Centennial Hunter Pty Limited

ANVIL HILL PROJECT

environmental assessment

VOLUME 6 - APPENDIX 13a

Umwelt
Environmental Consultants

AUGUST 2006

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Executive Summary

Centennial Hunter Pty Limited (Centennial) proposes to establish an open cut coal mining operation, referred to as the Anvil Hill Project, in the Wybong area, 20 kilometres west of Muswellbrook (refer to **Figure 1.1** in **Section 1**). As part of the Environmental Assessment for the proposed Anvil Hill Project (the Project), Umwelt (Australia) Pty Limited (Umwelt) was commissioned by Centennial to prepare an *Aboriginal Archaeological Assessment*. The purpose of the assessment was to gain an understanding of Aboriginal occupation and site distribution in the area proposed for impact by open cut mining and associated activities (the Proposed Disturbance Area) and in adjacent areas which have potential as Aboriginal Cultural Heritage Offsets for the Project. The Proposed Offset Areas include Anvil Hill itself, Wallaby Rocks and the adjacent slopes leading to Wybong Creek, Limb of Addy Hill, Western Rocks and sections of Big Flat Creek (refer to **Figure 1.2** in **Section 1**).

Consultation Process

Aboriginal community involvement is an essential component of the Aboriginal heritage assessment process. There were sixteen Aboriginal stakeholder groups that registered interest in consultation for the Project following the advertisement and notification process. The Aboriginal stakeholder groups included Aboriginal Native Title Consultants, Giwiirr, Hunter Valley Aboriginal Corporation, Hunter Valley Cultural Consultants, Lower Wonnarua Tribal Consultancy Pty Limited, Ungooroo Aboriginal Corporation, Upper Hunter Heritage Consultants, Upper Hunter Wonnarua Council Inc, Valley Culture, Wanaruah Custodians, Wanaruah Local Aboriginal Land Council, Wattaka Wonnarua CC Service, Wonnarua Culture Heritage, Wonnarua Elders Corporation, Wonnarua Nation Aboriginal Corporation and Yarrawalk.

Umwelt, in consultation with the sixteen Aboriginal stakeholder groups and the Department of Environment and Conservation (DEC), developed a survey strategy and recording methodology based on landform elements and archaeological terrain units (refer to **Sections 1**, **2** and **6** for details). The survey strategy was designed to incorporate investigation of the Proposed Disturbance Area and the Proposed Offset Areas (refer to **Figure 1.2**).

Centennial provided the opportunity for all sixteen Aboriginal community groups to participate in the survey and fourteen chose to take part over two periods from the 4 May to 25 May 2005 and 29 November to 7 December 2005 (22 days in total). Two additional groups, Muswellbrook Cultural Consultants and Mingga Consultants, informed Centennial of their interest in the Project after the survey had commenced and thus were not involved in the fieldwork. Muswellbrook Cultural Consultants and Mingga Consultants (and the two groups that chose not to participate in the survey) were provided with a copy of the draft report for comment and were given the opportunity to attend a site visit prior to providing comment.

Survey Results

The survey covered the Proposed Disturbance Area (2238 hectares) and Proposed Offset Areas (1078 hectares). The survey identified 173 Aboriginal sites within the total survey area, including 69 sites in the Proposed Disturbance Area and 98 sites in the Proposed Offset Areas and 6 sites are within areas which will not be impacted (refer to **Figure 6.2** in **Section 6**). These sites were primarily artefact scatters (88 sites) and isolated finds (69 sites) with mudstone and silcrete flakes dominating the assemblages. The majority of these sites (98) were identified on creek banks or within 30 metres of watercourses, and some of the sites were associated with potential archaeological deposit (PAD). Sixteen rockshelter sites with surface evidence of Aboriginal occupation (including stone artefacts and in some cases calcined bone, shell and worked shell) and PAD were also recorded. The rockshelter sites are all within the Proposed Offset Areas (Anvil Hill had four rockshelter sites; Wallaby

Rocks nine rockshelter sites; Limb of Addy Hill one rockshelter site and Western Rocks four rockshelter sites).

The rail loop alignment was modified to avoid a significant site (SC10), resulting in the conservation of SC10 and also avoiding disturbance of four other sites. Further survey of the modified rail loop alignment will be conducted in consultation with the Aboriginal groups to confirm management outcomes for the portion of the Proposed Disturbance Area that has not been surveyed to date, in particular the drainage line crossings.

Observations of the landscape within the Proposed Disturbance Area indicate prior land use included cultivation, quarrying, clearing of mature trees by ringbarking and ripping, pastoralism and the establishment of farm infrastructure and utilities. This has led to the high levels of erosion of topsoil and the degradation of sites and potential archaeological deposits (refer to **Section 4.1** for a detailed description of previous land use history and **Figures 4.1** to **4.3** for aerial photographs showing the cumulative impact of European land-use on the Proposed Disturbance Area over time). Observations of the landscape within the Proposed Offset Areas indicate similar levels of disturbance within the cleared areas of the slopes and along the main watercourses, but an overall more intact soil profile within those areas associated with Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks.

The survey results indicate that evidence for repeated and long term Aboriginal occupation was related to the location of reliable water. Within the Proposed Disturbance Area the highest concentration of artefacts and sites is at creek confluences or associated with former chains of ponds (refer to **Figure 6.2**). Within the Proposed Offset Areas the higher density of archaeological artefacts and sites is located in areas such as the confluence of Wybong Creek and Big Flat Creek and from the base of Wallaby Rocks downslope to Wybong Creek. It is also reflected in the greater evidence for occupation of the rockshelter sites on the northern and western sides of Wallaby Rocks and the rockshelter at the western end of the Western Rocks (WC33), which are closest to, and face Wybong Creek. The rockshelter sites on Anvil Hill, and the sites that are located at a distance from reliable water, have minimal evidence of Aboriginal occupation.

Site Significance

The significance of the sites and PADs located within the Proposed Disturbance Area and Proposed Offset Areas was assessed in relation to Aboriginal cultural heritage value and archaeological research potential. Information in relation to the Aboriginal cultural heritage value of the sites and PADs was provided throughout the survey period and further information was incorporated into this report following comment by the Aboriginal stakeholder groups on the draft.

The 69 sites in the Proposed Disturbance Area (30 isolated finds and 39 artefact scatters) were assessed by the Aboriginal stakeholder groups as having Aboriginal heritage value. In relation to archaeological values, the 69 sites include 65 sites assessed as having low research potential, three sites with low to moderate research potential and one site with high research potential.

The 98 sites in the Proposed Offset Areas include 75 sites assessed as having low research potential, five sites with low to moderate research potential, four sites with moderate research potential, four sites with moderate to high research potential and 10 sites with high research potential.

The six sites which are outside of the Proposed Disturbance Area and will be managed under an Aboriginal Heritage Management Plan include five sites which have low research potential and one site which has moderate research potential.

Proposed Management Strategy

The proposed Management Strategy includes:

- a combination of surface collection, grader scrapes and excavation of the 69 sites in the Proposed Disturbance Area; and

- conservation management for the 98 sites in the Potential Offsets Area, including 16 rockshelters.

The proposed management strategy for salvage of all 69 sites within the Proposed Disturbance Area has taken into account the overall significance of the sites (combined Aboriginal cultural heritage value and archaeological research potential) and the results of a geomorphic assessment provided by Dr Peter Mitchell (refer to **Section 10** and **Appendix 7**). This strategy includes a combination of surface collection for all of the sites and grader scrapes within parts of the Proposed Disturbance Area associated with Clarks Gully, Anvil Creek and Big Flat Creek. This strategy targets artefact scatters and isolated finds within the Proposed Disturbance Area that have low to moderate research potential (refer to **Table 8.4**). It also appropriately tests the riparian corridor archaeological terrain unit which is assessed as having high research potential and Aboriginal and archaeological sensitivity (refer to **Table 8.5**). Manual excavation will be undertaken in areas where the grader scrapes reveal features such as hearths, heat treatment pits, knapping floors or significant artefact concentrations (refer to **Appendix 11** for details of the proposed Research Design and Methodology for the salvage).

Site AC13, located on Anvil Creek and within an area targeted for mine infrastructure, was assessed as having high Aboriginal heritage value during the survey and site visit and high archaeological research potential. This site will be subject to a detailed geomorphic investigation, a subsurface test pitting program, large area manual excavation and grader scrapes. Site SC10 located on Sandy Creek, and in an area initially targeted for a rail corridor, was assessed as having high Aboriginal heritage value and moderate archaeological research potential. The design of the rail corridor has been modified to enable of this site to be conserved. It has also led to the conservation of two other isolated finds and two artefact scatters.

The management strategies proposed for the sites/archaeological terrain units within the Proposed Disturbance Area were determined in relation to their overall significance and in recognition of Centennial providing Proposed Offset Areas with sites within archaeological terrain units evaluated as having equal or greater overall significance (refer to **Section 8.3** for further discussion in relation to significance). In this regard, Centennial is committed to conserving all identified sites and the landscapes in which they occur, within the Proposed Offset Areas. The Proposed Offset Areas proposed will conserve 98 of the 173 Aboriginal sites identified during fieldwork. These sites include 16 rockshelters with artefacts and PAD, 37 isolated finds and 45 artefact scatters.

Comments from the Aboriginal stakeholder groups on the significance assessment and the proposed management options are included in full in **Appendix 8** and summarised in **Section 8** and **10**. Comments have been received from 13 of the 18 Aboriginal stakeholder groups to date. The Aboriginal cultural significance of individual sites cannot be discussed as no specific site by site assessment was provided by the Aboriginal stakeholder groups in their comments on the draft report. The Aboriginal cultural heritage significance of the archaeological terrain units that form the survey area were, however, assessed as having high Aboriginal cultural heritage significance by three of the groups. The archaeological or scientific significance assessment for the sites and the archaeological and Aboriginal cultural heritage significance of the terrain units within which they are located, form the basis for the management options discussed in **Section 9** of this report.

The Proposed Offset Areas will conserve all the rockshelter sites within Wallaby Rocks, Limb of Addy Hill, Western Rocks and Anvil Hill. Anvil Hill rockshelter sites (four sites), however, may be affected by the indirect impacts of blasting. This impact can be mitigated and management strategies for the rockshelters on Anvil Hill are discussed in **Section 9**.

The Proposed Offset Areas conserve the archaeological terrain units within the survey area which are assessed as having the *highest Aboriginal heritage value* based on archaeological research potential and comments provided by the Aboriginal stakeholder group representatives during fieldwork and the site visit on 11 May 2006 (several Aboriginal stakeholder groups including WNAC, UAC, stated that they believe all of the archaeological terrain units within the study area are of high cultural significance). The Proposed Offset Areas provide an extensive area that Aboriginal stakeholders, archaeologists and the general community can access for teaching and educational purposes throughout the life of the mine and into the future. The Anvil Hill area will be isolated for the majority of the life of the mine, however, it will not be directly impacted by mining and will be available for organised access.

An Aboriginal Heritage Management Plan will be prepared for the Project, including the Offset Areas. The management strategies prepared within the Aboriginal Heritage Management Plan will be formulated in consultation with the Aboriginal stakeholder groups and DEC. As the Offset Areas are also important from an ecological perspective, there will need to be integration of the management approach to achieve Aboriginal Heritage and Ecology objectives.

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APPENDICES

1.0 Introduction

Centennial Hunter Pty Limited (Centennial), a wholly owned subsidiary of Centennial Coal Company Limited, proposes to establish an open cut coal mining operation in the Wybong area, 20 kilometres west of Muswellbrook and approximately 10 kilometres north of the township of Denman (refer to **Figure 1.1**). The proposal, known as the Anvil Hill Project (the project), is based on a large, undeveloped coal reserve of approximately 150 million tonnes (Mt) that has the potential to provide thermal coal to both domestic and export markets. Agreement has been reached to supply coal to Macquarie Generation's Bayswater Power Station, provided the mine development obtains government approval.

The project is classified as a 'major project' which requires the approval of the NSW Minister for Planning. An Environmental Assessment (EA) will be prepared to seek project approval to mine up to 10.5 million tonnes per annum (Mtpa) using truck and shovel methods. Approval will be sought for a 21 year project life, concurrent with the duration of a mining lease to be sought for the operation. If approved, Centennial is targeting commercial production by early 2008, and it is expected the project could provide ongoing employment for up to 250 people.

Umwelt (Australia) Pty Limited (Umwelt) was commissioned by Centennial to prepare an Aboriginal heritage assessment as part of the EA for the proposed development. The strategy for the archaeological assessment was informed by a series of meetings and detailed consultation with the Aboriginal stakeholder groups and DEC.

In order to better understand Aboriginal occupation in the Anvil Hill area, Umwelt, in consultation with the Aboriginal stakeholder groups, undertook a cultural heritage survey with a survey strategy and recording methodology based on landform elements and archaeological terrain units. The proposed survey strategy was formulated with the Aboriginal stakeholder groups during a workshop on 1 March 2005. This workshop also included a site visit and discussions related to conservation values with input from the Aboriginal stakeholder groups in relation to appropriate potential Aboriginal cultural heritage offsets.

This report provides an assessment of the impact of the proposed development on Aboriginal cultural heritage within the Proposed Disturbance Area for the project. The Proposed Disturbance Area includes all land which may be directly impacted or disturbed in some way due to open cut mining activities and associated facilities (refer to **Figure 1.2**). This report also assesses the Aboriginal cultural heritage of surrounding areas which are assessed as having potential as offset areas for Aboriginal cultural heritage, including Anvil Hill, Wallaby Rocks, Limb of Addy Hill, Western Rocks and parts of Big Flat Creek and Wybong Creek (refer to **Figure 1.2**).

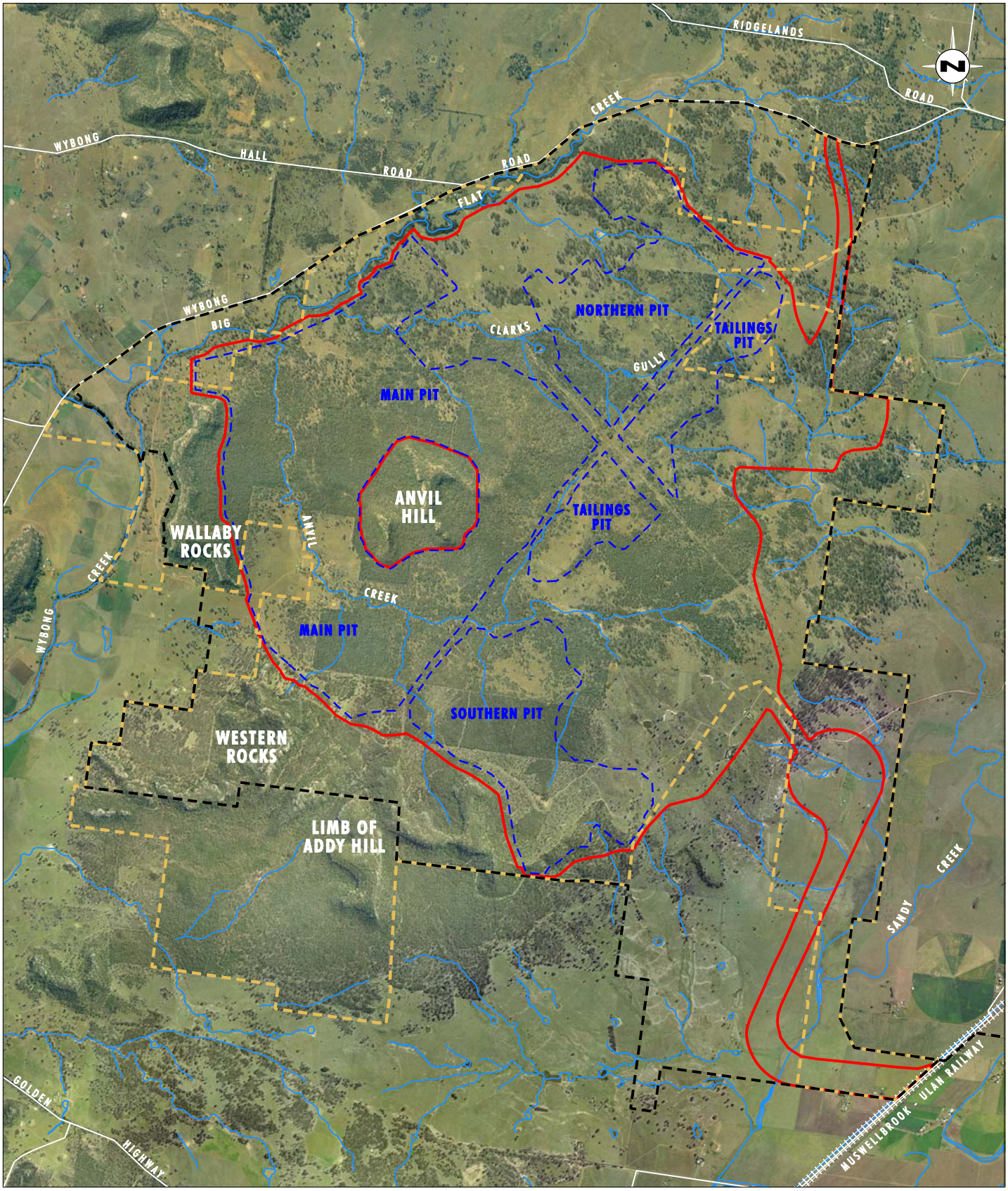
1.1 Survey Area

The total project application area is 3763 hectares including the Proposed Disturbance Area of 2238 hectares (refer to **Figure 1.2**). The Aboriginal archaeological survey area (hereafter the survey area) incorporates areas assessed as having potential as offset areas for Aboriginal cultural heritage and is 3462 hectares in area.

The Proposed Disturbance Area was modified to avoid a significant site (SC10) after the Aboriginal stakeholder group comments were received on the draft report. This involved a modification to the rail loop alignment, with the current alignment shown on **Figure 1.2**. The avoidance of impact on site SC10 was supported by the Aboriginal groups. Whilst the modified alignment has been assessed based on predictive modelling (refer to **Sections 2, 7**

FIGURE 1.1

Locality Plan



Source: Dept. of Lands (2003), ortho-rectified by Plateau Images
Base Map: Mine Consult (2005)

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Project Area
- Survey Area
- Proposed Mining Area

FIGURE 1.2

Proposed Disturbance Area, Survey Area and Project Application Area

and **10**), part of the alignment is not in the survey area covered in this report. This area will be subject to further survey to confirm management outcomes, particularly in the drainage lines, in consultation with the Aboriginal stakeholder groups.

1.2 Objectives

The key objectives of the archaeological assessment were to:

- carry out Aboriginal consultation in compliance with the DEC (2004) *Interim Community Consultation Requirements for Applicants* and to meet the provisions of these requirements;
- with the assistance of the local Aboriginal stakeholder groups undertake a cultural heritage survey within the project area including those areas identified as Proposed Offset Areas;
- encourage active participation by the local Aboriginal stakeholder groups in the identification, significance assessment and management decisions about Aboriginal cultural heritage sites and values within the project area; and
- fulfil the requirements of the DEC (now incorporating the NPWS) Guidelines (1997) for archaeological survey and assessment.

1.3 Statutory and Policy Framework

As this development is a 'Major Project' which will be assessed under Part 3A of the *Environmental Planning and Assessment Act* 1979, the provisions of the *National Parks and Wildlife Act* 1974 do not apply. This means that Section 87 permits and Section 90 consents under the *National Parks and Wildlife Act* 1974 will not be required for any investigation/salvage works undertaken as part of this project, if approved. Should the project be approved, the investigation and salvage of Aboriginal sites within the Proposed Disturbance Area will be undertaken in accordance with the management strategies outlined in **Section 10**. Any management strategies for Aboriginal heritage sites within Proposed Offset Areas will be integrated with the ecological management of these areas.

The information presented in this report follows the *NPWS Standards and Guidelines for Archaeological Report Writing* 1997 and DEC's draft Part 3A assessment guideline *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*, July 2005. Aboriginal consultation has been undertaken in accordance with the above guidelines and following DEC's *Interim Community Consultation Requirements for Applicants* 2004.

1.4 Aboriginal Stakeholder Consultation and Participation

Aboriginal stakeholders are the primary determinants of the significance of their heritage and therefore Aboriginal stakeholder consultation is integral to Aboriginal heritage assessment. The consultation and assessment process reflects the recognition of the importance of Aboriginal stakeholder groups in the assessment and management of their heritage.

Two processes of significance assessment are undertaken in Aboriginal heritage assessment: the assigning of Aboriginal cultural significance, which can only be carried out by the Aboriginal stakeholders; and the assigning of archaeological or scientific significance,

which is carried out by the archaeologist. The archaeologist in consultation with the Aboriginal stakeholder groups develops appropriate management recommendations in light of both the archaeological and Aboriginal cultural significance assessments.

The consultation process for the current project has followed the Department of Environment and Conservation's (DEC's) recent *Interim Community Consultation Requirements for Applicants* (2004). Aboriginal stakeholder groups were involved in all facets of the study including a workshop for determination of a conservation offset strategy and the development of the survey strategy. All registered Aboriginal stakeholder groups participated in field survey and site identification and recording. All groups will also be provided the opportunity to review the draft of this report. The consultation process was aimed at ensuring that the Aboriginal stakeholder groups had the opportunity to contribute to assessment outcomes by:

- assisting with the design of the survey strategy;
- involvement in the identification of Aboriginal heritage sites through participation in fieldwork;
- influencing the assessment of cultural and scientific significance;
- providing relevant information regarding the cultural significance values of Aboriginal objects/places;
- contributing to the development of the cultural heritage management strategy; and
- providing comment on draft assessment reports prior to their submission.

Table 1.1 provides information relating to the Aboriginal stakeholder groups that participated in the project.

Table 1.1 - Aboriginal Stakeholder Groups

	Name of Group	Primary Contact
1.	Aboriginal Native Title Consultants (ANTC)	John and Margaret Matthews
2.	Giwiirr Consultants (GC)	Rodney Matthews
3.	Hunter Valley Aboriginal Corporation (HVAC)	Trevor Griffiths
4.	Hunter Valley Cultural Consultants (HVCC)	Christine Matthews
5.	Lower Wonnarua Tribal Consultancy Pty Ltd (LWTC)	Barry Anderson
6.	Ungooroo Aboriginal Corporation (UAC)	Graham Ward
7.	Upper Hunter Heritage Consultants (UHHC)	Darryl Matthews
8.	Upper Hunter Wonnarua Council Inc (UHWC)	Victor Perry
9.	Valley Culture (VC)	Larry van Vliet
10.	Wanaruah Custodians (WC)	Barbara Foot
11.	Wanaruah Local Aboriginal Land Council (WLALC)	Barry McTaggart
12.	Wattaka Wonnarua CC Service (WWCCS)	Des Hickey
13.	Wonnarua Culture Heritage (WCH)	Joe Hampton or Joseph Griffiths
14.	Wonnarua Elders Corporation (WEC)	Rhoda Perry/Tom Miller
15.	Wonnarua Nation Aboriginal Corporation (WNAC)	Robert Lester
16.	Yarrawalk	Scott Franks
17.	Muswellbrook Cultural Consultants (MCC)*	Brian Horton
18.	Mingga Consultants** (MC)	Clifford Matthews

*MCC registered interest in December 2005 and has only been involved in the project's consultation program since that time.

**MC registered interest in late April 2006 and has only been involved in the project's consultation program since that time.

Further details regarding the extensive Aboriginal consultation program are provided in **Section 3**.

1.5 DEC Consultation

Consultation with DEC's regional archaeologist has been ongoing since the commencement of the project. Liam Dagg, Acting Manager Conservation and Planning for the Environment Protection & Regulation Division of the North East Branch of DEC met with Jan Wilson (Cultural Heritage Manager, Umwelt) on 6 December 2004 to discuss the following:

- the proposed changes to DEC jurisdiction for Aboriginal archaeological issues (to identify key government contacts);
- an overview of the Anvil Hill Project;
- the history of prior archaeological research and the nature of the known Aboriginal archaeological context of the project area;
- the proposed Aboriginal archaeological survey strategy and schedule;
- the adequacy of the proposed Aboriginal consultation program; and
- the government perspective on offset strategies.

Considering the outcomes of this meeting, DEC was forwarded a letter on 16 December 2004, outlining the proposed detailed Aboriginal consultation program for the duration of the project (refer to **Appendix 1**). Positive feedback on this approach was given during a telephone conversation with Liam Dagg, DEC, on 20 December 2004. On 28 January 2005, DEC was contacted by letter as part of the notification process for Aboriginal consultation.

DEC was invited to attend and participate in a meeting and workshop held with the Aboriginal stakeholder groups on 1 March 2005. The aim of this meeting was to inform the groups about the nature of the project, to prepare the survey strategy and workshop ideas about conservation values and Proposed Offset Areas. DEC was not able to attend the workshop.

DEC was provided with a summary of the outcomes of the meeting and the proposed survey strategy for the project on 24 March 2005. This update provided a summary of comment about the draft survey strategy from the Aboriginal stakeholder groups and details regarding the proposed fieldwork including Aboriginal community involvement. Liam Dagg, DEC, indicated acceptance of the survey strategy.

Liam Dagg took one year of leave from DEC in mid 2005. His replacement, Claire Everett, Archaeologist, DEC, was not appointed until January 2006. Claire was consulted during late February to early March 2006 regarding the project in order to provide an update of the Aboriginal consultation program and to discuss the definition, description and registration of sites identified during fieldwork. Claire Everett, DEC, provided feedback for site registration and requested that the sites not be registered as archaeological terrain units due to the problems that arise with the Aboriginal Heritage Information Management Systems (AHIMS) database from this practice.

Claire Everett also attended a site inspection of the project application area and the presentation of the draft Aboriginal archaeological assessment report to the Aboriginal community on 11 May 2006. Claire was provided with a draft copy of the report at that

meeting. Further information in relation to the outcomes of this site visit and meeting will be provided in **Section 8.4** in relation to the Aboriginal stakeholder groups.

1.6 The Structure of the Report

Section 2 describes the nature of the proposal and its likely direct and indirect impacts on Aboriginal cultural heritage sites.

Section 3 presents detailed information related to the extensive Aboriginal stakeholder consultation and participation program.

Section 4 provides information about the environmental context of the project area including topography and hydrology, geology and soils, flora and fauna and the impacts of prior land use.

Section 5 provides information related to the archaeological context of the project area and discusses the ethnography, known sites and prior archaeological research. A predictive model for site location within the project area is then formulated using the information supplied in **Sections 4** and **5**.

Section 6 discusses the methodology and results of the survey within the project area and identifies areas proposed for further investigation.

Section 7 details the geomorphological history of the project area and discusses the potential for the location of late Pleistocene/early Holocene cultural heritage material in a stratified context.

Section 8 discusses the Aboriginal cultural heritage and archaeological or scientific significance of the sites/potential archaeological deposits (PADs) located during the survey.

Section 9 presents a discussion of management options for the sites/PADs and outlines the preferred management option from an Aboriginal and archaeological perspective.

Section 10 provides a management strategy for the project area.

Section 11 lists reports and publications referred to in the text.

1.7 Project Team

Mary-Jean Sutton (Senior Archaeologist) co-ordinated the Aboriginal archaeological assessment and was the main author of this report. Background research and the archaeological context were written by Kathleen Beech (Anthropologist) and Mary-Jean Sutton. Jan Wilson (Cultural Heritage Manager) reviewed and edited this assessment report and provided strategic direction for the project. Jan also assisted in writing some section of the report. Emma St-Pierre (Archaeologist), Jan Wilson, Jillian Ford (Archaeologist) and Mary-Jean Sutton were involved in the fieldwork components of this project. Jillian Ford assisted in the compilation of site descriptions and survey coverage and Aboriginal consultation.

1.8 Acknowledgments

The following individuals are acknowledged for their contribution:

- Aileen Hogan, landholder, for provision of soils report;
- all land owners that provided access within the survey area; and
- Robert Parkinson, Land and Property Information Service, Department of Lands, NSW.

2.0 The Proposal and Nature of its Impact

2.1 Project Description

Detailed mine and project planning has been undertaken to develop a Conceptual Mine Plan with indicative stage plans provided at project years 2, 5, 10, 15 and 20. The features that influenced the design of the mine and the equipment selection for the mine are the dyke that runs from the south-west to the north-east across the eastern side of the project area and the 500 kV power line that runs at right angles to the dyke. Consequently, there are four distinct mining areas, as shown on **Figure 2.1**.

The conceptual mine layout for the proposed open cut mine and all associated infrastructure is shown on **Figure 2.1**. The proposed open cut mine will involve the following activities:

- land clearing and topsoil removal completed in advance of mining;
- drill and blast in advance of use of truck and shovel mining techniques; and
- progressive shaping and revegetation of overburden emplacement areas.

An access road will be located within the north-east of the Proposed Disturbance Area off Wybong Road. The coal preparation plant and other surface facilities will be located in the south-east. Product coal will be conveyed to a rail loading bin on the rail loop which will link to the existing Muswellbrook-Ulan rail line in the south-east.

Scheduling has allowed for concurrent operation of the four pits for most of the mine life. The proposed mining method has been adapted to this layout and is planned to provide an efficient mining operation in which environmental impacts can be minimised.

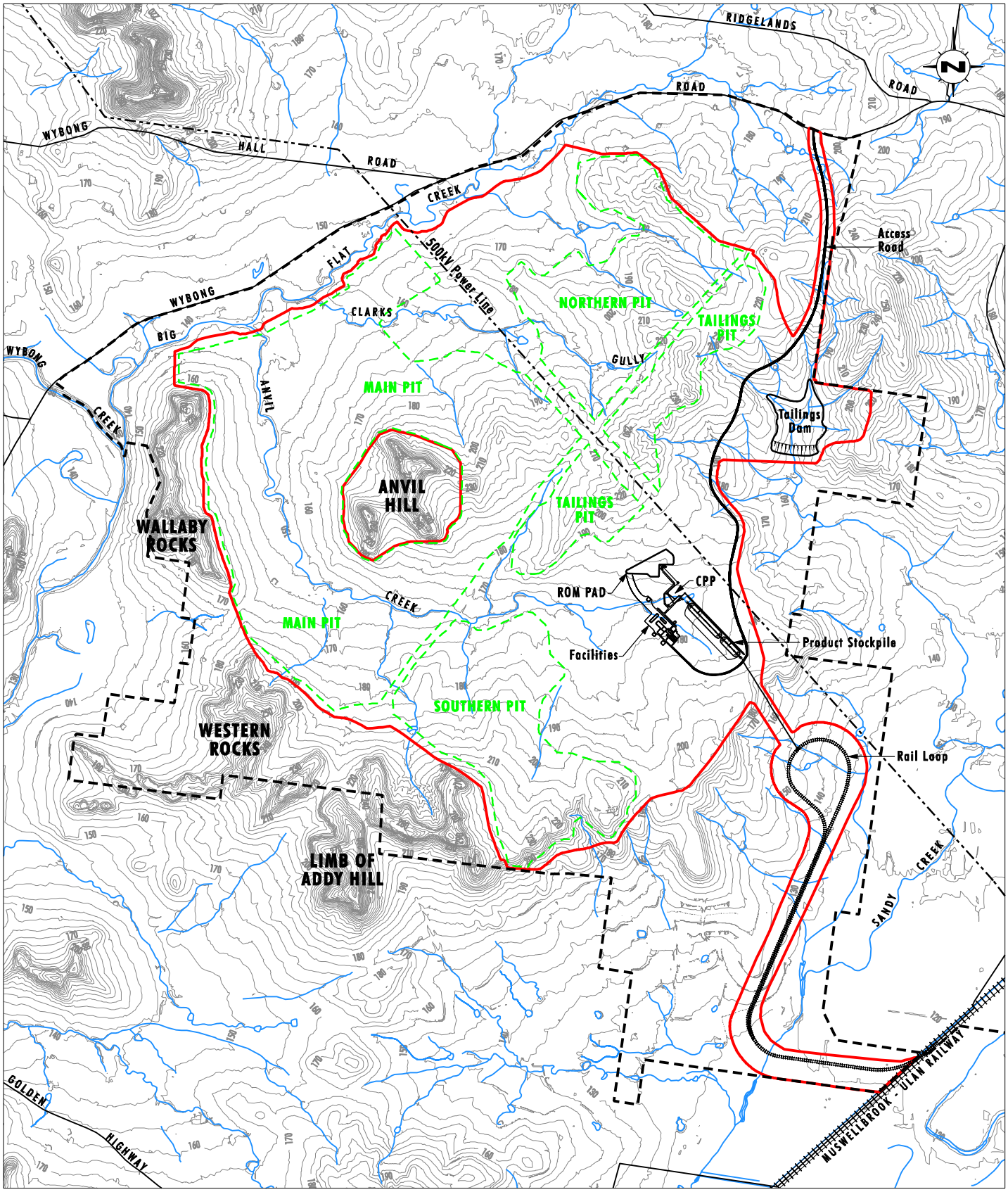
Rehabilitation of the overburden emplacement areas and backfilled pits will be conducted progressively over the life of the mine, as an integral component of mining operations. Rehabilitation will be scheduled to commence as soon as possible after mining disturbance, to minimise the disturbed area at any point in time.

The primary objective of mine rehabilitation will be to create a stable final landform with acceptable post-mining land use capability. The proposed final land use will include self-sustaining indigenous vegetation communities, consisting of native and naturalised tree, shrub and grass species.

2.2 Potential Impacts on Aboriginal Sites

Figures 1.2 and **2.1** illustrate the area to be impacted by proposed open cut mining and associated infrastructure. All Aboriginal objects and places identified within this area will be destroyed. There is no potential for conservation of Aboriginal objects or places within the Proposed Disturbance Area without modifications to the proposed mine plan.

Figure 1.2 indicates that Anvil Hill will not be directly impacted by the current mining proposal and can be considered as a Proposed Offset Area; however, indirect impacts such as dust emission and vibration from blasting have the potential to damage/destroy/disturb some types of Aboriginal sites on Anvil Hill (for example rockshelters). This indirect impact also applies to other rocky plateau areas being assessed as Proposed Offset Areas. These areas are Wallaby Rocks and Limb of Addy Hill (including the western portion of this area shown as the 'Western Rocks' on **Figure 1.2**), which like Anvil Hill have steep conglomerate clifflines that have the potential to be susceptible to the effects of blasting.



Source: Mine Consult (2005)
Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Project Area
- Proposed Mining Area

FIGURE 2.1

Conceptual Mine Layout

Whilst there is a potential for conservation of Aboriginal places and objects within the area demarcated as Anvil Hill it should be noted that access to Anvil Hill will not be possible once open cut mining commences. Therefore, Aboriginal custodians will not be able to access any sites on Anvil Hill for the duration of the life of the mine. There may also be some restrictions to access due to blasting within the other rocky plateau areas. The indirect impact of blasting and restrictions to access due to blasting are addressed in **Section 9**, and an independent report on the effects of blasting is included in **Appendix 2**.

2.2.1 Summary of Potential Impacts

For the purpose of this assessment it has been assumed that all Aboriginal places/objects identified within the Proposed Disturbance Area will be destroyed by open cut mining and associated infrastructure (refer to **Figures 1.2** and **2.1**). Activities such as blasting may (indirectly) adversely affect adjoining areas with clifflines that have the potential to contain sites, such as rockshelters. The direct and indirect impacts are assessed within **Section 9** of this report.

3.0 Aboriginal Stakeholder Consultation and Participation

3.1 Notification and Registration

Centennial placed an advertisement in the Muswellbrook Chronicle on 28 January 2005 and the Hunter Valley News on 2 February 2005 (refer to **Appendix 3**), notifying their intention to proceed with the Anvil Hill Project and inviting Aboriginal stakeholder groups to register an interest in being involved in the consultation process. Prior to this, on 27 January 2005, Centennial had written to thirteen known Aboriginal stakeholder groups in the locality providing an introduction to the project and introducing Umwelt as the consultancy preparing the EA (incorporating the Aboriginal heritage assessment) for the project. Centennial provided information in relation to the proposed consultation program, seeking involvement from the Aboriginal stakeholders during the pre-survey, survey and assessment period. The known Aboriginal stakeholder groups at the time included WNAC, WC, LWTC, Combined Council Hunter Valley Aboriginal Corporation (now ANTC), WWCCS, UHHC, Yarrawalk, HVCC, UAC, UHWC, VC, WLALC and WCH.

The five agencies listed in the DEC Interim Requirements (2004) were notified on 28 January 2005, with a request for current contact details for all known Aboriginal stakeholder groups/individuals for the area. These agencies included DEC, Muswellbrook Shire Council, Native Title Services, Registrar of Aboriginal Owners and the Wanaruah Local Aboriginal Land Council.

The recommended 10 working days from the date of advertising was allowed for Aboriginal groups/individuals to formally register their interest in the project. UHHC, HVAC, Yarrawalk, ANTC, UHWC and WEC responded to this advertisement. Three previously unknown Aboriginal stakeholder groups were identified during the notification process, that is GC, HVAC and WEC.

3.2 Consultation for Survey Strategy and Conservation Values

Umwelt, on behalf of Centennial, invited 16 of the Aboriginal groups listed in **Table 1.1** (MCC did not exist at that time) to participate in the initial meeting for the project, held in Denman on 1 March 2005.

Follow up telephone contact was made with each group to ensure that they had received their invitation to the meeting and to discuss any comments or concerns prior to the meeting. On request by Scott Franks of Yarrawalk, a meeting was held with Jan Wilson and Mary-Jean Sutton of Umwelt to discuss his concerns about the consultation program prior to the Denman meeting. All 16 known Aboriginal stakeholder groups were represented at the Denman meeting on 1 March 2005 (refer to **Appendix 4** for meeting correspondence and **Appendix 5** for the list of representatives who attended the meeting).

At the initial meeting, a description of the project was presented by Centennial and workshops were conducted to design the survey strategy and to obtain feedback from the groups about the Aboriginal heritage values they would like to see conserved within any Aboriginal heritage offsets. The groups were also requested to provide information in relation to any stories or known cultural heritage sites or places (including mythological sites/places) in the project area (refer to **Appendix 4** for details of correspondence).

3.2.1 Workshop Approach

At the 1 March 2005 meeting, all Aboriginal stakeholder group representatives were provided with a copy of an information package which included colour maps showing known archaeological sites within the project application area, a summary of previous relevant archaeological studies, a copy of the presentation by Centennial and Umwelt given on that day. Also provided was a form on which to provide comments on the consultation program, the proposed survey strategy, the methods of involvement of the Aboriginal stakeholder groups for the fieldwork (tender or rotation) and any comments on cultural knowledge and mythological sites (refer to **Appendix 6** for a copy of the presentation – please note that the proposed disturbance boundary for the project has altered slightly since this meeting and the survey methodology was adjusted accordingly in consultation with the Aboriginal stakeholder groups).

During the meeting, Aboriginal representatives discussed potential conservation offsets and the conservation values they prized and also worked on the survey strategy. Representatives were provided with large A1 sized posters of the Project Application Area and surrounding locality and were given colour marker pens to mark up transects within the areas they suggested for survey. This meeting also included a site visit to representative locations of the Proposed Disturbance Area including Anvil Creek, Big Flat Creek and other parts of the landscape.

3.2.2 Workshop Outcomes

It was agreed during the survey strategy workshop that the areas that should be covered for the survey included:

- both sides of creek lines;
- around hills and the tops of hills;
- a representative sample of all other landforms; as well as
- roads and tracks.

Feedback on Aboriginal cultural heritage values indicated that Aboriginal stakeholders believe that a Proposed Offset Area should preferably:

- contain Aboriginal heritage sites as all Aboriginal heritage sites are considered of high significance to Aboriginal people;
- have a diverse range of sites within it (not just artefact scatters);
- be at least of equal size to the Proposed Disturbance Area;
- be of equal or greater value to the Aboriginal stakeholders as the Proposed Disturbance Area;
- have tourism potential;
- should be easily accessible;
- retain biodiversity – lots of different food and medicine plants and prey animals;
- have a stakeholder benefit – it should provide opportunities for employment and places for children to learn about Aboriginal culture; and

- have reliable water sources.

It was also mentioned that any Proposed Offset Area that was set aside by Centennial should have appropriate signage, for example 'Traditional land of the Wanaruah people'.

Other ideas for cultural heritage offsets that were not tied to land included:

- a contribution towards a keeping place and/or a regional study;
- an educational package;
- involvement of communities in mine rehabilitation; and
- permanent employment opportunities for Aboriginal people in the mine including traineeships.

3.2.3 Follow up Consultation after Workshop

After compilation of Aboriginal stakeholder group input from the 1 March 2005 meeting, a proposed survey strategy was sent to all Aboriginal stakeholder groups for comment (16 March 2005). In addition to commenting on the survey strategy, the stakeholder groups were asked to comment on their preference for fieldwork participation (for example, tender process or all groups involved on a rotational basis) and in relation to conservation offsets. Comments received are summarised in **Table 3.1**.

In total, 14 written and two verbal responses were received from the 16 Aboriginal stakeholder groups. Written formal responses from the Aboriginal stakeholder groups relating to the draft survey strategy are included in **Appendix 7**. All comments were incorporated into the final survey strategy where appropriate.

Table 3.1 – Summary of Comments made by Aboriginal Groups

Aboriginal Group	Representative	Response to Workshop
WEC	Tom Miller and Rhoda Perry	No written comment received. Rhoda stated that WEC members are 'too elderly' to be involved in the survey and only wish to be included in the consultation process; thus they would not provide comment on the survey strategy.
WLALC	Barry French, Sites Officer, and Ernie French	WLALC had no preference for fieldwork involvement, but had the following comments about cultural heritage conservation offsets: 'Grinding grooves, skeletal remains, rock art, carved/scarred trees, burials and rock shelters are protected by being fenced under a conservation area' (correspondence 29 March 2005).
UAC	Graham Ward, CEO	UAC commented that they would prefer Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups. UAC had the following comments/issues about the proposed survey strategy: 'All ground to be surveyed including offset' (correspondence 18 March 2005).

Table 3.1 – Summary of Comments made by Aboriginal Groups (cont)

Aboriginal Group	Representative	Response to Workshop
WC	Barbara Foot	Mary-Jean Sutton of Umwelt met with Barbara Foot on 5 April 2005 to gain her comments for the proposed survey strategy. Barbara's comments included concerns that the survey should only be undertaken by Wonnarua people and that 16 groups were too many. Barbara was concerned about the number of people involved in the survey and the knowledge of people doing the work. She commented that during the survey people should be kept in pairs so they don't get lost. Barbara wants a surveyor to monitor topsoil stripping within the Proposed Disturbance Area. She wanted to look at all photos and be involved in the identification of scarred trees. Barbara commented about cultural heritage conservation offsets and stated that a cultural centre and a keeping place and any money towards such a centre would be a tangible benefit. She wanted benefits towards education and highlighted that the benefits should be to the community and not to any one group.
UHWC	Victor Perry, Cultural Heritage Manager	UHWC provided written comment on 1 March 2005 stating that they preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups. Victor had the following comment about cultural heritage conservation offsets 'needs to have landscapes included in whole conservation offsets and the land should be outside of the lease'. UHWC also commented that: 'Our council has concerns regarding the number of days for the survey and, we believe that our representatives need to be present each day during the field investigation of this area. From our point of view the whole area has to be surveyed, and our representatives need to be able to physically review, and record each site on a one by one basis' (correspondence 31 March 2005).
VC	Larry van Vliet	VC preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups. VC had the following comments/issues about the proposed survey strategy: 'This strategy for the proposed survey is very good and Valley Culture agrees with all the steps that the survey will be carried out' (correspondence dated 24 March 2005).
ANTC	John and Margaret Matthews	ANTC (formerly CCHVAC) preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups. ANTC had the following comments about the proposed survey strategy: 'Survey all landforms Survey all creeklines Grader scrapes'. ANTC had the following comment about cultural heritage conservation offsets: 'keeping place. ect' (correspondence 1 March 2005).

Table 3.1 – Summary of Comments made by Aboriginal Groups (cont)

Aboriginal Group	Representative	Response to Workshop
UHHC	Darrel Matthews	UHHC agreed with the proposed survey strategy. UHHC preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups. UHHC had the following comments about the proposed survey strategy: 'Grader scrapes Survey creek lines all of Survey landforms all of'. UHHC had the following comment about cultural heritage conservation offsets: 'keeping place for our culture and heritage' (correspondence 3 March 2005).
LWTC	Barry Anderson	LWTC agreed with the proposed survey strategy for the project, and preferred for Aboriginal stakeholder group involvement in fieldwork to be tendered out (correspondence 17 March 2005).
WCH	Joseph Griffiths	WCH preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal stakeholder groups, and had the following comments/issues about the proposed survey strategy: 'All the groups within the Wonnarua Boundary should be involved as they all hold culture values within the boundary….Wonnarua Culture Heritage do value these heritage as our heritage is very special within our boundary there it is lots of things that can't be explained if you require further info we can be contacted on the above numbers' (correspondence 21 March 2005).
WNAC	Robert Lester, Chairperson	WNAC commented: 'We consider the proposed survey strategy for the Anvil Hill Project as adequate. However, in the light of any unknown factors at the time our position may change, should it be revealed that Native Title issues should have been brought to our attention during the consultation meeting of the 1st March 2005, if the area within the whole of the application area has Crown Lands involved….' (correspondence 31 March 2005). The letter provides objections to the involvement of some other Aboriginal stakeholder groups who registered interest in the project.
WWCCS	Des Hickey, Manager	Des Hickey of WWCCS advised that his comments regarding the survey strategy were the same as Robert Lester of WNAC (Des Hickey pers comm. 4 April 2005). WWCCS commented that they support the survey strategy and that the survey should include: 'Both sides of all creek lines Around all hills and their tops (including Anvil Hill, Limb of Addy Hill which are outside the project and others throughout the project area) All other landforms and all roads and tracks'. (correspondence 5 April 2005)

Table 3.1 – Summary of Comments made by Aboriginal Groups (cont)

Aboriginal Group	Representative	Response to Workshop
Yarrawalk	Scott Franks, Managing Director	Yarrawalk objected to the involvement of other Aboriginal stakeholder groups apart from itself in the consultation process. Yarrawalk insisted that: 'Being involved in all field work every day that the project in going. We will not except any other groups recommendations regarding this area. The developer must except that trodional owners have the over riding say in regard to all and any destruction of our land. Yarrawalk does not support community groups, to be given the opportunity to make money by consenting to the destruction of our land'. Yarrawalk argued that they are the only group who can prove 'Wonnarua descendancy' and therefore should be the only group consulted for the project (correspondence 29 March 2005).
HVAC	Julie Griffiths	HVAC agreed with the proposed survey strategy for the project. HVAC stated that they preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups. HVAC had the following comments/issues about the proposed survey strategy: 'I agree with this but I believe it should be real community groups not individuals that are out to finance there own private pockets. I feel that it should be groups who give back to the community. These groups need to act in appropriate manner and behaviour'. HVAC had the following comments about cultural heritage conservation offsets: 'I feel this was great and I gave my ideas on the day and I believe it should be something for the community a whole so that we can educate' (correspondence 1 March 2005).
GC	Rodney Matthews, Manager	GC preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups. GC had the following comments/issues about the proposed survey strategy: 'walk all creeklines both side Survey around anvil hill Survey other landforms'. GC had the following comments about cultural heritage conservation offsets: 'keeping place All sites are of high significance Area should have sites' (correspondence 1 March 2005).

Table 3.1 – Summary of Comments made by Aboriginal Groups (cont)

Aboriginal Group	Representative	Response to Workshop
HVCC	Christine Matthews	HVCC preferred Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups. HVCC commented on the proposed survey strategy and said that 'all areas should be considered for search'. HVCC had the following comments about cultural heritage conservation offsets 'any area's that are found with cultural importance and Anvil Hill and other hills should be offset for the future'. HVCC also commented that 'creekline both sides walk over, test pits, flora and fauna relocation to unmined Anvil Hill, spiral search of Anvil Hill and other hills, offset areas, heavily wooded area search, signage of local land'. (correspondence 3 March 2005).

3.2.4 Summary

As outlined in the table above, of the fifteen groups who responded (WEC did not wish to comment), thirteen agreed with the proposed survey strategy. Yarrawalk and UHWC disagreed with the survey strategy. Yarrawalk objected to other Aboriginal stakeholder groups being consulted and involved in the proposed survey strategy but provided no comment on the actual design of the survey strategy. UHWC disagreed with the number of field days proposed in the survey strategy and also stated that they wanted to be involved in the field survey every day to record sites. WC had some concerns about the involvement of all Aboriginal stakeholder groups but did not object to the proposed survey strategy.

3.3 Fieldwork involvement

The majority of Aboriginal stakeholder groups preferred fieldwork to be provided on a rotational basis in order to involve all groups rather than by a tender selection process.

All fifteen Aboriginal stakeholder groups which registered interest in fieldwork involvement for the project were sent an invitation (5 April 2005) to provide a submission for rotational involvement in the proposed Aboriginal heritage survey. WEC was not invited as they did not wish to be involved in the survey. The submission form requested that the groups provide information in relation to the experience of the representatives they proposed for participation in the survey. There were selection criteria for participation to ensure that the survey could be carried out effectively and safely by people with appropriate experience.

All fifteen Aboriginal stakeholder groups which wished to be involved in the survey were allotted field days. Only one stakeholder group failed to attend their field days (WCH). Representatives involved in fieldwork are listed in **Table 6.1** in **Section 6**.

3.4 Draft Aboriginal Archaeological Assessment Review

The draft Aboriginal archaeological assessment report was provided to 16 registered Aboriginal stakeholder groups for their comment on 11 May 2006 at a meeting in the Anglican Hall at Denman. All 18 Aboriginal stakeholder groups were invited to attend the meeting, however, only 16 could attend on the day. Draft reports were forwarded to the two

groups that could not attend the meeting. An opportunity was provided on the day of the meeting for the Aboriginal stakeholder groups to visit the sites they had identified as significant during the survey period and to visit sections of the Proposed Offset Areas. Claire Everett of the DEC also attended the meeting and site/Offset visit.

A form was provided to the Aboriginal stakeholder groups to assist with providing detailed comments on the cultural heritage significance of each identified site and to gain input regarding Proposed Offset Areas and the appropriateness of the draft management strategy presented in **Section 10;** and the draft Research Design and Methodology presented in **Appendix 11**.

Finalisation of the draft report took place after the Aboriginal stakeholder groups' 21 day comment period expired. All comments from the Aboriginal stakeholders regarding the draft report are summarised in **Section 9.5**. All comments received to date are attached in full in **Appendix 8**.

3.5 Summary

Eighteen Aboriginal groups were consulted for this project in accordance with the DEC Aboriginal Cultural Heritage Guidelines (1997 - formerly NSW National Parks and Wildlife Service) and the *DEC Interim Community Consultation Requirements for Applicants* circulated by DEC in December 2004. These groups included the WLALC, the Local Aboriginal Land Council responsible for the study area. Seventeen other groups represent the Aboriginal stakeholders in the general region. MCC and MC were not established until after the fieldwork component of the project was completed (December 2005 for MCC and April 2006 for MC) and thus have only been included in the latter stages of the consultation program.

Table 3.2 provides a summary of all Aboriginal consultation for the project.

Table 3.2 – Summary of Consultation

Date	Form of Consultation	Aboriginal Stakeholder Groups contacted
27 January 2005	Letter of Introduction.	WNAC, WC, LWTC, CCHVAC, WWCCS, UHHC, Yarrawalk, HVCC, UAC, UHWC, VC, WLALC and WCH.
28 January 2006	Advertisement in Muswellbrook Chronicle.	
2 February 2005	Advertisement in Hunter Valley News.	
28 January 2005	Letters of notification were sent by Umwelt to five agencies including those indicated in DEC's guidelines for stakeholder consultation.	
11 February 2005	Umwelt sent an invitation to sixteen registered Aboriginal stakeholder groups to participate in the consultation program and a survey strategy and conservation values workshop on 1 March 2005.	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, WEC and Yarrawalk.
Weeks of 11 February to 1 March 2005	Follow up telephone contact made by Umwelt to discuss proposed meeting and confirm attendance	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, WEC and Yarrawalk.

Table 3.2 – Summary of Consultation (cont)

Date	Form of Consultation	Aboriginal Stakeholder Groups contacted
Week prior to 1 March 2005	Meeting with Yarrawalk representative Scott Franks at Umwelt to discuss his concerns regarding Aboriginal consultation program	Yarrawalk.
1 March 2005	Meeting held with Aboriginal stakeholder groups and Centennial that provided an introduction to the project, workshop on draft survey strategy and conservation values and potential Aboriginal cultural heritage offsets, and also provided a site inspection of Anvil Hill	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, WEC and Yarrawalk.
16 March 2005	A proposed survey strategy and map of proposed survey coverage sent to all Aboriginal stakeholder groups for comment on 16 March 2005	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, WEC and Yarrawalk.
16 March 2005 – April 2006	Comments on survey strategy received by Umwelt from Aboriginal stakeholder groups and discussions over telephone regarding proposed strategy. Incorporation of comments into draft survey strategy	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, WEC and Yarrawalk.
5 April 2005	Invitation sent to all Aboriginal stakeholder groups that stated they wished to be involved in fieldwork including a job package and submission form for groups to fill in for involvement in fieldwork on a rotational basis	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, and Yarrawalk.
29 April 2005	Written acceptance of nominated representatives for fieldwork. All registered groups interested in fieldwork involvement were provided field time	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, and Yarrawalk.
29 April 2005 to 4 May 2005	Follow up telephone correspondence with Aboriginal stakeholder groups for confirmation of fieldwork dates	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, and Yarrawalk.
5 May to 22 May 2005	Fieldwork involvement with all Aboriginal stakeholder groups for Stage 1	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WNAC, WWCCS, and Yarrawalk.
May 2005 to November 2005	Follow up telephone and written correspondence to organise Stage 2 fieldwork	
November to December 2005	Fieldwork involvement with all Aboriginal stakeholder groups for Stage 2	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WNAC, WWCCS, and Yarrawalk.
11 May 2006	Presentation of draft Aboriginal archaeological assessment report to Aboriginal stakeholder groups and site inspection of significant archaeological sites and offset areas	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, MCC, MC WEC and Yarrawalk.

Table 3.2 – Summary of Consultation (cont)

Date	Form of Consultation	Aboriginal Stakeholder Groups contacted
11 May 2006	Provision of draft Aboriginal archaeological assessment report to Aboriginal stakeholder groups for comment	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, MCC, MC, WEC and Yarrawalk.
31 May to 2 June 2006	Follow up telephone contact with Aboriginal stakeholder groups to discuss draft Aboriginal archaeological assessment report comments including a follow up fax	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, MCC, MC, WEC and Yarrawalk.
June 2006	Finalisation of draft Aboriginal archaeological assessment report	ANTC, GC, HVAC, HVCC, LWTC, WLALC, UAC, UHHC, UHWC, VC, WC, WCH, WNAC, WWCCS, MCC, MC, WEC and Yarrawalk.

4.0 The Environmental Context

The purpose of this section of the report is to describe the local environmental context of the survey area which incorporates the Proposed Disturbance Area and the broader project area as previously defined (refer to **Figure 1.2**). The environmental context provides information about the landscape including the topography, hydrology, geology, soils and fauna and flora, all of which are important factors relating to Aboriginal resource exploitation and Aboriginal site distribution.

This section commences with a discussion of past European land use practices. An understanding of past land use practices is important as it provides information that assists with understanding how the survey area has changed since European settlement and how this may have affected the survival/integrity of any Aboriginal sites it contains. The information provided in this section is used (along with the archaeological context provided in **Section 5**) to prepare a predictive model for site location and site type for the survey area (refer to **Section 5.9**).

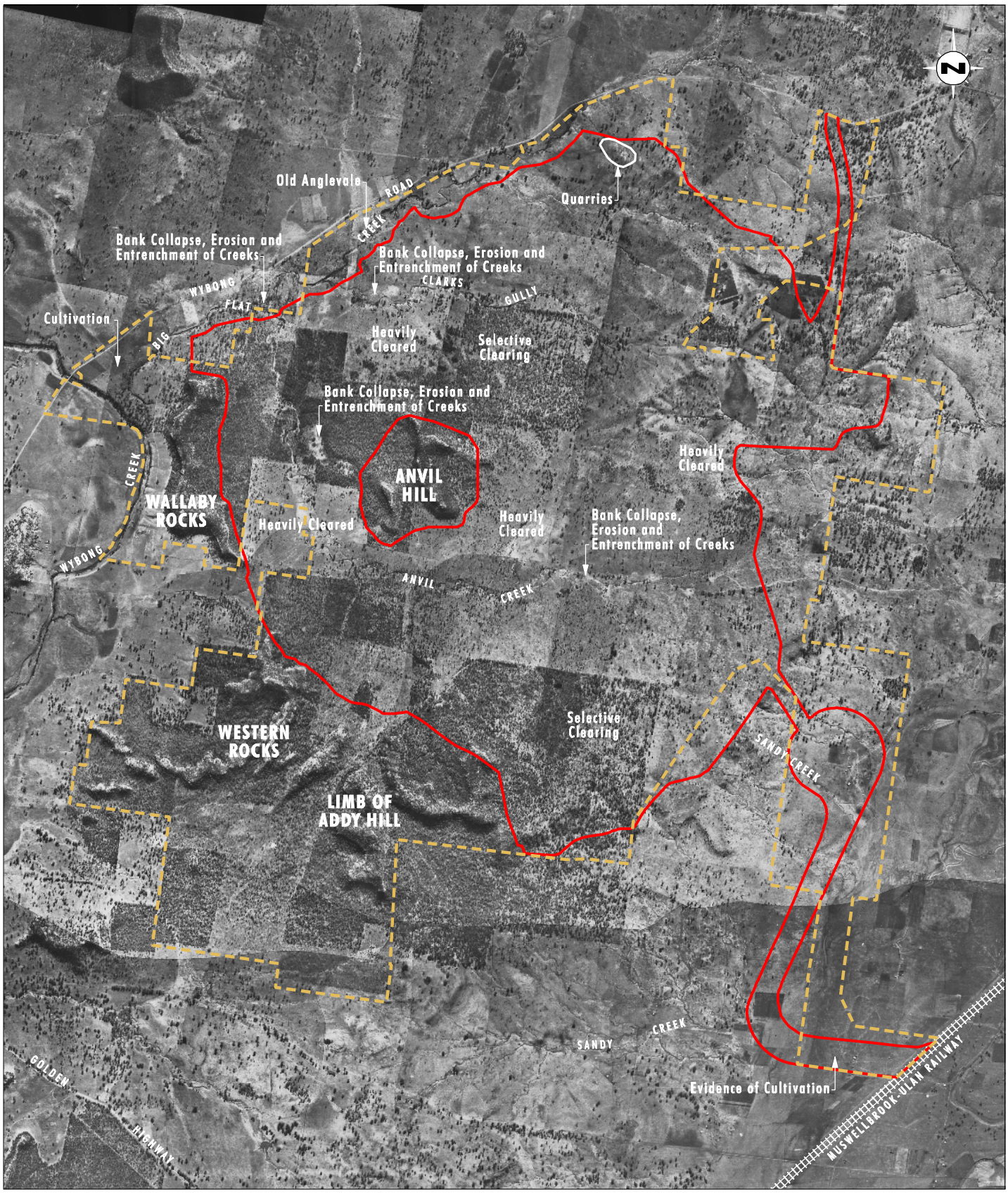
4.1 Previous Development and Prior Land Use History

Settlement of the survey area by Europeans began in the mid to late nineteenth century. The earliest property settled was Old Anglevale which is located off Wybong Road (refer to **Figure 4.1**). Families still living in the area such as the Hogans, Rays and McTaggarts are descended from some of the earliest settlers within the locality. Areas on Anvil Hill, such as Anvil Rock, have been visited historically by early settlers and more recently locals report visiting this area for picnics. Evidence of frequent visitation was noted near Anvil Rock and also in areas of Wallaby Rocks during pre-survey inspections from evidence of modern debris from picnicking in the shelters.

Some prior development related to mining occurred in the survey area. In the late 1940s, an exploratory mining shaft for coal was sunk and this shaft can still be identified on the Hogan's property. Agriculture has been, and continues to be, the main form of land use that has affected the integrity of the landscape. The survey area has been cleared to varying extents and clearing of the floodplains, slopes and hills was extensive by the 1930s. Areas of upper slope and scree slope and plateau associated with Anvil Hill, Wallaby Rocks and to a lesser extent Limb of Addy Hill and the Western Rocks had been subject to more selective clearing (refer to **Figure 4.1**). This selective clearing is currently evidenced by old stumps and ring-barked trees remaining in these areas.

By the 1930s limited cultivation was evident within the south-east of the survey area along the lower reaches of Sandy Creek and across the Hunter River floodplain (refer to **Figure 4.1**). As early as the 1930s land clearance and over-grazing had resulted in erosion and scalding which is visible along the creeklines, ridges, spurs and slopes in **Figure 4.1**. The creeks were already deeply entrenched and gullying evident in the aerial photography shown on **Figure 4.1**. Bank collapse was also evident along Big Flat Creek and Wybong Creek. The upper catchments of the creeks in the Wallaby Rocks, Anvil Hill and to a lesser extent Limb of Addy Hill and Western Rocks areas appear to have suffered far less from erosion, presumably due to the greater retention of vegetation in these areas.

Figure 4.2 provides an aerial photograph of the survey area in 1967. The aerial photograph shows a general increase in clearing and erosion, especially within the Proposed Disturbance Area in association with the creeklines, slopes and the ridge in the north-east of the area. There is also evidence of a quarry in the north-east of the Proposed Disturbance Area. Once again the Anvil Hill, Wallaby Rocks, and to a lesser extent Limb of Addy Hill and Western Rocks areas, appear to have only been selectively cleared by this time.



Base Map: United Photos (2006), ortho-rectified by Umwelt

0 0.5 1.0 2km

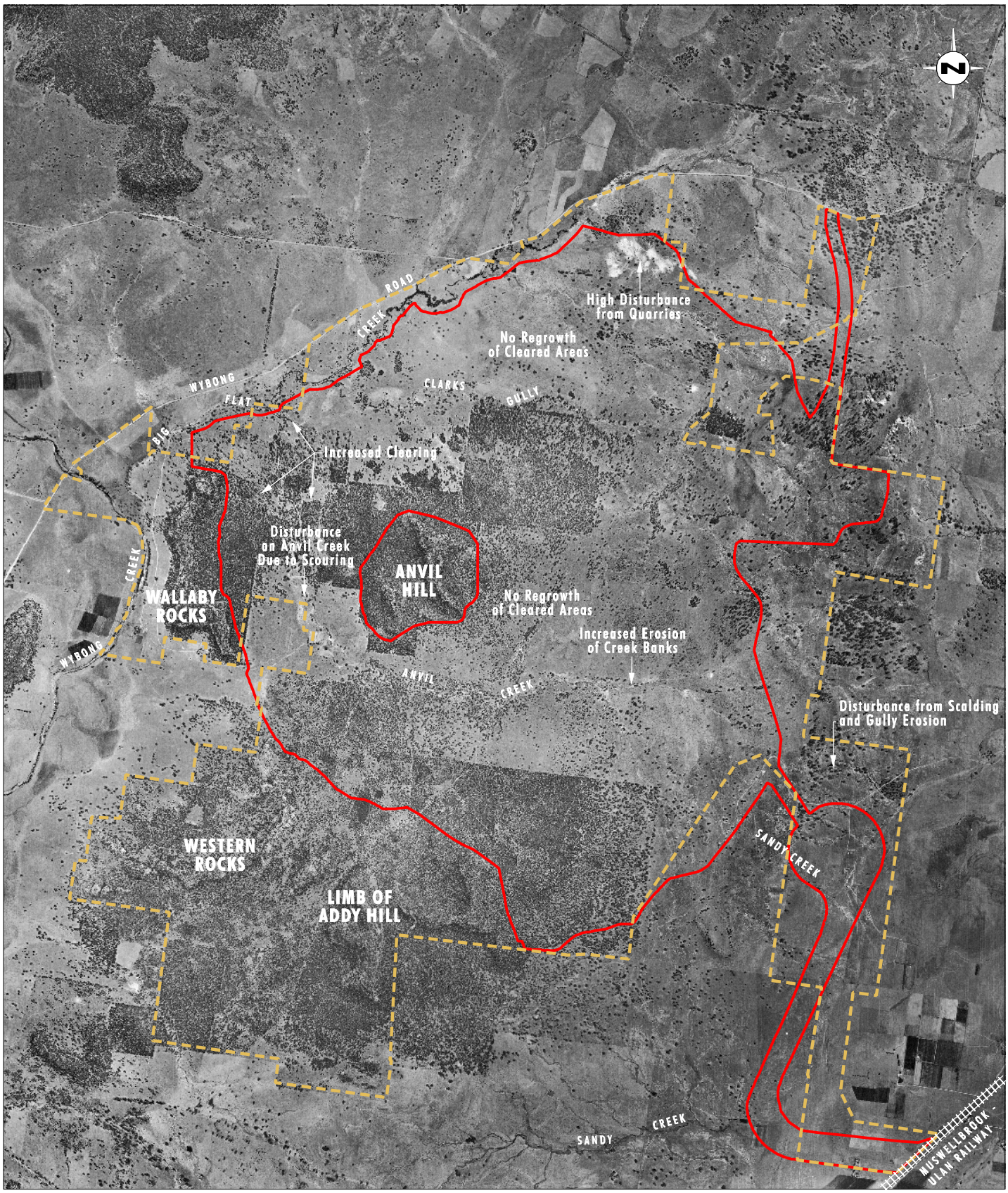
Legend

- Proposed Disturbance Area
- Survey Area

FIGURE 4.1

1930 Aerial Photograph of Anvil Hill Project Area

File Name (A4): R06_V1/1858_381.dgn



Base Map: United Photos (2006), ortho-rectified by Umwelt

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Survey Area

FIGURE 4.2

1967 Aerial Photograph of Anvil Hill Project Area

Whilst not visible in the aerial photograph, evidence currently exists of the past use of the creek banks of Big Flat Creek as charcoal retorts (the burning of timber to make charcoal as fuel for cars) during the period of World War II (1939-45).

Figure 4.3 indicates the survey area in 2003. The aerial photograph shows a general increase in the tree cover in the centre of the Proposed Disturbance Area and around Anvil Hill since 1967, and a general decrease in areas denuded by soil loss due to erosion. There is, however, an increase in impact from vegetation clearance to the north-west of Limb of Addy Hill and from farm infrastructure (roads and dams) and utilities (power easement).

In general, prior European land use within the survey area has resulted in deeply entrenched watercourses that have been subject to scouring and gullying and bank collapse. There is also evidence of the loss of topsoil from ridges, spurs, slopes and floodplains; the mixing of soil on limited areas of floodplain and lower slope due to cultivation; trampling of the ground surface by hard hoofed animals; and the general loss of the integrity of the pre-existing vegetation communities.

European land use practices have had less adverse effect on the general Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks areas which are within the survey area, but outside the Proposed Disturbance Area. These areas have retained sufficient vegetation to limit the effects of erosion, but have been subject to selective bulldozing for roads and fence lines, and erosion is present in areas where this has occurred.

Evidence of quarry activity is currently located at the base of Wallaby Rocks (on the western side), on the Ray property and also on the Walker property south of Anvil Hill and north of Limb of Addy Hill. The quarries are not evident in the aerial photograph but their general location is shown on **Figure 4.1**.

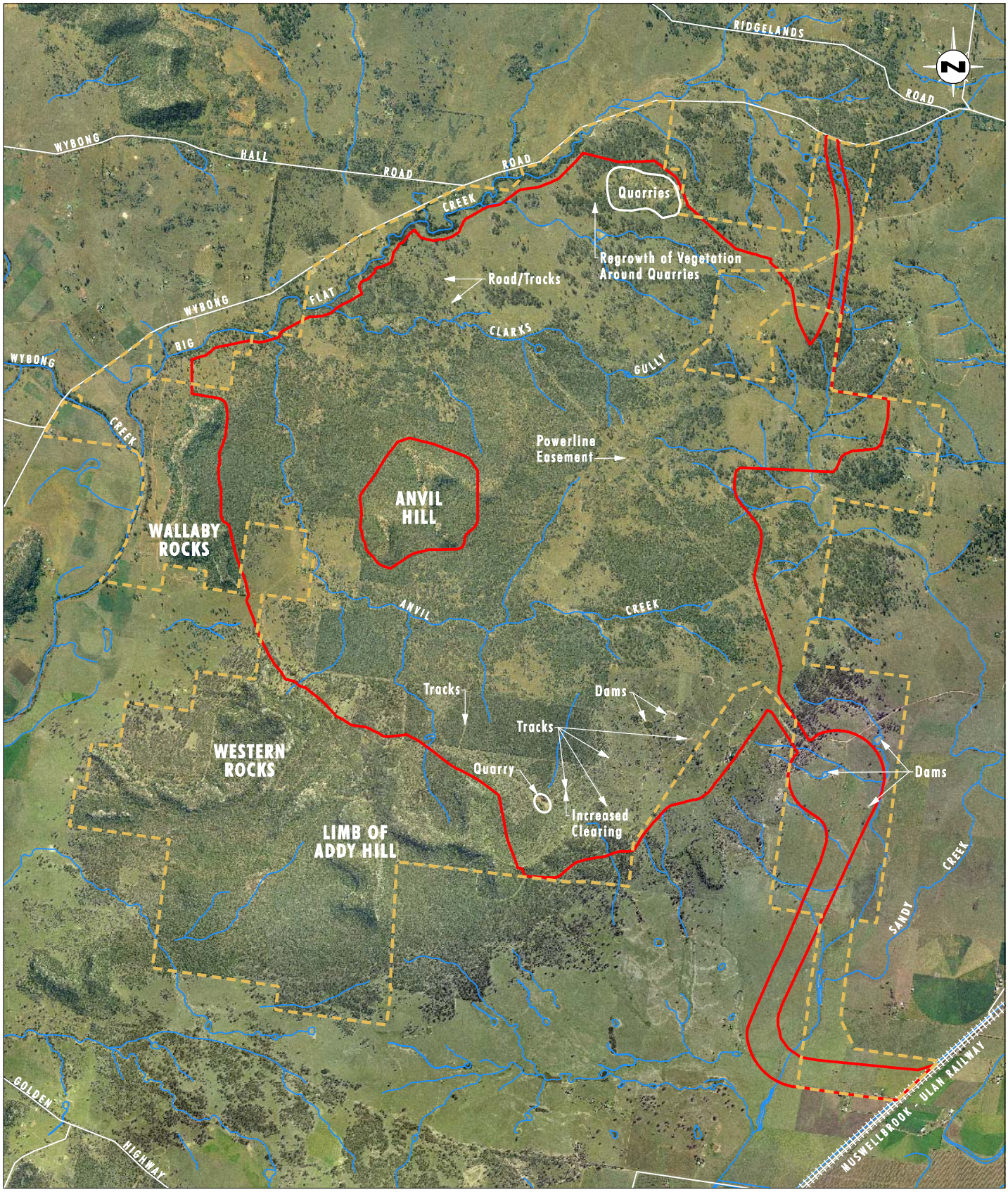
In addition, sheep and goats were observed (during pre-survey inspections) camping in rock shelters along the northern and western clifflines of Wallaby Rocks. There was also evidence of use of the rockshelters by macropods, goannas and wombats. Damage to the integrity of the deposits within the rockshelters is apparent from this use. Lesser disturbance from sheep and goats was observed in the shelters located on Anvil Hill, Limb of Addy Hill and the Western Rocks; however, these shelters had evidence of use by wild dogs, foxes, macropods, wombats and goannas.

Areas immediately surrounding the survey area consist of mostly small rural holdings, dominated by rural residential land use, but also include more intensive agricultural land uses such as vineyards, irrigation (for lucerne) and dairies.

4.1.1 Implications for Aboriginal Resource Distribution/Site Location

Prior land use practices in the survey area are likely to have resulted in the following implications for Aboriginal resource distribution and site location (refer to **Section 5** for definitions of site types mentioned below):

- the removal of scarred and/or carved trees during land clearance;
- the removal of floral species that were valued resources for Aboriginal people;
- the removal of faunal species that were valued resources for Aboriginal people;
- the introduction of non-endemic flora and fauna that has replaced some native flora and fauna, making it difficult to reconstruct the pre-European Aboriginal resource base;



Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Survey Area

FIGURE 4.3

2003 Aerial Photograph of Anvil Hill Project Area

File Name (A4): R06_V1/1858_329.dgn

- a change in the hydrology of the creeks and thus in their morphology and endemic flora and fauna which could have been resources utilised by Aboriginal people;

- disturbance and in some cases destruction of artefact scatters located along creek lines due to erosion and the construction of dams;

- an increase in the downslope movement of soil (colluvium) and any artefacts it may contain, and the mixing and reburial of artefacts from different sites and of different ages in areas where this colluvium has aggraded at the base of slopes;

- in areas of cultivation, both vertical and horizontal movement and mixing of artefacts of different ages within the soil profile;

- destruction by cultivation or stock trampling of sites such as Bora rings, stone arrangements and cairns (if they existed);

- the disturbance of potential archaeological deposits within rockshelters by macropods, wombats, goannas, sheep and feral animals such as goats, wild dogs and foxes; and

- destruction of potential sites located in areas associated with farm infrastructure and quarrying activities.

4.2 Topography and Hydrology

The survey area lies within the Central Lowlands. Hughes (ERM 2004a) describes the Central Lowlands topography as a:

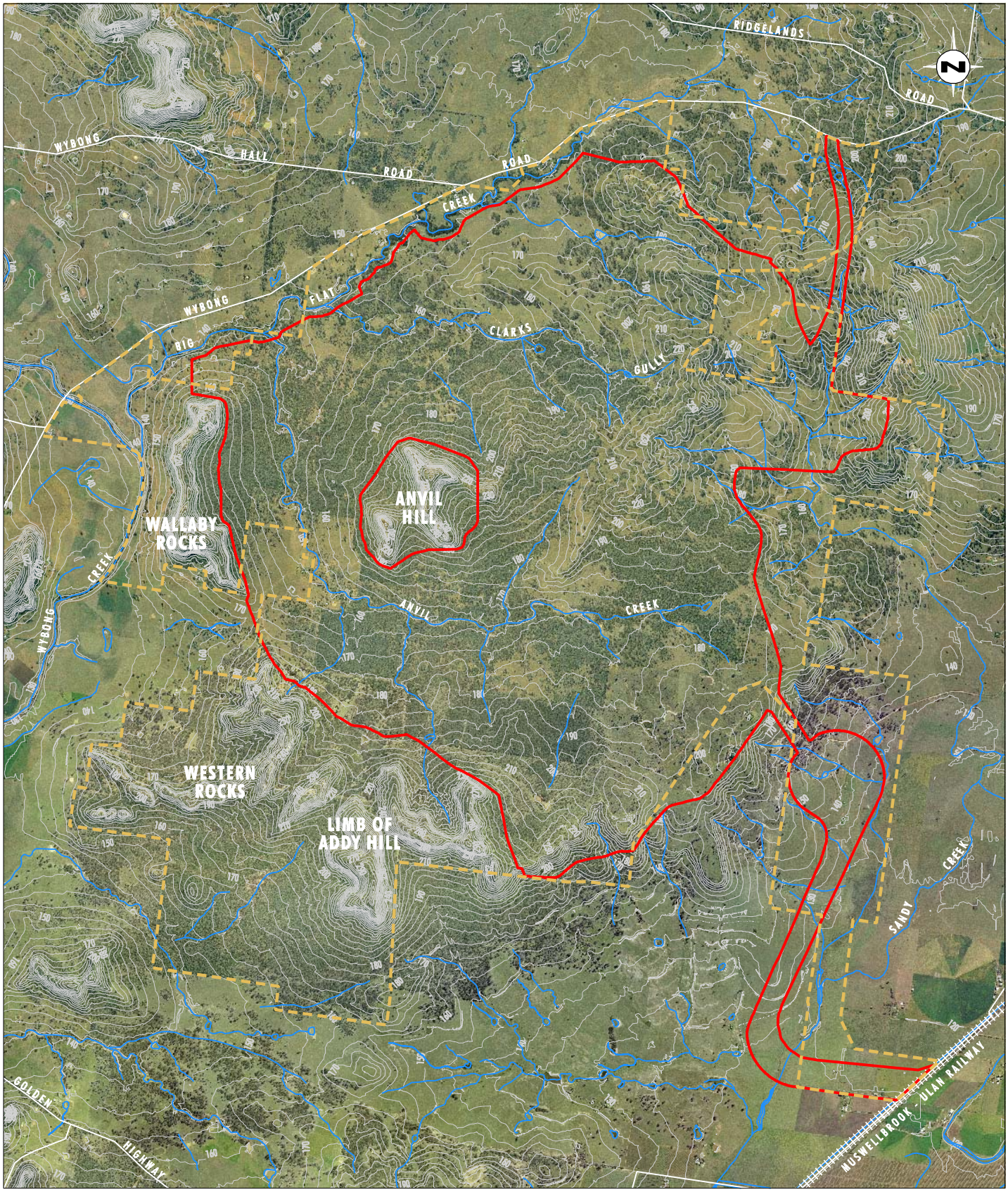
> "belt of lowlands developed on relatively weak sedimentary rocks. These lowlands continue down to the coast. While the general altitude gradually rises inland from sea level to 500 m at Murrurundi, the local relief in any given locality rarely exceeds 60 m. The landscape is undulating or gently hilly with an abrupt transition to the steep country on either side. A line of alluvial flats between 0.5 and 2.5 km wide extends along the Hunter River and its major tributaries where they flow through the lowland belt".

The topography of the survey area varies from lower slopes and floodplain towards the Hunter River in the south, through undulating and hilly lands to plateaus with sheer, rocky clifflines; and then to the mid and lower slopes and floodplain of Big Flat Creek and Wybong Creek in the north and north-east (refer to **Figure 4.4**).

The survey area is drained by Anvil Creek, Clarks Gully, Big Flat Creek and Sandy Creek. Anvil Creek and Clarks Gully flow into Big Flat Creek, which flows into Wybong Creek, a tributary of the Goulburn River. The Goulburn River joins the Hunter River approximately 4.8 kilometres downstream from Denman. Sandy Creek drains to the Hunter River at Denman.

The main channels of Big Flat Creek and Wybong Creek lie outside the Proposed Disturbance Area; however, many of Big Flat Creek's north-eastern and southern tributaries and a small number of Wybong Creek's tributaries will be impacted if development proceeds. Clarks Gully drains the north-west corner of the survey area and the majority of this creekline and its tributaries are within the Proposed Disturbance Area. Anvil Creek drains the centre of the survey area and the majority of the creekline and its tributaries are within the Proposed Disturbance Area. Sandy Creek drains the south-east corner of the survey area; however, the majority of the creekline and its tributaries are outside the Proposed Disturbance Area.

Anvil Creek, Clarks Gully and Sandy Creek are ephemeral in nature and currently contain flow only after substantial rain. Water is then retained for a short period in a few small, deep



Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images
Note: Contour Interval 5m

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Survey Area

FIGURE 4.4

Topography of the Survey Area

pools along their channels. Big Flat Creek is more permanent in nature and whilst it only flows after extensive rain it does contain water in larger pools towards its lower reaches and its confluence with Wybong Creek. Wybong Creek (which is outside the Proposed Disturbance Area but partially within the survey area) is the most permanent of the watercourses.

The current morphology of the creeks however, cannot be seen to reflect their nature prior to European land clearance and subsequent entrenchment. Similar to creeks in other parts of the Hunter Valley, it is far more likely that all of these watercourses had far shallower, grassy channels interspersed by chains of ponds. Permanence of the water within the creeks is however, likely to have increased with stream order. Thus, Big Flat Creek and Wybong Creek are more likely to have had permanent to semi-permanent water than Anvil Creek, Clarks Gully or Sandy Creek.

Dominant topographic features of the survey area are four areas of conglomerate plateaus with steep rocky clifflines above heavily vegetated, steep to very steep scree slopes. These are:

- Anvil Hill which rises to approximately 230 metres Australian Height Datum (mAHD), being 70 metres above the surrounding area at its highest point and is central to the Proposed Disturbance Area but excluded from it;

- Wallaby Rocks which rises to approximately 220 mAHD, being 100 metres above the surrounding area and is to the west of the Proposed Disturbance Area;

- Limb of Addy Hill which also rises approximately 290 mAHD above the surrounding area and is to the south-west of the Proposed Disturbance Area; and

- the Western Rocks which also rise approximately 250 mAHD above the surrounding area and are to the south-west of the Proposed Disturbance Area.

Anvil Hill consists of two flat-topped rocky outcrops connected by a saddle, whilst Wallaby Rocks is a single, linear plateau that dominates the local skyline within the survey area and provides expansive views of the local landscape. Limb of Addy Hill consists of multiple dissected plateaus. For the purpose of this report these have been divided into the three eastern plateaus that are called ‘Limb of Addy Hill’ and numerous smaller plateaus to the west that are called the ‘Western Rocks’ (refer to **Figure 4.4**).

The clifflines of all the plateaus have been subject to cavernous weathering and all plateaus have large boulders on their scree slopes which may also have been subject to cavernous weathering. All of the plateaus provide expansive views of the surrounding landscape and all have spurs that provide relatively easy routes for their ascent.

The conglomerate clifflines of the plateaus are ideal locations for rockshelters which may have been suitable for use by Aboriginal people. Ethno-historical data shows that Aboriginal people at similar locations such as Castle Rock (1.6 kilometres to the north-west of the north-western edge of the Proposed Disturbance Area) exploited these areas of higher elevation for camping in order to survey the surrounding landscape and to watch out for the approach of marauding tribes such as the Kamilaroi (see Ridley in ERM 2004a) (refer to **Section 5.1**).

In terms of suitability for occupation, the northern and western margins of Wallaby Rocks and the far western margin of the Western Rocks are the closest areas to what is likely to have been the most permanent sources of water, Big Flat Creek and Wybong Creek (refer to **Figure 4.4**). Thus if rockshelters exist in these areas they may have been subject to higher levels of occupation than rockshelters on Anvil Hill and Limb of Addy Hill where water would not have been available, except after substantial rain.

4.2.1 Impact of European Land Use

The availability of water is a determining factor for Aboriginal site location and it is a general expectation that larger camp sites will be located near permanent water and semi-permanent water and smaller camp sites will be located in areas where water resources are more ephemeral. As discussed in **Section 4.2**; however, European land use practices have changed the morphology of the watercourses within the survey area so that it is now difficult to know where water may have been available on a permanent or semi-permanent basis and thus to be accurate in predicting the size and location of sites likely to be located in association with the various reaches of the creeklines. In order to address this issue, a geomorphological inspection of the Proposed Disturbance Area was undertaken following the survey. The results of the geomorphological inspection are discussed in **Section 7**.

European land use has also resulted in major erosion of areas along the banks of the creeks within the survey area. This erosion is likely to have acted to damage or destroy sites located in close proximity to the creeklines in these areas.

4.2.2 Implications for Aboriginal Resource Distribution/Site Location

The topography and hydrology of an area directly impact upon the likelihood of Aboriginal occupation. For example, areas of low gradient in association with permanent or semi-permanent water are generally preferred for camp sites, and creek confluences are often the location of sites. Areas such as spur crests and hill and plateau tops that offer broad outlooks may also be used for camp sites when there is a requirement to watch out for approaching allies/enemies, plan a hunt or take advantage of a cooling breeze. Creeklines or spur crests may provide excellent travel routes between resources; however, spur crests are generally at a distance from water and thus are only likely to contain small amounts of artefactual material related to this transient use. Clifflines may contain rockshelters suitable for occupation and the scree slopes below clifflines may have large boulders (that have fallen from the cliffs above) which may have cavernous weathering making them suitable as shelters.

It is feasible to suggest that larger sites within the survey area are more likely in areas of low gradient along Big Flat Creek and at the confluence of Big Flat Creek and Clarks Gully, and Big Flat Creek and Anvil Creek. The most reliable water source and thus largest camp site however, could be predicted at the confluence of Big Flat Creek and Wybong Creek (outside the Proposed Disturbance Area). Smaller camp sites are likely in areas of low gradient along the lower reaches of Anvil Creek and Clarks Gully with sites becoming smaller and more widely dispersed in the higher reaches of these creeks and their tributaries.

In the south-eastern corner of the survey area, it could be expected that sites will be located in areas of low gradient associated with Sandy Creek. Site size and density would be expected to increase in the higher order tributaries and along the main channel of Sandy Creek closer to the Hunter River.

Rockshelter sites are likely in association with the plateaus. Rockshelter use is generally transient in nature as the shelters were mainly used for camping when it was necessary to escape wet weather, the heat and/or the cold. In general people camped in the open. Shelters are usually not pleasant places as they invariably contain macropod fleas and ticks. Rockshelters with suitable sandstone walls were also used for art and in this case shelter use may have been limited to a small group of initiated people. The most intensive rockshelter occupation can be expected in those rockshelters closest to permanent or semi-permanent water sources. More transient rockshelter use can be expected further from permanent water and rockshelters that are easily accessed are more likely to have been

used for camping than those high on cliffs that are difficult or dangerous to access. The latter may have been used for rock art of a secret/sacred nature.

4.3 Geology and Soils

The western section of the survey area is underlain by Triassic interbedded conglomerate, sandstone and siltstone of the Narrabeen Group. Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks are exposures of these Triassic conglomerates which contain very tightly packed small to large pebbles and cobbles. The Permian Newcastle Coal Measures containing sandstone, shale, mudstone, conglomerate and coal seams are located to the east and underlying the Triassic conglomerates.

Kovac and Lawrie (1991) identified one major and four minor soil landscapes within the survey area. The Sandy Hollow soil landscape dominates the area. The yellow solodics of this soil landscape are associated with flats, drainage lines and gentle slopes within the survey area. The Castle Rock soil landscape also contains yellow solodics which are associated with the undulating low hills in the north-eastern corner of the survey area. The topsoil in the areas dominated by yellow solodics ranges in depth from 4 to 40 centimetres (GSS Environmental 2006: 5-6). In the east the yellow solodics intergrade with brown clays of the Dartbrook Formation soil landscape. The brown clays are associated with the low hills and undulating slopes along the far east of the survey area. Topsoil in this area ranges between 10 and 15 centimetres.

High rocky plateaus such as Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks are contained within the Lees Pinch (lp) soil landscape. This landscape is characterised by shallow sands ranging in depth between 5 and 15 centimetres. Slopes in this landscape range from 30% to 90% in gradient.

The Hunter soil landscape occurs in the far south-east of the survey area and is associated with the Hunter River alluvium. This soil landscape is associated with black alluvial clays and topsoil ranges in depth from 5 to 25 centimetres.

Only minor areas of alluvial deposit are located within the survey area. These areas occur at the confluence of Anvil Creek and Big Flat Creek and further west to the confluence of Wybong Creek and Big Flat Creek.

4.3.1 Impact of European Land Use Practices

European land use practices such as pastoralism, agriculture and the establishment of settlements within the survey area has led to an increase in erosion of the topsoil along creeklines and on slopes and ridges, and the deep entrenchment and gullying of the watercourses.

4.3.2 Implications for Aboriginal Resource Distribution/Site Location

The nature of the conglomerate outcropping in the survey area makes it ideal for cavernous weathering and the formation of rockshelters suitable for human occupation; however, it makes the rockshelter walls unsuitable for the production of rock art or for engravings.

Areas where sandstone outcrops along the beds of creeks or along their banks are often used for the grinding of sharp edges on stone axes or for sharpening the points of fire hardened spears however, the nature of the coarse conglomerate indicates that these activities are unlikely in the survey area. If sandstone is exposed it will only be in the base of

the deeply entrenched creek channels which are the product of European land use practices. Thus grinding grooves are highly unlikely in these areas.

The geology also indicates that ochre quarries or quarries used for the extraction of stone for stone implement manufacture are highly unlikely in the survey area.

As documented in **Section 4.2.1**, soil erosion has the potential to have damaged or destroyed sites such as artefact scatters. Also of importance in relation to soils is that ecotones (areas where one soil landscape meets another; for example where alluvium overlays and abuts other soil landscapes), offer a broader array of plant, and thus prey animal species in a restricted area. These areas were often targeted by Aboriginal hunter-gatherers due to this species diversity and may be expected to contain camp sites, especially if they are located near semi-permanent or permanent water. In relation to the survey area, sites related to ecotones could be located along Big Flat Creek and Wybong Creek and also along the lower reaches of Sandy Creek where it enters onto the Hunter River floodplain (refer to **Figure 4.4**).

4.4 Flora

The survey area contains a variety of vegetation communities (refer to Umwelt (2006) Ecological Assessment). The following 10 vegetation communities have been mapped within the survey area:

- Narrow-leaved Ironbark Woodland;
- Slaty Box Woodland;
- Forest Red Gum Riparian Woodland;
- Native Grassland;
- Bull Oak Woodland;
- Drooping She oak Dry Shrubland;
- Swamp Oak Riparian Forest;
- Red Ash Woodland;
- Tall Shrubland;
- Sheltered Grey Gum Woodland; and
- White Box Yellow Box Blakeley's Red Gum Woodland.

Many plant species exist within these vegetation communities which are documented in the broader ethno-historical record of NSW and the ethno-historical record of the Upper Hunter, as Aboriginal resource plants. **Table 4.1** below provides a list of these plant species.

Table 4.1 - Aboriginal Economic Plants

Common and *Scientific* Name	**Use**	**Reference**
amulla *Eremophila debilis (previously Myoporum debile)*	Food plant	MacDonald and Davidson 1998
berry saltbush *Einadia hastata*	Food plant	Low 1989: 129
blue-leafed ironbarks *E. fibrosa* spp. *Nubile*	Economic Plant	MacDonald and Davidson 1998
blue flax lily *Dianella* sp. and *Dianella longifolia*	Food and Economic Plant	Low 1989: 8
box mistletoe *Amyema miquelii*	Food plant	Low 1989: 14
bulrush *Typha* sp.	Food and economic plant	Low 1989: 109; Zola & Gott 1992:8
burrawang *Macrozamia communicus*	Food plant	MacDonald and Davidson 1998
chocolate lily *Dichopogon strictus*	Food plant	Zola & Gott 1992:42
common reed *Phragmites australis*	Food and economic plant	Low 1989: 131
cooba *Acacia salicina*	Economic plant	Hurst (1942)
cycads/burrawang *Macrozamia spiralis*	Food plant	MacDonald and Davidson 1998
cypress pine *Callitris* spp.	Economic plant	MacDonald and Davidson 1998
drooping mistletoe *Amyema pendulum* subsp. *Pendulum*	Food plant	Low 1989: 14
early Nancy *Wurmbea biglandulosa*	Food plant	Low 1989: 113
eucalypts	Economic plant	MacDonald and Davidson 1998
false sarsaparilla *Hardenbergia violacea*	Medicinal plant	Low 1989: 210
fern roots	Food plant	Brayshaw 1986:74-75
five corners *Styphelia triflora*	Food plant	Low 1989: 43
fringed lily *Thysanotus tuberosus*	Food plant	Low 1989: 113
gargarloo *Parsonsia eucalyptophylla*	Food plant	Ted Fields pers. comm.
giant yams	Food plant	Brayshaw 1986:74-75
grass trees *Xanthorrhoea glauca and Xanthorrhoea johnsonii*	Food plant and economic plant	MacDonald and Davidson 1998
grevillea *Grevillea Montana*	Food plant	Low 1989: 171
grey box *Eucalyptus moluccana*	Economic plant	MacDonald and Davidson 1998

Table 4.1 - Aboriginal Economic Plants (cont)

Common and *Scientific* Name	**Use**	**Reference**
head-ache vine *Clematis glycinoides* var. *glycinoides*	Medicinal plant	Low 1989: 151
hill hibiscus *Hibiscus sturtii*	Economic plant	Low 1989: 128
kangaroo grass *Themeda australis*	Food and medicinal plant	Greenway 1910:16 MacDonald and Davidson 1998 Zola & Gott 1992:58
kurrajong *Brachychiton populneus*	Food and economic plant	Low 1989: 27; MacDonald and Davidson 1998 Zola & Gott 1992:36
mat-rush *Lomandra* sp. wattle mat-rush *Lomandra filiformis* and *Lomandra confertifolia;* pale mat-rush *Lomandra glauca,* spiny-headed mat rush *Lomandra longifolia,* and many-flowered mat rush, *Lomandra multiflora* subsp. *Multiflora.*	Food and economic plant	Low 1989: 131, 174; MacDonald and Davidson 1998 Zola & Gott 1992:59
melaleucas	Economic plant	Albrecht 2000 in ERM 2004:34
mistletoe *Amyema* spp. *Amyema congener* subsp. *congener*	Food plant	MacDonald and Davidson 1998
mountangarra – native broom *Jacksonia scopiera*	Economic plant	MacDonald and Davidson 1998
narrow-leaved geebung *Persoonia linearis*	Food plant	Low 1989: 43-44
narrow-leaved Ironbark *Eucalyptus crebra*	Economic plant	pers. comm. various Aboriginal people from the Dubbo Region (2000) and shields etc. pers. obs. of scarred trees and NPWS Site cards
native cherry *Exocarpos cupressiformis*	Food and economic plant	Brayshaw 1986:74-75
native geranium *Geranium* sp. *Geranium solanderi* var. *solanderi*	Medicinal plant	Zola & Gott 1992:47, 56
native raspberry *Rubus rosifolius*	Food plant	MacDonald and Davidson 1998
native willow *Acacia salicina*	Native economic plant	MacDonald and Davidson 1998
northern sandalwood *Santalum lanceolatum*	Food and medicinal plant	Low 1989: 80, 100, 101, 172, 207
onion orchid *Microtis unifolia*	Food plant	Cunningham et al. 1992: 200
panicum grass *Panicum* spp.	Food plant	MacDonald and Davidson 1998

Table 4.1 - Aboriginal Economic Plants (cont)

Common and *Scientific* Name	**Use**	**Reference**
paperbark mistletoe *Amyema gaudichaudii*	Food plant	Low 1989: 14
pigweed *Portulacca oleracea*	Food plant	MacDonald and Davidson 1998
plantains *Plantago Debilus*	Food plant	MacDonald and Davidson 1998
Port Jackson fig *Ficus rubiginosa*	Food plant	MacDonald and Davidson 1998
rats tail grass *Sporobulus creber*	Economic plant	Cribb and Cribb 1986
red ash *Alphitonia excelsa*	Economic and medicinal plant	http://www.brisrain.webcentral.com.au/old_site/database/Alphi_excelsa.htm
ruby saltbush *Enchylaena tomentosa*	Food and economic plant	Bindon 1998: 111
rushes and sedges *Juncus &Cyperus* sp. including sticky sedge *Cyperus fulvus,* a sedge *Cyperus gracilis,* sharp rush (*Juncus acutus* subsp. *acutus, Juncus homalocaulis* and *Juncus usitatus,*	Food and/or economic plants	Low 1989:105; Zola & Gott 1992:60
rusty fig *Ficus rubiginosa form rubiginosa*	Food plant	Low 1989: 41
saw sedge *Gahnia* sp. rough saw sedge *Gahnia aspera*	Food and economic plant	Low 1989:105; Zola & Gott 1992:60
she-oak mistletoe *Amyema cambagei*	Food plant	Low 1989: 14
spike rush *Eleocharis acutas and Eleocharis cylindrostachys*	Food plant	Low 1989:109
swamp dock *Rumex brownii*	Food plant	Low 1989: 28, 30, 153-154
sword sedge *Lepidosperma* spp.	Economic Plant	MacDonald and Davidson 1998
tarvine *Boerhavia dominii*	Food plant	Low 1989: 14, 105
tiger orchid *Cymbidium canaliculatum*	Food plant	Low 1989: 125
umbrella sedge *Cyperus eragrostis*	Economic plant	MacDonald and Davidson 1998
water ribbon *Triglochin procera*	Bullet-shaped tubers roasted and eaten	Zola & Gott 1992: 12
western grey-box *Eucalyptus microcarpa*	Economic plant	NPWS site cards and pers. obs. of scars on trees from bark removal
wombat berry *Eustrephus latifolius*	Food plant	MacDonald and Davidson 1998

Table 4.1 - Aboriginal Economic Plants (cont)

Common and *Scientific* Name	**Use**	**Reference**
white feather honeymyrtle *Melaleuca decora*	Food plant	Low 1989: 171
wonga wonga vine *Pandorea pandorana* subsp. *pandorana*	Economic Plant	Cunningham et al. 1992: 602
macrozamia nuts/seeds *Macrozamia* sp.	Food plant	Brayshaw 1986:74-75

4.4.1 Impact of European Land Use Practices

Although there are many Aboriginal resource plants still growing within the survey area, European land use practices have had a significant impact on their distribution and density. This impact is far more apparent within the Proposed Disturbance Area. Outside the Proposed Disturbance Area and within the broader survey area it is most apparent along the valley floors associated with Big Flat Creek, Wybong Creek and the lower reaches of Sandy Creek where vegetation clearance, grazing and in some areas cultivation has led to the loss of many of the Aboriginal resource species that would normally have grown in these areas. Although subject to selective clearing and some grazing pressure, the scree slopes and slopes in close association with Anvil Hill, Wallaby Rocks, Limb of Addy Hill and the Western Rocks which dominate the landscape outside the Proposed Disturbance Area exhibit a far greater diversity of Aboriginal food, medicine and economic plant species than the landscape within the Proposed Disturbance Area.

4.4.2 Implications for Aboriginal Resource Distribution/Site Location

It is difficult to evaluate the suite of Aboriginal food plants that would have been available within the Proposed Disturbance Area due to the degree of vegetation clearance; however, there is potential that this area would have provided some species not available in the areas associated with the plateaus and thus would have been subject to the gathering of plant resources not available in these areas.

The plateaus and their environs provide many seasonal plant and medicine foods which would have made the area attractive for transient visits throughout the year. They also contain two carbohydrate sources (*Macrozamia* sp. and *Gahnia* sp.); however, both of these are highly seasonal plant foods that have high energy costs for their preparation, and thus are not sufficient on their own to act as a staple carbohydrate (energy) source.

Better staples are provided by easily gathered and processed aquatic plants such as the bulrushes, water ribbons, spike rush and sedges which would have been available in slow moving water and pools within the lower reaches of all the creeklines. Areas such as these would have been the focus of longer term Aboriginal occupation. Longer term Aboriginal occupation results in the discard of more cultural material, making these areas more obvious archaeologically than areas subject to transient use, where few artefacts are discarded.

Thus, whilst there are more Aboriginal resource plants currently remaining in the Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks areas, the material evidence of the exploitation of these plant resources may be difficult to discern. On the other hand, the material evidence of the use of staple carbohydrate plant foods gathered from within pools along the creeklines (which are mostly now absent) in the Proposed Disturbance Area may be more easily observed archaeologically, if such evidence has not been destroyed by erosion of the creek banks.

4.5 Fauna

Numerous Aboriginal prey species were noted during fauna surveys undertaken of the survey area for the EA (refer to Umwelt (2006) Ecological Assessment). **Table 4.2** lists the species and identifies if they were located within the Proposed Disturbance Area or within the broader survey area.

Table 4.2 - Aboriginal Prey Species

Common Name	Scientific Name	Proposed Disturbance Area	Survey area (excluding the Proposed Disturbance Area)
quail	*Coturnix* spp.	present	absent
wood duck	*Chenonnetta jubata*	present	present
black duck	*Anas superciliosa*	present	present
teal	*Anas gracilis*	present	present
pelican	*Pelecanus conspicullatus*	present	present
white-faced heron	*Egretta novaehollandia*	present	present
straw-necked ibis	*Threskiornis spinicollis*	absent	present
masked lapwing	*Vanellus miles*	present	present
bronzewings	*Phaps* spp.	present	present
crested pigeon	*Ocyphaps lophotes*	present	present
peaceful dove	*Geopelia striata*	present	present
lace monitor	*Varanus varius*	present	present
eastern bearded dragon	*Pogon barbata*	present	present
red-naped snake	*Furina diadema*	present	present
blue-bellied black snake	*Pseudechis guttatus*	absent	present
snake-necked turtle	*Chelodina longicollis*	present	absent
short beaked echidna	*Tachyglossus aculeatus*	present	present
koala	*Phascolarctos cinereus*	absent	present
common wombat	*Vombatus ursinus*	present	present
squirrel glider	*Petaurus norfolkensis*	present	Present
common ringtail possum	*Pseudocheirus peregrinus*	present	Present
common brushtail possum	*Trichosurus vulpecula*	present	Present
eastern grey kangaroo	*Macropus giganteus*	present	Present
common wallaroo	*Macropus robustus*	present	Present
red-necked wallaby	*Macropus rufogriseus*	present	Present
brush-tailed rock wallaby	*Petrogale penicillata*	absent	habitat present
swamp wallaby	*Wallabia bicolor*	present	present

Table 4.2 indicates that a diverse range of prey species inhabit the survey area and with few exceptions most are found both within and outside of the Proposed Disturbance Area. The difference in species distribution is understood to relate to specialised habitat requirements (brush-tailed rock wallabies) or due to habitat reduction/modification (quail, koala and snake-necked turtle). Overall, the entire area would have provided a diverse faunal resource base for Aboriginal hunter-gatherers, with some areas such as Big Flat Creek and Wybong Creek providing many aquatic species in greater abundance and for longer periods than the more ephemeral creeklines. Freshwater mussels were not identified during the faunal study and were not known to local landholders within any of the creeklines.

Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks provide habitat for a range of mammals, including the common wombat (*Vombatus ursinus*), the brush-tailed rock-wallaby (*Petrogale penicillata*) and potentially the spotted-tail quoll (*Dasyurus maculatus*). A diversity of woodland birds was also observed to be utilising these areas, which would have provided for the hunting of prey species not available in areas of lower gradient and without rock outcrop.

Aquatic and semi-aquatic habitat is limited within the Proposed Disturbance Area due to the ephemeral nature of the creeks and their tributaries. In these areas flow is limited to brief periods after substantial rain. When flow ceases, habitat for aquatic and semi-aquatic species is limited to small fish in the larger pools and species such as the snake-necked turtle and freshwater crayfish that are able to move between isolated pools and to farm dams which were located throughout the Proposed Disturbance Area during the survey. Isolated pools along the creeks and tributaries would have been a focus point for prey species and subsequently for Aboriginal hunter-gatherers.

4.5.1 Impact of European Land Use Practices

Historical records suggest that there were large numbers of Aboriginal prey species in the Hunter Valley especially in the 'open undulating country and on the flood plains of the Hunter and Goulburn Rivers' (ERM 2004:34). John Gould observed many waterfowl on the wetlands of the Hunter River from Singleton to Scone (Albrecht 2000:12 cited from ERM 2004:36). Other smaller animals mentioned as occurring in abundance by Albrecht (2000:10-12) included bandicoot, long-nosed potoroo, native cat, fruit bats, wonga wonga and other pigeons, doves, and many other unnamed species of birds. Fish are also mentioned in Brayshaw (1986) as having occurred in abundance in the Hunter River (namely perch) during the early stages of European settlement.

Allan Cunningham (1825 in Brayshaw 1986:19) described the wildlife of the Denman area:

> Kangaroos and Emus particularly the former are abounding in every part of our Route but were too swift for our dogs, having fared rather sumptuously of late were in no disposition to exert themselves to catch the game, that was bounding about us in all parts of the timbered land.

Of Patrick Plains near Singleton, Peter Cunningham (1827:152-3 in Brayshaw 1986:19) wrote:

> These plains are the great resort of our wild turkeys, which you will see here stalking majestically about, and which afford an excellent and most delicate repast.

Fawcett (1898:153 in Brayshaw 1986:79) described how the Wonnarua sometimes caught kangaroos, wallabies and emus with nets. He noted that these were particularly useful in wooded areas where they were fixed amongst the trees in semi-circles. He also suggested that fire was used to aid the hunting of kangaroos and wallabies:

> The grass in certain districts was first burnt off, and about a month afterwards, when the young grass had sprung again, these animals all congregated there to eat the sweet young pasturage.

Hunting by early European settlers and habitat change brought about by agricultural practices has acted to diminish species diversity and at the same time to allow some species to proliferate (for example grey kangaroos which exist in larger numbers due to farm dams providing a constant water supply) across the Hunter Valley and within the survey area.

4.5.2 Implications for Aboriginal Resource Distribution/Site Location

The relatively diverse number of prey species present within the Proposed Disturbance Area and the broader survey area suggests that the whole of the area would have been used for hunting with different areas being targeted at different times for specific resources. It is unlikely that these hunting activities would have resulted in the discard of sufficient material evidence to be archaeologically visible. It is more likely that the base camps used by the hunters before and after hunts will be located during survey and that these will contain evidence of implements manufactured for hunting and butchering and discarded after use. These sites are most likely to be found in association with areas of low gradient close to permanent or semi-permanent water sources.

4.6 Summary

The environmental context of the survey area indicates that it was an area that provided a diverse array of habitats for Aboriginal floral and faunal resources and that the entire area would have been utilised by Aboriginal hunter-gatherers during their daily foraging activities. The availability of drinking water would have been a limiting factor on how many people could have exploited the area, where they could have camped and how long they could have camped in any one place.

Based on the environmental context, the most likely areas to locate significant concentrations of material evidence of Aboriginal occupation in the survey area are:

- areas of low gradient associated with permanent to semi-permanent water, especially near creek confluences;
- within rockshelters, especially along the northern and western sides of Wallaby Rocks and the far western end of Western Rocks; and
- near ecotones (for example where Sandy Creek enters the Hunter River floodplain and where alluvial deposits overlap the footslopes along Big Flat Creek or Wybong Creek).

The previous land use in the area has the potential to have destroyed or at least damaged the integrity of Aboriginal sites that were/are located in the area. Erosion of the creeklines whilst having the potential to destroy sites, also has the potential to uncover artefacts making them visible during survey.

Based on the environmental context, site types assessed as unlikely within the survey area are:

- rockshelters with art or engravings (due to the nature of the geology);
- grinding grooves (due to the nature of the geology);
- sites that retain stratigraphic integrity (due to erosion and soil disturbance resulting from European land use practices);
- scarred and carved trees (due to vegetation clearance); and
- ochre or stone quarries (due to the nature of the geology).

5.0 The Archaeological Context

This section presents the known archaeological context of the survey area and draws upon information recorded by early ethnographers and prior research. The information provided in this section is used (along with the environmental context) to prepare a predictive model for site location and site type within the survey area (refer to **Section 5.9**).

5.1 Ethnographic References

The survey area lies in the Central Lowlands of the Hunter Valley which is the country of the Wonnarua[1] people. Due to the violent and rapid invasion of the Hunter Valley by Europeans there is very little detailed information available about the Aboriginal way of life prior to the arrival of the colonists (Davidson and Lovell-Jones, 1993: Ch 4). Reliance must be placed on what Davidson and Lovell-Jones call the 'salvage' work of secondary sources such as Curr (1887), Brayshaw (1966; 1986), Miller (1986) and Wood (1972). It should be noted that there are many problems with the use of these ethnographic references, for example Miller (1985:88) argues that ethnographers such as Howitt, Fawcett, Breton, Dawson, Matthews and Curr were not trained anthropologists or archaeologists and their records are an interpretation of the Wonnarua who they believed to be a dying race of 'an almost extinct culture'. These interpretations are therefore biased and ethnocentric. Miller (1985:88) also points out that some sources such as Howitt, had 'never travelled to the Hunter Valley and relied on letters from an informant who lived in the area as did Curr'.

Early European observers recorded the lives of the Wonnarua as intensely religious and constrained by strictly enforced laws (Ridley 1864 in Brayshaw 1986). The traditional lives of the ancestral Wonnarua focused on the Hunter Valley and were structured around a schedule of social interactions designed to take advantage of seasonal availability of resources; meaning that people moved often, but not at random. Before the arrival of the Europeans the Wonnarua was a large grouping of individual family units and bands which occasionally came together for religious and ceremonial functions (Davidson and Lovell-Jones, 1993:3). People travelled freely within the broad area of responsibility of their own group. Social responsibilities and obligations meant that people also travelled beyond their own territories to attend ceremonies with neighbours, to trade and to develop social networks that linked people across extensive areas. The Wonnarua are recorded as having had social links from the coast to the western plains of NSW (Brayshaw 1986a: 38-41).

Ancestral Aboriginal people often lived and travelled in small groups of less than 20 people, but regularly met relations and neighbours for ceremonies where hundreds and sometimes thousands of people gathered for weeks at a time. Events like this were scheduled when and where seasonal resources were plentiful. Successive gatherings were rotated between a number of sites to allow the local environment to fully recover from periods of intensive exploitation. These gatherings were an opportunity to trade a wide range of goods from ceremonial songs and dances to stone axes, spears and native tobacco (Mulvaney 1986). Different groups sometimes specialised in producing high quality trade goods.

Most of the time, Aboriginal people were recorded as living in small groups moving regularly from camp site to camp site, living on local resources. There is little ethnographic evidence about where Aboriginal people camped; however, there is mention of the importance of fresh water. Also of importance when determining the location of camp sites, was the suitability of a site as a vantage ground in the case of enemy attack (Fawcett 1989:152 in Davidson and Lovell-Jones, 1983:5). While camping at a particular site, people would travel each day

[1] The Wonnarua have variously been called: Wanaruah, Wonaruah, Wanarua and Wonnah-Ruah. Wonnarua is the spelling which will be used in this report except where a direct quote from another source is cited.

through the surrounding country to gather plant foods and to hunt or to visit areas that provided other required resources (for example stone, ochre, bark and resin). The daily foraging area was generally within a day's walk of camp (usually within about 5 kilometres).

There are several reports that describe the country as having extensive grasslands with few trees and extensive floodplains (Breton 1833, Cunningham 1827, Howe 1819). These grasslands are thought to have occurred because Aboriginal people were continually burning the countryside as part of their responsibility to look after the land and as a hunting strategy. Fire stick farming was a major economic activity of the Wonnarua (Davidson and Lovell-Jones, 1993:5). Burning cleared the undergrowth and fresh growth produced green shoots that attracted prey animals. Fawcett (1898) refers to the use of fire by the Wonnarua; and other early accounts (Cunningham 1827, Mitchell in ERM 1999) also report the use of fire in the area.

Kangaroos, emus, possums and fish were recorded as plentiful (Breton 1833, Cunningham 1827, Dawson 1830), and mention was made of an abundance of food on the flatter ridges and plains that supported large populations of kangaroos (Cunningham 1827: 157). Breton (1833) and Eyre (1859) noted suitable trees were also available to provide bark for shelters and wooden implements such as shields.

Most of the evidence for Aboriginal occupation in the Hunter Valley comes from stone implements (generally termed artefacts). Unfortunately, there is little ethnography concerning the production and use of stone implements. The only known mention is in regard to the use of quartz as a barb on spears and of the use of stone hatchets (Brayshaw 1986a: 66, 68).

European arrival in the Hunter Valley began with the discovery of coal at Newcastle in 1797. By 1801 the Valley was reserved by the Crown as both a new convict settlement (a penal settlement was established in the Newcastle area in 1804) and for its resources in coal and timber (particularly Cedar) (Davidson and Lovell-Jones, 1993:8). This reservation placed on the region by the Crown effectively 'restricted or alienated free settlement to the area' (Davidson and Lovell-Jones, 1993:8). However, by 1819 the demand for grazing land and land for rural settlement increased beyond the current bounds of the colony's free settlement area and in 1821 Henry Dangar was commissioned to undertake a survey of the Hunter area to assess its suitability for settlement and farming.

Davidson and Lovell-Jones state that within months of Dangar reporting the Hunter Valley as suitable for settlement, claims for purchase and leasehold were being made from selectors in Sydney. 'By 1825 both sides of the Hunter River and associated brooks had been claimed' (Davidson and Lovell-Jones, 1993:8). The rapid settlement in the area disrupted the Aboriginal economy and, in a very short time, the Aboriginal population was substantially affected by a combination of starvation, introduced diseases and massacres.

First contact between the Wonnarua and the settlers may have been cordial (see citations in Davidson and Lovell-Jones, 1993:10) but rapidly turned hostile and violent with the Aboriginal community actively resisting the colonisation and appropriation of their land and resources, and the European landholders and their stockmen implementing 'widespread and indiscriminate' violence against Aboriginal people. This violence escalated significantly after 1826 and was fuelled in particular by the institutionalised violence by the Mounted Police (Davidson and Lovell-Jones, 1993:14-15, MacDonald and Davidson, 1998:60).

Documentary evidence suggests that by 1830 (only nineteen years after the first European settlers arrived in the Hunter) 'all armed resistance by local Aborigines' had ceased (Davidson and Lovell-Jones, 1993:17) and the traditional use of the land by the Wonnarua and their social structure and interactions had dramatically been affected – all within one generation. On the other hand, there are also some accounts of cultural ceremonies being

conducted decades later, such as a ceremony held at Bulga in 1852, noted by Blyton et al. (2004:9); and a ceremony held at the junction of the Page and Isis Rivers at Gundy reported in the 1870s (McDonald 1878:255-258).

Since European settlement the Hunter Valley landscape has undergone radical changes. European colonisation saw the establishment of pastoral holdings, small towns and villages. Blyton et al. (2004:9) argue that the European pattern of settlement and land use rapidly became the normative occupation pattern 'replacing traditional Aboriginal communities' (Blyton et al., 2004:9). Davidson and Lovell-Jones (1993:17) also argue that shortly after European settlement all that remained were isolated family groups of Wonnarua existing 'on the fringes of towns and on properties trying as best they could to survive in a European modified environment'.

There is evidence in primary historical documents suggesting that many of the locations in which Europeans first settled (homestead locations) and/or areas later designated as reserves for Aboriginal people (such as St Clair, also referred to as 'Mount Olive', and 'Glennies Creek' and Redbourneberry Hill Reserve) near Singleton, were actually pre-European camp sites (refer to accounts referring to Ogilvies Hill and Dart Brook in ERM 2004a:121:123 and Table 4.5:129-134; Maitland Mercury 1851; Blanket returns reported in Singleton Argus 1879 cited in ERM 2004a:99; The Singleton Times, 31 May 1862 cited in ERM 2004a:109). This conclusion was based on the assumption that the location of Aboriginal camp sites at first contact with Europeans was where they camped prior to this time.

Wonnarua descendants such as the Millers, who are active in Aboriginal cultural heritage in the Hunter today, continued to live in these areas up to the twentieth century despite European settlement (see Miller 1985:157; Singleton Times Newsletter 1992:3-4). European settlement and encroachment on resources and traditional camping groups restricted Aboriginal occupation and dramatically affected Aboriginal communities, but it did not completely destroy connections to traditional camping grounds. There is a continuation of cultural connection and in some cases occupation of these places such as St Clair and Redbourneberry Hill that date well into the twentieth century. Redbourneberry Hill Reserve and St Clair are registered Aboriginal places on the DEC AHIMS database.

The Aboriginal stakeholders were requested to provide any relevant cultural history during the consultation program and fieldwork. No specific information has been provided to date.

5.1.1 Implications for Aboriginal Resource Distribution/Site Location

The ethnography for the Hunter Valley region indicates that:

- the availability of fresh water was a determining factor in the location of Aboriginal camp sites;
- locations that provided good vantage points were also favoured as camp sites;
- Aboriginal people had a main camp site from which they dispersed during the day to hunt and gather food plants and other resources. Thus there should be one main camp site surrounded by smaller satellite sites which were used as day time camps (lunch time camps and butchery sites);
- Aboriginal people removed bark from trees to make containers and shields and evidence of bark removal may be exhibited by mature native trees if they survived European land clearance;

- there is no ethnographic evidence to suggest the survey area was used for ceremonial purposes despite these being observed elsewhere in the Hunter Valley;

- camp sites are likely in the same areas initially targeted for homesteads by Europeans. These are usually where there is a good freshwater supply; and

- post-contact sites (sites that contain evidence suggesting they were used after European settlement) are likely to be rare due to the rapid destruction of the Aboriginal population.

5.2 Site Type

In accordance with the NPWS Guidelines for archaeological report writing (1997), this subsection provides definitions of the various types of Aboriginal sites known from the archaeological record of the broader Hunter region. It should be noted that many of these site types are not relevant to the survey area; however, reference is made to them in the following subsections to provide information to justify why such sites are not considered relevant for the survey area.

The most common site types located by archaeologists during survey in the Hunter are sites that contain scatters of stone artefacts. Stone artefacts are pieces of stone modified for, or by, human use. Stone artefacts are robust and preserve well in the archaeological record when other forms of evidence of Aboriginal exploitation are lost due to preservation biases (wooden implements, food remains).

Burials and ceremonial sites (including carved trees), whilst known in the Hunter Valley are exceedingly rare site types due to their poor survival in the archaeological record (Witter, 2003:10). Ceremonial Bora rings are historically documented in the Hunter Valley at Castle Rock, Gundy near Scone, and at Booragul near Lake Macquarie. The close proximity of the Castle Rock Bora ring (within an easy day's walk from the survey area) suggests that it is highly unlikely that a Bora ring would be located in the survey area. Stone quarries and ochre quarries are rarely found in the Hunter region and the geology of the survey area indicates that they are highly unlikely to occur. Rockshelter sites are rare in the Hunter Valley. The geology of the plateaus; however, suggests that they are highly likely within the survey area (but outside the Proposed Disturbance Area). Grinding grooves are also relatively rare, and due to the geology unlikely to occur in the survey area (Witter, 2003:10). Scarred trees are relatively uncommon but also unlikely within the survey area due to vegetation clearance. More common sites to be found throughout the Hunter Valley are isolated finds and artefact scatters, both of which are highly likely to occur in the survey area.

Aboriginal archaeological sites can be divided roughly into secular (concerned with worldly things) and non-secular (concerned with secret, sacred, ceremonial and ritual things) site types. This division is not made by archaeologists; it is strictly drawn from Aboriginal ideologies (manners of thinking, systems of belief). The division is not always clear cut as some site types may be secular in some circumstances and non-secular in others. The secular or non-secular nature of each of the site types is indicated below. Sites that are non-secular in nature generally have much higher Aboriginal cultural heritage significance than sites of a secular nature.

Isolated Find/Artefact

The site type described as an 'isolated find' or 'isolated artefact' consists of a single stone artefact. The vast majority of stone artefacts were tools used in day to day activities and were therefore were secular in nature. There are some stone artefacts, however, that were used in special rituals/ceremonies that were non-secular in nature (that is, ceremonial axes, tjuringa [engraved or decorated stones], stone knives used in cicatrisation). Isolated finds

may represent lost or discarded artefacts, but may also be the surface expression of a larger scatter of artefacts in a sub-surface context.

Artefact Scatter or Open Camp site

An artefact scatter or open camp site refers to areas (in the open landscape, not in a rockshelter or cave), that contain two or more stone artefacts, generally located within 100 metres of each other. In general, artefact scatters are secular in nature. Artefact scatters may result from the activities of a single person or a group of people. They may reflect a single occupation episode, or multiple episodes of occupation of a single place.

Rock Art Site

The term 'rock art site' generally refers to Aboriginal ochre paintings or ochre or charcoal drawings located on a rock slab (generally in a sheltered place like the floor of a cave or rockshelter), boulder, cliff-face, cave or rockshelter wall or roof, or wall of a rock overhang. The majority of rock art sites are found in positions that are sheltered from the elements. This observation, however, is probably biased to some extent, as rock art would not preserve well in open positions. Rock art sites are generally believed to be non-secular in nature.

Engraving Site

The term 'engraving site' refers to places where Aboriginal people have incised (using techniques such as pecking or abrasion) some form of motif into rock. The engravings may be on a rock outcrop, rock slab, boulder, cliff-face, rock overhang, or in a cave or rockshelter. Engraving sites are not necessarily located in sheltered positions, but are most often located on softer rock types (like sandstone). Engraving sites are generally believed to be non-secular in nature.

Rockshelter Sites

The term 'rockshelter site' refers to rockshelters/rock overhangs that contain evidence such as stone artefacts and/or bones and/or plant remains (from meals eaten at the site) and/or hearths (fireplaces). Most rockshelter sites are secular in nature, however, those that also contain rock art or engravings are often believed to be non-secular in nature.

Precontact Burial Sites

The term 'precontact burial site' refers to Aboriginal skeletal material dating to a time before white settlement. The skeletal material may be buried, interred in a cave/rockshelter/under a ledge, in a tree hollow, or exposed on a platform in a tree. Burial sites are generally believed to be non-secular in nature by contemporary Aboriginal people.

Stone Arrangements

Stone arrangements may take the form of single or multiple cairns, upright standing stones, lines or rings of stones or even stones arranged into figurative designs such as snakes or turtles. The location of many of the recorded stone arrangements suggests that they were related to ceremonial grounds and in particular initiation grounds (McBryde 1974:31-42), while others appear to mark tribal boundaries (Leney 1907:72-77). Stone arrangements it would appear can be either secular or non-secular depending on their purpose.

Shell Middens

Middens are accumulations of shells that have been discarded after human (Aboriginal) meals. Midden sites are commonly located along the coast and estuaries and less often

located in inland areas in association with waterways and lakes. Middens sometimes contain burials, but are most often simply domestic waste and as such are generally secular in nature.

Grinding Grooves

Grinding grooves are grooves on rock surfaces that have been manufactured by the sharpening of stone axe heads, stone chisels or fire hardened wooden spear points. Grinding grooves are commonly located on sandstone ledges that outcrop in creek and river beds, as the availability of water enhances the speed with which grinding proceeds. Less commonly, grinding grooves are located on rock surfaces away from water and on stone types other than sandstone. Grinding grooves appear to be secular in nature.

Stone Quarries

Stone quarries are places where Aboriginal people have sourced raw material for the manufacture of tools. Quarries may be cobble beds in rivers or on beaches, or they may be rock outcrops. When outcrops are exploited the quarrying activity may take the form of the flaking of rock from the outcrop, or scree from below the outcrop may be used instead. In some areas the stone may be dug from beneath the earth as Aboriginal stone knappers often preferred rock which had not been dried out by exposure to the elements (Tindale 1965: 140; Jones and White 1988:61-62). Stone quarries can be either secular or non-secular in nature depending on the Dreaming with which they are associated (Jones and White 1988).

Ochre Quarries

Ochre quarries are places where Aboriginal people sourced ochre (hydrated iron oxides and iron hydroxides - Whitten and Brooks 1972:269) which they used for body decoration, implement decoration and rock art. Ochre quarries can be either secular or non-secular in nature depending on local belief systems.

Ceremonial Grounds

In the Hunter region the main type of ceremonial ground recorded was the Bora. Bora grounds generally consisted of two earthen rings or two rings outlined with stones. The Bora ground was used during male initiation ceremonies (Fife 1995). Bora grounds are believed by many contemporary Aboriginal people to be non-secular in nature, however, the literature suggests that generally only the viewing of the smaller of the two rings was restricted to initiated males (for a summary of the data recorded about Bora grounds see Fife 1995).

Scarred and Carved Trees

Aboriginal people often removed the bark from the trunks of trees to make toe holds (to aid in climbing to extract honey or possums from tree hollows), bowls, shields, spearthrowers, coolamons, canoes and/or for roofing material for shelters. The bark removal leaves scars on the tree trunk which indicates the Aboriginal use of an area. Other trees were carved with designs. These carved trees were used to mark ceremonial grounds and burials (Etheridge 1918:84; McBryde 1974:126). Scarred trees are generally secular in nature while carved trees are always non-secular.

Post-contact Burial Sites

This term refers to burials/interments that have taken place since European settlement and that are not located in a recognised cemetery and are not documented. If they are documented then they are considered Aboriginal historic sites and not Aboriginal

archaeological sites. They may be secular or non-secular depending on the status/position of the deceased.

Missions/Reserves/Contact sites

These places are where Aboriginal people lived in post-European settlement. They are often documented in historical literature as being places of a shared history of interaction between Aboriginal people and non-Aboriginal people.

Waterholes/Wells

These are generally natural rock waterholes that contain water used for drinking or for special ritual purposes. Sometimes these holes are made larger by grinding out the sides and base and sometimes they are protected by placing large stones over the hole to keep out animals and to prevent the water from evaporating. These may be either secular or non-secular in nature.

Massacre Sites

This term refers to an area known from the Aboriginal oral history, or from local history, to have been the location of an Aboriginal massacre. Most Aboriginal massacres occurred during the early European settlement period.

5.3 Antiquity

Few studies in the Hunter region have been able to contribute detail on the chronological sequence of Aboriginal occupation. Thus, areas that contain sites that have the potential to add to our knowledge of the longevity and changing nature of the Aboriginal occupation of the area are highly significant.

The predominant site types recorded in the Hunter Valley are the artefact scatter or open camp site. These sites are discovered due to the exposure of the artefacts by erosion processes. The erosion processes that reveal the sites also destroy their ability to retain artefacts in a stratified and dateable context that could provide evidence of changes in landscape use over time. The artefacts exposed on the ground surface may result from a single visit or from discard events from repeated visits, which could span time periods of 10s, 100s or even 1000s of years. Even when artefact assemblages are located in the landscape (open sites) in a sub-surface context, disturbance to the soil profile (through both human agency and natural geomorphic processes) mean these assemblages lack any stratigraphic integrity. These problems led researchers to endeavour to use various artefact types, such as backed blades, Bondi points and eloueras as temporal markers to date elements of surface scatters, or in the case of sub-surface assemblages, to use the geomorphic history of the soil profile to provide a maximum date for the artefacts it contains.

For example, the presence of backed artefacts (backed blades and Bondi points) in a site has often been used as a temporal marker, given that these artefacts were long considered to date to the last 4000 years (Kuskie and Kamminga 2000:526). This approach is problematic for two reasons; the first is that the appearance of this technology is now thought likely to be older than the commonly used date (refer Hiscock and Attenbrow 1998) and to extend back around 7000 years; and the second is that in the context of a conflated surface site these artefacts provide neither a minimum nor maximum age for the rest of the assemblage. Even taking into account the percentage of the assemblage that can be recognised as being a product of blade production (approximately 3 to 8% of most assemblages) this still generally leaves more than 90% of the assemblage without any chronological control. In these cases it is generally assumed that the upper or ‘A’ horizon of

the texture-contrast soils located throughout the Hunter Valley date to the last 5000 to 6000 years. Thus the artefacts they contain should also date from this time period.

Where older dates have been recorded it has been where geomorphic processes have acted to bury and protect soil surfaces from subsequent disturbance. For example, Pleistocene occupation evidence was located by Koettig (1986, 1987) at Glennies Creek (Fal Brook) north of Singleton. The dated material came from a hearth feature located on a buried alluvial terrace within the Unit B of a solodized solonetz soil at a depth of approximately one metre (Koettig 1986: 11). Dates obtained from the Glennies Creek excavations range between 13020±360 and 34580 ±650 BP (with regard to the 34580 ±650 BP date, Koettig (1987: 34) suggests that dates from such contexts are best used to provide 'an order of magnitude general age' as opposed to a direct date for occupation).

A second Pleistocene date has been reported by Kuskie (in Kuskie and Kamminga 2000:215) for artefacts identified in a clay horizon at Wollombi Brook (west of Singleton) that were confirmed by a geomorphologist to be late Pleistocene in age (between 18,000 and 30,000 years). These terrace dates are generally consistent with the ages quoted for terrace deposits in Nanson et al. (2003) and Hughes and Sullivan (1997). A third Pleistocene date of 14,750 BP (uncalibrated) was taken from a fragment of charcoal in the base of a dune at Moffats Swamp near Medowie (close to Port Stephens).

Rockshelters are often targeted for excavation as they 'were frequently inhabited and often contain a record of human activities over a considerable period of time' (Witter, 2003:24). Rockshelters have the potential to contain artefacts in a stratified deposit and thus provide better dating opportunities than open sites. Few rockshelters with deposit are currently recorded in the Hunter Valley. This is attributable in large part to a lack of development requiring archaeological survey and assessment in areas around the margins of the valley where suitable geology exists for the formation of rockshelters. The oldest date presently known from the excavation of a rockshelter in the Hunter is 7750±120BP from Bobadeen (Moore 1970) near Cassilis. Overall, analysis of rockshelters in the Upper Hunter region indicates that dates of occupation generally span the early mid to late Holocene period (ERM 2004a:71); however, this information comes from a very limited number of rockshelter sites and the results are likely to be biased by this small sample size.

Other Pleistocene dates in neighbouring regions include Lime Springs on the Liverpool Plains, Capertee in the Blue Mountains and Mangrove Swamp, south-east of the Hunter Valley. All of these sites indicate that Aboriginal occupation was present during the Pleistocene and spans a period of at least 20,000 years (ERM 2004a:73). Thus it can be predicted that Aboriginal occupation of the Hunter Valley will be found to have similar antiquity when suitable sites are located for sub-surface investigation.

5.4 Previous Archaeological Research

This section presents information relating to sites listed on DEC's Aboriginal Heritage Information Management System (AHIMS) Register and sites known to be within or in close proximity to the proposed survey area.

A review of a number of relevant studies from areas not immediately adjacent to the survey area was carried out as part of the assessment. Although not in the immediate vicinity of the survey area, these studies provide important contextual information for the purposes of significance assessment and evaluation of the pattern of Aboriginal occupation and use of the area.

The identification and study of Aboriginal cultural heritage sites in the Hunter Valley area has mainly evolved from the legislative requirement to undertake environmental impact

assessments prior to proposed mining and other developments. Such assessments have resulted in the identification of more than 2200 Aboriginal sites in the region. A large proportion of these sites occur in the area between Singleton and Muswellbrook where coal mines and their associated infrastructure are concentrated. This bias in site location results from the fact that archaeological investigation in the Hunter tends to occur only in relation to mine proposals or other industrial development (MacDonald and Davidson, 1998:3). MacDonald and Davidson also note that the development of the Hunter Valley mining industry 'has resulted in the destruction of more than 70% of the sites recorded in the region' (MacDonald and Davidson, 1998:3-4). On the other hand, Hughes argues (cited in ERM 2004) that many sites in the upper Hunter Valley would have been destroyed by natural flooding, European settlement (land use practices such as rural and urban settlement, infrastructure construction, erosion from and salinity associated with pastoralism and agriculture) and the general passage of time (for example certain types of sites such as shell middens, burials and scarred and carved trees would not preserve over time). Many of the 2200 sites have been destroyed without investigation and less than 1% of the sites have been recorded in any detail (MacDonald and Davidson, 1998:3-4). The loss and destruction of so many sites has increased the Aboriginal and archaeological significance of those that remain.

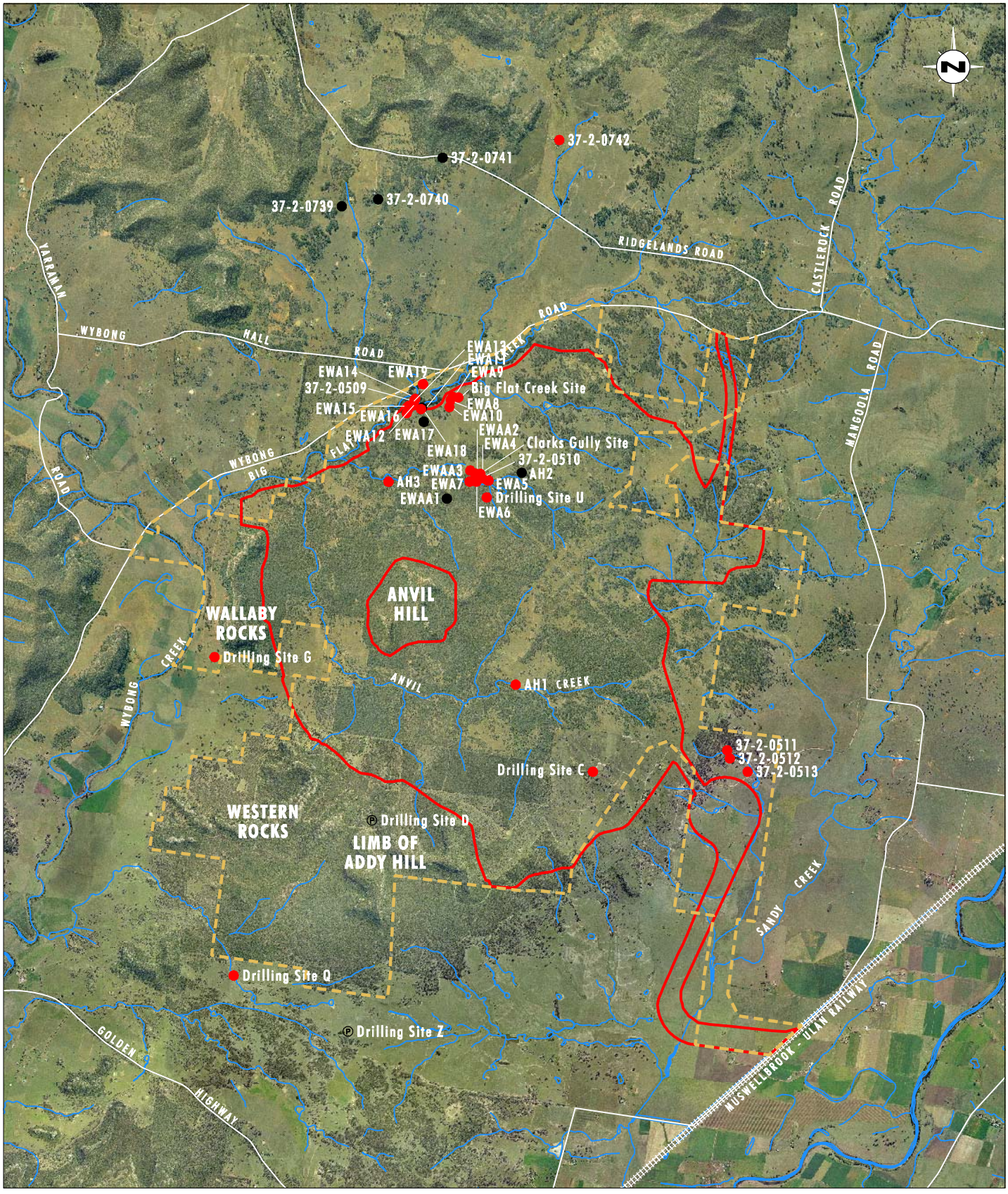
5.5 DEC Aboriginal Heritage Information Management System (AHIMS) Site Search

Prior to undertaking fieldwork, a search was conducted of the AHIMS Register for any sites recorded within a 5 kilometre radius of Anvil Hill (it should be noted that the DEC advise that the register of Aboriginal sites cannot be guaranteed to be free from error and currently has a program of site verification underway to address some of these inaccuracies). The search parameters included sites recorded on the Sandy Hollow 9033-111-N 1:25,000 Topographic Sheet within the AMG reference range from 267000E to 286000E and from 643000N to 6420000N. Recorded sites are summarised in **Table 5.1**. Eleven sites were registered on the AHIMS database within this area (refer to **Figure 5.1**). Nine of these sites were recorded as the result of two surveys; one for a fibre optic cable route (Silcox, 1984) and one for a transmission line (Ruig, 1993). Both surveys passed through the current survey area.

In addition, several carved trees associated with a ceremonial Bora ground were identified by local residents along Spring Creek, in the vicinity of Castle Rock, 14 kilometres west of Muswellbrook. This site has since been registered on the AHIMS Register as AHIMS# 37-2-0067 and is located approximately 4.7 kilometres from the current survey area.

Table 5.1 - Results of AHIMS Site Search within a 5 kilometre radius of Anvil Hill

AHIMS Site ID	Site Name	AMG Easting	AMG Northing	Site Type	Recorded by
37-2-0509	Sandy Hollow, Singleton 1 (Big Flat Creek)	281430	6426990	Open camp site/ artefact scatter	Silcox 1/7/84
37-2-0510	Sandy Hollow, Singleton 2 (Clarks Gully)	282270	6426090	Open camp site/ artefact scatter	Silcox 1/7/84
37-2-0511	Sandy Hollow, Singleton 3	284970	6423040	Open camp site/ artefact scatter	Silcox 1/7/84
37-2-0512	Sandy Hollow, Singleton 4	285000	6422950	Open camp site/ artefact scatter	Silcox 1/7/84



Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

Legend

- Proposed Disturbance Area
- Survey Area
- Artefact Scatter
- Isolated Find
- Ⓟ Potential Archaeological Deposit

FIGURE 5.1

Location of Previously Recorded Aboriginal Sites within Approximate 5km radius of Anvil Hill

Table 5.1 - Results of AHIMS Site Search within a 5 kilometre radius of Anvil Hill (cont)

AHIMS Site ID	Site Name	AMG Easting	AMG Northing	Site Type	Recorded by
37-2-0513	Sandy Hollow, Singleton 5	285200	6422800	Open camp site/ artefact scatter	Silcox 1/7/84
37-2-0739	Manobalai-Castle Rock 2	280610	6429190	Isolated find (Low significance)	Ruig 23/7/93
37-2-0740	Manobalai-Castle Rock 3	281020	6429270	Isolated find (Low significance)	Ruig 23/7/93
37-2-0741	Manobalai-Castle Rock 4	281750	6429740	Isolated find (Low significance)	Ruig 23/7/93
37-2-0742	Manobalai-Castle Rock 5	283070	6429940	Open camp site/ artefact scatter (Medium significance)	Ruig 23/7/93
37-2-0067	Spring Creek/ Castle Rock	286854	6432138	Carved trees	David Bell 1980
37-2-0738	Manabolai-Castle Rock 1	280120	6431910	Isolated find	Ruig 23/7/93

Six other archaeological sites were identified on the AHIMS database when parameters were extended to a 15 kilometre search area. These sites are summarised in **Table 5.2**.

Table 5.2 - Previously Recorded Sites up to 15 kilometres from Anvil Hill

AHIMS Site ID	Site Name	AMG Easting	AMG Northing	Site Type	Proximity to Proposed Disturbance Area	Recorded by
37-2-0140	Reedy Creek	270082	6428990	Open camp site/artefact scatter	9.9 km north-west of Proposed Disturbance Area	Williams 4/2/82
37-2-0141	Reedy Creek	270082	6428990	Axe Grinding Grooves	9.9 km north-west of Proposed Disturbance Area	Williams 4/2/82
37-2-0142	Reedy Creek	269850	6429000	Shelter with Deposit	10 km north-west of Proposed Disturbance Area	Williams 4/2/82
37-2-0143	Melon Creek	270901	6424340	Axe Grinding Groove	8.7 km south-west of Proposed Disturbance Area	Williams 4/2/82
37-2-0745	Gungal 2	265040	6426090	Open camp site/artefact scatter	14.4 km west of Proposed Disturbance Area	Appleton 14/3/94
37-2-0746/ 37-2-0747[1]	Gungal 1	265400	6425930	Open camp site/artefact scatter[1]	14 km west of Proposed Disturbance Area	Appleton 14/3/94

Note this is a double entry of identical site information with different site numbers as confirmed with DEC, 6/12/04. It is assumed that these sites are the same and have been inadvertently entered twice in the database.

The results of the AHIMS site searches indicate that artefact scatters (53%) are the most common site type identified in the vicinity of the survey area, reflecting the findings for the Hunter Valley in general. Isolated finds (24%) are the second most common site type in the AHIMS site search results followed by axe grinding grooves (12%), carved trees (5.5%) and shelter with deposit (5.5%).

Further sites identified within the survey area that are not listed on the DEC AHIMS database are discussed in **Sections 5.6** and **5.7**.

5.6 Previous Desk Top Reviews of the Survey Area

Two desk top reviews have been undertaken for the survey area, by Navin Officer in 2001 and Witter in 2003.

5.6.1 Anvil Hill Coal Project Pre-Feasibility Study Cultural Heritage Desktop Review (2001)

Navin Officer Heritage Consultants (2001) carried out a cultural heritage desktop review of the Anvil Hill project area. This report did not involve any field survey or site inspections. Of relevance, the review resulted in a predictive model for site type and site location within the project area.

Navin Officer (2001:7-8) reported that the landform elements and features with potential for archaeological sites within the current survey area include:

- flats and valley flats associated with Big Flat Creek and Anvil Creek near reliable water;
- low gradient basal slopes near reliable water;
- ridge and spurline crests;
- old growth trees; and
- surface rock exposures.

Navin Officer (2001:8-9) assessed that the site types likely to occur within the current survey area include:

- scatters of stone artefacts;
- isolated finds;
- potential archaeological deposit (PAD);
- grinding grooves;
- burials in rockshelters or in sandy, easy to dig, deposits on valley floors[2]; and

[2] Navin Officer (2001) argued that burials are likely within the survey area as two burial sites have been located within the local region. Site 37-2-540 was recorded by S Evans and G Morris of the NPWS. This site was found on an abandoned alluvial terrace which was 50 to 100 metres above the active floodplain (Steele 1991:11 cited in Navin Officer 2001:9). In relation to the survey area it is assessed that burials are unlikely in the floodplain deposits as the floodplains are still active and have periods of dry and water logging due to flooding. Moisture fluctuations of this type are highly deleterious to the preservation of skeletal material.

- rockshelters with potential for archaeological deposit and if the sandstone is suitable rock art[3].

Navin Officer concluded that the sites types less likely to occur within the current survey area were:

- scarred and carved trees;
- stone quarry and procurement sites; and
- contact sites.

5.6.2 Exploration Lease 5552 (Witter 2003)

In 2003, Witter was commissioned by Centennial Hunter Pty Limited to conduct a desktop study of archaeological resources within, and in the vicinity of, EL 5552 in order to predict the location of Aboriginal archaeological sites. Based on his predictive model, Witter assessed the scale of impact the proposed open cut mining operation would have on Aboriginal archaeological sites within EL 5552.

Witter's predictive model identified 17 potential archaeological sites within EL 5552, including one potential precinct zone (Location 1 – north-west corner of the study area). This precinct is at the confluence of two major watercourses, Wybong Creek and Big Flat Creek. Witter estimated that if the entire area were occupied by Aboriginal people as a precinct it would be a site complex about 0.5 by 2 kilometres in size. Descriptions of the 17 potential archaeological sites predicted by Witter are summarised in **Table 5.3**.

Table 5.3 - Summary of Witter's Potential Site Locations

Site	Location	Potential Archaeology
1a	Creek flats between a major confluence and a swamp billabong area in narrows of the Wybong Creek Valley	Extensive large camp sites, part of a site precinct.
1b	Butte and cliffs immediately above the creek flats of 1a	Potential rockshelter deposits and art.
2	Saddle at head of tributary on divide between Wybong and Anvil Creek drainages near potential precinct location 1	Medium camp site.
3	Creek narrows connecting Anvil Creek and Big Flat Creek drainages	Medium camp site and high habitat diversity.
4	Central creek basin	Large camp site artefacts already known to be present. Access to creek basin where there are likely to be waterholes and ephemeral ponding.
5	Saddle. Access gap between buttes	Medium camp site. Diverse habitat.
6	Tributary head with sandstone outcrops on the escarpment	Small camp site. Potential spring.

The second burial site 37-2-107 identified by Navin Officer (2001:9) was located immediately south of the survey area. This burial was located "in the deposit of a very small rockshelter". Although it is thought unlikely that a burial will be found within rockshelter deposits in the survey area, this possibility cannot be ruled out without inspection of the rockshelters in the area.

[3] As the rockshelters in the survey area are formed from a very coarse conglomerate it is highly unlikely they will have been used for art.

Table 5.3 - Summary of Witter's Potential Site Locations (cont)

Site	Location	Potential Archaeology
7	Confluence	Medium with microblade technology/workshops. Diverse habitat on escarpment, possibly spring fed.
8	Confluence.	Large with microblade technology/workshops. Diverse habitat on escarpment, possibly spring fed, similar environment to known sites nearby.
9	Confluence	Small with microblade technology/workshops. Diverse habitat on escarpment, possibly spring fed, similar environment to known sites nearby.
10	Tributary head. Small basin below ridge peak	Small camp site.
11	Saddle connecting Anvil Creek and Clarks Gully drainages	Small camp site.
12	Central Creek basin	Large camp site. Already known as a large site with full access to the creek basin resources where there are likely to be waterholes and ephemeral ponding.
13	Confluence	Medium camp site. Diverse habitat on escarpment, similar environment to known sites nearby.
14	Confluence	Medium camp site. Diverse habitat on escarpment, similar environment to known sites nearby.
15	Confluence. Creek flats	Medium camp site.
16	Creek flats	Medium camp site. Already known to have extensive occupation on terrace.
17	Confluence. Area of two watercourses joining a larger creek	Large camp site.

One notable difference between the two predictive models is that Witter restricts his site types to camp sites of varying sizes and rockshelter sites possibly with art and does not include other site types such as the burials predicted by Navin Officer (2001).

5.7 Previous Archaeological Survey and Assessment

The distribution of sites previously recorded within and in the vicinity of the survey area is shown on **Figure 5.1**. As part of the preparation of the predictive model for site type/location and the preparation of the survey methodology, a review was undertaken of several reports prepared for archaeological assessments undertaken within the survey area or within the immediate vicinity of the survey area. An overview of relevant data contained in these reports is presented in this section. Further reports were assessed for areas at a greater distance (>5 kilometres) including work conducted by Brayshaw (1981, 1983), Davies (1992), Dean-Jones (1989, 1990), Effenberger (1993), URS (2000) and ERM (2004a).

5.7.1 Archaeological Survey for Transmission Line (Silcox, 1984)

Silcox was commissioned to undertake an archaeological survey along the route of a proposed transmission line from Bayswater to Mount Piper. Silcox's study located and recorded five artefact scatters: one near Big Flat Creek, one near Clarks Gully and three in a cluster further to the south-east (refer to **Figure 5.1**). Three of these sites (37-2-0509, 37-2-

0510 and 37-2-0513) are within the current Proposed Disturbance Area. All of the sites were within 50 metres of the nearest watercourse. The dominant artefact types were flakes and flaked pieces. The dominant raw material used for artefact manufacture was indurated mudstone. This report could not be located in the DEC AHIMS library and the information provided in this section was derived from Ruig (1993).

5.7.2 Fibre Optic Cable Route Manobalai to Castle Rock (Ruig, 1993)

In 1993, Telecom Australia commissioned an archaeological survey for a proposed fibre optic cable route that was to extend south-east from the Oakdale Exchange to the Castle Rock Exchange in the Upper Hunter Valley. Castle Rock lies approximately 5 kilometres to the north-east of Anvil Hill; Oakdale lies approximately 8.5 kilometres to the north. At the time of the study no sites were previously recorded with DEC in this area. As mentioned in **Section 5.6.1**, however, several carved trees associated with a ceremonial Bora ground were identified by local residents along Spring Creek, in the vicinity of Castle Rock and approximately 4.7 kilometres from the current survey area.

Ruig's survey identified a total of five Aboriginal archaeological sites (AHIMS #37-2-0738 to #37-2-0742). Four of these sites (#37-2-0738 to #37-2-0741) are within 5 kilometres of Anvil Hill. The fifth site (#37-2-0742) is over 5 kilometres from Anvil Hill. The dominant artefact types found at Sites #37-2-0739 to #37-2-0742 were flakes and flaked pieces. Retouched flakes were also recorded: eight out of the 35 recorded artefacts were retouched flakes. The dominant raw material was mudstone (25 of the 35 artefacts were mudstone) with silcrete (eight found at #37-2-0742) and quartz (one) also recorded. Site #37-2-0742 (an artefact scatter) comprised a mix of 30 flakes/flaked pieces made from silcrete and mudstone. The other artefact scatter (#37-2-0741) had a much smaller assemblage comprising only two artefacts. Ruig's report describes this site as an open camp site/artefact scatter; however, due to an ambiguity in the site type and site description fields on the site report card she submitted to the NPWS it was registered on the AHIMS database as an isolated find. For the purposes of this report this site has been viewed as an artefact scatter.

Ruig concluded that Sites 37-2-0738 to #37-2-0741 were of low cultural, educational and scientific significance for the following reasons:

- they were all located within highly disturbed landscapes;
- they were all isolated finds or, in the case of #37-2-0741, contained only small numbers of artefacts;
- they make use of raw materials common to the Upper Hunter Valley region;
- they exhibit no specific technological traits; and
- they have no potential to educate the general public about prehistoric Aboriginal occupation and way of life.

It was not necessary to disturb/destroy the sites as the proposed fibre optic cable route passed sufficient distance from all four sites that there would be no impact.

Site #37-2-0742, however, was assessed as being of medium archaeological significance due to:

- the high density of artefactual surface material - approximately one artefact per 15 m^2;

- the fact that several surface artefacts were in the process of eroding out of sub-surface deposits, indicating there is high potential for the existence and emergence of further artefactual material; and

- that the technology and raw material used at this site is common to that used throughout the Hunter Valley; hence this site is not unique in what it can make available to public education.

As this site was located directly on the route of the proposed cable Telecom re-routed the cable, as recommended by Ruig, to avoid impact with the site.

5.7.3 Exploration Licence (EL) 5552, Anvil Hill (Umwelt, 1999)

In 1999, Umwelt was commissioned by Powercoal Pty Limited to provide advice on the potential impact that a preliminary exploration drilling program within EL 5552 would have on Aboriginal sites/PADs in the area. The purpose of the field survey was to define a suite of unconstrained drilling locations for the exploration program rather than provide a detailed record of Aboriginal archaeological sites within the lease area.

Field inspection found that only four of the proposed drilling locations revealed any archaeological material (open scatters – Drill Location C, G, S, U and the vicinity of Q). These drill locations are shown on **Figure 5.1**. Only two of these drill locations fall within the Proposed Disturbance Area (Drilling Location U and Drill Location C). The remaining Drill Locations (G, S and Q) fall outside the Proposed Disturbance Area but within the survey area. All stone artefactual material found was assessed as being of little archaeological significance. Raw materials observed included indurated mudstone, green siliceous material, quartz, silcrete, silicified conglomerate and quartzite. The artefact assemblage included cores, flakes (including blade flakes) and flaked pieces.

In addition to these finds, a number of rockshelters with the potential to contain archaeological deposits were observed within the cliffs near Drill Location D. Although no archaeological material was observed on the surface of this Drill Location the overhangs in the adjacent cliffline were considered to have considerable archaeological potential. Drill Location Z was also considered to have at least moderate archaeological potential given that it was within the saddle area between Limb of Addy Hill and Denman Knob in an area that provides access from the Wybong Creek catchment east to the Hunter River. It was expected that archaeological material could be below the ground surface in this area. This Drill Location is outside the survey area for this project.

5.7.4 Great Northern Coal Project Bulk Sample Pit (Witter, 2002)

In 2002, Witter was engaged by HLA-Envirosciences Pty Limited to prepare an archaeological survey as part of a Statement of Environmental Effects being prepared for Powercoal Pty Limited. The survey was undertaken to assess the potential impact of a proposed bulk sample pit and associated infrastructure on Aboriginal cultural heritage in the vicinity of EL 5552.

Witter's survey retraced the survey area covered by Silcox in 1984 which resulted in the location and recording of open camp sites 37-2-0509 and 37-2-0510. Witter's investigation; however, covered the same area in greater detail. Witter grouped the artefact locations he found into three larger sites: Anvil Vale, Big Flat Creek and Clarks Gully Creek (refer to **Figure 5.1**). A large proportion of Witter's Anvil Vale site encompasses the area registered by Silcox as open camp site 37-2-0509. A large proportion of Witter's Clarks Gully Site encompasses the area registered by Silcox as open camp site 37-2-0510. Only two sites, EWA 1 and EWA 19, defined by Witter, are independent and discrete spatially from the Silcox sites.

Witter recorded a total of 144 artefacts during his survey. Seventy-nine of these artefacts were found at the Anvil Vale site. The finds were mainly low density concentrations of artefacts consisting predominantly of what Witter describes as debitage, a couple of cores, some flake tools, including a snapped microconvex ('thumbnail') made on a blade, a large quartzite axe preform, a broken quartzite hammerstone, a burren and a flake tool with a serrated edge, which Witter assessed was an uncommon specialist tool type. Witter believed some microblade technology took place at this site albeit of a minor nature (Witter, 2002:33).

The Big Flat Creek site, located about 200 metres upstream of the Anvil Vale site, was described by Witter (2002) as containing low density concentrations of artefacts consisting of a scatter of 22 pieces of debitage as well as a flake tool and a quartz core. The artefacts were mostly small, broken and made from tuff (this form of rhyolitic tuff is generally termed mudstone in most reports) without cortex. The assemblage was similar to that found at Anvil Vale, and it was assessed as forming part of a continuous background scatter of artefacts (tuff debitage) along the creek. Given the probability that similar concentrations were predicted by Witter along the entire valley bottom associated with the creek, no special archaeological significance was assigned to this site.

At the Clarks Gully site Witter recorded 29 pieces of debitage, as well as an orange chert flake tool and a silcrete spall tool[4]. The highest density of artefacts was found along the creek margin (20 artefacts). The artefact assemblage indicated to Witter a wide range of implement manufacture and use, including microblade production. The presence of numerous 'expanded' (a term not defined by Witter) flakes indicated to Witter large tool resharpening activity and the presence of relatively large intermediate type flakes and plunge terminations indicated the possibility of flake tool manufacture. Most of the exposure, however, was thought by Witter to be superficial, and he concluded that the majority of the assemblage could still be buried within the remnant soil profile. More artefacts were located in this area as clusters 100 metres back from the creek. Witter notes that the artefact assemblage did not represent a particularly rich site in the context of the Hunter Valley, 'and is probably a typical example of what can be expected to be found away from the major streams in the locality' (2002:36).

The assemblages found at Anvil Vale and the nearby Big Flat Creek site, were reported by Witter to be dominated by tuff (mudstone) without cortex, whilst at the Clarks Gully site where tuff was also dominant, there was a greater number of artefacts with cortex. From these results, Witter concluded that people camping on Big Flat Creek may have been importing material and continuing to reduce the same implement, as opposed to regularly resupplying their flaking material (Witter, 2002:30).

Witter discusses two other sites of interest beyond the larger site groupings. One was a small microblade workshop (EWA 19) located in a small scald of the valley bottom north of Big Flat Creek (located just to the north of Site 37-2-0509 – refer to **Figure 5.1**). This workshop is isolated and consisted of five silcrete flakes, four of which were blades. Witter suggests that the site may represent a 'quick repair event' servicing backed blade tools when away from the camp.

The other find of interest to Witter was a small elouera of orange chert which was found on the footslope below Anvil Hill. This was assessed as an uncommon and interesting artefact type manufactured from unusual stone material. It was described as part of a hafted flake tool and had probably been transported extensively. This artefact was located within the survey area just south-south-east of Site 37-2-510. Protection of this site was recommended by Witter.

[4] A spall tool is a naturally fracturing flat spall of stone which is retouched in the manner of a flake tool.

None of the sites found during the course of Witter's survey were assessed as having exceptional educational or aesthetic importance. Nonetheless some of the individual artefacts were seen to represent a high quality of craftsmanship and had aesthetic value, such as the axe preform, the broken hammerstone, microblade core, burren, microconvex, and the isolated orange chert elouera. The Aboriginal community placed a similar aesthetic importance on these artefacts.

Witter did not register any of his sites on the AHIMS database. Given the proximity of many of his finds to Sites 37-2-0509 and 37-2-0510, it has been assumed, for the purposes of this report, that Witter's sites are not distinct from these previous recordings. Site EWA 1 and EWA 19 are the only sites which could possibly be considered as separate sites.

5.7.5 Survey for Exploratory Bore Holes, Anvil Hill (Russell 2002)

Russell carried out an archaeological assessment for Powercoal Pty Limited as part of the preliminary stages of the Anvil Hill Exploration Program. The purpose of this report was to assess the potential impact of eight proposed drilling lines. Russell identified three Aboriginal archaeological sites within the area of the proposed drilling lines. These included AH-1, AH-2 and AH-3 (refer to **Figure 5.1**). AH-1 and AH-3 are artefact scatters and AH-2 is an isolated find. AH-1 was outside the drilling line impact area but was associated with an area of PAD within the impact area.

Table 5.4 provides information in relation to the sites located by Russell (2002).

Table 5.4 - Archaeological sites identified by Russell (2002)

Site	Site Type	Landform	Dimensions	Condition	Site Contents
AH-1	Artefact Scatter with associated PAD	Footslope	50 by 30 metres	Weathering	2 silcrete flaked pieces 1 silcrete core 1 mudstone flake 3 mudstone flaked pieces
AH-2	Isolated find	Hillslope	1 by 1 metre	Highly disturbed	1 mudstone core
AH-3	Artefact Scatter	Hillslope	40 by 20 metres	Weathering. Disturbed	4 silcrete flaked pieces 1 mudstone flake 2 mudstone flaked pieces

Russell argued that AH-1 was part of a wider PAD area which ran parallel to Anvil Creek. She assessed that only part of this scatter had been revealed by natural erosion and pastoralism (2002:12). Russell recommended an alternative drilling line that would not impact on the site and PAD.

As the proposed drilling would impact on site AH-2 it was proposed that the drilling rig vehicle avoid this site, or application be made for a Section 90 Consent to allow for site destruction. AH-3 was in close proximity to where the drill rig (15 metres) would be set up and Russell proposed mitigation measures such as fencing and realignment of the rig to avoid this site (2002:19).

5.7.6 ERM 2004a

In 2004 ERM undertook a review of the archaeology in the Upper Hunter Valley on behalf of Upper Hunter Aboriginal Heritage Trust. Following is a number of ERM's conclusions that are seen to be relevant to the current assessment:

- artefact assemblages will typically be comprised of (*sic*) flaked stone with a component associated with the manufacture of backed artefacts. Backed artefacts typically make up about 1% or 2% (and up to 5% in rare cases) of an assemblage;

- evidence of backed artefacts is generally found wherever large numbers of artefacts have been recorded;

- cores and flakes associated with backed artefact manufacture typically show evidence of platform modification to increase platform angles. This modification is sometimes referred to as faceting, and is typical of open site assemblages between Singleton and Muswellbrook (ERM 2004a:57);

- the backed artefact component may typically include a larger proportion of asymmetric, elongate 'Bondi point' forms and a smaller proportion of symmetric 'geometric microlith' forms in the same assemblage;

- eloueras occur occasionally and sometimes exhibit usewear chipping and polishing along the chord;

- artefact assemblages have, on rare occasions, included small grindstones or fragments thereof, and ground-edge hatchet heads made on flat ovate water rolled small cobbles (McCarthy 1976:47);

- hearths, comprising tight concentrations of heat-retainer stones clearly distinguishable from the natural environment are rare;

- sites along creeklines have potential for sub-surface archaeological deposit. Topsoil is often quite deep, commonly between 100 mm and 300 mm;

- the small numbers of artefacts found on slopes and ridge crests generally do not allow identification of particular activities, but do provide evidence for occupation of these areas and at the very least transient movement over, and use of, all parts of the landscape;

- in areas close to the Hunter River (very likely to have been the major foci of occupation) alluvial deposits may have buried sites, or periods of flooding may have eroded and displaced archaeological material. Nevertheless excavations at a number of sites indicate that high density sub-surface assemblages may occur in this context (Hiscock and Shawcross 2000, Hughes and Shawcross 2000);

- sites on or within colluvial deposits are also rare, however they do occur (for example, Hughes and Hiscock 2000, ERM 2004) and may represent stratified cultural deposits providing evidence of chronological change;

- archaeological sites other than artefact scatters or isolated artefacts are not common;

- quarry sites have been identified where silcrete outcrops; however the vast majority of raw material used in the manufacture of stone artefacts would have been derived (quarried/collected) from the Hunter River;

- axe-grinding grooves often occur where suitable sandstone is located in association with water or a creek line;

- scarred trees are rare, presumably because most trees that may be old enough to have been scarred have been cleared or died naturally (and rotted away or been burnt in fires); and

- art sites, ceremonial sites or Bora grounds are also rare and are either deteriorating or can no longer be located (ERM 2004a:57-58).

5.8 Summary and Discussion

Table 5.5 provides a summary of the 39 known sites within and in proximity to the survey area. The sites shown in **bold** type are the sites located within the Proposed Disturbance Area.

Table 5.5 - Archaeological sites located within the Anvil Hill Survey area

AHIMS Site ID#	Site Name	Site Type	Proximity to Proposed Disturbance Area	Recorded by
37-2-0509	**Sandy Hollow, Singleton 1 (Big Flat Creek)**	**Open camp site/ artefact scatter**	**within Proposed Disturbance Area**	**Silcox 1/7/84**
37-2-0510	**Sandy Hollow, Singleton 2 (Clarks Gully)**	**Open camp site/ artefact scatter**	**within Proposed Disturbance Area**	**Silcox 1/7/84**
37-2-0511	Sandy Hollow, Singleton 3	Open camp site/ artefact scatter	0.24 km east of Proposed Disturbance Area	Silcox 1/7/84
37-2-0512	Sandy Hollow, Singleton 4	Open camp site/ artefact scatter	0.15 km east of Proposed Disturbance Area	Silcox 1/7/84
37-2-0513	**Sandy Hollow, Singleton 5**	**Open camp site/ artefact scatter**	**within the Proposed Disturbance Area (located on the boundary)**	**Silcox 1/7/84**
37-2-0739	Manobalai-Castle Rock 2	Isolated find (Low significance)	2.3 km outside of Proposed Disturbance Area	Ruig 23/7/93
37-2-0740	Manobalai-Castle Rock 3	Isolated find (Low significance)	2.3 km north of Proposed Disturbance Area	Ruig 23/7/93
37-2-0741	Manobalai-Castle Rock 4	Isolated find (Low significance)	2.4 km north of Proposed Disturbance Area	Ruig 23/7/93
37-2-0742	Manobalai-Castle Rock 5	Open camp site/ artefact scatter (Medium significance)	2.4 km north of Proposed Disturbance Area	Ruig 23/7/93

Table 5.5 - Archaeological sites located within the Anvil Hill Survey area (cont)

AHIMS Site ID#	Site Name	Site Type	Proximity to Proposed Disturbance Area	Recorded by
37-2-0067	Spring Creek/Castle Rock	Carved Trees	4.7 km from Proposed Disturbance Area	David Bell 1980
37-2-00738	Manobalai/Castle Rock 1	Isolated Find	5.05 km from Proposed Disturbance Area	Ruig 23/7/93
Unregistered	**Drilling Site C**	**Artefact scatter**	**within Proposed Disturbance Area**	**Umwelt 1999**
Unregistered	Drilling Site D	Rockshelter with potential for archaeological deposit	Approximately 0.5 km south of the Proposed Disturbance	Umwelt 1999
Unregistered	Drilling Site G	Artefact scatter	0.6 km west of Proposed Disturbance Area	Umwelt 1999
Unregistered	500 m from drilling site Q	Artefact scatter	2.7 km south-south-west of Proposed Disturbance Area	Umwelt 1999
Unregistered	**Drilling Site U**	**Artefact scatter**	**within Proposed Disturbance Area**	**Umwelt 1999**
Unregistered	Drilling Site Z	Rockshelter with potential for archaeological deposit	Approximately 3 km south of the Proposed Disturbance Area	Umwelt 1999
Unregistered	**AH1**	**Artefact scatter**	**within Proposed Disturbance Area**	**Russell 2002**
Unregistered	**AH2**	**Isolated find**	**within Proposed Disturbance Area**	**Russell 2002**
Unregistered	**AH3**	**Artefact scatter and associated PAD**	**within Proposed Disturbance Area**	**Russell 2002**
Unregistered	**Anvil Vale Site (EWA 12)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Anvil Vale Site (EWA 13)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Anvil Vale Site (EWA 14)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Anvil Vale Site (EWA 15)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**

Table 5.5 - Archaeological sites located within the Anvil Hill Survey area (cont)

AHIMS Site ID#	Site Name	Site Type	Proximity to Proposed Disturbance Area	Recorded by
Unregistered	**Anvil Vale Site (EWA 16)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Big Flat Creek Site (EWA 8)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Big Flat Creek Site (EWA 9)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 2)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 3)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 4)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 5)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 6)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**Clarks Gully Site (EWA 7)**	**Artefact scatter**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**EWA 1**	**Isolated find**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**EWA 10**	**Isolated find**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**EWA 11**	**Isolated find**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**EWA 17**	**Isolated find**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	**EWA 18**	**Isolated find**	**within Proposed Disturbance Area**	**Witter 2002**
Unregistered	EWA 19	Isolated workshop	Outside Proposed Disturbance Area immediately north 500 metres	Witter 2002

From the previous archaeological research and the AHIMS Register search results it is evident that artefact scatters (commonly referred to as open camp sites) and isolated finds

are the most common site types previously identified by archaeologists within and in close proximity to the survey area.

5.8.1 Site Distribution

Table 5.6 indicates the distribution within the landscape of all previously recorded sites within and in close proximity of the survey area (6 kilometres). This table lists the location of the sites in relation to general terrain units derived from the archaeological literature review. Because researchers use different definitions for terrain units, the terrain units have been re-classified to enable compilation of the data. The terrain units used are as follows:

- crests and upper slopes;
- mid slopes;
- footslopes/lower slopes;
- banks or terraces of minor channels (including ephemeral and lower order tributaries, and swamps);
- banks or terraces of major channels/creeks (close to channels); and
- alluvial flats/floodplains (away from the channels).

Table 5.6 - Distribution of Previously Recorded sites in the Landscape

Previous Archaeological Study	Crests & Upper Slopes	Mid Slopes	Footslopes/Lower Slopes	Banks/ Terraces of Minor Water-courses	Banks/ Terraces of Major Water-courses	Alluvial Flats/ Flood-plains
Bell 1980	1	0	0	0	0	0
Silcox 1984*	0	0	0	5	0	0
Ruig 1993#	0	0	5	0	0	0
Umwelt 1999	1	0	3	2	0	0
Witter 2002	0	5	6	2	0	6
Russell 2002	0	0	2	1	0	0
Total	**2**	**5**	**16**	**10**	**0**	**6**

*Based on information provided on site cards.
Ruig records only major watercourses on her site cards. Ruig's recordings do not detail the distance to ephemeral watercourses such as first and second order streams.
Note: Nearly all of the sites located on lower slope and footslope are located beside minor (ephemeral) creeks/drainage lines (first and second order streams based on Strahler 1961).

Table 5.7 presents the distance of the sites from the nearest watercourse.

Table 5.7 - Distance to Nearest Watercourse of Previously Recorded Sites

Previous Archaeological Study	<30 metres	30-100 metres	100-200 metres	>200 metres
Bell 1980				1
Silcox 1984	2	3	0	0
Ruig 1993	0	0	0	5
Umwelt 1999	4	0	0	2
Witter 2002	9	9	1	0
Russell 2002	3	0	0	0
Total	**18**	**12**	**1**	**8**

The tables indicate that the majority of the sites are close to watercourses. It is suggested that the lack of sites in close proximity to major watercourses is related to the general lack of ground surface visibility in these areas, rather than an actual reflection of Aboriginal use of the landscape. Major watercourses generally have floodplains with relatively deep alluvial deposits. The banks in these cases generally tend to be subject to bank collapse which leaves vertical faces not conducive to the retention of artefacts. On the other hand, minor watercourses tend to erode their banks by gullying and scouring, leaving large areas for the exposure of artefacts. Thus, artefact scatters are more easily observed along minor watercourses. PADS, however, are more likely in association with larger watercourses where deeper alluvial deposits act to bury sites or in the rocky plateaus such as Limb of Addy Hill which are likely to contain rockshelters with PAD (as indicated by Umwelt 1999 in relation to Drilling Site D).

5.8.2 Site Types/Artefact Types

Table 5.8 summarises the site type and site contents of previously recorded sites within and in close proximity to the survey area.

The artefacts generally consist of flakes, retouched flakes, flaked pieces and cores. The dominant raw material is generally indurated mudstone (recorded as tuff by Witter 2002) and silcrete with quartz, quartzite and chert commonly making up a minor component of the assemblages.

Table 5.9 indicates the number of artefacts in the sites within and in close proximity to the survey area.

Table 5.8 - Summary Site Type and Site Contents of Previously Recorded Sites

Previous Archaeological Study	No. of Sites	Rockshelter with potential to have archaeological deposits	Scarred Tree/ Carved Tree	Isolated Artefacts	Artefact Scatters	Dominant Artefact Type	Dominant Raw Material	Sites Within the Proposed Disturbance Area
Bell 1980	1	0	1	0	0	0	0	0
Silcox 1984	5	0	0	0	5	Flakes	Indurated Mudstone	2
Ruig 1993	6	0	0	4	2	Flakes	Indurated Mudstone	2
Umwelt 1999	5	2	0	0	4	Flakes	Indurated Mudstone	2
Witter 2002	19*	0	0	5	14	Broken flakes, some retouched flakes	Indurated Mudstone	17
Russell 2002	3	0	0	1	2	Flaked pieces	Indurated Mudstone	3
Total	**39**	**2**	**1**	**9**	**27**			**26**

*Witter refers to these 19 sites as EWA (Exposure With Artefacts). These EWAs are then defined as 4 archaeological sites. For the purposes of this table the EWAs were analysed.

Table 5.9 – Site Size (Artefact Numbers) – Previously Recorded Sites

Previous Archaeological Study	No. of Sites with <10 artefacts	No. of Sites with 10<20 artefacts	No. of Sites with 20<50 artefacts	No. of Sites with 50<100 artefacts
Silcox 1984 *	2	1	2	0
Ruig 1993	5	0	1	0
Umwelt 1999	3	0	0	1
Witter 2002	14	3	2	0
Russell 2002	3	0	0	0
Total	**27**	**4**	**5**	**1**

*Two were rockshelters with potential for archaeological deposit. No artefacts were identified.

Overall, artefactual material was found to occur in highest numbers and greatest density along banks and terraces of minor watercourses. In general, assemblage size was relatively small, with only one site having more than 50 artefacts and no sites having more than 100 artefacts.

5.8.3 Knapping Methods Utilised within and in Close Proximity of the Anvil Hill Survey Area

Witter (2002) provides some discussion of the knapping methods used in the survey area. Witter argues there is a strong division between Aboriginal knapping methods at sites along Big Flat Creek and on Clarks Gully. The artefacts on Big Flat Creek 'are mostly small, broken, made on tuff without cortex, and have unifacial unmodified platforms and feather terminations' (2002:33). Witter argues that this implies 'a narrow range in stone flaking, perhaps related to a somewhat specialised pattern of land use' (2002:33). There are two assemblages at Anvil Vale which are quite similar. Witter argues that the concentration of artefacts at Anvil Vale:

> was probably due to it being on relatively high terrace within a bend of the creek. Some microblade production took place, but was a minor activity. The two microblade workshops recorded on Big Flat Creek (EWA-16&19) were both small and used silcrete (2002:33).

Anvil Vale (specifically EWA-15) contained unusual tool types including an axe preform, broken hammerstone, burren and a serrate flake tool (Witter 2002:34). An isolated orange chert elouera was also identified by Witter (2002:36) (see EWA-1).

Artefacts at Clarks Gully indicated to Witter 'large tool resharpening due to numerous expanded flakes, some micro-blade production and some flake tool manufacture due to relatively large intermediate type flakes and plunge terminations' (Witter 2002:34). Witter argues that these knapping methods reflect 'longer duration of occupation and the increased amount of cortex on the artefacts may have reflected on-going resupply of raw material to the camp' (2002:34).

No backed blades were identified by Witter, but he did identify evidence of bi-facial flaking at all areas he examined (2002:32-36).

The above suggests that, even though artefact scatters are the most common site type, within this site type there are sites that contain artefact assemblages that reflect a variety of activities undertaken by Aboriginal people across the landscape.

5.9 The Predictive Model

The formulation of a predictive model is undertaken to indicate where sites are most likely to be located, what types of sites these are likely to be, and what they are likely to contain. It should also contain information in relation to where sites are likely to have survived both natural destruction processes (for example, creek migration, erosion, bioturbation) and European land use practices. Also of importance, the predictive model suggests where sites should not be found and what types of sites should not be found. Such atypical sites/site types will be of increased archaeological significance due to their rarity (refer to **Section 8** for a definition of rarity).

Predictive models are also used to formulate an appropriate methodology for survey and/or sub-surface investigation as the model pinpoints those areas that are the most archaeologically sensitive and that must be surveyed. This does not mean that the rest of the area can be ignored as an adequate sample of each landscape unit must be surveyed in order for the predictive model to be tested and refined. Otherwise all predictive models will be self-fulfilling with sites only being found in those areas predicted.

The formulation of the following predictive model combines the information drawn from the previous archaeological research as summarised in this section and viewed in the light of the environmental data (refer to **Section 4**).

In relation to the Proposed Disturbance Area it can be predicted that:

- the majority of the sites located will be artefact scatters and isolated artefacts;
- the majority of artefact scatter and isolated find sites will be located on footslopes and lower slopes associated with Anvil Creek and its tributaries, Clarks Gully and its tributaries, Sandy Creek and its tributaries, Big Flat Creek and its tributaries;
- the majority of the artefact scatter and isolated find sites will be within 30 metres of these watercourses;
- confluences of the creeks and tributaries may be the focus of relatively larger artefact scatter sites than those along the watercourses in general;
- the artefact scatter sites will typically have assemblages with less than 10 artefacts and will rarely exceed 50 artefacts;
- there is a possibility that there will be larger artefact scatter sites in areas that are ecotones; for example, where Sandy Creek approaches the Hunter River floodplain in the south-east of the Proposed Disturbance Area and where the alluvial deposits of Big Flat Creek abut the lower slopes to the south of Big Flat Creek in the north of the Proposed Disturbance Area;
- there may also be sites on the southern side of Big Flat Creek that are related to the exploitation of the ecotone associated with the slope on the southern side of the creek and the floodplain on the northern side of the creek;
- low numbers of small, widely dispersed, artefact scatter and isolated find sites may also be located at the lower slope/footslope boundary, less commonly on the upper slope and even less commonly on the midslope;
- low numbers of small, widely dispersed, artefact scatter and isolated find sites may also be located on spur crests and in saddles;

- quartz and quartzite pebbles from the local conglomerates may be a source of raw material for knapping;
- the dominant raw material used in artefact manufacture and visible in surface scatters will be indurated mudstone followed by silcrete;
- the most likely source of the mudstone and silcrete will be cobbles from the Hunter River. Witter (2002:36) argues that the EWA-19 site is likely to be located within 7 kilometres of a larger site near a silcrete source based on the evidence found at that site. However, this source has yet to be identified;
- other raw materials such as quartz, quartzite, petrified wood, porcellanite, crystalline tuff, chalcedony and volcanics will commonly be located in the larger assemblages but always as a minor component of the assemblage;
- the predominant artefact types will be flakes and flaked pieces followed by cores and retouched flakes;
- a small component of the larger assemblages will reflect microblade technology;
- retouched flakes will commonly be located in the larger assemblages but always as a minor component of the assemblage. A retouched flake was also identified as an isolated find at AHIMS #37-2-740;
- ground artefacts (grindstones and axes) may be located in larger assemblages but will not be a common component of the assemblages; and
- freehand percussion will be the dominant knapping method.

Site types unlikely to be found in the Proposed Disturbance Area are:

- scarred and carved trees;
- Bora rings;
- burials (as there are no rockshelters);
- rockshelters with deposit or art (as the geology is not suitable);
- grinding grooves (as the geology is not suitable);
- ochre quarries or stone quarries (as the geology is not suitable); and
- post-contact archaeological sites such as missions, camp sites with knapped glass or massacre sites, as these are not indicated by the ethno-historical research in this area.

In relation to the survey area (outside of the Proposed Disturbance Area);

- PADs are most likely along Big Flat Creek and Wybong Creek where alluvium will have acted to bury and preserve sites and erosion does not act to reveal artefacts;
- the PADs are likely to have sub-surface assemblages of more than 100 artefacts;
- burials are possible (but not likely) in rockshelters;

- rocky clifflines such as on Anvil Hill, Wallaby Rocks, Limb of Addy Hill and the Western Rocks are highly likely to contain rockshelter sites which have the potential for archaeological deposit; and

- the rockshelters are likely to reflect transient use but this use should be more intensive along the northern and western sides of Wallaby Rocks and the far western end of the Western Rocks due to their proximity to more reliable water.

Site types unlikely to be found in the survey area (and outside the Proposed Disturbance Area) are:

- scarred and carved trees;

- Bora rings;

- rockshelters with art (as the geology is not suitable);

- grinding grooves (as the geology is not suitable);

- ochre quarries or stone quarries (as the geology is not suitable); and

- post-contact archaeological sites such as missions, camp sites with knapped glass or massacre sites as these are not indicated by the ethno-historical research in this area.

5.9.1 Predicted Site Integrity

The following predictions are made for site integrity within the survey area:

- the ridges and associated crests, spurs, secondary spurs and saddles will have higher integrity for artefact scatters/isolated finds based on the density of intact vegetation and minimal ground surface disturbance in these terrain units;

- Limb of Addy Hill, Anvil Hill and Wallaby Rocks have the potential to have rockshelter deposits with integrity. The degree of integrity will, however, depend on the depth of the deposit and the damage incurred to the deposits from use by macropods, wombats, goannas, sheep goats, foxes and wild dogs;

- artefact scatters/isolated finds located in deeper alluvial deposits may retain integrity below the plough zone;

- artefacts within the plough zone have been subject to vertical and horizontal displacement during cultivation and thus will be without integrity and will have no relationship to artefacts below them and beneath the plough zone;

- artefact scatters/isolated finds associated with ephemeral creeks are unlikely to retain integrity due to erosion and stock trampling; and

- artefact scatters on slopes will have been affected by the downslope movement of soils causing the redistribution of the artefacts down the slope and their remixing and reburial downslope.

6.0 Survey

This section provides details of the fieldwork carried out as part of the Aboriginal archaeological assessment. Discussions are provided in relation to the survey methodology, the results of the survey, the effective coverage and the Aboriginal sites identified.

6.1 Field Team

The survey team consisted of two archaeologists, Mary-Jean Sutton (Senior Archaeologist) and Jillian Ford (Archaeologist) accompanied by six representatives from the Aboriginal community on any given survey day. The proposed survey strategy was prepared after 1 March 2005 workshop and comprised a field season of 20 field days with six Aboriginal community representatives present on each day. Due to wet weather, and a few Aboriginal community groups not turning up on their allotted days, or not providing the number of community representatives previously confirmed; the number of field days was increased to 22 to ensure effective survey coverage.

Fieldwork for the survey area had to be undertaken over two field seasons due to issues with access to some private land holdings. The first season was carried out from 4 May to 25 May 2005. The second season was from 29 November to Wednesday 7 December 2005. **Table 6.1** provides a list of the Aboriginal community groups and the representatives involved in the fieldwork.

Table 6.1 – Aboriginal Community Representation during Fieldwork

Representatives	Aboriginal community group
John Matthews Margaret Matthews	Aboriginal Native Title Elders Council
Michele Stair Rodney Matthews Colleen Stair	Giwiirr Consultants
Steven Boney Shelly (Michelle) Morris Trevor Griffiths	Hunter Valley Aboriginal Corporation
Donna Horton Christine Matthews Trevor Archbold	Hunter Valley Cultural Consultants
Barry Anderson Jeffrey Swan Maree Waugh	Lower Wonnarua Tribal Consultancy
Rhonda Ward Dahlene Hall Allan Paget	Ungooroo Aboriginal Corporation
Darryl Matthews Justin Matthews Melissa Newman	Upper Hunter Heritage Consultants
Georgina Berry Tracey Skene	Upper Hunter Wonnarua Council
Michael Stair David van Vliet Elizabeth Howard	Valley Culture
Barbara Foot David Foot Richard Foot	Wanaruah Custodians

Table 6.1 – Aboriginal Community Representation during Fieldwork (cont)

Representatives	Aboriginal community group
Barry French David French Cliff Matthews Tony Matthews Kylie Griffiths	Wanaruah Local Aboriginal Land Council
Stan Ardler Marty Feeny Mark Hickey	Wattaka Wonnarua CCS
Robert Lester Darren Duncan Luke Hickey	Wonnarua Nation Aboriginal Corporation
Thomas Franks Mary Franks Danny Franks James O'Heir	Yarrawalk

Wonnarua Culture Heritage did not participate in the survey as they failed to attend on their allotted days and despite numerous phone calls, could not provide representatives during their agreed survey period.

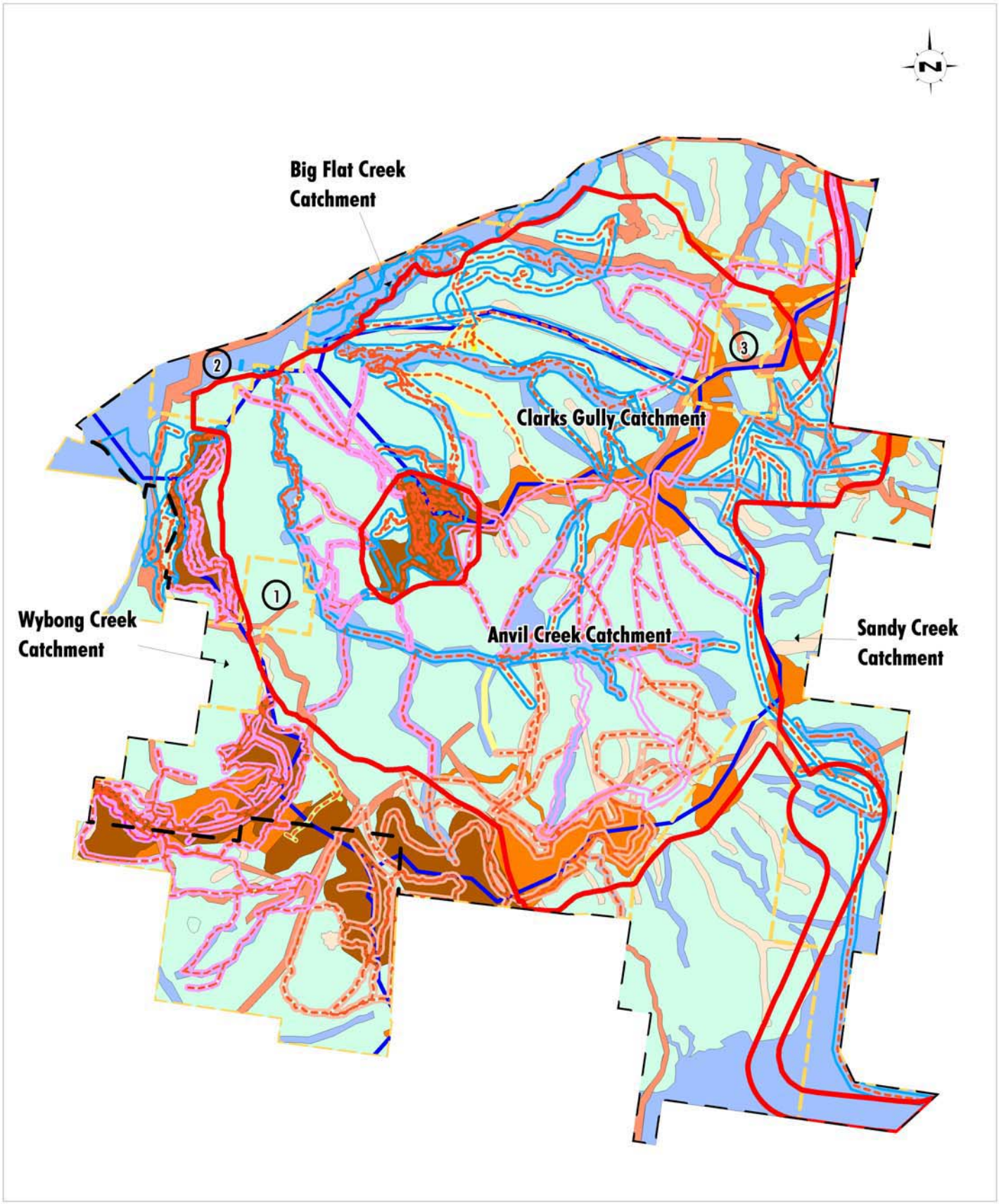
6.2 Survey Strategy

A draft survey strategy was formulated after the workshop with the Aboriginal groups on 1 March 2005. This was circulated to the groups and finalised following the 21 day comment period. The areas that Aboriginal stakeholder workshop participants suggested for survey coverage included:

- both sides of all creeklines;
- around all hills (plateaus) and their tops (including Anvil Hill, Limb of Addy Hill and Wallaby Rocks which are outside the Proposed Disturbance Area but within the survey area);
- a representative sample of all other landforms; and
- roads and tracks that would provide ground surface visibility.

As noted above the workshop participants suggested that they wished to survey around the hills (plateaus) in a spiral. Due to the steepness of clifflines and the steepness and thickness of vegetation on the scree slopes of the plateaus this was not possible when attempted. Instead the plateaus were surveyed by the survey team walking around the base of the cliffline/top of the scree slope and climbing up to inspect rockshelters within the cliffline (where this was possible). Large boulders on the scree slope were also inspected for evidence of cavernous weathering and occupation. The tops of the plateaus were inspected for evidence of occupation. Survey transects were then walked from the base of the scree slope following spurs down to the valley floor (or from the valley floor back to the scree slope – refer to **Figure 6.1**).

The remainder of the survey was undertaken in accordance with the Aboriginal stakeholder suggestions and as agreed with the DEC; however, three properties (designated as Exclusion Zones 1 to 3 on **Figure 6.1** within the Proposed Disturbance Area could not be



Source: Umwelt (2006)

0 1 2 km

Legend

- Survey Area
- Proposed Disturbance Area
- Project Application Area
- Catchment Boundary
- (1) Exclusion Zones
- Modified
- Ridgeline Crest and Saddle
- Riparian Corridor
- Plateaus
- Simple Slope
- Spur Crest
- 80 m Corridor
- 50 m Corridor
- 40 m Corridor
- 20 m Corridor
- 15 m Corridor

FIGURE 6.1

Survey Area and Archaeological Terrain Units, Catchment Boundaries that were surveyed extensively and exclusion areas

surveyed due to a lack of an access agreement between the landholder and Centennial. In order to ensure effective survey coverage of the project disturbance area, a representative sample of the landforms in these excluded properties was surveyed in other areas within the Proposed Disturbance Area where access was possible. In total, 98.05 hectares within the Proposed Disturbance Area could not be surveyed as access was not possible. The proposed rail loop corridor has been recently modified to avoid SC10. This area includes tributaries of Sandy Creek including a confluence of Sandy Creek to the south east. This modification to the proposed disturbance area will be surveyed in consultation with the Aboriginal community stakeholder groups to confirm management outcomes. Outcomes of this survey will be provided to the Aboriginal community stakeholder groups for comment. Survey of this area will follow the survey strategy outlined above. Estimated survey coverage was 923.8 hectares of a survey area of 3462 hectares (approximately 26.6%).

Many tracks were surveyed throughout the Proposed Disturbance Area; however, tracks that were covered in conglomerate gravel, with little to zero ground surface visibility, were not inspected due to the low detection factor for archaeological materials. The survey within the Proposed Disturbance Area was far more intensive than within the sections of survey area that fell outside the disturbance impact boundary. Access to properties outside the Proposed Disturbance Area was also restricted by some landholders.

Information recorded during the survey for the survey area included:

- the nature of the landforms and vegetation;
- the nature of drainage lines and the effects of erosion on bank stability and surface exposure;
- the effects of erosion and disturbance on the area as a whole;
- the aesthetic values of the area and outlooks available from the area;
- the availability of Aboriginal resources;
- archaeological sites and their contents (that is, details of artefacts);
- potential archaeological deposits;
- significance of the area to the Aboriginal community (for example, based on information brought forward by community representatives during the survey);
- diversity of archaeological sites within the area; and
- the presence and condition of Aboriginal archaeological sites.

The survey methodology ensured that:

- a sample of all different environmental contexts within the survey area were sampled;
- the survey focused on exposures when identified in the field and all ground surfaces with high ground surface visibility were inspected;
- all mature trees were inspected for evidence of Aboriginal scarring or carving;
- all stone outcrops were inspected for evidence of quarrying;

- rock outcrops and platforms associated with watercourses were inspected for evidence of grinding grooves or engravings;

- a sample of clifflines and scree slopes on all plateaus (which are all outside the Proposed Disturbance Area) were inspected for rockshelters with evidence of occupation;

- any additional places specifically requested by the Aboriginal stakeholders during the survey were inspected;

- survey recording forms were completed for each archaeological survey area inspected and details about the environment were recorded (for example, natural resources, soil, geology, disturbance, visibility and erosion);

- a site recording form was filled out for each Aboriginal site identified. Each exposure with artefacts identified was recorded on a separate DEC Aboriginal heritage site recording form;

- a detailed stone artefact recording form was filled out for Aboriginal sites with less than 10 artefacts. This included recording details about raw material, artefact type, size class, cortex and other relevant attributes. Sites with larger assemblages were not recorded in detail but counts were made of artefact types and raw material types and sufficient information recorded to allow for significance assessment; and

- field maps of artefact distribution were produced and photographs taken of flagged artefacts and of a selection of the artefacts.

Areas such as the plateaus and their environs that are outside the Proposed Disturbance Area and thus have potential as Offset Areas for Aboriginal cultural heritage had the following additional information recorded:

- ease of access;

- similarity to the area proposed for development impact;

- aspects related to visitor safety; and

- the potential benefits of the area for education about Aboriginal cultural heritage.

This information is important to assess the suitability of the areas as Proposed Offsets for Aboriginal cultural heritage, from the perspective of allowing for effective management of the sites they contain, whilst allowing for visitation in a safe environment by the Aboriginal community and the broader community if applicable.

6.3 Defining Sites

The majority of sites located during the survey were artefact scatters and isolated finds. The area of these sites was defined by the visibility of artefacts on the ground surface (including the length and width of an exposure where artefacts were visible) and by the area of potential archaeological deposit (PAD) associated with the artefact exposure (please note that term 'PAD' is used to imply the likelihood of further artefactual material in a sub-surface context; it does not imply that the deposits will have archaeological integrity). Defining the limits of an artefact scatter/isolated find site is problematic because ground surface exposure has such a strong influence on artefact visibility. Excavations have shown that surface evidence is not a

good indicator of the extent of a site and that commonly, the majority of artefacts present are still buried in the soil's A horizon (Koettig 1994).

Rockshelters sites were identified by the presence of material evidence (stone artefacts, shell, bone) on the surface of the deposit, or by their occurrence within the drip line. PAD was identified within the rockshelters wherever there was surface evidence of occupation and sufficient intact deposit to suggest that further sub-surface material was likely. There were no rockshelters observed that were suitable for occupation that had deposit but no visible evidence of occupation.

Sites were numbered according to catchment. These catchments were divided up into Big Flat Creek, Wybong Creek, Anvil Creek, Sandy Creek and Clarks Gully Catchments. The catchments are shown on **Figure 6.1** and the locations of the sites are indicated on **Figure 6.2**.

6.4 Archaeological Terrain Units

A system of archaeological terrain units were used to ensure effective survey coverage of the landscape within the survey area (refer to **Figure 6.1**). The terrain units were also used prior to the survey to develop the draft survey strategy (which drew upon the predictive model). The use of archaeological terrain units also ensured the possibility of comparison of the results of the survey with the survey and salvage results of other areas in the Upper Hunter. **Table 6.2** provides definitions of the archaeological terrain units within the survey area.

Table 6.2 – Archaeological Terrain Units

Archaeological Terrain Unit	Definition
Modified Terrain	Modified terrain refers to a landform which has been completely transformed by non-Aboriginal land use such as roads and quarries.
Plateaus	Plateaus refer to the dominant rock outcrops of Anvil Hill, Limb of Addy Hill, Western Rocks and Wallaby Rocks and include the scree slopes, clifflines, rocky crests and pinnacles.
Ridge line crest and saddle	A crest is a smoothly convex landform that stands above almost all points in the adjacent terrain. A ridge line comprises a narrow crest with short adjoining slopes; crest length is greater than crest width. The ridge lines within the Anvil Hill survey area consist of crests and saddles. The ridge line crests and saddles are associated with the lower terrain units of the plateaus. A saddle on a ridge line is an area which occurs between two higher points (crests) on the ridge line.
Riparian Corridor	Riparian corridor includes the creek lines, major and minor drainage channels, creek banks, floodplain, alluvial terrace and footslopes directly associated with watercourses.
Spur crest	A smoothly convex landform that stands above all or almost all points in the adjacent terrain and runs off a ridge line. The crest is the highest point running along the spur.
Simple Slope	Simple slope includes all, footslope, lower slope, mid slope and upper slope land form elements (outside the riparian corridor).

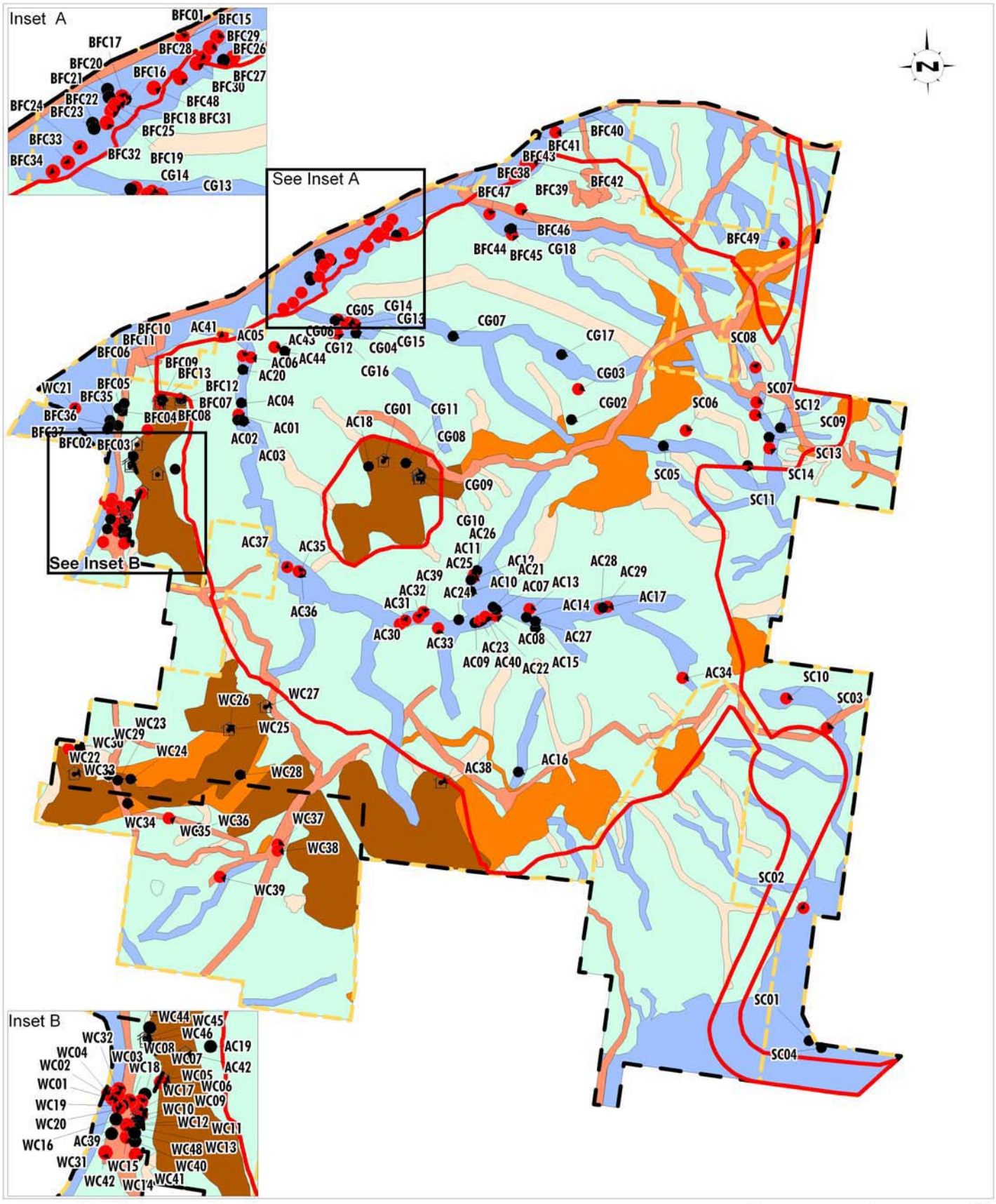


FIGURE 6.2

Archaeological Sites recorded by Umwelt (2005) and Archaeological Terrain Units

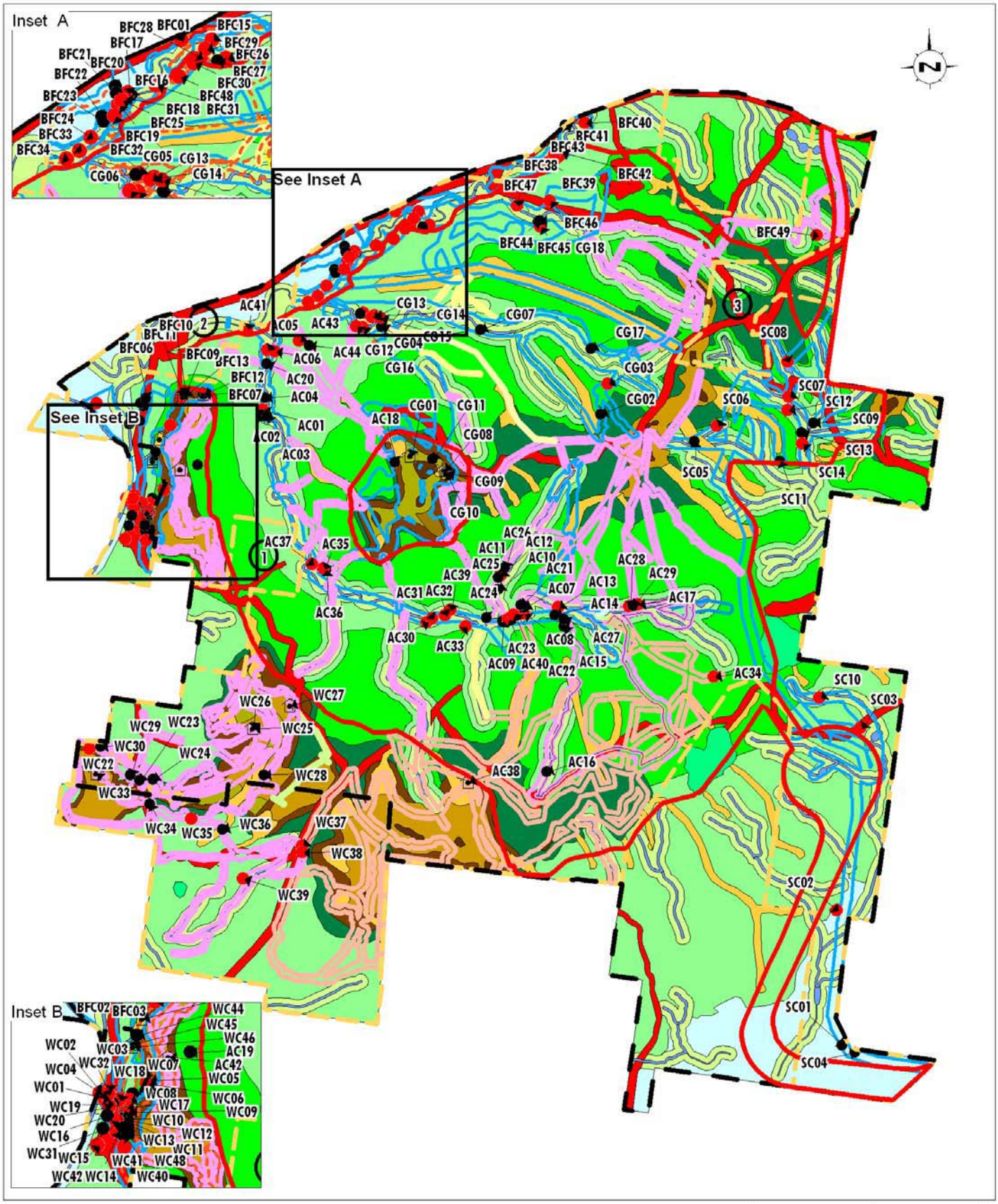
6.5 Landform Elements

In order to ensure that the survey results and effective coverage meet DEC's requirements, the Aboriginal archaeological survey area was analysed by landform elements. The division of the landscape into landform elements and the recording of landform elements in the field is important to gaining an understanding archaeological site patterning and Aboriginal occupation across the landscape of the survey area. It also aids when comparing and interpreting evidence of Aboriginal occupation of the survey area with evidence of Aboriginal occupation in the general locality and the Upper Hunter Valley region in general.

Records taken in the field regarding landforms are tabulated in **Appendix 9**. **Figure 6.3** provides a map of all landform elements and survey transects within the survey area. **Table 6.3** provides definitions for the landform elements.

Table 6.3 – Landform Elements

Ridgeline Crest	A crest is a smoothly convex landform that stands above almost all points in the adjacent terrain. A ridge line comprises a narrow crest with short adjoining slopes; crest length is greater than crest width. The ridge lines within the Anvil Hill survey area consist of crests and saddles (refer below). The ridge line crests and saddles are lower terrain units to the rock outcrops.
Spur (secondary)	A spur which runs off a spur.
Spur Crest	Spur crest refers to an elongated crest which runs from a ridge crest.
Ridgeline Saddle	A saddle on a ridge line is an area which occurs between two higher points (crests) on the ridge line.
Spur/saddle	A smoothly convex landform that stands above all or almost all points in the adjacent terrain and runs off a ridge line. A saddle is an area which occurs between two higher points (crests) along the spur.
Scree Slope	Scree is defined as 'colluvium deposited after falling or rolling from cliffed or steep slopes, consisting of loose rock fragments of gravel size or larger and generally lacking a fine interstitial component' (McDonald et al. 1998:160). A scree slope can be defined as mostly upper slope buried by colluvial deposit.
Upper Slope	Slope element adjacent to and below a crest and a scree slope. This landform is not buried by colluvial deposit and is slightly higher than mid slope and further away from water.
Moderate Slope	Slope element below upper slope and above lower slope.
Lower slope	Waning slope, below moderate mid slope and a footslope.
Footslope	Slope element adjacent to and above a floodplain and includes in some cases what is referred to in site notes and previous archaeological research as creek bank. This footslope landform element is part of the simple slope archaeological terrain unit when it is more than 30 metres from the creek bank. It is within the riparian corridor terrain unit when it is within 30 metres of the creek bank.
Floodplain	Flat or gently inclined area associated with a stream channel. There may be active erosion and/or aggradation by channelled and overbank stream flow.
Modified	An area which has been significantly altered by human effort. For example a road or quarry
Creek line	Creek line refers to the inside of the creek/watercourse and includes the floodplain between the two creek banks.



Legend

- Survey Area
- Proposed Disturbance Area
- Project Area
- Exclusion Zones
- Isolated Find
- Artefact Scatter
- Shelter with Pad
- Creekline
- Floodplain
- Footslope
- Hillock
- Lower Slope
- Moderate Midslope
- Modified
- Ridgeline Crest
- Saddle Ridgeline
- Scree Slope
- Secondary Spur
- Spur Crest
- Spur Saddle
- Upper Slope
- 80 m Corridor
- 50 m Corridor
- 40 m Corridor
- 20 m Corridor
- 15 m Corridor

FIGURE 6.3

Landform Elements and Survey Coverage by Umwelt (2005)

6.5.1 Aboriginal Resource Richness

In order to evaluate the Aboriginal resource richness of the landscape within the survey area a number of environmental attributes were assessed during the intensive surveys of the sub-catchments. These were:

- outlook;
- suitable overhangs for shelter within conglomerate clifflines and on scree slopes;
- availability of economic plants;
- occurrence of faunal prey species;
- suitability for camping (areas of gentle gradient);
- fresh water availability;
- availability of stone resources; and
- location of a creek confluence.

The results of the evaluation will be discussed in detail in **Section 6.6**.

6.6 Results of the Survey

6.6.1 Erosion/Disturbance and Ground Surface Visibility

Ground surface visibility was poor on the slope landform elements (footslope, lower slope, moderate slope, upper slope) due to the density of vegetation and grass cover on these landform elements. Roads and tracks often had poor ground surface visibility due to the use of gravel/road base and a cover of the naturally occurring gravel derived from the local conglomerate.

Ground surface visibility was greatest in areas of gully erosion and scalding associated with the creeklines and their tributaries within the Proposed Disturbance Area and particularly in association with Clarks Gully. Clarks Gully riparian corridor had mostly skeletal topsoil due to the impact of gully erosion and scalding which has been accelerated due to stock grazing and trampling along the creekline and associated terraces and slopes. Sections of Anvil Creek and Big Flat Creek (where slopes abutted the creekline) exhibited similar problems with erosion which provided high ground surface visibility.

Artefact scatters were often located in association with ants' nests, scalds near creeklines and on the gullies produced by advanced erosion. Parts of Big Flat Creek, Anvil Creek, Wybong Creek and Sandy Creek, which were not actively eroding, or were areas of soil aggradation, did not contain large scalds or gullies and were far less likely to exhibit evidence of exposed archaeological material. This result is likely to have been biased by the low ground surface visibility and lack of exposures along these riparian corridors.

Scree slopes, slopes and ridge crests associated with Anvil Hill, Limb of Addy Hill, Western Rocks and Wallaby Rocks had poor ground surface visibility (particularly Anvil Hill) due to thick vegetation which was sometimes almost impenetrable.

Colluvial deposits derived from slopewash have also impacted on ground surface visibility on the lower slopes of the scree slopes as they have buried and obscured the ground surface.

Rockshelters within the plateaus had poor artefact visibility due to the dusty nature of the deposits; the large amounts of sheep and goat manure and vegetation growing in the driplines. These problems were particularly in evidence for the rockshelters on Wallaby Rocks.

Disturbance from animals such as sheep, goats, wombats, foxes, feral dogs and kangaroos has led to the deposits within most rockshelters being highly disturbed and in many cases resulted in the deposits moving out of the rockshelter and washing downslope. Thus many of the rockshelters had deposits with poor stratigraphic integrity.

6.6.2 Effective Coverage

Table 6.4 provides information in relation to the effective coverage of the survey in accordance with the DEC Guidelines (1997). Each numbered survey transect detailed in **Table 6.4** corresponds to the change in landform element as observed during fieldwork. Transects are mapped on **Figure 6.3**. Details of the length of exposure, vegetation and soil descriptions are provided in **Appendix 9** for each site recorded during fieldwork. All substantial exposures were inspected during fieldwork. This methodology is similar to Kuskie (1999)'s strategy for the Mt Arthur North Mining Lease where archaeological survey time focussed on areas of ground surface visibility to achieve '100% survey coverage'. Kuskie (1999) drove to exposures which were then inspected by field team members during the Mt Arthur archaeological survey. This method of coverage was argued by some of the Aboriginal stakeholders during the Denman meeting on 1 March 2005 as the preferred strategy for fieldwork. Coverage of exposures within the Anvil Hill survey area was coupled with representative coverage of all landforms. No vehicle transects were carried out during fieldwork. All field transects were inspected by foot and mapped using a GPS. GPS routes were also developed prior to fieldwork to ensure that all exposures on aerial photographs were inspected and all known archaeological sites and areas of potential were investigated. Survey time was not focussed on areas with high grass and vegetation cover such as the simple slope archaeological terrain unit as landforms within this terrain unit often had low to zero ground surface visibility. In consultation with the respective Aboriginal community members involved in fieldwork, transects were not completed in long grass with poor ground surface visibility. However, it should be noted that all landforms including those with poor ground surface visibility had a representative sample covered (see **Tables 6.5** and **6.6**).

Table 6.4 - Effective survey coverage Anvil Hill Survey Area

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
1	Moderate mid slope	A/B	8247	5%	5%	2	412
2	Scree slope		2622	0%	0%	3	0
3	Saddle ridgeline	B	12493	5%	5%	1	625
4	Upper slope	A/B	2333	5%	5%	2	117
5	Modified	A/B	6540	30%	25%	2	1635
6	Moderate mid slope	A/B	3724	5%	5%	2	186
7	Lower slope	A/B	4503	5%	5%	2	225
8	Creek bank/footslope	A/B	3042	5%	5%	2	152
9	Creek line	A/B	873	5%	5%	2	44
10	Lower slope	A/B	11491	5%	5%	2	575

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
11	Creek bank/footslope	A/B	15297	5%	5%	2	765
12	Creek line	A/B	3441	5%	5%	2	172
13	Moderate mid slope	A/B	8875	5%	5%	2	444
14	Creek line	A/B	5951	5%	5%	2	298
15	Moderate mid slope	A/B	12352	5%	5%	2	618
16	Spur crest	A/B	22347	5%	5%	2	1117
17	Modified	B	3027	5%	5%	1	151
18	Lower slope	A/B	10829	5%	5%	2	541
19	Upper slope	A/B	11540	5%	5%	2	577
20	Creek bank/footslope	A/B	24091	5%	5%	2	1205
21	Creek bank/footslope	A/B	12665	5%	5%	2	633
22	Lower slope	A/B	42574	5%	5%	2	2129
23	Upper slope	A/B	743	5%	5%	2	37
24	Moderate mid slope	A/B	16157	5%	5%	2	808
25	Creek line	A/B	1889	10%	5%	2	94
26	Creek bank/footslope	A/B	15315	10%	5%	2	766
27	Creek line	A/B	6422	10%	5%	2	321
28	Spur crest	B	12039	5%	1%	1	120
29	Scree slope	B	23973	5%	1%	1	240
30	Moderate mid slope	B	1483	5%	1%	1	15
31	Saddle ridgeline	B	112525	5%	1%	1	1125
32	Spur crest	B	3570	5%	1%	1	36
33	Spur crest	B	4219	5%	1%	1	42
34	Spur crest	B	5508	5%	1%	1	55
35	Creek bank/footslope	B	2780	20%	15%	1	417
36	Scree slope	B	2158	20%	15%	1	324
37	Upper slope	B	1247	20%	15%	1	187
38	Moderate mid slope	B	9438	20%	15%	1	1416
39	Lower slope	B	3292	20%	15%	1	494
40	Creek line	B	858	20%	15%	1	129
41	Creek bank/footslope	B	20204	20%	15%	1	3031
42	Creek line	B	15507	20%	15%	1	2326

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
43	Creek bank/footslope	B	32239	20%	15%	1	4836
44	Creek line	B	14694	20%	15%	1	2204
45	Creek line	B	3953	20%	15%	1	593
46	Creek bank/footslope	B	10715	20%	15%	1	1607
47	Creek line	B	854	20%	15%	1	128
48	Creek line	B	227	20%	15%	1	34
49	Creek bank/footslope	B	73010	20%	15%	1	10952
50	Lower slope	B	29111	20%	15%	1	4367
51	Creek line	B	19741	20%	15%	1	2961
52	Modified	B	27799	20%	15%	1	4170
53	Creek line	A/B	1652	10%	5%	2	83
54	Floodplain	A/B	64878	10%	5%	2	3244
55	Creek bank/footslope	A/B	37082	10%	5%	2	1854
56	Creek line	A/B	7367	10%	5%	2	368
57	Lower slope	A/B	938	10%	5%	2	47
58	Modified	B	31284	20%	15%	1	4693
59	Creek bank/footslope	A/B	6494	10%	5%	2	325
60	Spur crest		173909	0%	0%		0
61	Lower slope		32293	0%	0%		0
62	Moderate mid slope		2125	0%	0%		0
63	Upper slope		2965	0%	0%		0
64	Modified	B	1873	30%	30%	1	562
65	Moderate mid slope	A/B	1783	5%	5%	2	89
66	Lower slope	A/B	15961	10%	5%	2	798
67	Modified	B	22267	10%	5%	1	1113
68	Moderate mid slope	A/B	529	10%	5%	2	26
69	Spur crest	A/B	297	10%	5%	2	15
70	Modified	B	1470	10%	5%	1	73
71	Saddle ridgeline	A/B	6442	10%	5%	2	322
72	Scree slope	A/B	24342	10%	5%	2	1217
73	Spur crest	A/B	3403	10%	5%	2	170
74	Lower slope	A/B	196204	5%	3%	2	5886
75	Scree slope	B	80839	40%	40%	1	32336
76	Scree slope	B	33	5%	3%	1	1

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
77	Upper slope	B	45236	5%	3%	1	1357
78	Creek bank/footslope	B	57165	5%	3%	1	1715
79	Scree slope	B	37163	5%	3%	1	1115
80	Lower slope	B	24	5%	3%	1	1
81	Modified	B	78474	40%	30%	1	23542
82	Saddle ridgeline	B	70375	5%	3%	1	2111
83	Spur saddle	A/B	29355	5%	3%	2	881
84	Spur crest	A/B	26485	5%	3%	2	795
85	Creek line	A/B	35550	5%	3%	2	1067
86	Spur crest	A/B	22695	5%	3%	2	681
87	Saddle ridgeline	A/B	117633	5%	3%	2	3529
88	Spur crest	A/B	22658	5%	3%	2	680
89	Spur crest	A/B	4321	5%	3%	2	130
90	Spur saddle	A/B	38744	5%	3%	2	1162
91	Spur crest	A/B	547	5%	3%	2	16
92	Spur saddle	A/B	12291	5%	3%	2	369
93	Ridgeline crest	B	4579	5%	3%	1	137
94	Spur crest	A/B	13133	5%	3%	2	394
95	Spur crest	B	22850	5%	3%	1	686
96	Creek bank/footslope		19927	0%	0%	3	0
97	Moderate mid slope		37791	0%	0%	3	0
98	Spur crest		7946	0%	0%	3	0
99	Upper slope		580	0%	0%	3	0
100	Scree slope		2512	0%	0%	3	0
101	Spur crest		29435	0%	0%	3	0
102	Lower slope		18649	0%	0%	3	0
103	Creek line	A/B	2414	10%	5%	2	121
104	Scree slope		33494	0%	0%	3	0
105	Lower slope	A/B	13245	15%	10%	2	1324
106	Creek bank/footslope	A/B	8090	15%	10%	2	809
107	Upper slope		126990	0%	0%	3	0
108	Upper slope	A/B	5119	15%	10%	2	512
109	Modified	B	57207	30%	30%	1	17162
110	Secondary spur	A/B	6855	10%	10%	2	686
111	Spur crest		856	0%	0%	3	0
112	Saddle ridgeline	A/B	52233	5%	0%	2	0
113	Moderate mid slope		178461	0%	0%	3	0

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
114	Spur crest		210	0%	0%	3	0
115	Spur crest		7421	0%	0%	3	0
116	Spur crest		19640	0%	0%	3	0
117	Ridgeline crest		2528	0%	0%	2	0
118	Ridgeline crest		6310	0%	0%	2	0
119	Creek line	A/B	858	10%	5%	2	43
120	Lower slope		2597	0%	0%	2	0
121	Creek bank/footslope		3960	0%	0%	2	0
122	Moderate mid slope		900	0%	0%	2	0
123	Spur crest		1039	0%	0%	3	0
124	Modified	B	58726	10%	5%	1	2936
125	Modified	B	22	80%	80%	1	18
126	Creek bank/footslope	B	6163	60%	70%	1	4314
127	Lower slope	A/B	32559	15%	10%	2	3256
128	Moderate mid slope	A/B	39658	15%	10%	2	3966
129	Scree slope	A/B	95583	15%	10%	2	9558
130	Spur crest	A/B	12054	15%	10%	2	1205
131	Saddle ridgeline	A/B	16609	15%	10%	2	1661
132	Spur crest	A/B	4426	15%	10%	2	443
133	Spur crest	A/B	1793	15%	10%	2	179
134	Lower slope	B	24945	3%	3%	1	748
135	Upper slope	B	409	3%	3%	1	12
136	Moderate mid slope	B	121521	3%	3%	1	3646
137	Creek bank/footslope	B	170432	3%	3%	1	5113
138	Lower slope	B	2150	3%	3%	1	64
139	Creek line	A/B	911	3%	3%	2	27
140	Creek line	A/B	12777	3%	3%	2	383
141	Spur crest	A/B	9229	3%	3%	2	277
142	Spur crest	B	1546	3%	3%	1	46
143	Creek line	A/B	13853	10%	5%	2	693
144	Modified	B	46930	10%	5%	1	2347
145	Spur crest	A/B	1478	10%	5%	2	74
146	Spur crest	A/B	17223	10%	5%	2	861
147	Creek line	A/B	11939	10%	5%	2	597
148	Creek line	A/B	27066	10%	5%	2	1353
149	Creek line	A/B	1004	10%	5%	2	50
150	Creek bank/footslope	A/B	33523	10%	5%	2	1676

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
151	Creek line	A/B	278	15%	10%	2	28
152	Creek line	A/B	278	15%	10%	2	28
153	Creek line	A/B	270	15%	10%	2	27
154	Lower slope		122873	0%	0%	3	0
155	Creek bank/footslope		294083	0%	0%	3	0
156	Creek line	A/B	36627	10%	5%	2	1831
157	Lower slope	A/B	1174	10%	5%	2	59
158	Moderate mid slope		77866	0%	0%	3	0
159	Modified	B	16128	30%	30%	1	23360
160	Upper slope		35702	0%	0%	3	0
161	Scree slope		2257	0%	0%	3	0
162	Upper slope		713	0%	0%	3	0
163	Moderate mid slope	A/B	455	10%	8%	2	36
164	Creek line	A/B	6082	20%	15%	2	912
165	Saddle ridgeline		2233	0%	0%	3	0
166	Lower slope	B	24720	20%	15%	1	3708
167	Creek bank/footslope	B	30844	20%	15%	1	4627
168	Spur crest	B	2246	20%	15%	1	337
169	Creek line	B	1842	20%	15%	1	276
170	Creek line	B	46689	20%	15%	1	7003
171	Creek line	B	260	20%	15%	1	39
172	Lower slope		39290	0%	0%	3	0
173	Upper slope	B	20642	30%	20%	1	4128
174	Modified	B	9344	30%	20%	1	1869
175	Creek bank/footslope	A/B	103124	10%	5%	2	5156
176	Spur crest	A/B	6111	10%	5%	2	306
177	Moderate mid slope	A/B	13304	10%	5%	2	665
178	Creek line	A/B	36186	10%	5%	2	1809
179	Moderate mid slope		6971	0%	0%	3	0
180	Moderate mid slope	A/B	6154	10%	5%	2	308
181	Spur crest		4621	0%	0%	3	0
182	Creek line	A/B	3625	10%	5%	2	181
183	Spur crest		23618	0%	0%	3	0
184	Ridgeline crest	A/B	35722	5%	3%	2	1072
185	Saddle ridgeline		6470	0%	0%	3	0

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
186	Creek line	A/B	5810	5%	5%	2	290
187	Creek line	A/B	1076	5%	5%	2	54
188	Modified	B	1048	40%	40%	1	419
189	Spur crest	A/B	394	3%	5%	2	20
190	Saddle ridgeline	B	247214	40%	30%	1	74164
191	Spur crest	B	29162	3%	5%	1	1458
192	Upper slope	B	329749	3%	5%	1	16487
193	Scree slope	B	32457	3%	5%	1	1623
194	Creek bank/footslope		38345	0%	0%	3	0
195	Lower slope		142967	0%	0%	3	0
196	Spur crest	B	75868	3%	5%	1	3793
197	Moderate mid slope		285816	0%	0%	3	0
198	Spur crest	A/B	11235	3%	5%	2	562
199	Upper slope	A/B	109	3%	5%	2	5
200	Modified	B	45281	40%	30%	1	13584
201	Spur crest	A/B	22017	10%	5%	2	1101
202	Ridgeline crest	B	7308	30%	20%	1	1462
203	Modified	B	62981	40%	40%	1	25193
204	Lower slope	A/B	5229	3%	5%	2	261
205	Scree slope	A/B	57228	3%	5%	2	2861
206	Creek line	A/B	11627	3%	5%	2	581
207	Creek bank/footslope	A/B	21167	3%	5%	2	1058
208	Creek line	A/B	13122	3%	5%	2	656
209	Spur crest		8494	0%	0%	3	0
210	Spur crest		14224	0%	0%	3	0
211	Spur crest		1816	0%	0%	3	0
212	Spur crest		13210	0%	0%	3	0
213	Ridgeline crest		1457	0%	0%	3	0
214	Spur crest		694	0%	0%	3	0
215	Spur crest		8085	0%	0%	3	0
216	Scree slope		430	0%	0%	3	0
217	Spur crest	B	10227	5%	5%	1	511
218	Spur crest	B	2372	5%	3%	1	71
219	Creek line	A/B	217	5%	3%	2	7
220	Creek bank/footslope		3799	0%	0%	3	0
221	Scree slope		153221	0%	0%	3	0

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
222	Ridgeline crest	B	5117	5%	3%	1	154
223	Secondary spur	B	26793	20%	15%	1	4019
224	Upper slope	A/B	21720	5%	5%	2	1086
225	Ridgeline crest		21696	0%	0%	3	0
226	Spur saddle	A/B	144668	5%	5%	2	7233
227	Spur crest	A/B	23657	5%	5%	2	1183
228	Moderate mid slope		68562	0%	0%	3	0
229	Spur crest		10553	0%	0%	3	0
230	Spur crest	B	4874	5%	5%	1	244
231	Spur crest	B	292	5%	5%	1	15
232	Modified	B	28893	30%	30%	1	8668
233	Spur crest	B	6889	5%	5%	1	344
234	Secondary spur	B	7463	5%	3%	1	224
235	Ridgeline crest	B	2707	5%	3%	1	81
236	Moderate mid slope		12131	0%	0%	3	0
237	Lower slope		2848	0%	0%	3	0
238	Upper slope		5734	0%	0%	3	0
239	Spur crest		5147	0%	0%	3	0
240	Moderate mid slope		19073	0%	0%	3	0
241	Creek bank/footslope		2882	0%	0%	3	0
242	Lower slope		122241	0%	0%	3	0
243	Spur crest		21493	0%	0%	3	0
244	Scree slope		1806	0%	0%	3	0
245	Upper slope	A/B	1717	10%	5%	2	86
246	Creek bank/footslope	A/B	179195	10%	5%	2	8960
247	Lower slope	A/B	34444	10%	5%	2	1722
249	Moderate mid slope	A/B	22662	10%	5%	2	1133
250	Creek line	A/B	587	10%	5%	2	29
251	Creek line	B	10280	20%	15%	1	1542
252	Creek line	A/B	47392	10%	5%	2	2370
253	Upper slope	A/B	27791	3%	1%	2	278
254	Creek bank/footslope	A/B	406151	3%	1%	2	4062
255	Moderate mid slope		113048	0%	0%	3	0
256	Moderate mid slope		47859	0%	0%	3	0

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
257	Spur crest		9566	0%	0%	3	0
258	Lower slope	A/B	72779	5%	5%	2	3639
259	Creek line	A/B	3695	10%	5%	2	185
260	Creek line	A/B	28578	10%	5%	2	1429
261	Floodplain	A/B	147594	10%	5%	2	7380
262	Modified	B	45000	20%	20%	1	9000
263	Creek line	A/B	20345	10%	5%	2	1017
264	Spur crest		61872	3%	3%	3	1856
265	Hillock	B	5755	5%	3%	1	173
266	Creek bank/footslope		19245	0%	0%	3	0
267	Creek line	A/B	13575	10%	5%	2	679
268	Modified	B	621	30%	30%	1	186
269	Lower slope	A/B	157479	5%	5%	2	7874
270	Modified	B	32952	20%	20%	1	6590
271	Spur crest	A/B	10465	3%	3%	2	314
272	Creek line	A/B	6080	10%	5%	2	304
273	Creek line	A/B	1931	10%	5%	2	97
274	Creek bank/footslope	A/B	12237	5%	5%	2	612
275	Moderate mid slope	A/B	1466	3%	3%	2	44
276	Creek line	A/B	2975	10%	5%	2	149
277	Creek line	A/B	10478	10%	5%	2	524
278	Creek line	A/B	6841	10%	5%	2	342
279	Creek line	A/B	12636	10%	5%	2	632
279	Creek line	A/B	5487	10%	5%	2	274
280	Creek line	A/B	1801	10%	5%	2	90
281	Creek line	A/B	2410	10%	5%	2	120
282	Creek line	A/B	1023	10%	5%	2	51
283	Creek line	A/B	24355	10%	5%	2	1218
284	Moderate mid slope	A/B	738	5%	5%	2	37
285	Modified	B	578	20%	20%	1	116
286	Lower slope		304460	0%	0%	3	0
287	Creek bank/footslope	A/B	385790	10%	5%	2	19289
288	Modified	B	55042	20%	20%	1	11009
289	Creek line	A/B	22667	10%	5%	2	1133
290	Floodplain	A/B	95527	5%	1%	2	955

Table 6.4 - Effective survey coverage Anvil Hill Survey Area (cont)

Survey Transect	Landform Element	Extent of erosion	Total Sample Area of transect (m^2)	Surface Visibility %	Percentage of Exposure within transect (Archaeological Visibility)	Ground Disturbance	Effective survey coverage (m^2)
291	Moderate mid slope	B	10508	30%	20%	1	2102
292	Creek line	A/B	8735	10%	5%	2	437
293	Moderate mid slope		19619	0%	0%	3	0
294	Spur crest		22627	0%	0%	3	0
295	Creek line	A/B	13908	10%	5%	2	695
296	Creek line	A/B	32722	10%	5%	2	1636
297	Creek bank/footslope	A/B	397	10%	5%	2	20
298	Creek line	A/B	1354	10%	5%	2	68

Table 6.5 - Coverage of Archaeological Terrain Units by Umwelt Archaeological Survey within the Survey Area

Archaeological Terrain Unit	Total Area in Umwelt Survey Area 2005 (ha)	Area of combined transects (ha)	Coverage of total terrain unit within the Survey Area (%)
Modified	204.4	60.2	29.4
Ridgeline crest and saddle	227.7	61.0	26.8
Riparian Corridor	530.8	250.0	47.1
Plateaus	338.3	154.9	45.8
Simple slope	1987.6	329.5	16.6
Spur crest	173.2	68.2	39.4
Totals	3462.0	923.8	26.7

Table 6.6 - Coverage of Archaeological Terrain Units by Umwelt Archaeological Survey within the Proposed Disturbance Area

Archaeological Terrain Unit	Total Area in Proposed Disturbance Area	Area of Combined Transects (ha)	Coverage of total terrain unit within the Proposed Disturbance Area (%)
Modified	112	30.924994	27.6
Ridgeline Crest and Saddle	187	48.562654	25.9
Riparian Corridor	316	178.488846	56.48
Plateaus	6	2.62	43.66
Simple Slope	1481	256.899723	17.35
Spur Crest	136	58.370565	42.91
Totals	2238	575.869953	25.7

The effective coverage table (**Table 6.4**) shows that due to poor ground surface visibility in the higher gradient landform elements (including spur crest, ridge crests, lower slope, mid slope, upper slope and scree slope), detection of archaeological sites was substantially lowered. Site detection was lower due to long grass in these landforms and thick vegetation particularly in the plateaus of Wallaby Rocks, Anvil Hill, Limb of Addy Hill including Western Rocks which made ground surface visibility poor. This poor ground surface visibility will bias some of the survey results when attempting to understand Aboriginal occupation across the survey area and site distribution. However, this bias should be considered limited as during survey of modified tracks which passed through these higher landforms (ridge crests, spur crests, mid slope, lower slope and upper slope) which had higher ground surface visibility, very few archaeological sites were detected within the Proposed Disturbance Area and within the survey area (with the exception of Wallaby Rocks where the Anvil Hill ROW passes around this geographic feature).

The scree slope landform element had poor ground surface visibility. The extent of erosion and ground surface disturbance is not commented in **Table 6.4** due to the burial of the original slope landform by colluvial gravels and deposits washing and eroding down slope. Transects which followed the spur crest landforms down to watercourses did not indicate that spur crests were used by Aboriginal people as travel routes within the survey area by the poor number of archaeological sites detected.

Creeklines and creek banks/footslope landforms particularly Clarks Gully had the greatest ground surface visibility after the modified landform due to the impact of gully, rill and mass movement erosions on these banks which heightened the detection of archaeological materials. Anvil Creek's northern and southern tributaries and the north-eastern tributaries of Big Flat Creek had the lowest ground surface visibility of all the watercourses within the survey area due to the depth of vegetation (particularly Casuarina) growing along the creekbanks. Site distribution shows a bias on the watercourses within the survey area due to these landforms having the greatest ground surface visibility.

6.6.3 Sites Recorded in the Anvil Hill Survey Area

A total of 173 sites were located during the survey**.** **Table 6.7** provides a summary of the sites within each catchment area that were located during the survey. The majority of sites (103) identified during the survey were located within the riparian corridor archaeological terrain unit including Big Flat Creek, Anvil Creek, Clarks Gully, Wybong Creek and Sandy Creek. This terrain unit included the landform elements defined as creek banks, creek beds, floodplains, flats and terraces, and also the adjacent footslopes and lower slopes within 30 metres of the watercourses and their tributaries. A substantial number of sites (22) were located in the rocky plateaus archaeological terrain unit which included Wallaby Rocks, Anvil Hill, Western Rocks and Limb of Addy Hill. These areas were found to provide suitable rockshelters for human occupation (and large numbers of shelters that were not suitable for human occupation). Many of the shelters had broad outlooks across the landscape and all of the plateaus had extensive outlooks from their summits.

Table 6.7 - New Sites Located in the Anvil Hill Project Area

Creek Catchment	No. of Sites	Site Types	Site Locations
Anvil Creek	44 sites identified	20 isolated finds 22 artefact scatters 2 rockshelters with surface artefacts and potential archaeological deposit	**Riparian Corridor Archaeological Terrain Unit** 18 artefact scatters within footslope (creek bank) landform element of Anvil Creek. 17 isolated finds within footslope (creek bank) landform element of Anvil Creek 1 artefact scatter within the creek bed of Anvil Creek. **Rocky Plateau Archaeological Terrain Unit** 1 isolated find on the scree slope landform element. 1 rockshelter on the spur crest landform element. 1 rockshelter on the saddle/ridgeline landform element. **Simple Slope Archaeological Terrain Unit** 1 isolated find on the mid slope landform element. 1 artefact scatter on the midslope landform element. 2 artefact scatter on the lower slope landform element. 1 isolated find on the lower slope landform element.
Big Flat Creek	49 sites identified	18 isolated finds 30 artefact scatters 1 rockshelter with surface artefacts and potential archaeological deposit	**Riparian Corridor Archaeological Terrain Unit** 21 artefact scatters on the footslope (creek bank) landform element of Big Flat Creek. 9 isolated finds on the footslope (creek bank) landform element of Big Flat Creek. 2 isolated finds on major confluence of Big Flat Creek and Wybong Creek. 2 isolated finds on the floodplain landform element of Big Flat Creek. 1 artefact scatter on the floodplain landform element of Big Flat Creek. **Simple Slope Archaeological Terrain Unit** 1 artefact scatter on midslope below Wallaby Rocks facing Big Flat Creek 1 artefact scatter on lower slope below Wallaby Rocks facing Big Flat Creek **Rocky Plateau Archaeological Terrain Unit** 1 rock shelter with artefacts and PAD within scree slope landform element. 1 isolated find on scree slope landform element. 5 artefact scatters on scree slope landform element. **Modified Archaeological Terrain Unit** 1 artefact scatter on modified landform element. 4 isolated finds on modified landform element.

Table 6.7 - New Sites Located in the Anvil Hill Project Area (cont)

Creek Catchment	No. of Sites	Site Types	Site Locations
Clarks Gully	18 sites identified	6 isolated finds 8 artefact scatters 4 rockshelters with potential archaeological deposit and archaeological evidence	**Riparian Corridor Archaeological Terrain Unit** 1 isolated find within creek bed of Clarks Gully 2 isolated finds on footslope (creek bank) of Clarks Gully 7 artefact scatters on footslope (creek banks) of Clarks Gully **Rocky Plateau Archaeological Terrain Unit** 2 rockshelters with artefacts and PAD within spur saddle landform element of Anvil Hill facing Clarks Gully 2 rockshelters with artefacts and PAD within secondary spur landform element of Anvil Hill facing Clarks Gully 1 isolated find on spur saddle landform element of Anvil Hill facing Clarks Gully. **Simple Slope Archaeological Terrain Unit** 1 artefact scatter on midslope above Clarks Gully 1 isolated find on upper slope above Clarks Gully 1 isolated find on lower slope above Clarks Gully
Sandy Creek	14 sites identified	6 isolated finds 8 artefact scatters	**Riparian Corridor Archaeological Terrain Unit** 3 isolated finds on floodplain of Sandy Creek 2 artefact scatters on floodplain of Sandy Creek 3 isolated finds on footslope (creek banks) of Sandy Creek 5 artefact scatters on footslope (creek banks) of Sandy Creek **Modified Archaeological Terrain Unit** 1 artefact scatter on vehicle track and transmission easement/dams which are modified landforms within and nearby Sandy Creek

Table 6.7 - New Sites Located in the Anvil Hill Project Area (cont)

Creek Catchment	No. of Sites	Site Types	Site Locations
Wybong Creek	48 sites identified	19 isolated finds 20 artefact scatters 9 rockshelters with archaeological evidence and PAD	**Riparian Corridor Archaeological Terrain Unit** 5 artefact scatters on the footslope (creek bank) landform element of Wybong Creek facing Wallaby Rocks. 1 isolated find on the footslope (creek bank) landform element of Wybong Creek facing Wallaby Rocks. 1 artefact scatter on floodplain landform element of Wybong Creek facing Wallaby Rocks. 1 isolated find on the confluence of Wybong Creek and Big Flat Creek of Wallaby Rocks. **Simple Slope Archaeological Terrain Unit** 6 isolated finds on mid slope of Wallaby Rocks leading down to Wybong Creek 5 artefact scatters mid slope of Wallaby Rocks leading down to Wybong Creek **Rocky Plateau Archaeological Terrain Unit** 3 rockshelters with artefacts and PAD on scree slope of Wallaby Rocks facing Wybong Creek 1 artefact scatter on scree slope of Wallaby Rocks facing Wybong Creek 1 rockshelter within spur crest of Wallaby Rocks 1 isolated find on spur crest of Wallaby Rocks 1 rockshelter on midslope of Wallaby Rocks facing Wybong Creek 4 rockshelters within the saddle ridgeline of Wallaby Rocks. 1 isolated find on the saddle ridgeline of Wallaby Rocks. 2 isolated finds on the upper slope of Wallaby Rocks **Spur Crest Archaeological Terrain Unit** 1 artefact scatter on a spur crest leading down from Wallaby Rocks to Wybong Creek 2 isolated finds on a spur crest leading from Wallaby Rocks to Wybong Creek **Ridgeline Crest Archaeological Terrain Unit** 1 isolated find on midslope of Wallaby Rocks leading to Wybong Creek **Modified Archaeological Terrain Unit** 5 isolated finds on modified landforms; vehicle tracks adjacent to Wallaby Rocks and Wybong Creek 6 artefact scatters on modified landforms; vehicle tracks adjacent to Wallaby Rocks and Wybong Creek

Table 6.7 - New Sites Located in the Anvil Hill Project Area (cont)

Creek Catchment	No. of Sites	Site Types	Site Locations
TOTALS	173 sites (69 isolated finds, 88 artefact scatters, 16 rockshelters with artefacts and PAD		62 artefact scatters within riparian corridor archaeological terrain unit 41 isolated finds within riparian corridor archaeological terrain unit 11 artefact scatters within simple slope archaeological terrain unit 9 isolated finds within simple slope archaeological terrain unit 16 rockshelters with PAD and archaeological evidence within the plateau archaeological terrain unit 6 artefact scatters within the plateau archaeological terrain unit 7 isolated finds within plateau archaeological terrain unit 8 artefact scatters within modified archaeological terrain unit 9 isolated finds within modified archaeological terrain unit 1 artefact scatter within spur crest archaeological terrain unit 2 isolated finds within spur crest archaeological terrain unit 1 isolated find within ridge line crest archaeological terrain unit.

Full site descriptions of all recorded sites are provided in **Appendix 9**. **Appendix 9** includes details of site integrity, disturbance, resources, outlook and aspect and the dimensions and defining features of the sites.

6.6.4 Previously Recorded sites in the Anvil Hill Survey Area

Previously recorded archaeological sites are shown on **Figure 5.1** and discussed in **Section 5**. The archaeological sites identified by Witter including EWA3, Clarks Gully Site and EWA8 to EWA18 and Russell's sites AH1 to AH3 were located during the survey. Registered sites AHIMS# 37-2-0509, 37-2-0510, 37-2-0511, 37-2-0512 and 37-2-0513 were also located in the field. Witter's site EWA1, EWA2 and EWA4 to EWA6 and registered site #37-2-0510 were not located during fieldwork due to factors such as vegetation cover and ongoing erosion in these areas. SC10 was a site originally recorded as AHIMS sites #37-2-511 to #37-2-513 by Silcox (1984).

6.6.5 Site Integrity and Sub-surface Deposits

The integrity of each site is discussed along with details of prior land-use and disturbance in **Appendix 9**. The locations of the sites discussed are shown on **Figure 6.2**. The majority of the artefact scatters within the Proposed Disturbance Area are located in areas that retain only skeletal to thin topsoil. Artefact scatter sites assessed as having the potential for retaining a level of integrity and a potential for sub-surface artefacts included AC13 (Russell's site recorded as AH-1) in the upper reaches of Anvil Creek and WC21 at the confluence of Big Flat Creek and Wybong Creek (refer to **Section 8.3.6** for further details related to PAD).

The confluence of Anvil Creek and Big Flat Creek (excluded from the survey due to access issues) is also predicted as highly likely to contain surface artefacts and PAD, based on the survey results, soil mapping and the predictive model. No other PADS assessed as retaining levels of integrity were identified in the survey area.

The tributaries and confluences of Sandy Creek which pass through the modified rail loop (not originally surveyed due to recent modifications to the rail loop to avoid SC10) are also predicted as highly likely to contain surface artefacts and PAD, based on the survey results, soil mapping (GSS 2006) and the predictive model. It is not possible to assess the extent and significance of PAD for these tributaries without physically inspecting the modified rail loop. However, based on the survey results to date, sites are likely to be located in association with tributaries of Sandy Creek on the boundary of the rise from the edge of the floodplain to lower slope in the area most affected by the proposed loop (its northern extent). These areas will require field survey and geomorphic investigation.

It is predicted, based on previous survey of the adjacent areas for the original rail loop, that the modified rail loop area was also ploughed for cropping of lucerne and disturbed by grazing cattle. Ploughing affects the integrity of the top 30 centimetres (approximately) of topsoil (A unit). Therefore, this area is unlikely to retain sub-surface artefacts in an undisturbed context. It is also likely that it will be difficult to detect artefacts on the ground surface (apart from in erosion scours associated with tributaries), due to the poor ground surface visibility within the Sandy Creek floodplain and associated foot slope and lower slope landforms. Further geomorphic investigation may be required to ascertain the extent of disturbance by prior land use in this area.

PADs that have suffered moderate to high degrees of disturbance and that are predicted to retain only low to moderate numbers of artefacts in a sub-surface context, were recorded in association with many of the sites identified during the survey. These included sites on the eastern bank of Wybong Creek below Wallaby Rocks; and sites on the tributaries and minor confluences of Sandy Creek in the north-east of the survey area. A selection of sites with PAD and their environs that exhibited complex geomorphological histories were subject to

geomorphic investigation by a qualified geomorphologist, Peter Mitchell (Groundtruth Consulting 2006), and his results are summarised in **Section 7** and included in full in **Appendix 10**.

All sixteen rockshelters identified on Wallaby Rocks, Anvil Hill, Western Rocks and Limb of Addy Hill retained surface artefacts and deposit assessed as PAD. The deposits in the majority of these rockshelter sites; however, are assessed as unlikely to retain stratigraphic integrity due to bioturbation associated with use of the rockshelters by animals (including macropods, wombats, foxes, sheep and goats). Trampling by sheep and goats has overturned the deposit to a depth of at least 10 centimetres, whilst burrows more than 50 centimetres in depth were observed. The rockshelters which are assessed as likely to retain some stratified deposit below the current disturbance zone are WC05, WC25, WC26, WC27 and WC45, (refer to **Plates 6.1** to **6.5**).

Site WC05 is a rockshelter located on the western side of Wallaby Rocks within the Wybong Creek Catchment which has at least 50 centimetres of deposit within the shelter (however, some of the deposit from this shelter is eroding out of the shelter and moving down the scree slope). Sites WC25, WC26 and WC27 are rockshelters identified on the north-western side of Western Rocks and are within a forested area with minimal to zero ground surface disturbance from erosion or animals and between 20 and 50 centimetres of deposit. Site WC45 is a rockshelter identified on the western end of Wallaby Rocks within the Wybong Creek Catchment. This site, although disturbed by a fox burrow, had partially intact, deep deposit more than 50 centimetres in depth in some sections of the rockshelter floor. These sites are described in more detail in **Appendix 9** and their location is shown on **Figure 6.2**.

Due to the combined effects of previous European land use practises, bioturbation and erosion, none of the PADs identified within the Proposed Disturbance Area are considered to have the potential for stratified evidence of Aboriginal occupation.

6.6.6 Site Location and Artefact Numbers

Tables 6.8 to **6.13** provide summaries of the geographic location of the sites and their contents within the survey area.

Table 6.8 - Distribution of Sites in the Landscape of the Survey Area

Landform Element	No. of Sites
Creek banks (footslope)	91
Creek bed	2
Scree Slope	11
Lower slope	4
Mid slope	17
Upper slope	3
Saddle Ridgeline	6
Spur Crest	6
Confluence – Creek Terrace	3
Floodplain	9
Modified	17
Secondary Spur	1
Spur Saddle	3
Total	**173**

PLATE 6.1
Facing north east, WC05 Rockshelter on Wallaby Rocks blue flags indicate artefact distribution

PLATE 6.2
Facing north, WC25 Rockshelter on Limb of Addy Hill (Western Rocks) Rhonda Ward of Ungooroo Aboriginal Corporation standing inside shelter and blue flags are marking artefact distribution

PLATE 6.3
Facing south west, WC26 Rockshelter on Wallaby Rocks indicating depth of deposit, flags show location of artefactual evidence

PLATE 6.4
Facing north east, WC27 Rockshelter on Wallaby Rocks indicating depth of deposit, flags show location of some artefactual evidence

Table 6.9 - Distance to Nearest Water Course

Distance to water course	<30 metres	30-100 metres	100-200 metres	>200 metres	Total
No. of sites	98	11	16	48	**173**

Table 6.10 - Site Type and Site Contents

Total No. of Sites	Isolated Artefacts	Artefact Scatters	Rockshelters with artefacts and PAD	Dominant Artefact Type	Dominant Raw Material Type
173	69	88	16	Flake	Mudstone

Table 6.11 - Assemblage Size

No. of sites with <10 artefacts	No of sites with 10<20 artefacts	No. of sites with 20<50 artefacts	No. of sites with 50<100 artefacts	No. of sites with 100+ artefacts
144	11	11	4	3

Table 6.12 – Dominant Raw Material in Artefact Assemblages by Catchment

Catchment	Mudstone	Silcrete	Basalt	Quartz	Tuff	Petrified Wood	Chert	Conglomerate Pebbles
Anvil Creek	36	5	1	1	0	0	0	1
Big Flat Creek	43	5	0	0	1	0	0	0
Clarks Gully	16	2	0	0	0	0	0	0
Sandy Creek	9	2	1	0	0	2	0	0
Wybong Creek	45	0	0	1	1	1	0	0
Total	**149**	**14**	**2**	**2**	**2**	**3**	**0**	**1**

Table 6.13 – Dominant Artefact Type in Assemblages by Catchment

Catchment	Flake (including retouched flakes)	Axehead	Flaked Piece	Broken Flake	Core	Heat Shatter	Blade	Flake used as a core
Anvil Creek	32	1	5	4	1	1	0	0
Big Flat Creek	39	0	1	5	4	0	0	0
Clarks Gully	8	0	3	5	1	0	1	0
Sandy Creek	11	0	0	2	1	0	0	0
Wybong Creek	42	0	0	2	3	0	0	1
Total	132	1	9	18	10	1	1	1

6.6.6.1 Discussion of Site Location and Artefact Numbers

Distribution of Sites in the Landscape

The majority of sites identified in the survey area were artefact scatters and isolated finds within the creek bank landform element (91 sites). The modified and the midslope landform element had the second highest number of sites (17 sites) followed by the scree slope (11 sites, all which were artefact scatters apart from three rockshelters which sat above the scree slope). The remaining rockshelters are identified within the spur crest, saddle ridgeline, spur saddle, secondary spur and mid slope landform elements within the plateaus archaeological terrain unit (see **Table 6.5** for further description). The distribution of sites across the landscape reflects the results of previous archaeological research in that the majority of the sites are located in the riparian corridor terrain unit (near creek lines and within 30 metres of the watercourse - 98 sites as shown in **Table 6.9**). The areas that have been substantially modified, such as roads and dams, have a high number of sites as they provide useful ground surface visibility not generally available in the landscape. It should be noted; however, that many of these sites fall within the simple slope archaeological terrain unit.

The second highest frequency of sites were located over 200 metres from the nearest watercourse (48 sites). This high frequency at a distance from a water source is due to the location of sites on the rocky plateaus that dominate the survey area and provide a suite of different resources to those available in areas of lower gradient. Of the 48 sites, 16 sites are rockshelters with PAD and the remaining sites are a combination of small artefact scatters and isolated finds.

There are only 27 isolated find and artefact scatter sites that fall in the intervening area between the riparian corridor and the areas associated with the rocky plateaus. The scatters in these areas are small and widely dispersed. Whilst ground surface visibility is thought to have restricted the location of further sites within this intervening area, the evidence observed suggests that the area would only contain widely dispersed sites with low numbers of artefacts.

The highest number of sites identified during the survey lie within the Big Flat Creek Catchment (49), followed by the Wybong Creek (48), Anvil Creek (44), Clarks Gully (18) and Sandy Creek (14) Catchments. These results are biased to some extent by the actual total area of each catchment within the survey area and the percentage of ground surface visibility available. In many cases where multiple sites have been recorded along the creeklines it is highly likely that they represent the visible evidence of a light scatter of artefacts that extend along the whole creekline, with creek confluences and areas with chains of ponds, having relatively denser, overlapping concentrations.

Site Types, Raw Materials and Artefact Types

Site assemblages are generally small, with 144 of the 173 sites containing less than ten artefacts. The dominant raw material (as predicted from previous archaeological research within the region) is mudstone followed by silcrete. Some mudstone and silcrete identified within the survey area exhibited evidence of heat treatment rather than being simply heat affected. This was distinguished by greasy lustre appearing on ventral surfaces of flakes and within flake scars on cores (but not on the dorsal surface of the flake or on regions of the core that had not been flaked). This suggests heat treatment of cores prior to flaking. Other artefacts did display attributes such as crazing and potlidding associated with being subject to uncontrolled heat from bushfires.

Other raw materials used for artefact manufacture identified within the survey area included basalt, quartz, tuff, petrified wood, chert, siltstone, hornfels, tuff, chalcedony and worked mussel shell. These raw materials were generally recorded as minor components of the

larger assemblages, for example site SC10 near Sandy Creek, formerly recorded by Silcox (1984) (refer to **Plates 6.6** and **6.7**). This site contained the widest diversity of raw material types and artefact types (including large hornfels choppers, axe heads and numerous knapping floors) recorded during the survey. The site is very badly eroded and retains no integrity; however, it is highly likely to have large numbers of reworked artefacts within redeposited soil that has aggraded in some areas across the site (behind exposed tree roots and in areas of low gradient).

The AC13 site on Anvil Creek also has numerous knapping floors and a wide variety of raw materials including mudstone, petrified wood, silcrete, quartz and hornfels artefacts (refer to **Plates 6.8** and **6.9**). WC33, a rockshelter located on Western Rocks facing Wybong Creek also has a large assemblage. This site is within easy walking distance of Wybong Creek which would have been the most permanent water source in the survey area. The location of the rockshelter provided a great outlook over the locality (refer to **Plates 6.10** and **6.11**).

The dominant artefact type is the flake (including retouched flakes) followed by flaked pieces, broken flakes and cores. The larger assemblages include artefact types such as axe heads, heat shatter, blades, flakes used as cores, manuports, backed blades, Bondi points, hammerstones, scrapers, choppers and one blade core. Sites with backed artefacts (backed blades and Bondi points) are identified in all catchments, the highest frequency is at Big Flat Creek Catchment which also has a significantly higher frequency of cores in assemblages. .

Worked mussel shell believed to have been sourced from Wybong Creek prior to non-Aboriginal occupation (neither European oral history, historical evidence or the results of flora and fauna surveys have identified fresh water mussels in Wybong Creek) was identified in the WC47 rockshelter on Wallaby Rocks. Mussel shell fragments were also located in rockshelter sites WC45 and WC46 within Wallaby Rocks. All three sites have an outlook over Wybong Creek and artefact scatter site WC02 is located on the slope below the rockshelters and above Wybong Creek. This site also contained worked mussel shell and shell fragments (refer to **Plates 6.12** to **6.14**).

This suite of sites with worked shell and shell fragments, all associated with Wybong Creek, form an identifiable site complex which is a rare find in the Upper Hunter Valley region. ERM's (2004a) Upper Hunter Baseline Study, which provides an archaeological review of the region, does not mention the existence of similar sites in the region. No other rockshelter sites or artefact scatter sites with worked shell could be identified within inland NSW. This conclusion is based on a search of the National Museum of Canberra's artefact database and an email to the Australian Archaeology online discussion group (AUSARCH); both of which failed to locate any evidence of inland rockshelters or artefact scatters with worked shell.

The location of the worked shell is surprising as fragile organic materials like mussel shell do not often survive intact in the archaeological record due to trampling by stock and disintegration over time. The worked shell supports the high significance assessment for rarity and representativeness of these sites (WC02 and WC47 – refer to **Section 8.3** for further discussion in relation to significance).

6.6.7 Aboriginal Resource Richness

6.6.7.1 Outlook

Locations that provided a broad outlook were important to Aboriginal hunter-gatherers and are seen as a factor in site location. Anvil Hill, Wallaby Rocks, Limb of Addy and Western Rocks all have evidence of Aboriginal occupation within their rockshelters. Wallaby Rocks has the largest rockshelters and in general these rockshelters have deeper deposits and more potential for archaeological deposit than those in the other plateau areas. Use of

PLATE 6.5
Facing south, WC45 Rockshelter on Wallaby Rocks showing deposit within shelter

PLATE 6.6
Facing Sandy Creek floodplain, Site SC10 formerly recorded by Silcox (1984) location of large numbers of artefacts with different raw materials

PLATE 6.7
Ground axe part of SC10 assemblage

PLATE 6.8
AC13 site previously identified by Russell as AH on Anvil Creek, facing north east, area shown has numerous mudstone knapping floors along gullies

PLATE 6.9
AC13 Facing west, location of site extends into area shown which is also the location of small soaks with chain of ponds morphology

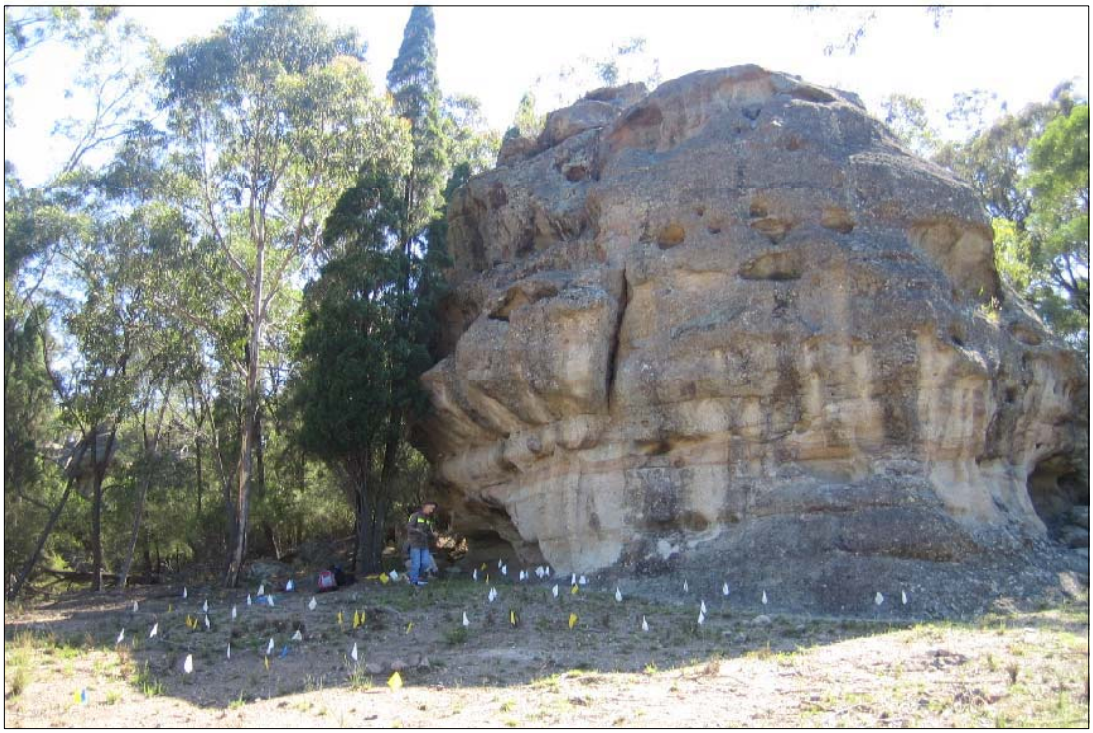


PLATE 6.10
Facing north east, WC33 rockshelter on Western Rocks which faces Wybong Creek, flags show artefact distribution

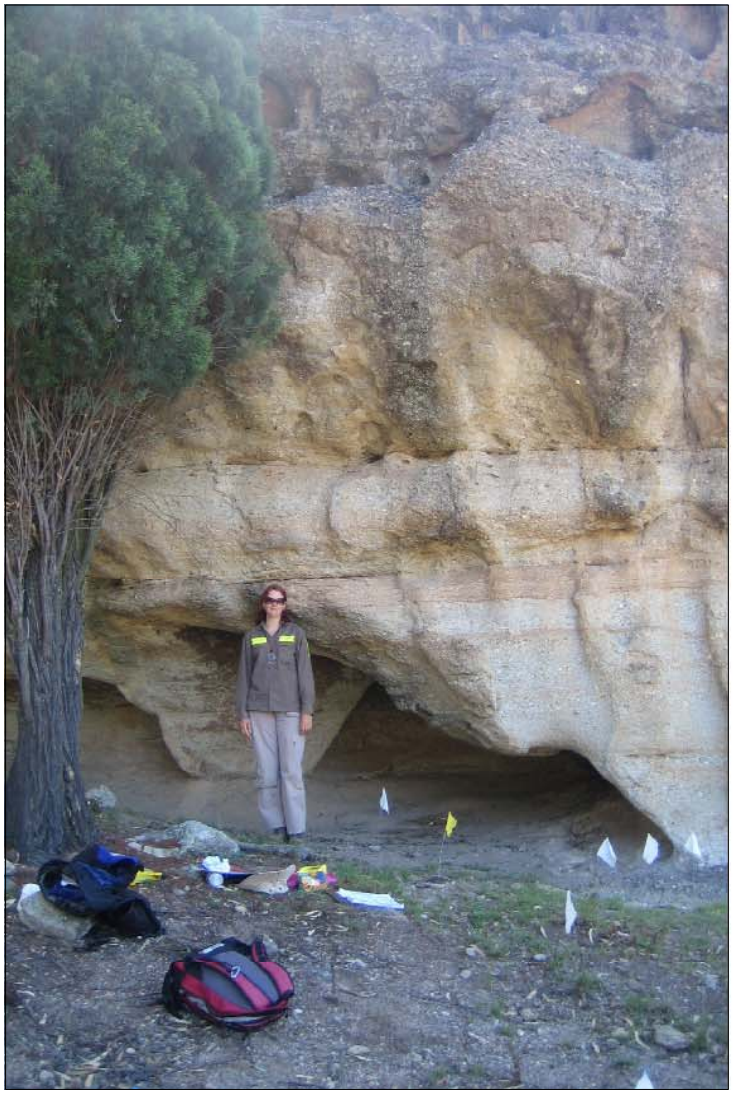


PLATE 6.11
Facing north east, close up of WC33 rockshelter on Western Rocks which faces Wybong Creek

PLATE 6.12
Overview of WC02 artefact scatter, facing north west on Wybong Creek. Flags show artefact distribution

PLATE 6.13
WC02 artefact scatter on Wybong Creek adjacent to Wallaby Rocks, close up of retouched margin and edge damage from trampling

PLATE 6.14
WC02 artefact scatter on Wybong Creek adjacent to Wallaby Rocks, close up of retouched margin and edge damage from trampling

rockshelters has been shown to significantly increase the rate of weathering of rockshelters and thus to enlarge the area and deepen the deposit (Hughes, 1976, 1977 and 1978). The focus on use of these rockshelters appears to be partially due to Wallaby Rocks having a broad view across the landscape, especially towards Wybong Creek and Big Flat Creek. It is recognised that these areas also have the most reliable water supply and that this would have been the primary reason for the greater use of these rockshelters.

Few sites were identified on simple slope and crest archaeological terrain units which currently provide an outlook across the landscape. This result may partially be related to poor ground surface visibility in this area, but is also likely to be a reflection of the prior vegetation coverage where visibility would have been restricted in these areas due to trees. Areas assessed as having a broad outlook are shown on **Figure 6.4**.

6.6.7.2 Economic Plant and Prey Species

The distribution of economic plant and prey species was a determining factor in how Aboriginal hunter-gatherers used the landscape. Site distribution in proximity to the main channels of Wybong Creek, Anvil Creek, Big Flat Creek, Sandy Creek and Clarks Gully is assessed as not wholly related to their exploitation for drinking water, but as the creeks provided habitat for aquatic plants, aquatic fauna (ducks, grebes, swamp hens, egrets, herons, yabbies, eels and freshwater mussels) and acted as a focus for larger mammals which also required drinking water. Evidence of the use of freshwater mussel by Aboriginal people was evident in artefact scatter WC02 on the creek bank of Wybong Creek and in the rockshelters of Wallaby Rocks that face Wybong Creek including WC47 (see **Plates 6.15** and **6.16**). This evidence was related not only to the use of mussels as food but also the use of the shells to make tools.

6.6.7.3 Suitable Camping Areas

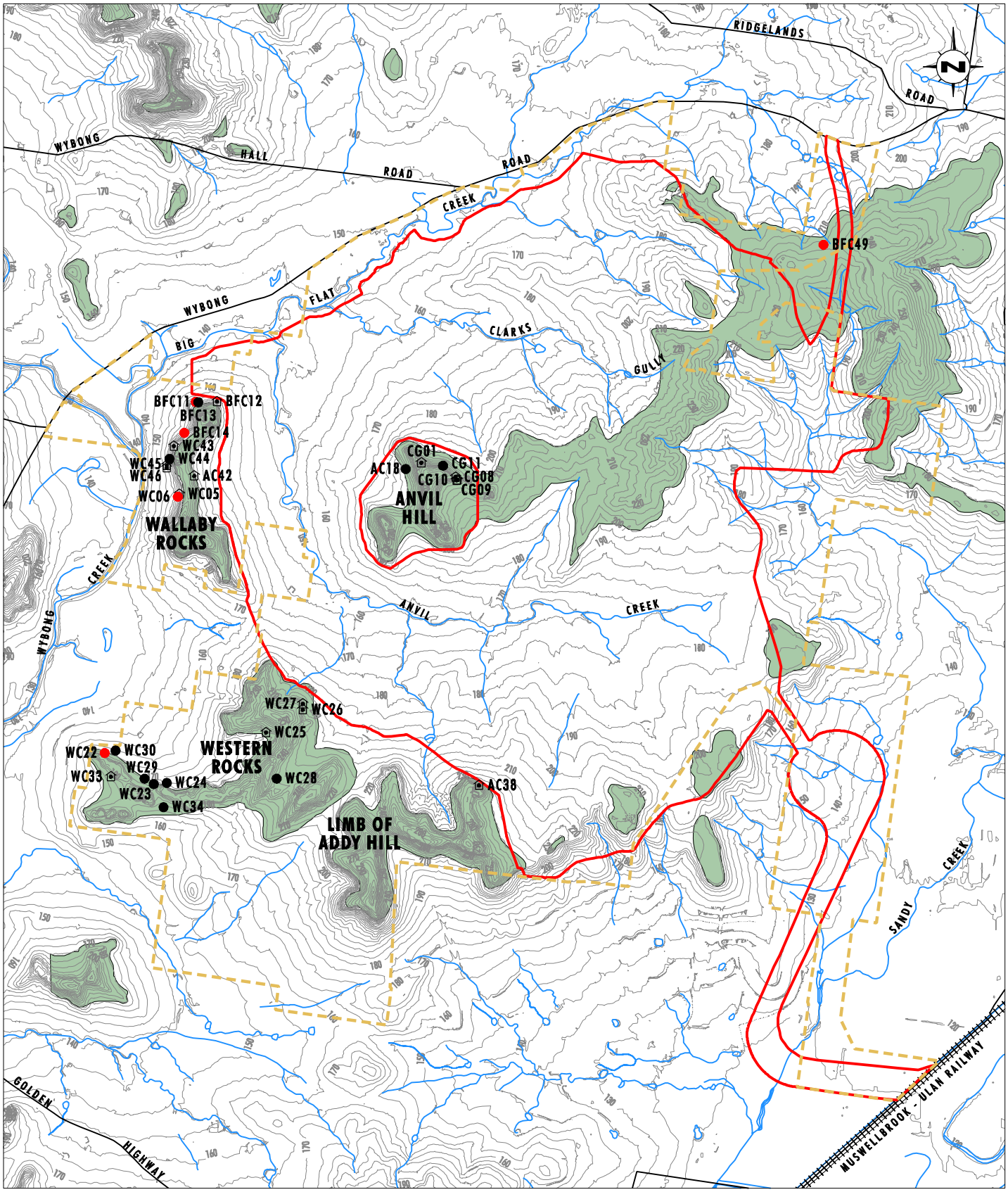
Gradient has proven to be a determining factor for the location of artefact scatters and evidence of Aboriginal occupation within the survey area. There was no evidence that Aboriginal people camped in creek beds (sites located in creek beds were the result of mass movement of materials from the creek banks). There was minimal evidence indicating that the steeper ridgelines and spurs within the survey area were used for occupation; instead it appears that these areas were travel routes subject to transient use only.

The rockshelters that were used for occupation were those with level floors and that were relatively easy to approach from the slope below. Artefacts located on the steep scree slopes below the shelters were associated with the movement of artefacts out of the rockshelter deposits, due to disturbance from animals and then downslope movement due to water (slope wash) and gravity.

The creek flats and high (level) terraces at creek confluences were also well drained features in the landscape that would have been suitable for suitable for camping; however, sites were limited in these areas due to poor ground surface visibility.

6.6.7.4 Fresh Water Availability and Creek Confluences

The availability of fresh water was a significant determining factor for site location and this is supported by the large number of sites in the riparian corridor. The reliability of fresh water sources is a determinant on how many people can camp in an area and how long they can stay. The more permanent the water supply, the larger the group that can stay and/or the longer the group can stay. Stays of longer duration and stays by more people both result in the discard of more cultural material and thus larger assemblages of artefacts. An example of a site that fits this description is that of the large site on Anvil Creek (Russell's AH1 site re-identified as AC13). Since the survey, this site has been shown by geomorphic inspection



Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Survey Area
- Areas with an Extensive Outlook
- Artefact Scatter
- Isolated Find
- Shelter with PAD

FIGURE 6.4

Archaeological Sites within Areas that Provide an Extensive Outlook

PLATE 6.15
Facing south, WC47 Rockshelter on Wallaby Rocks with worked mussel shell. These blue flags show artefact distribution

PLATE 6.16
Close up of worked mussel shell (centre), shell fragment and artefact located in WC47's assemblage. Similar shell was located in WC02 directly below the rockshelter

(Mitchell 2006 – refer to **Appendix 10** and **Section 7**) to be associated with a reach of the creek that had (prior to European land clearance) a chain of ponds morphology that provided reliable water on a semi-permanent basis. Large numbers of artefacts with numerous knapping floors and areas showing specific foci of occupation are noticeable eroding from this site.

The confluence of Clarks Gully and Big Flat Creek and also Wybong Creek and Big Flat Creek contain large artefact scatters with associated PAD. Minor confluences of Sandy Creek including sites SC10 (formerly recorded as 37-2-0511, 37-2-0512 and 37-2-0513) also show the importance of minor creek confluences as foci for Aboriginal occupation within the survey area. Whilst this site had the largest assemblage recorded, in general, sites located on minor confluences contained smaller numbers of artefacts than those located at the larger confluences. Ground surface visibility and degrees of erosion; however, may be biasing these results.

The site distribution and their relationship to major and minor creek confluences is shown on **Figure 6.5**.

6.6.7.5 Availability of Stone Resources

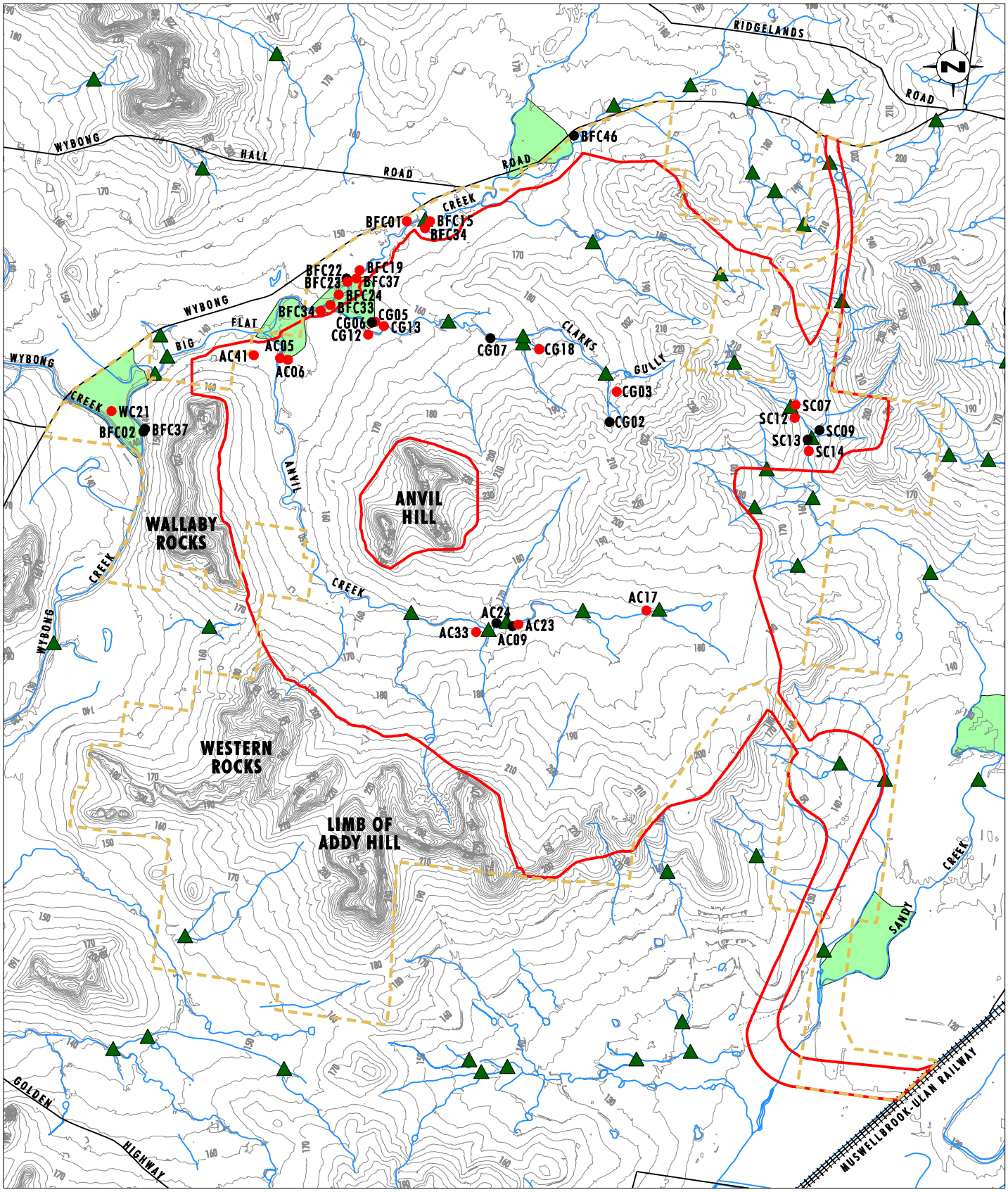
Mudstone (often termed indurated mudstone or rhyolitic tuff) and silcrete are the dominant raw materials used for artefact manufacture within the survey area. There are no sources of mudstone or silcrete within the survey area. Those mudstone and silcrete artefacts within the sites that retained cortex were observed to have been derived from water-worn cobbles. The closest source of mudstone is the Goulburn River and for both mudstone and silcrete is available from the Hunter River. These rivers are the most likely source of the majority of the raw material transported into the survey area for implement manufacture. The local conglomerates do not contain mudstone (rhyolitic tuff) or silcrete; however, artefacts were observed that had been manufactured from pebbles from the conglomerate (quartz and quartzite), which could have been sourced from the channels of the watercourses, rockshelter walls and driplines, or in eroded areas where the rock outcrop was exposed.

6.6.7.6 Sites near Ecotones

This site association is harder to discern due to other factors that influence site location within these areas. For example, within the present survey area the ecotones occur where floodplain alluvium overlaps slopes with yellow solodics or where they are located on opposite sides of creek lines. These areas are closely tied to the floodplains and thus to creek confluences, water resources and aquatic habitats and therefore, the fact that they are near an ecotone may have been only a secondary factor in their location. Sites likely to have been influenced by an ecotone as a contributing factor to their location are the sites along the main channel of Big Flat Creek and Wybong Creek and SC10 on Sandy Creek where the lower slope is overlapped by the Hunter River floodplain (refer to **Figure 6.2**).

6.7 Assessment of Predictive Model and Interpretation of the Results

This section of the report assesses the results of the survey in view of the predictive model and offers an interpretation of the results in relation to generally accepted models of Aboriginal occupation in the Upper Hunter.



Base Map: Dept. of Lands (2003), Geospectrum (2004)
Note: Contour Interval 5m

Legend

- Proposed Disturbance Area
- Survey Area
- Major Confluence
- Minor Confluence
- Artefact Scatter
- Isolated Find

FIGURE 6.5

Location of Creek Confluences and Archaeological Site Distribution

6.8 Assessment of the Predictive Model

For ease of comparison, the following subsections are set out in the same manner as in the predictive model (refer **Section 5.9**). The discussion is made in relation to the sites within and outside of the project disturbance area;

6.8.1 The Proposed Disturbance Area

In relation to the Proposed Disturbance Area it was found that:

- the majority of the sites located were artefact scatters and isolated artefacts;
- the majority of artefact scatter and isolated find sites were located on footslopes and lower slopes associated with Anvil Creek and its tributaries, Clarks Gully and its tributaries, Sandy Creek and its tributaries and the tributaries of Big Flat Creek;
- the majority of the artefact scatter and isolated find sites were within 30 metres of these watercourses;
- confluences of the creeks and tributaries were the focus of larger numbers of artefact scatter sites than along the watercourses in general. These sites were also found to contain larger assemblages than those along the watercourses in general (these results could be biased to some extent by ground surface visibility);
- the artefact scatter sites did typically have assemblages with less than 10 artefacts and rarely exceeded 50 artefacts (the exceptions to this being AC13, AC37, BFC31, CG18, SC10 and WC21);
- the location of camp sites near ecotones does appear to be at least a secondary factor in site distribution;
- low numbers of small, widely dispersed, artefact scatter and isolated find sites were located on the upper slope (3 sites) and on the lower slope (4 sites). The midslope appears more favoured (17 sites) then the scree slope with (11 sites);
- spur crests, spur saddles and secondary spurs contained small numbers of sites (6 for spur crest, 3 for spur saddle and 1 for secondary spur) most of which were rockshelters; and though they may have been used for travel routes down to the creeks and watercourses this has not resulted in the discard of sufficient artefactual material to make them evident in the landscape (this result may be biased due to very poor ground surface visibility in these landforms);
- quartz and quartzite pebbles from the local conglomerates were used as a source of raw material for knapping;
- the dominant raw material used in artefact manufacture was indurated mudstone followed by silcrete;
- the most likely source of the mudstone and silcrete does appear to be cobbles from the Goulburn or Hunter River;
- other raw materials such as quartz, quartzite, petrified wood, chalcedony and volcanics (basalt) were commonly located in the larger assemblages but always as a minor component of the assemblage. Porcellanite, often found in Upper Hunter Valley

assemblages was absent as was crystalline tuff. Siltstone and hornfels were present though not predicted;

- the predominant artefact types were flakes followed by flaked pieces, cores and retouched flakes. Broken flakes were also found to be common, though they were not mentioned in earlier reports (it is likely that they were incorrectly placed in the flaked piece category);

- a small component of the larger assemblages did reflect microblade technology (WC21, SC10) as well as some of the smaller sites along Anvil Creek (AC30, AC37), Big Flat Creek (WC44, BFC15 and BFC23), Clarks Gully (CG08) and Sandy Creek (SC14) and the rockshelters of Wallaby Rocks (WC25, WC33, WC43, WC46 and WC47);

- retouched flakes were commonly located in many of the assemblages;

- axes were located in one of the larger assemblages (SC10) and were not a common component of the smaller assemblages except for in sites WC08 and AC02; and

- freehand percussion was the dominant knapping method.

Site types that were not found in the Proposed Disturbance Area are:

- scarred and carved trees;

- Bora rings;

- burials;

- rockshelters with deposit or art;

- grinding grooves;

- ochre quarries or stone quarries; and

- contact archaeological sites such as missions, camp sites with knapped glass or massacre sites.

6.8.1.1 Deviations from the Predictive Model

PAD with archaeological integrity was not predicted within the Proposed Disturbance Area, PAD with the potential for at least some spatial integrity was; however identified as present in the AC13 site. The size and complexity of the visible assemblage in the AC13 site indicated that this section of Anvil Creek may once have supplied more permanent water than is currently the case. This suggested major changes to the morphology of the creekline since European settlement. In order to gain a greater understanding of the geomorphological history of this and other areas assessed as having a complex geomorphological history (observed during the survey) a geomorphological assessment was organised (refer to **Section 7** for a summary and **Appendix 10** for the full report).

6.8.2 The Survey Area (outside the Proposed Disturbance Area)

In relation to the survey area (outside of the Proposed Disturbance Area) it was found that:

- PADs with some stratigraphic integrity (below the cultivation zone/current disturbance zone) are assessed as possible within the floodplain of Big Flat Creek and Wybong

Creek where alluvium has acted to bury and preserve sites and erosion has not acted to reveal artefacts;

- the PADs in these areas are assessed as likely to have sub-surface assemblages of more than 100 artefacts;

- burials were not located in the rockshelters and are not likely within the floodplain deposits due to moisture fluctuations resulting in poor preservation;

- rocky clifflines such as on Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks did contain rockshelter sites which have artefacts and some of which are assessed as having PAD that could retain stratigraphic integrity below the current disturbance zone; and

- the visible evidence within the rockshelters does reflect transient use of most shelters and more intensive use along the northern (but not western) side of Wallaby Rocks and the far western end of the Western Rocks.

Site types not found in the survey area (and outside the disturbance area are):

- scarred and carved trees;

- Bora rings;

- rockshelters with art;

- grinding grooves;

- ochre quarries or stone quarries; and

- contact archaeological sites such as missions, camp sites with knapped glass or massacre sites.

6.8.2.1 Deviations from the Predictive Model

The location of freshwater mussel shell in sites associated with Wybong Creek and in shelters on Wallaby Rocks was not predicted and is a rare find that indicates how the ecology of the creekline has changed since European settlement.

6.9 Site Integrity

Based on the survey results the following revisions are required to predictions related to site integrity within the survey area.

6.9.1 The Proposed Disturbance Area

In relation to site integrity within the Proposed Disturbance Area it was found that:

- in general artefacts scatters and isolated finds associated with ephemeral creeks are highly unlikely retain integrity due to erosion and stock trampling; and

- the lack of soil on the slopes does indicate that artefact scatters will have been affected by the downslope movement of soils causing the redistribution of the artefacts down the slope and their remixing and reburial downslope.

6.9.2 The Survey Area (outside the Proposed Disturbance Area)

In relation to site integrity within the survey area but outside the Proposed Disturbance Area it was found that:

- in areas of gentle gradient on the ridge and spur crests and associated crests, spurs, secondary spurs and saddles moderate to low integrity existed for artefact scatters/isolated finds. This is based on the density of intact vegetation and ground surface disturbance from European land use practices including clearing, pastoralism and frequent visitation as well as the construction of roads and tracks in these terrain units;

- all of the rockshelters on Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks that have surface artefacts are also likely to have further artefacts in a sub-surface context. Due to impact by various animals (most importantly sheep and goats); however, only some of those rockshelters with deeper deposit (over 10 centimetres) are likely to have deposits that retain integrity below the current level of surface disturbance. These rockshelters include AC38, BFC12, WC05, WC25, WC26, WC27, WC45 WC46 and WC47 (refer to **Figure 6.2**);

- it is possible that artefact scatters located in deeper alluvial deposits on the northern side of Big Flat Creek and Wybong Creek may retain integrity below the plough zone/current disturbance zone; and

- artefacts within the plough zone (in areas of cultivation – refer to **Figures 4.1** to **4.3**) will have been subject to vertical and horizontal displacement during cultivation and thus will be without integrity and will have no relationship to artefacts below them and beneath the plough zone.

6.10 Areas where Access for Survey was Restricted

As mentioned in **Section 6.2,** survey was not possible for three properties within the Proposed Disturbance Area due to the lack of an access agreement between the landholders and Centennial. In order to be able to more accurately predict the potential for these properties to have sites, and the type and condition of those sites, surveys were undertaken in close proximity to the properties and in the same archaeological terrain units and landform elements (refer to **Figure 6.3**).

Area 1 is located on the western side of Anvil Creek on the central western boundary of the Proposed Disturbance Area. The majority of this area within the Proposed Disturbance Area is comprised of the Simple Slope Archaeological Terrain Unit (lower, mid and upper slope landform elements between Wallaby Rocks and Anvil Creek). The area also contains a small section of the Riparian Corridor Archaeological Terrain (creek bed, creek bank, creek terrace and footslope landform elements) and a short section (approximately 150 metres) of the middle reaches of Anvil Creek. The surveys undertaken on the Simple Slope Archaeological Terrain Unit on the western side of Anvil Creek did not locate any sites and the area was generally assessed as having low potential for PAD due to the shallow to skeletal soils and the high levels of prior disturbance. The Riparian Corridor Archaeological Terrain Unit along the middle reaches of Anvil Creek was found to contain two artefact scatters (AC35 and AC37) and one isolated find. An inspection of both the eastern and western banks of Anvil Creek directly upstream and downstream of Area 1 failed to locate any artefactual material. The general integrity of the creek environs in this area is poor and thus, though it is possible that the area may contain artefact scatters and/or isolated finds, it

is assessed that these sites will not retain archaeological integrity and will have low numbers of artefacts in a sub-surface context.

The section of Area 1 that falls outside the Proposed Disturbance Area but with the Project Application Area consists of the Simple Slope Archaeological Terrain Unit (upper and midslopes) associated with Wybong Creek. This terrain unit was found to have multiple artefact scatter and isolated find sites in the area between Wallaby Rocks and Wybong Creek. It is assessed that this evidence is not directly applicable to the this section of Simple Slope as it is located further from reliable water and is not directly associated with rockshelters within the plateau. It is, however, an area that would have provided easy access from Anvil Hill to Wybong Creek and may have acted as a travel way. It also may have provided a travel route between Wallaby Rocks and Western Rocks. This area will not be directly impacted by the proposed project and does have potential as an Offset Area. Overall, there is insufficient information to provide a confident prediction of the extent of Aboriginal occupation of this area.

Area 2 is located in the north-western corner of the Proposed Disturbance Area. The section of Area 2 within the Proposed Disturbance Area incorporates Simple Slope Archaeological Terrain Unit (lower, mid and upper slopes) on the southern side of Big Flat Creek to the north of Wallaby Rocks (and the rockshelters with evidence of occupation located in this area). It is assessed that this area is similar in nature to the Simple Slope Archaeological Terrain Unit to the east of Wybong Creek and to the west of Wallaby Rocks. This area was found to have numerous artefact scatters and isolated finds that are assessed as having the potential for moderate numbers of artefacts in a sub-surface (albeit disturbed) context. These sites occur on the slopes below rockshelters with evidence of occupation. It is assessed that Area 2 within the Proposed Disturbance Area has similar potential for artefact scatters and isolated finds with the potential for moderate numbers of artefacts in a sub-surface context.

The section of Area 2 that falls outside the Proposed Disturbance Area but within the Project Application Area includes a section of the Riparian Corridor Archaeological Terrain Unit (floodplain, creek bed, creek bank, creek terrace, footslope) associated with the lower reaches of Big Flat Creek (approximately 1.5 kilometres in length) and the confluence of Big Flat Creek and Anvil Creek. It also includes small areas of Simple Slope Archaeological Terrain Unit (lower slopes) associated with the southern side of Big Flat Creek. It is assessed that this area has a high potential for artefact scatters and isolated finds with the potential for high numbers of artefacts in a sub-surface context. On the northern side of Big Flat Creek there is the potential for there to be some integrity to the deposits below the current disturbance zone. This area will not be directly impacted by the proposed project and does have potential as an Offset Area.

The majority of Area 3 is located in the north-eastern corner of the Proposed Disturbance Area and includes the Simple Slope (lower, mid and upper slopes), Ridge Crest and Riparian Corridor (creek bed, creek bank, creek terrace and footslope landform elements) Archaeological Terrain Units. The gradient in this area is relatively steep and the creeklines include short first and second order tributaries of Big Flat Creek and Sandy Creek. Surveys of similar areas to the north and south did not locate any sites on the ridge crest and only a small number of isolated find and artefact scatters (2 to 19 artefacts) associated with the creeklines. The general integrity of the creek environs in this area is poor and thus, though it is possible that the area may contain artefact scatters and/or isolated finds, it is assessed that these sites will not retain archaeological integrity and will have low numbers of artefacts in a sub-surface context.

The small section of Area 3 that is outside the Proposed Disturbance Area but within the Project Application Area contains the same Archaeological terrain units as they are within the Proposed Disturbance Area and thus it is assessed that this area may contain artefact scatters and/or isolated finds, that will not retain archaeological integrity and will have low

numbers of artefacts in a sub-surface context. While this area has little archaeological research potential its inclusion within an Offset Area would provide for the conservation of sites in the upper slope/upper tributary system.

Part of the area proposed for the modified rail loop has not been surveyed to date. This area includes the same Archaeological Terrain Units recorded within the Proposed Disturbance Area and includes sections of the Riparian Corridor of Sandy Creek (flood plain, creek bed, creek bank and footslope landform elements), Simple Slope (lower slope landform element), Spur Crest (spur landform element) Archaeological Terrain Units. Survey of similar Terrain Units in the original rail corridor resulted in the location of two isolated finds (SC01 SC04) and one artefact scatter (SC02) on the floodplain landform element of the Riparian Corridor Archaeological Terrain Unit. One large artefact scatter (SC10) was also located within the Riparian Corridor Archaeological Terrain Unit and extending into the Simple Slope Archaeological Terrain Unit. SC10 was located at the break of slope between the lower slope and floodplain. This site had low archaeological integrity but high numbers of artefacts on the ground surface. It is predicted that moderate to high numbers of artefacts will be located in areas of ground surface exposure within the lower slope landform elements leading to the edge of the floodplain. . The integrity of such areas, however, will be low based on the previous land use history of the area (grazing and farming) which has accelerated erosion and loss of topsoil.

It is also predicted that the lower reaches of Sandy Creek approaching the Hunter River may contain sub-surface artefacts. As ground surface visibility will be low in this area it is likely that a geomorphic inspection will be required to gain a greater understanding of the landscape history of the area and to pinpoint areas that may require subsurface investigation. For example, areas where sites may have been buried by Hunter River alluvium or by colluvial fans deposited from upslope.

6.11 Summary

Sites were commonly located along the ephemeral tributaries that drain the slopes and on the floodplains of the major creeklines. A small number of large sites with over 100 artefacts and PAD were found eroding from the banks and terraces of the footslope which leads down to the floodplain of Sandy Creek and at the confluence of Wybong Creek and Big Flat Creek.

The confluence of Wybong Creek and Big Flat Creek is a major foci for occupation based on artefact distribution and the number of artefacts that extend from the base of Wallaby Rocks downslope to Wybong Creek to the west of the survey area and outside the Proposed Disturbance Area. This focus for occupation is most likely due to more reliable water and more abundant economic resources. The greater occupation of the rockshelters on the northern and western sides of Wallaby Rocks and the rockshelter at the western end of the Western Rocks (WC33) which are closest to and face Wybong Creek also supports the importance of this more reliable water supply and the resource abundance of the area. Both of which are necessary characteristics for longer term and/or repeated Aboriginal occupation.

The extensive AC13 artefact scatter site is not located on a floodplain or terrace or at a creek confluence; instead this site is located on the creek bank and lower slopes adjacent to Anvil Creek and adjacent to what are now a series of infilled chain of ponds (Mitchell 2006 – refer to **Section 7** and **Appendix 10**). The chain of ponds would have supplied a more reliable water source than other areas along the creekline and offered the opportunity for longer term and/or repeated occupation of the area.

Artefacts were located on steep slopes due to movement of artefacts out of rockshelters at the base of the cliffline/top of the scree slope in the plateaus, particularly Wallaby Rocks. Very few sites were found on spur crests and ridgeline crests, lower slope or upper slopes

but sites were located on the lower slope/footslope boundary. The lack of sites in many landform elements may be due to low ground surface visibility in these areas.

Quartz and quartzite pebbles from the local conglomerates were used as a source of raw material for knapping. The dominant raw material used in artefact manufacture and visible in surface scatters was indurated mudstone followed by silcrete as predicted. However, other raw materials not predicted were identified including chalcedony, hornfels, petrified wood and local mussel shell. No porcellanite was found in any of the assemblages. The predominant artefact types were flakes. There was indication of backed blade technology in artefact scatters along Anvil Creek, Sandy Creek, Wybong Creek, Big Flat Creek and Wallaby Rocks. Retouched flakes were commonly located in the larger assemblages and often made up a significant component of assemblages. Some mudstone and silcrete appeared to have been heat treated while large numbers of heat affected artefacts were found particularly in assemblages near Wybong Creek within the Riparian Corridor terrain unit and on the Wallaby Rocks Plateau and its associated slopes as well as at numerous sites at Anvil Creek including the AC13 site. Edge ground axes, were located but were not a common component of the assemblages. No grindstones were identified. Large core (chopping) tools were found in the assemblages of Sandy Creek in SC10.

Freehand percussion was the dominant knapping method. An elouera that were identified by Witter in the Anvil Vale site was not located during the survey.

The use of mussel shell for tools is a rare find and was identified in an artefact scatter at Wybong Creek (WC02) and in Rockshelter site WC47 on Wallaby Rocks (that overlooks (WC02). Shell fragments and burnt shell and bone were also identified in shelter deposits within Wallaby Rocks including sites WC45 and WC46.

No contact archaeological sites such as missions, camp sites with knapped glass or massacre sites were identified. However, the remains of an old camp oven were identified on the confluence of Big Flat Creek and Clarks Gully near artefact scatters. There is no way of knowing if this is related to Aboriginal occupation.

Axe grinding grooves were not identified. This result is due to the coarse, conglomeratic nature of the rock that was available in outcrop in pre-European times. Suitable sandstone currently outcrops in some areas near artefact scatters on the minor confluences of Sandy Creek and also within Big Flat Creek on the Sormaz property; however, this outcrop has been exposed by deep entrenchment of the creeklines since European land clearance and was not available to the Aboriginal people that camped in these areas.

No ochre quarries, burial sites, shell middens, ceremonial grounds or stone arrangements were identified. Due to extensive land clearing as shown on the aerial photographs (**Figures 4.1** to **4.3**), there are few mature trees surviving in the Proposed Disturbance Area and no scarred or carved trees were located.

In relation to the three properties that could not be surveyed due to access restrictions (refer to **Figure 6.1**), it is assessed that those sections of Areas 1 and 3 within the Proposed Disturbance Area are likely to have isolated finds and artefact scatters associated with the creeklines; however these sites are likely to be in a highly disturbed context and have the potential for only low numbers of artefacts in a sub-surface context. The section of Area 2 within the Proposed Disturbance Area is assessed as likely to have artefact scatters and isolated finds with the potential to have moderate numbers of artefacts in a sub-surface context. Of the areas of the properties that fell outside the Proposed Disturbance Area, but within the Proposed Offset Areas, it is assessed that there is insufficient information to confidently predict the likely contents of Area 1 except to say that it is likely to have some value as an offset. Area 2 has a high potential for artefact scatter sites and isolated finds and for moderate and large numbers of artefacts in a sub-surface context. The section of

Area 3 is assessed as likely to have small numbers of isolated finds and artefact scatters and only very low numbers of artefacts in a sub-surface and highly disturbed context. All three sections of the properties that fall outside the Proposed Disturbance Area have value for incorporation into Proposed Offset Areas.

The modified area for the proposed rail loop has a high potential for isolated finds and artefact scatter sites with moderate to large assemblages in surface and/or a sub-surface context. Further survey will be carried out in consultation with the Aboriginal community, particularly focusing on the drainage lines, to confirm management outcomes for this area.

7.0 Geomorphic Investigations

During the survey period areas were noted that appeared to have complex geomorphic histories. A geomorphic assessment was arranged in order to more accurately recreate what these areas would have been like during their period of occupation by Aboriginal hunter-gatherers; and thus to better understand Aboriginal site distribution. Peter Mitchell of GroundTruth Consulting Pty Ltd accompanied Mary-Jean Sutton and Jillian Ford (Archaeologists, Umwelt) to visit the areas of interest on 6 March 2006. This section of the report provides a summary of the results of the geomorphic inspection and discusses how the results assist with explaining the site distribution pattern observed during the survey. The geomorphic inspection is also used to inform the management options presented in **Section 9** of this report. The full Geomorphic Assessment is included in **Appendix 10**. **Figure 7.1** indicates the locations discussed in the text.

7.1 Area 1 — Upper Catchment of Sandy Creek

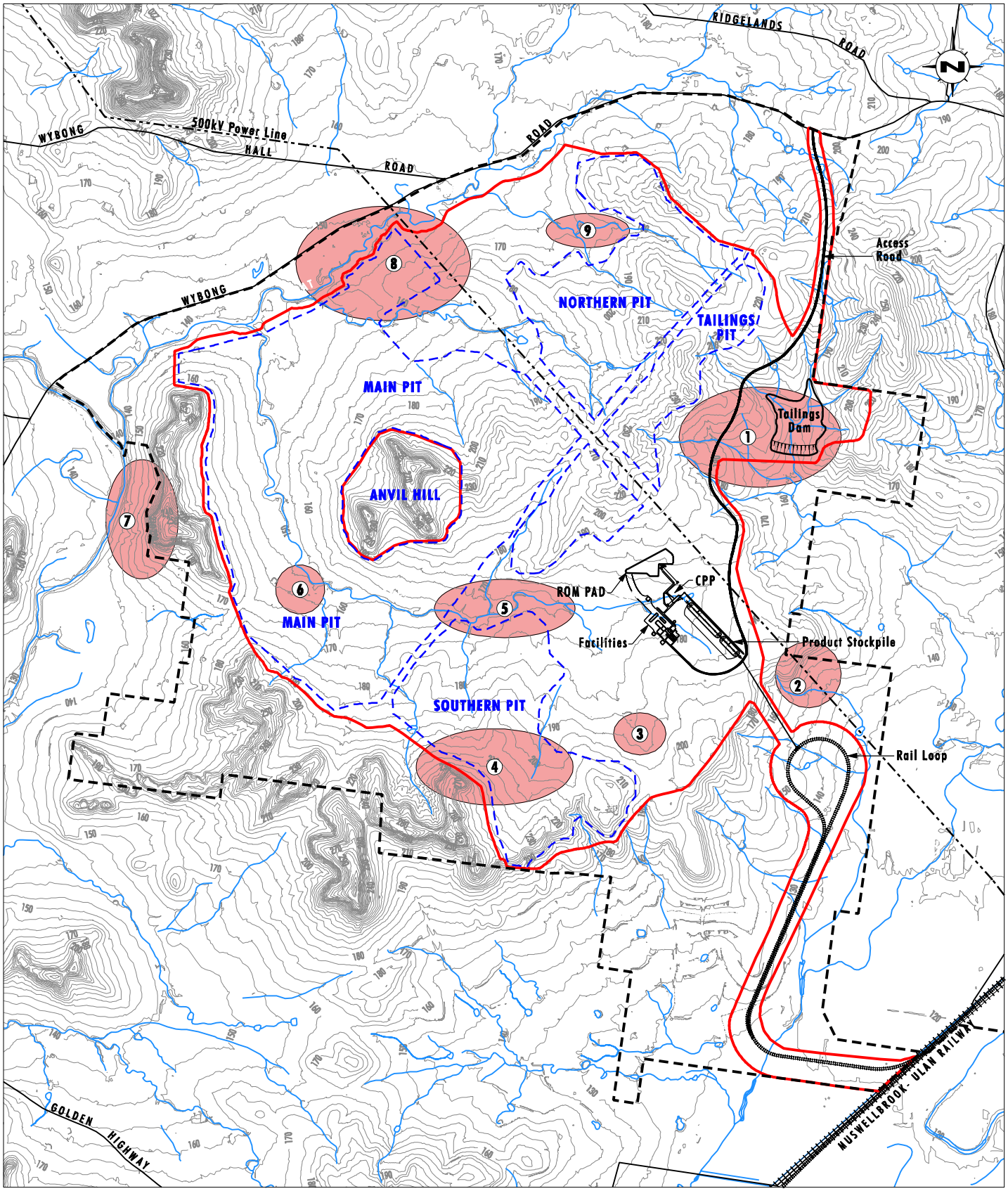
This area contains isolated find and artefact scatter sites SC6, SC7, SC8, SC9, SC11, SC12 and SC13. These sites are all located in the Riparian Corridor Terrain Unit and have between 1 and 10 artefacts. The area is described by Mitchell (2006: 6) as containing:

- wide, alluviated valleys containing shallow gravels over quartz and lithic sandstones;
- slope 3 to 5 degrees;
- regenerating vegetation;
- stony uniform cracking black clay profiles on creek flats;
- no evidence of buried soil profiles;
- shallow texture contrast soils on terraces and slopes;
- A-horizon sandy loam (higher sand content near rock outcrops);
- shallow uniform stony loams on higher slopes;
- sheet eroded to an average depth of 20 to 30 mm;
- minor rills to gullies 2 metres deep; and
- evidence extensive earthworks including gully shaping and armouring of banks with sandstone boulders.

Mitchell (2006: 6) concludes that any sites located in this area would have been ‘very damaged’ by European land use practises and subsequent erosion that the prospect for the ‘recovery of intact Aboriginal sites in Area 1 is low’. Thus no further geomorphological/archaeological investigation was recommended.

7.2 Area 2 – Lower Catchment of Sandy Creek

This area contains the SC10 artefact scatter site. This site is located in the Riparian Corridor Terrain Unit and has more than 300 surface artefacts. The site is on the lower slope immediately adjacent to the Hunter River floodplain.



Source: Mitchell (2006)
Base Map: Dept. of Lands (2003), Geospectrum (2004), Mine Consult (2005)
Note: Contour Intereval 5m

Legend

- Proposed Disturbance Area
- Project Area
- Proposed Mining Area
- Areas inspected for Geomorphological Investigation

FIGURE 7.1

Areas inspected for Geomorphological Investigation

The area is described by Mitchell (2006: 6) as:

- disturbed by sheet erosion;
- having high ground surface visibility;
- consisting of yellow brown texture contrast soils in the upslope areas and brown alluvial clay in the downslope areas;
- having evidence of very low amplitude gilgai micro-relief in the downslope areas (and outside the Proposed Disturbance Area) that may have provided attractive food resources after flooding.; and
- having no obvious signs of the creek having had a chain of ponds morphology.

Due to the degree of sheet erosion the site is highly unlikely to have intact artefactual material. Mitchell (2006: 8) concludes that this site could be 'preserved by small adjustments in the project layout'; and that 'further testing to define the site limits … [using] … a combination of grader scrapes and hand excavation would be appropriate' methods of determination.

7.3 Area 3 – Upper Tributary Anvil Creek

This area contains the AC34 artefact scatter site. The site is located in the Riparian Corridor Terrain Unit and contains small assemblage of three artefacts. The area is a poorly defined headwater of Anvil Creek.

The area is described by Mitchell (2006: 8) as containing:

- slope less than 1 degree; and
- shallow yellow texture contrast soil over cherty shale.

Mitchell (2006: 8) concludes that the 'shallow soil … and its location high in the catchment suggests that this area is unlikely to be archaeologically significant.'

7.4 Area 4 – Base of Limb of Addy Hill — Upper Anvil Creek Catchment

This area contains the AC16 isolated find site which is located in the Riparian Corridor Archaeological Terrain Unit. The area, near an abandoned quarry, was investigated as the soils report for the project (GSS Environmental 2006) suggested the area had deep sands. As deep sands could bury intact artefact scatters or even contain burials it was appropriate to have a geomorphic inspection of this area

The area is described by Mitchell (2006: 8) as containing:

- gravelly colluvium and in situ weathered conglomerate in the area of the site and quarry;
- a gravelly colluvial mantle that makes up the forested slope below the ridge and above the site; and

- no evidence of any sand sheet.

Mitchell (2006: 8) further notes that 'the forested area would have had high value for food and fibre resources … but the absence of water and stony ground suggest that it is unlikely that any important Aboriginal site is present …'

7.5 Area 5 – Central to Upper Reaches of Anvil Creek

This area contains 25 artefact scatters and isolated find sites all of which are located in the Riparian Corridor Archaeological Terrain Unit. Specifically this area contains the AC13 site formerly recorded by Russell (2002) as AH-1. In this area some of the geomorphic elements of the stream system were assessed by Mitchell (2006:9) as being 'reasonably intact'. The area is also described by Mitchell (2006:8) as having:

- low gradient;
- sub-circular depressions (12 to 25 metres in length and 3 to 5 metres wide) along the length of the channel (in this area), which are remnants of a 'chain of ponds' relating to pre-European times;
- a low terrace feature about 1 metre high grading back to the hillslope;
- a strongly developed harsh texture contrast soil profile;
- hard setting A-horizon;
- bleached A2-horizon over columnar yellow grey clay;
- artefacts eroding from the A2-horizon; and
- an old set of cattle yards and another indeterminate structure.

Mitchell (2006:9) suggests that the old structures indicate that early European graziers chose this site for its reliable water supply. For the same reason the area would have been a foci of Aboriginal occupation. Mitchell (2006:9) states:

> The Aboriginal sites along this part of the creek contain a relatively large number of artifacts and where they are seen to be eroding from the biomantle it is likely that more remain intact within the soil. The suspected presence of original ponds that can be identified and mapped provides a rare opportunity for a more detailed archaeological investigation that may reveal a great deal about Aboriginal activities at a central water source.

Mitchell (2006: 10) states that any archaeological investigation of this site (AC13) should be guided by prior detailed geomorphic mapping and stratigraphic analysis.

7.6 Area 6 – Anvil Creek Lower Reaches

This area contains one isolated find (AC36) and two artefact scatters (AC35 and AC37) containing between one and 56 artefacts, all of which are located in the Riparian Corridor Archaeological Terrain Unit. The area is described by Mitchell (2206: 12) as having:

- steeper gradient;
- eroded creek bed and banks;
- entrenchment of creek to 2.5 metres;
- bedload of fine gravel;
- an early 18th Century channel that has a shallow dished cross-section;
- a harsh texture contrast soil profile on the creek terrace;
- paper barks on the terrace indicating it is poorly drained and intermittently flooded; and
- the presence of ironstone nodules and cemented zones in the A2-horizon that confirm the poorly drained nature of the terrace.

Mitchell (2006:12) concludes that the poorly drained nature of this area would have meant it was not an area favoured for an Aboriginal camp site. No further geomorphic/archaeological investigation was thought warranted in this area.

7.7 Area 7 Wybong Creek – West of Wallaby Rocks

This area contains 27 isolated find and artefact scatter sites on the slope between Wallaby Rocks and the eastern side of Wybong Creek and the western and northern margins of Wallaby Rocks that contain six rockshelter sites. The area is described by Mitchell (2006:12) as having:

- near vertical cliffs of sandstone and conglomerate with numerous fretted hollows (rockshelters);
- cliffs with maximum relief of 80 m and steep colluvial (scree) slopes with large scattered boulders;
- concave slope that flattens out to where it merges with a high terrace along Wybong Creek;
- at midslope gravel mantle is 2.5 to 3 metres deep consisting of crudely bedded sandstone and conglomerate gravels;
- a sequence representing continuous accumulation of slope debris; and
- no evidence of buried soil surface or soil formation.

Mitchell (2006: 12) notes that the sites are outside the development impact area and thus will not be directly impacted and thus will not require further investigation. He also notes; however, that as the 'cliff line is strongly controlled by rock structure' that there is the potential for 'collateral damage' to the clifflines and the rockshelters they contain 'from blasting in the open cut.'

7.8 Area 8 Terrace - Big Flat Creek/Clarks Gully Confluence

This area contains numerous isolated find and artefact scatter sites containing between one and 77 artefacts on the banks of both Big Flat Creek and Clarks Gully and within the Riparian Corridor Archaeological Terrain Unit. The area is described by Mitchell (2006: 12) as having:

- artefacts eroding from the topsoil of a harsh texture contrast profile along the edge of the terrace;
- soil similar to the terraces of Anvil Creek with a hardsetting A-horizon over a strongly bleached A2-horizon;
- stream channel incised to 2 to 2.5 metres below estimated 19th century level;
- bed of stream contains post-European point bars and gravels;
- relic point bars of course sand also occur on the margin of the terraces as poorly defined levee which may contain artefactual material at shallow depth;
- some evidence that original channel had chain of ponds form that may have provided more reliable water for Aboriginal people;
- an example of a large pond in Clarks Gully just upstream of the confluence with Big Flat Creek; and
- evidence of a buried land surface within the wall of the large pond with a weakly developed topsoil and no visible artefacts.

Mitchell (2006: 14) notes that the majority of the sites are outside the development impact area and thus will not be directly impacted and thus will not require further investigation. He also notes; however, that in those areas to be impacted (including the area of the large pond on Clarks Gully and including sites CG04, CG05, CG06, CG12 to CG16) further archaeological investigation should be guided by detailed geomorphic mapping and interpretation of the soil stratigraphy. Grader scrapes were seen as an adequate method for the geomorphic study.

7.9 Area 9 Sormaz Gully - Big Flat Creek

This area contains numerous gullies associated with the upper reaches of Big Flat Creek. The area is described by Mitchell (2006: 14) as having:

- deep gully erosion;
- well developed harsh texture contrast soils above 3 metres of sandy colluvium over a base of weathered sandstone and conglomerate;
- the topsoil is hardsetting and strongly bleached;
- no buried soils or and surfaces; and
- steep gradients.

Mitchell (2006: 15) notes that there were no artefacts located in this area and that the area itself does not warrant any further investigation, due to the above characteristics.

7.10 Summary

Mitchell summarises his findings in relation to the artefact scatters and isolated finds as follows:

- the larger concentrations of artefacts are located in the vicinity of areas 2, 5, 7, and 8;
- these areas are on third order or higher streams;
- all have some supporting evidence of the original presence of ponds of permanent water;
- none have any evidence of older preserved land surfaces or buried soil profiles that might extend archaeological knowledge into the Pleistocene;
- if further archaeological work is to be undertaken it should be in these areas;
- based on earlier studies of texture contrast soils (Dean-Jones and Mitchell 1993), the sites are unlikely to retain stratigraphic integrity though some spatial integrity may remain;
- intact hearths or burials are the only means of accurately dating the artefact scatter and isolated find sites as the use of charcoal for dates or sediments for thermoluminescence dating will provide dates of a spurious nature. This is because there is no way of actually associating the artefacts (which are moving down through the soil profile and/or being exposed and reburied) with the material being dated; and
- further geomorphic investigation is warranted in the vicinity of Clarks Gully near the confluence with Big Flat Creek and in the area associated with the AC13 site and the SC10 site if it is to be impacted.

The results of the geomorphic investigation are taken into account in:

- **Section 8** in relation to the archaeological significance and research potential of the sites; and
- **Section 9** where management options for the sites are discussed.

The results will then form part of the basis for the management strategy prepared for the sites in **Section 10**.

8.0 Significance Assessment

Cultural heritage significance is a measure of the relative value or importance of heritage sites. Significance is assessed according to principles outlined originally in Australia in the Burra Charter (1979), which was adapted from the UNESCO sponsored ICOMOS (International Council for Monuments and Sites) Venice Charter. The assessment of significance assists in the determination of appropriate cultural heritage management procedures for sites/artefacts that may be threatened by development activities. Assessing the significance of Aboriginal archaeological sites is an extremely complicated process that must take into account the interests of many parties.

The Burra Charter defines cultural significance as the 'aesthetic, historic, scientific or social value for past, present or future generations' of a place. The NSW NPWS (1997 – now part of the DEC) provides further discussion on the assessment of cultural significance for Aboriginal sites, and for artefact scatter sites in particular. Categories of significance relevant to Aboriginal archaeological sites include Aboriginal significance, archaeological/scientific significance, aesthetic significance, tourism potential and educational significance. *The NSW NPWS Guidelines for Archaeological Report Writing* (1997: 25) states:

> While Aboriginal sites and places may have educational, tourism, and other values to groups in society their principle values are likely to be in terms of their cultural/social significance to Aboriginal people and their scientific significance to archaeologists. It is thus possible to identify two main streams in the overall significance assessment process: the assessment of cultural/social significance to Aboriginal people and the assessment of scientific significance to archaeologists.

Therefore, within this report the significance of the sites within the survey area will be assessed in relation to their Aboriginal significance and their scientific significance. The criteria for assessing each type of 'significance' will be detailed in the sections to follow. The scientific significance assessment of the sites recorded during the survey for this project and those previously recorded will be discussed and justifications for the significance ranking provided. Descriptions of the sites are provided in **Appendix 9** and the location of the sites is shown on **Figure 6.2**.

8.1 Aboriginal Cultural Significance

Table 8.1 was provided in a proforma to the Aboriginal stakeholder groups on 11 May 2006, during the presentation of the draft Aboriginal Archaeological Assessment for the Anvil Hill Project to allow the groups to rate the cultural significance of each site and to provide comments on each site. None of the 13 groups who provided comments chose to offer information on the cultural significance of individual sites. Therefore, it is not possible to rank individual sites by their Aboriginal cultural heritage significance. UAC, UHHC, WNAC, Yarrawalk, WLALC and WWCCS commented that all of the survey area is of high cultural heritage significance and the remaining seven groups (WC, MC, MCC, GC, UHWC, VC and LWTC) did not provide specific comment on the cultural significance of the survey area. The comments provided in **Table 8.1** are those provided during the survey only.

Table 8.1 - Aboriginal Significance of Sites

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
Anvil Creek Catchment				
AC01	Artefact Scatter	In	2	No comments provided during survey.
AC02	Isolated Find	In	1	Representatives from WLALC and ANTC regard axe heads as important rare finds.
AC03	Isolated Find	In	1	No comments provided during survey.
AC04	Isolated Find	In	1	No comments provided during survey.
AC05	Artefact Scatter	In	26	No comments provided during survey.
AC06	Artefact Scatter	In	5	No comments provided during survey.
AC07	Isolated Find	In	1	No comments provided during survey.
AC08	Artefact Scatter	In	8	No comments provided during survey.
AC09	Isolated Find	In	1	No comments provided during survey.
AC10	Isolated Find	In	1	No comments provided during survey.
AC11	Artefact Scatter	In	20	No comments provided during survey.
AC12	Artefact Scatter	In	19	No comments provided during survey.
AC13	Artefact Scatter	In	over 100	No comments provided during survey.
AC14	Isolated Find	In	1	No comments provided during survey.
AC15	Isolated Find	In	1	No comments provided during survey.
AC16	Isolated Find	In	1	No comments provided during survey.
AC17	Artefact Scatter	In	2	No comments provided during survey.
AC18	Isolated Find	In	1	No comments provided during survey.
AC19	Isolated Find	Out	1	No comments provided during survey.
AC20	Isolated Find	In	1	No comments provided during survey.
AC21	Isolated Find	In	1	No comments provided during survey.
AC22	Isolated Find	In	1	No comments provided during survey.
AC23	Artefact Scatter	In	2	No comments provided during survey.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
AC24	Isolated Find	In	1	No comments provided during survey.
AC25	Isolated Find	In	1	No comments provided during survey.
AC26	Isolated Find	In	1	No comments provided during survey.
AC27	Isolated Find	In	1	No comments provided during survey.
AC28	Artefact Scatter	In	1	No comments provided during survey.
AC29	Isolated Find	In	1	No comments provided during survey.
AC30	Artefact Scatter	In	14	No comments provided during survey.
AC31	Artefact scatter	In	2	No comments provided during survey.
AC32	Artefact scatter	In	3	No comments provided during survey.
AC33	Artefact scatter	In	10	No comments provided during survey.
AC34	Artefact scatter	In	3	No comments provided during survey.
AC35	Artefact scatter	In	2	No comments provided during survey.
AC36	isolated find	In	1	No comments provided during survey.
AC37	Artefact scatter	In	56	No comments provided during survey.
AC38	Rock shelter with isolated find and potential deposit	Out	1	No comments provided during survey.
AC39	Artefact scatter	In	2	No comments provided during survey.
AC40	Artefact scatter	In	13	No comments provided during survey.
AC41	Artefact scatter	In	4	No comments provided during survey.
AC42	Shelter with Isolated Find and PAD	Out	1	No comments provided during survey.
AC43	Artefact scatter	In	2	No comments provided during survey.
AC44	Isolated find	In	1	No comments provided during survey.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
Big Flat Creek Catchment				
BFC01	Artefact Scatter	Out	4	No comments provided during survey.
BFC02	Isolated Find	In	1	No comments provided during survey.
BFC03	Isolated Find	Out	1	No comments provided during survey.
BFC04	Isolated Find	Out	1	No comments provided during survey.
BFC05	Isolated Find	Out	1	No comments provided during survey.
BFC06	Isolated Find	Out	1	No comments provided during survey.
BFC07	Isolated Find	Out	1	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC08	Artefact Scatter	Out	3	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC09	Artefact Scatter	Out	9	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC10	Artefact Scatter	Out	10	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC11	Artefact Scatter	Out	14	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC12	Rock shelter with deposit	Out	20	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC13	Isolated Find	In	1	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC14	Artefact Scatter	Out	2	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
BFC15	Artefact Scatter	Out	4	No comments provided during survey.
BFC16	Isolated Find	Out	1	No comments provided during survey.
BFC17	Artefact Scatter	Out	3	No comments provided during survey.
BFC18	Artefact Scatter	Out	3	No comments provided during survey.
BFC19	Artefact Scatter	Out	32	No comments provided during survey.
BFC20	Isolated Find	Out	1	No comments provided during survey.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
BFC21	Isolated Find	Out	1	No comments provided during survey.
BFC22	Isolated Find	Out	1	No comments provided during survey.
BFC23	Isolated Find	Out	3	No comments provided during survey.
BFC24	Artefact Scatter	Out	4	No comments provided during survey.
BFC25	Artefact Scatter	Out	5	No comments provided during survey.
BFC26	Artefact Scatter	Out	2	No comments provided during survey.
BFC27	Isolated Find	Out	1	No comments provided during survey.
BFC28	Artefact Scatter	Out	4	No comments provided during survey.
BFC29	Artefact Scatter	Out	4	No comments provided during survey.
BFC30	Artefact Scatter	In	22	No comments provided during survey.
BFC31	Artefact Scatter	Out	77+	No comments provided during survey.
BFC32	Artefact Scatter	Out	6	No comments provided during survey.
BFC33	Artefact Scatter	Out	2	No comments provided during survey.
BFC34	Artefact Scatter	Out	2	No comments provided during survey.
BFC35	Isolated Find	Out	1	No comments provided during survey.
BFC36	Isolated Find	Out	2	No comments provided during survey.
BFC37	Isolated Find	In	1	No comments provided during survey.
BFC38	Artefact Scatter	Out	9	No comments provided during survey.
BFC39	Artefact Scatter	Out	12	No comments provided during survey.
BFC40	Artefact Scatter	Out	7	No comments provided during survey.
BFC41	Isolated Find	Out	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC42	Artefact Scatter	Out	2	UAC said that every artefact and site is of high significance: there is no such thing as low significance.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
BFC43	Artefact Scatter	Out	2	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC44	Isolated Find	In	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC45	Artefact Scatter	In	5	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC46	Isolated Find	In	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC47	Artefact Scatter	In	40+	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC48	Artefact Scatter	In	2	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
BFC49	Artefact scatter	Out	4	No comments provided during survey
Clarks Gully Catchment				
CG01	Rock shelter with deposit	Out	3	High significance.
CG02	Isolated Find	In	1	No comments provided during survey.
CG03	Artefact Scatter	In	3	No comments provided during survey.
CG04	Isolated Find	In	1	No comments provided during survey.
CG05	Artefact Scatter	In	5	No comments provided during survey.
CG06	Isolated Find	In	1	No comments provided during survey
CG07	Isolated Find	In	1	No comments provided during survey.
CG08	Rock shelter with isolated find and potential deposit	Out	1	Shelters are of high significance to the Aboriginal community – representatives of UHHC were present during recording.
CG09	Rock shelter with deposit	Out	0	Shelters are of high significance to the Aboriginal community – representatives of UHHC were present during recording. This shelter has PAD and is adjacent to a shelter which contains artefacts.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
CG10	Rock shelter with deposit	Out	7	Shelters are of high significance to the Aboriginal community – representatives of UHHC were present during recording. This shelter has PAD and is adjacent to a shelter which contains artefacts.
CG11	Isolated Find	Out	1	No comments provided during survey.
CG12	Artefact Scatter	In	7+	No comments provided during survey.
CG13	Artefact Scatter	In	4	No comments provided during survey.
CG14	Artefact Scatter	In	9	No comments provided during survey.
CG15	Artefact Scatter	In	4	No comments provided during survey.
CG16	Artefact Scatter	In	6	Comment supplied that the entire creek bank both sides has the potential to contain sub-surface artefact or surface artefact which cannot be seen because of poor visibility.
CG17	Isolated find	In	1	No comments provided during survey
CG18	Artefact Scatter	In	Over 50	No comments provided during survey.
Sandy Creek				
SC01	Isolated Find	Out	1	No comments provided during survey.
SC02	Artefact Scatter	Out	4	No comments provided during survey.
SC03	Artefact Scatter	Out	8	No comments provided during survey.
SC04	Isolated Find	Out	1	No comments provided during survey.
SC05	isolated find	In	1	No comments provided during survey.
SC06	Artefact scatter	In	4	No comments provided during survey.
SC07	Artefact scatter	In	4	No comments provided during survey.
SC08	Artefact scatter	In	10	No comments provided during survey.
SC09	Isolated find	In	1	No comments provided during survey.
SC10	Artefact scatter	Out	300+	No comments provided during survey.
SC11	Isolated find	In	1	No comments provided during survey.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
SC12	Artefact scatter	In	2	No comments provided during survey.
SC13	Isolated find	In	1	No comments provided during survey.
SC14	Artefact scatter	In	19	No comments provided during survey.
Wybong Creek				
WC01	Artefact Scatter	Out	13	No comments provided during survey.
WC02	Artefact Scatter	Out	22	Representatives of WWCCS commented on importance of worked shell and the beauty of the area.
WC03	Artefact Scatter	Out	3	No comments provided during survey.
WC04	Artefact Scatter	Out	3	No comments provided during survey.
WC05	Rock shelter with deposit	Out	2	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC06	Artefact Scatter	Out	2	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC07	Isolated Find	Out	I	No comments provided during survey.
WC08	Artefact Scatter	Out	21+	No comments provided during survey.
WC09	Artefact Scatter	Out	11	No comments provided during survey.
WC10	Isolated Find	Out	1	No comments provided during survey.
WC11	Isolated Find	Out	1	No comments provided during survey.
WC12	Isolated Find	Out	1	No comments provided during survey.
WC13	Isolated Find	Out	1	No comments provided during survey.
WC14	Artefact Scatter	Out	2	No comments provided during survey.
WC15	Artefact Scatter	Out	2	No comments provided during survey.
WC16	Isolated Find	Out	1	No comments provided during survey.
WC17	Artefact Scatter	Out	2	No comments provided during survey.
WC18	Artefact Scatter	Out	2	No comments provided during survey.
WC19	Isolated Find	Out	1	No comments provided during survey.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
WC20	Artefact Scatter	Out	32	No comments provided during survey.
WC21	Artefact Scatter	Out	190+	No comments provided during survey.
WC22	Artefact Scatter	Out	3	No comments provided during survey.
WC23	Isolated Find	Out	1	No comments provided during survey.
WC24	Isolated Find	Out	1	No comments provided during survey.
WC25	Rock shelter with deposit	Out	4	Representatives of UHWC and UAC all value rock shelters and see them as very important places.
WC26	Rock shelter with deposit	Out	1	Representatives of UHWC and UAC all value rock shelters and see them as very important places.
WC27	Rock shelter with deposit	Out	4	Representatives of UHWC and UAC all value rock shelters and see them as very important places.
WC28	Isolated Find	Out	1	No comments provided during survey.
WC29	Isolated Find	Out	1	No comments provided during survey.
WC30	Isolated Find	Out	1	No comments provided during survey.
WC31	Isolated Find	Out	1	No comments provided during survey.
WC32	Artefact Scatter	Out	4	No comments provided during survey.
WC33	Shelter with Artefact Scatter and PAD	Out	50+	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC34	Isolated Find	Out	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC35	Artefact Scatter	Out	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC36	Isolated Find	Out	1	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC37	Artefact Scatter	Out	6	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC38	Artefact Scatter	Out	2	UAC said that every artefact and site is of high significance: there is no such thing as low significance.

Table 8.1 - Aboriginal Significance of Sites (cont)

Site Number	Site type	In/out Proposed Disturbance Area	Number of artefacts	Comments provided during the survey
WC39	Artefact Scatter	Out	2	UAC said that every artefact and site is of high significance: there is no such thing as low significance.
WC40	Isolated Find	Out	1	No comments provided during survey.
WC41	Artefact Scatter	Out	2	No comments provided during survey.
WC42	Artefact Scatter	Out	5	No comments provided during survey.
WC43	Rock shelter with deposit	Out	2	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC44	Isolated Find	Out	1	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC45	Rock shelter with deposit and isolated find	Out	6	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC46	Rock shelter with deposit	Out	39+	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place.
WC47	Rock shelter with deposit	Out	32	Representatives of HVAC remarked about the significance of Wallaby Rocks as an important place. This shelter was also important due to rarity of worked shell, shell fragments and the presence of backed blades.
WC48	Isolated Find	Out	1	No comments provided during survey.

8.2 Archaeological or Scientific Significance

The archaeological significance of Aboriginal sites is assessed according to their value to contribute to the scientific/archaeological understanding of Aboriginal culture. This is generally termed their archaeological research potential.

8.2.1 Archaeological/Scientific Significance Assessment

The archaeological or scientific significance of Aboriginal sites was assessed according to their value to contribute to furthering of the archaeological/scientific understanding of Aboriginal culture (their archaeological research potential). Six criteria were assessed for each site to deduce its archaeological research potential from a local and regional perspective. These criteria were:

- rarity;
- representativeness;

- integrity;
- connectedness;
- complexity; and
- potential for archaeological deposit.

8.3 Ranking of Criteria for Evaluating Archaeological Significance

Table 8.2 indicates how the sites were evaluated in relation to each of the six criteria to assess their overall archaeological research potential. Following the table, the criteria are discussed and justification is provided for the assessment of particular levels of significance for each of the sites. The sites were afforded a numerical value for each significance criterion so that an overall significance assessment could be quantified. The values for each criterion were scored as follows:

- low significance was afforded a score of 1;
- moderate significance was afforded a score of 2; and
- high significance was afforded a score of 3.

Overall significance was scored as follows:

- low significance 12-15;
- low to moderate significance 16-19;
- moderate significance 20-23;
- moderate to high significance 24-27; and
- high significance 27+.

If a site was assessed to have low local significance (when compared to other sites within a 5 kilometre radius) for any criterion then this aspect of the site was also deemed to be low at the regional level. If, however, the site was assessed as having moderate or high archaeological significance on a local scale, it was then assessed against other sites known from the literature in the broader Hunter Valley area. In most cases this resulted in the site having lower significance on a regional level.

Table 8.2 - Criteria used in evaluating Archaeological Significance

Criterion	Low (Score of 1)	Moderate (Score of 2)	High (Score of 3)
Rarity	The location of the site within the landscape, its type, integrity, contents and/or potential for sub-surface artefacts, are common within the local and regional context.	The location of the site within the landscape, its type, integrity, contents and/or potential for sub-surface artefacts, are common within the regional context but not the local context.	The location of the site within the landscape, its type, integrity, contents and/or potential for sub-surface artefacts, are rare within the local and regional context.
Representativeness	This site, when viewed in relation to its type, contents, integrity and location in the landscape, is common within a local and regional context and sites of similar nature (or in better condition) are already set aside for conservation within the region.	This site, when viewed in relation to its type, contents, integrity and location in the landscape, is uncommon within a local context but common in a regional context and sites of similar nature (or in better condition) are already set aside for conservation within the region.	This site, when viewed in relation to its type, contents, integrity and location in the landscape, is uncommon within a local and regional context and sites of similar nature (or in better condition) are not already set aside for conservation within the locality or region.
Integrity	Stratigraphic integrity of the site has clearly been destroyed due to major disturbance/loss of topsoil. The level of disturbance is likely to have removed all spatial and chronological information.	The site appears to have been subject to moderate levels of disturbance, however, there is a moderate possibility that useful spatial information can still be obtained from sub-surface investigation of the site, even if it is unlikely that any useful chronological evidence survives.	The site appears relatively undisturbed and there is a high possibility that useful spatial information can still be obtained from sub-surface investigation of the site, even if it is still unlikely that any useful chronological evidence survives. (In cases where both spatial and chronological evidence is likely to survive the site will gain additional significance from high scores for rarity and representativeness).
Connectedness	There is no evidence to suggest that the site is connected to other sites in the local area or the region through: – their chronology (rarely known); – their site type (e.g. connectedness could be argued between an axe quarry, a nearby set of axe grinding grooves and an adjacent site exhibiting evidence of axe reduction);	There is some evidence to suggest that the site is connected to other sites in the local area or the region through: – their chronology (rarely known); – their site type (e.g. connectedness could be argued between an axe quarry, a nearby set of axe grinding grooves and an adjacent site exhibiting evidence of axe reduction);	There is good evidence to support the theory that the site is connected to other sites in the local area or the region through: – their chronology (rarely known); – their site type (e.g. connectedness could be argued between an axe quarry, a nearby set of axe grinding grooves and an adjacent site exhibiting evidence of axe reduction);

Table 8.2 - Criteria used in evaluating archaeological significance (cont)

Criterion	Low (Score of 1)	Moderate (Score of 2)	High (Score of 3)
Connectedness (cont)	– by the use of an unusual raw material, knapping technique/reduction strategy; – similar designs/motifs in the case of art sites and engravings; and/or – information provided by Aboriginal oral history.	– by the use of an unusual raw material, knapping technique/reduction strategy; – similar designs/motifs in the case of art sites and engravings; and/or – information provided by Aboriginal oral history.	– by the use of an unusual raw material, knapping technique/reduction strategy; – similar designs/motifs in the case of art sites and engravings; and/or – information provided by Aboriginal oral history.
Complexity	The site does not exhibit and is not predicted to contain either of the following in a sub-surface context: – a complex assemblage of stone artefacts in terms of artefact types and/or raw materials (including use of local and imported raw materials) and/or knapping techniques/reduction strategies; and/or – features such as hearths or heat treatment pits, activity areas.	The site exhibits or can be predicted to contain one of the following in a sub-surface context: – a complex assemblage of stone artefacts in terms of artefact types and/or raw materials and/or knapping techniques/reduction strategies and/or use of local and imported raw materials; and/or – features such as hearths or heat treatment pits, activity areas.	The site exhibits or can be predicted to contain both of the following in a sub-surface context: – a complex assemblage of stone artefacts in terms of artefact types and/or raw materials and/or knapping techniques/reduction strategies and/or use of local and imported raw materials; and – features such as hearths or heat treatment pits, activity areas.
PAD	The site does not have or has only a low potential to contain sub-surface archaeological material that has stratigraphic integrity or is of a nature that suggests its sub-surface investigation would assist with answering questions of contemporary archaeological interest or that indicate it should be preserved for its future research potential.	The site has a moderate potential to contain sub-surface archaeological material that has stratigraphic integrity or is of a nature that its sub-surface investigation would assist with answering questions of contemporary archaeological interest or that indicate it should be preserved for its future research potential.	The site has a high potential to contain sub-surface archaeological material that has stratigraphic integrity or is of a nature that its sub-surface investigation would assist with answering questions of contemporary archaeological interest or that indicate it should be preserved for its future research potential.

8.3.1 Rarity

The scientific significance of a site is assessed as higher if it is perceived as unique or rare within the local area and/or within the region. This rarity may relate to the type of site, the age of the site, the location of the site in the landscape, the preservation of the site (undisturbed sites are rare), the nature of the site contents (it may contain artefact types or reduction strategies that are unknown or not well represented in other sites; it may contain raw material types or mixes of raw material types that are not usually found in sites or are unusually informative of Aboriginal resource use in that area, it may contain hearths or other features rarely preserved in sites).

The majority of artefact scatters and isolated finds (AC01, AC03, AC04, AC06 to AC12, AC14 to AC17, AC19 to AC36, AC40, AC41, AC43 to AC44, BFC01 to BFC06, BFC14 to BFC25, BFC27 to BFC29, BFC31 to BFC49, CG02, CG04 to CG07, CG16 to CG18, SC03, SC05, SC07, SC11, SC13, WC03 to WC04, WC06 to WC20, WC22 to WC24, WC28 to WC32, WC34 to WC42) recorded within the survey area are assessed as having low archaeological significance for rarity in a local and regional context. This assessment was based on the following factors:

- they are artefact scatters and/or isolated finds which are the most common site types in the local area and the region;
- they contain similar artefact types and raw material types as other sites in the local area and the region;
- their location within the landscape (along watercourses) is typical of sites in the local area and the region;
- their poor condition (due to a mix of land clearance, pastoralism, ongoing erosion and bioturbation) is typical of the sites in the local area and the region; and
- similar sites are presently conserved within existing Heritage Management Zones or Conservation Areas in the Upper Hunter (for example the Loders Creek Conservation Areas (Bulga Open Cut Mine), the Bulga Underground Mine Conservation Area (Bulga Underground Mine), the Saddlers Creek Conservation Area (Bayswater No. 3), the McLeans Hill Heritage Management Zone (Mount Arthur North Mine) and the Yorks Creek Conservation Area (Mt Owen Mine).

Artefact scatters and isolated finds AC02, AC05, AC37, AC39, BFC13, BFC26, BFC30, CG03, CG11 to CG15, SC01, SC02, SC04, SC06, SC08, SC09, SC12, SC14, WC01, WC44 and WC48 are assessed as having moderate archaeological significance for rarity within a local context and low archaeological significance for rarity within a regional context. BFC07 to BFC11 are assessed as having moderate archaeological significance for rarity within a local and regional context. These assessments are based on the following factors:

- the sites are located within landforms which are rarer in the local context and in the case of BFC07 to BFC11 in the regional context; and/or
- they are assessed as retaining a slightly higher degree of integrity (as they are less disturbed by European land use activities) than the majority of the sites locally and in the case of BFC07 to BFC11 in the regional context; and/or
- they contain rarer artefact types such as axes (ACO2).

Artefact scatters and isolated finds AC18, SC10 and WC21 are assessed as having high archaeological significance for rarity in a local context and low archaeological significance for rarity on a regional context. These assessments are based on the following factors:

- the sites are located within landforms that are rarer in the local context and/or regional context (isolated find AC18 was located on the scree slope); and/or
- they retain a relatively higher degree of integrity (as they are less disturbed by European land use activities) than other sites in similar landform contexts (sections of AC13 have been buried by colluvium and/or alluvium; WC21 is in an area of deep alluvial deposit at the confluence of Wybong Creek and Big Flat Creek and may retain some integrity below the cultivation zone); and/or
- they retain artefact types and raw material types that are relatively rare to very rare in the local and regional context (SC10 contains multiple core tools and multiple artefacts manufactured from chalcedony and chert).

Artefact scatter site AC13 is assessed as having high archaeological significance for rarity in a local context and moderate archaeological significance for rarity in regional context. WC02 is assessed having high archaeological significance for rarity on both a local and regional scale. These assessments are based on the following factors:

- they are a much larger sites in terms of areal extent and artefact numbers than predicted for the site location (AC13 is a very large artefact scatter site located in the upper tributary system where it was not expected from the predictive model); and/or
- they have the potential for a higher density artefact scatter in a sub-surface context than predicted (AC13); and/or
- they retain artefact types that are rare in the local and regional context (WC02 contains worked [modified for use as a tool] freshwater mussel shell which is previously unrecorded in the Upper Hunter region).

All 16 rockshelter sites with artefact(s) and PAD (AC38, AC42, BFC12, CG01, CG08, CG09, CG10, WC05, WC25, WC26, WC27, WC33, WC43, WC45, WC46, WC47) are assessed as having high archaeological significance for rarity within a local and regional context. This assessment is based on the following factors:

- there are no previously recorded rockshelter sites within a 5 kilometre radius of the project area; and
- there is only one previously recorded rockshelter site (#37-2-0142) within a 15 kilometre radius of the project area.

In reality there is a high probability that there are many more rockshelter sites with evidence of Aboriginal occupation within the local conglomerate outcrops within numerous of the landholdings in the Wybong, Sandy Hollow and Denman area; however, as they are not currently recorded on the DEC/AHIMS site register they cannot be taken into account within this assessment for rarity.

8.3.2 Representativeness

One of the aims of cultural heritage management is to ensure that a representative sample of sites is preserved for future generations. The objective is to preserve a sample of every type of site in the range of landscapes in which they occur to provide for future research that may

have different research agendas than those of the contemporary Aboriginal and archaeological community.

Isolated finds and artefact scatters AC01 to AC12, AC14 to AC17, AC19 to AC20, AC22 to AC37, AC39 to AC41, AC44 to AC44, BFC1 to BFC11, BFC13 to BFC18, BFC20 to BFC25, BFC27, BFC32 to BFC33, BFC35 to BFC39, BFC41 to BFC49, CG02, CG04 to CG07, CG11 to CG17, SC01 to SC09, SC11 to SC14, WC03 to WC04, WC06 to WC20, WC22 to WC24, WC28 to WC32, WC34 to WC42, WC44 are assessed as having low archaeological significance for representativeness within a local and regional context. This assessment is based on the following factors:

- they are common site types;
- they are located in terrain units where sites are common;
- the disturbed nature of many of the sites and the disturbed nature of their environs precludes artefacts occurring in a stratigraphic context; and
- similar sites are presently conserved within existing Heritage Management Zones or Conservation Areas in the Upper Hunter (for example the Loders Creek Conservation Areas (Bulga Open Cut Mine), the Bulga Underground Mine Conservation Area (Bulga Underground Mine), the Saddlers Creek Conservation Area (Bayswater No. 3), the McLeans Hill Heritage Management Zone (Mount Arthur North Mine) and the Yorks Creek Conservation Area (Mt Owen Mine).

Isolated finds and artefact scatters AC18, AC21, BFC19, BFC26, BFC28 to BFC31, BFC34, BFC40, CG03, CG18, WC01 and WC48 are assessed as having moderate archaeological significance for representativeness in a local context and low archaeological significance within a regional context. This assessment is based on the following factors:

- they are located in terrain units where sites are not common locally;
- the sites indicate a representative sample of Aboriginal occupation across the local landscape in landform elements where ground surface visibility was poor; and
- similar sites are conserved in similar terrain units in conservation areas and heritage management zones within the region.

Artefact scatters SC10 and WC21 are assessed as having high archaeological significance for representatives within a local context and low archaeological significance for representatives within a regional context. This assessment is based on the following factors:

- the sites contain rarer artefact types/and or use of more unusual raw materials for artefact production (SC10); and/or
- the sites have are assessed as having slightly greater potential for sub-surface artefacts that retain stratigraphic integrity (WC21); and/or
- similar sites are not conserved within similar terrain units in conservation areas and heritage management zones within the region (SC10 is located at the boundary of the ecotone between the lower slope/footslopes associated with Sandy Creek and the floodplain of the Hunter River).

Artefact scatter site AC13 is assessed as having high archaeological significance for representativeness within a local context and moderate archaeological significance for

representativeness within a regional context. Artefact scatter site WC02 is assessed as having high archaeological significance for representativeness within a local and regional context. This assessment is based on the following factors:

- it is a much larger site in terms of areal extent and artefact numbers than predicted for the site location (AC13 is a very large artefact scatter site located in the upper tributary system where it was not expected from the predictive model);
- it has the potential for a higher density artefact scatter in a sub-surface context than predicted (AC13); and
- it retains artefactual material that are rare in the local and regional context (WC02 contains worked [modified for use as a tool] freshwater mussel shell which is previously unrecorded in the Upper Hunter region).

All 16 rockshelter sites with artefact(s) and PAD (AC38, AC42, BFC12, CG01, CG08, CG09, CG10, WC05, WC25, WC26, WC27, WC33, WC43, WC45, WC46, WC47) are assessed as having high archaeological significance for representativeness within a local and regional context. This assessment is based on the following factors:

- they represent a previously unrecorded site type within a 5 kilometre radius of the project area;
- they represent a site type only recorded once (#37-2-0142) within a 15 kilometre radius of the project area;
- they each represent rockshelter types of varying dimensions, with varying aspects, varying contents and varying degrees of integrity;
- one rockshelter site (WC45) contains artefactual material (burnt shell, calcined bone) that is rare in sites locally and regionally; and
- one rockshelter site (WC47) contains worked shell previously unrecorded locally and regionally.

As mentioned above, there is a high probability that there are many more rockshelter sites with evidence of Aboriginal occupation within the local conglomerate outcrops within numerous of the landholdings in the Wybong, Sandy Hollow and Denman area; however, as they are not currently recorded on the DEC/AHIMS site register they cannot be taken into account within this assessment of representativeness.

8.3.3 Archaeological Integrity

The archaeological integrity or intactness of a site is important when assessing its significance and conservation value. A site that has been subject to minimal disturbance following its creation contains considerably more information about environmental change and/or cultural sequences than a similar site that has been disturbed by European land use practises, natural geomorphic processes, bioturbation and has been degraded by erosion.

Site integrity is assessed relative to the sites located locally and to known sites within management zones and conservation areas in the broader region. Site integrity is as assessed follows:

- Low integrity – Site and site area (including likely sub-surface deposits) has been substantially disturbed (all or more than half of the predicted site area). Landscape context has been largely destroyed. Soil skeletal or A-horizon missing. Stratigraphic

integrity has been substantially disturbed/destroyed. Low to no likelihood of obtaining useful archaeological information from sub-surface investigation of the site.

- Medium integrity – Site and site area (including likely sub-surface deposits) has not been subject to cultivation but has been impacted to a moderate degree by low grade disturbance from cattle trampling and low levels of erosion that impact up to half of the predicted site area. Landscape context is relatively intact. Stratigraphic integrity is likely to have been disturbed but there is a possibility that some useful archaeological information can still be obtained from sub-surface investigation of the site.

- High integrity – Site and site area (including likely sub-surface deposits) are relatively undisturbed. Landscape context is relatively intact. Stratigraphic integrity is likely to be relatively intact and it is likely that useful information can be obtained from sub-surface investigation of the site.

Within the survey area, many of the isolated finds and artefact scatters (AC01 to AC12, AC14 to AC35, AC40, AC41, AC43, AC44, BFC01 to BFC11, BFC25, BFC31 to BFC39, BFC41 to BFC49, CG02, CG04 to CG15, CG17, SC01 to SC04, SC07, SC10, SC11, SC13, WC28 to WC42, WC44 and WC48) and seven rockshelters (AC42, CG01, GCO8, GCO9, GCO10, WC33 and WC43) are assessed as having low archaeological significance for integrity within a local and regional context. This lack of integrity is due to factors such as disturbance by vegetation clearance, high levels of erosion, cultivation, construction of farm infrastructure such as dams and fences. In relation to the rockshelters the major cause of loss of integrity was trampling of the shallow deposits by sheep and goats.

Isolated finds with associated PAD (BFC27, SC05, SC09, WC010, WC11 and WC12) and artefact scatters with associated PAD (BFC26, BFC28, BFC29, BFC30, BFC40, GC03, GC16, CG18, SC06, SC08, SC12, WC01, WCO8 and WC09) are assessed as having moderate significance for archaeological integrity within a local context and low archaeological integrity within a regional context. In these sites the topsoil horizon was only partially eroded and though the stratigraphic integrity of the soil was likely to be disturbed it was assessed that some useful spatial information could be gathered from sub-surface investigation of these sites. When viewed in a regional context; however, there are many similar sites presently conserved in management zones and conservation areas.

One isolated find with associated PAD (AC36), four artefact scatters with associated PAD (AC13, AC37, AC39, WC21) and seven rockshelters with associated PAD (AC38, BFC12, WC05, WC25, WC26, WC27, WC46) are assessed as having moderate significance for archaeological integrity within a local and regional context. In the isolated find and artefact scatter sites the topsoil horizon was only partially eroded and, although the stratigraphic integrity of the soil was likely to be disturbed, it was assessed that some useful spatial information could be gathered from sub-surface investigation of these sites. Furthermore, when viewed in a regional context; there were only small numbers of similar sites presently conserved in management zones and conservation areas. In relation to the rockshelter sites there was sufficient deposit in the shelters that some may remain below the present disturbance zone that could retain archaeological integrity (or there were areas of the shelter where the deposits could still retain integrity). As there are no currently recorded rockshelter sites within known conservation areas or management zones within the Upper Hunter Region the ranking is the same regionally as locally.

No isolated finds or artefact scatters are assessed as having high archaeological significance for integrity with in a local or regional context due to prior disturbance. Two of the rockshelter sites with associated PADs (WC45 and WC47); however, are assessed as having high significance within a local and regional context. In both these sites it was assessed that there was sufficient depth of deposit below the current disturbance zone to preserve deposit with the potential for stratigraphic integrity.

Figure 8.1 indicates those sites as having some potential to retain some level of integrity.

8.3.4 Connectedness

Connectedness refers to the relationship between sites within an area. Connectedness can be considered in a number of ways, at a number of scales. In its broadest sense, 'connectedness' refers to patterns linking sites within an area. Connectedness is often difficult to ascertain as the chronological sequence of use of surface sites is unknown at this stage of their assessment. Thus connectedness must be related to other features of sites and/or their assemblages. Sites may appear connected due to their location within the landscape (for example a series of sites associated with a terrain unit or landform element) or because of the nature of their assemblages (for example the use of similar raw materials and reduction sequences aimed at producing similar implement types) or the nature of features within the sites (for example heat treatment pits, hearths, knapping floors). In some cases, it may be that a series of sites within an area relates to a number of different activities which are in fact all components of a single land use system (for example a stone quarry, a camp site at which reduction of that stone takes place, a sandstone outcrop on which that stone is ground). As mentioned above, the difficulty with assessing such an aspect of connectedness arises in demonstrating that all of the sites relate to the same period of time. While it is broadly possible to assign some artefacts to limited time periods (backed blades, Bondi points, eloueras, edge ground axes), these time periods still span thousands of years and the artefacts in question generally only represent a minor component of most assemblages and thus their presence cannot be used to make statements about the majority of the artefacts within any assemblage. Thus, the use of 'artefact types' to date surface assemblages remains too broad (e.g. 4000 years) to be useful in discussing the operation of a pattern of land use at any given time and to make judgments related to connectedness.

For this assessment, connectedness is assessed relative to the sites located locally and to known sites within management zones and conservation areas in the broader region. Site connectedness is as assessed follows:

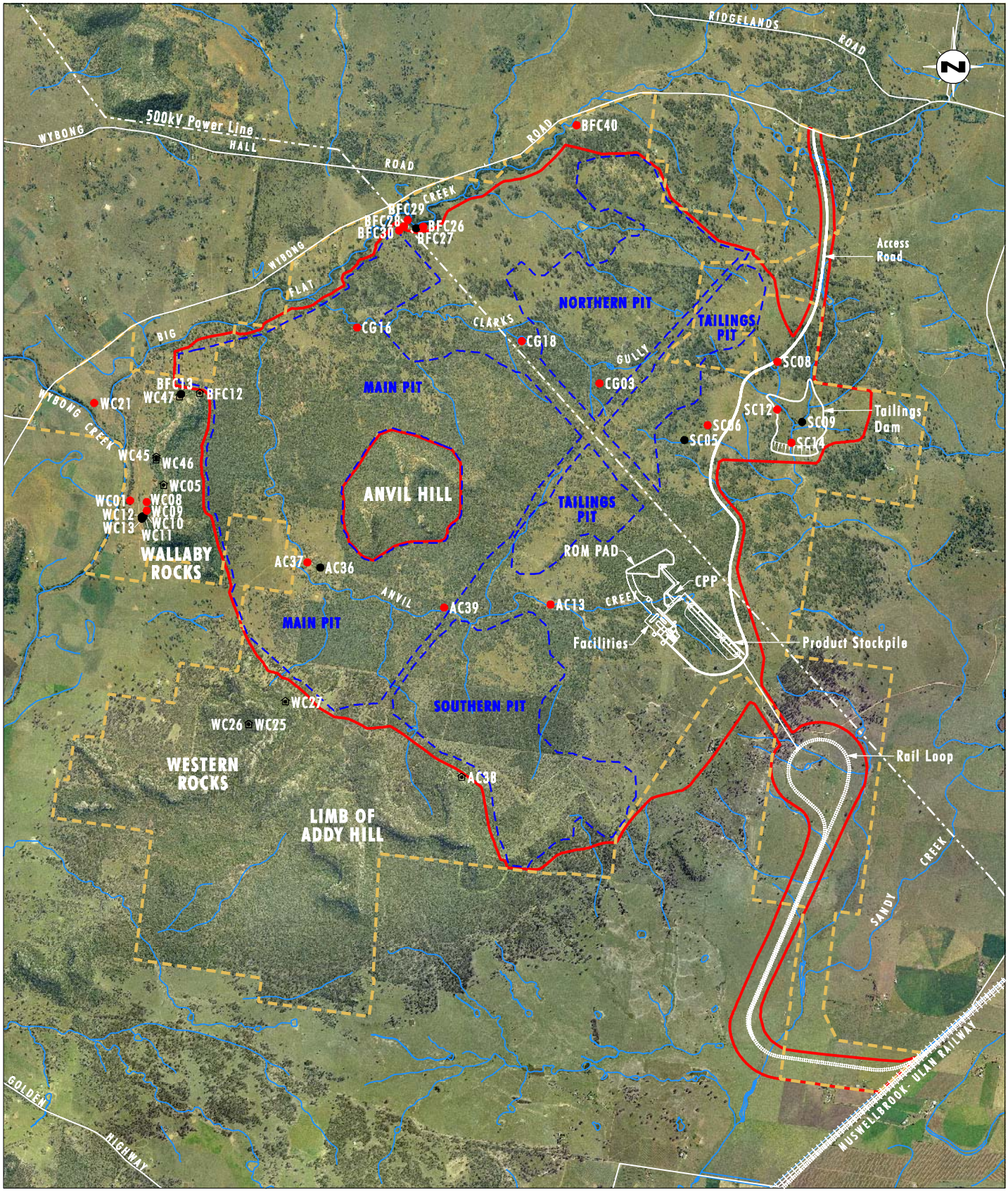
- connectedness is ranked as low if all the sites have in common with other sites is their location within the landscape and that they contain common artefact types, manufactured by common knapping methods from common raw materials;

- connectedness is ranked as moderate if the sites are located within a less common terrain unit (plateaus, in association with chains of ponds in the upper tributary system); and

- connectedness is ranked as high if the sites contain rare or unique artefactual material and appear connected though their location within the landscape (a rockshelter site above a slope that contains a site and both contain a rare artefactual material).

Within the survey area, most isolated finds and artefact scatters (AC01 to AC11, AC16 to AC20, AC22 to AC36, AC40 to AC41, AC43 to AC44, BFC01 to BFC06, BFC14 to BFC18, BFC20 to BFC23, BFC25, BFC32 to BFC33, BFC35 to BFC49, CG02 to CG07, CG12 to CG17, SC01 to SC03, SC05 to SC09, SC11 to SC14, WC04, WC14 to WC17, WC22 to WC24, WC28 to WC42, WC48) are assessed as having low significance for connectedness on both a local and regional scale.

Isolated finds and artefact scatters (AC12 to AC14, AC21, AC37, AC39, AC42, BFC07 to BFC11, BFC13, BFC19, BFC24, BFC26 to BFC31, BFC34, CG01, CG11, CG18, SC04, SC10, WC01, WC03, WC06 to WC13, WC18 to WC20 and WC44) are assessed as having moderate archaeological significance for connectedness within a local context and low archaeological significance for connectedness within a regional context.



Source: Mitchell (2006)
Base Map: Dept. of Lands (2003), Ortho-rectified by Plateau Images, Mine Consult (2005)

Legend

- Proposed Disturbance Area
- Survey Area
- Proposed Mining Area
- Artefact Scatter (Open Camp Site)
- Isolated Find
- Shelter with PAD

FIGURE 8.1

Sites with Potential for retaining Archaeological Integrity

File Name (A4): R06_V1/1858_361.dgn

Rockshelter sites AC38, AC42, CG01, CG08, GC09 and CG10 are assessed as having moderate archaeological significance for connectedness within a local and regional context.

Artefact scatters WC02 and WC21 and rockshelters BFC12, WC05, WC25 WC26, WC27, WC43, WC45 WC46 and WC47) were assessed as having high archaeological significance for connectedness within a local and regional context. Connectedness in this instance was related to the location of the sites in the landscape (plateaus, slopes, riparian corridor associated with Wybong Creek), plus a connection between the use of resources from Wybong Creek (freshwater mussel), the working of the freshwater mussel shells to make tools (WC02 and WC47), the use of the area of the Wybong Creek/Big Flat Creek confluence and the generally larger assemblages that suggest long term or repeated occupation of an area near reliable water.

8.3.5 Complexity

The complexity of a site is an indication of its ability to contribute information on the local Aboriginal culture. The complexity of a site may be indicated by the number and/or density of stone artefacts it contains, or by the range of raw materials, knapping methods, reduction strategies and/or features that occur within it. Features that may occur within a site include knapping floors, heat treatment pits, hearths or other items that do not fall within the description of a generalised scatter of flaked stone artefacts.

Isolated finds and artefact scatters AC01 to AC07, AC09 to AC11, AC14 to AC20, AC21 to AC37, AC39 to AC41, AC43, AC44, BFC01 to BFC11, BFC13 to BFC18, BFC20 to BFC25, BFC27, BFC32 to BFC39, BFC41 to BFC49, CG02 to CG07, CG11 to CG17, SC01 to SC09, SC11 to SC14, WC01, WC03, WC04, WC06 to WC07, WC09 to WC19, WC22 to WC24, WC26 to WC32, WC34 to WC42, WC44 and WC48) and rockshelters (AC38, AC42, CG01, CG08, CG09, WC26 WC27 and WC43) are assessed as having low archaeological significance for complexity within a local and regional context. This assessment is based on the following factors:

- the sites contain a very low number of artefacts and raw material types;
- freehand percussion is the only knapping method present and there are too few artefacts to investigate reduction strategies;
- there is little likelihood of there being sufficient artefacts in a sub-surface context to increase the complexity of the site; and
- the sites are so disturbed there is little or no likelihood of them retaining intact archaeological features.

Artefact scatter sites AC08, AC12, BFC19, BFC26, BFC28, BFC29, BFC30, BFC31, BFC40, CG18, WC08, WC20, and WC25 and rockshelter sites BFC12, CG10 are assessed as having moderate archaeological significance for complexity within a local context and low significance for complexity within a regional scale. This assessment is based on the following factors:

- the surface assemblages and nature of the sites indicated that there was a potential for a medium density scatter of artefacts in a relatively undisturbed sub-surface context; and/or
- the sites appeared to contain knapping floors that can be studied to gain a greater understanding of reduction strategies; and/or
- the sites contained a mix of both locally and imported raw materials.

Artefact scatter site WC02 and rockshelter sites WC05 and WC45 are assessed as having moderate archaeological significance for complexity within a local and regional context for the reasons outlined above. The upgrading to moderate of the regional significance assessment relates to the inclusion of the worked shell in WC02 and the potential for the deep deposits in the WC05 and WC45 rockshelters to contain a moderately complex sub-surface assemblage in what is a rare site type in the Upper Hunter Region.

Artefact scatter sites AC13, SC10 and WC21 and rockshelter site WC33 are assessed as having high significance for complexity on a local scale and moderate significance for complexity on a regional scale. This assessment is based on the following factors:

- Artefact scatter site AC13 has knapping floors of different raw materials that can be studied to gain a greater understanding of reduction strategies (including microblade production) and large numbers of artefact types and raw material types. It also has the potential to have a complex sub-surface assemblage.

- Artefact scatter site SC10 has large numbers of artefact types and raw material types and has the potential to retain a large number of sub-surface artefacts in a highly disturbed.(reworked) context.

- Artefact scatter site WC21 has large numbers of artefact types and raw material types. It also has the potential to have a complex sub-surface assemblage. The site is also predicted to contain intact deposit below the cultivation zone that may contain large numbers of artefacts.

- Rockshelter WC33 contains the largest rockshelter assemblage including artefacts manufactured from a wide variety of raw materials, primary, secondary and tertiary reduction, freehand percussion, bipolar reduction and evidence of blade manufacture. The shallow deposits within this shelter are also highly likely to have further artefacts albeit in a disturbed context.

Rockshelter sites WC46 and WC47 are assessed as having high significance for complexity within a local and regional context. The higher assessment is due to the sites exhibiting some or all of the following factors:

- the rockshelter contained evidence of occupation including surface stone artefacts, burnt and fragmented freshwater mussel shell (WC46);

- the rockshelter contained evidence of occupation including surface artefacts, calcined bone, fragmented shell and worked shell (WC47); and

- the rockshelter contained deep deposit with the potential for intact deposits below the current disturbance zone (WC46 and WC47).

8.3.6 Potential for Archaeological Deposit (PAD)

For a site to be able to contribute to an understanding of cultural sequences, it must contain distinguishable features or aspects that can be shown to have been created at different times within the context of that site or between sites. For such relationships to be possible the artefacts or features within the sites need to be located within a stratified context. It is also possible that a site may contain artefacts in a sub-surface context that may not remain in a stratified context, but that may by the investigation add to the knowledge of Aboriginal use of the landscape/resource base in a more general sense.

Most isolated find and artefact scatter sites (AC01 to AC04, AC06 to AC07, AC11, AC16 to AC37, AC39 to AC41, AC43, AC44, BFC01 to BFC11, BFC13 to BFC25, BFC27, BFC31 to BFC39, BFC41 to BFC49, CG02, CG04 to CG07, CG11, CG16 to CG17, SC01 to SC04, SC07, SC11, SC12, WC06 to WC07, WC14 to WC20, WC22 to WC24, WC28 to WC42, WC44 and WC48) and rockshelter sites (AC42, CG08, CG09 and WC43) are assessed as having low archaeological significance for PAD within a local and regional context due to the highly disturbed nature of the soil profile within the sites and the unlikelihood of them containing sub-surface in a stratified context, but that may by their investigation add to the knowledge of Aboriginal use of the landscape/resource base in a more general sense.

Isolated find and artefact scatter sites AC05, AC08 to AC10, AC12, AC14 to AC15, BFC26, BFC28 to BFC30, BFC40, CG03, CG12 to CG15, CG18, SC05 to SC06, SC08 to SC10, SC12, SC14, WC02, WC08 to WC13 and rockshelters CG01 and CG10 are assessed as having moderate archaeological potential for PAD within a local context and low archaeological significance for PAD within a regional context. The local moderate significance assessment is based on the potential of the sites to have sufficient sub-surface artefacts, some of which may retain some spatial integrity, that by their investigation they could add to the knowledge of Aboriginal use of the landscape/resource base in a more general sense. None of these sites are thought to retain the potential for moderate significance on a regional basis as many similar sites within management zones and conservation areas are assessed as having greater potential for PAD.

Artefact scatter sites AC38, WC01, WC03, WC04, and rockshelter sites BFC12, WC46 and WC47 are assessed as having moderate archaeological significance for PAD within a local and regional context. The local moderate significance assessment is based on the potential of the sites to have sufficient sub-surface artefacts, some of which may retain some spatial integrity that by the investigation could add to the knowledge of Aboriginal use of the landscape/resource base in a more general sense. These sites are thought to retain the potential for moderate significance on a regional basis as many similar sites within management zones and conservation areas are assessed as having less potential for PAD.

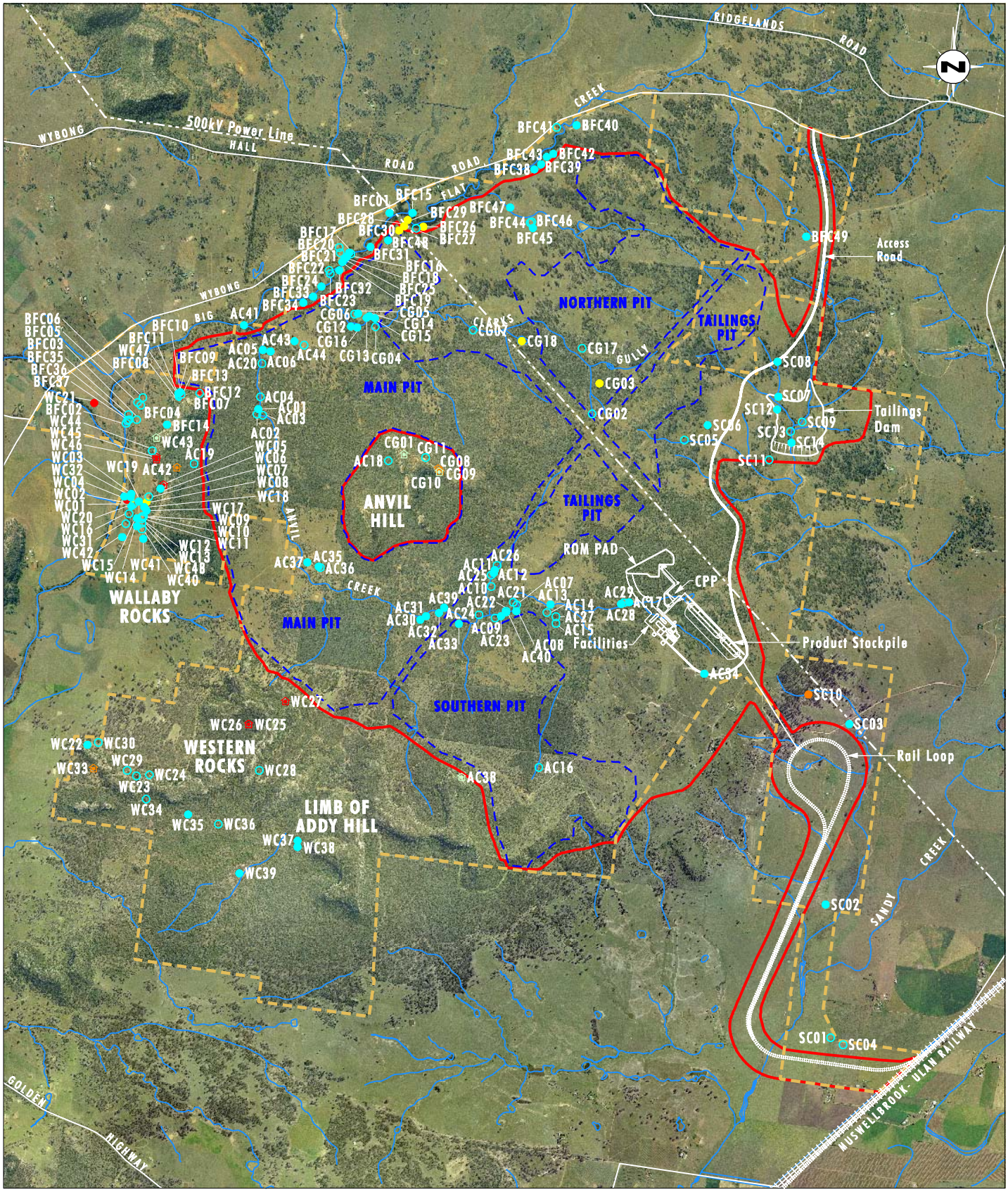
Artefact scatter site WC21 is assessed as having high archaeological significance for PAD within a local context and moderate archaeological significance for PAD within a regional context. The higher local significance for PAD is due to the depth of deposit which may allow for sub-surface artefacts in an undisturbed context below the current disturbance zone.

Artefact scatter site AC13 and rockshelter sites WC05, WC25, WC26, WC27 and WC45 are assessed as having high archaeological significance for PAD within a local and regional context. AC13 was afforded the higher ranking for PAD due to the high likelihood of a complex assemblage within a sub-surface context. The location of this site in the upper tributary system of Anvil Creek, in an area not predicted to have large and complex sites, adds to its significance within a regional context. The rockshelter sites were afforded high significance for PAD as they have a depth of deposit that provides the potential for stratified deposits below the current disturbance zone. If this proves to be correct, these sites (if investigated) could add significantly to our knowledge of the chronology of use of the landscape in this area and the Upper Hunter in general. As there are so few rockshelter sites recorded in the region their significance for PAD is also high in a regional context.

Table 8.3 summarises the archaeological significance assessment. **Figure 8.2** shows the overall archaeological significance of the sites.

8.3.7 Archaeological Research Potential

As mentioned in **Section 8.2.1**, the archaeological research potential of a site is based on an assessment of six criteria related to their:



Source: Mitchell (2006)
Base Map: Dept. of Lands (2003), Ortho-rectified by Plateau Images, Mine Consult (2005)

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Survey Area
- Proposed Mining Area
- Artefact Scatter (Open Camp Site)
- Isolated Find
- Shelter with PAD

Aboriginal Cultural Heritage Significance:

- Low
- Low to Moderate
- Moderate
- Moderate to High
- High

FIGURE 8.2

Archaeological Significance

- rarity;
- representativeness;
- integrity;
- connectedness;
- complexity; and
- potential for archaeological deposit.

Table 8.3 summarises the archaeological significance assessment of the 173 sites located within the survey area. Their overall significance assessment equates to their archaeological research potential which in turn relates to their ability to answer questions of relevance to the contemporary archaeological and Aboriginal community. Within the Hunter Valley research questions currently relate to topics such as antiquity of occupation, Aboriginal use of the landscape, how the use of the landscape was tied to resource availability and the technologies used for stone tool production.

All of the isolated finds and the majority of the artefact scatters are assessed as having low or low to moderate potential to answer contemporary research questions. This assessment is due to a combination of the following factors:

- their disturbed nature;
- their limited potential to retain sub-surface archaeological material in a stratified context;
- their limited potential to have large numbers of artefacts in a sub-surface context; and
- in relation to the isolated finds and artefact scatters, as they are located within terrain units and landform elements that are commonly found to contain artefacts in the Upper Hunter area (e.g. in areas of low gradient and near drainage lines) or which have already been subject to extensive sub-surface investigation in the region including recent work by Clarke and Kuskie (2004) for Mt Arthur North Mining Lease (Umwelt in prep.) and for Mt Owen and Glendell Open Cut Mines.

One artefact scatter (SC10) is assessed as having moderate research potential as it has:

- a large and complex assemblage; however,
- it does not retain any archaeological integrity.

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
	Local	Regional	Local	Regional	Local	Regional	Local	Regional	Local	Regional	Local	Regional	Score	Significance
AC01	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC02	2	1	1	1	1	1	1	1	1	1	1	1	13	Low
AC03	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC04	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC05	2	1	1	1	1	1	1	1	1	1	2	1	14	Low
AC06	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC07	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC08	1	1	1	1	1	1	1	1	2	1	2	1	14	Low
AC09	1	1	1	1	1	1	1	1	1	1	2	1	13	Low
AC10	1	1	1	1	1	1	1	1	1	1	2	1	13	Low
AC11	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC12	1	1	1	1	1	1	2	1	2	1	2	1	15	Low
AC13 (incorporating AH1 Russell 2002)	3	2	3	2	2	2	2	1	3	2	3	3	28	High
AC14	1	1	1	1	1	1	2	1	1	1	2	1	14	Low
AC15	1	1	1	1	1	1	2	1	1	1	2	1	14	Low
AC16	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC17	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC18	3	1	2	1	1	1	1	1	1	1	1	1	15	Low
AC19	1	1	1	1	1	1	1	1	1	1	1	1	12	Low

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
AC20	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC21	1	1	2	1	1	1	2	1	1	1	1	1	14	Low
AC22	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC23	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC24	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC25	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC26	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC27	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC28	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC29	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC30	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC31	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC32	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC33	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC34	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC35	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC36	1	1	1	1	2	1	1	1	1	1	1	1	13	Low
AC37	2	1	1	1	2	1	2	1	1	1	1	1	15	Low
AC38	3	3	3	3	2	2	1	1	1	1	2	2	24	Moderate to high
AC39	2	1	1	1	2	1	2	1	1	1	1	1	15	Low
AC40	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC41	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC42	3	3	3	3	1	1	2	2	1	1	1	1	22	Moderate

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
AC43	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
AC44	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC01	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC02	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC03	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC04	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC05	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC06	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC07	2	2	1	1	1	1	2	1	1	1	1	1	15	Low
BFC08	2	2	1	1	1	1	2	1	1	1	1	1	15	Low
BFC09	2	2	1	1	1	1	2	1	1	1	1	1	15	Low
BFC10	2	2	1	1	1	1	2	1	1	1	1	1	15	Low
BFC11	2	2	1	1	1	1	2	1	1	1	1	1	15	Low
BFC12	3	3	3	3	2	2	3	3	2	2	2	2	30	High
BFC13	2	1	1	1	1	1	2	1	1	1	1	1	14	Low
BFC14	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC15	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC16	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC17	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC18	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC19	1	1	2	1	1	1	2	1	2	1	1	1	15	Low
BFC20	1	1	1	1	1	1	1	1	1	1	1	1	12	Low

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
BFC21	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC22	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC23	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC24	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
BFC25	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC26	2	1	2	1	2	1	2	1	2	1	2	1	18	Low to Moderate
BFC27	1	1	1	1	2	1	2	1	1	1	1	1	14	Low
BFC28	1	1	2	1	2	1	2	1	2	1	2	1	17	Low to Moderate
BFC29	1	1	2	1	2	1	2	1	2	1	2	1	17	Low to Moderate
BFC30	2	1	2	1	2	1	2	1	2	1	2	1	18	Low to Moderate
BFC31	1	1	2	1	1	1	2	1	2	1	1	1	15	Low
BFC32	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC33	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC34	1	1	2	1	1	1	2	1	1	1	1	1	14	Low
BFC35	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC36	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC37	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC38	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC39	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC40	1	1	2	1	2	1	1	1	2	1	2	1	16	Low
BFC41	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC42	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC43	1	1	1	1	1	1	1	1	1	1	1	1	12	Low

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
BFC44	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC45	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC46	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC47	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC48	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
BFC49	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG01	3	3	3	3	1	1	2	2	1	1	2	2	24	Moderate to High
CG02	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG03	2	1	2	1	2	1	1	1	1	1	2	1	16	Low to Moderate
CG04	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG05	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG06	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG07	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG08	3	3	3	3	1	1	2	2	1	1	1	1	22	Moderate
CG09	3	3	3	3	1	1	2	2	1	1	1	1	22	Moderate
CG10	3	3	3	3	1	1	2	2	2	2	2	2	26	Moderate to High
CG11	2	1	1	1	1	1	2	1	1	1	1	1	14	Low
CG12	2	1	1	1	1	1	1	1	1	1	2	1	14	Low
CG13	2	1	1	1	1	1	1	1	1	1	2	1	14	Low
CG14	2	1	1	1	1	1	1	1	1	1	2	1	14	Low
CG15	2	1	1	1	1	1	1	1	1	1	2	1	14	Low
CG16	1	1	1	1	2	1	1	1	1	1	1	1	13	Low

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
CG17	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
CG18	1	1	2	1	2	1	2	1	2	1	2	1	17	Low to Moderate
SC01	2	1	1	1	1	1	1	1	1	1	1	1	13	Low
SC02	2	1	1	1	1	1	1	1	1	1	1	1	13	Low
SC03	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
SC04	2	1	1	1	1	1	2	1	1	1	1	1	14	Low
SC05	1	1	1	1	2	1	1	1	1	1	2	1	14	Low
SC06	2	1	1	1	2	1	1	1	1	1	2	1	15	Low
SC07	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
SC08	2	1	1	1	2	1	1	1	1	1	2	1	15	Low
SC09	2	1	1	1	2	1	1	1	1	1	2	1	15	Low
SC10	3	1	3	1	1	1	2	1	3	1	2	1	20	Moderate
SC11	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
SC12	2	1	1	1	2	1	1	1	1	1	2	1	15	Low
SC13	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
SC14	2	1	1	1	2	1	1	1	1	1	2	1	15	Low
WC01	2	1	2	1	2	1	2	1	1	1	2	2	18	Low to Moderate
WC02	3	3	3	3	1	1	3	3	2	2	2	1	28	High
WC03	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
WC04	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC05	3	3	3	3	2	2	3	3	2	2	3	3	32	High

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
WC06	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
WC07	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
WC08	1	1	1	1	2	1	2	1	2	1	2	1	16	Low to Moderate
WC09	1	1	1	1	2	1	2	1	1	1	2	1	15	Low
WC10	1	1	1	1	2	1	2	1	1	1	2	1	15	Low
WC11	1	1	1	1	2	1	2	1	1	1	2	1	15	Low
WC12	1	1	1	1	2	1	2	1	1	1	2	1	15	Low
WC13	1	1	1	1	2	1	2	1	1	1	2	1	15	Low
WC14	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC15	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC16	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC17	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC18	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
WC19	1	1	1	1	1	1	2	1	1	1	1	1	13	Low
WC20	1	1	1	1	1	1	2	1	2	1	1	1	14	Low
WC21	3	1	3	1	2	2	3	3	3	2	3	2	28	High
WC22	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC23	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC24	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC25	3	3	3	3	2	2	3	3	2	2	3	3	32	High
WC26	3	3	3	3	2	2	3	3	1	1	3	3	30	High
WC27	3	3	3	3	2	2	3	3	1	1	3	3	30	High
WC28	1	1	1	1	1	1	1	1	1	1	1	1	12	Low

Table 8.3 – Scientific Significance Assessment for Sites in the Anvil Hill Project Area (cont)

Site Name	Rarity		Represent-ativeness		Archaeological Integrity		Connectedness		Complexity		Potential for archaeological deposit		Overall Archaeological Significance	
WC29	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC30	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC31	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC32	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC33	3	3	3	3	1	1	1	1	3	2	1	1	23	Moderate
WC34	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC35	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC36	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC37	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC38	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC39	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC40	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC41	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC42	1	1	1	1	1	1	1	1	1	1	1	1	12	Low
WC43	3	3	3	3	1	1	3	3	1	1	1	1	24	Moderate to High
WC44	2	1	1	1	1	1	2	1	1	1	1	1	14	Low
WC45	3	3	3	3	3	3	3	3	2	2	3	3	34	High
WC46	3	3	3	3	2	2	3	3	3	3	2	2	32	High
WC47	3	3	3	3	3	3	3	3	3	3	2	2	34	High
WC48	2	1	2	1	1	1	1	1	1	1	1	1	14	Low

Artefact scatters, AC13, WC02 and WC21 are assessed as having high research potential as they exhibit:

- a large and complex assemblage;
- knapping floors that can be conjoined to determine knapping techniques;
- different artefact reduction methods (freehand percussion, bipolar reduction, microblade production);
- a high potential for a large and complex sub-surface assemblage;
- some potential for stratigraphic integrity or at least spatial integrity; and
- in the case of AC13, as it is located in a landform element (upper tributary) not predicted to contain a large and complex assemblages; and
- in the case of WC02 and WC21 as they are part of a site complex associated with Wybong Creek and the rockshelters on Wallaby Rocks; and
- as they contain rarely located mussel shell and even rarer worked mussel shell (this association is due to their containing mussel shell and/or worked mussel shell (WC02).

Rockshelter sites CG08, CG09, AC42 and WC33 are assessed as having moderate to high research potential due to the following reasons:

- the lack of rockshelter sites on the DEC/AHIMS register which gives these sites high rarity and representativeness values; and
- their connectedness to other rockshelter sites on the same rocky plateau.

These sites are not assessed as having high research potential as:

- the deposit within the shelter is shallow (less than 10 centimetres or 10 centimetres on average) and totally disturbed by bioturbation; and/or
- they exhibit minimal archaeological evidence;
- they have a morphology suitable for transient use (small, uncomfortable and/or difficult to access) rather than long term occupation; and
- they have no potential to add to our knowledge of the chronology of Aboriginal occupation by their sub-surface investigation.

Rockshelters AC38, CG01, CG10 and WE43 are assessed as having moderate to high research potential due to the following reasons:

- the lack of rockshelter sites on the DEC/AHIMS register which gives these sites high rarity and representativeness values; and
- their connectedness to other rockshelter sites on the same rocky plateau;
- they have moderate numbers of surface artefacts and the potential for moderate numbers of artefacts in a sub-surface context; archaeological evidence; and
- they have a morphology more suited for longer term occupation (higher, wider).

These sites are not assessed as having high research potential as:

- the deposit within the shelter is shallow (less than 10 centimetres or 10 centimetres on average) and totally disturbed by bioturbation; and
- their assemblages are not assessed as complex; and
- they have limited potential to add to our knowledge of the chronology of Aboriginal occupation by their sub-surface investigation.

Rockshelter sites BFC12, WC05, WC25, WC26, WC 27, WC45, WC46 and WC47 are assessed as having high research potential due to the following reasons:

- the lack of rockshelter sites on the DEC/AHIMS register which gives these sites high rarity and representativeness values; and
- their connectedness to other rockshelter sites on the same rocky plateau;
- they exhibit relatively large and complex assemblages (including mussel shell and bone);
- they have a high potential for further artefacts in a sub-surface context;
- they have deposits that have sufficient depth to retain stratigraphic integrity below the current disturbance zone;
- the shelters have a morphology (high, wide and relatively deep) and a location in the landscape (close to reliable water) suitable for long term occupation; and
- they display connectedness to each other and to other artefact scatter sites on the slopes below (due to the inclusion of mussel shell and/or worked mussel shell);
- they have the potential to add to our knowledge of the chronology of Aboriginal occupation by their sub-surface investigation.

Table 8.4 summarises the overall archaeological significance and thus research potential of each of the sites. The table also indicates if the sites are within or outside the Proposed Disturbance Area. From the table it can be observed that there are almost equal numbers of isolated finds and artefact scatters of low significance and thus low research potential within the Proposed Disturbance Area as there are outside the Proposed Disturbance Area (and within the survey area). There are more artefact scatter sites of moderate potential outside the Proposed Disturbance Area than within it and all but one of the sites of moderate to high or high research potential are outside the Proposed Disturbance Area. The artefact scatter site AC13, assessed as having high research potential, is within the Proposed Disturbance Area.

It should be noted that the survey area was selected to incorporate areas predicted to have archaeological significance and thus research potential based on the results of the predictive model. These areas were investigated for their potential as Offset Areas for Aboriginal cultural heritage. Therefore, it is not surprising that some of the sites located in these areas are assessed as having such high research potential.

Table 8.4 - Archaeological Research Potential and Location in relation to the Development

Site Type	Low Research Potential		Low to Moderate Research Potential		Moderate Research Potential		Moderate to High Research Potential		High Research Potential	
Inside or outside Proposed Disturbance Area	In	Out	In	Out	In	Out	In	Out	In	Out
Isolated Find	AC02, AC03, AC04, AC07, AC09, AC10 AC14, AC15, AC16, AC18, AC20, AC21, AC22, AC24, AC25, AC26, AC27, AC29, AC36, BFC44, BFC46, CGO2, CGO4, CGO6, CGO7, CG17, SC05, SC09, SC11, SC13	AC19, BFC02, BFC03, BFC04, BFC05, BFCO6, BFCO7, BFC13, BFC16, BFC20, BFC21, BFC22, BFC23, BFC27, BFC35, BFC37, BFC41, CG1, SC01, SC04, WC07, WC10, WC11, WC12, WC13, WC16, WC19, WC23, WC24, WC28, WC29, WC30, WC31, WC34, WC36, , WC39, WC40, WC44, WC48								
Artefact Scatter	AC01, AC05, AC06, AC08, AC11, AC12, AC17, AC23, AC28, AC30, AC31, AC32, AC33, AC34, AC35, AC37, AC39, AC40, AC41, AC43, AC44, BFC45, BFC47, BFC48, CGO5, CG12, CG13, CG14, CG15, CG16, SC06, SC07, SC08, SC12, SC14	BFC01, BFC08, BFC09, BFC10, BFC11, BFC14, BFC15, BFC17, BFC18, BFC19, BFC24, BFC25, BFC31, BFC32, BFC33, BFC34, BFC36, BFC38, BFC39, BFC40, BFC42, BFC43, BFC49, WC03, SC02, SC03, WC04, WC06, WC09, WC14, WC15, WC17, WC18, WC20, WC22, WC32, WC35, WC37, WC38, WC41, WC42	BFC30 CGO3 CG18	BFC26 BFC28 BFC29 WC01 WC08		SC10			AC13	WC02, WC21

Table - 8.4 Archaeological Research Potential and Location in relation to the Development (cont)

Site Type	Low Research Potential		Low to Moderate Research Potential		Moderate Research Potential		Moderate to High Research Potential		High Research Potential	
Rockshelter						CGO8, CG09 AC42, WC33		AC38 CG01 CG10 WC43		BFC12, WC05 WC25, WC26 WC27, WC45 WC46, WC47
Subtotal	**65**	**80**	**3**	**5**	**0**	**5**	**0**	**4**	**1**	**10**
Total	**145**		**8**		**5**		**4**		**11**	

8.3.8 Sensitivity/Research Potential of the Archaeological Terrain Units/Landform Units

The predictive model indicates that the most likely location for Aboriginal artefact scatters is in proximity to the main and ephemeral watercourses (within 30 metres). Previous studies indicate that high numbers of artefacts are often found in these locations. Sites located during the survey also indicate that these areas form a focus for Aboriginal occupation most probably due to water availability, suitable gradients for camping and more abundant plant and animal resources. The major watercourses (Big Flat Creek and Wybong Creek) and the confluences of watercourses, including the major confluence of Wybong Creek and Big Flat Creek and the minor confluences of Anvil Creek and Big Flat Creek, Big Flat Creek and Clarks Gully and the minor confluences of Sandy Creek's tributaries are all foci for Aboriginal occupation. Thus the Riparian Corridor Archaeological Terrain Unit and the landform elements it encompasses (floodplain, creek terrace, creek bank, footslope, creek confluences) have high archaeological sensitivity.

Due to lack of continuous ground surface visibility it is not possible to know if the artefact scatters and isolated finds located along the creeklines represent discrete areas of occupation or if they are the visible expression of continuous and overlapping occupation. What is apparent; however, from the exposures investigated, is that there are areas such as the creek confluences and areas in close proximity to chains of ponds or ecotones that have higher artefact concentrations and that are more likely to reward sub-surface investigation to add to our knowledge of the Aboriginal use of the area.

Artefact scatter site AC13 is an example of a site in an area identified by the geomorphic inspection (refer to **Section 7** and **Appendix 10**) as having had a chain of ponds morphology where more reliable water would have been available. Site AC13 is assessed as having high archaeological significance and will be destroyed by the project if it proceeds with its present mine plan.

Isolated find and artefact scatter sites BFC29, BFC37, BFC38, BFC39, CG05, CG06 and CG14 represent artefacts in exposures associated with the banks of Clarks Gully and Big Flat Creek and in close proximity to the confluence of these watercourses. This is another area that would have acted as a focus for Aboriginal occupation and though these sites cannot be afforded high archaeological significance due to their highly disturbed nature and low artefact numbers, the confluence area is afforded high archaeological sensitivity for its greater potential for artefacts in a sub-surface context and its greater potential to reward sub-surface investigation.

Based on the predictive model and the results of the survey of other creek confluences, Anvil Creek's confluence with Big Flat Creek (Area 2) which could not be surveyed due to access problems) is also highly likely to be another foci for Aboriginal occupation. This area is mainly outside the Proposed Disturbance Area but the area of the lower reach of Anvil Creek just upstream of the confluence and the Riparian Corridor in this area will be destroyed by the project if it proceeds with its present mine plan. This area is also afforded high archaeological sensitivity and is assessed as having the capacity to reward sub-surface investigation.

The predictive model also suggests that sites may be identified in the upper reaches of Sandy Creek within the proposed modified rail loop. These (potential) sites may also be foci for Aboriginal occupation based on their location in the landscape (the break of slope at the lower slope/floodplain boundary). Further survey will be undertaken to identify and the number and nature of the sites in this area, to confirm management outcomes for this area.

The predictive model also suggested that sites would be located in areas of low gradient but at altitude that provided an expansive outlook, such as within the Ridge Crest and Spur Crest

Archaeological Terrain Units. The results of the survey confirmed that these areas retained low numbers (4) of dispersed artefact scatter and isolated find sites that contained low numbers of artefacts. This evidence is seen to reflect transient use of these areas as travel routes. Poor ground surface visibility was an inhibiting factor for site detection in the spur crest and ridge crest terrain units, however, those sites located are seen to be a representative sample of what is likely to be found in these areas. The Ridge and Spur Crest Archaeological Terrain Units are assessed as having an overall low archaeological significance and thus low research potential. These terrain units are not assessed as warranting sub-surface investigation.

Outside the Proposed Disturbance Area the Rocky Plateau Archaeological Terrain Unit, including Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks, were suggested in the predictive model, as areas that would provide an expansive outlook and also possible evidence of Aboriginal occupation in rockshelters. The results of the survey confirmed this prediction and all of the rocky plateaus are afforded an overall moderate (Anvil Hill), moderate to high (Limb of Addy Hill and Western Rocks), or high (Wallaby Rocks) archaeological significance and research potential. Overall, Wallaby Rocks is assessed as the most sensitive archaeological landform as the rockshelter sites contained within this plateau have the greatest research potential. This research potential extends to the artefact scatter sites on the slopes below Wallaby Rocks and above Wybong Creek (WCO1 and WC21). It is assessed that the Wybong Creek/Wallaby Rocks area (outside the Proposed Disturbance Area) was the area of greatest intensity of Aboriginal occupation within the survey area due to the reliability of the water source and its aquatic habitats, the rockshelter morphology (large overhangs with deep flat benches suitable for occupation) and an expansive outlook over the surrounding landscape. These factors made it an excellent area for longer term and repeated Aboriginal occupation.

The western extent of Western Rocks was also predicted as highly likely to have evidence of longer term occupation in rockshelters (if rockshelters were found to exist in this area). One rockshelter (WC33) was located that confirmed this prediction. Unfortunately the rockshelter, whilst having a large and complex assemblage, had only shallow and highly disturbed deposit.

Shelters on Anvil Hill and Limb of Addy Hill are not close to reliable water and were found to exhibit evidence suggesting only transient use. Anvil Hill also has less favourable shelter morphology (shape, size, ease of access) and is more isolated than the surrounding rocky outcrops.

Shelters on Anvil Hill and Limb of Addy Hill were generally low (sitting height only), shallow (no real overhang to afford shelter), often within the cliffline (rather than at the base of the cliffline and sometimes difficult to access) with floors that sloped to the outside and with no outside ledge.

As rockshelter sites are rare in the local and regional context they must be afforded relatively high archaeological sensitivity and thus research potential. However; it should be noted that similar shelters are also likely to exist in the region in the nearby rocky outcrops of Black Jack Mountain, Castle Rock and Brays Hill.

The Simple Slope Archaeological Terrain Unit within the Proposed Disturbance Area was found to have 20 widely dispersed, small artefact scatter and isolated find sites. The majority of these sites were located on the midslope, which was not as predicted. Ground surface visibility has affected site location in the Simple Slope Archaeological Terrain Unit; however, those sites located indicate that this terrain unit retains little likelihood of archaeological integrity due to European land-use practices or of complex site assemblages, thus the sites have been afforded low archaeological significance and low research potential

Two areas of Simple Slope Archaeological Terrain Unit outside the Proposed Disturbance Area; however, were found to have, or are predicted to have, moderate archaeological significance and research potential. These areas are the slopes on the eastern side of Wybong Creek to the west of Wallaby Rocks and the slopes to the south of Big Flat Creek and to the north of Wallaby Rocks respectively.
Finally, all sites in the Modified Terrain Unit are assessed as having low archaeological significance and research potential due to their poor physical integrity and the scarcity of archaeological evidence located within the sites located.

Table 8.5 provides a summary of the Archaeological sensitivity and research potential of the Archaeological Terrain Units.

Table 8.5 - Terrain Units: Assessed Archaeological Sensitivity and Research Potential

Modified	Simple Slope	Ridge Crest	Spur Crest	Riparian Corridor	Rocky Plateau
Low	Low to Moderate	Low	Low	High	Moderate to High

8.4 Summary of Significance

The Aboriginal significance and archaeological significance and research potential of the sites and archaeological terrain units located within the survey area have been summarised in **Tables 8.1** to **8.5** respectively. As outlined in **Section 8.1**, the Aboriginal cultural significance of individual sites cannot be discussed as no specific site by site assessment was provided by the Aboriginal stakeholder groups in their comments on the draft report. The Aboriginal cultural heritage significance of the archaeological terrain units that form the survey area were, however, assessed as having high Aboriginal cultural heritage significance by four of the groups.

The archaeological or scientific significance assessment for the sites and the archaeological and Aboriginal cultural heritage significance of the terrain units within which they are located will form the basis for the management options discussed in **Section 9** of this report.

9.0 Management Options

This section of the report will provide a discussion on the direct and indirect impact of the proposed development on the known Aboriginal sites, archaeological terrain units and landform elements located within the Proposed Disturbance Area and within the broader survey area (and outside the Proposed Disturbance Area). This latter area was surveyed to assess its potential as an Offset Area for Aboriginal cultural heritage.

Following the impact assessment, various management options are discussed for the sites and the terrain units/landform elements and the preferred management options identified.

9.1 Impact Assessment

9.1.1 Direct Impacts

In **Section 2.3** it was concluded that all Aboriginal sites and archaeological terrain units/landform elements within the Proposed Disturbance Area would be destroyed by the project under the current mine plan. The current mine plan will result in the destruction of 30 isolated find and 39 artefact scatter sites, all but one of which (AC13), are assessed as having low (65 sites), or low to moderate (BFC30, CG03, CG18), archaeological significance and research potential. The one remaining site, AC13 (an artefact scatter site on Anvil Creek) is assessed as having high archaeological significance.

Management options for the sites within the Proposed Disturbance Area are discussed in **Section 9.3**.

The direct impact of the proposal on the cultural landscape within the Proposed Disturbance Area must also be considered. **Table 9.1** and **Table 9.2** provide a summary of the area of the archaeological terrain units and landform elements within the Proposed Disturbance Area that will be directly impacted by the project. The archaeological and cultural heritage significance/sensitivity of these areas is also shown within the tables. The nature of the management of these areas will be informed by the significance/sensitivity of the areas and the capacity of Centennial to offset their loss by conserving areas of similar or greater significance/sensitivity elsewhere.

Table 9.1 - Archaeological Terrain Units within the Proposed Disturbance Area

Archaeological Terrain Units	Significance/Sensitivity	Total (ha)
Modified	Low	112
Plateaus	Moderate, Moderate to High or High	6
Ridge line crest and saddle	Low	187
Riparian Corridor	High	316
Spur Crest	Low	136
Simple Slope	Low to Moderate	1481
Total Proposed Disturbance Area		**2238**

Table 9.2 - Landform Elements within the Anvil Hill Proposed Disturbance Area

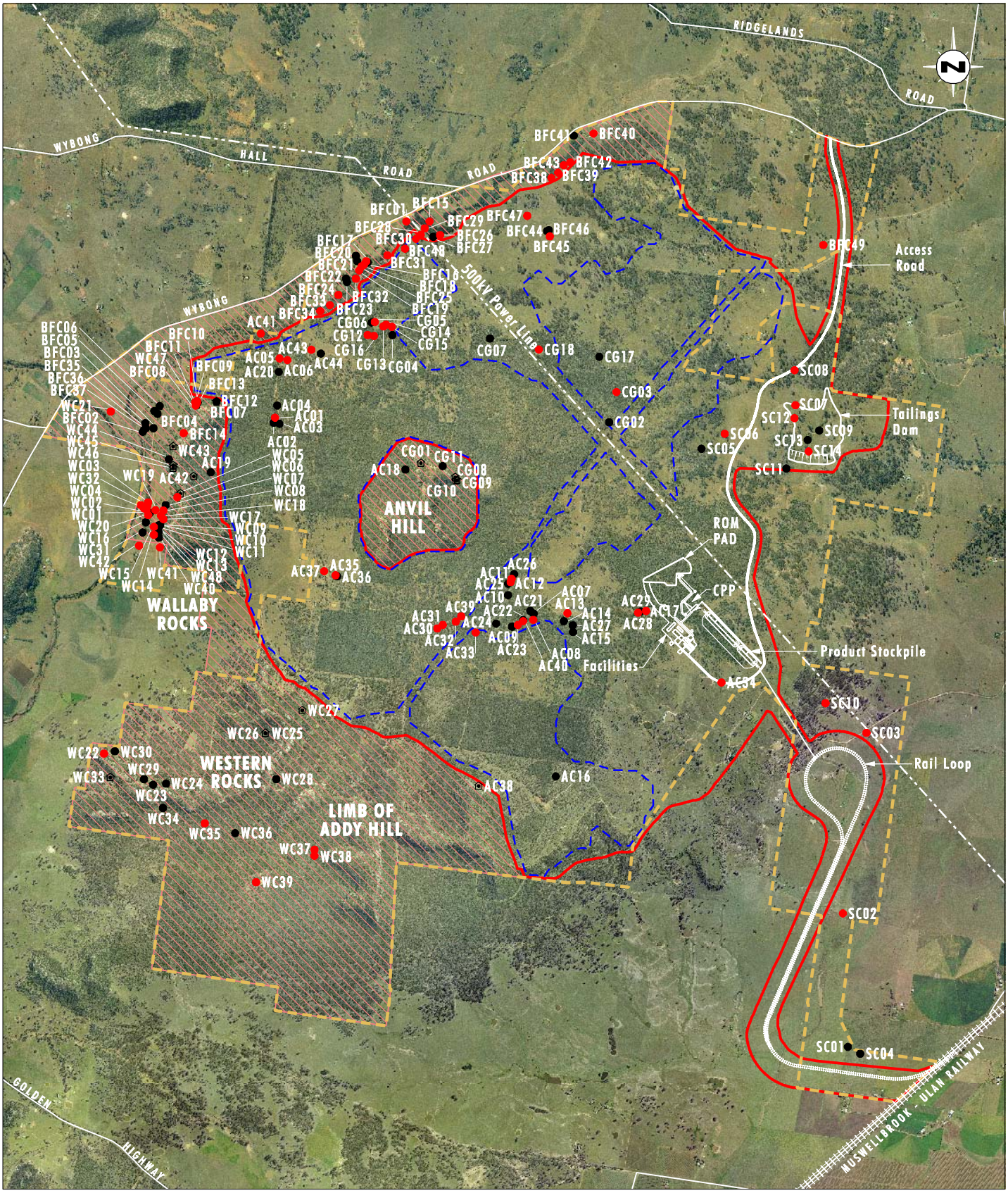
Landform element	Significance/Sensitivity	Area (Ha)
Ridgeline Crest	Low	13
Spur (secondary)	Low	1
Spur Crest	Low	132
Ridgeline Saddle	Low	34
Spur/saddle	Low	12
Scree Slope	Low	6
Upper Slope	Low	217
Moderate Slope	Low	764
Lower slope (more than 30 m from creekline)	Low	522
Footslope	High	315
Floodplain	High	42
Modified	High	112
Creekline/Creek bed	High	68
Total Proposed Disturbance Area		**2238**

9.1.2 Mitigation of Direct Impacts

From the outset of the Aboriginal consultation program for the Anvil Hill Project, Centennial has accepted that the most appropriate mitigation for loss of Aboriginal cultural heritage sites and values within their Proposed Disturbance Area would be to provide an appropriate Offset Area that would conserve similar sites and values outside their Proposed Disturbance Area. With this in mind, areas surrounding the Proposed Disturbance Area were included in the survey and/or assessment (some adjoining areas where access was not available were assessed according to the results of the survey of similar and adjoining areas).

The Proposed Offset Areas are shown on **Figure 9.1** and include Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks and the 16 rockshelter sites they contain. They also include a section of the main channel of Big Flat Creek and areas of slope between Wallaby Rocks and Wybong Creek and the confluence of Big Flat Creek and Wybong Creek. The archaeological terrain units/landform elements and sites within this area have been assessed as having moderate, moderate to high or high archaeological significance/sensitivity and high Aboriginal significance/sensitivity.

For comparative purposes (with the Proposed Disturbance Area) the areas of the archaeological terrain units and landform elements within the Proposed Offset Areas are presented in **Tables 9.3** and **9.4**.



Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

0 0.5 1.0 2km

Legend

- Proposed Disturbance Area
- Survey Area
- Proposed Mining Area
- Proposed Offset Area
- Artefact Scatter (Open Camp Site)
- Isolated Find
- Shelter with PAD

File Name (A4): R06_V1/1858_370.dgn

FIGURE 9.1

Proposed Offset Areas and Site Distribution

Table 9.3 - Archaeological Terrain Units within the Proposed Offset Area

Archaeological Terrain Units	Significance/Sensitivity	Total (ha)
Modified	Low	90
Plateau	Moderate to High	334
Ridge line crest and saddle	Low	42
Riparian Corridor	High	164
Spur Crest	Low	22
Simple Slope	Low to Moderate	426
Total Proposed Offset Areas Surveyed		**1078**

Table 9.4 - Landform Elements within the Proposed Offset Area

Landform element	Significance/Sensitivity	Area (ha)
Ridgeline Crest	Low	7
Spur (secondary)	Low	5
Spur Crest	Low	65
Ridgeline Saddle	Low	151
Spur/saddle	Low	37
Hillock	Low	2
Scree Slope	Low	121
Upper Slope	Low	65
Moderate Slope	Low	50
Lower slope	Low	286
Footslope	High	111
Floodplain	High	64
Modified	High	90
Creekline/Creek bed	High	24
Total Proposed Offset Areas		**1078**

Tables 9.1 to **9.4** indicate that the Proposed Offset Area is not directly comparable to the Proposed Disturbance Area, in that the areas of the various archaeological terrain units and landform elements are not similar. Therefore, the Proposed Offset Area does not provide for the conservation of a similar landscape to that proposed for impact by the project. The Proposed Offset Areas do; however, provide for the conservation of all of the site types and the most significant of the sites located in the survey area. The Proposed Offset Areas also allow for the conservation of larger numbers of each site type than will be impacted by the Proposed Disturbance Area.

During earlier consultation in relation to developments within the Upper Hunter Valley the DEC provided input into what they believe are appropriate values for Proposed Offset Areas for Aboriginal cultural heritage. **Table 9.5** provides an evaluation of the Proposed Offset Areas from a DEC perspective.

Table 9.5 - Evaluation of the Proposed Offset Areas and values nominated by the DEC

Values of Proposed Offset Areas Nominated by the DEC	Evaluation
Proposed Offset Areas should contain sites of high Aboriginal and archaeological significance	The Proposed Offset Areas do contain rockshelter and artefact scatter sites of high Aboriginal and archaeological significance.
Proposed Offset Areas should have the potential to have sub-surface archaeological material in an area that has some archaeological integrity	The Proposed Offset Areas do contain rockshelter sites and artefact scatter sites that have the potential to have sub-surface artefactual material below the current disturbance zone which will retain at least spatial integrity.
Proposed Offset Areas should have similar sites, within similar archaeological terrain units/landform elements to the areas being impacted by the development	The Proposed Offset Areas do not have similar sites in similar archaeological terrain units/landform elements as within the Proposed Disturbance Area. The Proposed Offset Areas represent mainly rocky plateaus and high order watercourses and few low order watercourses, whereas the Proposed Disturbance Area has no rocky plateaus and lower order watercourses. Both have artefact scatter sites and isolated finds, and there will be more sites conserved within the Proposed Offset Areas than destroyed within the Proposed Disturbance Area.
Proposed Offset Areas should contain a wide variety of archaeological terrain units/landform elements that would have provided a wide variety of resources of value to Aboriginal people living a hunter-gatherer lifestyle	The Proposed Offset Areas have a relatively wide variety of archaeological terrain units/landform elements that do provide for a wide variety of Aboriginal resources such as aquatic plants and animals, food, medicine and fibre plants. Prey animals and rockshelters.
Proposed Offset Areas should retain areas of remnant vegetation	The Proposed Offset Areas have been subject to selective clearing in association with the plateaus and almost total clearing associated with the slopes and floodplains of Big Flat Creek and Wybong Creek. Within the plateau environs there are areas, however, where remnant vegetation has or is re-establishing.
Proposed Offset Areas should have no major erosion problems or problems with rubbish dumping, noxious weeds, feral animals or stock	Erosion within the Proposed Offset Areas is limited to the creeklines and roads and is not seen as problematic. The removal of stock and feral animals (specifically goats) would have to form part of the management plan for the Proposed Offset Areas. This will reduce the damage to the rockshelters sites and allow regeneration of native plant species in cleared areas. Noxious weeds are not a problem in the Proposed Offset Areas. Any problems arising with noxious weeds could be managed by a spraying program.
Proposed Offset Areas should be connected and not be set aside as isolated pockets of land.	The majority of Proposed Offset Areas are connected. It will not be possible to connect Anvil Hill to the other areas proposed for Offsets until after mining has concluded between Anvil Hill and the plateau areas to the west and south-west. The remainder of the Proposed Offset Area is connected.
Proposed Offset Areas should have easy access for community groups (Aboriginal and non-Aboriginal)	Easy access is available to the area along Big Flat Creek from Wybong Road and to Wallaby Rocks and parts of Wybong Creek by the Anvil Hill ROW. Access is currently available to Limb of Addy and Western Rocks. From Anvil Hill ROW along farm tracks (these may require some upgrading).

Table 9.5 indicates that the Proposed Offset Areas retain the majority of the values previously suggested by the DEC as appropriate. The area where there is some deviation relates to the comparability of the Archaeological Terrain Units/landform elements within the Proposed Offset Areas and the Proposed Disturbance Area and easy access. It is suggested that the high Aboriginal and archaeological significance of many of the sites within the Proposed Offset Areas may offset this lack of comparability.

Table 9.6 provides a breakdown of the Proposed Offset Areas and how/if these meet the criteria set by the Aboriginal stakeholder groups for Proposed Offset Areas at the workshop held on 1 March 2005. Other comments received from the Aboriginal stakeholder groups during the meeting on 1 March 2005, that are not directly related to the values of the land within the Proposed Offset Areas included:

- any Proposed Offset Area that was set aside by Centennial should have appropriate signage, for example 'Traditional land of the Wanaruah people';
- Centennial could provide a contribution towards a keeping place and/or a regional study;
- Centennial could provide an educational package;
- Centennial could provide involvement of representatives of Aboriginal stakeholder groups in mine rehabilitation; and
- Centennial could provide permanent employment opportunities for Aboriginal people in the mine including traineeships.

Only the first dot point actually relates to the Proposed Conservation Offsets and the acceptance of this dot point should form part of the Aboriginal Heritage Management Plan prepared for the Proposed Offset Areas to be set aside for loss of culture heritage values within the Proposed Disturbance Area.

The remainder of the options are economic in nature and are not associated with the evaluation of the Proposed Offset Areas. Such suggestions may, however, form part of an agreement between Centennial and the relevant Aboriginal stakeholder groups but fall outside the scope of the evaluation of the Proposed Offset Areas.

Table 9.6 - Evaluation of the Proposed Offset Areas and Values nominated by the Aboriginal Stakeholder Groups during Workshop on 1 March 2005

Values of Proposed Offset Areas Nominated by Aboriginal Stakeholders	Evaluation
A Proposed Offset Area should contain Aboriginal heritage sites as all Aboriginal heritage sites are considered of high significance to Aboriginal people	The Proposed Offset Areas include 37 isolated finds, 38 artefact scatters and 16 rockshelters with artefacts and PAD.
Any Proposed Offset Area should have a diverse range of sites within it (not just artefact scatters)	The Proposed Offset Areas include 37 isolated finds, 38 artefact scatters and 16 rockshelters with artefacts and PAD. The Proposed Disturbance Area does not contain any rockshelters and thus the Proposed Offset Areas have a more diverse range of sites.
Any Proposed Offset Area should be at least of equal size to the Proposed Disturbance Area	The Proposed Offset Areas are not of the same size as the Proposed Disturbance Area. However, the Proposed Offset Areas do encapsulate a larger area of archaeologically sensitive landform elements and archaeological terrain units than within the Proposed Disturbance Area.
Any Proposed Offset Area should be of equal value or greater value to the Aboriginal stakeholders as the Proposed Disturbance Area	Comments provided during the survey by the Aboriginal groups highlighted the significance and value of Wallaby Rocks and Wybong Creek as Proposed Offset Areas as they were places considered to be of high cultural significance.
Any Proposed Offset Area should have tourism potential	The rockshelters on Wallaby Rocks and its associated artefact scatters and isolated finds on the slopes leading down to Wybong Creek were seen by the Aboriginal stakeholder groups involved in the survey of these areas as areas with excellent tourism potential due to their ease of access from Anvil ROW and also as the sites are easily accessible and the artefacts in the sites tell a story about what Aboriginal people were doing in the area. The landscape in this area was found to be the most aesthetically pleasing and the vegetation included a limited variety of Aboriginal economic plants.
Any Proposed Offset Area should be easily accessible	The Proposed Offset Areas of Wallaby Rocks, the northern creek banks and floodplain of Big Flat Creek and Wybong Creek will be readily accessible via Anvil Hill ROW and Wybong Road. Access will be able to be organised to Anvil Hill for the majority of the mine life. Limb of Addy Hill and Western Rocks are less easily accessible but do provide Aboriginal economic plant species not available at Wallaby Rocks. Western Rocks could be accessed through Anvil Hill ROW (with the provision of some roadworks) but sections of Limb of Addy Hill are more difficult and need to be accessed on foot.
Any Proposed Offset Area should retain Biodiversity – lots of different food and medicine plants and prey animals	The Proposed Offset Areas provide a diverse range of habitats and a diverse range of plant and animal species that were utilised/hunted by Aboriginal people. They have a much higher diversity of useful plant species than located within the Proposed Disturbance Area.

Table 9.6 - Evaluation of the Proposed Offset Areas and Values nominated by the Aboriginal Stakeholder Groups during Workshop on 1 March 2005 (cont)

Values of Proposed Offset Areas Nominated by Aboriginal Stakeholders	Evaluation
Any Proposed Offset Area should have a stakeholder benefit – it should provide opportunities for employment and places for children to learn about Aboriginal culture	The Proposed Offset Areas could have an Aboriginal stakeholder benefit if there is an opportunity to use the area for cultural tourism and if Aboriginal community representatives find employment as part of the ongoing management of the areas. The Proposed Offset Areas also have numerous sites and resources that make them suitable as teaching places.
Any Proposed Offset Area should have reliable water.	The Proposed Offset Areas of Wallaby Rocks and Western Rocks and their surrounds to the west are associated with Wybong Creek which is assessed as having had the most reliable water within the Project Area. Big Flat Creek was assessed as more ephemeral in nature than Wybong Creek but it too would have provided more reliable water than the majority of the low order tributaries in the Proposed Disturbance Area.

9.1.3 Indirect Impacts

In **Section 2.3** it was assessed that indirect impacts such as dust emission and vibration from blasting had the potential to damage, destroy and/or disturb Aboriginal sites such as rockshelters with deposit and rockshelters with art that may have been located on Anvil Hill, Wallaby Rocks, Limb of Addy Hill and Western Rocks. As there are no rockshelters with art, within the Proposed Disturbance Area or the broader survey area, dust emission is not thought to be a problem that will require mitigation in relation to Aboriginal cultural heritage.

In February 2006, following the survey and the location of the rockshelter sites, a geotechnical consultant was commissioned to assess the likely indirect impact of ground vibration, overpressure and blasting on the rockshelter sites, all of which are located within the areas being assessed for their potential as Offset Areas for Aboriginal cultural heritage. The field assessment of the rockshelters and the associated plateaus was undertaken by RCA Australia on 1 and 2 March 2006. This report is still being completed and will be included in full in this report.

Preliminary results of the RCA Australia assessment indicate the need to refine and manage the blasting regime to protect the structural integrity of the rockshelter sites in the Wallaby Rocks, Western Rocks and Limb of Addy plateaus. Centennial have committed to refine and manage the blasting regime so as not to significantly increase the risk of instability or affect the structural integrity of the rockshelter sites in the Wallaby Rocks, Western Rocks and Limb of Addy Hill plateaus. Centennial have committed to achieve this outcome, which may potentially involve an ongoing monitoring program and review of blast design. Blasting, however, may result in the following impacts to rockshelters on Anvil Hill:

- damage to the rockshelters and their deposits; and
- potential lack of access by Aboriginal people to many of the rockshelter sites during stages of the life of the mine due to the plateau and rockshelters becoming unstable and dangerous during and after blasting.

Consequently, there may be some loss of Aboriginal and archaeological significance of the rockshelters and the plateau archaeological terrain unit as it relates to Anvil Hill.

9.1.4 Mitigation of Indirect Impacts

The following management options are being investigated to mitigate against the impacts of blasting on Anvil Hill and the Anvil Hill rockshelter sites (CGO1 CG08, CG09, and CG10):

- reinforcement of the roof of the rockshelters with stainless steel bolts to anchor rock in place; and/or
- the removal of loose rock that cannot be stabilised for safety purposes.

In view of the Aboriginal and archaeological significance of the rockshelter sites on Anvil Hill and Anvil Hill in general, it is considered appropriate that Centennial undertake the mitigation procedures outlined above. These are considered appropriate mitigation measures provided they are undertaken in consultation with the DEC and the Aboriginal stakeholder groups and in line with the advice of a geotechnical consultant; and with the provision that there are no significant impacts to the rockshelters of equal and/or higher significance within Wallaby Rocks, Limb of Addy Hill and Western Rocks.

Monitoring of the cliffline boulders and rockshelters on Anvil Hill by a suitably qualified geotechnical consultant to ensure that the mitigation measures implemented are managing the effects of blasting adequately, is another mitigation measure appropriate for this area.

Monitoring of the cliffline boulders and rockshelters on Wallaby Rocks, Limb of Addy Hill and Western Rocks by a suitably qualified geotechnical consultant, is also appropriate to ensure that blasting is not causing any adverse effects.

9.2 Management Options

The management options discussed within this section aim to address the development of a management strategy that recognises the Aboriginal cultural heritage value and archaeological (scientific) significance of individual sites and groups of sites in the landscape. The Aboriginal significance/value of the sites and areas is detailed in the correspondence received from each of the groups (refer to **Appendix 8**) and is summarised in **Sections 8.1** and **8.4**. The archaeological/scientific significance of the sites is detailed in **Section 8.2** and is based on their research potential;

The range of management options potentially available for the sites within the Anvil Hill Project Area are presented in **Section 9.2.1** to **9.2.4**. Each option is discussed, and where appropriate, is nominated as the preferred management option for selected sites. **Figure 9.2** indicates the preferred management option for each of the sites.

The management options explored in this section of the report have been developed in consideration of comments made by the Aboriginal group representatives who participated in the fieldwork, and who provided comments on this draft report.

9.2.1 Option 1 Site Conservation

Conserve all or a selected number of Aboriginal sites/areas within the Proposed Disturbance Area and/or provide an appropriate Offset Area/Areas to offset the loss of archaeological and Aboriginal cultural heritage sites and values within the Proposed Disturbance Area.

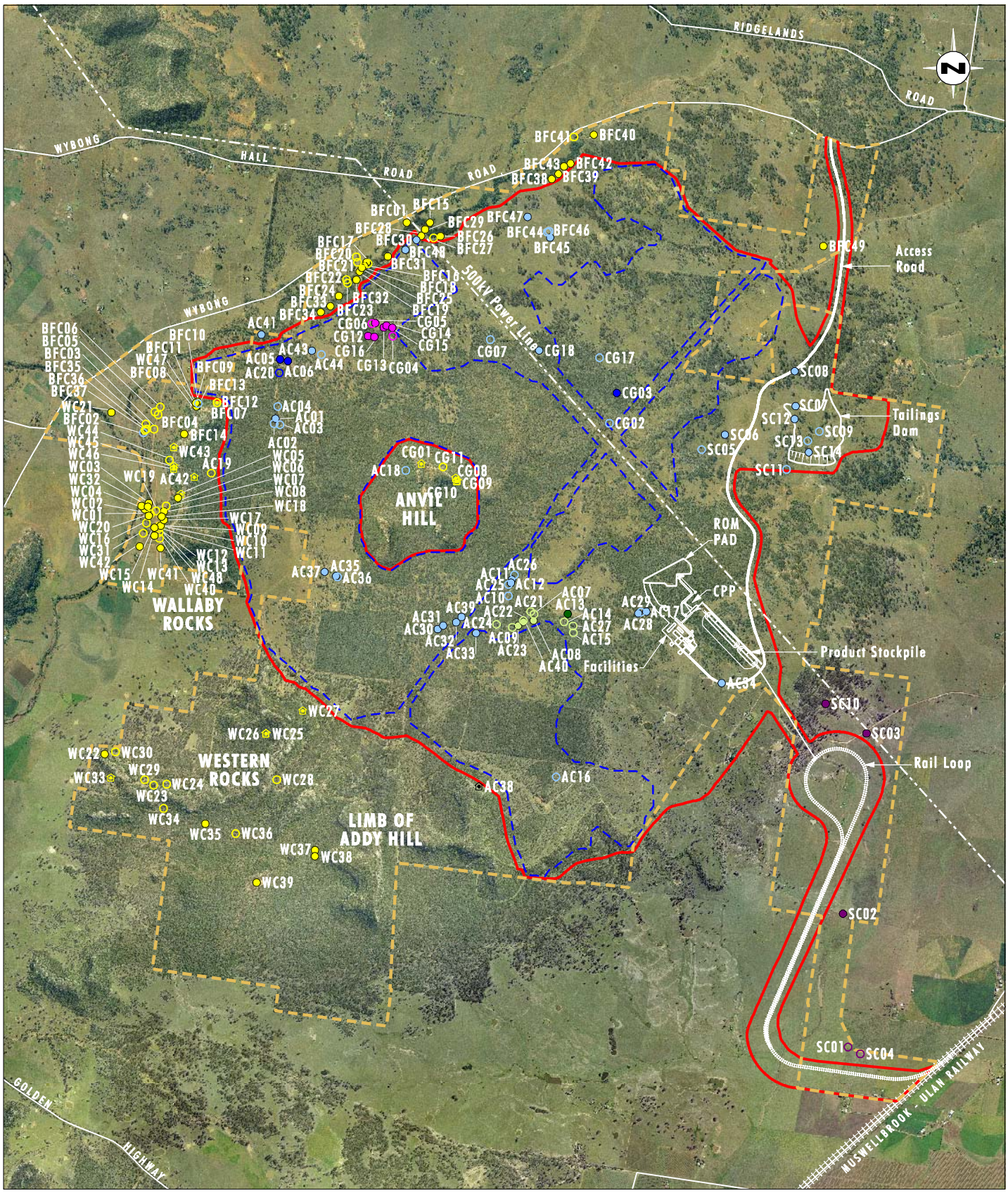
Discussion

The present Anvil Hill mine concept plan indicates that development will impact on all archaeological sites within the Proposed Disturbance Area (refer to **Figure 9.2** and **Table 8.4**). Changes to the mine plan to conserve sites within this area would only be warranted if the sites are of moderate, moderate to high, or of high Aboriginal and archaeological significance; and if there could not be an appropriate conservation offset strategy to ensure that sites of a comparative nature were being conserved elsewhere.

Artefact scatter site AC13 (high significance) is located within the Proposed Disturbance Area. Artefact scatter site SC10 (moderate significance) was located along the edge of the rail corridor, however the rail corridor was moved to avoid impact with the site, thus enabling its conservation.

AC13 is located within the area set aside for the mine infrastructure, specifically a large mine water dam. It is possible that the plan could be modified to avoid impacting the entire area of AC13 and thus enable part conservation; however, it is probable that works associated with erosion control and drainage will have to be undertaken in this area that will directly impact the site. The proximity to mine infrastructure would make its ongoing management problematic. Thus a geomorphic investigation followed by a manual excavation(s) is the preferred management outcome for this site.

Anvil Hill is outside the Proposed Disturbance Area and thus can be set aside as a Proposed Offset Area; however, due to blasting impacts some mitigation works will be necessary in this area (as discussed in **Section 9.1.4.** This area should be managed for conservation under



Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

Legend

- Proposed Disturbance Area
- Survey Area
- Proposed Mining Area
- Artefact Scatter (Open Camp Site)
- Isolated Find
- Shelter with PAD

Management Options:

- Surface collection
- Surface collection and grader scrapes both sides of the creek and within the confluence
- Surface collection and grader scrapes both sides of the creek
- Detailed geomorphological investigation, surface collection detailed sub surface investigation and open area excavation
- Conservation of this site in a Potential Offset Area.
- Surface collection and grader scrapes both sides of the creek within the confluence geomorphic investigation
- Managed in-situ under an Aboriginal Heritage Management Plan

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FIGURE 9.2

Preferred Management Options for Aboriginal Heritage in Anvil Hill Project Application Area including Proposed Offset Areas

an Aboriginal Heritage Management Plan prepared in consultation with the relevant Aboriginal stakeholder groups and the DEC. This plan should include annual monitoring of the rockshelter sites to ensure the mitigation measures implemented are adequate).

There is no requirement for Centennial to impact any of the other sites recorded within the survey area and outside the Proposed Disturbance Area. These sites and their environs are assessed as appropriate for management for conservation under an Aboriginal Heritage Management Plan as Offset Areas for Aboriginal cultural heritage.

Preferred Option

Conservation within Offset Areas is the preferred management option for the artefact scatter, isolated find and rockshelter sites located during the survey that are outside the Proposed Disturbance Area (refer to **Table 8.4** and **Figure 9.2**). The Proposed Offset Areas and the sites they contain should be managed under an Aboriginal Heritage Management Plan prepared in consultation with the DEC and the relevant Aboriginal stakeholder groups.

A management strategy for the Proposed Offset Areas will be prepared with integration of cultural heritage and ecological management objectives. This will be necessary as the Proposed Offset Areas for Aboriginal cultural heritage are incorporated within Ecological Proposed Offset Areas. Therefore, it is essential that proposed management strategies are developed in consultation to ensure there is no conflict.

Conservation is also the preferred management option for site SC10. The rail loop alignment has now been modified to allow for the conservation of this site.

Conservation of the remaining artefact scatter and isolated find sites within the Proposed Disturbance Area is not feasible under the current mine plan; however, their destruction should be balanced by the setting aside of Proposed Offset Areas for the conservation of Aboriginal sites outside the Proposed Disturbance Area.

9.2.2 Option 2 Site Destruction without Salvage

Proceed with the development and subsequent destruction/damage of all sites within the Proposed Disturbance Area without any further investigation/salvage.

Discussion

All of the artefact scatter and isolated find sites within the Proposed Disturbance Area, are identified as having significance to the Aboriginal stakeholder groups participating in the project (refer to **Section 8.1**). Discussions during the survey and comments from the Aboriginal stakeholder groups provided on the draft report indicate that this option is not appropriate from their perspective. The minimum requirement of the Aboriginal stakeholder groups is the collection of the artefacts from the sites so that they can be protected from damage/destruction/loss and so that they can be used in the future for teaching purposes.

From an archaeological perspective, although most areas and the majority of the sites within the Proposed Disturbance Area have been disturbed, there are a few areas/sites that are assessed as retaining sufficient integrity and/or can be predicted to have sufficient numbers of sub-surface artefacts to warrant some form of sub-surface investigation. For the remainder of the sites surface collection is appropriate, as the analysis of these artefacts can assist with gaining a greater understanding of the Aboriginal use of the landscape.

In summary, it is not thought appropriate to destroy any of the sites without surface collection and/or sub-surface investigation.

Preferred Option

Site destruction without salvage is not seen as an appropriate management option for any of the sites in the Proposed Disturbance Area.

9.2.3 Option 3 Site Destruction with Salvage (Surface Collection only)

Proceed with the development within the Proposed Disturbance Area following the surface collection of all of the recorded sites.

Discussion

As discussed in **Section 9.2.2** surface collection of artefact scatter and isolated find sites is the minimum requirement of the Aboriginal stakeholder groups for the sites recorded in the Proposed Disturbance Area. As also discussed, there were some sites/areas; however, that in addition to surface collection indicated that some form of sub-surface investigation was appropriate due to their potential to retain some integrity and/or to have moderate to high numbers of artefacts in a sub-surface context.

The artefact scatter sites and isolated find sites for which surface collection (only) is thought appropriate are those that are in areas of high disturbance, retain no integrity and which have no potential or only low potential for artefacts in a sub-surface context.

Preferred Option

Surface collection is the preferred management option for the following artefact scatter and isolated find sites (refer to **Figure 9.2**):

AC01 to AC04, AC10 to AC12, AC16 to AC18, AC25, AC26, AC28 to AC37, AC39, AC41, AC43, AC44, BFC13, BFC03, BFC30, BFC37, BFC44 to BFC48, CG02, CG07, CG17, CG18, SC05 to SC09 and SC11 to SC14.

9.2.4 Option 3 Site Destruction with Salvage (Surface Collection and Sub-surface Investigation)

Undertake surface collection and sub-surface salvage of all sites within the Proposed Disturbance Area.

Discussion

As detailed in **Section 9.2.3** surface collection only is an appropriate management option for a number of the artefact scatter and isolated find sites in areas of high disturbance, that retain no integrity and which have no potential or only low potential for artefacts in a sub-surface context. There are also a number of sites and the areas that area assessed as having the potential to retain some integrity and/or to have moderate to high numbers of artefacts in a sub-surface context.

Sub-surface investigation in the form of grader scrapes (following the collection of surface artefacts) is considered appropriate within some of the creek confluences and along some sections of the creeks within the Proposed Disturbance Area. Detailed geomorphic analysis is also appropriate for some of these areas.

Sub-surface salvage and geomorphic investigation in the form of test pits, manual excavation and then grader scrapes is assessed as appropriate for AC13.

Preferred Management Option

Areas targeted for sub-surface investigation should include (refer to **Figure 9.2**):

- Anvil Creek – grader scrapes (discontinuous) both sides of Anvil Creek within the area of AC07 to AC09, AC21 to AC24 and AC40 (downstream of AC13) and AC14, AC15 and AC27 (upstream of AC13);

- Big Flat Creek and Anvil Creek confluence – grader scrapes within the creek confluence and within the Proposed Disturbance Area and in proximity to the AC05, AC06 and AC20 sites;

- Big Flat Creek and Clarks Gully – grader scrapes and geomorphic investigation of the area of the creek confluence between Clarks Gully and Big Flat Creek (within the Proposed Disturbance Area) and extending upstream along both sides of Clarks Gully within the area of the CG04, CG05, CG06, CG12 and CG16 sites;

- Clarks Gully – grader scrapes and geomorphic investigation of the creek terrace to the north of the CG16 site; and

- Clarks Gully – grader scrapes within creek confluence between Clarks Gully tributaries in the area of the GC03 site.

Further sub-surface investigation may be required as a management outcome for the impacted tributaries of Sandy Creek dependent on the results of the further survey for the proposed modification to the rail loop. Any methodology for sub-surface investigation will be devised in consultation with the Aboriginal community stakeholder groups.

The methodology for the grader scrapes should include the halting of the scraping and the undertaking of manual excavation if areas of artefact concentration, or areas with features (such as hearths and heat treatment pits), are encountered.

The sub-surface investigation of AC13 should include detailed geomorphological investigation including test pitting to identify areas for manual excavation and grader scraping following surface collection and manual excavation

9.3 Preferred Management Options

Figure 9.2 indicates the sites and their individual preferred management option. The management options include conservation, surface collection and sub-surface investigation. These management options will form the basis of the management strategy presented in **Section 10**.

9.4 Aboriginal Group Comments after Review of Draft Assessment Report

Comments from the Aboriginal stakeholder groups on the draft management options are included in this section. Comments were received from 13 of the 18 Aboriginal stakeholder groups by completion of the 21 day review period. These comments are summarised below. The full comments from each group (that provided written feedback) are included in **Appendix 8**.

9.4.1 Aboriginal Native Title Elders Consultants

No comment received.

9.4.2 Giwiirr Consultants

On 2 June 2006, GC provided written comment on the draft report. This correspondence stated that GC read the draft report and "support…a (section 90) to carry out a surface collection for these sites.

1. Anvil Hill
2. Big Flat Creek
3. Clarks Gully
4. Sandy Creek
5. Grader Scrapes & excavation on site AC13".

9.4.3 Hunter Valley Aboriginal Corporation

No comment received.

9.4.4 Hunter Valley Cultural Consultants

No comment received.

9.4.5 Lower Wonnarua Tribal Consultancy Pty Ltd

On 2 June 2006, Mr Barry Anderson verbally commented on the draft report on behalf of LWTC. Mr Anderson stated that, LWTC agreed in principle with the management recommendations and Proposed Offset Areas proposed in the draft report. However, LWTC would not support the Anvil Hill Project without a written commitment from Centennial that a percentage of all staff employed during the development and working life of the mine must be of Aboriginal descent.

9.4.6 Mingga Consultants

MC provided written comment on 5 June 2006. They stated that "Anvil Hill would be a good place to do some hand excavations, test pits, and also some grader scrapes on site AC13. Site SC10 would be a nice spot to scatter the artefacts so that people can go and have a look at them".

9.4.7 Muswellbrook Cultural Consultants

On 1 June 2006, MCC provided written comment on the draft report.

MCC stated they did not know of any cultural significance/values for the Anvil Hill Area (such as stories or mythological sites) that could be recorded as part of the Aboriginal cultural heritage assessment. MCC did not have any other comments or general input regarding the cultural values of the Proposed Disturbance Area, the Proposed Offset Areas and/or the identified sites.

MCC agreed that the:

- proposed management strategy provided in **Section 10** of the draft report and detailed in **Table 10.1** was a suitable strategy from an Aboriginal cultural heritage perspective;

- draft Research Design and Methodology for the salvage of the sites within the Proposed Disturbance Area detailed in the draft report was suitable from an Aboriginal Cultural Heritage perspective; and that

- conservation of 98 sites and the terrain units within the Proposed Offset Areas will assist with compensating for the loss of the sites and terrain units within the Proposed Disturbance Area; if the sites within the Proposed Disturbance Area are salvaged in the way discussed in **Section 10** of the draft report.

MCC stated that if the Anvil Hill Project is approved they would prefer that artefacts salvaged are placed in site SC10 "for teaching purposes" as well as some artefacts being placed at the Wanaruah Local Aboriginal Land Council. MCC also would like to see that it is not only sites that we protect but "the wildlife, trees, land, plants and the air that we breathe".

9.4.8 Ungooroo Aboriginal Corporation

On 2 June 2006, UAC provided written comment on the draft report. UAC stated that the project area "is of high importance to the Aboriginal community. (Culturally)". UAC did reiterate that they would like further response by Umwelt and Centennial regarding "employment opportunities for Aboriginal people…to date no written response has been forthcoming from Centennial Coal".

UAC objected to WNAC's correspondence within **Appendix 2** of the draft report which states that members of UAC are members of the WNAC or WLALC. UAC reiterated in their written correspondence that WLALC and WNAC do not have "authority to speak or act on their behalf or any of the members of UAC".

Mr Ward agreed with the undertaking of grader scrapes within areas nominated in the draft report. UAC reiterated:

> we do not rate Aboriginal Artefacts as high or low as we feel all Artefacts are of signifance to the aboriginal community. Not only as teaching aids, but also the connection to the Wanaruah people that walked the land, and utilised the materials given by mother earth.

UAC "reluctantly, agree with the Anvil Hill report and have no objections to the project proceeding".

9.4.9 Upper Hunter Heritage Consultants

On 2 June 2006, UHHC provided written comment on the report. UHHC commented in this correspondence that Anvil Hill is a "significant place for our ancestors as they would have used the high ground" as a place where they could oversee potential threats approaching and that they could have also used the high ground as a place where they could spot the best place to hunt for their food and the rock shelters would have provided them with shelter from rough weather.

UHHC also stated that they agreed with any measures taking place to protect the rock shelters from any damage that may take place in the course of blasting and any other mining activities that could effectively damage or cause these shelters to collapse. "We…are against the destruction of any of our Culture and Heritage. But we can't stand in the way of the future, so we would like to salvage what we can in this progress for future generations to look back and learn from…."

Below is a summary of key recommendations made by UHHC:

- surface collection for all sites for the Anvil Creek Catchment, Big Flat Creek Catchment, Clarks Gully Catchment and Sandy Creek Catchment that are within the proposed impact area;

- test pitting for sites AC05, AC11-12, AC37, BFC30, BFC47, CG18;

- test pitting, manual excavation and grader scrapes along the chain of ponds for AC13;

- conservation of SC10, if conservation is not possible surface collection, subsurface investigation and analysis of artefacts and their return to this site after analysis. UHHC would like to see this site conserved and kept as a teaching place for future generations;

- no further investigation is recommended for Wybong Creek as it will not be impacted by the proposal; and

- if a significant site such as a burial is uncovered during any test pitting, manual excavation or grader scrapes all work should stop and appropriate measures are to be put in place to protect any such site.

9.4.10 Upper Hunter Wonnarua Council Inc

On 2 June 2006, UHWC provided written comment on the draft report. UHWC commented that the draft report does not "record any Aboriginal significance" and needs to contain "an Aboriginal Cultural Heritage Assessment".

UHWC have objected to the report as they cannot support the report without this assessment and have also requested a meeting with Centennial and DEC.

Tracey Skene who represented UHWC during the meeting on 11 May 2006 at Denman mentioned a songline and the identification of a large artefact scatter on the Wither's property which is outside the Proposed Disturbance Area and in an area that was not accessed for the survey carried out for this report (due to permission being denied by the landholder). Umwelt requested further information from Miss Skene during the meeting. No mention of the songline or this site was provided by UHWC in their comments to date.

9.4.11 Valley Culture

On 29 May 2006, VC provided written comment on the draft report, stating that "Valley Culture agree to the draft report and would like to continue to be apart of any future work". VC commented that the surrounding locality "within walking distance" of Anvil Hill contains evidence of "cultural acitivity" and "large numbers of cultural sites" and stated that "If at any time during a grader scrape anything is unearthed I would like to see further investigation into that area".

9.4.12 Wanaruah Custodians

WC provided written comment on the draft report stating that they had examined the report "and agree to the job going ahead". WC stated that the comments made by WNAC are "misleading" as Barbara Foot has resigned from WNAC several times and WNAC "is not authorised to represent" her or her family members. WC requested that WNAC's comments on the survey strategy attached in **Appendix 7** be removed from the final report.

9.4.13 Wattaka Wonnarua CC Service

WWCC provided combined written comment with WNAC and of Yarrawalk. These comments are summarised in **Section 9.4.16** and attached in full in **Appendix 8**.

9.4.14 Wonnarua Culture Heritage

No comment received.

9.4.15 Wonnarua Elders Corporation

No comment received.

9.4.16 Wonnarua Nation Aboriginal Corporation

WNAC, Yarrawalk and WWCCS provided a combined written comment on 1 June 2006.

WNAC, WWCCS and Yarrawalk objected to the draft report for the following reasons:

- Aboriginal consultation was undertaken with all Aboriginal stakeholder groups who registered interest in the Anvil Hill Project following DEC's Interim Community Consultation guidelines. It is WNAC, WWCCS and Yarrawalk's view, that some of these groups "are not of Wonnarua descent" and therefore, by consulting with these groups Umwelt "contaminates the outcomes of any discussions when the numbers of groups involved are private business with vested interests…"; and

- that all registered Aboriginal stakeholder groups were afforded the opportunity to be involved in fieldwork during the survey and the use of these different groups representatives to survey different parts of the survey area on different days in what was described as an "ad hoc manner". WNAC, WWCCS and Yarrawalk state that this survey approach demeans the integrity of "Wonnarua Peoples Heritage".

  WNAC, WWCCS and Yarrawalk consider the whole of the study area to be of high significance to the Wonnarua People and "strongly object to our Country being considered as insignificant by the proposed recommendation to have it managed by Aboriginal people this is Wonnarua Country and should only be managed by Wonnarua people or their authorised nominees…"

WNAC, WWCCS and Yarrawalk have requested a meeting with Centennial to discuss their concerns further and to discuss "offset arrangements for the destruction of our lands". WNAC, WWCCS and Yarrawalk have indicated that at that time they will provide further comments regarding the Anvil Hill Project.

9.4.17 Wanaruah Local Aboriginal Land Council

WLALC provided written comment on 6 June 2006. These comments can be summarised as:

- the survey of Anvil Hill showed that "a number of items of significance to the culture and heritage of Aboriginal people were in existence throughout the proposed site"; and

- the survey area is "considered sensitive to Aboriginal existence in the past and the terrain is such that many items may have been covered by soil and water movement".

WLALC requested that in "view of the items found and the areas history and connection to local Aboriginal people it is considered that further investigations should be undertaken prior to a final determination being accepted".

WLALC recommended:

> That further surveys be carried out in a grid fashion utilizing grader scrapings and excavations to determine if there are items of significance to the culture and heritage of Aboriginal people.
>
> That if items are found this type of survey is extended to cover all areas of concern and areas in the proximity of the sites identified.

9.4.18 Yarrawalk

Yarrawalk provided combined written comment with WNAC and WWCCS. These comments are summarised in **Section 9.4.16** and attached in full in **Appendix 8**.

9.5 Summary Of Aboriginal Comments

Four of the thirteen Aboriginal stakeholder groups (WNAC, WWCCS, Yarrawalk and UHWC) that provided comment on the draft report have objected to aspects of the draft Aboriginal archaeological assessment for the Anvil Hill Project. WNAC, WWCCS and Yarrawalk have objected to the report based on the fact that Aboriginal consultation was undertaken with the eighteen Aboriginal stakeholder groups that registered an interest in the Anvil Hill Project. Aboriginal consultation was, however, carried out following DEC's *Interim Community Consultation Requirements* (2004). Umwelt is obliged to follow these requirements despite the fact that some groups object to the principles they contain.

UHWC objected to the draft report as they considered that no Aboriginal cultural heritage assessment was undertaken. UHWC's representatives, Georgina Berry and Tracey Skene, were involved in the fieldwork program for the survey. UHWC was also consulted for the duration of this project from its inception, including the formulation of the draft survey strategy, the workshops for values for potential offsets for Aboriginal cultural heritage and they also participated in the survey. Comments by the Aboriginal community were recorded each day during fieldwork. UHWC were not involved in fieldwork for every survey day, however, they were afforded and accepted the opportunity to attend the site visit after the meeting on 11 May 2006, and they were requested to provide an Aboriginal cultural heritage assessment. The provision of the Aboriginal cultural heritage assessment is the duty of the Aboriginal stakeholder groups involved in the project. It cannot be provided by the archaeological consultant. In this respect UHWC have had ample opportunity to provide an assessment of the cultural heritage values of the Anvil Hill survey area but have failed to do so.

The remaining comments from Aboriginal stakeholder groups supported the findings of the draft report and have been integrated where appropriate into **Section 10** and **Appendix 11**.

There will be ongoing consultation with the Aboriginal community during the Project, and in particular in relation to involvement in the implementation of the management strategy outlined in **Section 10**.

10.0 Management Strategy

The following management strategy is based on the preferred management options discussed in **Section 9** and draws upon both the Aboriginal and archaeological significance/sensitivity of the sites and the archaeological terrain unit/landform elements in which they occur.

Table 10.1 presents a summary of the management measures assessed as appropriate for the sites located within the project area. The sites are shown on **Figure 9.2** and are colour coded to indicate their individual management strategy. This overall management strategy assumes that Centennial will:

- provide the Proposed Offset Areas for Aboriginal cultural heritage to protect Aboriginal sites and associated terrain within the area indicated on **Figure 9.2**. Centennial currently owns or has agreement to purchase the majority of this land. It is noted that some of this land is still subject to agreement with private landholders and there may need to be some boundary adjustments if such agreement is not reached;

- manage the blasting regime so that blasting does not have a detrimental impact to the plateaus and rockshelter sites identified at Wallaby Rocks, apart from Site AC42;

- in consultation with the relevant Aboriginal stakeholder groups and the DEC provide for the survey of the areas within the Proposed Disturbance Area where access was denied by landholders and undertake:

  - the recording of any sites that may be located in these areas;
  - the significance assessment of the sites that may be located in these areas; and
  - management of the sites appropriate to their level of Aboriginal and archaeological significance;

- prepare an Aboriginal Heritage Management Plan in consultation with the DEC and the Aboriginal stakeholder groups to facilitate the ongoing management of the sites and archaeological terrain units/landform elements located within the areas set aside as Offsets for Aboriginal cultural heritage; and

- prepare a management strategy for sites/archaeological terrain units in the Proposed Offset Areas. This management strategy will be integrated with ecological management objectives and form part of the overall Aboriginal Heritage Management Plan.

Table 10.1 - Management Strategy for Sites within the Anvil Hill Project Area

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
AC01	Artefact Scatter	In	Low	Surface collection
AC02	Isolated Find	In	Low	Surface collection
AC03	Isolated Find	In	Low	Surface collection
AC04	Isolated Find	In	Low	Surface collection
AC05	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and within confluence of Big Flat creek within project disturbance area.

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
AC06	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and within confluence of Big Flat creek within project disturbance area.
AC07	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC08	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek.
AC09	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC10	Isolated Find	In	Low	Surface collection.
AC11	Artefact Scatter	In	Low	Surface collection.
AC12	Artefact Scatter	In	Low	Surface collection.
AC13	Artefact Scatter	In	High	Detailed geomorphic investigation followed by surface collection and a detailed sub-surface investigation including test pits and open area excavation and detailed artefact analysis.
AC14	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC15	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC16	Isolated Find	In	Low	Surface collection.
AC17	Artefact Scatter	In	Low	Surface collection.
AC18	Isolated Find	In	Low	Surface collection.
AC19	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
AC20	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek and within confluence of Big Flat creek within project disturbance area.
AC21	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC22	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC23	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek.
AC24	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC25	Isolated Find	In	Low	Surface collection.
AC26	Isolated Find	In	Low	Surface collection.
AC27	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek.
AC28	Artefact Scatter	In	Low	Surface collection.
AC29	Isolated Find	In	Low	Surface collection.

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
AC30	Artefact Scatter	In	Low	Surface collection.
AC31	Artefact Scatter	In	Low	Surface collection.
AC32	Artefact Scatter	In	Low	Surface collection.
AC33	Artefact Scatter	In	Low	Surface collection.
AC34	Artefact Scatter	In	Low	Surface collection.
AC35	Artefact Scatter	In	Low	Surface collection.
AC36	Isolated Find	In	Low	Surface collection.
AC37	Artefact Scatter	In	Low	Surface collection.
AC38	Rock shelter with isolated find and PAD	Out	Moderate to High	Conservation in Proposed Offset Area.
AC39	Artefact Scatter	In	Low	Surface collection.
AC40	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek.
AC41	Artefact Scatter	In	Low	Surface collection.
AC42	Shelter with Isolated Find and PAD	Out	Moderate	Conservation in Proposed Offset Area.
AC43	Artefact Scatter	In	Low	Surface collection.
AC44	Isolated Find	In	Low	Surface collection.
BFC01	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC02	Isolated Find	In	Low	Surface collection.
BFC03	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC04	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC05	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC06	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC07	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC08	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC09	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC10	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC11	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC12	Rock shelter with PAD	Out	High	Conservation in Proposed Offset Area.
BFC13	Isolated Find	In	Low	Surface collection.

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
BFC14	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
BFC15	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC16	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC17	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC18	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC19	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC20	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC21	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC22	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC23	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC24	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC25	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC26	Artefact Scatter	Out	Low to Moderate	Conservation in Proposed Offset Area.
BFC27	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC28	Artefact Scatter	Out	Low to Moderate	Conservation in Proposed Offset Area.
BFC29	Artefact Scatter	Out	Low to Moderate	Conservation in Proposed Offset Area.
BFC30	Artefact Scatter	In	Low to Moderate	Surface collection.
BFC31	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC32	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC33	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC34	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC35	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC36	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC37	Isolated Find	In	Low	Surface collection.
BFC38	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC39	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC40	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC41	Isolated Find	Out	Low	Conservation in Proposed Offset Area.
BFC42	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
BFC43	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area.
BFC44	Isolated Find	In	Low	Surface collection.
BFC45	Artefact Scatter	In	Low	Surface collection.
BFC46	Isolated Find	In	Low	Surface collection.
BFC47	Artefact Scatter	In	Low	Surface collection.
BFC48	Artefact Scatter	In	Low	Surface collection.
BFC49	Artefact Scatter	Out	Low	This site will not be impacted. The site will be managed in-situ, under the Aboriginal Heritage Management Plan
CG01	Shelter with Artefact Scatter and PAD	Out	Moderate to High	Conservation in Proposed Offset Area.
CG02	Isolated Find	In	Low	Surface collection.
CG03	Artefact Scatter	In	Low to Moderate	Surface collection and grader scrapes within confluence
CG04	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG05	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG06	Isolated Find	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG07	Isolated Find	In	Low	Surface collection
CG08	Shelter with Artefact Scatter and PAD	Out	Moderate	Conservation in Proposed Offset Area
CG09	Shelter with Artefact Scatter and PAD	Out	Moderate	Conservation in Proposed Offset Area
CG10	Shelter with Artefact Scatter and PAD	Out	Moderate to High	Conservation in Proposed Offset Area
CG11	Isolated Find	Out	Low	Conservation in Proposed Offset Area

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
CG12	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG13	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG14	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG15	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG16	Artefact Scatter	In	Low	Surface collection and grader scrapes both sides of creek and across creek confluence with Big Flat Creek within project disturbance area and detailed geomorphic investigation
CG17	Isolated find	In	Low	Surface collection
CG18	Artefact Scatter	In	Low to Moderate	Surface collection
SC01	Isolated Find	Out	Low	This site is no longer within the Proposed Disturbance Area as the rail loop has been modified. The site will be managed under an Aboriginal Heritage Management Plan
SC02	Artefact Scatter	Out	Low	This site is no longer within the Proposed Disturbance Area as the rail loop has been modified. The site will be managed under an Aboriginal Heritage Management Plan
SC03	Artefact Scatter	Out	Low	This site is no longer within the Proposed Disturbance Area as the rail loop has been modified. The site will be managed under an Aboriginal Heritage Management Plan
SC04	Isolated Find	Out	Low	This site is no longer within the Proposed Disturbance Area as the rail loop has been modified. The site will be managed under an Aboriginal Heritage Management Plan
SC05	Isolated find	In	Low	Surface collection
SC06	Artefact scatter	In	Low	Surface collection
SC07	Artefact scatter	In	Low	Surface collection
SC08	Artefact scatter	In	Low	Surface collection
SC09	Isolated find	In	Low	Surface collection

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
SC10	Artefact scatter	Out	Moderate	This site is no longer within the Proposed Disturbance Area as the rail loop has been modified. Artefacts salvaged form the Proposed Disturbance Area will be placed within a fenced area within the SC10 site. The site will be managed under an Aboriginal Heritage Management Plan and will be available for access by the Aboriginal stakeholder groups.
SC11	Isolated find	In	Low	Surface collection
SC12	Artefact scatter	In	Low	Surface collection
SC13	Isolated find	In	Low	Surface collection
SC14	Artefact scatter	In	Low	Surface collection
WC01	Artefact Scatter	Out	Low to Moderate	Conservation in Proposed Offset Area
WC02	Artefact Scatter	Out	High	Conservation in Proposed Offset Area
WC03	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC04	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC05	Rock shelter with deposit	Out	High	Conservation in Proposed Offset Area
WC06	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC07	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC08	Artefact Scatter	Out	Low to Moderate	Conservation in Proposed Offset Area
WC09	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC10	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC11	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC12	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC13	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC14	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC15	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC16	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC17	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC18	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC19	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC20	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC21	Artefact Scatter	Out	High	Conservation in Proposed Offset Area

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
WC22	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC23	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC24	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC25	Shelter with Artefact Scatter and PAD	Out	High	Conservation in Proposed Offset Area
WC26	Shelter with Artefact Scatter and PAD	Out	High	Conservation in Proposed Offset Area
WC27	Shelter with Artefact Scatter and PAD	Out	High	Conservation in Proposed Offset Area
WC28	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC29	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC30	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC31	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC32	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC33	Shelter with Artefact Scatter and PAD	Out	Moderate	Conservation in Proposed Offset Area
WC34	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC35	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC36	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC37	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC38	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC39	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC40	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC41	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC42	Artefact Scatter	Out	Low	Conservation in Proposed Offset Area
WC43	Rock shelter with deposit	Out	Moderate to High	Conservation in Proposed Offset Area
WC44	Isolated Find	Out	Low	Conservation in Proposed Offset Area
WC45	Rock shelter with deposit and isolated find	Out	High	Conservation in Proposed Offset Area
WC46	Rock shelter with deposit	Out	High	Conservation in Proposed Offset Area

Site Name	Site Description	In or Out Project Disturbance Area	Archaeological Significance	Preferred Management Option
WC47	Rock shelter with deposit	Out	High	Conservation in Proposed Offset Area
WC48	Isolated Find	Out	Low	Conservation in Proposed Offset Area

The grader scrapes outlined for specific sites detailed in **Table 10.1** will be limited to the Proposed Disturbance Area. Should significant numbers of artefacts or features (such as hearths or heat treatment pits) be uncovered by the grader scrapes in any area, the grader scrapes will cease in that area and manual excavation will be undertaken to salvage the area of artefact concentration and/or features. Grader scraping may recommence at a distance thought appropriate by the relevant Aboriginal stakeholder group representatives and the archaeologist supervising the work.

The proposed surface salvage and subsequent analysis will be undertaken in accordance with the methodology outlined in **Appendix 11**. All registered Aboriginal community groups will be consulted regarding the salvage works and provided with an opportunity to be involved in fieldwork through a tender process. The results of the salvage and artefact analysis will be provided to the Aboriginal groups and DEC within two years of the conclusion of all sub-surface investigations.

The care and control of the artefacts retrieved during the salvage program is determined through consultation with the Aboriginal stakeholder groups and the DEC (refer to **Appendix 11**). MC, MCC and UHHC are the only groups that have provided written feedback in relation to the “Care” of the artefacts. All three groups stated that they would like to see the artefacts salvaged placed at site SC10 which is to be conserved in perpetuity. MCC also suggested some of the artefacts be returned to WLALC.

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APPENDIX 1

Copy of correspondence provided to DEC on 16 December 2004

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16 December 2004

Mr Liam Dagg
Acting Manager Conservation Planning
Environment Protection & Regulation Division
North East Branch
Department of Environment and Conservation
Locked Bag 914
COFFS HARBOUR 2410

Dear Liam

Re: Anvil Hill Project Aboriginal Consultation Program

As you are aware, Umwelt (Australia) Pty Limited has been commissioned by Centennial Hunter to undertake the Aboriginal archaeological assessment of the area proposed for open cut mine development in the Wybong area, west of Muswellbrook (the Anvil Hill Project). Taking into account your suggestions at our recent meeting (19 November 2004) we have prepared an Aboriginal consultation program which we believe addresses the matters discussed and will allow Umwelt to provide our services to Centennial Hunter in a timely manner.

The following is a schedule and description of each of the steps we envisage for the Aboriginal Consultation Program.

Aboriginal Consultation Program

1. Centennial Hunter will circulate a letter to DEC's currently listed relevant Aboriginal interest groups/Elders introducing the Company and providing a brief description of the Anvil Hill project. The letter will advise that Umwelt has been commissioned to undertake the Aboriginal archaeological assessment for the project and that a full program of Aboriginal consultation is to be undertaken. It will also indicate that there will be an inaugural meeting to provide further details of the project and to consult in relation to the field survey strategy and the potential for offsetting any identified items of heritage significance. This letter will include a map indicating the proposed mine area. It will also discuss Centennial Hunter's willingness to address the potential ecological and cultural heritage implications of the project and to involve the local Aboriginal community in determining appropriate mitigation strategies.

2. Umwelt will then send a letter to the same groups/Elders inviting them to an inaugural meeting to be held at a venue in close proximity to the proposed mine (Note that this venue is yet to be finalised but is planned to be at Wybong, Muswellbrook or Denman). The letter will request that prior to the meeting the groups/Elders make inquiries amongst their members and the general Aboriginal community to ascertain if there are any known cultural heritage issues within the proposed mine area and/or if there are any stories known about the area. It will be requested that this information be brought along to the meeting so that it can be taken into account when preparing the survey strategy and be considered in all later discussions related to significance and management recommendations (it is recognised that even if nobody comes forward at this stage that information may emerge as the project progresses). At the same time the letter is sent, Centennial Hunter will advertise the inaugural meeting in a local Muswellbrook paper, the Sydney Morning Herald or the Australian and the Koori News. The advertisement will invite interested Aboriginal groups/people (that have not received letters of invitation) to contact Umwelt if they wish to participate in the inaugural meeting. Respondents will be provided with details about the meeting and the agenda. The agenda for the meeting will be as follows:

- Coffee/tea on arrival.
- A discussion of the nature of the Anvil Hill project presented by Centennial Hunter.
- Break for coffee/tea.
- A workshop related to gaining an understanding of what the meeting participants think are important features/aspects of any potential offset area. The workshop will be facilitated by Umwelt and will take the form of a brainstorming session (ideas collated on a whiteboard)
- Lunch
- Brief tour of a section of the proposed mine and surrounding area (the tour has to be restricted to areas where landholders give permission for access).
- Return to hall for a second workshop. Based on the information presented to the participants throughout the day they will be invited to workshop the survey strategy. The workshop will be facilitated by Umwelt and will take the form of a brainstorming session (ideas collated on a whiteboard) followed by the actual plotting of the Aboriginal participants' suggestions onto an A1 copy of the map. This will be laminated so that it can be marked and erased as often as necessary. As the survey strategy is to be planned at this meeting, the groups will need to ensure that the representatives in attendance have the knowledge/permission to have input on their group's behalf. Copies of the survey strategy and outcomes of the meeting will be circulated to the groups/Elders following the meeting.
- Fieldwork participation. Following completion of this consultative approach, the survey design will be finalised, and the fieldwork program will be discussed. The survey strategy must take into account OH&S requirements, and landholder concerns of excessive vehicle movement causing damage to paddocks, noise and dust emissions and increased risk of bushfire. It is proposed that Aboriginal participation in the fieldwork will be as follows:

    i. Up to six Aboriginal participants (and two archaeologists) will be involved in the fieldwork for the first half of the survey period. (Please note: the time spent in the field for each group will depend on how many groups indicate an interest. If it remains at the present 12 groups we will suggest they each be involved for half of the survey. If a higher number of groups indicate an interest the days in the field for any participant may be lessened accordingly).
    ii. A similar arrangement will be implemented for the second half of the fieldwork.
    iii. Each group will be present for surveys within both the proposed mine area and surrounding areas as necessary.
    iv. All groups will be invited to be represented at the end of the survey period to visit all significant sites and/or areas identified by the Aboriginal groups. At this time management recommendations will be discussed (see dot point 3).
    v. Cultural issues raised by representatives at the pre-survey workshop will be taken into account in the survey strategy.
    vi. The survey needs to commence by February 2005. The Aboriginal participants will be required to walk long distances often in very steep and rugged landforms and carry their water needs (and on many occasions morning tea and lunch). Thus only people with adequate fitness levels should take part in the survey. Other representatives will have the opportunity to visit the sites/areas of significance at the end of the survey period (see dot point iv above).
    vii. Payment to the groups for the survey will be discussed. It is envisaged that it will take the form of a job package approach with each group paid a flat rate per day plus travelling expenses. All participants will be required to hold both Public Liability and Workers Compensation insurances, and will need to participate in a safety induction process prior to fieldwork.

3. At the end of the survey period a second meeting will be held where:

   i. Results of the survey will be presented (all sites and areas identified as having cultural heritage significance) in a PowerPoint presentation.
   ii. Group/Elder representatives will then be invited to visit all those sites identified as significant from an Aboriginal cultural heritage perspective and any sites for which further investigation is thought warranted. During the visit management recommendations will be discussed for the sites within the proposed mine impact area (collection, subsurface salvage) and within the potential offsets (management under an Aboriginal Cultural Heritage Management Plan). In view of the planned discussions it will be recommended that the representatives sent by the groups be people that are in the position to make informed comment and report the results of the visit back to their own group.
   iii. Group/Elder representatives will be invited to have further input to the Aboriginal significance of the proposed mine development area and the proposed ameliorative strategies.

4. Following the second meeting input from the meeting/site visit will be included in the draft report.

5. A third meeting will be held where the findings of the draft report will be presented to the groups/Elders as a PowerPoint presentation and hard copies circulated for their written comment. The groups will be given 10 working days to supply their informed comment for inclusion in the final report.

DEC Consultation

DEC (including Glenn Morris) will be invited to attend all meetings with the Aboriginal community and if not present will be kept up to date with written reports on the outcomes of the meetings. DEC will also be afforded the opportunity to take part in the consultation process during the field survey period. Further meetings with DEC will be organised if required to present the results of the survey and assessment prior to finalisation of the draft report. Field visits/site visits will be provided to DEC if required.

Due to the current uncertainty surrounding DEC's requirements in relation to Aboriginal consultation, it would be appreciated if DEC would supply written feedback on the adequacy of the Aboriginal consultation program outlined above so that Umwelt can organise the inaugural meeting shortly after the Christmas break (at present we are planning to have the meeting in mid-January 2005). If DEC requires any further information or clarification of any of the points listed above please ring either Ben Ferris or myself on 4950 5322.

Yours faithfully

J. Wilson

Jan Wilson
Aboriginal Archaeology Manager

APPENDIX 2

Geotechnical Report for Rockshelters

GEOTECHNICAL INVESTIGATION

ANVIL HILL PROJECT WYBONG DISTRICT

Prepared for

UMWELT AUSTRALIA

On behalf of

CENTENNIAL HUNTER PTY LTD

Prepared by

RCA AUSTRALIA

RCA ref 5384-004/1
CLIENT ref 1858

June 2006

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LANDSLIDE RISK ASSESSMENT – EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Hydrogeology
Contaminated Site Assesment
Contaminated Site Auditing
Construction Materials Testing
Construction Quality Control
QMS Auditing

RCA ref 5384-004/1
Client ref 1858

15 June 2006

Umwelt (Australia) Pty Limited
PO Box 838
TORONTO NSW 2283

Attention: Mr Ben Ferris

GEOTECHNICAL INVESTIGATION
ANVIL HILL PROJECT, WYBONG ROAD, WYBONG

1 INTRODUCTION

This report describes a geotechnical investigation carried out for the proposed Anvil Hill Project located in the vicinity of Wybong, New South Wales.

This work was commissioned by Umwelt (Australia) Pty Limited (herein referred to as Umwelt) on 13 February 2006 (Umwelt letter reference: 130206a).

Based on information provided by Umwelt (Ref [1]) and discussions with Umwelt, it is understood that the geotechnical investigation is required to assess the potential impact of blasting on rock shelters and structures within or adjacent to the Anvil Hill Project area.

Data provided in relation to the project comprised:

- Background information pertaining to the Anvil Hill Project, dated 30 January 2006 compiled by Umwelt (Ref [1]). Attachments to this letter included: site locality plan, site stratigraphy and an aerial photograph showing the approximate locations of sixteen (16) selected rock shelters.
- Report by Wilkinson Murray Pty Ltd, "Blast Overpressure and Vibration: Evaluation of Impacts for Hunter Valley Mines" (Ref [2]).

- Centennial Hunter Pty Limited (Centennial) structure plan and selected bore logs for the Great Northern Seam within the Anvil Hill Project Area.

This report contains descriptions of the rock shelters and structures inspected at the site together with comments on existing risk of instability and potential impact of mine blasting. The factual data on which this report is based is presented in the attached appendices.

2 REVIEW OF AVAILABLE DATA

2.1 SITE LOCATION

A copy of a locality plan produced by Umwelt (Figure 1) for the Anvil Hill Project is presented in Appendix A.

A copy of an aerial photograph showing the approximate locations of selected rock shelters and structures compiled by Umwelt is attached in Appendix A. This photo indicates the rock shelters and structures are located on cliff faces associated with rock escarpments within and adjacent to the boundaries of the Anvil Hill Project disturbance area.

2.2 REGIONAL GEOLOGY

Reference to the Hunter Coalfield Regional Geology 1:100,000 scale geology sheet indicates the rock escarpments and rock shelters are located within the Narrabeen group of sedimentary rocks which overlie the coal measures in the Wybong area. Inspection of rock shelters and structures within the Anvil Hill Project and its immediate environs indicates they occur in Conglomerate escarpments and outcrops.

A typical stratigraphic section for the Anvil Hill Project supplied by Centennial (Figure 2 Appendix A) indicates the stratigraphy within the Anvil Hill Project has adopted Newcastle Coal Measures nomenclature.

None of the principal geological structures identified by Centennial on a geological structure interpretation map of the Anvil Hill project area intersect with the subject rock shelters and structures. Some minor faults shown on the Centennial structure interpretation are in close proximity to some of the sixteen selected rock shelters and structures.

2.3 BLAST DESIGN

The blast design is currently under review. The most recent advice was received from Umwelt via email on 17 May 2006. This email indicated Centennial has committed to a blast design that will protect the integrity of the rock shelters and rock structures. After discussions with Centennial, a blast vibration frequency of 10Hz or greater has been assumed for blast induced impact analysis.

The estimated impact of blast induced vibration was assessed using several references (Ref [2] to [8]) as listed after Section 5.4 of this report. The principal references used were:

- Reference [3] Standards Association of Australia, AS 2187.2-2006: Explosive – Storage and Use Part 2: Use of Explosives, Standards Association of Australia, 2006; and

- Reference [4] Australian Coal Association Research Programme, Final Report, Structure Response to Blast Vibration, ACARP C9040, November 2002.

The relevant extracts from AS 2187 are attached in Appendix B.

3 FIELD INVESTIGATIONS

Field work was conducted on 1 and 2 March 2006 and 4 May 2006, and guided by an Umwelt archaeologist fourteen (14) rock shelters and two (2) landmark rock structures were inspected by our senior engineering geologist. Two additional rock shelters were assessed from photographs supplied by Umwelt. The inspections comprised:

- detailed mapping and digital photography of each rock shelter and structure visited by our Senior Engineering Geologist;

- assessment of the existing stability of each rock shelter and structure and the potential impact of long-term erosion and proposed blasting.

Approximate locations for the rock shelters are shown on the attached aerial photo produced by Umwelt in Appendix A. The landmark rock structures known as “Anvil Rock” and “The Book” are located on the southern arm of Anvil Hill.

4 ROCK SHELTERS AND STRUCTURES DESCRIPTION

General descriptions are given below, with detailed descriptions of each rock shelter and landmark rock structure assessed presented on the Inspection Reports in Appendix C.

4.1 WALLABY ROCKS

In general the rock shelters are located along the base of conglomerate rock escarpments some twenty to forty metres in height. It appears the rock shelters have been formed by preferential weathering of weaker sandy beds or lenses that occur within the more competent massive conglomerate rock mass. These weaker sandy beds and/or lenses are characterised by clay and/or chlorite cement/matrix.

The dimensions of the inspected rock shelters and structures ranged from 15 to 50m in length, 1 to 5m in height and 1m to 5.5m deep.

4.2 ANVIL HILL

In general the rock shelters are located along the base of conglomerate rock escarpments or slopes some ten to twenty metres in height. The weathering processes that formed these rock shelters appeared to be similar to that observed at the Wallaby Rocks shelters and structures.

The dimensions of the inspected rock shelters ranged from 5 to 30m in length, 0.5 to 4m in height and 2m to 7.5m deep.

At the request of Umwelt two (2) landmark rock structures located on the southern arm of Anvil Hill were included in the blast impact assessment. These landmark rock structures are known as “Anvil Rock” and “The Book”. “Anvil Rock” is located on the crest of a ten metre high escarpment and “The Book” is located on the western side the same escarpment.

4.3 LIMB OF ADDY HILL

Only one rock shelter (Site ID AC38) was inspected in this locality. In general the conglomerate outcrop formed an irregular rock slope rather than an escarpment as observed at Wallaby Rocks. Rock shelters were smaller and occurred more randomly up and the down sloping rock outcrop. The rock shelter inspected and others observed nearby were typically less than 10m wide and less than 2m high.

The weathering process that formed these rock shelters appeared to be similar to that observed at the Wallaby Rocks shelters.

4.4 WESTERN ROCKS

In general the conglomerate outcrop formed an irregular rock slope near the top of the hill rather than an escarpment as observed at Wallaby Rocks. The rock shelters were smaller and occurred more randomly up and the down sloping rock outcrop compared to Wallaby Rocks. The weathering process that formed rock shelters and structures in this locality appeared to be similar to that observed at the Wallaby Rocks shelters.

The dimensions of the inspected rock shelters ranged from 5 to 24m in length, 1 to 3m in height and 1m to 4 in depth.

5 DISCUSSION AND COMMENTS

5.1 BLAST INDUCED IMPACT MECHANISMS ON ROCK SHELTERS AND LANDMARKS

The blast induced impact on the rock shelters and landmark rock structures will comprise ground vibration and air pressure waves. An assessment of the blast impact mechanisms on the rock shelters and landmark rock structures inspected is discussed below.

5.1.1 GROUND VIBRATION

Blast induced ground vibration is commonly measured in terms of Peak Particle Velocities (PPV). Wilkinson Murray Pty Ltd (Ref [2]) predicted PPV at rock shelters and landmark rock structures using explosive charge weight scaling formulae.

Reference to AS2187.2-2006, Appendix J, Section J4, pp.116 (Ref [3]) indicates "…ground vibration levels can vary from two-fifths to four times that estimated" using explosive charge weight scaling formulae. A copy of AS2187.2-2006, Section J4 is attached in Appendix B of this report.

Reference to Spathis and Brodbeck (Ref [5]) pp.2-3 indicates, "The occurrence of repetitive loading, such as that caused by routine blasting is rarely a problem for the integrity of a structure, unless the frequency [*of the blast*] coincides with a natural frequency of some element of the structure".

Reference to AS2187.2-2006 section J4, pp.105 to 109 (Ref [3]) indicates frequency dependent criteria are the recommended approach for assessing ground vibration damage to structures.

Reference to AS2187.2 (Ref [3]), ACARP C9040 (Ref [4]), Armstrong (Ref [8]) and Figure 4 of Wilkinson Murray (Ref [2]) indicates cosmetic damage threshold for PPV ranges from 15mm/s at frequencies of = 4Hz up to 27mm/s at 20Hz.

Cosmetic damage is defined in Table J4.4.2.2 of AS2187.2 (Ref [3]) as, "The formation of hairline cracks … or propagation of existing cracks in plaster or drywall surfaces; …the formation of hairline cracks in the mortar joints of brick/concrete block construction".

Wilkinson Murray Pty Ltd (Ref [2]) did not model blast vibration frequency. Information from Umwelt indicates Centennial has committed to a blast induced ground vibration frequency at a level which will protect the integrity of the rock shelters and structures. After discussions with Centennial, a blast vibration frequency of 10Hz or greater has been assumed for blast induced impact analysis. For a blast design with a nominal ground vibration frequency of 10Hz the cosmetic damage threshold PPV would be 18 mm/s. This threshold PPV was taken from Figure J4.4.2.1 presented in AS2187.2 (Ref [3]) and included in Appendix B of this report.

Wilkinson Murray Pty Ltd (Ref [2]) preliminary blast model indicated PPV ground vibration impacting selected rock shelters and landmark rock structures ranged from 1 mm/s up to and exceeding 400 mm/s, that is well above the cosmetic damage threshold. Blast induced ground vibrations well in excess of the cosmetic damage limit have the potential to cause minor and major damage to the rock shelters and landmark rock structures as defined in Table 1 Section 5.3 of this report.

The potential blast induced damage implications to rock shelters and landmark rock structures are discussed in Section 5.2 of this report.

5.1.2 OVERPRESSURE

Typical overpressure damage criteria as cited in ACARP C9040 (Ref [4]) indicates overpressure greater than or equal to 151 dBL is likely to cause occasional window damage. Overpressure equal to or greater than 171 dBL is likely to cause frequent window damage.

Blast modelling by Wilkinson Murray (Ref [1]) for the Anvil Hill Project indicates overpressure at the rock shelters and landmark rock structures will range from 100 to 150 dBA.

The modelled overpressure is less than or equal to lower bound damage threshold for occasional window damage as indicated in Section J5 of AS2817.2-2006 (Ref [3]). A copy of AS2817.2-2006 (Ref [3]) Section J5 is attached in Appendix B of this report.

Based on inspection of selected rock shelters and landmark rock structures it is unlikely the modelled range of overpressure will cause significant damage to rock shelters and landmark rock structures.

5.2 POTENTIAL BLAST INDUCED DAMAGE TO ROCK SHELTERS AND LANDMARKS

Based on inspection of selected rock shelters and landmark rock structures, blast induced ground vibrations have the potential to cause cosmetic, minor and major damage.

5.2.1 COSMETIC DAMAGE POTENTIAL CONSEQUENCES

All of the selected sites are vulnerable to cosmetic damage, however this type of damage would be difficult to differentiate from natural weathering processes. The cosmetic damage is likely to present as:

- an increased rate of sloughing of weathered crust from weaker sandy beds/lenses resulting in undercutting and loss of support;
- propagation and/or opening of existing defects along joints and bedding partings.

5.2.2 MINOR DAMAGE POTENTIAL CONSEQUENCES:

- Destabilise 'perched' boulders along cliff line; with the potential for boulder(s) to roll or topple down slope. This event is unlikely to impact the artefact bearing soil deposits in the floor of the rock shelters, however access to shelters may be affected. The selected sites that are vulnerable to this type of damage are Site ID: WC47 and WC25.
- New cracks propagated in conglomerate roof, which may compromise the stability of the rock shelters and prevent safe access to the artefact bearing soil deposits on the floor of rock shelters. All of the selected sites are vulnerable to this type of damage.

5.2.3 MAJOR DAMAGE POTENTIAL CONSEQUENCES

- Detachment of “hanging” joint bounded blocks observed adjacent to or within rock shelters that may disturb artefact bearing soil deposits on floor of rock shelters. The selected sites that are vulnerable to this type of damage are Site ID: WC46, CG09 and CG10.

- The partial or complete collapse of roof cantilevers and cliff overhangs, which may sterilise sections of artefact bearing soil deposits on the floor of the rock shelters. The selected sites that are vulnerable to this type of damage are Site ID: WC05, WC43, WC45, CG01, AC42 and AC38.

- Toppling of “Anvil Rock” or change in appearance of “The Book”.

5.3 RISK ASSESSMENT OF BLAST INDUCED DAMAGE ON ROCK SHELTERS AND STRUCTURES

In assessing the risk of blast induced damage of the rock shelters and landmark rock structures the following factors have been taken into consideration:

- The dimensions and resonant frequency of the rock shelters and landmark rock structures.

- The apparent weathering and strength of the rock mass.

- The frequency and condition of bedding partings and joint defects in the rock mass within and adjacent to the rock shelters/structures.

- The qualitative consequences of blast impact on rock shelters and landmark rock structures.

The qualitative terms used to describe the risk of blast impact damaging the rock shelters and landmark rock structures are defined in Table 1.

The risk assessment for each of the rock shelters and landmark rock structures inspected is presented on the inspection reports in Appendix C and analysis of significant damage due to blast impact is on Table D1 in Appendix D and summarised in Table 2 to Table 4.

The risk level at each of the rock shelters and landmark rock structures has been assessed using the Australian Geomechanics Society risk analysis matrix presented in Appendix E, adapted damage classifications from AS 2187.2-2006 Table J4.4.2.2 attached in Appendix B and potential blast damage as discussed in Section 5.2 of this report.

Table 1 *Risk Level Implications*

Risk Level		Example Implications (1)
H	High Risk	Major damage is possible as a result of blast impact. Major damage defined as rock shelter roof fall/collapse or change in appearance of landmark rock structures.
M	Moderate Risk	Minor damage is possible as a result of blast impact. Minor damage is defined as the formation of new defects in the rock mass and possible detachment of "hanging" joint blocks.
L	Low risk	Cosmetic damage is possible as a result of blast impact. Cosmetic damage defined as an increased rate of sloughing of the weathered crust from weaker sandy beds/lenses and the propagation of existing defects along joints and bedding partings.

Note:

(1) Damage classification adapted from AS 2187.2-2006 Table J4.4.2.2 attached in Appendix B of this report and potential blast induced damage consequences as discussed in Section 5.2 of this report.

Comments in parentheses relate to features adjacent to rock shelters which have the potential to affect access or the amenity of the rock shelters.

Table 2 *Estimated Risk of Blast induced Damage for Selected Rock Shelters at Wallaby Rocks*

Old Site ID	New Site ID	Morphology	Roof conditions	Estimated Risk of Damage
16	BFC 12	Weathered recess at base of massive Conglomerate cliff face	Massive Conglomerate bedding parting. > 3m; joint spacing. >5m.	Low
17	WC 47	Weathered recess at base of massive conglomerate cliff face. (“Perched“ boulders on cliff crest above.)	Massive conglomerate, bedding parting. > 3m; joint spacing >20m. (Cliff top boulders)	Low (High)
18	WC 43	Weathered recess at base of massive conglomerate cliff face. (Relatively thin cliff top overhang with pervasive defects.)	Bedded conglomerate, bedding parting. 0.3-5m; joint spacing >10m. (Cliff top overhang)	Low (High)
22	WC 45	Conglomerate/sandstone roof with cantilevered sections and defects that daylight in cliff recesses above shelter. (Cliff top overhang with pervasive defects)	Bedded conglomerate, bedding parting. > 1m; joint spacing > 4m (Cliff top overhang)	Moderate (Moderate)
23	WC 46	Weathered recess at base of massive Conglomerate cliff face (“Hanging” joint bounded blocks on overhang of shelter)	Massive conglomerate, no bedding partings; joint spacing >2m (“Hanging” joint blocks)	Low (High)
25	WC 05	Weathered recess at base of massive Conglomerate cliff face. (Laminated sandy roof sections)	Bedded conglomerate, bedding parting. > 2.5m; joint spacing >18 m (Laminated roof)	Low (Moderate)

Table 1 *Estimated Risk of Blast induced Damage for Selected Rock Shelters at Anvil Hill*

Old Site ID	New Site ID	Morphology	Roof conditions	Estimated Risk of Damage
42	CG01	Conglomerate/sandstone cantilever roof with multiple recesses and defects that daylight in overhead rock face.	Cantilevered conglomerate beds partially separated from rock mass above bedding parting 0.4-2m; joint spacing >3 m	Moderate to High
50	CG08	Rock "Igloo" weathered recess in base of isolated massive conglomerate domed outcrop.	Massive conglomerate, joint spacing >1m	Low
51	CG09	Weathered recess at base of massive conglomerate cliff face (“Hanging” joint bounded blocks on rock face above shelter)	Bedded conglomerate, bedding parting. 1-3m; joint spacing >2m (“Hanging” joint blocks)	Low (Moderate)
52	CG10	Weathered recess at base of massive conglomerate cliff face (“Hanging” joint bounded blocks on rock face above shelter)	Bedded conglomerate, bedding parting. 1-7m; joint spacing >2m (“Hanging” joint blocks)	Low (Moderate)

Table 2 *Estimated Risk of Blast induced Damage for Selected Rock Shelters and at Limb of Addy Hill & Western Rocks*

Old Site ID	New Site ID	Morphology	Roof conditions	Estimated Risk of Damage
80	WC25	Rock "Cave" weathered recess in base of massive conglomerate rock slope. (“Perched” boulder on rock slope above)	Bedded conglomerate, bedding parting. 1-2m; joint spacing >7m (“Perched” boulder)	Low (Moderate)
81	WC26	Weathered recess near top of massive Conglomerate cliff face	Massive conglomerate, bedding parting. 0.5-3m; joint spacing >8m	Low
82 (1)	WC27	Weathered recess in massive Conglomerate rock mass.	Bedding in conglomerate roof	Low (1)
115 (1)	AC42	Weathered recess in massive Conglomerate rock mass.	Bedding in conglomerate roof	Moderate (1)
134	WC33	Weathered recess in base of isolated massive conglomerate domed outcrop.	Massive conglomerate, bedding parting. 1-3m; joint spacing > 5m.	Low
175	AC38	Conglomerate cantilevered roof with defects that daylight in overhead rock face.	Bedded conglomerate, bedding parting. 0.5-3m; joint spacing >3m.	Moderate

Notes:
(1) Risk assessed from photographs and measurements suppled by Umwelt.

Table 3 *Estimated Risk of Blast Induced Damage for Selected Landmark Rock Structures on the Southern Arm of Anvil Hill*

Name	Morphology	Condition	Estimated Risk of Damage
The Book (1)	A recessed conglomerate/ sandstone cliff face divided in half by a near vertical "Spinal" joint., with a rock overhang above. "Pages" are approximately 7 to 8m high and 2 to 2.5m wide.	An unsupported rock overhang projects approx. 2 to 3m out over "pages".	Moderate (1)
Anvil Rock (1)	Free standing Conglomerate/sandstone pedestal, with preferentially weathered 'neck' approximately 1.5m above ground level.	Massive Conglomerate crown supported on a friable 'neck' and base. Crown diameter up to 1.5 neck diameter.	High (1)

Notes:
(1) Risk assessed from photographs suppled by Umwelt and estimated measurements.

5.4 SIGNIFICANT DAMAGE

Given the potential consequences of blast impact on the rock shelters and landmark rock structures as discussed in Section 5.2 of this report it was decided to define a significant damage threshold that would preserve these landscape features.

Based on inspection of selected rock shelters and landmark rock structures, discussions with Umwelt and with reference to available literature, a definition for significant damage was discussed and agreed to with Umwelt. The agreed definition is as follows:

- Significant damage is defined as blast induced impacts that significantly increase the risk of instability or impact the structural integrity of the rock shelters and landmark rock structures, resulting in the loss of amenity to the rock shelters and change in the appearance of the landmark rock structures.

Based on inspection of selected rock shelters/landmark rock structures and discussions with Umwelt it was decided cosmetic damage did not constitute "significant damage". Blast induced minor and major damage implications were considered to exceed the definition of significant damage.

5.5 METHODOLOGY FOR THE ESTIMATION OF THE SIGNIFICANT DAMAGE THRESHOLD

The detailed analysis for each rock shelter and landmark is presented on Table D1 in Appendix D of this report. The methodology for this analysis is discussed below.

For each of the selected rock shelters and landmark rock structures a four step process was devised to estimate a significant damage threshold that would preserve these landscape features from significant damage.

5.5.1 STEP - RCA MODEL

Review of available references (Ref [1] to [8]) indicates previous studies have focused on blast impact for man-made structures, in particular, residential dwellings. To facilitate a structured analysis of the selected rock shelters and landmark rock structures RCA has assumed the response of these rock structures to blast induced stresses would be similar to mass concrete structures of similar morphology and dimensions.

An outline of the RCA model procedure is presented in Appendix D.

5.5.2 STEP 2 - ESTIMATION OF RESONANT FREQUENCY

Applying static analysis from Section 6 of AS1170.4-1993 (Ref [7]) indicated the estimated mean vibration period or resonant frequency of the rock shelters and landmark rock structures ranges from 3Hz up 16Hz. A complete list of the estimated resonant frequencies of the rock shelters and landmark rock structures is presented in Table D1 in Appendix D of this report.

5.5.3 STEP 3 - ESTIMATION OF DAMAGE THRESHOLD

For each rock shelter and landmark a threshold Peak Particle Velocity range was estimated for cosmetic, minor and major damage levels. The analysis was based on the ACARP (Ref [4]) analysis of structure response to blast vibration, using the blast induced ground vibration frequency of 10 Hz proposed by Centennial and the observed morphology of each rock shelter and landmark presented in the inspection reports in Appendix C.

5.5.4 STEP 4 - ESTIMATION OF SIGNIFICANT DAMAGE THRESHOLD

Based on the definition for significant damage given in Section 5.4 of this report the initial damage threshold adopted for each rock shelter and landmark rock structure was the minor damage threshold PPV range. The minor damage threshold was then reduced based on the vulnerability of each rock shelter and landmark to blast induced damage.

The vulnerability of each rock shelter and landmark to blast induced damage was assessed using the following criteria:

- Reduce the initial threshold if the estimated risk of damage to the rock shelter or landmark rock structure is moderate or high.
- Reduce of the initial threshold if the mean resonant frequency of the rock shelter or landmark rock structure is within the range of 10 ± 2Hz.
- Reduce of the initial threshold if the cultural rating of the rock shelter or landmark rock structure is high.

The resultant estimated significant damage threshold for each rock shelter and landmark are presented in Table 6 of this report.

5.6 THE ESTIMATED SIGNIFICANT DAMAGE THRESHOLD FOR ROCK SHELTERS AND LANDMARK ROCK STRUCTURES

A detailed analysis for each of the selected rock shelters and landmark rock structures is presented in Appendix D and summarised in Table 6. In addition Table 6 presents treatment options that may assist in the preservation of culturally significant rock shelters and landmark rock structures. The assignment of treatment options is based on inspection reports presented in Appendix C and analysis presented in Appendix D.

5.6.1 TREATMENT OPTIONS

Centennial will investigate the following treatment options A to E as mining proceeds, to prevent significant damage to rock shelters and landmark rock structures from blast impacts.

Treatment Options are as follows:

A. Remove or stabilise cliff top boulders
B. Controlled detachment of joint bounded blocks or install stainless steel rock anchor(s) to fix in place.
C. Reinforcement of cantilevered roof rock beams with stainless steel tie rods bridging existing cracks/joints or ‘necks’.
D. Reinforcement of massive roof beams with stainless steel tie rods bridging existing joints.
E. Install stainless steel supports to increase stability of free standing rock formations.

Table 4 *Treatment options for selected rock shelters and landmark rock structures*

Old Site ID	New Site ID	Morphology	Estimated Risk of Damage(1)	Estimated Significant Damage Threshold(2)	Treatment Option (3)
16	BFC12	Weathered recess at base of massive Conglomerate cliff face	Low	= 210 to 280	D
17	WC47	Weathered recess at base of massive conglomerate cliff face. ('Perched' boulders on cliff crest above.)	Low (High)	= 180 to 230	D (A)
18	WC43	Weathered recess at base of massive conglomerate cliff face. (Relatively thin cliff top overhang with pervasive defects.)	Low (High)	= 140 to 200	D (C)
22	WC45	Conglomerate/sandstone roof with cantilevered sections and defects that daylight in cliff recesses above shelter. (Cliff top overhang with pervasive defects)	Moderate (Moderate)	= 90	C
23	WC46	Weathered recess at base of massive Conglomerate cliff face. ("Hanging" joint bounded blocks on overhang of shelter)	Low (High)	= 190 to 260	D (B)
25	WC05	Weathered recess at base of massive Conglomerate cliff face. (Laminated sandy roof sections)	Low (Moderate)	= 190 to 260	D
42	CG01	Conglomerate/sandstone cantilever roof with defects that daylight in overhead rock face.	Moderate to High	= 90	C
50	CG08	Rock "Igloo" weathered recess in base of isolated massive conglomerate domed outcrop.	Low	= 190 to 260	D
51	CG09	Weathered recess at base of massive conglomerate cliff face. ("Hanging" joint bounded blocks on rock face above shelter)	Low (Moderate)	= 170 to 240	D (B)
52	CG10	Weathered recess at base of massive conglomerate cliff face. ("Hanging" joint bounded blocks on rock face above shelter)	Low (Moderate)	= 200 to 260	D (B)
80	WC25	Rock "Cave" weathered recess in base of massive conglomerate rock slope. ("Perched" boulder on rock slope above)	Low (Moderate)	= 200 to 260	D (B)
81	WC26	Weathered recess near top of massive Conglomerate cliff face.	Low	= 140 to 200	D
82	WC27	Weathered recess in massive Conglomerate rock mass.	Low	= 140 to 200	D
115	AC42	Weathered recess in massive Conglomerate rock mass.		= 90	D
134	WC33	Weathered recess in base of isolated massive conglomerate dome.	Low	= 170 to 220	None
175	AC38	Conglomerate cantilevered roof with defects that daylight in overhead rock face.	Moderate	= 90	C
The Book		A recessed conglomerate/sandstone cliff face divided in half by a near vertical "Spinal" joint, with a cantilevered rock overhang above.	Moderate	= 90	C
Anvil Rock		Free standing Conglomerate/sandstone pedestal, with preferentially weathered 'neck' approximately 1.5m above ground level.	High	= 90	E

Notes:

(1) See Section 5.3 for explanation of Risk Assessment.
(2) Measured in terms of Peak Particle Velocity PPV (ground) mm/s. Refer to Sections 5.4 to 5.6 for discussion on Significant Damage.
(3) . Definitions for treatment options are given in Section 5.6.1 of this report.

Yours faithfully
RCA AUSTRALIA

Jeremy Everitt
Senior Engineering Geologist

Mark Delaney
Principal Engineering Geologist

REFERENCES

[1] Umwelt (Australia) Pty Limited, Re: Geotechnical Assessment, Aboriginal Rock Shelters, Anvil Hill Project, Umwelt (Australia) Pty Limited, Reference 300106a, 30 January 2006.

[2] Bullen, Dr R, Blast Overpressure and Vibration: Evaluation of Impacts for Hunter Valley Mines, Wilkinson Murray Pty Ltd.

[3] Standards Association of Australia, AS 2187.2-2006: Explosive – Storage and Use Part 2: Use of Explosives, Standards Association of Australia, 2006.

[4] Australian Coal Association Research Programme, Final Report, Structure Response to Blast Vibration, ACARP C9040, November 2002.

[5] Spathis, AT and Brodbeck, A, Future Directions in Ground Vibration and Air Blast Control within an Australian Regulatory Context, International Society of Explosives Engineers 2005.

[6] Spathis, AT, Fallacies in Blast Vibration Analysis, Orica Australia, October 2001.

[7] Standards Association of Australia, AS 1170.4-1993: Minimum design load on landmark rock structures, Standards Association of Australia, 1993.

[8] Armstrong, LW, Blast Induced Vibration Monitoring and Waveform Analysis.

Appendix A

Umwelt Figures

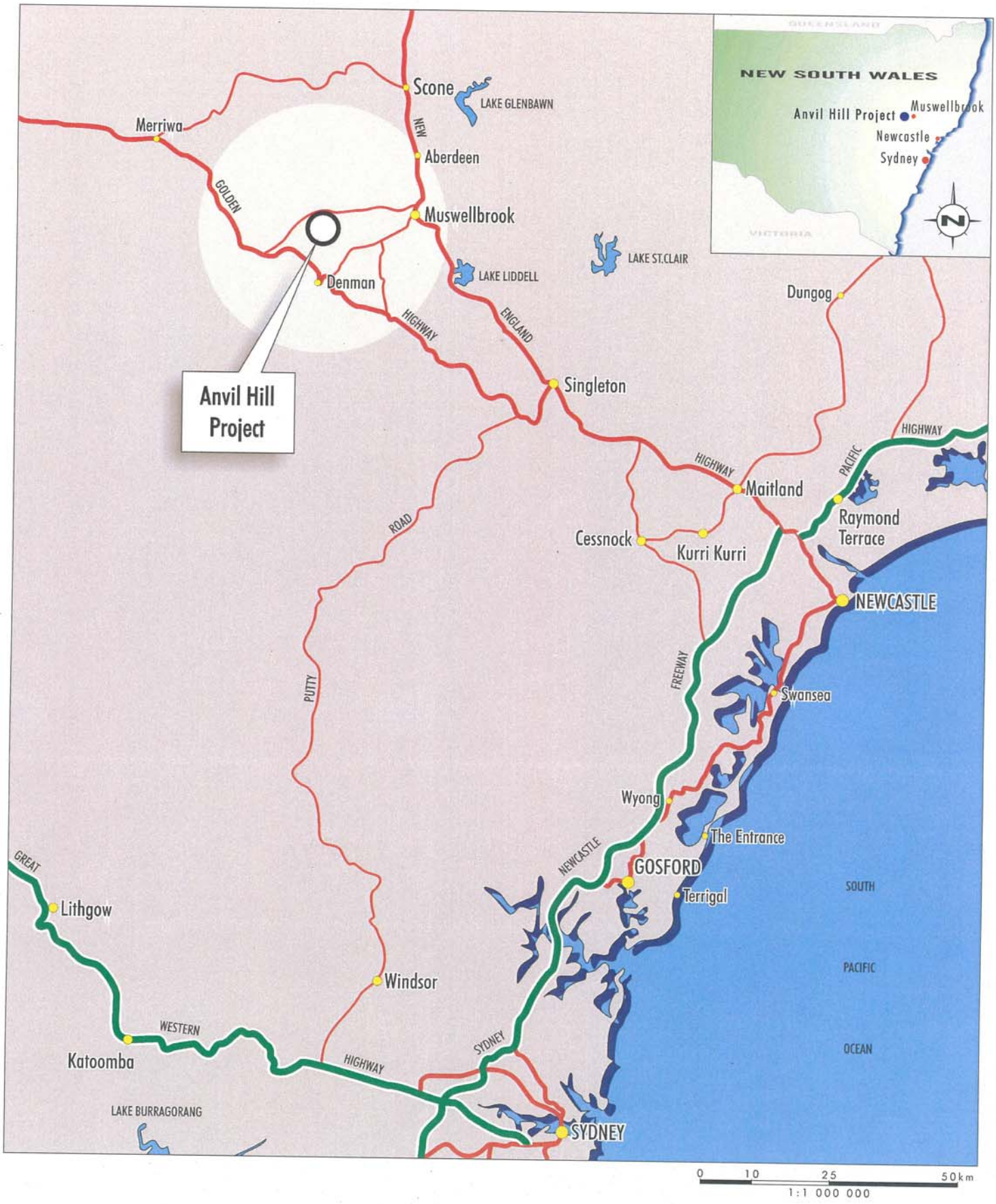


FIGURE 1

Locality Plan

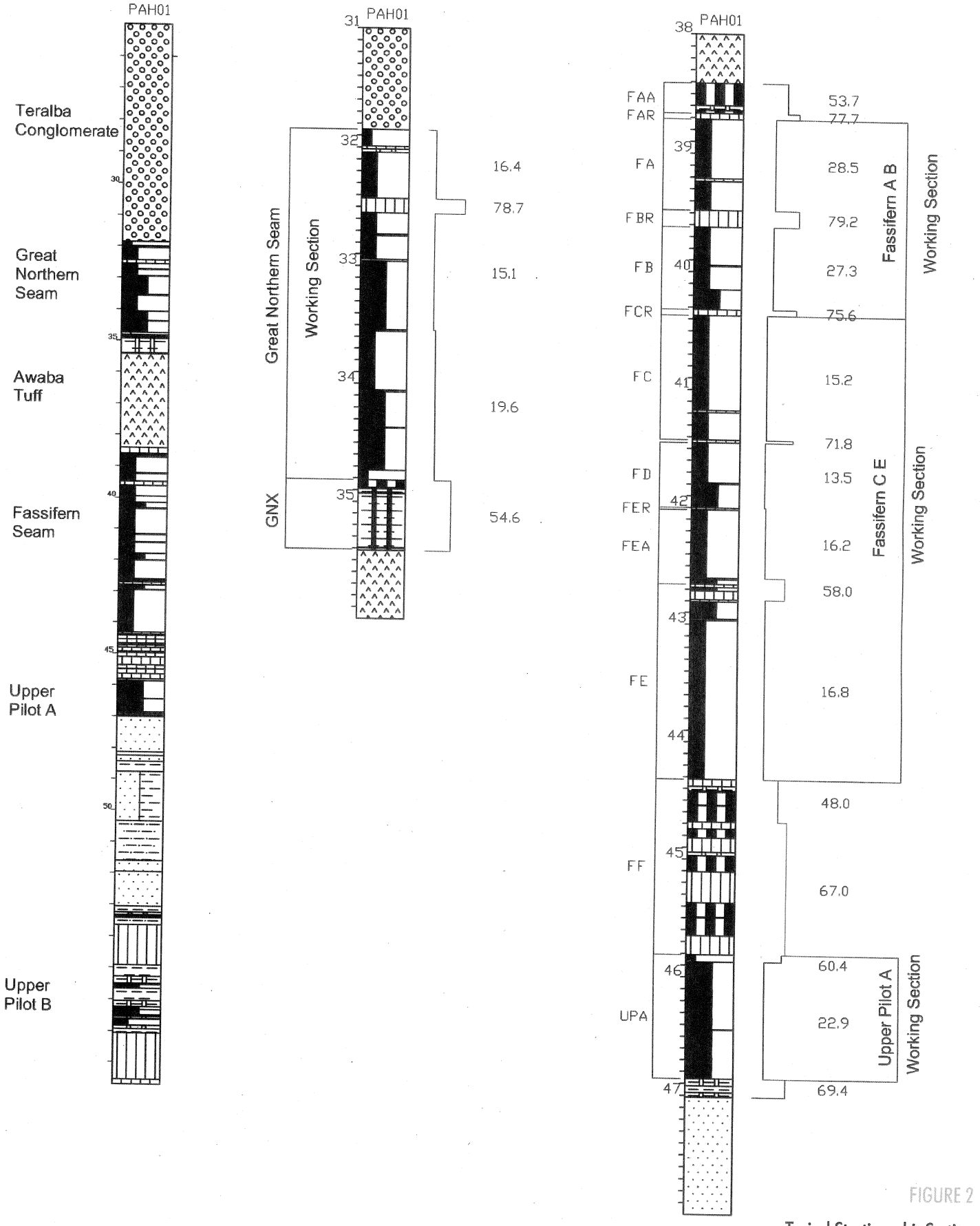
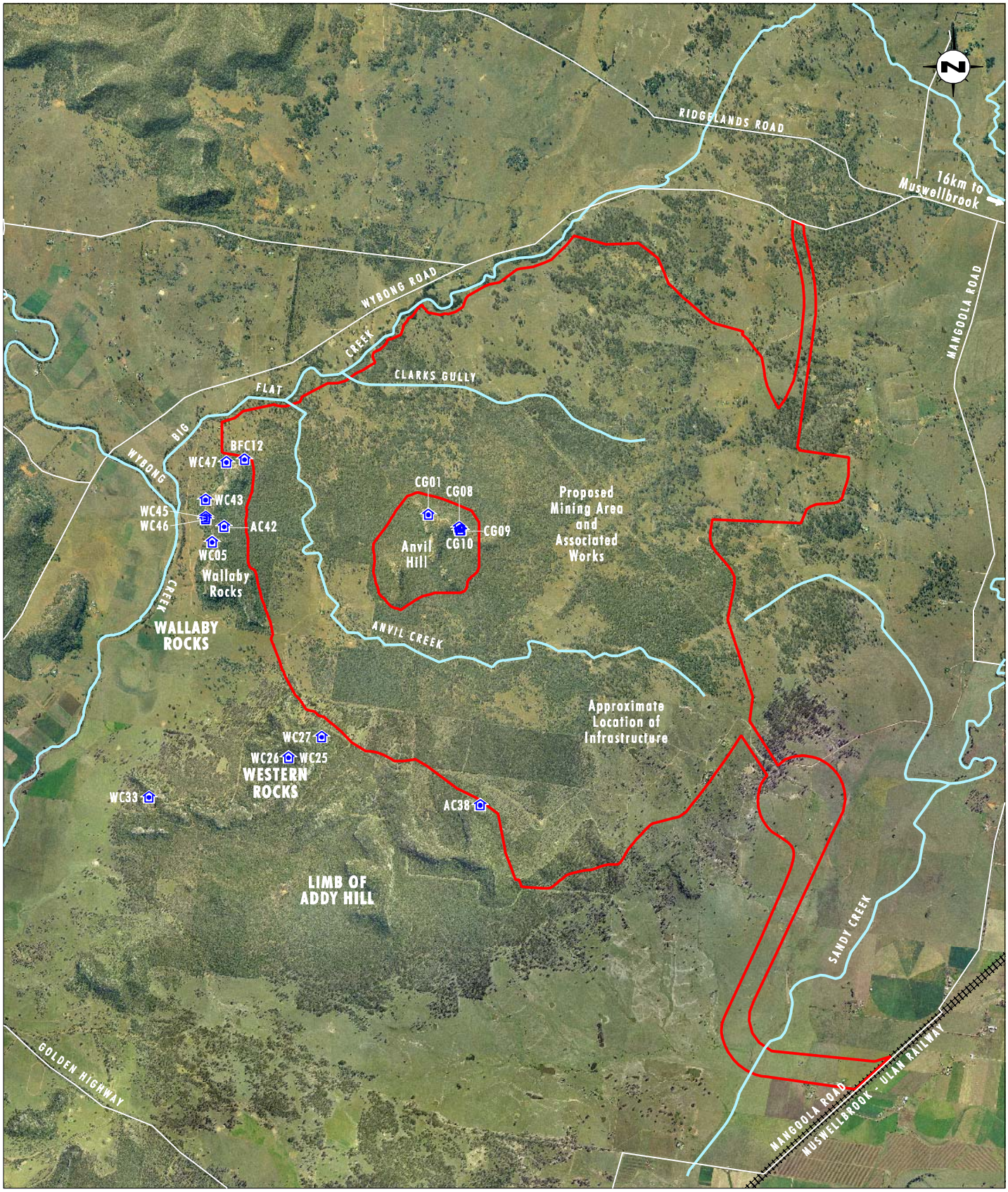


FIGURE 2

Typical Stratigraphic Section

Source: Centennial Hunter Pty Ltd

File Name (A4): V1/1858_280.dgn



Source: Centennial Hunter Pty Limited (2003), Umwelt (2004, 2005)

Legend

- Proposed Disturbance Boundary
- Aboriginal Rockshelter

FIGURE 3

Location of Aboriginal Rock Shelters
Anvil Hill Project

Umwelt revised Site ID and co-ordinates 13/4/06

Preliminary (old) Site ID	Site ID	Type	Coord System	Easting (m)	Northing (m)	Significance
115	AC42	SHELPAD	MGA56	279598	6425083	Moderate
16	BFC12	SHELPAD	MGA56	279791	6425715	High
42	CG01	SHELPAD	MGA56	281524	6425195	Moderate to High
50	CG08	SHELPAD	MGA56	281814	6425074	Moderate
51	CG09	SHELPAD	MGA56	281831	6425050	Moderate
52	CG10	SHELPAD	MGA56	281822	6425047	Moderate to High
25	WC05	SHELPAD	MGA56	279485	6424937	High
80	WC25	SHELPAD	MGA56	280206	6422908	High
81	WC26	SHELPAD	MGA56	280206	6422908	High
134	WC33	SHELPAD	MGA56	278890	6422533	Moderate
18	WC43	SHELPAD	MGA56	279424	6425336	Moderate to High
22	WC45	SHELPAD	MGA56	279423	6425173	High
175	AC38	SHELPAD	MGA56	282013	6422460	Moderate to High
23	WC46	SHELPAD	MGA56	279423	6425153	High
17	WC47	SHELPAD	MGA56	279620	6425688	High
82	WC27	SHELPAD	MGA56	280518	6423101	High

Shaded rows indicate coordinates have changed

Appendix B

AS2187.2-2006: Appendix J, Section J4, Ground Vibration Levels.

AS2187.2-2006: Appendix J, Section J5, Air Blast Levels

J4.4.3 *Frequency dependent levels*

Frequency-dependent guide levels described in British Standard BS 7385-2 and the United States Bureau of Mines (USBM) RI 8507 are given below. The levels specified are peak component particle velocities, and the methodologies used for assessing the frequencies, are similar in both documents.

The frequency-dependent guide values from BS 7385-2 for the prevention of minor or cosmetic damage occurring in structures from ground vibration are shown in Table J4.4.2.1 and Figure J4.4.2.1 below:

TABLE J4.4.2.1

TRANSIENT VIBRATION GUIDE VALUES FOR COSMETIC DAMAGE (BS 7385-2)

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structure. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

NOTES:

1 Values referred to are at the base of the building.

2 For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

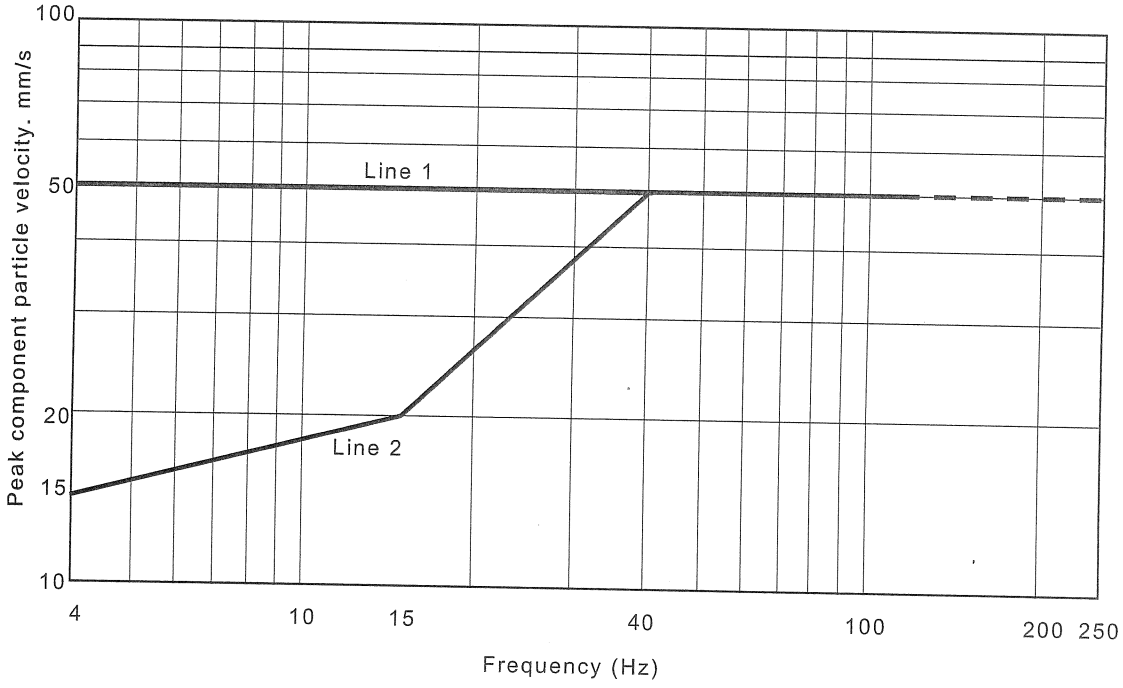


FIGURE J4.4.2.1 TRANSIENT VIBRATION GUIDE VALUES FOR COSMETIC DAMAGE (BS 7385-2)

British Standard 7385-1 damage classification is shown in Table J4.4.2.2.

TABLE J4.4.2.2

BS 7385-1:1990—DAMAGE CLASSIFICATION

Damage classification	Description
Cosmetic	The formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in the mortar joints of brick/concrete block construction
Minor	The formation of cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks
Major	Damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks etc.

The frequency dependent alternative blasting criteria for low-rise residential buildings given in (USBM) RI 8507 are shown in Figure J4.4.2.2 and Table J4.4.2.3.

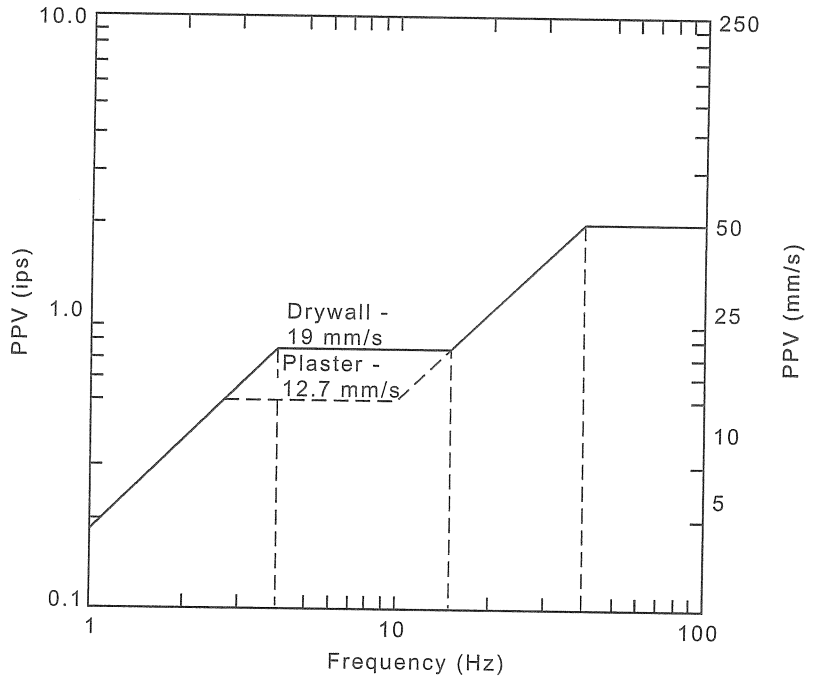


FIGURE J4.4.2.2 USBM 'SAFE' BLASTING VIBRATION LEVEL CRITERIA

USBM damage classifications are shown in Table J4.4.2.3.

TABLE J4.4.2.3

USBM DAMAGE CLASSIFICATION

Uniform classification	Description of damage
Threshold	Loosening of paint; small plaster crack at joints between construction elements; lengthening of old cracks
Minor	Loosening and falling of plaster; cracks in masonry around openings near partitions; hairline to 3 mm cracks (0 to 1/8 in); fall of loose mortar
Major	Cracks of several mm in walls; rupture of opening vaults; structural weakening; fall of masonry, e.g., chimneys; load support ability effected

Authoritative investigations (see Paragraph J8, Item 1) suggest that the guide values and assessment methods given in BS 7385-2 and (USBM) RI 8507 are applicable to Australian conditions, and are recommended for explosives users with the facilities to make use of these methods.

The estimation of the frequency of each vibration component to be used in structural damage assessment is complex. Simple approaches suggested within the BS 7385-2 and (USBM) RI 8507 includes—

(a) frequency of the maximum PPV amplitude peak;

(b) dominant frequency of the component vibration time history; and

(c) zero crossing frequency of the PPV amplitude peak.

The (USBM) RI 8507 and BS 7385-2 methodologies for assessing frequencies have been widely used for many years, and were suitable for use with desktop and laptop computers with the power that was commonly available in the 1980s and early 1990s. It appears that the motion frequencies determined by simple methods, such as zero crossing, are conservative for assessing damage potential.

NOTE: A method under development, which may give greater accuracy, uses the (USBM) RI 8507 frequency-dependent limits (which are similar to the limits specified in BS 7385-2) but with a more accurate methodology for assessing frequencies.

The method has been tested and published [see Fragblast 7–Beijing (1992) which may be found at http://www.isee.org and search their publications]. At the time of writing this Standard, software systems for the practical use of this method by explosives users were being developed, but were not in general use.

J4.5 Recommended ground vibration limits

NOTE: Statutory requirements for human comfort limits for ground vibration may apply in respective jurisdictions.

The maximum levels for ground vibration for human comfort, which some authorities have chosen, are provided in Table J4.5(A). Recommended limits for ground vibration for control of damage to structures are provided in Table J4.5(B).

Frequency-dependent limits have the capacity to precisely deal with the hazards presented by ground vibration and are seen as the basis for best practice blasting. The particular frequency-dependent criteria should be reported with the measurements. All the limits given in Tables J4.5(A) and J4.5(B) are peak component particle velocities, as used in overseas Standards and guidelines. The classification of type of structure may be difficult and when in doubt, a more conservative limit from the nearest description in Table J4.5(B) should be applied.

TABLE J4.5(A)

GROUND VIBRATION LIMITS FOR HUMAN COMFORT CHOSEN BY SOME REGULATORY AUTHORITIES (see Note to Table J4.5(B))

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Sensitive site*	Operations lasting for less than 12 months or less than 20 blasts	10 mm/s maximum unless agreement is reached with occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely effect the equipment operation

*A sensitive site includes houses and low rise residential buildings, theatres, schools, and other similar buildings occupied by people.

NOTE: The recommendations in Table J4.5(A) are intended to be informative and do not override statutory requirements with respect to human comfort limits set by various authorities. They should be read in conjunction with any such statutory requirements and with regard to their respective jurisdictions.

TABLE J4.5(B)

RECOMMENDED GROUND VIBRATION LIMITS FOR CONTROL OF DAMAGE TO STRUCTURES (see Note)

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency-dependent damage limit criteria Tables J4.4.2.1 and J4.4.4.1
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

NOTE: Tables J4.5(A) and J4.5(B) do not cover high-rise buildings, buildings with long-span floors, specialist structures such as reservoirs, dams and hospitals, or buildings housing scientific equipment sensitive to vibration. These require special considerations, which may necessitate taking additional measurements on the structure itself, to detect any magnification of ground vibrations that might occur within the structure. Particular attention should be given to the response of suspended floors.

J5 AIRBLAST LEVELS

J5.1 General

Airblast can cause discomfort to persons and, at high levels, damage to structures and architectural elements, and at very high levels, injury to persons.

The airblast levels at which people become annoyed are well below levels at which damage has been proven to occur. The evaluation of the effects of blasting should separate human response and structural/architectural damage effects of airblast. Of particular importance in this regard is the frequency content of the airblast. For example, an airblast that is inaudible to humans may still be responsible for structural/architectural damage effects. Conversely, an airblast level that causes human discomfort may have negligible structural/architectural damage effects. The limits set out in Paragraphs J5.2, J5.3 and J5.4 below offer a robust means for differentiating such effects and are based upon studies conducted by various workers in blasting.

The sound pressure level [*SPL* (*dBL*)] is defined as follows:

$$SPL = 10 \log_{10} \left(\frac{P}{P_0} \right)^2 \quad \ldots \text{J5.1}$$

where P is the pressure level (Pa) and P_0 is the reference pressure of 20 mPa. It is generally accepted that aural pain will occur in humans for *SPL* greater than 140 dBA for frequencies in the range 20 Hz to 20 kHz and for *SPL* between 160 dBL and 170 dBL for frequencies below 20 Hz.

General control limits currently used in Australia are not frequency dependent. It is probable that continuing research and development will result in the development of frequency-dependent limits and these should be adopted when available.

J5.2 Human comfort limits

NOTE: Statutory requirements for human comfort limits for airblast may apply in respective jurisdictions.

Human comfort limits for airblast are linked to the annoyance produced. Several factors contribute to annoyance by impulsive sounds such as airblast. These include the loudness, duration and number of events plus the time of day and the nature of the disturbance.

J5.3 Damage limits

From Australian and overseas research, damage (even of a cosmetic nature) has not been found to occur at airblast levels below 133 dBL. The probability of damage increases as the airblast levels increase above this level. Windows are the building element currently regarded as most sensitive to airblast, and damage to windows is considered as improbable below 140 dBL.

A limit of 133 dBL is recommended as a safe level that will prevent structural/architectural damage from airblast. Reference to Tables J4.4.2.2 and J4.4.2.3 should be made when classifying damage.

J5.4 Recommended airblast limits

Airblast limits for human comfort chosen by some regulatory authorities are provided in Table J5.4(A). Recommended damage control limits are given in Table 5.4(B). All the limits are expressed as peak linear sound pressure levels. The classification of type of structure may be difficult and, when in doubt, a more conservative limit from the nearest description in Table J5.4(B) should be applied.

TABLE J5.4(A)

AIRBLAST LIMITS FOR HUMAN COMFORT CHOSEN BY SOME REGULATORY AUTHORITIES (see Note to Table J5.4(B))

Category	Type of blasting operations	Peak sound pressure level (dBL)
Human comfort limits		
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% blasts per year. 120 dBL maximum unless agreement is reached with occupier that a higher limit may apply
Sensitive site*	Operations lasting for less than 12 months or less than 20 blasts	120 dBL mm/s for 95% blasts. 125 dBL maximum unless agreement is reached with occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely effect the equipment operation

* A sensitive site includes houses and low rise residential buildings, hospitals, theatres, schools, etc., occupied by people.

TABLE J5.4(B)

RECOMMENDED AIRBLAST LIMITS FOR DAMAGE CONTROL (see Note)

Category	Type of blasting operations	Peak sound pressure level (dBL)
Damage control limits		
Structures that include masonry, plaster and plasterboard in their construction and also unoccupied structures of reinforced concrete or steel construction	All blasting	133 dBL maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables located above the ground	All blasting	Limit to be determined by structural design methodology

NOTE: Tables J5.4(A) and J5.4(B) are intended to be informative and do not override statutory requirements, particularly with respect to human comfort limits set by various authorities. They should be read in conjunction with any such statutory requirements and with regard to their respective jurisdictions.

J6 OPERATING PRACTICE

J6.1 General

Shotfirers should endeavour to reduce ground vibration and airblast to as low a level as practically possible to reduce the possibility of discomfort, damage, worry or complaint. This should be reinforced by frequent consultation with persons who may be affected by the blast.

Relevant blast personnel should be given regular training in these aspects of blasting. Blast performance should be regularly reviewed and possible improvements implemented to ensure a good relationship is maintained with persons who may be affected by the blast and the regulatory authorities.

Table J6.1 give guidance on the various options available for controlling ground vibration and airblast.

Blast monitoring records should, wherever possible, include the following:

(i) The location of each blasthole collar.

(ii) Face survey information indicating the proximity of the nearest blastholes to any free faces within the blast.

(iii) Full time histories of the ground vibration and airblast responses.

(iv) Weather conditions, especially wind speed, cloud cover and direction and any other notable conditions such as rain.

(v) Information derived from a video of the blast.

(vi) Any subjective information from the shotfirer and any persons who may be affected by the blast.

A copy of these records should be included in the site blast records.

J4 GROUND VIBRATION LEVELS

J4.1 General

The maximum levels for ground vibration for human comfort that some authorities have chosen are set out in Paragraphs J4.2 to J4.5.

NOTE: The maximum levels advised in this Appendix are designed to be informative and are not intended to override existing statutory requirements, particularly with respect to human comfort limits set by various authorities.

The methods of data analysis for these limits are also presented. In part, such analyses are a departure from that described in earlier and other Standards and the intention is to provide sufficient detail so that expert persons may implement these in hardware and/or software.

J4.2 Ground vibration

Vibration transmitted through the ground may cause damage to structures and architectural elements or discomfort to their occupants. The vibration levels at which people become annoyed are well below vibration levels at which damage occurs. The likelihood of such damage or discomfort may be ascertained by measuring the vibration from a blast close to the location of concern such as a building or other structure.

For all limits it is necessary to measure in three orthogonal directions, one in the vertical direction and the other two in perpendicular horizontal directions. Such measurements align with most structural members in man-made structures. From such measurements it is possible to derive the Vector Peak Particle Velocity (VPPV) and the Peak Component Particle Velocity for each direction (PCPV). The magnitude of the vector particle velocity (v_p) is the amplitude of the vector sum of three time-synchronised velocity components directly measured by an instrument. When not measured directly it may be determined by the following Equation:

$$v_p = \sqrt{v_x^2 + v_y^2 + v_z^2} \qquad \ldots \text{J4.2}$$

where v_x, v_y and v_z are the synchronized instantaneous velocity components of the x, y and z axes, respectively. The VPPV is the maximum of v_p.

J4.3 Human comfort limits

NOTE: Statutory requirements for human comfort limits for ground vibration may apply in respective jurisdictions.

General guidance on human response to building vibrations is given in AS 2670.2, ISO 2631-2 and BS 6472.

J4.4 Damage limits

J4.4.1 *General*

Frequency independent and frequency dependent guide levels are described in both British Standard BS 7385-2 and the United States Bureau of Mines (USBM) RI 8507. The levels specified are peak component particle velocities, and the methodologies used for assessing the frequencies are similar in both documents.

Frequency-dependent criteria are important for assessing the blast-induced vibration effects on buildings and other structures and are the recommended approach.

J4.4.2 *Frequency-independent levels*

Frequency-dependent criteria may not be readily implemented for all parties concerned with this Standard.

For explosives users who do not have the facilities to use frequency-dependent assessment methods, the levels specified in Table J4.5(B), which are more conservative for most blasting applications, will reduce the potential for damage. The Table should be used in conjunction with the notes that follow it.

Wherever possible, the ground vibration levels from all blasting operations must be limited to the damage limit criteria shown below in Figures J4.4.2.1 or J4.4.2.2 at all sites not in the ownership or control of the organisation commissioning the blasting.

Appendix C

RCA Rock Shelters and landmark rock structures
Inspection Reports

Rock Shelter Inspection Report

Rock Shelter I.D.	AC38 (175)			
GPS (MGA co-ordinates):	Easting (m)	2 78 879-890		
	Northing (m)	64 22 533-537		
Dimensions of Rock Shelter	Width (m)	8		
	Height (m)	1 to 1.5		
	Depth (m	3 to 4		

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding	1-2	255-265	0.5-3	None / =2
Joint set 1	40-50	210-220	= 3	None / =1
Joint set 2				

Photos

STABILITY ASSESSMENT: Bedding parting in conglomerate roof only 0.5m above rock shelter opening. The rock shelter is considered to have a MODERATE risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	AC42 (115)	
GPS (MGA co-ordinates):	Easting (m)	2 79 598
	Northing (m)	64 25 053
Dimensions of Rock Shelter	Width (m)	5 to 7
	Height (m)	= 1.5
	Depth (m	= 2.7

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding				
Joint set 1				
Joint set 2				

Stability assessed from Umwelt photographs and measurements.

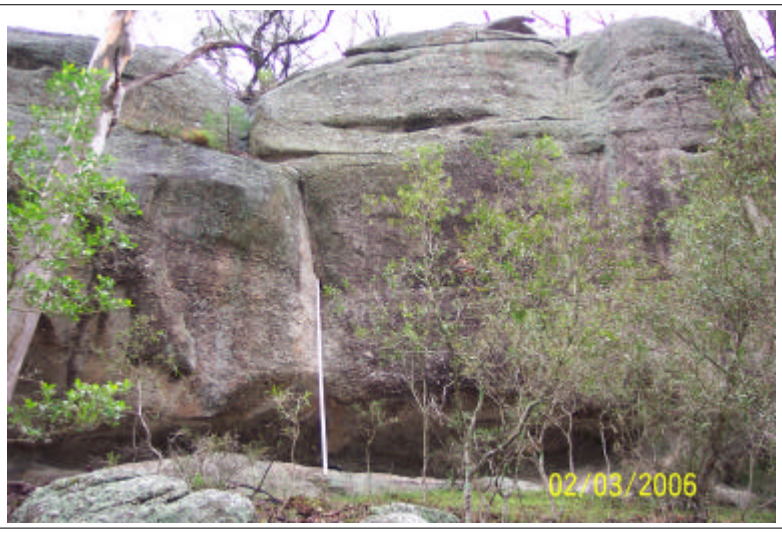
Photos

Note: bedding parting within a metre of shelter roof.

STABILITY ASSESSMENT: Bedding partings in Conglomerate roof are considered to have a MODERATE risk of instability.

Rock Shelter Inspection Report

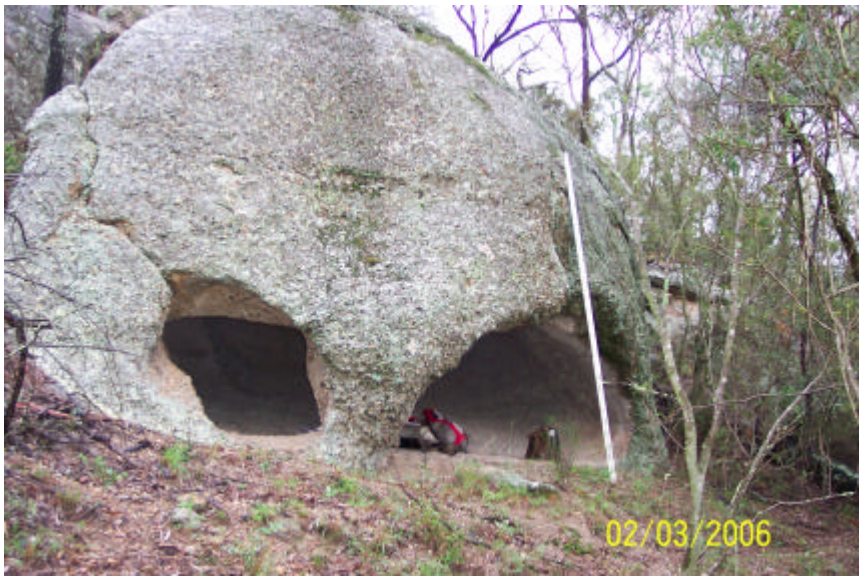
Rock Shelter I.D.	CG09 (51)				
GPS (MGA co-ordinates):	Easting (m)	281773-831			
	Northing (m)	6425038-050			
Dimensions of Rock Shelter	Width (m)	9 to 11			
	Height (m)	0.5 to 1.2			
	Depth (m	5 to 7.5			
Geology					
Rock Description: type, strength, weathering, texture, colour, minor components.		Defects			
		Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately					
weathered, massive with sandy lenses.					
clasts: rounded, pebble, matrix: fine to medium					
grained sand, cement: quartz or iron oxide.					
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.					
Bedding		1-3	350-360	1-7	None
Joint set 1		70-80	230-240	3-5	None / =2
Joint set 2		80-85	335-345	3-5	None / =2
Joint set 3		65-75	040-050	2-4	None / =2
Joint set 4		70-80	305-315	2-3	None / =1
Photos					



STABILITY ASSESSMENT: Massive conglomerate roof. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability. *'Hanging' joint blocks on rock face above shelter are considered to have a MODERATE risk of instability.*

Rock Shelter Inspection Report

Rock Shelter I.D.	CG08 (50)			
GPS (MGA co-ordinates):	Easting (m)	281814 to 837		
	Northing (m)	6425072 to 075		
Dimensions of Rock Shelter	Width (m)	2 to 7		
	Height (m)	1.5 to 2		
	Depth (m	4 to 6		
Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding				
Joint set 1	60-90	315-325	~5	None / =2
Joint set 2	70	140-150	1 to 7	None / =2
Photos				



STABILITY ASSESSMENT: Rock “Igloo” has relatively short massive conglomerate arches.

It is considered to have a LOW risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	CG01 (42)	
GPS (MGA co-ordinates):	Easting (m)	281 563-540
	Northing (m)	6425 212-233
Dimensions of Rock Shelter	Width (m)	30
	Height (m)	2 to 4
	Depth (m	3 to 5

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill/ aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding	2-3	220-250	0.4 to 2	none
Joint set 1	35-40	215-225	= 3	None / = 2
Joint set 2				

Photos

STABILITY ASSESSMENT: Bedding 0.4 to 1m spacing in roof with weathered recesses along sandy chloritic beds, resulting in multi-layered roof. Low angle joints located at rear of roof beds weaken roof structure. MODERATE to HIGH risk of instability for cantilevered roof beds.

Rock Shelter Inspection Report

Rock Shelter I.D.	BFC12 (16)	
GPS (MGA co-ordinates):	Easting (m)	2 79 603 to 607
	Northing (m)	64 25 655 to 696
Dimensions of Rock Shelter	Width (m)	30 to 34
	Height (m)	1.5 to 5
	Depth (m	2.5 to 7.5

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill/ aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Recessed into beds/lenses, with clay/chlorite matrix.				
Bedding	~2	170-180	3 to 5	none
Joint set 1	55-65	285-295	15-20	None/ = 2
Joint set 2	80-85	070-090	= 5	None/ = 1

Photos

STABILITY ASSESSMENT: No obvious joint bounded blocks within rock shelter. Natural rock buttresses and widely spaced defects. The rock shelter is considered to have a LOW risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	Anvil Rock	
GPS (MGA co-ordinates):	Easting (m)	2 81 244
	Northing (m)	64 24 516
Dimensions of Rock Shelter	Width (m)	1.5 to 3
	Height (m)	~5
	Depth (m)	

Geology	
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects
Conglomerate, medium strength, moderately weathered, massive with sandy lenses. clasts: rounded, pebble, matrix: fine to medium grained sand, cement: quartz or iron oxide. Pedestal 'neck' a result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.	Stability assessed from Umwelt photographs and measurements.

Photo

STABILITY ASSESSMENT: Anvil Rock is a free standing Conglomerate rock pedestal.

The base of the pedestal is very friable. Anvil Rock is considered to have a HIGH risk of instability when subjected to blast impact.

Rock Shelter Inspection Report

Rock Shelter I.D.		CG10 (52)
GPS (MGA co-ordinates):	Easting (m)	281773
	Northing (m)	6425038
Dimensions of Rock Shelter	Width (m)	28 to 30
	Height (m)	2 to 3
	Depth (m	2 to 4

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding	1-3	350-360	1-7	None
Joint set 1	70-80	230-240	3-5	None / =2
Joint set 2	80-85	335-345	3-5	None / =2
Joint set 3	65-75	040-050	2-4	None / =2
Joint set 4	70-80	305-315	2-3	None / =1

Photos

STABILITY ASSESSMENT: Massive conglomerate roof. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability. *'Hanging' joint blocks on rock face above shelter are considered to have a MODERATE risk of instability.*

Rock Shelter Inspection Report

Rock Shelter I.D.	WC46 (23)	
GPS (MGA co-ordinates):	Easting (m)	2 79 463 / 279423
	Northing (m)	64 25 091 / 6425153
Dimensions of Rock Shelter	Width (m)	50
	Height (m)	3 to 5
	Depth (m	3.5 to 5.5

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Joint set 1	80	280	3 to 4	None / =1
Joint set 2	62	~120	2 to 15	None / =1
Joint set 3	58	260-280	= 2	None / =2
Joint set 4	62-70	260-270	= 2	None / =2

Photos

STABILITY ASSESSMENT: Rock shelter has a massive conglomerate roof with widely spaced joints. It is considered to have a LOW risk of instability. *'Hanging' conglomerate blocks bounded by overhanging open joints are considered to have a HIGH risk of instability.*

Rock Shelter Inspection Report

Rock Shelter I.D.	WC45 (22)	
GPS (MGA co-ordinates):	Easting (m)	2 79 413 to 419
	Northing (m)	64 25 166 to 178
Dimensions of Rock Shelter	Width (m)	30
	Height (m)	1 to 2.5
	Depth (m)	4 to 4.5

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding	~2	~050	1 to 3	None / = 1
Joint set 1	80-85	140-160	4 to 10	None / = 2
Joint set 2				

Photos

Rock shelter

Rock overhang above rock shelter

STABILITY ASSESSMENT: Rock shelter has a bedded conglomerate roof, with sections partially detached along bedding considered to have a MODERATE risk of instability. *A rock overhang above rock shelter is relatively thin, with pervasive joints considered to have a MODERATE risk of instability.*

Rock Shelter Inspection Report

Rock Shelter I.D.	WC43 (18)	
GPS (MGA co-ordinates):	Easting (m)	2 79 420 to 424
	Northing (m)	64 25 336 to 356
Dimensions of Rock Shelter	Width (m)	30
	Height (m)	1.5 to 1.8
	Depth (m)	2.5 to 3.5

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding	= 2	020-050	0.3 to 5	None / = 1
Joint set 1	~80	140-160	10 to 15	None / = 2
Joint set 2				

Photos

Rock Shelter

Cliff face & overhang above

STABILITY ASSESSMENT: Massive conglomerate roof. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability.

Relatively thin rock overhang along crest of cliff face is considered to have a HIGH risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.		WC33 (134)
GPS (MGA co-ordinates):	Easting (m)	2 78 879-890
	Northing (m)	64 22 533-537
Dimensions of Rock Shelter	Width (m)	6
	Height (m)	1.2 to 2
	Depth (m	2 to 3

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding	2-5	015-025	1-3	None / =1
Joint set 1	70-80	350-360	= 5	None / =1
Joint set 2	50-55	240-250	= 5	None / =1

Photos

STABILITY ASSESSMENT: Massive conglomerate outcrop. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	WC27 (82)	
GPS (MGA co-ordinates):	Easting (m)	2 80 518
	Northing (m)	64 23 101
Dimensions of Rock Shelter	Width (m)	22 to 24
	Height (m)	2 to 3
	Depth (m)	3 to 4

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately weathered, massive with sandy lenses. clasts: rounded, pebble, matrix: fine to medium grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				

Stability assessed from Umwelt photographs and measurements.

Photos

STABILITY ASSESSMENT: Massive conglomerate roof. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	WC26 (81)	
GPS (MGA co-ordinates):	Easting (m)	2 80 206
	Northing (m)	6 422 908
Dimensions of Rock Shelter	Width (m)	1.8
	Height (m)	2.5
	Depth (m	17

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding	~5	130-140	0.5-3	None
Joint set 1	70	160-170	8-10	None / 1
Joint set 2	85	020	8-10	None / 1

Photos

STABILITY ASSESSMENT: Rock Shelter is a notched recess near the crest of the rock face

Risk of instability is considered to be LOW.

Rock Shelter Inspection Report

Rock Shelter I.D.	WC25 (80)	
GPS (MGA co-ordinates):	Easting (m)	2 80 206
	Northing (m)	6 422 908
Dimensions of Rock Shelter	Width (m)	7
	Height (m)	2
	Depth (m	3

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding	~6	130-140	1-2	None
Joint set 1	65	300	>7	None / 2
Joint set 2	60	180-190	>7	None / 2

Photos

STABILITY ASSESSMENT: Shelter has open joints in conglomerate roof that is considered to have a LOW risk of instability. *The "perched" boulder on rock slope above shelter is considered to have a MODERATE risk of instability.*

Rock Shelter Inspection Report

Rock Shelter I.D.	WC05 (25)	
GPS (MGA co-ordinates):	Easting (m)	279485 to 494
	Northing (m)	6424937 to 987
Dimensions of Rock Shelter	Width (m)	40
	Height (m)	2.5
	Depth (m	5.3

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding	2	~050	=0.3	None
Bedding	6-8	050	2.5 to 5	None
Joint set 1	82-86	166-172	18 to 60	None / =2
Joint set 2				

Photos

STABILITY ASSESSMENT: Rock shelter has a massive conglomerate roof with widely spaced joints. It is considered to have a LOW risk of instability. Laminations in cross bedded sections of roof are considered to have a MODERATE risk of instability.

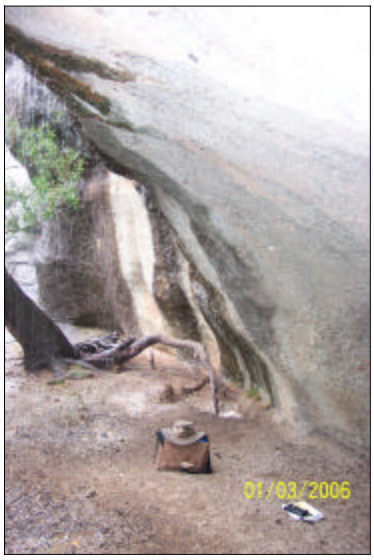
Rock Shelter Inspection Report

Rock Shelter I.D.	WC47 (17)	
GPS (MGA co-ordinates):	Easting (m)	279620
	Northing (m)	6425688
Dimensions of Rock Shelter	Width (m)	15 to 20
	Height (m)	2.5 to 2.8
	Depth (m	1 to 3.4

Geology

Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of sandy beds/lenses with clay/chlorite matrix.				
Bedding in sandy lenses	2-5	020-050	= 0.5	None
Bedding in conglomerate roof			3-6	
No joints observed				

Photos



STABILITY ASSESSMENT: Massive conglomerate roof. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability.

Detached boulders 'perched' along cliff top are considered to have a HIGH risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.		
GPS (MGA co-ordinates):	Easting (m)	
	Northing (m)	
Dimensions of Rock Shelter	Width (m)	
	Height (m)	
	Depth (m	

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
Shelter recess result of preferential weathering of very low strength sandy beds/lenses with clay/chlorite matrix.				
Bedding				None / =1
Joint set 1				None / =1
Joint set 2				None / =1

Photos

STABILITY ASSESSMENT: Massive conglomerate outcrop. No obvious joint bounded blocks within the rock shelter. The rock shelter is considered to have a LOW risk of instability.

Rock Shelter Inspection Report

Rock Shelter I.D.	The Book	
GPS (MGA co-ordinates):	Easting (m)	
	Northing (m)	
Dimensions of Rock Shelter	Width (m)	~4 to 5
	Height (m)	~7 to 8
	Depth (m)	~2 to 3

Geology				
Rock Description: type, strength, weathering, texture, colour, minor components.	Defects			
	Dip Angle	Dip direction	Spacing (m)	Infill / aperture (mm)
Roof: Conglomerate, medium strength, moderately				
weathered, massive with sandy lenses.				
clasts: rounded, pebble, matrix: fine to medium				
grained sand, cement: quartz or iron oxide.				
The Book recess result of joint controlled preferential weathering of cliff face.				
Bedding				
Joint set 1	~90		2-3	
Joint set 2				

Photos

No photo

STABILITY ASSESSMENT: The Book is a recessed near vertical rock face, with the 'spine' and 'pages' defined by a near vertical joint set at approximately equi-distant spacing. The Book is considered to have a MODERATE risk of instability when subjected to blast impact.

Appendix D

RCA Analysis of Rock Shelters and Landmark rock structures

RCA Model for rock shelters and landmark rock structures

based on:

RCA assumption 1: *Model rock shelter / structure response to blast impacts using: ACARP Report C9040 Structure Response to Blast Vibration*

ACARP Report C9040 Structure Response to Blast Vibration

In-plane strain for a uniform wall/panel:
The maximum strain ' ε ' can be estimated using:

Equation 1

$$\varepsilon = \frac{\Delta}{H} (\text{Sin}\phi\ \text{Cos}\phi)$$

where:

ε is maximum strain in μ mm/mm

H is height of structure

RCA assumption 2: *Assume H = mean height and depth of rock shelter*
σ is bisect of L/B angle of wall panel

$\text{Sin}\phi\ \text{Cos}\phi$ is a maximum of 0.5, when $\phi = 45^{o}$, i.e., H=W

Δ is given by equation 2

Equation 2

$$\Delta = \frac{\text{PCPV x amplification factor}}{2\ \pi\ f}$$

RCA assumption 3: PCPV stands for Peak Component Particle Velocity
PCPV = Peak Particle Velocity x (0.57 to 1)
To calculate damage threshold PCPV
assume PPV(ground) as supplied by Umwelt = PCPV

the value of the amplification factor is as follows:

1 for PPV > 100mm/s
2 for PPV >5 <100 mm/s
4 for PPV <5 mm/s

f is frequency in Hertz

RCA assumption 4: Modelled strain limits for Conglomerate rock as equivalent to mass concrete:

Mass Concrete Strain Limits as given in ACARP Report Table 22

Concrete Strength (MPa)	10	30
Tensile Failure Strain ($\mu\varepsilon$)	700	860
Compressive Failure Strain ($\mu\varepsilon$)	875	1080

RCA assumption 5: The assumed damage thresholds for the rock shelters / structures are as follows:

Cosmetic damage likley to occur at PCPV & frequency given in AS2187.2 - 2006 Figure J4.4.2.1
Minor damage is likely to occur when mass concrete tensile failure strain exceeded
Major damage likely to occur when mass concrete compressive failure strain exceeded

The damage threshold ranges shown in Table 5384 D.1 have been calculated using the procedure outlined in Section 5.5 of RCA report 5384-004/0 June 2006.

Example Implications for Damage Categorys [1]
Cosmetic damage defined as an increased rate of sloughing of the weathered crust from weaker sandy beds/lenses and the propagation of existing defects along joints and bedding partings.
Minor damage is defined as the formation of new defects in the rock mass and possible detachment of “hanging” joint blocks.
Major damage defined as rock shelter roof fall/collapse or change in appearance of landmark rock structures.

Note:
1. Example Implictions taken from Table 1 Section 5.3 of RCA report 5384-004/0 June 2006.

5384 Table D1: Data & Analysis

7/06/2006

Old Site I.D.	New Site I.D.	Cultural Rating	Rock Shelter Observations								Analysis										
			Width		Height		Depth		Morphology	Roof conditions	Estimated Risk of Damage [2]	Fundamental Vibration Period T_f for longest dimension [3]				Orthogonal Vibration Period T_o for shortest dimension [3]				Mean Resonant Vibration Frequency for Rock Structure	Proposed Mean Blast Vibration Frequency [4]	Estimated Significant Damage [5] Threshold for Rock Structure [6]
			Min. (m)	Max. (m)	Min. (m)	Max. (m)	Min. (m)	Max. (m)				Min (sec)	f (Hz)	Max (sec)	f (Hz)	Min (sec)	f (Hz)	Max (sec)	f (Hz)	f (Hz)	(Hz)	*mm/s*
16	BFC12	High	30	34	1.5	5	2.5	7.5	Weathered recess at base of massive Conglomerate cliff face	Massive Conglomerate bedding parting. > 3m; joint spacing. >5m.	Low	0.65	*1.53*	0.74	*1.35*	0.04	*23.20*	0.13	*7.73*	*3.54*	10	≥ 210 to 280
17	WC47	High	15	20	2.5	2.8	1	3.4	Weathered recess at base of massive conglomerate cliff face. ("Perched" boulders on cliff crest above.)	Massive conglomerate, bedding parting. > 3m; joint spacing >20m. (Cliff top boulders)	Low (High)	0.33	*3.07*	0.43	*2.30*	0.02	*58.00*	0.06	*17.06*	*7.48*	10	≥ 180 to 230
18	WC43	Moderate to High		30	1.5	1.8	2.5	3.5	Weathered recess at base of massive conglomerate cliff face. (Relatively thin cliff top overhang with pervasive defects.)	Bedded conglomerate, bedding parting. 0.3-5m; joint spacing >10m. (Cliff top overhang)	Low (High)	0.65	*1.53*	0.65	*1.53*	0.04	*23.20*	0.06	*16.57*	*6.55*	10	≥ 140 to 200
22	WC45	High		30	1	2.5	4	4.5	Conglomerate/sandstone roof with cantilevered sections and defects that daylight in cliff recesses above shelter. (Cliff top overhang with pervasive defects)	Bedded conglomerate, bedding parting. > 1m; joint spacing > 4m. (Cliff top overhang)	Moderate (Moderate)	0.65	*1.53*	0.65	*1.53*	0.07	*14.50*	0.08	*12.89*	*5.32*	10	≥ 90
23	WC46	High		50	3	5	3.5	5.5	Weathered recess at base of massive Conglomerate cliff face. ("Hanging" joint bounded blocks on overhang of shelter)	Massive conglomerate, no bedding partings; joint spacing >2m. ("Hanging" joint blocks)	Low (High)	1.09	*0.92*	1.09	*0.92*	0.06	*16.57*	0.09	*10.55*	*4.13*	10	≥ 190 to 260
25	WC05	High		40		2.5		5.3	Weathered recess at base of massive Conglomerate cliff face. (Laminated sandy roof sections)	Bedded conglomerate, bedding parting. > 2.5m; joint spacing >18 m. (Laminated roof)	Low (Moderate)	0.87	*1.15*	0.87	*1.15*	0.09	*10.94*	0.09	*10.94*	*4.41*	10	≥ 190 to 260
42	CG01	Moderate to High		30	2	4	3	5	Conglomerate/sandstone cantilever roof with defects that daylight in overhead rock face.	Cantilevered conglomerate beds partially separated from rock mass above bedding parting 0.4-2m; joint spacing >3 m.	Moderate to High	0.65	*1.53*	0.65	*1.53*	0.05	*19.33*	0.09	*11.60*	*4.89*	10	≥ 90
50	CG08	Moderate	2	7	1.5	2	4	6	Rock "Igloo" weathered recess in base of isolated massive conglomerate domed outcrop.	Massive Conglomerate outcrop jt.sp. >1m	Low	0.04	*23.00*	0.15	*6.57*	0.07	*14.50*	0.10	*9.67*	*13.08*	10	≥ 190 to 260
51	CG09	Moderate	9	11	0.5	1.2	5	7.5	Weathered recess at base of massive conglomerate cliff face. ("Hanging" joint bounded blocks on rock face above shelter)	Bedded conglomerate, bedding parting. 1-3m; joint spacing >2m. ("Hanging" joint blocks)	Low (Moderate)	0.24	*4.18*	0.24	*4.18*	0.09	*11.60*	0.13	*7.73*	*5.37*	10	≥ 170 to 240
52	CG10	Moderate to High	28	30	2	3	2	4	Weathered recess at base of massive conglomerate cliff face. ("Hanging" joint bounded blocks on rock face above shelter)	Bedded conglomerate, bedding parting. 1-7m; joint spacing >2m. ("Hanging" joint blocks)	Low (Moderate)	0.61	*1.64*	0.65	*1.53*	0.03	*29.00*	0.07	*14.50*	*5.89*	10	≥ 200 to 260
80	WC25	High		7	2	3		3	Rock "Cave" weathered recess in base of massive conglomerate rock slope. ("Perched" boulder on rock slope above)	Bedded conglomerate, bedding parting. 1-2m; joint spacing >7m. ("perched boulder)	Low (Moderate)			0.15	*6.57*			0.05	*19.33*	*12.95*	10	≥ 200 to 260
81	WC26	High	17	21	2	3		1.8	Weathered recess near top of massive Conglomerate cliff face.	Massive conglomerate, bedding parting. 0.5-3m; joint spacing >8m.	Low	0.37	*2.71*	0.46	*2.19*			0.05	*19.33*	*8.08*	10	≥ 140 to 200
82 [1]	WC27	High		24	2	3	3	4	Weathered recess in massive Conglomerate rock mass.	Bedding in conglomerate roof.	Low			0.52	*1.92*			0.07	*14.50*	*8.21*	10	≥ 140 to 200
115 [1]	AC42	Moderate		5		1		2.7	Weathered recess in massive Conglomerate rock mass.	Bedding in conglomerate roof.	Moderate			0.11	*9.20*	0.05	*21.48*	0.05	*21.48*	*15.34*	10	≥ 90
134	WC33	Moderate		6	1.2	2	2	3	Weathered recess in base of isolated massive conglomerate dome.	Massive conglomerate, bedding parting. 1-3m; joint spacing > 5m.	Low	0.13	*7.67*	0.13	*7.67*	0.03	*29.00*	0.05	*19.33*	*11.56*	10	≥ 170 to 220
175	AC38	Moderate to High		8	1	1.5	3	4	Conglomerate cantilevered roof with defects that daylight in overhead rock face.	Bedded conglomerate, bedding parting. 0.5-3m; joint spacing >3m.	Moderate	0.17	*5.75*	0.17	*5.75*	0.05	*19.33*	0.07	*14.50*	*8.67*	10	≥ 90
The Book		High	4	5	7	8	2	3	A recessed conglomerate / sandstone cliff face divided in half by a near vertical "Spinal" joint., with a cantilevered rock overhang above.	An unsupported rock overhang projects approx. 2 to 3m out over cliff face.	Moderate			0.17	*5.75*			0.09	*11.60*	*8.68*	10	≥ 90
Anvil Rock		High	1.5	3		5			Free standing Conglomerate/sandstone pedestal, with preferentially weathered 'neck' approximately 1.5m above ground level.	Massive Conglomerate crown supported on a friable 'neck' and base. Crown diameter up to 1.5 neck diameter.	High			0.11	*9.20*			0.03	*29.00*	*9.20*	10	≥ 90
			2	**3**	**1**	**1**	**1**	**2**	**Minimum Value**				**1**		**1**		**11**		**8**			
			30	**50**	**7**	**8**	**5**	**8**	**Maximum Value**				**23**		**9**		**58**		**21**			
			17	**20**	**2**	**3**	**3**	**4**	**Mean Value**				**4**		**3**		**22**		**14**			

Notes: 1. Shelter not visited, assessment based on photos supplied by Umwelt & interpolted measurements.
2. Estimated Risk of Damage due to blast induced ground vibration as discussed in Section 5.3 of RCA report 5384-004/0 June 2006.
3. Structure Period ' T ' determined using methodology set out in AS1170.4-1993 pp.39
4. Mean blast induced ground vibration frequency proposed by Centennial
5. Significant damage defined Section 5.4 of RCA Report 5384-004/0 June 2006.
6. Estimated Significant Damage Threshold assessed based on procedure discussed in Section 5.5 of RCA report 5384-004/0 June 2006.

Appendix E

Landslide Risk Assessment – Example of Qualitative Terminology for use in Assessing Risk to Property

LANDSLIDE RISK ASSESSMENT - EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

Qualitative Measures of Likelihood

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur	$>10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions	$\approx 10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions	$\approx 10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances	$\approx 10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances	$\approx 10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful	$<10^{-6}$

Note: "≈" means that the indicative value may vary by say ±1 order of magnitude, or more.

Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

Note: The "Description" may be edited to suit a particular case.

Qualitative Risk Analysis Matrix – Level of Risk to Property

LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1 Catastrophic	2 Major	3 Medium	4 Minor	5 Insignificant
A - ALMOST CERTAIN	VH	VH	H	H	M
B - LIKELY	VH	H	H	M	L-M
C - POSSIBLE	H	H	M	L-M	VL-L
D - UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

Risk Level Implications

Risk Level		Example Implications(1)
VH	VERY HIGH RISK	Extensive, detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical.
H	HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M	MODERATE RISK	Tolerable, provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L	LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.

(2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.

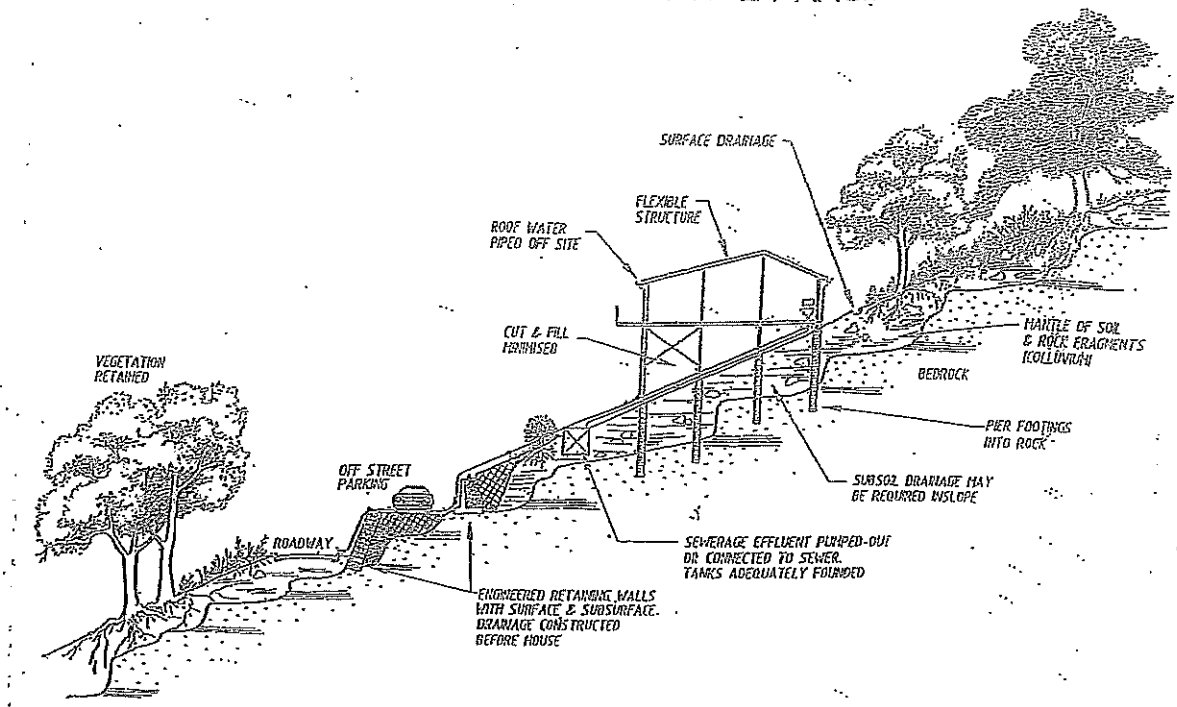
This figure is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in *Australian Geomechanics,* Vol 35, No 1, 2000 which discusses the matter more fully.

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

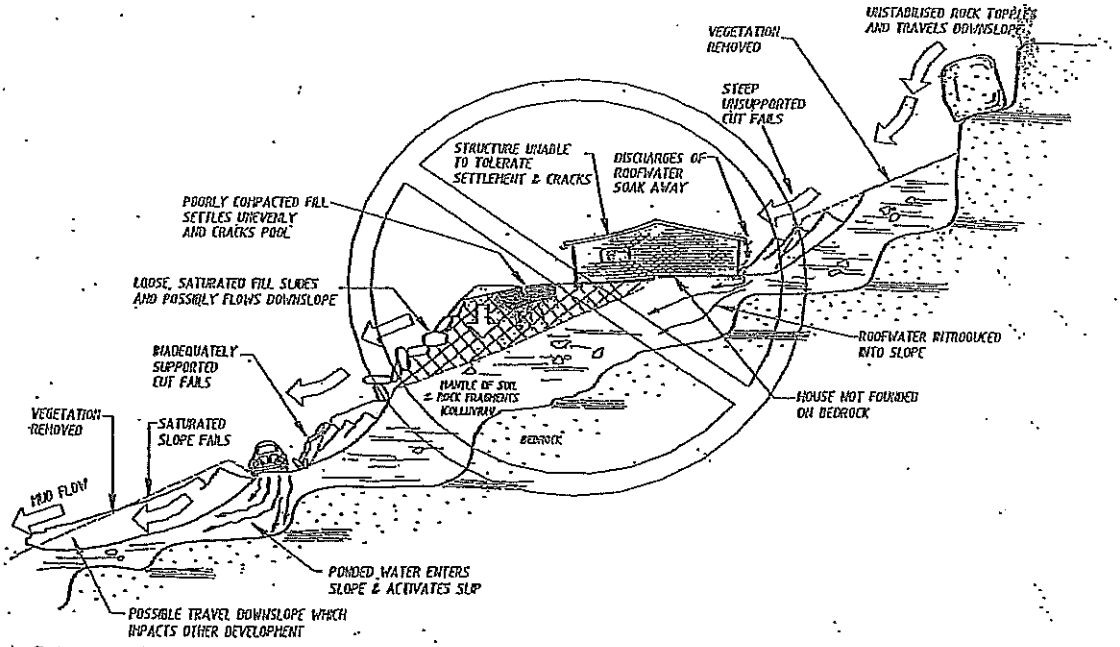
	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS AND DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORDS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
Cuts	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements.
Fills	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill which, if it fails, may flow a considerable distance including on to property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble, etc, in fill.
Rock outcrops & boulders	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary	Disturb or undercut detached block or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weep holes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE Surface	Provide at tops of cut and fill slopes. Discharge to street, drainage or natural water courses. Provide general falls to prevent blockage by saltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slops and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
Subsurface	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
Septic and sullage	Usually requires pump-out of mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water tight and adequately founded.	Discharge sullage directly on to and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL AND LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site visits by consultant may be appropriate during construction.	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

This figure is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in *Australian Geomechanics,* Vol 35, No 1, 2000 which discusses the matter more fully.

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



Illustrations of Good and Poor Hillside Practice

This figure is an extract form LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in *Australian Geomechanics*, Vol 35, No 1, 2000 which discusses the matter more fully.

APPENDIX 3

Copy of Newspaper Advertisements for Notification Process

Centennial Hunter Pty Limited
Anvil Hill Project
Aboriginal Archaeological and Cultural Heritage Study

Notification and Registration of Interests in Consultation

Centennial Hunter Pty Limited proposes to seek approval for a new open cut coal mine and ancillary facilities in the Wybong area, west of Muswellbrook. Umwelt (Australia) Pty Limited is undertaking environmental assessments for the Anvil Hill Project, on behalf of Centennial, and seeks registration of interested Aboriginal groups or individuals to participate in the consultation program for Aboriginal cultural heritage and archaeology study.

Following registration a meeting is planned for 1 March 2005 to discuss the proposed Anvil Hill Mine project specifically in relation to Aboriginal cultural heritage and archaeology and the management of these issues.

The Aboriginal community is invited to register interest through Mary-Jean Sutton, Senior Archaeologist, from Umwelt. **Registration must be received prior to 22 February 2005** by telephone 02 4950 5322, fax 02 4950 5737, email msutton@umwelt.com.au or post PO Box 838 Toronto NSW 2283.

APPENDIX 4

Correspondence to Aboriginal Community for proposed meeting on 1 March 2005

Umwelt (Australia) Pty Limited
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283

Umwelt
Environmental Consultants

Ph. 02 4950 5322
Fax. 02 4950 5737

ABN 18 059 519 041

15 February 2005

Mr Rodney Matthews
Giwirr Consultants
8 Fitzgerald Avenue
MUSWELLBROOK NSW 2333

POSTED

Dear Rodney

Re: Anvil Hill Project—Aboriginal Consultation Process

Umwelt (Australia) Pty Limited has been commissioned by Centennial Hunter Pty Limited to undertake the Aboriginal archaeological assessment of its proposed open cut coal mine at Anvil Hill, near Muswellbrook. As an important part of the assessment an Aboriginal consultation program will extend for several months over the pre-survey, survey and assessment period.

Input is sought from the Aboriginal groups/Elders to implement an effective consultation programme. An initial meeting will be held on 1 March 2005 at Denman Anglican Church Hall, Cnr Church and Palace Street, Denman and an Agenda is attached. As an interested party you are invited to participate in the consultation by attending the workshop, contributing to the determination of a survey strategy and providing knowledge held by you and others in your group on any known cultural heritage sites (including mythological) sites in the proposed mine area and if there are any stories known about the area. DEC is also invited to attend all meetings with the Aboriginal community.

This initial meeting is a key component in the consultation programme and will outline the aims and schedule of both the consultation programme and the survey strategy. To get the most effectiveness from the meeting, please return the RSVP before 23 February 2005 and bring relevant information along to the meeting so that it can be taken into account when preparing the survey strategy and in ongoing discussions. If you do identify knowledge holders in the wider community we would be grateful if you could provide us with their details so that we can ensure that they are also afforded the opportunity to participate in the project. It would be appreciated if your representative(s) have the knowledge and permission to have input on behalf of the group. Time will be limited on the day and therefore it will be important to keep to the agenda. We encourage Aboriginal community groups and Elders who wish to discuss additional issues that are outside the agenda to let us know prior to the meeting.

Although not a DEC requirement, Centennial Hunter recognises that this first day of consultation will involve a whole day workshop and therefore proposes to pay each group $500 plus $50 travelling expenses to attend and participate in the first workshop. A limit of two persons/group will be set for the workshop.

Centennial Hunter recognises the potential that its project has to impact on sites/areas of cultural heritage value. As part of the impact assessment, Centennial Hunter is committed to providing conservation outcomes, including consideration of appropriate offsets. This will be included in the consultation programme.

We look forward to working with you on this project. If you have any questions or require clarification of any matters please contact Mary-Jean Sutton, who is the contact for Aboriginal heritage for this project or myself on 4950 5322.

Yours faithfully

Jan Wilson
Aboriginal Archaeology Manager

APPENDIX 5

List of Aboriginal Community Representatives and Organisations at meeting on 1 March 2005

APPENDIX 5

Attendance Record

Name	Group
Margaret Matthews	Aboriginal Native Title Consultants
John Matthews	Aboriginal Native Title Consultants
Allen Paget	Ungooroo Aboriginal Corporation
Darlene Hall	Ungooroo Aboriginal Corporation
Joshua Hickey	Wonnarua Nation Aboriginal Corporation
Robert Lester	Wonnarua Nation Aboriginal Corporation
Scott Franks	Yarrawalk
Tom Franks	Yarrawalk
Barry French	Wanaruah Local Aboriginal Land Council
Ernie French	Wanaruah Local Aboriginal Land Council
Darrel Matthews	Upper Hunter Heritage Consultants
Des Hickey	Wattaka Wonnarua CC Service
Trevor Archbold	Hunter Valley Cultural Consultants
Barry Anderson	Lower Wonnarua Tribal Consultancy Pty Ltd
Maree Waugh	Lower Wonnarua Tribal Consultancy Pty Ltd
Julie Griffiths	Hunter Valley Aboriginal Corporation
Barbara Foot	Wanaruah Custodians
Rodney Matthews	Giwirr
Bev Van Vliet	Valley Culture
Victor Perry	Upper Hunter Wonnarua Council Inc
Tracey Skene	Upper Hunter Wonnarua Council Inc
Rhonda Perry	Wonnarua Elders Corporation

APPENDIX 6

Copy of Presentation to Aboriginal Community at meeting on 1 March 2005 and Feedback Form

Anvil Hill Project

Aboriginal Cultural Heritage Workshop

1 March 2005

Umwelt
Environmental Consultants

Planned Outcomes of Today's Workshop

- An understanding of the scope of the project;
- A list of criteria set by the Aboriginal community of what they view as important values for a conservation offset;
- A map of places/sites/landscapes to incorporate into the survey strategy for the project area and for areas which are available for consideration as potential offsets;
- A map showing areas of sensitivity and known cultural places to be included in the proposed survey; and
- A map of areas the Aboriginal community wants to focus on for the survey to integrate into the total survey strategy.

Agenda for Workshop

- Arrive for Tea and Coffee (10.00 am)
- Overview of the Anvil Hill Project (presented by Centennial Hunter) (10.20 am)
- Break for coffee/tea (10.45 am)
- Site Context, Potential Offset Values Workshop and Discussion (11.00 am to 12 noon)
- Lunch (12 noon to 12.45 pm)

Agenda for Workshop (cont)

- Tour of a section of the proposed impact area and some areas which might be useful for potential offsets (12.45 to 2.30 pm)
- Tea/coffee at hall (2.30 pm)
- Survey strategy workshop (2.45 pm to 4.00 pm)
- Fieldwork participation (4.00 pm)
- Finish meeting (4.45 pm)

SESSION 1:

OVERVIEW OF THE ANVIL HILL PROJECT

Overview of the Anvil Hill Project – Session 1

The objective of this session is to provide the Aboriginal community with an understanding of the proposed development and its potential impacts on cultural heritage.

SESSION 2:

SITE CONTEXT AND POTENTIAL OFFSETS VALUES DISCUSSION

Aims of Workshop – Session 2

To provide Aboriginal community groups with an understanding of previous work that has been undertaken in the project area and the opportunity to:

- express what places are of value;
- express what characteristics make a place/site/ landscape important and of value;
- identify places/sites/landscapes they have potential to consider as offsets, conserved for future generations;

Aims of Workshop – Session 2 (cont)

- express what areas are important to cover for the survey;
- identify a list of characteristics or objectives which are important to address in the survey; and
- discuss any issues with regard to the proposed survey and how it will be carried out.

Previous Archaeological Work in the Project Area

- Rex Silcox 1984 - Archaeological Survey of Proposed Transmission Line
- Jill Ruig 1993 - Archaeological Survey for a Transmission Line Fibre Optic Cable Route Manobalai to Castle Rock
- Pam Dean-Jones - Umwelt 1999, Exploration Licence 5552, Anvil Hill
- Dan Witter - HLA Envirosciences 2002, Great Northern Coal Project Bulk Sample Pit
- Dan Witter - HLA Envirosciences 2003, Great Northern Coal Project Bulk Sample Pit Desktop Assessment
- Meaghan Russell - HLA Envirosciences 2002, Survey for Exploratory Bore Holes, Anvil Hill

What is important to you?

We would like to find out from you what is important and of value for potential conservation offsets?

What areas have important cultural heritage values or your knowledge about sites and places (including mythological sites) within the project area?

A form in Annex C provides a place for you to provide comments.

What is a Conservation Offset?

A conservation offset refers to an area of land that can or has potential to be set aside or conserved for future generations. A conservation offset will not be directly impacted by a proposed project.

Ecological value is also an important consideration for such areas.

What are important Cultural Heritage Considerations for an Offset?

- Land that can be available to the Aboriginal community to use for camping, bushwalks, bush tucker, fishing and to enjoy for future generations.
- Land that has cultural value to the Aboriginal community and may or may not also have scientific (archaeological) importance.
- Anything else?

DEC's Considerations for Cultural Heritage Offsets

DEC considers the following as important for Aboriginal Heritage Conservation Areas:

- sites of high Aboriginal and archaeological significance;
- sites with potential for buried archaeological material in areas with archaeological integrity;
- areas that have been relatively undisturbed since the time of Aboriginal occupation;

DEC's Considerations for Cultural Heritage Offsets (cont)

- areas or sites which covers lots of different landforms (ie. creek, slope, ridge etc) that would have provided different environments for food, medicine and other resources of value to Aboriginal people;
- similar landforms to those which will be destroyed by the mining proposal;
- areas of remnant native vegetation;
- no major erosion problems or problems with rubbish dumping, noxious weeds or feral/introduced animals; and
- accessible for community groups.

Potential Offset Areas for Consideration

- Anvil Hill
- The Limb of Addy Hill area and ridge country to the north-west and associated slopes, spurs and drainage lines.

SESSION 3:

SURVEY STRATEGY WORKSHOP

Survey Strategy Objectives

The aims of the survey are to:

- identify Aboriginal objects and places within the project area and within potential areas for conservation offsets;
- identify areas of sensitivity and potential archaeological deposit within the project area and within areas with potential as conservation offsets; and
- record these identified places and areas and to recommend management strategies.

Survey Strategy – Issues to Consider

Some issues to think about when developing the survey strategy:

- Landform
- Disturbance and previous land use history (for example, pastoralism, cultivation)
- Exposure
- Outlook
- Watercourse and permanency
- Natural resources for Aboriginal people

Survey Strategy – Issues to Consider (cont)

Some issues to think about when developing the survey strategy:

- identified and known Aboriginal places and objects (for example, DEC Aboriginal Heritage Information Management Systems (AHIMS), places known to community groups and places not registered but surveyed by archaeologists);
- proposed impact and potential conservation areas;
- geology (conglomerate outcropping) and soils;
- confluence of watercourses (where two watercourses meet);
- gradient for camping;
- current knowledge for archaeological sites in the upper Hunter valley;

Survey Strategy – Background Information

Predictive Modelling for Project Area

Table 1 – Distance to nearest Watercourse for Previously Recorded Sites

Previous Archaeological Study	<30 metres	30<100 metres	100<200 metres	200+ metres
Silcox 1984	2	3	0	0
Ruig 1993	0	0	0	4
Umwelt 1999	4	0	0	2
Witter 2002	9	9	1	0
Russell 2002	3	0	0	0
Total	**18**	**12**	**1**	**6**

Survey Strategy – Background Information (cont)

Predictive Modelling for Project Area

Table 2 - Summary Site Type and Site Contents of Previously Recorded Sites

Previous Archaeological Study	No. of Sites	Potential Rock Shelter	Scarred Tree/ Carved Tree	Isolated Artefacts	Artefact Scatters	Major Category of Artefact	Major Raw Material	Sites within the Disturbance Boundary
Silcox 1984	5	0	0	0	5	Flakes	Indurated Mudstone	2
Ruig 1993	5	0	0	3	2	Flakes	Indurated Mudstone	2
Umwelt 1999	5	2	0	0	4	Flakes	Indurated Mudstone	2
Witter 2002	19*	0	0	5	14	Broken flakes, some flakes	Indurated Mudstone	17
Russell 2002	3	0	0	1	2	Flaked pieces	Indurated Mudstone	3
Total	**37**	**2**	0	**9**	**27**			**26**

*Witter refers to these 19 sites as EWA (Exposure With Artefacts). These EWA's are then defined into 4 archaeological sites. For the purposes of this report the EWA's were analysed.

Survey Strategy – Background Information (cont)

Predictive Modelling for Project Area

Table 3 – Site Size (Artefact Numbers) – Previously Recorded Sites

Previous Archaeological Study	No. of Sites with <10 artefacts	No. of Sites with 10<20 artefacts	No. of Sites with 20<50 artefacts	No. of Sites with 50<100 artefacts	No. of Sites with 100+ artefacts
Silcox 1984 *	2	1	2	0	0
Ruig 1993	4	0	1	0	0
Umwelt 1999	3	0	0	1	0
Witter 2002	14	3	2	0	0
Russell 2002	3	0	0	0	0
Total	**26**	**4**	**5**	**1**	**0**

*Unknown due to absence of report in AHIMS library

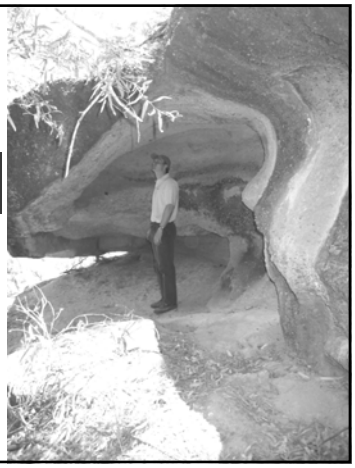
Proposed Areas to Survey

- Both sides of each of the creek lines (Big Flat Creek, Anvil Creek, Sandy Creek and Clarks Gully) and their major tributaries, and their adjoining floodplains; and
- Anvil Hill including a survey around the base of the outcropping cliff face to look for rock shelters or overhangs formed by boulders rolled down from the cliffs; survey of the top of the hill and survey of the east-west trending spur that runs up to the north-eastern corner of Anvil Hill (most likely travel route).

Project Area

Bushland associated with minor tributaries, facing south

Conglomerate overhang, Limb of Addy Hill, facing south (AMG 0280677, 6422094)



Proposed Areas to Survey (cont)

- Limb of Addy Hill and associated ridges including a survey of at least a representative sample of the area around the base of the outcropping cliff faces to look for rock shelters or overhangs formed by boulders rolled down from the cliffs; survey of the top of the formations.
- A representative sample of the other landform units including lesser hills, spur crests and upper, mid and lower slopes/foot slopes.
- A representative sample of the other landform units including, ridges, spur crests and upper, mid and lower slopes/foot slopes associated with the ridgelines and tributaries of Sandy Creek.

Survey Information to Collect

The following information will be recorded during the site survey:

- Landscape and terrain and how this may relate to Aboriginal occupation of the area.
- Local plant life – the variety of different types of plants present and whether they could have been used for food, medicine, shelter or fibre sources for Aboriginal people.
- Local animal life – the variety of different animals present and whether they could have been used as food sources for Aboriginal people.

Survey Information to Collect (cont)

- Geomorphic history of the area in relation to soil profiles/depths and both natural and human causes of disturbance to the soil profile/loss of the soil profile that may impact Aboriginal site integrity.
- Details of the geology and if it provides any Aboriginal resources (eg. stone for manufacture of tools, rock shelters/caves for habitation, surfaces for rock art/and or engraving, surfaces for sharpening tools).
- Ground surface visibility.

Survey Information to Collect (cont)

- AMG location of any sites within the development area or potential offsets.
- Nature of any sites within the development area or potential offsets (location in the landscape, size, contents, site integrity, visibility).
- Nature of any artefacts located within the development area or potential offsets (recorded to DEC standards).
- Examples of site recording forms are provided in the supplement.

Ongoing Consultation Process

- Comments from workshop to be integrated into this part of the survey strategy.
- Opportunity to be involved in the survey.
- Opportunity during survey to comment on Aboriginal significance of sites and the rationale of significance and management recommendations for the site or Potential Archaeological Deposit (PAD).
- Site meeting with all Aboriginal groups to visit/review sites of significance.

Ongoing Consultation Process (cont)

- Draft report stage: Circulation of the draft report and PowerPoint presentation detailing the results of the assessment following fieldwork and the management recommendations.
- Ten working days will be provided to comment on the report. Comments will be incorporated into the draft report.
- Aboriginal community groups are encouraged to provide input or to directly contact the archaeologists involved in the project assessment report up until its finalisation.
- Contact details for the archaeologists are provided below.

Ongoing Consultation Process (cont)

Contact details:

Jan Wilson & Mary-Jean Sutton
Work phone: (02) 4950 5322
Work fax: (02) 4950 5737

Umwelt (Australia) Pty Limited
PO Box 838
2/20 The Boulevarde
TORONTO NSW 2283

SESSION 4:

FIELDWORK PARTICIPATION AND OH&S REQUIREMENTS

Fieldwork Participation

Representation of groups in the field

- Option 1: To include all groups but to split fieldwork time on a rotational basis.
- Option 2: Tender the fieldwork and select groups based on certain selection criteria.

Fieldwork Participation (cont)

Number of people to be involved in the fieldwork

- Due to OH&S issues regarding moving large groups of people around the site and general safety – maximum of six Aboriginal representatives out on site at any time.

OH&S Requirements

A Safe Work Method Statement (SWMS) for fieldwork has been developed for the project.

A site induction will be carried out for all fieldwork representatives on site, involving discussion of the SWMS and an informal method for conducting day to day risk assessments.

OH&S Requirements (cont)

In order to ensure the safety of the fieldwork team, the following information will need to be provided prior to fieldwork:

- name of representative attending;
- contact details (including mobile phone no.);
- next of kin's name and contact details/emergency contact's details; and
- information concerning any allergies or medications representatives may be taking. This medication should be brought on site and its location made known to the team supervisor in the case of a medical emergency.

OH&S Requirements (cont)

Representatives must be wearing appropriate Personal Protective Equipment and Clothing on site which includes:

- closed shoes, preferably steel cap boots;
- long trousers due to snakes and surveying in scrub;
- hat;
- a bottle of water; and
- sun screen.

OH&S Requirements (cont)

The project area is a big site and losing people is a potential risk.

To counter this risk, the field team will meet together in the morning and leave site together in the afternoon. We need to be able to account for everyone and make sure everyone leaves the site together.

There will be a sign in/sign off process for fieldwork to help with this issue.

OH&S Requirements (cont)

Representatives are expected to bring their own food as we will be eating on site.

There will be no opportunity to leave site during the survey to get lunch.

Anvil Hill Project

OH&S Requirements (cont)

Water will be available in the field vehicles. Tea and coffee will also be available, but representatives are encouraged to bring their own thermos of hot water as these supplies will be limited.

Sun screen and first aid kits will also be available in all field vehicles. A satellite phone will be with the field team on site and is available for emergencies but not for personal calls. Two way radios will also be available for communication on site.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: .....

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No
IF YES,
Please choose one of the following preferences for fieldwork:

☐ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

.....
.....
.....
.....

I have the following comments/issues about cultural heritage conservation offsets

.....
.....
.....
.....

Signed..... Date.....

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

.....
.....
.....
.....
.....
.....
.....
.....

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

APPENDIX 7

Written responses from Aboriginal Community regarding draft Survey Strategy

Attention: Mary-Jean Sutton.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Combined Council Aboriginal Corporation

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No

IF YES,

Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

Survey all landforms
Survey all creeklines
Grinder Scrapes.

I have the following comments/issues about cultural heritage conservation offsets

Keeping place "ect"

Signed Matthew M Martin Date 3.3.2005

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.

Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Hunter Valley Aboriginal Corporation
ABN: 78 127 059 847

Group Name: Hunter Valley Aboriginal Corporation

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No
IF YES,
Please choose one of the following preferences for fieldwork:

☐ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy
I agree with this but I believe it should be real community groups not indivicuals that are out there to finance there own private pockets. I feel that it should be groups who give back to the community. These groups need to act in appropriate manner and behaviour.

I have the following comments/issues about cultural heritage conservation offsets
I feel this was great and I gave my ideas on the day and I believe it should be something for the community as whole so that we can educate.

Signed Julie Griffiths Date 4-3-05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.
The workshop was very well presented a shame that some members thought they had a right to behaviour like apes and ashamed all the others who were in attendance.

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: HUNTER VALLEY CULTRAL CONSULTANTS

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? (Yes)/No
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy
ALL AREAS SHOULD BE CONSIDERED FOR SEARCH.

I have the following comments/issues about cultural heritage conservation offsets
ANY AREA'S THAT ARE FOUND WITH CULTURAL IMPORTANCE AND ANVIL HILL AND OTHER HILLS SHOULD BE OFFSET FOR THE FUTURE.

Signed C Matthews Date 03/03/05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

CREEK LINE BOTH SIDES WALK OVER, TEST PITS, FLORA AND FAUNA RELOCATION TO UNMINED ANVIL HILL, SPIRAL SEACH OF ANVIL HILL AND OTHER HILLS OFFSET AREAS, HEAVILY WOODED AREA SEARCH, SIGNAGE OF LOCAL LAND

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.

Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Giwiirr

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

As Stated before.

I have the following comments/issues about cultural heritage conservation offsets

Signed ..... Date 17.3.2005

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Attention: Mary-Jean Sutton

FAXED 3.3.2005

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Enviro's

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

uld your group be interested in involvement in fieldwork? (Yes) No

IF YES,
ase choose one of the following preferences for fieldwork:

/ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy
walk all creeklines both side
Survey around anvil hill
Survey other landforms

I have the following comments/issues about cultural heritage conservation offsets
keeping place
All sites are of high significance
Area should have sites

Signed [signature] Date 3.3.2005

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.

Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Lower Wonnarua Tribal Consultancy Pty Ltd

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/~~do not agree~~ with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/~~No~~
IF YES,
Please choose one of the following preferences for fieldwork:

☐ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☑ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

.....

.....

.....

.....

I have the following comments/issues about cultural heritage conservation offsets

.....

.....

.....

.....

Signed ..... Barry Anderson ..... Date 17-3-05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

The LWTC were not happy with the way Yarrawalla and Upper Hunter Wonnarua Council carried on at the workshop. This is not the way that aboriginal groups that represent the community, safety for everyone should be first not fighting over traditional rights. DEC policy is that every group must be consulted only, and its up to the developer who they has on site.

.....

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Copy given to Ben

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: ~~BR~~ UNGOOROO AB CORP

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/~~No~~
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

WE DO NOT AGREE WITH THE TENDER PROCESS

I have the following comments/issues about cultural heritage conservation offsets

ALL GROUND TO BE SURVEYED INCLUDING OFFSET

Signed Glen Date 18-3-05.

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

Comments lodged Prior.

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd. Fax (02) 4959 5737.

02657157777

ATTN: Mary-Jean Sutton.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Upper Hunter Heritage Consultants

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes No

IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

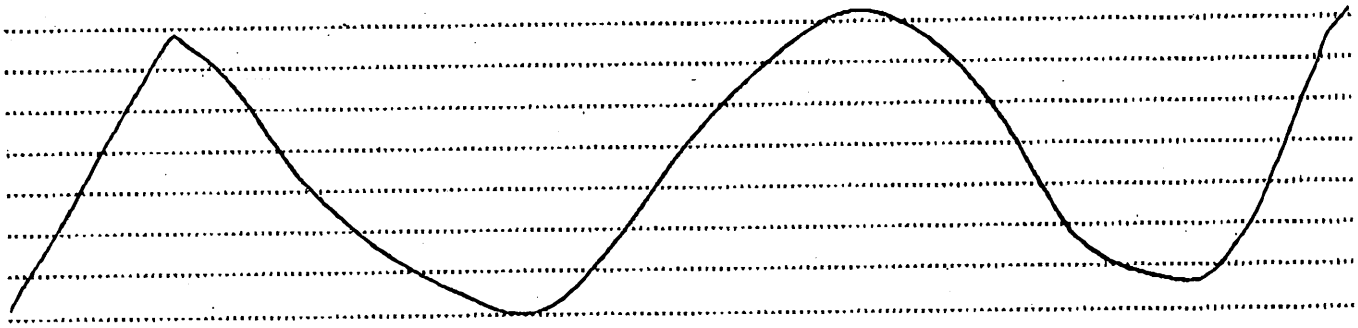
- Grader Scrapes
- Survey Creek lines All of
- Survey land forms All of.

I have the following comments/issues about cultural heritage conservation offsets

Keeping Place for our Heritage & Culture

Signed. O Matthews Date 3.3.05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.



We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.

Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

65721889

Upper Hunter Wonnarua Council Inc

PO BOX 184 SINGLETON NSW 2330
PHONE: 02 6571 4888 FAX: 02 6571 4889

ABN: 24 070 620 198

Unwelt Australia Pty Ltd
PO Box 838
TORONTO NSW 2283

31st March 2005

ATT: **Mary Jean Sutton**
Senior Archaeologist

REF: **Anvill Hill Project / Survey Strategy**

Dear Mary Jean Sutton

Thank you for your letter concerning the proposed survey strategy. Our council has concern's regarding the number of days for the survey and, we believe that our representatives need to be present each day during the field investigation of this area.

From our point of view the whole area has to be surveyed, and our representatives need to be physically reviewed, and record each site on a one by one basis.

Yours sincerly
UHWC
V Perry

Fifth page is on Kym's Liddell file

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: UPPER HUNTER WONNARUA COUNCIL

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

I have the following comments/issues about cultural heritage conservation offsets

NEEDS TO HAVE LANDSCAPES INCLUDED AS A WHOLE CONSERVATION OFFSETS AND THE LAND SHOULD BE OUTSIDE OF THE LEASE.

Signed [signature] Victor Perry Date 1ST MARCH 2005

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned either at the end of this meeting or by fax at the 3 March 2005 as we would like to proceed with fieldwork on March 14.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

0265425652

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: Valley Culture

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? Yes/No
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy
This strategy for the proposed survey is very good. And Valley Culture agrees with all the steps that the survey will be carried out.

I have the following comments/issues about cultural heritage conservation offsets
No comment or have any issues as of yet.

Signed L. Van Wyk Date 29-3-05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.
As of yet we have no comment. I am sure I've done this before and agreed with the survey Strategy.

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: WANARUAH LOCAL ABORIGINAL LAND COUNCIL

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? (Yes)/No
IF YES,
Please choose one of the following preferences for fieldwork:

☐ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

I have the following comments/issues about cultural heritage conservation offsets
Grinding Grooves, Skeletal remains, rock art, carved/scarred trees, burials and rock shelters are protected by being fenced under a conservation area.

Signed Barry G French Date 29.3.05

Erni Grant 29.3.2005

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Wattaka
Wonnarua Cultural C. Service

W.W.C.C.S

Umwelt

Australia Pty Limited
2/20 The Boulevarde
PO Box838
Toronto NSW 2283

Att: Mary-Jean Sutton
Senior Archaeologist

Re: Proposed Survey Straegy, Anvil Hill Project

Dear Mary

Wattaka W.C.C.S agrees with the Proposed Survey Strategy that was suggested at the Metting on 1 March 2005 at Denman.

* Both sides of all creek lines
* around all hills and their tops (including Anvil Hill, Limb of Addy Hill which are outside
* the project and others throughout the project area)
* all other landforms, and all roads and tracks.

Howrver, Wattaka W.C.C.S suports the vewes of the Wonnarua Nation Aboriginal Corporation concerning our Wonnarua Cultural Heritage Values.

Des Hickey
Manager
W.W.C.C.S

4 Kennedy street Singleton 2330
Ph: 02 65711713 Fax 0265712609 Mob: 0432977178 ABN 88 758 080759

[redacted]

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: WATTAKA WONNARUA C.C.S

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/d[redacted] with the proposed survey strategy for the Anvil Hill Project.

uld your group be interested in involvement in fieldwork? Yes/No

YES,

Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy

WATTAKA SUPPORT THE SURVEY STRATEGY

I have the following comments/issues about cultural heritage conservation offsets

Signed Des Hickey Date 5-4-05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

WONNARUA CULTURE HERITAGE
ABN: 22 526 875 861
19 O'Donnell Crescent
METFORD NSW 2323
Fax & Phone: 02 4934 6437
Mob: 0432 029702

Fax

To: MARY-JEAN SUTTON From: GORDON GRIFFITHS

Fax: 0249505737 Pages: 2.

Re: ANVIL HILL PROJECT Date: 21-3-05

AS PER REQUESTED

Anvil Hill Coal Project Inception Meeting and Workshops
1 March 2005

Group Name: WONNARUA CULTURE HERITAGE

I have been involved and consulted in the proposed survey strategy and conservation offsets workshops for the Anvil Hill Project by Umwelt (Australia) Pty Ltd.

Please circle

I agree/do not agree with the proposed survey strategy for the Anvil Hill Project.

Would your group be interested in involvement in fieldwork? (Yes) No
IF YES,
Please choose one of the following preferences for fieldwork:

☑ Aboriginal involvement in fieldwork to be rotational and involve all Aboriginal community groups.

☐ Aboriginal community group involvement to be tendered out.

I have the following comments/issues about the proposed survey strategy
All the Groups within the Wonnarua Boundary should be involved as they all hold Culture Values within the Boundary

I have the following comments/issues about cultural heritage conservation offsets

Signed [signature] Date 21-3-05

Comments about the workshop/project. Comments concerning knowledge about mythological sites within project area or any information about cultural heritage and what you/your group value.
Wonnarua Culture Heritage do Value there Heritage as our Heritage is very Special within our Boundary there is a lot of things that Could be explained if need necessary further info can Can be Contacted on the above Number

We would appreciate if this form could be filled out and returned by fax asap.
Please fax to Mary-Jean Sutton, Umwelt (Australia) Pty Ltd, Fax (02) 4959 5737.

Wonnarua Nation
Aboriginal Corporation
PO Box 3066
Singleton Delivery
Centre NSW 2330
Phone: 02 6572 1077
Fax: 02 6571 4364

Facsimile Message

Please deliver immediately to the person for whom this is intended. If there are any problems with transmission of this message, or if there are any pages missing, please contact us on Ph: (02) 6572 1077, Fax: (02) 6571 4364

To:	Umwelt Australia Consultants
Attention:	Mary-Jean Sutton, Senior Archaeologist
Fax No:	024950 5737
Sender:	Robert Lester
Contact No:	above
Date:	31 March 2005
Number of Pages Including this one:	5

Message: Response to Anvil Hill Project.

Wonnarua Nation Aboriginal Corporation

ABN No 50 012 829 925.

31 March 2005

Umwelt Environmental Consultants
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283

Attention: Mary-Jean Sutton, Senior Archaeologist.

Dear Ms Sutton,

We consider the proposed survey strategy for the Anvil Hill Project as adequate. However, in the light of any unknown factors at this time, our position may change, should it be revealed that Native Title issues should have been brought to our attention during the consultation meeting of the 1st March 2005, if the area within the whole of the application area has Crown Lands involved.

Background information:
WNAC is the only body established within the Hunter Valley that currently holds Native Title Rights and Interests on behalf of Wonnarua People. Wonnarua People determined at openly advertised community meetings that WNAC be the body to hold those rights & interests on their behalf.

We are also the only authorised body to represent Wonnarua People, determined by Wonnarua People at those open community meetings, to deal with Cultural Heritage issues on behalf of Wonnarua People as outlined within the provisions of our constitution adopted by Wonnarua People, which now forms the Lore & Customs of Wonnarua People as to our decision making process's since its incorporated on the 11th June 1999, under the Federal, Aboriginal Councils and Associations Act 1974 for among other things, holding those interests mentioned above.

Our membership is made up of those persons asserting they are a Wonnarua descend of the original Peoples and that membership now exceeds 230 persons. Their rights to be consulted and/or participate in any surveys required regarding Wonnarua Lands and/or Wonnarua People, has been ceded to WNAC by virtue of their membership of WNAC and their participation in the development of the WNAC constitution.

We have made this information verbally available to your company in the past. However, it is now time to put the issue in writing to your Company, and others working in this field. WNAC demands, as the authorised representatives of Wonnarua People to be involved all consultation and/or survey works related to our Country and/or our People.

WONNARUA NATION ABORIGINAL CORPORATION
Office address: 44 George Street Singleton NSW
PO Box 3066 Singleton Delivery Centre NSW 2330
Ph: 02 6572 1077 Fax: 02 6571 4364 Email: wnac@bigpond.com

Failure to include the WNAC in consultation and survey works will result in our consideration of commencing legal proceeding against any organisation, company or Government agency for that exclusion.

If your company choose and/or wishes to deal with unauthorised persons to be consulted with, and/or participate in survey works, that is your right. However, please advise your clients of our position on this matter to avoid any misunderstanding in the future.

Please find accompanying a list of private business with the names of those persons associated with those business's that are currently being consulted and/or participating in survey works related to Wonnarua Country. These persons are members of the WNAC and have not been authorised by WNAC to represent any views and/or opinions of Wonnarua People regarding those works and/or consultations you require on this project, and/or any other projects where you are acting for a client.

As a first instance, we strongly oppose any consultation and/or involvement in survey works by any person/s who cannot provide evidence of they descent to the original Wonnarua Peoples and/or if they cannot provide evidence that they have been authorised by Wonnarua People, through our Corporation to be involved in our Cultural Heritage Matters, in particular, when any recommendations are being considered to destroy our Cultural Heritage materials/values.

The following members of WNAC are unauthorised by Wonnarua People to represent them in any consultation and/or survey works these people represent themselves, and do not have any right, over and above, the rights of our collective Lores & Customs of Wonnarua Peoples.

These private business's have a select membership and/or directorship that benefit from their activities. It is our understanding, that there is no provision within any of their constitutions to supply any communal benefits as a whole to both Wonnarua and/or non-Wonnarua Aboriginal Peoples within the Hunter Valley;

1. Ungrooroo Aboriginal Corporation, members of WNAC are Rhonda Ward & Alan Paget.

2. Wanaruah Custodians, members of WNAC are Barbara Foot & David Foot.

3. Hunter Valley Cultural Consultants, member of WNAC, Christine Matthews.

4. Lower Hunter Valley Council Inc, members of WNAC are Lea-Ann Miller & Tom Miller.

5. Upper Hunter Valley Wanaruah Council, members of WNAC are Rhoda Perry, Victor Perry & Tracey Skene.

6. Lower Wonnarua Tribal Consultancy P/L, members of WNAC are Barry Anderson & Debbie Anderson, Arthur Flecther.

7. Upper Hunter Heritage Consultants, member of WNAC, Darrel Matthews.

8. Wonnarua Elders Council, members of WNAC are Rhoda Perry & Tom Miller.

9. Combined Council Hunter Valley Aboriginal Corporation, members of WNAC are Margaret Matthews and Associate member John Matthews.

10. Giwirr Consultants member of WNAC, Rodney Matthews.

11. Valley Culture, non-member WNAC, Larry Van Vliet & Bev Van Vliet to our understanding, is not Wonnarua Person.

12. Wattaka (WWCCS), member of WNAC, Des Hickey. However, Mr. Hickey has given a written commitment to WNAC to enter into an agreement regarding these works.

13. Wannaruah Cultural Heritage, to our understanding, these person are not Wonnarua Person, Jo Hampton & Gordon Griffith.

14. Hunter Valley Aboriginal Corporation, Julie Griffith.

15. Yarra Walk Enterprises (YWE), non-member of WNAC. However, members of this organisation assert their Wonnarua descent. It should also be said that Mr. Franks has given a verbal commitment of working towards establishing a unified voice for the Traditional Owners of Wonnarua Lands, discussions are underway with Mr. Franks.

16. Wanaruah Local Aboriginal Land Council, members of WNAC are Darrel Matthews, Rhoda Perry, Victor Perry, Barbara Foot, David Foot, Rhonda Ward, Alan Paget, Christine Matthews, Rodney Matthews, Larry Van Vliet & Beveley Van Vliet, John Matthews & Margaret Matthews, Scott Franks

It is our firm belief that Local Aboriginal Land Council do not have a role to play in relation to Cultural Heritage Management where there are Traditional Owner Groups established.

The NSWALR 's Act 1983, under **Functions of Local Aboriginal Land Councils clause 51 (1) (m) states;** "to promote the protection of Aboriginal culture and the heritage of Aboriginal persons in its area". This does not give LALC's a decision making role on behalf of a Community, Traditional Owner Group, or a participating role to be consulted and/or be involved in survey works.

However, where there are no Traditional Owner Groups established then we would support the LALC's acting in a custodianship role to deal with Cultural Heritage Management issues until a Group is established.

In making the above statement, we accept and welcome the participation of the LALC's within Wonnarua Country, as they can provide assistance to the Traditional Owners. Clause 51 of the NSWALR's Act 1983, under **Objects of a Local Aboriginal Land Council** states the following; "The objects of each Local

Aboriginal Land Council are to improve, protect and foster the best interests of all Aboriginal persons within the Council's area and other persons who are members of the Council".

It is WNAC's view, that all Wonnarua People who participate in development of our constitution for Wonnarua Lores & Customs, should comply with those determinations made at the time, so as to comply with the requirements of the Commonwealth Native Title Act 1994, to progress claims on behalf of all Wonnarua People.

Please take our resolve seriously, we will take any legal opportunity at our disposal to ensure our 230 plus Wonnarua descendants are fully represented and our adopted Lores & Customs are upheld and respected by all involved in dealing with our Cultural Heritage Materials/Values. This resolve also applies to our own People breaching these Lores & Customs.

I can be contacted on the number above or (m) 0417 212 896 if you require any further information and or clarification if our point is not clear.

Yours sincerely

Robert J. Lester
Chairperson

0265410445

YARRAWALK
SEARCHING FOR OUR CULTURE & HERITAGE
PO Box 906 MUSWELLBROOK
NSW AUSTRALIA 2333
02 65410445 \ 0422175839 Fax 02 65410445
Yarrawalk@bigpond.com

29th march 2005
Umwelt Environmental Consultant
Re :Anvil Hill
Dear Ms Sutton,

As per your letter march 2005, Please be advise that YARRAWALK is seeking to be involved in any and all consultation meetings and field work, we would also like to state Yarrawalk is a made up of ONLY a membership that can prove Wanaruah DESCENDANCY via a genealogy report that has been compiled by the NSW Native Title Services.

We would be more then happy to meet with yourself and your client if you like to discuss this we would also be more then happy to supply you with a copy of the report so you can see just whom is traditional owner of this area. This would be supplied on a need to know basic and we would hope that you would not allow it to be seen or used out side any dealings with Yarrawalk.

Please be advised that our position is very clear we will not except or support any other groups comments regarding this area as at this stage it is very clear that no other groups apart from Yarrawalk can prove formal written tries to this area as a result of this we must insist on being involved in all field work regarding this project.

The idea of allowing non Wanaruha people the opportunity to make money which will result in the destruction of our land is wrong their for Yarrawalk must insist on.

- **Being involved in all field work every day that the project in going.**
- **We will not except any other groups recommendations regarding this area.**
- **The developer must except that trod lonal owners have the over riding say in regard to all and any destruction of our land.**
- **Yarrawalk dose not support community groups, to be given the opportunity to make money by consenting to the destruction of our land.**

Yours faithfully

Scott Franks
Managing director

Part B of the Anvil Hill Project Aboriginal Archaeological Assessment is located in Volume 7 of the Environmental Assessment

Centennial Hunter Pty Limited

Centennial Hunter Pty Limited
Anvil Hill Project Office
Shop 14
Campbells Corner Building
Brook Street
Muswellbrook NSW 2333
Tel: (61-2) 6543 2800

Umwelt
Environmental Consultants

Umwelt (Australia) Pty Limited
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283
Ph. 02 4950 5322
Fax 02 4950 5737
www.umwelt.com.au