1646	Browns Road 32	Shelter with Art	Biosis and Niche surveys	Sandstone ridgeline of the Hawksbury soil landscape.
52-2-3639	DM 15	Shelter with Art	Biosis and Niche surveys	Sandstone ridgeline of the Hawksbury soil landscape.
52-2-3644	DM 20	Shelter with Art and PAD	Biosis and Niche surveys	Sandstone ridgeline of the Hawksbury soil landscape.
52-5-0273	Sandy Creek 21	Shelter with Art and Deposit	Biosis and Niche surveys	Sandstone ridgeline of the Hawksbury soil landscape.

Table 11: Landform summary

Landform	Landform area (Ha)	Area effectively surveyed (m^2)*	% of landform effectively surveyed	Number of Aboriginal sites
Sandstone slopes, ridgelines and drainage lines of the Hawksbury soil landscape.	437.6	252.26	57.65%	8

* *This value presents the Biosis Research survey and the Niche Areas effectively surveyed within the Subject Area.*

Plate 3: General photograph of DM 13 open floor area.

Plate 4: General photograph of Art Panel 3 within Browns Road site 32.

Plate 5: General photograph of DM 15 shelter cavern.

Plate 6: General photograph of DM 20 shelter cavern.

Plate 7: General photograph of Sandy Creek 21 interior.

Plate 8: Close up photograph of flaked artefacts located within Sandy Creek 21.

9. Analysis and discussion

Within the Upper Nepean catchment area of the Woronora Plateau, a predictive model has been developed that indicates that Aboriginal cultural heritage sites are likely to be in areas that have abundant resources, are close to permanent water sources and have good vantage points over the surrounding area, as discussed in Section 5.

The diversity of natural resources has allowed for a long history of Aboriginal occupation, as is evidenced by the vast number of archaeological sites identified within the ridgelines of the Hawkesbury Sandstone that defines this region. Ethnographic accounts suggest that Aboriginal groups were mobile, largely dispersed and were moving seasonally for resource exploitation and/or ceremonial activities. Those pathways were documented to exist through the Illawarra escarpment, connecting the highland plateau with the coast. The Upper Nepean catchment was likely a place of transient, though continued occupation throughout colonisation of the region and remains a significant natural asset to the community into current times. It also remains highly valued and utilised by the local Aboriginal community as it contains well preserved art sites that show a network stories and evidence of complex culture depicted in the archaeological record.

10. Scientific values and significance assessment

10.1 Assessment framework

The Burra Charter (Australia ICOMOS 1999) defines the basic principles and procedures to be observed in the conservation of important places. It provides the primary framework within which decisions about the management of heritage sites in Australia should be made. The Burra Charter defines cultural significance as being derived from the following values:

Table 12: Scientific values as outlined by the Burra Charter

Value type	Description
Aesthetic Value	Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.
Historic Value	Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.
Scientific Value	The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information.
Social Value	Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

10.2 Other approaches

The categorisation into aesthetic, historic, scientific and social values is one approach to understanding the concept of cultural significance. However, more precise categories may be developed as understanding of a particular place increases.

The NSW DECCW guidelines for the significance assessment of Aboriginal archaeological sites are contained within the Aboriginal Cultural Heritage Standards and Guidelines Kit (National Parks and Wildlife Service 1997). The Kit identifies with two main streams in the overall significance assessment process: the assessment of cultural/social significance to Aboriginal people and the assessment of scientific significance to archaeologists.

This approach encapsulates those aspects of the Burra Charter that are relevant to Aboriginal archaeological sites. The guidelines specify the following criteria for archaeological significance, as paraphrased in Table 13.

Table 13: Criteria specified for archaeological significance

Criteria	Description
Research potential	It is the potential to elucidate past behaviour which gives significance under this criterion rather than the potential to yield collections of artefacts. Matters considered under this criterion include – the intactness of a site, the potential for the site to build a chronology and the connectedness of the site to other sites in the archaeological landscape.
Representativeness	As a criterion, representativeness is only meaningful in relation to a conservation objective. Presumably all sites are representative of those in their class or they would not be in that

Criteria	Description
	class. What is at issue is the extent to which a class of sites is conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole. The conservation objective which underwrites the 'representativeness' criteria is that such a sample should be conserved.
Rarity	This criterion cannot easily be separated from that of representativeness. If a site is 'distinctive' then it will, by definition, be part of the variability which a representative sample would represent. The criteria might best be approached as one which exists within the criteria of representativeness, giving a particular weighting to certain classes of site. The main requirement for being able to assess rarity will be to know what is common and what is unusual in the site record but also the way that archaeology confers prestige on certain sites because of their ability to provide certain information. The criterion of rarity may be assessed at a range of levels: local, regional, state, national, and global.
Educational Potential	Heritage sites and areas should be conserved and managed in relation to their value to people. It is assumed that archaeologists have the ability to speak of the value of sites to members of their own profession. Where archaeologists or others carrying out assessments are speaking for the educational value of sites to the public, the onus is on them to go to the public for an assessment of this value, or to reputable studies which have canvassed public demand for education. The danger, otherwise, is that archaeologists would be projecting their values onto a public which is itself given no voice on the matter.
Aesthetics	Archaeologists are not expected to include an assessment of aesthetic significance along with their assessment of scientific significance. In relation to heritage places, aesthetic significance is generally taken to mean the visual beauty of the place. Aesthetic value is not inherent in a place, but arises in the sensory response people have to it. Although the guidelines provide no expectation for archaeologists to consider aesthetic values it is often the case that a site's or a landscape's aesthetic is a significant contributory value to significance. Examples of archaeological sites that may have high aesthetic values would be rock art sites, or sites located in environments that evoke strong sensory responses. For this reason, we consider it appropriate to include aesthetic values as part of the significance assessments for the sites identified during this assessment.

Table 14: Significance Assessment – individual sites

AHIMS ID	Site Name	Features	Aesthetic value	Rarity	Representativeness	Scientific (archaeological) value/ Research Potential	Education Potential
48-5-0056	DM 13	Shelter with Deposit	Low	Common	Low	Low	Low
52-2-1645	Browns Road Site 31	Shelter with Art	Low	Common	Low	Low	Low
52-2-1646	Browns Road Site 32	Shelter with Art	High – attributed by a large number of (4) stencils and (14) motifs	Rare	High – presence and diversity of motifs provides high representational values	High	Moderate
52-2-3639	DM 15	Shelter with Art	Low	Common	Moderate	Low	Low
52-2-3640	DM 16	Shelter with Art	High – this shelter contains a number of well-preserved diverse motifs with uncommon drawing techniques.	Moderate – use of bi-chrome art technique	High	High	Moderate
52-2-3641	DM 17	Shelter with Deposit	Low	Common	Low	Low	Low
52-2-3644	DM 20	Shelter with Art and Potential Archaeological Deposit (PAD)	Low	Common	Low	Low	Low

AHIMS ID	Site Name	Features	Aesthetic value	Rarity	Representativeness	Scientific (archaeological) value/ Research Potential	Education Potential
52-5-0273	Sandy Creek Road 21	Shelter with Art and Deposit	Moderate	Moderate – Anthropomorphic figure with large eyes is considered an irregular motif within the Upper Nepean Catchment	Moderate	Moderate	Low

** The above significant assessments were determined by Biosis Research (2007a) during the Dendrobium Area 3 Aboriginal Cultural Heritage Assessment*

10.3 Assessment of cultural significance

The entire Subject Area holds cultural significance to the local Aboriginal community. This is the contemporary view held by Aboriginal people that all Aboriginal objects and sites are important within the region, due to their interconnectivity with the natural landscape and past occupation of the region.

The range in Aboriginal cultural heritage sites within the Subject Area are representative of intact and tangible items of cultural heritage, providing a strong cultural link to generations past. These Aboriginal cultural heritage sites are seen to hold high cultural significance based on this strong cultural connection. Any damage that may occur to these sites has an impact to the local Aboriginal Community (Knight, 2020 *per comms*.).

A statement of cultural significance has been provided in Section 5 of the Aboriginal Cultural Heritage Assessment associated with this report.

11. Impact assessment

11.1 Potential for harm

The Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011) requires that both direct and indirect harm to Aboriginal objects and Aboriginal places be considered. Generally direct harm refers to occasions where an activity physically impacts a site or objects and therefore affects the heritage values possessed by the site or objects. Indirect harm is usually taken to mean harm stemming from secondary consequences of the activity and may affect sites or objects as an indirect consequence of the activity. Examples of such indirect harm are increased visitors to a site, or increased erosion in an area as a result of an activity.

The potential for mine subsidence induced ground movements to harm Aboriginal objects or areas of Aboriginal cultural value is dependent on many factors, including the nature of the Aboriginal cultural heritage sites or areas of cultural value themselves. MSEC (2020) describes how longwall mining can result in the fracturing buckling and stepping at the ground surface. The magnitude of these effects is largely dictated by factors such as the mine's geometry, the depth of cover (how deep the coal is below the ground surface), the extracted seam thickness, the geology above the mine, and the presence of geological features such as joints or faults, especially near the ground surface.

In the case of Aboriginal cultural heritage, the nature of the heritage sites and features is also a very important consideration in the potential effects of subsidence induced ground movements. Whether a site is a sandstone shelter sites or a culturally significant area, all tangible and intangible cultural heritage values must be considered in determining the likely impact, if any.

For sandstone shelter sites, the types of changes will be similar or identical to those that would be expected due to natural weathering processes but exacerbated by subsidence. For example, a naturally weathering block which will have detached and fallen at some point in time may be detached and fall sooner due to differential movements of the rock strata induced by subsidence (Biosis Research and The Ecology Lab 2007: 29).

Monitoring of the effects of subsidence induced ground movements to Aboriginal cultural heritage sites has been conducted since the 1990s (see Sefton 2000, Biosis Research 2007, Biosis Research 2009, ERM 2010, Kayandel 2008, Niche 2013 to 2020). Subsidence movements cause may cause harm in the form of block fall, exfoliation, cracking, opening and/or closing of existing faults and fissures (Biosis Research 2009).

Preventative management measures can be implemented in some circumstances, but for the most part the management of Aboriginal cultural heritage sites relies on monitoring of the sites and implementing pre-arranged management responses should they be triggered by harm. For most Aboriginal heritage sites there are often no suitable remediation measures as these can often be more intrusive and harmful to heritage value than the effects of the subsidence, which as described above is usually an extension or acceleration of pre-existing natural weathering processes. As an example, the process of accessing a site and cutting stress relief slots, which requires heavy drilling or sawing machinery, in close proximity to a grinding groove platform would be likely to be more damaging to the site and its cultural context than the subsidence induced cracking or shearing of surface strata.

11.1.1 Consideration of potential harm

For the Project, the consideration of potential harm to Aboriginal cultural heritage sites from subsidence into two distinct categories:

- Sites susceptible to harm from subsidence from induced ground movements resulting in physical impacts to Aboriginal cultural heritage sites.
- Intrinsic heritage values of Aboriginal cultural heritage sites that are connected through a cultural landscape. Although these sites may not be directly affected through subsidence, the harm of surrounding sites impacts interconnected cultural values of the landscape.

Table 15 present the subsidence predictions for each of the Aboriginal cultural heritage sites located within the Subject Area that have been used to inform sites that will be harmed by the extraction of Longwall 19. Columns highlighted in dark grey show Aboriginal cultural heritage sites that will be directly harmed and require an AHIP. Further explanation of these results has been provided in Section 6 of the ACHA.

11.2 Subsidence movements

Subsidence impacts are caused by the compression and extension of localised rock strata that may result in cracking of rock mass and buckling of strata (outlined in Plate 9), which can result in harm to Aboriginal cultural heritage sites through the forms of rockfalls and roof collapse, surface cracking and exfoliation and changes in seepage patterns (Department of Planning, 2008). The extent subsidence movements are dependent on factors such as degree of movement and geology and structure of subsurface rock strata.

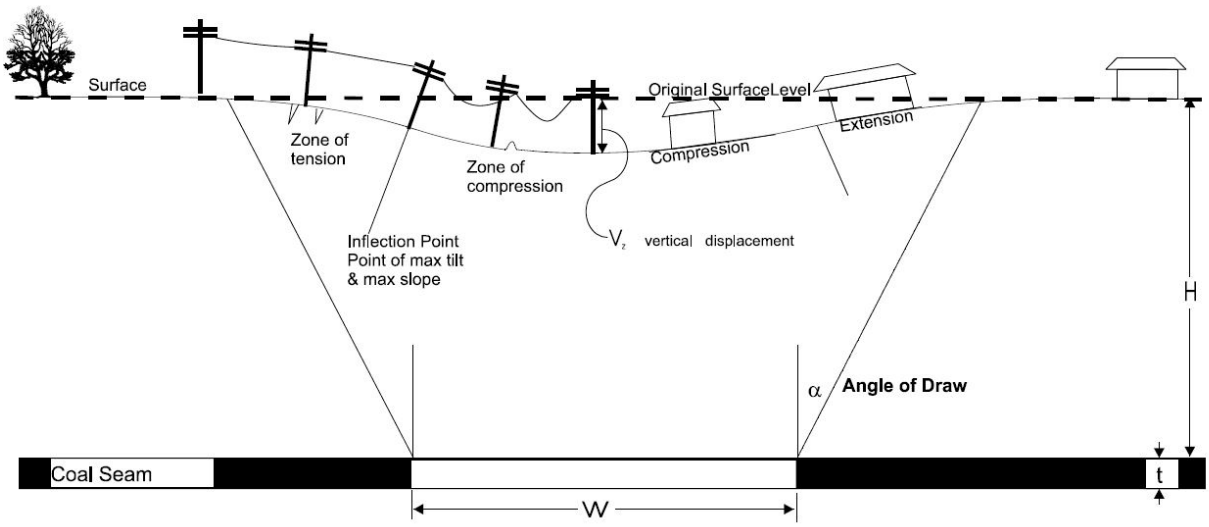

Plate 9: Diagram representation of surface subsidence components in flat topography (Department of Planning, 2008).

Longwall 19 is situated between Wongawilli Creek to the west, Sandy Creek to the east and Cordeaux Dam to the north east. The valleys associated with the Wongawilli and Sandy Creeks will result in closure and down slope movements in these areas. Four (4) Aboriginal cultural heritage sites are predicted to in the potential subsidence impact zone (MSEC 2020).

In summary the activity that has the potential to harm Aboriginal cultural heritage sites is the extraction of coal approximately between 280 to 450 m below the ground surface, using longwall mining methods which will result in mining induced ground movements (subsidence) at the surface.

Table 15: Aboriginal cultural heritage sites location within the 600 m boundary of the subsidence zone for the Subject Area

Site ID	Site Name	Site Feature	Location relative to Longwall 19	Maximum predicted total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km-1)	Maximum predicted total sagging curvature (km-1)
48-5-0056	DM 13	Shelter with Deposit	310 m north	1850	25	0.75	0.60
52-2-1645	Browns Road Site 31	Shelter with Art	500 m south	<20	<0.5	<0.01	<0.01
52-2-1646	Browns Road Site 32	Shelter with Art	230 m south	<20	<0.5	<0.01	<0.01
52-2-3639	DM 15	Shelter with Art	0 m	1600	30	0.60	0.20
52-2-3640	DM 16	Shelter with Art	580 m south west	<20	<0.5	<0.01	<0.01
52-2-3641	DM 17	Shelter with Deposit	480 m west	<20	<0.5	<0.01	<0.01
52-2-3644	DM 20	Shelter with Art and Potential Archaeological Deposit (PAD)	0 m	1350	4	0.10	0.09
52-5-0273	Sandy Creek Road 21	Shelter with Art and Deposit	0 m	900	25	0.50	0.06

The impact assessment is provided below in Table 16.

Table 16: Impact assessment summary

AHIMS ID#	Site name	Type of harm	Degree of harm	Consequence of harm
48-2-0056	DM 13	**Direct.** Potential disturbance from subsidence movements • Cracking at compression points at the site, leading to rock fall and block movement. Large block falls could cover those stone artefacts that have previously been identified at the site.	**Direct harm**	Total loss of value
52-2-1645	Browns Road Site 31	**None.** The proposed activities do not have the potential to impact the site.	**None.** The proposed activities do not have the potential to impact the site.	Partial loss of values (cultural)
52-2-1646	Browns Road Site 32	**None.** The proposed activities do not have the potential to impact the site.	**None.** The proposed activities do not have the potential to impact the site.	Partial loss of values (cultural)
52-2-3639	DM 15	**Direct.** Potential disturbance from subsidence movements • Cracking of horizontal bedding planes of the shelter; leading to changes to water flow and seepage; causing damage to the Art Panel and the growth of microflora at the site; and	**Direct harm**	Total loss of value
52-2-3640	DM 16	**None.** The proposed activities do not have the potential to impact the site.	**None.** The proposed activities do not have the potential to impact the site.	Partial loss of values (cultural)
52-2-3641	DM 17	**None.** The proposed activities do not have the potential to impact the site.	**None.** The proposed activities do not have the potential to impact the site.	Partial loss of values (cultural)
52-2-3644	DM 20	**Direct.** Potential disturbance from subsidence movements • Cracking of horizontal bedding planes of the shelter; leading to changes to water flow and seepage; causing damage to the Art Panels and the growth of microflora at the site; and	**Direct harm**	Total loss of value

AHIMS ID#	Site name	Type of harm	Degree of harm	Consequence of harm
		• Cracking at compression points at the site, leading to rock fall and block movement. Large block falls could cover the PAD that has previously been identified at the site.		
52-5-0273	Sandy Creek Road 21	**Direct.** Potential disturbance from subsidence movements. • Cracking of horizontal bedding planes of the shelter; leading to changes to water flow and seepage; causing damage to the Art Panels and the growth of microflora at the site; and • Cracking compression points at the site, leading to rock fall and block movement. Large block falls could cover stone artefacts that have been identified at the site.	**Direct harm**	Total loss of value

*The definitions for these categories can be described as:

Type of harm: Direct- may occur as the result of an activity which disturbs the ground including, but not limited to, site preparation activities, installation of services and infrastructure, roadworks, excavating, draining and flood mitigation methods or changes to waterflows affecting the value of cultural site. Indirect- affect sites or features located immediately beyond or within the area of the proposed activity. This may include increased impact on art in shelter from increased visitation, destruction from increased erosion and changes in access to wild food resources. (OEH, 2011.

Degree of harm: Total: the object(s) will be directly harmed in their entirety. Partial- some objects will be directly or indirectly harmed; however a portion of a site may remain unaffected. None- there will be no harm.

Consequence of harm: Total loss of value- Tangible heritage values will remain subsequent to the harm. Partial loss of value- intangible heritage values will remain subsequent to the harm. No loss of value- there will be no harm, and no loss of value

12. Management and mitigation measures

The Aboriginal cultural heritage sites located directly above the proposed Longwall 19 have been assessed to be directly harmed by its extraction (MSEC 2020) and will require an AHIP. The sites include:

- DM 13 (AHIMS ID #48-5-0056);
- DM 15 (AHIMS ID #52-2-3639);
- DM 20 (AHIMS ID#52-2-3644); and
- Sandy Creek Road 21 (AHIMS ID#52-5-0273).

The predicted impacts of the above Aboriginal cultural heritage sites will result in physical harm.

The remainder of the Aboriginal cultural heritage sites located within the Subject Area may experience partial harm to intangible values due to a loss of cultural connectivity as outlined in Section 11.1.2. The sites include:

- Browns Road Site 31 (AHIMS ID#52-2-1645);
- Browns Road Site 32 (AHIMS ID#52-2-1646);
- DM 16 (AHIMS ID#52-2-3640); and
- DM 17 (AHIMS ID#52-2-3641).

The above Aboriginal cultural heritage sites are not predicted to experience physical harm.

The proposed works cannot be avoided. The current longwall design has been subject to predictive modelling and previous design reiterations to achieve minimal cumulative impact to the surface environment.

An Aboriginal Heritage Impact Permit (AHIP) will be required to undertake the proposed activity as it may result in harm to Aboriginal Objects.

Management measures are warranted to mitigate the potential partial loss of value to the site that may result from the proposed mining activities. Management and mitigation measures are also warranted to ensure continued compliance with the *National Parks and Wildlife Act 1974*.

13. Recommendations

Niche was commissioned by IMC to complete an ACHA and subsequent AHIP application for the extraction of Longwall 19 within Dendrobium Area 3A.

The ACHA was carried out in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (*OEH, 2011). It included consultation with RAPs in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a) (details of which are in Appendix B).

An assessment of the potential impact of the proposed works and associated ground disturbance indicates that AHIMS registered sites DM 13 (AHIMS ID #48-5-0056), DM 15 (AHIMS ID #52-2-3639), DM 20 (AHIMS ID#52-2-3644) and Sandy Creek Road 21 (AHIMS ID#52-5-0273) have the potential to be impacted by the proposed works.

This assessment has determined that the proposed works ***do not*** have the potential to impact AHIMS registered sites Browns Road Site 31 (AHIMS ID#52-2-1645), Browns Road Site 32 (AHIMS ID#52-2-1646), DM 16 (AHIMS ID#52-2-3640) and DM 17 (AHIMS ID#52-2-3641).

Based on community consultation to date with the RAPs for the Project, and with the completion of this AR by Niche, the following recommendations have been made:

Table 17: Recommendations

Recommendations	
	Aboriginal Heritage Impact Permit
1.	IMC should continue to consult with the Aboriginal community for the life of the Project in accordance with the consultation guidelines.
2.	An application for an AHIP will be required to undertake the proposed activity as it may result in harm to the following Aboriginal cultural heritage sites: • DM 13 (AHIMS ID#48-2-0056); • DM 15 (AHIMS ID#52-2-3639); • DM 20 (AHIMS ID# 52-2-3644); and • Sandy Creek Road 21 (AHIMS ID#52-5-0273).
3.	The following Aboriginal cultural heritage site cards should be updated on the AHIMS: • Sandy Creek Road 21 (AHIMS ID#52-5-0273); • Browns Road Site 32 (AHIMS ID#52-2-1646); • DM 13 (AHIMS ID#48-2-0056); and • DM 15 (AHIMS ID#52-2-3639).
4.	A subsidence monitoring program is to be implemented progressively over the life of the Project. The subsidence monitoring program should include monitoring of all Aboriginal sandstone shelter sites located within the angle of draw of the Project. The program should include (but not be limited to) the following: • Details on how the Aboriginal community will be consulted with for subsidence monitoring. • A schedule for undertaking the subsidence monitoring at the nominated sites. • An impact TARP specific to each of the sites being monitored.

Recommendations	
5.	The Aboriginal Management Plan for Dendrobium Area 3A should be revised to include provisions and recommended management strategies determined by the outcomes of this assessment, and any further recommendations provided by the terms of the AHIP approval, provided by Heritage NSW.
	General
6.	All workers should have cultural awareness training so they are made aware of their obligations under the NPW Act and any conditions of any future AHIP prior and during and after construction activities.
7.	In the unlikely event that suspected human remains are encountered during construction, all work in the area that may cause further impact, must cease immediately and: • The location, including a 20 m curtilage, should be secured using barrier fencing to avoid further harm. • The NSW Police must be contacted immediately. • No further action is to be undertaken until the NSW Police provide written notification to IMC. • If the skeletal remains are identified as Aboriginal, then IMC or their agent must contact: ▪ The Heritage NSW, of the DPC Enviroline on 131 555; and representatives of the RAPs. ▪ No works are to continue until the Heritage NSW provides written notification to the proponent or their Agent.

References

Attenbrow, V 2010 *Sydney's Aboriginal Past: Investigating the archaeological and historical records.* University of New South Wales Press, Sydney.

Australian Government, 1992. *National Strategy for Ecologically Sustainable Development.* Ecologically Sustainable Development Steering Committee. ISBN 0 644 27253 8.

Australia ICOMOS, International Council on Monuments and Sites, 2013. *The Burra Charter: the Australia ICOMOS charter for places of cultural significance.*

Biosis Research 2004. *Dendrobium Area 3 Lake Cordeaux foreshore seismic testing Review of Environmental Factors*: Archaeological Survey. An unpublished report for BHP Billiton- Illawarra Coal.

Biosis Research 2007 *Dendrobium Area 3 Archaeological and Cultural Heritage Assessment*. An unpublished report for BHP Billiton-Illawarra Coal.

Biosis Research, 2009. *Dendrobium Coal Mine- Area 3 Aboriginal Heritage Plan*. Report for BHP Billiton-Illawarra Coal.

Biosis Research 2012. *Bulli Seam Operations Aboriginal Cultural Heritage Assessment*. An unpublished report for BHP Billiton Illawarra Coal.

Biosis Research 2010. *Dendrobium Area 3A, Aboriginal Management Plan*. An unpublished report prepared for BHP Billiton Illawarra Coal.

Biosis 2013. Dendrobium Area 3A, Longwall 8 End of Panel Report (Ecology and Cultural Heritage). An unpublished report prepared for South32 – Illawarra Coal.

Biosis 2015 *Dendrobium Colliery Longwall 10: Monitoring of Aboriginal Heritage Sites*. An unpublished report for BHP Billiton Illawarra Coal.

Biosis 2016 *Dendrobium Colliery Longwall 11: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

Department of Environment and Conservation, NSW,2005. *A History of Aboriginal People of the Illawarra 1770 to 1970,* Hurstville, NSW, Department of Environment and Conservation (NSW).

Department of Environment and Conservation, 2010a *Aboriginal Cultural heritage consultation requirements for proponents 2010.* Hurstville, NSW, Department of Environment and Conservation (NSW).

Department of Environment and Conservation, 2010b. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* New South Wales Department of Environment, Climate Change and Water, Sydney.

Dibden, J. 2019. *Drawing in the land-. Rock Art of the Upper Nepean, Sydney Basin New South Wales* . Terra Australis. Australian National University Press.

Hazelton, P. A. and Tille, P.J. 1990. *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet Soil Conservation Service NSW,* Sydney.

Kayandel Archaeological Services 2008 *Aboriginal Cultural Heritage Assessment, Metropolitan Coal Project, Metropolitan Colliery, Helensburgh, NSW*. An unpublished report for Helensburgh Coal Pty Ltd.

Kayandel Archaeological Services 2012 *Longwall subsidence impact monitoring January and March 2012 Metropolitan Colliery, Helensburgh, NSW*. An unpublished report for Helensburgh Coal Pty Ltd.

McDonald J.J 1994. *Dreamtime Superhighway: An analysis of Sydney Basin Rock Art and Prehistoric Information Exchange.* An unpublished thesis, Australian National University.

Mining Subsidence Engineering Consultants 2020 *Subsidence Predictions and Impact Assessments for Longwall 19 Dendrobium Area 3A.* An unpublished report prepared for Illawarra Coal.

New South Wales Heritage Office, 2001. *Assessing Heritage Significance (NSW Heritage Manual update).* DUAP.

New South Wales Department of Planning, 2008. *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield - Strategic Review.* Niche Environment and Heritage 2013a *West Cliff Longwall 35 End of Panel Heritage Assessment*. An unpublished report prepared for BHP Billiton Illawarra Coal.

Niche Environment and Heritage 2013b *Longwalls 20-22 Subsidence Impact Monitoring of Aboriginal Cultural Heritage Sites: Metropolitan Coal July 2013*. An unpublished report prepared for Metropolitan Coal.

Niche Environment and Heritage 2014a *West Cliff Colliery Longwall 36 End of Panel Heritage Assessment*. An unpublished report prepared for BHP Billiton Illawarra Coal.

Niche Environment and Heritage 2014b *Dendrobium Colliery Longwall 9: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

Niche Environment and Heritage 2015a *Metropolitan Coal Longwall 22: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2015b *Metropolitan Coal Longwall 23: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2016 *Metropolitan Coal Longwall 25: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2017a *Metropolitan Coal Longwall 26: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for Peabody Energy and Metropolitan Coal.

Niche Environment and Heritage 2017b Tahmoor South Project: Historical Heritage Assessment. An unpublished report for Tahmoor Coal Pty Ltd.

Niche Environment and Heritage, 2017c*. Dendrobium Mine – Plan for the future: Coal for Steelmaking*. Aboriginal Cultural Heritage Assessment. Prepared for South32 Illawarra Coal .

Niche Environment and Heritage 2017d *Dendrobium Colliery Longwall 12: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

Niche Environment and Heritage 2018 *Dendrobium Colliery Longwall 13: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

Niche Environment and Heritage 2019a *Dendrobium Colliery Longwall 14: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

Niche Environment and Heritage, 2019b*. Longwall 20 – 21 Aboriginal Cultural heritage Assessment.* Prepared for South32 Illawarra Coal.

Niche Environment and Heritage 2020 *Dendrobium Colliery Longwall 15: Monitoring of Aboriginal Heritage Sites*. An unpublished report prepared for South32 – Illawarra Coal.

NSW Minerals Council 2013. Mining Methods. Available at http://www.nswmining.com.au/industry/mining-methods Accessed 26 October 2014.

Office of Environment and Heritage ,2011.*Guide to investigating, assessing and reporting on Aboriginal Cultural heritage in NSW: Part 6 National Parks and Wildlife Act 1974*, Office of Environment and Heritage, Sydney South, N.S.W.

Organ, Michael ,1990. *Illawarra and South Coast Aborigines 1770-1850,* University of Wollongong, Wollongong, Aboriginal Education Unit.

Regal, R and Reeves, J. 2017 '*Overview of the monitoring of sandstone overhangs for the effects of mining subsidence in the Southern Coalfields*.' In Mine Subsidence Technological Society 10th Triennial Conference proceedings Mine Subsidence: Adaptive Innovation for Managing Challenges.

Sefton, C. 1988 *Prehistory of the Illawarra*. Unpublished MA Thesis, University of Sydney, Sydney.

Sefton, C. 1998a. *Site and Artefact Patterns on the Woronora Plateau*. M.A Thesis, University of Wollongong, Wollongong.

Sefton, C. 1990.*1989-1990 Archaeological survey of the Cordeaux River and Woronora River by the Illawarra.*

Sefton, C. 2000. *Overview of the monitoring of sandstone overhangs for the effects of mining subsidence in the Illawarra Coal Measures.* An unpublished report for Collieries Division, BHP Coal.

Sefton, C. 2002. *Archaeological Survey of longwall 9 and 10 Application Elouera Colliery.* An unpublished report for BHP Billiton Illawarra Coal Holdings Pty Ltd.

Tindale, N. 1974 *Aboriginal Tribes of Australia*. Australian National University, Canberra.

Wesson 2009. *Murni Dhunhang Kirrar: Living in the Illawarra*.

Young A 1982. *Upland Swamps (Dells) of the Woronora Plateau, NSW.* Unpublished PhD thesis. University of Wollongong.