Indigenous and Non-Indigenous Heritage Study, Muswellbrook Coal Company No. 1 Open Cut Extension

Prepared for

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EXECUTIVE SUMMARY

HLA-Envirosciences Pty Limited was commissioned in September 2001 by Muswellbrook Coal Company Limited to conduct an archaeological assessment of the Indigenous and non-Indigenous heritage of the proposed extension of cut mining activity to the northeast of the extant No. 1 Open Cut. This archaeological assessment was undertaken between November 2001 and March 2002, and will be incorporated into the finalised Environmental Impact Statement (EIS) for the proposed mining activity.

The No. 1 Open Cut Mine is located approximately 1.6km to the east of Muswellbrook, in the Central Lowlands of the Hunter Valley, New South Wales. The proposed extension area consists of two discrete sections – Extension A (western component) and Extension B (northeast component). Both sections are planned for open cut mining, commencing over the next 5 years and concluding at the end of 2013. The total area of disturbance from the development is approximately 93 hectares (938560m^2).

The principal aims of this assessment were to provide information about the nature of the archaeological resources within the proposed mining extension area and formulate management recommendations for those resources during development. This investigation therefore entailed the compilation of background archaeological, historical and geomorphological information of the locality, the archaeological survey of the extension to record any observable archaeological materials, the identification of additional areas of archaeological potential, the significance assessment of all archaeological resources identified, and the development of appropriate management recommendations in consultation with the local Aboriginal community.

Five local Aboriginal community groups, who are considered to represent the Aboriginal landowners, were involved throughout the development of this report: the Upper Hunter Wonnarua Council (UHWC), the Wanaruah Local Aboriginal Land Council (WLALC), the Lower Hunter Wonnarua Council (LHWC), the Wonnarua Tribal Council (WTC) and the Wonnaruah Nation Aboriginal Corporation (WNAC). Each community was contacted at the onset of the project, to determine their desired level of involvement. Representatives of three groups - the UHWC, the WLALC, and the LHWC – joined representatives of HLA-Envirosciences during the field survey. Mr Victor Perry (UHWC) subsequently prepared a Cultural Heritage Assessment to identify the concerns of the Aboriginal community regarding the development. A draft of this report was also forwarded to each group for comment prior to its final submission.

Two site visits were conducted for the archaeological survey – one on the 11th and the 12th of December 2001 and another on the 9th May 2002. Thirty-one intensive pedestrian archaeological survey units (ASUs) were conducted throughout the proposed mining area to effectively sample all landform units. A number of areas were discounted for the survey – being open cut mining, rehabilitation areas and a subsidence exclusion zone – as they were highly disturbed and it was considered that all archaeological materials within these areas have most likely been destroyed. Unsurveyed areas totalled 34 hectares (342340m square). Of the remaining 59 hectares (596220m square), 37 hectares were examined by intensive pedestrian survey units (63.5%).

Surface visibility conditions were generally low throughout the extension area at the time of survey, with vegetation the primary limiting factor of visibility. Visibility was noted to be especially poor within Extension A of the study area, resulting from the moderate to dense grass cover of the area. Analysis of the visibility conditions within each ASU calculated that between 10% and 20% of each survey unit was effectively available for artefact detection. This level of surface visibility is considered as satisfactory to enable an effective assessment of the archaeological resources of the extension area, and provide an adequate basis for assessing the archaeological significance of the area and formulating appropriate management recommendations.

The survey recorded 6 Indigenous sites within the extension area. Four Indigenous sites were defined as occupation sites, being scatters or isolated finds of stone artefacts, and the remaining two sites were scarred trees. These sites were located across all landform units of the study area – being positioned within ridge crest, hillslope and lower order stream landform units. Within the occupation sites, artefact distribution was uniformly low, with a total of 8 artefacts recorded and with no site containing more than 3 artefacts. Only two raw stone materials recorded (indurated mudstone and silcrete), and only three artefacts types were evident (flakes, flaked pieces and cores). All sites had experienced some level of disturbance, mainly as a result of human activity within the landscape. The two remaining sites are scarred trees, one of which is located on the boundary of the proposed development area. All remaining Indigenous sites are located within the limits of the proposed development, and will be directly impacted by the extension of open cut mining activity. Each site will be essentially destroyed by the development.

No non-Indigenous heritage items were identified within the study area, although the proximity of the Muswellbrook Brickworks to the proposed development area was noted. However, development impacts to the item were considered to be minimal and no specific management recommendations have been formulated for the item.

The assessment of the archaeological (scientific) significance of the sites recorded was done in accordance with the criteria outlined by the relevant guidelines – the NSW National Parks and Wildlife Service's *Aboriginal Cultural Heritage Standards and Guidelines Kit* (1997) and the *Aboriginal Cultural Heritage* and the *Integrated Development Assessment Guidelines* (2000). All Indigenous sites recorded by the survey were considered to be of low archaeological (scientific) significance due to their minimal research potential and high level of disturbance. However, one of these sites (M-1) was noted to have subsurface potential. The two scarred trees were defined to be of moderate archaeological significance due to the rarity of that site type within the local and regional contexts. The cultural significance of the extension area was assessed independently by the UHWC in the Aboriginal Cultural Heritage Assessment Report attached as **Appendix A**.

The formulation of management recommendations in this report was based on a number of considerations, including legal requirements, development impact, archaeological context and the concerns of the Indigenous community. An important component of these recommendations is the ongoing involvement of all Aboriginal community groups identified by this report.

Sites M-2, M-3 and M-3 (occupation sites) were assessed to be of low archaeological (scientific) significance, no objection was raised to the issuing of Consent to Destroy permits for these sites. The subsurface potential of site M-1 (occupation site) was considered to require additional archaeological research, and subsurface testing is recommended for this site. Due to the positioning of site M-6 (scarred tree) on the existing boundary of the study area, it is considered possible that the tree may be retained in its current position during the proposed development. It is strongly recommended that the tree be retained in situ. Site M-5 (scarred tree) is centrally positioned within Extension A and its relocation may be required to retain its heritage significance. Recommendations were formulated outlining the required procedure if the relocation or removal of either tree is the only feasible option during the development.

Additional archaeological research is also recommended prior to the commencement of works, to further clarify the archaeological resources of the study area. As visibility was assessed to be especially poor within Extension A at the time of the survey, it is recommended that this area be cleared and resurveyed prior to development. If additional archaeological materials are recorded as a result, additional management recommendations will be required for the proposed development. This may entail the extension of the archaeological subsurface testing program to sample the different landform units of the study area if further clarification of the archaeological resources of the study area is required.

1.0 INTRODUCTION

1.1 Project Description

The Muswellbrook Coal Company Limited (MCC) operates the two mines within one colliery holding near Muswellbrook in the Hunter Valley, both of which produces thermal coal for both export and domestic markets. MCC is currently proposing the extension of mining activity for one of these mines – the No. 1 Open Cut – within the existing lease area (CCL 713).

HLA-Envirosciences was commissioned in September 2001 to conduct an archaeological survey for Indigenous and non-Indigenous sites within the proposed extension area. The report is designed to provide information about the nature of the archaeological resources within the proposed No. 1 Open Cut extension areas and develop management recommendations for those resources during the development process. This study will be incorporated into the completed Environmental Impact Statement (EIS) regarding the proposed development.

The study has been undertaken to the following standards;

- The NSW National Parks and Wildlife Service *Aboriginal Cultural Heritage Standards and Guidelines Kit* (National Parks and Wildlife Service 1997);
- The NSW National Parks and Wildlife Service *Aboriginal Cultural Heritage* and the *Integrated Development Assessment Guidelines* (National Parks and Wildlife Service 2000); and
- The NSW Heritage Office *Heritage Manual (Heritage Office and the Department of Urban Affairs and Planning 1996)*.

1.2 Study Area

The proposed MCC No. 1 Open Cut extension occupies approximately 93 hectares to the east of the town of Muswellbrook. The previously mined No. 1 Open Cut is located approximately 1.6km to the east of Muswellbrook, 1.5km to the east of the No. 2 Open Cut, as illustrated in **Figure 1**. The proposed extension area will consist of two areas, outlined below, located to the direct northeast adjacent to the original No. 1 Open Cut.

1.3 Authorship

This report was prepared by Meaghan Russell (BA Hons) and Vanessa Hardy (BA Hons), with Dr Iain Stuart responsible for overall quality control and review.

1.4 Acknowledgements

We would also like to thank the following individuals, companies and community groups for their contribution to the production of this project:

- The Muswellbrook Coal Company Limited, specifically Mark Howes for his assistance during the field survey.
- The Upper Hunter Wonnarua Council, specifically Victor Perry and Barry French.

- The Wanaruah Local Aboriginal Land Council; specifically Noel Downes, Steven O'Grady and Beverly Van Vliet.

- The Wonnarua Tribal Council, for providing comments on this report.

- The Wonnaruah Nation Aboriginal Corporation, for providing comments on this report.

2.0 COMMUNITY PARTICIPATION

For the purposes of this report, four Aboriginal community groups were contacted at the outset of this project:

- The Upper Hunter Wonnarua Council (UHWC),
- The Wanaruah Local Aboriginal Land Council (WLALC);
- The Wonnarua Tribal Council (WTC), and
- The Wonnaruah Nation Aboriginal Corporation (WNAC).

Information was supplied regarding the proposed development, and the archaeologists discussed the project with the each group prior to the fieldwork to determine the level of preferred involvement. As a result, representatives of two community groups - the UHWC and the WLALC - were involved in the field survey. Mr Victor Perry (UHWC) subsequently prepared a report outlining the cultural significance of all sites surveyed, found in **Appendix A**. A draft copy of this report was also sent to the each of the four above listed community groups for their comments.

As a result of changing NPWS consultation guidelines, the Lower Hunter Wonnarua Council (LHWC) was contacted during the course of this assessment. Information was supplied to the Council regarding the proposed development, and as a result of discussions between the archaeologists and the LHWC, representatives of the Council were involved in the second survey session of this assessment. Throughout the development of the MCC proposed extension, the Muswellbrook Coal Company Community Consultative Committee (MCCCC) was established to provide a forum for communication between MCC and the broader community. The Committee involves representatives of the Muswellbrook Shire Council, local landowners and the Upper Hunter Wonnarua Local Aboriginal Council. This committee meets quarterly to discuss any issues or concerns relating to the project.

A draft of this report was forwarded to all the above community groups for their comment prior to final submission. All responses received are attached in **Appendix A**.

In addition, MCC have discussed the project with a number of the above groups. On 6th November 2001 four of the above groups (UHWC, WLALC, WTC and WNAC) were invited to attend the Planning Focus Meeting for the proposal, which was subsequently held on 14 November 2001. All groups were provided with a copy of the Planning Focus Meeting Document that outlined the proposal and discussed the associated environmental, economic, social and cultural issues that would need to be addressed in the environmental assessment of the proposal. Mr Noel Downes (WLALC) and Mr Tom Miller (WTC) attended and participated in the Planning Focus Meeting.

3.0 DEVELOPMENT IMPACTS

3.1 Impact History

Like much of the Central Lowlands of the Hunter Valley, the study area has been subject to considerable local disturbance ever since non-Indigenous settlement. Since the arrival of European settlers in the Hunter Valley in 1820s, the area has been a focal area for agricultural, pastoral and mineral activity (Turner 1995). As a result, the area has experienced a high level of disturbance during the past two centuries, which has resulted in the modification of large areas of the natural landscape since the nineteenth century.

Early settlement throughout the Hunter Valley resulted in widespread disturbance of the landscape for the purposes of logging, agricultural cultivation, pastoral grazing and residential development. Land was extensively cleared, the Lower Hunter swamplands were drained and sections of the Hunter River were realigned for flood mitigation purposes, to hasten the recession of floodwaters into the sea (Brayshaw 1986a). The construction of the first roads in the area also dates to the 1820s, which enabled an increased flow of people into the region. This was directly related to the onset of the Hunter Valley Gold Rush, and the nineteenth century influx of emigrants into the area. As a result, the level of occupation throughout the Hunter Valley (and specifically the Central Lowlands) rose dramatically and resulted in the development of rural communities. This level of settlement accelerated the processes of land clearance, cultivation, grazing and construction, transforming the landscape.

However, it was the development of large-scale coal mining and power industries in the Hunter Valley that has most dramatically disturbed the natural landscape of the region. Although earlier efforts at coal exploitation are known, the first large-scale coal mining activity in the area dates to the 1850s. These operations were the predecessors of the modern mines in the Central Lowlands – large-scale operations such as the three Bayswater Colliery operations, Mount Arthur North, Drayton, Bengalla and Dartbrook. It is these most recent operations that have caused the greatest disturbance throughout the region, through the removal of large sections of earth for open cut mining, and all the associated impacts on the existing landscape (drainage patterns, vegetation, fauna and so on). As a result, the landscape of the Central Lowlands has been irrevocably altered.

The specific land use history of the study area, outlined in detail in **Section 7.7**, has entailed disturbance resulting from three main activities:

- Pastoral grazing;
- Domestic construction; and
- Coal mining.

The study area was under private ownership until its 1944 acquisition by MCC. Until that time, pastoral activity was the dominant activity throughout the lease area. Although a relatively low-impact activity, pastoral activity has a number of associated disturbances including the widespread clearance of vegetation, the trampling and compaction of grazing areas, and the acceleration of natural erosion processes. These impacts of pastoral grazing have been known to impact on archaeological materials contained within the landscape, particularly relevant for small, portable materials such as stone tools, through the post-depositional movement and destruction of archaeological materials.

The construction of, at least, two domestic residences has also impacted on the study area. The Bimbadeen homestead complex is still occupied as a residence, and one abandoned, collapsed domestic structure is found to the south of the Coal Road which passes through the study area. Both structures have entailed the construction of the actual structure and associated access roads (high-level, localised disturbance), and have resulted in the clearance of native vegetation (low-scale, generalized disturbance).

Although not currently mined, sections within the study area have been subject to both underground and open cut mining. Underground mining activity is commonly associated with subsidence impacts, where the collapse of the underlying geology and soil profile can lead to cracking of the ground surface and even the complete collapse of landscape sections. Within the study area, the central section of Extension A has experienced a number of impacts from subsidence. This area is so unstable from subsidence that entry is not permitted as sections of the underlying soil structure have completely collapsed into the previously mined caverns. Any archaeological materials once contained within this area have most likely experienced post-depositional movement, by either falling into the underground workings or from the movement associated with subsidence. This subsidence zone is illustrated in **Figure 2** and in **Plate 1**.

Sections within the study area have also been subject to previous open cut mining (as identified in **Figure 2**). The open cut mining of these areas entailed the total removal of the entire soil deposit, which would also have resulted in the destruction of any archaeological site in the area. Following the completion of the open cut mining, the mined areas were backfilled and have been developed as rehabilitation areas. In these areas, the earth originally removed has been essentially placed back into the open pit.

Additionally, the associated mining activity has led to the construction of a number of access roads within the area, most notably the Coal Road (**Figure 2**).

Although the impact of Indigenous occupation on the natural landscape is recognised to be relatively minimal by modern standards, there have undoubtedly been impacts as a result of the past 20,000 years of occupation. The lighting of deliberate fires is most likely one of the major impacts of Indigenous occupation, with fire utilised for a number of reasons such as to drive game from cover, for cooking, to expedite travel and to protect settlements through controlled burning (Goudie 1986). Fire is known to have a direct impact on the formation of major types of vegetation, through its influence on seed germination, the control of insects and fungi and the modification of physiochemical elements in plants (Goudie 1986). In general terms, areas subject to fires have shown increased diversity in vegetation.

Disturbances to the study area have been mapped according to different zones as detailed below (**Figure 3**):

TABLE 1 – DISTURBANCES TO THE STUDY AREA

DISTURBANCE ZONE	DESCRIPTION (AS RELATING TO THE STUDY AREA)
High	Areas which have been mined currently or in the past. Sites or areas of archaeological potential in this zone would be destroyed.
Moderate-High	This zone contains the subsidence exclusion area where parts of the surface soils have already collapsed due to mining underneath. Although some of the surface is intact, its structure is unstable due to this area being thoroughly mined beneath.
Moderate	During the field survey, areas of moderate disturbance were determined as being those of high erosion, construction areas and those disturbed to a lesser extent from mining and pastoralism.

Low	There were no almost or completely undisturbed areas noticed during the survey of the study area.

3.2 Proposed Development

MCC are proposing the extension of the No. 1 Open Cut mine into the study area, the limits of which are identified in **Figure 2**. This total area measures 93 hectares. For management purposes, the total extension area has been divided into two extension areas – Extension A and Extension B.

Extension A consists of the westernmost section of the development, located to the direct east of the existing No. 1 Open Cut. Extension A will be first mined under current development planning, and will be worked over four years. Mining of Extension B, the western section of the development area, continues mining activity to the east and northeast of Extension A. Mining will begin in the northeast limit of this extension, and will subsequently progress in a southwest direction over a five-year period. The line dividing Extensions A and B occurs to the west of the extant Bimbadeen homestead. All spoil removed through mining activity within the development area will be placed within existing mining voids unless required for earthworks for environmental management.

The MCC Conceptual Mine Development Plan was presented to the DMR in August 2001 and outlined the below development timetable.

TABLE 2: DEVELOPMENT TIMING

DATE	PLANNED DEVELOPMENT
Late 2002/2003	Initial mining from eastern highwall of No. 1 Open Cut into Extension A.
2006	Planned commencement of mining in Extension B.
Late 2013	Planned cessation of coal recovery.

3.3 Potential Impact

The extension of open cut mining activity into the study area will require the total removal of the entire soil deposit throughout the impacted area (identified on **Figure 2**). The complete removal of this soil profile will therefore result in the destruction of any archaeological material within these areas.

There will also be potentially damaging impacts of the above development on the surrounding areas through movement of the mined materials and the entry and exit of workers and materials. However, as this infrastructure has already been established for the operational No. 1 and No.2 Open Cuts, existing infrastructure will be utilised and no additional construction is expected beyond the limits of development as identified in **Figure 2**.

4.0 STUDY PLAN AND OBJECTIVES

This study is part of an Environmental Impact Statement (EIS) for the proposed extension of the MCC No. 1 Open Cut. It is designed to provide information about the nature of the Indigenous and non-Indigenous archaeological resources within the extension area, the impact of the proposed development, and the management of those resources during the development process. The main aims of the study are:

- To identify and record the extent and nature of archaeological material of human occupation and land use within the limits of the extension area;
- Identify areas of archaeological potential within the study area that may contain additional material evidence;
- To assess the significance of the archaeological resource identified;
- To consult with the relevant local Aboriginal communities, as identified below;
- To assess the impacts of the proposed mine development on the known archaeological material within the study area and areas of archaeological potential;
- Provide details of any archaeological sites or relics in accordance with statutory requirements, specifically those of the NSW National Parks and Wildlife Service and the NSW Heritage Office; and
- Present recommendations for the management of and/or mitigation of development impact to the archaeological resource identified.

To achieve these aims, a review of relevant archaeological, historical and environmental information was undertaken to place the survey in local context and enable the development of predictive models. A field survey was also conducted to locate any archaeological material within the development area, and further assess its archaeological potential. The development of management recommendations for the extension area was therefore based on the above contextual information, the statutory requirements relating to heritage management and on the significance assessments made of each surveyed site.

Throughout the report process, a number of issues were determined as limiting factors, including:

- Visibility conditions at the time of survey; and
- Safe access within the subsidence exclusion zone.

As with all archaeological landscape surveys, ground surface conditions place a limitation on the effectiveness of survey and assessment. Where visibility conditions are substantially restricted by factors such as vegetation cover, archaeological assessment can only be based on predictive methods and likelihood estimates. In addition, assessments of sub-surface potential are also based on probability in the context of the available information for an area and are not considered to be a definitive assessment.

The subsidence zone within Extension A was determined by MCC staff as unsafe to enter and was therefore not surveyed (as identified in **Figure 2**). This area's assessment was instead based on predictive models. This was a major limitation to this archaeological assessment, the implications of which are discussed in **Section 11.0**.

Additional concerns and issues that impacted upon the report methodology included:

- The development of a survey strategy to cover all landform units within the study area;
- A focus on material or sites displaying unusual qualities in comparison to other known sites in the region;
- The need to maximise efficiency within overall project constraints;
- The need to obtain sufficient information to be able to provide overall management advice; and
- The need to integrate the concerns of the Indigenous community.

5.0 LANDSCAPE CONTEXT

Developing an understanding of the environment is an essential archaeological tool in interpreting past human behaviour as different parts of the landscape have been utilised in different ways in the past. By understanding the topography and natural resources of an area it becomes easier to determine what type of sites may occur and their potential distribution. An understanding of environmental processes also enables archaeologists to predict the types of sites that may have survived since their original deposition.

A number of environmental classification systems exist for the Hunter Valley. Story *et al.* (1963) divided the entire valley into eight major sub-regions: the Southern Mountains, Central Goulburn Valley, Merriwa Plateau, Liverpool and Mt Royal Ranges, Barrington Tops, North-Eastern Mountains, Central Lowlands and the Coastal Zone. This was part of a broader Commonwealth Scientific and Industrial Research Organisation (C.S.I.R.O.) initiative to enable effective land management. The study area of this report is wholly contained within the Central Lowlands, a lowland belt that passes through the centre of the Hunter Valley, extending between the Merriwa Plateau, North -Eastern Mountains and Southern Mountains, down to the Coastal Zone. In the same report, Story *et al.* (1963) also defined a series of Land Systems for the Hunter Valley. A total of 43 were outlined, although the proposed MCC No. 1 Open Cut limit is contained wholly within the Glendower Land System.

The following analysis of the geological and topographical features of the study area will be related to the relevant characteristics of the Central Lowlands and the Glendower Land System.

5.1 Geology

Identification of the underlying geological formations of the landscape is important in order to understand the resources within, and development of, the study area. This has a direct impact on the nature and intensity of human activity throughout the landscape, specifically of the procurement of stone material for stone tool manufacture and the exploitation of coal during the recent past.

The Muswellbrook region is situated within the Sydney (geological) Basin near the north-eastern boundary, delineated by the Hunter Thrust System (CH2M Hill 1998). This System separates the Carboniferous rocks of the New England Fold Belt from the younger Permian and Triassic rocks of the Sydney Basin to the southwest. Permian rocks occupy one-fifth of the Hunter Valley, extending in a belt between Newcastle and Murrurundi. The study area is located wholly within the Permian geological landscape, which is composed of shale, sandstone and conglomerate (Story et al. 1963). These rocks can attain a thickness of 17000 feet in the east, but thin out to no more than a few hundred feet in the west. They are moderately resistant to weathering, and have been folded in to a series of meridional domes with moderate dips except where near major faults. This underlying variation is expressed in the relief of the terrain - through the undulating to gently rolling hills.

Undifferentiated Carboniferous sediments, including siltstone, shale, tuff, ignimbrite and conglomerate, form the bedrock of the Muswellbrook area. The upper part of the local stratigraphic sequence consists of (from youngest to oldest); Gyarran Volcanics, Greta Coal Measures, Braxton Formation, Quaternary alluvium and colluvium. The coal seams in the Muswellbrook area are known as the Greta Coal Measures, which consist of a number of coal seams and interbedded sediments such as siltstone, sandstone and conglomerate. The coal seams are (from oldest) the Loder, Lewis, St Heliers, Muswellbrook and Fleming Seams.

There are few rock outcrops through this landscape (Story *et al.* 1963). Within the study area, surface outcrops of coarse-grained stone materials such as sandstone and shale were observed to occur across hillslopes. A concentration was specifically noted within the proposed road deviation to the south of the Coal Road. After the initial archaeological survey, a specialist assessment was conducted of the geological resources of the study area by Connolly (pers. comm.) in accordance to the methods outlined in McDonald et al (1998). This concluded that the two different stone materials were evident in the stone outcrops to the south of Coal Road:

1) Sandstone
Found in moderate abundance, and found in subrounded tabular, stony fragments. The sandstone as present in a cutting is weathered, coarse grained, light coloured and likely heat affected. The source of heat affected stone is a natural process, resulting from the natural spontaneous combustion of underground coal reserves in area.

2) Shale / Mudstone
Found in abundance, and found in boulders and subangular platy fragments, this material is found in stratigraphically higher locations. The rock is not continuous but occurs as sporadic outcrops. The rocks at this location are mudstones appearing to contain some fossils possibly brachiopods. They are hard, light coloured, fissile. The stone is likely heat affected, from the natural spontaneous combustion of underground coal reserves in area.

The dominant stone materials found in Central Lowlands archaeological sites – indurated mudstone and silcrete – are commonly found in creek line deposits (Kuskie 2000b), although none were noted during the field survey. This availability and distribution of stone materials has a number of archaeological implications, as evidence of stone extraction and working can be reasonably predicted to be concentrated in areas of stone availability. Although stone can be transported for working, it is more efficient to knap raw materials on site.

5.2 Soils

Soil analysis has important ramifications for archaeological research, through the potential impact of different soils on human activity and the impact on archaeological evidence within the landscape. The soils known to occur throughout the study area are identified here, in order to delineate their nature and impact on the survival and location of archaeological material.

Soils are produced through the weathering of underlying geological formations (Story et al. 1963). Soils alter due to varying conditions such as climate, topography, parent material, organisms and time. The natural chemical and physical constitution of the soil is also impacted by the underlying rock, with grain size, clay minerals, plant nutrients, and the retention capacity of the soil impacted.

The soils of the Central Lowlands are commonly podzolics in the higher rainfall areas and solonetzic under lower rainfall areas. More fertile soils are found along the river flats surrounding the Hunter River and its major tributaries, which are commonly targeted for agricultural cultivation. The Glendower Land System contains a wide range of soils, being essentially podsolic and solonetzic. Both soil groups are typically free of stony rubble, and are generally alkaline due to the presence of free lime in the landscape. The primary features of these soils are extreme variability in soil quality, with extensive areas of low fertility and high erosion hazard, and restricted areas of high fertility along flood plains and volcanic areas. These characteristics infer a relatively low agricultural potential and high soil erosion hazard throughout the area.

Kovac and Lawrie (1991) have mapped the soils of the Muswellbrook and Singleton areas, creating the Soil Landscapes of Singleton 1:25,000 Sheet. On this map, the study area has been mapped as occurring within the Roxburgh and Dartbrook soil landscape groups, the characteristics of which are summarised below.

TABLE 3 – SOIL LANDSCAPE PROPERTIES

SOIL LANDSCAPE	TOPOGRAPHY	SOILS	LIMITATIONS
Rx Roxburgh	Undulating low hills and hills on Permian sandstone, shale, mudstone conglomerate and coal. Relief 60m – 120m. Slopes 8%-10%.	Yellow podsolic soils on upper to mid slopes and red Solodic soils on more rounded hills. Lithosols on crests. Brown podsolic soils on slopes with conglomerate outcrops. Yellow Soloths in some gullies.	High to very high erosion hazard, shallow bedrock depth. Potential dispersive soils.
Db Dartbrook	Smooth undulating rises and low hills on calcareous shale and sandstone, and alluvium. Relief 30m – 80m. Slopes 3% - 6%.	Brown Clays and Black Earths on upper to mid-slopes, Euchrozems and non-calcic Brown Soils on mid to lower slopes, and Prairie Soils on alluvial flats.	Moderate to high erosion hazard. High shrink-swell potential.

A more specific soils analysis is currently being conducted of the proposed MCC extension by R.J. Connolly Environment Management Consulting Pty. Limited. Excluding the areas currently mined, the study area is essentially dominated by yellow duplex soils, both mottled and whole coloured. The mottled yellow duplex soils are found in association with the drainage channels of the study area, whereas the whole coloured soils are found across both hillslopes and ridge crests. This broad pattern only deviates in two areas – where brown subsoil is found along two ridge crests of the study area (ridge line in Extension A and B respectively).

The characteristics of the above soils have implications for land use and post-depositional processes in the study area. These soils have a limited potential for agriculture, which is essentially concentrated in the river flats surrounding the Hunter River to the west of Muswellbrook. However, pastoral activity is not limited by this soil profile, as identified by Connolly (2001) in the definition of two land capability classes within the extension area;

- Class IV – Suitable for grazing with minimal constraints. Land not suitable for cultivation; and
- Class V – Suitable for grazing with considerable constraints. Land unsuitable for agriculture with considerable constraints.

Class IV essentially defines all of Extension A and partially extends into the western portion of Extension B. Class V occupies the south-eastern and eastern sections of Extension B. Due to the characteristics of these soils, past agricultural cultivation within the study area is not likely, and pastoral grazing (in Extension A at the very least) is more probable.

Both soil landscapes are also subject to extensive moderate to high-level erosion (Kovac and Lawrie 1991) with crests and hillslopes susceptible to sheetwash and limited rill erosion, and gully and stream bank erosion of alluvial soils along watercourses. This has been aggravated by the widespread vegetative clearance across the study area (discussed below). The increased movement of soils by this erosion is also likely to impact on archaeological material, through the post-depositional movement of material (specifically the small, portable material heritage items such as stone tools) contained within the soil profile.

5.3 Climate

Climatic conditions in an area have a recognised impact on the soils and vegetation of the area, and therefore in a broader sense, also on human occupation (Kovac and Lawrie 1991). The rainfall and temperature conditions of the Muswellbrook area are discussed below to identify their potential impact on human activity, and on archaeological material already deposited within the landscape.

The climate of the Upper Hunter is predominantly sub-humid. In summer, the weather in the Muswellbrook region is dominated by synoptic high-pressure systems that alternate with the low-pressure systems every three to five days. In winter, the climate is modified by mid-latitude westerlies and high-pressure systems alternating with cold fronts. Winter is drier than summer, with regular frosts and fogs occurring from mid-autumn to late spring (CH2M Hill 1998). Frost incidence is related to the distance of the area from the coast and local relief. Scone and Jerry's Plains (to the north and south of Muswellbrook respectively) average 18 days with frost per annum (Kovac and Lawrie 1991). Average minimum temperatures for the Muswellbrook area are below 5° in winter and 13-17°C in summer. Average maximum temperatures are between 17-19°C in winter and between 28-31°C during summer. Relative humidity is highest in June (80%) and lowest in November (60%). This area has been defined as Climatic Zone 3B by Kovac and Lawrie (1991). For this area, the mean annual rainfall is 580mm, with a summer maximum. Monthly rainfall is 50-60mm in the summer, and 30-40mm in the winter. Rainfall has a known impact on soil qualities throughout the region, as it affects the rate of leaching of free lime in the soil, so that the soils in higher rainfall areas are more acidic. Although plant growth is not limited by rainfall, the low temperatures experienced in June, July and August do limit cultivation.

This has important implications for archaeological materials within the landscape. Short periods of heavy rainfall occur periodically in the Hunter Valley, usually in late summer, which are capable of producing short-term runoff. This rainfall is the dominant climatic factor affecting the erosion cycle of the area, which has a direct impact on archaeological materials contained within the landscape (Kovac and Lawrie 1991). Erosion has been clearly identified as potentially able to affect the distribution and condition of archaeological sites, specifically the small and portable artefactual material (Indigenous and non-Indigenous) through the post-depositional movement of artefacts.

5.4 Vegetation

The distribution of vegetation and water resources within the local landscape are important factors influencing patterns of Aboriginal land use and occupation. Additionally, the effectiveness of the archaeological survey is directly impacted by visibility conditions, of which vegetative cover is an important feature.

The vegetation of the Glendower Land System is characteristically Savannah woodland of box, gum and ironbark (Story *et al.* 1963), which is broadly reflective of the wider Hunter Valley landscape, 75% of which was originally covered by Eucalypt woodlands. The main plant species are likely to include grey box (*Eucalyptus moluccana*), spotted gum (*Eucalyptus maculata*), narrow-leaved red ironbark

(*Eucalyptus crebra*), bull oak (*Casurina leuhmannii*), yellow box (*Eucalyptus melliodora*), white box (*Eucalyptus albens*), and blakelys red gum (*Eucalytus blakelyi*) (Kovac and Lawrie 1991). This form of vegetation is characteristic of a habitat with fluctuating temperatures that can range from damp to dry. As a result of clearance, grasses are widespread throughout the region. Of the grasses, *Stipa aristiglumis* is common on areas of Black Earths, *Poa* sp. on Krasnozems and Chocolate Soils, and *Thermada australis* elsewhere. Most of the Central Lowlands has been cleared due to grazing, which has had a dramatic and generally negative impact on the stability of the soil and vegetation of the area (Story *et al.* 1963). Where this has occurred, grasses are the dominant vegetative community, both the above native grasses and a number of introduced or improved pasture species.

Within the study area, the native vegetation has been predominantly cleared as a result of mining and pastoral activity. This has resulted in the increase of the grass cover of the area (both natural and introduced grasses). This is especially prevalent in Extension A, the gentler hillslopes and ridge crests that have been predominantly utilised for grazing (**Plate 2**). The single residence of the property – Bimbadeen – is also built within this area, which has furthered land clearance. Extension A is therefore characterised by a moderate to dense grass cover. Much of Extension B, however, has been left uncleared due to its topography. The area to the north of the homestead, especially, is defined by steep hillslopes that are unsuited to pastoral and/or domestic development. This area has been therefore left essentially uncleared, and is characterised by a moderate to dense native vegetation consisting mainly of Eucalypt species and a moderate grass cover.

5.5 Topography

Landscape analysis is an important part of an archaeological survey. Different types of landforms will have been used differently in the past (Kuskie 2000a), therefore a background understanding of these landforms within a study area is necessary to the development of predictive models detailing site location and site types. Therefore, discussion of the topographic features of the study area is necessary to identify likely activities and archaeological evidence as they occur across the landscape.

The Central Lowlands of the Hunter Valley essentially consists of gently undulating rolling hills of low altitude, with local relief rising steadily from the coast to Murrurundi (at 1600 feet). Within this, local relief throughout the belt varies little, rarely exceeding 200 feet, and slopes rarely exceeding 15%.

The Hunter River, which drains the Hunter Valley, is the primary hydrological feature in the area. It begins in the Barrington Mountains before passing immediately to the west of Muswellbrook in its path to the ocean at Newcastle. Alluvial flats extend from the Hunter River and its major tributaries throughout the Lowlands, generally between 0.5 to 4 miles. The town of Muswellbrook is located almost entirely within this Hunter Valley floodplain terrain. Bounding the Lowlands are abrupt transitions to steeper country on either side (Story *et al.* 1963).

The Glendower Land System that defines the study area is generally centred along the water channels throughout the Central Lowlands. Four landform units have been defined as characteristic of this System;

1) Moderately steep rounded hills. Frequent outcrops of sandstone or conglomerate. Gullying and sheet erosion common. 65% of area.

2) Moderately steep hills composed of lime-rich sandstone or shale. Exhibit either rounded with slopes, or tabular hills with undulating summits bounded by steep slopes. Includes low sandstone cliffs, gentler foot slopes. 20% of area.

3) Undulating areas in major valleys, no rock outcrops. 10% of area.

4) Alluvium in valley bottoms, dominantly sandy but some clay. Terraced areas, subject to flooding. Under 5% of area.

These landscape features can occur simultaneously or in isolation within an area. Within the study area, two of the above characteristics were observed, essentially divided by the central Skeletar ridge that traverses the area in a general east-west direction. To the south of the ridge, the terrain is defined by a series of gentle hillslopes rising to a number of ridge line peaks. There was a large amount of surface stone deposits, mainly in the form of sandstone, shale and basalt (all course grained stone materials), throughout this area, specifically throughout the upper hillslopes and crests. To the north of the Skeletar ridge, the terrain was noticeable different and was instead defined by a series of long, narrow secondary ridgelines characterised by steep slopes and highly eroded gullies. Erosion was more common throughout the study area, with sheetwash and stream flow both major factors. Within the study area limits, local relief varies between 220m and 280m AHD, although the nearby Skeletar Ridge reaches a height of 333m.

A number of watercourses are significant to the location of the study area. A number of tributaries flow into the Hunter River throughout its course, consisting of both named upper order streams and numerous lower order drainage channels. In the Muswellbrook area, Dart Brook and Muscle Creek are the largest of these tributaries, although Sandy Creek is the closest to the study area. Located approximately 2km to the north-west of the MCC extension area, this seasonally flowing tributary is presumed to have local significance as the largest watercourse of the immediate area. However, the study area contains a number of lower order streams that lead into the above creek lines, all of which are essentially erosion drainage channels that function to direct water runoff into the larger creek lines.

5.6 Landform Units

A standard guide for describing landform divisions is McDonald *et al.* (1998). The categories defined in this reference are designed for a variety of land division purposes, being a two layered technique involving treating the landscape as a series of 'mosaics'. The tiles of the mosaics are described being of two distinct sizes - the larger categories are referred to as *landform patterns* with the smaller being *landform elements* within these patterns. Landform patterns are large-scale landscape units, more than 600m, while landform elements are the individual features contained within these broader landscape patterns and only measure about 40m across. There are around 40 of the larger *landform pattern* units described with over 70 *landform elements*. However of all the *landform elements* there are 10 morphological types. These are relevant to archaeological survey for they divide the landscape into standardized elements that can be used for comparative analyses. These elements are; *Crest, Hillock, Ridge, Simple slope, Upper slope, Mid-slope, Lower-slope, Flat, Open depression* and *Closed depression.*

The landform units defined for the Muswellbrook study area were identified with reference to McDonald *et al.* (1998), and the hydrology with reference to Strahler's (1952) stream order classification. Four landform units were defined as occurring within the study area, based on the morphological type, slope, dimensions and geomorphological agents of landform elements throughout the study area. The level of detail outlined by McDonald *et al.* (1998) is generally beyond what is required for archaeological analysis, and the eight landform units defined for this report are based in the generalized landform elements outlined above. No division was made between upper and lower hillslope units within the study area, as they did not exhibit sufficient differences in morphology, slope class and visibility. The landform units defined are outlined in detail below and illustrated in **Figure 5**.

Within the proposed extension limits, areas previously mined (the open cut itself) and areas of rehabilitation were not assigned a landform unit, as they are the result of recent mining activity. Within the study area, this therefore totalled (258320m square).

5.6.1 Landform Unit 1 (LFU 1): Ridge crests

A number of ridges are found in throughout the Muswellbrook area, and one of these ridge systems dominates the study area. As illustrated in **Figure 5**, a ridge runs across the study area from NE to SW from which a series of smaller ridgelines extend to the NW. These ridges are essentially long and narrow, extending no more than 2km in length and no more than 200m in width. The main ridgeline from which the secondary ridges extend is only slightly wider than above, being in average no more than 300m wide. The crests of these ridges are relatively flat and broad, with the degree of slope being generally level (less than 1%).

There has been much disturbance across these crests resulting from mining activity, pastoral and residential development. The main ridgeline, specifically, has been more highly developed than the secondary narrow ridge crests extending from it. The main ridge crest has been extensively cleared, with remnant vegetation indicative of regrowth rather than original vegetation. A moderate to dense grass cover is the defining feature of much of the crest, resulting from the above clearance and grazing activity. Visibility is consequently relatively low across much of the ridge crest (below 10%), although there are a number of exposures that have resulted from erosion and disturbance. Visibility is increased in these areas to between 40% and 80%. The secondary ridge crests have been less disturbed, as their steep topography have made them unsuited to grazing, but they have been impacted from the construction of vehicle access roads. These crests have retained a greater degree of natural vegetation, but also exhibit a moderate to dense grass cover. Visibility conditions are similar as outlined above.

5.6.2 Landform Unit 2 (LFU 2): Hillslopes

The southern portion of the study area is occupied by a series of hillslopes with a gently to very gentle slope (below 3%), which can extend for up to 800m. These slopes have been utilised in the past for pastoral grazing, which has accelerated the clearance of natural vegetation in the area. Although much of the native tree and shrub species have been cleared, the area is covered with a moderate to dense grass cover that has limited general visibility to almost zero (**Plate 2**). However, a number of exposures are located throughout the area, caused by natural erosion processes and human disturbance (such as vehicle access tracks). Within these exposures, visibility is increased to between 30% and 80%. There are a small number of lower order streams within the area, that are essentially dry gullies and that function as the influx for the pastoral dams of the area.

5.6.3 Landform Unit 3 (LFU 3): Steep Hillslopes

The hillslopes occupying the northern portion of the study area are morphologically distinct to those described above and are therefore discussed separately. These slopes are much steeper than above (between 10% and 30%) and lead down to a series of respective gullies, drainage lines that can hold water in times of high rainfall (**Plate 3**). These hillslopes generally extend between 50m and 100m. The vegetation of the hillslopes has remained essentially uncleared as they are not utilised for grazing or for mining activity. The hillslopes are therefore covered with a medium to dense grass and tree cover. Erosion is relatively limited, but the impact of water (precipitation and sheet wash) and wind are evidenced through exposed areas of erosion. On average, visibility is less than 10%, but increases in areas of erosion to between 40% and 80%.

5.6.4 Landform Unit 4 (LFU 4): Lower Order Streams

A number of low order drainage depressions run through the study area, found at the base of the above-mentioned ridgelines and hillslopes, collectively grouped as one landform unit due to their similarities in slope, geomorphological agents and activity, vegetation and visibility. These gullies are not substantial drainage lines, being 1st and 2nd order streams, but each would have held water in times of high rainfall.

These narrow open depressions are on average between 5m and 10m in width, and are characterised by moderately inclined to steep sidewalls (**Plate 3**). The hillslopes lead directly into the gullies, with no terraces or flats separating the landform units. The substantial grass and tree cover remaining along and within the gullies has reduced the visibility to on average less than 10%. Sheetwash is the main erosion process affecting these stream channels, with water from the above slopes being washed into the channels and directed north. This has resulted in a number of limited exposures along the channels, which create patches of increased visibility (30% to 70%).

5.6.5 Landform Unit 5 (LFU 5): Upper Order Streams

These watercourses, being 3rd and 4th order streams, have been distinguished from the above lower order streams as numerous lower order streams enter these creeks. The numerous lower order streams of the study area flow into a series of larger creek lines and drainage systems, which eventually run into the large creek lines of the area -Dart Brook, Muscle Creek and a number of smaller creeks. These all are connected to the Hunter River, which although not within the study area, was undoubtedly a defining feature of human occupation and landscape use in the Muswellbrook area.

Only two upper order streams occur within the study area, as illustrated in **Figure 5**. These streams share much the same characteristics of the above lower order streams, being relatively narrow and characterised by steep sidewalls. These channels are on average between 5m and 15m in width, and where covered by the same moderate to dense grass and tree cover as described above. Sheetwash also impacts on these channels, with water directed into and along these larger channels. This has resulted in a number of limited exposures along the channels, which create patches of increased visibility (30% to 70%).

TABLE 4 – LANDFORM UNIT DIVISION

LFU	MORPHOLOGICAL TYPE	AREA, M^2	% OF STUDY AREA	DIMENSIONS	SLOPE CLASS	GEOMORPHOLOGICAL ACTIVITY
LFU 1	Ridge crest	124860	13.3	50m – 250m wide	Very gently inclined.	*Erosion*; sheet wash. *Human activity*; land clearance, road construction, residential construction.
LFU2	Hillslopes	459050	48.9	Up to 800m	Very gently to gently inclined..	*Erosion*; sheet wash. *Human activity*; grazing, land clearance, road construction.
LFU3	Steep Hillslopes	59720	6.4	50m – 150m wide	Moderately inclined to steep.	*Erosion*; sheet wash. *Human activity*; land clearance, road construction.

TABLE 4 – LANDFORM UNIT DIVISION						
LFU	**MORPHOLOGICAL TYPE**	**AREA, M^2**	**% OF STUDY AREA**	**DIMENSIONS**	**SLOPE CLASS**	**GEOMORPHOLOGICAL ACTIVITY**
LFU 4	Lower order streams	35120	3.7	5m – 10m wide	Moderately inclined to steep walls.	*Erosion*; sheet wash, stream flow. *Human activity*; land clearance.
LFU 5	Upper order streams	1490	0.2	5m – 15m wide	Moderately inclined to steep walls.	*Erosion*; sheet wash, stream flow. *Human activity*; land clearance.
	Rehabilitation	187630	20			
	Open Cut	70690	7.5			
TOTAL		**938560**	**100%**			

Key to slope Classes: *Level* (under 1%), *Very gently inclined* (1%), *Gently inclined* (3%), *Moderately inclined* (10%), *Steep* (23%), *Very steep* (37%), *Precipitous* (60%), *Cliffed* (80%).

5.7 Land Use History

The study area was under private ownership until the 1944 commencement of the No. 1 Open Cut under MCC. Until this time, pastoral activity was most likely the dominant form of land use, which would have resulted in the clearance of widespread vegetation throughout the area. Grazing impact, although not substantial, has the potential to accelerate the natural erosion processes of the area and impact on extant archaeological material in the landscape. This is especially relevant for small, portable materials, such as stone tools.

The construction of, at least, two domestic residences has also impacted on the study area. A homestead complex – Bimbadeen – is found within Extension A of the proposed development and is occupied by a MCC employee as a residence. The collapsed remains of another domestic structure if found to the south of the Coal Road as it passes through the development area. Both structures were presumably built for the purposes of managing the pastoral resources of the property, as neither was originally associated with the management of the nearby mine. Both structures have entailed the construction of the actual structure and associated access roads (high-level, localised disturbance), and have resulted in the clearance of native vegetation (low-scale, generalized disturbance).

Although there is currently no open cut mining activity within the limits of the study area, previous mining activity has resulted in a number of impacts within the study area. These two large areas of open cut mining are identified on **Figure 2**. The open cut mining of these areas entailed the total removal of the entire soil deposit, which would also have resulted in the destruction of any archaeological site in the area. Following the completion of the open cut mining, the mined areas were backfilled and have been developed as rehabilitation areas. In these areas, the earth originally removed has been essentially placed back into the open pit.

Sections within the study area have also been subject to underground mining activity (**Figure 2**). Although the surface impact of this form of mining is often minimal, subsidence is associated with underground mining and has had a considerable impact on the study area. In additional to the surface 'cracking' often associated with subsidence, sections of the study area have also become highly unstable as the roofs of the underground tunnels have begun to collapse. As a result, a subsidence 'exclusion zone' is contained within the study area, where no access is permitted by MCC due to the highly unstable

ground surface. This area is identified on **Figure 2**. Any archaeological materials in this area have most likely been subject to post-depositional movement, through either falling into the collapsed mine shafts or being moved as a result of cracking and minor soil shifts.

Additionally, the use of the local area for both underground and open cut mining by MCC has resulted in the installation of mining infrastructure in the study area. This is mainly evidenced by the construction of the Coal Road, a public road, that passes through the study area, and is utilised by the mine.

5.8 Areas of Archaeological Potential

Examination of known archaeological patterning within the Hunter Valley and the topographic characteristics of the study area enable the identification of areas of archaeological sensitivity within the study area. Additionally, discussion of the geomorphological processes and human impacts affecting different areas throughout the study area will also be utilised to predict areas where archaeological materials have survived since their original deposition.

Watercourses have repeatedly been identified as areas of archaeological potential in the Hunter Valley region. This is due to the repeated association of archaeological materials with creek lines and their associated flats, such as the occupation sites that are commonly located within 50m of a watercourse. Within the study area, there are two distinct landscape areas:

1) The Northeast section: characterised by narrow ridgelines, steep hillslopes and deeply incised drainage depressions.

2) The Southern and Western sections: characterised by broad ridgelines, gentle hillslopes and gently incised drainage depressions.

Although a number of lower order watercourses are contained within the northeast of the extension, the topography of this area is not considered conducive to occupation sites due to the steep hillslopes and lack of terraces or flats along the watercourses. Additionally, it is unlikely that archaeological materials will be found along these hillslopes and drainage channels due to high level of erosion (sheetwash) affecting these slopes. This high level of water action is capable of moving archaeological materials, particularly the small and portable stone artefacts expected, so the possibility of locating in situ sites along these slopes is minimal.

The gentler topography defining the west of the study area is considered to be more suited to occupation, with the degree of slope generally less than 3%. This area also contains a number of lower order watercourses, which originally functioned to move water to the west of the study area. As they are not major watercourses, no large or concentrated sites are therefore expected along their banks. This area has been subject to increased disturbance from human occupation and use, resulting from the widespread clearance of vegetation, the construction of the Bimbadeen homestead and from mining activity (subsidence). This has aggravated the existing natural erosion impacting the area, and it is considered unlikely that an *in situ* site will be found in this area.

6.0 ARCHAEOLOGICAL CONTEXT - INDIGENOUS

6.1 Archaeological Research in the Hunter Valley

The earliest archaeological studies of the Hunter Valley date to the 1930s, with McCarthy and Davidson (1943) undertaking work at Singleton for the Australian Museum. This work continued into the 1940s, with McCarthy and Davidson (1943) aiming to understand Aboriginal occupation of the Hunter Valley from the material evidence. The surveys located Aboriginal sites across terraces and slopes but had limited success along the main river systems. The Australian Museum continued to fund archaeological work in the Hunter Valley into the late 1960s, as the area had not previously been intensively surveyed and was close enough to the Museum to allow long field trips. In 1965-1967, the Museum sponsored a survey that demonstrated a range of sites were found throughout the region, such as paintings in rock shelters, rock engravings, axe-grinding grooves, stone tool and manufacturing sites as well as habitation sites (Moore 1970). Moore also excavated a number of sites to investigate the subsurface nature of open scatters, and dated the occupation of a single rock shelter site to the Holocene period.

Throughout this period, outside interest was generally limited, with individual studies being undertaken by interested locals such as W.H. Mathews, a surveyor who located and produced accounts and drawings of some Aboriginal sites(Moore 1970).

The majority of archaeological knowledge about Aboriginal occupation of the Hunter Valley results from the many EIA and REF archaeological reports conducted throughout the region. The majority of these archaeological reports have focussed on the large-scale mining and power industries of the Central Lowlands. The table below lists reports and research carried out on Aboriginal heritage in the Hunter Valley. Those marked with an asterisk are mining sites or power stations.

TABLE 5 - LITERATURE REVIEW OF ARCHAEOLOGICAL SURVEYS

AREA	STUDY AUTHORSHIP
Aberdeen	(Brayshaw 1992)
*Bayswater #2 and #3	(Hughes 1981, Davidson *et al* 1993, McDonald 1997)
*Bengalla	(Rich 1993, White 1998)
*Black Hill	(Baker, 1996, Brayshaw 1982c)
Bolwarra Heights	(Baker 1997,Brayshaw 1995)
*Camberwell Lease	(Koettig 1996a, 1992)
Central Lowlands	(Burton *et al.* 1990)
Cessnock	(Kuskie 1996)
*Cumnock South	(Effenberger 1992; Stuart 1996a)
*Dartbrook	(Brayshaw 1981, Dean-Jones 1990, Hardy 2001, Ruig 1997, Stuart 2000)
*Drayton	(Kamminga 1978, Kuskie 2000b, Russell & Hardy 2001)
Fal and Carrow Brook Valleys	(Dyall 1977)
Glennies Creek	(Brayshaw 1986b,Dowling 1991, Koettig 1986a, 1986b, 1987; Lilley 1987; Koettig 1990)
Jerry's Plains	(Silcox 1998)
*Kayuga	(Ruig 1997, Stuart 2000b)
Kurri Kurri	(Stuart 1994c)
Lower Hunter (Tomago and Eraring)	(Bowdler and Gollan 1982)
*Lemington	(Baker 1993, Brayshaw 1982a, 1982c, 1983b; Dean-Jones 1995,

TABLE 5 - LITERATURE REVIEW OF ARCHAEOLOGICAL SURVEYS	
AREA	**STUDY AUTHORSHIP**
	Haglund and Rich 1995; Kuskie 1999, 2000d)
*Liddell	(Brayshaw 1983a; Stuart 1996a)
Lochinvar	(Stuart 1994b)
Maitland	(Stuart 1999)
Minmi	(Everett 1996a, Stuart 1995)
Moffats Swamp Dune	(Baker 1994)
*Mount Arthur North and South	(Dyall 1980,Dyall 1981, Hughes 1985; Kuskie 2000b, 2000a)
*Mt Pleasant	(ERM Mitchell McCotter Pty Ltd. 1996, ERM Mitchell McCotter Pty Ltd. 1997, Rich 1995,)
*Mt Thorley	(Brayshaw 1994; Stuart 1994a)
*Nardell	(Stuart 1997)
Tenambit Wetlands	(Everett 1996b)
Tomago	(Effenberger 1996)
*Ravensworth/Narama	(Brayshaw 1983c; Brayshaw and Haglund 1984, Godwin 1987, Rich 1992b, 1992a; Rich 1992f, 1992c, 1992d, 1992e)
*Redbank Creek, United Collieries Lease	(Hiscock 1984)
*Wambo	(Brayshaw 1984, Corkhill 1990, Dyall 1980b; Rich 1991a, 1991b)
* United Collieries	(Dyall 1981, Koettig and Hughes 1983)
*Warkworth	(Haglund and Rich 1995; Kuskie 1998, Rich 1994)
*West Muswellbrook	(Energy Authority of New South Wales 1981)
*West Bolwarra	(Brayshaw 1985)

Archaeological research of mining areas located within close proximity to the study area will be briefly discussed below to provide a regional archaeological context to this report. These sites include Mount Pleasant, Bengalla, Bayswater, Dartbrook, Drayton, Mount Arthur and Black Hill. This research will be reviewed in more detailed in **Section 5.2** (Research Themes), and the physical area of relevant assessments is identified on **Figure 4**. The results of the survey, specifically the conclusions drawn in respect to site types and location, will be discussed and later utilised to develop predictive models through delineating archaeological patterning in the local area.

Mount Pleasant

Rich (1995) also conducted an investigation of the Mount Pleasant Mine. A total of 327 sites were identified by the survey – 180 isolated finds, 67 artefact scatters with only 2 or three artefacts, and 26 artefact scatters with more than 10 artefacts. The highest density of sites was found along gullies and along lower portions of ridges and slopes. The total number of artefacts recorded were 1408, and of these silcrete was the dominant stone material (58%). Mudstone was also common (28%). Visibility was determined to be a major limitation of this survey, with only 1.3% of the lease area calculated to be visible.

ERM Mitchell McCotter (1996, 1997) undertook additional surveys of the Mount Pleasant lease. In the emplacement area, a total of 90 sites were identified (almost entirely artefact scatters) which consisted of a total of 3,592 artefacts. One large and complex site was located, which in itself contained over 2,500 artefacts.

Bengalla

Rich (1993) investigated the Bengalla Coal Mine lease, in a large-scale survey encompassing 1,300 hectares in 65 days. A total of 39 sites and 19 isolated artefacts were recorded as a result, with a total of 1,777 artefacts. Silcrete was the dominant material, comprising 60% of the artefacts, with indurated mudstone also prominent. Quartz, volcanics and other materials were found in small numbers. Artefacts essentially consisted of manufacturing debitage, with flakes, flaked pieces and so on comprising 82% of the artefacts. Cores numbered 8.5% of the total, backed blades 1.3% and axes and pebble tools 1.1%. Most of the artefacts recorded were less than 50mm in size.

The results of the survey identified that most archaeological evidence is concentrated along streams and site density decreased upstream and away from stream banks. Rich (1993)concluded that there were two types of site by looking at site distribution in relation to a stone source in the survey area. Residential base was the first type of site, showing a range of activities including stone tools. The second type of site being smaller one-off activity camps representing resource extraction. The data collected by Rich (1993) supported this model with 'larger' sites occurring every 1.4 kilometres. The main weakness Rich (1993), identified with the study were the effects of visibility on the survey results. Visibility of artefactual material being stronger along stream banks, therefore increasing the likelihood of finding sites in this feature of the landscape in comparison to others. Rich (1993) also concluded that her results were biased by the examination of only sections of sites which were visible on the surface rather than on the analysis of the entire site which is possible through excavation.

Bayswater Colliery

Hughes (1981) conducted an early archaeological assessment of the Bayswater lease, which entailed the survey of the 700 hectare proposed extension for Bayswater Colliery No. 2. Little information is available about this initial archaeological survey, and it will not therefore be discussed in detail.

Davidson *et al* (1983) conducted the initial survey of Bayswater No. 3. The survey covered a broad area of 4700 hectares, but focussed on the watercourses of the region as of higher archaeological potential. A total of 84 sites were identified, that ranged from 1m to 62,5000m square in area. The majority of sites were occupation sites, such as artefact scatters and isolated finds. Other site types identified included scarred trees (4) and axe-grinding grooves (2). Analysis of the stone artefacts observed indicated that mudstone was the dominant stone material utilised in manufacture, with silcrete as the next common. Flake portions and flakes were the most common artefact types, with flaked pieces, retouched flakes and cores also present.

McDonald (1997) conducted an assessment of the Bayswater No. 3 site, which utilised a combination of landscape survey and test excavation. A total of 35 sites were located throughout the lease area, most of which were in proximity to tributary watercourses. These areas were of a high visibility, due to the large numbers of exposures. Excavation centred on sites in four different areas – one adjacent to a major creek line (MacDonald Creek), one located atop a ridge crest, one adjacent a spring fed waterhole and several test pits across a large area associated with MacDonald Road South. In addition, 'several' charcoal patches and a single stone feature was excavated only to be revealed as of natural origin.

The project excavated a total of 158m square across the Bayswater No. 3 lease area. The site adjacent the creek line exhibited a large and low-density artefact surface scatter, and excavation consisted of total of 155 test pits each measuring 0.25m square. As a result, a total of 70 sub-surface artefacts were recovered, and were observed to be at a comparable density as the surface deposit. The ridge crest site involved the excavation of a 15m square area, again excavated in 0.25m square units. This site revealed a large sub-

surface deposit, with 840 artefacts recovered. The third excavation, located adjacent the site of a waterhole with known grinding grooves, also proved to contain a substantial sub-surface deposit. A 5m square trench was excavated, and a total of 283 artefacts were removed. Quartz was identified as the dominant material. The excavations at MacDonald Road South included test pits at three locations. A backhoe was used to excavate 120 units, each 1m square. A mechanical sieve was used, and as a result, a total of 587 artefacts were recovered. The minimum number of artefacts recovered from a unit was sixty.

The results of the excavation indicate a number of interesting patterns. Of initial interest is that all excavated sites and areas contained some sub-surface archaeological material. Even low surface artefactual densities (such as the creek site) indicate a relatively high potential for sub-surface archaeological material in the local area. The high numbers of sub-surface artefacts recovered in an excavation of the ridge crest site (the largest site excavated) also indicates that this landform unit is potentially underrated in archaeological predictions. Sites along watercourses have traditionally been defined as of higher archaeological potential than higher landform units. The excavation of a large number of subsurface artefacts, at a relatively high density, on a ridge crest site indicates that this assumption is not entirely accurate.

Dartbrook

Previous surveys of Dartbrook Mine have been conducted in advance of proposed development, and include Brayshaw (1981), Ruig (1997), Stuart (2000), and Hardy (2001). As a result of these surveys, several archaeological sites have been registered in the vicinity of the mine.

In general terms the archaeological work carried out in this region suggests that creek lines contain the greatest numbers and densities of sites. Poor visibility is frequently an impediment to high survey coverage. It has often been recommended that further work where large numbers of sites occur along creek lines, or testing in areas where visibility is poor, be carried out.

The middle reaches of creek lines were designated as being of moderate archaeological sensitivity within the Kayuga area (Ruig 1997). Within the Dartbrook lease area, an unnamed creek that runs through the east of the lease was inspected by Stuart (2000) who determined it to be of moderate sensitivity. A number of sites were found along the line of this creek, and it was determined that a 50m buffer zone by established for the creek line to prevent disturbance to these resources. The rest of the lease area was considered to be of low archaeological sensitivity. In the areas of slopes and crest the major issue raised was that of visibility, although the reduced visibility along hillslopes and crests was acknowledged as a limiting factor of this assessment. As a result, additional survey in times of higher visibility was recommended.

Drayton

Dyall (1977) undertook the first archaeological survey of Drayton Mine, in a survey designed to assess the proposed lease area. A total of 24 sites were recorded as a result.

Kamminga (1978) also conducted a survey of the proposed Drayton lease. At that time, no archaeological sites had been found in the Hunter Valley at an elevation higher than 150m above sea level, and as a result, (Kamminga 1978) believed that the landscape of Drayton was not of high archaeological potential due to its high elevation and intermittent stream flows. (Kamminga 1978) identified the lowland area within the lease, an area flooded by the ash dam, as an area of archaeological potential, but the construction of the dam had effectively destroyed or obscured any archaeological material. Only one site was recorded by this survey, located near a permanent water hole.

Kuskie (2000b) later produced an EIS for both Drayton Coal and Coal Operations Australia, in preparation of a proposed rail loop. This projects lies directly north of the current study area and extends northwest, with a section of surveyed area within the Drayton Lease boundaries. The 14 new sites that were recorded fell mainly within or close to the northern boundary of the Drayton lease. Sites were found throughout 53% of the surveyed area, but the densest artefact scatters lay within 50m of the Ramrod Creek. One site of historic significance was also recorded.

The most recent study of the mine lease was conducted by HLA (Russell and Hardy 2001). This survey was limited to an area of proposed development within the lease area (A173 and Rocky Knob) but covered an area of 130 hectares and a variety of landform units (ridge crests, hillslopes, upper and lower order streams). This survey recorded a total of 14 sites, all of which were defined as occupation sites (artefact scatters, isolated finds). Mudstone and silcrete were the dominant stone materials utilised in manufacture, but minor frequencies of quartz and porcelanite were also observed. Sites were positioned in all landform units within the study area, being found in ridge crest, hillslope and watercourse landform units. Although this broad distribution was recognised, the density of artefacts was observed to increase in association with the streams (drainage depressions) of the area. The majority of artefacts were found concentrated in association with two creek lines of the study area, with one site containing in excess of 200 artefacts.

Mount Arthur North and South

Mount Arthur is located to the southwest of Muswellbrook. A number of archaeological assessments have been conducted at the both North and South mines as part of EIS work.

Dyall's (1980) study at Mount Arthur North identified 20 artefact scatters, 2 grinding grooves and a low-density scatter of artefacts extending along the two main watercourses. The grinding grooves were contained within a stone boulder of a creek bed. Six of the artefact scatters were large complexes, containing over 100 artefacts each. Artefacts were composed primarily of flakes and blades, but ground-edge axes, bondi points, geometric microliths and flake-edge axes were also present.

In a later survey of Mount Arthur South, Dyall (1981) located 24 artefact scatters. Dyall (1981) interpreted the site distribution data as reflecting larger campsites centred in the lower valleys, and smaller campsites established on minor streams for occasional visits. It was further proposed that the smaller streams might have been occupied in summer, with an increase in natural resources of the area.

Koettig and Hughes (1985) conducted a large study of the Mount Arthur area, which comprised the investigation of Mount Arthur North, Mount Arthur South and Plashett Dam through a combination of landscape survey, salvage collections and excavation. At Mount Arthur North, a total of 93 artefact scatters were identified, concentrated mainly along the watercourses of the study area. This was related to the survey strategy and visibility in the study area, rather than actual patterning in Aboriginal landuse. The surface survey was essentially restricted to the watercourses of the area, as within the area of development impact they were determined to be of a higher archaeological potential. Additionally, throughout the survey area, there was a higher visibility along creeklines. Of the watercourses surveyed, sites were found in higher densities along Whites Creek. Silcrete and mudstone were the most common stone materials located, which were determined to be largely non-alluvial in origin. Other materials – quartz, petrified wood and volcanics – were determined to be alluvial in origin. Most flaked artefacts recorded were less than 50mm in size, although as a general trend, artefacts were longer (noticeably elongated) at the larger sites.

In the related investigation at Mount Arthur South, Koettig and Hughes (1985) identified a total of 135 artefact scatters and one grinding groove in a landscape survey. However, of these only 28 were recorded in detail, and these all occurred along Saddlers Creek and its tributaries (the development area). This was therefore only a sample of the archaeology of the Mount Arthur South lease area.

Mount Arthur North is contained within a relatively high terrain landscape of the Hunter Valley, such as the Muswellbrook lease area. The actual Mount Arthur forms a high point in the surrounding terrain, being 482m above sea level. As only a limited number of studies have examined higher terrain areas within the Hunter Valley, the data recorded by this survey and the conclusions made are roughly applicable to this archaeological assessment, as they provide evidence for relatively intensive occupation of high terrain areas, particularly in association with the watercourses of the local area.

Blackhill

Brayshaw (1982) conducted a survey of the Blackhill lease area, in advance of the planned mining activity. Six artefact scatters and four isolated artefacts were located, in addition to two previously recorded sites. These sites contained mainly mudstone and silcrete, which was found mainly as flakes and flaked pieces and cores. No sites were identified on ridge crests or slopes, despite reasonable exposures.

6.1.1 Summary

A large number of archaeological surveys have been conducted in the vicinity of Muswellbrook Coal Mine, with the Central Lowlands of the Hunter Valley being intensively studied. These surveys have predominantly been unpublished, conducted as part of Environmental Impact Assessments (EIAs) and Reviews of Environmental Factors (REFs), being related directly to the development of the large-scale mining and power industries. This research forms a considerable body of archaeological knowledge about Aboriginal occupation and activity within the Hunter Valley.

Knowledge of these studies is important to place this assessment within a broader archaeological context. From the above research, archaeological patterning in site types and distributions can be delineated for the Central Lowlands area, which has been utilised to develop the analytical framework for this study and to develop a predictive archaeological model for the study area.

Like the MCC lease area, a number of the above mines are located in high terrain areas, such as Bengalla Mine that is also located in a similar distance from the Hunter River. The results of these studies are therefore seen as broadly comparable to the study area of this report in terms of landscape characteristics, especially so when considering the relatively few archaeological surveys of such high areas in the Hunter Valley. The results of the above surveys are therefore utilised to reflect on the nature of occupation and land use in high landscape areas in the Hunter Valley. These studies, in the wider context of archaeological knowledge of Hunter Valley occupation, indicate that despite earlier concepts of Indigenous occupation and land use, high landscape areas in the Central Lowlands potentially contain substantial archaeological material. This material may reflect different levels of occupation and land use, and may range from ephemeral and incidental land use to long term and intensive use.

Discussion of these studies also enables the identification of Hunter Valley research themes, which is crucial in the later determination of the archaeological (scientific) significance of a site and/or area. Sites are determined as significant due to their research potential, the ability to answer the questions posed by the research themes is discussed below.

6.2 Research Themes

From the large body of archaeological research throughout the Hunter Valley region, a number of research themes have been delineated to identify the focal archaeological issues. These issues have had a major impact on the direction on archaeological research in the Hunter Valley, and include;

- Chronology,
- Stone Artefact Studies, and
- Occupation models.

Chronology

Since the first archaeological work in the area, the age of the Aboriginal occupation in the area has been of interest. Of excavated and dated sites in the region, most sites have been found to be from the Holocene Period (less than 10,000 years old). Holdaway (1993) notes however that the implications of Dean-Jones and Mitchell's (1992) report are site formation process are unlikely to create in-situ deposits suitable for dating (1992:29-31). There is also a lack of suitable hearths for dating in the Central Lowlands (1992:29-31). Thus despite the great amount of archaeological research which has been conducted in the Hunter Valley the amount of dated assemblages is relatively low.

There are three sites in the Central Lowlands which date to outside the Holocene period. A site at Glennies Creek shows that Aboriginal occupation dates back to at least 10,000 years (Koettig 1986b). Kuskie (2000b) has identified artefacts from a site in the Lemington Mine near Wollombi Brook as being of a Pleistocene age, although the final report on this site is not yet in circulation. It is reported that Hughes has also located Pleistocene era artefacts on the Carrington Mining lease, however this report does not seem to be held by NPWS Site Report collection.

The survey of the Glennies Creek to Singleton pipeline recommended that excavations be undertaken at six locations along the northern section of pipeline route where visibility was poor. This resulted in the further identification of five sites. The soils were characterised as being texture contrast soils with strongly distinctive Units A and Units B (whether this equates with the development of A and B horizons in soil profiles is unclear). Artefacts were found in Unit B that were estimated by a geomorphologist to date between 10,000 and 30,000 years ago. A radiocarbon date was obtained from charcoal in Unit B, this was 13 020 +- 360 BP (Koettig 1986). Further archaeological work concentrated on two sites SGCD 9 and 16. These are located in the valley of Foy Brook near Mount Olive. The sites are on small alluvial flats adjacent to Foy Brook and surrounded on either side by steeply rising slopes to ridge crests. The investigation strategy was to excavate a series of pits along the pipeline route. A backhoe was used to remove sediment and then place it on the ground to be sorted by archaeologists. The emphasis of the work was to obtain samples of artefacts from the Unit B layer.

The results of the work established that Unit B was dated to between 10 to 30,000 years ago and that artefacts recovered from that Unit must date to that age. A feature interpreted as a hearth was discovered and dated to greater than 20,000 BP (a more precise date was not able to be obtained due to the small sample of charcoal collected). The artefacts recovered from Unit B were made from volcanic rock and contained a greater ratio of core to flakes than from the artefacts recovered from Unit A. However, the low numbers of artefacts recovered limited the analysis.

The conclusion of Koettig's work was that there were artefacts associated with Unit B and that these on stylistic and dating grounds were between 10 to 30,000 years old. This is the oldest date from the Hunter Valley and indicates that the valley of Foy Brook has the potential to contain quite old archaeological deposits.

Stone Artefact Studies

The primary archaeological evidence found throughout the Hunter Valley are stone artefacts. Correspondingly, there has been a great degree of archaeological interest in the production of stone tools, specifically stone tool reduction sequences (discussed separately below). In addition, the identification of stone material types, the availability and use of stone materials and the procurement behaviour at stone resources have also been major archaeological issues.

Stone Material Types

The identification of stone material types in the Hunter Valley have followed earlier classifications by Hughes (1984). Stone materials identified within archaeological deposits of the Hunter Valley include indurated mudstone, silcrete, quartz, fossilised wood, chert, porcelanite and local volcanics. These are divided into sedimentary, igneous, and igneous/sedimentary categories, and are briefly outlined below.

TABLE 6 – STONE MATERIAL TYPES

ROCK TYPE	MATERIAL	CHARACTERISTICS	DISTRIBUTION
Sedimentary	Mudstone	Colours include yellow to red, white. Very fine grained, can be highly indurated with silica. Varies from well to poorly cemented (affects flaking).	Occurs in Permian sedimentary rocks, therefore potentially throughout the entire Hunter Valley. Probably as a lag on stone surfaces. The main known source is from the Hunter River gravels.
	Chert	Is presumably a graduation of highly siliceous grade of mudstone. Excellent flaking qualities.	Similar to above.
	Siltstone	Unindurated, relatively soft material.	Permian beds. Found throughout the Mt Arthur area.
	Quartz	A very stable mineral that does not chemically alter during weathering or metamorphism. Does not seem readily flakeable, but there may be usable pebbles.	Occur as pebbles and cobbles in the Triassic sandstone conglomerates of the area, formed by the weathering of geodes or veins. Often brought down by the mountain streams in the gravel bedload.
	Quartzite	A hard, silica rich stone formed from sandstone that has been recrystallised by heat or strengthened by slow infilling of silica in the voids between sand grains. Does not seem readily flakable, but there may be usable pebbles.	Similar to above.

TABLE 6 – STONE MATERIAL TYPES			
ROCK TYPE	MATERIAL	CHARACTERISTICS	DISTRIBUTION
	Petrified Wood	Silicified wood.	Origin probable from Permian or Carboniferous sedimentary rocks.
Igneous	Basalt	Marginally flakable.	Few outcrops in the Hunter Valley. Known in the Hunter River gravels.
Igneous / Sedimentary	Silcrete	Normally grey in colour, but can be white, red, brown or yellow. It easily shatters into sharp, angular pieces.	Similar to mudstone – throughout the Hunter Valley and known in Hunter River gravels.
	Porcelanite	White, fine grained and well cemented material.	Geological source not well known.

Mudstone is the most common stone material found throughout the Hunter Valley, with silcrete the next common group. Kuskie (2000b) suggests that what is commonly referred to as 'mudstone' is in fact 'rhyolitic tuff'. However as the majority of archaeological surveys have labeled this raw stone material as mudstone, this terminology will be maintained for the current study.

Quartz, fossilised wood, chert, porcelanite, and local volcanics are found in lesser frequencies. The technical potential of these stone materials vary, but in general high precision flaking is only possible with well-indurated material. As a result, different raw materials have different qualities that are relevant to stone tool manufacture. For example, although mudstone and silcrete are preferred for their flaking qualities, coarse-grained sandstone is the most common raw material utilised for axe grinding (Hiscock and Mitchell 1993).

Regional Sequences

This theme began with McCarthy and Davidson (1943), but has been refined extensively since then. The first Hunter Valley stone tool sequence was first generally defined from excavations at two rock shelters, Lapstone Creek and Capertees, in eastern New South Wales. These excavations found two distinct phases of stone tool types. The upper phase (or most recent) known as Eloueran is characterised by ground edge axes, knives, eloueras and scrapers. The second phase known as Bondaian is made up of predominantly geometric microlithic tools including Bondi points, burins, fabricators and scrapers (McCarthy 1976). Later excavations identified a third phase, the Capertian. The Capertian assemblage includes uniface pebble implements, cores, blocks, dentate saws and hammerstones. This sequence has been known as the Eastern Regional Sequence (McCarthy 1976).

Later research further refined this sequence. Hiscock's work in the mid eighties at the Sandy Hollow Rockshelter, in the Central Lowlands, determined a dominant reduction sequence involving the manufacture of backed blades (Hiscock 1984; 1986). From the Sandy Hollow excavation, Hiscock found three chronologically diagnostic strategies, he labeled these Pre-Bondaian, Bondaian I and Bondaian II. These phases are defined as:

- **Pre-Bondaian** (pre 1300BP) – Distinguished by absence of backed blades, medium sized flakes, no platform preparation, large amount of force and indirect striking techniques.

- **Bondaian Phase I** (c.1300 to 820BP) - Backed blades present, larger elongated flakes, platform preparation, rotation of core and core retouch.

- **Bondaian Phase II** (c.820 BP to present) – Backed blades present, shorter wider flakes, small amount of platform preparation and precise application of smaller force for flaking.

Archaeological work has not located much evidence from McCarthy's (1976) "Capertian" period although there is some reference in Hiscock's (1984, 1986) work to "pre-Bondaian" stone tools. The majority of sites found in the Hunter however date to the "Bondaian" period often called the "Small Tool" or "Microblade" tradition. This period dates from around 4000 years BP. Aboriginal people appear to have concentrated in this period on manufacturing stone tools which archaeologists refer to as "Bondi Points", "Geometric microliths" or "microblades". It is generally suggested that these types of stone artefacts were much smaller and required a greater degree of stone working skill than ones used in earlier periods.

Hiscock (1986,1984) argued that a particular reduction strategy was present in each of these phases and that certain analytical methods could be used to characterise surface artefact assemblages. Hiscock's (1986, 1984) research and methodology gained attention from the archaeological community which resulted in an emphasis on detailed analysis of stone artefacts and establishing reduction sequences.

Reduction Sequences

Archaeological research examining stone tool manufacturing techniques have revolved around reduction techniques - the methodology employed to remove flakes from a core and to further refine those flakes. Of interest are the different stages of the reduction process, and the technologies employed in those varying stages, and how entire reduction sequences were refined and changed over time. This research has generally concentrated on the way that two tool types - geometric microliths and backed blades (probably used as spear barbs) - were made. This has been a major theme of archaeological research in the Hunter Valley, specifically the Central Lowlands, due to the high level of survey and excavation in the region.

Hiscock (1986) was a major force in the development of comprehensive reduction sequences. Through conjoining and classification and measurement of individual technological attributes on a number of sites, the following generalized reduction sequence was identified:

1) The selection of stone material;

2) Initial reduction that produces large flakes;

3) Selection of flakes for further reduction;

4) 'Tranchet' reduction;

5) Selection of flakes for backing; and

6) Backing.

Tranchet reduction is the knapping theme identified in the three collections examined by Hiscock (1986) from Redbank Creek, and involves:

- Initial removal of a large, thick flake from a core;

- Retouch of the flake by blows to the ventral surface that remove small flakes from the dorsal surface: retouch on the lateral margins acts to establish potential platforms and retouch on the proximal and distal ends establishes ridges and removes unwanted mess;

- Blows are applied to the platforms established on the lateral margins in step 2, removing flakes from the ventral surface of the tranchet retouched flake; and

- Stages 2 and 3 are alternated to enable reduction to continue.

Hiscock (1986) asserts that the generalized 'rules of stone-working' were strictly followed by the knappers, but individual variation could occur with the timing and extent of knapping behaviour. This was utilised to explain the variation observed among a number of different reduction sequences. The steps outlined above could take place in different locations, such as at the initial reduction site at the stone source or elsewhere. Hiscock (1986) further suggested that stone knapping was an organised 'production line', with initial reduction of several sizeable cores.

However, later research (Haglund 1989) encountered substantial problems in applying Hiscock's (1986) definitions and methods to the analysis of Hunter Valley sites. In applying this methodology to the analysis of tuff flakes from three sites on the Merriwa River (a major tributary of the Goulburn River), Haglund found that Hiscock's methods for measuring some traits were based on a personal assessment of what was likely to have happened. Haglund (1989) concluded that although this type of analysis was able to delineate valid and useful information, it is then subject to variation during analysis, if clarification is not gained on the following points:

- Definitions require clarification;

- Traits identified as diagnostic vary with regard to value (particularly if the sample size is small); and

- The identification and evaluation of these traits reflects the analyst's bias and experience to varying degrees.

Later excavations at three Redbank Creek sites, Hiscock (1993) determined a particular reduction sequence for the production of Backed Blades, which was labeled the Redbank A Strategy. This strategy has six particular phases, although the order in which these phases occur does vary. Additional information from open scatter sites between Saltwater Creek and Mt Arthur further refined this manufacturing technique. In this reduction method a variety of stone tool materials were utilised, and Hiscock (1993) proposed that this was the predominant reduction method of the Central Lowlands.

A number of additional works have also been conducted to examine reduction sequences, such as at Camberwell, Bulga and Narama (Rich 1992). These studies have identified a large number of reduction sequences that although they are aimed at producing backed blades, they are different from those described by Hiscock (1993). Rich's (1992) study at Narama Mine utilised the same definitions and methodology as Hiscock (1993) at the Redbank sites, but had contrasting results. Rich (1992) found that there were few examples of the Redbank A Strategy in the excavated deposits, and that an alternating flaking strategy was used at Narama to obtain flakes suitable for the production of backed blades. Due to the close location of Narama to the Redbank sites, this suggests that regional reduction sequences are not fully understood, and what have been termed regional reduction sequences may in fact be site specific reduction sequences.

Occupation Models

Initial work in the Hunter Valley aimed to understand the nature of Aboriginal occupation and determine the nature of land use. This theme has been maintained by contemporary research, which often aims to identify and explain archaeological patterning in site type, content and distribution. For this end, general theories have been developed outlining the relationship between land use patterns and the resulting archaeological evidence and more specific models have also been developed examining this patterning in the Central Lowlands.

Koettig (1994) proposed a model based on evidence from salvage excavations in the Central Lowlands, specifically at Camberwell and Bulga. This model argued that camps were ordered according to strict rules based on the location of water sources, the size and composition of the group and the length of the occupation. Therefore, at sites where separate features are close together and their distribution is fairly continuous, this represents repeated occupation. Where episodes are widely spaced and limited in number, one or a small number of occupation episodes may have occurred but it does not imply that the group size was small. The frequency of occupation in one location is likely to relate directly to the resources available in the area. Ethnographic information was also incorporated into this model.

Dean-Jones and Mitchell (1993) suggested that occupation could be associated with ridgelines, due to their elevated positions that provided linkage route and high visibility across the landscape. Terraces and other mid-slopes positions were also promoted as favourable, especially during winter months where lower terrain areas were subject to frost hollow effects. Larger sites were noted to occur in valley units, because of the additional resources. Additionally, the impact of saline water on Aboriginal occupation was raised as an issue that may have affected the seasonality of occupation in some catchments.

Rich (1995) in a study of the Mt Pleasant coal lease argued that people utilised technological solutions in conjunction with other survival strategies. Groups were mobile and moved to the resources of the area, which were managed through the use of facilities such as fish traps and fire. This aimed to increase the reliability and productivity of food resource.

Witter, in a 1995 NPWS Workshop (unpublished) proposed a model to interpret open artefact scatters in the Hunter Valley. Most occupation sites were interpreted as being largely peripheral to one or more base camps in close association with the Hunter River. These base camps would contain archaeological evidence of more intensive and/or long-term use by a large group of people. In summary, Witter's (1990) model essentially proposes that:

- Base Camps are the loci for foraging for aquatic and plant resources and for preparing equipment for kangaroo hunting. These sites are expected to occur along major watercourses, particularly permanent sources, and would be evidenced by open artefact scatters containing general-purpose stone tools of local raw material along with areas containing evidence specialist microblade production such as high quality or thermally altered stone material, microblade reduction sequences and possibly heat treatment hearths.

- Satellite sites are the loci of specialist activity, such as the repair and maintenance of hunting equipment. As the water sources of these areas are generally intermittent, they are instead conceived as areas of seasonal activities such as hunting peripheral to the more permanent settlement of base camps. These sites are expected within the upper catchment areas and along ridgelines and crests, and may be evidenced by good quality cores.

Although these tenets are generally maintained by archaeological interpretations in the Hunter Valley, there are a number of analytical problems in determining a site as a base camp or specialist satellite camp from landscape surveys. Although base camps are definable from their association with major watercourse and evidence of large-scale stone tool manufacture, determining the status of other sites is often more complex. For example, a site (or series of sites) located along lower order tributaries may be alternatively labeled as a base camp or a specialist satellite site from the surface assemblage recorded, although they are not found in association with major watercourses there may be evidence indicating intensive occupation.

Similar problems also occur in determining the temporal occupation of a site. Although sites may be dated from subsurface deposits, landscape surveys can only assess potential occupation dates from geomorphic analysis and any clearly associated datable materials (such as in contact sites). Therefore, determining whether a site has been intensively occupied once or been occupied at a low level over a substantial period of time cannot be determined.

The models briefly outlined above have been examined in greater detail to provide the analytical framework for this archaeological assessment, and in order to develop the predictive modelling required for the survey (**Section 5.3**).

6.3 Research at Muswellbrook Coal Mine

The earliest archaeological surveys of the study area date to 1981, with (Brayshaw 1981a, Brayshaw 1981b; Brayshaw 1981c) conducting three small-scale surveys of the Muswellbrook area. Two of these (a and b) extended partially into the current MCC extension area.

Brayshaw (1981b) examined most of the study area in a study to determine the possible subsidence impact from previous underground mining located between the No. 1 and No. 2 Open Cuts. A pedestrian survey was conducted over the area, with particular attention paid to creek lines and erosion exposures for grinding grooves and campsites. A scarred tree was located as a result of this survey, located within the current Extension A approximately 40 metres to the east of the original No. 1 Open Cut. This tree is therefore contained within the study area of this assessment. The tree displays two excision marks, both elliptical in shape and consistent with other known scarred trees in the area. Another survey by Brayshaw (1981a) also partially extended into the current study area, in crossing the western section of the development area. However, no sites were recorded as a result.

Later assessments were undertaken in advance of proposed developments. Stuart (1996) conducted an archaeological assessment of the planned MCC No. 2 Open Cut extension and the associated proposed rail loop to connect the mine to the main railway. The archaeological survey covered a total area of 1.4 hectares, and consideration of the visibility conditions at the time of survey indicated that the effectiveness of the survey coverage was approximately fifty percent. The survey located a total of sixteen sites as a result – four artefact scatters and twelve isolated finds (all occupation sites). The dominant stone material found at these sites was indurated mudstone, with silcrete the next major group. The only other material found was chert. These sites were predominantly determined to be of low archaeological significance, although four sites were determined to be of medium archaeological significance.

Rheinberger (1998) conducted a large-scale study of the Muswellbrook area that incorporated 5 areas to the east of Muswellbrook. Two of these areas (CBA 1 and 2) partially extended into the current study area. This survey resulted in the total recording of twenty-one sites and six isolated finds. The sites consisted of eighteen open camps (occupation sites), two scarred trees and one grinding groove. However,

only one site was recorded within CBAs 1 and 2 – site ML 205, an isolated find consisting of a single chert flake located on a ridge crest.

6.4 Archaeological Modelling

Models are a heuristic device for understanding a particular subject or issue by relating material observations with theory. Although there are a wide variety of types of models a common characteristic (or requirement) is that they are predictive in nature and be capable of being evaluated in some way (See papers in Chorley and Haggett 1969).

Archaeological modelling provides a framework for understanding the data collected in a given area. A model can be predictive, in that it predicts the likely nature of the archaeological material within a particular area and can also be interpretive, proposing a suggested association between the archaeological record and past human behaviour. Studies which suggest relationships between the material recorded on the ground and choices or activities of people in the past are using some form of model, whether this is explicitly stated or not.

A summary of the models reviewed for this study can be seen in the Table in **Appendix B**.

The existing archaeological models outlined in **Appendix B** have been evaluated partly as a way of understanding the results of previous archaeological work and partly as a way of developing an understanding of the archaeological evidence from the study area. The basis for the evaluation is set out below.

6.4.1 Analytical Framework

In evaluating archaeological models it is important to understand the nature of the evidence used as this will help in deciding whether a particular model is worth considering or not. In general two broad types of evidence are used (usually together) for developing archaeological models

- The archaeological record (any material remains from past human activity)

- Ethnographic information (historical or contemporary evidence of human groups typically hunter-gather groups)

Often some of the 'data' used to create a model will be broad scale general information gathered from a variety of sources. This can be general physiological information, ethnographic data relating to people with similar lifestyles to those being studied or historical recordings of aspects of behaviour of the people within the study region. All of these sources will have some interpretive problems associated with their use. Their application must be carefully thought out if the information is to be useful and to provide workable models.

Scale of the model

Different generalizations about people can be related to different scales of human behaviour, which can then be related to aspects of the archaeological record. For example one model may relate to location of elements within a site while another model may relate to the location of sites within a region or within a catchment. Differing types and levels of data can assist in developing a model. While the purpose of a model is to provide an explanatory framework it also needs to be careful to specify a scale of investigation. Some elements of past behaviour may be evident from one artefact or small areas within a site while others will only be visible on a larger scale requiring multiple sites for their interpretation.

Type of model

As there is such a wide variety of model types it is important to consider what type of model is being discussed. For example, inductive models are based on letting the data suggest the relationships in the models and the power of prediction is therefore limited by the data that is to hand. Another model type is the static model. The best example being a simple map which shows the relationships between things on the map but does not explain the relationships between these things. Dynamic models attempt to show process based on theories about the entities being modeled. Archaeologists, when they embraced model building in the early 1970s looked towards system's theory as a way of modelling human behaviour and models are often expressed in that way. Dynamic models were constructed as deductive models generating testable hypotheses that could be evaluated by the archaeological evidence.

Many of the models in the Hunter Valley combine elements of the static model and the inductive model, being based on the mapping of sites in the environment and based on observations that the mapping produces. Hence, early on the observation that site density is much greater along rivers and streams was made. But the lack of a developed body of theory about settlement patterns has made it difficult for archaeological explanation to move beyond that point.

Predictions and Interpretations Made

The aim of evaluating archaeological models in the Central Lowlands is to help predict where sites may be located in the landscape of the study area. Therefore the predictions and interpretations of each model need to be considered. In general terms there are more similarities between the models than differences. There are two broad areas of focus for the models;

- Distribution of sites across the landscape; and
- Differences between types of sites found (large versus small etc.)

There is also a third scale looking at individual activity areas within sites which is less commonly studied and requires a level of information associated with excavation.

Summary of Models

It is clear that there is a general similarity of settlement models in that the Base Camp/Specialist site distinction is common and base camps are commonly predicted to occur along major watercourses whereas specialist sites are to be found in the upper catchment areas and along ridgelines and crests.

It is notable that all models relate to the last 5000 years and have not attempted to model Aboriginal settlement in the period prior to that time, although Witter (1995) does attempt a reconstruction of the environment back into the Pleistocene.

These models have a common element in that they are based on a rather generic reading of the ethnographic and ethnohistoric record. Witter however makes the point that the ethnographic models archaeologists are very familiar with are from Aboriginal societies studied in depth and these are mainly located in Northern and Central Australia. The ethnohistory for the Hunter Valley is comparatively poor (Witter nd:12, pers com 2002). Whether the subsistence and settlement patterns from two totally different ecosystems can be applied to the Central Lowlands is a question that has not been addressed.

Witter's model comes closer to specifically relating Aboriginal settlement patterns to the archaeological record although his model is based on a number of assumptions that do require evaluation, specifically the notion of substantial emphasis on kangaroo hunting in Aboriginal society. However his model does make some specific predictions, which with consideration of Koettig's model for campsites can be evaluated by survey results and ultimately excavation.

However the work of Dean-Jones and Mitchell (1992) is important in challenging the assumption of a one to one relationship between Aboriginal behaviour and the archaeological record. Open sites are clearly subject to bio-turbation and erosion and are arguably not "in-situ". Such a problem has been investigated by Holdaway *et al.* (1999) for open sites in Sturt National Park. An approach avoiding the concept of site and focusing on the individual artefact was used to determine how individual artefacts on a lagged landform were interrelated was developed and trialled in the project. While this is a promising approach, it is not clear how practical it might be as the authors avoid interpreting their results in a conventional ethnographically based framework.

The current study therefore follows the Witter (1995) model of Base Camps and Satellite Camps, as it seems to be at the heart of most other models while specifically explaining the technological and ecological aspects of the patterning.

6.4.2 Predictive Modelling

Using the range of studies conducted in the region a series of predictions can be made about the nature of the likely archaeological resource within the study area.

The majority of sites throughout the Hunter Valley date to the Holocene period, and sites within the study area are not expected to date beyond the past 5000 years. Although Pleistocene sites are known to occur in the Hunter Valley landscape, such sites are limited in the region and are unlikely to be located.

Occupation Sites

Occupation sites are the dominant type of site known throughout the Central Lowlands of the Hunter Valley (Hughes 1984), and are therefore expected to be the most common site type within the study area. Occupation sites consist of the archaeological evidence of camp sites or sites where the manufacture or maintenance of tools was carried out. They commonly consist of surface artefact deposits (artefact scatters and isolated finds), but can also include shelters with deposits and middens. Due to the geology and topography of the study area, no middens or shelters with deposits are expected.

Occupation sites have been found across all landform types, and in a wide variety of soil, slope and terrain types, as demonstrated by many archaeological studies throughout the Hunter Valley (Kuskie 2000a). However, this broad patterning can be further refined as the majority of known Indigenous sites throughout the area have been found in association with main watercourses (Kuskie 2001a). Sites are therefore often found in high densities along stream valleys and creek banks, and are generally no more than 50m beyond a water source. Within the study area, this corresponds with LFU 3 (lower order streams), LFU 4 (upper order streams) and LFU 2 (hillslopes).

Site distribution and artefact density seems to diminish with the distance removed from a water source, and as land rises into hills and ridges. Known sites found within hillslopes, ridges and crests are mainly small sites or isolated artefacts (Davidson *et al.* 1993). However, archaeologists are cautious about the meaning of this distribution as visibility is often reduced with an increased landscape height (primarily due to vegetation) and as survey has often focussed on watercourses in lower terrain units. In addition,

Dyall (1977) identified that an increase in artefactual deposits within lower landform units may actually be the result of post-depositional processes, such as sheetwash, that naturally moves archaeological material down the slope.

The stone material utilised is expected to reflect local stone resources and availability. From previous archaeological studies (e.g., Dyall 1980 and Kuskie 2000a), the main artefactual materials expected in the study area are indurated mudstone and silcrete.

Other features are sometimes associated with occupation sites, such as hearths that may have been used for food preparation, warmth and as stone heat treatment pits to improve the flaking properties of the raw stone material. These most often consist of an organised cluster of stones usually less than 1 metre in diameter and most commonly associated with charcoal or ash. These types of features could occur in the current study area.

Knapping Floors

Knapping floors are a particular feature of many Hunter Valley archaeological sites. This site type has been delineated from the above discussed as although knapping floors are most likely associated with occupation sites, the two are not mutually exclusive and knapping floors can occur in isolation.

In their most basic form, knapping floors can consist of a concentration of artefacts at a single location, the result of the production of stone tool artefacts. The number of artefacts has been known to vary between less than 100 to more than 2000. These sites usually contain a variety of artefacts, including the debitage from each stage of the reduction sequence and artefacts such as backed blades, used and retouched tools, hammerstones, anvils and manuports. Artefacts will most likely been produced from a number of raw materials, not all of which are necessarily available in that location. Artefact distribution will most likely be concentrated around the perimeter of the knapping floor, although there may be multiple knapping floors and these may overlap spatially (Maunsell McIntyre Pty. Ltd. 2000).

These are potentially very significant sites in enabling archaeologists to understand the reduction sequence of the site. Conjoin analysis may be attempted when all stages of the reduction process are represented at the site, through the refitting of artefacts produced from a single knapping event. This enables archaeologists to research behavioral strategies employed in the manufacture of stone tools.

Grinding Grooves

Grinding grooves are formed during the manufacture of ground edged tools, and are formed by the repeated rubbing of an axe blank on the stone to obtain a sharp edge while using the water as a lubricant. Grooves can be found in isolation or in multiple numbers, and can range from one groove to “several hundred” (Koettig 1996b), which probably reflect upon the number of times a particular location was visited and/or the suitability of the rock for the sharpening of axes. They are found in ‘suitable’ sandstone areas, which consist of a fine-grained homogenous material with an accessible water source nearby. Grinding grooves are often therefore found in direct association with creek lines, although they can also occur near holes in rock outcrops below seepage areas or beneath drip lines in shelters.

Grinding grooves are not expected within the study area, as although a number of lower order streams are located within the proposed extension, they do not exhibit the sandstone exposures associated with these site types. Additionally, no shelters or suitable stone outcrops are found throughout the remaining study area.

Scarred / Carved Trees

These sites normally consist of a carved motif on the exposed wood of a tree, caused by the removal of the bark that surrounds the motif. They are generally symmetrical, are regular in outline and regrowth and do not extend to the ground. The bark was utilised for a variety of purposes, including the construction of canoes, containers, boomerangs, or shields. They are most likely to be found on large, mature trees over 100 years in age. They are generally associated with high-ground ceremonial sites or burials, and are therefore more likely in higher landform units.

As tree scars can also have natural origins, the following criteria are generally accepted to identify a scarred tree with Indigenous origins (Maunsell McIntyre Pty. Ltd. 2000):

- **Shape and Location.** Scars are most often rounded and symmetrical in shape, elongated or rectangular in outline. Regrowth around the scar should be even, suggesting deliberate removal. The scar should occur above the base of the tree, at a height consistent with an adult person removing the bark.

- **Associated Axe Marks.** The use of stone tools to remove bark should produce bruised, blunt edged lines on the trunk surface around the edge of the scar. However, steel axes may have been used throughout the period since European occupation, which produce a much sharper line.

- **Age of Tree.** Tree must be old enough to have an adequate girth at the period when the bark was removed, being at least (usually) 150 years old. In areas of intensive later settlement, specifically European, the likelihood of scarred trees is reduced by widespread land clearance.

Although much of the study area has been cleared throughout the past two centuries, scarred trees may have survived throughout the landscape. These site types can be found across all landform units, therefore their distribution cannot be predicted.

Art Sites

This broad category encompasses a number of potential art sites, such as shelters with art and rock engravings. Art sites can be found across all topographic units, such as exposed rock ledges and shelters. These sites can range from single figures to large, complex sites that contain a wide variety of motifs.

Although there are numerous stone outcrops throughout the study area, they do not form the overhangs or platforms characteristically associated with this site type. It is therefore unlikely that art sites will be found within the study area.

Other Site Types

Quarries are sites that testify to the extraction of natural stone deposits in the landscape, and are consistently located in immediate association with stone outcrops. In a more specific definition, a lithic quarry refers to outcrops of bedrock where there is clear evidence of procurement activity such as pits, discarded hammerstones and large deposits of primary flaking debris. Due to the relatively limited stone deposits within the study area, quarry sites are not likely to be observed during the survey. However, as evidence of lithic exploitation can be as little as pebbles or cobbles that may derive from decomposed conglomerate rock or alluvial gravels, such sites may be found.

Stone arrangements are relatively rare sites, but may be potentially found in any landform unit. They can take on a number of different forms, and can range from simple mounds to complex ceremonial areas. Stone arrangements may be practical (ie, hunting hides and fish traps) or ceremonial (ie, initiation). The most common stone arrangement consists of stones in patterns, such as semi-circles and circles, pathways and lines. Stone arrangements have been identified in the Central Lowlands area, and may therefore be potential sites although their distribution may vary.

Burials are not common archaeological sites, but may be potentially found in any landform unit. A number of methods were used to bury the dead, which varied between areas and groups of people. Burials have been found in a variety of contexts: in deposits, in middens and in the open, and may be marked by stone arrangements, carved trees and other features. However, Kuskie (2000) notes that human remains tend to be placed in hollow trees, caves or sand deposits. Burials are relatively rare sites and are not commonly expected, but the recent discovery of a skeleton at Mount Arthur North (as yet unpublished) indicates that burials can occur in the local area.

Contact sites are also potentially found within the area due to the relatively long non-indigenous habitation of this area (post-1820s). These sites contain evidence of Aboriginal occupation concurrent with non-Indigenous settlement, such as missions, post-contact burials, massacre sites and other sites of significance to the post contact history of the Aboriginal inhabitants of an area. Other sites are often evidenced by the presence of non-Indigenous material within what is clearly an Aboriginal site, such as flaked glass found within a stone artefact scatter. Given the relatively long occupation, such sites could occur within the survey area.

6.4.3 Muswellbrook Coal Mine

The development of a series of predictive statements to the study area involves the application of Witter's Base Camp/Satellite Camp model, the known archaeological patterning and the landscape of the study area. The following predictions have been based on this context, and outline the likely site types and distributions expected:

- Occupation sites are expected to be the main site type throughout the study area. These sites are expected to represent the specialist satellite camps of the occupation model developed for the Hunter Valley, as the topography of the study area is located within a higher terrain that lacks permanent watercourses.

- These sites are theoretically expected in all landform units; creek lines, terraces and flats, upper and lower hillslopes, and ridge crests. However, sites are also predicted to be concentrated within 50m of a watercourse (LFUs 4 and 5 within the study area).

- Sites in association with upper order watercourses will be larger and more complex. As all watercourses within the study area are lower order drainage depressions, no large and complex sites are expected.

- Few sites are expected in the along the northeast hillslopes (LFU 3) and drainage lines (LFU 5) of the study area, due to the high level of erosion. In this area, artefactual material may be expected on ridge crests or in the base of drainage channels as a result of erosion.

- As a result, sites are most likely to occur in the gentler hillslopes and ridges occupying the west of the study area, in close association with watercourses.

- Sites will most likely consist of stone artefacts, found in small, low-density assemblages. Indurated mudstone and silcrete are expected to be the main raw materials utilised. As specialist satellite camps, the majority of artefacts are expected to be artefact types and cores, with minimal amounts of debitage.

- Potential site types, not discounted due to later disturbance, may include:
    - Scarred or carved trees; and
    - Stone arrangements.

- The following site types are not expected due to the topography of the study area and the level of subsequent disturbance.
    - Grinding grooves;
    - Art sites;
    - Middens; and
    - Quarries.

- Those areas highly disturbed from mining activity, residential development and pastoralism are not likely to contain archaeological evidence.

Due to the elevation and topography of the proposed extension, it is considered that the archaeology of the area will most likely reflect its use for specialist satellite camps rather than intensively occupied base camps.

However, the occupation model presented in this report has been primarily derived from archaeological research in lower terrain areas of the Central Lowlands. Archaeological studies of higher terrain areas within the landscape have been relatively limited, as discussed in **Section 5.1**, and by extension have contributed little to the development of archaeological models of Hunter Valley occupation. Although the general tenets of these models have been accepted and applied in studies of higher terrain areas, further work is required to adequately assess the archaeological patterning of occupation in higher landscape areas. The analysis of the survey results in light of the proposed model will need to examine the effective application of the model in high landscape areas.

7.0 ARCHAEOLOGICAL CONTEXT – NON-INDIGENOUS

7.1 Hunter Valley Research

Numerous studies have examined the non-Indigenous heritage of the Hunter Valley. A number of studies among this large body of work include Wood (1972), Margan (1973), Mitchell (1973), Armstrong (1983), and Branagan and Diessel. (1993). The majority of this work has entailed historical accounts of early European settlement of the Hunter Valley, and the development of the region based on research into primary historical resources such as letters and diaries. Much attention has also been paid to the family history of the region, with many genealogical societies founded throughout the area. A number of studies have also been conducted about specific themes and/or areas in the history of the region, such as coal mining (Booker 1953, Branagan 1972, Energy Authority of New South Wales 1981).

The Muswellbrook area has also been subject to a number of historical reviews, such as by Turner (1995), Magee (1984), McCalden (1968), and Muswellbrook & Upper Hunter Historical Society (1981, 1991). These studies have primarily examined the pastoral, urban and industrial development of the region since European arrival, in a broader Hunter Valley context.

The focus of historical archaeological research within the region has been heavily influenced by the increasing need for conservation on older buildings and areas within the Hunter Valley. With the growing recognised need to maintain and conserve early European buildings and areas has spawned an industry that relies upon archaeological and historical assessments. As employed in the conservation process, archaeological research has tended to focus on extant structures rather than broader areas. As a result, architectural studies by historical archaeologists have been highlighted as an important area.

7.2 Research Themes

The development of Muswellbrook throughout the past two centuries is broadly reflective of the history of the local region, with common heritage themes found throughout the Hunter Valley. Additionally, these themes are generally reflective of the broader themes in historical archaeology. The NSW Heritage Office has defined a number of themes, at both a national and state level, that reflect these broader themes. The issues discussed below are those among this list that are directly relevant to the development of the Muswellbrook area.

- Towns, suburbs and villages
- Agriculture and pastoralism
- Transport
- Industry

These will be briefly outlined below, to delineate the potential archaeological material within the development area. Greater attention will be paid to the known activities associated with the study area – specifically coal mining and to a lessor extent, pastoralism and agricultural cultivation.

Towns, Suburbs and Villages

Muswellbrook, originally spelt Musclebrook after the nearby creek, was founded in 1833 with Surveyor Robert Dixon defining the town plan. This was based on a reserve already set aside for a government village, and applied principles established by Governor Darling (Government Order No. 28, 30 May 1829). It was designed to provide a rectilinear grid with allotments of half an acre, but surveyors were

allowed to make adjustments according to the terrain. At Muswellbrook, the surveyor also included larger cultivation lots and reserved land between the river and town for pastoral movements.

The first blocks of the town were sold in 1834, and the first houses erected shortly after. Muswellbrook was placed in a central location between the two other emerging towns of Merton and Invermein (Scone). The town grew steadily, so that by 1842, a new subdivision of the settlement was opened to the south of the river and called Forbestown. Within 10 months, this subdivision contained more than 40 houses. Forbestown was incorporated into the town of Muswellbrook in 1848.

The town grew steadily throughout the nineteenth century, as outlined by the demographic growth in **Table 7** below. The construction of the settlement's flourmill (1841) reflects upon the early importance of wheat in the community, with wool also a major economic factor. The coming of the railway (1869) furthered this process with the towns' economy and status as a regional centre boosted.

TABLE 7 - DEMOGRAPHIC GROWTH, MUSWELLBROOK	
YEAR	**POPULATION**
1840	215
1870	1445
1881	1074
1891	1298
1901	1710
1911	1895

Agriculture and Pastoralism

The agricultural and pastoral industries of the Hunter Valley are closely related through the development of the region, through the associated requirements for water, adequate stock feed (grasses) and fertiliser for agriculture.

Agricultural cultivation was among the first activities of the European settlers in the region, as it was required to sustain the settlers. This entailed the early development of crops (primarily wheat), orchards, vineyards and vegetable production. Associated industries were quick to develop from this, such as the flour milling and threshing needed to process wheat. However, it soon became apparent that areas of the Hunter Valley, particularly the lower regions such as Muswellbrook, were not suited to wheat crops as they frequently were prone to disease "rust". In response, barley became a preferred crop and the wheat-associated industries such as the flourmills were made redundant.

The development of the Hunter Valley wine industry also dates to this early period, with an early thrust in the 1820s and 1830s for vineyard cultivation. This led to the development of early vineyard estates, although none were large or extensive. Winemaking was re-energized in the 1960s with the development of the modern industry.

Agricultural cultivation has continued as a major economic factor of the area, being the dominant land use activity, specifically around the fertile lands of the Hunter River.

The expansion of settlement throughout the Valley also entailed the expansion of pastoral activity. By the 1820s, grazing had reached the Goulburn and Hunter Rivers. Pastoralism was a focal activity of early settlement in the Hunter Valley, as reflected in an 1828 census. This indicates that the majority of

properties were pastoral in nature, and that virtually all of the larger estates were pastoral rather than agricultural lands.

Cattle-grazing was more popular than the sheep industry throughout the area (Kovac and Lawrie 1991). Traditionally, this was relegated to less productive areas of land, but this changed as the industry gained in value. As an extension of this industry, dairying developed as an important activity in the Muswellbrook area. This was concentrated on the alluvial flats and terraces between Scone, Gundy and Muswellbrook, due to the higher quality pasture land in these areas. A number of dairies were established in the area by the early 1900s, in response to the advances in refrigeration technology. This pastoral growth led to the local development of manufacturing facilities, such as tanneries and meat freezing centres (Turner 1995).

Although sheep grazing has traditionally been of lower significance in the area an industry developed early for the breeding of thoroughbred horses. At Muswellbrook, horse breeding was known by 1833 by Peter McIntyre at "Kayuga". As the earliest properties were generally unfenced, stock had to be guarded, and to maintain control stock were usually kept in small herds.

Transport

The development of a transport network was essential to the development of the above industries, through enabling the movement of economic products. The pastoral need for stock routes was particularly an influential factor to the development of roads due to the difficulty of transporting stock by ship.

In Muswellbrook, roads were the most important means of transport until 1869 when the Great Northern Railway reached the town (Turner 1995). The essential roads for Muswellbrook were those linking it to Sydney, the east coast, to the west and northwest. Within the Muswellbrook area, the main difficulty facing road construction was the Hunter River and its tributaries. However, even in this era, roads continued to be focal in the movement of goods between the producer and railway station. The line to Muswellbrook greatly improved communications with the lower Valley as well as boosting the local economy.

Since the 1970s, the expansion of coal mining in the Muswellbrook area has also involved the development of conveyor belt transportation and motor vehicles as well as railway transport.

Industry

The earliest industries in the Muswellbrook area were agricultural cultivation and pastoral exploitation. Wool and wheat were the major economic supports of the Muswellbrook community until the twentieth century development of the large-scale power and coal industries.

However, other significant industries developed included milling, textiles and meat preservation. Especially in the period following the First World War, many of the larger rural properties were broken into smaller farms and dairying replaced wool and wheat as the main rural industry. This trend continued till the late 1970s.

However, it was the development of the power and mining industries that defined the area. Mining activity has largely focussed on coal exploitation (discussed separately below), but gold and limestone have also been exploited. The 1950s witnessed an establishment of a number of large-scale power operations in the Upper Hunter, an industry that is closely related to the contemporary development of large-scale mining operations in the area. Through the need for an intensive power supply, a number of

collieries were opened throughout the Muswellbrook region such as Liddell, Foybrook and Liddell State. In 1964, construction began on the Liddell Power Station 8kms to the south of Muswellbrook. The station was fully operation by 1972 and had a dramatic impact on the area through employment, housing and commerce.

The discovery of coal in New South Wales dates from 1797, with simultaneous discoveries in the Southern Coalfield to the south of Wollongong and in the Hunter Valley near Newcastle (Pittman 1912). These early discoveries led to the development of an extensive coal industry in the state, especially in the Hunter Valley that was soon recognised for its coal producing potential. By the late nineteenth century, a period of intensive coal mining had begun in the Hunter Valley.

Early coal exploitation centred around the Newcastle area, so that by 1889, 18 new collieries were being developed (Davies 1993). Exploitation in the Muswellbrook area was slower to develop, with coal only being discovered in 1907 through the construction of a well (Turner 1995). Small tonnages of coal, however, were also being mined from near Muswellbrook as early as 1870, through the earliest mining operations in the local area such as the Kayuga Colliery on Coal Creek Road (founded 1894). This later expanded in 1906 to become the Kayuga Coal Mining Company.

The discovery of coal in the Muswellbrook district dates to the 1860s, with a small seam uncovered to the south of Muswellbrook by the construction of the rail line (McDonald 1990). However, until the formation of the Muswellbrook Coal Company Ltd, coal exploitation in the local area was limited. The coal deposit exploited by MCC throughout its history was also discovered by chance in 1907, when water boring operations in the town common exposed underlying coal of the Greta Coal Measures. The company was founded with the successful mining lease taken by H.N. Jeans, and the beginning of operations in the No. 1 Colliery, that same year (Turner 1995). Early operations focussed on the No. 1 Underground, underground mining activity that was accessed from shafts remote to the study area. Coal was extracted from the Lewis, St Heliers and Muswellbrook Seams. In 1933, the company merged with the St Heliers Coal Company Ltd, which was exploiting a seam discovered by J. Loader in 1923. The resultant operation became the No. 2 Muswellbrook Open Cut.

The Muswellbrook No. 1 Open Cut, the extension of which this report is interested, was mined from 1944 to 1970. Located adjacent the study area to the west, the open pit enabled coal to be extracted from the Loder, Lewis, St Heliers and Muswellbrook Seams. By June 1945, production at the open cut had reached 1350 tons. Total production figures for the company at this time was 200 tons daily. However, within nine months, the open cut had produced 150,000 tons and by November 1945, it alone had produced 206,521 tons of coal (McDonald 1990).

The extent of the pit was considerably beyond the current pit limits, as peripheral areas have since been backfilled in the western and southwestern sections of the mine (Douglas Partners Pty Limited 1997).

During the 1930s, the Depression had economic repercussions for the Greta Coal collieries, as it did across the entire coal industry throughout NSW. Although there was a partial revival during WWII, the decade from 1955 to 1965 saw the further decline of the older collieries through industrial problems, industry reorganisation, mechanization and the lack of markets (Davies 1993). However, MCC defied these trends to open a third colliery in 1944, which at the time was the largest open cut coal mine in Australia with a yield of 9,000,000 tonnes of coal from three seams (Turner 1995). However, it was not until the 1940s, when stimulated by World War II, that the mine developed as an important coalfield (Booker 1953).

Open pit mining is not a twentieth century innovation, being utilised much earlier (BC). However, progress in pit mining technology was exceedingly slow and changes throughout the centuries were limited to minor changes in manually operated simple mechanical tools. Extraction methods for coal mining remained relatively basic until the mid-twentieth century, utilising either steam or hand power. Hand mining methods required the "grunching" (drilling and blasting) with hand filling and wheeling in 15 cwt skips followed by a combination of horse haulage and ropeways. In steep seams, the main tunnels were driven to a depth of 2200 feet at a dip of c. 40°, with levels every 60 yards. Haulage of coal to the surface was by rope (endless or main and tail) haulage in tunnels, and cage hoisting through steeply inclined tunnels or vertical shafts. Timber supports were used throughout (Davies 1993).

Mechanization of mining methods continued at a relatively slow pace, but steam was utilised as early as 1890 and was the preferred power source by the early 1900s, although hand methods were still standard (Davies 1993). Many of the older NSW collieries made the transition to steam in the mid-twentieth century , such as Abermain No. 2 (1938) the first to complete a major mechanization programme (Davies 1993). The onset of real open pit mining was in the early twentieth century (1904-07) period when new techniques were pioneered in Utah, such as the replacement of the original churn drills with larger and heavier rotary rigs (Crawford and Hustrulid 1979) Blasting practices similarly evolved from hand-loaded and tamped holes, to mechanised loading and shooting of slurry explosives. Waste haulage also went through a similar development, with the adaptation of modern transport innovations. However, there have been no basic changes in the fundamentals of early manual pit design methods.

The MCC operations mine coal of the Great Coal Measures, which is found in limited incidence around Muswellbrook. This Measure consists of a mixture of fine conglomerate sandstone, clay shale, coal seams and bands of ironstone and dates to the early middle Permian Age (Davies 1993). It ranges from 100 to 300 feet in thickness, with the contained coal seams measure a maximum thickness of 34 feet. Apart from the usual geological characteristics of splitting, faulting and dykes, this seam also exhibits the following traits;

- The low ash, high volatiles and a high gas yield make the Greta seam a premium gas making coal which has no equal in Australia;
- It is easily combustible, making it desirable for use in steam engines (railway/ships);
- The steep dips of the seams required steep mining techniques; and
- The high sulphur top coal has a high incidence of spontaneous combustion, which has had a direct influence on extraction techniques.

The No. 1 Open Cut currently mines the Loder Seam utilising highwall auger mining methods, and the extension will involve mining through previous underground workings in most coal seams (Fleming, St Heliers, Muswellbrook and Lewis). Previous mining activity has left up to 55% of the resource intact. MCC currently mines from 6 seams within the Greta Coal Measure – the Fleming, Muswellbrook, St Heliers, Hallett, Upper Lewis and Lower Lewis. These seams exhibit the above range of characteristics, which have had a direct impact on the development of the coal mining industry in Muswellbrook.

7.3 Muswellbrook Coal Company Research

The history of the Muswellbrook Coal Company has also been examined by some recent historical studies (McDonald 1990, McDonald 1999). These two texts outline the chronological development of the Company, within the context of the concurrent development of Muswellbrook and the Hunter Valley.

They also include more personal details and stories of the individuals associated with the Company throughout its development. Although they do not contain large amounts of detailed information about the early development of the study area, the development of the No. 1 and 2 Open Cuts are traced with detail from the 1940s to the present day.

To date there has been no assessment of the non-Indigenous heritage items potentially located within the proposed development limit. However, in order to place the study area in a broader context, a number of relevant heritage studies will be briefly discussed below.

Among the general histories of Muswellbrook are Magee (1984), McCalden (1968), Muswellbrook & Upper Hunter Historical Society (1981, 1991) and Turner (1995). A historical study has also been exclusively devoted to the history of the Muswellbrook Coal Company (McDonald 1999), which details the development of the company from its formation in 1907 to 1997.

However, the most detailed study of the non-Indigenous archaeology of the Muswellbrook area comes from the *Muswellbrook Heritage Study* authored by EJE Group. This document catalogues all identified heritage items of significance within the Muswellbrook Shire, and contains an inventory sheet detailing each feature. This document is the therefore the most useful to any archaeological study of the Muswellbrook Shire as it enables a clear examination of the material evidence of the Shire. There are no identified heritage items of any significance within the study area.

To determine those items protected by commonwealth and state legislation within the Muswellbrook Shire, a search was conducted of the following registers – the Muswellbrook Local Environmental Plan, the NSW State Heritage Register and the Australian National Commission's Register of the National Estate. Within the Shire, as of the 22nd of November 2001, 10 items heritage items are listed under the NSW State Heritage Register, 43 on the Register of the National Estate and 51 on the Muswellbrook LEP. However, none of these items were located within the study area.

7.4 Archaeological Modelling

The below discussion indicates the likely archaeological evidence found within the study area, based in the known heritage activities within and in association to the study area and the common archaeological indicators of this activity. This will address both structural heritage (buildings, infrastructure) and artefactual heritage. The use of the study area has been derived from historical accounts of the region, and also mapped from a series of twentieth century Rowan parish plans.

Pastoralism

Archaeological indicators of pastoralism do not commonly survive later development. Grazing is the primary activity, and is by its very definition a low impact activity that is generally evidenced through fencing and the provision of water supplies (dams). However, the development of associated infrastructure – such as shearing sheds, dips and slaughterhouses - are more likely to be found on heritage sites. It was more economical to conduct these activities on site rather than transport stock animals and/or pastoral by-products, these features are often found on private properties.

Analysis of the twentieth century Rowan Parish plans (1906, 1917, 1923, 1932, 1942, 1968) indicates that throughout the period 1906 to 1942, the study area was been under the private ownership of two individuals - Thomas S. Hall and George Bowman. As area was not mined until the commencement of operations on the No. 1 Open Cut in 1944, it is most likely that prior this time the study area was used as pastoral grazing land, reflecting the dominant Muswellbrook industry. Throughout Muswellbrook's

history cattle was the pastoral focus (through both grazing/meat and later for dairying), it is likely the study area has strong associations with these kinds of pastoralism. The above listed archaeological indicators may therefore be found within the extension area. The 1968 parish plan indicates that the area to the west of the proposed extension was subdivided for the construction of the Muswellbrook Power Station. Otherwise, the property divisions for the study area remain the same, although the landowners are no longer identified. This does not necessarily indicate a transfer in land ownership.

Agricultural Cultivation

Agricultural cultivation sustained the Muswellbrook community for a number of years prior to the twentieth century expansion in coal and power industries. Primary archaeological indicators of agricultural cultivation are rare, due to the impact of later land use or continued cultivation. However, evidence such as 'ridge and furrows' (the mounds resulting from ploughing) are possible. The associated agricultural infrastructure is often more lasting than this form of evidence, and can include flourmills and threshing floors (necessary for wheat processing) that are common archaeological features of heritage sites. These facilities were often localised for economic viability and are therefore expected to be located closer to the town's limits rather than on a private property. However, features such as fences and remnant vegetation (such as orchards, indicated by fruit trees) may be located within the study area.

Domestic Occupation

Prior to the coal mining operations discussed below, the study area may have supported the domestic settlement associated with pastoral and agricultural activity. Material evidence of this would most likely consist of structural evidence of the building (or if demolished, evidence of foundations). Associated features may include: gardens, water supply, electric supply, lavatory or laundry. Artefactual material would most likely be associated with the area, but may not be contained within sub-surface deposits.

Coal Mining

The construction and continued operation of a coalmine, utilising both open cut and underground methodologies, is characterised by a number of features. Primarily, open cut coal mines require the total removal of earth to access the underlying coal seam and are therefore highly visible elements in the landscape. Underground construction may not have a large impact on the ground surface (other than minor movement from subsidence) but will involve surface infrastructure.

The removal of coal requires the use of heavy machinery, which will be housed close to the mine site. Roads or rail lines need to be constructed to move the large amount of earth and coal removed from the ground. Water and power supplies need to be acquired for the mine, most likely evidenced through dams and water pipes. Amenities need to be provided for the mine staff, and this may even involve the construction of a 'mine village' for staff. Processing areas are also required to extract the coal from the other materials of the seam.

However, it must be recognised that the onset to open cut mining activity may have obliterated any potential archaeological evidence of pastoralism, agricultural cultivation and domestic construction.

Based on the above information, a series of statements can be made about the most likely heritage items and/or areas expected within the study area:

- Pastoralism (specifically cattle) was most likely the dominant activity in the area until the development of coal mining. This would be evidenced through dams, fences and stockyards. The distribution of these feature types do not confirm to an established pattern.

- Coal mining activity in the area was primarily restricted to underground operations. No access points or built infrastructure were located within the study area, so little evidence (beyond subsidence) will be found of underground mining in this area.

- The development of the No. 1 Open Cut will define the western portion of the area but associated infrastructure will not generally extend into the study area. Only mine access roads are predicted to occur within the development area.

- The relatively low scale of mining impact in the area indicates that archaeological material of pastoralism in the area may be extant within the landscape. Therefore, material evidence may be located.

- Evidence of early domestic occupation may be located within the study area. As this is presumably related to pastoral activity, domestic structures of estate holders and/or estate workers are potential heritage items. Associated material evidence – such as water supply, sewerage, gardens and artefactual material may be found.

8.0 SURVEY METHODOLOGY

Similar methodologies were employed for both the Indigenous and non-Indigenous archaeological assessments, as outlined below. Where different strategies were employed, these are clearly identified.

Background archaeological, historical and environmental information was compiled for the report prior to the field survey, to enable an understanding of the potential archaeological resources of the area, and the probable impacts from subsequent environmental and human activity. The known Indigenous and non-Indigenous sites of the area were identified through search agencies, as previously discussed. Where available, detailed information was gathered for each relevant site within the local area.

Based on this information, a series of maps were produced for reference in the field that identified relevant sites, landform units and the development area. All known Indigenous sites within the local area were mapped, to enable a site distribution analysis. Detailed maps of the proposed development were also obtained from MCC.

The different methodologies employed in the survey – for ground-truthing, the survey for archaeological sites, and the assessment of archaeological potential – are outlined below.

8.1 Ground Truthing

Previous archaeological surveys of the study area were compiled and a catalogue of all known archaeological sites within the immediate area developed. From this catalogue, Indigenous and non-Indigenous sites within the study area were delineated. Detailed information was obtained for each site, such as site type, location, environmental context and content. Previous significance assessments, where available, were also determined.

Information on each known archaeological site within the study area was taken into the field for verification. Each site was located and recording details such as site type, positioning and content were inspected in the field for accuracy in the original recording. Any inaccuracies in the extant records were noted and amended.

The primary limitation of this form of archaeological survey is the quality of existing site data, as brief or inaccurate extant recordings may make site relocation difficult. This is particularly applicable to the relocation of Indigenous sites, as many of the Indigenous sites listed with the NPWS in the area were located prior to 1980. Records before this date are often poor in quality and contain only minimal information about site location and content, making relocation difficult. The existing records for non-Indigenous heritage items for this area are of relatively high quality and the relocation of known heritage items and sites in the field was not problematic.

A number of heritage database searches were conducted to identify the known heritage of the study area, as outlined below.

8.1.1 Heritage Database Searches

The known archaeological sites and heritage items of the study area were identified through searches of the relevant heritage databases, which included:

- Aboriginal Sites Register (NSW National Parks and Wildlife Service),
- Register of the National Estate (Australian Heritage Commission),

- State Heritage Register (NSW Heritage Commission),
- Hunter Valley Regional Environmental Heritage Schedule (Muswellbrook Shire Council), and
- Muswellbrook Shire Heritage Register (Muswellbrook Shire Council).

The results of these searches are outlined below.

8.1.1.1 NSW National Parks and Wildlife Service Register Search

A search of the NSW National Parks and Wildlife's Aboriginal Sites Register was conducted on the 7th of November 2001. This was undertaken to identify any known archaeological sites within the development area and also to examine the archaeological patterning of site distribution and types in the local landscape. The search therefore centred on the area of the proposed development, but also incorporated the surrounding area to enable broader perspective on the archaeology of the area. The search parameters were as follows: Area Zone 56: Eastings: 301000 - 307000, Northings: 6426000 - 6432000. Eleven sites were listed as occurring within the above co-ordinates, as listed in **Table 8** and illustrated in **Figure 4**.

Further research into the previous surveys within and adjacent to the study area also indicated that a number of known sites are not yet registered with NPWS. The sites surveyed by Stuart (1996) - MB-2 to MB-16, and MC-1 to MC-4 – are not in the NPWS register, nor is the site recorded by Rheinberger (1998) - ML 205. These sites have been added to the below table and are also illustrated in **Figure 4**.

TABLE 8 – NPWS SEARCH RESULTS

NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE	LANDFORM UNIT
37-2-1841	*NA*	306850	6431320	*NA*	*NA*
37-2-1845	*NA*	306500	6428820	*NA*	*NA*
37-2-1454	NH 1	306050	6426350	Isolated Find	Footslope
37-2-1455	NH 2	306190	6426329	Artefact Scatter	Footslope
37-2-1456	NH 3	306180	6426348	Artefact Scatter	Footslope
37-2-1457	NH 4	306600	6426300	Isolated Find	Footslope
37-2-1458	NH 5	306600	6426100	Isolated Find	Footslope
37-2-0160	Black Hill, Gyarran	304050	6426150	Open Camp	Hillslope
37-2-0104	Bimbadeen / Muswellbrook	*305182*	*6430193*	Scarred Tree	Hillslope
37-2-0139	Muscle Creek	305830	6426500	Open Camp	Gully bank
37-2-0158	Flower Gardens Flat	303570	6427180	Open Camp	
	MB-2	305840	6426500	Isolated Find	Valley bottom
	MB-3	305880	6426560	Isolated Find	Valley bottom
	MB-4	305900	6426600	Artefact Scatter	Valley bottom
	MB-5	305880	6426620	Isolated Find	Valley bottom
	MB-6	305870	6426660	Isolated Find	Valley bottom
	MB-7	305780	6427140	Isolated Find	Valley bottom
	MB-8	305780	6427140	Isolated Find	Valley bottom
	MB-9	305820	6427900	Artefact Scatter	Valley bottom
	MB-10	305880	6427980	Isolated Find	Valley bottom
	MB-11	305950	6427980	Artefact Scatter	Valley bottom
	MB-12	305980	6428060	Isolated Find	Valley bottom

TABLE 8 – NPWS SEARCH RESULTS					
NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE	LANDFORM UNIT
	MB-13	305980	6428060	Isolated Find	Valley bottom
	MB-14	306000	6428100	Artefact Scatter	Valley bottom
	MB-15	306060	6428120	Isolated Find	Valley bottom
	MB-16	306150	6428320	Isolated Find	Valley bottom
	MC-1	305320	6432150	Isolated Find	Ridge crest
	MC-2	*NA*	NA	Isolated Find	Ridge crest
	MC-3	304770	6433900	Artefact Scatter	Creek flats
	MC-4	305050	6433900	Isolated Find	Hillslope
	ML 205	306220	6429630	Isolated Find	Ridge crest

Examination of the site cards indicated that only one of the above sites is located within the study area, as identified below.

TABLE 9 – KNOWN INDIGENOUS SITES WITHIN STUDY AREA					
NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE	LANDFORM UNIT
37-2-0104	Bimbadeen / Muswellbrook	*305182*	*6430193*	Scarred Tree	Hillslope

The current NPWS site record for 37-2-0104 is inaccurate in the location of the site. Originally, plotting of the site was done on the basis of the NPWS grid references, which placed the tree well beyond the limits of the study area. However, examination of the original survey (Brayshaw 1981a) indicated that the site is actually located within the development area, 40m to the east of the original No. 1 Open Cut, within the hillslope landform unit. Survey did not extend into this area, as it was defined by MCC as an unsafe distance to approach the No. 1 Open Cut highwall. Although the site was not therefore verified in this survey, it is to be considered in the assessment of the extension area.

The sites detailed in **Table 8** indicate that the most common landform unit for registered sites are valley banks (54%), then followed by footslope (18%). The most common form of site type registered are isolated finds (63%), second most common was artefact scatters (24%). The most common kind of site and landform unit from the register and research results was isolated finds on valley banks (35%), followed by artefact scatters on valley banks (12%).

These results may not reflect what kinds of sites will be found during this survey due to different kinds of recording bias. Sites registered may represent a minor percentage of the archaeological resources of the area, due to the limited number of surveys in the area and their relatively restricted coverage across all landform units beyond watercourses. This general focus on watercourses has furthered the stereotype that such features are focal in Indigenous occupation of the Hunter Valley, persistently undervaluing the use of other kinds of landscape unit. For example, higher slopes and ridges were strategically vital for Indigenous owners so they could see out over their country and observe their neighbours (e.g. warfare) and environment (bushfires, storms). Additional biases include the visibility of sites and relics during surveys, often increasing along creek lines and lower terrain areas due to increased erosion processes. These erosion processes are also capable of moving archaeological materials from higher to lower landform units, mainly through water movement. Creeklines and lower terrain areas are also often more accessible during pedestrian survey than steeper slopes and ridges. Although creek lines are commonly

regarded as areas of higher archaeological potential, archaeologists must recognise that these forces have impacted upon site patterning as understood today and that other landform units are also of a high archaeological potential.

These biases and results will be evaluated further in the predictive modelling of Indigenous occupation for the study area in **Section 5.3.**

8.1.1.2 Register of the National Estate

The Register of the National Estate, a heritage database operated by the Australian Heritage Commission, was searched on the 22nd of November 2001. No items were identified within or in close proximity to the study area.

8.1.1.3 NSW State Heritage Register

The State Heritage Register, a heritage database operated by the NSW Heritage Commission, was searched on the 22nd of November 2001. No items were identified within or in close proximity to the study area.

8.1.1.4 Regional Environmental Heritage Schedule

The Hunter Valley Regional Environmental Heritage Schedule, a database that identifies heritage items within all shires of the Hunter Valley, was searched on the 22nd of November 2001. One item was identified as located in close proximity to the study area, as identified below.

TABLE 10 – REGIONAL ENVIRONMENTAL HERITAGE SCHEDULE		
ITEM NO*	**ITEM NAME**	**LOCATION**
MUSW/ R030	Muswellbrook Brickworks	Off Coal Road, Muswellbrook

** Item No. derived from the Muswellbrook Heritage Study Inventory (1996).*

The Consent authority for this item is the Muswellbrook Shire Council.

8.1.1.5 Muswellbrook Shire Heritage Register

The Muswellbrook Shire Heritage Register, a database that identifies heritage items within the Muswellbrook Shire, was searched on the 22nd of November 2001. One item was identified as located in close proximity to the study area, as identified below.

TABLE 11 – MUSWELLBROOK SHIRE HERITAGE REGISTER		
ITEM NO*	**ITEM NAME**	**LOCATION**
MUSW/ R030	Muswellbrook Brickworks	Off Coal Road, Muswellbrook

** Item No. derived from the Muswellbrook Heritage Study Inventory (1996).*

The Consent authority for this item is the Muswellbrook Shire Council.

8.2 Archaeological Site Survey

The field survey also aimed to record any additional archaeological sites and/or relics.

The concept of an 'archaeological site' is complex, particularly for Indigenous sites. As defined in **Appendix F**, an archaeological site "*…is any location that contains evidence of human activity*". However, in the study of Indigenous archaeology in particular, it has been recognised that the entire landscape has the potential to contain artefacts and that a spatial definition of 'sites' can often be simply a product of visibility and exposure. Artefacts are therefore often recorded in terms of discrete 'sites', where concentrations of artefactual material are observed. This report has maintained this terminology, throughout the allocation of different site numbers between areas separated by some distance (usually between 100-200 metres) or when a spatial distance between artefacts corresponded to a change in landform.

Relics, as defined in **Appendix F**, a relic is defined as meaning any deposit, object or material evidence which relates to the settlement of the area that comprises New South Wales (not being Aboriginal settlement), and which is 50 or more years old. Relics can therefore consist of domestic structures, railway culverts, stone walls, ploughed fields and so on. As there is no formal register of "relics" held by the NSW Heritage Office, there may be additional heritage items within the study area than are known from the database searches conducted above.

Where the field survey located any archaeological material, a number of methods were used in the field to recording information, including photography, standardised recording forms and field notes. During the survey, notes were taken on the relevant details of the sites and heritage items, including the land use of the study area, the degree of disturbance, visibility and exposure conditions and landform types. For the recording of Indigenous sites, the standard NSW National Parks and Wildlife Service Site Record Forms were used during the survey (as found in **Appendix D**).

The aim of this methodology was to produce sufficient information to assess the significance of each site and identify potential for further work. It was recognised as not possible to record all the data relating to even one site within the study area, as this is a long and involved process, and therefore recording was designed to produce a comprehensive record of the field study while identifying specific locations and general areas requiring additional research.

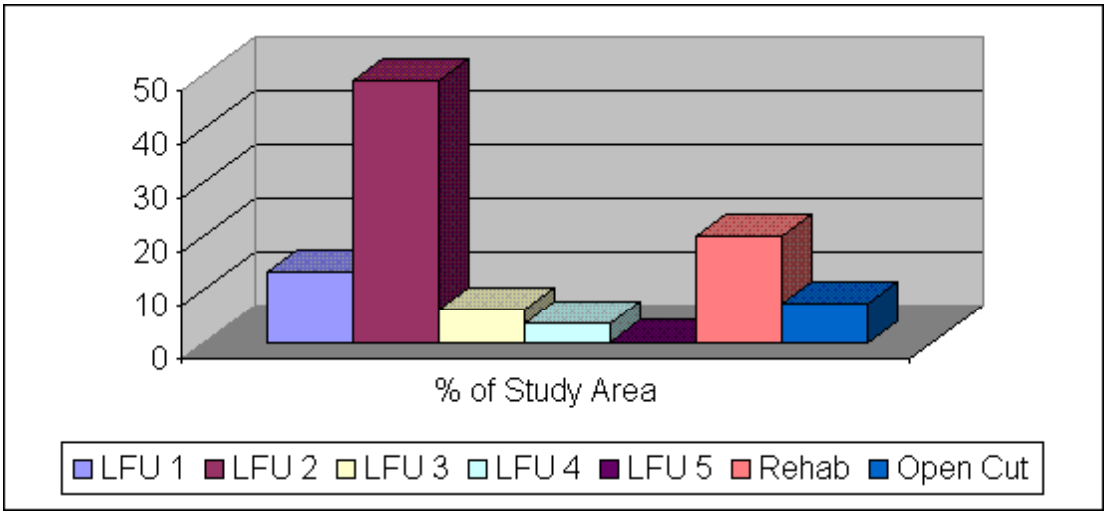
8.2.1 Survey Strategy

The field investigations were restricted to the area of proposed development impact as outlined in **Section** and illustrated in **Figure 6**. A survey strategy was developed in order to achieve the aims of the study plan discussed in **Section 3.0**, which was a mixture of the report aims and the survey limitations. The survey strategy consisted of a series of Archaeological Survey Units (ASUs) that were conducted to cover all landform units in the development area. These are outlined in detail in **Section 7.0**.

8.2.1.1 Landform Aims and Methods

Following on from the landform divisions defined in **Section 4.6**, the survey was designed to allocate each survey unit to one landform type. Consideration was also given to focusing the survey units proportionally to reflect the overall landform divisions of the study area, within the limitations of visibility and access constraints. This enabled the production of data examining the distribution of sites

and artefacts within landscape types. The following graph represents the proportional areas of each landform type within the study area, in square metres.



LFU 1 (Ridge crest), LFU 2(Hillslopes), LFU 3 (Steep Hillslopes), LFU 4 (Lower order streams), LFU 5 (Upper order streams).

8.2.1.2 Coverage Aims and Methods

In order to attain the most accurate picture of the archaeology of the study area, it was considered necessary to cover as much of the proposed extension limits as area as possible within the time constraints. Specifically, it was necessary to cover all the landform units to assess the nature of both Indigenous and non-Indigenous land use across the landscape.

Intensive pedestrian survey was selected as the preferred methodology to most effectively survey the study area. This consisted of the survey team spreading out across the ASU and covering the area in a series of transects conducted at a slow walking pace. Due to the relatively low visibility conditions at the time of survey, areas of exposures were specifically targeted. This was considered sufficient, when combined with predictive models, to enable a general assessment of the archaeology of the area and indicate the nature of any additional work if required.

The effectiveness of the survey coverage is addressed in detail in **Section 9.0**, through the analytical assessment of general visibility, areas of exposure and visibility within the exposures in different LFUs and ASUs.

8.2.1.3 Recording Aims and Methods

The aim of the recording methodology outlined below was to produce sufficient information to assess the significance of each site and identify potential for further work. It was recognised as not possible to record all the data relating to even one site within the study area, and therefore recording was designed to produce a comprehensive record of the field study while identifying specific locations and general areas requiring additional research.

A number of methods were used in the field to record information, including photography, standardized recording forms and field notes.

Site Definition

While it is recognised that the entire landscape has the potential to contain artefacts and that a spatial definition of 'sites' can often be simply a product of visibility and exposure, artefacts were recorded in terms of discrete 'sites'. Different site numbers were allocated when the distance travelled from the previously recorded site made it useful that a separate location be recorded for management purposes (usually between 100-200 metres) or when a spatial distance between artefacts corresponded to a change in landform. Although individual recordings were made, recorded sites may be linked as part of a larger complex.

Each site was marked in the field with a flagged peg in order that it could be re-located by surveyors for MCC. The site co-ordinates provided in this report (**Table 8**) and in the NSW National Parks and Wildlife Service Sites Register Cards are supplied by MCC, based on the surveying of the peg locations. These pegs (and therefore the points in **Figure 4**) give an indication of the location of part of each site and do not denote the full extent of the material located.

Recording Forms

The standard NSW National Parks and Wildlife Service Site Record Forms (attached in **Appendix D**) were used during the survey. In addition, detailed notes were made about the locality, including the landform unit, soil profile, erosion, disturbance, vegetation and visibility. Each site was pegged during the field survey, in order to clearly identify the site for the development planners and to attain AMG grid references by a professional surveyor.

The aim of the notes and recording methods was to be able to reconstruct the data relating to what was found in the field. The results of the survey and recording can be found in **Section 9.0**.

8.3 Areas of Archaeological Potential

The identification of areas of archaeological potential is based on a number of factors, primarily the analysis of archaeological patterning, landform analysis, environmental factors (ie, geomorphological processes) and the level of disturbance within the development area.

The term "*areas of archaeological potential*" specifically refers to areas where sub-surface archaeological materials can be reasonably expected to occur, based on the above analytical factors. An alternate term for these areas is "*potential archaeological deposits" (PADs)*. The identification of these areas is not necessarily dependant on the presence of surface archaeological materials, but can instead be based on predictive modelling.

For the purposes of this report, a predictive model was developed based on the archaeological understanding of occupation in the local area, as developed from previous research in the Hunter Valley. This information was juxtaposed with environmental data of the local area, particularly the landform units defined for the study area and the geomorphological and natural processes that may have impacted on any archaeological materials within the landscape. As a result of this desktop study, an understanding was developed of the likely areas of archaeological potential areas within the proposed development area.

The desktop study was further refined during the field survey. After a detailed physical inspection of the study area, areas of archaeological potential were further assessed and defined. Where identified, these areas were recorded through both written and photographic mediums.

9.0 ARCHAEOLOGICAL SURVEY COVERAGE

9.1 Archaeological Survey Units

A total of 31 intensive pedestrian survey units were conducted across the study area, as identified below and illustrated in **Figure 6**.

TABLE 12 – ARCHAEOLOGICAL SURVEY UNITS			
ASU	**LFU**	**AREA, M²**	**SITES**
1	2	52330	M-1, M5
2	2	7420	M-2
3	4	7150	
4	2	36910	
5	4	6290	M-6
6	2	11590	
7	1	7040	
8	1	28720	
9	2	32980	
10	4	2140	
11	2	22780	
12	4	220	
13	1	5890	M-4
14	3	7490	
15	4	1840	M-3
16	1	10990	
17	2	11860	
18	2	10450	
19	1	34860	
20	3	4880	
21	5	790	
22	4	730	
23	3	1790	
24	4	1190	
25	3	1720	
26	1	3100	
27	3	2770	
28	4	2460	
29	3	7230	
30	2	28760	
31	2	24194	
TOTALS		**378564**	**6 Sites**

Each ASU is described in detail below. Unless otherwise stated, the ASUs were conducted on the original two day survey of the MCC proposed development area (11th and 12th December, 2001).

ASU 1

Survey covered the hillslope (LFU 2) occupying the southwest section of Extension A. The hillslope is very gently to gently inclined (less than 3% in slope), and covered with a moderate to dense grass cover. This hillslope is quite broad, with the survey team covering a 300m area from north to south. Although the natural vegetation had been essentially cleared, the grass cover was sufficient enough to restrict visibility to below 5%. Exposures are located throughout the area, mainly in association with disturbed areas such as vehicle access tracks, erosion exposures and in the areas of previous geotechnical test-pits.

Two sites were recorded in this ASU – M-1 (on occupation site) and M-5 (a scarred tree).

ASU 2

Survey covered the hillslope (LFU 2) to the direct east of ASU within Extension A. The hillslope is very gently to gently inclined (less than 3% in slope), and very disturbed from the nearby subsidence exclusion zone. Within this ASU is the borrow pit where earth was removed by the mine to backfill subsidence cracking. This section has been addressed as a separate ASU due to this disturbance, and the increased visibility it has caused throughout the hillslope, where visibility has been increased to an average 40%.

One site was recorded in this ASU – M-2 (an occupation site).

ASU 3

Survey covered the lower order watercourse and dam (LFU 4) to the direct north of ASU 1, within Extension A. The subsidence exclusion zone defined the eastern boundary of this ASU. The channel was dry at the time of survey, but functioned to direct water into the dam constructed at its base. It is most likely a natural drainage channel later modified to direct water into the dam. The channel is relatively broad (being on average 10m in width) with gently sloping sidewalls. Moderate to dense grasses occupied this ASU, both within and adjacent the channel, which restricted visibility to below 20%. Limited exposures are located throughout the ASU, mainly as a result from the construction of the dam.

No sites were located within this ASU.

ASU 4

Survey covered the westernmost hillslope of Extension A (LFU 2). The hillslope is gently inclined (3% in slope), and covered with a moderate to dense grass cover. The area of hillslope within the extension limits is approximately 150m at its greatest width. The limited vegetation within this area is essentially the result of regrowth, and the area is characterised by a moderate to dense grass cover. This restricted visibility was below 10%, although there are a number of erosion and disturbance exposures along the hillslope.

No sites were located within this ASU.

ASU 5

Survey covered the lower order stream (LFU 4) in the northwest of the Extension A. This stream leads to a large dam to the east, and was most likely a natural drainage channel modified to direct water into the dam. The channel was dry at the time of survey, and is relatively broad (being on average 10m to 15m in width) with gently sloping sidewalls. Moderate to dense grasses occupied this ASU, both within and adjacent the channel, which restricted visibility to below 20%. Limited exposures are located throughout the ASU, mainly as a result from the construction of the dam.

One site was located within this ASU – M-6 (a scarred tree).

ASU 6

Survey covered the northwest hillslope occupying the area of (LFU 2) to the north of ASU 4 in Extension A. This hillslope is gently inclined (3% in slope) and noticeably narrower than those described above, being only 50m in width on average. This ASU also exhibited an increased degree of vegetation than previous hillslopes, with more regrowth vegetation. The moderate to dense grass cover was still evident, however, which reduced general visibility to less than 20%. This is increased within the erosion and disturbance exposures located within the ASU.

No sites were located within this ASU.

ASU 7

Survey covered the north-westernmost ridge crest (LFU 1) within Extension A. This crest is relatively flat (with slope less than 1%), and quite narrow being only 50m in width (approximately). Vegetation along the crest essentially consisted of regrowth following earlier disturbance, and the whole area is covered with moderate to dense grasses. This grass cover restricted visibility to below 20%, although there are a number of erosion and disturbance exposures along the hillslope.

No sites were located within this ASU.

ASU 8

Survey covered the ridge crest (LFU 1) to the direct north of the subsidence exclusion zone within Extension A. This crest is relatively flat (with slope less than 1%), and on average 100m in width. Vegetation is relatively limited along the crest, and is the result of regrowth from earlier disturbance. The moderate to dense grass characteristic of the area is also widespread in this area, and restricted general visibility to below 20%, although this is increased in the relatively large numbers of erosion and disturbance exposures.

No sites were located within this ASU.

ASU 9

Survey covered the hillslope (LFU 2) to the north of ASU 8 within Extension A. Not all the hillslope is incorporated into the development area, with area surveyed being, at most, approximately 100m wide. The degree of slope is approximately 3% (gently inclined), and visibility was restricted to less than 10% by a moderate to dense grass cover and limited amounts of regrowth vegetation. There are, however, a number of erosion and disturbance exposures along the hillslope in which visibility is increased.

No sites were located within this ASU.

ASU 10

Survey covered the lower order stream (LFU 4) extending into the northern section of the Extension A. This stream leads to a large dam to the west, although it is believed to be a natural channel later modified to provide the dam with water. The channel was dry at the time of survey, and is relatively broad (being on average 10m width) with gently sloping sidewalls. Moderate to dense grasses occupied this ASU, both within and adjacent the channel, which restricted visibility to below 20%. Limited exposures are located throughout the ASU, mainly as a result from the construction of the dam.

No sites were located within this ASU.

ASU 11

Survey covered the hillslope (LFU 2) to the south of the Coal Road – the planned road deviation for Extension A. The hillslope is gently to moderately inclined (between 3% and 10% in slope), and is covered with a moderate to dense grass cover (**Plate 4**). Much of the natural vegetation had been cleared, but a revegetation area occupied the eastern section of this hillslope. The grass cover across the slope restricted general visibility to less than 10%, but there are a number of exposures throughout the slope. These are mainly associated with erosion processes and areas of later disturbance (such as the vehicle track). Visibility is also increased to between 30% and 50% in the revegetation area due to a lighter grass cover. A number of surface rock outcrops were also noted in this ASU, predominantly coarse-grained stone materials (sandstone, shale).

No sites were located within this ASU.

ASU 12

Survey covered the lower order stream (LFU 4) extending into ASU 11, the hillslope to the south of the Coal Road (Extension A). The survey team crossed the channel in the coverage of ASU 11. This drainage channel only partially extends into the study area (for approximately 30m). The channel was dry at the time of survey, and is relatively broad (being on average 10m width) with gently sloping sidewalls. The channel exhibited the same moderate to dense grass cover as the above ASU, which restricted general visibility to less than 10%.

No sites were located within this ASU.

ASU 13

Survey partially covered the ridge crest (LFU 1) to the west of Bimbadeen homestead within Extension B. Only a small area of this crest fell within the study area, approximately 50m square. This crest is relatively flat (with slope less than 1%), and highly disturbed from the construction of the nearby domestic residence and directly impacted from the vehicle access road that passes along the crest Vegetation has been essentially cleared, but a moderate grass cover beyond the vehicle track reduces general visibility to less than 30%.

One site was located in this ASU – M-4 (an occupation site).

ASU 14

Survey covered the steep hillslope (LFU 3) occupying the westernmost boundary of Extension B. This hillslope forms the boundary to two ridge crests, and only an area of approximately 100m in width was contained within the study area. This hillslope is morphologically distinct from the earlier discussed hillslopes, being substantially steeper (approximately 10% in slope) and narrower (not more than 50m in width). A higher degree of regrowth vegetation was noted in this ASU, with trees and shrubs added to the moderate grass cover. General visibility was approximately 10%, but this was increased in the exposures encountered within the area. Specifically, the large drainage channel running across the hillslope provided a large exposure. In this area visibility was increased to between 50% and 80%.

No sites were located within this ASU.

ASU 15

Survey covered the lower order stream (LFU 4) extending partially into ASU 14 within Extension B. The survey team crossed the channel in the coverage of ASU 15. This drainage channel originates in the upper hillslope and is essentially a erosion gully resulting from water runoff. The channel was dry at the time of survey, and (being on average 10m width) with gently sloping sidewalls. The channel exhibited the same moderate to dense grass cover as the above ASU, which restricted general visibility to less than 10

One site – M-3 (an occupation site) – was located within this ASU.

ASU 16

Survey covered the ridge crest (LFU 1) to the north of Bimbadeen homestead within Extension A. This crest is relatively flat (with slope less than 1%), and on average 100m in width. The crest has been highly disturbed by the construction of a vehicle access road, which has increased general visibility to between 40% and 70%.

No sites were located within this ASU.

ASU 17

Survey covered the hillslope (LFU 2) to the north of the Coal Road in Extension B, in the area surrounding the dam. The hillslope is gently inclined (approximately 3% in slope). There is little remnant tree and shrub vegetation, but a light grass cover occupies much of the area. A number of exposures are found within this area, mainly associated with the construction of the dam and associated fencing. As a result, general visibility is approximately 40%.

No sites were located within this ASU.

ASU 18

Survey covered the hillslope (LFU 2) to the west of ASU 18, beyond the dividing driveway to Bimbadeen (Extension B). The hillslope is gently inclined (approximately 3% in slope), and is essentially a regrowth vegetation area. Visibility is approximately 30% throughout the area, as the grass cover among the trees is relatively light.

No sites were located within this ASU.

ASU 19

Survey covered the ridge crest (LFU 1) to the southeast of Bimbadeen homestead within Extension B. This crest is relatively flat (with slope less than 1%), and on average 150m in width. Like ASU 19, the crest is essentially a regrowth vegetation area and average visibility is approximately 30% as the grass cover among the trees is relatively light.

No sites were located within this ASU.

ASU 20

The following survey units (ASU 20 – 31) were all covered in a broad west-east transect of the northwest area of Extension B. For this purpose, the survey unit divided into two groups – with Victor Perry, Barry French and Vanessa Hardy taking the northernmost transect, and Beverly Van Vliet, Steven O'Grady and Meaghan Russell taking the southernmost transect. As the areas covered by both survey teams were contained within the same LFUs, and consequently shared similarities in morphology, slope and geomorphological and human agents, they have been discussed together. Where differences were noted they will be addressed through a division into separate ASUs.

ASU 20 covered the steep hillslope (LFU 3) to the north of Bimbadeen homestead, which leads down to a deeply incised gully at its base. The area of this hillslope covered measures approximately 100m in width, and is steeply sloped (approximately 10%). A moderate vegetation cover (regrowth trees and grasses) covers the slope and reduces general visibility to less than 30%. There are however a number of exposures throughout the slope, mainly from the extensive sheetwash erosion.

No sites were located within this ASU.

ASU 21

Survey covered the upper order stream (LFU 5) to the east of ASU 21crossed in the northern transect. This drainage channel begins in the upper hillslope to the south and is fed by a series of lower order streams as it flows north. The channel was dry at the time of survey, and (being on average 10-15m width) with steeply sloping sidewalls. The channel exhibited the same moderate to dense grass and tree cover as the above ASU, which restricted general visibility to less than 20%. There were however a number of stream flow erosion exposures throughout the gully.

No sites were located within this ASU.

ASU 22

Survey covered the two lower order streams (LFU 4) that lead into ASU 22. These drainage channels begin in the upper hillslope to the south. The channel was dry at the time of survey, and (being on average 10-15m width) with steeply sloping sidewalls. The channel exhibited the same moderate to dense grass and tree cover as the above ASU, which restricted general visibility to less than 20%. There were however a number of stream flow erosion exposures throughout the gully.

No sites were located within this ASU.

ASU 23

Survey covered the steep hillslope (LFU 3) dividing the streams and ridge crests described above. Only a small portion of the hillslope was surveyed, being less than 50m in width. The area is steeply sloped (approximately 10%), and covered with a moderate to dense vegetation cover (regrowth trees and grasses) that reduces general visibility to less than 20%. There are however a number of exposures throughout the slope, mainly from the extensive sheetwash erosion.

No sites were located within this ASU.

ASU 24

Survey covered the two lower order streams (LFU 4) that form two small gullies between ASUs 21 and 25. They are divided by ASU 24, as described below, and form part of a larger drainage system as they both flow into the upper order stream described in ASU 22. Both drainage channels are essentially gullies caused by water movement (rainfall) down the steep hillslopes. Both were dry at the time of survey, and were roughly similar in morphology, being approximately 10m in width, with steeply sloping sidewalls and containing a moderate to dense grass cover. This reduced visibility within the channels to less than 20%, although this was increased by a number of stream flow erosion exposures throughout the gully.

No sites were located within this ASU.

ASU 25

Survey covered the steep hillslope (LFU 3) to the east of the gully described in ASUs 22 and 23. The hillslope was steeply sloping (approximately 10%), and was approximately 50m in width before reaching the ridge crest. A moderate to dense vegetation cover (regrowth trees and grasses) covered the slope, which reduced visibility at the time of survey to less than 20%. This was improved within the sheetwash erosion exposures found across the slope.

No sites were located within this ASU.

ASU 26

Survey covered the ridge crest (LFU 1) to the northeast of Bimbadeen homestead (approximately 50m in width), which was relatively flat with slope less than 1%. The crest has been disturbed by the construction of a vehicle access road and erosion processes, but general visibility was still less than 20% due to the moderate to dense grass and tree cover.

No sites were located within this ASU.

ASU 27

Survey covered this steep hillslope (LFU 3) to the east of ASU 26, although the total area covered by this LFU was quite narrow (being approximately 50m in width). The hillslope is relatively steep (approximately 10%) and covered with a moderate vegetation cover (regrowth trees and grasses). This reduces general visibility to less than 30%, although there are a number of sheetwash erosion exposures within the ASU.

No sites were located in this ASU.

ASU 28

Survey covered two conjoined lower order streams (LFU 4) between ASUs 27 and 29. One of these gullies extend into ASU 27. Both channels begin in the upper hillslope to the south and lead into an upper order stream to the direct north, and are therefore part of a larger drainage system. Both channels were dry at the time of survey, and were covered by a moderate to dense grass and tree cover. There were however a number of stream flow erosion exposures throughout the gully. General visibility was less than 20%. Both channels were on average 10m in width, and exhibited steeply sloping sidewalls.

No sites were located within this ASU.

ASU 29

Survey covered the steep hillslope (LFU 3) to the north of the mine management buildings, to the direct east of ASU 28 that partially extends into this ASU in the northern transect. The area of this hillslope covered measures approximately 100m in width, and is steeply sloped (approximately 10%). A moderate vegetation cover (regrowth trees and grasses) covers the slope and reduces general visibility to less than 30%. There are however a number of exposures throughout the slope, mainly from the extensive sheetwash erosion.

No sites were located within this ASU.

ASU 30

Survey covered the hillslope (LFU 2) to the east of ASU 27. This hillslope is morphologically different to those described above, due to its gentler degree of slope (3-5%). Survey covered an area approximately 100m in width, until the hillslope met the mine haul road. The area is characterised by a moderate to dense vegetation cover that has reduced general visibility to less than 20%. This is only slightly improved within the erosion exposures throughout the hillslope.

No sites were located within this ASU.

ASU 31

This survey unit was conducted on the 9th May 2002 as part of the additional survey of the study area. Survey covered the hillslope (LFU 2) to the direct east of the No. 1 Open Cut highwall, between the highwall and the fenceline. This area was believed to contain previously recorded site – a scarred tree. The degree of slope at this location ranged from 1% to 3%, and much of the area has been cleared and fenced. The existing vegetation in the area was wholly identified as regrowth, although some older trees were identified. A natural light to moderate grass cover is also found within this area, which limits average visibility to below 30%.

No sites were located within this ASU.

9.2 Unsurveyed Areas

Three major areas within the proposed extension limits were not surveyed as part of this report, as outlined below, due to safety issues and the impact of past mining.

TABLE 13 – UNSURVEYED AREAS	
AREA	AREA, M SQUARE
Subsidence Exclusion Zone	84020
Open Cut Mine	70690
Rehabilitation Area 1	54100
Rehabilitation Area 2	1370
Rehabilitation Area 3	132160
Total Area	**342340**

Subsidence Exclusion Zone

MCC has defined a subsidence exclusion zone within Extension A, as the area is known to be hazardous. Subsidence from the previous underground workings has resulted in a highly unstable ground surface that is prone to collapse (**Plate 1**). This would not allow archaeological survey within the area, as to stop to record a site may have caused the ground to collapse. In addition, many areas within the exclusion zone had been backfilled in order to secure any collapsing areas, and any contained archaeological material would have therefore been destroyed or buried. Consequently, it was determined by the survey team that predictive modelling would be utilised to assess the potential archaeological material within the area. The total area (m square) of the subsidence exclusion zone was 84020m square.

Open Cut Mining

The western limit of the study area is occupied by the existing No. 1 Open Cut. This area has not been backfilled since operations ceased in the pit, leaving the existing mine pit. As this operation entailed the complete removal of the natural soil profile of the area, it was not considered necessary to survey this area. The total area (m square) of land affected by open cut mining was 70690m square.

Rehabilitation Area 1

The first rehabilitation area within the proposed development limits occurs in Extension B, to the direct west of the MCC administration buildings. This area has been previously mined and backfilled, which has resulted in an artificial hill. As the very process of backfilling destroys or buries any associated archaeological material, it was not considered necessary to survey this area. The total area (m square) of this area was 54100m square.

Rehabilitation Area 2

This rehabilitation area occurs to the direct west of the mine access road, opposite Rehabilitation Area 3. As above, an artificial hill has been caused by the backfill of the earlier open cut and it was not determined as necessary to survey this area. The total area (m square) of this area was 1370m square.

Rehabilitation Area 3

The third backfill area within the proposed development limits occurs in Extension B, to the direct west of the MCC administration buildings. As above, an artificial hill has been caused by the backfill of the earlier open cut and it was not determined as necessary to survey this area. The total area (m square) of this area was 132160m square.

9.3 Survey Coverage Data

The area of proposed development totals 938560m^2. The archaeological coverage of the study area was limited by:

- Areas of open cut mining,
- Areas of rehabilitation, and
- The subsidence exclusion zone.

These areas occupied 342340m square, approximately 36% of the total study area. These areas have been highly disturbed, and it is considered that any archaeological materials contained within these areas have been destroyed. These areas have therefore been discounted in the below coverage analysis.

The below analysis therefore assesses the ASU coverage of the remaining study area, which occupies 596220m square.

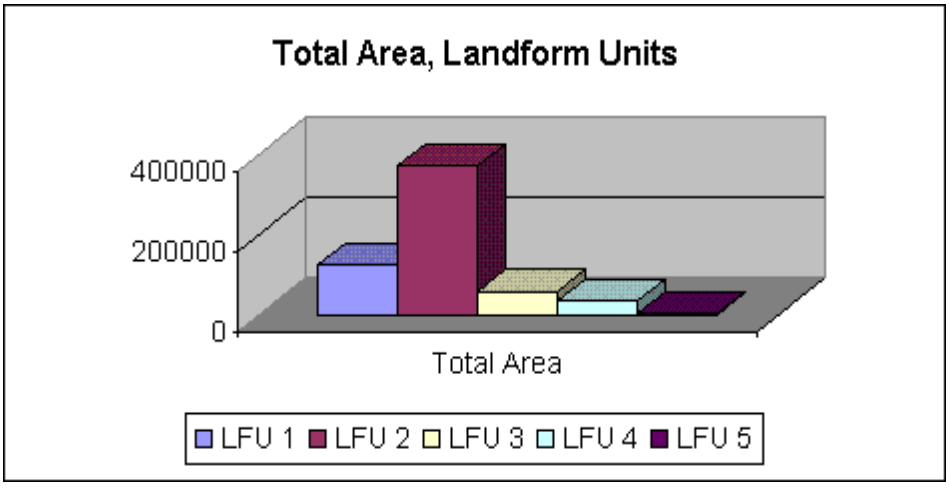
The ASUs discussed in **Section 7.3** inspected approximately 63.5% of the total remaining area (378564m^2). As illustrated in **Figure 6**, Extension A was comprehensively covered by the survey, with the only areas not surveyed being the subsidence exclusion zone and the open cut mining pit. Extension B was not surveyed to the same extent, especially the steep northeast hillslopes of the study area. In this area, a sampling strategy was determined to be most effective, due to the generally low visibility conditions and the high probability of post-depositional movement of artefacts in the area. This sampling strategy resulted in the two ASU transects across the area.

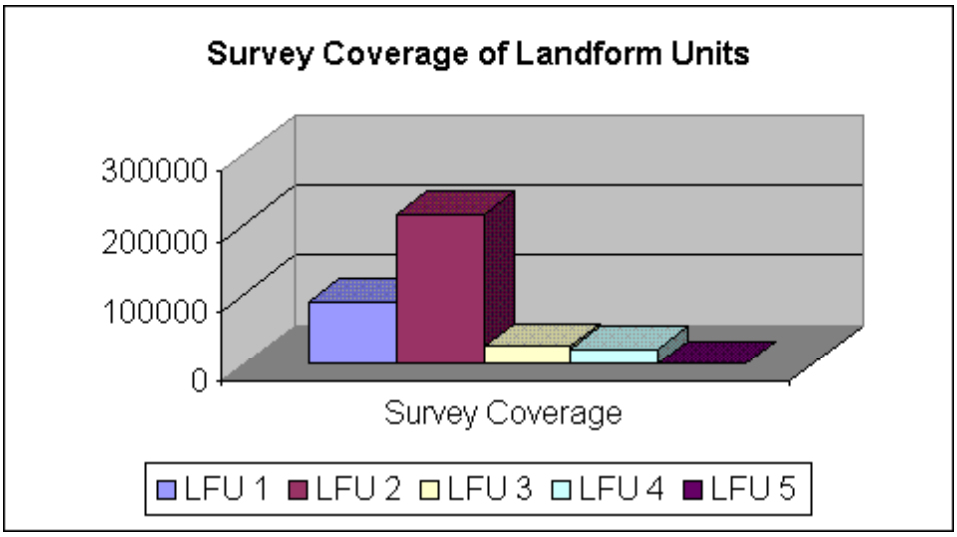
All landform units within the study area were sampled by pedestrian survey. **Table 14** summarizes the areas of landforms and the percentages of each landform surveyed.

TABLE 14 – SURVEYED AREA

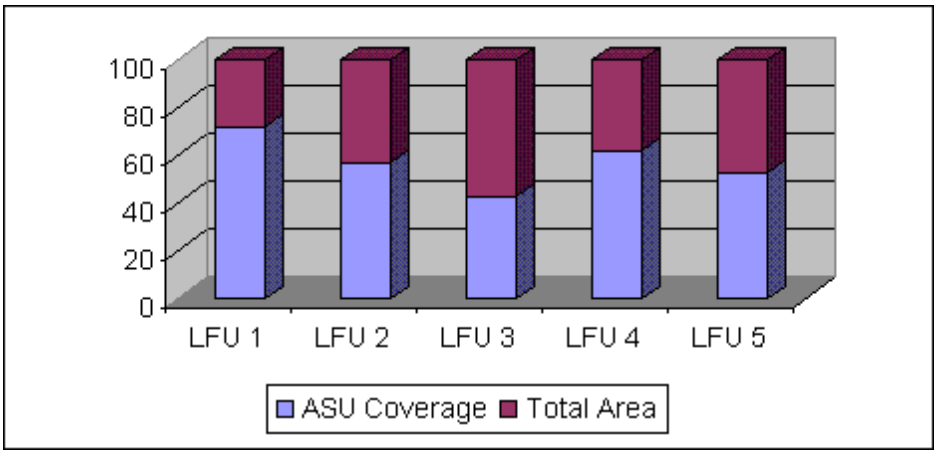
LFU NO.	LFU NAME	LFU AREA	ASU COVERAGE	% OF LFU SURVEYED
1	Ridge Crests	124860	90600	72%
2	Hillslopes	375030	239274	63.8%
3	Steep Hillslopes	59720	25880	43%
4	Lower Order Streams	35120	22020	62%
5	Upper Order Streams	1490	790	53%
TOTALS		**596220**	**378564**	**63.5%**

The graphs below indicate the comparisons of the areas of Landform Units within the study area and the level of survey coverage.





The fact that restrictions were placed on the surveyed areas of LFUs 4 and 8 can be seen in these but even more clearly in the following graph, which shows the covered areas of each landform.



The results of the survey coverage data show that the aim of covering a representative sample of the landform types was realised in the survey, with some limitations placed on the outcome due to issues of terrain and vegetation. The implication for the survey as a whole will be discussed further in **Section 11.0**.

9.3.1 Effective Coverage Analysis

To determine to effectiveness of the archaeological survey, the visibility conditions for each ASU is calculated below (**Table 15**). This type of analysis gives a clear indication of the surface visibility and other terrain conditions can have on the area of landforms available for detection and therefore the likelihood of locating archaeological material.

The restrictions on visibility will influence the likelihood of finding sites and will need to be taken into consideration when assessing the frequency of sites within the landscape.

TABLE 15 – SURVEY COVERAGE DATA

ASU	LFU	ASU AREA SQ. M	EXPOSURE	AREA OF EXPOSURE, SQ. M	VISIBILITY	AREA AVAILABLE FOR DETECTION, SQ. M	% OF ASU AREA AVAILABLE FOR SITE DETECTION
1	2	52330	5	2616.5	60	1569.9	3
2	2	7420	30	2226	70	1558.2	21
3	4	7150	15	1072.5	60	643.5	9
4	2	36910	5	1845.5	70	1291.85	3.5
5	4	6290	10	629	70	440.3	7
6	2	11590	10	1159	60	695.4	6
7	1	7040	10	704	60	422.4	6
8	1	28720	15	4308	70	3015.6	10.5
9	2	32980	10	3298	70	2308.6	7
10	4	2140	15	321	50	160.5	7.5
11	2	22780	15	3417	50	1708.5	7.5
12	4	220	15	33	50	16.5	7.5
13	1	5890	40	2356	70	1649.2	28
14	3	7490	20	1498	60	898.8	12
15	4	1840	20	368	60	220.8	12
16	1	10990	30	3297	80	2637.6	24
17	2	11860	25	2965	60	1779	15
18	2	10450	25	2612.5	65	1698.125	16.25
19	1	34860	25	8715	60	5229	15
20	3	4880	15	732	70	512.4	10.5
21	5	790	15	118.5	70	82.95	10.5
22	4	730	15	109.5	70	76.65	10.5
23	3	1790	15	268.5	70	187.95	10.5
24	4	1190	15	178.5	70	124.95	10.5
25	3	1720	15	258	70	180.6	10.5
26	1	3100	25	775	70	542.5	17.5
27	3	2770	15	415.5	70	290.85	10.5
28	4	2460	15	369	70	258.3	10.5
29	3	7230	20	1446	60	867.6	12

TABLE 15 – SURVEY COVERAGE DATA							
ASU	LFU	ASU AREA SQ. M	EXPOSURE	AREA OF EXPOSURE, SQ. M	VISIBILITY	AREA AVAILABLE FOR DETECTION, SQ. M	% OF ASU AREA AVAILABLE FOR SITE DETECTION
30	2	28760	25	7190	70	5033	17.5
31	2	24194	15	3629.1	70	2540.37	10.5
TOTALS		**378654**		**58930**		**38641**	

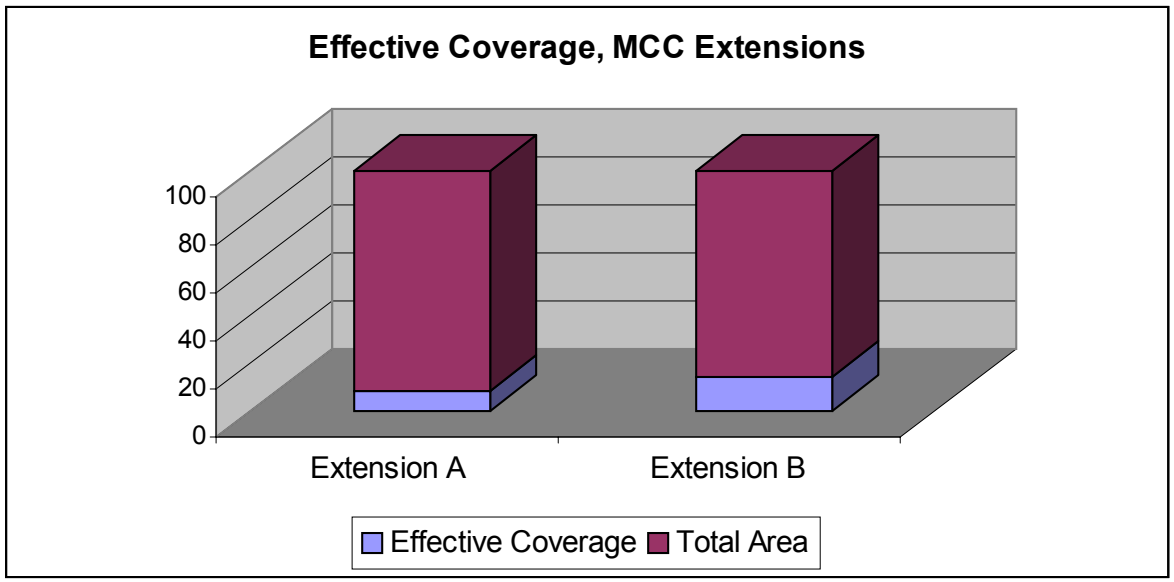
It can be seen from the above analysis that the effective coverage varied somewhat throughout this survey, but was uniformly between 3% and 30% throughout the study area. The primary limitation on visibility was the moderate to dense grass cover of the area that reduced visibility of the ground surface substantially.

There was also a definite variation in the effective visibility between Extensions A and B. When analysing the effective coverage for each area, based on the above level of visibility for each ASU, the average visibility for each Extension area was 8% and 13.8% respectively. This is illustrated in the below graph (pp68).

The differences in effective survey coverage between the two areas was essentially the higher and denser grass cover noted in Extension A, which was mainly cleared pastoral land. In contrast, Extension B is more highly disturbed (and therefore more areas of increased exposure) and has a greater area of natural tree and grass cover that is not as dense as the introduced grasses of Extension A. This is due to the restricted use of the steep gullies within Extension B, as they have been left relatively undisturbed.

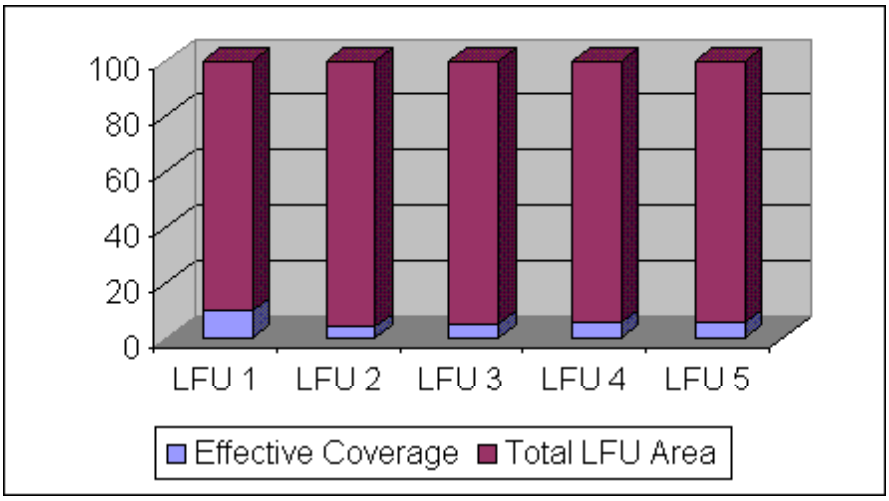
In both extensions, the level of effective coverage for each ASU is relatively low. However, it is only within Extension A that this level of survey coverage has had an adverse effect on the *effective* coverage of study area as a whole. Although the effectiveness of the survey has been reduced in Extension B, it is considered still possible to draw conclusions about the nature of the archaeological resources in that area based on both the current findings and previous known site patterning.

The conclusions drawn will be discussed further in **Section 10.0**.



Variations also occurred between and within landform types for effective survey coverage. The graph below (pp 69) represents the overall percentage of area available for site detection within each landform.

It can be seen from the above analysis that the effective coverage varied somewhat throughout this survey, but was relatively low for each landform unit of the study area. This is due to the restricted ASU coverage of the study area, which when combined with the generally low visibility conditions, has reduced the overall figure for the landform unit. As above, although this level of visibility for each landform unit is relatively low, it is not considered to have an adverse effect on their *effective* coverage. It is still possible to draw conclusions about the nature of the archaeological resource based on both the current findings and previous known site patterning. These conclusions will be discussed further in **Section 10.0**.



10.0 SURVEY RESULTS – INDIGENOUS HERITAGE

Two site visits were conducted for this assessment, one on the 11th and 12th of December, 2001, and another on the 9th of May, 2002.

On the 11th and 12th of December, 2001, the primary survey of the MCC lease area was conducted. The survey team consisted of Victor Perry and Barry French of the Upper Hunter Wonnarua Council, Steven O'Grady and Beverly Van Vliet of the Wanaruah Local Aboriginal Land Council, and Vanessa Hardy and Meaghan Russell of HLA-Envirosciences.

On the 9th of May, 2002, an additional survey was conducted aimed specifically at locating a previously recorded site within the study area. Due to a recording error within the NPWS Aboriginal Sites database, this site was not identified during the preliminary research of the assessment and was only identified after the field survey. The survey team on this day consisted of John Miller and Tracey Skene of the Upper Hunter Wonnarua Council, Rodney Matthews of the Wanaruah Local Aboriginal Land Council, John Waters and Marie Waugh of the Lower Hunter Wonnarua Council, and Meaghan Russell of HLA-Envirosciences.

The results of the fieldwork and assessment are discussed below, delineated into ground truthing, site survey and areas of archaeological potential results.

10.1 Ground Truthing

Only one known site within the study area was identified during the field survey, as discussed below.

TABLE 16 – GROUND TRUTHING RESULTS

NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE	GROUND TRUTHING RESULTS
37-2-0104	Bimbadeen / Muswellbrook	*305182*	*6430193*	Scarred Tree	Site Destroyed

Brayshaw recorded this scarred tree in a 1981 survey of the Muswellbrook Coal Mine. It was located in the area between the No. 1 and No. 2 Open Cuts, examined by Brayshaw to assess potential subsidence impacts from the then proposed underground mining activity.

The original report and existing records for the site was taken into the field for verification. The tree recorded displayed two scars, both facing 31°. The trunk of the tree split into two large branches approximately 2.5m above ground level, with a scar located on the each main branch. The following description of the scars were given:

1) Upper excision (right)
91cm long, 9.5cm deep, 100cm above ground. Inside edge of excision missing.

2) Lower excision (left)
117cm long, 9.5cm deep, 29cm above ground level. Inside edge of excision missing.

Brayshaw (1981) noted that the tree was dead at the time of survey, and that it occurred in an area of potential subsidence impacts. Brayshaw recommended that due to its relatively close position to the

original No. 1 Open Cut and the likely subsidence impacts, the tree may require relocation for its preservation if it cannot be guaranteed *in situ.*

A number of errors were noted within the existing NPWS site record, including inaccurate grid co-ordinates and errors in the description of the site's location. However, sufficient information was provided in the original report to identify likely site location/s. These included:

- Tree located within 40m of the original No. 1 highwall,
- Tree located 6m from wall of a small dam,
- Tree located 2m east of fence, and
- Tree located almost under a powerline.

A rough location map was made as part of the original 1982 recording, which is attached in **Appendix D**. . This depicts the tree as being within 40m of the high wall, approximately in the middle of the Extension A boundary. This area was first examined to identify the site (ASU 31). The tree was not relocated in this locality so other potential site locations were also examined. This included:

- Area within 60m of the No. 1 Open Cut highwall,
- Area surrounding all the dams of the study area, and
- Area beneath the powerlines within the study area.

The tree was not relocated in any of these locations.

It is considered likely that the tree has been destroyed since its original recording, most likely removed as part of land clearance within the MCC lease. Due to the existing subsidence impacts within the area from previous underground mining, such as cracking and spontaneous combustion, many trees within the MCC lease are now dead from the heat emerging from beneath the ground. During the field survey, evidence for the removal of dead trees within the MCC lease was noted, including the area within 40m of the No. 1 Open Cut highwall. As, at the time of its original recording the scarred tree was noted to be dead, this is considered to be a likely scenario.

10.2 Recorded Sites

A total of six sites were located during the field survey of the proposed development area at MCC – four occupation sites (isolated finds, artefact scatters) and two scarred trees. Each site is summarised below and identified on **Figure 2**.

TABLE 17 – SITE DESCRIPTIONS

SITE NO	SITE TYPE	ASU	LFU	AMGE	AMGN	DIMENSIONS	% EXPOSURE	% VISIBILITY	CONDITION / POTENTIAL
M1	Artefact Scatter	1	2	304327	6429316	3m by 3m	10	60	Highly disturbed.
M2	Isolated Find	2	2	304546	6429286	1m by 1m	30	70	Highly disturbed.
M3	Artefact Scatter	15	4	305006	6429742	2m by 2m	30	70	Highly disturbed.

TABLE 17 – SITE DESCRIPTIONS									
SITE NO	SITE TYPE	ASU	LFU	AMGE	AMGN	DIMENSIONS	% EXPOSURE	% VISIBILITY	CONDITION / POTENTIAL
M4	Artefact Scatter	13	1	305091	6429633	15m by 5m	20	60	Disturbed.
M5	Scarred Tree	1	2	304487	6429332	5m by 5m	15	60	Fair.
M6	Scarred Tree	5	4	304564	6429578	5m by 5m	30	60	Fair.

Each site is discussed individually below.

M-1: Artefact Scatter AMGE 304327 AMGN 6429316

This occupation site was recorded in ASU 1 and in LFU 2 (hillslope). It consists of two stone artefacts - 1 silcrete flaked piece (3-4cm) and 1 mudstone flaked piece (1-5cm) – located within an area 3m by 3m.

The site is located within an open grassed area within Extension A, approximately 80m from the No. 1 Open Cut highwall. At this locality, the degree of slope is approximately 1%. The site is located approximately 80m from a natural drainage depression, which is a lower order watercourse that only carries water in times of high rainfall (being water runoff). This section of the study area has been wholly cleared, with no trees remaining within a relatively large paddock. However, a moderate to dense grass cover defines this area, with the grasses reaching waist height at the time of survey. This has resulted in relatively poor visibility surrounding the site, with on average 10% of the area exposed and on average 60% visibility within those exposures.

This area has been moderately disturbed by previous and current land use, being utilised as pastoral grazing land and experiencing limited subsidence impacts from previously undermined areas. The site itself has been highly disturbed by recent geotechnical testing, as the recorded artefacts are all located within the limits of a rectangular trench resulting from subsurface testing. The artefacts are obviously no longer *in situ*, being situated atop disturbed earth. These trenches have also accelerated the erosion processes impacting the site, as they are now essentially erosion scars.

Although there is no surface indication of additional subsurface materials at this locality, the surrounding area is considered to be of moderate archaeological potential. As it is considered likely that the subsurface geotechnical testing exposed the recorded artefacts at this site, additional archaeological materials may be found in the subsurface context surrounding the site.

M-2: Isolated Find AMGE 304546 AMGN 6429286

This site was recorded in ASU 2 and in LFU 2 (hillslope). This site consists of a single artefact – a mudstone flaked piece (2-3cm).

The site is located within a ridge crest, with the degree of slope less than 1%. The site is located near the borrow pit of the subsidence zone, which is an excavated area of soil that has been used to stabilize the collapsing earth within the mine subsidence exclusion zone to the west. The artefact is positioned at the base of a spoil heap resulting from the excavation of the borrow pit, and was most likely deposited here from the earthwork excavation. The artefact is clearly not *in situ* as it is positioned atop disturbed earth.

Vegetation surrounding the site has been essentially cleared, although there is a patch of regrowth vegetation to the northwest.

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance in this locality, the area is considered to be of low archaeological sensitivity as any materials located here have most likely been destroyed or severely damaged.

M-3: Artefact Scatter AMGE 305006 AMGN 6429742

This site was recorded in ASU 15 and in LFU 4 (lower order drainage channel). The site contains two artefacts – a silcrete flaked piece (2-3cm) and a broken mudstone flaked piece (2-3cm).

The site is within the limit of a natural drainage channel that has been consolidated through more recent earthworks. Regrowth vegetation defines much of the associated hillslope, although the vegetation immediate to the site has been cleared by the construction of the drainage channel. As a result, general visibility has been increased through the exposed area around the site (approximately 20%), with on average 60% visibility within those exposures. The primary constraint on visibility is the moderate grass cover defining the hillslope and sidewalls of the drainage channel.

Within the drainage channel, visibility is increased through the clearance of vegetation and subsequent earthworks. In this area, exposures occupy approximately 80% of the channel and visibility within those exposures are on average 90%. The channel itself is on average 7m wide, and curves to follow the contour of the adjacent hillslope. The sidewalls of the drainage channel are short and steep, being 1m wide and at an angle of approximately 10%.

The artefacts are positioned on the edge of the drainage cutting, atop the steep sidewalls of the channel (**Plate 5**). The area surrounding the site is therefore very disturbed, being contained within a drainage channel cut into the hillslope. It is likely that the artefacts were deposited in their current location through post-depositional movement, specifically through the movement from the upper hillslope areas through water movement (sheetwash erosion).

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance in this locality, the area is considered to be of low archaeological sensitivity as any materials located here have most likely been destroyed or severely damaged. However, the artefacts located are considered to be indicative of land use of the upper hillslope and ridge landform units, which are defined to be of moderate archaeological sensitivity.

M-4: Artefact Scatter AMGE 305091 AMGN 6429633

This site was recorded in ASU 13 and in LFU 1 (ridge crest). This site contains three artefacts - 1 broken mudstone flake (2-3cm), 1 mudstone flaked portion (2-3cm) and 1 silcrete flaked portion (1-2cm).

The site is located within the limits of a vehicle access track to the north of Bimbadeen homestead, on a ridge crest with a degree of slope less than 1%. The original vegetation of the crest has been wholly cleared for the construction of a nearby domestic structure and for the access track that passes through the site.

The area is highly disturbed from the construction and continued use of the track. This disturbance has consisted of earthworks, and the movement of vehicles across the track has resulted in the compression of

the ground surface. Both impacts could have destroyed or severely impacted any archaeological materials once positioned here.

Due to this high level of disturbance and clearance, visibility within the track is quite high with approximately 50% and approximately 70% visibility within those exposures. The primary restraints on visibility within the track are the low and compressed grass cover, and the limited amounts of exposed conglomerate along the track exposed by the construction of the road. Beyond the cleared limits of the vehicle access track, a moderate to dense grass cover covers the crest and reduces visibility to approximately 10% exposure and approximately 60% visibility within those exposures.

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance due to the local construction (vehicle access track, associated domestic structure) in this locality, this area of the ridge crest is considered to be of low archaeological sensitivity. However, the artefacts located are considered to be indicative of land use of this ridge crest, and areas beyond this central area of disturbance are considered to be of moderate archaeological sensitivity.

M-5: Scarred Tree AMGE 304487 AMGN 6429332

This site was recorded in ASU 1 and in LFU 2 (hillslope). The site is located within Extension A of the study area on a gently inclined hillslope (2% degree of slope). The original vegetation of the area has been predominantly cleared for the pastoral and mining use of the land. A large gully passes approximately 20m to the east of the tree, constructed to funnel the drainage of excess construction into the nearby small dam. Visibility surrounding the tree is moderate to low, with the dense grass cover of the area the primary constraint. Exposures in this area are approximately 15%, with visibility within those exposures approximately 60%.

The tree is a large gum, approximately 25m high in total. The trunk forks approximately 150cm from the ground into two main branches, from which there are numerous smaller branches. One scar was identified on the main east branch of the trunk. The scar is located on the northern face of the trunk and is elliptical in shape, tapering at the top and base of the scar. It is located 173cm above ground level, and its dimensions are:

- 195cm high,
- 15cm wide,
- 7cm in depth,

There has been some minor damage to the base of the scar, resulting from the weathering of the bark. No associated archaeological materials were identified in the immediate area.

Additionally, the health of the tree appears to have been negatively affected by subsidence, with heat from underground spontaneous combustion emerging from cracking. However, subsequent discussions with an arboreal specialist indicated that the tree requires professional assessment to determine the status of its health and its' chance of regrowth.

M-6: Scarred Tree AMGE 304564 AMGN 6429578

This site was recorded in ASU 5 and in LFU 4 (lower order stream). The site is essentially positioned on the boundary of the study area within Extension A, being found approximately 40m from the wall of a large dam. The tree is the only remaining vegetation within a small fenced paddock at this location, with the surrounding vegetation wholly cleared. This has increased average visibility surrounding the tree to approximately 30%, although the moderate grass cover of the paddock is the primary restraining factor to visibility.

The tree is large Ironbark, approximately 30m high in total. The trunk forks approximately 15m from the ground into a number of smaller branches. Two scars were identified on the main trunk of the tree, positioned one above the other in a vertical line on its' eastern face. Approximately 50cm separates the two scars. The dimensions for the scars are as follow:

Scar 1 (base scar):	130cm above ground 122cm total length 23cm total width 6.5cm deep
Scar 2 (top scar):	340cm above ground 110cm total length 20cm total width Depth unknown

Both scars are elliptical in shape, tapering at the top and base of the scars. Both have minor bark damage around the scar, from the natural weathering of the tree. The area of damage for each scar is approximately 80cm for Scar 1 (below base of scar) and approximately 60cm for Scar 2 (below base of scar). The tree was dead at the time of survey.

No associated archaeological materials were identified in the immediate area.

10.3 Areas of Archaeological Potential

The assessment of areas of archaeological potential within the study area has been based on the juxtaposition of archaeological patterning, landscape analysis and the levels of disturbance throughout the area.

Archaeological patterning of the Indigenous occupation of the Hunter Valley has been mainly derived from previous archaeological assessments throughout the area. As detailed in **Section 6.0**, archaeological evidence of Indigenous occupation can be expected in all landform units throughout the Hunter Valley, although there is a definite intensification of land use surrounding the larger watercourses of the area. Previous research within high landscape areas (**Section 6.1**) has demonstrated that, in contrast to earlier attitudes, archaeological evidence of Indigenous occupation is also found widespread evidence indicating substantial occupation of high landscape areas such as at Muswellbrook Coal. When furthering this analysis with an assessment of the landscape of the study area, it was concluded that the area was of moderate archaeological sensitivity.

In recent history, the study area has since been disturbed by pastoral, mining and residential development. However, as these activities have generally been focussed in a low number of areas within the MCC landscape (such as at Bimbadeen and the mine infrastructure area), the remaining sections of the study area are only moderately disturbed. Although the widespread land clearance and grazing within the study area may have resulted in the post-depositional movement and disturbance of archaeological materials, it is considered likely that the majority of extant sites have survived these impacts. Conversely, areas of high disturbance are considered to be of low archaeological sensitivity as the subsequent impacts in these areas have most likely destroyed, severely damaged or moved any existing archaeological materials.

Therefore, the majority of the study area has been defined to be of moderate archaeological sensitivity as they may be additional archaeological materials within these areas. This area of moderate archaeological sensitivity is directly correlated with the area of moderate disturbance only illustrated on **Figure 3**.

However, no specific potential archaeological deposits (PADs) within the study area have been identified by this assessment. However, much of the area has been defined to be of moderate archaeological sensitivity due to the assessment of the archaeological patterning of the area and assessment of the level of disturbance throughout the study area have concluded that much of the study area should be considered to be of moderate archaeological sensitivity.

10.4 Summary

The single known site identified within the study area – a scarred tree (37-2-0104) – has been destroyed at some previous date, most likely as a result of clearance of dead trees within the MCC lease. This site is no longer to be considered in the management recommendations for the proposed development.

Six additional sites were recorded as a result of this assessment – four occupation sites and two scarred trees. Each site is summarised in the below table.

TABLE 18 – SITE DESCRIPTIONS

SITE NO	SITE TYPE	ASU	LFU	AMGE	AMGN	DIMENSIONS	% EXPOSURE	% VISIBILITY	CONDITION / POTENTIAL
M1	Artefact Scatter	1	2	304327	6429316	3m by 3m	10	60	Highly disturbed.
M2	Isolated Find	2	2	304546	6429286	1m by 1m	30	70	Highly disturbed.
M3	Artefact Scatter	15	4	305006	6429742	2m by 2m	30	70	Highly disturbed.
M4	Artefact Scatter	13	1	305091	6429633	15m by 5m	20	60	Disturbed.
M5	Scarred Tree	1	2	304487	6429332	5m by 5m	15	60	Fair.
M6	Scarred Tree	5	4	304564	6429578	5m by 5m	30	60	Fair.

Table 19 presents a summary of the material recorded in all occupation sites.

TABLE 19 – SITE CONTENT

SITE NO.	LFU	SILCRETE			MUDSTONE			TOTALS
		F	FP	C	F	FP	C	
M-1	2		1			1		**2**
M-2	2					1		**1**
M-3	4		1			1		**2**
M-4	1		1		1	1		**3**
Totals			**3**		**1**	**4**		**8**

Key to table: F = flake; FP = flaked piece; C = core.

11.0 SURVEY RESULTS - NON-INDIGENOUS HERITAGE

The assessment of the non-Indigenous heritage of the study area was conducted during the two site visits on the 11th and 12th of December, 2001, and on the 9th of May, 2002. This assessment was conducted by Vanessa Hardy and Meaghan Russell, archaeologists with HLA-Envirosciences.

The results of the fieldwork and assessment are discussed below, delineated into ground truthing, site survey and areas of archaeological potential results.

11.1 Ground Truthing

No known heritage items were identified within the study area, although a significant item of local heritage – the Muswellbrook brickworks – is located in close proximity to the study area. This item is described below.

TABLE 20 – KNOWN INDIGENOUS SITES WITHIN STUDY AREA

ITEM NO*	ITEM NAME	LOCATION	HERITAGE LISTINGS
MUSW/ R030	Muswellbrook Brickworks	Off Coal Road, Muswellbrook	Regional Heritage Environmental Schedule

** Item No. derived from the Muswellbrook Heritage Study Inventory (1996).*

Muswellbrook Brickworks

The Muswellbrook Brickworks are located to the northwest of the study area, removed from the MCC proposed development area by approximately 400m. They are accessed from Coal Road, to the west of the study area.

The Brickworks reportedly date to 1949, when it was established by Muswellbrook Industries to exploit the clay deposits of the Muswellbrook Coal Company open cut mine. The kilns have a total capacity of 180,000 bricks. The Brickworks were briefly closed in 1975, but were then reopened by O.J. O'Brien. The original fabric of the Brickworks has remained intact since its construction, including the three draft kilns and associated timber buildings. However, the conditions of the kilns have been described as requiring some repair to the roofs. The Brickworks also have several brick presses dating to the 1860s, which were imported from England. At the time of the 1996 MSC Heritage Study these machines were being restored for the production of bricks for heritage buildings that were built with these bricks.

When the 1996 recording of the item was made, the Brickworks were still operational, with three of the draft kilns actively firing coal. The Brickworks ceased operation in late 1997 (Mark Howes, pers. comm.).

The historic themes identified in the heritage assessment of the Brickworks are: Booms and Busts, Industrialisation and Decentralisation, and Technology. The Brickworks also reflect on the local themes of: The Economic Cycle of Muswellbrook, Coal Mining in the Muswellbrook District, and The Manufacture of Bricks in the Muswellbrook Area.

11.2 Archaeological Site Survey

Three non-Indigenous items of potential heritage significance were observed during the field survey, as identified below:

- Domestic Structure,
- Road and Culvert, and
- Stockyards.

Analysis of the fabrics utilised in their construction as the construction techniques indicated that these items may have been over 50 years in age, and therefore classified as relics under Section 139 of the NSW *Heritage Act* (1977 as amended 1998).

However, subsequent historical research indicated that none of the above items were over 50 years in age, as they all dated to Alan Cowley's occupation of the land (post-1954). The below history is derived from oral sources within Muswellbrook.

This section of the study area was originally part of a 3000 acre holding that extended from Muscle Creek Road across the ridge line of the study area. It also included the Bimbadeen Homestead. This land was owned by the Bowman family, who subdivided it in 1954 for sale. At this time, Cowley bought this section of land and within two years had constructed a stockman's hut (slab construction, corrugated iron roof) and a nearby stockyards. These two items were observed during the survey. The road and culvert items also noted during the survey post-date the construction of the stockman's hut, and most likely date to the 1960s.

As none of the above items are over 50 years in age, they will no longer be considered in this assessment.

11.3 Areas of Archaeological Potential

No areas of non-Indigenous archaeological potential were identified within the study area, as result of both the desktop and field assessments.

12.0 SIGNIFICANCE ASSESSMENTS

An assessment of significance is undertaken to explain why a particular site is important and to enable the appropriate site management to be determined. Cultural significance is defined in the *Australian ICOMOS Charter for the conservation of places of Cultural Significance* (the *Burra Charter*) as meaning "aesthetic, historic, scientific or social value for past, present or future generations" (Article 1.1). Cultural significance may be derived from the fabric of a place, association with a place, or the research potential of a place. The significance of a place is not fixed for all time, and what is of significance to us now may change as similar items are located, more historical research is undertaken and community tastes change.

12.1 Indigenous Heritage

The NSW National Parks and Wildlife Service *Aboriginal Cultural Heritage Standards and Guidelines Kit* emphasizes two streams of significance assessment

1. Aboriginal Cultural significance.
2. Archaeological/scientific significance

A variety of *criteria* for establishing significance have been proposed. The NPWS *Guidelines* make reference to the Register of the National Estate Significance Criteria, which can be useful in determining significance.

The cultural significance has been assessed separately by the appropriate Aboriginal community – the Upper Hunter Wonnarua Council.

Archaeological assessments of significance are therefore based on the research potential of a site, defined in the Burra Charter as scientific significance. This is considered to be the ability of a site and its contents to answer pertinent archaeological questions about the past. A document, "*Minimum requirements and standards for archaeological methodology and significance assessment to be used for cultural resource impact statements*" by Dan Witter of the NPWS (Witter 1995) developed categories of archaeological research so that the varying research approaches to archaeological sites can be conveniently organised. The framework outlined gives a broad approach to understanding a site's ability to answer relevant research questions.

In terms of Witter's categories, most of the archaeological work in the region initially began by looking at establishing regional pre-histories. More recent work however, has looked at two broad themes:

1) That of reconstructing specific activities on sites through detailed studies of stone knapping techniques, and

2) That of understanding cultural patterning by placing sites into environmental and cultural contexts. Understanding the research potential of sites located during the course of this project will involve considering each site's potential to add to these research problems. This would also need to be considered in terms of the models presented for research in the Central Lowlands of the Hunter Valley.

Each site recorded by the survey has already been assessed in relation to the archaeological model developed for the Hunter Valley (**Section 11.2.1**). In order to further clarify the archaeological potential of the sites, two aspects effecting the archaeological potential of sites are addressed separately in **Table 21**: site integrity and research potential.

It has been noted that the "…intactness of a site, the quality of its information, and its potential for the interpretation of activities or symbology depends upon its integrity. Even a typical flaked stone artefact site of small size takes on special importance if it is in a good state of preservation. A deposit or a surface may have stratigraphic or spatial integrity. The idea of integrity also includes the state of preservation, such as stencil shelter or the condition of bones in a burial" (Witter, 1995:3).

Witter provides the following categories used in defining levels of integrity. These have been used in the archaeological assessment for this study. The level of disturbance in the study area which is mapped in **Figure 3** can also be examined to understand how levels of integrity were determined on site during the field survey.

EXCELLENT	Disturbance erosion or development are minimal. (Low disturbance)
GOOD	Relatively undisturbed deposits or partially disturbed with an obvious in situ deposit. (Low disturbance)
FAIR	Some disturbance but the degree of disturbance is difficult to assess. (Moderate disturbance)
POOR	Clearly mostly destroyed or disturbed by erosion or development. (Moderate-High disturbance).
VERY POOR	Sites totally disturbed or clearly not in situ. (High disturbance)
DESTROYED	A known site that is clearly no longer there. (High disturbance)

Archaeological significance assessment also comes from bringing together and comparing the work done and knowledge available for the region. The potential to assess the significance of a site increases depending upon the information available for a region. Therefore the category of 'representativeness' has also been included in the assessment for the study. This is usually based on the regional context. "The regional context indicates what is usually found in the region, and includes explanations for what it means. It also provides a background for what is rare, outstanding, or surprising for the region" (Witter, 1995:3). Drawing on the archaeological background knowledge and results of previous work in the region and assessment of whether a site is rare or representative has been made.

The significance assessment (**Table 21**) also includes comments on the potential of a site to contain archaeological material. The extent of the deposit affects the research potential of the site. All sites have some potential to add to the knowledge base and therefore, the useable research data, for an area. However, sites with the potential for a depth of deposit have a higher research potential as they could provide information to further studies of activity areas and possibly provide dateable material to expand site chronologies.

TABLE 21 - SIGNIFICANCE ASSESSMENT					
SITE	SITE TYPE	REPRESENTATIVE -NESS	INTEGRITY / CONDITION	RESEARCH POTENTIAL	OVERALL SIGNIFICANCE
M-1	Artefact Scatter	Representative	*Poor.* Disturbed by grazing and geotechnical test-pit. Likely post-depositional movement.	*Moderate.* Small surface assemblage. Potential for sub-surface deposit.	Low
M-2	Isolated Find	Representative	*Very poor.* Very disturbed by earthworks. Likely post-depositional movement.	*Low.* Isolated Find with no indication of sub-surface deposit.	Low
M-3	Artefact Scatter	Representative	*Poor.* Disturbed by grazing and vehicles.	*Low.* Small surface assemblage. No indication of sub-surface deposit.	Low
M-4	Artefact Scatter	Representative	*Poor.* Disturbed by drainage channel construction and erosion.	*Low.* Small surface assemblage. No indication of sub-surface deposit.	Low
M-5	Scarred Tree	Rare	*Fair.* Tree potentially dead in current position.	*Moderate.* Tree	Moderate
M-6	Scarred Tree	Rare	*Fair.* Tree potentially dead in current position.	*Moderate.* Tree	Moderate

Each site is individually discussed below.

M-1: Artefact Scatter

Low numbers of artefacts (2 only) were identified on the surface at this location. Only one artefact type was found at the site – flaked pieces. Two stone materials were identified – silcrete and indurated mudstone. The artefacts occurred at a low density, with both artefacts found within a $2m^2$ area. When assessed in the broader context of the Hunter Valley, both the artefactual types and materials found at this site are common (representative) in the local and regional context.

The integrity of the site has been severely compromised through the test bore drilled at this location. This resulted in a high level of disturbance to the site through disruption to the soil profile and subsequent settling of the soil. In addition, the exposure of this area within a highly grassed area has accelerated the erosion impacting the site. It is considered likely that the recorded artefacts were exposed by the disturbance to this area, as their position found atop disturbed earth is clearly not *in situ*. As they are believed to come from subsurface deposits in this area, the site is considered to have the potential for additional subsurface materials.

Although the integrity of the site has been compromised by the drilling of the bore hole, it is considered possible that additional artefacts may be located in subsurface contexts. This site is therefore considered to be of moderate research potential, as further research of this locality may contribute to the archaeological knowledge of Indigenous occupation of high terrain areas within the Hunter Valley landscape. As research has primarily focussed on the lower terrain areas of the Central Lowlands of the Hunter Valley, this could be an important contribution to the archaeological knowledge of the area.

M-2: Isolated Find

Only one artefact was identified on the surface at this location – a flaked portion of indurated mudstone. The site has been highly disturbed from the excavation of earth from the adjacent borrow pit, where the soil has been used to stabilise the cracking from previously undermined land. The artefact is positioned at the base of a spoil heap resulting from the excavation of the borrow pit, and was most likely deposited here from the earthwork excavation. The artefact is clearly not *in situ* as it is positioned atop disturbed earth.

As the original location of the artefact is unknown, and it has been subject to a high level of disturbance, the site has been assessed to be of low archaeological significance. The high level of disturbance to the artefact, and its lack of any deeper archaeological context, has negated its potential to positively contribute to the archaeological knowledge of Indigenous occupation of the Hunter Valley.

M-3: Artefact Scatter

Low numbers of artefacts (2 only) were identified on the surface at this location. Only one artefact type was found at the site – flaked pieces. Two stone materials were identified – silcrete and indurated mudstone. The artefacts occurred at a low density, with both artefacts found within a $4m^2$ area. When assessed in the broader context of the Hunter Valley, both the artefactual types and materials found at this site are common (representative) in the local and regional context.

The integrity of the site has been compromised from earthworks in the area, in the construction of a drainage channel adjacent the site. This has resulted in a moderate level of disturbance to the site, as the earthworks pass within 1m of the recorded artefacts. It is possible that these earthworks destroyed or removed additional archaeological materials at this locality.

From the positioning of the artefacts, it is considered likely that they have been moved since their original deposition. The artefacts are positioned on the edge of the drainage cutting, atop the steep sidewalls of the channel, and they may have moved here as a result of post-depositional movement, specifically through the movement from the upper hillslope areas through water movement (sheetwash erosion).

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance adjacent the site, and the predicted post-depositional movement, the area is considered to be of low archaeological significance. The potential of this site to positively contribute to the archaeological knowledge of Indigenous occupation of the Hunter Valley is considered to be low.

M-4: Artefact Scatter

Low numbers of artefacts (3 only) were identified on the surface at this location. Only two artefact types were found at the site – a flake and two flaked pieces. Two stone materials were identified – silcrete and indurated mudstone. The artefacts occurred at a low density, with three artefacts found within a $10m^2$ area.

When assessed in the broader context of the Hunter Valley, both the artefactual types and materials found at this site are common (representative) in the local and regional context.
The integrity of the site has been compromised through the construction and continued use of a vehicle access track that passes through the site. This resulted in a high level of disturbance to the site through earthworks (minor levelling) and the continued traffic across the site. These forces have most likely resulted in the post-depositional movement of the recorded artefacts. Although the artefacts are not believed to be in their original positions, the location of three artefacts at this site is indicative of Indigenous occupation and land use along this ridge crest.

There is no surface indication of additional subsurface materials at this locality. Based on the high level of disturbance due to the local construction (vehicle access track, associated domestic structure) in this locality, this area of the ridge crest is considered to be of low archaeological sensitivity. Additionally, the potential of this site to positively contribute to the archaeological knowledge of Indigenous occupation of the Hunter Valley is considered to be low due to the high level of subsequent disturbance.

M-5: Scarred Tree

Scarred trees are relatively rare sites within the Hunter Valley, due to the relatively high level of land clearance throughout the past 200 years. Due to this rarity, scarred trees are commonly denoted to be of moderate to high archaeological significance.

One scar was identified on this tree – elliptical in shape and located 170cm from the ground. The tree is located within a hillslope landform unit, although it is not in a prominent landscape position. Although scarred trees are often associated with high landscape areas, they are found in all landform units such as hillslopes. No definitive decision regarding the functional or ceremonial status of the tree was determined during the survey, but it is most likely functional in purpose due to the relative proximity of the scar to the ground – being easily within arm reach.

This site has been defined as of moderate archaeological significance, due primarily to its rarity in the local and regional context.

M-6: Scarred Tree

Scarred trees are relatively rare sites within the Hunter Valley, due to the relatively high level of land clearance throughout the past 200 years. Due to this rarity, scarred trees are commonly denoted to be of moderate to high archaeological significance.

Two scars were identified on this one tree – both elliptical in shape and vertically aligned. The scar height ranged from 1.5m to 4.5m above the ground surface. The shape of the scars is indicative of a ceremonial rather than a functional site. Scars are commonly positioned towards the base of the trunk, within normal arm reach, and the scars on this tree would have required the scaling of the tree. Although such ceremonial sites are commonly associated with high landscape areas such as ridge crests, this site is considered to be ceremonial.

This site has been defined as of moderate archaeological significance, due to both its rarity in the local and regional contexts and its apparent ceremonial connotations.

12.2 Non-Indigenous Heritage

The basis for assessing cultural significance is the ICOMOS Australia Burra Charter and associated guidelines. The application of the Burra Charter and guidelines to the preparation of Conservation Plans is outlined in J S Kerr's *The Conservation Plan* (1990). The essential components of significance involve assessing the historical, aesthetic, scientific or social significance of a place.

The process of linking this assessment with a site's historical context has been developed through the Department of Urban Affairs and Planning and the Heritage Council of NSW State Heritage Inventory Program (SHIP) and is outlined in the *Heritage Assessment Guidelines, NSW Heritage Manual*. The *Heritage Assessment Guidelines,* established six evaluation criteria (which reflect four categories of significance and whether a place is rare or representative) under which a place can be evaluated in the context of State, Regional or Local historical themes. These Guidelines have recently (mid August 2001) been updated by the guideline *Assessing Heritage Significance,* which reflects recent legislative, changes to the Heritage Act. It is understood that the guidelines in the Heritage Manual will be successively upgraded to reflect the new assessment criteria.

The Heritage significance criteria are:

Criterion (a) – an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);

Criterion (b) – an item has strong or special association with the life or to works of a or person, or group of persons, of importance in NSW's cultural or natural history (or its the cultural or natural history of the local to area);

Criterion (c) – an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);

Criterion (d) – an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;

Criterion (e) – an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

Criterion (f) – an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

Criterion (g) – an item is important in demonstrating the principal characteristics of a class of NSW's:

cultural or natural places; or
cultural or natural environments.

(or a class of the local area's:

cultural or natural places; or
cultural or natural environments.)

An item is not to be excluded from the Register on the ground that items with similar characteristics have already been listed on the Register.

Significance Gradings

Different components a place may make a different relative contribution its heritage value. Loss of integrity condition may diminish significance. In some cases it may be useful to specify the relative contribution of an item or components. While it is useful to refer this table when assessing this aspect of significance it may need to be modified to suit its application to each specific item:

TABLE 22: SIGNIFICANCE GRADINGS

GRADING	JUSTIFICATION	STATUS
Exceptional	Rare or outstanding item of local or State significance. High degree of intactness. Item can be interpreted relatively easily.	Fulfils criteria for local or State listing
High	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or State listing.
Moderate	Altered or modified elements. Elements with little heritage value but which contribute to the overall significance of the item.	Fulfils criteria for local or State listing.
Little	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing.
Intrusive	Damaging to the item's heritage significance,	Does not fulfil criteria for. local or State listing

Following Kerr (2000) the cultural significance of a precinct or element within a precinct can be expressed in three broad ways (these encompass the significance criterion above):

1. Through the ability to demonstrate an aspect of the precincts significance. For example the fabric on the site could demonstrate how a site was used.

1. Through the association of the precinct with an important event or a particular person. The association may not require physical evidence of the event.

2. Through the ability of archaeological remains in a precinct to answer relevant research questions.

This applies as much to archaeological remains as it does to the built environment or the landscape. It is conceivable that archaeological remains may not have any research potential but have strong historical associations or a high ability to demonstrate an aspect of history.
The relationship between item and its historical context underlies this assessment process. Historical themes provide a context within which the heritage assessment criteria are applied, especially if historical values are critical to an understanding of an item's heritage significance.

Although no heritage items have been identified within the MCC proposed development area, the proximity of the Muswellbrook Brickworks to the study area has resulted in its inclusion in this assessment. The significance of the Muswellbrook Brickworks is discussed below.

Muswellbrook Brickworks

In reference to the significance criteria outlined above, this item has been defined to be of rare regional historic significance, rare local aesthetic significance and rare regional scientific significance (Muswellbrook Heritage Study 1996). These significance gradings have evolved primarily to the research potential of the Muswellbrook Brickworks to contribute to the following regional and local historic themes:

- Booms and Busts (Regional).
- Industrialisation and Decentralisation (Regional).
- Technology (Regional).
- The Economic Cycle of Muswellbrook (Local).
- Coal Mining in the Muswellbrook District (Local).
- The Manufacture of Bricks in the Muswellbrook Area (Local).

As derived from the Muswellbrook Heritage Study (1996), the statement of significance for this item is as follows:

> *A working example of downdraft brick kilns using traditional coal firing methods for the production of dry pressed bricks. In almost continuous use over a forty five year period. It is of regional historic significance in type, and is of similar scientific significance for its potential to reveal information about brickmaking methods in the Upper Hunter area over the past century.*

13.0 ANALYSIS

13.1 Effectiveness of Survey

The survey coverage analysis conducted in **Section 8.0** indicated that 36% of the total study area was highly disturbed from previous open cut mining, mining infrastructure and the subsidence exclusion zone. These areas were not surveyed as these developments (open cut pits, mining infrastructure) have effectively destroyed any existing archaeological materials within those areas. The subsidence exclusion zone was similarly not surveyed due to the safety issues regarding subsidence cracking.

Of the remaining area, approximately 63% was examined during the field survey. This area was covered in pedestrian survey units. This level of survey coverage is considered to be sufficient to enable an assessment of the archaeological resources of the study area.

Analysis of the effectiveness of survey coverage indicates that approximately 10% of the area surveyed was available for effective coverage. This varied slightly between Extensions A and B, which respectively averaged 8% and 13% for effective survey coverage. The primary restraint on visibility during the survey was the moderate to dense grass and tree cover of the study area. Although this was a considerable constraint, the results of the survey coverage data (**Table 13**) show that the aim of covering a representative sample of the landform types was realised in the survey.

In both extensions, the level of effective coverage for each ASU is relatively low. However, it is only within Extension A that this level of survey coverage is considered to have had an adverse effect on the *effective* coverage of study area as a whole. Within Extension A, high, dense grasses limited exposures to 5%.

Although the effectiveness of the survey has been reduced in Extension B, this level of survey coverage is considered sufficient to draw conclusions about the nature of the archaeological resources in that area based on both the current findings and previous known site patterning.

13.2 Indigenous Heritage

A total of six sites were recorded as a result of this field survey. These consisted of four occupation sites (artefact scatters and isolated finds) and two scarred trees.

The four occupation sites are characterised by a low density of artefacts, as no more than two were located in proximity to each other. The raw materials observed at these sites consisted solely of mudstone and silcrete, and artefact types found consisted solely of flakes and flakes pieces. Both the artefactual types and stone materials recorded are representative of the dominant archaeological patterns observed throughout the Central Lowlands, and the Hunter Valley.

Three of the four occupation sites were located in hillslope landform units (LFU 2 and 3) and one within a ridge crest (LFU 1). Although the size of this sample is too small to make any broad statements about site distribution within the area, it did differ from the results from the sites register and background research as no sites were found in association with watercourses or valley banks. This was predicted for dual reasons – the noted concentration of human activity around watercourses and the common post-depositional movement of artefacts towards watercourses resulting from erosion. Although no definitive statements can be made, it may be likely that the form of activity around these watercourses was not intensive enough to result in the deposition of large amounts of archaeological material. The observation of archaeological

material within the hillslope and ridge crest landform units similarly may indicate a non-intensive form of land use in these areas through the low-density of artefacts.
The two recorded scarred trees were found within two landform units – one within a hillslope unit and the other on the edge of a natural drainage depression. Both trees have been assessed to be of moderate archaeological (scientific) significance, as they are relatively rare site types within the local and regional context. Three scars were recorded in total (one on M-5, two on M-6), which were all elliptical in shape and of similar dimensions. The placement of the two scars on site M-6, the two scars being vertically aligned and being between 1.5m and 4.5m above ground level, are suggestive of ceremonial scars as their placement is not characteristically functional.

There have been few archaeological surveys concentrated within the higher terrain units of the Hunter Valley, which are often neglected in favour of lower landform units. The MCC lease is found in relatively high terrain (being 170m to 320m above sea level), so the above conclusions should be placed in a broader context to enable a greater understanding of human occupation and land use throughout the Hunter Valley. Although low-density occupation is not in itself characteristic of higher terrain units, as previous high terrain surveys have uncovered substantial evidence of occupation, it seems that this specific area was not intensively occupied.

The data recorded as part of the field survey has provided sufficient information to assist in assessing the significance of the sites recorded and, in turn, developing recommendations for the management of the archaeological resource in the context of the proposed development.

13.2.1 Review of Archaeological Modelling

In order to adequately assess each recorded site within the study area, each occupation site has been assessed in relation to the archaeological models discussed in **Section 5.4**. This assessment has applied Witter's Base Camp/Specialist Satellite Camp distinction to the archaeology of the study area, in order to define the nature and level of activity interpreted for each site and/or area. Witter's model is outlined in depth in **Section 5.2** and also as part of **Appendix B**. This model was selected as Witter's model is a result of work commissioned by NPWS in 1995. However, it should be noted that this model is one of many which can be used as a device in reconstructing and understanding Indigenous occupation of the land in the Hunter region before contact. No one model reviewed during the literature survey could be used exclusively. Further evaluation of other archaeological models and justification for using Witter's model is outlined in **Section 5.4.1**.

Table 23 assesses each recorded site within the study area in relationship to the model, by defining each site as either a base camp or satellite camp based on the archaeological evidence (composition, positioning, post-depositional movement) for each site.

TABLE 23 – RELATIONSHIP TO MODEL			
SITE	LFU	RELATIONSHIP TO MODEL	BASE / SATELLITE CAMP

TABLE 23 – RELATIONSHIP TO MODEL			
SITE	LFU	RELATIONSHIP TO MODEL	BASE / SATELLITE CAMP
M1	2	This site contains 2 artefacts, and is located within a hillslope landform unit. As the artefacts were located in direct association with a geo-technical test pit, the artefacts are probably not *in situ*, and were either exposed or moved by disturbance. Due to the low site assemblage, the site is considered to represent a low level of activity.	Satellite
M2	2	This site is an isolated find, which usually indicates either limited human activity or the post-depositional movement of the artefact (geomorphological processes or human disturbance). Due to its location adjacent a burrow pit, it is likely this artefact was exposed or moved during large-scale earthworks and is not in situ. As a single artefact, this site is considered to represent a low-level of activity.	Satellite
M3	4	This site contains 2 artefacts, and is located within a vehicle access track along a ridge crest. The immediate locality has been highly disturbed from the construction and use of the track, and it is likely that the artefacts have been moved since their original deposition. Due to the low site assemblage, the site is considered to represent a low level of activity.	Satellite
M4	1	This site contains 3 artefacts, and is located within a hillslope landform unit. As the artefacts were located within the limits of a later drainage channel, it is likely that they were moved by later disturbance and are not in situ. However, due to the low site assemblage, the site is considered to represent a low level of activity.	Satellite

The Base Camp/Satellite Camp distinction of the proposed model has been applied to the results of the field survey, in order to interpret the nature and level of activity across the landscape. It is considered that all sites recorded within the study area are reflective of specialized satellite camps, which entailed a low-level of activity across the entire area. This conclusion was based on the topography of the area, the positioning and the composition of the sites recorded.

The model proposed by this assessment is primarily based on the archaeological patterning of sites within the Central Lowlands rather than in higher terrain areas of the Hunter Valley. This has resulted from the increased level of archaeological research in lower areas of the Central Lowlands, where large and permanent tributaries form the focus of occupation (Base Camps) and the minor tributaries are generally associated with Satellite Camps. The conceptual application of this model to the study area suggested that the area would be utilised for specialist satellite camps, where a low-level (but potentially extensive) land use would be expected. This was confirmed by the field survey, which observed limited amounts of archaeological evidence relating to Aboriginal land use of the area. The types of archaeological evidence recorded were also indicative of satellite camps rather than base camps, as no evidence was observed for more permanent camp sites where food preparation and stone tool manufacture (among other activities) was undertaken. As no debitage was observed, it is considered most likely that the stone tools were not manufactured in this locality, and were instead brought into the area from base camps located elsewhere.

In general terms, these conclusions about the nature and level of land use in the study area confirm the archaeological model and predictions presented in **Section 5.4**. By extension, it is seen that the Base Camp/Satellite Camp distinction made in Hunter Valley archaeological models is considered to be equally applicable to higher terrain areas.

Other studies reviewed which support the high archaeological potential of undisturbed higher terrain areas include McDonald's (1997) research at Bayswater No. 3 and Rich's (1995) work at Mount Pleasant Mine. McDonald's excavation of a site on a ridge crest showed high densities of sub-surface artefacts. Rich (1995) also found high densities of artefacts along lower portions of ridges and slopes.

The predictive model development for this also assessment discussed the potential of locating scarred trees within the study area, as summarised below:

- Scarred trees have been located in all landform units throughout the region, and their positioning cannot be accurately predicted.
- They are generally associated with high-ground ceremonial sites or burials, and are therefore more likely in higher landform units.
- Scars are most often rounded and symmetrical in shape, elongated or rectangular in outline. Regrowth around the scar should be even, suggesting deliberate removal. Evidence of the use of stone tools or steel axes for bark removal may be found.
- The scar should occur above the base of the tree, at a height consistent with an adult person removing the bark.
- They are most likely to be found on large, mature trees over 100 years in age.

The location of two scarred trees within the study area indicates that although much of the area has been wholly cleared and is nor regrowth forest, there is remnant older vegetation within the development area. The common association between scarred trees and ceremonial areas is important, especially in regards to site M-6 that has been identified as a potential ceremonial site. However, the lack of associated archaeological materials and contemporary knowledge of the tree/s limits the conclusions regarding the archaeological significance of the tree/s.

However, when assessing the sites against known archaeological patterning throughout the Hunter Valley, they generally conform to the positioning within high terrain areas. The MCC lease area is itself located within relatively high terrain within the Central Lowlands of the Hunter Valley, although neither tree is located within a prominent ridge crest position within the MCC landscape.

13.3 Non-Indigenous Heritage

No non-Indigenous heritage items have been identified within the study area of this assessment, although the proximity of the Muswellbrook Brickworks to the MCC lease area has been identified as a potential issue. However, analysis of development impacts have concluded that the potential impacts to the site (including dust, noise and vibration) will be minimal. Therefore, unless the proposed MCC development plans are altered, there is no need to further consider this heritage item.

14.0 MANAGEMENT RECOMMENDATIONS

14.1 Management Context

A number of factors need to be taken into account when recommending strategies for treatment of the archaeological resource within a study area. In developing a framework for appropriate management consideration should include (but not necessarily be limited to) the following:

14.1.1 Legislative Framework

Sites of cultural heritage significance are protected or controlled by a number of varying levels of statutory control that vary according to Authority and site type. The nature and levels of controls on the project area are set out below.

COMMONWEALTH

Australian Heritage Commission Act (1975)

This is Commonwealth legislation that established the Australian Heritage Commission and the Register of National Estate. A search of the on-line Register of National Estate established that no items in this report were listed on the Register of National Estate.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

This legislation is the principal Commonwealth legislation protecting Indigenous heritage. The Act complements state/territory legislation and is intended to be used only as a 'last resort' where state/territory laws and processes prove to be ineffective.

Under the Act the responsible Minister can make temporary or long-term declarations to protect areas and objects of significance under threat of injury or desecration. The Act also encourages heritage protection through mediated negotiation and agreement between land users, developers and Indigenous people.

Since the passage of this legislation:

- around 200 applications have been lodged under the Act
- eight declarations have been made protecting objects of significance to Indigenous people
- emergency (i.e. temporary) declarations have protected five significant places, and
- two long-term declarations remain in place, one protecting women's sites under threat from a dam near Alice Springs and the other (with effect from July 2000) protecting Boobera Lagoon in northern New South Wales.

On 17 December 1998 responsibility for administration of the Heritage Protection Act was transferred by Administrative Arrangement Orders from ATSIC to the Environment and Heritage portfolio and the Act is now administered by Environment Australia.

NEW SOUTH WALES

National Parks and Wildlife Act (1974)

Under the provisions of the *National Parks and Wildlife Act* 1974, Aboriginal archaeological sites are defined as "relics". A "relic" means any deposit, object or material evidence (not being handicraft made 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.

Section 91 of the Act: "A person who is aware of the location of a relic that is the property of the Crown or, not being the property of the Crown, is real property, and does not, in the prescribed manner, notify the Director-General thereof within a reasonable time after he first becomes aware of that location is guilty of an offence against this Act unless he believes on reasonable grounds that the Director-General is aware of the location of that relic."

This means that if a relic is found the National Parks and Wildlife Service must be informed.

Under Section 90 of the Act:

(1) A person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or damage to, a relic or Aboriginal place is guilty of an offence against the Act

(1A) Subsection (1) does not apply with respect to a relic that is dealt with in accordance with Aboriginal tradition pursuant to section 85A.

(2) The Director-General may give consent for the purposes of subsection (1) subject to such conditions and restrictions as are specified therein.

(3) A person whose application for consent is refused, or who is dissatisfied with any condition or restriction subject to which the consent is given, may appeal to the Minister.

(4) The Minister:

(a) may refuse to grant the appeal, or

(b) may grant the appeal wholly or in part, and may give such directions in the matter as seem proper.

(5) The decision of the Minister on the appeal is final and is binding on the Director-General and the appellant, and shall be carried into effect accordingly.

(6) Where the regulations prescribe:

(a) the manner in which an appeal is to be made under this section the appeal shall be made in that manner, or

(b) the period within which an appeal is to be made under this section the appeal shall be made within that period.

(7) Where the Director-General fails to grant an application (other than an application for approval in respect of integrated development within the meaning of section 91 of the Environmental Planning and Assessment Act 1979) for consent, the application shall, for the purposes of this section, be deemed to be refused upon the expiration of:

(a) subject to paragraph (b) 7 days after the application was received by the Director-General, or (b) where the regulations prescribe some other period that other period.

Under Sections 86 and 90 of the *National Parks and Wildlife Act (1974)* a person is not allowed to disturb or excavate on any land for the purpose of discovering a relic or knowingly destroy, deface or damage or cause or permit the destruction, defacement or damage of a relic. Permits can be obtained to allow excavations or destruction of a relic.

It should be noted that because an item is not on a register or that an area has no items registered does not mean that there are no items of heritage significance in an area. This is because an area may not have been systematically surveyed for heritage items or that an item has been overlooked or that the heritage significance of an item or area has not been realised.

The following sites are potentially impacted by the proposed development, and are protected by the above legislation:

TABLE 24 – INDIGENOUS SITES IMPACTED

NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE
37-2-0104	Bimbadeen / Muswellbrook	305182	6430193	Scarred Tree
	M-1	304327	6429316	Artefact Scatter
	M-2	304546	6429286	Isolated Find
	M-3	305006	6429742	Artefact Scatter
	M-4	305091	6429633	Artefact Scatter
	M-5	304487	6429332	Scarred Tree
	M-6	304564	6429578	Scarred Tree

Heritage Act (1977 as amended 1998)

The *Heritage Act* (1977 as amended 1998) was passed to conserve the environmental heritage of New South Wales. The Heritage Act is binding on all State Government agencies. Items of heritage significance are protected by the means of Interim Heritage Orders or by listing on the State Heritage Register. Short-term orders under Section 130 of the Act, which was abolished in the 1998 amendments, continue for three years after the repeal of Section 130 by the amendments.

In addition special provisions have been passed to protect "relics". Under Section 139 of the Heritage Act

1) *A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.*

2) *A person must not disturb or excavate any land on which the person has discovered or exposed a relic except in accordance with an excavation permit.*

A "relic" is defined as meaning "any deposit, object or material evidence:

(a) which relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
(b) which is 50 or more years old.

There is no formal register of "relics" held by the NSW Heritage Office. Some of the sites listed on the State Heritage Register or on LEP's may either be "relics" or have relics associated with them. For items listed on the State Heritage Register, a permit is required to carry out activities to an item (Section 60) and a permit is required for excavation (Section 140).

No relics were identified within the study area by this assessment.

Environmental Planning and Assessment Act (1979) (EP&A Act)

The EP&A Act requires that consideration is given to environmental impacts as part of the land use planning process. In NSW environmental impacts are interpreted as including cultural heritage impact. Three parts of the EP&A Act are most relevant to Heritage. Part III relates to planning instruments including those at local and regional levels, Part IV controls development assessment processes and Part V refers to approvals by determining authorities.

Under the provisions of the EP& A Act Local Environmental Plans (LEP) can be made. Typically LEPs have provisions that protect items of environmental heritage. The study area is contained wholly within one local government areas – Muswellbrook Shire Council. All the heritage items listed on the LEP are protected by the planning legislation of each Local Government Authority, which can be easily obtained from the Council. A search of the heritage items listed on the Muswellbrook LEP was conducted on the 13th of December 2001, but no items were identified within the study area.

14.1.2 Development Impact

Each assessment for ways to mitigate impact, manage archaeological resources or salvage material can only be made with reference to the proposed impact of the development and any alternatives. The impact from the proposed development will essentially destroy any archaeological materials contained within the study area, as the extension of the open cut mine will entail the total removal of the entire soil deposit. Therefore the following sites will be destroyed under current planning:

- M1 (an occupation site),
- M2 (an occupation site),
- M3 (an occupation site),
- M4 (an occupation site), and
- M5 (a scarred tree).

Site M6 (a scarred tree) is positioned on the boundary of the proposed MCC development area. At present, its destruction as a result of the development is also assumed. However, it is noted that the tree could be retained through a minor modification to the proposed development plan, which is further discussed in the management recommendations for the site (**Section 14.2**).

Although no non-Indigenous heritage items have been identified within the study area, the proximity of the Muswellbrook Brickworks to the proposed development has been identified as a heritage issue. The brickworks are removed from the existing No. 1 Open Cut by approximately 200m, and therefore could be indirectly impacted by the proposed works. These impacts could feasibly include dust, noise and vibration impacts. However, it is also noted that the bulk of Extension A works will begin at the existing limit of the No. 1 Open Cut, as the extension of the open cut is essentially moving east from the existing No. 1 Open Cut highwall. The Brickworks are removed from this area by approximately 1000m.

As such, although indirect impacts have been identified for the Brickworks, they are considered to be minimal. Therefore, no specific management recommendations are presented for the Brickworks during development. However, if any alterations are made to the existing development plans, the development impact on the Muswellbrook Brickworks will require reassessment.

14.1.3 Archaeological Context

The significance and appropriate treatment of relics, sites and areas of archaeological potential can only be considered in the context of what is known about the archaeology of a particular area. Each site and study area should be considered on its own merits within the appropriate framework. This framework has been established through the discussion of previous archaeological research in and near the study area, and the major research themes that have resulted from this body of work.

A major issue in the rationale for the below management recommendations is the consideration of the disturbances to the finite nature of archaeological resources. Large-scale human occupation and development within the landscape, and this is particularly applicable throughout the Hunter Valley, has significantly disturbed the landscape, and most likely the archaeological resources within that landscape. This makes it difficult to provide a comprehensive context for the study area but also increases the rareness of the sites recorded within the local area.

This also impacts upon the significance assessments made for each site located throughout the area, as some sites found may be so disturbed that their scientific significance has been considerably lowered. Such sites no longer have the ability to answer research questions about the past and are often defined as low in significance.

14.1.4 Concerns of the Indigenous Community

Participation of the Indigenous community in overall archaeological should ideally, where possible, integrate the wishes of interested groups as part of the overall management of particular sites and areas.

In order to address the concerns of the Indigenous community relating to this development, an Indigenous Cultural Heritage Assessment has been made by Victor Perry, a representative of the Upper Hunter Wonnarua Council. This provides an assessment of the cultural value of a particular area, site or relic, which may differ from the assessment of scientific (archaeological) significance. However, it is an independent but equal part of the assessment process.

The Cultural Heritage Assessment (**Appendix A**) for the current study discusses a number of concerns and provides recommended strategies. Of relevance here are the following:

- That no objection is raised to the issue of Consent to Destroy for sites M2, M3 and M4, provided that the archaeological materials at each site are collected prior to development.

- That the area surrounding site M1 is of archaeological potential, and salvage works should be conducted in this area. This should consist of archaeological subsurface testing to identify the archaeological resources of this area.

- That if the proposed MCC development is altered in any way, the development impact to the known heritage of the study area will need to be reassessed.

It must be noted that the existing Cultural Heritage Assessment was authored prior to the second site visit conducted in May 2002. Therefore the report does not make any statement regarding the two additional sites located within the study area – the two scarred trees. It is recommended that upon submission of the second Cultural Heritage Assessment for the proposed MCC development, any recommendations made by the Aboriginal community groups are addressed and incorporated into the existing management framework.

14.2 Recommendations

14.2.1 Indigenous Heritage

A series of recommendations have been developed to manage the Indigenous archaeological resources and areas of archaeological potential identified by this report.

An important feature of the following recommendations for the management of Indigenous archaeological resources is the ongoing involvement with the relevant Aboriginal communities – the Upper Hunter Wonnarua Council, the Wonnarua Tribal Council, the Lower Hunter Wonnarua Council, the Wanaruah Local Aboriginal Land Council and the Wonnaruah Nation Aboriginal Corporation. This should be maintained throughout the development process and copies of all heritage assessments and recommendations should be made available to each community group. This form of community involvement is a standard requirement of the NSW National Parks and Wildlife Service in approving permits and applications, and is also a vital component of obtaining consent for proposed development works.

The management recommendations outlined below are aimed at mitigating adverse development impact on the archaeological resources of the study area. These recommendations outline the preferred management for all known sites during the development, and the correct management of procedure if additional archaeological resources are uncovered during construction.

Additionally, an Archaeological Management Plan (AMP) has been recommended for the proposed MCC development, and this discussed in reference to both known and potential archaeology of the study area.

Known Archaeological Sites

Site 37-2-0104, the scarred tree registered with NPWS, has been destroyed at some prior date and is not considered in the below recommendations.

1) No site within the MCC proposed extension limits can be disturbed without approval from the NSW National Parks and Wildlife.

   If the site in question cannot be avoided in development planning, it is recommended that a "Consent to Destroy" permit be applied for from the NSW National Parks and Wildlife Service. These permits are granted under Section 90 of the *National Parks and Wildlife Act (1974)*.

Archaeological and Aboriginal Cultural Heritage assessments are essential in obtaining such permits, with concurrence from both the archaeologist and Aboriginal communities. The form must be lodged by a qualified archaeologist and have the signatures of both the owner and applicant of the development. Planning time must be allocated for this permit application as processing time for these permits are officially up to 8 weeks, but frequently take longer.

2) The following sites within the study area have been determined as of low archaeological (scientific) significance. No further archaeological assessment is recommended for these sites prior to the commencement of works. It is therefore recommended that Consents to Destroy be applied for and the artefacts be collected from:

    a) M-2,
    b) M-3, and
    c) M-4.

3) Although site M1 (an occupation site) was also assessed to be of low archaeological (scientific) significance, this assessment identified the potential for subsurface archaeological materials at site. Consequently, additional archaeological research is recommended to clarify the archaeological resources of this site prior to the commencement of works.

    This should consist of subsurface archaeological testing at the site, conducted by a qualified archaeologist in conjunction with representatives of the local Aboriginal community groups. This form of excavation will require the consent of the NSW National Parks and Wildlife Service, through the submission of a Consent to Destroy permit for site M1 as the excavation will destroy the known site. The permit application will need to include a research design prepared by a qualified archaeologist and outlining the proposed methodology for the excavation of the site. Additionally, the surface materials of the site should be recorded in detail prior to excavation.

4) Site M-6 (a scarred tree) has been assessed to be of moderate archaeological significance. The tree is located on the existing boundary of the MCC proposed development area, being positioned on the northern boundary of Extension A. Due to its' positioning, it is considered possible that the tree may be retained in its current position during the development.

    It is strongly recommended that the tree be retained in situ.

    If the tree is to be retained in its current position, its' the proximity to the proposed development may result in indirect impacts from the construction works, such as from the movement of vehicles close to the site. To minimise any such indirect impacts, the following management recommendations are made:

    a) The tree should be appropriately fenced prior to the commencement of works to clearly identify the site to construction workers.

    b) The area defined by the fencing should be approximately 5m by 5m around the base of the tree.

    c) This should be done with star pickets and iridescent para webbing for maximum visibility.

However, if direct disturbance to the tree is the only feasible option, the relocation of the tree may be required so that it can survive and maintain part of its heritage significance. The successful relocation of a mature tree is difficult, and it is primarily recommended that an arboreal specialist conduct an inspection of the tree to determine its health and status, and the probability of it surviving excavation and relocation.

If it is concluded that the tree has any chance of surviving relocation, the following recommendations are made:

a) The relocation of the tree will require approval from the NSW National Parks and Wildlife Service, as its removal from its *in situ* position with destroy the location significance of the tree and may also result in its complete destruction. This will require the submission of a Consent to Destroy permit with a attached research design outlining the proposed methodology of the tree's relocation and its final position.

b) A professional mature tree transplanting company should be employed to conduct the excavation and relocation. The likelihood of the tree surviving its initial excavation will rely on a number of factors, such as sufficiently large equipment to collect the maximum amount of root material, which will require specialist assessment and execution.

c) The tree should be relocated within an environment similar to its original position, in regards to soils and landscape. Its final location should be retained as close to its original position as possible, which should be determined through discussions with an arboreal specialist, MCC staff, a qualified archaeologist, the local Aboriginal community groups and the NSW National Parks and Wildlife Service.

If the initial arboreal inspection indicates that the tree will have no chance of successfully surviving relocation, the tree's removal will be necessary to partially retain its heritage significance. In this scenario, the following recommendations are made:

a) The removal of the tree will require approval from the NSW National Parks and Wildlife Service, as this will result in the destruction of this site. This will require the submission of a Consent to Destroy permit (Section 90).

b) That during the removal of the tree, the section of the trunk containing the scar be separated from the remaining tree and removed for its protection.

c) The removal of the tree should be conducted by an arboreal specialist, and monitored by a qualified archaeologist and the local Aboriginal community groups involved. This monitoring will be required to ensure that the scar itself is not damaged during the works.

d) The final location for the storage and/or display of the removed section of the tree should be determined through discussions between MCC staff, the local Aboriginal community groups involved and the NSW National Parks and Wildlife Service.

e) Further, advice from a materials conservator specialist regarding the storage and/or display of the tree section should be acquired for the successful preservation of the scar.

f) The submission of the Consent to Destroy permit to the NSW National Parks and Wildlife Service will require the submission of a research design outlining the proposed

methodology to remove the tree, the archaeological monitoring of the tree's removal, and its management following removal. This will need to be prepared and submitted by a qualified archaeologist.

5) Site M-5 (a scarred tree) has been assessed to be of moderate archaeological significance. Although its retention in situ is the preferred management strategy for the site, its central positioning within Extension A may require that it be relocated so that it can survive and maintain part of its heritage significance.

As above, the successful relocation of a mature tree is difficult, and it is primarily recommended that an arboreal specialist conduct an inspection of the tree to determine its health and status, and the probability of it surviving excavation and relocation.

If it is concluded that the tree has any chance of surviving relocation, the following recommendations are made:

a) The relocation of the tree will require approval from the NSW National Parks and Wildlife Service, as its removal from its *in situ* position with destroy the location significance of the tree and may also result in its complete destruction. This will require the submission of a Consent to Destroy permit with a attached research design outlining the proposed methodology of the tree's relocation and its final position.

b) A professional mature tree transplanting company should be employed to conduct the excavation and relocation. The likelihood of the tree surviving its initial excavation will rely on a number of factors, such as sufficiently large equipment to collect the maximum amount of root material, which will require specialist assessment and execution.

c) The tree should be relocated within an environment similar to its original position, in regards to soils and landscape. Its final location should be retained as close to its original position as possible, which should be determined through discussions with an arboreal specialist, MCC staff, a qualified archaeologist, the local Aboriginal community groups and the NSW National Parks and Wildlife Service.

If the initial arboreal inspection indicates that the tree will have no chance of successfully surviving relocation, the tree's removal will be necessary to partially retain its heritage significance. In this scenario, the following recommendations are made:

a) The removal of the tree will require approval from the NSW National Parks and Wildlife Service, as this will result in the destruction of this site. This will require the submission of a Consent to Destroy permit (Section 90).

b) That during the removal of the tree, the section of the trunk containing the scar be separated from the remaining tree and removed for its protection.

c) The removal of the tree should be conducted by an arboreal specialist, and monitored by a qualified archaeologist and the local Aboriginal community groups involved. This monitoring will be required to ensure that the scar itself is not damaged during the works.

d) The final location for the storage and/or display of the removed section of the tree should be determined through discussions between MCC staff, the local Aboriginal community groups involved and the NSW National Parks and Wildlife Service.

e) Further, advice from an materials conservator specialist regarding the storage and/or display of the tree section should be acquired for the successful preservation of the scar.

f) The submission of the Consent to Destroy permit to the NSW National Parks and Wildlife Service will require the submission of a research design outlining the proposed methodology to remove the tree, the archaeological monitoring of the tree's removal, and its management following removal. This will need to be prepared and submitted by a qualified archaeologist.

Additional Archaeological Materials

If any additional archaeological materials are be uncovered during construction, the following management procedure is recommended:

1) Work must cease immediately to enable archaeological assessment.

2) The NSW National Parks and Wildlife Service should be notified, as a "Consent to Destroy" permit can only be obtained through this agency.

3) An archaeological and cultural assessment will need to be undertaken as part of this permit application process. Typically, this will require an archaeologist and representative of the relevant Local Aboriginal Land Councils to attend the site, make an assessment and lodge the appropriate documents.

Archaeological Management Plan

It is recommended that an Archaeological Management Plan (AMP) be developed for the management of the known and potential archaeological resources within the proposed MCC extension area. This AMP would need to outline the management of the sites and areas identified by this report, being:

- Sites M-1 to M6, and
- The subsurface potential of Site M-1,

The management recommendations presented for the above sites in this report could be utilised as the basis of the AMP policies regarding the sites.

Two additional issues have also been identified by this assessment, and will need to be addressed in the AMP. These are:

- The low visibility within Extension A of the proposed development, and
- The subsurface potential for archaeological materials within the study area.

This report identified a number of constraints affecting the effective assessment of the study area, specifically the low visibility conditions within Extension A at the time of survey. This low level of visibility significantly restricted the *effective coverage* of the archaeological survey within Extension A,

which limited the assessment of the study area. As much of this area has been assessed to be of moderate archaeological sensitivity, based on the archaeological patterning of the region and landscape analysis, it is considered likely that additional archaeological materials will be found within this area. This conclusion was reinforced when four additional sites - two occupation sites and two scarred trees - were identified within Extension A.

To rectify this imbalance in effective survey coverage, it is recommended that Extension A is subject to re-survey after clearance. This survey should maintain the landform unit divisions delineated by this assessment, and aim to cover a proportionate area of each landform unit.

Discussions with MCC staff have indicated that the clearance of the proposed extension area will be conducted in stages over a five-year period, as the development progresses. The archaeological re-survey of Extension A could therefore be conducted in two alternate ways:

1) *Re-survey to be conducted in stages as the work progresses.*
   As each area is cleared prior to development, the archaeological survey could have access to the entire cleared area. However, it should be noted that if additional materials are found they will need to be assessed and managed during the construction phase, which could slow the timing of MCC works.

2) *Re-survey to be conducted prior to development, through clearance of sample transects.*
   Prior to the commencement of works, a number of transects are cleared across Extension A through slashing (low impact clearance). These transects could be assessed for archaeological materials, and could be utilized as basis for assessing the archaeological potential of the remaining Extension A.

Details of the timing and methodology of the survey will need to be clarified as part of the AMP, and if any additional archaeological materials are identified as a result of these surveys, management recommendations will need to be formulated for their management during development and incorporated into the AMP.

The subsurface potential for archaeological materials within the study area was also identified by this assessment as a heritage issue. As stated, this assessment defined much of the study area is of moderate archaeological sensitivity, based on the archaeological patterning of the region and landscape analysis. Although no specific PADs were identified by the assessment, it is considered possible that subsurface archaeological materials will be found within the study area. This was also indicated within one known site – M-1 – where archaeological materials were exposed through previous subsurface disturbance.

A subsurface testing program is therefore recommended for the study area, and this should be incorporated into the AMP. At present, subsurface testing is only recommended for one locality:

- Site M-1;

due to the potential archaeological deposit (PAD) identified at the site. This form of excavation will require the consent of the NSW National Parks and Wildlife Service (Consent to Destroy permit) for Site M1 as the excavation will destroy the site. The permit application will need to include a research design prepared by a qualified archaeologist and outlining the proposed methodology for the excavation of the site. This subsurface testing work should be conducted by a qualified archaeologist in conjunction with representatives of the local Aboriginal community groups.

In addition, the results of the additional survey of Extension A may lead to the extension of this archaeological subsurface testing program. If further research prior to development is recommended following the additional landscape survey, the sampling of the study area through archaeological subsurface testing may be recommended. This would consist of the sampling of the study area, through testing of all the landscape units defined by this assessment. These will include:

a) LFU 1: Ridge crests,
b) LFU 2: Hillslopes,
c) LFU 3: Steep Hillslopes, and
d) LFU 4: Lower Order Streams.

If this form of subsurface testing is recommended, it will require the consent of the NSW National Parks and Wildlife Service, through the submission of a Preliminary Research Permit. As above, a research design will need to be submitted to the NPWS as part of this permit application, prepared by a qualified archaeologist and outlining the proposed methodology of the excavations. The subsequent subsurface testing work should be conducted by a qualified archaeologist in conjunction with representatives of the local Aboriginal community groups.

An important feature of the development of the AMP will be consultation between all of the following groups:

- NSW National Parks and Wildlife Service,
- Upper Hunter Wonnarua Council,
- Wanaruah Local Aboriginal Land Council;
- Wonnarua Tribal Council,
- Wonnaruah Nation Aboriginal Corporation,
- Lower Hunter Wonnarua Council,
- Muswellbrook Coal Company, and
- A qualified archaeologist.

This form of consultation will be required to determine the timing of works, the methodology of works and the role of each group in the works. This will need to be established in the preliminary stages of the AMP.

14.2.2 Non-Indigenous Heritage

The management recommendations outlined below are aimed at mitigating development impacts to the known and potential non-Indigenous heritage of the study area.

Known Heritage Items

Only one non-Indigenous heritage item was identified by this assessment as potentially impacted by the proposed development – the Muswellbrook Brickworks. Although not located within the study area, the item may be indirectly impacted from the adjacent development through dust, vibration and noise.

The Muswellbrook Brickworks have been identified as an item of local heritage significance on the Hunter Valley Regional Environmental Heritage Schedule and on the Muswellbrook Shire Heritage

Register. It cannot therefore be disturbed in any way without the consent of the Muswellbrook Shire Council.

However, the impact from the proposed development on the Brickworks has been assessed by be minimal, with the Brickworks substantially removed from the proposed works.

As such, no specific management recommendations are presented for the Brickworks during development. However, the proximity of the Brickworks to the development has been identified as a heritage issue and if any alterations are made to the existing development plans, the development impact on the Muswellbrook Brickworks will require reassessment.

Additional Heritage Items

As, under Section 139 of the *Heritage Act* (1977 as amended 1998), no relic can be disturbed in any way without the approval of the NSW Heritage Office, the following management recommendations are made in the event of the discovery of additional non-Indigenous heritage items:

1) Upon discovery of the relic, work must cease immediately while the proper authority is contacted (the NSW Heritage Office) and a permit determination is made.

2) Relics can only be disturbed with an approved Excavation Permit (Section 140) as issued from the NSW Heritage Office.

3) Archaeological assessments are essential in obtaining such permits, and will require an archaeologist to make an on-site assessment and lodge the appropriate documents.

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FIGURES


MUSWELLBROOK COAL COMPANY LIMITED
Dartbrook
Kayuga
Mount Pleasant
Ulan
Bengalla
Muswellbrook
Stratford
Wards River
GLOUCESTER BASIN
Bylong
Bayswater No. 2
Mt Arthur North
Bayswater No. 3
Saddlers Creek
Drayton
Liddell
Mount Owen
Newdell
Cumnock No. 1
CRANKY CORNER BASIN
Nardell
Howick
Glendell
Glennies Ck
Ravensworth/Narama
Camberwell
Hunter Valley
Rixs Creek
Lemington
Singleton
United
Wambo
Warkworth No. 1
Mount Thorley
Saxonvale/Bulga
South Bulga
Mudgee
Maitland
NEWCASTLE COALFIELD
Bloomfield
Kandos No. 3
Charbon
Southland
West Wallsend
Westside
Newstan
New Wallsend No. 2
KOORAGANG
CARRINGTON
NEWCASTLE
HUNTER COALFIELD
Teralba
Awaba
Running Stream
Airly
Cooranbong
Myuna
Catherine Hill Bay
Chain Valley
Wallarah
Moonee
Munmorah
Wyong
Wyee
Endeavour
WESTERN COALFIELD
Baal Bone
Invincible
Ivanhoe No. 2
Angus Place
Springvale
Clarence
Lithgow
Blue Mountains
Canyon
Katoomba
SYDNEY
N
Brimstone
Oakdale
Glenlee
Picton
Appin
Metropolitan
West Cliff
Tahmoor
Tower
Coal Cliff
Bargo
Cordeaux
South Bulli
SOUTHERN COALFIELD
WOLLONGONG
Elouera
Berrima
Avon
PORT KEMBLA
Sutton Forest
LEGEND
Underground Mine
Proposed U/G Mine
Opencut Mine
Proposed O/C Mine
Power Station
SCALE
0 25 50 75
Kilometres
MUSWELLBROOK COAL COMPANY LIMITED
Locality Plan
FIGURE 1
File Name: LOCALITY.CDR

A3

LEGEND

- ARCHAEOLOGICAL SITE
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS

0 100 200 300 400
metres

E 293000

E 294000

N 1431000

N 1430000

Approximate Crest Position (red dash)

Old No. 1 Open Cut (backfilled)

No. 1 Open Cut current Loder seam operations

Open Cut (Muswellbrook Seam)

M-1 M-2 M-3 M-4 M-5 M-6 37-2-104

HLA-Enviroscience Pty Limited
55-65 Grandview Street
Pymble, NSW
61 2 9988 4422

PREVIOUS LANDUSE IMPACTS
Muswellbrook Coal Company Ltd
Archaeological Assessment
Muswellbrook Coal Mine, NSW

FIGURE 2

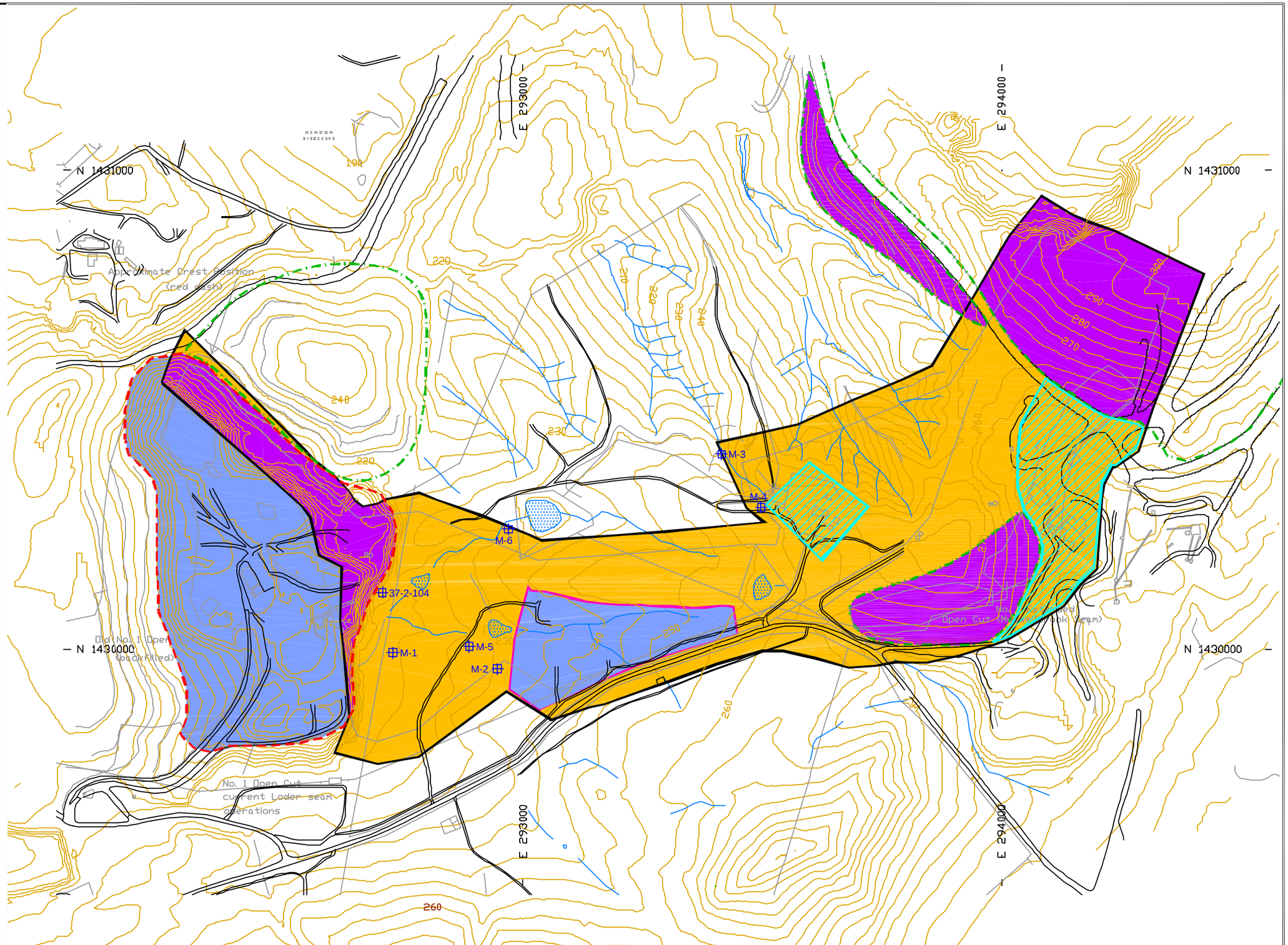
DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-005		June 2002	

A3

LEGEND

- ARCHAEOLOGICAL SITE
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS
- AREA OF HIGH DISTURBANCE
- AREA OF MODERATE TO HIGH DISTURBANCE
- AREA OF MODERATE DISTURBANCE

0 100 200 300 400
metres



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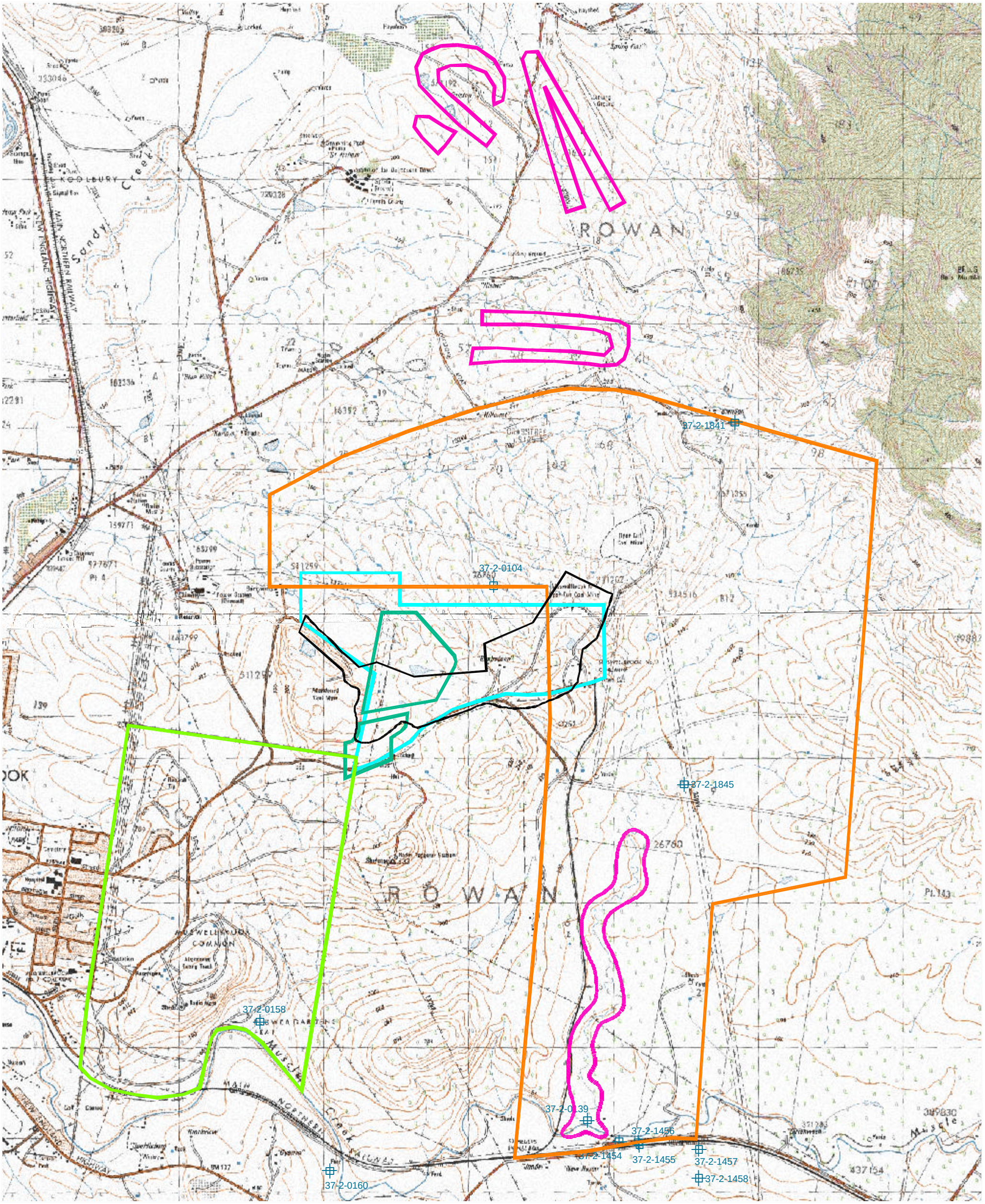
Pymble, NSW
61 2 9988 4422

DISTURBANCE ZONES
Muswellbrook Coal Company Ltd
Archaeological Assessment
Muswellbrook Coal Mine, NSW

FIGURE 3

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-012		June 2002	

A3



LEGEND

- STUDY AREA
- BRAYSHAW 1981 (a)
- BRAYSHAW 1981 (b)
- BRAYSHAW 1981 (c)
- RHEINBURGER 1998
- STUART 1996

37-2-1458 NPWS REGISTERED SITE

HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW 2073
61 2 9988 4422

PREVIOUS ARCHAEOLOGICAL SURVEYS
Muswellbrook Coal Company Ltd
Archaeological Assessment
Muswellbrook Coal Mine, NSW

FIGURE 4

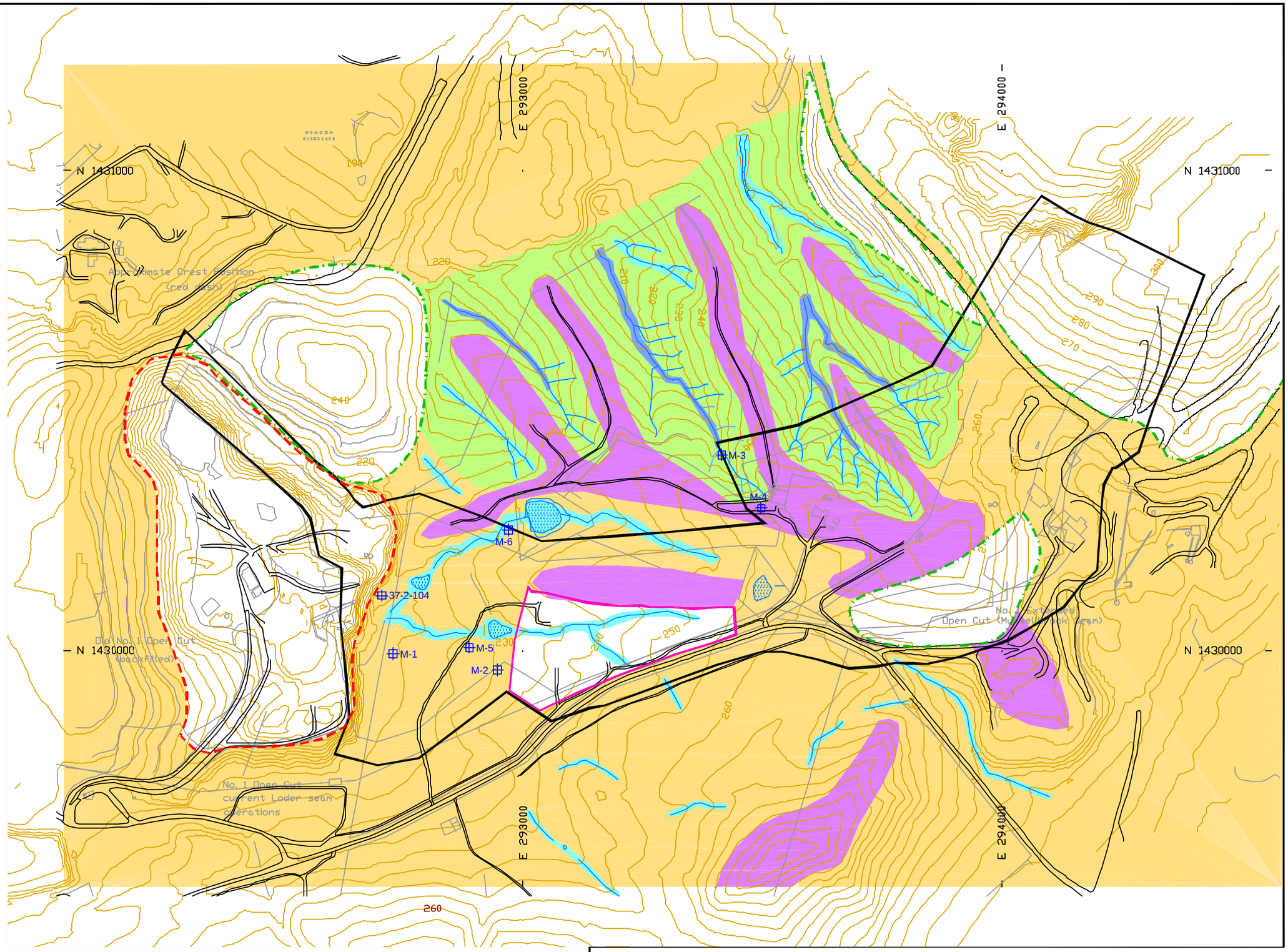
DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-004		April 2002	

A3

LEGEND

- ARCHAEOLOGICAL SITE
- LFU 1: RIDGE CRESTS
- LFU 2: HILLSLOPES
- LFU 3: STEEP HILLSLOPES
- LFU 4: LOWER ORDER STREAMS
- LFU 5: UPPER ORDER STREAMS
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE

0 100 200 300 400
metres



HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW
61 2 9988 4422

LANDFORM UNITS
Muswellbrook Coal Company Ltd
Archaeological Assessment
Muswellbrook Coal Mine, NSW

FIGURE 5

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-002		June 2002	

A3

LEGEND

- ARCHAEOLOGICAL SITE
- ARCHAEOLOGICAL SURVEY UNITS
- REHABILITATION AREA
- OPEN CUT MINING PIT
- SUBSIDENCE EXCLUSION ZONE
- INFRASTRUCTURE AREAS

0 100 200 300 400
metres

N 1431000
E 293000
E 294000
N 1430000
Approximate Crest Position (red dash)
No. 1 Open Cut (backfilled)
No. 1 Open Cut current Loder seam operations
No. 2 Extension Open Cut (Muswellbrook seam)
M-1
M-2
M-3
M-4
M-5
M-6
37-2-104

HLA-Envirosciences Pty Limited
55-65 Grandview Street
Pymble, NSW
61 2 9988 4422

ARCHAEOLOGICAL SURVEY UNITS
Muswellbrook Coal Company Ltd
Archaeological Assessment
Muswellbrook Coal Mine, NSW

FIGURE 6

DRAWN	PROJECT-FILE NUMBER	APPROVED	DATE	REVISED DATE
LJE	U888-003		June 2002	

PLATES

PLATE 1
Subsidence Exclusion Zone

PLATE 2
LFU 1: Hillslopes

PLATE 4
ASU 11

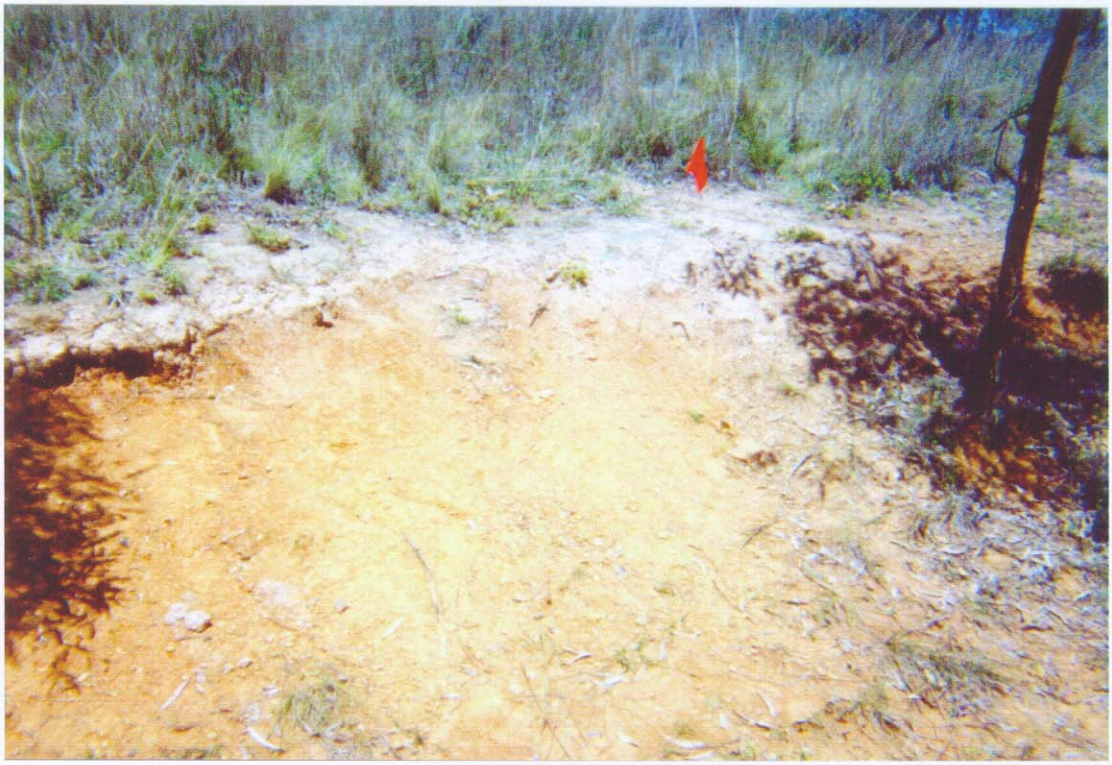


PLATE 5
Site M-3

APPENDIX A

CULTURAL HERITAGE ASSESSMENTS

The Aboriginal Cultural Heritage Assessment contained in Appendix A of the Indigenous and Non-Indigenous Heritage Study can be found in **Appendix J** of **Volume 3** of the EIS.

APPENDIX B

SUMMARY OF HUNTER VALLEY MODELS

Table 1 – Archaeological Settlement Models

Location/ Reference:	Types of Evidence used	Scale of model	Type of Model	Model summary and Predictions
Bulga salvage (Koettig 1994)	Archaeological ethnohistoric	Creek lines within Catchment	Deductive	Based on ethnohistoric accounts of Aboriginal campsites it is suggested that camps had strict size rules water/size and make up of group/length of stay. Residential units can spread over extremely large areas. The longer the stay more types of activities and greater disturbance 'treadage' of archaeological deposits. Implications of this are 1. Infrequent occupation relates to relatively widely distributed and infrequent archaeological features. 2. Repeated occupation would show different activity areas closer together and even superimposed. 3. Longer the stay more types of activities would be reflected in the archaeological remains. Where features are widely spaced and limited in number more likely only one of very few 'events' (doesn't mean small group). If the archaeological evidence is a continuous distribution along watercourse likely that were not camping at specific locations. The frequency of occupation in one location is likely to be related to the availability of certain resources (eg sites at Camberwell adjacent to grinding grooves).
Hunter Region (NPWS Workshop Witter nd) Mt Thorley (Witter in prep)	Archaeological, Ethnographic, Ethno-archaeological	Regional	Deductive	The model uses data from prior surveys and environmental info and diet reconstruction etc. to produce a complex model involving explanations of resource exploitation. Witter equates microblade production with the production of tools for mass hunting of kangaroos. As well it is posited that resources such as plant foods (in particular ribbon lily *Triglochin procera*) and eels would be exploited. Proposed 3 types of open sites… Foraging camps (to exploit stable resources), Base camps (mobile resources) and Satellite camps The functions of a foraging camp and the base camp would overlap but Witter suggests that there may well be spatial partitioning within the camp with concentrations of artefacts reflecting different activities and a peripheral scatter of artefacts on the margin of the camp. For foraging activities stone tools would be made of local material of varying quality, be of medium to light general purpose. For base camp activities evidence of microblade technology would be abundant in the form of high quality raw material and evidence of microblade reduction sequences.

Table 1 – Archaeological Settlement Models

Location/ Reference:	Types of Evidence used	Scale of model	Type of Model	Model summary and Predictions
				On satellite camps, which Witter sees as repair and maintenance of hunting equipment, evidence of good quality cores but microblade workshops would be small with few discarded expended cores. The base/foraging camp would be located near stream junctions or near wetlands where abundant food for foraging could be obtained (probably in an area that maximises environment types). Satellite camps would be located on ridges and at the heads of gullies.
Mt Pleasant & Bengalla (Rich 1995)	Archaeological	Catchment	Inductive/static	Identified that most archaeological evidence is concentrated along streams and site density decreased upstream and away from stream banks. Looked at site distribution in relation to a stone source in the survey area, but found no typical distance decay pattern… • Concluded that there were two types of site • Residential base showing a range of activities including manufacture of stone tools. • Smaller one off activity camps representing resource extraction. • Data collected seems to show some evidence for this with 'larger' sites occurring every 1.4-1.9 kms. • Points out problems of drawing conclusions from sections of sites (parts visible due to erosion etc.) • Other issues include • Different activities leave different amounts of debris • Hard to model full 'range' of activities (limited ethnography) • Time scale/build up • Changes in activities over time • Record shows discard rather than use.
Mount Arthur North (Kuskie 2000)	Archaeological	Catchment	Inductive	Kuskie's model includes the basis that most occupation falls within last 5000 years, although earlier occupation is possible not much evidence expected. That the entire area would have been used but with different purposes and frequencies, that intensive occupation occurs within 50m of major (3rd and 4th order) streams. Presents a picture of campsites on level ground near these major streams consisting of single or multiple family groups in small camps for varying sporadic periods throughout area. Campsites should be identified by evidence for a range of activities. A picture of intermittent use of sites in different seasons or different years and by differing groups over thousand of

Table 1 – Archaeological Settlement Models

Location/ Reference:	Types of Evidence used	Scale of model	Type of Model	Model summary and Predictions
				years presumably produces a very complex archaeological record. His model proposes that focussed individual activities would also have occurred on along minor drainage lines (especially low order streams) these sources of water likely to be more intermittent and focus of activities such as seasonal hunting etc. Activities and access to resources would have involved moving through the slope and ridge landforms. His model also looks at the significance of high points of terrain or 'vantage points'.
Central Lowlands (Dean-Jones and Mitchell 1992)	Geomorphology	Regional		Aims to establish environmental parameters from which site location can be predicted. Uses detailed consideration of environmental evidence to look at Environmental choices in occupation Environmental factors whereby sites may be preserved Environmental factors which allow sites to be detected in the present Changes in drainage lines and nature of duplex soils important considerations. Only 'site location' **not** 'site interpretation' and points out that, although related, there are problems with interpreting occupation strategies when only using a fraction/portion of sites/site complexes givens boundary definition is difficult. Model not well developed. Probably more important for raising important issues in interpretation.
Warkworth (Rich 1994)	Archaeological	Regional	Inductive/Static	Research Design for Sydney Uni research project with a view to dating open sites Proposed a General occupation model – small groups (family/extended family) using base camps for one or two nights with associated gathering camping near water. Larger sites are where several groups might meet, requiring greater resources and leaving evidence of a more diverse range of activities.
Haglund – Warkworth – Doctor's Creek and Sandy Hollow Creek	Archaeological	Catchment	Inductive	Identified that most archaeological evidence is concentrated along streams and site density decreased upstream and away from stream banks.

Table 1 – Archaeological Settlement Models

Location/ Reference:	Types of Evidence used	Scale of model	Type of Model	Model summary and Predictions
(Haglund 1992)	Archaeological/generic ethnohistorical	Catchment	Inductive	Data collected through filed observation and analysis. Assuming traditional male/female labour divisions Using residue and assuming backed blades were used as hunting tool. Notes a variation in sites both type and distribution. Environmental change suggests that when valleys drier a large kangaroo resource would exist and hunting parties would be likely to have smaller camps/waiting places overlooking water – would include repairs etc. to technology. When conditions more favourable larger 'family groups would visit including women and children. Suggests that one off/small numbers of artefacts could be found on travel routes such as ridgelines etc. Variety of sites located need to be classified in terms of time scale and repeated occupation etc before being used for analysis of landscape occupation models
Narama (Rich et al 1992)	Archaeological Excavation and previous surface surveys	Catchment	Inductive Static	Highest density of archaeological material found on a landform unit described as "alluvial terrace unit" located between two channels of Bayswater Creek. The terrace unit is described as being "the most pleasant camping locations" (1992:103), being well drained and accessible to water (1992:103) Low-density artefact scatters were located on the western hillslopes (i.e. on the crests of ridges) these were considered to be generalised occupation rather than focused occupation in the form of knapping floors located in proximity to creeks and waterholes (1992:104). However two areas of more higher density archaeological material were located on the western hillslopes but these were not considered to be knapping floors (1992:104). Knapping floors were identified as being close to creeks and waterholes and were seen as the remains of backed blade production. There is reference to the concept of "gearing up" i.e. the production and maintenance of tools prior to going on a hunting trip (probably derived from Dan Witter) as a reason for why backed blades were being produced. Backed blades were predominantly made using silcrete rather than indurated mudstone. The analysis of reduction sequences indicated that predominantly an alternative flaking strategy was being used rather than the "tranchet reduction" identified by Hiscock as occurring nearby in the Central Lowlands (1992:109). The silcrete seems to have been thermally altered to improve its flaking qualities although no evidence of heat treatment pits or hearths is explicitly reported.

Table 1 – Archaeological Settlement Models

Location/ Reference:	Types of Evidence used	Scale of model	Type of Model	Model summary and Predictions
Liddell (Umwelt 2001)	Generic ethnohistorical/ Archaeological	Catchment	Inductive/static	Makes a number of predictions about site location in relation to landform type but there is no specific link between generic ethnohistoric observations of settlement patterns to the specifics of site locations in the landscape.
Betty's Creek (Baker 1997)	Generic ethnohistorical/ Archaeological	Catchment	Deductive	Baker adopts a model based on generalised ethnographic observations that draw a dichotomy between a residential base – a place where the group lives and specialised field bases and task specific sites where resources are extracted or processed. Baker argues that concepts of "archaeological richness" such as numbers of archaeological features, range of reduction sequences and the nature of reduction strategies could help in identifying residential bases and other sites.

APPENDIX C

NPWS ABORIGINAL SITE REGISTER

SEARCH RESULTS

NPWS Aboriginal Sites Register, Search Results

NPWS SITE ID	SITE NAME	AMGE	AMGN	SITE TYPE
37-2-1841	*NA*	306850	6431320	*NA*
37-2-1845	*NA*	306500	6428820	*NA*
37-2-1454	NH 1	306050	6426350	Isolated Find
37-2-1455	NH 2	306190	6426329	Artefact Scatter
37-2-1456	NH 3	306180	6426348	Artefact Scatter
37-2-1457	NH 4	306600	6426300	Isolated Find
37-2-1458	NH 5	306600	6426100	Isolated Find
37-2-0160	Black Hill, Gyarran	304050	6426150	Open Camp
37-2-0104	Bimbadeen / Muswellbrook	*305182*	*6430193*	Scarred Tree
37-2-0139	Muscle Creek	305830	6426500	Open Camp
37-2-0158	Flower Gardens Flat	303570	6427180	Open Camp

Unregistered Sites

MB-2	305840	6426500	Isolated Find
MB-3	305880	6426560	Isolated Find
MB-4	305900	6426600	Artefact Scatter
MB-5	305880	6426620	Isolated Find
MB-6	305870	6426660	Isolated Find
MB-7	305780	6427140	Isolated Find
MB-8	305780	6427140	Isolated Find
MB-9	305820	6427900	Artefact Scatter
MB-10	305880	6427980	Isolated Find
MB-11	305950	6427980	Artefact Scatter
MB-12	305980	6428060	Isolated Find

MB-13		305980	6428060	Isolated Find
MB-14		306000	6428100	Artefact Scatter
MB-15		306060	6428120	Isolated Find
MB-16		306150	6428320	Isolated Find
MC-1		305320	6432150	Isolated Find
MC-2	*NA*	NA		Isolated Find
MC-3		304770	6433900	Artefact Scatter
MC-4		305050	6433900	Isolated Find
ML 205		306220	6429630	Isolated Find

APPENDIX D

NPWS SITE CARDS

Upper Hunter District REGISTER COPY

1. Map Name Muswellbrook ... Singleton ... 5. Site No. 37-2-104
2. Scale 1:25,000 ... 1:250,000 ... 6. Site type Shield Tree
3. Grid ref 9434.2944 ... 9330.0125 ...
4. Site name(s) Bimbadeen / Muswellbrook ... 7. Classification ...
8. Air photo ref ...
9. Cadastral ...
10. Land Status ... 11. ...

12. Directions for site relocation
East of New England Highway up Hill Street, Muswellbrook, towards Bimbadeen. Tree is 6 m west of dam wall, c 2 m east of fence and 40 metres east of Muswellbrook No 2 open cut coal pit, almost under powerline.

13. Owner E.R. Bromley ... 14. Tenant/Manager ...
Address Bimbadeen ... Address ...
Muswellbrook ...
Attitude ... Attitude ...

15. Site Description
Dead tree with two excisions, facing 31°. Tree split, inner sides of both excisions missing. Some recent steel axe marks on tree, + older saw scar penetrating both excisions

Upper excision, on right — 91 cm long, 9.5 cm deep, 100 cm above ground
Lower excision, on left — 117 cm long, 9.5 cm deep, 24 cm above ground.

16. Reasons for investigation Dames & Moore Survey
17. Condition G.V. good - tree may require removal eventually; it is very close to a mine + a dam; advanced stage of succulence
18. Interpretation ...
19. Visitation Rare
20. Recommendations See p. 3 of attached report
...

21. Environmental description of site locality
Grass bank & box, some clearance, several small dams, one less than 10 metres to east, & precipice into Muswellbrook No 2 Open Cut mine about 40 metres to west.

22. Relation to other sites in locality

23. Details of artifact collections —

24. Is plan or diagram of site attached? Yes/~~No~~

25. Are annotated photographs attached? Yes/~~No~~ How many? 2

26. Other additions

27. Importance of site to Aborigines —

28. Source of this information

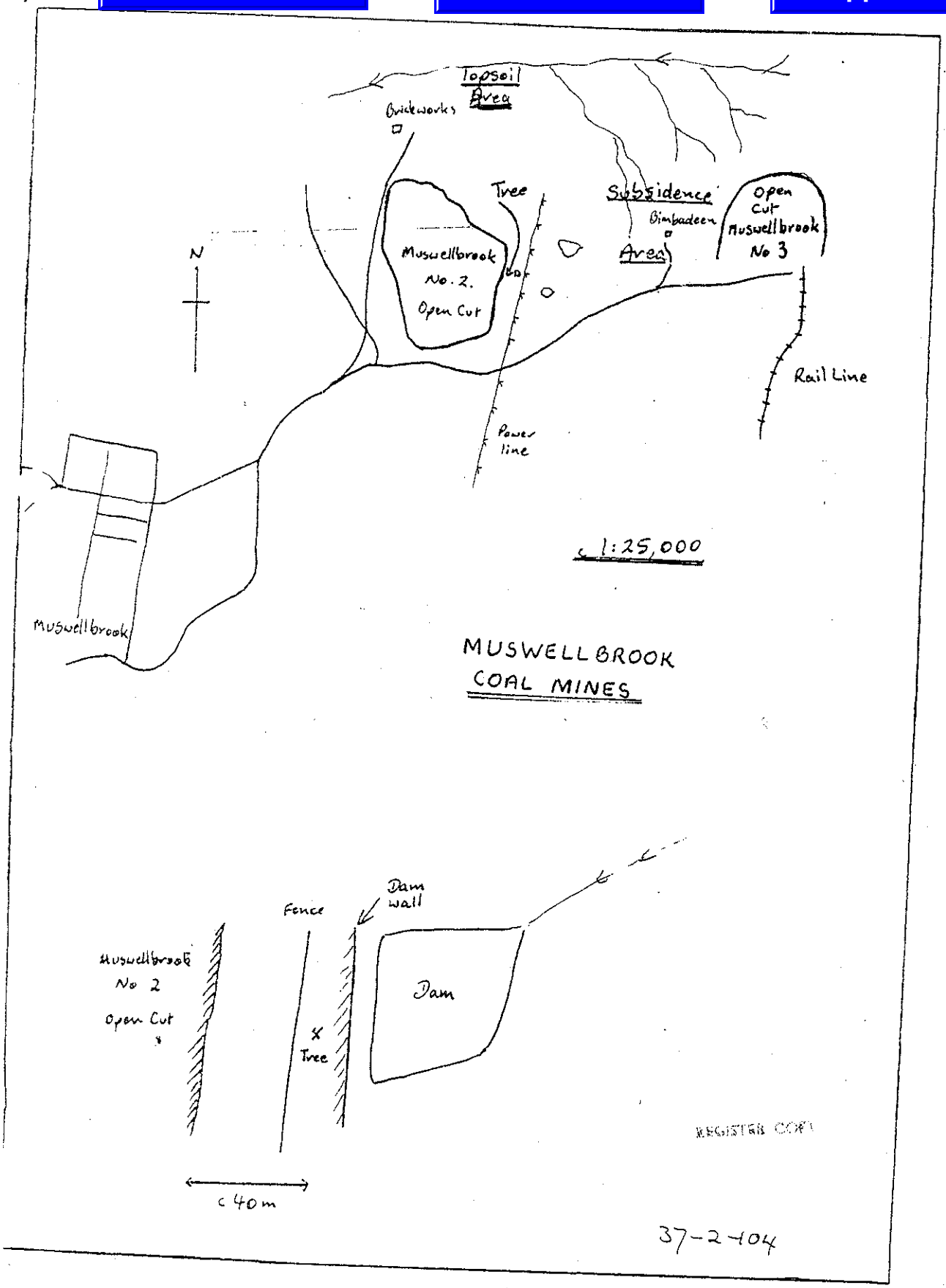
29. Oral sources of information —

30. Written references H. Brayshaw: ~~Consultant~~ Archaeological Investig of Muswellbrook Coal Mines.

31. Recorded by H. Brayshaw Filed by Jenni Sutton

Address

Date March 1981 Date 16/4/81


Topsoil Area
Brickworks
Tree
Subsidence Area
Bimbadeen
Open Cut Muswellbrook No 3
Muswellbrook No. 2. Open Cut
N
Rail Line
Power line
Muswellbrook
c 1:25,000
MUSWELLBROOK COAL MINES
Dam wall
Fence
Muswellbrook No 2 Open Cut
Tree
Dam
c 40m
REGISTERED COPY
37-2404

ARCHAEOLOGICAL INVESTIGATION OF MUSWELLBROOK COAL MINES

Helen Brayshaw,
Consultant Archaeologist.
March 1981.

37-2-104

INTRODUCTION

On March 25, 1981, an archaeological survey was carried out in the vicinity of Muswellbrook Nos 2 and 3 Coal Mines as part of an environmental feasability study being undertaken by Dames and Moore on behalf of Muswellbrook Industries Ltd.

The area between Nos 2 and 3 was being studied for possible subsidence effect of projected underground mining activities, and that to the north of No 2, near the brickworks, for effects of removal of topsoil for regenerative use in worked out areas.

AREA SURVEYED

The area under investigation is Permian Branxton formation of mudstone, sandstone and conglomerate to the north, and extends southwards onto the Permian Greta Coal Measures, comprising sandstone, conglomerate, shale and coal seams. The eastern end is steep with deeply graded gullies, flattening out as the gullies join a larger creek running east to west along the northern extremity of the area investigated.

Some clearing has taken place and a number of small dams have been constructed. In the steeper area particularly, however, the original forest of ironbark and box is intact. Occasionally sandstone is exposed in the gully beds, but otherwise the beds consist of sand and light gravel.

EXPECTATIONS

There is no record of archaeological sites within the immediate vicinity of the area, but recent surveys on the Muswellbrook coalfields suggested that surface campsites and possibly axe grinding grooves were the types of sites most likely to occur here.

37-2-104

SURVEY FINDINGS

The survey was conducted on foot, with particular attention being paid to creek beds and verges, and bare and eroding areas. No stone artefacts or flakes or grinding grooves were found.

However, immediately below a small dam, the easternmost from Bimbadeen homestead, and only about 40 metres west of the lip of No 2 open cut mine, is a dead tree form which two pieces of bark have been removed. Both excisions are elliptical in shape and consistent with the types of shields and containers used by the Aborigines of this area. The tree is split and the inside edge of each excision is missing.

Excision dimensions:

Lower, left: 117 cm long
9.5 cm deep
29 cm above ground

Upper, right: 91 cm long
9.5 cm deep
100 cm above ground.

RECOMMENDATIONS

This tree occurs in the area of possible subsidence effect. No other sites were found here. Extraction of coal from the proposed underground mine and transportation to the washery and railway line will take place over already disturbed disturbed ground and using existing facilities. It is therefore suggested that archaeologically the only concern is for the tree. Although it is dead and split, relics of this nature are uncommon in the area. This, together with its relatively precarious position close to the edge of the mine and below the dam, may lead the National Parks & Wildlife Service to require its removal for preservation, if that cannot be guaranteed in situ.

37-2-104

In the time available it was possible to make only a brief survey of the area designated for topsoil removal. No sites were found here. However, in view of the brevity of the survey and the fact that as yet no decision has been made as to the precise areas from which topsoil is to be removed, further archaeological advice will be required.

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☐ Additional information ☐

SITE IDENTIFICATION

Site name	M-1	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Extension A: located near western limit of development area (near earlier No. 1 Open Cut)				
How to get to the site	See report				
1:250,000 map name	Singleton			**NPWS map code**	
AMG Zone	56	**AMG Easting**		**AMG Northing**	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook
NPWS District Name (see map)				**NPWS Zone (see map)**	
Portion no.				**Parish**	Rowan

SITE DESCRIPTION

Site type(s)	Artefact Scatter	**Site type code (NPWS use only)**	
Description of site and contents CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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	Scatter contains; 1 silcrete flaked piece, 3-4cm 1 mudstone flaked piece, 1-5cm Two artefacts located within 3m square area.		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

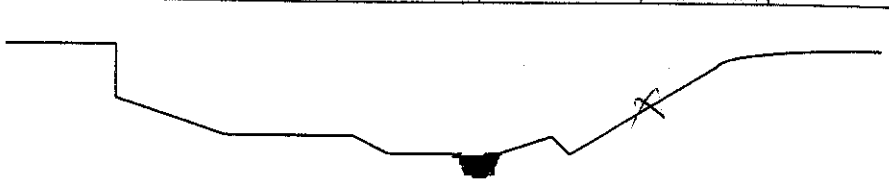
	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Hillslope	**Aspect**		**Slope**	1-3%
Mark position of the site					
Local rock type	Sandstone, shale	**Land use/effect**	Grazing		
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)	Savannah woodland	**Vegetation**	Moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Find

SITE MANAGEMENT

Site condition	Disturbed	Directly disturbed from geological test-pit (TP1). Also impacted from grazing and erosion.	
Management recommendations	Although disturbed, site assessed to potentially contain additional artefacts in subsurface contexts. Recommend Consent to Destroy be applied for, on the condition of subsurface testing of the site prior to development.		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Victor Perry, Martin Feeney Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Steven O'Grady, Beverly Van Vliet Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

Is the site important to local Aborigines	Yes		
Verbal/written reference sources		**ASR report number(s) (or title)**	C- C-
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Vanessa Hardy; Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☒ Additional information ☐

SITE IDENTIFICATION

Site name	M-2	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Extension A: located to the west of borrow pit (adjacent spoil heap)				
How to get to the site	See report				
1:250,000 map name	Singleton			**NPWS map code**	
AMG Zone	56	**AMG Easting**		**AMG Northing**	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook
NPWS District Name (see map)				**NPWS Zone (see map)**	
Portion no.				**Parish**	Rowan

SITE DESCRIPTION

Site type(s)	Isolated Find	**Site type code (NPWS use only)**	
Description of site and contents CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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	Site contains; 1 mudstone flaked piece, 2-3cm		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

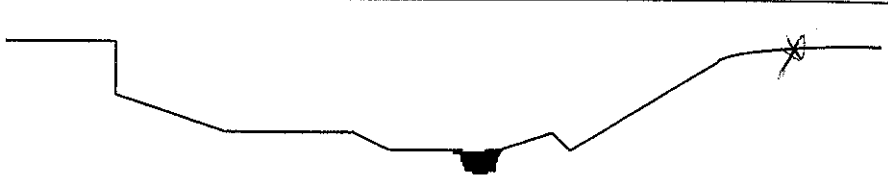
	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Crest	**Aspect**		**Slope**	1%
Mark position of the site					
Local rock type	Sandstone, shale	**Land use/effect**	Mine activity		
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)	Savannah woodland	**Vegetation**	Moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Finds

SITE MANAGEMENT

Site condition	Very disturbed	Artefact exposed through removal of earth for borrow pit. On edge of soil from spoil heap.	
Management recommendations	Of low archaeological significance, due to small number of artefacts and high likelihood of post-depositional movement. Low research potential. Recommend Consent to Destroy be applied for and artefacts collected.		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Victor Perry, Martin Feeney Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Steven O'Grady, Beverly Van Vliet Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333

Version: June 1998 | Data entered by: | Date entered:

Aboriginal Sites Register of NSW

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Is the site important to local Aborigines	Yes		
Verbal/written reference sources		**ASR report number(s) (or title)**	C- C-
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Vanessa Hardy; Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☒ Additional information ☐

SITE IDENTIFICATION

Site name	M-3	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Extension B: located on western boundary of development limit, within drainage channel				
How to get to the site	See report				
1:250,000 map name	Singleton			**NPWS map code**	
AMG Zone	56	**AMG Easting**		**AMG Northing**	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook
NPWS District Name (see map)				**NPWS Zone (see map)**	
Portion no.				**Parish**	Rowan

SITE DESCRIPTION

Site type(s)	Artefact Scatter	**Site type code (NPWS use only)**	
Description of site and contents CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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	Site contains; 1 silcrete flaked piece, 2-3cm 1 broken silcrete fragment, 2-3cm. Scatter contained in area 2m square		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

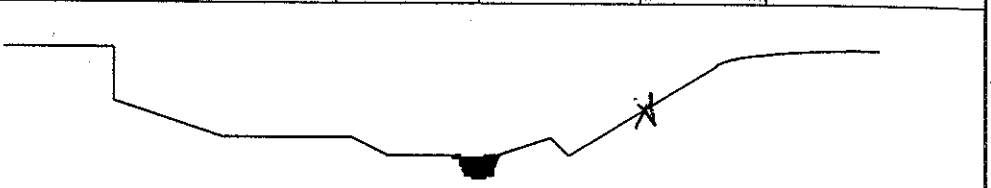
	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Hillslope	**Aspect**		**Slope**	1%
Mark position of the site					
Local rock type	Sandstone, shale	**Land use/effect**	Residential, mining activity		
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)	Savannah woodland	**Vegetation**	Moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Finds

SITE MANAGEMENT

Site condition	Disturbed	Disturbed from construction of drainage channel and from erosion (sheetwash).	
Management recommendations	Of low archaeological significance, due to small number of artefacts and high likelihood of post-depositional movement. Low research potential. Recommend Consent to Destroy be applied for and artefacts collected.		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Victor Perry, Martin Feeney Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Steven O'Grady, Beverly Van Vliet Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333

Version: June 1998	Data entered by:	Date entered:

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

sources		**number(s) (or title)**	C-
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Vanessa Hardy; Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☒ Additional information ☐

SITE IDENTIFICATION

Site name	M-4	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Extension B: located within vehicle access track to northwest of Bimbadeen homestead				
How to get to the site	See report				
1:250,000 map name	Singleton			**NPWS map code**	
AMG Zone	56	**AMG Easting**		**AMG Northing**	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook
NPWS District Name (see map)				**NPWS Zone (see map)**	
Portion no.				**Parish**	Rowan

SITE DESCRIPTION

Site type(s)	Artefact Scatter	**Site type code (NPWS use only)**	
Description of site and contents CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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	Site contains; 1 mudstone flake, 2-3cm1 silcrete flaked piece, 1-2cm Scatter located within 5m square area.		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

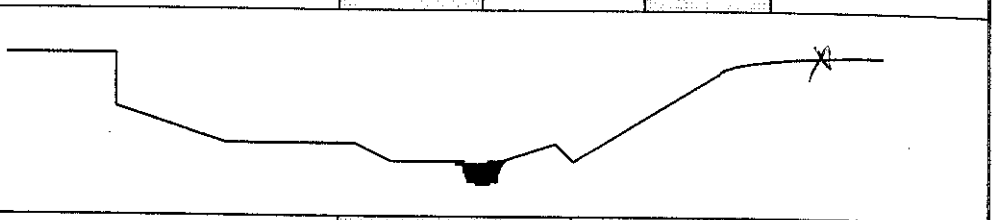
	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Ridge crest	**Aspect**		**Slope**	1%
Mark position of the site					
Local rock type		**Land use/effect**			
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)		**Vegetation**	Savannah woodland: moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Finds

SITE MANAGEMENT

Site condition	Disturbed	Disturbed from construction and continued use of vehicle access track.	
Management recommendations	Of low archaeological significance, due to small number of artefacts and high likelihood of post-depositional movement. Low research potential. Recommend Consent to Destroy be applied for and artefacts collected.		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Victor Perry, Martin Feeney Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Steven O'Grady, Beverly Van Vliet Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333
Is the site important to	Yes		

Version: June 1998 | Data entered by: | Date entered:

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

		(or title)	
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Vanessa Hardy; Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☒ Additional information ☐

SITE IDENTIFICATION

Site name	M-5	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Located within Extension A of the MCC development.						
How to get to the site	See report						
1:250,000 map name	Singleton				**NPWS map code**		
AMG Zone	56	**AMG Easting**	304487		**AMG Northing**	6249332	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook 9033-II-N		
NPWS District Name (see map)					**NPWS Zone (see map)**		
Portion no.					**Parish**	Rowan	

SITE DESCRIPTION

Site type(s)	Scarred Tree	**Site type code (NPWS use only)**	

Description of site and contents
CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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

The tree is a large gum, approximately 25m high in total. The trunk forks approximately 1.5m from the ground into two main branches, from which there are numerous smaller branches. One scar was identified on the east branch of the trunk:

Scar 1:
Dimensions: 173cm above ground
195cm total length
15m total width
7cm deep
Scar is elliptical in shape, tapers at top and base of scar. Full dimensions of scar are intact.

Scar is positioned on the northern face of the tree.

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

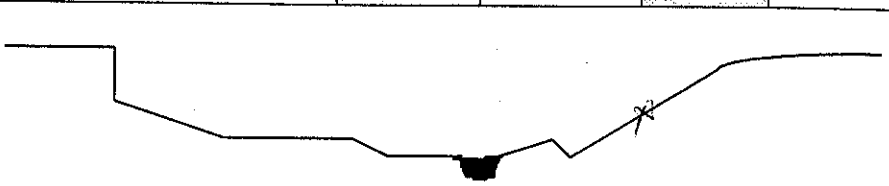
	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Hillslope	**Aspect**		**Slope**	1%
Mark position of the site					
Local rock type	Sandstone, shale	**Land use/effect**	Grazing		
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)	Savannah woodland	**Vegetation**	Moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Finds

SITE MANAGEMENT

Site condition	Good	Scar intact. Some weathering to bark on remainder of tree.	
Management recommendations	Preferred management is to retain site. If development plans continue, the relocation of tree required so that it can survive and maintain a principal part of its heritage significance.		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333 Lower Hunter Wonnarua Council
Is the site important to local Aborigines	Yes		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

local Aborigines			
Verbal/written reference sources		**ASR report number(s) (or title)**	C- C-
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

New Recording ☒ Additional information ☐

SITE IDENTIFICATION

Site name	M-6	**NPWS Site Number**	
Owner/manager	Muswellbrook Coal Company Limited		
Owner Address	PO Box 123 Muswellbrook NSW 2333		

LOCATION

Location	Located within Extension A of the MCC development: found to the west of the largest dam of Extension A.						
How to get to the site	See report						
1:250,000 map name	Singleton				**NPWS map code**		
AMG Zone	56	**AMG Easting**	304565		**AMG Northing**	6429578	
Method for grid reference	Topographic map	**Map scale (if method = map)**	1:25,000	**Map name**	Muswellbrook 9033-II-N		
NPWS District Name (see map)					**NPWS Zone (see map)**		
Portion no.					**Parish**	Rowan	

SITE DESCRIPTION

Site type(s)	Scarred Tree	**Site type code (NPWS use only)**	

Description of site and contents
CHECKLIST: eg. 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 decorated surface, motifs, colours, wet,/dry pigment, engraving technique, 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

Tree is large Ironbark, approximately 35m total height. The trunk forks approximately 15m from the ground into a number of smaller branches.

Two scars were identified on the main trunk of the tree:

Scar 1:
Dimensions: 130cm above ground
122cm total length
23cm total width
6.5cm deep
Scar is elliptical in shape, tapers at top and base of scar. Minor bark damage around base of scar from weathering, with some bark decayed (80cm below base of scar).

Scar 2:
Dimensions: 340cm above ground
110cm total length
23cm total width
Scar is elliptical in shape, tapers at top and base of scar. As with Scar 1, there is minor bark damage around base of scar from weathering, with some bark decayed (60cm below base of scar).

Both scars are aligned on the eastern face of the tree, being placed one above the other. 40cm seperates the two scars. The tree is the only remaining tree within this paddock, and is standing alone approximately 30m to the west of the largest dam of the MCC Extension A area.

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

	Attach photographs and sketches, eg. plan & section of shelter. **Do NOT dig, disturb or damage site or contents.**

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

SITE ENVIRONMENT

Land form	Hillslope	**Aspect**		**Slope**	1%
Mark position of the site					
Local rock type	Sandstone, shale	**Land use/effect**	Grazing		
Distance from drinking water		**Source**			
Resource zone (eg. estuarine, river, forest)	Savannah woodland	**Vegetation**	Moderate to dense grass ground cover. Main vegetation includes grey box, forest red-gum, spotted gum and ironbark.		
Edible plants		**Faunal resources** (include shellfish)			
Other exploitable resources (eg. ochre)					
Are there other sites in the locality	Yes	**Are they in the Sites Register**	Yes	**Other site types include**	Artefact Scatters, Isolated Finds

SITE MANAGEMENT

Site condition	Good	Minor bark damage around each of the scars, with 60cm-80cm of damaged and/or removed bark below each scar.	
Management recommendations	Retention of tree the preferred management option. Strongly recommeded that development plan is modified to retain tree (which is located on existing boundary of development area).		
Have artefacts been removed from site	No	**When**	
By whom		**Deposited at**	
Consent applied for	☐	**Consent issued**	☐
Date of issue		**Consent number**	

SITE INSPECTION AND RECORDING

Reason for investigation	EIS for Mine Extension		
Were local Aborigines contacted or present for the recording	☐ Not contacted ☒ Contacted and present ☐ Contacted but not present	**Names and addresses**	Upper Hunter Wonnarua Council PO Box 184 Singleton NSW 2330 Wanaruah Local Aboriginal Land Council PO Box 127 Muswellbrook NSW 2333 Lower Hunter Wonnarua Council
Is the site important to local Aborigines	Yes		

Version: June 1998	Data entered by:	Date entered:

Aboriginal Sites Register of NSW

NPWS, PO Box 1967, Hurstville NSW 2220

Standard Site Recording Form

local Aborigines			
Verbal/written reference sources		**ASR report number(s) (or title)**	C- C-
Photographs taken	Yes	**No. of Photos attached**	
Site recorded by	Meaghan Russell	**Date of recording**	
Address/institution	HLA-Envirosciences PO Box 726, Pymble NSW 2073		

APPENDIX E

NON INDIGENOUS ITEM RECORD

MUSWELLBROOK HERITAGE STUDY
Inventory 1996

MUSWELLBROOK BRICK WORKS

PRESENT NAME *Muswellbrook Brick Works*

PREVIOUS/OTHER NAMES

REFERENCE No *MUSW/R030*

PREVIOUS REFERENCE No

DATE INSPECTED *21st February 1998*

LOCATION

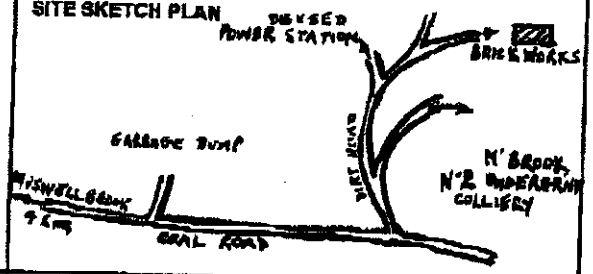
STREET No STREET NAME *Off Common Road/Coal Road*

TOWN/SUBURB *Muswellbrook* **POSTCODE** *2333*

LOCALITY *Muswellbrook*

LOCAL GOVERNMENT AREA *MUSWELLBROOK*

SITE SKETCH PLAN



PRESENT OWNER
NAME *Muswellbrook Brick Co Pty Ltd* **TYPE** *Private*

OWNERS ADDRESS *PO Box 228*

STREET No STREET NAME
TOWN/SUBURB *Muswellbrook* **POSTCODE** *2333*

PROPERTY DETAILS:

a **REAL PROPERTY DESCRIPTION** *Lot 101 DP579078 and interest in ROW*

b **SITE AREA** *4.759 hectares*

c **EXISTING ZONING** *7(L2) - Environment Protection - Urban Buffer*

CATEGORY *Other Works*

SUB CATEGORY *Brickworks*

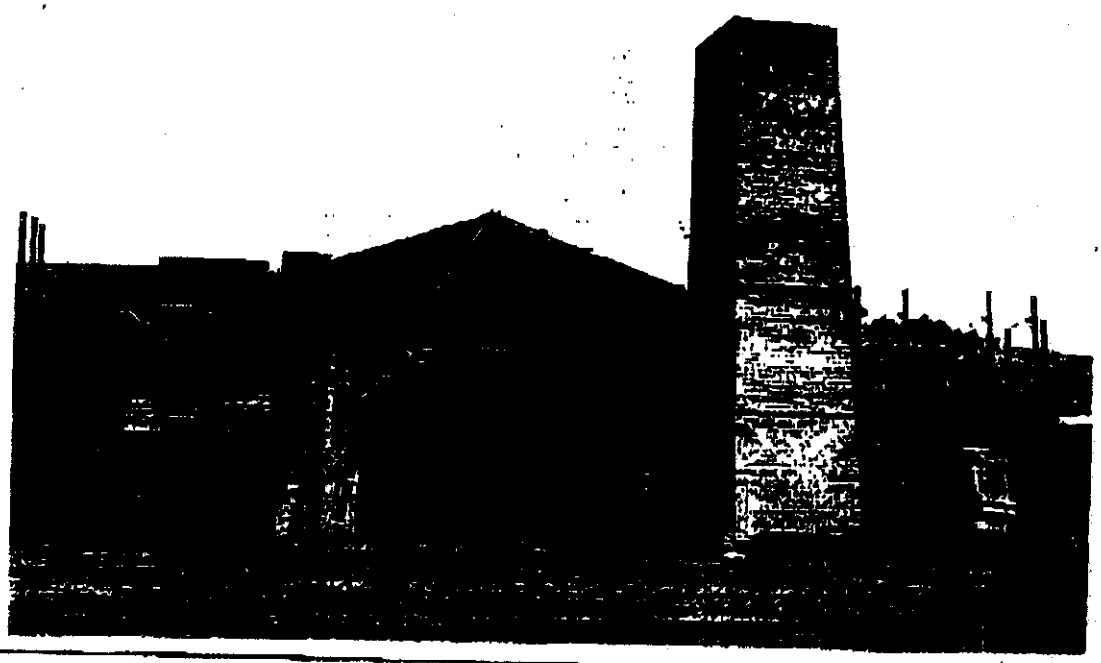
DATE OF CONSTRUCTION *c.1949*

ARCHITECT/DESIGNER *Unknown*

BUILDER *Unknown*

MAP REFERENCE *'56' 303700E, 6430150N AMG Aberdeen 9033-I-S*

PHOTOGRAPH



HERITAGE LISTING

- ☐ REGISTER OF THE NATIONAL ESTATE (AHC) - REGISTERED
- ☐ REGISTER OF THE NATIONAL ESTATE OF AUST. (AHC) - INTERIM
- ☐ REGISTER OF NATIONAL TRUST (NSW)
- ☐ REGISTER OF SIGNIFICANT TWENTIETH CENT. ARCHITECTURE (RAIA)
- ☐ DEPARTMENT OF PUBLIC WORKS HERITAGE AND CONS. REGISTER
- ☐ COMMONWEALTH HISTORIC SHIPWRECKS ACT (DECLARED SITE)
- ☐ HERITAGE COUNCIL REGISTER - PERMANENT CONS. ORDER
- ☐ HERITAGE COUNCIL REGISTER - INTERIM CONS. ORDER
- ☐ HERITAGE COUNCIL REGISTER - SECTION 130 ORDER
- ☐ HERITAGE COUNCIL REGISTER - NOMINATION
- ☐ NSW GOVT DEPT HERITAGE REGISTER (S170 HERITAGE ACT)
- ☐ NPWS HISTORIC SITES REGISTER
- ☐ NPWS ABORIGINAL SITES REGISTER (CONTACT SITES)
- ☐ INSTITUTION OF ENGINEERS (NSW) HERITAGE REGISTER
- ☐ EXISTING HERITAGE STUDY (WRITE NAME BELOW)
- ✓ REGIONAL ENVIRONMENTAL PLAN HERITAGE SCHEDULE
- ☐ LOCAL ENVIRONMENTAL PLAN HERITAGE SCHEDULE
- ✓ OTHER

HERITAGE REGISTER, MUSWELLBROOK SHIRE

HISTORICAL PERIOD

PERIOD	BUILT	USED
PRE 1820	☐	☐
1820 - 1835	☐	☐
1836 - 1850	☐	☐
1851 - 1875	☐	☐
1876 - 1900	☐	☐
1901 - 1920	☐	☐
1926 - 1950	✓	✓
1951 - 1975	☐	✓
POST 1976	☐	✓

HISTORICAL THEMES

S.H.I.P. THEMES	LOCAL THEMES
Booms and Busts	*The economic cycle of Muswellbrook*
Industrialisation and Decentralisation	*Coal mining in the Muswellbrook district*
Technology	*The manufacture of bricks in the Muswellbrook area*

HISTORICAL NOTES

Said to have been established in 1949 by Muswellbrook Industries in order to exploit clay deposits of its own Muswellbrook Coal Co. Pty Ltd open cut mine. The coal company also provided the shale and coal necessary for brick production. The works closed briefly in 1975 but were reopened by O.J. O'Brien. The present owners G. Jackson and D. Goodridge have retained the coal firing of the three down draft kilns enabling the production of many traditional colours. The kilns have a total capacity of 150,000 bricks. The brickworks also has several brick hand-presses made in England in the 1860's. The machines are currently being restored to be used in the production of bricks for heritage buildings which were built with these bricks.

PHYSICAL CHARACTERISTICS / DESIGN SPECIFICATIONS *3 down draft brick kilns, 2 roll crushers, mixing bowls and brick presses*

a ARCH. STYLE *Brick kilns, corrugated iron roofs and timber framed buildings* MATERIALS: Exterior
Interior *Brick lining to kilns*

b OTHER DETAILS OF PHYSICAL APPEARANCE *Square, banded draught stacks coal fired kilns to achieve traditional colours.*

c MODIFICATIONS

d CURRENT CONDITIONS ✓ INTACT ☐ REPAIRS REQUIRED
☐ ALTERED - UNSYMPATHETIC ☐ ALTERED - SYMPATHETIC
✓ ADDITIONAL COMMENTS: *Produced dry pressed bricks. Some roof replacement required.*

INFORMATION SOURCES

WRITTEN *Newcastle Sun 10.3.1965; Newcastle Morning Herald 15.8.1970; Heritage Register, Muswellbrook Shire*
ORAL *Current Owner, Geoff Jackson*
GRAPHIC

EVALUATION CRITERIA (S) = STATE (R) = REGIONAL (L) = LOCAL

HISTORIC	RARE ✓ *(R)*	REPRESENTATIVE ☐
AESTHETIC	RARE ✓ *(L)*	REPRESENTATIVE ☐
SOCIAL	RARE ☐	REPRESENTATIVE ☐
SCIENTIFIC	RARE ✓ *(R)*	REPRESENTATIVE ☐

STATEMENT OF SIGNIFICANCE

A working example of downdraft brick kilns using traditional coal firing methods for the production of dry pressed bricks. In almost continuous use over a forty five year period. It is of regional historic significance in type, and is of similar scientific significance for its potential to reveal information about brickmaking methods in the Upper Hunter area over the past century.

APPENDIX F

GLOSSARY

GLOSSARY

ARCHAEOLOGICAL SITE	Any location that contains evidence of human activity.
ARTEFACT	An object made of modified by human activity. In this report, the term has been used to describe pieces of stone that have been modified.
ARTEFACT SCATTER	A locality that contains evidence of Aboriginal occupation in the form of stone artefacts. Commonly defined as containing two or more artefacts within 50m or 100m of each other.
BACKED BLADE	Microlith implement; small, delicately retouched, probably functioned as spear barb.
BENCH	Landform element: a very short, very gently or gently inclined minimal mid-slope element.
BONDI POINT	A sub-type of microlith implement with abruptly angled backing retouch along one lateral margin so that it has asymmetrical plan.
CHERT	Highly siliceous rock, normally with high percentage of quartz. Presumably a graduation of highly siliceous grade of mudstone. Excellent flaking qualities.
CLAST	A grain or crystal inclusion within a finer-grained matrix (common in silcrete).
COBBLE	Waterworn stones of diameter greater than 64mm and less than 256mm. Often called pebbles.
CORE	A piece of stone from which flakes have been removed, that cannot otherwise be described as a retouched artefact.
DEBITAGE	Discarded debris from stone flaking. Usually a large quantity for every finished stone implement.
DRAINAGE DEPRESSION	Landform element that typically comprises of a shallow open depression with smoothly concave cross section, rising to moderately inclined side slopes. Often eroded or aggravated by sheetwash.
ELOUERA	Implement larger than a microlith and shaped like an orange segment. Tool made to be fixed onto wooden handle or haft, probably for obtaining/processing plant foods.

FLAKE	Complete or substantially complete piece of lithic material detached from a core. The primary fracture surface (ventral) exhibits features such as fracture initiation, bulb of force, undulation and lances.
FLAKED PIECE	Piece of lithic material detached from a core during the production of a flake.
GRINDING GROOVES	Elongated narrow depressions in soft rock (particularly sedimentary) generally associated with watercourses. Created by shaping of axes or ground stone artefacts.
HEAT TREATMENT	The intentional slow heating of stone, particularly silcrete, to above 300°, to alter its structure and improve flaking qualities.
HERITAGE ITEM	A building, work, archaeological site, place or moveable item over 50 years in age (refers to both non-Indigenous and Indigenous heritage).
INDURATED MUDSTONE	Mudstone altered by low-grade heat or pressure.
IN SITU	Archaeological materials located in original place of deposition.
ISOLATED FIND	A locality that contains evidence of Aboriginal occupation in the form of a single stone artefact removed by at least 50m from another stone artefact. .
KNAPPING	The manufacture of stone so that it breaks into flakes.
LANDFORM ELEMENT	Specific type of topographic feature, ie, ridge crest, hilllope, flat, bench, drainage depression.
LITHIC	Items of a hard, usually siliceous, nature utilized for stone tool manufacture.
MUDSTONE	Sedimentary rock typically consisting of more than 50% clay and silt. Very fine grained, can be highly indurated with silica. Varies from well to poorly cemented.
PAD	Potential Archaeological Deposit. Term indicates an area of possible archaeological material, commonly refers to sub-surface deposits.
PORCELANITE	White, fine-grained rock material. Well cemented. Geological source unknown.
POST-DEPOSITIONAL PROCESSES	The movement of archaeological materials after their original deposition. Refers to a number of processes – natural, human and animal.

QUARTZ	A hard transparent crystalline mineral widely distributed in rocks of all types. Occurs as pebbles and cobbles in the Triassic sandstone conglomerates of the Hunter Valley.
REDUCTION PROCESS	Process by which flakes are removed from a core, or manufacturing an implement by flaking and/or grinding, or progressively rejuvenating a tools working edge.
REDUCTION STRATEGY	Method of flaking and/or grinding a piece of stone in predetermined stages to produce an implement.
RIDGE CREST	Landform element that stands above most or all of the surrounding points in the adjacent terrain. Typically smoothly convex of with greater length than width.
RILL	A small channel cut by concentrated runoff through which water flows during and immediately after rain.
SANDSTONE	Cemented or compacted rock consisting of detrital grains. Quartz typically comprises most of the grains.
SCARRED TREE	Trees that contain scars caused by the removal of bark for use in the manufacture of canoes, containers, shields or shelters. Other carvings may relate to burial practices or spiritual beliefs.
SHEET EROSION	The removal of the upper layers of soil by rainwater movement (splash and/or runoff).
SILCRETE	Intensely indurated rock composed mainly of quartz clasts cemented by a matrix. Normally gray, but can be white, red, brown or yellow. Easily shatters into sharp, angular pieces.
SILTSTONE	Unindurated, relatively soft material. Permian in origin.
SITE	Location of material evidence of Aboriginal occupation or land use.
STONE ARTEFACT	A piece of stone with evidence of intentional human modification. `
STONE TOOL	A piece of flaked or ground stone used in an activity or fashioned for use as a tool.
TOPSOIL	A part of the soil horizon, typically the A1 Horizon, containing material that is usually darker, more fertile and better structured than the underlying layers.

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20th June 2002

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