MALABAR

MAXWELL UNDERGROUND MINE

Technical Report 5

Aboriginal Archaeological Review

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23 June 2026

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RE: Maxwell Mine Amended Woodlands Hill Seam Extraction Plan - Aboriginal Heritage Addendum Letter

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been engaged by Malabar Resources Limited (Malabar) to provide a supporting letter in relation to proposed amendments to the approved Woodlands Hill Seam Longwalls WHLW1 to WHLW4 Extraction Plan (the approved Extraction Plan).

This letter should be read as an addendum to the Aboriginal Archaeological Report (AAR) prepared by AECOM (2025), which supported the approved Extraction Plan.

2.0 Proposed Amendments

The proposed amendments relate to changes in longwall dimensions, including increases to longwall void widths, adjustments to chain pillar widths, and a minor extension to Longwall 4. The amended layout remains within the approved Development Layout and broader extent of longwall mining established under MOD2. The proposed amendments to the Extraction Plan are as follows:

- **WHLW1:** No change;
- **WHLW2:** No change to longwall geometry; decrease in tailgate chain pillar width from 30 m to 24 m;
- **WHLW3:** Increase in longwall void width from 150 m to 255 m and decrease in tailgate chain pillar width from 30 m to 28 m;
- **WHLW4:** Increase in longwall void width from 150 m to 255 m, increase in tailgate chain pillar width from 30 m to 32 m, and extension of the finishing (eastern) end by approximately 110 m, while remaining within the approved Development Layout; and
- **Longwall series extent:** Removal of WHLW15, such that the southern extent of the longwall series remains within the approved extent of longwall mining under the MOD2 layout.

AECOM has reviewed the revised longwall layout and supporting technical assessments, including the MSEC (2026) subsidence assessment, provided by Malabar to produce this supporting letter.

3.0 Assessment of Aboriginal Heritage Impacts

The AAR (AECOM 2025) assessed potential impacts to Aboriginal heritage values arising from subsidence effects associated with the extraction of Longwalls WHLW1 to WHLW4. This included consideration of subsidence, tilt, curvature, strain and horizontal shear deformation. These effects have the potential to impact Aboriginal archaeological sites and deposits through mechanisms such as vertical and horizontal displacement, ground cracking and any associated remediation works, as well as rilling and ponding. Importantly, the surface effects most relevant to Aboriginal archaeological sites and deposits are generally associated with zones of differential movement and deformation along the margins of subsidence zones, rather than the absolute magnitude of vertical subsidence alone.

An assessment of potential impacts to each Aboriginal site within the study area was provided in the AAR, with three levels of potential impact risk identified:

- **High** – physical impacts to Aboriginal sites and their associated Aboriginal objects will, or are highly likely, to occur;
- **Moderate** – Impacts to Aboriginal sites are possible but there is a degree of uncertainty as to the nature and extent of impacts; and
- **Low** –Impacts to Aboriginal sites are considered unlikely.

Based on this framework, sites within the study area were assigned an impact risk rating. Following review of the amended layout and subsistence predictions, 30 valid (i.e. not previously salvaged) sites within the Inner study area are assessed as moderate risk, 60 sites within the Outer study area are assessed as low risk, and one site (quarry site 37-2-1954) is assessed as low to moderate risk due to its location within both the Inner and Outer study areas. Relative to the original AAR assessment, seven additional sites are now located within the assessed subsidence impact area, and a small number of sites (also seven) have shifted from low to moderate risk as a result of the amended layout.

The amended subsidence predictions indicate an increase in maximum subsidence magnitudes at a number of Aboriginal archaeological sites and deposits relative to those previously predicted in the original Extraction Plan, but are consistent with those previously assessed under the approved MOD2 Layout. In general terms, sites previously predicted to experience negligible subsidence (<20 mm) in the Extraction Plan are now predicted to experience up to approximately 200–300 mm in some locations, while sites previously subject to higher subsidence (generally in the order of ~900–1000 mm) are now predicted to experience up to approximately 1000–1700 mm, depending on their position relative to the longwall panels.

However, the overall spatial pattern of subsidence and the distribution of affected sites remain generally consistent with the approved layout, with most sites located within the same subsidence influence zones as previously assessed. While the revised assessment results in seven additional sites falling within the subsidence impact area and the reclassification of seven sites from low to moderate risk, the identified impact pathways remain unchanged. Importantly, predicted deformation parameters (including tilt, curvature, hogging and sagging) vary across the amended layout, with some areas experiencing increases and others decreases relative to the approved layout. As such, the changes represent an increase in predicted subsidence magnitude rather than a change in subsidence behaviour or impact mechanism. No new impact pathways for Aboriginal archaeological sites and deposits have been identified, and the predicted subsidence conditions remain broadly consistent with those previously assessed and accepted as part of the MOD2 approval.

For quarry site SC-QS-2/Quarry (AHIMS ID #37-2-1954), predicted vertical subsidence across the site increases following the extraction of WHLW2 to WHLW4, with higher cumulative subsidence values expected across portions of the site, reaching up to approximately 1650 mm, compared to approximately 1000 mm previously assessed. Predicted tilt remains broadly consistent with previous estimates, while curvature indicates a minor increase in hogging and a corresponding decrease in sagging. Notwithstanding these changes, the site remains within the previously assessed subsidence impact envelope, and its spatial relationship to the longwall panels is unchanged.

Potential impacts to the quarry site continue to be associated with:

- Surface cracking and minor ground deformation; and
- Disturbance associated with any required surface remediation works.

Consistent with the AAR, these impacts are assessed as representing a low to moderate level of risk, noting that the extent of impacts is uncertain and that any impacts are likely to be indirect, primarily affecting the context or integrity of the site including any associated deposits rather than directly harming the artefacts themselves.

For other open artefact sites within the study area, predicted vertical subsidence varies depending on site location relative to the longwall panels, with higher values occurring in proximity to panel centres and lower values towards panel margins. Predicted deformation parameters, including tilt and curvature, also vary across the study area, with some locations experiencing increases and others decreases relative to those previously assessed. Importantly, the subsidence-related processes most relevant to Aboriginal archaeological sites and deposits, including ground cracking, erosion and any associated remediation works, are generally associated with zones of differential movement and deformation along the margins of subsidence zones, rather than the magnitude of vertical subsidence alone. As with the quarry site, these impacts are assessed as representing low to moderate levels of risk, consistent with the conclusions of the AAR.

4.0 Monitoring and Management Measures

The AAR established a framework for the monitoring and management of Aboriginal heritage values within the study area, which has been incorporated into the approved Heritage Management Plan (HMP) for the Maxwell Mine.

The amended subsidence assessment (MSEC 2026) indicates that, while predicted subsidence magnitudes increase in some areas and deformation parameters such as tilt and curvature vary across the study area, the mechanisms of impact and associated risk pathways remain unchanged. Accordingly, the existing monitoring and management measures are considered to remain appropriate.

Monitoring of Aboriginal sites and implementation of management and mitigation measures will continue to be undertaken in accordance with the approved AAR and HMP, including subsidence monitoring, archaeological inspection, and, where required, salvage in consultation with Registered Aboriginal Parties.

The amended subsidence assessment does not identify any new circumstances that would warrant revision of the approved management framework, including the management approach adopted for sites containing PAD.

Given that the amended subsidence assessment does not identify any new impact pathways or site-specific circumstances requiring additional management, the existing management framework remains appropriate. No additional or revised Aboriginal heritage management measures are required as a result of the proposed amendments to the Extraction Plan. The measures presented in Table 5 of the AAR, and an updated version included as Appendix A of this addendum, remain appropriate.

5.0 Conclusion

The amended Subsidence Assessment indicates that predicted subsidence magnitudes increase in some areas as a result of the revised longwall geometries. Notwithstanding this, the amended layout remains within the approved MOD2 mining envelope, and the mechanisms of impact and associated risks for Aboriginal heritage remain unchanged.

Accordingly, while predicted subsidence magnitudes increase in some areas and seven additional archaeological sites fall within the assessed subsidence impact area, no new impact pathways have been identified that would warrant revision of the approved management framework. The findings and recommendations of the AAR remain applicable..

Yours faithfully

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AECOM

Appendix A - Predicted impacts and management measures

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
1	37-2-0004	Mas 12;Mount Arthur South;	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Surface collection completed. Salvage excavation to be completed
2	37-2-0006	Mas 11;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
3	37-2-0042	Upper Saddler's Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
4	37-2-0053	MAS 15;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
5	37-2-0069	Saddler's Creek;	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
6	37-2-0070	Saddler's Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
7	37-2-0073	Saddler's Creek;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
8	37-2-0076	Saddler's Creek;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
9	37-2-0077	Saddler's Creek;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
10	37-2-0082	Saddlers Creek;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
11	37-2-0283	Saddlers Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
12	37-2-0289	MAS 14;Mt Arthur South;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
13	37-2-0362	Mas 16;Mount Arthur South;Collection	Artefact scatter + PAD	Low	Outer study area	Nil	Surface collection completed. No management
14	37-2-0363	MAS 17;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
15	37-2-0364	MAS 18;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
16	37-2-0365	MAS 19;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
17	37-2-0366	MAS 20;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
18	37-2-0383	MAS 37;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
19	37-2-0384	MAS 38;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
20	37-2-0396	MAS 52;Mt Arthur South;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
21	37-2-0397	MAS 53;Mt Arthur South;	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
22	37-2-0410	MAS 66;Mt Arthur South;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
23	37-2-0411	MAS 67;Mt Arthur South;	Artefact scatter + PAD	Moderate	Outer study area	Low	Monitoring. If impacted, surface collection and potential salvage excavation
24	37-2-0412	MAS 68;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
25	37-2-0417	MAS 73;Mt Arthur South;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
26	37-2-0421	MAS 5;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
27	37-2-0422	MAS 6;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
28	37-2-0423	MAS 7;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
29	37-2-0424	MAS 8;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
30	37-2-0425	MAS 39;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
31	37-2-0427	MAS 76;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
32	37-2-0428	MAS 77;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
33	37-2-0429	MAS 78;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
34	37-2-0430	MAS 4;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
35	37-2-0431	MAS 3;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
36	37-2-0432	MAS 2;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
37	37-2-0491	MAS 9;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
38	37-2-0493	MAS1;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
39	37-2-0499	MAS 10;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
40	37-2-0505	Mas 13;Mount Arthur South Collected	Artefact scatter + PAD	Moderate	Outer study area	Low	Surface collection completed. Salvage excavation required
41	37-2-1936	SC-OS-19	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Monitoring. If impacted, surface collection and potential salvage excavation
42	37-2-1946	SC-OS-29	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
43	37-2-1954	SC-QS-2 Quarry	Stone quarry	High	Outer/inner study area	Low/moderate	Monitoring. If impacted surface collection and potential salvage excavation
44	37-2-1986	SC-OS-20	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Monitoring. If impacted, surface collection and potential salvage excavation
45	37-2-4239	DS AS16 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
46	37-2-4240	DS AS17 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
47	37-2-4241	DS AS18 11	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
48	37-2-4242	DS AS19 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
49	37-2-4243	DS AS20 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
50	37-2-4245	DS AS22 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
51	37-2-4246	DS AS23 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
52	37-2-4247	DS AS24 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
53	37-2-4248	DS AS25 11	Artefact scatter	Low	Inner study area	Low	Surface collection required if impacted by subsidence or soil remediation
54	37-2-4249	DS AS26 11	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
55	37-2-4250	DS AS27 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
56	37-2-4251	DS AS27 11A	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
57	37-2-4275	DS AS51 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
58	37-2-4276	DS AS52 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
59	37-2-4277	DS AS53 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
60	37-2-4278	DS AS54 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
61	37-2-4279	DS AS55 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
62	37-2-4280	DS AS56 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
63	37-2-4281	DS AS57 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
64	37-2-4282	DS AS58 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
65	37-2-4283	DS AS59 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
66	37-2-4284	DS AS60 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
67	37-2-4285	DS AS61 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
68	37-2-4286	DS AS62 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
69	37-2-4287	DS AS63 11	Artefact scatter + PAD	Low	Inner study area	Low	Surface collection required if impacted by subsidence or soil remediation
70	37-2-4288	DS AS64 11	Artefact scatter	Low	Inner study area	Low	Surface collection required if impacted by subsidence or soil remediation
71	37-2-4289	DS AS65 11	Open artefact site	n/a	Outer study area	Low	Outside approved mining boundary
72	37-2-4290	DS AS66 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
73	37-2-4291	DS AS67 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
74	37-2-4292	DS AS68 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
75	37-2-4293	DS AS69 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
76	37-2-4294	DS AS70 11	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
77	37-2-4296	DS AS72 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
78	37-2-4297	DS AS73 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
79	37-2-4299	DS AS75 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
80	37-2-4301	DS AS77 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
81	37-2-4328	DS IF3 11 Collected	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
82	37-2-4329	DS IF4 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
83	37-2-4333	DS IF8 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
84	37-2-4334	DS IF9 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
85	37-2-4335	DS IF10 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
86	37-2-4351	DS IF26 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
87	37-2-4352	DS IF27 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
88	37-2-4353	DS IF28 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
89	37-2-4354	DS IF29 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
90	37-2-4355	DS IF30 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
91	37-2-4356	DS IF31 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
92	37-2-4357	DS IF32 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
93	37-2-4358	DS IF33 11	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
94	37-2-4428	DSD - IA7 - 12	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
95	37-2-4432	DS-AS27-11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
96	37-2-5840	MP-AS1-18 Collected	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
97	37-2-5848	MP-IA2-18 Collected	Artefact scatter	Low	Outer study area	NIl	Surface collection completed. No management

Prepared for
Malabar Resources Limited
ABN: 73 093 876 307

Maxwell Underground Mine Extraction Plan Woodlands Hill Longwalls 1-4

Aboriginal Archaeological Report

11-Feb-2025

Art by
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Delivering a better world

Maxwell Underground Mine Extraction Plan Woodlands Hill Longwalls 1-4

Aboriginal Archaeological Report

Client: Malabar Resources Limited

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11-Feb-2025

Job No.: 60576801

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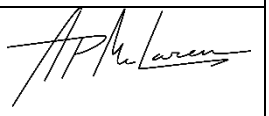
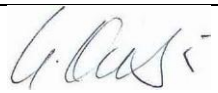
Quality Information

Document	Maxwell Underground Mine Extraction Plan Woodlands Hill Longwalls 1-4
Ref	60576801
	I:\secure\projects\605x\60576801\6. draft docs\6.1 reports\30.0 woodlands hill extraction plan\60576801_fnlrpt_woodlands aar extraction plan_2025_02_11.docx
Date	11-Feb-2025
Originator	Geordie Oakes
Checker/s	Andrew McLaren
Verifier/s	Darran Jordan

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
A	10/08/2024	Draft	Andrew McLaren/Principal Aboriginal Heritage Specialist	
B	12/02/2025	Final	Geordie Oakes /Principal Aboriginal Heritage Specialist	

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1.0 Introduction & background

1.1 Introduction

Maxwell Underground Mine (the Maxwell Mine) is an approved underground coal mining operation located in the Upper Valley of New South Wales (NSW), east-southeast of Denman and south-southwest of Muswellbrook (Figure 1). The Maxwell Mine is owned by Maxwell Ventures (Management) Pty Ltd, a wholly owned subsidiary of Malabar Resources Limited (Malabar). Malabar has approval to extract bord and pillar panels in the Whynot Seam and extract longwalls in the Woodlands Hill, Arrowfield and Bowfield Seams.

Malabar submitted an Environmental Impact Statement (EIS) for the Maxwell Underground Mine Project in July 2019 (State Significant Development [SSD] 9526).

Development Consent (SSD 9526) for the Maxwell Mine was granted by the Independent Planning Commission on 22 December 2020. The Maxwell Mine was subsequently approved under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* on 10 March 2021 (EPBC 2018/8287).

Malabar previously sought to modify Development Consent SSD 9526 under section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* for a minor extension to the mine entry area (Modification 1). Modification 1 was subsequently approved on 19 November 2021 and EPBC 2018/8287 was varied on 14 December 2021.

The development consent was further modified (Modification 2) on 19 October 2022 to allow for the following:

- Re-orientation of the longwall panels in the Woodlands Hill, Arrowfield and Bowfield Seams resulting in a minor increase in the approved underground mining extent;
- Reduction in the width of some of the longwall panels in the Woodlands Hill Seam;
- Repositioning of the upcast ventilation shaft site and associated infrastructure; and
- Other minor works and ancillary infrastructure components (e.g., access road and ancillary water management infrastructure for the repositioned ventilation shaft site).

The indicative layout of the panels in the Whynot Seam and the re-orientated panels in the Woodlands Hill Seam (from the approved Modification 2) is referred to as the MOD2 Layout in this report.

Malabar previously submitted an Extraction Plan for the first four bord and pillar panels in the Whynot Seam, referred to as Panels 2 to 5. AECOM Australia Pty Ltd (AECOM) prepared an Aboriginal Archaeological Report (AAR) to support the Whynot Seam Panels 2 to 5 Extraction Plan.

Malabar is now preparing an Extraction Plan for Longwalls 1 to 4 in the Woodland Hill Seam, referred to as WHLW1 to WHLW4. AECOM has been commissioned by Malabar to complete an AAR to support the Woodlands Hill Seam Extraction Plan.

It is understood that Malabar is required to prepare an Extraction Plan as part of Condition C8 (Part C) of their Development Consent for the Project. An extraction plan is used to manage subsidence associated with underground coal mining activities and must include updated predictions of impacts to Aboriginal cultural heritage incorporating any relevant information obtained since the Development Consent, with the results to be included in a broader Heritage Management Plan (HMP).

This AAR documents the results of AECOM's assessment of potential subsidence related impacts to known and potential Aboriginal heritage values from mining of WHLW1 to WHLW4 (the 'study area'), and has been compiled with reference to the *Extraction Plan Guideline* (NSW Department of Planning and Environment [DPE], 2022), the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water, 2010) and

Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (NSW Office of Environment & Heritage, 2011).

1.2 Maxwell Underground Mine Overview

The Maxwell Mine is located in the Upper Hunter Valley of NSW, within the Muswellbrook Shire Local Government Area (LGA). The Maxwell Mine is approved to extract a maximum of 8 million tonnes of run-of-mine coal per year over a period of 26 years.

The mine consists of the following areas:

- **Underground area**: comprising the proposed area of underground mining operations and the mine entry area to support underground mining and coal handling activities and provide for personnel and materials access;
- **Maxwell infrastructure (formerly Drayton mine)**: comprising previous open cut mining areas, existing coal handling and preparation plant (CHPP), train load-out facilities and rail loop, Antiene rail spur and other infrastructure and services; and
- **Transport and services corridor**: running between the underground area and Maxwell Infrastructure and including the proposed site access road, covered overland conveyor, power supply and other ancillary infrastructure and services.

The area within and surrounding the Maxwell Mine, which has previously been known as Mt Arthur South, Saddlers Creek and Drayton South, has long been identified as having a significant in-situ coal resource. Prospecting for coal commenced in the late 1940s, with exploration intensifying during the 1960s and 1970s. Open cut coal extraction and mining activities commenced at Maxwell Infrastructure in 1983 and ceased in October 2016. The previous open cut mining area is currently in the rehabilitation phase of the mine operations.

1.3 Subsidence assessment

This AAR and its associated impact assessment section utilises the results of the *Subsidence Predictions and Impact Assessments for Panels 1 to 4 in the Woodlands Hill Seam* (Subsidence Assessment) (MSEC, 2024) which predicts the effects from subsidence on the study area. The report was prepared specifically to support the Extraction Plan. The goals of the subsidence assessment were to:

- update the predicted subsidence effects for Panels 1 to 4 in the Woodlands Hill Seam based on the Extraction Plan;
- compare the maximum predicted subsidence effects and impacts with the maximum predicted values provided in the EIS and MOD2 Subsidence Assessments;
- update the predicted subsidence effects for each of the natural (including Aboriginal heritage) and built features due to the mining of Panels 1 to 4 in the Woodlands Hill Seam;
- review and, if required, update the impact assessments for each of these natural and built features; and
- provide recommendations for strategies to manage the potential impacts resulting from mining.

The findings of the assessment are provided in Section 3.0 of this AAR.

1.4 Report objectives

The overarching objectives of this AAR are as follows:

- to identify the Aboriginal cultural heritage values of the study area;
- to review potential impacts to these values as a result of proposed underground mining activities incorporating any relevant information obtained since the Development Consent;
- to provide an appropriate management strategy for avoiding or minimising potential harm to identified values (i.e., to inform updates to the existing approved HMP); and

- to prepare an AAR to support Malabar's Extraction Plan for the study area.

1.5 Study area

The study area for this assessment, delineated in Figure 2, has been defined on the basis of a Subsidence Assessment by MSEC (2024) and comprises land potentially susceptible to ground surface impacts as a result of the mining Panels 1 to 4 in the Woodlands Hill Seam. Based on potential effects from mining, the study area can be separated into two areas, as follows:

1. The "inner study area", approximately 185 hectares (ha) in size, which is based on the 26.5 degree angle of draw and considered the extent for conventional ground movements (i.e., vertical subsidence and its associated effects); and
2. The "outer study area", approximately 604 ha in size, which is based on a 600 metre (m) radius boundary drawn around Panels 1 to 4 in the Woodlands Hill Seam and represents the extent for far-field or valley-related effects (i.e., upsidence, closure, compressive strains etc.).

Collectively, these two areas are referred to as the "study area" in this assessment.

Land within the study area has been historically used for grazing, both sheep and cattle, and is currently utilised for cattle grazing and underground mine related activities on its northeastern boundary.

1.6 Aboriginal Cultural Heritage Management Plan

Aboriginal sites situated within the Maxwell Mine are currently managed under a HMP which was approved by the Department of Planning Housing and Infrastructure (DPHI) on 12 August 2024.This document outlines existing requirements for managing Aboriginal sites within the approved mining area. As part of the extraction plan, this document will be updated to include any management requirements specified in this AAR.

Figure 1 Regional context

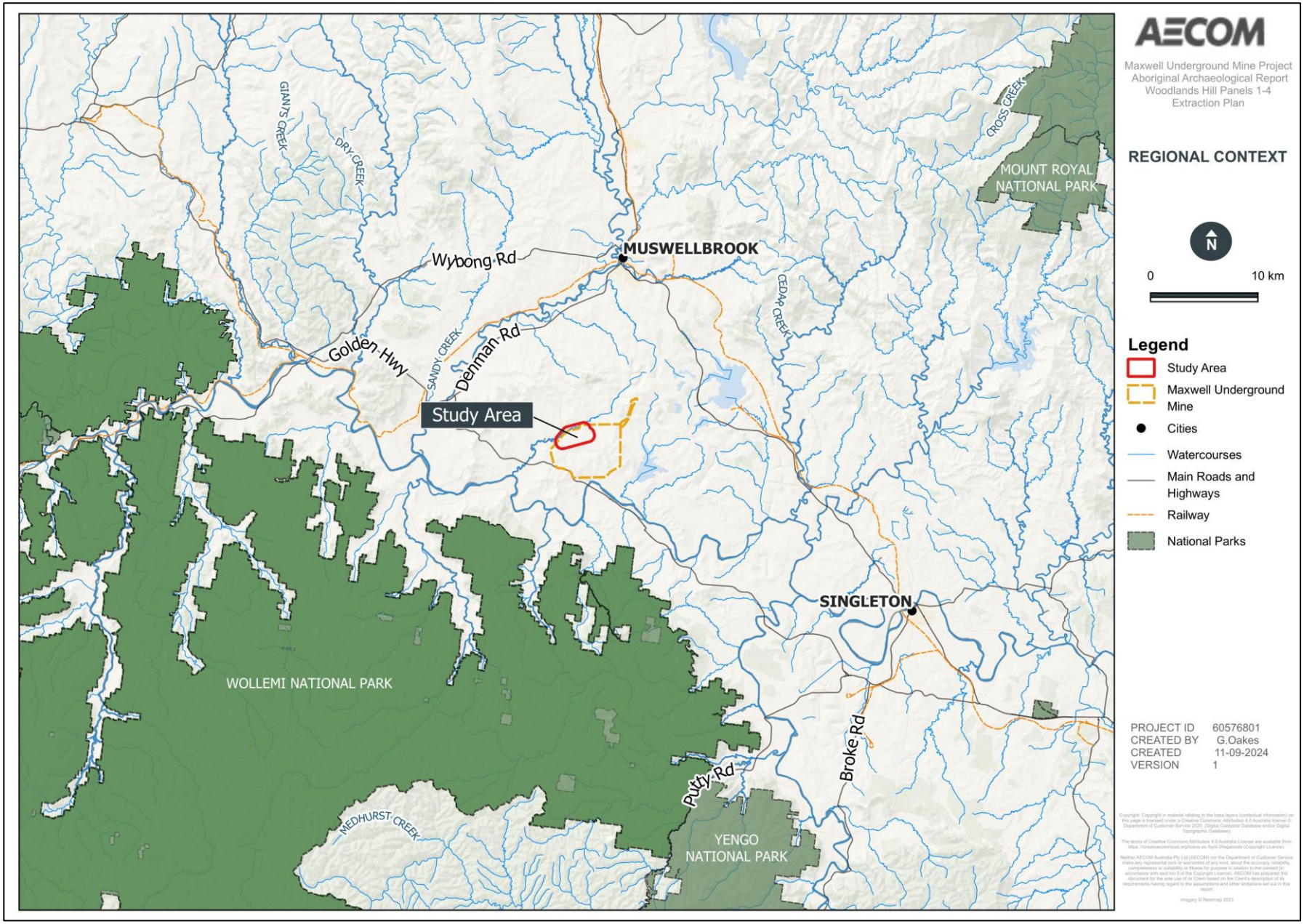
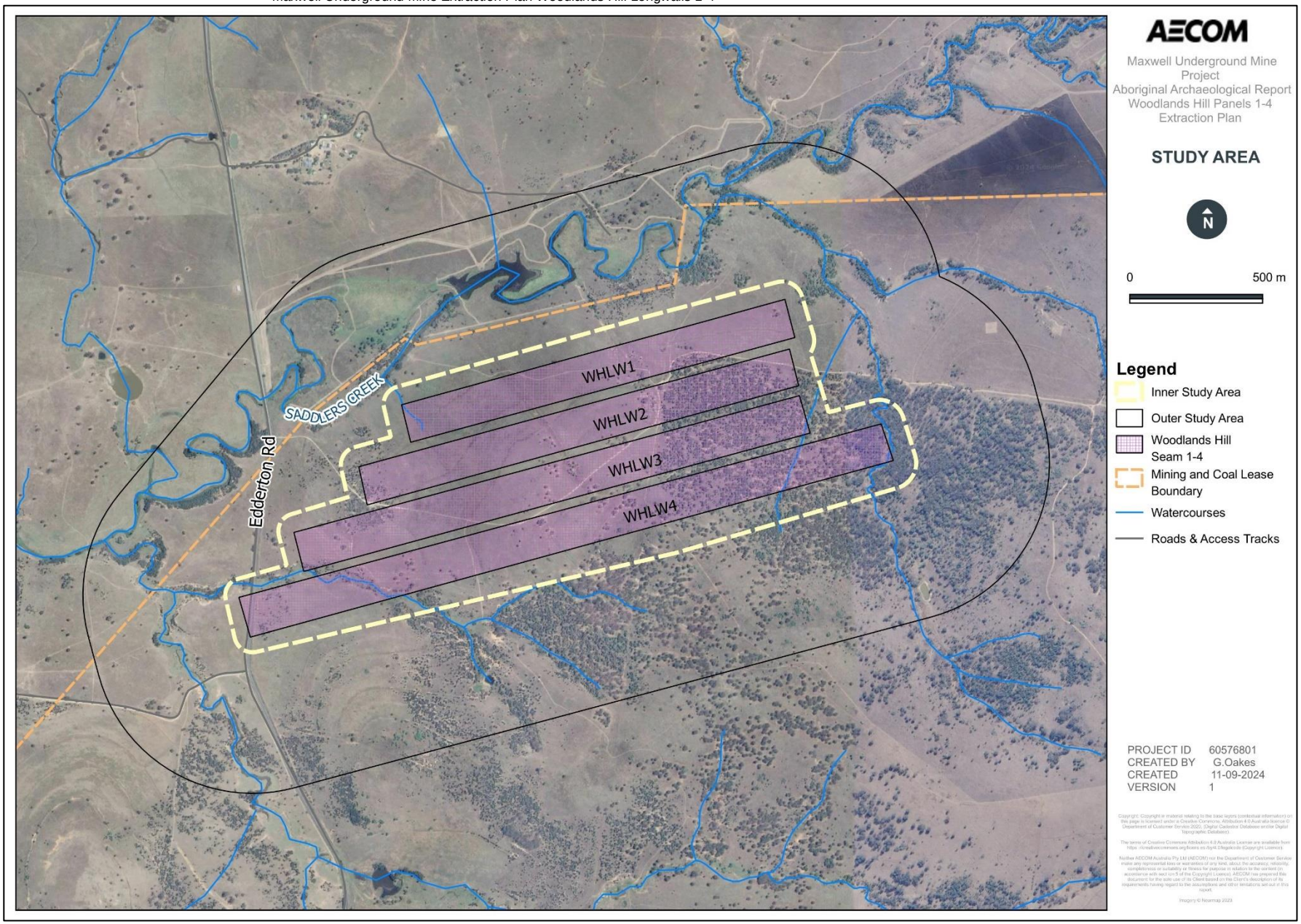


Figure 2 Study area


AECOM
Maxwell Underground Mine Project
Aboriginal Archaeological Report
Woodlands Hill Panels 1-4
Extraction Plan
STUDY AREA
N
0
500 m
WHLW1
WHLW2
WHLW3
WHLW4
SADDLERS CREEK
Edderton Rd
Legend
Inner Study Area
Outer Study Area
Woodlands Hill Seam 1-4
Mining and Coal Lease Boundary
Watercourses
Roads & Access Tracks
PROJECT ID 60576801
CREATED BY G.Oakes
CREATED 11-09-2024
VERSION 1

2.0 Archaeological context

2.1 Previous investigations within and surrounding the study area

A number of Aboriginal archaeological investigations have been completed within and surrounding the study area, primarily surveys but also some limited excavation works. Investigations of particular interpretive value due to their scope and/or findings include surveys undertaken by Kamminga (1978), Dyall (1980), Mills (2000), HLA Envirosciences (2002), Archaeological Risk Assessment Services (ARAS) (2006) and AECOM (2012; 2019). Three test excavation programs have been completed nearby to the study area (but not within it), including one by Koettig and Hughes (1985), one by ARAS (2010), and recent excavations by AECOM (2024) near Saddlers Creek just north of the study area. Summaries of these assessments are provided below.

Kamminga (1978) undertook a targeted survey of land within the Drayton Coal Lease as part of the preparation of the EIS for the coal mine, encompassing land northeast of the study area. No Aboriginal sites were identified during the survey. Kamminga (1978) suggested that the absence of sites during the survey was due to environmental factors, making the argument that most Aboriginal sites in the Upper Hunter Valley have previously been identified along the lower reaches of tributary streams, often below the 150 m contour but with particular focus on the Hunter River alluvial plain. Above this altitude, Kamminga (1978) suggests that streamflow becomes intermittent, and the range of available food resources becomes restricted. Despite this, he notes that transitory movement and settlement at these higher elevations could have occurred. Saddlers Creek, above about 230 metres Australian Height Datum, was ‘carefully’ surveyed with no Aboriginal objects identified, nor any raw material suitable for stone tool manufacture noted.

Dyall (1980) completed an archaeological survey for an extension to the original Drayton Coal Mine lease. During the survey, Dyall (1980) surveyed the headwaters of Saddlers Creek, northeast of the study area, where he recorded three Aboriginal sites (Site 1, Site 2 and Site 3), one of which he noted as of moderate side. Dyall collected the artefacts from all three sites and lodged them with the Australian Museum. Site 1 included four artefacts eroding out of both banks of the creek. These included two scrapers and two ‘blades’ with one of the blades backed. Site 2, the largest site, included 409 artefacts comprising a hammerstone, backed blades, scrapers, cores and waste flakes located along a 200 m stretch of the creekline. Site 3 included two flaked artefacts located on a tributary of Saddlers Creek. Raw materials included chert, rhyolite, quartz, jasper and a variety of siliceous material. Dyall (1980) suggest that the raw material was likely obtained from cobble beds in the Hunter River.

Koettig and Hughes (1985) undertook an archaeological survey of three separate development areas in the Hunter Valley. The areas included the Plashett Dams site/water storage area on Saltwater Creek, a proposed coal mine development at Mount Arthur North and a proposed coal mine development at Mount Arthur South. Initial surveys were completed by Dyall (1980, 1982), with follow up surveys completed by Koettig and Hughes (1985). Within the Plashett Reservoir area, east of the study area, a total of 86 open campsites consisting of stone artefacts scatters were recorded. The sites were concentrated along creeklines, especially Saltwater Creek, with artefacts recorded on bare, eroded exposures. Six of these sites (SC2, 8, 24, 44, 52 and 80) were subsequently excavated.

Survey of the Mount Arthur North area, north of the study area, resulted in the identification of 93 open artefact site, all consisting of stone artefact scatters. A programme of excavation and surface collection was carried out. The survey focused on areas adjacent to Whites Creek. Koettig and Hughes (1985) noted that sites tended to correspond in area to the surface exposures in which they were identified. Very few sites were recorded on hill slopes, ridges or along the upper portions of some creeklines where there were large areas of eroded ground. Within the Mount Arthur South area, which forms part of the study area, a total of 136 archaeological sites were located and recorded with quite a number of these located within the study area. Identified sites comprised open artefact sites and one site consisting of grinding grooves. The survey focused on areas adjacent to Saddlers Creek with artefact scatters mostly identified eroding out of the A soil horizons. The general pattern of site distribution was one of higher numbers of sites along major creeklines, i.e., Saddlers Creek, with numbers decreasing along tributaries. Indurated mudstone/tuff and silcrete were the most frequently recorded raw material. On the basis of proposed impacts, and the significance of associated impacted sites Koettig and Hughes undertook surface collection of sites MAS21, MAS39, MAS12, MAS24, MAS44, MAS46, MAS47, and MAS48, all located on Saddlers Creek. In addition, they completed excavations at MAS21, MAS39, and MAS24. However, very little information is provided about these excavations.

Mills (2000) undertook an archaeological survey to identify Aboriginal sites and areas of potential archaeological sensitivity within the proposed mine and haul road areas for the Saddlers Creek Mine, which encompassed the study area. The focus of the survey was Saddlers Creek; however, a number of its tributaries were also surveyed. Forty Aboriginal sites were identified, including seven isolated artefacts, 29 artefact scatters (nine with Potential Archaeological Deposit [PAD]), two quarry sites, and two scarred trees. The majority of artefact scatters and isolated finds were identified along ephemeral feeder creeks of Saddlers Creek. Mills (2000) found that evidence of Aboriginal activity was associated with the full length of these creeklines from their headwaters to the floodplain. In addition, at least two sites were identified on ridges and. eight sites were identified at least 200 m from creeklines. A total of 238 artefacts were recorded, including 127 (53%) flakes, 41 (17%) block fracture fragments, 28 (12%) cores, 19 (8%) flake fragments, 7 (3%) scrapers, 5 (2%) manuports, 4 (2%) hammerstones, 3 (1%) backed blades, 1 sharpening stone, 1 millstone, 1 anvil and 1 pebble axe. Indurated mudstone/tuff was the dominant material (48%), followed by silcrete (32%), quartzite (5%), chert (5%), quartz (3%), porcellanite (2%), siltstone (2%), sandstone (1%), basalt (1%), fossilised wood (0.5%), and glass (0.5%). Quarry site SC-QS-1 is described by Mills (2000:44) as a procurement site extending across an area of 150 m x 30 m and includes boulders and cobbles of mudstone, silcrete, chert and fossilised wood, associated with a high energy proto or palaeo-Hunter River. Quarry site SC-QS-2 is described by Mills (2000: 45) as extending across an area of around 500 m² and includes thousands of silcrete, chert, mudstone, and quartzite boulders. Evidence of use of the quarry is demonstrated by the presence of large numbers of cores and flakes, both primary and secondary.

HLA Envirosciences (2002) completed an archaeological survey for the Drayton Mine Extension, to the northeast of the study area. A total of 14 open artefact sites, containing a combined total of 171 artefacts, were recorded during survey and designated as DR1 through DR14. Indurated mudstone/tuff was the dominant material (51%), followed by silcrete (39%), quartz (5%) and porcellanite (5%). Artefacts comprised flakes (49%), flaked pieces (41%), cores (9%), and backed blades (1%). In general, most of the sites were assessed as of low significance due to their size, contents and condition. DR-3, DR6, DR7 and DR8 were assessed as being of higher significance, with DR-3, in particular, containing over 100 artefacts in association with an area subsurface potential. Sites were located along creeklines, ridgelines or crests. On this basis, authors argue that despite being located on relatively high terrain (i.e., 170 m- 320 m above sea level) these areas were highly utilised by Aboriginal people in contrast to previous occupation models for the Hunter Valley.

ARAS (2006) undertook an assessment for the Drayton Mine Extension, northeast of the study area. A total of 480 stone artefacts were recorded across the 39 open artefact sites that were identified during survey. A large proportion of the sites contained fewer than 10 artefacts, though five sites had over 50 artefacts and were associated with drainage lines or gullies. Of the 480 artefacts identified, 38% were complete flakes, 31% broken flakes, 26% flaked pieces and 5% cores. A majority of artefacts were of indurated mudstone/tuff (55%), followed by silcrete (25%), porcellanite (14%) and quartz (4.6%).

ARAS (2010) undertook a program of archaeological salvage program for 26 Aboriginal sites impacted by the Drayton Mine Extension. The salvage included surface collection of artefacts at 22 open artefact sites, mechanical grader scrapes at 11 locations and hand excavation at three locations. A total of 8,505 artefacts were recovered as part of the works. Of these, 7,500 artefacts were recovered from three distinct knapping locations at Ramrod Creek, identifying the creek and adjoining landform elements as archaeologically sensitive. OSL (optically stimulated luminescence) dating of deposits at Ramrod Creek and Delpah returned dates of 3-1.4 ka, placing them in the Late Holocene (3000-0 cal BP, after Hiscock, 2008). Raw materials utilised included porcellanite, silcrete, tuff and chert. At Ramrod Creek, porcellanite was the dominant raw material, while at Delpah, silcrete and tuff were co-dominant. ARAS (2010) proposed that two main site types, reflecting two differing site functions, were present within the area: fringe sites representing short-term occupation, and sites principally focused on the manufacture of backed artefacts. On the basis of site size (i.e., number of artefacts) and the ratio of discarded tools to waste material, ARAS (2010) proposed that sites adjacent to ridgelines and overlooking ephemeral water systems were the result of 'short term settlement'. Conversely, ARAS (2010) found that sites associated with Ramrod Creek were specific to stone tool manufacturing activities, with particular emphasis on producing Bondi points from porcellanite.

In 2012, AECOM completed an archaeological survey of the Drayton South Coal Project area, which included all of the study area. A total of 4,519 surface artefacts were identified during the survey, with these organised into 205 discrete sites for management purposes, including both the existing AHIMS sites and newly recorded sites. Sites comprised 143 artefact scatters, eight of which have associated areas of PAD, 59 isolated artefact sites and three stone quarries. The assessment found that the majority of artefacts (76.3%) were located within 250 m of watercourses. High significance was attributed to four sites, based on their rarity and research potential. Moderate significance was attributed to 18 sites and low significance to 183 sites. Complete flakes dominated the combined artefact assemblage, accounting for 50.2% by count, followed by broken flakes (18.9%) and flake shatter fragments (25.2%). Silicified tuff was the dominant raw material for the flake debitage component of the assemblage. Formed objects included 77 cores, 20 miscellaneous retouched flakes, 13 backed artefacts, six scrapers and nine bifacially-flaked, but non-ground, hatchet blanks. Two hammerstones, both exhibiting clear pitting, were also recorded.

In 2019, AECOM prepared the Maxwell Project ACHA. The surface development areas for the Project partially overlapped with the survey area completed for the Drayton South Coal Project in 2012 so only the areas not previously surveyed were investigated (this did not include the study area). During the survey, a total of 47 new Aboriginal archaeological sites, consisting exclusively of open artefact sites, were identified. Across these, a combined total of 545 stone surface artefacts were recorded. In addition, a Cultural Values Report (CVR) was prepared. For the CVR, Registered Aboriginal Parties (RAPs) indicated that the Project area sits within a broader cultural landscape that has cultural significance for Aboriginal people. Forming part of this cultural landscape were important landscape features such as Mount Arthur, the Hunter River and Saddlers Creek. Following approval of the Project, in July 2021 AECOM completed a surface collection of 39 Aboriginal sites to be impacted by the Project that formed a condition of the Project Approval.

The development consent was modified on 19 November 2021 (MOD1) to allow for the repositioning of infrastructure primarily at the MEA and realignment of a section of the site access road. Following approval of the MOD1 in December 2021 AECOM completed a surface collection of two Aboriginal sites to be impacted by the Project that formed a condition of the Project Approval.

The development consent was further modified (MOD2) on 19 October 2022 to allow for reorientation of the longwall panels as well as some other minor changes. In early 2023, AECOM completed an archaeological salvage for MOD2 of the Maxwell Underground Mine Project. As part of the salvage works, three small open artefact scatters sites were collected, and a program of archaeological salvage excavation was completed in an area of archaeological sensitivity associated with a 2nd order tributary of Saddlers Creek. A total 64 1 m² test pits were excavated within the area of sensitivity, sampling part of a level to very gently inclined creek flat, as well as a small section of associated slope within the area. A total of 213 lithic items were recovered during the test excavation program with the highest density recovered, 16 artefacts/m², from TP60 located roughly 45 m from the 3rd order tributary and approximately 330 m from Saddlers Creek's channel. The assemblage was dominated by flake debitage items, which account for 83.6% (n = 178) of the assemblage by count.

Flake debitage items include flake shatter (n = 58), complete flakes (n = 50), proximal flakes (n = 23), split flakes (n = 8), PDR flakes (n = 5), PDL flakes (n = 3), and redirecting flakes (n = 3). Non-flake debitage items included 28 angular shatter fragments (13.1%). Formed objects include five cores, three retouched flakes, two backed artefacts, and one scraper. The remainder of the assemblage included 23 heat shatter fragments. The investigation concluded that, relative to landform elements to the west, bordering Saddlers Creek itself, the area investigated was not intensely occupied. Other landscape features along Saddlers Creek and its tributaries, including confluences and terraces, it was suggested may have been more amenable to sustained and/or more intensive occupation, comprising what Shiner (2008), following Schlanger (1992), has described as 'persistent places'. Such landforms were assessed as retaining greater future research potential.

2.2 AHIMS Sites

The AHIMS database, administered by the Heritage NSW, contains records of all Aboriginal objects reported to the Secretary of the Department of Premier and Cabinet in accordance with section 89A of the NSW *National Parks and Wildlife Act 1974*. It also contains information about Aboriginal places that have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

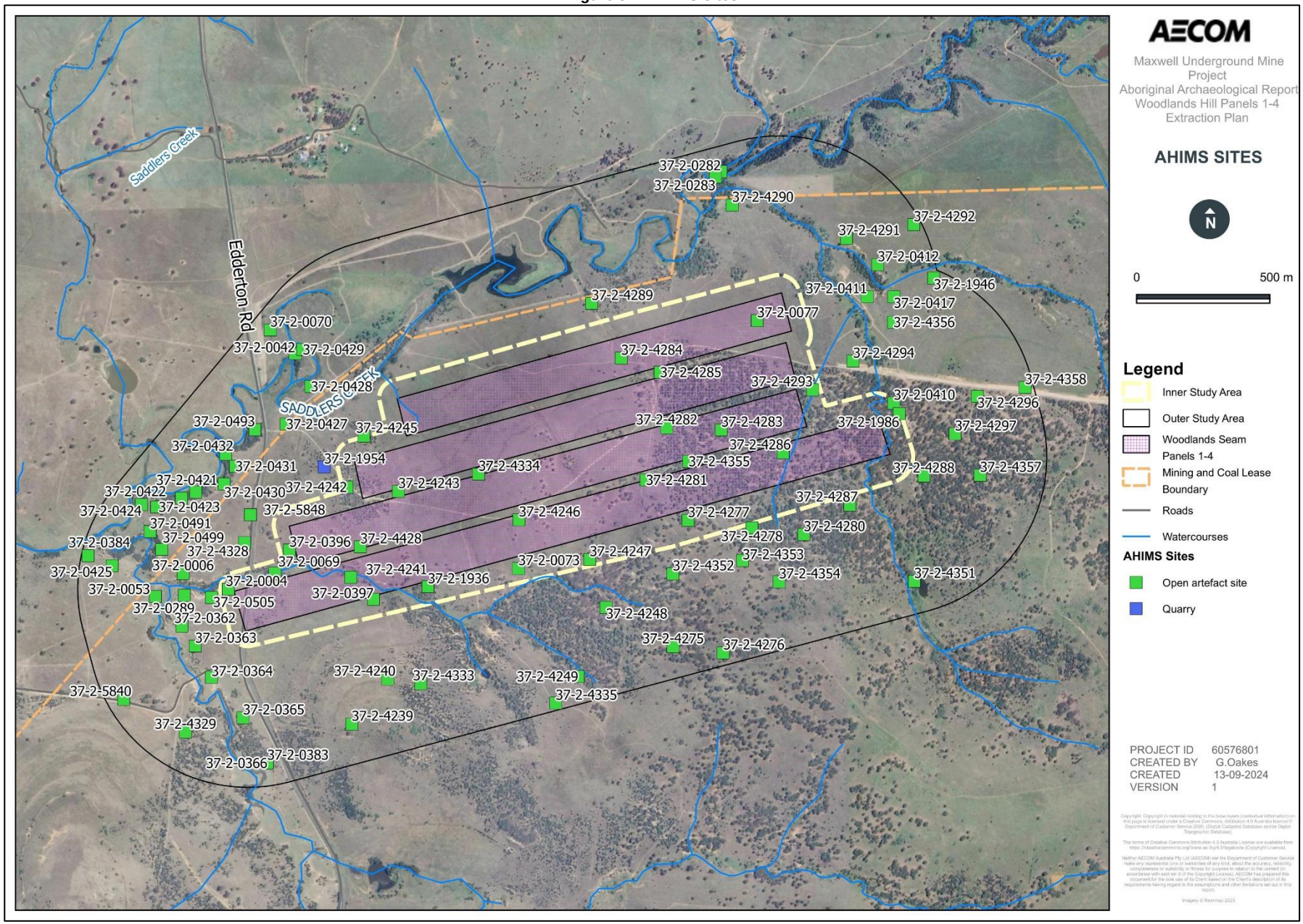
A search of the AHIMS database was undertaken on 11 September 2024 for land within the study area. Consideration of the location of previously recorded Aboriginal sites indicates that 90 are located within the outer study area, with 25 of these located fully or partially within the inner study area. Registered sites consist of 89 open artefact sites and one recorded stone quarry. Of these, 85 are listed as 'Valid' sites, three as destroyed and two as partially destroyed. The five sites either destroyed or partially destroyed include artefact sites within the study area that have been subject to surface collection (37-2-4328, 37-2-5840, 37-2-5848, 37-2-0505 and 37-2-0362) (Table 1).

Accounting for the above, a total of 87 valid Aboriginal sites, consisting of 86 open artefact sites and one stone quarry are recognised as being located within the study area. A list of these site is provided in Table 5. It is noted that in most instances site boundaries are not provided for sites recorded by Koettig and Hughes (1984) or those recorded by Mills (2000). In these instances, only centroid coordinates are available.

Table 1 AHIMS search results

Site Type	Count	%
Open artefact site (i.e., isolated artefacts and artefact scatters)	89	98.9
Stone quarry	1	1.1
Total	**90**	**100**

Figure 3 AHIMS sites



3.0 Subsidence impact assessment

As noted in Section 1.3, a Subsidence Assessment was completed for Panels 1 to 4 in the Woodlands Hill Seam by MSEC (2024) for inclusion in the Extraction Plan. The purpose of the assessment was to predict the effects of subsidence on the study area. As noted in Section 1.5, two study areas were considered as part of the assessment, including:

3. The “inner study area”, approximately 185 hectares (ha) in size, which is based on the 26.5 degree angle of draw and considered the minimum extent for conventional ground movements (i.e., vertical subsidence and its associated effects); and
4. The “outer study area”, approximately 604 ha in size, which is based on a 600 m radius boundary drawn around Panels 1 to 4 in the Woodlands Hill Seam and represents the minimum extent for far-field or valley-related effects (i.e., upsidence, closure, compressive strains etc.).

3.1 Overview of subsidence effects

As per the subsidence assessment (MSEC, 2024) completed for Panels 1 to 4 in the Woodlands Hill Seam, conventional or systematic subsidence movements expected from underground mining include the following:

- Subsidence – including both vertical and horizontal displacements;
- Tilt – change in slope to the ground;
- Curvature - rate of change of tilt;
- Strain - differential horizontal movements of the ground; and
- Horizontal shear deformation - described by various parameters including horizontal tilt, horizontal curvature, mid-ordinate deviation, angular distortion and shear index.

Alongside these, far-field movements can be an effect of subsidence, where survey marks, which are placed beyond the extracted panels over unmined coal areas are observed to move toward the mining area, often accompanied by very low-levels of strains. These types of movements generally do not result in impacts on natural or built features.

Vally-related effects are also a potential consequence of subsidence, with these effects often including upsidence, closure, as well as compressive and tensile strains that may occur in the outer study area. These can result in valley bulging movements, inward movement of valley walls, raised valley wall lips and faults. Valley-related effects caused by mine subsidence of Panels 1 to 4 in the Woodlands Hill Seam are not expected to be significant when compared conventional subsidence movements due to the proximity of Aboriginal heritage sites in relation to nearby valleys.

3.2 Predicted subsidence impacts and environmental consequences

Table 2 provides the maximum predicted conventional subsidence effects resulting from the extraction (i.e. first and second workings) of Panels 1 to 4 in the Woodlands Hill Seam, taken from the MSEC (2024) assessment for parts of the inner study area. The predicted tilts are the maximum values considered likely after extraction of each panel. The predicted curvatures are the maximum values at any time during or after the extraction of each of the panels. As shown, the maximum anticipated vertical subsidence for the study area is 1100 millimetres (mm), primarily concentrated above Panels 1 to 4 within the inner study area, with all panels anticipated to experience at least 1000 mm.

The maximum anticipated conventional strains resulting from the extraction of Panels 1 to 4 in the Woodlands Hill Seam, derived by applying a factor of 10 to the maximum predicted curvatures, are 7 mm/m tensile and 12 mm/m compressive (MSEC, 2024). These maximum strains occur where the depths of cover are shallowest in the western part of the mining area.

The effects of far-field horizontal movements on natural and built features near the panels and longwalls are not anticipated to be significant (MSEC, 2024).

Table 2 Maximum predicted incremental conventional subsidence effects for Panels 1 to 4 in the Woodlands Hill Seam (MSEC, 2024)

Panels	Maximum predicted incremental vertical subsidence (mm)	Maximum predicted incremental tilt (mm/m)	Maximum predicted incremental hogging curvature (km^{-1})	Maximum predicted incremental sagging curvature (km^{-1})
WHLW1	1050	25	0.5	1.1
WHLW2	1100	20	0.6	1.2
WHLW3	1000	20	0.5	1.1
WHLW4	1000	25	0.5	1.0

The extraction of panels can induce various ground deformations at the surface, including cracking, heaving, buckling, humping, and stepping. The severity and extent of these deformations are contingent upon factors such as mine geometry, depth of cover, overburden geology, natural joints in the bedrock, and the presence of near-surface geological structures. The range of surface cracking above Panels 1 to 4 in the Woodlands Hill Seam has been estimated based on the observations from the NSW coalfields for similar mining geometries and at similar depths of cover. The crack widths are estimated to be typically between 25 mm and 50 mm in approximately 50% of cases, between 50 mm and 100 mm in approximately 30 % of cases, between 100 mm and 150 mm in approximately 15 % of cases and greater than 150 mm in approximately 5 % of cases. Multiple cracks resulting in deformations of several hundred millimetres could also occur in some locations (i.e., less than 1 % of cases) (MSEC, 2024).

Surface compression heaving and stepping may also occur above Panels 1 to 4 in the Woodlands Hill Seam, with deformation heights generally expected to be less than 100 mm (MSEC, 2024). However, in some areas, vertical shear could exceed 300 mm in height (MSEC, 2024). In addition, sills may partially extend across the corners of the longwalls, leading to localized and irregular movements where the cover depth is shallowest. It is anticipated that localized surface cracking and stepping caused by these sills will generally be less than 50 mm in areas with the shallowest cover (MSEC, 2024).

Tables 3 and 4, provide the predicted maximum vertical subsidence predicted for quarry site SC-QS-2/Quarry (37-2-1954), and open artefact sites within the study area. For quarry site SC-QS-2/Quarry (37-2-1954), the predicted vertical subsidence in areas known to contain higher concentrations of surface artefacts will generally be <20 mm. Higher subsidence levels are predicted for the remaining portions of the site. However, it is noted that potential impacts to any Aboriginal objects present within these areas will be actively managed through monitoring. For open artefact sites maximum vertical subsidence varies between <20 mm to 1000 mm depending on the location of the site. The maximum predicted total conventional tilt is between 0.5 mm to 19 mm. These elevated tilts are predominantly observed around and within the perimeters of the panels, particularly in regions with greater depths of cover. The maximum predicted conventional curvatures are 0.45 km^{-1} for hogging and 1.0 km^{-1} for sagging.

Table 3 Maximum predicted total vertical subsidence, tilt and curvature effects for SC-QS-2/Quarry (MSEC, 2024)

Site	Panels	Maximum predicted incremental vertical subsidence (mm)	Maximum predicted incremental tilt (mm/m)	Maximum predicted incremental hogging curvature (km-1)	Maximum predicted incremental sagging curvature (km-1)
37-2-1954	WHLW1	< 20	< 0.5	< 0.01	< 0.01
	WHLW2	< 20 to 425	< 0.5 to 17	< 0.01 to 0.45	< 0.01 to 0.04
	WHLW3	< 20 to 500	< 0.5 to 17	< 0.01 to 0.45	< 0.01 to 0.04
	WHLW4	< 20 to 500	< 0.5 to 17	< 0.01 to 0.45	< 0.01 to 0.04

Table 4 Maximum predicted total vertical subsidence tilt and curvature effects for open artefact sites (MSEC, 2024)

Sites	Panels	Maximum predicted incremental vertical subsidence (mm)	Maximum predicted incremental tilt (mm/m)	Maximum predicted incremental hogging curvature (km-1)	Maximum predicted incremental sagging curvature (km-1)
Open artefact sites	WHLW1	950	18	0.30	0.95
	WHLW2	975	18	0.40	0.95
	WHLW3	975	19	0.45	0.95
	WHLW4	1000	19	0.55	1.0

3.3 Impacts to Aboriginal sites

The above-cited effects from subsidence have the potential to impact Aboriginal sites within the study area through the following mechanisms:

- Vertical displacement. Where vertical displacement of soils occurs, this has the potential to disturb or move Aboriginal objects/sites. Moreover, where remediation is required, there is a high potential for harm to Aboriginal objects/sites.
- Cracking and crack remediation (horizontal displacement). Where surface cracking occurs, Aboriginal objects/sites and any associated archaeological deposits may be disturbed or moved. Moreover, where remediation is required, there is a high potential for harm to Aboriginal objects/sites.
- Rilling. Changes in slope can cause or accelerate erosion patterns with the potential to disturb or move Aboriginal objects/sites.
- Ponding. Scouring and ponding around watercourses has the potential to disturb or move Aboriginal objects/sites.

Overall, the MSEC (2024) subsidence assessment finds that the predicted subsidence values based on the Extraction Plan Layout are largely the same as the predicted valued based on the MOD2 layout.

An assessment of potential impacts to Aboriginal sites located within the study area is provided in Table 5 with three levels of potential impact risk recognised, including:

- **High** – physical impacts to Aboriginal sites and their associated Aboriginal objects will, or are highly likely, to occur;
- **Moderate** – Impacts to Aboriginal sites are possible but there is a degree of uncertainty as to the nature and extent of impacts; and
- **Low** –Impacts to Aboriginal sites are considered unlikely.

As noted in Section 2, a total of 90 Aboriginal sites, consisting of 89 open artefact sites and one stone quarry are recognised as being located within the study area. Table 5 lists the known Aboriginal sites within the study area with an impact assessment completed for each site. Management measures included in Table 5 reflect those proposed within the existing HMP for the Project.

Table 5 Predicted impacts and management measures

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
1	37-2-0004	Mas 12;Mount Arthur South;	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Surface collection completed. Salvage excavation to be completed
2	37-2-0006	Mas 11;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
3	37-2-0042	Upper Saddler's Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
4	37-2-0053	MAS 15;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
5	37-2-0069	Saddler's Creek;	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
6	37-2-0070	Saddler's Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
7	37-2-0073	Saddler's Creek;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
8	37-2-0077	Saddler's Creek;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
9	37-2-0082	Saddlers Creek;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
10	37-2-0283	Saddlers Creek;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
11	37-2-0289	MAS 14;Mt Arthur South;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
12	37-2-0362	Mas 16;Mount Arthur South;Collection	Artefact scatter + PAD	Low	Outer study area	Nil	Surface collection completed. No management
13	37-2-0363	MAS 17;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
14	37-2-0364	MAS 18;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
15	37-2-0365	MAS 19;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
16	37-2-0366	MAS 20;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
17	37-2-0383	MAS 37;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
18	37-2-0384	MAS 38;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
19	37-2-0396	MAS 52;Mt Arthur South;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
20	37-2-0397	MAS 53;Mt Arthur South;	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
21	37-2-0410	MAS 66;Mt Arthur South;	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
22	37-2-0411	MAS 67;Mt Arthur South;	Artefact scatter + PAD	Moderate	Outer study area	Low	Monitoring. If impacted, surface collection and potential salvage excavation
23	37-2-0412	MAS 68;Mt Arthur South;	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
24	37-2-0417	MAS 73;Mt Arthur South;	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
25	37-2-0421	MAS 5;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
26	37-2-0422	MAS 6;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
27	37-2-0423	MAS 7;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
28	37-2-0424	MAS 8;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
29	37-2-0425	MAS 39;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
30	37-2-0427	MAS 76;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
31	37-2-0428	MAS 77;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
32	37-2-0429	MAS 78;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
33	37-2-0430	MAS 4;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
34	37-2-0431	MAS 3;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
35	37-2-0432	MAS 2;Mt Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
36	37-2-0491	MAS 9;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
37	37-2-0493	MAS1;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
38	37-2-0499	MAS 10;Mount Arthur South;	Artefact scatter	n/a	Outer study area	Low	Outside approved mining boundary
39	37-2-0505	Mas 13;Mount Arthur South Collected	Artefact scatter + PAD	Moderate	Outer study area	Nil	Surface collection completed. Salvage excavation required
40	37-2-1936	SC-OS-19	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Monitoring. If impacted, surface collection and potential salvage excavation
41	37-2-1946	SC-OS-29	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
42	37-2-1954	SC-QS-2 Quarry	Stone quarry	High	Outer/inner study area	Low/moderate	Monitoring. If impacted surface collection and potential salvage excavation
43	37-2-1986	SC-OS-20	Artefact scatter + PAD	Moderate	Inner study area	Moderate	Monitoring. If impacted, surface collection and potential salvage excavation
44	37-2-4239	DS AS16 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
45	37-2-4240	DS AS17 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
46	37-2-4241	DS AS18 11	Artefact scatter + PAD	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
47	37-2-4242	DS AS19 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
48	37-2-4243	DS AS20 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
49	37-2-4245	DS AS22 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
50	37-2-4246	DS AS23 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
51	37-2-4247	DS AS24 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
52	37-2-4248	DS AS25 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
53	37-2-4249	DS AS26 11	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
54	37-2-4275	DS AS51 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
55	37-2-4276	DS AS52 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
56	37-2-4277	DS AS53 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
57	37-2-4278	DS AS54 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
58	37-2-4280	DS AS56 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
59	37-2-4281	DS AS57 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
60	37-2-4282	DS AS58 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
61	37-2-4283	DS AS59 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
62	37-2-4284	DS AS60 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
63	37-2-4285	DS AS61 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
64	37-2-4286	DS AS62 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
65	37-2-4287	DS AS63 11	Artefact scatter + PAD	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
66	37-2-4288	DS AS64 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
67	37-2-4289	DS AS65 11	Open artefact site	n/a	Outer study area	Low	Outside approved mining boundary
68	37-2-4290	DS AS66 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
69	37-2-4291	DS AS67 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
70	37-2-4292	DS AS68 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
71	37-2-4293	DS AS69 11	Artefact scatter	Low	Inner study area	Low	Surface collection required if impacted by subsidence or soil remediation
72	37-2-4294	DS AS70 11	Artefact scatter	Low	Outer study area	Nil	Surface collection completed
73	37-2-4296	DS AS72 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
74	37-2-4297	DS AS73 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
75	37-2-4328	DS IF3 11 Collected	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
76	37-2-4329	DS IF4 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
77	37-2-4333	DS IF8 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
78	37-2-4334	DS IF9 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
79	37-2-4335	DS IF10 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
80	37-2-4351	DS IF26 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
81	37-2-4352	DS IF27 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
82	37-2-4353	DS IF28 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
83	37-2-4354	DS IF29 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
84	37-2-4355	DS IF30 11	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
85	37-2-4356	DS IF31 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
86	37-2-4357	DS IF32 11	Artefact scatter	Low	Outer study area	Low	Surface collection required if impacted by subsidence or soil remediation
87	37-2-4358	DS IF33 11	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management
88	37-2-4428	DSD - IA7 - 12	Artefact scatter	Low	Inner study area	Moderate	Surface collection required if impacted by subsidence or soil remediation
89	37-2-5840	MP-AS1-18 Collected	Artefact scatter	Low	Outer study area	Nil	Surface collection completed. No management

	Site ID	Site name	Site type	Scientific significance	Location	Impact risk assessment	Management
90	37-2-5848	MP-IA2-18 Collected	Artefact scatter	Low	Outer study area	NII	Surface collection completed. No management

4.0 Management requirements

The following management recommendations are made regarding the identified Aboriginal objects/sites located within the study area identified for the extraction plan, with recommendations made on the basis of:

- identified Aboriginal heritage sites within the study area;
- the results of the archaeological investigations described in Section 2.0; and
- the impact assessment detailed in Section 3.0.

These management requirements are currently included in the approved HMP.

4.1 Subsidence monitoring

As required by the existing HMP for the Maxwell Mine, monitoring will be conducted during and after secondary workings to measure subsidence impacts against predictions. Monitoring will also be conducted to determine whether any Aboriginal objects or sites at high or moderate impact risk have been or are likely to be affected above the underground mining area (see Table 5). A summary of the monitoring results will be provided in the Annual Review.

Monitoring during secondary workings will consist of the following:

- Monthly visual inspections of potentially affected Aboriginal objects/sites when the longwall face is approaching within 100 m and continuing until at least 200 m past that point.
- Records of the nature, location and extent of all subsidence-related surface impacts and a photo of any detected damage.

Monitoring post-secondary workings will consist of the following:

- Visual inspections of archaeological objects/sites with high or moderate risk of impact once the longwall face has retreated at least 500 m past that point.
- Records of the nature, location and extent of all subsidence-related surface impacts and a photo of any detected damage.

4.2 Management and mitigation

Where subsidence-related impacts are identified within proximity of an existing Aboriginal object/site, or where remediation works are required to address subsidence impacts, the following will be undertaken:

- An inspection will be undertaken by a qualified archaeologist and RAP to determine the nature and extent of impacts, and whether mitigation (which may include further monitoring, surface collection or open area salvage excavation) is required.
- If subsidence monitoring identifies cracking, erosion or any other subsidence related effects that would damage an Aboriginal object/site, the object/site will be salvaged in accordance with procedures outlined within the HMP.
- If an object/site will be impacted by surface remediation activities, it will be salvaged in accordance with procedures outlined within the HMP.
- Aboriginal Site Impact Record (ASIR) cards should be prepared and submitted to the AHIMS database for all impacted/salvaged sites.

The above management requirements are made for potential subsistence-related impacts to Aboriginal sites located within the study area. These reflect those included in the consolidated HMP for the project, alongside broader management requirements for Aboriginal sites. The consolidated HMP for the project is also attached to the Woodland Hill Panels 1 to 4 Extraction Plan.

5.0 Reference cited

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