

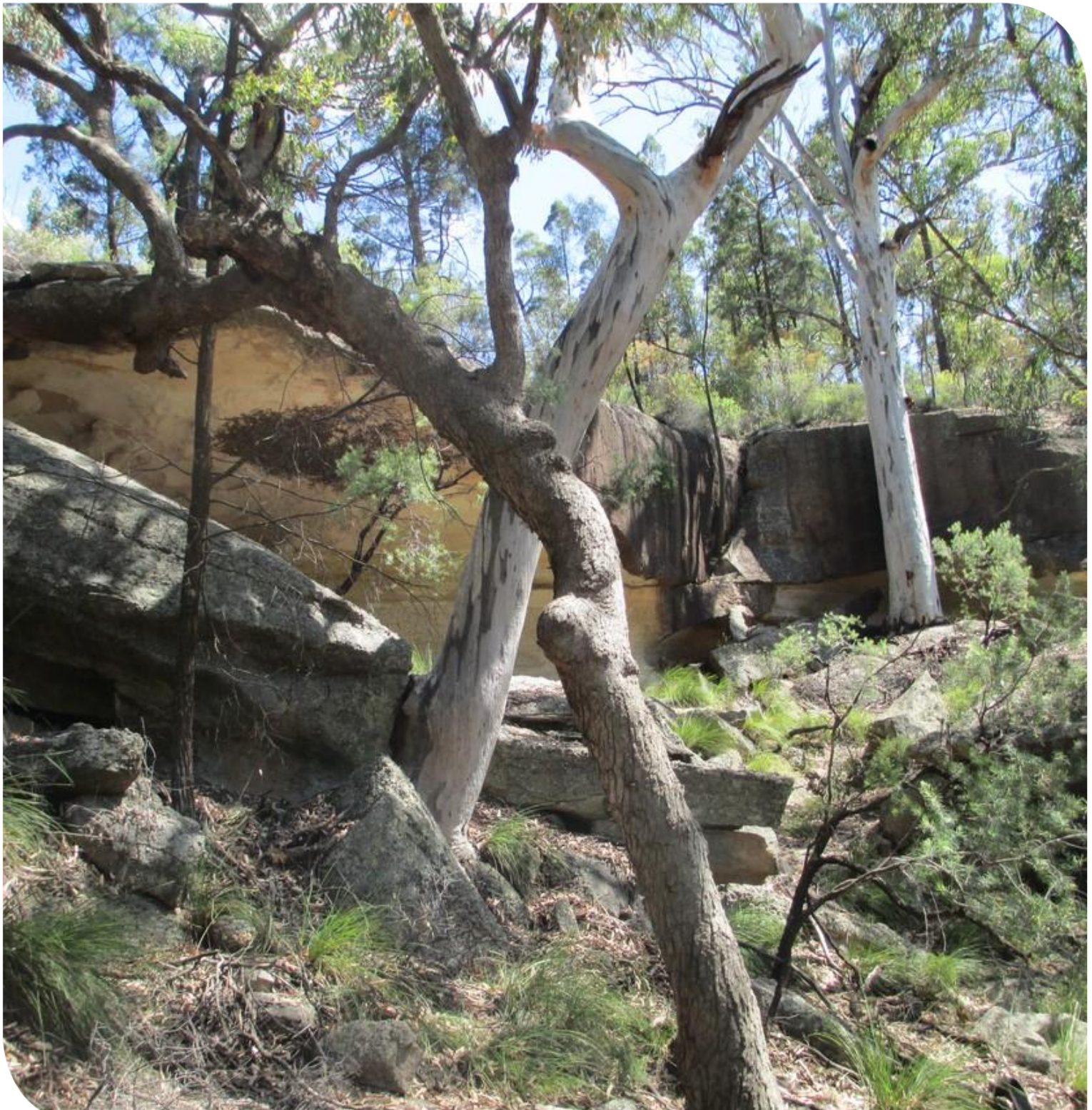
Moolarben Coal Operations

UG1 Longwalls 101 - 103

Monitoring of Aboriginal Heritage Site PAD 3

Prepared for Moolarben Coal

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1. Introduction

The Moolarben Coal Complex is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfields of New South Wales (NSW) in the Mid-Western Regional Council Local Government Area. The Underground 1 (UG1) underground mine is a component of the approved Moolarben Coal Complex (Figure 1). The UG1 Underground Mine uses longwall mining methods to extract coal from the Ulan Seam.

The approved Moolarben Coal UG1 Longwalls 101-103 Extraction Plan outlines the proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences in the UG1 mining area during the secondary extraction of Longwalls 101 to 103. The UG1 Longwalls 101-103 Extraction Plan – Heritage Management Plan (EP-HMP) is a component of the Extraction Plan and provides specific heritage objectives and measures for the management of heritage sites above the relevant panels. The monitoring measures described in the EP-HMP are consistent with the approved complex-wide Heritage Management Plan (complex-wide HMP) which outlines the management of Aboriginal and Historic Heritage across the Moolarben Coal Complex.

The EP-HMP includes subsidence predictions and a monitoring program for the Aboriginal heritage site identified as PAD 3 (AHIMS# 36-3-0839) consistent with section 5.9.1 of the complex-wide HMP.

Niche Environment and Heritage (Niche) was commissioned by Moolarben Coal Operations Pty Ltd (MCO) to conduct the post-mining monitoring of the Aboriginal cultural heritage site PAD 3 in accordance with the EP-HMP and broader complex-wide HMP.



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GDA 1994 MGA Zone 55

Niche PM: Jamie Reeves
Niche Proj. #: 5572
Client: Moolarben Coal Operations

Location of PAD3 (AHIMS# 36-3-0839)

Moolarben Coal Complex UG1 Mining Area

Figure 1

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2. Monitoring Assessment Methods

Niche completed an inspection in accordance with section 5.9.1 of the Complex Wide HMP (2017: 40) which describes the framework for monitoring of Aboriginal archaeological sites and subsidence impacts:

Monitoring will involve inspecting and recording the condition of these specific Aboriginal archaeological sites within three to six months after undermining has occurred. Each inspection will involve recording of data on environmental conditions, pre-existing human and natural impacts, heritage evidence present and any identified changes to these environmental and heritage conditions compared with previous inspections. The potential cause (subsidence or other impacts) of changes to the condition of individual sites will be assessed.

Monitoring will be focussed on the features of the site that make it significant (e.g. grooves, art, artefacts and/or PAD).

A report documenting the results of monitoring will be prepared (this report) that details the methodology of the inspections, conditions of the environment and Aboriginal heritage evidence at the relevant sites, comparisons with previously reported conditions at each site, identification of any natural and/or human impacts during the intervening period, identification of any implications for the ongoing management and protection of Aboriginal heritage evidence at the Moolarben Coal Complex, and documentation of the actual impacts of operations on the Aboriginal archaeological sites.

The following methods were used to conduct the monitoring and assessment.

Comparison of conditions pre-extraction and post-extraction at the site using:

- Photographs taken during the Longwall 101-103 Extraction Plan (Dec. 2016) (Niche 2017)
- Site records (scale plans) made during the Longwall 101-103 Extraction Plan, to identify changes in:
 - shelter shape/composition
 - context around the shelter conditions (block fall, fallen trees for example)
- Observations of conditions at the site location to document recent changes:
 - Fallen/moved/out of place sandstone blocks with fresh surfaces
 - Cracking/separation of the ground surface
 - Cracking/separation of sandstone rock surfaces
 - Evidence of differential movement of sandstone (unweathered exfoliation spalls, roof-fall fragments, movement along bedding planes or joints)
- Documentation of changes using scaled plans, photographs and notes made on-site.

With all observations of change, a consideration and determination of the potential cause (subsidence or other impacts) has been assessed.

2.1 Describing Mine Subsidence

This monitoring report uses the terminology employed by the expert panel who prepared the *Impacts of underground coal mining on natural features in the Eastern Coalfield: strategic review* (NSW Department of Planning 2008). The terminology is as follows:

Subsidence effects: describe subsidence itself – i.e. deformation of the ground mass caused by mining

Subsidence impacts: describe the physical changes to the ground and its surface caused by subsidence effects.

Environmental (heritage) consequences: *The consequences of these impacts including cliff falls, rock falls and damage to Aboriginal heritage sites. Consequences are the resultant change in heritage value of a site due to impacts.*

3. Background Information

3.1 PAD 3 description and pre-extraction condition

PAD 3 is a large rock shelter with one artefact and PAD associated with an isolated rock outcrop.

PAD 3 is immediately below the ridge top plateau, and consists of two cavernously weathered areas, separated by a brief area of vertical rock outcrop where there is no overhang. The shelter measures 28 m x 5 m x 6 m (length, depth, height), and has large block fall and a steep slope immediately out the front of the shelter. While it is a big shelter, for the most part the site has a sloping floor with small areas of flat PAD in each cavern. A single artefact (a tuff blade core) was found in the drip line of the eastern cavern, and in this location the small area of PAD was observed to be a noticeably darker colour and more consolidated than the sediment further back in the shelter. No art was present.

Archaeological assessment identified the site as having low archaeological significance. The site was approved to be impacted by the mining of UG1 with possible fracturing of sandstone and subsequent rockfalls as a result of mining.

3.2 Predicted subsidence effects and approved impacts

The UG1 Longwall 101-103 Extraction Plan Aboriginal Cultural Heritage Technical Report (Niche 2017: 21) stated:

The rock shelter sites are at risk of change from subsidence effects such as cracking or movement of rock strata, block fall or rock fall and mass movement on steep slopes. Because the rock shelter sites are all sites that contain PAD and/or artefacts, change that would be considered harm would need to be change that effects either the artefact or PAD, which would be changes like mass movement, rather than cracking or differential movement of strata.

MSEC (2017) predicted that for sites located within rock shelters or overhangs there is a potential for fracturing of sandstone and subsequent rockfalls, which could potentially affect artefact scatters, isolated finds or PAD associated with the relevant rock shelter. PAD 3 was considered to have a higher risk of impact resulting from the extraction of Longwalls 101-103, due to the structure/nature of this site.

MSEC (2017) calculated the potential subsidence impacts at each identified Aboriginal heritage site in the UG1 Longwall 101-103 area. The description of subsidence effects on PAD 3 is as summarised in Table 1.

Table 1: MSEC subsidence predictions for Aboriginal heritage sites in UG1 study area after LW103

Site	Description	Maximum Predicted Subsidence (mm)	Maximum Predicted Tilt (mm/m)	Maximum Predicted Hogging Curvature (1/km)	Maximum Predicted Sagging Curvature (1/km)
PAD 3 Moolarben Coal	Rock Shelter with Artefacts (1 artefact) and PAD	2150	1	>3	>3

4. Monitoring observations

4.1 Post-extraction monitoring

The PAD 3 site was inspected on 20 February 2020 by Jamie Reeves.

The inspection involved making observations of conditions at the site, comparing scaled plan and cross section drawings, and photographs prepared during the 20 December 2016 (pre-mining) baseline recording of the site (Niche 2017). Sketches of the observed changes were made directly onto the original plans and photographs were also taken from a safe observation distance due to potentially unstable conditions.

The following changes were observed at the site during the inspection:

- Vertical and horizontal cracking of the rock matrix.
- Detached pieces of the vertical rock outcrop and rockfall.
- Overhang collapse of the eastern cavern of the shelter.
- Bedding plane separation.
- Cracks in the rock matrix and separation of joints/bedding planes estimated to range between 1 mm and 30 mm in width.
- Cracking and deformation of the ground surface.

Evidence of the following mechanisms of change were observed:

- Mechanical fracture of the rock matrix.
- Movement/failure of rock outcrop/overhang structure along pre-existing bedding planes, joints and weathered areas.

There was no evidence of other non-mining related changes at the site. The mining related impacts were consistent with the predictions of MSEC (2017).

Plate 1 and Plate 2 present a comparison of pre-extraction and post-extraction conditions at PAD 3 from the same observation point, providing an overview of the main changes observed at the site after longwall mining. Plate 3, Plate 4, Plate 5 and Plate 6 show detail of the changes observed at PAD 3.



Observation points:

1. PAD 3 shelter ceiling (rock visible in this photo is inside of shelter) – eastern cavern
2. PAD 3 overhang – western cavern

Plate 1. PAD 3 (36-3-0839) 20 December 2016 (pre-extraction). Aspect: south.



Observation points:

1. Overhang collapse (rock visible is the former roof of the shelter)
2. Rock fall due to mechanical failure of rock matrix and movement along existing joints

Plate 2. PAD 3 (36-3-0839) 20 February 2020 (post-extraction). Aspect: south.



Observation notes:

Eastern cave of site PAD 3 with the identified single artefact located at the scale.

Plate 3. PAD 3 (36-3-0839) 20 December 2016 (pre-extraction). Aspect: east.



Observation notes:

Eastern cave of site PAD 3 showing overhang rock collapse post-extraction. The artefact location and PAD is under the large fallen block.

Example of vertical cracking of rock matrix and horizontal movement along bedding planes present at right.

Plate 4. PAD 3 (36-3-0839) 20 February 2020 (post-extraction). Aspect: east.



Observation notes:

Western cave of site PAD 3 post-extraction. A section of the overhang had partially fallen. Cracking, separation of joints and deformation/cracking of softer sandstone below the overhang are visible.

Part of the area identified as PAD is under the rock fall, a small part of the PAD surface remains visible at left.

Plate 5. PAD 3 (36-3-0839) 20 February 2020 (post-extraction). Aspect: south.



Plate 6. PAD 3 (36-3-0839) 20 February 2020 (post-extraction). Aspect: south-west. Panorama showing collapsed eastern cavern (left) and partially fallen western cavern (right).

Observation points:

1. Overhang collapse of eastern cavern. A pre-existing fissure has failed and the fallen block (that was the suspended overhang of the eastern cavern) has dropped down and collapsed forward.
2. Detachment and fall of rock from the outcrop above the western cavern.
- A. Original shape of the eastern cavern overhang can be seen in profile here

5. Comparison of pre- and post-extraction condition

PAD 3 was inspected on 20 December 2016 prior to mining of Longwalls 101-103 in the UG1 area and again on 20 February 2020 subsequent to mining.

The UG1 Longwalls 101-103 Extraction Plan noted that a significant subsidence impact on Aboriginal heritage sites was a trigger to consider salvage where safe to do so. A site is considered to be “affected by significant subsidence impacts” if it exhibits one or more of the following consequences that cannot be attributed to natural weathering or deterioration:

- overhang collapse;
- cracking of sandstone that coincides with the feature(s) of the site that make it significant; and
- rock fall that damages the feature(s) of the site that make it significant.

The assessment below uses the term subsidence impact to describe the physical changes observed, and the term consequence to describe the change in heritage value due to the subsidence impacts.

PAD 3 was previously assessed to be of low archaeological significance (Niche 2017: 20).

The site was subject to subsidence effects resulting from the extraction of LW103. The subsidence impacts at the site included mass movement consisting of overhang collapse and rock falls. The subsidence impacts have resulted in the single artefact present at PAD 3 being covered by an overhang collapse, and most of the PAD present at site PAD 3 being also covered by debris from rock fall.

The heritage consequences of the subsidence impacts are that the site PAD 3 has lost heritage value. Notwithstanding, post-extraction the assessed archaeological value of the site PAD 3 remains: low archaeological significance.

6. Management Options and Recommendations

Subsidence impacts to site PAD 3 have been documented. While there has been a diminishment of the site's heritage value, this value remains as low.

A consequence of this impact is that further investigation or possible salvage excavation of this potential archaeological deposit cannot be conducted due to the overhang collapse, rock fall and ground instability.

The AHIMS and MCO databases should be updated with the changed condition of the site.

The Extraction Plan for UG 1 has recently been updated to include Longwall 104 and Longwall 105, including an update to management measures for identified rock shelters S2MC434 and S2MC435. This includes the consideration of salvage and/or excavation prior to longwall extraction based on consultation with a suitably qualified archaeologist. All other heritage management measures remain unchanged.

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