

**Dendrobium Area 3B  
Longwalls 9 to 18:  
Heritage Impact Assessment**

**Final Report**

**March 2012**



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## DOCUMENT CONTROL SHEET

<b>PROJECT</b>	Dendrobium Area 3B Aboriginal Cultural Heritage Assessment
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<b>BIOSIS PROJECT NO</b>	12255
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<b>REPORT FOR</b>	BHP Billiton Illawarra Coal
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<b>REPORT TITLE:</b>	Dendrobium Area 3B Longwalls 9 to 18: Heritage Impact Assessment
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Draft B	Asher Ford	Melanie Thomson Nathan Garvey		12 March 2012
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- Toni Stevens (Cardno)
- James Barbato (MSEC)
- Ashleigh Pritchard (GIS Operator Biosis Research)

## ABBREVIATIONS

ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
BHPBIC	BHP Billiton Illawarra Coal
DECCW	Department of Environment, Climate Change and Water NSW (formerly Department of Environment and Climate Change and now OEH – see below)
DRE	Department of Resources and Energy
DoPI	NSW Department of Planning and Infrastructure
EA	Environmental Assessment
EP& A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1979</i>
HIA	Heritage Impact Assessment
NPW Act	<i>National Parks &amp; Wildlife Act 1974</i>
OEH	Office of Environment and Heritage
SMP	Subsidence Management Plan

## EXECUTIVE SUMMARY

BHP Billiton Illawarra Coal (BHPBIC) is proposing to undertake longwall mining within Dendrobium Area 3B (Figures 1 and 2). BHPBIC commissioned Biosis Research to prepare a Heritage Impact Assessment (HIA) to inform the Dendrobium Area 3B, Longwall 9 to 18, Subsidence Management Plan (SMP). The Dendrobium Area 3B SMP Area extends around the proposed Longwall 9 to 18 layout and is the Study Area for the purpose of this HIA (Figure 2). This HIA reviews the heritage assessments undertaken for the Study Area to date and outlines the protocols for the baseline recording and ongoing management of Aboriginal and historical heritage items within the Study Area.

The current Study Area has been subject to a number of intensive archaeological surveys that have identified a total of 23 Aboriginal archaeological sites, predominantly rock shelters. These sites are registered on the OEH Aboriginal Heritage Information Management System (AHIMS). Biosis Research (2007) concluded that Dendrobium Area 3 contains a typical example of archaeological sites in this region of the Woronora Plateau (Biosis Research 2007: 76-77), containing both a diversity of sites and a diversity of motifs and art techniques. The condition of the sites and art is variable with charcoal art poorly preserved. The cumulative survey efforts of previous researchers, in conjunction with the current surveys, present a strong sample of the archaeology of the Study Area, giving confidence that the archaeological and cultural values of the Study Area have been accurately characterised.

No historical sites have been identified in the Study Area by previous assessments. Searches undertaken of the Commonwealth Heritage List, State Heritage Register, State Heritage Inventory, Wollongong Local Environmental Plan 2009 and Wollondilly Local Environmental Plan 2011 did not identify any historical heritage items in the Study Area.

The subsidence impact assessment for Aboriginal sites in the Study Area is presented in Section 3.0. This assessment was made using the parameters in Sefton's Principal Components Analysis methodology and in conjunction with the subsidence predictions provided by MSEC (MSEC 2012: 75). The assessment of risk was made using the criteria outlined in Section 3.1 and identified five sites at low risk of impact, 15 at a very low risk of impact and three at negligible risk of impact.

Recommended management and mitigation measures are discussed in Section 4.0. In summary, the recommended management measures are a continuation of protocols in place for Dendrobium Area 3A and are as follows:

1. Baseline recording of all Aboriginal rock shelters with art sites should be undertaken prior to the commencement of longwall mining; and,
2. Monitoring of all Aboriginal sites in the SMP should be undertaken during mining and after all subsidence movement has finished

Monitoring methodology, schedule, action responses and reporting is fully discussed in Section 4.0. Contingency plans for any unexpected discovery of Aboriginal sites, ancestral remains and ongoing community consultation is discussed in Section 5.0.

# CONTENTS

<i>Document Control Sheet</i> .....	<i>i</i>
<i>Acknowledgments</i> .....	<i>i</i>
<i>Abbreviations</i> .....	<i>i</i>
<i>Executive Summary</i> .....	<i>ii</i>
<b>CONTENTS</b> .....	<b><i>i</i></b>
<b>1.0 Introduction</b> .....	<b>4</b>
1.1 Project Background .....	4
1.2 Objectives .....	5
1.3 Statutory Requirements .....	5
<b>2.0 Review of Previous Heritage Assessments</b> .....	<b>9</b>
2.1 Regional Overview .....	9
2.2 Local Overview .....	10
2.3 Biosis Research 2007 Study Methods and Results.....	13
2.4 Aboriginal Sites within the Study Area.....	17
2.5 Historic Sites within the Study Area .....	18
2.6 Archaeological Summary.....	18
<b>3.0 Impact Assessment</b> .....	<b>20</b>
3.1 Subsidence Impact Prediction Modelling.....	20
3.2 Subsidence Impact Predictions .....	24
<b>4.0 Recommended Management and Mitigation Measures</b> .....	<b>31</b>
4.1 Historic Heritage.....	31
4.2 Aboriginal Heritage .....	31
<b>5.0 Aboriginal Heritage Contingency Plans</b> .....	<b>41</b>
5.1 Discovery of Unanticipated Aboriginal Cultural Material.....	41
5.2 Discovery of Unanticipated Human Remains .....	41
5.3 Ongoing Aboriginal Stakeholder Involvement.....	42
<b>REFERENCES</b> .....	<b>45</b>
<b>ANNEXURES</b> .....	<b>47</b>
<b>Annex 1: Aboriginal site descriptions</b> .....	<b>48</b>

**TABLES**

*Table 1: Aboriginal Sites within the Study Area*..... 17

*Table 2: Subsidence Monitoring Results for Aboriginal Sites in the Southern Coalfield* ..... 21

*Table 3: Comparison of Number of Impacts at Large Wet and Large Dry Shelter Sites*..... 22

*Table 4: Comparison of Number of Impacts at Shelter Sites by Landform*..... 22

*Table 5: Subsidence Risk Categories and Criteria*..... 24

*Table 6: Summary of the predicted risk of impact to Aboriginal Sites in Study Area* ..... 25

*Table 7: Principle Components Assessment*..... 26

*Table 8: Management activities, mitigation and timeframes for Aboriginal heritage.* ..... 35

*Table 9: Monitoring requirements for all Aboriginal sites within the Study Area*..... 36

*Table 10 Performance Measures and Indicators - TRIGGER ACTION RESPONSE PLAN (TARP)*..... 39

**FIGURES**

*Figure 1: Location of the Study Area in a regional context*..... 6

*Figure 2: Aerial Photograph of Study Area*..... 7

*Figure 3: Dendrobium Mine Area 3B Proposed Longwall Layout*..... 8

*Figure 4: Previous Survey Effort for the Study Area* ..... 16

*Figure 5: Aboriginal heritage sites in the Study Area*..... 19

## 1.0 INTRODUCTION

BHP Billiton Illawarra Coal (BHPBIC) is proposing to undertake longwall mining within Dendrobium Area 3B (Figure 1 and 2). BHPBIC commissioned Biosis Research to prepare a Heritage Impact Assessment (HIA) to inform the Dendrobium Area 3B, Longwall 9 to 18, Subsidence Management Plan (SMP). The Dendrobium Area 3B SMP area has been defined, as a minimum, as the surface area enclosed by a 35 degree angle of draw from the limit of proposed mining and by the predicted 20 mm subsidence contour resulting from the extraction of the proposed longwalls (MSEC 2012). The extent of the SMP area is the Study Area for the purpose of this HIA (Figure 2). This HIA reviews the heritage assessments undertaken for the Study Area to date and outlines the protocols for the baseline recording and ongoing management of Aboriginal and historical heritage items within the Study Area.

An Archaeological and Cultural Heritage Assessment (ACHA) for Dendrobium Mine Area 3 (which includes the current Study Area) was undertaken by Biosis Research in 2007. This study included the entire Dendrobium Mine Area 3, which was broken into three sub areas; Area 3A, Area 3B and Area 3C. The assessment involved a comprehensive archaeological survey of known sites and the identification, recording and assessment of previously unidentified cultural heritage sites. The 2007 study also supported an Aboriginal Heritage Impact Permit (AHIP) application for Area 3A to impact Aboriginal archaeological sites; however as the longwall layouts for Area 3B and 3C had not been finalised a longwall specific impact assessment for these areas could not be completed. An updated ACHA is currently being prepared to support an AHIP application for Dendrobium Area 3B.

The recommendations and protocols detailed in this HIA are based on the findings of the Biosis Research 2007 ACHA. The Area 3B ACHA will further inform the HIA and the recommendations and protocols provided in this HIA may require revision depending on the outcomes of the Dendrobium Area 3B ACHA and AHIP.

### 1.1 Project Background

BHPBIC are proposing to continue underground mining operations in Dendrobium Area 3. The proposed development will include mining of Longwalls 9 to 18, including extraction of coal from the Wongawilli Seam in Dendrobium Area 3B using longwall mining techniques (Figure 3). Biosis Research has been commissioned by BHPBIC to prepare an HIA to support the SMP for Dendrobium Area 3B and provide advice to mitigate potential impacts to the cultural heritage values that exist within the proposed SMP Area.

The Study Area for the HIA is defined as the surface area that could be potentially affected by vertical subsidence and is inclusive of sensitive structures where additional subsidence impacts may occur as a result of the extraction of coal from Longwall 9 to 18 (Figure 2). This includes the 35 degree angle of draw from the proposed extents of Longwall 9 to 18, the predicted limit of vertical subsidence and features sensitive to far-field movements (MSEC 2012).

This HIA should be read in conjunction with these other specialist studies undertaken as part of the Dendrobium Area 3B SMP.



## 1.2 Objectives

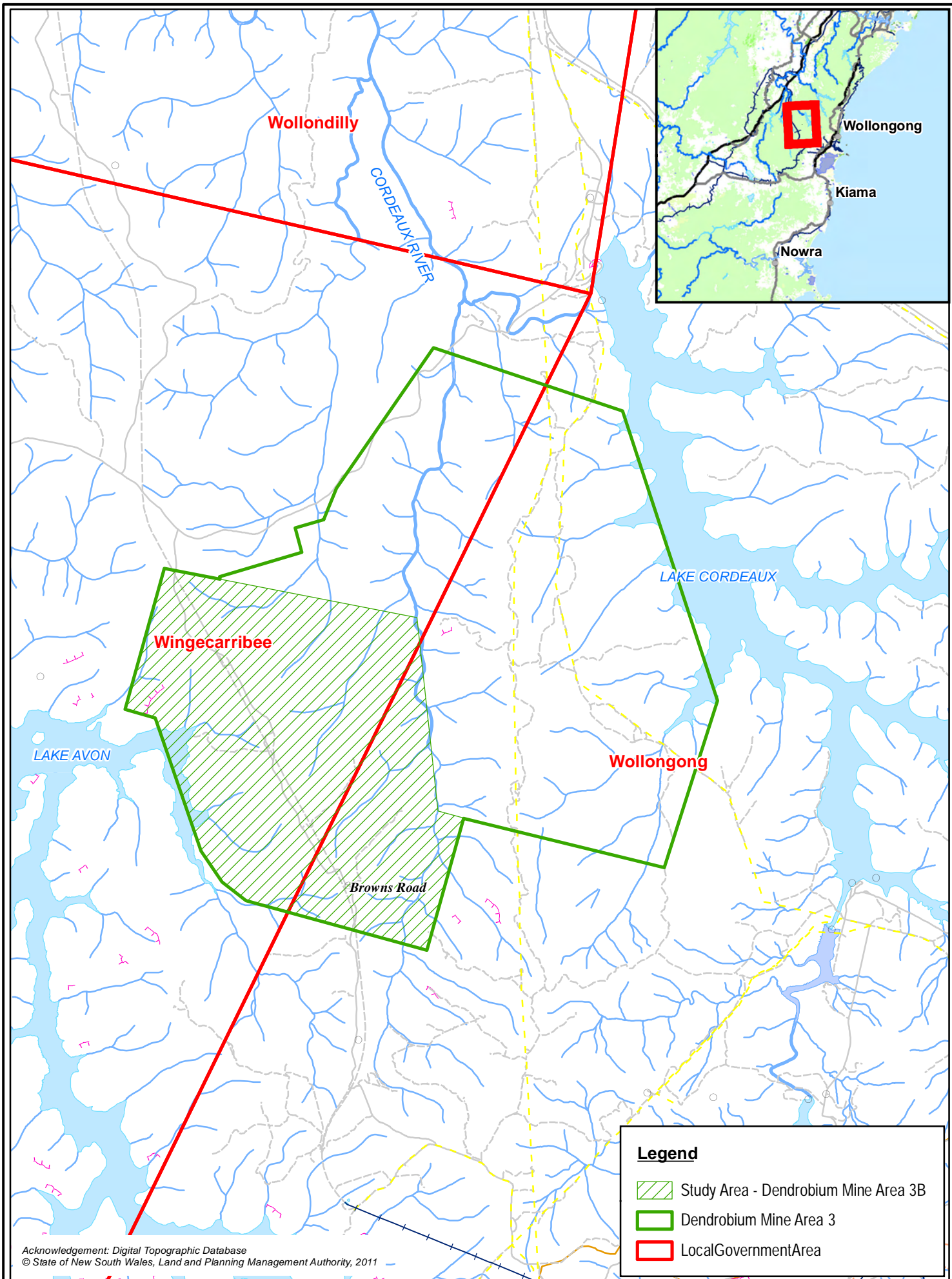
The objectives of the HIA are to:

- Review previous heritage assessments of the Study Area;
- Describe and assess significance for the Aboriginal archaeological sites and Historic heritage items within the Study Area;
- Identify the likelihood of subsidence impacts for Aboriginal and historical archaeological sites within the Study Area using Sefton (2000) parameters, the 2007 Biosis Research ACHA results and MSEC (2012) subsidence predictions;
- Establish the methodology for a monitoring program to detect and measure any changes at identified heritage sites due to mining subsidence; and,
- Propose management options and mitigation measures for any cultural heritage sites that may be affected due to mining subsidence.

## 1.3 Statutory Requirements




The Dendrobium Area 3B SMP will be submitted to the Department of Planning and Infrastructure (DoPI) and Department of Resources and Energy (DRE) for approval under the requirements of the Dendrobium Mining Development Consent (DA-60-03-2001). This development consent was approved under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Other relevant legislation, planning instruments and guidelines that will inform the ACHA and this HIA include:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Aboriginal and Torres Strait Islander Heritage Protection Amendment Act 1987*;
- *ICOMOS Australia Burra Charter 1999* (the Burra Charter); and
- *National Parks & Wildlife Act 1974* (NPW Act) (as amended 2010).



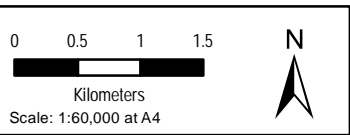
Acknowledgement: Digital Topographic Database  
 © State of New South Wales, Land and Planning Management Authority, 2011

**Legend**

-  Study Area - Dendrobium Mine Area 3B
-  Dendrobium Mine Area 3
-  Local Government Area

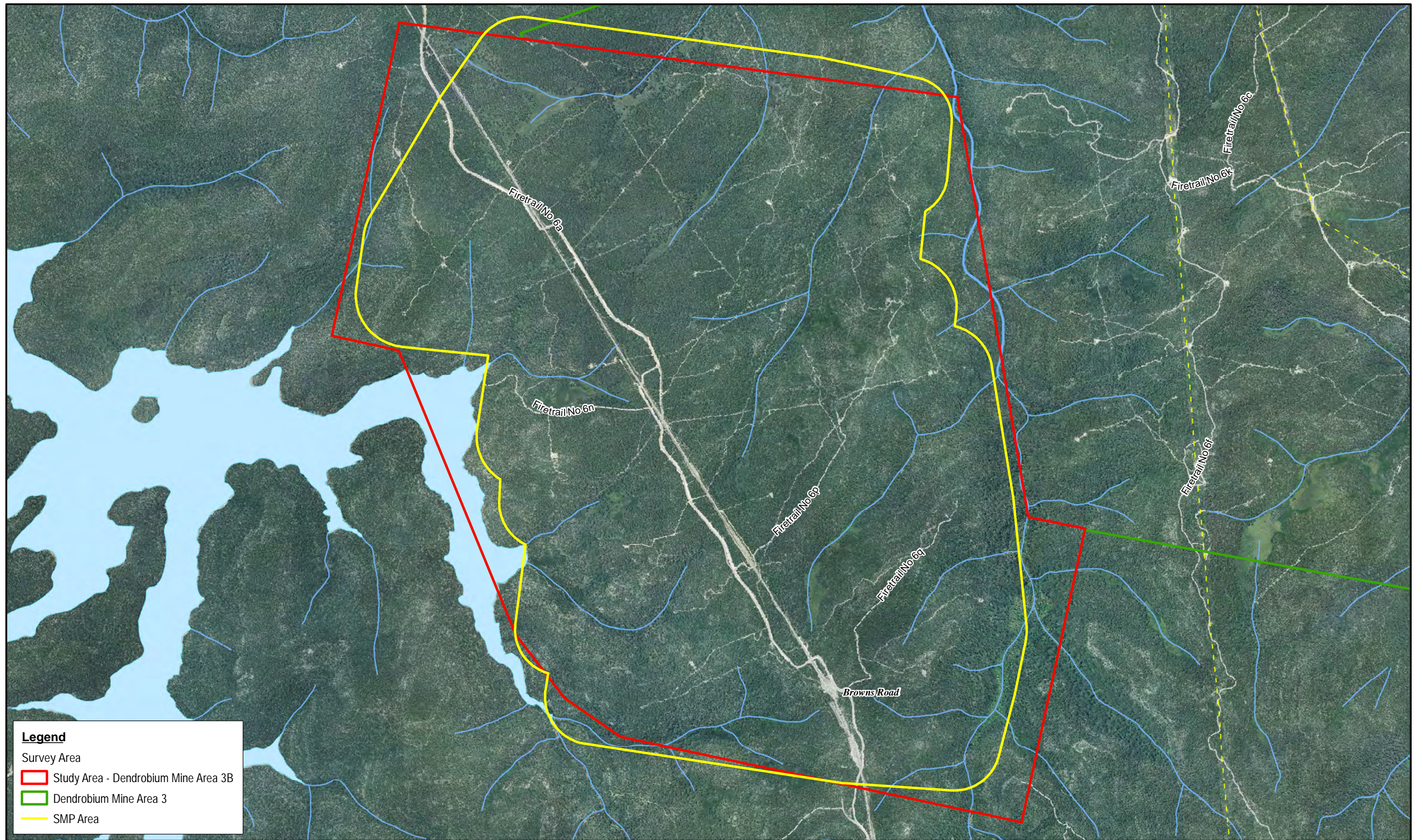
**Figure 1: Location of the Study Area**

Date: 14 February 2012 Matter: 12255  
 Checked By: ASF Drawn By: JMS  
 Location: P:\12200s\12255\Mapping\HIA



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 Canberra, Wangaratta.



**Legend**

- Survey Area
- Study Area - Dendrobium Mine Area 3B
- Dendrobium Mine Area 3
- SMP Area



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Figure 2: Aerial Photograph of Study Area

Date: 15 February 2012

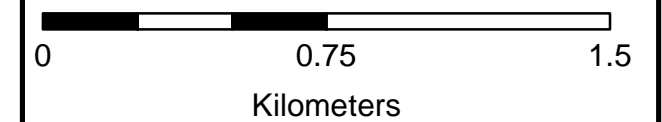
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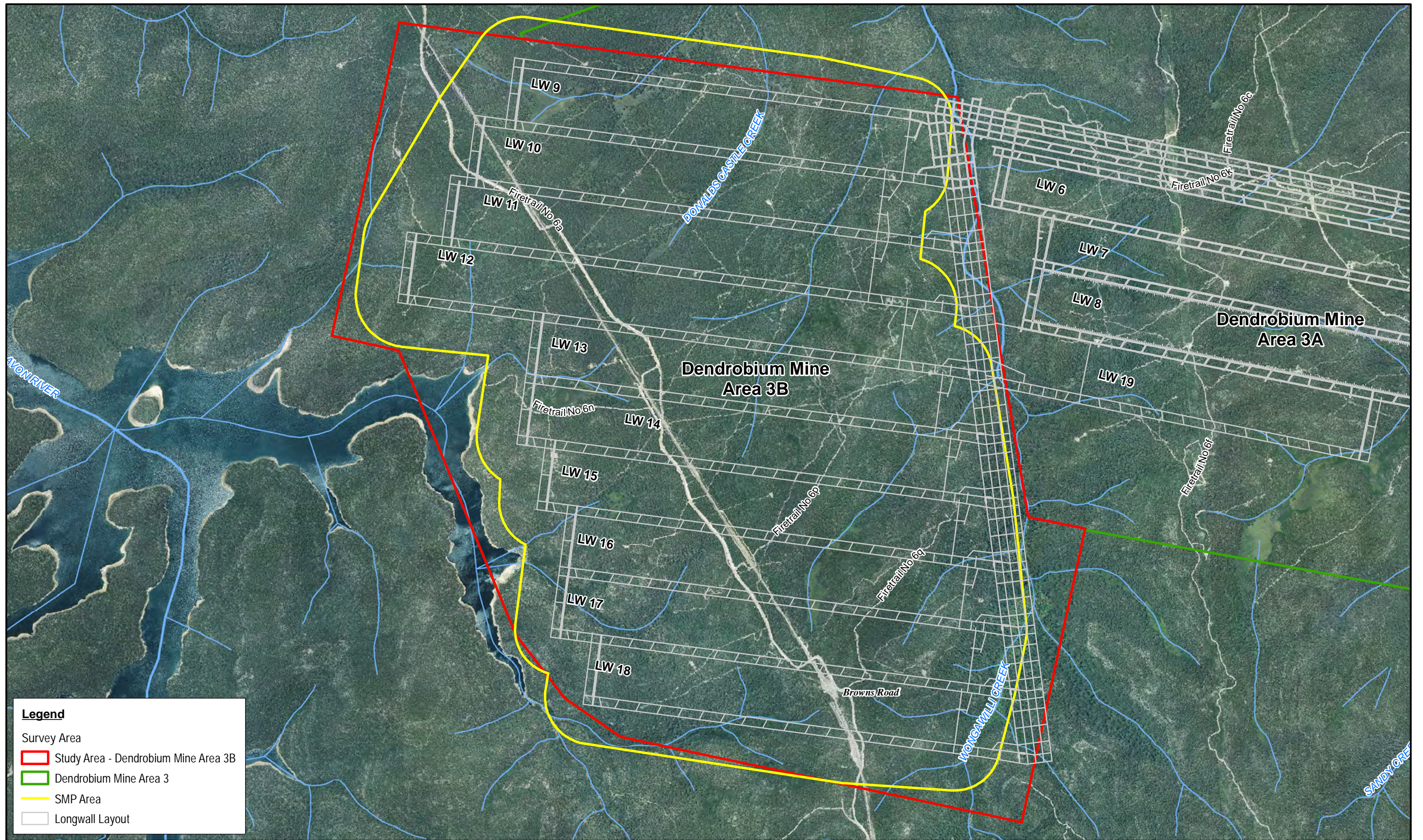
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**Acknowledgements:**  
Aerial Imagery - BHPBIC  
© Land & Property Information (LPI) 2011  
Site data - OEH  
This product contains Data which is copyright to the  
Commonwealth of Australia (c.2003-)



Scale: 1:20,000 at A3  
Map Projection: Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid of Australia, Zone 56



**Legend**

- Survey Area
- Study Area - Dendrobium Mine Area 3B
- Dendrobium Mine Area 3
- SMP Area
- Longwall Layout



**Figure 3: Dendrobium Mine Area 3B Proposed Longwall Layout**

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**Acknowledgements:**  
 Aerial Imagery - BHPBIC  
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 Site data - OEH  
 This product contains Data which is copyright to the Commonwealth of Australia (c.2003-)

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Scale: 1:20,000 at A3 Map Projection: Transverse Mercator Horizontal Datum: Geocentric Datum of Australia 1994 Grid: Map Grid of Australia, Zone 56	

## 2.0 REVIEW OF PREVIOUS HERITAGE ASSESSMENTS

Previous studies undertaken in the Southern Coalfields have considered the Study Area through archaeological survey and desktop assessments. Ten studies have been completed on the Study Area, One of these studies has assessed historic heritage while the remainder have focused on Aboriginal heritage. The results of these previous studies are discussed in Sections 2.1 and 2.2 and an overview of the regional and local archaeological context is discussed below.

### 2.1 Regional Overview

Previous archaeological work in the region began in the early 1960s, with the identification of a large shelter containing Aboriginal art and deposit by Fred McCarthy in 1961. This shelter site became known as ‘Whale Cave’ and has been discussed as part of academic investigations into regional variations of rock art and the prehistory of the Illawarra (Office 1984; Sefton 1988; and McDonald 1994).

Very little archaeological excavation work has been undertaken in the Illawarra region, outside of coastal and estuarine areas. Those shelters that have been excavated within the inland plateau environment have yielded dates of  $2220 \pm 70$  BP, with evidence of the earliest occupation at Mill Creek 11 (Koettig 1985). More recent dating of the deposits at Mill Creek 11 and 14 yielded similar dates (Koettig 1990: 22). Biosis Research excavated Brennans Creek 2 and Brennans Creek 6 at West Cliff Colliery near Appin and recovered organic material in the deposits that yielded minimal dates of  $1791 \pm 40$  BP (BC2) and  $838 \pm 51$  BP (BC6). While not dating the rock art the study did show a recent utilisation of the sites by Aboriginal people.

The spatial patterning of aboriginal sites in the region has been investigated by Officer who undertook an Honours study examining regional art variation in the Sydney basin in 1984. Sefton also undertook a Master’s thesis on regional Aboriginal site spatial patterning in the Woronora Plateau in 1998. More recently, this spatial patterning of Aboriginal sites in the Dendrobium area has been revisited by environmental impact assessments (Rich 1989; Biosis Research 2007).

A regional overview of archaeological work undertaken is provided below.

**Officer (1984)** completed his Honours Thesis on regional rock art variation in the Campbelltown region. This thesis consisted of the formal analysis of 57 sandstone shelters and seven engraving sites in the Campbelltown region, and aimed to explore and describe the formal variability within a local body of art, at a local and regional level (Officer 1984: 2). He identified strong localised ties between the coast and hinterland, despite a linguistic boundary and other evidence for cultural dichotomy (Officer 1984).

**Sefton (1998)** completed postgraduate work that focussed on site and artefact patterns on the Woronora Plateau. The data used for this investigation was collected over a number of years (between 1970 and 1998) by the Illawarra Prehistory Group. The Study Area comprised a 351 square km area stretching from the Illawarra Escarpment in the east, north to the Woronora River, west to Wallandoola River and the southern reaches of the Cataract Catchment (Sefton 1988: 5).

The analysis of shelter sites and attributes demonstrated clear patterns between shelters, shelter attributes, drainage basins on the Woronora Plateau and the inland/coastal associations of the shelter sites (Sefton 1988:166). The results indicated a difference in settlement patterns, population size and differential use of the study area. These differences corresponded with the ethnographic observations of a coastal/inland subdivision of the *Tharawal* population, and the concept of a drainage basin based territorial division within the study area (Sefton 1988).

**Rich (1989)** undertook a survey of proposed road upgrades, of Fire Road no. 15 and Cordeaux Road near Mount Kembla partly along the Illawarra Escarpment and along American Creek. Rich (1989: 12) provided a discussion of the likelihood of sites being located within her study area. She noted that the top of the Illawarra Escarpment is quite flat and would have been a good access route for travel between the coast and inland. Sites located on the escarpment would reflect temporary stop over camps with low density scatters representing maintenance and sharpening of tools rather than the manufacturing of tools. However, such low density of artefacts would be difficult to locate due to the poor visibility in the area, and within the road corridor study area, would probably have been damaged or destroyed by the development of the road. Along American Creek which was within the road corridor it is possible that open occupation sites may have been present, these would probably have been low density scatters reflecting local materials and utilized by small family groups (Rich 1989:12).

During the survey no Aboriginal Archaeological sites were located within the road corridor, nor had any sites previously been recorded within the corridor. The survey corridor was very narrow up to 10 m wide of the existing road, and it did not include any of the flat ground at the top of the escarpment or along American Creek. The corridor was very disturbed by road construction and ground visibility was very low due to grass cover, leaf litter and gravel and bitumen roads.

## 2.2 Local Overview

There has previously been archaeological surveys and cultural heritage assessments conducted within and in the immediate vicinity of the Study Area. These investigations, include Sefton's four surveys (1990, 1991, 1994 and 1997), and more recent assessments undertaken by Navin Officer (2000), and Biosis Research (2004, 2007) to determine the impacts of mining activities. These investigations are summarised below.

**Sefton (1990)** completed an archaeological survey of the Cordeaux and Woronora rivers as part of the Illawarra Prehistory Group with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. Surveys were undertaken of two areas 30 kilometres apart; one in the Cordeaux Catchment area, of particular relevance to the current Study Area, and the other in the Woronora Eastern Catchment area.

During the survey a total of 87 archaeological sites were located within the Cordeaux Catchment Study Area. Sefton (1990: 26-27) provides useful statistical data about site types and content based on the site information recorded during the survey. The most common site types were shelters with 58 shelters found, followed by 29 grinding sites, two rock engraving sites and two engraved groove channel sites.

A total of 667 motifs are depicted within the shelters. The most common art technique is charcoal drawing (571 motifs), followed by 57 red drawings, 42 red stencil, 17 white stencil 13 red painting, seven bichrome and four white drawings.

**Sefton (1991)** conducted an additional survey concentrating on the areas around Wongawilli Creek, a tributary of the Cordeaux River. Wongawilli Creek runs along the eastern side of the Study Area. Sites recorded during this survey that are located within the Study Area include: *Browns Road Site 8* (52-2-1623), *Browns Road Site 11* (52-2-1626), *Browns Road Site 12* (52-2-1627) and *Browns Road Site 13* (52-2-1628).

A comparative analysis of the site types and their frequencies within both the Woronora and Cordeaux Catchments lead Sefton to conclude that due to higher numbers of grinding groove sites and shelters with artefacts in the Woronora Catchment, this area had sustained larger population than the Cordeaux Catchment area. From the analysis of art motifs and art techniques Sefton inferred that this increased artistic expression is related to more complex social and religious life.

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

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

The survey concentrated on sandstone outcrops and surface scatters were only looked for where walking tracks had exposed the ground. Within the area surveyed by Sefton 53 shelters with art were located and 17 had stone artefacts. Thirteen grinding grooves were located, two stone arrangements and one engraved groove channel. Seven sites were recorded during this survey that are located within the current Study Area: *Upper Avon 35* (52-2-1771), *Upper Avon 36* (52-2-1772), *Upper Avon 37* (52-2-

1773), *Upper Avon 38* (52-2-1774), *Upper Avon 39* (52-2-1775), *Upper Avon 40* (52-2-1776) and *Upper Avon 41* (52-2-1778) (Sefton 1994: Figure 4).

**Sefton (1997)** undertook an archaeological survey of the Avon River as part of the Illawarra Prehistory Group with a grant received from the Australian Institute of Aboriginal and Torres Strait Islander Studies. The study area includes the western section of the Avon River, between the Illawarra Escarpment and the confluence with the Nepean River. It is west of the current Study Area, on the opposite side of Lake Avon. During this survey, the same methodology was used as for her 1994 survey (see above). The survey located 104 shelters, with art the most frequent artefact found in shelters. Eighty-two shelters with art were located and most of the shelters contained a deposit. Stone artefacts were found in 50 of the shelters and shell was located in one of the shelters. Grinding grooves were the most frequent artefact found in open sites, 19 in total. There were six stone arrangements and two engraved groove channel sites.

**Navin Officer (2000)** completed a large-scale cultural heritage assessment for the Dendrobium Coal Project, which included the majority of the current Study Area. Other areas in the study included the Nebo Colliery, Kemira Colliery and the West Cliff Colliery Emplacement Area. Sample areas selected for the field survey were within the zones of proposed impact, areas that were assessed as being archaeologically sensitive and areas that had gaps in the record. The survey methodology aimed to re-assess previously recorded sites and identify new sites located within proposed impact zones. The field survey consisted of targeted surveys consisting of two differing methodologies. The first involved selecting areas aimed at locating sandstone shelters (i.e. sandstone cliff lines and open sandstone platforms), and the second to focus on areas of exposure where there was potential for detection of open campsites i.e. along existing tracks. The Navin Officer 2000 survey effort for the current Study Area is shown in Figure 4. Any large trees spotted during the survey were also targeted and inspected for cultural scarring (Navin Officer 2000: 12).

Navin Officer (2000: 49-50) provide a good discussion on considerations of visibility and site obtrusiveness on the Woronora Plateau and Illawarra Escarpment. The obtrusiveness of sandstone rock shelter and overhang sites, even in heavily vegetated areas is always high, so these sites are likely to be detected and inspected during survey. In comparison the obtrusiveness of surface sites, such as axe grinding grooves, engraved channels and motifs on sandstone platforms, or stone artefact scatters, which occur virtually anywhere, is low to very low because of the limited ground surface visibility described above. Sandstone shelves suitable for axe grinding grooves and channels are more often than not covered in leaf litter from bushes that grow on trapped sediment. The concept of visibility is also applicable to the surface of shelter sites when considering archaeological potential or looking for artefacts exposed in drip lines (Navin Officer 2000: 49).

During this survey 19 previously recorded Aboriginal sites were re-located and 11 previously un-recorded sites were located and recorded. Five of the recorded sites located during this survey are located within the current Study Area: *Dendrobium 1* (52-2-2209), *Dendrobium 2* (52-2-2208), *Dendrobium 6* (52-2-2246), *Dendrobium 7* (52-22248) and *Dendrobium 8* (52-2-3068) (Navin Officer 2000: 39-41).



**Biosis Research (2004)** undertook an archaeological survey of the Lake Cordeaux foreshore and proposed seismic lines within Dendrobium Area 3. The seismic line alignments were assessed by walking the entire length of the alignments, and all areas of archaeological potential within the proximity of the seismic lines were closely inspected, especially sandstone overhangs and shelters. Survey of the boreholes involved inspecting a 100 m radius around the location of the proposed borehole. Pedestrian survey was conducted along the proposed foreshore seismic testing lines. Landforms where the dominant foreshore slope was gentle and areas where overhangs occurred were included in the survey.

The survey resulted in the identification of 10 new Aboriginal archaeological sites. One of these sites, DM2, a Shelter with Deposit, is located within the current Study Area.

Biosis Research (2004: 27) found that the types of sites recorded during the seismic transects and borehole survey are highly characteristic of the sites that have been previously recorded in Dendrobium Area 3. The sites discovered generally conform to the models previously developed for the area, which can be summarised as follows:

Shelter sites will be common where conditions are suitable, and most will contain art; stone artefact sites are present, though difficult to detect, and rarely contain high numbers or densities of artefacts; other sites, may be present depending on local conditions.

However, the results of the foreshore survey are quite different from the site prediction models formed for the region. Biosis Research found that *“stone artefact scatters are relatively rare in the local and general area, however the foreshore survey resulted in the discovery of seven new stone artefact sites. At least two of the sites – DM3 and DM7 - contain notably high artefact numbers for the region. DM3 is particularly noteworthy for its very high number of estimated artefacts, it has great potential to provide information of the sourcing and use of stone raw materials in the catchment by Aboriginal hunter-gatherer populations. At DM3, DM6 and DM7 more artefacts are very likely to occur away from the eroded lake margin, in the intact soil deposits nearby* (Biosis 2004: 27).

## **2.3 Biosis Research 2007 Study Methods and Results**

Biosis Research (2007) undertook an archaeological and cultural heritage assessment of Dendrobium Area 3 for proposed longwall mining activities by BHPBIC. During this survey 65 Aboriginal archaeological sites were re-assessed or newly identified. Twenty-three Aboriginal archaeological sites recorded by Biosis Research (2007) are located within the current Study Area (Figure 5). Details for these sites are provided in Section 2.4.2 to 2.4.24.

### **2.3.1 Survey Methods**

The 2007 survey methodology was designed in consultation with the local Aboriginal community and aimed to locate archaeological sites within Dendrobium Area 3 with reference to the following information:

- Previously recorded sites within the Study Area; and,
- Areas of archaeological potential as identified by the background research, including sandstone cliff lines, and creeks and their tributaries.

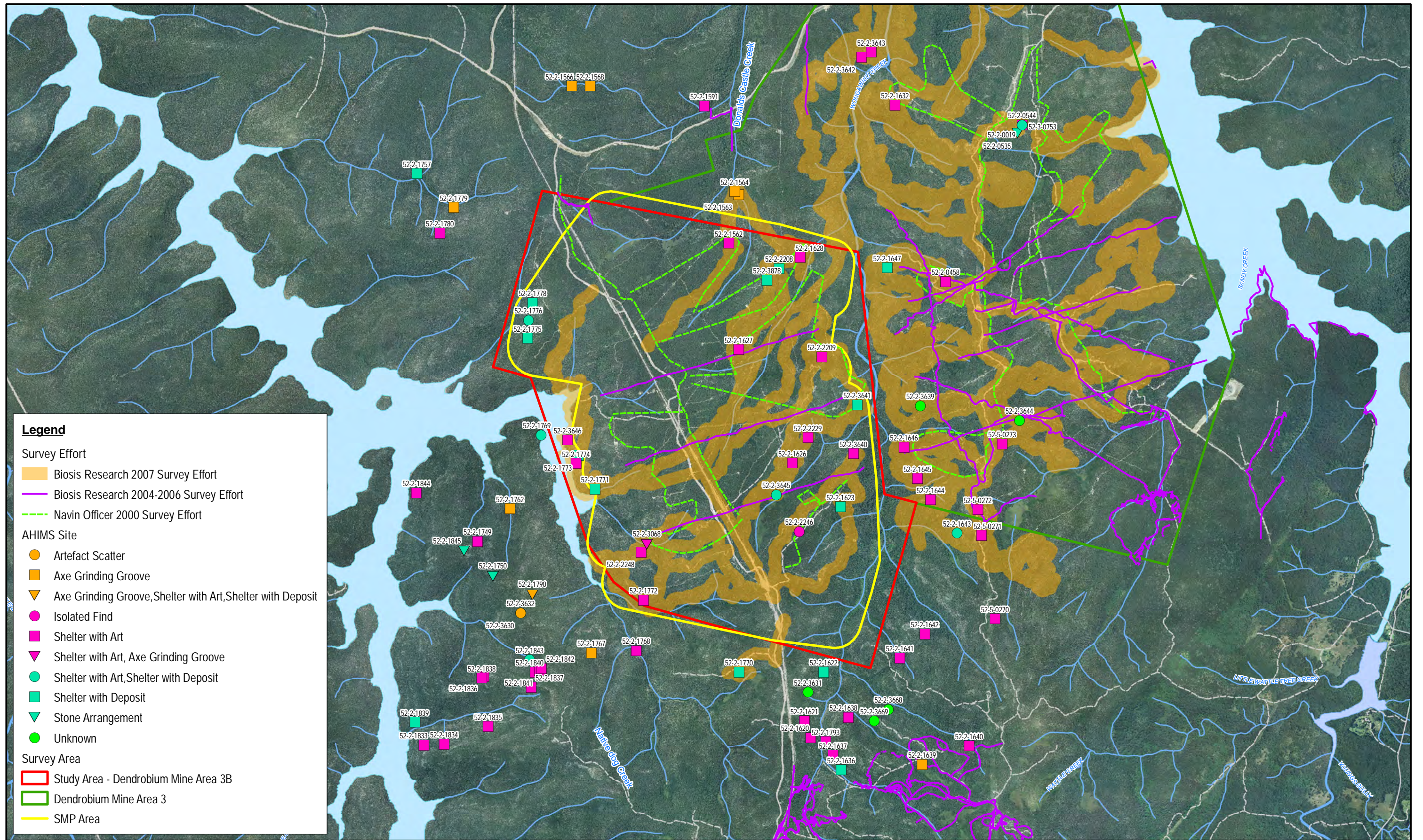
The most sensitive landforms associated with Aboriginal archaeological sites within the Study Area are those associated with the Hawkesbury Sandstone soil landscape. These landforms comprise drainage features which produce deeply incised, rocky gullies and valleys suitable for the formation of sandstone overhangs and shelters. Previous surveys either tended to focus on these more sensitive landforms by undertaking targeted contour and drainage surveys, or by employing opportunistic surveys that focused on areas of previous disturbance (e.g. vehicle tracks) or potential impact areas (e.g. seismic lines). This was achieved by walking parallel to these characteristic topographic features and inspecting for suitable overhangs and open sandstone platforms. Figure 5 shows transects previously surveyed within Dendrobium Area 3 by Biosis Research (2007) as well as Biosis Research (2004, 2006) and Navin Officer (2000).

The 2007 survey involved using a targeted method of ‘contour surveying’, as has been used previously at Dendrobium and similar environments (Navin Officer 2000; Sefton 1990, 1991, 1994, 1997 and 1999). The survey team varied between 5 and 7 team members over 16 days (Biosis Research 2007: 62-63). The survey targeted areas within Dendrobium Areas 3A, 3B and 3C, inspecting landforms and areas identified in the predictive modelling as having a high likelihood for the presence of archaeological sites. In general, all sandstone cliff lines and ridgelines, creeks and drainage lines were surveyed. All traversed areas were recorded using hand-held GPS units. The survey resulted in 23 Aboriginal archaeological sites being recorded or relocated in Dendrobium Area 3B (Table 1). No historical sites were recorded in the Study Area.

The spurs and side slopes of the Study Area, particularly those that flank Wongawilli Creek, are high gradient slopes, often extending several hundred linear metres from top to base. For each transect the survey team spread out evenly along the length of the slopes (from top to bottom), and proceeded in a line moving along the side of the slope—or contour—with each member maintaining a consistent level, and hence spacing, between themselves. For much of the Study Area the rugged nature of the slopes, scarps and cliffs naturally constrained or separated the survey lines. Generally however it was observed that the slopes ‘stepped’ down in stages, with less inclined slopes breaking to cliffs, scarps or boulder terraces (where sandstone shelter sites are likely to occur) before becoming less inclined again, and then breaking again. This stepped slope profile is a characteristic of the Hawkesbury landscape (Hazelton and Tille 1990: 46).

The results of this survey showed that the area contains archaeological sites typical of the Woronora Plateau, and observations from this assessment are generally consistent with previous major studies in the area (Navin Officer 2000; Sefton 1994 and 1997). The area contains a diversity of shelter sites, art motifs and techniques consistent with the local region. It was concluded that the area presented a strong sample to accurately characterise Aboriginal site patterning for the Study Area (Biosis 2007: 77).

Biosis Research (2007) provided a subsidence impact assessment and recommendations for Aboriginal archaeological sites within Dendrobium Mine Area 3A. Subsidence impact assessments for Areas 3B and 3C were not undertaken as longwall layouts for these areas had yet to be developed.



**Legend**

**Survey Effort**

- Biosis Research 2007 Survey Effort
- Biosis Research 2004-2006 Survey Effort
- Navin Officer 2000 Survey Effort

**AHIMS Site**

- Artefact Scatter
- Axe Grinding Groove
- Axe Grinding Groove, Shelter with Art, Shelter with Deposit
- Isolated Find
- Shelter with Art
- Shelter with Art, Axe Grinding Groove
- Shelter with Art, Shelter with Deposit
- Shelter with Deposit
- Stone Arrangement
- Unknown

**Survey Area**

- Study Area - Dendrobium Mine Area 3B
- Dendrobium Mine Area 3
- SMP Area



**Figure 4: Previous Survey Effort for the Study Area**

Date: 16 February 2012	Drawn by: ANP
Job number: 12255	Checked by: ASF
Location: ..P:\12200s\12255\Mapping\HIA Mapping\12255_F4_HIA Survey Effort.mxd	

**Acknowledgements:**  
 Aerial Imagery - BHPBIC  
 © Land & Property Information (LPI) 2011  
 Site data - OEH  
 This product contains Data which is copyright to the Commonwealth of Australia (c.2003-)

Kilometers

Scale: 1:35,000 at A3  
 Map Projection: Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia 1994  
 Grid: Map Grid of Australia, Zone 56

## 2.4 Aboriginal Sites within the Study Area

Within the Study Area, there are 23 Aboriginal sites recorded on the (AHIMS) register maintained by the Office of Environment and Heritage (OEH). These sites are listed in Table 1 and shown in Figure 5. Descriptions and scientific significance assessments for each site based on the findings of the 2007 Biosis Research ACHA are provided in Annex 1.

**Table 1:** Aboriginal Sites within the Study Area

Site Number	Site Name	Site Type	Scientific Significance	Cultural Significance
52-2-1562	Donald Castle Creek Site 1; Cordeaux Catchment area	Shelter with Art	Low	High
52-2-1623	Browns Road Site 8	Shelter with Deposit	Low	High
52-2-1626	Browns Road Site 11	Shelter with Art	Low	High
52-2-1627	Browns Road Site 12	Shelter with Art	Moderate	High
52-2-1628	Browns Road Site 13	Shelter with Art	Low	High
52-2-1771	Upper Avon 35	Shelter with Deposit	Moderate	High
52-2-1772	Upper Avon 36	Shelter with Art	High	High
52-2-1773	Upper Avon 37	Shelter with Deposit	Low	High
52-2-1774	Upper Avon 38	Shelter with Art	Low	High
52-2-1775	Upper Avon 39	Shelter with Deposit	Low	High
52-2-1776	Upper Avon 40	Shelter with Art, Shelter with Deposit	Low	High
52-2-1778	Upper Avon 41	Shelter with Deposit	Low	High
52-2-2208	Dendrobium 1	Shelter with Deposit	Low	High
52-2-2209	Dendrobium 2	Shelter with Art	Low	High
52-2-2229	SITE 1 - DB1	Shelter with Art	Low	High
52-2-2246	Dendrobium 6	Isolated Artefact	Low	High
52-2-2248	Dendrobium 7	Shelter with Art	Low	High
52-2-3068	Dendrobium 8	Shelter with Art; Grinding Grooves	Low	High
52-2-3640	DM 16	Shelter with Art	High	High
52-2-3641	DM 17	Shelter with Deposit	Low	High
52-2-3645	DM 21	Shelter with Art; Shelter with Deposit	High	High

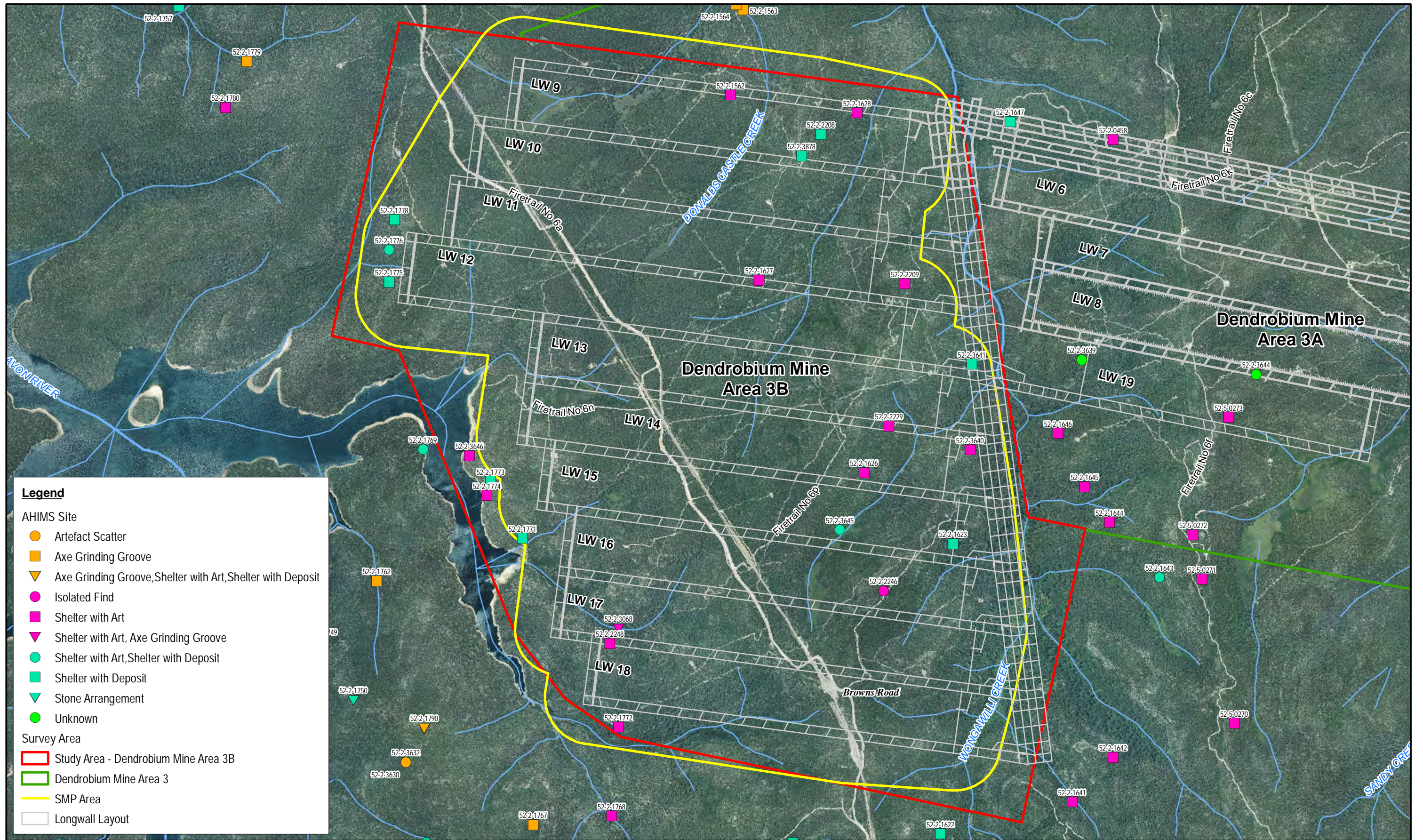
Site Number	Site Name	Site Type	Scientific Significance	Cultural Significance
52-2-3646	DM 22	Shelter with Art	Low	High
52-2-3878	DM 2	Shelter with Deposit	Low	High

## 2.5 Historic Sites within the Study Area

No historical sites have been identified in the Study Area by previous assessments. Searches undertaken of the Commonwealth Heritage List, State Heritage Register, State Heritage Inventory, Wollongong Local Environmental Plan 2009 and Wingecarribee Local Environmental Plan 2010 did not identify any historic heritage items in the Study Area.

## 2.6 Archaeological Summary

The current Study Area has been subject to a number of intensive archaeological surveys that have identified a total of 23 Aboriginal archaeological sites, predominantly rock shelters located within the Study Area. These sites are registered on the OEH AHIMS. Biosis (2007) concluded that the Study Area contains a typical example of archaeological sites in this region of the Woronora Plateau (Biosis Research 2007: 76-77). The Study Area contains both a diversity of sites and a diversity of motifs and art techniques. The condition of the sites and art is variable with the charcoal art poorly preserved. The cumulative survey efforts of previous researchers and the current surveys present a strong sample of the archaeology of the Study Area, giving confidence that the archaeological and cultural values of the study have been accurately characterised.



**Legend**

**AHIMS Site**

- Artefact Scatter
- Axe Grinding Groove
- ▼ Axe Grinding Groove, Shelter with Art, Shelter with Deposit
- Isolated Find
- Shelter with Art
- ▼ Shelter with Art, Axe Grinding Groove
- Shelter with Art, Shelter with Deposit
- Shelter with Deposit
- ▼ Stone Arrangement
- Unknown

**Survey Area**

- ▭ Study Area - Dendrobium Mine Area 3B
- ▭ Dendrobium Mine Area 3
- ▭ SMP Area
- ▭ Longwall Layout



Biosis Research Pty. Ltd. 8 Tate Street Wollongong NEW SOUTH WALES 2500	
Figure 5: AHIMS Search Results.	
Date: 16 February 2012	Drawn by: ANP
Job number: 12255	Checked by: ASF
Location: ..P:\12200s\12255\Mapping\HIA Mapping\12255_F5_HIA AHIMS.mxd	

**Acknowledgements:**  
 Aerial Imagery - BHPBIC  
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 Site data - OEH  
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 Commonwealth of Australia (c.2003-)

0 0.75 1.5  
Kilometers

Scale: 1:20,000 at A3  
 Map Projection: Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia 1994  
 Grid: Map Grid of Australia, Zone 56

## 3.0 IMPACT ASSESSMENT

During and following the extraction of coal via longwall mining methods, overlying rock strata are subject to varying degrees of subsidence, tilt and strain (MSEC 2007). At the surface, the ground subsides vertically and also moves horizontally towards the centre of the mined goaf (MSEC 2007). These movements can cause slumping of soils on poorly consolidated landform elements such as talus slopes and cracking of rigid areas such as sandstone platforms, ledges and cliffs. These ground surface changes can potentially impact on cultural heritage sites.

### 3.1 Subsidence Impact Prediction Modelling

It is difficult to make precise statements of impact due to subsidence impacts to Aboriginal shelter sites, and subsidence impact prediction modelling for Aboriginal shelter sites is still developing. Following on from Sefton's (2000) review of subsidence impacts in the Southern Coalfield, the majority of subsequent subsidence impact prediction modelling has been based on a Principle Components Analysis using a combination of shelter, longwall and subsidence characteristics and parameters. In order to determine the level of risk of impacts to Aboriginal shelter sites from subsidence impacts in Dendrobium Area 3B, ratings and criteria have been developed considering the following:

- Potential of subsidence impacts to impact on Aboriginal shelter sites;
- A review of the results of Aboriginal shelter subsidence monitoring in the wider Southern Coalfield; and,
- A review of the results of Aboriginal shelter subsidence monitoring in the Dendrobium and Delta (Elouera) Collieries which share similar geological characteristics with the Study Area.

#### 3.1.1 Subsidence Impacts

The 2008 *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield Strategic Review* defines subsidence effects as “the deformation of the ground mass surrounding a mine due to mining activity” (DoP 2008: vii). Subsidence impacts are the changes to the ground that subsequently occur as a result of subsidence effects. Subsidence impacts are not always recognisable within Aboriginal shelters or are difficult to separate from normal background effects. Any change of Aboriginal shelter site condition observed during subsidence mining is managed under the assumption that it could possibly be the result of a subsidence impact.

Changes to Aboriginal shelter site conditions resulting from subsidence impacts associated with longwall mining were first recorded by Lambert and Rosenfield in the mid to late 1980's (Sefton 2000: 23-24). To date, changes in shelter conditions have been recorded at 17 sites in the Southern Coalfields (see Annex 2). Of these changes, nine are directly attributed to subsidence impacts and two are possibly related to subsidence impacts. In the case of changes in conditions at two sites, 52-2-1619 Browns Road 4 and PAD 3, Sefton noted that block fall in these shelters occurred along pre-existing cracks and there were no clear indicators if it was a result of subsidence impacts or a natural block fall event.



Changes to shelter conditions attributed to subsidence impacts include small movement along joints, tension cracking of strata, cliff collapse or block fall and increased water seepage of shelter sandstone surfaces. While subsidence impacts do not always have direct heritage values impacts, i.e impacts to art panels, they can cause a change in shelter conditions that can then lead to a heritage values impact, such as altering water seepage patterns that then adversely affects art panels. Thus the heritage values at a given Aboriginal shelter site, such as the presence or absence of art panels, will influence the risk of a heritage values impact due to subsidence impacts.

### 3.1.2 Review of Aboriginal Site Monitoring Results in the Southern Coalfield

Subsidence monitoring data has been collected for 104 shelter sites in the Southern Coalfield by Biosis Research, Sefton and Niche (Table 2). Eleven (10.6%) of these sites have had a change in condition due to subsidence impacts. A combination of large overhang size and presence of bedding planes with water seepage remains the most common shared characteristics in shelters that have experienced a change in shelter condition due to subsidence. Of the 11 sites where change has been recorded, eight had water seepage prior to the commencement of mining and only one site has a shelter volume of less than 50 cubic metres. All shelters where a change in condition has been recorded had a maximum predicted subsidence movement of greater than 300 mm; however predicted tilt, tensile and compressive strains varied greatly across sites. Other contributing characteristics distinguishable in the data as possibly contributing to the risk of impact resulting from subsidence impacts included maximum predicted subsidence movement and landform.

**Table 2:** Subsidence Monitoring Results for Aboriginal Sites in the Southern Coalfield

Number of sites monitored	Number of sites impacted (%)
104	11 (10.6%)

There are 22 sites (21%) in the dataset that were documented during baseline recording (prior to mining) as having a combination of water seepage and a shelter volume of more than 50 cubic metres. These sites are referred to as large, wet sites. Of these large, wet sites eight (36%) have had changes in shelter conditions. In comparison, of the 31 large dry shelters (no water seepage, shelter volume greater than 50 cubic metres) only two (6.5%) have been subject to subsidence impacts. These trends are relatively consistent with Sefton's 2000 review in which four (44%) of the nine large shelter sites with water seepage suffered subsidence impacts, in comparison to only one (7.14%) of the 14 large dry shelter sites (Table 3).

Of the shelter sites impacted by subsidence, there is only one shelter site with a volume of less than 50 cubic metres, 52-2-0277 Sandy Creek Road 25. This site is unusual in that it is a relatively small shelter created by cavernous weathering and is part of a larger rock platform. Subsidence impacts at the site included minor cracking and the separation of a vertical joint on the rear wall of the shelter. It is possible that these impacts are related to a combination of the presence of joints and the size of the larger rock platform in which it is located.

**Table 3:** Comparison of Number of Impacts at Large Wet and Large Dry Shelter Sites

Site Characteristics	Sites monitored (% of overall sites)	Sites impacted (% of impacted sites)
Large wet sites	22 (21%)	8 (73%)
Large dry sites	31 (30%)	2 (19%)

Landform also appears to play a role with higher rates of impacts being observed at lower valley slopes ridge/plateau tops (25% of sites impacted), upper ridge/valley slopes (15% of sites impacted) and lower valley slopes (14% of sites impacted). This is in comparison with the lower rate of impacts in the main landform in which shelters are located, which is valley bottoms (6% of sites impacted). However, rates of subsidence impact associated with landforms may also be coincidental with other factors such as water seepage, which have higher chances of occurring in some landforms. For example the vast majority of sites with water seepage are located in lower valley slopes (39.3% of all sites have water seepage) and valley bases (30.7% of all sites have water seepage).

**Table 4:** Comparison of Number of Impacts at Shelter Sites by Landform

Landform	Sites monitored (% of overall sites)	Sites impacted in landform (% of impacted sites in landform)	% of all impacted sites
Lower valley slopes	28 (27%)	4 (14%)	36%
Ridge/plateau tops	8 (8%)	2 (25%)	18%
Valley bottoms	49 (47%)	3 (6%)	28%
Upper ridge/valley slopes	13 (12%)	2 (15%)	18%
Unrecorded	6 (6%)	0 (0%)	0%

A preliminary Discriminant Analysis (DA) of the Southern Coalfield Aboriginal site subsidence monitoring data has been undertaken by Biosis Research. The DA aimed to discriminate between sites that experienced subsidence impacts and/or heritage values impacts and those that did not. While the results are only preliminary, trends indicate that large wet sites on ridge tops or valley bottoms are the characteristics that best predict the potential for sites to be impacted. These findings are consistent with Sefton's 2000 findings and the simple analysis provided above.

### 3.1.3 Aboriginal Site Monitoring in the Dendrobium and Delta (Elouera) Collieries

Subsidence monitoring data has been collected for 17 shelter sites within the Dendrobium and Delta (Elouera) Colliery areas. These colliery areas share similar geological characteristics to the current Project Area, such as geology and depth of coal seams being mined, and are of direct relevance in assessing the risk of impact from subsidence. Of these sites, two sites (11.8%), 52-2-2252 and 52-5-0277, have undergone changes in shelter condition.

Site 52-2-2252 is a large dry shelter and 52-5-0277 is a small wet shelter. Subsidence predictions for 52-2-2252 and 52-5-0277 had maximum predicted vertical movements of between 900mm to 1540mm and maximum predicted tensile strains of between 2.5mm/m and 7.4mm/m. Only one other site had similar subsidence predictions, 52-5-0278, but was not subject to subsidence impacts.

The frequency of changes in shelter condition observed at Aboriginal shelter sites in the Dendrobium and Delta Collieries is higher than observed across the Southern Coalfield in general. However the dataset is still small and the difference in trends between the Southern Coalfield and Dendrobium/Delta datasets should be treated with caution.

### **3.1.4 Risk of Impact Ratings and Criteria**

The development of an impact prediction methodology has attempted to provide reasonably accurate subsidence impact predictions to shelter sites, which, in combination with a cultural heritage significance assessment, is then used to provide appropriate avoidance, mitigation and management recommendations (generally subsidence monitoring and response plans). The risk of impact criteria adopted for the purposes of this assessment are shelter size (volume), the presence of water seepage, maximum predicted subsidence movement and the presence/absence of art. Risk categories are from moderate to negligible and reflect subsidence effect occurrence and actual impacts to heritage values from subsidence effects monitored to date. A description of risk categories and criteria is provided in Table 5.

The subsidence risk assessment for Aboriginal sites in the Project Area is presented in Table 7. This assessment includes all the parameters considered in Sefton's 2000 Principle Components Analysis and subsidence predictions provided by MSEC (MSEC 2012: 75). This additional information is provided for comparison purposes only. The assessment of risk was made using the criteria outlined in Table 5. A summary of potential impacts is provided in Table 5 and accounts for variability of subsidence effects by indicating that none or partial harm may occur. To date no impacts from subsidence effects have resulted in a total loss of heritage values and this is reflected in the consequence of harm column.

**Table 5: Subsidence Risk Categories and Criteria**

Category	Description	Criteria
Moderate	Moderate chance of subsidence effects occurring. Impacts to heritage values are possible.	<ul style="list-style-type: none"> <li>• The shelter has an art panel present;</li> <li>• The shelter has a volume greater than 50 cubic metres;</li> <li>• The shelter has joints or bedding plans subject to water seepage; and,</li> <li>• Maximum predicted subsidence is greater than 300mm.</li> </ul>
Low	Low chance of subsidence effects occurring. Impacts to heritage values unlikely.	<ul style="list-style-type: none"> <li>• The shelter has a volume greater than 50 cubic metres; and,</li> <li>• Maximum predicted subsidence is greater than 300mm</li> </ul>
Very Low	Very low chance of subsidence effects occurring. Impacts to heritage values are highly unlikely.	<ul style="list-style-type: none"> <li>• The shelter has a volume less than 50 cubic metres and maximum predicted subsidence is greater than 300mm; or</li> <li>• The shelter has a volume more than 50 cubic metres and maximum predicted subsidence is less than 300mm.</li> </ul>
Negligible	Impacts to heritage values are unlikely and if they did occur would normally be indistinguishable from natural environmental effects.	<ul style="list-style-type: none"> <li>• The shelter has a volume less than 50 cubic metres;</li> <li>• Maximum predicted subsidence is less than 300mm, tensile strain predictions are &lt;0.5mm/m and compressive strain estimates are &lt;0.01mm/m.</li> </ul>

○ .

### 3.2 Subsidence Impact Predictions

The subsidence impact assessment for Aboriginal sites in the Study Area is presented below in Table 6. This assessment was made using the parameters in Sefton's PCA and in conjunction with the subsidence predictions provided by MSEC (MSEC 2012: 75), detailed in Table 7. The assessment of risk was made using the criteria outlined in Section 3.1.

**Table 6:** Summary of the predicted risk of impact to Aboriginal Sites in Study Area

Site Number	Site Name	Site Type	Significance	Risk of Impact
52-2-1562	Donald Castle Creek Site 1; Cordeaux Catchment area	Shelter with Art	Low	Very Low
52-2-1623	Browns Road Site 8	Shelter with Deposit	Low	Very Low
52-2-1626	Browns Road Site 11	Shelter with Art	Low	Very Low
52-2-1627	Browns Road Site 12	Shelter with Art	Moderate	Low
52-2-1628	Browns Road Site 13	Shelter with Art	Low	Very Low
52-2-1771	Upper Avon 35	Shelter with Deposit	Moderate	Very Low
52-2-1772	Upper Avon 36	Shelter with Art	High	Very Low
52-2-1773	Upper Avon 37	Shelter with Deposit	Low	Negligible
52-2-1774	Upper Avon 38	Shelter with Art	Low	Very Low
52-2-1775	Upper Avon 39	Shelter with Deposit	Low	Very Low
52-2-1776	Upper Avon 40	Shelter with Art, Shelter with Deposit	Low	Very Low
52-2-1778	Upper Avon 41	Shelter with Deposit	Low	Very Low
52-2-2208	Dendrobium 1	Shelter with Deposit	Low	Low
52-2-2209	Dendrobium 2	Shelter with Art	Low	Very Low
52-2-2229	SITE 1 - DB1	Shelter with Art	Low	Very Low
52-2-2246	Dendrobium 6	Isolated Artefact	Low	Negligible
52-2-2248	Dendrobium 7	Shelter with Art	Low	Very Low
52-2-3068	Dendrobium 8	Shelter with Art; Grinding Grooves	Low	Low
52-2-3640	DM 16	Shelter with Art	High	Very Low
52-2-3641	DM 17	Shelter with Deposit	Low	Very Low
52-2-3645	DM 21	Shelter with Art; Shelter with Deposit	High	Low
52-2-3646	DM 22	Shelter with Art	Low	Negligible
52-2-3878	DM 2	Shelter with Deposit	Low	Low

**Table 7: Principle Components Assessment**

SITE NAME	SITE NUMBER	L (m)	W (m)	H (m)	Volume m <sup>3</sup>	Aspect	BF / CW / SP	ART Y/N	Location	Wet / DRY	Location End LW	Location in LW	DIR	SUBS	Tensile Strain	Comp Strain	Tilt	Previously Undermined	Previously monitored
DONALD CASTLE CREEK SITE 1; CORDEAUX CATCHMENT AREA	52-2-1562	6.5	1	3	19.5	NE	CW	Y	LVS	D	N	M	-	875	18	0.25	0.04	No	No
BROWNS ROAD SITE 8	52-2-1623	8	4.5	1.8	64.8	SE	BF/CW	N	LVS	W	N	E	-	50	1	0.02	<0.01	No	No
BROWNS ROAD SITE 11	52-2-1626	8	2	2	32	W	BF/CW	Y	LVS	W	N	E	-	1875	25	0.4	0.55	No	No
BROWNS ROAD SITE 12	52-2-1627	17	3.5	1.5	89.25	E	BF/CW	Y	LVS	D	N	M	N	950	10	0.15	0.06	No	No
BROWNS ROAD SITE 13	52-2-1628	14	3.5	1.5	73.5	E	BF	Y	LVS	W	N	E	-	225	8	0.20	0.02	No	No
UPPER AVON 35	52-2-1771	15	4.5	3.5	236.25	S	BF	N	LVS	D	N	O	E	<20	<0.5	<0.01	<0.01	No	No
UPPER AVON 36	52-2-1772	29.6	5.5	7.5	1221	S	BF	Y	UVS	W	N	O	N	<20	<0.5	<0.01	<0.01	No	No
UPPER AVON 37	52-2-1773	4	3	1.8	21.6	SE	BF/CW	N	LVS	D	N	O	E	<20	<0.5	<0.01	<0.01	No	No
UPPER AVON 38	52-2-1774	12	3	3	108	W	CW	Y	LVS	D	N	O	E	<20	<0.5	<0.01	<0.01	No	No
UPPER AVON 39	52-2-1775	6	3.5	5	105	NW	CW	N	UVS	W	Y	O	E	<20	<0.5	<0.01	<0.01	No	No
UPPER AVON 40	52-2-1776	17	3	2.3	117.3	SW	CW	Y	UVS	D	Y	O	E	<20	<0.5	0.02	<0.01	No	No
UPPER AVON 41	52-2-1778	12	4	4.5	216	W	CW	N	UVS	D	Y	O	E	<20	<0.5	<0.01	<0.01	No	No
DENDROBIUM 1	52-2-2208	14.5	2.9	1.8	75.69	E	BF/CW	N	UVS	D	N	E	-	1650	20	0.10	0.45	No	No
DENDROBIUM 2	52-2-2209	7.5	1.4	7	73.5	E	BF	Y	UVS	D	N	O	W	<20	<0.5	<0.01	<0.01	No	No
SITE 1 - DB1	52-2-2229	4.5	2	1.2	10.8	E	BF	Y	UVS	D	N	E	-	2400	20	0.2	0.7	No	No
DENDROBIUM 6	52-2-2246	-	-	-	-	-	-	N	RT	D	N	E	-	2025	25	0.45	0.6	No	No
DENDROBIUM 7	52-2-2248	18	1.9	1.9	64.98	N	BF	Y	UVS	D	Y	E	-	275	7	0.2	0.70	No	No

SITE NAME	SITE NUMBER	L (m)	W (m)	H (m)	Volume m <sup>3</sup>	Aspect	BF / CW / SP	ART Y/N	Location	Wet / DRY	Location End LW	Location in LW	DIR	SUBS	Tensile Strain	Comp Strain	Tilt	Previously Undermined	Previously monitored
DENDROBIUM 8	52-2-3068	11.5	3.1	1.5	53.5	NW	BF/CW	Y	UVS	D	N	E	-	575	9	0.2	0.15	No	No
DM 16	52-2-3640	12.5	2	4	100	S	BF/CW	Y	LVS	D	Y	E	-	<20	<0.5	<0.01	<0.01	No	No
DM 17	52-2-3641	13	3.5	1.5	68.25	E	BF/CW	N	UVS	D	Y	O	SW	<20	<0.5	<0.01	<0.01	No	No
DM 21	52-2-3645	9	3.5	2	63	NW	CW	Y	VB	D	N	M	-	1375	25	0.55	0.08	No	No
DM 22	52-2-3646	7.5	1.5	1.5	17	W	BF/CW	Y	LVS	D	N	O	E	<20	<0.5	<0.01	<0.01	No	No
DM 2	52-2-3878	9	3	2	54	E	BF/CW	N	UVS	D	N	E	-	500	3	0.2	0.02	No	No

**Abbreviations:**

- L overhang / sandstone platform length
- W overhang / sandstone platform width
- H overhang height
- Volume in m<sup>3</sup>
- Aspect direction shelter faces
- Faces aspect main apparent formation process either block fall (BF) or cavernous weather (CW) or sandstone platform (SP)
- Art Y = present  
N = absent
- LOC RT = ridge top  
UVS = upper valley slope  
LVS = lower valley slope  
VB = valley bottom (lowest cliff line)
- Wet / dry D = surfaces mainly not affected by water seepage  
W = surface mainly affected by water seepage
- LOC END LW Y = located within 100m of the end of a longwall, wither inside or outside the longwall  
N = not located within 100m of the end of a longwall, wither inside or outside the longwall
- LOC IN LW O = located outside the longwall and chain pillar  
CP = located under the longwall and chain pillar  
E = located closer to the edge of the longwall than the middle (centre)  
M = located closer to the centre of the longwall than the end
- DIR LW Direction of the nearest longwall
- SUBS Maximum predicted subsidence
- Tensile Strain Maximum predicted tensile strain
- Comp. Strain Maximum compressive strain
- Tilt Maximum tilt

### 3.2.1 Specific Site Impact Assessments

Based on the information in Tables 3 and 4, the following impact assessment has been described in terms of ‘risk of impact’ for Aboriginal sites within the Study Area.

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<b><i>Donald Castle Creek Site 1</i></b>	<b><i>52-2-1562</i></b>	<b><i>Shelter with Art</i></b>
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This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 9. The site has a small volume, less than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Browns Road Site 8</i></b>	<b><i>52-2-1623</i></b>	<b><i>Shelter with Deposit</i></b>
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This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 15. The site has a small volume, less than 50 m<sup>3</sup>, and water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Browns Road Site 11</i></b>	<b><i>52-2-1626</i></b>	<b><i>Shelter with Art</i></b>
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This site has moderate maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 14. The site has a small volume, less than 50 m<sup>3</sup>, and water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Browns Road Site 12</i></b>	<b><i>52-2-1627</i></b>	<b><i>Shelter with Art</i></b>
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This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located between Longwalls 11 and 12. The site has a moderate volume, more than 50 m<sup>3</sup>, but no water seepage is present. The risk of impact to this site is predicted to be low.

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<b><i>Browns Road Site 13</i></b>	<b><i>52-2-1628</i></b>	<b><i>Shelter with Art</i></b>
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This site has some moderate maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located above Longwall 9. The site has a moderate volume, more than 50 m<sup>3</sup>, and water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Upper Avon 35</i></b>	<b><i>52-2-1771</i></b>	<b><i>Shelter with Deposit</i></b>
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This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 300 m west of Longwall 16. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Upper Avon 36</i></b>	<b><i>52-2-1772</i></b>	<b><i>Shelter with Art</i></b>
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This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 200 m south of Longwall 18. The site has a large volume, more than 50 m<sup>3</sup>, and water seepage is present. The risk of impact to this site is predicted to be very low.



**Upper Avon 37****52-2-1773****Shelter with Deposit**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 400m west of Longwall 15. The site has a small volume, less than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be negligible.

**Upper Avon 38****52-2-1774****Shelter with Art**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 400m west of Longwall 15. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

**Upper Avon 39****52-2-1775****Shelter with Deposit**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 200m west of Longwall 12. The site has a large volume, more than 50 m<sup>3</sup>, and water seepage is present. The risk of impact to this site is predicted to be very low.

**Upper Avon 40****52-2-1776****Shelter with Art / Shelter with Deposit**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 200m west of Longwall 12. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

**Upper Avon 41****52-2-1778****Shelter with Deposit**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 200m northwest of Longwall 12. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

**Dendrobium 1****52-2-2208****Shelter with Deposit**

This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 9. The site has a moderate volume, more than 50 m<sup>3</sup>, but no water seepage is present. The risk of impact to this site is predicted to be low.

**Dendrobium 2****52-2-2209****Shelter with Art**

This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 200m north of Longwall 12. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

**Site 1 – DB 1****52-2-2229****Shelter with Art**

This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located between Longwalls 14 and 15. The site has a small volume, less than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>Dendrobium 6</i></b>	<b>52-2-2246</b>	<b><i>Isolated Artefact</i></b>
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This site is an isolated artefact on the surface. The risk of impact to this site is predicted to be negligible.

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<b><i>Dendrobium 7</i></b>	<b>52-2-2248</b>	<b><i>Shelter with Art</i></b>
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This site has moderate maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located on the end of Longwall 18. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low .

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<b><i>Dendrobium 8</i></b>	<b>52-2-3068</b>	<b><i>Shelter with Art / Grinding Grooves</i></b>
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This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 17 and 200 m north of the end of Longwall 18. The site has a moderate volume, more than 50 m<sup>3</sup>, but no water seepage is present. The risk of impact to this site is predicted to be low.

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<b><i>DM 16</i></b>	<b>52-2-3640</b>	<b><i>Shelter with Art</i></b>
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This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located on the end of Longwall 14. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low .

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<b><i>DM 17</i></b>	<b>52-2-3641</b>	<b><i>Shelter with Deposit</i></b>
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This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 100 m north of the end of Longwall 13. The site has a large volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

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<b><i>DM21</i></b>	<b>52-2-3645</b>	<b><i>Shelter with Art / Shelter with Deposit</i></b>
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This site has high maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 15. The site has a moderate volume, more than 50 m<sup>3</sup>, but no water seepage is present. The risk of impact to this site is predicted to be low .

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<b><i>DM 22</i></b>	<b>52-2-3646</b>	<b><i>Shelter with Art</i></b>
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This site has very low maximum predicted systematic tensile strains, an overall subsidence movement of less than 300 mm and is located 400 m southwest of Longwall 14. The site has a small volume, less than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be negligible.

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<b><i>DM 2</i></b>	<b>52-2-3878</b>	<b><i>Shelter with Deposit</i></b>
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This site has moderate maximum predicted systematic tensile strains, an overall subsidence movement of more than 300 mm and is located above Longwall 9. The site has a moderate volume, more than 50 m<sup>3</sup>, and no water seepage is present. The risk of impact to this site is predicted to be very low.

## 4.0 RECOMMENDED MANAGEMENT AND MITIGATION MEASURES

The following management and mitigation measures are recommended for cultural heritage sites that may be impacted due to subsidence impacts. The recommendations are made to inform the SMP. The heritage performance measures and indicators - Trigger Action Response Plan (TARP) is presented in Table 10.

### 4.1 Historic Heritage

No historical sites have been identified in the Study Area and no management measures for historical heritage items are required.

Further, it is not anticipated that any heritage sites will be identified in the Study Area and as such no contingency has been developed. In the event that historic heritage item or site is found mitigation measures will be developed in consultation with the relevant stakeholders.

### 4.2 Aboriginal Heritage

Within the Study Area, there are 23 recorded Aboriginal sites that may be subject to subsidence impacts. As discussed in Section 3, predicting the likelihood of subsidence impacts to Aboriginal sites is subject to a degree of variation. However only minor changes in monitored Aboriginal site conditions due to subsidence impacts have occurred to date and none of the impacts have directly affected a rock art panel. It is expected that any impacts to Aboriginal archaeological sites from subsidence movement in the Study Area are likely to be low. Management responses for impacts to Aboriginal heritage in the Study Area need to be carefully considered so as to be commensurate with the level and likelihood of impact.

The proposed assessment, strategies, timing and nomination of all activities in regards to Aboriginal sites in the Study Area are described below.

#### 4.2.1 Baseline Recording of Sites in Dendrobium Area 3B

All the currently known Aboriginal archaeological sites within Dendrobium Area 3B have been subject to recording at the level appropriate for registration on the AHIMS.

It is recommended that further detailed baseline recording be undertaken prior to the extraction of the proposed longwalls. The purpose of the detailed baseline recording is to:

- Mitigate the risk of potential impact through more detailed archival recording of all shelter sites; and,
- Provide a set of baseline records for the monitoring program.

A monitoring regime established by Sefton (2000) and amended and continued by Biosis Research (2007), has proven effective in observing changes to Aboriginal shelter sites due to subsidence impacts.

The recording and monitoring regime described in this HIA aims to implement a similar monitoring program, and to establish recording procedures that are up-to-date with current technologies and practice and capture a record of the rock art in its current context. To this end, it is recommended that the following activities be undertaken:

- Recording of each shelter site with rock art on specially prepared recording forms;
- Comprehensive photographic coverage of shelters and art panels using slide and high resolution digital photography, showing art and panels in their wider context and in relation to each other;
- Art panels will be digitally and slide photographed at scales appropriate to their size and complexity, including:
  - Single frame coverage of the panel;
  - If required, set distance scale photography for montage of the panel (digital only);
  - Single frame coverage of individual motifs;
  - If required, set distance scale photography for montage of individual motifs (digital only); and,
  - Where informative, close-up photography of notable features of the rock art (e.g. superimposition of motifs or media) and its context (e.g. joints, cracks, seepage, mineral or organic accretions).
- Spherical photographic coverage of selected shelters using high resolution digital photography and appropriate image stitching techniques at selected sites;
- Elevation plans of shelter walls recording structural and surface features including, but not limited to, the art, graffiti, joints, bedding planes, exfoliation scars, cracks, mineral and micro-organism growth, drip line and water seepage locations; and,
- The identification and recording through digital photography of specific monitoring points, informed by Sefton's (2000) and Biosis Research's (2007) previous work, generally being pre-existing cracks, joints, areas of seepage located on or adjacent to art panels, or in other parts of the shelter.

Upon completion of the baseline recording and prior to the commencement of longwall mining in Dendrobium Area 3B a report and archival material shall be submitted to OEH.

The report should include a detailed description of each of the shelter sites recorded, including in the case of rock art sites a full list of the art present describing media, application techniques and motif types. In addition the rock art present at each site shall be interpreted using an appropriate level of observation (the more complex the site the more detailed the interpretation), including digital enhancement where appropriate (David *et al.* 2001). The archival material would consist of all digital

photographs, spherical photography and written records for each site transferred to archival quality CD-ROM in accordance with the NPWS Standards and Guidelines (NSW NPWS 1997).

#### **4.2.2 Monitoring**

The results of the archival recording procedures will be used for ongoing comparisons to determine any impact from mining. The following general schedule is proposed for the monitoring of the Aboriginal sites within Dendrobium Area 3B.

##### ***General Schedule***

- *Baseline archival recording:*  
Prior to longwall mining beginning in Dendrobium Area 3B.
- *Impact assessment recording:*  
Three to six months after each predicted subsidence movement at the site (that is when a longwall makes its closest traverse to the site), and/or (if the longwall is to finish mining within 6 months).
- *Final assessment recording:*  
At the completion of all subsidence movements at the site. The results of the assessment to be reported in End of Panel Reports and/or Annual Environmental Management Reports.

Any impacts will be assessed by comparing the results of the impact recording stages with the baseline data. Movement at and within the site will be monitored by comparing observations of the monitoring points, and general observations of the surrounding landscape and whether it shows evidence of subsidence impact. Specific monitoring requirements for Aboriginal sites are described in Table 9.

##### ***Impact and Risk Management Schedule***

In the event that there are subsidence impacts to any site being monitored, or impact to the immediate context surrounding the shelter, management strategies specific to the impact will be developed. The management strategies will be implemented in accordance with current conservation practice and the conservation principles contained within the Australia International Council on Monuments and Sites (ICOMOS) *Burra Charter*, and industry best practice. Registered Aboriginal parties would be consulted regarding appropriate management methodologies and any advice would be taken into consideration in the development of the management strategies. All contingent management strategies will be developed in consultation with the registered Aboriginal parties, BHPBIC, and OEH. In all cases monitoring will only be conducted when a site and condition specific risk assessment determines it is safe to do so. The triggers and suggested management actions are described in Table 8 and Table 10.

#### **4.2.3 Reporting**

Reports will be produced and submitted to OEH and registered Aboriginal stakeholders at the following project milestones:

- Completion of baseline recording; and,
- Completion of each monitoring activity, including End of Panel reporting.

As described in Section 4.2.1, the baseline recording report will include an inventory with a detailed description of each of the shelter sites recorded, including in the case of rock art sites a full list of the art describing media, application techniques and motif types. In addition the rock art present at each site will be interpreted using an appropriate level of observation (the more complex the site the more detailed the interpretation), including digital enhancement where appropriate (David *et al.* 2001).

The monitoring reports will include observations on any changes observed within the monitored shelters, and an interpretation of the mechanisms effecting those changes. Ongoing review of the factors influencing the preservation of shelters and the rock art will be included in each report where relevant observations and findings are made.

**Table 8:** Management activities, mitigation and timeframes for Aboriginal heritage.

Management Activity	To Be Completed By	In Consultation With	Timeframe	Impact = Mitigation		Outcomes
<b>Aboriginal Heritage</b>						
<b>Baseline Recording</b>	Heritage Specialist	BHPBIC	<b>Prior to the Commencement of longwall mining</b>			Completion of baseline condition recording.
<b>Monitoring – During Extraction</b>	Heritage Specialist Registered Aboriginal Parties if required.	Registered Aboriginal Parties  BHPBIC	During the extraction of Longwalls 9 to 18	<b>Impact / Change Observed</b>  If an impact or change is observed as a result of subsidence then an appropriate mitigation strategy should be developed in consultation with a heritage specialist, registered Aboriginal parties, and the landowner.	<b>Mitigation</b>  Inform registered Aboriginal parties and OEH in writing.  Site inspection with registered Aboriginal parties to document and photograph any observed changes / impacts.  Discussion of potential remediation / mitigation. Consultation with OEH will be required if remediation or mitigation measures affect the archaeological values at individual sites  Use appropriate specialists to undertake physical remediation activities	The following information relating to relevant Aboriginal archaeological sites will be recorded: <ul style="list-style-type: none"> <li>▪ Impacts / no impacts</li> <li>▪ Mitigation / Remediation undertaken</li> <li>▪ Consultation</li> <li>▪ Recommendations</li> </ul>
			Following the extraction of Longwalls 9 to 18 as part of the End of Panel reports (3 months following mining activities)			
<b>Monitoring – Following Extraction</b>			Long-term site monitoring – undertaken 12 months following the extraction of Longwalls 9 to 18.			
<b>Monitoring – Long Term</b>						

**Table 9:** Monitoring requirements for all Aboriginal sites within the Study Area.

Site Number	Site Name	Site Type	Subject to Baseline Recording	Subject to Monitoring	Monitoring to occur
52-2-1562	Donald Castle Creek Site 1; Cordeaux Catchment area	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 9</li> <li>▪ 12 month following extraction of Longwall 9</li> </ul>
52-2-1623	Browns Road Site 8	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 15 and 16</li> <li>▪ 12 month following extraction of Longwall 15 and 16</li> </ul>
52-2-1626	Browns Road Site 11	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 14 and 15</li> <li>▪ 12 month following extraction of Longwall 14 and 15</li> </ul>
52-2-1627	Browns Road Site 12	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 11 and 12</li> <li>▪ 12 month following extraction of Longwall 11 and 12</li> </ul>
52-2-1628	Browns Road Site 13	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 9</li> <li>▪ 12 month following extraction of Longwall 9</li> </ul>
52-2-1771	Upper Avon 35	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 15 and 16</li> <li>▪ 12 month following extraction of Longwall 15 and 16</li> </ul>
52-2-1772	Upper Avon 36	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 18</li> <li>▪ 12 month following extraction of Longwall 18</li> </ul>
52-2-1773	Upper Avon 37	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 15</li> <li>▪ 12 month following extraction of Longwall 15</li> </ul>
52-2-1774	Upper Avon 38	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 15</li> <li>▪ 12 month following extraction of Longwall 15</li> </ul>
52-2-1775	Upper Avon 39	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 12</li> <li>▪ 12 month following extraction of Longwall 12</li> </ul>



Dendrobium Area 3B: Longwall 9-18 Heritage Impact Assessment

Site Number	Site Name	Site Type	Subject to Baseline Recording	Subject to Monitoring	Monitoring to occur
52-2-1776	Upper Avon 40	Shelter with Art, Shelter with Deposit	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 12</li> <li>▪ 12 month following extraction of Longwall 12</li> </ul>
52-2-1778	Upper Avon 41	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 12</li> <li>▪ 12 month following extraction of Longwall 12</li> </ul>
52-2-2208	Dendrobium 1	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 9 and 10</li> <li>▪ 12 month following extraction of Longwall 9 and 10</li> </ul>
52-2-2209	Dendrobium 2	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 11 and 12</li> <li>▪ 12 month following extraction of Longwall 11 and 12</li> </ul>
52-2-2229	SITE 1 - DB1	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 13 and 14</li> <li>▪ 12 month following extraction of Longwall 13 and 14</li> </ul>
52-2-2246	Dendrobium 6	Isolated Artefact	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 16 and 17</li> <li>▪ 12 month following extraction of Longwall 16 and 17</li> </ul>
52-2-2248	Dendrobium 7	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 17 and 18</li> <li>▪ 12 month following extraction of Longwall 17 and 18</li> </ul>
52-2-3068	Dendrobium 8	Shelter with Art; Grinding Grooves	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 17 and 18</li> <li>▪ 12 month following extraction of Longwall 17 and 18</li> </ul>
52-2-3640	DM 16	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 13 and 14</li> <li>▪ 12 month following extraction of Longwall 13 and 14</li> </ul>
52-2-3641	DM 17	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 13</li> <li>▪ 12 month following extraction of Longwall 13</li> </ul>

Site Number	Site Name	Site Type	Subject to Baseline Recording	Subject to Monitoring	Monitoring to occur
52-2-3645	DM 21	Shelter with Art; Shelter with Deposit	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 15 and 16</li> <li>▪ 12 month following extraction of Longwall 15 and 16</li> </ul>
52-2-3646	DM 22	Shelter with Art	Yes	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 14</li> <li>▪ 12 month following extraction of Longwall 14</li> </ul>
52-2-3878	DM 2	Shelter with Deposit	No	Yes	<ul style="list-style-type: none"> <li>▪ 3-6 months following extraction of Longwall 9 and 10</li> <li>▪ 12 month following extraction of Longwall 9 and 10</li> </ul>

**\*\*Note: if changes to any sites resulting from subsidence are observed, additional monitoring at these sites will occur to measure, manage and mitigate further impact\*\***

**Table 10** Performance Measures and Indicators - TRIGGER ACTION RESPONSE PLAN (TARP)

<i>During &amp; post mining</i>	<i>Trigger</i>	<i>Action</i>	<i>Response</i>
<b>Aboriginal Archaeology</b>			
	<i>Negligible</i>		
	<ul style="list-style-type: none"> <li>- Change in shelter conditions not attributable to natural weathering or preservation that do not alter the heritage values of the place – mineral growth or micro-organism growth</li> <li>- Changes external to shelter that effect the sites context – ground cracking, boulder slumping, rock and/or tree falls</li> </ul>	<ul style="list-style-type: none"> <li>- Continue with monitoring program if safe to do so</li> <li>- Condition assessment and photographic record</li> <li>- Notify relevant specialists</li> <li>- Notify registered Aboriginal parties</li> </ul>	<ul style="list-style-type: none"> <li>- Continue with proposed monitoring program</li> <li>- Condition assessment recorded</li> </ul>
	<i>Minor</i>		
	<ul style="list-style-type: none"> <li>Change in shelter conditions not attributable to natural weathering or preservation – change in drip line or seepage, cracking or exfoliation of overhang or shelter, movement or opening of existing planes and joints</li> </ul>	<ul style="list-style-type: none"> <li>- Review monitoring program and modify if necessary</li> <li>- Report to key stakeholders as required</li> <li>- Condition assessment and photographic record</li> <li>- Consider development of site management plan to mitigate effects</li> <li>- Continue with monitoring program (as reviewed) if safe to do so</li> <li>- Notify relevant specialists</li> <li>- Notify registered Aboriginal parties</li> </ul>	<ul style="list-style-type: none"> <li>- Continue with proposed monitoring program</li> <li>- Condition assessment recorded</li> </ul>

<i>During &amp; post mining</i>	<i>Trigger</i>	<i>Action</i>	<i>Response</i>
<b>Aboriginal Archaeology</b>			
	<i>Severe</i>		
	Change in shelter conditions not attributable to natural weathering or preservation – cracking or exfoliation of art panel, movement of existing planes and joints at panel, block fall within shelter or overhang, shelter or overhang collapse	<ul style="list-style-type: none"> <li>- Review monitoring program and modify if necessary</li> <li>- Report to key stakeholders</li> <li>- Site visit and discussions with DRE and resource managers</li> <li>- Condition assessment and photographic record</li> <li>- Develop site management plan to mitigate effects</li> <li>- Continue with monitoring program (as reviewed) if safe to do so</li> <li>- Notify relevant specialists</li> <li>- Notify registered Aboriginal parties</li> </ul>	<ul style="list-style-type: none"> <li>- Continue with proposed monitoring program</li> <li>- Condition assessment recorded</li> </ul>

## 5.0 ABORIGINAL HERITAGE CONTINGENCY PLANS

To evaluate the potential for aboriginal cultural heritage sites to be impacted by the proposed mining predictive modelling, field survey of accessible areas and predicted impacts from the mining were modelled. However, even with extensive assessments the possibility exists that previously unknown Aboriginal sites may be identified in the Study Area during longwall mining. All Aboriginal places and objects are protected under the NPW Act. This protection extends to Aboriginal objects and places that have not been identified. As a result OEH requires an Unanticipated Discovery Plan to be developed for cultural heritage assessments.

The following contingency plans have been provided to guide appropriate management actions in the event that new Aboriginal sites are identified. Management strategies should be implemented in accordance with current conservation practice and the conservation principles contained within the Australia International Council on Monuments and Sites (ICOMOS) *Burra Charter* and industry best practice. It is recommended that Aboriginal communities who have registered an interest in consultation for the Dendrobium Area 3B ACHA are consulted regarding appropriate management methodologies.

### 5.1 Discovery of Unanticipated Aboriginal Cultural Material

The following contingency plan describes the actions that must be taken in instances where Aboriginal cultural material is discovered or unearthed:

- 1) **Discovery:** Should unanticipated Aboriginal cultural material be identified during any surface works, works must cease in the vicinity of the find.
- 2) **Notification:** OEH must be notified of the find.
- 3) **Management:** In consultation with OEH, registered Aboriginal parties and a qualified archaeologist, a subsidence impact assessment should be undertaken and management strategy developed to manage the identified Aboriginal cultural material. A subsidence monitoring program may be required for Aboriginal sites, using a methodology consistent with that outlined for Aboriginal shelters in Section 4.2.
- 4) **Recording:** The find will be recorded in accordance with the requirements of the NPW Act and OEH guidelines.

### 5.2 Discovery of Unanticipated Human Remains

The following contingency plan describes the actions that must be taken in instances where human remains or suspected human remains are discovered. Any such discovery at the activity area must follow these steps:

- 1) **Discovery:** If suspected human remains are discovered during any surface works all activity in the vicinity of the human remains must stop (to ensure minimal damage is caused to the remains), and the remains must be left in place and protected from harm or damage.

- 2) **Notification:** Once suspected human skeletal remains have been found, the Coroner's Office and the NSW Police must be notified immediately. Following this, the find must be reported to OEH and it is recommended that it is also reported to the Illawarra Local Aboriginal Land Council.
- 3) **Management:** If the human remains are of Aboriginal ancestral origin an appropriate management strategy will be developed in consultation with registered Aboriginal parties and OEH.
- 4) **Recording:** The find will be recorded in accordance with the requirements of the NPW Act and OEH guidelines.

## 5.3 Ongoing Aboriginal Stakeholder Involvement

### 5.3.1 Recording of New Sites

Should previously unknown Aboriginal archaeological cultural heritage sites be identified the registered Aboriginal parties (if not present at the site visit) will be notified. The notification will be made via letter, facsimile or e-mail.

### 5.3.2 Baseline Recording and Monitoring

For baseline recording and scheduled monitoring visits (if required) the registered Aboriginal parties should be notified in writing – either by letter, facsimile or e-mail – three weeks prior to the scheduled work commencing. Attendance and participation in site inspections will be subject to attendees satisfying standard requirements for contractors and meeting mutually agreeable terms of involvement and payment with BHPBIC. These requirements will be advised to the registered Aboriginal parties in the written notification described above. As a condition of involvement in the field survey program, registered Aboriginal parties are required to provide copies of current insurances including public liability and workers compensation prior to commencement of field surveys. In addition, all field participants will be required to comply with all BHPBIC standard occupational health and safety requirements including appropriate personal protection equipment and random drug and alcohol testing.

Individual Aboriginal stakeholder behaviour and the provision of cultural knowledge and values for the Study Area will be considered in determining those individuals to be included in future field work. Due to logistical and occupational health and safety requirements, BHPBIC must limit the number of representatives from each registered stakeholder group to one or two persons on any one day. Multiple representatives however can be rotated between different site visits over time.

### 5.3.3 Review of Consultation

The registered Aboriginal parties list will be subject to review. If registered Aboriginal parties are consistently unable to be contacted, or if they have requested no further involvement in the project, they will cease to be notified unless BHPBIC is notified by the group that they wish to recommence consultation.

Any Aboriginal groups not listed as registered stakeholders who wish to be included in ongoing consultation will be included in the notification and reporting process described above. Participation in monitoring visits by non-registered groups will be determined on a case by case basis.





## REFERENCES

Australia ICOMOS. 1999. *The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (The Burra Charter), Guidelines to the Burra Charter: Cultural Significance and Conservation Policy. Pamphlet*, Australia ICOMOS (Inc).

Biosis Research 2007. *Dendrobium Area 3 Archaeological and Cultural Heritage Assessment*. Report for BHP Billiton.

David, B., Brayer, J., McNiven, I., and A. Watchman. 2001. Why digital enhancement of rock paintings works: rescaling and saturating colours. *Antiquity* 75: 781-792.

Koettig, M.K. 1985. *Archaeological Investigation of three sites on Upper Mills Creek, near Lucas Heights, Sydney*. Unpublished report to MWDA. Report held by NSW NPWS.

Koettig, M.K. 1990. *Report on Salvage Excavations at M14, Upper Mill Creek, near Lucas Heights, Sydney*. Report to the Waste Management Authority, NSW.

McDonald, J. 1994. *Dreamtime Superhighway: An Analysis of Sydney Basin Rock Art and Prehistoric Information Exchange*. Unpublished PhD Thesis. Australian National University.

Navin Officer, 2000. *Dendrobium Coal Project: Cultural Heritage Assessment*. A Report to Olsen Environmental Consulting Pty Ltd on behalf of BHP Coal Illawarra.

Office, K. 1984. *From Tuggerah to Dharawal: variation and function within a regional art style*. Unpublished BA (Hons) Thesis ANU, Canberra.

Rich, E. 1989. *Upper Avon Access Road: Archaeological Survey for Aboriginal and Historic Sites*. Report for the Water Board.

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

Sefton, C. 1990. *Archaeological Survey of the Cordeaux River and Woronora River*. Illawarra Prehistory Group, Wollongong.

Sefton, C. 1991. *1990-1991 Archaeological Survey of the Cordeaux River*. Report by Illawarra Prehistory Group for Australian Institute of Aboriginal and Torres Strait Islander Studies.

Sefton, C. 1994. *1993-1994 Archaeological Survey of the Avon River*. Report by Illawarra Prehistory group for the Australian Institute of Aboriginal and Torres Strait Islands Studies.

Sefton, C. 1997. *1996-1997 Archaeological Survey of the Avon River*. Report by Illawarra Prehistory Group for the Australian Institute of Aboriginal and Torres Strait Islander Studies.

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

# ANNEXURES

## **ANNEX 1: ABORIGINAL SITE DESCRIPTIONS**

### Donald Castle Creek Site 1 (52-2-1562)

This art shelter site is located 150m from the western side of the swamp towards the end of a small ridgeline, 2km from fire road 6A. The sandstone overhang is 6.5m in length and faces north east (Plate 1). The art within the shelter is located on the rear wall and consists of 1 charcoal outline and infill motif of a frontal human figure and 1 charcoal indeterminate motif (Plate 2). The deposit on the floor of the shelter is cream sandy loam approximately 20 cm deep, which has been deposited from slope wash and cavernous weathering. The living area is 3 x 1 m in size and there is a level area at the front of the shelter which is also 3 x 1 m in size.



**Plate 1:** Overhang at shelter with art site 52-2-1562

**Plate 2:** Charcoal motif identified in 52-2-1562

The art is in poor condition, it is fading and there is lichen growing on the shelter surfaces. The floor deposit however is undisturbed.

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### *Statement of Significance*

This is a shelter with art. The art is located on a single panel on the rear wall and consists of a single charcoal outline and infill frontal human motif, and a single indeterminate charcoal motif. The art is in poor condition with lichen growing on the shelter surfaces. The site is an example of a common site type, with poorly preserved features: it has low rarity, representative and general value.

Significance: **LOW**

### **Browns Road Site 8 (52-2-1623)**

This shelter and artefact site is located 150 m east of fire trail 6Q about 1km from the 6A-6Q junction. The site is located 200 m from a tributary of Wongawilli Creek. The sandstone overhang measures 8 x 4.5 x 1.8 m in size and has a living area 3 x 2 m in size. The site was formed by block fall and cavernous weathering. The floor deposit is light brown loamy sand 10 cm deep deposited by slope wash and weathering. No art was recorded within the shelter but during the original survey 1 chert flake artefact was located on the drip line.

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***Statement of Significance***

This is a shelter with deposit. There was a single surface artefact recorded in the drip line at this site. The deposit is light brown coloured loamy sand. The site is a typical example of a common site type, and has no remarkable features or characteristics.

Significance: **LOW**

**Browns Road Site 11 (52-2-1626)**

This art shelter site is located on the second last western tributary to Wongawilli Creek before Donald castle Creek leaves 6A. The site is located 1.2 km north of 6A-6Q junction. The sandstone overhang measures 8 x 2 x 2 m and the living area is 1 x 3 m (Plate 3). The site was formed by block fall and cavernous weathering. The art within the shelter extends the full length of the shelter with remnants of 6 charcoal undeterminable motifs and 1 charcoal outline and infill of an eel motif (Plate 4). The floor deposit is grey loamy sand to a depth of 20 cm.



**Plate 3:** Large sandstone overhang of site 52-2-1626.

**Plate 4:** Charcoal eel motif in site 52-2-1626.

The art is in fair to poor condition and the floor deposit is undisturbed.

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***Statement of Significance***

This is a shelter with art, containing 6 indeterminate charcoal motifs and a single outline and infill charcoal eel. The art is in a fair to poor condition. The site is an example of the most common type of site and art in the study area, but it does contain a moderate number of motifs. While it has low rarity value, the well preserved eel motif provides some representative value to the site. The site has low value against the general criterion, as it has a limited number of mostly unidentifiable motifs.

Significance: **LOW**

**Browns Road Site 12 (52-2-1627)**

This site is a shelter with art, located on the second cliff line down from the top of the ridge. The site is located on the western mid slope overlooking a tributary of Wongawilli Creek. It is about 1km from 6A fire road and 400 m past the first swamp and under the top cliff line. The shelter was formed by block fall and cavernous weathering. There is more recent block fall located along the back of the shelter. The sandstone overhang measures 17 x 3.5 x 1.5 m in size (Plate 5) the living area is 1 x 1m in size and the shelter faces east.

The art within the shelter was described in a prior site recording as consisting of from left to right on the rear wall 1 eel, 6 indeterminates, 1 oval, 1 frontal female figure, all with outline and infill and 1 outline human figure. On the upper roof wall are two indeterminates with outline and infill, 1 charcoal outline frontal human male. During the current survey 2 panels were recorded each 3 x 0.5 m in size, containing a total of 10 Charcoal outline and infill motifs (Plate 6).



**Plate 5:** art shelter site 52-2-1627



**Plate 6:** charcoal motifs in site 52-2-1627

The floor of the shelter originally was recorded as having a deposit 22 cm deep that consists of cream sandy loam from the weathering of the shelter. The current survey found that the deposit was limited due to recent block fall.

The site is in good condition, the shelter is dry and the artwork is well preserved. There are wasp nests and lichen on the surfaces of the shelter as well as dust from the roadway.

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***Statement of Significance***

This site is a shelter with art. The site is a large, low roofed overhang with 2 art panels that contain 10 charcoal outline and infill motifs. The shelter is dry, and the charcoal art is generally in good condition being protected from direct sunlight. The motifs include a frontal human, a single eel, and a range of indeterminate figurative motifs and shapes. The site is a well preserved example of a common site type and common site features, affording low rarity value and moderate representative value. The site has some value against the general criterion.

Significance: **MODERATE**

**Browns Road Site 13 (52-2-1628)**

This art shelter site is located on the last creek which flows into the Wongawilli Creek before Donald Castle Creek about 2km from fire road 6A. The shelter is situated on the second bottom cliff line above a small waterfall in the creek valley. There is a swamp to the east of the shelter. The aspect is to the east north east with an excellent vista. The sandstone overhang measures 14 x 3.5 x 1.5 m and was formed by block fall (Plate 7). There is no living area. The floor is mainly a sandstone rock ledge with a 2 m drop below the site. There is a limited deposit of yellow sand. Artwork recorded in the original site card consists of 2 charcoal outline and infill indeterminates on the rear wall, 2 charcoal outline and infill kangaroos and 1 white outline and charcoal infill bird print under slabs forming the roof and towards the rear, and on another section of the roof 1 charcoal kangaroo in outline and infill and 3 indeterminates in outline and infill. These motifs were re-recorded in the current survey across two panels (Plate 8).



**Plate 7:** shelter overhang depicting minimal floor deposit, site 52-2-1628. **Plate 8:** art motif in site 52-2-1628.

The shelter has had rock fall at the back of the shelter and extreme cavernous weathering. There is evidence of water seepage at the northern end of the shelter and there is lichen, mould and white organism growth on the surface of the shelter obscuring and damaging art work.

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***Statement of Significance***

This is a shelter with art, with an excellent vista over a swamp and drainage line, giving it some aesthetic value. The art assemblage contains 9 charcoal outline and infill motifs and a single white clay outline and charcoal infill bird. The remaining charcoal motifs are all indeterminate save for a single macropod. The art is poorly preserved, due to seepage, lichen growth, mould and white organism growth and chemical weathering, The site is an example of a common site type in very poor condition, and has no remarkable features or characteristics.

Significance: **LOW**



**Upper Avon 35 (52-2-1771)**

This artefact shelter site is on the eastern side of the Native Dog Creek on a small inlet on the store water. It is about 10m above the stored water. The sandstone overhang of the site is 15 x 4.5 x 3.5 m and the living area is 4 x 1 m. The shelter was formed by block fall. The floor deposit is 30 cm deep and is yellow-grey loamy sand formed by cavernous weathering. During the original recording of the site seven artefacts were located. During the current survey nine artefacts were located, these were as follows: 1 quartzite scraper, 1 quartz core, 2 mudstone flakes, 1 quartzite flake, 1 mudstone core, 1 petrified wood flake, 1 quartz flake and red ochre. Four artefacts that were recorded in the original survey were not relocated; these are 1 fossilised wood core, 2 mudstone flakes and 1 quartz flake.

The site is in good condition, there is continued cavernous weathering of the shelter, and the deposit has been disturbed by wombats.

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***Statement of Significance***

This site is a shelter with archaeological deposit, situated just above the high water level of Lake Avon. The site had 9 artefacts recorded on the deposit surface, and the undisturbed yellow-grey loamy deposit is estimated to be about 30cm deep. The site has a relatively high number of surface artefacts, suggesting a potentially rich deposit and affording value under the general criteria. Shelters with deposit are not rare, the site has some representative value as it has one of the larger surface assemblages of stone artefacts in the area.

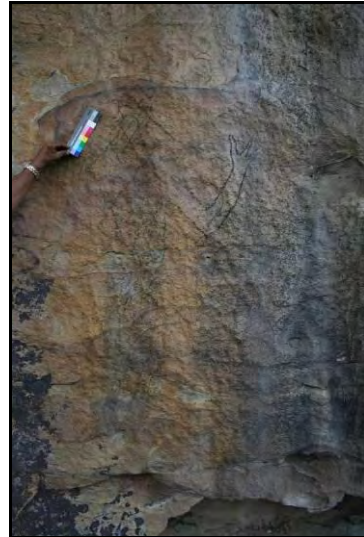
Significance: **MODERATE**

**Upper Avon 36 (52-2-1772)**

This art and artefact shelter site is a large cliff face that faces east south east on the north side of the last eastern tributary of Native Dog Creek. The sandstone overhang is 29.6 x 5.5 x 7.5 m in size with a living area 12 x 1 m in size (Plate 9). The shelter was formed by block fall and cavernous weathering. The floor deposit is medium grey brown sandy soil approximately 10 to 20 cm deep, which has been formed by weathering. The floor of the eastern part of the shelter is covered with loose rock whilst the western part of the floor has the sandy deposit. Art recorded within the shelter across two panels each 2 x 10 m includes: 1 charcoal outline and striped infill from human figure with hands up (Plate 10), 1 charcoal outline and infill kangaroo motif, 1 charcoal infill male frontal human figure with arms down, 1 charcoal outline frontal male human figure with arms up and red ochre infill and charcoal criss-cross infill, 1 charcoal outline and infill bird motif, 1 charcoal outline and infill of a human figure with hair and tools. All the faces in the motifs have eyes and due to the large surfaces the artwork is very large.



**Plate 9:** sandstone overhang of art and artefact shelter site 52-2-1772.



**Plate 10:** charcoal human motif with raised hand in site 52-2-1772.

A number of artefacts were located within the shelter these include: a broken volcanic flake, a silcrete fragment, a silcrete flake, 2 complete quartz flakes and 2 broken quartz flakes, 1 broken chert flake and 1 crystal quartz flake. During the current survey a silcrete microlith back blade and 4 quartz flakes were not relocated.

This site is in fair to poor condition, there is water seepage on the surfaces of the shelter which have left stains. The surfaces have silcreted but areas of the surface have considerable charcoal loss. Algae and lichen grow on the surfaces. The shelter is exposed to elements such as wind and rain.

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### *Statement of Significance*

This shelter site has both art and archaeological deposit. The deposit consists of 5 stone artefacts on the deposit surface, suggesting some potential for further material in the grey-brown sandy loam deposit, which is undisturbed and estimated to be 20cm deep. The art assemblage is on two panels, and contains 6 recognisable motifs including charcoal outline and infill anthropomorphic figures, charcoal outline and infill macropod and bird, charcoal outline and infill anthropomorphic figure with hair and material culture items. All motifs are large, and have eyes. The art is in poor condition with stains evidencing water seepage. Nevertheless, the relatively large assemblage of big motifs, with multiple techniques affords rarity value, and the site is generally representative of charcoal and ochre motif art for the study area and region.

Significance: **HIGH**

### **Upper Avon 37 (52-2-1773)**

This artefact shelter site is a small cavern in a section of steep continuous sandstone cliff line about 100m above the stored water on the eastern side of Native Dog Creek and about 1km west of 6A fire road. The sandstone overhang measures 4 x 3 x 1.8 m in size with a 1 x 1 m living area. The floor deposit is cream yellow sand to a depth of 5cm formed by the weathering of the shelter. In the original recording of the site 1 grey silcrete flake was identified on the drip line. During the current survey the artefact could not be re-located.

The cavern is very weathered and the deposit has been disturbed by wombat diggings.

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#### ***Statement of Significance***

This site is a shelter with archaeological deposit. The site had 1 artefact recorded on the deposit surface. The deposit is a cream coloured loam, and is disturbed by animal digging. The deposit is estimated to be no more than 5cm deep, suggesting limited potential for further or informative archaeological material, and low value under the general criteria. The site has low rarity and representative values, as it is neither rare nor has notable features.

Significance: **LOW**

### **Upper Avon 38 (52-2-1774)**

This art shelter site is located 50m above the stored water below a small waterfall on a little side creek on the eastern side of Native Dog Creek and about 1km west of 6A fire road. The sandstone overhang measures 12 x 3 x 3 m in size formed by cavernous weathering, the living area is 3 x 2 m in size. The floor deposit is yellow loamy sand 50cm deep caused by shelter weathering. Five charcoal indeterminate motifs are located on the rear wall.

The art is in poor condition and the shelter suffers from exfoliation. The floor deposit is undisturbed.

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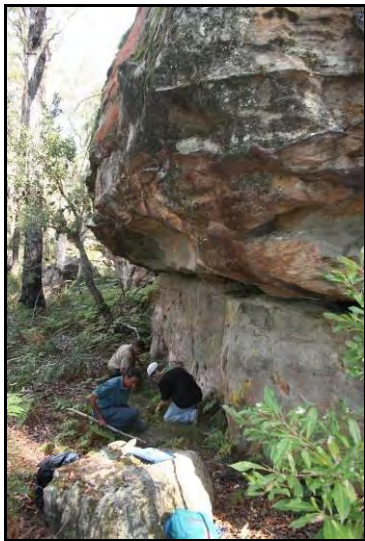
#### ***Upper Avon 38 (52-2-1774)***

This site is a shelter with art. The art consists of 5 indeterminate charcoal motifs, which are in poor condition. The art panels and shelter on the whole, are actively exfoliating. Whilst it has multiple motifs, this site and art is a poorly preserved example of the most common site and art type, with no remarkable characteristics under either the representativeness criterion, or the general criterion.

Significance: **LOW**

**Upper Avon 39 (52-2-1775)****Dendrobium 1 (52-2-2208)**

This shelter site with a deposit is located east of fire road 6A in the Cordeaux Catchment Area, between Cordeaux Dam and Avon Dam. The site comprises a long narrow and high shelter formed primarily by block fall. The shelter is situated at the north end of a cliff line which is approximately 7 m high, it is formed by laterally bedded sandstone; there is a large softer bed at the join of the roof and back wall. The roof is cracked along the bedding and at right angles to the bedding. The shelter measures 14.5 x 2.9 x 1.8 m and faces south east (Plate 11). The floor deposit is medium grey sandy deposit up to nearly 1m deep. During the original survey 3 artefacts were located at the north end of the shelter; these were 2 milky quartz flakes and 1 grey chert flat. During the current survey a total of 5 artefacts were located, 2 complete and one broken quartz flakes, one quartz split cobble and 1 broken silcrete flake (Plate 12). The site was assessed during the original survey to have moderate potential to be larger than the recorded area, to contain more artefacts and to have *in situ* archaeological material.

**Plate 11:** sandstone overhang, site 52-2-2208**Plate 12:** artefacts from site 52-2-2208

The site is in good condition, the deep floor deposit is undisturbed. The shelter is subject to continuous weathering, there is a crack in the roof and lichen and yellow micro-organisms are growing on the roof.

***Statement of Significance***

This site is a shelter with archaeological deposit. There were 5 artefacts recorded on the surface of the deposit, which is a medium grey sandy deposit, estimated to be 1m deep. The deposit is undisturbed. The site is an example of a common site type, has some representative value and moderate value under the general criterion.

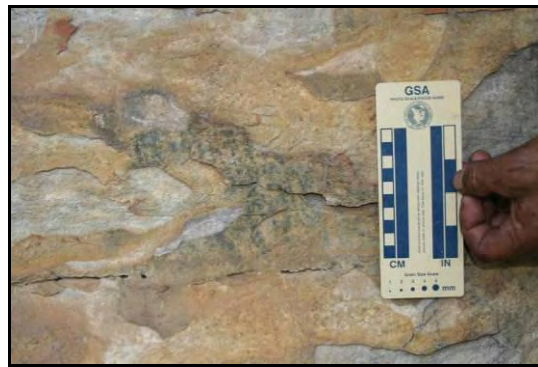
Significance: **LOW**

### **Dendrobium 2 (52-2-2209)**

This art shelter site is located on the top sandstone cliff line situated on a small ledge 2 m from the slope. From fire road 6A walk north east along the southwest spur crest to the northern point. The shelter is under the cliff line. The shelter is a long narrow and high shelter formed by rock fall, 300 m from the nearest creek (Plate 13). The shelter measures 7.5 x 1.4 x 7 m in size. There is no deposit on the floor, just exfoliated chunks of sandstone. The art located within the shelter comprises one panel 1 x 1 m in size with a charcoal infill and outline indeterminate motif (Plate 14).



**Plate 13:** Art shelter site 52-2-2209



**Plate 14:** Art with infill motif in site 52-2-2209

The art is in poor condition. There is no water seepage on the surfaces of the shelter, however the site is exposed to the elements such as wind and rain.

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### ***Statement of Significance***

This shelter with art contains a single charcoal outline and infill motif. The art is in poor condition because it is exposed to the weather. This site and the charcoal art is a poorly preserved example of the most common site and art type, with no exceptional characteristics or features that suggest representative value.

Significance: **LOW**

### **Site 1 – DB1 (52-2-2229)**

This art shelter site is a small sandstone overhang situated on the lowest sandstone outcropping cliff line adjacent and to the Wongawilli tributary and west of Wongawilli Creek. The shelter has been formed by block fall and cavernous weathering there is one horizontal bedding plane evident at the base of the roof. The shelter measures 4.5 x 2 x 1.2 m in size. The deposit is medium yellow sand to a depth of 5 and 20 cm. The floor slopes and has a number of sandstone rocks present. The

rock fall and the deposit have been formed by cavernous weathering and exfoliation. The art consists of a charcoal outline and infill indeterminate on the back roof panel.

The art is in very poor condition due to the chemical weathering of the site, particularly the roof. Approximately 95 % of the original hardened surface has eroded. The remnant art is present on approximately 10% of the remnant case hardened surface.

### **Dendrobium 6 (52-2-2246)**

This isolated artefact is located on a non-maintained bush track and consists of a tuff flake.

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#### *Statement of Significance*

This site is a single stone artefact site on a non-maintained bush track. The site has some disturbance from the vehicle track, and contains only the single artefact. There is some potential for further artefacts to be present. The site has little representational and rarity value as isolated finds can and do occur virtually anywhere and in any landscape.

Significance: **LOW**

### **Dendrobium 7 (52-2-2248)**

This art shelter site can be located from a point 50m north of the rain gauge on fire road 6A, proceed west along seismic line track a distance of approximately 900 m. The site is located approximately 80m north of the seismic line track and immediately south of an unnamed creek that flows into Avon Dam. The shelter consists of a long, narrow sandstone overhang situated on the mid to lowest cliff line outcrop (Plate 15). The shelter was formed by blockfall and weathering with one major horizontal bedding plane with minor vertical cracking. There is some minor rock fall on the shelter floor. The shelter measures 18 x 1.9 x 1.9 m in size. The floor deposit is medium yellow brown sand of a depth between 5 and 15 cm. The art within the shelter depicts 1 charcoal outline and infill indeterminate motif (Plate 16). One broken quartz flake was identified; however it was too difficult to determine if it was an actual artefact.



**Plate 15:** sandstone overhang of site 52-2-2248



**Plate 16:** charcoal motif within site 52-2-2248

The art is in poor condition, lichen and yellow mould are growing on the shelter surfaces and over

some of the art. The shelter is subject to the elements such as wind and rain.

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***Statement of Significance***

This is a shelter with art. The art consists of a single indeterminate charcoal outline and infill motif. The art is in poor condition due to lichen and mould growth on the art panel. This site is a poorly preserved example of the most common site and art type, with no remarkable characteristics.

Significance: **LOW**

**Dendrobium 8 (52-2-3088)**

This art shelter site can be located from a point 50 m north of the rain gauge on fire road 6A, proceed west along seismic line track a distance of approximately 850 m. The site is located approximately 80m north of the seismic line track and immediately south of an unnamed creek that flows into Avon Dam. The shelter was formed by block fall and cavernous weathering. The floor deposit is medium yellow sand approximately 5 to 10 cm deep. There is rock fall around the front of the shelter (Plate 17). The art within the shelter comprise one charcoal infill indeterminate motif on a panel 200 x 500 cm in size (Plate 18).



**Plate 17:** sandstone overhang of site 52-2-3088

**Plate 18:** charcoal motif within site 52-2-3088

The art is in poor condition. The shelter is exposed to the elements wind and rain and the surfaces have black and white mould, lichen and water leeching.

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***Statement of Significance***

This is a shelter with art. The art consists of a single indeterminate solid charcoal motif. The art is in poor condition due to white mould and lichen growth, water seepage and exposure to sunlight and the weather on the art panel. This site is a poorly preserved example of the most common site and art type, with no remarkable characteristics.

Significance: **LOW**

**DM16 (52-2-3640)**

This shelter with art site is situated on the mid to upper valley slopes of a ridgeline that extends east to Wongawilli Creek. The sandstone cliff line on which the overhang is situated is quite steep and only accessible to the east of the site. It is a large, sandstone overhang that has been formed by block fall and cavernous weathering. The shelter faces south, in relatively dry open woodland conditions. The site measures 12.5 x 2 x 4 m (Plate 19), with a moderate living floor area of approximately 1.5 x 10 m (Plate 20). The shelter faces an open, gradual slope, 250m north to the nearest Wongawilli tributary.



**Plate 19:** Overhang at site DM 16



**Plate 20:** View along overhang at DM 16, facing east

The shelter contains a high number of art motifs, many of which are now indistinguishable. The art is situated along the full length of the shelter, and is location on two panels that run parallel to one another. The art comprises 6 charcoal outline with red infill wombats (Plate 21), 2 charcoal outline and infill macropods, 1 white ochre hand stencil (Plate 22), 4 charcoal outline and infill bats, 6 charcoal outline and infill indeterminate, 1 charcoal outline indeterminate, 1 red ochre outline and infill indeterminate and 1 charcoal outline and red ochre infill indeterminate motifs.



**Plate 21:** One of the outline and infill wombats at site DM 16



**Plate 22:** White hand stencil in centre of shot at site DM 16

There is a large living floor, although minor block fall and accumulation of weathered sandstone create a slope within this area. Along the shelter there is probably a liveable area of 8 x 2 m. The deposit consists of undisturbed medium yellow sand between 5 and 30 cm deep. No stone artefacts were identified on the surface however.

The solid cliff line has been formed by block fall and minor weathering processes. There are no



major bedding places, although there are two vertical weathering cracks at the north eastern end. A number of horizontal small quartz pebble lenses run the full length of the shelter. Some chemical weathering processes and minor exfoliation is occurring across the roof, and upper sections of the rear wall. Some of the exfoliation is affecting some of the art.

No significant water seepage is occurring over the lip of the shelter, although some water is running down the eastern side of the shelter and washing across the floor along the rear of the outcrop. Some black micro-organism growth and leeching is evident across parts of the roof.

The overall condition of the overhang is quite good, although weathering and exfoliation are processes that will continue to affect the surface of the shelter and art.

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### *Statement of Significance*

This site is a shelter with art. The shelter contains over twenty animal and indeterminate motifs, including clearly recognisable charcoal outline wombats with bi-chrome infill. The shelter is dry and the art is in generally good condition, although some portions of the panel have been affected by water seepage, micro-organism growth, leeching and some exfoliation. The diversity of art and technique at the shelter give it some rarity value, and high representative value. This large shelter and the large art panel with a high number of motifs provide a strong aesthetic. The shelter has a yellow, fine sandy deposit, but no surface artefacts were recorded. The site has high value against the general criteria, having good research potential.

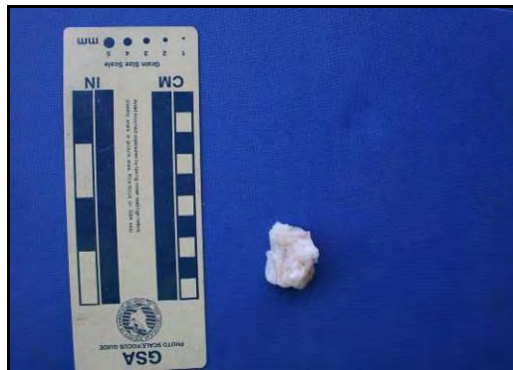
Significance: **HIGH**

### **DM17 (52-2-3640)**

This site comprises a shelter with deposit, situated on the upper sandstone cliff line of the Wongawilli Creek valley. It is a moderate overhang located along a large, continuous cliff line that has been formed by block fall and subsequent weathering, above a very steep drop-off to the nearby creek. The overhang measures 13 x 3.5 x 1.5 m (Plate 23), and has a flat open living space of approximately 9 x 2 m in size. No art was identified within the shelter.



**Plate 23:** Weathered overhang at site DM 17



**Plate 24:** Quartz core located at site DM 17

The living area deposit consisted of fine yellow grey sand, estimated to be 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 (Plate 24). No further stone material was identified. The deposit remains undisturbed and is in good condition.

The overhang has been subject to significant chemical weathering. Almost all surfaces were affected by lichen, mould, micro-organism growth and leeching. If any art is present it is not longer visible. Some water seepage occurs over the lip of the shelter, however, no seepage was evident across the rear wall of the shelter. The shelter has two horizontal bedding planes and no cracks were evident.

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### *Statement of Significance*

This site is a shelter with archaeological deposit. There was a single artefact recorded on the surface of the deposit, which is a yellow-grey fine sandy deposit, estimated to be no greater than 15cm deep. The deposit is undisturbed. The site is an example of a common site type, has some representative value and moderate value under the general criterion.

Significance: **LOW**

### **DM21 (52-2-3645)**

This site is a shelter with art and archaeological deposit. The shelter is situated on the end of a small sandstone spur, and is right next to a swamp, at the same level as the swamp (Plate 25). The shelter is cavernously weathered, and has a wide but low entrance that opens out to a large cavern. There is some seepage present on the shelter walls and roof, and the shelter is slightly damp. Green lichen and mould growth cover the majority of the shelter's inside surface (Plate 26, Plate 28). The shelter measures 9 x 3.5 x 2 m.



**Plate 25:** General view of DM21

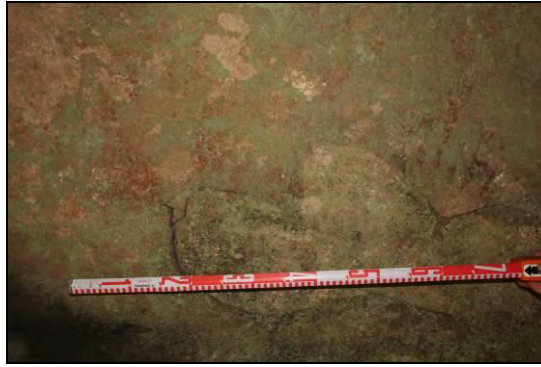


**Plate 26:** Inside view of DM21

The art at this shelter consists of at least 10 red ochre stencils, a single white clay hand print, scratching associated with one set of stencils, and indeterminate charcoal motifs that are obscured by lichen and mould (Plate 27). There were 7 flaked stone artefacts recorded on the floor of the shelter, and the site has a good archaeological deposit, estimated to be at least 20 cm deep.



**Plate 27:** Stencils, print, scratching and charcoal motifs on roof of DM21



**Plate 28:** Mould and lichen growth at DM21

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***Statement of Significance***

This shelter with art contains red ochre hand stencils in good condition; white clay prints, scratched motifs and charcoal motifs in poor condition. The range and superposition of art in the shelter is uncommon for the area, and the preservation of several styles and techniques in a single shelter gives the site high representative value, and high research potential. The site also has archaeological deposit. The location of the shelter next to a swamp, and the striking nature of the well preserved stencils give the site a strong sense of place and high aesthetic and landscape values.

Significance: **HIGH**

**DM22 (52-2-3646)**

This site is a shelter with art. The shelter has been formed by a combination of block fall and cavernous weathering, and measures 7.5 x 1.5 x 1.5 m (Plate 29). The art consists of one charcoal partial anthropomorphic figure, and one indeterminate charcoal motif (Plate 30).



**Plate 29:** General view of site DM22



**Plate 30:** Partial charcoal anthropomorphic figure at DM22

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***Statement of Significance***

This is a shelter with art. The art is located on a single panel on the rear wall and consists of a partial human motif with eyes and two indeterminate motifs. The art is all charcoal outline, and in

poor condition, with lichen and mould growing on the shelter surfaces. The site is an example of a common site type, with poorly preserved features: it has low rarity, representative and general value.

Significance: **LOW**

### **DM2 (52-2-3878)**

This shelter with deposit site is situated on the upper slopes of a significant ridgeline. The shelter has a northerly aspect. The floor was flat, with a thin mobile layer of loose sandy soil covering the surface, with dark brown humic sandy soil exposed in some places below this (Plate 31). The flat floor area measured approximately 3 m deep by 9m wide. Two artefactual pieces of stone were identified on the surface of the shelter floor. The shelter was formed by a very tall cliffline, with the roof 2 m high above the floor. No large cobbles were present in the sandstone forming the overhang. No art was visible on the shelter walls.



**Plate 31:** Cliff line overhang at site DM 2



**Plate 32:** Quartz artefacts located at DM 2

The artefacts consisted of a large broken quartz cobble with water worn cortex, and a small quartz flake also with water rolled cortex (Plate 32). No art is present at this site as it is exposed to the elements and covered in moss and other micro-organism growth. The cliff line shelter is in a stable condition.

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### ***Statement of Significance***

This site is a single stone artefact site on a non-maintained bush track. The site has some disturbance from the vehicle track, and contains only the single artefact. There is some potential for further artefacts to be present. The site has little representational and rarity value as isolated finds can and do occur virtually anywhere and in any landscape.

Significance: **LOW**