MOOLARBEN COAL PROJECT

APPENDIX I2

Aboriginal Cultural Heritage Assessment

MOOLARBEN COAL PROJECT

ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT

A report to
Moolarben Coal Mines Pty Limited

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ARCHAEOLOGICAL RISK ASSESSMENT SERVICES
MOOLARBEN COAL PROJECT

CONTENTS PAGE

APPENDICIES

LIST OF FIGURES

LIST OF TABLES

2 Executive Summary

Archaeological Risk Assessment Services Pty Ltd (ARAS) was engaged to undertake an assessment of the Aboriginal heritage values of the proposed Moolarben Coal Project (MCP) area, located in the Western Coal fields of NSW, 40 kms north-east of Mudgee and 25 kms east of Gulgong.

The assessment located and recorded a total of 1,299 Aboriginal Objects. This cultural record is made up of: 47 open stone artefact scatter sites of varying densities, 156 individual stone artefact isolated finds, 17 rock shelter sites, a grinding groove site and a scarred tree site. A majority of this record (87%) is made up of exposed stone artefactual material eroding from areas of bare soil exposure with less than five (5) artefacts in density.

The assessment of Aboriginal cultural values was by invitation through letters (see Appendix 3) and a community meeting. No one was identified within the existing Aboriginal groups as having cultural knowledge about the proposed Moolarben Coal Project development area. Whilst local Aboriginal people generally expressed an interest in archaeological sites and their protection, there were no objections to the proposed coal mine project going ahead on cultural assessment grounds.

The mine layout and associated infrastructure areas are likely to impact on a total of (139) Aboriginal sites, a majority being located within the open cuts 1-3 footprint and infrastructure areas. It is the intention of Moolarben Coal Mines Pty Ltd (MCM) to apply for development approval under Part 3A of the Environmental Planning & Assessment Act 1979 to disturb the above sites.

To assist MCM in managing the identified Aboriginal heritage resources within the Stage 1 Project Approval area, the company has given a commitment to implement an Aboriginal Cultural Heritage Management Plan in partnership with the three participating Aboriginal community groups.

NOTE: Open Cut 3 Extension Area – Studies outside and South of EL6288

This area was originally assessed as part of the Stage 1 Project approval area. Due to the timing of granting of mining lease approvals, this area will be considered in this report only within a comparative research framework and not as an assessment of Aboriginal heritage impacts.

3 Introduction & Background

The Moolarben EL6288 area is located in the western coal fields of NSW, 40 kms north-east of Mudgee and 25 kms east of Gulgong. Immediately to the west is the Ulan Coal Mine and to the east the approved and under construction Wilpinjong Mine. The Goulburn River runs through the north of the area and forms a natural extraction limit. Adjoining national parks include the Goulburn River National Park to the north-east and the Munghorn Gap Nature Reserve to the south-east (see Figure 1).

EL6288 covers an area of 11,000Ha (110 sq km) comprising rural land, private and public lands and some public infrastructure. It is characterised by substantial topographical relief, with land elevation ranging from about 400m RL in valleys to 600m RL on adjacent ranges. A substantial portion is heavily vegetated, with some cleared land for pastoral use on the valley floors. A small airstrip is located adjacent the railway line (see Figure 2).

Open cut mine pit limits are defined by physical and economic constraints including the Gulgong to Sandy Hollow Railway Line, the Ulan/Cassilis Road to the north, Moolarben Creek to the west and geological constraints such as sub-crop and washouts. All open cuts are bounded by increasing overburden cover with the Munghorn Nature Gap Reserve and steep slopes identified as constraints.

The underground mine limits are defined by both surface constraints and a depth of cover. Several resource blocks have been identified with the main areas falling below the ridge lines which generally run in north-south directions.

Infrastructure will be located either side of the Gulgong to Sandy Hollow Railway Line comprising coal stockpiling, washing plant and rail loading facilities. A balloon loop will enable coal to be railed to enter either Lithgow or Newcastle.

ARAS Pty Ltd was engaged by MCM to undertake a cultural heritage impact assessment of Stage 1 Project Approval area. This report is concerned with the first stage of the Moolarben Coal Mine development project. The study area is approximately 34.8 km2 (see Figure 2).

3.1 Legislative Requirements – NSW Department of Environment & Conservation's role in protecting Aboriginal Objects and Sites, Part 3A *Environmental Planning and Assessment Act 1979*

It is necessary for the current project to identify matters which are relevant in assessing whether a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies is likely to have an impact on Aboriginal cultural heritage. In order to comply with the above requirement, a proponent should consider the following when making an assessment:

- Justification for any likely impact(s), including any alternatives considered for the proposal;

- Any measures which can be implemented to avoid, mitigate or offset the likely impact(s); and

- Demonstration that the input by affected aboriginal communities has been considered when determining and assessing impacts, developing options, and making final recommendations to ensure that aboriginal cultural heritage outcomes can be met by the proposed development.

The *National Parks & Wildlife Act* 1974 (as amended in 2001, NPW Act 1974) provides statutory protection for all Aboriginal Objects and Aboriginal Places. An "Aboriginal object" is defined under the Act as "any deposit, object, or material evidence (not being a handicraft for sale) relating to Aboriginal habitation of the area that comprises New South Wales being habitation before or concurrent with the occupation of that area by persons of non Aboriginal extraction, and includes Aboriginal remains (as defined within the meaning of the NPW Act 1974: See ***Guide-lines for Aboriginal Heritage Impact Assessment*** July 2003).

An "Aboriginal Place" is a place which has been declared so by the Minister administering the NPW Act 1974 because he or she believes that the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal Objects (see ***Guide-lines for Aboriginal Heritage Impact Assessment*** July 2003). The NPW Act 1974 does not provide protection for spiritual areas or natural resource areas that have no physical evidence of Aboriginal occupation or use, unless they have been declared an Aboriginal Place.

Under section 90 of the NPW Act 1974, a person must not destroy, deface, damage, or desecrate, or cause or permit the destruction, defacement, damage, or desecration of, an Aboriginal object or Aboriginal Place, unless the Aboriginal object or Aboriginal Place is dealt with in accordance with a Heritage Impact Permit (previously known as a Consent to Destroy) issued by the Director General of the Department of Environment and Conservation (DEC).

DEC acknowledges that it is Aboriginal people who should determine the cultural significance of Aboriginal heritage, and DEC has a strong commitment to working in partnership with Aboriginal people to manage and conserve Aboriginal cultural heritage.

DEC also recognizes that Aboriginal cultural heritage includes both traditional and contemporary associations of Aboriginal people with the environment as well as physical sites. DEC has provided this study with an outline of Aboriginal consultation procedures required for cultural heritage work conducted in the Blue Mountains area.

3.2 Definition of a site

The DEC advise developers and consultants that the term "site" is used to group Aboriginal Objects or define a location where an Aboriginal object or cultural item

occurs. They propose general criteria to assist in the classification of a site. Sites can be defined as:

- Exposures where archaeological evidence is revealed;
- Topographic or land form unit where occupation evidence has been recorded. This may be an entire landform unit (ridge, creek, valley) or part of a landform unit (saddle on ridge, creek bank);
- Sites which have physical boundaries defined by rocks (stone arrangement), earthworks (mounds) or cleared land (ceremonial ground);
- Sites defined by aboriginal community groups as culturally significant;
- Arbitrary or the assignation of a boundary for the convenience of recording (in cases where the site would probably be much larger if based on the criteria above). Arbitrary criteria include the use of a fence-line, dirt track or gully as a boundary. In some cases the area may simply be designated as 50m x 50m, or as a smaller sample plot, on the basis of convenience;
- Artefact density (in some cases a site boundary may be defined by the average number of flakes per square metre). This is a specialised type of arbitrary criterion and justification of the rules used must be made explicit; and
- The chosen definition of a site or isolated find needs to be specified for the study. It is the consultant's responsibility to decide on an appropriate definition, suited to the particular project, the research goals and comparability with other regional studies. Dec requires site forms to be completed for isolated finds.

3.3 Study Area and Proposed Development

The proposed MCP will comprise of three open cut mines, one underground mines together with a coal preparation plant, coal handling and storage facilities, rail loop and train loading system and associated mine infrastructure and services.

The development of the open cut and underground mines will operate concurrently. The Ulan Seam, which ranges from around 11m to about 13m thick, will be mined with the full seam recovered in the open cut mines and a partial section in the underground mine. Both domestic and export thermal coal will be produced.

3.4 Study Team

The study team for the MCP consisted of the principal archaeological consultant Giles Hamm and field staff support Dr Roger Luebbers, Jodie Mitchell, Trudy White and Rob Tickle.

4 Partnership with Aboriginal communities

4.1 Aboriginal Consultation: DEC Interim Guide-lines and new process

In January 2005, the NSW Department of Environment & Conservation (DEC) introduced new Aboriginal Community Consultation guide-lines in response to changes to legal definitions of what constituted adequate Aboriginal community consultation. In these guide-lines DEC explains that:

- Aboriginal heritage has both cultural and scientific/archaeological significance and that both should be the subject of assessment to inform its decision-making;

- Aboriginal people are the primary determinants of the significance of their heritage;

- Aboriginal community involvement needs to occur early in the assessment process to ensure that their values and concerns are taken fully into account, and so that their own decision-making structures are able to function; and

- Information arising out of consultation allows the consideration of Aboriginal community views about significance and impact, as well as the merits of management or mitigation measures to be considered in an informed way.

Hence, when administering its approval functions under the NPW Act, DEC requires applicants to consult with the Aboriginal community about the Aboriginal cultural heritage values (cultural significance) of Aboriginal objects and places within the area being considered for development.

However, community consultation is not a sign-off or approval process. The NPW Act establishes the Director General of DEC as the decision-maker. DEC recognises that its decisions will not always be consistent with the views of the Aboriginal community and that there may not always be agreement within the Aboriginal community. However, DEC will take into account all relevant information it receives as part of its decision-making process.

The community consultation process ensures Aboriginal communities have the opportunity to improve assessment outcomes by:

- Influencing the design of the assessment of cultural and scientific significance;

- Providing relevant information regarding the cultural significance values of the objects/places;

- Contributing to the development of cultural heritage management recommendations; and

- Providing comment on draft assessment reports prior to their submission.

(DEC Interim Guide-lines 2005).

To comply with the above process, DEC now requires developers to:

"actively seek to identify stakeholder groups or people wishing to be consulted about the project and invite them to register their interest.

To this end, it will be sufficient for the proponent to provide written notification to:

(a) the bodies listed below:

- Local Aboriginal Land Council(s);
- Registrar of Aboriginal Owners;
- Native Title Services;
- local council(s); and
- Department of Environment and Conservation[1]; and

(b) via an advertisement in the local print media.

The notification must set out details of the proposal and invite registrations from interested groups or individuals. A closing date for registration of interest must also be included. The time allowed should reflect consideration of the project's size and complexity, but must in all cases allow at least 10 working days to respond.

The proponent must record all registrations received in writing before the closing date. DEC requires the proponent to include all parties that have registered their interest in Step 2 below. Respondents that do not register by the due date may still participate in the consultation process in Step 3" (DEC Interim Community Consultation Requirements for Applicants Guide-lines 2005).

To comply with the above process, MCM placed an advertisement in the Mudgee Guardian on the 6th May 2005 seeking expressions of interest from Aboriginal community groups who may have an interest in a proposed development project within the current mine lease area.

The Aboriginal groups that originally responded were:

- Mudgee Local Aboriginal Land Council based in Mudgee;
- Murong Gialinga Aboriginal & Torres Strait Islander Corporation based in Mudgee;

[1] Address correspondence to Executive Director Operations, Department of Environment and Conservation, PO Box A290, Sydney South NSW 1232.

- Warrabinga Native Title Claimants Aboriginal Corporation based in Kandos; and

- Mr Craig McConnell who lives in Mudgee.

An initial consultation meeting was held on 14th of June 2005 in Mudgee with representatives of the above organisations and MCM (see Appendix 3). The purpose of this meeting was to introduce the project and receive Aboriginal community input about how the Aboriginal cultural assessment was to be conducted (ie. survey design etc).

A further meeting to discuss the study area, survey methodology and drill site assessment was held on the 26th of July in Mudgee (see Appendix 3)

Subsequent to this meeting, applications were sought for nominations for work. Following DEC guidelines process the following groups were engaged for the initial field work only: Mudgee Local Aboriginal Land Council, Murong Gialinga Aboriginal & Torres Strait Islander Corporation and Warrabinga Native Title Claimants Aboriginal Corporation. It was agreed that a total of six Aboriginal field workers could be accommodated in the survey assessment.

Each community group has stated that they will provide a written comment concerning the proposal and the final reports' recommendations.

4.2 Aboriginal Community Groups' Consultation and Native Title Issues

Following advice of Mr Alan Wells of Wells Environmental Services, to identify the relevant Aboriginal community groups who might have an interest in the project area, ARAS Pty Ltd also sought appropriate advice from Mr Glen Morris of DEC. Three local Aboriginal organisations were identified as being the likely bodies that may assist with the project's consultation and these were:

- Mudgee Local Aboriginal Land Council based in Mudgee;

- Murong Gialinga Aboriginal & Torres Strait Islander Corporation based in Mudgee; and

- Warrabinga Native Title Claimants Aboriginal Corporation based in Kandos.

4.3 Pre-Survey Design and Consultation Meetings

The first meeting to discuss the project and cultural heritage work was undertaken in Mudgee at the Mid Western Regional Council offices on the 14th of June 2005.

The aim of the meeting was to:

- Explain the project; and
- Provide an opportunity for the local aboriginal community to have an input into the assessment process.

A second meeting was held in Mudgee on the 26th of July 2005 and was also attended by Mr Ian Callow, Project Manager, MCP. This meeting allowed more in depth discussion of the nature of the likely development impacts and the Aboriginal cultural heritage assessment process.

4.4 Aboriginal Cultural Heritage Assessment Process

Following the above consultation meetings, it was agreed that the assessment process would consist of two major components, these being:

- archaeological assessment; and
- Aboriginal cultural assessment.

The first component consisted of conducting an archaeological field survey of the main mine footprint site and surrounding land where infrastructure was being planned. This survey was carried out with members of three local Mudgee Aboriginal groups, between June 2005 & January 2006.

The second component involved undertaking a cultural assessment. This component was discussed with the three Aboriginal groups participating in the project and members were invited to become involved in a cultural assessment. A letter inviting Aboriginal groups to participate in such an assessment was sent to each of the groups. Following a period of notification, no formal response was received from any of the groups to be involved in such an assessment (see Appendix 3).

A third Aboriginal consultation meeting was held on the evening of the 7th of March 2006 in Mudgee in which all three Aboriginal groups were represented (see Appendix 3). The purpose of this meeting was to explain the following:

- The impact of the proposed *Part 3A changes of the Environmental Planning and Assessment Act 1979.*These changes were explained by Mr Mike Young of the NSW Department of Planning;
- Current mine plan: Mr Ian Callow, Project Manager – MCP;
- Results of the Archaeological Survey Assessment: Giles Hamm ARAS Pty Ltd; and
- Likely subsidence impacts on Aboriginal Heritage: Steve Ditton Strata Engineering Pty Ltd.

It was agreed at the above meeting that Giles Hamm would prepare a draft report for comment to each Aboriginal group. It was also agreed that any comments or cultural knowledge concerning Aboriginal Sites or Objects of significance within the MCP should be forwarded to Giles Hamm within two weeks of this meeting date.

On the 10th & 11th of April 2006, onsite meetings for the MCP area with all Aboriginal groups in attendance were held to discuss specific management issues relating to likely mining impacts on Aboriginal Sites and Objects. Aboriginal community groups were represented by the following people: Mudgee LALC, Mr Larry Flick, Murong Gialinga, Mr David Maynard and Ms Wendy Lewis representing Warrabinga Native Title Claimants Aboriginal Corporation.

Also present at these onsite meetings were Giles Hamm ARAS Pty Ltd, Mr Alan Wells, Wells Environmental Services and Mr Steve Ditton Subsidence expert, Strata Engineering Pty Ltd.

5 Project Approval (Stage 1): Description of Impacts

5.1 Open Cut Mines

The proposed open cut mining areas for the MCP area are shown by Figure 2. The proposal is to develop Open Cut 1 first followed by Open Cut 2 and Open Cut 3.

The full Ulan Seam will be mined in two passes and processed separately to produce the two coal products.

The open cut pit limits are based on physical limits such as the rail, roads, creeks and geological constraints as well as economic limits based on a strip ratio. The proposed realignment of Wollar Road will allow the extension of the Open Cut 1 to the north-east and the recovery of additional coal. Access to Open Cut 1 will be from Ulan-Wollar Road for both heavy and light vehicles. Access to Open Cut 2 and 3 will be from Open Cut 1. Carr's Gap Road will be affected by mining in Open Cut 2. The project would seek to permanently or temporarily close this road. Moolarben Road will be relocated with the development of Open Cut 3.

Pit depths generally range from 10 to 50m and due to the undulating topography final pit boundaries will need to be determined, but having regard to physical, ecological and economic constraints.

Conventional truck and excavator mining systems will be used with a haulback system to maximise in-pit backfill of waste. Variations including dozer push will also be used.

Mining will commence in the lower strip ratio areas of Open Cut 1 in the southern area and proceeding north towards the Ulan/Cassilis and Ulan-Wollar Roads. Similarly Open Cut 2 and Open Cut 3 would be mined down strike from north to south, which will maximise the amount of waste dumped in-pit.

Production from Open Cut 1 is scheduled to commence towards the end of 2007 reaching approximately 8Mt per annum ROM coal. The mine will have life of approximately 6 years. Open Cut 2 will have a life of approximately 3 years and Open Cut 3 will have a life of approximately 4 years at maximum productive rates.

5.2 Underground Mine

The proposal is to develop the Underground 4 mine and produce coal in 2009. The Underground 4 mine layout is shown by Figure 3. Access to the seam will be via drifts from the surface facilities area. A ventilation shaft will also be sunk near the mine entry and a ventilation fan installed.

The underground workings will be in the D and E top section of the Ulan Seam. The coal will be extracted using longwall mining methods. The longwall panels will be approximately 250m wide and up to 2.5km long. The cover in the area is generally in excess of 100m and suitable barriers will be provided for the Ulan/Cassilis Road, Goulburn River in the west and the Goulburn River National Park in the east. This will achieve maximum coal recovery with minimum effects on man made and natural surface features. A Subsidence Management Plan will be prepared for approval.

Production from the longwall will commence in 2009 and annual production will be approximately 4Mt ROM. The Underground 4 mine will have a life of approximately 12 years.

5.3 Coal Handling and Preparation Facilities

The proposed coal handling facilities are shown on Figure 2.

The ROM coal from the open cut mines will be unloaded from the trucks at the dump station located on the north western edge of Open Cut 1. The coal will be crushed to -125mm and conveyed to the raw coal stockpile at the Coal Preparation Plant (CPP).

The underground ROM coal will be conveyed to the surface and stockpiled. Coal will then be reclaimed, crushed to -125mm and conveyed to the raw coal stockpile at the CPP. The raw coal will be crushed to -50mm and reclaimed to feed the CPP. The CPP will be a dense medium plant and will produce two products. Firstly, a low ash thermal coal suitable for export and the production of Ultra Clean Coal and secondly, a high ash middlings product suitable for domestic power station consumption.

After washing, the coal will be conveyed to the product stockpiles. A rail loading loop and train loading bin will be constructed. The product coal will be reclaimed from the product stockpiles and loaded on to trains for transportation by rail to the various markets.

The rail loading loop will allow departing trains to travel in the direction of either Newcastle or Port Kembla, permitting the coal to be exported or delivered locally to Delta Electricity or Macquarie Generation power stations.

5.4 Surface Facilities

Other surface facilities will include buildings for the bathhouse, workshop, store and offices at both the Open Cut 1 and Underground 4 mines, including fuel store and car parking areas.

Water management infrastructure including bore field, dams and drainage systems will be constructed together with access roads and other surface earthworks.

5.5 Infrastructure and Services

The Gulgong - Sandy Hollow Railway Line runs through the project area and the rail loading loop will be constructed adjacent to the existing rail line.

The capacity of this line is currently being increased by ARTC and will be sufficient to transport the Moolarben production when it comes on line.

Power will be supplied at 66kV from the existing country Energy Ulan Switchyard. The 66kV power line will be run adjacent to the road and rail corridor to the Coal Handling facilities where a 66/11kV substation will be constructed.

A water supply system including storage dams and tanks will be installed. Water will be sourced for mining operations according to an approved MCM water management strategy.

6 Objectives of the Study

The objectives of the cultural heritage impact assessment were to:

- Assess items of Aboriginal heritage significance including landscapes, areas, places, Aboriginal sites/objects and practices;
- Assess items of historic, scientific, aesthetic, anthropological, cultural, spiritual and/or archaeological (Aboriginal) significance;
- Determine whether the development proposal is likely to cause any impact or damage to Aboriginal Objects or potential sites found within the study area;
- Provide management advice as to likely land use restrictions posed by the location and significance of Aboriginal heritage objects or potential Aboriginal heritage objects located within the study area; and

- Provide recommendations for any further cultural heritage work to mitigate any likely impacts before development begins.

7 Cultural Heritage Background Research and Previous Archaeological Work

7.1 Known Aboriginal Cultural Heritage Issues and Background Research

The consultant reviewed the NSW Department of Environment & Conservation's (DEC) Aboriginal Heritage Information Management System to determine if any known Aboriginal sites were registered near or on the land proposed for development. The results of the register search (see Appendix 1) show there are several registered Aboriginal sites located within the study area. A number of existing Aboriginal sites are also located within a 3 kilometre radius of the study area (see Table 1 below and Figure 3).

Table 1 Known Aboriginal sites located within or near the study area within a 3-5kms radius. Key: OS=Open Site, RS=Rockshelter

Ulan ID#	Site Name	DEC Site #	Site Type	Eastings	Northings
62	Identifier 62 or S4	36-3-040	Artefact scatter	756000	6428000
65	Identifier 65 or S3	36-3-041	Artefact scatter and grinding grooves	756510	6428030
66	Identifier 66		isolated find	756550	6428338
67	Identifier 67		isolated find	756552	6428448
68	Identifier 68 or F3		isolated find	756464	6428520
69	Identifier 69 or F1		isolated find	756545	6428599
70	Identifier 70 or S5	36-3-038	isolated find	756000	6428000
71	Identifier 71 or F4	36-3-038?	artefact scatter	756660	6428867
72	Identifier 72		artefact scatter	756701	6428906
	Cook Gap	36-3-0015	Axe grinding groove	760387	6415931
	Ulan; Murragamba	36-3-0016	shelter with art	760796	6421957
	Wollar	36-3-0020	shelter with art	777958	6415823
	Cooks Gap	36-3-0027	Axe grinding groove	7603873	6415931
	Ulan	36-3-0039	scarred tree	760828	6427722
	Ulan Creek; Site 2	36-3-0042	Axe grinding groove, shelter with art, shelter with deposit	762944	6428010
	Ulan; Wilpinjong Creek	36-3-0044	Bora/ceremonial, carved tree	771442	6420278
	Ulan Creek; Site 18	36-3-0060	open camp site	760215	6426006
	Ulan Creek; Site 19	36-3-0061	open camp site	760878	6426622
	Ulan Creek; Site 21	36-3-0063	open camp site	761207	6428074
	Bobadeen	36-3-0068	shelter with art	761661	6427966
	Wollar; Gulgong	36-3-0074	open camp site	781478	6414502

Ulan ID#	Site Name	DEC Site #	Site Type	Eastings	Northings
	Wattle Creek No.2	36-3-0098	shelter with art	769880	6422760
	Yawanna No.2	36-3-0101	shelter with art	774740	6421270
	Wilpinjong	36-3-0103	scarred tree	767950	6422190
	Yawanna No.1	36-3-0106	shelter with art	774780	6421260
	Yawanna No.3	36-3-0115	axe grinding groove	774800	6420900
	Yawanna No.4	36-3-0116	open camp site	775200	6420600
	Deridgeree No.3	36-3-0124	axe grinding groove	777480	6427480
	Wattle Creek No.1	36-3-0133	shelter with art	769500	6422630
	Murragamba No.1	36-3-0134	shelter with art	761300	6421170
	Moolarben Creek MC1	36-3-0222	open camp site	760420	6420820
	MC2	36-3-0223	open camp site	760420	6420880
	MC11	36-3-0237	artefact	763384	6421070
	MC10	36-3-0238	artefact	763226	6422860
	MC8	36-3-0239	artefact	763193	6422680
	MC6	36-3-0240	artefact	763113	6421940
	MC4	36-3-0241	artefact	763161	6421650
	WC/1	36-3-0287	Art (pigment or engraved)	765680	6425480

7.2 Ethno-historical Accounts and Aboriginal Cultural Geography

Ulan and surrounding areas lie within the Wiradjuri cultural/linguistic grouping. Tindale (1974) and Horton (1994) show the Wiradjuri language boundary extending to the north-east of Merriwa Plateau. The most comprehensive overview of ethno-historical work completed in the study region comes from Pearson (1984). From his PhD research on the Upper Macquarie River Valley and his ethno-historical analysis, Pearson provides several broad cultural hypotheses about the nature of the local Aboriginal occupation. The most significant hypothesis concerns population size and clan territories.

Pearson argues that:

> *The evidence given by these and other 19th century observers suggests that the Upper Macquarie was inhabited by large localised groups of Aborigines who in normal conditions of daily life were divided into groups of up to twenty individuals....The small groups coalesce relatively quickly into groups of 80-150 people to take advantage of a guaranteed or desirable resource (such as seasonal food resources or goods offered by the Wellington mission* (Pearson 1984, p 60).

Pearson goes on to make the case that there was likely to be no significant seasonal factor that may have affected local Aboriginal migrations in the well watered Upper Macquarie. Early observers such as Barron Field (1822) and Colo (1826) estimated that a single family group (ie. clan) in the Upper Macquarie

and Hawkesbury regions may have used a territory with a circumference of between 40-60 kilometres.

Pearson also speculates that there may have been three distinct clan territories centred on Bathurst, Wellington and Mudgee/Rylstone. Natural boundaries (ie. creeks, rivers, valleys) may have separated these territories. Using the primary resources of mixed woodland and grasslands; which are found along the edges of the Bathurst Plains, the Bell River Valley, above Wellington and the Cudgegong River flats and around the upper Capertee Valley near Mudgee, a total population estimate is put at 500-600 Aboriginal people.

Aboriginal people living in Mudgee today are likely to have descended from one of these clans with at least two clans belonging to the Mudgee-Rylstone grouping: (ie. Darbee & Budgee Budgee clan groupings).

Authors such as Howitt (1904) have also written on Wiradjuri customs and traditions, the most significance of these being the *Burbung ceremony.* This ceremony is associated with male initiation and involves the preparation of special earth mounds and usually the application of red ochre. A messenger is sent out to neighbouring groups who are invited to attend a ceremony where young men are ready to be initiated. Ethnographic accounts of Wiradjuri people are also to be found in the historical writings of Dawson (1881), Mitchell (1864) and Lawson (1822).

Kabila (1998) has written on historically significant sites to Wiradjuri people in the Upper Macquarie Valley and in particular places such as: Wellington, Wellington Town Common, Bell River Flats and Apsley Mission. There are few or virtually no historical accounts however of Aboriginal people living near Ulan or within the study area.

7.3 Registered Sites of Cultural Significance

A search of the DEC Aboriginal Heritage Information Management System show there are no known places or sites of cultural significance located near the study area. According to Glen Morris Senior Aboriginal Sites Officer with DEC, records from the NSW National Parks and Wildlife Service Sacred Sites Survey show that there were no living Aboriginal people interviewed in the 1980's who knew of places or sites of sacred value located near the study area (Glen Morris pers comm. 2005).

Site types that have been typically recorded in the general region include (see Figure 3):

- Open campsites made up of stone artefacts dominated by tuff, silcrete and quartz assemblages and sometimes containing hearth material in the form of burnt or cracked sandstone heat retainers. These sites vary in complexity and density depending on their physical condition in the modern landscape and their proximity to major resource zones;

- Scarred Trees representing Aboriginal removal of bark material to make shelters, dishes, canoes, string, shields, boomerangs and carved trees. Within the study area most Aboriginal scars are found on River Red gum (*Eucalyptus camaldensis*) or Blakely's Red Gum (*Eucalyptus blakelyi*), White Box (*Eucalpytus albens)* and Grey Box (*Eucalyptus largiflorens*). There is a strong correlation between large canoe type scars and more permanent river watercourses (ie. associated with the use of the Goulburn, Cudgegong and Macquarie River flood plains);

- Carved Trees represent important Aboriginal ceremonial or burial marker locations. They are usually carved on high quality timber such as red gum. A slab of bark is removed and then the inner wood tissue is carved using a stone axe or heavy duty cutting tool. Common designs found on carved trees are diamond or linear cross hatching motifs;

- Burial sites are sites, which show evidence of Aboriginal burial in discrete locations. Burials in the study region are usually associated with major areas of occupation found next to rivers, lagoons, lakes, waterholes and some creeks. Skeletal material is normally discovered eroding out of a sandy deposits where interment is easiest. Burials may occur in an isolated context or they may be part of a larger cemetery;

- Bora rings are sites containing an arrangement of natural stone to represent ceremonial or ritual practice. They are often found near traditional ceremonial grounds in areas of abundant surface rock. Rocks may be arranged in a circular fashion or oval shapes signifying important ritual meaning for a ceremony. Often bora rings are found isolated on ridge tops or flat hilltops overlooking a significant stretch of country;

- Art sites. These types of sites reflect Aboriginal use of sandstone outcrops for the purpose of painting, engraving or drawing traditional designs. Art sites are often found in areas where people are using country that has good sources of sandstone in the form of rock shelters, offers cover from the elements or may be located next to a stream or river;

- Common symbols found in art sites are hand stencils, figurative art representing animal or human forms, tracks of animals and patterns of lines or circles that may represent landscape elements to a traditional story;

- Axe grinding grooves. These types of sites are associated with Aboriginal people using sandstone outcrops to sharpen stone implements and in particular stone axes. Grinding grooves are usually 5 - 20 cm in length and 2-3 cm depth depending on how often the person is using the groove section. Grooves may be found in clusters and are usually concentrated around a surface rock pool where people use water to assist them in sharpening an edge;

- Contact sites. A contact site is a site where there is evidence of Aboriginal people living traditionally in close proximity to European settlement.

Aboriginal people may be using European items in traditional hunting and gathering practices. For instance bottle glass being substituted for stone, or metal being substituted for bone or stone;

- Sites may be associated with Aboriginal people working for European settlers such as gathering bark sheeting for bark slab huts. Often historic items associated with that contact would be found in certain traditional campsites; and

- Waterhole/well. These types of sites as well as being important places for obtaining water, they may also be sacred places and of religious significance to living Aboriginal people.

7.4 Food resources

Edible plant species likely to be found within the study area are represented by Yams (*Dioscorea*), Native Cherry (*Exocarpos cupressiformis*), Emu Bush (*Eremophila*), Scrub Nettle (*Urtica incisa*), Kurrajong roots (*Brachychiton populneus*), Geebungs (*Persoonia*), Wild Tomatoes (*Solanum*), Bulbine Lily (*Bulbine bulbosa*) and Flax Lily (*Dianella*).

Animal species exploited would have probably been Swamp wallaby (*Wallabia bicolour*), Eastern Wallaroo (*Macropus robustus*), Grey Kangaroo (*Macropus major*) Kangaroo Rat (*Dipodomys*) and Ring tail possum (*Pseudocheirus laniginosus*). Gould's Goanna would have been the main reptile species eaten. In the creeks and rivers Yellow Belly and Yabbies would also been readily available.

7.5 Stone raw materials for tool manufacture

Geologically, the most common outcrops observed are quartz, greywacke with acid volcanics, tuffs, slates, and siltstones are also common. Some stone raw materials used to make stone tools are likely to have been extracted from local creek beds as gravels.

7.6 Early Contact

Aboriginal occupation around Ulan/Moolarben appears to have been relatively undisturbed by European settlement until at least the late 1820s. Surveyors William Lawson and George Cox both led expeditions to the Cudgegong River area in 1821-1822 to locate new grazing pastures. Over the next few years new pastoral runs were taken up in the Mudgee/Wellington area. More settlement followed, causing conflict with the local Aboriginal population. A period of Martial Law was instituted by Governor Brisbane between Bathurst, Wellington and Mudgee in 1824. There was considerable resistance by local Aboriginal people led by Windradyne a senior Wiradjuri guerrilla leader. Intense fighting occurred between 1824-1826. Many Aboriginal people were killed and actual numbers are hard to estimate.

Reverend Gunther, of Wellington Mission, reported on Aboriginal living conditions between Wellington-Dubbo-Cassilis-Mudgee in 1839-1840. He observed that most Aborigines he met were living on European stations by the late 1840's (Gunther, Journal 1839-1840).

The clearing of creek flats and adjoining foot hills and the establishment of small farms progressed slowly from the 1850s onwards. Development impacts were usually associated with the physical impact of clearing or logging – mainly to gain grazing land or supply supports for use in early mine shafts. Ploughing along creek flats has occurred for many years. A majority of the present day land-use within the study area is associated with sheep and cattle production.

Coal was first discovered and worked at Ulan in the 1920s and mined sporadically through the 1950s (Connell Wagner 1992b). No 1 Underground Mine produced coal from 1942 and the No 2 Underground Mine was developed in 1957. In 1977, mine site facilities were commissioned and the No 2 Underground Mine was fully developed.

Open-cut mining was located within the Ulan Creek valley near its confluence with the Goulburn River. The open-cut mine and associated activities such as haul roads have impacted mainly cleared and cultivated land.

Underground mining has proceeded northward from the open-cut mine, below some areas sampled during previous surveys. Studies of the extent and distribution of subsidence effects in this area provides some indication of what is likely to happen in areas overlying the proposed north and north-westward extensions (Haglund 1992).

7.7 Local Archaeological Studies

Between 1980–1981 and 1991–1992 Haglund carried out a series of archaeological surveys of mine leases covering parts of the Ulan Mine Exploration area (see Figure 3). She identified at least 60 Aboriginal archaeological sites within UCML mining leases. In addition to the above, Edgar (1997) recorded 27 sites in the northeast corner of the Ulan lease area (refer Fig. 3 Edgar 1997). Haglund commented that large portions of existing lease area had yet to be inspected. Table 2 below summarises her findings.

Table 2: Sites recorded as a result of Haglund's 1990s assessments

Report Code	Field Code	Land Form	Size	Boundary Criteria	Deposit Type	Visible Artefacts	Materials represented	Condition	Comments
WV/8	Kwk4	Hill crest; low hill in valley	?		Sandy with leaf litter, vis<10%				
MC6	Kbd2	Valley floor & foot slopes			Pale sand with grass	1C, 5F	2 quartz, 1 chert, 2 quartzite, 1 petrified wood	Many wombat holes	Patchy visibility

Report Code	Field Code	Land Form	Size	Boundary Criteria	Deposit Type	Visible Artefacts	Materials represented	Condition	Comments
MC7	Kbd4	Valley floor			Sand with grass	Not recorded		Many wombat holes	Not recorded due to failing light
MC8	Bt2	Hill slope	c.30m x ?	Fence and edge of track	Decaying rock and red sand	c.20 fragments	Quartz and chert	Trampled, eroded, disturbed	Visible artefacts damaged, site may continue beyond fence (woodland)
MC10	Mc13	Valley floor and foot slopes	10mx10m	Track and erosion scar	Eroding B horizon	1C, 3F	3 chert, 1 quartz	Graded, wash, eroding	Site may continue both sides of track, poor visibility
MC12	Mc12	Hill slope	c.10m x10m		Sandy, rocky	2F, >3FF	Chert	Wash, ploughing	Probable remains of minor knapping event
MC13	Kht1	Creek banks, hill slope	C30m dlam	Edge of clearing	Coarse sand and rock frags = lag	>50 ? C, F, Ff	Quartz	Severe erosion, disturbed	Severely affected by logging erosion. <10 artefacts/m square
MC14	Kht2	Hillside	c.60m(?)	Track	Eroding colluvium	F, Ff	Quartz	Track, severe erosion and wash	Appears to relate to MC13 nearby; 1 artefact? 5-10m of track
MC15	Mc14	Ridge crest	x.20m dlam	Tracks (intersecting)	Sandy, silty soil, A2-B horizon	C, F, Ff and traffic prod.	Quartz	Traffic, graded, eroded	Some artefacts crushed, many traffic products
BO1	Kl1	Hill slope	?50mx 20m	Exposures	Topsoil, degrading	C & F (sample recording)	Quartz	Parts much disturbed, road, ploughing	Low lying areas may retain good deposit
BO2	Krm3	Hill slope	c.5mx 2m?	Exposure on track	Topsoil, degrading	2C, 4F & 1Fp	Quartz	Track worn, slope cleared	Single knapping event. Small area, extends beyond track
BO3	Krm2	Hill slope	c.6mx 2m?	Patchy exposure	Topsoil, degrading	2F	Quartz	Disturbed by post clearing	Minor knapping/ discard event?
BO4	Krm1	Hill slope	c.30m x2m?	Exposure along track	Topsoil, degrading	Core, 3F	Quartz, chert	Soil profile disturbed by road ploughing	Remains of minor, disturbed scatters of background scatter?

Report Code	Field Code	Land Form	Size	Boundary Criteria	Deposit Type	Visible Artefacts	Materials represented	Condition	Comments
BO8	Bc/11	Creek bank & footslopes	c.100 mx50 m?	Exposure along track and near dam	Topsoil, degrading	1C, 2F, 7FF	Quartz, chert	Surface graded, possibly ripped	Areas between track and creek may retain some less disturbed deposit
BO9	Area 1	Flat crest of low ridge	Crest c.350 mx50 m	Patchy exposure	Degrading surface	1C, 1F	Quartz	Severely eroded	Very sparse, little or no potential for research
DU3	Area 2	Rock platform above deep gullies and minor creeks	c.300 mx20 m	Exposed rock platform	Bare rock	Sample of c.40 artefacts recorded: C, F, FF backed pieces, hammer and anvil stones	Quartz, chert, basalt, quartzite, petrified wood	Exposed to wash	Represents repeated activities? Probably linked to shelter site just below western end

Her studies aimed to collect available background information, including oral history, and to get at least 50% survey coverage of surfaces affected by the proposed open-cut mining and associated works. She explains that:

> *A less intensive sampling of other areas aimed to define the types of sites likely to be present, patterns of distribution and, if possible, probable frequencies. Three levels of intensity of survey coverage were aimed for: 100% survey of open sites and some selected areas and, in some areas, 25% survey or single traverse to assess topography, visibility and similarity to areas of more detailed survey.*
>
> *Samples of stone artefacts were collected from sites which would be destroyed by the proposed mining activities, and selected rock shelters adjacent to the proposed open-cut mine were tested for the presence of stone artefacts, but no extensive excavation had been carried out within the mine area prior to the 1996 salvage excavation(Haglund 1997:34)*

In these two years (i.e.1980 & 1981), Haglund reported on the results of two surveys conducted in the existing mine and proposed open cut and underground operations at Ulan. The areas examined are located northwest of the Goulburn River encompassing land units featuring a limited alluvial plain cut by minor tributaries of that river and prominent high ridge structures of sandstone outcrops.

As a data set, these results apply to past habitation in relatively close proximity (800m – 2500 m) of a major waterway and accordingly have potential for setting up comparative insights for the MCP. To the south of the mine are a subset of habitation phenomena in the ephemeral catchment that makes up the head waters of this major river system.

In 1992, Haglund also surveyed a proposed access route, an area proposed for surface facilities for an extension of the underground mine as well as carrying out sample surveys of three areas of different topography, concentrating on valleys bordered by cliff faces. One of the sample areas overlapped somewhat with the present study area.

She explains that:

> *As survey conditions were different during the 1996 season, a portion of the overlap was re-surveyed (= the east part of the Brokenback Unit, refer section 5.4).*
>
> *The surface scatters of stone artefacts identified within CCL 741 during previous surveys were found mainly within cleared, often cultivated, areas.*
>
> *The scatters were seen on and in yellow podsolic soils and yellow earth soils which both form firm and well drained surfaces which may be affected by sheet-flooding and severe erosion, but are unlikely to become unpleasantly boggy. In these cleared areas the surface often seemed lowered by deflation of surface wash. The artefacts were mostly exposed on the surface or covered by a thin layer of accumulated debris and turf, except on alluvial flats close to the creek bank or in minor sandy patches where the cover could be deeper and exposure occurred mainly in the sides of small gullies or erosion scars.*
>
> *Some of the erosion was possibly recent, and due to prolonged droughts. However, some artefacts with a heavy growth of lichen must have been exposed for considerable amounts of time. Given the soil characteristics, there was and is little chance of finding organic archaeological material in these open sites(Haglund 1997:25)*

7.8 Site Location Modelling

Based on her three main Ulan survey assessments, Haglund (1997) argues that Ulan site location modelling can be explained in the following way:

> *…it is likely that at least some water-holes, springs and soaks could be found to be closely associated with archaeological material. It is also possible that more extensive and intensive investigation will reveal examples of additional site types(Haglund 1997: 26)*

And she further explains that:

> *It should be noted that previous investigations have concentrated on two landforms, ridge slopes and/or valley floors, depending on what type of topography was most likely to be affected by particular proposed developments. These landforms are also, according to present models, those most likely to contain Aboriginal sites. However, judging from sample surveys in adjoining areas, open sites are likely to occur also on*

ridge crests, and quarry sites where there are outcrops of suitable rock, eg, basalt (Haglund 1997: 26).

7.9 Limitation of Sampling Methods and Previous Archaeological Assessment

Several factors from previous archaeological work are likely to effect the assessment of archaeological landscape values within the study area:

- The absence of any form of analysis of data sets to elicit discard patterning in the study area or indeed illuminate any of the primary characteristics of the archaeological record itself or the behavioural systems behind it;

- Site areas, density values, industrial attributes, tabulations of material types, landscape delineation, and similar elements in archaeological investigation that are designed to underscore the significance of cultural materials that may be lost if the mine proceeds as proposed are not adequately described;

- Haglund's overall assessment of significance is not comparable because she has too many lines of evidence which are fragmented and not discussed in any wholisitic way; and

- Sites are discussed but not at an intersite level where comparability can be analysed.

7.10 Chronology of Aboriginal occupation in the Central Western & North-West Slopes

Chronology of Aboriginal occupation within the broader region is known to be at least 29,000-34,000 years BP (see Kamminga & Mulvaney 1999). The Pleistocene sites of Cuddie Springs and Tambar Springs provide some evidence of early human exploitation of open plain landforms which also contain megafaunal species (ie. Diprotodonts). Attenbrow (2003) reports a date of 11,050 + 135 Years BP for a rockshelter site occupation (Loggers) within the Upper Mangrove catchment.

In 1994, Patrick Gaynor obtained a date of 20,000 years BP from Crazy Man Rock Shelter in the Warrumbungles National Park. In 1970 David Moore completed excavation of a small rock shelter at Bobadeen. This excavation site adjoins but is not within the Moolarben Coal Mine Lease. The Bobadeen shelter excavation produced a basal occupation date of 5,500 years BP (Moore, 1970, 1981). In 1961, Tindale completed an excavation at Noola Rockshelter in the Rylstone area and suggested a date of approximately 12,000 years BP for basal occupation. Another site Botobolar 5 has been dated to 5770 +/- 100 years BP.

Haglund's archaeological surveys, test excavations of rock shelters and open sites and surface collection of stone artefacts were all completed within the Ulan mine lease area in the early 80s. A salvage of shelter site 36-3-177 was the first major sub-surface investigation within Ulan Coal Mine Lease areas.

7.11 Regional Studies, Current Research Issues and Occupation Models

The most comprehensive overview of archaeological work completed near the study region comes from Attenbrow (1981, 1982, 1987, 1997, 2003 & 2004), Vinnicombe (1980), Pearson (1981), and MacDonald (1992). In her landmark study of the Upper Mangrove Creek area Attenbrow, investigated ways in which chronological and spatial changes in density of archaeological sites and stone artefacts can be interpreted and explained in terms of demography and human behaviour. The research aim of her doctoral thesis was to investigate pre-colonial land-use and subsistence strategies in the coastal regions of south-eastern New South Wales, land between the Great Dividing Range and its associated ranges and the ocean shoreline. Her main study area however focussed on the Upper Mangrove Creek catchment, which is dominated by forested hills, ranges and dissected sandstone plateaux. The Upper Mangrove Creek catchment lies within the coastal hinterland. The Upper Mangrove area is located approximately 100kms south-east of the study area.

Her fieldwork results which include excavation and survey, show 80 archaeological traits at 59 archaeological sites, with 10 isolated finds, and 167 potential habitation shelters being recorded in the random sampling units (see also Attenbrow 1987). The archaeological evidence showed there were 35 archaeological deposits, 22 rock art images, 22 grinding groove areas, and one burial. Thirty-two archaeological traits were located in rockshelters, five in open deposits and 22 on open rock (sandstone exposures or rock platforms).

The ten isolated finds were all stone artefacts on open deposits (Attenbrow 1987). The average density of sites and archaeological traits in the random sampling units, and the inferred density of sites and traits in the total catchment, is ca 6/sq km and ca 8/sq km respectively.

Attenbrow explains the significance of these results:

> *Sites/archaeological traits were recorded in all topographic zones. However, the number and density of sites in each topographic zone varies, as does the number and density of each type of trait and the contents of each of the traits. Two of the three main traits – archaeological deposits and images – are found in all topographic zones. Grinding areas have a more restricted distribution in the random sampling units being recorded in only the periphery ridgetops, subsidiary valley bottoms and subsidiary ridgesides. However, they have been found in other zones in the catchment outside the random sampling units – albeit in small numbers (two on peninsula ridgetops and two in the main valley bottom).*
>
> *The number of sites in each zone varies between two and 24, and the site density between 2/sq km and 12/sq km.. The total number of traits in each zone varies from three to 26, while their density varies from 3/sq km to 15/sq km.. The highest frequencies of sites and traits are found on periphery ridgetops, though subsidiary ridgesides also have a high frequency of traits. The high frequencies of sites and traits in these two*

zones are a function of the larger area of land within these categories. The highest density of sites and traits is in the main valley bottoms. The lowest frequency and density of sites and traits were recorded on the peninsula ridgetops and the main ridgesides. (Attenbrow:2004: 96-97)

7.12 Site Location and Land-use Model

Attenbrow's explanation for what the above archaeological evidence means is explained in the following way:

On this basis, it is proposed that the catchment's inhabitants were relatively mobile hunter-gatherers who moved between many short-term base camps within their country, with group size varying according to weather, season and locality. While in the catchment, family groups stayed at base camps for several nights undertaking a range of domestic tasks, members going out daily to obtain food and raw materials.

Tasks undertaken at activity locations away from base camps may have included: (a) hunting, butchering, fishing (including eels) and shellfishing (freshwater mussel), plant and honey collecting; (b) procuring raw materials, such as stone, wood, plant fibre and resin; and, (c) religious or ritual responsibilities.

During these daily forays, to places inside or outside the catchment, damaged tools and implements would have been mended, and food prepared and/or eaten at locations away from the base camp. People also may have sought protection in rockshelters during the day from the extreme heat of summer, the frosts and cold winds of winter, and the rain at any time of the year. Individuals or small groups would have made occasional longer trips for subsistence, trade or social purposes to places which necessitated the use of overnight/transit camps away from their base camps. Large gatherings for ceremonial purposes probably occurred at locations outside the catchment.

Within the catchment, in addition to the numerous archaeological deposits (habitations), there are also many sites with images (mostly pigment drawings in shelters) and grinding grooves (and a scarred tree outside the random sampling units). Together, this suite of archaeological sites demonstrates that many of the activities described above were carried out.

Overnight camping and a range of domestic tasks were undertaken at habitations. The grinding grooves indicate that the shaping and sharpening of ground-edged implements occurred, and the pigment and engraved images were likely created in association with both religious and secular activities. Although there is no outcropping bedrock in the catchment from which stone artefacts can be made, pebbles and cobbles eroded from the Hawkesbury sandstone and conglomerate beds in the Narrabeen sandstones are available on the ridgesides and in creek beds (Chapter 3).

> *Some catchment habitations may have been used as transit camps by people travelling from one locality to another on ceremonial business or to procure raw materials by direct access or trade – for example, along the historically documented route between the Hunter Valley and Brisbane Waters via the Wollombi Valley and the ridge forming the catchment's eastern boundary, which also linked with other routes extending west as far as Mudgee-Rylstone* (McCarthy 1936: 2-3; 1939a: 1; 1939b: 407; 1939c: 100; (Attenbrow 2004: 73-74).

For the assessment of habitation, Attenbrow (2004) uses the terms base camp, transit camp and activity locations to define how Aboriginal people used the landscape of the Upper Mangrove Creek catchment. There are both short term and long term base camps identified as sites of intense or transitory use. What remains unknown about these sites is whether their function and use varied over time. One issue that is important to consider is whether assemblage variability can be analysed identifying types of domestic activities.

7.13 Vinnicombe

In 1979, Pat Vinnicombe (1980) undertook a regional archaeological assessment of the Gosford/Wyong area within the Sydney Basin. The study set out to survey an area containing three major eco-systems, each of which, theoretically, would reflect different land use patterns (Plog 1976:143). An intensive survey was then made of a sample area of each eco-system, identifying the general classes of sites and plotting their frequency and distribution.

An assessment of the relationship between the sites and easily identifiable features of the natural environment, for example, geology, altitude ranges, drainage characteristics, and routes would be made. The study's observations would then be used to extrapolate to the entire study area and thus predict where different types of sites would be likely to occur, and in what numbers.

Vinnicombe's (1980) three eco-systems pre-selected for intensive survey were:-

1. **Open coastline and coastal estuary** – fully tidal, high salinity, eg. Brisbane Water and Bouddi Peninsula.

2. **Riverine estuary** – tidal margins, low salinity, eg. junction of Mangrove Creek with the Hawkesbury River.

3. **Inland sclerophyll forest** – upper valley catchment, fresh water, eg. Upper Mangrove Creek.

Surveys of these three major eco-systems were supplemented by spot surveys in other areas selected at random during the course of the study (Vinnicombe 1980).

Her results proved to be very important in terms of site locational modelling. Her study recorded over 240 sites. Below she explains her results in relation to

environmental site location factors such as water, type of sandstone, land-unit, aspect, site size, site contents etc:

> *Site location and prediction is discussed in relation to water resources, geology, topography, and aspect. Site content is based on data distilled from the 243 sites located and recorded during the course of intensive surveys. In addition to the above are the many sites which were recorded during spot surveys and ad hoc inspections.*
>
> *Rock shelters were numerically predominant among the sites located. The combined number from the three intensive surveys was 127 shelter sites and 469 potential habitation shelters, totally 596 shelters in all……*
>
> *Generally speaking, the availability of water was not found to be a critical factor in site location. Indeed, where shelters have art but no appreciable habitation deposit, water is not a pre-requisite to site selection. Although the initial assessment of the availability of water in relation to shelters near ridge tops is that permanent water could be obtained only from major creeks in the valley far below, or from seasonal creeks in the nearest lateral or side gully, an intimate knowledge of the terrain often proves this assumption to be incorrect. In many places, especially on terraces near ridge tops, or in association with exposed bands of rock, there are rock holes and aquifers or seepages of water. Many of these are dependable even in very dry weather, and a small amount of preparatory excavation in the clay substrate near seepages or drips will allow a sufficient collection of water for drinking purposes.*
>
> *The majority of rock shelters are located on steep valley slopes in Hawkesbury Sandstone. They may be distributed anywhere up and down the slope, but are usually associated with exposed sandstone bands. The average elevation above creek level (not sea level) is 50 – 60 metres (Exhibit 4). Both the highest exposure of Hawkesbury Sandstone where the plateau falls away, and the lowest exposure when the Hawkesbury Sandstone meets the Narrabeen Group, are preferred localities for shelters.*
>
> *Habitation sites are more likely to occur near the valley floors while art sites tend to occur in the larger shelters immediately below the ridge top.*
>
> *ii. Size*
>
> *The size of rock shelter sites varies considerably, and there is no inter-correlation between shelter length, depth or height. The size of shelter selected as a site in the Bouddi Peninsula ranges from length 0.5-42 m, depth 1-14 m, height 1-7 m, and floor area 1.2-196 sq.m. At Spencer the sizes range from length 2.5-26.5 m, depth 0.5-15 m, height 1-24 m, and floor area 2-300 sq.m. At Upper Mangrove, the sizes range from length 2.5-26.5 m, depth 1-7 m, height 1.15-8 m, and floor area 3-172 sq.m.*
>
> *All sizes of rock shelters therefore have to be inspected.*

iii. Orientation

Utilised shelters may face in any direction, but a preference is shown for shelters with a northerly or north-westerly aspect, that is, shelters which obtain the sun. Conversely, a minority of sites seem to be selected because they are cool and shaded and face in a southerly direction.

Where valleys are steep and narrow, the south-facing rock bands tend to weather into profiles less suited to habitation than those that are north-facing. There are therefore less potentially habitable shelters to choose from on steep southerly aspects.

At the valley heads where hillslopes are more open and gentle, the geomorphological differences in weathering appear less marked. Shelters suitable for habitation are equally distributed in all directions, but preferences for the choice of northerly shelters are more marked.

iv. Content – Archaeological deposit

Rock shelter deposits may range from a thin scatter of debris on bedrock with little or no evidence of artefacts or other human usage, to thick accumulations of habitation and sedimentary refuse which may include stone artefacts, bone, shell, ash and more rarely vegetable remains.

v. Content – Art

***Location**: Although many art sites are located high up in shelters immediately below the plateau escarpment, art sites may occur at any level of the valley slope, on any aspect, and in any size of shelter. Sometimes situations where art occurs do not even rate as a habitation shelter from the human usage point of view – they are too small and too low to have been used as camp sites. Some art sites appear to have been selected because of unusual features produced by cavernous weathering. Shelters with re-curved ceilings, complex honeycomb weathering and rhythmic or concentric graining are frequently chosen as art galleries.*

Within the shelters, the images may be on walls and ceilings, high or low. Art may also be found on the recurved area of the ceiling so that it can only be seen from inside the shelter looking outwards. Images are also often placed within niches or frames of honeycombing, in association with striking iron-stain patterns, or they follow the natural contours of the rock. The disposition of images in relation to one another is also often dictated by natural conformities in the rock.

***Techniques**: Rock shelter art may take the form of wet pigment paintings (rare), wet pigment stencils of hands and artefacts (distribution restricted to certain sites only) and dry pigment drawings (the most common technique in the study area).*

Paintings are predominantly in red pigment, though white and black may also occur.

Stencils are predominantly in white, followed by red, with less common examples in shades of yellow ochre or pink. No black stencils were observed.

The dry pigment drawings are predominantly in black. This is usually assumed to be charcoal, but analytical tests are currently being made to establish whether this is indeed the case. It is possible that some black pigment may be manganese rather than charcoal. Other colours used in the dry pigment drawings are red ochre, white (presumably kaolin though no tests have been made) and more rarely, yellow ochre.

Rock shelters may also contain examples of engravings in pecked or abraded outline, in fully pecked intaglio techniques, or fully pecked and abraded technique. There are also examples of lightly scratched engravings in which there is a colour difference in the rock rather than an incised line, and what may be areas of rock rubbed smooth without any indication of pigment. Examples of rock engravings within shelters are rare.

***Subjects**: The number of images in any given site may vary from one to hundreds. Although the most impressive galleries are often those with the greatest number of images, numbers of superimpositions do not necessarily reflect importance. Some of the smaller sites contain unique compositions or unique subject matter.*

The subjects portrayed are varied.

Stencils are usually of hands or forearms and artefacts such as boomerangs, axes and sticks. Objects other than these are rare. Although shields feature prominently in the engravings, they were not noted among stencils or drawings. Hand stencils include those of children as well as of adults. Both left and right hands occur. No mutilation was noted. The majority of Aboriginal women in the Broken Bay area had the terminal two joints of the little finger on the left amputated when young. It may therefore be deduced that if women stencilled their hands, they refrained from stencilling the left hand.

Paintings and drawings include human beings, both male (indicated by genitalia and the pubic apron associated with initiation) and female (indicated by breasts protruding laterally from the torso). Humans are often represented with arms held high up in the manner adopted when dancing. There are also therianthropic figures which combine both human and animal characteristics. The combination of human with lizard or goanna-like features are the most common.

Of the animals portrayed, macropods are dominant. Emu, fish, echidnas and reptiles are also present. There is marked selectivity in the animals

chosen for representation, and noticeable omissions from the art record. With the above exceptions, the smaller animals are neglected, or very rarely represented.

c. Open Camp Sites

i. Location

Open camp sites undoubtedly occur, but they are now sub-surface and are no longer visible. Apart from the shore-line middens, too little data have been obtained on open sites for any reliable predictions to be made. Of the five open sites that were seen during the course of the study, two were on alluvial banks of a creek, and the remaining three were on a high plateau. Theoretically, open sites may occur in any position where the terrain is sufficiently flat to make a camp, and where water is available.

e. Grinding Grooves

i. Location

The great majority of grinding grooves are found on exposures of Hawkesbury Sandstone in creek beds at the heads of valleys. Exceptions do occur on exposure of the Narrabeen Group, principally the Undifferentiated and Gosford Formations, where grooves may be associated with wet sclerophyll or rainforest-type vegetation. In the Brisbane Water survey area, where there is but limited Hawkesbury Sandstone, the number of grooves was markedly lower than in the other areas where Hawkesbury Sandstone is dominant.

Grooves often occur at or near the top of a waterfall immediately above the intersection between the Narrabeen and Hawkesbury Formations, or at the top of a waterfall on a steep side-gully. They are also likely to occur around rock pools on ridge tops or on rock platforms near aquifers. In these situations, grooves are often but not always associated with engravings, and sometimes with water diversion channels. Sometimes there are also associated circular depressions, varying in diameter from 3-8 cms, which do occur in nature, but which may also be associated with functional use.

ii. Content and discussion

Grinding groove sites may vary in number from a single groove to hundreds in a single locality, for example Somersby Falls. Since it is calculated that an average groove would take approximately 6 hours to grind, the number of working hours represented by the larger sites is considerable.

Within the survey areas, the greatest number of grooves located at any one site was 81 in Spencer, and 80 in Upper Mangrove Creek, with the

average number of grooves per site being 16.5 and 13.5 for the respective areas.

Variation in size between the areas was not found to be great although the length of groove at Upper Mangrove Creek tended to be shorter than at Brisbane Water or Spencer. The average length of groove over the whole area was calculated to be 29.3 cm, width 7.5 cm, and depth 1.2 cm (Table 14). This calculation excludes a number of outsize grooves, much wider than the average, and usually longer as well as deeper. These grooves suggest a usage other than that of grinding axes(Vinnicombe 1980:24-26).

7.14 Vinnicombe's Conclusion

In her estimation of site density across the entire 1,634 sq km of Gosford/Wyong region, Vinnicombe (excluding some 550 km2 of siltstone and shale) argues for an average site density of 18 sites/sq km. She predicted that thirteen times more sites are likely to be located in an area of 1579 sq km.

In her analysis of significance the key site attribute factors Vinnicombe argued for were:

- Aspect;
- Content and likely Potential Archaeological Deposits; and
- Location in the Landscape.

7.15 Potential Archaeological Deposits (PADs)

Vinnicombe (1980) in her work in the Gosford/Wyong region introduced the concept of PH; or Potential Habitation Shelter. Later Sullivan (1978) further refined the term to Potential Archaeological Deposit. Here Vinnicombe explains the basis of her argument for assessing PAD's:

A satisfactory accumulation of deposit therefore only occurs if the site was utilized to the extent that a more of less level platform became built up, or if blocks of stone fallen from the roof of the shelter formed lintels against which the deposit accumulated. Shelters with a deposit suitable for excavation are mostly of the latter category. Evidence of casual and infrequent use of shelters with outward sloping floors may well have slipped downslope beyond the drip-line, and subsequently become concealed by vegetation and leaf litter. And where there has been some accumulation of deposit, the continued process of deposition from active erosion of the shelter or from external slope-wash, may conceal evidence of human occupation. Test pits excavated in shelters with floor deposits but with no visible surface artefacts have proved that 10 out of 14 such tested sites do in fact contain evidence of usage (Vinnicombe and Attenbrow 1978; Attenbrow 1980). It is therefore certain that many more shelters were utilised by the Aborigines than is suggested by the present

study, which is based principally on surface evidence (Vinnicombe:1980:VIII:3-4) .

The recording and testing of PADs by Attenbrow in the Mangrove Creek Dam study revealed much additional evidence about Aboriginal occupation of the area. By the end of the Attenbrow's excavation program, 24 sites with archaeological deposit had been identified, *one-third* of which were identified only through the testing of PADs.

7.16 Research Issues Arising from Attenbrow's work

A number of research questions/approaches arise out of Attenbrow's work and these can be summarised in the following way:

- It would be fruitful to look at the various aspects of a larger catchment's archaeological record as an integrated body of data (cf. Nelson 1991: 57-8, 89-90);

- All archaeological traits and their assemblages, all materials and manufacturing processes and their tool-kits should be considered;

- The issue of raw material selection and reduction sequences as they relate to the concept of mobility and risk, and the degree of risk involved in acquiring a certain resource needs to be considered (see Myers 1989: 84, 90-1; Odell 1996: 53; Torrence 1989a: 61-2, 2001: 88); and

- The incorporation of such test excavations in future development projects where potential archaeological deposits exist, whether in rockshelters or in open countryside, is essential (Attenbrow: 2004:245).

7.17 Macdonald: Early Ceremonial Use of Ridge-Systems

In her 1992 study of a site known as Mt Yengo 1 (Big Yengo 1) located above the McDonald River within the Hunter Range (some 70 kms south-east of the study area), Joe MacDonald recorded engravings which appear to be older than an initial occupation date of 5,980 +290 Years BP for the main shelter site. Further dating and excavation has shown the most intensive period of occupation for this site is between 2,000 & 1500 Years BP declining after 540 +180 Years BP. The most interesting evidence for this site is the difference between the stencil art work and the rock engravings. The latter appears much older and therefore there is a possibility that early occupation of the Hunter Range is associated with ceremonial use of elevated ridge systems. At least 90% of the engravings are of circles with two of them having a pecked central dot. There are macropod and bird tracks pecked solid (intaglio technique). MacDonald has described this art style as Panaramitee.

The painted and stencil art contains figurative styles with 2 anthropomorphs, an emu and an eel present. Hand stencils, bird tracks and parallel lines are the most commonly recorded motifs. Also included in the stencilled art are

boomerang, club, straight sticks and axe motifs. MacDonald also reports a rare art style technique called paint wash (MacDonald 1992).

7.18 Site Prediction and Site Location Factors

Site selection factors can be broadly classified as factors that influence hunter-gatherer prehistoric land-use patterns. Significant among these factors are environmental and social parameters for settlement. Environmental factors can be summarised as involving access to permanent water, availability of flat dry ground, avoidance of cold air drainage, access to a variety of resource zones, visible aspect across variable terrain, protection from prevailing winds and terrain or topography providing access to other settlement areas.

Social or cultural factors can be summarised as involving territorial boundaries, social grouping and family size, ceremonial and ritual requirements, mobility networks and seasonal resource requirements.

According to Vinnicombe (1980), Attenbrow (1987, 2003 & 2004), Pearson (1981), Haglund (1981 & 1997) and more recently Navin & Officer (2005) at Wilpinjong, several topographic and landform factors will influence where sites are likely to be found within or near the study area. These can be summarised accordingly:

- The presence of water with extensive artefact scatters close to relatively permanent water (springs, soaks, rivers and permanent creeks) and sparse artefact scatters adjacent to the intermittent streams is important;

- Following attenbrow (2004) and vinnicombe's (1980) example: rock-shelters without archaeological evidence, but with particular dimensions and characteristics, are likely to contain archaeological materials. These rockshelters are called *potential archaeological deposits* (pad shelters). A rockshelter was deemed to be a pad if it had dimensions of 2m x 1m or space for at least two people to gain 'adequate shelter'. The following criteria were used in the field:

    1. Floor space: suitable for two people to sleep in a curled-up position, that is, flat and horizontal with a minimum area of 2m x 1m;

    2. Height: sufficient for two people to stand or stoop in a comfortable working position, that is at least 1.2m hight;

    3. Protection: the overhang is deep enough (from dripline to back wall) to protect the floor area from weather, that is, 1m minimum;

    4. Dryness: the floor (or part of it), and inside the rockshelter generally, must be dry; and

    5. Accessibility: the rockshelter must be easily accessible; and

- Campsites are likely to be well above flood levels while minor sites will tend to be on well-drained areas such as minor spurs, low hills or the banks of deeply incised streams;

- Sites within forest landscapes are likely to occur within 150 metres of water sources; and

- Valley floor and basal valley slope landforms are likely to contain the greatest diversity of occupational materials with upper valley slopes the least likely to contain site potential.

It is clear from the above review, that site locations within the Goulburn River and Moolarben Creek floodplains are significantly influenced by elevated ground which can provide a safe haven from flood waters and access to ecological resources.

Rich ecotones are likely to be found where lowlands dissect floodplain land units producing rich wetlands and swamps. These places are more than likely to have been favoured by Aboriginal people living in pre-European landscapes. Another important site location factor is likely to be access to stone tool raw material resources. As a majority of reported artefacts are made from quartz, cherts and tuffs and some of these raw materials may outcrop on some ridge systems.

7.19 Site Visibility-Site Detection Factors

One of the most important factors in locating sites or artefacts on the ground is whether they can be detected or discovered easily. A number of discovery factors will affect how well sites or artefacts are located within a survey area. Schiffer, Sullivan and Klinger (1978) provide a useful summary of what the most important factors are likely to be in detecting sites or artefacts on the ground (see Table 3 below, taken from Dancey, 1981)

Table 3: Site detection factors that may affect an archaeological survey (after Dancey 1981)

General Factors	Definition	Specific Examples
Abundance	The frequency or prevalence of site or artefact type in the study area	Sites and artefacts occur in highly variable quantities, from rare to abundant
Clustering	The degree to which archaeological materials are spatially aggregated	Various degrees of clustering may be found between dispersed and clustered
Obtrusiveness	The probability that particular archaeological material can be discovered by a specific technique	Artefact size, composition, surface morphology, heat retention, and other physical, chemical and Biological properties

General Factors	Definition	Specific Examples
Visibility	The extent to which an observer can detect the presence of archaeological materials at or below a given place	Site area, artefact density, artefact size, surface area of exposure, frequency of exposure
Accessibility	The effort required to reach a particular place	Climate, biotic environment, terrain, roads, land holding patterns.

7.20 Significance of Water and Access to Plant & Animal resources

Two environmental factors are likely to be important to interpreting the archaeological evidence from this study; the location of spring fed systems and the productivity of eco-tones between catchments.

We know from work undertaken by Brayshaw (1986) Pearson (1981) and Vinnicombe (1980) that Aboriginal use of a range of plant and animal resources in and around the Ulan Region was dependent on understanding seasonal availability. Much of this evidence comes from observation made of coastal Aboriginal populations or observations made near first settled districts (ie. Bathurst, Mudgee, Newcastle, Parramatta, etc.) rather than in remote mountainous terrain. Table 4 below, sets out the more common economic plant and animal foods recorded by early settlers and observers.

Table 4: Common economic plant and animal foods recorded by early settlers and observers

Species Name	Source	Common Name/ Use
Blechnum	Barrallier (1802)	Rhizome/Fern roots roasted in ashes
Dioscorea traversa	Backhouse (1843)	Yam. Often found near brooks
Doryanthus excelsa	Three-D (1843)	Giant Lily. Stems and roots roasted cooked and made into paste/Johnny cake.
Zamia spiralis	Threkeld (1843) Backhouse (1843)	Cycads. Seeds soaked for several weeks in swamp. Pounded and roasted.
Exocarpus cupressiformis	Cunningham (1825)	Native/Wild Cherry
Sterculia heterophyllus	(Cunningham 1843)	Kurrajong. Capsules roasted and made into paste.
Themeda australis	(Cunningham 1823)	Grass seeds ground for paste like Johnny cakes.
Xanthorrhoea resinosa arborea	(Threlkeld in Gunson 1974)	Grass Tree. Nectar eaten from flower stems-stems used for spear shafts. Resin used in hafting.
Acmena smithii	Hunter (1793)	Lillipilli. Edible fruit.

Species Name	Source	Common Name/ Use
Persoonia sp	Hunter (1793)	Geebung. Fruits eaten or flowers.
Doryanthes excelsa	Backhouse (1836)	Giant/Gymea Lily. Stems roasted and eaten.
Lomandra longifolia	Threkeld in Gunson (1974)	Long Leaf Mat Rush Edible stems and strips for making dilly bags and reed mats.
Ostrea angasi Anadara trapezia Velesunio sp Pyrazus ebeninus	Threkeld in Gunson (1974) Ebsworth (1826)	Lakes and shallow estuaries. Mud Oyster Sydney Cockle Freshwater Mussel Mud Whelks.
Anguillidae	Collins (1798)	Freshwater eels Caught in narrow channels near lakes and rivers using basket nets
Macropus major Macropus robustus Wallabia bicolour	Fawcett (1898)	Eastern grey kangaroo Eastern Wallaroo Swamp wallaby Caught by netting in forested areas. Burning patches of grass to attract new growth and game.
Perameles nasuta	Ebsworth (1826)	Long Nose Bandicoot
Trichosurus vulpecular Pseudocheirus laniginosus	Dawson (1830) Meredith (1846)	Possums-ring tail and brush tail. Caught by cutting hole into trunk of tree. Access by cutting toe holes in tree. Important food staple. Favoured in spring.
Tachyglossus aculeatus	Collins (1798)	Echidna. Cooked in ovens. Eggs highly prized.
Varanus varius	Backhouse (1843)	Lace Monitor or goanna
Egernia sp. Agamidae sp Monelix spilotes	Backhouse (1843) Graham (1863) Oxley (1820)	Lizards and snakes Skinks, dragons and pythons. Cooked roasted. Cooked in pit.
Dromaius novaehollandiae	Collins (1798) Hunter (1793)	Emu. Hunted using boomerang and clubs.
Grubs	Backhouse (1863) Meredith (1844)	Root grubs from gum trees. Seen as luxuries.
Waterfowl various species	Mundy (1815)	Caught in nets in major wetlands. Hunted using large boomerangs.
Chelonda longicolis	Backhouse (1843)	Tortoise. Caught sunning on logs in rivers.
Fish various species	Meredith (1844) Graham (1839).	Mullet-Catfish, Cod & Perch. Caught using nets, snares and spears. Some nets made from stringy bark.

7.21 Site Definition and Problems of Site Recording

A significant issue in recording hunter-gatherer open space occupation is how to define an occupation location or "site". The DEC advise developers and Consultants that the term "site" is used to group objects or define a location where a relic or cultural item occurs. The general criterion used to define sites is set out below. Sites may be:

- Exposures where archaeological evidence is revealed;
- Topographic or land form units where occupation evidence has been recorded. This may be an entire landform unit (ridge, creek, valley) or part of a landform unit (saddle on ridge, creek bank);
- Having physical boundaries defined by rocks (stone arrangement), or earthworks (mounds) or cleared land (ceremonial ground);
- Having cultural significance to aboriginal community groups;
- Having an arbitrary boundary or the assignation of a boundary for the convenience of recording (in cases where the site would probably be much larger if based on the criteria above). Arbitrary criteria include the use of a fence-line, dirt track or gully as a boundary. In some cases the area may simply be designated as 50m x 50m, or as a smaller sample plot, on the basis of convenience; and/or
- Having a specific artefact density. In some cases a site boundary may be defined by the average number of flakes per square metre. This is a specialised type of arbitrary criterion and justification of the rules used must be made explicit.

The chosen definition of a site or isolated find needs to be specified for the study. It is the Consultant's responsibility to decide on an appropriate definition, suited to the particular project, the research goals and comparability with other regional studies. DEC requires site forms to be completed for isolated finds.

In addition to the above, the NPW Act 1974 (amended) also defines Aboriginal object as:

> "*any deposit, object, or material evidence (not being a handicraft for sale) relating to indigenous and non European habitation of the area that comprises New South Wales being habitation both prior to and concurrent with the occupation of that area by persons of European extraction and includes Aboriginal remains*" (NPW Act 1974 Section 5: Part 1 pp: 8-9).

Other issues concerning site integrity, site formation and factors of disturbance have been argued by a number of authors. Following on from the work of

Schiffer (1987) who helped describe the pattern of transformational processes, both cultural and non cultural that create the archaeological record; Hurst Thomas (1991) argues four distinct cultural processes that affect the final condition of the archaeological record (ie. especially for open space occupation). These processes are defined as "deposition, reclamation, disturbance and re-use" (Hurst Thomas 1991:132). These processes are briefly described below.

Deposition: These are actions usually cultural in origin that cause the accumulation of the archaeological record. This can be simple discard of cultural material at a site, burying the dead or the construction of a hearth. Size of cultural objects is one major influence on the way cultural objects are incorporated into the cultural deposit. This is called size-sorting effect.

Reclamation: This is the process where archaeological material is reincorporated back into a systemic context. Examples of this would be people re-using occupation areas or new people settling on an old campsite location that has been abandoned by another family group.

Disturbance: This process mainly refers to human or natural actions, which transform the archaeological record from its origin depositional context. Human actions would refer to prehistoric land-use patterns where materials are swept away or moved from a campsite to clear the ground. Modern human actions would be; vegetation clearing on hillslopes increasing sheet erosion and removing small artefacts, that are redeposited on lower slopes and flats.

Removal of old trees containing scars or carvings on them. Dam building and road building causing an increase in surface erosion and possible destruction of buried deposits. Cattle walking across sites causing artefacts to be scuffed, broken or working edges damaged. Trees falling over causing displacement of sub surface artefacts. Bushfire causing a heat distortion effect with surface artefacts and the collection of charcoal. Natural processes can refer to downslope slippage, gully and sheet erosion, and bioturbation by tree roots and insects.

Re-use: This process usually refers to how people may re-use cultural objects in a different way for a different purpose. An example could be stone tools used for another purpose or hearth stones used as anvils etc.

Given the above site disturbance factors, any comparison of open sites and their content, can only be used as an indication of land-use in land unit context. The comparison will be limited in determining the true extent of occupation, unless ground exposure is uniform across several land units and measured at a consistent scale.

7.22 Stone Technology and its variability

Hunter gatherer occupation sites or campsites (ie. rock shelter or open space) are likely to have a broad range of tool types due to the variety of activities undertaken at a site over a certain period of time. These types of sites are contrasted to the more specialized sites where food gathering or hunting requires

a more restricted range of tool kit. Tools that are broken or exhausted are often found at these types of sites as well as resharpening flakes from a tool user carrying out tool maintenance (Kooyman 2000).

Lithic analysis can also lead to information about where a tool may have been manufactured and why it was discarded. The analysis of lithic debitage can also provide information on whether the tool was manufactured close to a quarry site or transported from a distance. Evidence such as the amount of decortification flakes, unmodified or broken flakes or flakes with specific types of platform can all lead to an understanding of the stages of tool manufacture.

Modelling of prehistoric hunter gather behaviours using lithic analysis has led to some researchers to speculate on the level of sedentism or mobility. The assumption that mobility of a group limits the type of the toolkit has been put forward by a number of researches (Walker 1978, Bleed 1986, & Bamforth 1986). Conversely, greater sedentism usually means groups will have a greater range of resources to choose from at one site and thus their toolkits will contain more variety (Odell 1994). The more mobile a group is the more likely they are to standardize their core technology (Odell 1994).

Curation of tools is another important consideration in assessing lithic variability. Odell (1996) argues that curation will usually reduce the need for raw material supply. This leads on to the concept of gearing up or preparing tools in advance of use. This further raises the question of the functionality and versatility of tool types that may or may not tell us something about how prehistoric hunters maximised opportunity when using a range of landscape in the past.

7.23 Sample Size Considerations and Inter-site Comparisons

A recent article by Hiscock (2001) on the effects of sample size on the interpretation of archaeological patterning of Holocene stone artefact assemblages requires some consideration in comparing sites across landscapes. The central issue for most consulting reports is the recording of rarer types of artefacts (ie. backed artefacts) in relation to the entire site assemblage. Comparing the variation of assemblages between sites and using this to define site function may be refuted on the grounds that the sample sizes of site assemblages are too small to provide statistically valid comparisons.

Hiscock explains his proposition by using a hypothetical example:

> *Even in sites where only one specific kind of knapping activity takes place, such as the manufacture of backed artefacts, the various objects employed and created will be probably discarded at different rates. For instance, many flakes will be rapidly discarded, cores are likely to be discarded less frequently, backed artefacts less frequently still, and hammerstones may be rarely thrown away.*
>
> *These differences in the likelihood of discard relate to a number of factors, including the length of "use-life" of each kind of object. When only a few of these objects have been discarded it is likely that the assemblages will be*

> *dominated by only those classes of object that are discarded frequently such as flakes and cores in this example. As occupation of the site continues and the size of the assemblage grows with further discard of material, it is likely that objects such as backed artefacts and hammerstones may be eventually discarded* (Hiscock 2001:50).

Hiscock further argues that a sample required to contain all possible categories of artefacts in a particular locality is proportional to the relative abundance of the rarest artefact type. Thus while some sites or regions with sample sizes of between 50-100 may be adequate, sites in other regions with 1000-10,000 may be too small to provide a more complete assemblage composition or as Orton (1992) has put it, there is no absolute sample size in which all sites or regions are likely to contain an adequate sample of the total variation in assemblage composition.

8 Environmental and Landscape Context

8.1 Land system features of Study Area: General Characteristics

The study area falls within the Sydney Basin physiographic land system (see Murphy & Laurie 1998). Generally the land is described as having low undulating hills and hillslopes from 400-680m above sea level on sandstone plateaux with extensive rock outcrop. Narrabeen Sandstone is the dominant parent rock. Parts have lower colluvial slopes of sandstone plateaux escarpments with low undulating rises and creek flats. Four soil landscapes are found within the study area and these are: Lees Pinch, Ulan, Bald Hill and Munghorn Plateau (see Murphy & Laurie 1998 & Table 5 below).

Table 5: Soil Landscapes of the study area. After Jammell Environmental Planning Services (2005)

Landscape	Landform	Lithology	Typical soils	Limitations
Ulan	Low undulating rises and creek flats. Elevations between 360-570 m. Slopes between 2-10%. Local relief varies between 10-40 m.	*Undifferentiated and Illawarra Coal Measures* Shale, sandstone, conglomerate, chert, coal and torbanite.	Yellow podzolic, yellow solodic/ solonetz, yellow and brown earths, and earthy sands.	Mod to high erosion hazard and susceptible to soil structure degradation. Imperfectly drained on the lower slopes and depressions. High soil salinity levels and low soil fertility.
Lees Pinch	Sandstone plateau and hillslopes with boulder debris. Elevations between 400-680 m. Slopes between 15-40%. Local relief from 60-240m.	*Narrabeen Group and Illawarra Coal Measures* Sandstone, Wollar sandstone, conglomeratic sandstone, chert, shale coal, torbanite.	Shallow siliceous sands, shallow acid s, yellow earths, yellow podzolic s.	Steep slopes are high erosion hazard when cover is low. Very low fertility, acidic surface s. Low to very low water holding capacity and high permeability.

Landscape	Landform	Lithology	Typical soils	Limitations
Munghorn Plateau	Low Undulating hills form plateaux from 600 – 700 m. Slopes from 3 – 10% and local relief varies from 20 – 60 m.	*Narrabeen Group and Illawarra Coal Measures* Sandstone, Wollar sandstone, conglomeratic sandstone, chert, shale coal, torbanite	Shallow siliceous sands, shallow acid s, yellow earths, yellow podzolic s.	High to very high erosion hazard when ground cover is low. Low soil fertility and low water holding capacity.
Bald Hill	Low Hillocks with elevations from 460 – 600 m. Slopes 10-35%. Local Relief from 60 – 120 m. Drainage lines are 300 – 500 m apart	*Tertiary Basalt*, Olivine basalt, dolerite, teschenite.	Euchrozems – chocolate s Intergrades, Chocolate s.	Steep Slopes with rock outcrops; stoniness; mod to high fertility and water holding capacity.

Source: Adopted from DLWC (1998) & Jammell (2005).

8.2 Landform units distribution in the study area

The study area is dominated by numerous intermittent watercourses which flow into Moolarben, Lagoon, Murragamba and Wilpinjong Creek systems. To the north and west of the study area flows the Goulburn River. The area is bounded by a series of sandstone ridge systems (ie. Moolarben, Munghorn & Lennox) of Narrabeen Sandstone which reach elevations of 620 metres. Within the valley of Moolarben Creek, low undulating rises and flats dominate the topography. Relief is 10-40m. The Ulan Soil Landscape makes up approximately 60-70% of the entire study area, followed by the Munghorn Plateau with approximately 15%.

8.3 Climate, Geology and Soils

The climate of the study area has been defined by Edwards (1979) and is described as having rainfall 575 to 670mm, with hot summers and mild to cold winters. The study area is reasonably protected from severe southerly and westerly winds. The geology consists of Triassic Narrabeen Sandstones overlying Permian Sedimentary rocks of the Illawarra Coal Measures. Shale, sandstones, conglomerate, chert, red and green mudstones are found within the study area (Murphy & Laurie 1998). Research shows the greatest influence on soil development within the study area has been the bedrock sandy conglomerate(s) and throughout the majority of soil profiles examined, textures ranged from gravely sandy clay loams to sandy clays.

8.4 Vegetation Communities

The vegetation of the study area has been characterised by Aitkens (2006). His general vegetation community description is set out below.

8.4.1 Vegetation of the Valley Floor

Woodland remnants throughout the predominantly cleared valleys are generally restricted to creek lines and road corridors. Some areas of remnant vegetation also exist as isolated patches within the agricultural landscape. Many of these remnant woodlands and forests are floristically variable, with some being characterised by White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Redgum (*E. Blakelyi*). The community characterised by these species is listed as endangered under the TSC Act and EPBC Act (Grassy White Box Woodland). Woodlands dominated by Rough-barked Apple (*Angophora floribunda*) are commonly found along the creek lines, often in association with Yellow Box (*E. melliodora*) and Blakely's Redgum (*E. Blakelyi*). The adjoining sandy terraces of the Permian geological period also host monotypic communities dominated by Rough-barked Apple (*A. floribunda*). More clayey soils support Grey Box (*E. moluccana*) dominated communities.

Near the juncture of the Triassic and Permian geological formations is a layer of tuff that supports Slaty Box (*E. dawsonii*) woodlands. This vegetation community often supports a grassy understorey similar to the White Box Grassy Woodlands of the central tablelands. Immediately upslope of the Slaty Box (*E. dawsonii*) Woodlands near the footslope to the adjoining ridgeline midslopes are ironbark forests dominated by Narrow-leaved Ironbark (*E. crebra*). Other species may include Caley's Ironbark (*E. caleyi*), Broad-leaved Ironbark (*E. nubula*), Red Stringybark (*E. macrohyncha*) and Grey Gum (*E. punctata*). *Goodenia macbarronii*, an annual herb that is listed as threatened on the TSC Act and EPBC Act, has been located within the majority of these communities, particularly near the juncture between the Triassic and Permian geological formations.

8.4.2 Vegetation of the Midslopes

The majority of the midslopes throughout the locality are vegetated due to the unsuitability of these landscapes for agriculture. A variety of communities occur along these slopes with some being characterised by White Box (*E. albens*), while others being dominated by Ironbark. Soils derived from sandstone are generally characterised by Ironbarks such as Narrow-leaved Ironbark (*E. crebra*) and Broad-leaved Ironbark (*E. fibrosa*). Grey Gum (*E. punctata*) also occurs in association with these species.

Mid slopes with soils derived from shale are generally steep and are relatively fertile in comparison to the sandstone dominated communities, thus supporting a vegetation community dominated by White Box (*E. albens*). Similar vegetation dominated by White Box (*E. albens*) is also found on basalt derived soils, which is comparatively of greater grass and herb diversity to the shale derived woodlands. The understorey of White Box (*E. albens*) is generally grassy with few shrubs. This community is likely to fall under the endangered listing, as specified on the schedules of the TSC Act and EPBC Act (Grassy White Box Woodland).

8.4.3 Vegetation of the Ridgelines

The majority of the ridgelines throughout the locality are vegetated rather than utilised for agriculture, probably due to the poor soil fertility that is associated with Triassic sandstone geologies. Principally, two communities occur throughout this landscape, these being Scribbly Gum (*E. rossii*) woodlands and Ironbark forests. Shale enriched sandy soils are generally characterised by Ironbarks such as Black Cyperus Pine (*Callitris endlicheri*), Narrow-leaved Ironbark (*E. crebra*) and Broad-leaved Ironbark (*E. fibrosa*). Grey Gum (*E. punctata*) and Stringybark (*E. euginoides*) also occur in association with these species. The predominantly shrubby understorey of this broad vegetation class is mostly dominated by prickly species such as *Acrotriche rigida.*

Sandier infertile soils generally support woodland vegetation dominated by Scribbly Gum (*E. rossii*) and Narrow-leaved Ironbark (*E. crebra*). Rocky outcrops throughout these landscapes support localised occurrences of mallee dominated by Dwyer's Redgum (*E. dwyeri*) and various heath species. Creek lines within these landscapes are generally characterised by Scribbly Gum (*E. rossii*) and Parramatta Redgum (*E. parramattensis*), particularly in the first order ephemeral drainage lines. Semi-permanent creeklines are generally supportive of Scribbly Gum (*E. rossii*), Rough barked Apple (*A. floribunda*) and Blakely's Redgum (*E. Blakelyi*).

8.5 Land-use History, Soil Disturbance and ground visibility

Settlement near Ulan began in the 1850's (see Tickle 2006 & Roberts 1974). The first agricultural leases were taken up in 1840's. The first houses built date to the 1850's, with one of the first ones being owned by the McDonalds and made from stone construction. Much of the land clearing began after the 1860's, as gradually pockets of timbered country were removed of scrub. River and large creek flats were favoured for cropping areas with wheat and oats being the main crop types used. This activity brought about some ploughing and surface erosion causing run-off and no doubt disturbing potential Aboriginal occupation.

An area just to the north of where an early bridge crossed the Goulburn River on the Cassilis road is considered to have had permanent water and was favoured by local Aboriginal people as a good source of water.

9 Assessment Methodology: Archaeological & Cultural

The Consultant decided to approach the archaeological and cultural assessment design process using the following methodology:

- Review previous archaeological survey methods and assess their usefulness;
- Consult the local Aboriginal community as to how the ground survey should be carried out and at what scale;
- Consider the rarity of the type of landform that was to be assessed; and

- Consult local Aboriginal community groups on how the cultural assessment should be conducted.

9.1 Coverage Data

The survey coverage data was recorded in the following way:

Survey Team / Survey Unit
Survey Transect Location (GPS amgs)
Land Unit
Slope
Exposure/Feature Type
Visibility of Ground Surface
Vegetation Cover
Vegetation type
Land-use
Drainage Type
Distance to water
Soil and rock type
Erosion Type
Cultural Evidence present

9.2 Field recording Methods

The consultant put together a ten person survey team consisting of himself, a senior archaeologist, two archaeological field assistants and six Aboriginal field assistants. The survey was conducted over a 35 day period. Sample areas were defined by three main constraints (see Figures 4 & 5) these being:

- Areas designated within the MCP area;
- Available bare ground surface to detect sites; and
- The level of disturbance likely for mine development activity areas.

The main mine footprint area of disturbance is located within Open Cuts 1-3 and the proposed Infrastructure area. An area known as Underground No 4 is also proposed for underground development.

9.2.1 Field Assessment Search Strategies

The development of effective techniques for detecting archaeological cultural materials is an essential objective of the field assessment search strategy to provide accurate characterizations of significant attributes of the surface archaeology in the MCP. Design issues both practical and theoretical were addressed in setting out the overall strategy for the search team to pursue in its daily operation. At the centre of the approach is a sampling strategy utilizing

transects to obtain data sets from key landscape units that will be impacted by the MCP.

The approach applied in the course of the survey also takes into account past land use practices that may alter or otherwise modify the preservation, visibility, and distribution of cultural deposits that were formed in the landscape prior to the arrival of pastoralism. The following discussion reviews the key elements in the search design.

9.2.2 Transect Definition

In this study the area of the land unit designated for survey is referred to as the "Transect" which is the land that is set aside from surrounding landscape for the purpose of obtaining sample records. It is an area with clearly delineated boundaries that can be systematically mapped for the purposes of describing its archaeological content. The ideal shape of a transect is a linear polygon that gains at least one of its boundaries by an obvious line such as a fence, track, a row of trees, or a row of flags to serve as a guide to orient the search team at the time of initial formation.

In practice the area finally searched however often mirrored the shape of a pasture or was constrained at least at one of its borders by natural features such as the sinuous alignment of a creek bed, rocky outcrops, or the outer margins of a farm track. Some transects coincided entirely with human made boundaries, such as vehicle tracks, boundary fences, and walking trails because of heightened ground exposure levels offered by these features.

9.2.3 Transect Placement

The placement of transects was influenced most strongly by combined theoretical and practical considerations. While detailed rationale are presented in the context of individual transects below, the general principles are summarized here as follows.

9.2.3.1 Practical Constraints

- Access is limited to land with owner permission and conditional on owner requests to avoid damage to crops, stock disturbance, or scheduled activities such as lambing, ploughing, etc. Fluctuating conditions of access in some cases prevented the completion of survey activity and in one instance access was withdrawn the time of survey.

- Heavy rainfall created saturated conditions that either prevented access in certain situations or postponed survey activity for a period of time.

- Precipitous topography, especially in escarpment landscape limited access and confined routine inspection of rock shelters to areas with greater ease of access that did not require advanced climbing skills to search.

- Steep terrain presented safety risks to search team personnel and therefore searches were managed according to the health needs of members who would otherwise be at an unacceptable risk.

- A portion of the land unit that was considered to have less than 20% surface visibility was usually eliminated owing to a reduced opportunity to detect the surface archaeology.

- Transect placement attempted to avoid land in which extensive drainage diversion channels and associated surface scraping were considered to have severely altered the surface archaeology. Land modification of this type was most pronounced in the low-to-mid-slope landscapes in Open Cut 3 and in the vicinity of the airstrip in Open Cut 1.

9.2.3.2 Aboriginal Inputs to Placement

- The opinion of Aboriginal members of the search team were routinely sought in the placement of transects in each of the open cut study areas. This resulted in the creation or widening of search areas in OC1 (2 transects covering spurs intersecting with Transect 1), IS (widening of the main long transect on Bora Creek).

9.2.3.3 Theoretical Issues

- A principal theory underpinning the sampling strategy considers that the energy available for human habitation increases along an axis running down the catchment and accordingly residential patterns will be influenced by the flow of water. This model suggests that the biomass increases and the food chain lengthens with the accumulation and flow of water in the drainage network from its headwaters to the lower catchment and that cultural responses to gravity can be measured in terms of discard patterns as a function of topographic relief;

- In its simplest form, this model is based on the theory that the influence of human populations on one another is inversely proportional to the distance between them and that occupation intensity and technological and economic diversity as expressed in terms of artefact density, functional diversity, and organizational complexity will increase downstream. The energy harnessed in a given landscape is derived from the flow of resources originating further up the catchment under the influence of such factors as windfall energy transfer through the habitat (profits), habitat stability, precipitation rates, environmental stress and the distribution of natural resources in the landscape, just to name a few examples of environmental factors; and

- Transect alignment to document these responses should then ensure that this pattern is adequately captured by obtaining samples representing topographic relief, prominent soil types, and major vegetation regimes. Transects should be oriented at right angles and parallel to gradient change and they should furthermore sample cultural materials discarded at various points between the

lowest and highest elevations in the study area. The ideal orientation of the sample areas sought in the MCP extended along drainage lines, from the drainage line up slope into mid-slope locations, and again parallel and at right angles to ridge tops and escarpment systems. The selection of areas in which to conduct the search, while guided by theoretical concerns, were nevertheless influenced by the practical constraints discussed above.

9.2.4 Transect Size

The transect should be large enough to record the primary attributes of depositional characteristics of cultural materials discarded at any one point in the landscape, concentrating especially on clustering behaviour, boundary limits, site size, industrial character, and artefact density. The most appropriate size is typically determined experimentally during the course of the survey (see Figures 4 & 5).

9.3 Survey Search Techniques: how they were done and their objectives

9.3.1 Basic Search Technique

The basic search technique (BST) deployed for this project is designed to detect the highest number of artefacts across the entire transect area to give a reasonably accurate account of 100% of the visible surface archaeology. To accomplish this, search team personnel were asked to space themselves at intervals of 6-8m at a starting point in the transect and move slowly forward in a line searching the ground surface and flagging any cultural materials identified as they passed over them (see Photograph 1). Individuals were encouraged to fully search areas with the greatest exposure, such as scalds and eroded surfaces, openings in vegetation and cuttings.

Photograph 1 Seen here surveying OC3 at Moolarben Creek applying BST in wet conditions, the search team formed comparatively straight lines in open pastures to locate and flag cultural materials on the ground. With ground visibility here estimated to average 50±10%, the team effectively identified all medium to large sized stone artefacts in the transect

Objects were picked up for inspection to confirm artefact identification and if doubts arouse, the supervising archaeologist was asked to make a judgment. The progress of the search was expected to slow considerably in areas of high visibility to enable comprehensive detection to take place. This process commenced at an established boundary, such as a fence or a line of trees and when the full length of the transect was searched, the team reversed the process towards the opposite end, with the inside boundary of the search being marked by a line of flags.

A series of sweeps would then be taken in this manner until all of the transect had been inspected. Shape irregularities in the transect required customized adjustments of this process to guarantee that all areas were covered uniformly. This technique prevents gaps or holes from occurring in the area actually searched and allowed the search to progress rapidly and effectively across all of the area contained within the transect.

The size of the search team varied between 8-4 members depending on the availability of personnel at any given time. The supervising archaeologist was present at all times and is included in this figure of team size.

Variations in the objectives and field conditions gave rise to the development of additional search techniques. Descriptions of these are as follows;

9.3.2 The Walk Over Search Technique

The walk over search technique (WOST) is aimed at gaining a first impression of the larger cultural materials in a transect in which impairment in visibility caused by standing vegetation, fallen timber, and heavy rock scree rendered detection of

smaller objects nearly impossible to achieve. Rock shelters, scarred trees, boulder faces with grinding grooves, rock water holes, and artistic images are typically identified in a walk over. Smaller objects in the cultural materials inventory such as stone flakes and other elements in the stone technology are considered too small and obtrusive to routinely detect in this type of setting using this technique. This approach was applied in the Moolarben surveys on or at the boundary of ridge top transects and in gully landscapes in which the prevailing impediments to detection are heavy forest cover, abundant plant litter, differential lighting conditions, and abundant boulder fields and rock outcrops.

9.3.3 Intensive Search Technique

The objective of the intensive search technique (IST) is to closely examine surface exposure in which low numbers of artefacts are expected to occur but detection is considered to be difficult due to abundant gravel or stone accumulation that hamper identification. This technique was deployed in creek beds running through gully floor sediments, which typically are exposed in vertical embankments, infill fans, or animal burrows in OC1. It was occasionally employed in the alluvial valley transects in order to investigate small scale fine grain artefact concentrations where visibility patterns allowed only limited vision, and, whether carried out in the valley or gully landforms, the search proceeded at a crawl, often with team members stooping over or assuming positions on their knees. The purpose of this technique is to gain detailed artefact records of habitation in potentially significant landscape features where exposure is geographically so limited as to require special search responses.

9.3.4 Shelter Search Technique

Natural rock shelters, overhangs, and shelters created by leaning stone slabs were specifically targeted for systematic inspection by the shelter search technique (SST), with four objectives being identified. These were to identify and describe:

- Artefacts on both floor sediments and the adjacent talus slope that typically form at the outside edge of sandstone ceilings beyond the dripline. Searches of the talus were expected to be thorough and comprehensive, but compliance rates depended on the preference of individual search team members, some devoting seconds, others minutes of search time;

- Sedimentary sections exposing floor deposits created in animal burrows or by erosion so as to evaluate the depth of accumulation and possible artefact content;

- Artistic images on the walls and ceiling of the enclosed space; and

- Grinding grooves in rocks inside or adjacent to the shelter.

9.3.5 Principles of the Search

There are several technical issues addressed in the design of the search as an operation that were addressed in the MCP. These are the following:

- The principle of searching areas within a given transect where visibility permitted detection was seen as a major objective of the search strategy. Where visibility was greater than an estimated 50%, search team personnel were asked to inspect 100% of the ground surface. Conversely, where visibility was less than an estimated 20%, and hence detection levels were greatly reduced, the area was considered unsuitable;

- Some cultural materials such as anvils, cores, hammers and grinding stones are large enough to locate despite limitation in visibility. Conversely, the smaller component of core reduction processes in tool manufacture is typically too small to consistently detect by the techniques adopted in this project; and

- An essential objective of the basic search technique was to ensure that uniform coverage was maintained so that artefact inventories could be regarded as a reliable indicator of the surface archaeology. This approach is considered to produce more accurate records than the practice adopted by previous projects of spacing searchers 50 m apart and allowing rapid movement across the transect regardless of different conditions of visibility.

9.3.6 Visibility In Transects

The effective coverage maintained by survey personnel is a measure of both the area of the ground surface that is available for viewing and that which is in some way obscured from vision. Visibility is usually expressed in terms of a percentage of the visible surface area and should be accompanied with an expression of the variability across the search area. Some of the factors affecting visibility include the standing vegetation, breakdown products of plant fibre, layers of sediment overfill, and accumulations of stone, timber and other naturally occurring materials. A comparison of survey results between transects should take in to account the influence differences in visibility exert on the findings. The following observations summarize the main issues encountered in calculating visibility across landforms surveyed up to this point.

9.3.7 Pastures

Pastures blanket the valley floor and extend upwards to mid-slope locations where rocks commonly outcrop. They constitute more that 90% of the development footprint. A freshly ploughed pasture offers the best visibility until crop growth or grazing changes the character of ground cover and the nature of the ground surface itself. A comparison of three groups of transects on the drainage lines illustrates the role localized environmental and land use patterns strongly influence the detection of cultural materials in pastures with different histories.

Photograph 2:
Shown here in IS Transect No 8 (encompassing an erosion gully caused by diversion of surface runoff through a railroad culvert) is a typical example of marked differences in visibility patterns seen at a micro-scale between the red soil and the stubble in the surrounding pasture. Visibility of the red soil is estimated at greater than 90%, whereas that of the pasture varies between 30-70% per square metre due to different quantities of loose plant material, live weeds, and matting formed by a combination of both plant material and fine sediment. Search team members were asked to slow the search to concentrate in areas of high visibility such as this. As expected, no artefacts were discovered here.

The paddocks with the best visibility in conditions presenting the lowest degree of variability are located on Moolarben Creek (Transects 6-9) east of Ted Mayberry's place. The area was freshly ploughed 2-3 months ago and exhibit short crop growth that is estimated to obscure 10% of the ground surface, giving an effective coverage of 90%. In this case, the tilling appears to have imposed uniform visibility by removing the vegetation and therefore the effective cover applies evenly across each of the sample transects.

By contrast, other paddocks close to drainage lines exhibited markedly different conditions that obstructed artefact detection in several significant ways. In the case of the transects in the lease area at Bora Creek, the top soil has been compacted by cattle and signs of tilling have almost completely disappeared, (see Plate 2). Stubble from the last harvest and a living broad leaf weed were abundant in patches – these totally obscured the ground surface in some areas. Furthermore, a thin matt consisting of stubble, loose plant fibre and a fine-grained sediment formed an irregular mosaic in the pasture, with distinctive patches spread over hundreds of square metres. Despite the fact that it is a thin veneer and blends well with the ground itself, this matt obscures almost everything beneath it, blotting out any small artefacts that may be present. It is not possible without resorting to fine grained mapping of this situation to calculate the areas affected in this way, but casual observation suggests that it is less invasive in the northern portion of the main long transect at Bora Creek and that it is often patchy in the remainder of the transect. It is incidental elsewhere on the lease area. This evidence suggests a markedly uneven visibility ranging from $\leq$ 20% -70% per square metre in the transect as a whole. I have observed that artefacts "disappear" from view near the edge of this matt, which leads to the conclusion that site boundary definition in this paddock is most likely an artefact of visibility rather than either discard behaviour or dispersal mechanisms associated with cultivation.

A transect in IS (the last one completed that extends into Bora Creek at the highway verge, is nearly devoid of vegetation and while it is by definition "bare," trampling by cattle when the soil was saturated has compressed almost all rock into the ground within the fenced paddock. In this situation, artefact detection is locally difficult to achieve owing to the formation of a fine sediment coating, which

in my estimation obscures 30% of the ground surface. Accordingly the visibility factor is 70% ±10 for this small transect.

9.3.8 Mid-Slope Transects

The visibility in transects located in this section of the landscape is generally the product of partial vegetation modification at the upper margins of the cultivation zone and the existence of natural stands of vegetation that may contain a mixture of indigenous and exotic species. Exposures with greater than 20% visibility are typically confined to former residential clearings, farm or logging tracks, and fire affected openings and the opportunities for artefact detection are necessarily limited. Searches have accordingly concentrated on these areas wherever possible owing to the generally closed nature of the forest setting generally. In light of this the visibility observed in the tracks, while highly variable, provided the best opportunity to examine the surface archaeology. As measured across the full width of track transects, the visibility ranges in this position in the landscape type between 30-80%.

9.3.9 Ridge Top and Escarpment Transects

Photograph 3: *Rock escarpment OC1 Gully 3*

Visibility estimates for the higher more precipitous settings in the study area are much more difficult to calculate than any other landscape type owing to contrasting vegetation growth patterns, plant litter, and the imposing contribution presented by sandstone formations and their associated scree slopes (see Plate 3). Bare rock is present everywhere including on animal paths and beneath the understorey that typically is dense and difficult for searchers to penetrate.

Soil appears to be limited in distribution on slopes and is typically exceedingly thin. Lighting conditions, sometimes presenting as harsh contrasts of light and dark or made dim on overcast days significantly hampered artefact recognition. The only location in this landscape in which artefact searches could realistically succeed in the time schedules provided included animal paths or tracks and around the opening of shelters. Visibility of these particular areas is estimated to vary between 60-95% per square metre, but the areas themselves are unlikely to represent as much 5% of the total transect area being searched.

9.4 Recording Field Results

A team of archaeologists followed the search team through the field survey compiled records containing essential data for a subsequent analysis and characterization of the area's local archaeology. At least one archaeologist with advanced professional experience was engaged in this process with the team and made all final decisions in respect to environmental description of the transect and the content of cultural materials flagged by the team of searchers.

The MCP made available a surveyor to record the exact position of each artefact located in the study throughout the field recording process. The capacity to analyse each locality as a discrete site if necessary gives the project unparalleled capacity, along with high standards in compiling an accurate site inventory, to provide detailed descriptions of artefact distribution patterns, density statements and boundary definitions that meet the current standards of best practice in the heritage field throughout Australia.

9.5 Recording Archaeological Data

In addition to the above, the Consultant drew a sketch map of each site relating any local features to the site's landscape context. Artefactual data was recorded about artefact types, artefact size and attribute criteria summarised below.

Table 6: Artefact types, artefact size and attribute criteria

Artefact Type	**(see Glossary of Terms Appendix 4)**
Artefact Dimensions	All artefacts were measured according to maximum length, width and thickness in mm. A vernier calliper was used for all block measurements.
Raw Material	Type of raw material (see Glossary of Terms)
Raw material Cortex	This was recorded as a% of the total artefact surface
Platform Type	Board or Focal
Termination Type	Feather, Hinge, Plunge
Present or Absence of retouch	Number of edges
Use-wear	Only where the evidence was clear using a x10 hand lens

9.6 Cultural Assessment Process

The consultant invited members of the Aboriginal community groups to participate in a cultural assessment process. This was done both informally and formally, through letter and a community consultation meeting (see Appendix 3).

10 Survey Coverage Data:

The survey area consists of three main landform types:

- Ulan Soil Landscape: consisting principally of Moolarben and Lagoon Creek Valleys;
- Lees Pinch Soil Landscape: consisting of Sandstone Mid Slopes and Rock outcrops
- Munghorn Plateau: consisting elevated steep upper slopes, cliff-lines, ridge crests, tors and pinnacles

Factors limiting survey coverage were:

- Tree and leaf litter ground cover;
- Grass cover;
- Disturbed soil areas such as quarry locations and associated vehicle tracks; and
- Tree clearing within the forest.

The MCP area is approximately 34.8 km^2. Of this 34.8 km^2 area, approximately 80% (28km^2) has no ground surface visibility due to forest or pasture grass vegetation cover (see Figures 4 & 5). Apart from sandstone formations (cliff lines features, pinnacles and tors) within the escarpment areas, sheet erosion caused by animal grazing, forestry track development and some road and quarry extraction areas were the only available ground surface to assess for buried or exposed artefactual material.

A total of 84 transects were completed within the MCP (see Figures 4 & 5, Photographs 1-3 and Plates 1-11).

The assessment of scarred trees was made based on the criteria that older mature box and red gum species were likely to contain cultural scars and therefore were targeted by surveyors on the ground.

10.1 Effective Survey Coverage Analysis:

Effective Coverage is defined as a statement of how much of the survey area was covered which could have revealed sites.

Thus the formula for effective coverage is:

(sample area) x (c) x (e) x (v) x (b) = effective coverage

10.2 Areas foot surveyed; MCP

10.2.1 Exploration Lease

Total area of Study Area Exploration Lease = 34.8 km^2 (348000000 m2)

Total area available for foot survey= 6. 8km^2 (680000000m^2)

Approximately [62]% or [4.2km^2] 42000000m^2 of available Exploration Lease was surveyed on foot (see Figure 5).

Background = 75%

Average Visibility = 25%

Exposure = 50%

Effective Coverage is defined as a statement of how much of the survey area was covered which could have revealed sites.

Thus the formula for effective coverage is:

(sample area) x (c) x (e) x (v) x (b) = effective coverage

or [42,000,000] m^2 x [0.50] x [0.25] x [0.75] = [3,937,500] m^2

Thus [57]% of the available Exploration Lease area could be said to be effectively covered.

11 Archaeological Survey Result and Recording of Sites

A total of 1,299 Aboriginal Objects have been recorded as a result of the survey assessment (222 Sites). This cultural record is made of: 156 individual stone artefact isolated finds, 47 open stone artefact scatter sites of varying densities, 17 rock shelter sites with artefacts and/or art, a scarred tree site, a grinding groove site and 12 Potential Archaeological Deposits.

There are also 3 known registered Aboriginal sites also likely to be effected by the proposal, these are: 36-3-0042, 36-3-0222 and 36-3-0223 (see Figures 6-9: Table 7 below). A majority of this record (87%) is made up of exposed stone artefactual material eroding from cleared pasture land and forestry tracks with less than 10 artefacts in density.

The most concentrated occupation areas located within the MCP area are:

- Central Moolarben Creek Alluvial Flats: Mayberry Property Open Cut 3;
- Underground No 4 Northern Ridge Lines: Westwood Property; and

- Bora Creek Alluvial Flats: Ulan Coal Mines Property leased by Malcolm Powers.

(see Figures 8 & 9).

Table 7: Showing survey results of the Moolarben Coal Project Exploration Lease assessment. S1MC= Stage 1 Moolarben Coal

MOOLARBEN COAL ARCHAEOLOGICAL SITES SUMMARY TABLE:
Subsidence Risk Rating L=Low, M=Moderate, High=High

Stage 1 Approvals Area S1MC=Stage 1 Moolarben Coal I=Impacted P=Preserved

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 1	S1MC1	Scarred Tree	760670	6424444	1	I	OC 1/T4
Stage 1: Open Cut 1	S1MC2	Artefact Scatter	760840	6424339	14	I	OC 1/T4
Stage 1: Open Cut 1	S1MC3	Isolated Find	760846	6424309	1	I	OC 1/T4
Stage 1: Open Cut 1	S1MC4	Isolated Find	760866	6424307	1	I	OC 1/T4
Stage 1: Open Cut 1	S1MC5	Artefact Scatter	760867	6424306	3	I	OC 1/T4
Stage 1: Open Cut 1	S1MC6	Isolated Find	760890	6424301	1	I	OC 1/T4
Stage 1: Open Cut 1	S1MC7	Isolated Find	760867	6424294	1	I	OC 1/T4
Stage 1: Open Cut 1	S1MC8	Isolated Find	760548	6424002	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC9	Isolated Find	760508	6424018	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC10	Isolated Find	760645	6424004	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC11	Artefact Scatter	760924	6423968	3	I	OC1/T5
Stage 1: Open Cut 1	S1MC12	Isolated Find	760933	6423948	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC13	Isolated Find	761054	6423910	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC14	Isolated Find	761050	6423907	1	I	OC1/T5
Stage 1: Open Cut 1	S1MC15	Isolated Find	761252	6425269	1	I	OC1/T6
Stage 1: Open Cut 1	S1MC16	Isolated Find	761168	6425107	1	I	OC1/T7
Stage 1: Open Cut 1	S1MC17	Isolated Find	760997	6425271	1	I	OC1/T7
Stage 1: Open Cut 1	S1MC18	Isolated Find	759777	6425026	1	P	OC1/T8
Stage 1: Open Cut 1	S1MC19	Isolated Find	759786	6425012	1	P	OC1/T8
Stage 1: Open Cut 1	S1MC20	Isolated Find	759816	6425028	1	P	OC1/T8
Stage 1: Open Cut 1	S1MC21	Isolated Find	760296	6425214	1	I	OC1/T8
Stage 1: Open Cut 1	S1MC 22	Isolated Find	760297	6425216	1	I	OC1/T8
Stage 1: Open Cut 1	S1MC 23	Isolated Find	760269	6425239	1	I	OC1/T8
Stage 1: Open Cut 1	S1MC24	Isolated Find	760514	6425250	1	I	OC1/T8
Stage 1: Open Cut 1	S1MC25	Isolated Find	761802	6425783	1	I	OC1 T10
Stage 1: Open Cut 1	S1MC26	Isolated Find	761766	6425183	1	P	OC1 T10
Stage 1: Open Cut 1	S1MC27	Isolated Find	761828	6425100	1	P	OC1 T10
Stage 1: Open Cut 1	S1MC28	Isolated Find	761627	6425002	1	P	OC1 T10
Stage 1: Open Cut 1	S1MC29	Isolated Find	761619	6424707	1	P	OC1 T10
Stage 1: Open Cut 1	S1MC30	Isolated Find	761135	6424559	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC31	Isolated Find	761132	6424567	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC32	Isolated Find	761124	6424585	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC33	Isolated Find	761125	6424584	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC34	Isolated Find	761128	6424583	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC35	Isolated Find	761125	6424584	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC36	Isolated Find	761255	6424616	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC37	Isolated Find	761255	6424616	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC38	Isolated Find	761279	6424617	1	I	OC1 T11
Stage 1: Open Cut 1	S1MC39	Isolated Find	761279	6424617	1	I	OC1 T11
Stage 1: Open Cut 1	PAD 1	Pad 1	761452	6424581	N/A	P	OC1 T11

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 1	PAD 2	Pad 2	761265	6423464	N/A	P	OC1 T14
Stage 1: Open Cut 1	PAD 3	Pad 3	761265	6423392	N/A	P	OC1 T14
					56		
Stage 1: Open Cut 2	S1MC40	Artefact Scatter	760441	6421958	12	I	OC2 T1
Stage 1: Open Cut 2	S1MC41	Isolated Find	760384	6421732	1	I	OC2 T1
Stage 1: Open Cut 2	S1MC42	Isolated Find	760408	6421838	1	I	OC2 T1
Stage 1: Open Cut 2	S1MC43	Artefact Scatter	760558	6421874	9	I	OC2 T2
Stage 1: Open Cut 2	S1MC44	Isolated Find	760550	6421657	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC45	Isolated Find	760582	6421721	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC46	Isolated Find	760547	6421941	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC47	Isolated Find	760637	6422033	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC48	Isolated Find	760569	6421916	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC49	Isolated Find	760543	6422069	1	I	OC2 T2
Stage 1: Open Cut 2	S1MC50	Isolated Find	760340	6422126	1	I	OC2 T3
Stage 1: Open Cut 2	S1MC51	Isolated Find	760434	6422195	1	I	OC2 T3
Stage 1: Open Cut 2	S1MC52	Isolated Find	760422	6422175	1	I	OC2 T3
Stage 1: Open Cut 2	S1MC53	Artefact Scatter	759942	6422062	39	I	OC2 T4
Stage 1: Open Cut 2	S1MC54	Artefact Scatter	760966	6421764	3	P	OC2/T6
Stage 1: Open Cut 2	S1MC55	Rockshelter&Artefacts	760964	6421902	8	P	OC2/T7
Stage 1: Open Cut 2	S1MC56	Rockshelter&Artefacts	760936	6421882	1	P	OC2/T7
Stage 1: Open Cut 2	S1MC57	Artefact Scatter	760906	6421882	16	P	OC2/T7
Stage 1: Open Cut 2	S1MC58	Artefact Scatter	761241	6419040	10	I	OC2 T16
Stage 1: Open Cut 2	S1MC59	Artefact Scatter	761274	6419089	8	P	OC2 T16
Stage 1: Open Cut 2	S1MC60	Artefact Scatter	761555	6418906	12	P	OC2 T16
Stage 1: Open Cut 2	S1MC61	Isolated Find	761650	6418891	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC62	Isolated Find	761503	6418958	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC63	Isolated Find	761502	6418979	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC64	Isolated Find	761502	6418979	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC65	Isolated Find	761382	6418984	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC66	Artefact Scatter	761345	6418974	24	P	OC2 T16
Stage 1: Open Cut 2	S1MC67	Artefact Scatter	761298	6418996	52	P	OC2 T16
Stage 1: Open Cut 2	S1MC68	Isolated Find	761300	6419026	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC69	Isolated Find	761300	6419031	1	P	OC2 T16
Stage 1: Open Cut 2	S1MC70	Isolated Find	761427	6419023	1	P	OC2/T17
Stage 1: Open Cut 2	S1MC71	Isolated Find	761427	6419023	1	P	OC2/T17
Stage 1: Open Cut 2	S1MC72	Isolated Find	761421	6419023	1	P	OC2/T17
Stage 1: Open Cut 2	S1MC73	Isolated Find	761429	6419089	1	P	OC2/T17
Stage 1: Open Cut 2	S1MC74	Isolated Find	761687	6419730	1	P	OC2/T18
Stage 1: Open Cut 2	S1MC75	Isolated Find	761683	6419722	1	P	OC2/T18
Stage 1: Open Cut 2	S1MC76	Isolated Find	761683	6419722	1	P	OC2/T18
Stage 1: Open Cut 2	S1MC77	Isolated Find	761597	6419653	1	P	OC2/T18
Stage 1: Open Cut 2	PAD 4	Pad 4	761685	6419735	N/A	P	OC2 T7
Stage 1: Open Cut 2	PAD 5	Pad 5	761685	6419735	N/A	P	OC2 T7
Stage 1: Open Cut 2	PAD 6	Pad 6	761341	6420748	N/A	P	OC2 T7
					220		

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 3	S1MC78	Artefact Scatter	761628	6417183	12	I	OC3/T1
Stage 1: Open Cut 3	S1MC79	Isolated Find	761592	6417154	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC80	Isolated Find	761535	6417281	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC81	Isolated Find	761547	6417308	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC82	Isolated Find	761563	6417309	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC83	Isolated Find	761557	6417330	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC84	Artefact Scatter	761580	6417360	6	I	OC3/T1
Stage 1: Open Cut 3	S1MC85	Isolated Find	761613	6417323	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC86	Isolated Find	761612	6417508	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC87	Isolated Find	761615	6417500	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC88	Isolated Find	761608	6417465	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC89	Isolated Find	761591	6417421	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC90	Isolated Find	761579	6417403	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC91	Isolated Find	761631	6417624	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC92	Isolated Find	761659	6417596	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC93	Isolated Find	761659	6417588	1	I	OC3/T1
Stage 1: Open Cut 3	S1MC94	Artefact Scatter	761638	6417728	3	I	OC3/T1
Stage 1: Open Cut 3	S1MC95	Isolated Find	762537	6415994	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC96	Isolated Find	762530	6416009	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC97	Isolated Find	762523	6416029	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC98	Isolated Find	762475	6416038	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC99	Isolated Find	762553	6416059	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC100	Isolated Find	762414	6416282	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC101	Isolated Find	762415	6416282	1	I	OC3/T2
Stage 1: Open Cut 3	S1MC102	Artefact Scatter	762379	6416477	3	I	OC3/T2
Stage 1: Open Cut 3	S1MC103a	Artefact Scatter	762693	6416081	2	I	OC3/T2
Stage 1: Open Cut 3	S1MC103	Artefact Scatter	763978	6415601	184	I	OC3/T3
Stage 1: Open Cut 3	S1MC104	Artefact Scatter	764042	6415564	4	P	OC3/T3
Stage 1: Open Cut 3	S1MC105	Isolated Find	763996	6415683	1	P	OC3/T3
Stage 1: Open Cut 3	S1MC106	Isolated Find	764013	6415735	1	P	OC3/T3
Stage 1: Open Cut 3	S1MC107	Isolated Find	766017	6415739	1	P	OC3/T3
Stage 1: Open Cut 3	S1MC108	Isolated Find	764026	6415756	1	P	OC3/T3
Stage 1: Open Cut 3	S1MC109	Isolated Find	764023	6416068	1	P	OC3/T4
Stage 1: Open Cut 3	S1MC110	Isolated Find	764118	6416246	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC111	Isolated Find	764135	6416310	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC112	Isolated Find	764136	6416312	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC113	Isolated Find	764140	6416326	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC114	Isolated Find	764148	6416337	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC115	Isolated Find	764124	6416425	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC116	Isolated Find	764114	6416357	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC117	Isolated Find	764095	6416462	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC118	Isolated Find	764026	6416575	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC119	Isolated Find	764027	6416566	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC120	Isolated Find	764095	6416601	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC121	Isolated Find	764111	6416632	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC122	Isolated Find	764066	6416619	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC123	Isolated Find	764064	6416622	1	P	OC3/T5

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 3	S1MC124	Isolated Find	764070	6416630	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC125	Isolated Find	764058	6416612	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC126	Isolated Find	764056	6416612	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC127	Isolated Find	764121	6416573	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC128	Isolated Find	764161	6416333	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC129	Isolated Find	764118	6416557	1	P	OC3/T5
Stage 1: Open Cut 3	S1MC130	Artefact Scatter	762600	6418163	23	P	OC3 T6
Stage 1: Open Cut 3	S1MC131	Isolated Find	762763	6418104	1	P	OC3 T6
Stage 1: Open Cut 3	S1MC132	Artefact Scatter	763451	6417107	33	P	OC3 T6
Stage 1: Open Cut 3	S1MC133	Artefact Scatter	763477	6417119	7	P	OC3 T6
Stage 1: Open Cut 3	S1MC134	Isolated Find	763507	6417086	1	P	OC3 T6
Stage 1: Open Cut 3	S1MC135	Artefact Scatter	763535	6417042	32	P	OC3 T6
Stage 1: Open Cut 3	S1MC136	Artefact Scatter	762737	6417948	5	P	OC3 T6
Stage 1: Open Cut 3	S1MC137	Isolated Find	762338	6418398	1	P	OC3 T6
Stage 1: Open Cut 3	S1MC138	Isolated Find	762315	6418451	1	P	OC3 T6
Stage 1: Open Cut 3	S1MC139	Artefact Scatter	762549	6417807	23	I	OC3 T7
Stage 1: Open Cut 3	S1MC140	Artefact Scatter	761278	6416654	4	P	OC3 T8
Stage 1: Open Cut 3	S1MC141	Isolated Find	761409	6416796	1	I	OC3 T8
Stage 1: Open Cut 3	S1MC142	Isolated Find	761479	6417036	2	I	OC3 T8
Stage 1: Open Cut 3	S1MC143	Artefact Scatter	761535	6417066	3	I	OC3 T8
Stage 1: Open Cut 3	S1MC144	Isolated Find	761519	6417142	1	I	OC3 T8
Stage 1: Open Cut 2	PAD 8	Pad 8	761478	6421053	0	P	OC2 T13
Stage 1: Open Cut 2	PAD 9	Pad 9	761552	6421040	0	P	OC2 T13
Stage 1: Open Cut 2	PAD 10	Pad 10	761551	6421051	0	P	OC2 T13
Stage 1: Open Cut 2	PAD 11	Pad 11	761426	6420964	0	I	OC2 T13
Stage 1: Open Cut 2	PAD 12	Pad 12	761318	6420832	0	I	OC2 T14
Stage 1: Open Cut 3 Ext	PAD 13	Pad 13	763275	6413124	0	P	OC3extT16
Stage 1: Open Cut 3 Ext	PAD 14	Pad 14	763364	6413260	0	P	OC3extT16
Stage 1: Open Cut 3 Ext	S1MC145	Artefact Scatter	763522	6414627	3	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC146	Isolated Find	763547	6414737	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC147	Isolated Find	763601	6414489	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC148	Isolated Find	763547	6414737	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC149	Isolated Find	763670	6414648	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC150	Isolated Find	763671	6414682	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC151	Isolated Find	763665	6414695	1	TBA	OC3extT1
Stage 1: Open Cut 3 Ext	S1MC152	Rockshelter&Artefact	762957	6412252	1	TBA	OC3ext T2 rock shelter
Stage 1: Open Cut 3 Ext	S1MC153	Isolated Find	763109	6412564	1	TBA	OC3ext T2
Stage 1: Open Cut 3 Ext	S1MC154	Isolated Find	763112	6412564	1	TBA	OC3ext T2
Stage 1: Open Cut 3 Ext	S1MC155	Artefact Scatter	763104	6412606	18	TBA	OC3ext T2
Stage 1: Open Cut 3 Ext	S1MC156	Isolated Find	763053	6412682	2	TBA	OC3ext T2
Stage 1: Open Cut 3 Ext	S1MC157	Artefact Scatter	762857	6412127	36	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC158	Isolated Find	762720	6412108	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC159	Isolated Find	762658	6412095	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC160	Isolated Find	762654	6412088	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC161	Isolated Find	762717	6412091	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC162	Isolated Find	762984	6412134	1	TBA	OC3extT3

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 3 Ext	S1MC163	Isolated Find	762995	6412127	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC164	Isolated Find	762995	6412127	1	TBA	OC3extT3
Stage 1: Open Cut 3 Ext	S1MC165	Artefact Scatter	763188	6412062	104	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC166	Isolated Find	763233	6412120	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC167	Isolated Find	763173	6411950	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC168	Artefact Scatter	763233	6411903	9	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC169	Isolated Find	763250	6411971	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC170	Isolated Find	763269	6411989	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC171	Isolated Find	763307	6412060	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC172	Isolated Find	763240	6412147	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC173	Artefact Scatter	763325	6412115	9	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC174	Isolated Find	763249	6412171	1	TBA	OC3extT4
Stage 1: Open Cut 3 Ext	S1MC175	Artefact Scatter	763336	6412136	67	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC176	Isolated Find	763440	6412219	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC177	Isolated Find	763440	6412219	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC178	Isolated Find	763419	6412217	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC179	Isolated Find	763424	6412217	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC180	Isolated Find	763401	6412202	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC181	Isolated Find	763387	6412195	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC182	Isolated Find	763382	6412187	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC183	Isolated Find	763376	6412189	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC184	Isolated Find	763372	6412183	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC185	Isolated Find	763372	6412183	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC186	Isolated Find	763370	6412173	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC186	Isolated Find	763379	6412170	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC187	Isolated Find	763330	6412171	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC189	Isolated Find	763362	6412199	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC190	Isolated Find	763375	6412200	1	TBA	OC3ext T5
Stage 1: Open Cut 3 Ext	S1MC191	Isolated Find	764653	6413756	1	TBA	OC3extT6
Stage 1: Open Cut 3 Ext	S1MC192	Isolated Find	764616	6413781	1	TBA	OC3extT6
Stage 1: Open Cut 3 Ext	S1MC193	Isolated Find	764635	6413766	1	TBA	OC3extT6
Stage 1: Open Cut 3 Ext	S1MC194	Artefact Scatter	764662	6413641	45	TBA	OC3extT7
Stage 1: Open Cut 3 Ext	S1MC195	Isolated Find	764669	6413564	1	TBA	OC3extT7
Stage 1: Open Cut 3 Ext	S1MC196	Isolated Find	764793	6413676	1	TBA	OC3extT7
Stage 1: Open Cut 3 Ext	S1MC197	Isolated Find	764747	6413670	1	TBA	OC3extT7
Stage 1: Open Cut 3 Ext	S1MC198	Isolated Find	764754	6413624	1	TBA	OC3extT7
Stage 1: Open Cut 3 Ext	S1MC199	Artefact Scatter	764552	6413924	19	TBA	OC3extT8
Stage 1: Open Cut 3 Ext	S1MC200	Isolated Find	763411	6412356	1	TBA	OC3extT9
Stage 1: Open Cut 3 Ext	S1MC201	Isolated Find	763372	6412340	1	TBA	OC3extT9
Stage 1: Open Cut 3 Ext	S1MC202	Isolated Find	763539	6412417	1	TBA	OC3extT9
Stage 1: Open Cut 3 Ext	S1MC203	Artefact Scatter	763121	6412157	12	TBA	OC3extT10
Stage 1: Open Cut 3 Ext	S1MC204	Isolated Find	763179	6412234	1	TBA	OC3extT10
Stage 1: Open Cut 3 Ext	S1MC205	Isolated Find	763164	6412126	1	TBA	OC3extT10
Stage 1: Open Cut 3 Ext	S1MC206	Isolated Find	763137	6412199	1	TBA	OC3extT10
Stage 1: Open Cut 3 Ext	S1MC207	Artefact Scatter	763164	6412163	2	TBA	OC3extT10
Stage 1: Open Cut 3 Ext	S1MC208	Isolated Find	764346	6414604	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC209	Isolated Find	764320	6414658	1	TBA	OC3ext T11

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 3 Ext	S1MC210	Artefact Scatter	764307	6414767	3	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC211	Isolated Find	764300	6414922	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC212	Isolated Find	764181	6415241	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC213	Isolated Find	764196	6415322	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC214	Isolated Find	764375	6414738	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC215	Isolated Find	764283	6415180	1	TBA	OC3ext T11
Stage 1: Open Cut 3 Ext	S1MC216	Isolated Find	765085	6415070	1	TBA	OC3ext T12
Stage 1: Open Cut 3 Ext	S1MC217	Artefact Scatter	764952	6414851	18	TBA	OC3ext T12
Stage 1: Open Cut 3 Ext	S1MC218	Isolated Find	764865	6414705	1	TBA	OC3ext T13
Stage 1: Open Cut 3 Ext	S1MC219	Isolated Find	764883	6414722	1	TBA	OC3ext T13
Stage 1: Open Cut 3 Ext	S1MC220	Artefact Scatter	764886	6414770	3	TBA	OC3ext T13
Stage 1: Open Cut 3 Ext	S1MC221	Isolated Find	763492	6412270	1	TBA	OC3extT15
Stage 1: Open Cut 3 Ext	S1MC222	Isolated Find	763550	6412268	1	TBA	OC3extT15
Stage 1: Open Cut 3 Ext	S1MC223	Artefact Scatter	763625	6412243	14	TBA	OC3extT15
Stage 1: Open Cut 3 Ext	S1MC224	Artefact Scatter	763682	6412644	19	TBA	OC3extT15
Stage 1: Infrastructure IS	S1MC225	Isolated Find	761752	6425887	1	I	IS T1
Stage 1: Infrastructure IS	S1MC226	Isolated Find	761726	6426232	1	I	IS T2
Stage 1: Infrastructure IS	S1MC227	Isolated Find	761825	6426206	1	I	IS T2
Stage 1: Infrastructure IS	S1MC228	Artefact Scatter	762428	6426370	13	I	IS T3
Stage 1: Infrastructure IS	S1MC229	Isolated Find	762430	6426375	1	I	IS T3
Stage 1: Infrastructure IS	S1MC230	Artefact Scatter	761640	6426786	69	I	IS T5
Stage 1: Infrastructure IS	S1MC231	Isolated Find	761907	6426804	1	I	IS T5
Stage 1: Infrastructure IS	S1MC232	Isolated Find	761926	6426825	1	I	IS T5
Stage 1: Infrastructure IS	S1MC233	Artefact Scatter	761954	6426840	2	I	IS T5
Stage 1: Infrastructure IS	S1MC234	Isolated Find	761990	6426858	1	I	IS T5
Stage 1: Infrastructure IS	S1MC235	Isolated Find	762126	6426823	1	I	IS T5
Stage 1: Infrastructure IS	S1MC236	Artefact Scatter	762199	6426811	14	I	IS T5
Stage 1: Infrastructure IS	S1MC237	Isolated Find	762202	6426805	1	I	IS T5
Stage 1: Infrastructure IS	S1MC238	Isolated Find	762211	6426803	1	I	IS T5
Stage 1: Infrastructure IS	S1MC239	Isolated Find	762220	6426805	1	I	IS T5
Stage 1: Infrastructure IS	S1MC240	Artefact Scatter	762231	6426802	7	I	IS T5
Stage 1: Infrastructure IS	S1MC241	Artefact Scatter	762272	6426800	10	I	IS T5
Stage 1: Infrastructure IS	S1MC242	Isolated Find	762291	6426800	1	I	IS T5
Stage 1: Infrastructure IS	S1MC243	Isolated Find	762310	6426800	1	I	IS T5
Stage 1: Infrastructure IS	S1MC244	Isolated Find	762395	6426732	1	I	IS T5
Stage 1: Infrastructure IS	S1MC244	Artefact Scatter	761552	6426828	30	I	IS T6
Stage 1: Infrastructure IS	S1MC245	Isolated Find	761747	6426767	1	I	IS T7
Stage 1: Infrastructure IS	S1MC246	Isolated Find	761820	6426775	1	I	IS T7
Stage 1: Infrastructure IS	S1MC247	Isolated Find	761831	6426745	1	I	IS T7
Stage 1: Infrastructure IS	S1MC248	Isolated Find	761863	6426758	1	I	IS T7
Stage 1: Infrastructure IS	S1MC249	Isolated Find	761863	6426771	1	I	IS T7
Stage 1: Infrastructure IS	S1MC250	Isolated Find	761860	6426773	1	I	IS T7
Stage 1: Infrastructure IS	S1MC252	Isolated Find	761867	6426779	1	I	IS T7
Stage 1: Infrastructure IS	S1MC253	Isolated Find	761870	6426772	1	I	IS T7
Stage 1: Underground No 4	S1MC254	Artefact Scatter	763332	6431357	2	Low	UG4 T1
Stage 1: Underground No 4	S1MC255	Isolated Find	763332	6431357	1	Low	UG4 T3

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Underground No 4	S1MC256	Artefact Scatter	762878	6429620	23	Low	UG4 T5
Stage 1: Underground No 4	S1MC257	Artefact Scatter	762850	6429600	4	Low	UG4 T5
Stage 1: Underground No 4	S1MC258	Artefact Scatter	762865	6429652	2	Low	UG4 T5
Stage 1: Underground No 4	S1MC259	Isolated Find	762889	6429671	1	Low	UG4 T5
Stage 1: Underground No 4	S1MC260	Isolated Find	762849	6429605	1	Low	UG4 T5
Stage 1: Underground No 4	S1MC261	Rockshelter&Artefact	762876	6429660	2	Low	UG4 T5
Stage 1: Underground No 4	S1MC262	Isolated Find	762876	6429676	1	Low	UG4 T5
Stage 1: Underground No 4	S1MC263	Isolated Find	762177	6430458	1	Low	UG4 T5
Stage 1: Underground No 4	S1MC264	Grinding Grooves &Artefacts	762010	6430705	78	Moderate	UG4 T5
Stage 1: Underground No 4	S1MC265	Artefact Scatter	762224	6430592	3	Low	UG4 T5
Stage 1: Underground No 4	S1MC266	Isolated Find	763000	6431393	1	Low	UG4 T6
Stage 1: Underground No 4	S1MC267	Rockshelter&Artefact	761945	6430063	10	Low	UG4 T7
Stage 1: Underground No 4	S1MC268	Isolated Find	761875	6430102	1	Low	UG4 T7
Stage 1: Underground No 4	S1MC269	Isolated Find	761882	6430110	1	Low	UG4 T7
Stage 1: Underground No 4	S1MC270	Isolated Find	762024	6430287	1	Low	UG4 T7
Stage 1: Underground No 4	S1MC271	Rockshelter&Artefacts	763749	6428829	8	Low	UG4 T8
Stage 1: Underground No 4	S1MC272	Artefact Scatter	763827	6428747	2	Low	UG4 T8
Stage 1: Underground No 4	S1MC273	Isolated Find	762660	642864	1	Low	UG4 T9
Stage 1: Underground No 4	S1MC274	Isolated Find	761580	6426932	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC275	Isolated Find	761878	6426869	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC276	Isolated Find	761877	6426917	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC277	Isolated Find	761862	6426931	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC278	Isolated Find	761688	6426940	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC279	Isolated Find	761551	6426963	1	Low	UG4 T10
Stage 1: Underground No 4	S1MC280	Rockshelter&Artefacts	762822	6427883	45	High	UG4 T11
Stage 1: Underground No 4	S1MC281	Artefact Scatter	762865	6432219	11	Low	UG4 T12
Stage 1: Underground No 4	S1MC282	Artefact Scatter	762851	6432207	65	Low	UG4 T12
Stage 1: Underground No 4	S1MC283	Rockshelter&Artefacts	762912	6432185	6	Low	UG4 T12
Stage 1: Underground No 4	S1MC284	Rockshelter&Artefacts	762877	6432127	8	Low	UG4 T12
Stage 1: Underground No 4	S1MC285	Rockshelter&Artefacts	762905	6431976	2	Low	UG4 T12
Stage 1: Underground No 4	S1MC286	Rockshelter&Artefacts	762868	6431969	28	Low	UG4 T12
Stage 1: Underground No 4	S1MC287	Rockshelter&Artefacts	763240	6430143	28	High	UG4 T4
Stage 1: Underground No 4	S1MC288	Rockshelter&Artefacts	763336	6430223	1	High	UG4 T4
Stage 1: Underground No 4	S1MC289	Rockshelter&Artefacts	763795	6429838	9	High	UG4 T4
Stage 1: Underground No 4	S1MC290	Rockshelter&Artefacts	763739	6429835	5	High	UG4 T4
Stage 1: Underground No 4	S1MC291	Isolated Find	763726	6429853	1	High	UG4 T4
Stage 1: Underground No 4	S1MC292	Isolated Find	763406	6429904	1	High	UG4 T4
Stage 1: Underground No 4	S1MC293	Isolated Find	763385	6429901	1	High	UG4 T4
Stage 1: Underground No 4	S1MC294	Rockshelter&Artefacts	763673	6429849	2	High	UG4 T4
Stage 1: Underground No 4	S1MC295	Isolated Find	763273	6429928	1	High	UG4 T4
Stage 1: Underground No 4	S1MC296	Rockshelter&Artefacts	763503	6429961	12	High	UG4 T4
Stage 1: Underground No 4	S1MC297	Rockshelter&Artefacts	763420	6430329	5	High	UG4 T4
Stage 1: Underground No 4	PAD 7	Pad 7	763846	6428750	0	Low	UG4 T8
Stage 1: Open Cut 1	S1MC298	Artefact Scatter	759258	6423654	75	I	OC 1 T16
Stage 1: Open Cut 1	S1MC299	Isolated Find	759331	6423850	1	I	OC1 T17
Stage 1: Open Cut 1	S1MC300	Artefact Scatter	759071	6423798	41	I	OC1 T20
Stage 1: Open Cut 1	S1MC301	Artefact Scatter	758997	6424100	10	I	OC1 T21

Moolarben Coal Development Area	Site Name	Site Type	Eastings	Northings	Artefact Density	Impact Status	MC Transect
Stage 1: Open Cut 1	S1MC302	Artefact Scatter	758881	6423779	20	I	OC 1 T22

Table 7 above and Figures 8 & 9 show that Aboriginal occupation is evenly spread over a number of key land-units.

11.1 Open Cut 1

A total of 44 Aboriginal Sites have been recorded for the Open Cut 1 area (see Table 8 below). As the table below shows, the dominant site type is single isolated artefact finds randomly distributed across a number of land unit associations.

Table 8: Site types recorded in association with Open Cut 1 area

Site Type	Number
Isolated Finds	33
Artefact Scatters	7
Scarred Trees	1
PADs (Potential Archaeological Deposits)	3

Generally, the area is dominated by open woodland and forest, ground visibility is poor, however a good section of this area has been cleared for open grazing. There are two environmental features located either within or near Open Cut 1 area which may have influenced local Aboriginal occupation patterns, these being:

- Moolarben Creek to the west (approx 500 metres); and
- A single “L” shaped ridge which runs in a east- west direction with some shelter outcrops located on the edges of the gully features all facing west and south.

The ridge-line described above can be defined as an “L” shaped valley which may have been associated with people hunting and occupying areas on a seasonal basis between the Moolarben and the Murragumba catchments.

The greatest evidence for occupation is concentrated within artefact scatter sites S1MC: 2, 298,300,301 and 302 comprising a total of 160 stone artefacts. All archaeological material recorded is eroded or scalded patches of bare soil with exposed artefactual material. Most sites were recorded associated with flat ground with some minor ridge crest occupation evidence. None of the material was recorded insitu. These sites show a pattern of short term occupation with overlapping discard events dominated by quartz stone tool technology with some silcrete.

A majority of the artefacts recorded are unmodified complete flakes made from quartz material. There are virtually no finished tools associated with these open

sites. A single scarred tree representing a dish scar container is located within the central part of Open Cut 1(see Figure 8). Three Potential Archaeological Deposits have been recorded as rockshelter deposits located on the eastern extremity of Open Cut 1.

11.2 Open Cut 2

A total of 38 Aboriginal Sites have been recorded for the Open Cut 2 area (see Table 9 below). As the table below shows, the dominant site type is single isolated artefact finds randomly distributed across a number of land unit associations.

Table 9: Site types recorded in association with Open Cut 2 area

Site Type	Number
Isolated Finds	26
Rockshelters with art or artefacts	2
Artefact Scatters	7
PADs (Potential Archaeological Deposits)	4

Generally, the area is dominated by open woodland and forest, ground visibility is poor, however a good section of this area has been cleared for open grazing (within the western boundary). The dominant environmental features of Open Cut 2 area which may have influenced local Aboriginal occupation patterns, are:

- Moolarben Creek to the west (approx 250-500 metres); and
- A single broad U shaped ridge which runs in a north-south direction with some shelter outcrops located on the edges of the gully features all facing west; and
- Some sandstone tors and pinnacles located on the top of the ridge and lower mid slopes.

The ridge-line described above may have been used as a transit feature, especially at the northern end of the ridge where it forms a natural saddle allowing Aboriginal people to traverse across to both Moolarben and Murragamba Creek catchments. Three recorded Aboriginal sites are located near this feature. Also of interest are three springs recorded by P Dundon (SP 18, 19 and 77,) located within the northern section of Open Cut 2, within a short distance of the saddle feature previously discussed (see Figure 9 & 10).

The greatest evidence for occupation is represented by open artefact scatter sites S1MC: 40, 53, 57, 58, 60, 66 and 67 comprising a total of 162 stone artefacts. These sites are located in two distinct clusters with S1MC 40 & 53 situated within the northern section of Open Cut 2 not far from three existing spring sites.

Sites 57, 58, 60 & 66 are all located within 100 metres of the alluvial terraces of Moolarben Creek (see Figure 9). Also of interest located near the above sites is a recorded Spring Site 22 (see Figure 10: P Dundon 2006).

All archaeological material recorded is eroded or scalded patches of bare soil with exposed artefactual material. Most sites were recorded associated with flat ground with some minor ridge crest occupation evidence. None of the material was recorded in-situ. These sites show a pattern of short term occupation with overlapping discard events dominated by quartz stone tool technology with some tuff material present. More substantial occupation evidence may be found closer to recorded spring sites, however this question would have to be tested.

A majority of the artefacts recorded are unmodified broken and complete flakes followed by flaked pieces made from quartz material. There are virtually no finished tools associated with these open sites. Two rock shelter sites: S1MC 55 & 56 are located approximately 350 metres to the east of the northern open site complex (ie. sites 40 & 53) within the main ridge-line system (see Figure 9). Three Potential Archaeological Deposits have been recorded as rockshelter deposits and are located on the eastern extremity of Open Cut 2 around a large pinnacle feature along the main north-south ridge-line.

11.2.1 Known Registered DEC Aboriginal Sites

There are two registered DEC Aboriginal sites located near the north-eastern boundary of Open Cut 2 these are:

- 36-3-0222; and
- 36-3-0223.

36-3-0222 (MC1) was recorded in 1999 by David Maynard of Murong Gialinga ATSIC as part of a Development Application for Timber clearing on “The Lagoon” property. The site is described as artefact scatter containing six artefacts scattered over an area of 14m x 6m. The site is located in an area just below a ridge on a gentle slope 15 metres west of an existing fence-line. Artefactual raw material is made from quartz, white chert and yellow mudstone (see Figure 9); and

36-3-0223 (MC 2) was also recorded in 1999 by David Maynard as part of the same exercise as already described above. The site an isolated find is located 100 metres west of 36-3-0222 on an exposure near a fence-line on a gentle slope. A single creamy grey chert flake was recorded (see Figure 9).

Both sites are described as being effected by erosion processes, but also may contain more buried archaeological material. Neither site was relocated part of the current investigation.

11.3 Open Cut 3

A total of 68 Aboriginal Sites have been recorded for the Open Cut 3 area (see Table 10 below). As the table below shows, the dominant site type is single isolated artefact finds randomly distributed across a number of land unit associations.

Table 10: Site types recorded in association with Open Cut 3 area

Site Type	Number
Isolated Finds	53
Artefact Scatters	15

Generally, the area is dominated by open pasture used for sheep grazing and ploughed land for cropping. Ground visibility is poor, however on the upper footslopes at the break of slope sheet erosion provides good surface visibility. The dominant environmental features of Open Cut 3 area which may have influenced local Aboriginal occupation patterns, are:

- Moolarben Creek to the west and east (within 50-200 metres);
- A single narrow "L" shaped ridge which runs in a north-south direction with some shelter outcrops located on the edges of the gully features all facing east; and
- Some sandstone tors and pinnacles located on the top of the ridge and lower mid slopes.

The ridge-line described above may have been used as a transit feature, especially at the northern end of the ridge where it forms a natural saddle allowing Aboriginal people to traverse across to both Moolarben and Lagoon Creek catchments. This area is commonly known as Brown's Gully. Also of interest are eight springs recorded by P Dundon (SP 4, 5, 7, 8, 9, 10, 11, 23) located along the main Moolarben Creek drainage line and on the margins of the lower midslopes (see Figure 10).

The greatest evidence for occupation is represented by a series of open artefact scatter sites S1MC: 78, 103, 130, 131, 135 and 139, comprising a total of 307 stone artefacts. These sites and other low density artefact scatters are located in three distinct clusters. One cluster (S1MC: 103-109, 135-131 and 110 -119) follows the margins of Moolarben Creek with another cluster S1MC 95-102 being located within the western boundary of Open Cut 3 to the west of Moolarben Creek. A third cluster of low density artefact scatter sites (S1MC 136-139) is located to the northern area of Open Cut 3 associated with the southern banks of Moolarben Creek.

All archaeological material recorded is eroded or scalded patches of bare soil with exposed artefactual material. Some material was exposed due to deep ploughing along the margins of Moolarben Creek, whilst other sites were located

on the margins of foothills. Most sites were recorded associated with flat ground with some minor ridge crest occupation evidence. None of the material was recorded in-situ.

These sites show a pattern of intensive use of Moolarben Creek drainage line, with a higher concentration of occupation observed towards the central and southern end of Moolarben Creek. Quartz artefactual material is common, however at one site S1MC 103, there is a high diversity of raw material types used. More substantial occupation evidence may be found closer to unexposed sections of Moolarben Creek especially near recorded spring sites, however this question would have to be tested.

A majority of the artefacts recorded are unmodified broken and complete flakes followed by flaked pieces made from quartz material. There is a low density of utilised implements associated with some of these open sites (ie. S1MC 103).

11.3.1 Infrastructure Area

A total of 29 Aboriginal Sites have been recorded for the Infrastructure area (see Figure 8 & Table 12 below). As the table below shows, the dominant site type is single isolated artefact finds randomly distributed across a number of land unit associations.

Table 12: Site types recorded in association with Infrastructure area

Site Type	Number
Isolated Finds	22
Artefact Scatters	7

Generally, the area is dominated by open pasture used for sheep grazing and ploughed land for cropping. Ground visibility is poor, however on the upper footslopes at the break of slope sheet erosion provides good surface visibility. The dominant environmental features of the Infrastructure area which may have influenced local Aboriginal occupation patterns are:

- Bora Creek to the north and south (within 50-200 metres); and

- An “L” shaped ridge (Lennox Ridge) with long gully features which backs onto the Cassilis –Ulan road where several known rockshelter sites have been recorded.

The greatest evidence for occupation is represented by a series of open artefact scatter sites S1MC: 228, 230, 236 and 244 comprising a total of 136 stone artefacts. These sites and other low density artefact scatters are located in a single distinct linear cluster. The most intensive occupation recorded is located on the southern bank of (within 30 metres) Bora Creek on the edge of the existing plough zone.

All archaeological material recorded is eroded or scalded patches of bare soil with exposed artefactual material. Some material was exposed due to deep ploughing along the margins of Bora Creek, whilst other sites were located on the margins of foothills. Most sites were recorded associated with flat ground. None of the material was recorded in-situ.

These sites show a pattern of intensive use of Bora Creek drainage line. Quartz artefactual material is common, however at one site S1MC 230, there is a higher diversity of raw material types used. More substantial occupation evidence may be found closer to unexposed sections of Bora Creek, however this question would have to be tested.

A majority of the artefacts recorded are unmodified broken and complete flakes followed by flaked pieces made from quartz material. There is a low density of utilised implements and cores associated with some of these open sites (ie. S1MC 230).

11.4 Underground No 4

A total of 44 Aboriginal Sites have been recorded for the Underground No 4 area (see Figure 8 & Table 13 below). As the table below shows, the dominant site type is single isolated artefact finds randomly distributed across a number of land unit associations.

Table 13: Site types recorded in association with Underground No 4 area

Site Type	Number
Isolated Finds	20
Artefact Scatters	8
Rockshelter & artefacts	15
Grinding Grooves	1
PAD's (Potential Archaeological Deposits)	1

Generally, the area is dominated by the Munghorn Plateau ridge system, a broad sandstone ridge which is heavily vegetated by dry sclerophyll eucalypt forest. The area has some hobby farming in discrete pockets. Sandstone cliff-lines, pinnacles and tors are also common in some areas. Ground visibility is poor, however there are forestry tracks which criss-cross parts of the escarpment. The dominant environmental features of Underground No 4 area which may have influenced local Aboriginal occupation patterns are:

- Goulburn River escarpment on the northern boundary;
- Sandstone Pinnacle formations;
- Ulan Creek ephemeral drainage; and

- A series of cliff-lines that run in a north-south alignment and may contain shelter occupation potential.

The greatest evidence for occupation is represented by a series of 15 rock shelter sites: S1MC: 261, 264, 267, 270, 280, 283, 284, 285, 287, 288, 289, 290, 294, 296 and 297. Site S1MC 280 has been previously recorded by Haglund in 1987 and is known as DEC Registered Site 36-3-0042. This site was recorded as a rockshelter with art and grinding grooves. It is located on its own in the southern portion of Underground No 4 area (see Figure 8). Artefact Scatter Sites containing over 10 artefacts are represented by sites: S1MC 256, 264, 281, and 282.

Site distribution is reflected in four distinct site clusters. One site grouping is focussed near an the area known as "The Drip" in the northern boundary of Underground No 4(see Figure 8) where five rockshelters containing artefacts and deposits and two artefact scatters are present (S1MC: 280-286). The second site cluster consists of 4 rockshelters with artefacts and deposits, an artefact scatter and a grinding groove site with artefacts (S1MC: 264, 265, 267, 287, 288 and 297).It is located on the central western margin of Underground No 4 (see Figure 8).

The third site grouping is located on the eastern central margin of Underground No 4 surrounding a large pinnacle formation. This site grouping contains sites S1MC: 289, 290, 291, 294 and 296. All these sites represent low level rock shelter occupation. The fourth site grouping is located in the central portion of Underground No 4 and contains sites S1MC: 256, 257, 258, 259, 260, 261 and 262. These sites consist of three low density artefact scatters, three Isolated Finds and a single rockshelter.

All archaeological material recorded is eroded or scalded patches of bare soil with exposed artefactual material lying within or near rockshelter drip-lines or around rock shelter sites. Most sites were recorded associated with flat ground with some minor ridge crest occupation evidence. None of the material was recorded in-situ. Few shelter sites that faced west contained occupation evidence. Shelters or overhangs with wet floors through water leaks contain little or no occupation evidence.

These sites show a pattern of low level rockshelter occupation focussed around ephemeral creek-lines and temporary waterholes between the Goulburn River and Bora Creek. There is a clear decrease in site density from the Drip-line to the Central portion of Underground No 4. Occupation evidence increases again south and east within 500 metres of Bora Creek. Given all the archaeological evidence is surficial, little is known about the scale of rock-shelter use or its likely chronology. This would be a question worthy of testing in the field.

A majority of the artefacts recorded are unmodified broken and complete flakes followed by flaked pieces made from quartz material, followed by tuff artefacts. The sites containing the greatest diversity of artefactual material within Underground No 4 are: S1MC: 264, 280, 282, 286 & 287.

11.4.1 Potential Archaeological Deposits (PAD's)

A total of 14 PAD's have been recorded as a result of the assessment. This site category is recognised by DEC as a temporary site category and therefore should be recorded for registration purposes. It is the aim of this assessment to develop a management strategy that will help determine the cultural integrity of this site category. There is an even distribution of PAD's recorded throughout MCP area, with the most obvious recording bias being the size of the floor space area available for potential habitation and the likely accessibility of the shelter for everyday use.

11.4.2 Site Condition

Of the 302 sites recorded: 4 rock shelter sites, 4 open artefact scatter sites, a scarred tree and one grinding groove site located near "The Drip" are considered to be in fair to good condition. The remaining 292 sites (Rockshelter, Isolated Finds and Artefact Scatter sites) are considered to be in poor condition. This state of preservation will ultimately have a bearing on how much information can be recorded from the site.

12 Analysis

12.1 Site Distribution, terrain landform type and land elements

As discussed previously, approximately 51(%) of sites are located within a valley floor, alluvial floodplain or drainage channel context in the MCP area (see Figure 8 & 9 Table 14 below). Approximately 43(%) are located on elevated features such as ridge crests, knolls, saddles or spurs or on mid slopes. The most rarely occupied land unit are upper slopes. A majority of open space occupation is found on land units that are flat and located near water sources.

Within the ridge systems, a majority of occupied shelters are located within 500 metres of water sources and access corridors.

Table 14 below describes the distribution of sites against Land-Unit Types.

Table 14: Sites and Land Unit Association

Landform Unit	Isolated Finds	Artefact Scatter	Scarred Tree	Grinding Grooves	Rock-shelters	PADs	Total
Ridge Crest	23	10		0	4	5	**37**
Alluvial Flat	61	24	1		1	0	**87**
Drainage Channel	54	13		1		0	**68**
Hillock (Knoll)	32	4				0	**36**
Closed Depression	0	0	0	0	0	0	**0**
Upper Slope	3	0				5	**3**
Mid Slope	35	5			11	4	**51**
Foot Slope	8	3			2		**13**

Landform Unit	Isolated Finds	Artefact Scatter	Scarred Tree	Grinding Grooves	Rock-shelters	PADs	Total
Saddle	2	1					**3**
Spur	2	2					**4**
TOTALS	**219**	**63**	**1**	**1**	**18**	**14**	**302**

Table 15: Site distribution across soil landscape units

Soil Landscape Unit	Transects	Site Numbers
Ulan Soil Landscape	21	180
Lees Pinch Soil Landscape	37	58
Munghorn Soil Landscape	22	60
Bald Hill Soil Landscape	4	4

Table 15 above shows that Ulan soil landscape contains the highest concentration of sites.

12.2 Slope, Distance to water, access to resources (food and stone materials)

Sites located within the Ulan Soil Landscape have slopes of between 2-5 degrees. Sites located within Lees Pinch Soil Landscape have slopes of between 5-10 degrees. Three main creek systems (Bora, Moolarben, Spring) found across the study area have varying proportions of sites located near them. Moolarben Creek is the most surveyed drainage line and has the highest concentration of recorded sites. It is also the most disturbed natural feature located within the study area.

There are no reported quarried outcrops of flaked stone material within the survey area. Quartz pebbles and cobbles are found eroding from Narrabeen and Conglomerate sandstones. Some local cherts are also found eroding in gravel layers of local lithosols. Local gravel deposits are however generally of poor quality for flaked stone tool raw material. Two distinct local tuffs (yellow and black) have been identified from archaeological sites further west and south of the study area.

12.3 Site Contents, Stone Artefact Assemblages, Site Age, Sub surface potential, Cultural Landscape Variability

12.3.1 Site Contents

Open Sites

Of the 205 open sites recorded, only eight sites (S1MC:298, S1MC:67, S1MC:103, S1MC:175, S1MC:230, S1MC:264, S1MC:65 – see Figures 7 & 8) have a density of more than 50 artefacts. Table 16 below describes the main features of these sites:

Table 16: Main features of significant open sites recorded in MCP area

Site Name	Site Location	Site Description
S1MC 67 OC2:T16	Open paddock Creek Flats	Open artefact scatter comprising 52 artefacts distributed over a 62 m x 34.4m area within a open paddock cleared for grazing. Artefacts are exposed by grader works from a vehicle track construction. The site is located close to an ephemeral creek area. No in situ deposits have been observed. The site is in poor condition.
S1MC 103 OC3 T3	Open paddock Creek Flats	Open artefact scatter comprising of 184 artefacts distributed over a 750m x 100m area. Part of the site (90%) has been disturbed by ploughing and cropping. No in situ deposits have been observed. The site is in poor condition.
S1MC 175 OC 3 ext T5	Open paddock Hillock	Open artefact scatter comprising of 67 artefacts distributed over a 17m x 39.4m area. This site is located on a hillock feature overlooking creek flats. There is a possibility that buried archaeological deposits may be located near this site. The site is in fair condition.
S1MC 230 IS T5	Open paddock Creek Flats	Open artefact scatter comprising of 69 artefacts distributed over a 58.5m x 262m area. This site is located on creek flats on the margin of Bora Creek. There is a possibility that buried archaeological deposits may be located near this site. Part of the site (60%) has been impacted by ploughing.
S1MC 264 UG No 4 T5	Forest Creek Flats	Grinding Groove site located on a single boulder feature within a drainage line. 78 grinding grooves have been recorded on a sandstone boulder. The site covers an area of 13m x13.5m.The site is in good condition.
S1MC 282 UG No 4 T12	Forest Creek Flats	Open artefact scatter comprising of 65 artefacts distributed over a 15m x 160m area. This site is located along a vehicle track above an existing ephemeral creek, near the Goulburn River. There are no sub-surface deposits associated with this site. The site is in poor condition.
S1MC 298 OC 1 T16	Open paddock Ridge slope/Knoll	Open artefact scatter comprising of 75 artefacts distributed over a 60m x 27m area. This site is located along a ridge on a vehicle track above an existing ephemeral creek. There are no sub-surface deposits associated with this site.

Rock shelter Sites

Table 17: Main features of significant rock shelter sites recorded in MCP

Site Name	Site Location	Site Description
S1MC 267 UG No 4: T7	Ridge Crest Munghorn Plateau	Small rock shelter facing west. Dimensions: 2.2mH x4.6mWx2.4D with shallow gravel deposit 10cm depth. A scatter of 10 artefacts are lying in front of the shelter's drip-line. Good condition. No cultural material observed on the shelter's floor.

Site Name	Site Location	Site Description
S1MC 271 UG No 4: T8	Ridge Crest Munghorn Plateau	Small size rock shelter facing south. Dimensions:2.2mH x11.5mW x 4.2mD.Shallow sandy deposits > 20cm depth. A scatter of 8 artefacts are located in front of the shelter. No artefacts were observed on the shelter's floor. Good condition.
S1MC 280 36-3-0042 UG No 4:T11	Ridge Crest Munghorn Plateau	Medium size rock shelter facing north-west. Dimensions: 2.4H x13.3W x5.7mD. Deposits of >60cm in places. Single faded red hand stencil located on eastern wall. Small cluster of 8 grinding grooves and grinding patch located on boulder on eastern side of shelter. Extensive European graffiti on sections of shelter's back wall. Rabbit burrows located in several places within shelter floor. Fair condition, however stencil art almost faded. A scatter of 45 artefacts located just outside shelter's drip-line.
S1MC 283 UG No 4 T12	Ridge Crest Munghorn Plateau	Medium sized rockshelter facing east. Dimensions: 5mH x 14.8mW x 4.4mD. Rock floor. Good condition. Scatter of 6 artefacts located in front of shelter's drip-line. No cultural material observed on shelter's floor. This site contains rock art depicting hand stencils made in red (10) and (2) white ochre and a goanna figure drawn in white ochre. A large sandstone slab is lying within the shelter and contains European graffiti engraved on its surface. There could be more hand stencils located within shelter's roof or walls. More intensive recording is required.
S1MC 284 UG No 4 T12	Ridge Crest Munghorn Plateau	Small rockshelter facing west. Dimensions: 2.5mH x 4.6mW x 2.4mD. Shallow deposit 25cm in depth. Good condition. Scatter of 8 artefacts located in front of shelter's drip-line. No cultural material observed on shelter's floor.
S1MC 286 UG No 4 T12	Ridge Crest Munghorn Plateau	Small rockshelter facing west. Dimensions: 2.3mH x 8.7mW x 3mD. Shallow deposit 15cm in depth. Good condition. Scatter of 28 artefacts located in front of shelter's drip-line. No cultural material observed on shelter's floor.
S1MC 287 UG No 4 T4	Ridge crest Munghorn Plateau	Medium sized rockshelter facing west. Dimensions: 5.5mH x 31mW x 6.6mD. Shallow deposit 15cm in depth. Good condition. Scatter of 28 artefacts located in front of shelter's drip-line. No cultural material was observed on the shelter's floor.

Grinding Groove Sites

Apart from grinding grooves being recorded in association with rock shelter site S1MC 280 (36-3-0042) only one grinding groove site was recorded within the study area. Table 18 below describes its main features:

Table 18: Main features of significant grinding groove site recorded

Site Name	Site Location	Site Description
S1MC 264 UG No 4 T5	Drainage channel Munghorn Plateau	Small sandstone boulder 13m x 13.5m lying within tributary channel of Goulburn River covered with 78 grinding grooves. Grooves measure on average 22.4cm x 6.6cm x 1.4cm. The site is in good condition. Grooves are assumed to have been made as a result of stone axe grinding activities. Site is located at the head of a gully feature.

Scarred Trees

A total of one scarred tree was recorded as a result of this assessment. One tree S1MC 1 is located within the Open Cut 1 footprint area (see Figure 8). Table 19 below describes the main characteristics of the recorded tree.

Table 19: Main characteristics of scarred tree recorded

Site Name	Site Location	Site Description
S1MC 1 OC 1 T4	Scarred Tree located within open paddock on flat.	Dish/Coolamon scar located on Box Tree. Species unknown. Dimensions: L:90cm W:50cm RG:7.5cm. Girth: 2.70 m Height of Tree: 10m. Height of Scar above ground:50cm Condition: Dead

12.3.2 Stone Artefact Assemblage Characteristics

A total of 1,298 stone artefacts have been recorded as a result of this assessment. Table 20 below provides the break down of the main stone raw materials used to manufacture flaked stone tools. As can be seen, quartz raw material dominates all assemblage components, accounting for 81.6% of the total raw material count. The next most commonly used raw materia is Tuff, accounting for 10.6% of the total assemblage count. Silcrete is also used, but in much lower proportions.

Table 21 shows that a majority of the assemblage recorded is made up of Broken Flakes, followed by Flaked Pieces and Complete Flakes. Retouched or used items only account for 2.2% of the total assemblage contents. Cores make up approximately 8.5% of the total assemblage content. A majority of cores are multi-platform type made from quartz and tuff materials. A total of 4 backed pieces (ie. geometrics) were identified with 3 being recorded, within Transect 4 Underground No 4. All three backed pieces are made from Tuff material.

A majority of flakes (Complete and Broken Proximal) contain approximately 75% broad platforms with 18% containing focal platforms. Cortex is found on approximately 12% of all stone artefact items. A comparison was made of the size of Complete Flakes. Tables 22 & Table 23 below shows that a majority of

quartz complete flakes are between 10mm and 40mm in length and 10 and 25mm wide. Whilst the complete flake size distribution for Tuff is much broader, showing a more diverse flake selection process operating.

Table 20: Raw Material Distribution Chart

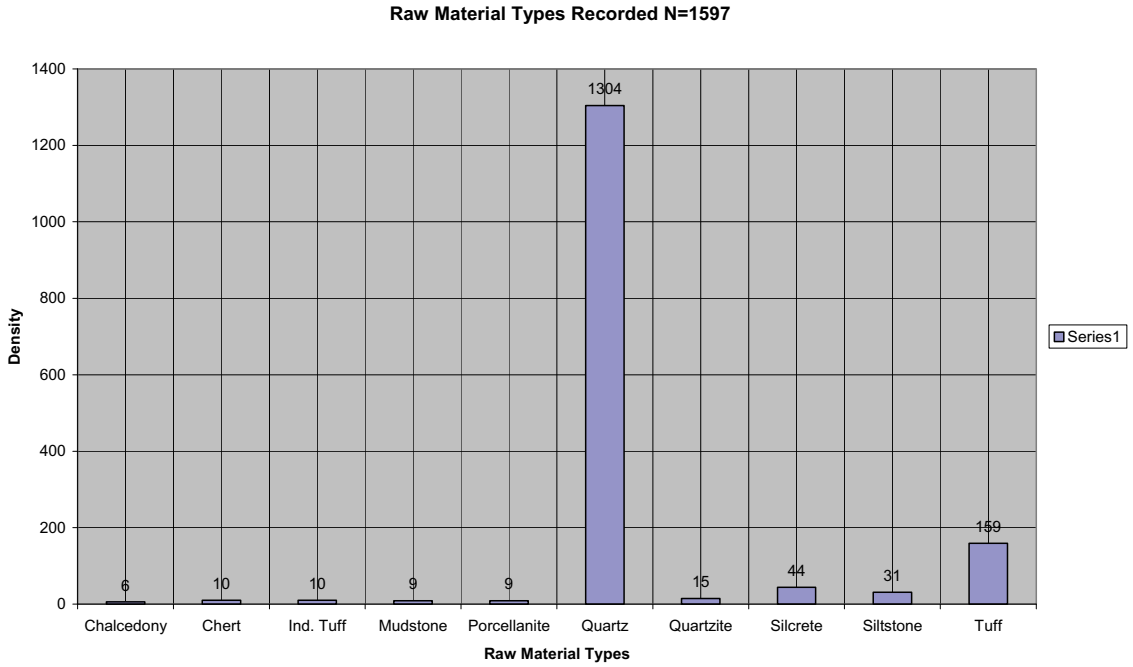
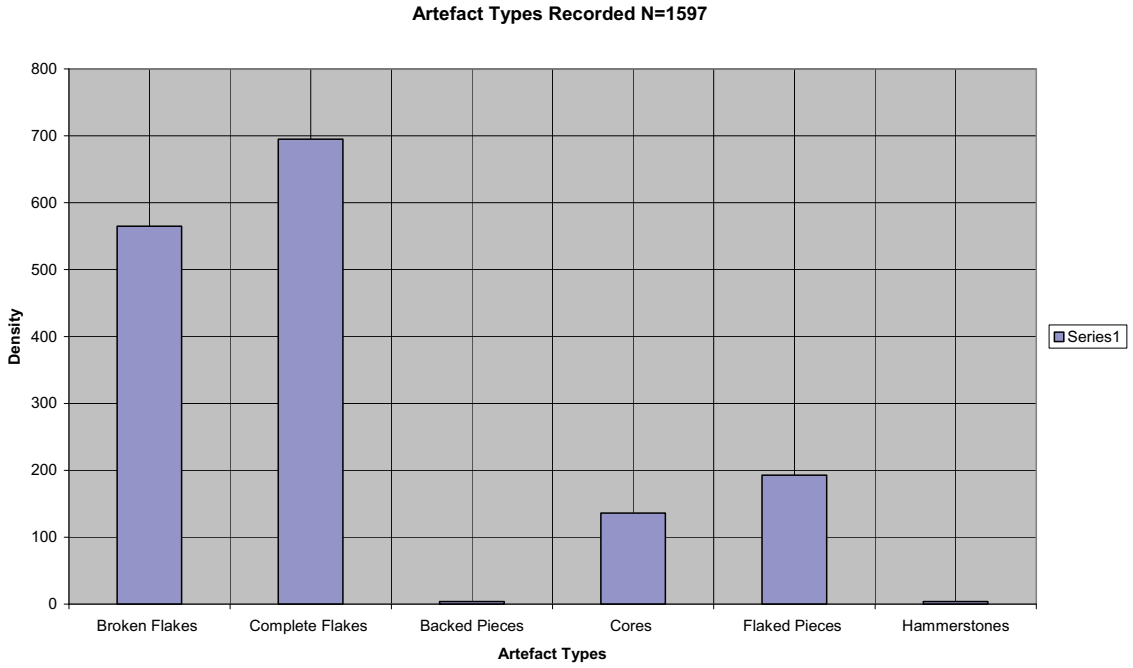
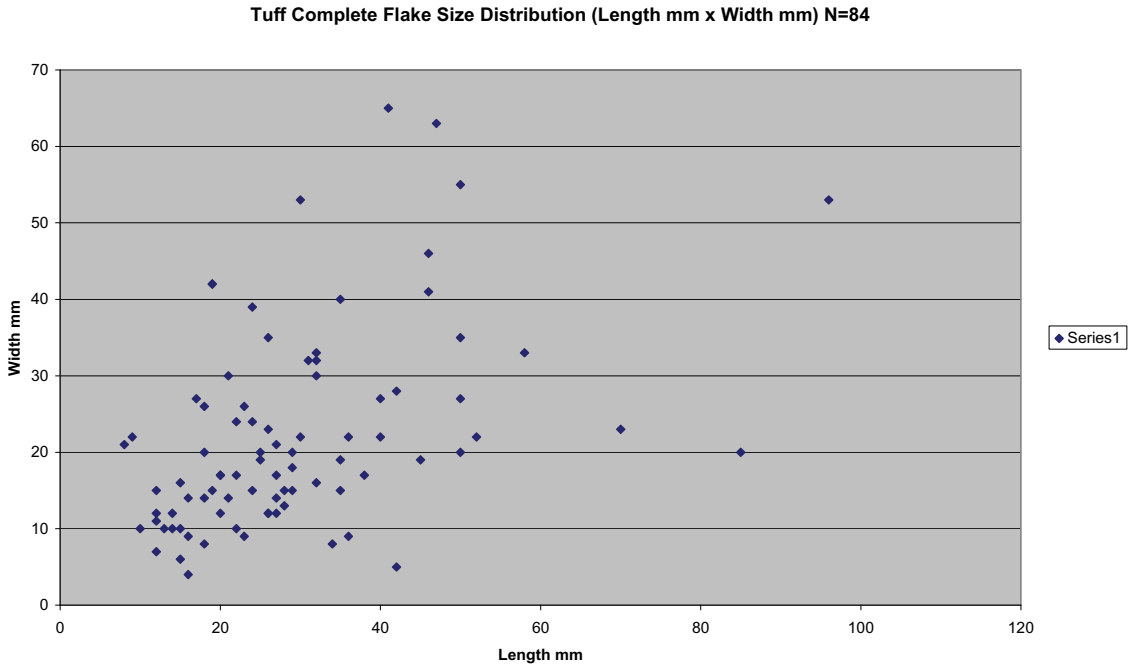


Table 21: Artefact Types Recorded Chart



Tables 22 & 23: Complete Flake Measurement Chart: Tuff & Quartz



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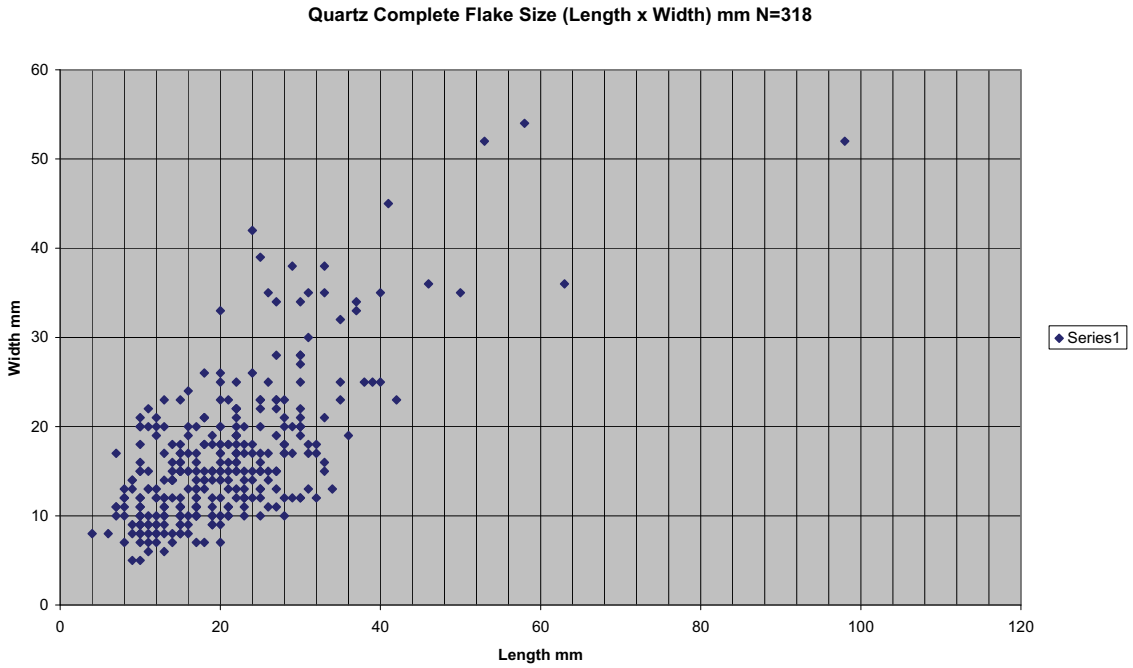

12.3.3 Inter-site Comparability

If we examine assemblage size between the sites recorded, we see a higher proportion of larger sites located near watercourses (ie. springs and soaks) than sites found along ridge-lines or escarpments. Sites with 10 or less artefacts are

more likely to be found on ridge crests, whilst sites with 10 or more artefacts, are likely to be found close to permanent or semi permanent water on flatter ground. Sites with densities greater than 50 show a wider range of artefact and raw material types.

There is no clear distribution pattern of the types of artefacts recorded between sites except a high degree of broken material. This breakage pattern could very well be a result of a higher impact due to animal treadage along watercourses and vehicle mechanical damage within the ridge-line systems. The most interesting sites from an assemblage composition comparison are: SM1C: 103, 165, 230 and 282.

Rock shelter occupation shows that out of a total of 310 shelter sites investigated, only two sites contained evidence of diverse human occupation activities (ie. making art, grinding tools and discarding artefacts) S1MC: 280 (36-3-0042) and 283. Only two other shelter sites: 286 & 287 showed artefact densities of greater than 20 artefacts on their floor surface.

Aspect does not appear to be an important indicator of rock shelter occupation with equal numbers either facing west or north or north-west. Floor space and slope may be a better indicator of human habitation potential with most of the shelters with occupation evidence having floor areas greater than 2m x 1m x 1.2m. In fact, Moolarben Aboriginal shelter site selection seems to prefer an area of 2m x 4m x 2m. Dryness is also another likely site selection factor that could influence occupation potential with no shelters recorded with occupation evidence having wet floors.

12.3.4 Site Age and Subsurface potential

Without evidence of buried hearths (ie. ancient fireplaces) rock shelter deposits containing dateable carbon material are the only evidence that could be dated directly, none of the open sites recorded in the study area can be directly dated. This obviously means that true age cannot be known. Another technique of indirect dating is seriation (see Section 7.2.1). Only a small proportion of the total assemblage is regarded as being associated with a backed blade sequence. This may mean that the surface evidence is only a few hundred or thousand years old. One can only speculate, given the extent of erosion and likely disturbance along the Moolarben Creek Tributary and surrounding landforms, that most sites are probably not more than 1-2,000 years old.

Although a majority of the soils are shallow over much of the study area, within the immediate Moolarben Creek catchment there is some alluvial soil development. This coupled with the fact that human occupation is likely to be concentrated within a certain distance from creek margins, shows there is some potential for buried open deposits.

12.3.5 Limitations of the Data

The most significant limitation of the survey data is the lack of ground visibility on larger areas of flat land (open paddocks adjacent to Moolarben and Spring

Creeks). Due to the above, more archaeological evidence was expected in areas within 100 metres along most of Moolarben Tributary's catchment. Of the 19% of the study area assessed on foot, the remaining 80% has relatively low potential for further assessment (ie. steep slopes and heavy vegetation cover). Land that may hold greater promise is likely to be within 50-100 metres of watercourses further east of the study area, especially within the Murragamba Creek catchments.

Although ploughing has no doubt removed potential sub surface deposits in some alluvial land units; where occupation material has accumulated over a long period of time, it is likely that more buried evidence would be expected to be found.

12.4 Comparisons with other survey and excavation results

Comparisons with the work of Haglund (1981, 1987, 1997), Attenbrow (2004), Vinnicombe (1980), Pearson (1981), Navin Officer (2005) and MacDonald (1992) show that sites recorded within the study area are well represented in the existing archaeological record. Dated sites are few and dated sites within an open space context are rare. Across different landscape units recorded sites found within the study area fall within two main categories:

- Short term occupation sites usually represented by a single or several discard events (ie. Isolated Find discarded after use); and

- Specific long term seasonal nodal sites which display a range of human activities, including tool preparation and manufacture, rock art displays, shelter or open space occupation centred around a number of key seasonal resources (ie. Springs, wetlands etc).

As discussed by Vinnicombe (1981) and Attenbrow (2004) the above site types can be further described using a site catchment model:

- Hunter-gatherers used a catchment area by having a number of short term base camps where a family group size varied according to seasons and locality;

- Hunter-gatherers also used transit like camps which acted as a stop over point for procurement of raw materials, or exchange of trade items or preparation of food; and

- Specific activity locations (ie. Rock art sites, Grinding Grooves etc) which may have represented a prime place of choice to undertake specific local activities (ie. high quality sandstone area at the head of a gully to grind axe material, high quality sandstone to engrave, paint or undertake stencil art, area close to a high quality source of ochre which had ceremonial significance, stone source quarry site).

In contrasting the location and content of sites within the study area, a majority of sites recorded are already commonly represented in the existing archaeological

record. Haglund (1997) has recorded many examples of artefact scatters and isolated finds within the adjacent Ulan lease. Open sites (principally artefact scatters, isolated finds made from quartz and tuff) have been commonly recorded on alluvial flats, valley bottoms and ridge crests. Many of these sites are found as a result of natural or man made soil disturbance processes and are missing key finished tool items or evidence of campsite structures. Rock shelter sites are less common, especially those with art and grinding grooves present.

RESEARCH ISSUES ARISING FROM SURVEY ASSESSMENT RESULTS

For sites that are likely to be impacted by mining development, the scientific value of those archaeological sites and objects need to be considered within a local and regional archaeological research framework. Research questions that are of major interest concerning these threatened sites concern the following research issues:

- Undisturbed open sites which may demonstrate discrete human activities and that can be linked to a specific Aboriginal resource use (ie. spring or soak);

- Sites that can tell us about tool manufacturing, raw material selection and local reduction processes (ie. identifying knapping floors of one particular type of raw material);

- Rock art analysis of motif assemblages, application techniques and their rarity. This research may tell us something about local social and ceremonial activity(ie. wet pigment paintings which are rare vs dry pigment paintings which are common);

- The test excavation of Potential Archaeological Deposits within a discrete catchment area and the measurement of degree of floor area used, floor slope, wetness and access to transport corridors;

- Development of a staged subsidence monitoring programme to provide local data on subsidence impacts on rock shelter, grinding groove and open sites with participation of all Aboriginal groups over the life of the Underground Mine;

- The impact of graffiti on local rock art sites and how is it to be effectively monitored;

- The number of discard items recorded as Isolated Finds that are actually used as tools as opposed to the discard of unmodified flakes or broken flakes(Usewear and Residue analysis; and

- Dateable rock shelter sites that may provide discrete time-lines to when the Moolarben and Murragumba Creek Valleys were first occupied.

Individually the majority of the sites recorded within the study are not unique or rare, but commonly represented. However, taken as a site complex or cultural

landscape, they do represent more evidence of a wider more diverse pattern of prehistoric land-use and may provide evidence of linking transport routes (corridors) or patterns of seasonal movement across a broader region. A lack of clearly dateable material remains on these kinds of sites remains a problem in constructing local or regional chronologies. Sites may be considered common or representative because they are only identified within a small area (ie. development area).

12.5 Aboriginal views of sites and cultural landscape value

As part of the assessment process each Aboriginal group participating in the survey was asked what cultural landscape values the project area may contain. A number of issues were raised and are summarised below:

- Sites located within the escarpment area (Underground No 4 area) called "The Drip" have high cultural value because they represent easily identified material remains that can show living Aboriginal people about Aboriginal land-use, the area is also ceremonially important due to the type of rock art sites present;

- Sites, objects and known places of cultural significance (Hands on the Rock, The Drip) within Wiradjuri country are linked together; and

- Due to the impact of white settlement and government assimilation policies, traditional knowledge of Wiradjuri sites within the development area have not been passed on from generation to generation.

For a more detailed explanation of Aboriginal cultural values (see Appendix 3).

13 Significance Assessment

The Consultant has based his Significance Assessment of the Moolarben cultural resource on the following criteria:

- NSW Department of Environment & Conservation Guide-lines;

- Australian Heritage Commission National Estate criteria;

- Archaeological Significance Assessment;

- Aboriginal Social Significance; and

- Educational.

It is important to state that not all cultural heritage sites or places are equally significant or important and consequently worthy of long term preservation. A detailed discussion of significance criterion and how it has changed over time has recently been undertaken by Byrne et al (2001). The most important criteria for the assessment of the Moolarben Aboriginal cultural resource are the Aboriginal

social significance, scientific archaeological significance and educational significance. Excluding Aboriginal social significance, these specific criteria will be defined.

13.1 Aboriginal social significance

MCM has undertaken to consult directly with all Aboriginal community groups affected by the mining proposal.

Scientific significance is defined as: "The scientific or research value of a place. This will depend upon the importance of the data involved, on its rarity, quality or representativeness and on the degree to which the place may contribute further substantive information" (Byrne et al 146:2002).

In the MCP context, the Consultant has used the following archaeological assessment criteria concerning Aboriginal history and past land-use, which are represented by the following headings:

- Information Potential/Research Value;
- Regional Research Priorities;
- Representativeness;
- Rarity;
- Educational; and
- Cultural Landscape Values.

13.2 Information and Research Potential

This criterion is relevant to assessing an area's research potential in understanding of Australia's cultural history or human occupation of Australia. An area's cultural resource may have the potential to provide information that will contribute to understanding past human behaviour. Three factors are considered important in assessing a site, suite of sites or cultural object as having research potential:

- A place or site's intactness or integrity (this may include the state of preservation of a site or cultural remains). An intact site or place may reveal a greater amount of cultural evidence for past human behaviour. Sites in poor condition may be limited in what they can contribute to further research;
- Whether a site or cultural object (relic) may demonstrate connectedness to other sites within a landscape or within a regional context; and

- The chronological potential of a site or suite of sites to provide dates of human history for that particular evidence of occupation. Whether the site or place has potential for dateable deposits or strata.

13.3 Regional Research Priorities

This research criterion is important for assessing significance when information will contribute on a regional level and assist other researchers in the understanding of past human behaviour. It is usually understood in the context of regional research priorities. Some priorities may be focussed on chronology, others on technological variability, while others may be looking at site function.

13.4 Representativeness

This archaeological assessment criterion is based on a conservation objective. It is relevant when assessing what a site or place may contribute if it was preserved for future generations. The concept has to be assessed in a regional and local context. If very little of this type of site or suite of sites has been conserved, then it becomes a conservation priority. The aim for cultural resource managers is to conserve a representative sample of sites or places for future generations and research.

The main problem of this criterion is that much of the comparative data for site conservation, especially on a regional scale has not been systematically gathered by many conservation agencies. Defining variability may be an aim for cultural resource managers, but if nothing is known about what has been destroyed or lost due to natural or human development processes then comparisons concerning representativeness are meaningless.

Without the above information, archaeologists are encouraged to assess representativeness based on their field experience and on their reading of the representative literature.

13.5 Rarity

This concept of significance criteria concerns the issue of how distinct a site or cultural object may be compared to other similar sites or objects. Rare implies that sites or objects of this nature have not been readily reported or assessed in a local or regional context before. The criterion of rarity may be assessed at a range of levels including; local regional, national, state or international.

13.6 Educational Potential

Sites or places that help educate the broader public about Aboriginal history are valuable resources. It is usually the level of information retrieved from sites or objects that can really assist in enlightening the public about what happened at a particular place in the past. This educational potential comes from the work of the archaeologist in translating their finds or research results into everyday language that people can understand.

The educational outcomes may be newspaper articles, books, video presentations, lectures, radio broadcasts and information brochures. The information may be displayed as part of a local or regional museum. A mining company may use the research results to inform their employees about Aboriginal cultural history and occupation of a local area. The Aboriginal community may take the information and use it in local schools to teach and educate children about Wiradjuri Aboriginal history and culture.

13.7 Cultural Landscape Value

This value combines the concept of aesthetic and social significance to a broader context of how living Aboriginal people perceived the local landscape and their sites or cultural objects within it. This Aboriginal concept may be connected to the understanding of religious and scenic values where places and natural features may contain inherent Wiradjuri cultural landscape values.

Sites or cultural objects found within a landscape, which is “untouched” or has natural scenic beauty, may be important when assessing cumulative impact or broader landscape disturbance. Aboriginal people will place a value on an entire landscape (with all its natural features) and how that may be affected by development impact.

13.8 Significance Results

13.8.1 Information and Research Potential

The following sites are considered to have some research potential based on their contents and condition: S1MC 103, S1MC 230, S1MC 264, S1MC 282, S1MC 280 (36-3-0042), S1MC 283, S1MC 286 and S1MC 287.

13.8.2 Regional Research Values and Representativeness

The following sites are considered to have some regional research value: S1MC 103, S1MC 264, S1MC 280 (36-3-0042), and S1MC 283.

13.8.3 Rarity

The following sites were considered rare based on their content, landscape aspect and research potential: S1MC 264 & S1MC 283.

13.8.4 Educational Potential

The following sites are considered to have some educational potential: S1MC 103, S1MC 264, S1MC 280 (36-3-0042), and S1MC 283.

13.8.5 Cultural landscape Values

The following local features and places are considered to have some Aboriginal cultural landscape value:

- The Drip;
- Moolarben Creek; and
- Goulburn River and Bora Creek.

Much of the cultural knowledge of these places comes from both oral and written historical sources.

13.9 Significance Rating

Based on the above significance criteria, Table 24 below summarises the main significance rating for each site.

Table 24 below shows level of scientific significance assessed for Aboriginal sites/objects located within the project area.

Table 24: Level of scientific significance assessed for Aboriginal sites/ objects located within the project area S1MC=Stage 1 MCP area.

Low	Medium	High
S1MC: 2-66, 68-102, 103a-229, 231-263, 265-270, 272-279, 281, 285, 288-297, 299-302	S1MC:1, 67, 267, 271, 284, 298 36-3-0222, 36-3-0223	S1MC: 103, 230, 264, 280 (36-3-0042), 282, 283, 286, 287.

14 Conclusions

Of a total of 222 sites recorded for the MCP area, eight sites (ie. 103, 230, 264, 280 (36-3-0042), 282, 283, 286, 287 – see Figures 6 &7) are considered to be of high archaeological significance. However, given some of these sites are located within a disturbed context, further archaeological investigation may not be warranted. The remaining 214 sites are considered of medium or low archaeological significance and depending on the nature of the development impacts may not require further archaeological investigation.

From an Aboriginal cultural assessment point of view, the most sensitive Aboriginal cultural landscape is located within the northern area of Underground No 4 (ie. near “The Drip”). However, general Aboriginal community consultation advice has stated that all sites (archaeological or cultural) are of value, but none of the community members interviewed objected to the mining proposal going ahead.

14.1 Assessment of Mining Development Impacts

A number of sites will be impacted by the proposal and these can be defined by the type of impact associated with the proposed mining development.

14.1.1 Surface and Underground Mining Impacts

Table 25 below sets out which sites will be impacted and conserved by the MCP.

Table 25: Aboriginal Sites, Objects and PADs which will be impacted and conserved by the Moolarben Stage 1 mine development proposal: Note This does not include sites located in Open Cut 3 Extension area.

Type of Mining Impact	Sites to be impacted	Sites likely to be preserved as a result of the proposal	Potential Archaeological Deposits Impacted	Potential Archaeological Deposits Preserved
Open cuts 1-3	105	64	2	11
Road construction	0	0	0	0
Infrastructure Impacts	22	7		
Underground No 4 Subsidence Impacts	12	31		

14.1.2 Subsidence Impact Assessment: Underground No 4.

The assessment of subsidence impacts on Aboriginal heritage have been undertaken by Strata Engineering Pty Ltd subsidence specialist Mr Steve Ditton (see Strata Engineering 2006). Mr Ditton's report relates to Aboriginal sites and Objects located within Underground No 4 Approved area. His final report will be distributed to all Aboriginal community groups for comment. Assessment of long term subsidence impacts is unknown for most sites, however an assessment of subsidence risk has been made and this is used as a guide to assess likely impacts.

Impacts on sandstone shelters, sandstone outcrops (tors, pinnacles, etc) and associated drainage lines are likely to involve cracking, shearing and movement of loose sandstone structures located within or near existing sites. The main findings of his report are described in Table 26 below.

Table 26: Aboriginal Sites and Objects and the risk of subsidence impacts

High Risk of subsidence impacts: 11 sites	Moderate Risk of subsidence impacts: 1 site	Low Risk of subsidence impacts: 31 sites
S1MC 280 (36-3-0042) S1MC 287-297.	S1MC 264	S1MC 254-263, 265-279, S1MC 281-286.

14.1.3 Conservation outcomes

A total of 102 sites will be conserved as a result of the mining proposal.

15 Management Recommendations

The management recommendations of this report are based on the following:

- Scientific assessment of the archaeological survey results;
- Assessment of Aboriginal cultural values;
- An on site Aboriginal consultation meeting held on the 10th & 11th of April 2006 with all three Aboriginal community groups involved; and
- An assessment of the likely mine development impacts and the revision of mine development areas to avoid impacting Aboriginal sites and Objects.

Subject to final approval of the MCP from the NSW Department of Planning, 139 Aboriginal sites and Objects (see Table 27 below & Figures 6 & 7) are likely to be impacted by the mine development and will require Part 3A planning approval

15.1 Site Management Strategies and Conservation Options

Subject to final approval of the MCP from the NSW Department of Planning, (139) sites (see Table 27 below & Figures 6 & 7) are likely to be impacted by the mine development and will require Part 3A planning approval. Following an Aboriginal community onsite meeting held between on the 10th & 11th of April, a series of management recommendations were developed for specific Aboriginal sites and objects likely to be effected by the MCP. Table 27 below sets out the final recommendations for all Aboriginal sites and objects excluding the area south of Exploration Lease 6288. These management strategies and options include:

- Conservation and preservation of Aboriginal sites and objects from likely mine construction impacts;
- Archaeological salvage and test excavations of Aboriginal sites and Aboriginal objects ;
- Surface collection of Aboriginal Objects;
- Intensive insitu recording of Aboriginal sites likely to be impacted from mining development; and
- On going monitoring and assessment of subsidence impacts for sites located in the approved Underground No 4 area.

Table 27: MCP Aboriginal Objects and Sites and Management Status

MOOLARBEN COAL ARCHAEOLOGICAL SITES SUMMARY TABLE:

Stage 1 Approvals Area S1MC=Stage 1 Moolarben Coal

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
S1MC1	Scarred Tree	760670	6424444	1	Left insitu
S1MC2	Artefact Scatter	760840	6424339	14	Surface Collection
S1MC3	Isolated Find	760846	6424309	1	Surface Collection
S1MC4	Isolated Find	760866	6424307	1	Surface Collection
S1MC5	Artefact Scatter	760867	6424306	3	Surface Collection
S1MC6	Isolated Find	760890	6424301	1	Surface Collection
S1MC7	Isolated Find	760867	6424294	1	Surface Collection
S1MC8	Isolated Find	760548	6424002	1	Surface Collection
S1MC9	Isolated Find	760508	6424018	1	Surface Collection
S1MC10	Isolated Find	760645	6424004	1	Surface Collection
S1MC11	Artefact Scatter	760924	6423968	3	Surface Collection
S1MC12	Isolated Find	760933	6423948	1	Surface Collection
S1MC13	Isolated Find	761054	6423910	1	Surface Collection
S1MC14	Isolated Find	761050	6423907	1	Surface Collection
S1MC15	Isolated Find	761252	6425269	1	Surface Collection
S1MC16	Isolated Find	761168	6425107	1	Surface Collection
S1MC17	Isolated Find	760997	6425271	1	Surface Collection
S1MC18	Isolated Find	759777	6425026	1	Conservation
S1MC19	Isolated Find	759786	6425012	1	Conservation
S1MC20	Isolated Find	759816	6425028	1	Conservation
S1MC21	Isolated Find	760296	6425214	1	Conservation
S1MC 22	Isolated Find	760297	6425216	1	Conservation
S1MC 23	Isolated Find	760269	6425239	1	Conservation
S1MC24	Isolated Find	760514	6425250	1	Surface Collection
S1MC25	Isolated Find	761802	6425783	1	Surface Collection
S1MC26	Isolated Find	761766	6425183	1	Conservation
S1MC27	Isolated Find	761828	6425100	1	Conservation
S1MC28	Isolated Find	761627	6425002	1	Conservation
S1MC29	Isolated Find	761619	6424707	1	Conservation
S1MC30	Isolated Find	761135	6424559	1	Surface Collection
S1MC31	Isolated Find	761132	6424567	1	Surface Collection
S1MC32	Isolated Find	761124	6424585	1	Surface Collection
S1MC33	Isolated Find	761125	6424584	1	Surface Collection
S1MC34	Isolated Find	761128	6424583	1	Surface Collection
S1MC35	Isolated Find	761125	6424584	1	Surface Collection
S1MC36	Isolated Find	761255	6424616	1	Conservation
S1MC37	Isolated Find	761255	6424616	1	Conservation
S1MC38	Isolated Find	761279	6424617	1	Conservation
S1MC39	Isolated Find	761279	6424617	1	Conservation
PAD 1	Pad 1	761452	6424581	N/A	Conservation
PAD 2	Pad 2	761265	6423464	N/A	Conservation
PAD 3	Pad 3	761265	6423392	N/A	Conservation

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
S1MC40	Artefact Scatter	760441	6421958	12	Test Excavations and Salvage
S1MC41	Isolated Find	760384	6421732	1	Test Excavations and Salvage
S1MC42	Isolated Find	760408	6421838	1	Test Excavations and Salvage
S1MC43	Artefact Scatter	760558	6421874	9	Test Excavations and Salvage
S1MC44	Isolated Find	760550	6421657	1	Test Excavations and Salvage
S1MC45	Isolated Find	760582	6421721	1	Test Excavations and Salvage
S1MC46	Isolated Find	760547	6421941	1	Test Excavations and Salvage
S1MC47	Isolated Find	760637	6422033	1	Test Excavations and Salvage
S1MC48	Isolated Find	760569	6421916	1	Test Excavations and Salvage
S1MC49	Isolated Find	760543	6422069	1	Test Excavations and Salvage
S1MC50	Isolated Find	760340	6422126	1	Test Excavations and Salvage
S1MC51	Isolated Find	760434	6422195	1	Test Excavations and Salvage
S1MC52	Isolated Find	760422	6422175	1	Test Excavations and Salvage
S1MC53	Artefact Scatter	759942	6422062	39	Conservation
S1MC54	Artefact Scatter	760966	6421764	3	Conservation
S1MC55	Rockshelter&Artefacts	760964	6421902	8	Conservation
S1MC56	Rockshelter&Artefacts	760936	6421882	1	Conservation
S1MC57	Artefact Scatter	760906	6421882	16	Conservation
S1MC58	Artefact Scatter	761241	6419040	10	Conservation
S1MC59	Artefact Scatter	761274	6419089	8	Conservation
S1MC60	Artefact Scatter	761555	6418906	12	Conservation
S1MC61	Isolated Find	761650	6418891	1	Conservation
S1MC62	Isolated Find	761503	6418958	1	Conservation
S1MC63	Isolated Find	761502	6418979	1	Conservation
S1MC64	Isolated Find	761502	6418979	1	Conservation
S1MC65	Isolated Find	761382	6418984	1	Conservation
S1MC66	Artefact Scatter	761345	6418974	24	Conservation
S1MC67	Artefact Scatter	761298	6418996	52	Conservation
S1MC68	Isolated Find	761300	6419026	1	Conservation
S1MC69	Isolated Find	761300	6419031	1	Conservation
S1MC70	Isolated Find	761427	6419023	1	Conservation
S1MC71	Isolated Find	761427	6419023	1	Conservation
S1MC72	Isolated Find	761421	6419023	1	Conservation
S1MC73	Isolated Find	761429	6419089	1	Conservation
S1MC74	Isolated Find	761687	6419730	1	Conservation
S1MC75	Isolated Find	761683	6419722	1	Conservation
S1MC76	Isolated Find	761683	6419722	1	Conservation
S1MC77	Isolated Find	761597	6419653	1	Conservation
PAD 4	Pad 4	761685	6419735	N/A	Conservation

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
PAD 5	Pad 5	761685	6419735	N/A	Conservation
PAD 6	Pad 6	761341	6420748	N/A	Conservation
36-3-0222	Artefact Scatter	760420	6420820	6	Intensive Recording and Salvage
36-3-0223	Isolated Find	760420	6420880	1	Intensive Recording and Salvage
S1MC78	Artefact Scatter	761628	6417183	12	Test Excavations and Salvage
S1MC79	Isolated Find	761592	6417154	1	Test Excavations and Salvage
S1MC80	Isolated Find	761535	6417281	1	Surface Collection
S1MC81	Isolated Find	761547	6417308	1	Surface Collection
S1MC82	Isolated Find	761563	6417309	1	Surface Collection
S1MC83	Isolated Find	761557	6417330	1	Surface Collection
S1MC84	Artefact Scatter	761580	6417360	6	Surface Collection
S1MC85	Isolated Find	761613	6417323	1	Surface Collection
S1MC86	Isolated Find	761612	6417508	1	Surface Collection
S1MC87	Isolated Find	761615	6417500	1	Surface Collection
S1MC88	Isolated Find	761608	6417465	1	Surface Collection
S1MC89	Isolated Find	761591	6417421	1	Surface Collection
S1MC90	Isolated Find	761579	6417403	1	Surface Collection
S1MC91	Isolated Find	761631	6417624	1	Surface Collection
S1MC92	Isolated Find	761659	6417596	1	Surface Collection
S1MC93	Isolated Find	761659	6417588	1	Surface Collection
S1MC94	Artefact Scatter	761638	6417728	3	Surface Collection
S1MC95	Isolated Find	762537	6415994	1	Surface Collection
S1MC96	Isolated Find	762530	6416009	1	Surface Collection
S1MC97	Isolated Find	762523	6416029	1	Surface Collection
S1MC98	Isolated Find	762475	6416038	1	Surface Collection
S1MC99	Isolated Find	762553	6416059	1	Surface Collection
S1MC100	Isolated Find	762414	6416282	1	Surface Collection
S1MC101	Isolated Find	762415	6416282	1	Surface Collection
S1MC102	Artefact Scatter	762379	6416477	3	Surface Collection
S1MC103a	Artefact Scatter	762693	6416081	2	Surface Collection
S1MC103	Artefact Scatter	763978	6415601	184	Conservation
S1MC104	Artefact Scatter	764042	6415564	4	Conservation
S1MC105	Isolated Find	763996	6415683	1	Conservation
S1MC106	Isolated Find	764013	6415735	1	Conservation
S1MC107	Isolated Find	766017	6415739	1	Conservation
S1MC108	Isolated Find	764026	6415756	1	Conservation
S1MC109	Isolated Find	764023	6416068	1	Conservation
S1MC110	Isolated Find	764118	6416246	1	Conservation
S1MC111	Isolated Find	764135	6416310	1	Conservation
S1MC112	Isolated Find	764136	6416312	1	Conservation
S1MC113	Isolated Find	764140	6416326	1	Conservation
S1MC114	Isolated Find	764148	6416337	1	Conservation
S1MC115	Isolated Find	764124	6416425	1	Conservation
S1MC116	Isolated Find	764114	6416357	1	Conservation
S1MC117	Isolated Find	764095	6416462	1	Conservation

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
S1MC118	Isolated Find	764026	6416575	1	Conservation
S1MC119	Isolated Find	764027	6416566	1	Conservation
S1MC120	Isolated Find	764095	6416601	1	Conservation
S1MC121	Isolated Find	764111	6416632	1	Conservation
S1MC122	Isolated Find	764066	6416619	1	Conservation
S1MC123	Isolated Find	764064	6416622	1	Conservation
S1MC124	Isolated Find	764070	6416630	1	Conservation
S1MC125	Isolated Find	764058	6416612	1	Conservation
S1MC126	Isolated Find	764056	6416612	1	Conservation
S1MC127	Isolated Find	764121	6416573	1	Conservation
S1MC128	Isolated Find	764161	6416333	1	Conservation
S1MC129	Isolated Find	764118	6416557	1	Conservation
S1MC130	Artefact Scatter	762600	6418163	23	Conservation
S1MC131	Isolated Find	762763	6418104	1	Conservation
S1MC132	Artefact Scatter	763451	6417107	33	Conservation
S1MC133	Artefact Scatter	763477	6417119	7	Conservation
S1MC134	Isolated Find	763507	6417086	1	Conservation
S1MC135	Artefact Scatter	763535	6417042	32	Conservation
S1MC136	Artefact Scatter	762737	6417948	5	Conservation
S1MC137	Isolated Find	762338	6418398	1	Conservation
S1MC138	Isolated Find	762315	6418451	1	Conservation
S1MC139	Artefact Scatter	762549	6417807	23	Test Excavations and Salvage
S1MC140	Artefact Scatter	761278	6416654	4	Conservation
S1MC141	Isolated Find	761409	6416796	1	Test Excavations and Salvage
S1MC142	Isolated Find	761479	6417036	2	Test Excavations and Salvage
S1MC143	Artefact Scatter	761535	6417066	3	Test Excavations and Salvage
S1MC144	Isolated Find	761519	6417142	1	Test Excavations and Salvage
PAD 8	Pad 8	761478	6421053	0	Conservation
PAD 9	Pad 9	761552	6421040	0	Conservation
PAD 10	Pad 10	761551	6421051	0	Conservation
PAD 11	Pad 11	761426	6420964	0	Conservation
PAD 12	Pad 12	761318	6420832	0	Conservation
S1MC225	Isolated Find	761752	6425887	1	Conservation
S1MC226	Isolated Find	761726	6426232	1	Conservation
S1MC227	Isolated Find	761825	6426206	1	Conservation
S1MC228	Artefact Scatter	762428	6426370	13	Conservation
S1MC229	Isolated Find	762430	6426375	1	Conservation
S1MC230	Artefact Scatter	761640	6426786	69	Test Excavations and Salvage
S1MC231	Isolated Find	761907	6426804	1	Test Excavations and Salvage
S1MC232	Isolated Find	761926	6426825	1	Test Excavations and Salvage

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
S1MC233	Artefact Scatter	761954	6426840	2	Test Excavations and Salvage
S1MC234	Isolated Find	761990	6426858	1	Test Excavations and Salvage
S1MC235	Isolated Find	762126	6426823	1	Test Excavations and Salvage
S1MC236	Artefact Scatter	762199	6426811	14	Test Excavations and Salvage
S1MC237	Isolated Find	762202	6426805	1	Test Excavations and Salvage
S1MC238	Isolated Find	762211	6426803	1	Test Excavations and Salvage
S1MC239	Isolated Find	762220	6426805	1	Test Excavations and Salvage
S1MC240	Artefact Scatter	762231	6426802	7	Test Excavations and Salvage
S1MC241	Artefact Scatter	762272	6426800	10	Test Excavations and Salvage
S1MC242	Isolated Find	762291	6426800	1	Test Excavations and Salvage
S1MC243	Isolated Find	762310	6426800	1	Test Excavations and Salvage
S1MC244	Artefact Scatter	761552	6426828	30	Conservation
S1MC245	Isolated Find	761747	6426767	1	Test Excavations and Salvage
S1MC246	Isolated Find	761820	6426775	1	Test Excavations and Salvage
S1MC247	Isolated Find	761831	6426745	1	Test Excavations and Salvage
S1MC248	Isolated Find	761863	6426758	1	Test Excavations and Salvage
S1MC249	Isolated Find	761863	6426771	1	Test Excavations and Salvage
S1MC250	Isolated Find	761860	6426773	1	Test Excavations and Salvage
S1MC252	Isolated Find	761867	6426779	1	Test Excavations and Salvage
S1MC253	Isolated Find	761870	6426772	1	Test Excavations and Salvage
S1MC254	Artefact Scatter	763332	6431357	2	Conservation
S1MC255	Isolated Find	763332	6431357	1	Conservation
S1MC256	Artefact Scatter	762878	6429620	23	Monitor subsidence
S1MC257	Artefact Scatter	762850	6429600	4	Conservation
S1MC258	Artefact Scatter	762865	6429652	2	Conservation
S1MC259	Isolated Find	762889	6429671	1	Conservation
S1MC260	Isolated Find	762849	6429605	1	Conservation
S1MC261	Rockshelter&Artefact	762876	6429660	2	Conservation
S1MC262	Isolated Find	762876	6429676	1	Conservation
S1MC263	Isolated Find	762177	6430458	1	Conservation
S1MC264	Grinding Grooves &Artefacts	762010	6430705	78	Monitor subsidence: Intensive recording.
S1MC265	Artefact Scatter	762224	6430592	3	Conservation
S1MC266	Isolated Find	763000	6431393	1	Conservation
S1MC267	Rockshelter&Artefact	761945	6430063	10	Monitor subsidence

Site Name	Site Type	X Centre	Y Centre	Artefact Density	Management Recommendation
S1MC268	Isolated Find	761875	6430102	1	Conservation
S1MC269	Isolated Find	761882	6430110	1	Conservation
S1MC270	Isolated Find	762024	6430287	1	Monitor subsidence
S1MC271	Rockshelter&Artefacts	763749	6428829	8	Monitor subsidence
S1MC272	Artefact Scatter	763827	6428747	2	Conservation
S1MC273	Isolated Find	762660	642864	1	Conservation
S1MC274	Isolated Find	761580	6426932	1	Conservation
S1MC275	Isolated Find	761878	6426869	1	Conservation
S1MC276	Isolated Find	761877	6426917	1	Conservation
S1MC277	Isolated Find	761862	6426931	1	Conservation
S1MC278	Isolated Find	761688	6426940	1	Conservation
S1MC279	Isolated Find	761551	6426963	1	Conservation
S1MC280	Rockshelter&Artefacts	762822	6427883	45	Monitor subsidence: Intensive recording.
S1MC281	Artefact Scatter	762865	6432219	11	Monitor subsidence
S1MC282	Artefact Scatter	762851	6432207	65	Monitor subsidence
S1MC283	Rockshelter&Artefacts	762912	6432185	6	Monitor subsidence
S1MC284	Rockshelter&Artefacts	762877	6432127	8	Monitor subsidence
S1MC285	Rockshelter&Artefacts	762905	6431976	2	Monitor subsidence
S1MC286	Rockshelter&Artefacts	762868	6431969	28	Monitor subsidence
S1MC287	Rockshelter&Artefacts	763240	6430143	28	Monitor subsidence: Intensive recording.
S1MC288	Rockshelter&Artefacts	763336	6430223	1	Monitor subsidence: Intensive recording.
S1MC289	Rockshelter&Artefacts	763795	6429838	9	Monitor subsidence: Intensive recording.
S1MC290	Rockshelter&Artefacts	763739	6429835	5	Monitor subsidence: Intensive recording.
S1MC291	Isolated Find	763726	6429853	1	Monitor subsidence: Intensive recording.
S1MC292	Isolated Find	763406	6429904	1	Monitor subsidence: Intensive recording.
S1MC293	Isolated Find	763385	6429901	1	Monitor subsidence: Intensive recording.
S1MC294	Rockshelter&Artefacts	763673	6429849	2	Monitor subsidence: Intensive recording.
S1MC295	Isolated Find	763273	6429928	1	Monitor subsidence: Intensive recording.
S1MC296	Rockshelter&Artefacts	763503	6429961	12	Monitor subsidence: Intensive recording.
S1MC297	Rockshelter&Artefacts	763420	6430329	5	Monitor subsidence: Intensive recording.
PAD 7	Pad 7	763846	6428750	0	Conservation
S1MC298	Artefact Scatter	759258	6423654	75	Test Excavation & Salvage
S1MC299	Isolated Find	759331	6423850	1	Surface Collection
S1MC300	Artefact Scatter	759071	6423798	41	Intensive Recording & Surface Collection
S1MC301	Artefact Scatter	758997	6424100	10	Surface Collection
S1MC302	Artefact Scatter	758881	6423779	20	Surface Collection

15.2 Road Corridor

Between Open Cut 2 & 3 there is a proposed road corridor. This proposed road crosses an existing drainage line and passes a series of recorded open sites to its east. It is recommended that this section of road corridor be tested for potential buried archaeological deposits.

15.3 Conservation Management Option

This option will either involve leaving an identified Aboriginal site or Aboriginal Object in place and therefore undisturbed within the landscape. It may also required protection using fencing or the appropriate construction barriers to prevent accidental damage.

15.4 Aboriginal Cultural Heritage Management Plan

It is recommended, that MCM prepare an Aboriginal Cultural Heritage Management Plan in order to assist it in managing likely cultural resources found within their mine lease area.

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18 APPENDICIES

APPENDIX 1: DEC AHMIS Site Register Search Results.

Department of
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List of Sites (Partial)

Grid Reference Type = AGD (Australian Geodetic Datum) Zone = 55 Estate = Munghorn Gap Nature Reserve Feature Search Type = AHIMS Features

Site ID	Site Name	Datum	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0019	Cooyal Creek;	AGD	55	764765	6408170	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0025	Munghorn Reserve;Munghorn Reserve 1;	AGD	55	769272	6411205	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0026	Munghorn Reserve;Munghorn Reserve 2;	AGD	55	768392	6412153	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0147	Betialwen Mtn.;	AGD	55	766200	6410390	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		1333
		Status	Valid									

Number of Sites : 4

Printed By Morris,Glen

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List of Sites (Partial)

Grid Reference Type = AMG Zone = 55 Easting From = 758000 Easting to = 778000 Northing From = 6408000 Northing to = 6427000 Feature Search Type = AHIMS Features

Site Id	Site Name	Grid Ref. Type	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0060	Ulan Creek;Site 18;	AMG	55	760215	6426006	None	☐	☐	Artefact	Open Camp Site		1299
		Status	Valid									
36-3-0061	Ulan Creek;Site 19;	AMG	55	760878	6426622	None	☐	☐	Artefact	Open Camp Site		1299
		Status	Valid									
36-3-0076	Wollar Creek;Wandoona;Gul(	AMG	55	777949	6410697	None	☐	☐	Artefact	Open Camp Site		
		Status	Valid									
36-3-0098	Wattle Creek NO:2;	AMG	55	769880	6422760	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0101	Yawanna NO:2;	AMG	55	774740	6421270	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0103	Wilpinjong;	AMG	55	767950	6422190	None	☐	☐	Modified Tree (Carved or Scarred)	Scarred Tree		
		Status	Valid									
36-3-0106	Yawanna No.1;	AMG	55	774780	6421260	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0115	Yawanna No.3;	AMG	55	774800	6420900	None	☐	☐	Grinding Groove	Axe Grinding Groove		
		Status	Valid									
36-3-0116	Yawanna No.4;	AMG	55	775200	6420600	None	☐	☐	Artefact	Open Camp Site		1333
		Status	Valid									
36-3-0133	Wattle Creek No:1;	AMG	55	769500	6422630	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									
36-3-0134	Murragamba No:1;	AMG	55	761300	6421170	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid									

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Aboriginal Heritage Information Management System

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& Conservation

List of Sites (Partial)

Grid Reference Type = AGD (Australian Geodetic Datum), Zone = 55, Map Sheet like 541%, Feature Search Type = AHIMS Features

Site ID	Site Name	Datum	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0015	Cook Gap;	AGD	55	760387	6415931	None	☐	☐	Grinding Groove	Axe Grinding Groove		
		Status	Valid								Permit(s)	
36-3-0016	Ulan;Murragamba;	AGD	55	760796	6421957	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0020	Wollar;	AGD	55	777958	6415823	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0027	Cooks Gap;	AGD	55	760387	6415931	None	☐	☐	Grinding Groove	Axe Grinding Groove		
		Status	Valid								Permit(s)	
36-3-0039	Ulan;	AGD	55	760828	6427722	None	☐	☐	Modified Tree (Carved or Scarred)	Scarred Tree		361
		Status	Valid								Permit(s)	
36-3-0042	Ulan Creek;Site 2;	AGD	55	762944	6428010	None	☐	☐	Artefact	Axe Grinding Groove		361
		Status	Valid						Art (Pigment or Engraved)	Shelter with Art	Permit(s)	
									Grinding Groove	Shelter with Deposit		
36-3-0044	Ulan;Wilpinjong CReek;	AGD	55	771442	6420278	None	☐	☐	Ceremonial Ring (Stone or Earth)	Bora/Ceremonial		
		Status	Valid						Modified Tree (Carved or Scarred)	Carved Tree	Permit(s)	
36-3-0060	Ulan Creek;Site 18;	AGD	55	760215	6426006	None	☐	☐	Artefact	Open Camp Site		1299
		Status	Valid								Permit(s)	
36-3-0061	Ulan Creek;Site 19;	AGD	55	760878	6426622	None	☐	☐	Artefact	Open Camp Site		1299
		Status	Valid								Permit(s)	
36-3-0063	Ulan Creek;Site 21;	AGD	55	761207	6428074	None	☐	☐	Artefact	Open Camp Site		1299
		Status	Valid								Permit(s)	
36-3-0058	Bobadeen;	AGD	55	761661	6427966	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		1299
		Status	Valid								Permit(s)	

AHIMS
Aboriginal Heritage Information Management System

Department of
Environment
& Conservation

List of Sites (Partial)

Grid Reference Type = AGD (Australian Geodetic Datum), Zone = 55, Map Sheet like 541%, Feature Search Type = AHIMS Features

Site ID	Site Name	Datum	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0074	Wollar;Gulgong;	AGD	55	781478	6414502	None	☐	☐	Artefact	Open Camp Site		
		Status	Valid								Permit(s)	
36-3-0098	Wattle Creek NO:2;	AGD	55	769880	6422760	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0101	Yawanna NO:2;	AGD	55	774740	6421270	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0103	Wilpinjong;	AGD	55	767950	6422190	None	☐	☐	Modified Tree (Carved or Scarred)	Scarred Tree		
		Status	Valid								Permit(s)	
36-3-0106	Yawanna No.1;	AGD	55	774780	6421260	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0115	Yawanna No.3;	AGD	55	774800	6420900	None	☐	☐	Grinding Groove	Axe Grinding Groove		
		Status	Valid								Permit(s)	
36-3-0116	Yawanna No.4;	AGD	55	775200	6420600	None	☐	☐	Artefact	Open Camp Site		1333
		Status	Valid								Permit(s)	
36-3-0124	Deridgeree No.3;	AGD	55	777480	6427480	None	☐	☐	Grinding Groove	Axe Grinding Groove		
		Status	Valid								Permit(s)	
36-3-0133	Wattle Creek No:1;	AGD	55	769500	6422630	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0134	Murragamba No:1;	AGD	55	761300	6421170	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		
		Status	Valid								Permit(s)	
36-3-0222	Moolaben Creek MC1	AGD	55	760420	6420820	None	☐	☐	Artefact	Open Camp Site		
		Status	Valid								Permit(s)	

AHIMS
Aboriginal Heritage Information Management System

Department of
Environment
& Conservation

List of Sites (Partial)

Grid Reference Type = AGD (Australian Geodetic Datum), Zone = 55, Map Sheet like 541%, Feature Search Type = AHIMS Features

Site ID	Site Name	Datum	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0223	MC2	AGD	55	760420	8420880	None	☐	☐	Artefact	Open Camp Site		
		Status	Valid								Permit(s)	
36-3-0237	MC11	AGD	55	763384	6421070	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0238	MC10	AGD	55	763226	6422860	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0239	MC8	AGD	55	763193	6422680	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0240	MC6	AGD	55	763113	6421940	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0241	MC4	AGD	55	763161	6421650	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0287	WC/1	AGD	55	765680	6425480	None	☐	☐	Art (Pigment or Engraved)			
		Status	Valid								Permit(s)	
36-3-0337	MC7	AGD	55	763136	6422480	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0352	Slate Gully	AGD	55	775670	6417775	None	☐	☐	Artefact			
		Status	Valid								Permit(s)	
36-3-0419	WCP 142	AGD	55	771026	6420475	None	☐	☐	Potential Archaeological Deposit (PAD			
		Status	Valid								Permit(s)	
36-3-0420	WCP 143	AGD	56	770646	6420565	None	☐	☐	Potential Archaeological Deposit (PAD			
		Status	Valid								Permit(s)	

List of Sites (Partial)

Grid Reference Type = AMG Zone = 55 Easting From = 758000 Easting to = 778000 Northing From = 6408000 Northing to = 6427000 Feature Search Type = AHIMS Features

Site Id	Site Name	Grid Ref. Type	Zone	Easting	Northing	Access Restrictions			Site Features	Site Types (recorded prior to June 2001)	Further Info. Contact	Report ID
						Gender	General	Location				
36-3-0147	Betialwen Mtn.;	AMG	55	766200	6410390	None	☐	☐	Art (Pigment or Engraved)	Shelter with Art		1333
		Status	**Valid**									
36-3-0159	X 29;	AMG	55	758410	6426580	None	☐	☐	Artefact	Open Camp Site		361
		Status	**Valid**									
36-3-0222	Moolaben Creek MC1	AMG	55	760420	6420820	None	☐	☐	Artefact	Open Camp Site		
		Status	**Valid**									
36-3-0223	MC2	AMG	55	760420	6420880	None	☐	☐	Artefact	Open Camp Site		
		Status	**Valid**									
36-3-0236	MC3	AMG	55	758420	6424550	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0237	MC11	AMG	55	763384	6421070	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0238	MC10	AMG	55	763226	6422860	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0239	MC8	AMG	55	763193	6422680	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0240	MC6	AMG	55	763113	6421940	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0241	MC4	AMG	55	763161	6421650	None	☐	☐	Artefact			
		Status	**Valid**									
36-3-0287	WC/1	AMG	55	765680	6425480	None	☐	☐	Art (Pigment or Engraved)			
		Status	**Valid**									

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 9585 6444
Standard Site Recording Form Revised 5/88

1:250,000 map sheet: Dubbo NPWS Code

AMG Grid reference (250K / 25K): 760420 mE 6420880 mN
* Full reference - please include leading digits

Scale of map used for grid reference [ ] 25K, 50K (preferred) [ ] 100K [ ] 250K
Please use largest scale available

1:25K, 50K, 100K map name: WOllAR

Site name: MC2 Locality/property name: "The LAGOON"

NPWS District: Upper Hunter Region:

HEAD OFFICE USE ONLY:
NPWS Site no: 36-3-0223
Site types:
Accessioned by: Date:
Data entered by: [initials] Date: 11/6/99

Owner/Manager: Malcom Swords
Address: "the Lagoon" Ulan via Mudgee 2850

Reason for investigation: D.A. for Timber Clearing

Portion no: 93
Parish: Moolarben

Photos taken? yes
How many attached? 1 copy

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff) (Draw diagram on separate sheet.) Turn off Ulan Mudgee Road 3 klms South of Ulan Travell 4 klms East to the Lagoon" Homestead. Site is located 700 mtrs Nth East of Homestead on corner of cultivation just below Ridge slope which overlooks a Large dead tree and dam site is 3 mtrs from fence near Timbered Area

Other sites in locality? yes Site Types include: Open Camp.
Are sites in NPWS Register? yes

Have artefacts been removed from site? No When? —
By whom? — Deposited where? —

Is site important to local Aborigines? yes
Give contact(s) name(s) + address(es): DAVE MAYNARD 20 LANG St Mudgee. NSW. Murong Gialinga Atsic

Contacted for this recording? yes
(Attach additional information separately) If not, why not? —

Verbal/written reference sources (including full title of accompanying report) NPWS Report Catalogue #

Checklist: surface visibility, damage/disturbance/threat to site
Condition of site: Isolated Artefact on Exsposed Area. Possible Artefacts in grassed Area.

Recommendations for management & protection (attach separate sheet if necessary)
Further investigation Recommended

Site recorded by: DAVE MAYNARD Date: 16.1.99
Address/institution: MURONG GIALINGA ATSIC 20 LANG St Mudgee NSW

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no:

1. Land form a. beach / hill slope / ridge top, etc: Slope b. site aspect: West c. slope: /

d. mark on diagram provided or on your own sketch the position of the site: e. Describe briefly:

1. Local rock type: Narrabeen s/stone 2. Land use/effect: PAST cultivation

2. Distance from drinking water: 1·5 KM Source: Moolaben Creek

3. Resource Zone associated with site (estuarine, riverine, forest etc): forest.

4. Vegetation: Trees over Area. scattered

5. Edible plants noted: /

6 Faunal resources (include shellfish): /

7. Other exploitable resources (river pebbles, ochre, etc): quarrys. Mudgee-flagstone on Slopes.

Site type:

Open Camp.

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination,

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth

QUARRIES: rock type, depth, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.

Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

MC2 is Located on an exposed area 100 Mtrs West from MC1. Artefacts 3 Mtrs off fence. Other material could be in the area.

Soils sandy silt. Pebbly.
1 Artefact was noted creamy grey chert

Most of the area has been cleared in past years. Forest Trees growing on opposite side of fence and up the slopes.

/

Attach sketches etc. eg. plan & section of shelter, show relation between site contents, indicate north, show scale.

Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 9585 6444

Standard Site Recording Form Revised 5/88

1:250,000 map sheet: Dubbo NPWS Code

AMG Grid reference (Full reference - please include leading digits): 250K 760420 mE (25K); 250K 6420820 mN (5/6 25K)

Scale of map used for grid reference (Please use largest scale available): [✓] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: WOLLAR

HEAD OFFICE USE ONLY:

NPWS Site no: 36-3-0222

Site types.

Accessioned by: _____ Date: _____

Data entered by: AMA Date: 11/6/99

Owner/Manager: Malcom Swords

Address: "The LAGOON" ULAN via Mudgee. NSW 2850

Site name: Moolaben Creek. MC1 Locality/property name: "The Lagoon"

NPWS District: Upper Hunter Mudgee Region:

Reason for investigation: D.A. for timber clearing

Portion no: 93

Parish: MOOLARBEN

Photos taken? YES

How many attached? 3 Colypies

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff) (Draw diagram on separate sheet.): TURN OFF ULAN-Mudgee Rd 5 KMS SOUTH OF ULAN. TRAVEL ABOUT 4 KMS EAST TO "The LAGOON" HOMESTEAD SITES ARE LOCATED 800 MTRS NTH EAST OF HOMESTEAD AT A CORNER OF A CULTIVATION JUST BELOW THE RIDGE SLOPE WHICH OVERLOOKS A LARGE DEAD TREE BESIDE A DAM. ALONG A FENCE NEAR A TIMBERED AREA.

Other sites in locality? YES

Are sites in NPWS Register? YES

Site Types include: Open Camps and Shelters with Artefacts

Have artefacts been removed from site? NO When? —

By whom? — Deposited where? —

Is site important to local Aborigines? YES

Give contact(s) name(s) + address(es): DAVE MAYNARD MURONG GIALINGA ATSIC. 20 LANG ST MUDGEE NSW 2850

Contacted for this recording? YES

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report):

NPWS Report Catalogue #

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: SURFACE VISIBILITY good ON eroded AREA. OUTSIDE GRASS COVER WAS 95%. The cleared AREA HAS been CULTIVATED through. The site IS ON the extream CORNER

Recommendations for management & protection (attach separate sheet if necessary): SITE MAY NEED A MARKER below the site if plowing is done IN the future TO AVOID SITE. further investigation Recommended

Site recorded by: DAVE MAYNARD

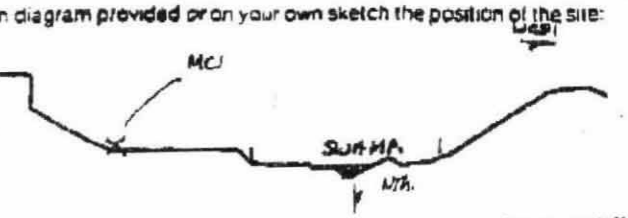
Address/institution: 20 LANG ST MUDGEE NSW. 2850 MURONG GIALINGA ATSIC

Date: 16.1.99

SITE POSITION & ENVIRONMENT	OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: Slope below Ridge b. site aspect: WEST c. slope: WEST

d. mark on diagram provided or on your own sketch the position of the site:



e. Describe briefly: SITE IS IN AN AREA JUST below the Ridge on gentle slope. 15 MTRS from fence Running EAST WEST OVER looking Moolarben Creek.

f. Local rock type: NARRABEEN. S/S

g. Land use/effect: GRAZING + CULTIVATION

2. Distance from drinking water: 1·5 KM Source: Moolarben Creek.

3. Resource Zone associated with site (estuarine, riverine, forest etc): Cleared some Tree Stands scattered

4. Vegetation: Some Geebung, GRASS TREES, MACROZAMIA ON Ridges SCATTERED TREES IN AREA.

5. Edible plants noted: AS ABOVE.

6. Faunal resources (include shellfish): ✓

7. Other exploitable resources (river pebbles, ochre, etc): QUARRYS. Mudgee Flag STONE ON side of Ridges

Site type:

OPEN CAMP

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar, shape, position, size, patterns, axe marks, regrowth.

QUARRIES, rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.

Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

MCI IS LOCATED ON AN EXPOSED AREA 14 X 6 MTRS outside corner of plowed AREA IN the PAST. heavy GRASS COVER outside of exposed AREA WAS 90%. site is below Ridge Line on slope below Ridge Tree line More ARTEFACTS could be found IN GRASSED AREA AT site.

Soil is Silty sandy & pebbly.
SIX ARTEFACTS were found consisting of flake material, quartz, cream & white chert. Dark yellow MUDSTONE with. Red CORTEX.

✓

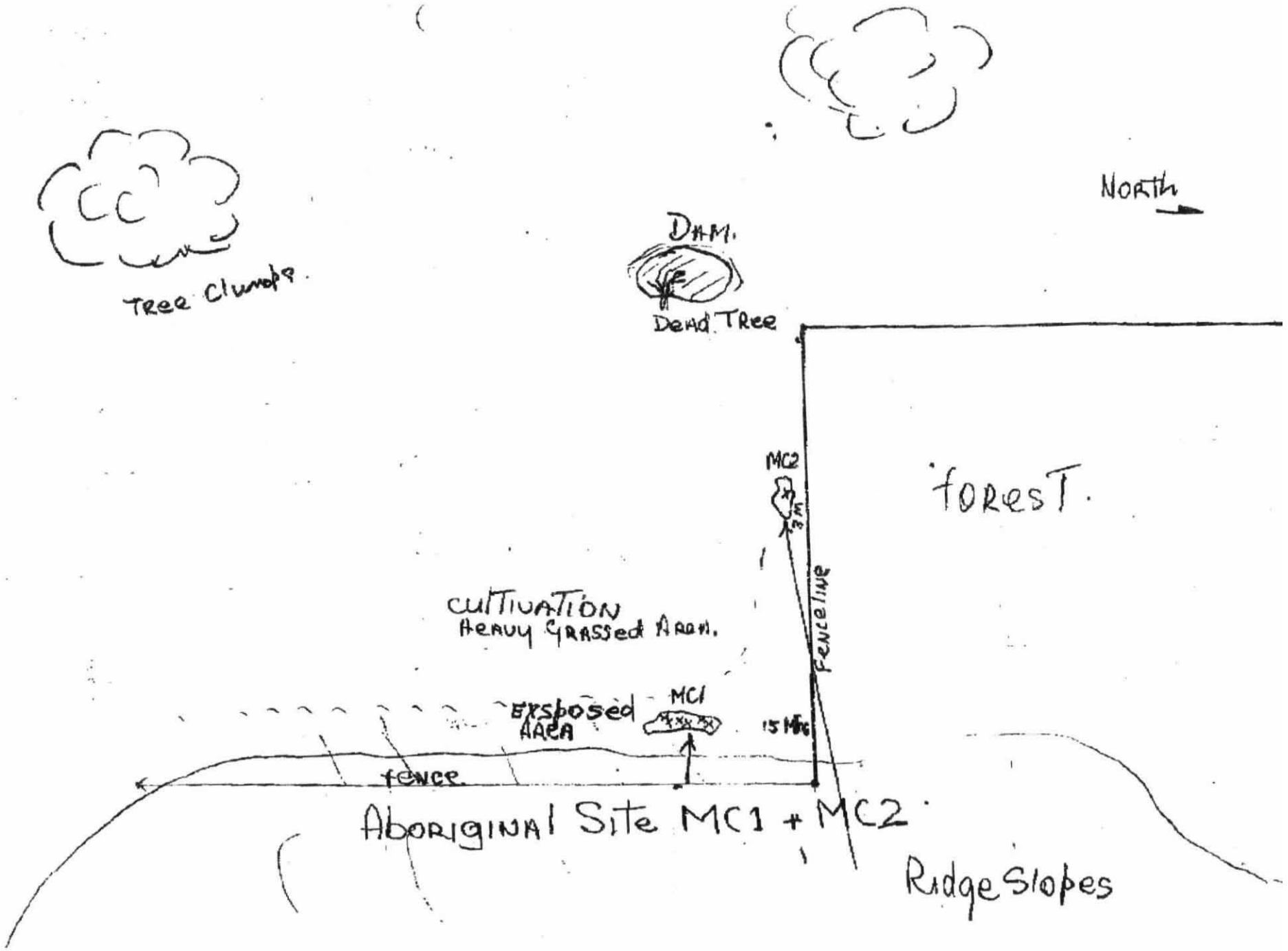
✓

Tree Vegetation WAS CONFINED to small AREAS scattered over the cultivation. White Box, Stringy Bark, Gum ACACIA CALLITRIS, lower story Lower story. Geebung, EPACRIS, HAKEAS, the Largest Stand of Trees close To the Lower slopes Run beside A fence on opposite side where sites ARE Located.

✓

Attach sketches etc, eg, plan & section of shelter, show relation between site contents, indicate north, show scale.

Attach annotated photos (stereo where useful) showing scale, particularly for art sites.


Tree Clumps
DAM.
Dead Tree
NORTH
MC2
3m
forest.
CULTIVATION
Heavy Grassed Area.
Fenceline
Exposed
Area
MC1
15m
fence.
Aboriginal Site MC1 + MC2
Ridge Slopes

APPENDIX 2: PLATES

Plate 1: Artefact Scatter Site: S1 MC 103 located in ploughed paddocks. Open Cut 3. Red flags represent artefacts.

Plate 2: Artefact Scatter Site: S1 MC 298: Open Cut 1 area. Red flags represent artefacts.

Plate 3: Artefact Scatter Site: S1 MC 230: Bora Creek. Infrastructure Area. Red flags represent artefacts.

Plate 4: Grinding Groove and Artefacts Scatter Site: S1MC 264 within Ulan Creek drainage. Underground No 4. Red flags represent artefacts.

Plate 5: Rock shelter Site S1MC 280 (36-3-0042)Underground No 4.Red flags represent surface artefacts.

Plate 6: Rock shelter Site S1MC 280 (36-3-0042)Underground No 4 Area. Close up of faded red hand stencil on back wall .

Plate 7: Rock shelter Site S1 MC 283: Underground No 4 Area.Red flags represent surface artefacts.

Plate 8: Rock shelter Site S1MC 286: Underground No 4 Area. Red flags represent surface artefacts.

Plate 9: Rock shelter Site S1MC 287: Underground No 4 Area. Red flags represent surface artefacts.

Plate 10: Rock shelter Site S1MC 267, Underground No 4: Red flags represent surface artefacts.

Plate 11: Rock shelter Site S1MC 271: Underground No 4.

ARCHAEOLOGICAL RISK ASSESSMENT SERVICES
MOOLARBEN COAL PROJECT

APPENDIX 3

CULTURAL ASSESSMENT: ABORIGINAL COMMUNITY RESPONSES.

Only available on request and with approval of the interviewee.

Appendix 4.

GENERAL GLOSSARY OF TERMS

Aboriginal Object	Aboriginal object is defined under the Act as "any deposit, object, or material evidence (not being a handicraft for sale) relating to Aboriginal habitation of the area that comprises New South Wales being habitation before or concurrent with the occupation of that area by persons of non Aboriginal extraction, and includes Aboriginal remains (as defined within the meaning of the NPW Act 1974: See ***Guide-lines for Aboriginal Heritage Impact Assessment*** July 2003).
Analytical Recording	A process of site recording which obtains detailed archaeological data useful in archaeological analysis.
Analysis	Evaluation of archaeological data to determine the archaeological significance of sites recorded within an impact area.
Archaeological Deposit	A layer of soil material containing archaeological remains.
Archaeological Investigation	The process of assessing the archaeological potential of an impact area by a qualified archaeologist.
Archaeological Comparability	The evaluation of whether archaeological sites are uniformly different or similar across an impact area.
Archaeological data	Archaeological information that is recorded as a result of an archaeological investigation.
Archaeological Significance	The evaluation of the scientific significance of a site, artefact, object or potential archaeological deposit as being unique, representative, information laden, intact or disturbed, easily dateable, or having special qualities that will add new knowledge to our understanding of human history.
Artefact	Any object made by human agency(stone artefacts).

Artefact Scatter	A collection of artefacts usually lying as a lag deposit on an eroding surface.
Assemblage	1. A group of stone artefacts found in close association with one another. 2. Any group of items designated for analysis-without any assumptions of chronological or spatial relatedness (Witter 1995).
Avoidance	A management strategy which protects Aboriginal sites within an impact area by development totally avoiding them.
Broken Flake	A flake which is either a distal fragment or proximal fragment.
Campsite	A site which contains a variety of artefactual data not specific to one type of stone tool reduction sequence.
Complete Flake	A flake which is whole and not broken.
Core	A lump or nodule of stone from which flakes have been removed.
Debitage	Unmodified flakes or fragments of stone material removed as a result of stone tool manufacture or modification.
Flake	A piece of stone detached from a core displaying a bulb of percussion and striking platform.
Flaked Piece	A fragment of stone where negative flake scarring is visible but no obvious striking platforms are present.
Hearth	The site of a campfire represented by charcoal, burnt earth, ash and sometimes stones used as heat retainers.
Intensive Recording	The process of recording in detail aspects of a site or object's cultural fabric and character using the latest scientific methods otherwise unavailable at the time of the archaeological survey.

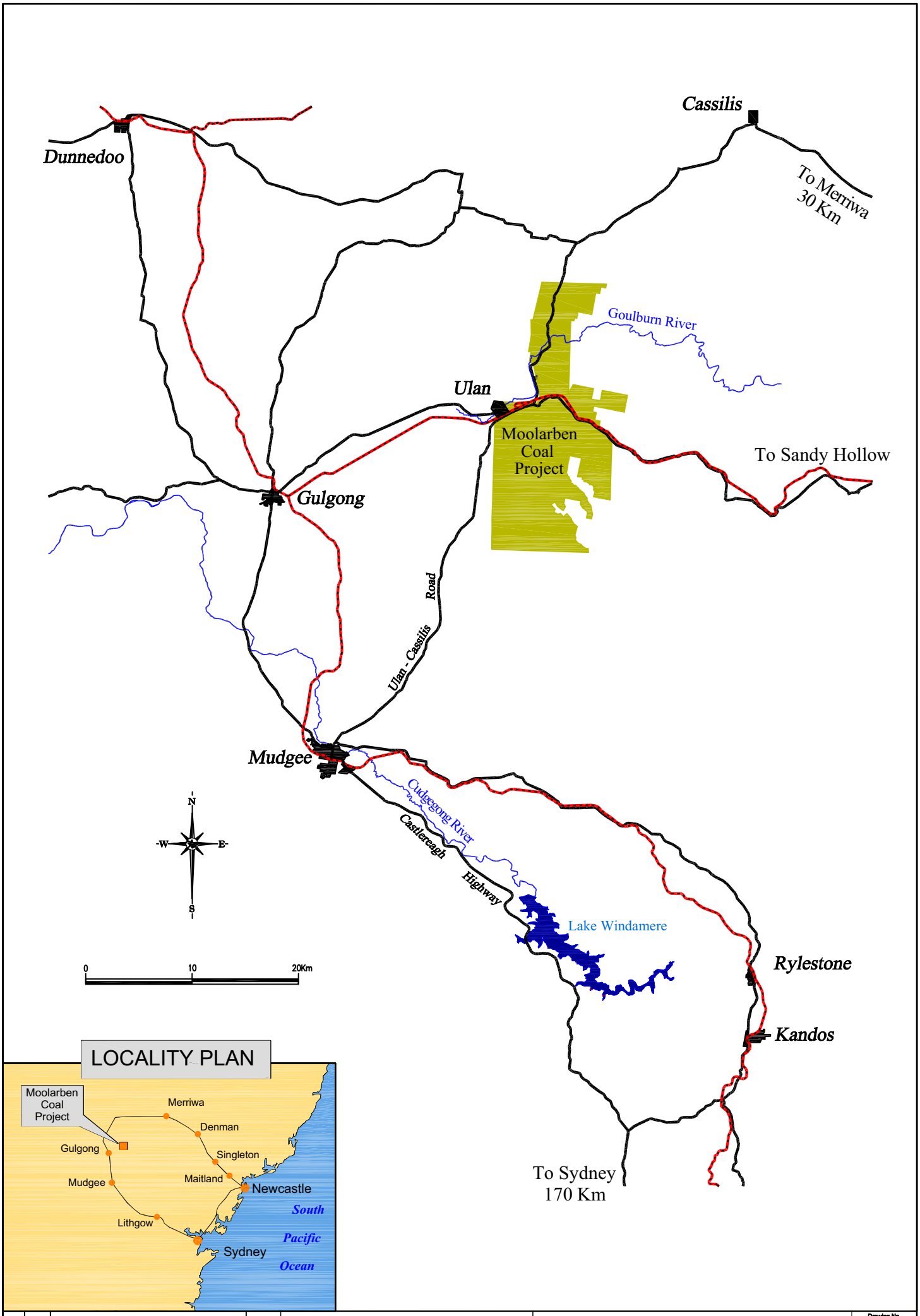
Isolated Find	A single artefact found in an isolated context.
Impact Area	An area that requires archaeological investigation and management assessment.
Knapping Floor	A location on a site which normally represents a stone artefact reduction episode.
Landform	Any one of the various features that make up the surface of the earth.*
Landscape	That part of the land's surface, more or less extensive being viewed or under study, that relates to all aspects of its physical appearance, including various vegetation associations and landforms.*
Land system	An area, or group of areas, commonly delineated on a map, throughout which there is a recurring pattern of topography, soils, and vegetation.*
Land Unit	An area of common landform, and frequently with common geology, soils, and vegetation types, occurring repeatedly at similar points in the landscape over a defined region. It is a constituent part of a land system.*
Management Plans	Conservation plans which identify short & long term management strategies for all known sites recorded within an impact area.
Methodology	The procedures used to undertake an archaeological investigation.
Minimum Requirements	The minimum standard for which NPWS will accept the reporting of an archaeological investigation.
Mitigation	To address the problem of conflict between land use and site conservation.
Open Site	An archaeological site situated within an open space (eg. archaeological material located on a creek bank, in a forest, on a hill etc).
Open Area Excavation	A method of excavation where large areas of an archaeological site are open at any one time. A horizontal representation of Aboriginal occupation of different archaeological features

	is considered to be more important than vertical stratigraphic relationships.
Research Design	A research strategy for carrying out an intensive archaeological investigation and analysis.
Sampling	The process of selecting part of an area under archaeological investigation as a basis for generalizing about the whole.
Sample Unit	An area of investigation which is uniform size or density and which can be quantified for analytical reasons.
Salvage	A method by which an archaeological site or group of sites may be fully investigated before they are totally destroyed by a development.
Site	A place where past human activity is identifiable.
Site Recording	The systematic process of collecting archaeological data for an archaeological investigation.
Spatial Significance	A site which may contain potential sub-surface deposits or in-situ material useful in the analysis of human use of land and site formation process.
Summary Recording	A process of site recording where archaeological data is collected on a summary level only.
Survey Coverage	A graphic and statistical representation of how much of an impact area was actually surveyed and therefore assessed.
Technological Significance	Artefactual material which may contain types or items although not unique, may be included in a sample to demonstrate an aspect of stone artefact variability.
Test excavation	A process of exploratory excavation done on a small scale used to determine site extent, site condition and excavation potential.

GLOSSARY BIBLIOGRAPHY

Soil Conservation Service of N.S.W 1986 Glossary of Terms used in Soil Conservation(pp 76-77).

Witter, D. 1995 A classification of Australian Stone Artefacts and principles of taxonomy. Unpublished report.



LOCALITY PLAN

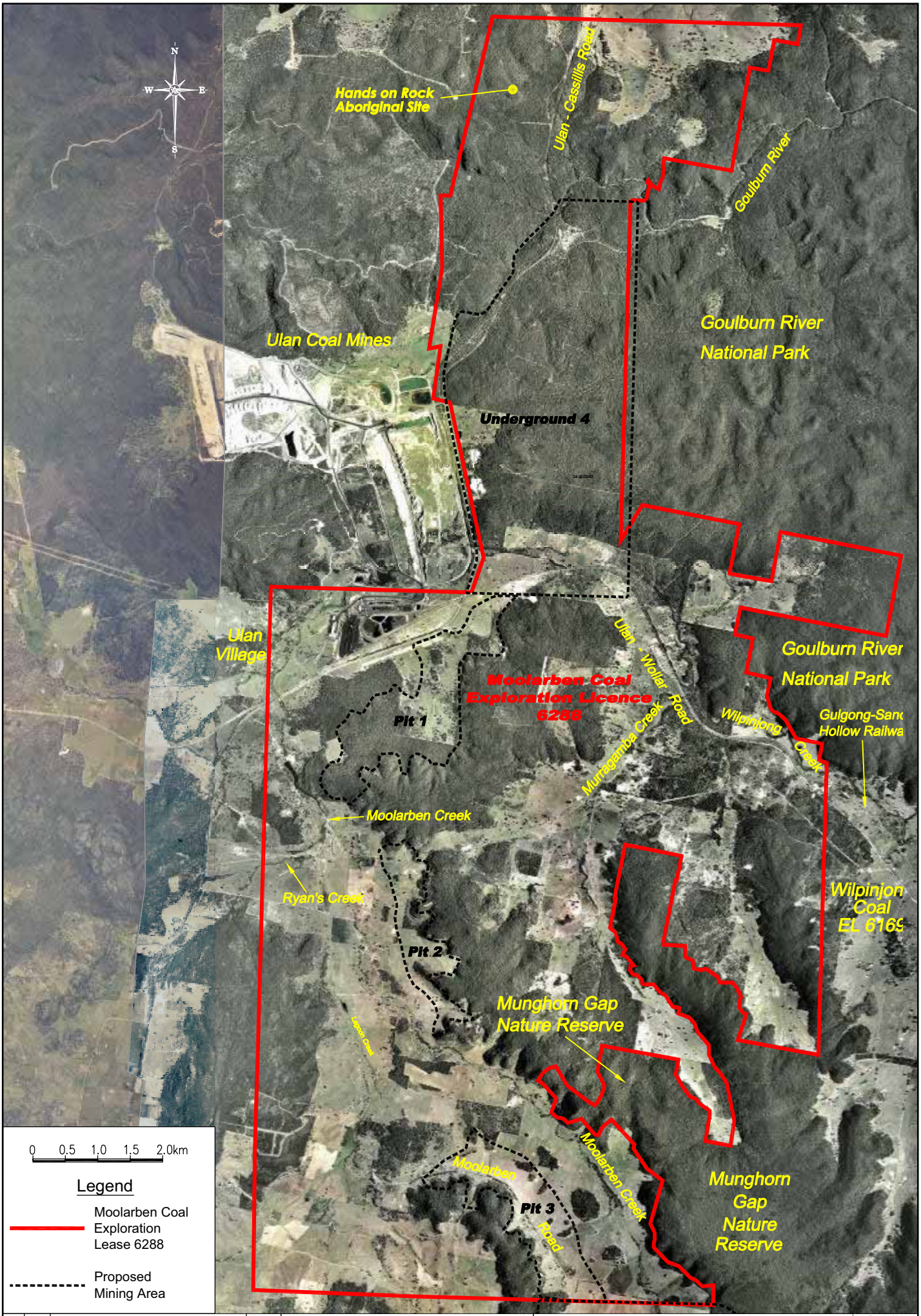
Rev.	Drawn	Description	Approved
A	NM	Issued Drawing	AW

Moolarben Coal Mines Pty Limited
ABN 82 108 601 672
Level 14 213 Miller Street North Sydney NSW 2060
Phone: 02 9922 3777
Fax: 02 9923 2427

MOOLARBEN COAL PROJECT - FIGURE 1
GENERAL LOCATION MAP
SHOWING STUDY AREA

Date	Scale:	Drawn	Checked	Approved
05.04.2006	NTS	NM	AW	AW

Drawing No. 01469
Revision No. A
Sheet Size A4



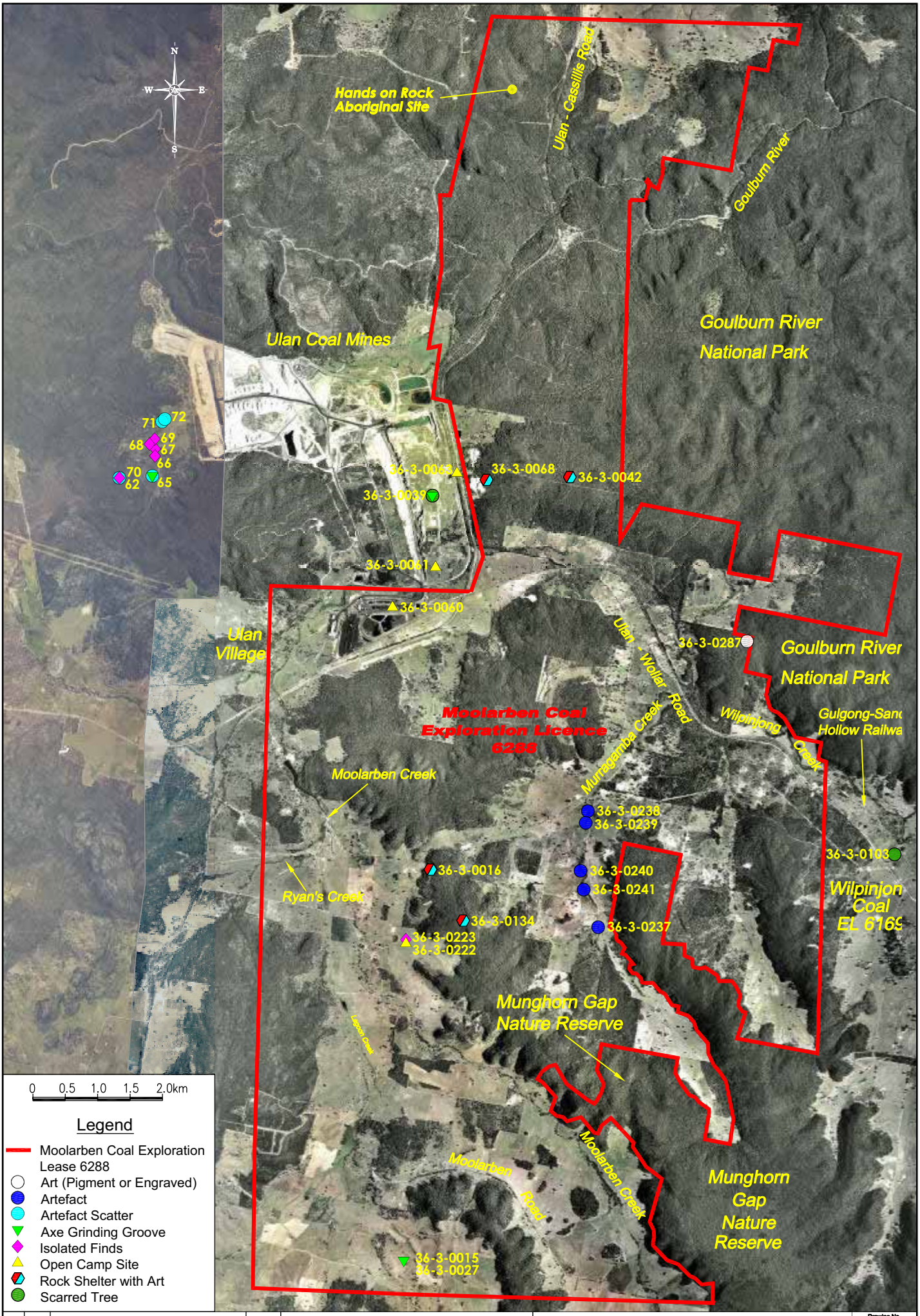
Rev.	Drawn	Description	Approved
A	NM	Issued Drawing	AW

Moolarben Coal Mines Pty Limited
ABN 82 108 601 672
Level 14 213 Miller Street North Sydney NSW 2060
Phone: 02 9922 3777 Fax: 02 9923 2427
Prepared by Co-Resources Pty Ltd Ph: 02 85 718888

MOOLARBEN COAL PROJECT - FIGURE 2
PROPOSED MINING AREAS
MOOLARBEN STUDY AREA

Date	Scale:	Drawn	Checked	Approved	Sheet Size
03.04.2006	1: 75,000	NM	AW	AW	A4

Drawing No. 01452
Revision No. A



Rev.	Drawn	Description	Approved
B	NM	"Hands on Rock" Added.	AW
A	NM	Issued Drawing	AW

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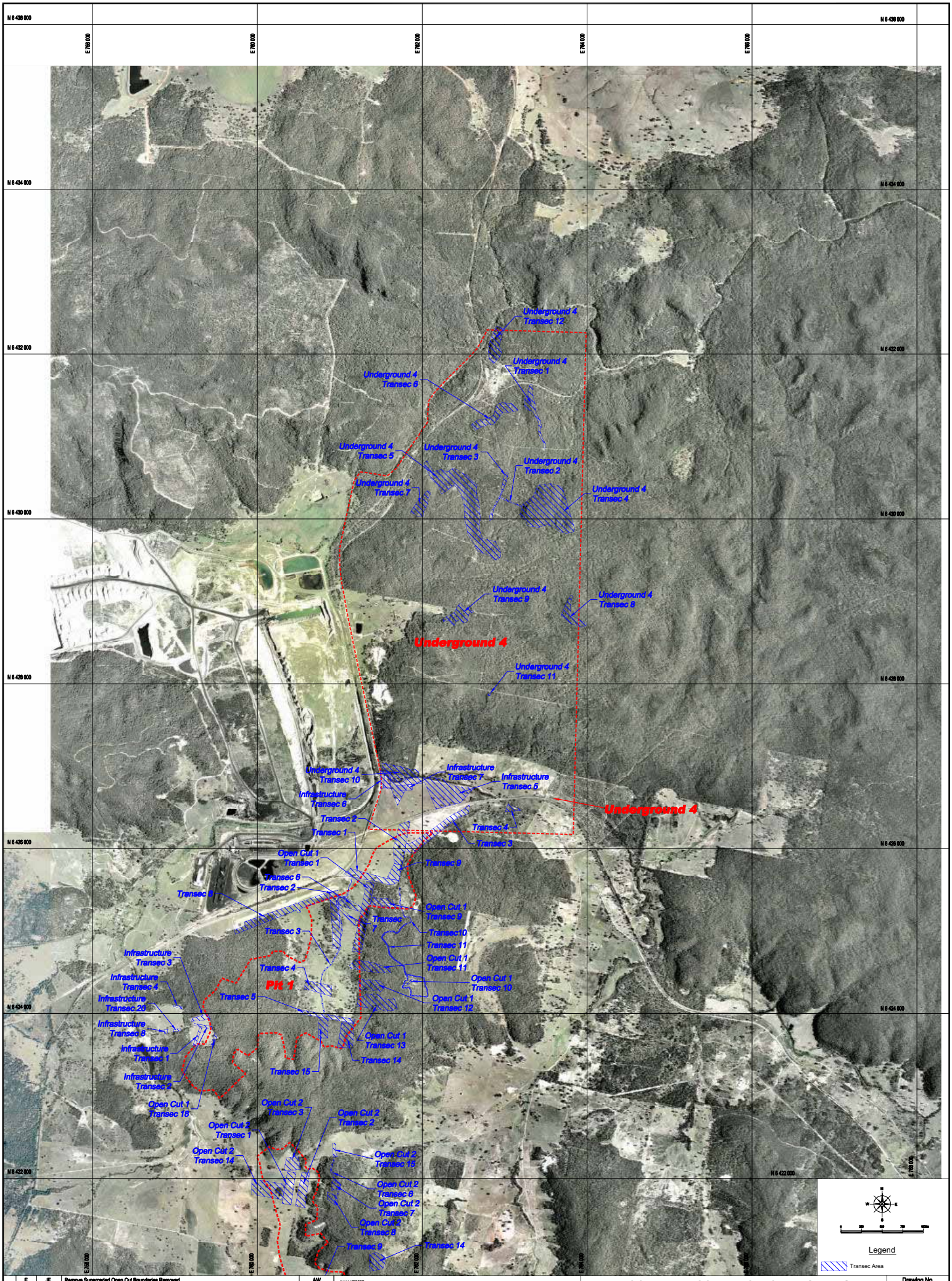
MOOLARBEN COAL PROJECT - FIGURE 3
ABORIGINAL SITES SURROUNDING MOOLARBEN STUDY AREA

Date	Scale:	Drawn	Checked	Approved	Sheet Size
23.03.05	1: 75,000	NM	AW	AW	A4

Drawing No. 01419
Revision No. B



Revision				
	E	JF	Remove Superceded Open Cut Boundaries Removed	AW
	D	CS	Open Cut 3 Extension Removed	AW
	C	NM	Figure Number Added to Title Block	AW
	B	NM	Transec 20 in Pit 1 Added	AW
	A	NM	Issued Drawing	AW
	Rev	Drawn	Description	Approved

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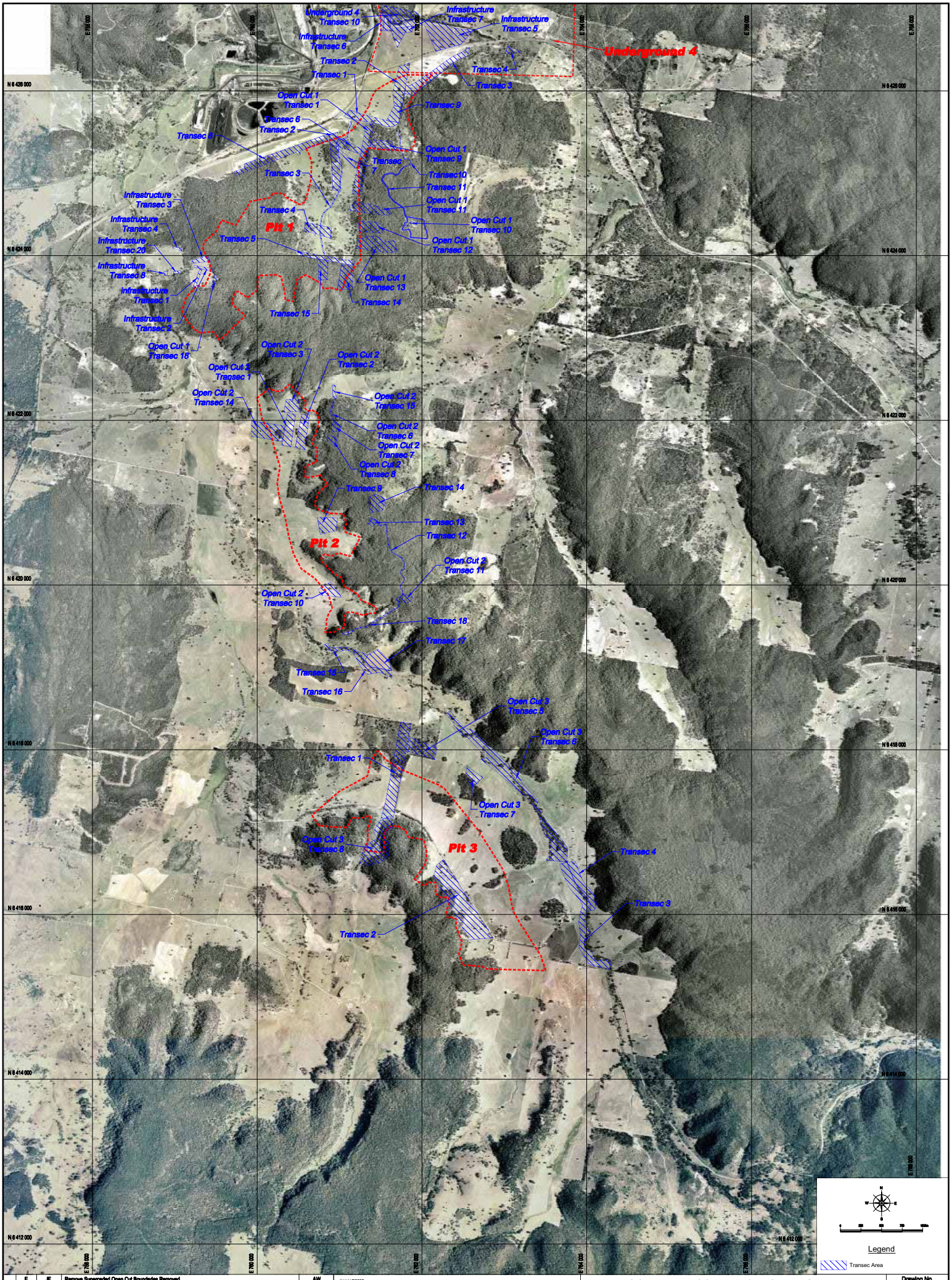
MOOLARBEN COAL PROJECT - FIGURE 4
TRANSEC AREAS
SHEET 1 OF 2 - NORTHERN AREA

Date	Scale:	Drawn	Checked	Approved	Sheet Size
23.05.2006	1:20.000 at A1	JF	AW	AW	A1

Drawing No. 01391
Revision No. E



Revision				
	E	JF	Remove Superceded Open Cut Boundaries Removed	AW
	D	CS	Open Cut 3 Extension Removed	AW
	C	NM	Figure Number Added to Title Block	AW
	B	NM	Transec 20 in Pit 1 Added	AW
	A	NM	Issued Drawing	AW
	Rev	Drawn	Description	Approved

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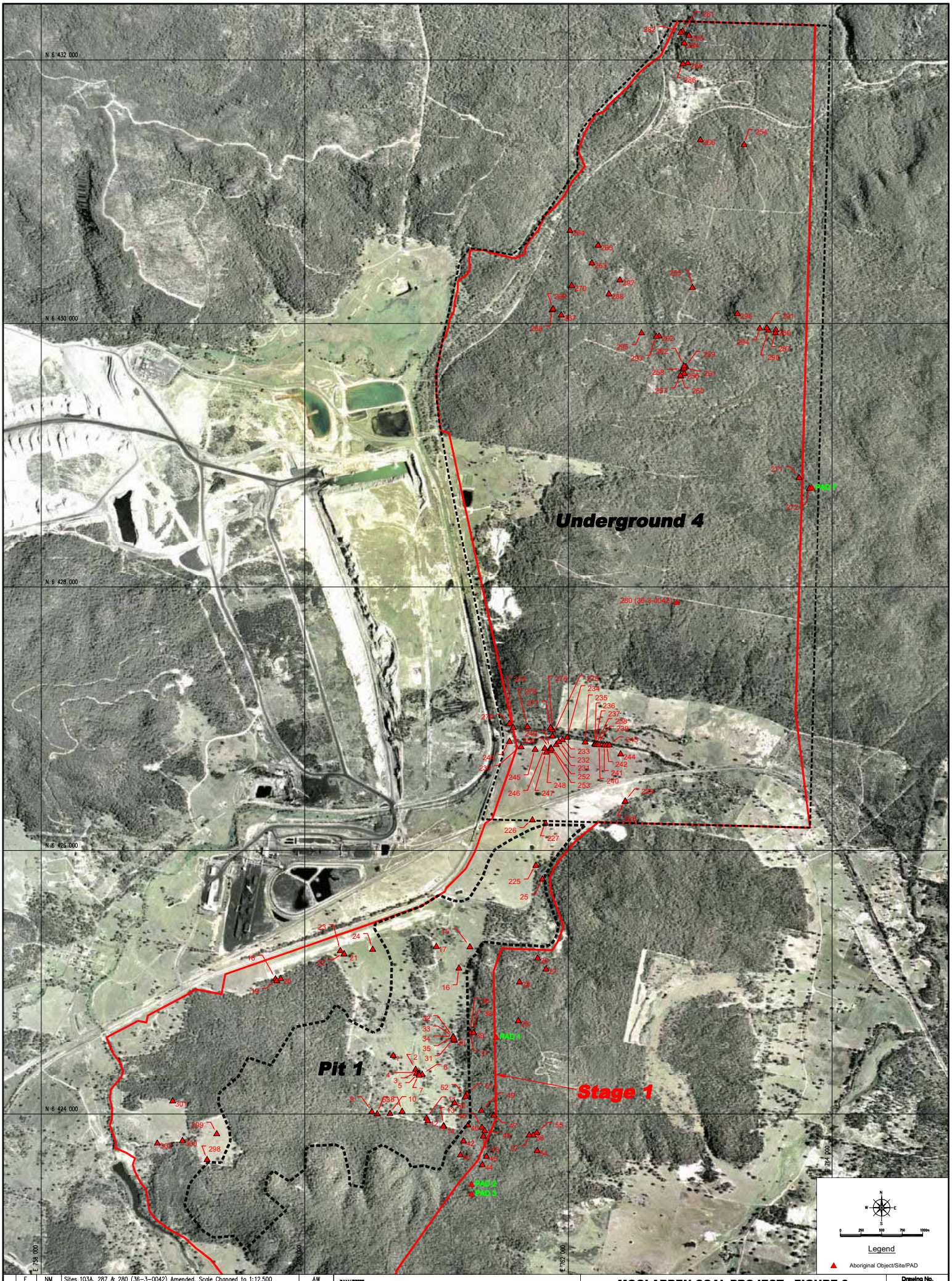
MOOLARBEN COAL PROJECT - FIGURE 5
ABORIGINAL SITES AND OBJECTS
SHEET 2 OF 2 - SOUTHERN AREA

Date	Scale:	Drawn	Checked	Approved	Sheet Size
23.05.06	1:20.000 at A1	JF	AW	AW	A1

Drawing No. 01391
Revision No. E



Revision				
E	NM	Sites 103A, 287 & 280 (36-3-0042) Amended. Scale Changed to 1:12,500	AW
D	NM	Sites 36-6-0222, 36-3-0223 & 36-3-0042 Added.	AW
C	NM	Artefact Sites 103 Added	AW
B	NM	Artefact Sites MC1, T16, T17, T21 & T22 Renamed to be 298 -302	AW
A	NM	Issued Drawing	AW
Rev.	Drawn	Description	Approved

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MOOLARBEN COAL PROJECT - FIGURE 6
ABORIGINAL SITES AND OBJECTS
SHEET 1 OF 2 - NORTHERN AREA

Drawing No.	Revision No.
01397	E

Date	Scale:	Drawn	Checked	Approved	Sheet Size
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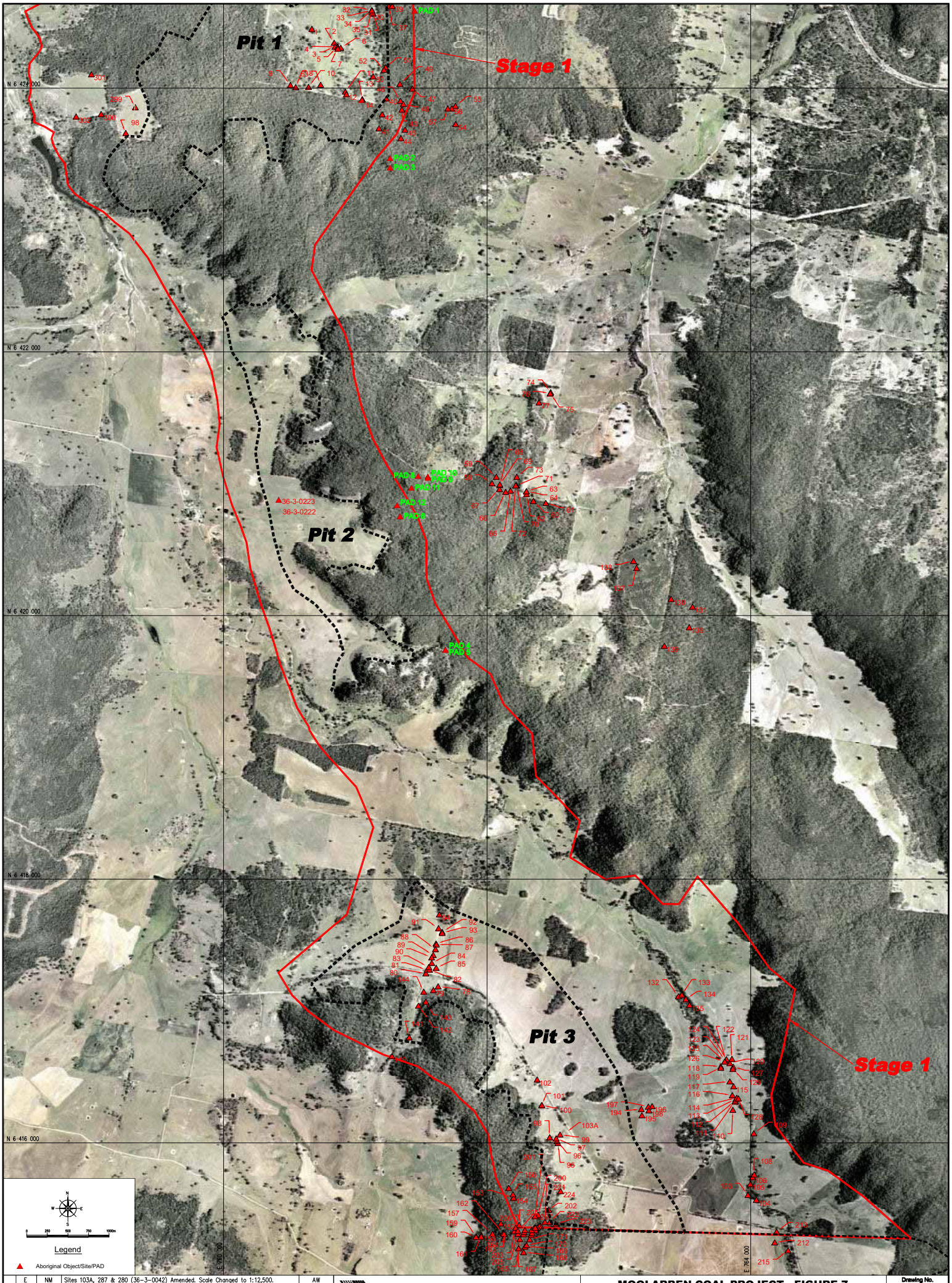

Revision	Rev.	Drawn	Description	Approved
	E	NM	Sites 103A, 287 & 280 (36-3-0042) Amended. Scale Changed to 1:12,500.	AW
	D	NM	Sites 36-6-0222, 36-3-0223 & 36-3-0042 Added.	AW
	C	NM	Artefact Sites 103 Added	AW
	B	NM	Artefact Sites MC1, T16, T17, T21 & T22 Renamed to be 298 -302	AW
	A	NM	Issued Drawing	AW

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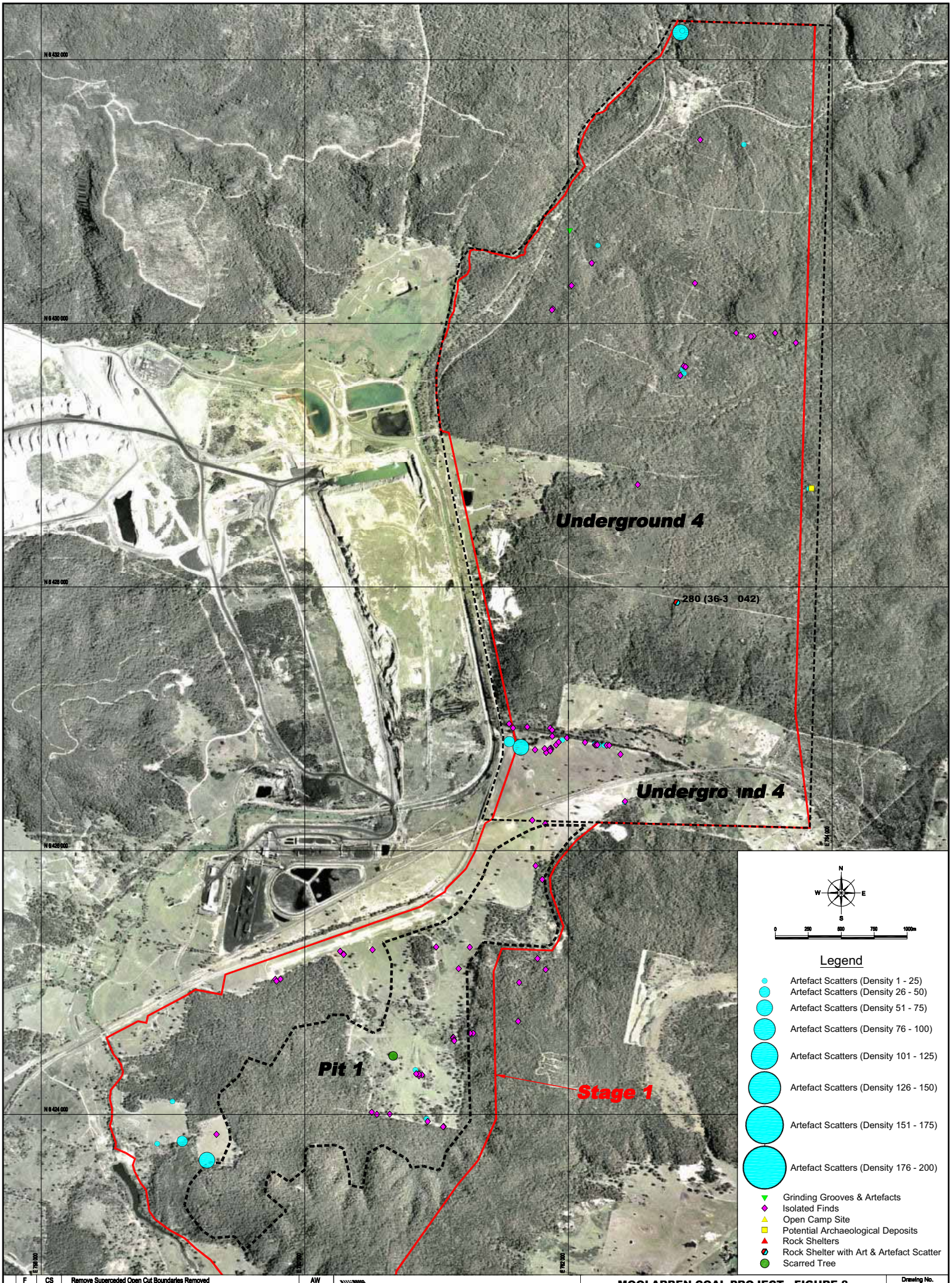
MOOLARBEN COAL PROJECT - FIGURE 7
ABORIGINAL SITES AND OBJECTS
SHEET 2 OF 2 - SOUTHERN AREA

Date	Scale:	Drawn	Checked	Approved	Sheet Size
03.04.2006	1:12,500 at A1	NM	AW	AW	A1

Drawing No. 01397
Revision No. E



Revision				
F	CS	Remove Superceded Open Cut Boundaries Removed		AW
Rev	Drawn	Description		Approved

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MOOLARBEN COAL PROJECT - FIGURE 8
ABORIGINAL SITES AND OBJECTS - DETAILED PLAN
SHEET 1 OF 2 - NORTHERN AREA

Drawing No.	Revision No.	Sheet Size
01398	F	A1

Date	Scale:	Drawn	Checked	Approved
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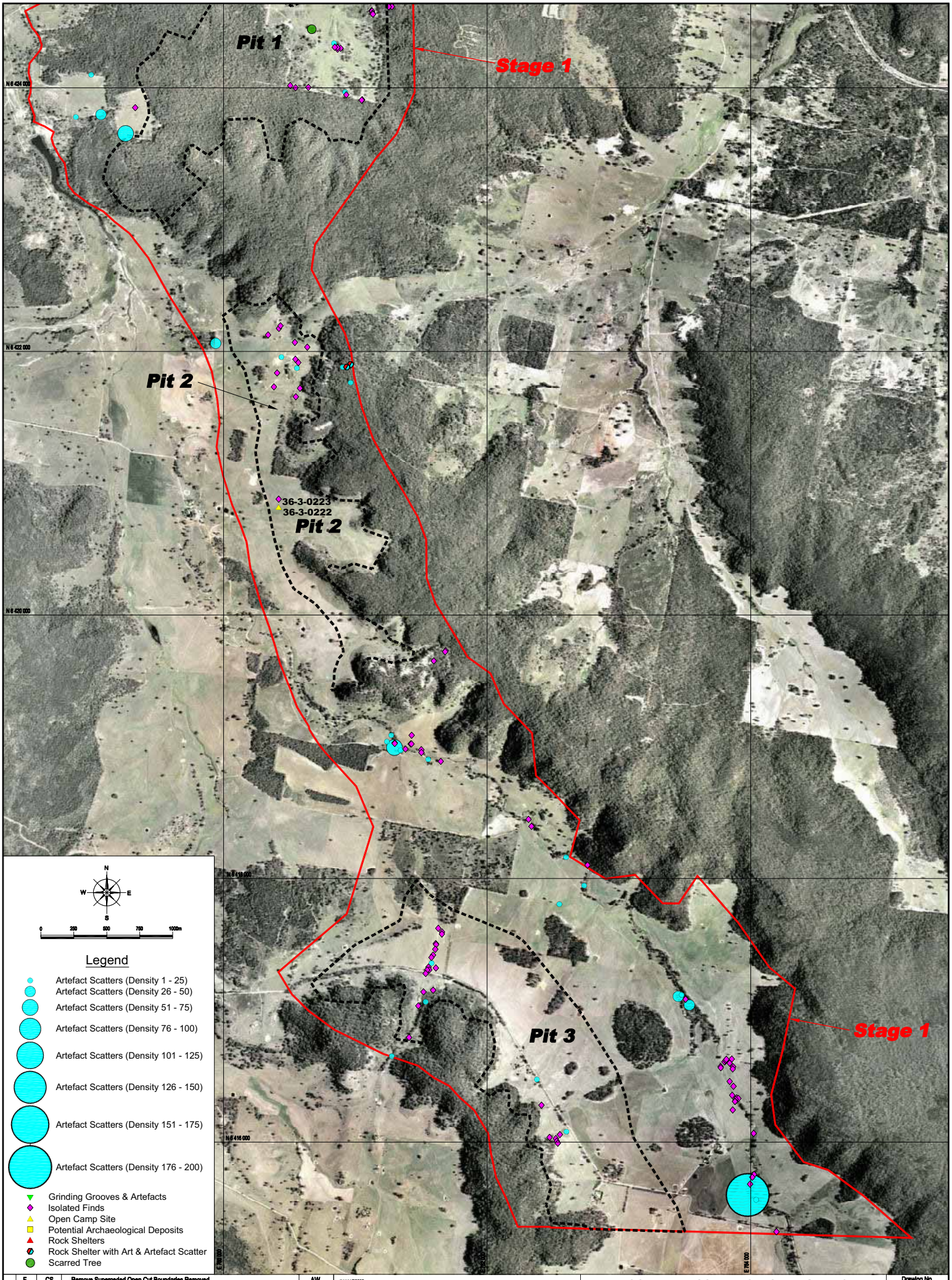

Revision	Rev	Drawn	Description	Approved
	F	CS	Remove Superceded Open Cut Boundaries Removed	AW

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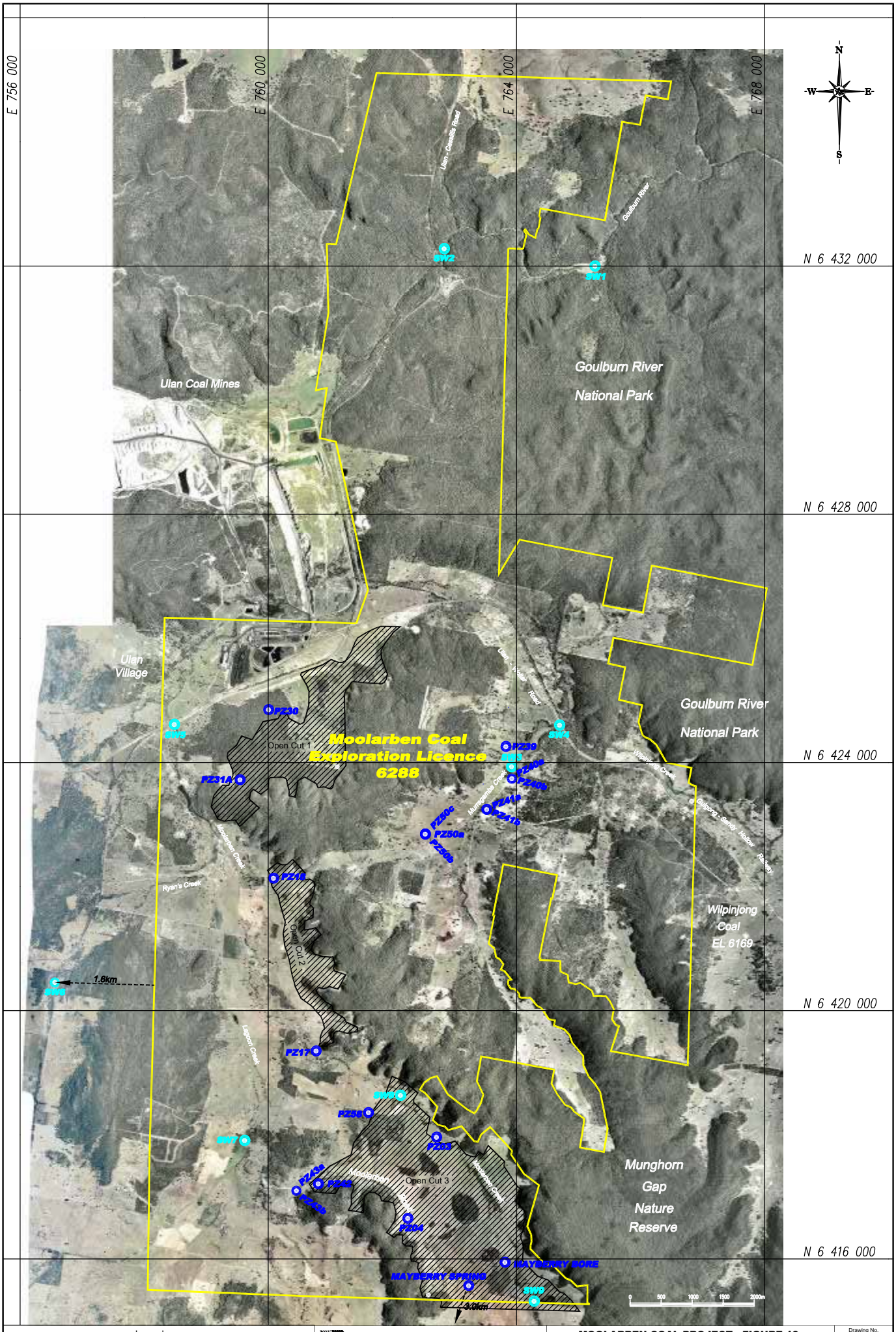
MOOLARBEN COAL PROJECT - FIGURE 9
ABORIGINAL SITES AND OBJECTS - DETAILED PLAN
SHEET 2 OF 2 - SOUTHERN AREA

Date	Scale:	Drawn	Checked	Approved
22.05.06	1:12.500 at A1	CS	AW	AW

Drawing No.	Revision No.	Sheet Size
01398	F	A1



Legend

PZ04 Groundwater Monitoring Piezometer

Open Cut Boundaries

SW1 Surface Water Monitoring Sites

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MOOLARBEN COAL PROJECT - FIGURE 10
GROUNDWATER LOCATION PLAN

Drawing No.	Revision No.
00764	D

Date	Scale:	Drawn	Checked	Approved	Sheet Size
03.04.2006	1: 25,000	NM	AW	AW	A1