



Integra Coal Operations Pty Ltd

ABN: 96 118 030 998

Glennies Creek Open Cut Coal Mine

Aboriginal Heritage Assessment

Prepared by

HLA Envirosiences Pty Ltd

October, 2007

**Specialist Consultant Studies Compendium:
Part 5**

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Aboriginal Heritage Assessment

of the

Glennies Creek Open Cut Coal Mine

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Aboriginal Heritage Assessment - Proposed Open Cut Mine, Glennies Creek Colliery, Hunter Valley, NSW

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EXECUTIVE SUMMARY

INTRODUCTION

Integra Coal Operations Pty Ltd (ICO) proposes to develop the Glennies Creek Open Cut Coal Mine, 12km north of Singleton in the Hunter Valley, NSW. ICO through R.W Corkery & Co. Pty Limited is preparing an *Environmental Assessment* (EA) required under the *Environmental Planning and Assessment Act* (1979) for this proposed development. Since an integral part of an environmental assessment is the Aboriginal heritage, HLA Envirosciences Pty Ltd (HLA) has been commissioned to undertake a comprehensive Aboriginal heritage assessment of the proposed impact zone.

This assessment is in response to the requirements of the Department of Environment and Climate Change (DECC) in relation to the development of this project. The DECC specific requirements in relation to Heritage are outlined below with the corresponding sections of this report relevant to them identified.

Government Authority	Paraphrased Requirement	Relevant Section
HERITAGE		
Department of Environment and Conservation (22/12/04)	Provide a detailed assessment of Aboriginal heritage including: - an archaeological assessment in accordance with the NPWS IDA Guidelines for Aboriginal Cultural Heritage; - an Aboriginal cultural heritage assessment in accordance with the NPWS IDA Guidelines; - details (as indicated in the IDA Guidelines) of inclusive consultation with the local Aboriginal community;	Entire Report
	If sites or areas of Aboriginal heritage significance are identified through the assessment process, consideration will need to be given to appropriate conservation options.	Section 6
	Conduct a search of the Aboriginal Heritage Information Management System.	Section 3.2
	An assessment should be undertaken by an appropriately qualified person in consultation with the local Aboriginal community.	Sections 1.3 and 2
	Detail on a plan Aboriginal objects and places of significance.	Figure 5
	Prepare a contingency plan that details the measures to be taken in the event that Aboriginal objects are discovered.	Section 6
	Provide details of extensive consultation with the local Aboriginal community as per the then DEC <i>Interim Community Consultation Requirements for Applicants</i> .	Section 2

ABORIGINAL CONSULTATION

Aboriginal consultation was undertaken in line with the then DEC's (2005) *Interim Community Consultation Requirements for Applicants* and included:

- contacted the DECC's Executive Director Operations, Cultural Heritage Division;
- contacted the DECC Northeast Environment Protection and Regulations Division (EPRD) to advise on the relevant Aboriginal stakeholders;
- contacted Glen Morris of DECC to identify relevant Aboriginal stakeholders;
- contacted the Wanaruah Local Aboriginal Land Council (LALC) to identify their interest in the project and any relevant Aboriginal groups;
- contacted Singleton Council;
- searched the Native Title Tribunal to identify possible Native Title holders;
- searched the Office of Registrar of Aboriginal Corporations; and
- advertised in the *Singleton Argus* and *Muswellbrook Chronicle* newspapers between Friday 11 February and Monday 21 February 2005, allowing 10 days for registrations of interest.

The subsequent fieldwork involved 12 of the Aboriginal groups local to the region. Detailed information on the consultation and timeframes can be identified in **Section 2** of this report.

SURVEY METHODOLOGY AND RESULTS

The archaeological field survey of the proposed Glennies Creek Open Cut Coal Mine study area was conducted on 14 and 15 March 2005, by Jakub Czastka (HLA), Alan Williams (HLA), Emma Harrison (HLA) and representatives from 12 Aboriginal groups (see **Section 2**). Additional fieldwork was undertaken on the 7 March 2006 by Alan Williams (HLA) and two Aboriginal representatives.

A systematic survey was undertaken, which covered the whole study area, excluding those areas that were considered to heavily impacted (such as the current Camberwell North Pit for example). Later modifications to the Project Site, also meant the proposed Haul Roads D and E, and the Camberwell Coal Handling and Preparation Plant (CHPP) were also not included in the survey, because they were believed to be similarly extensively impacted. The study area was some 320 hectares in size, and was therefore split into representative transects that were manageable to record. The survey covered the whole study area and recorded all information on a survey recording sheet as described in **Section 4.1** and on base maps of the site provided by R.W. Corkery & Co. Pty Limited. The results are presented in **Table 10**.

The study area was split into 24 transects (**Figure 3**), which were separated through landform type or some other relevant geographical change. Each transect was individually described for potential surface and subsurface archaeology. The start, end and any other relevant features were located with GPS, while multiple photographs across each transect were undertaken.

SITES IDENTIFIED

Nineteen areas were identified as either containing or having the potential to contain Aboriginal archaeological deposits, and are discussed in detail in **Sections 4.3** and **4.4** of this report. All these areas have been identified as areas of high sensitivity in **Figures 4** and **5**.

MANAGEMENT STRATEGY

Despite the high impact that has been proposed for the study area, specifically the complete destruction of 90ha and other associated impacts of about 50ha, the site has already been highly modified by current and past land use in the area. The previous existence of the Camberwell North Pit, the current open cut and Possum Skin Dam, as well as pastoralism have left an area that retains little archaeological material.

Nineteen areas have been highlighted by this survey to contain Aboriginal objects or sites (**Figure 4**). In all cases these are either artefact scatters or isolated finds situated on disturbed or heavily eroded contexts. These areas have been highlighted as of high sensitivity. However, it should be noted that this allocation of sensitivity was based purely on the fact that Aboriginal objects are protected under the *National Parks & Wildlife Act* (1974), regardless of their specific location. No evidence was found to suggest these sites were surface manifestations of a larger buried archaeological deposit.

Geomorphological evidence reveals that the deforestation of the area in the recent past has allowed heavy erosion of the slopes and ridge crests into the drainage lines and creeks (**Plate 10**). However, since the majority of the study area is on the edge of the Fal Brook catchment, there are few areas that can be considered accumulation zones, the most likely being the area now encompassed by Possum Skin Dam (**Plate 3**), although now completely modified – this area was where a large concentration of artefacts was found, adding to this hypothesis. In general, the surface and sections revealed a soil profile of truncated B horizon with modified colluvium above (**Plates 19** to **23** inclusive), the former consisting of an orange clay with polyhedral peds, while the latter is a light brown sandy loam with abundant sub angular and angular stones. As can be seen from this brief description here, the two soil units are unlikely to be from the same location due to the evident differences in their composition. Furthermore, the soils in most locations were generally quite shallow before bedrock was reached, typically under 50cm (**Plates 11** and **25**). The potential, therefore, for substantial in situ subsurface deposits (considering bioturbation can exceed 1 metre) is minimal across the study area.

For these geomorphological reasons, aside from the nineteen sites, the study area has been given a low sensitivity rating in terms of archaeology and requires no further archaeological investigation. However, two other issues that need to be considered are the large areas of exposed bedrock along the drainage lines and the previous sites that still exist within Possum Skin Dam.

During the survey, a large number of flat exposed sandstone outcroppings were evident across the site, but particularly within the northern area of the proposed open cut. Although no engravings or axe grinding grooves were evident during the survey, the geomorphology reveals that these areas may have subsequently been buried by colluvium from upslope. For this reason all personnel should be advised of the potential risk of finding Aboriginal sites within the sandstone surfaces, and the appropriate steps that should be undertaken if this occurs. Specifically, to stop work and contact the DECC Northeast EPRD regional archaeologist for discussion.

Two sites were identified in the late 1980s during the original survey for the current Glennies Creek Colliery (Lilley 1987). These sites, National Parks and Wildlife Services (NPWS) numbers # 37-3-0188 and # 37-3-0189 were submerged within Possum Skin Dam during its construction. Although not relevant to this study, HLA has pursued the issue of these sites and the survey for the dam, and has currently found no fault with Glennies Creek mine and their management of the process. The submergence of sites, while not common, does not constitute a “disturbance” under the Act and for this reason is perfectly acceptable. The location of these two sites could not accurately be determined, aside from within Possum Skin Dam, and therefore may be impacted by this project. Therefore, since these sites are largely small artefact scatters – most likely similar to the ones identified in this study, any approval to disturb artefacts should incorporate them as well. The logistics of how these would be relocated and recovered following approval will need to be addressed early in the planning stages.

As stated in **Section 6.2**, this project has been declared as a Major Project and as such, falls under Part 3A of the *Environmental Planning and Assessment Act 1979* (as amended). Therefore, it does not require permits under the *National Parks and Wildlife Act 1974*. Hence, the management of the nineteen sites, considered surface scatters with no evidence of subsurface deposits, should be to record and collect them in consultation with the Aboriginal communities prior to the proposed development proceeding. An Agreement between the Aboriginal stakeholders regarding who retains the collected artefacts would need to be negotiated prior to any collection.

The collection of these sites in conjunction with the Aboriginal communities should be made a requirement in the Statement of Commitments prepared for the project.

A number of matters were highlighted in the requirements of the DECC for this proposal to be included in this report, specifically issues of the Aboriginal community over the destruction of waterways in the Hunter Area, the native title claim of Mimaga Wajaar Traditional Custodians and the DIPNR requirement of the Mt Owen Project for a monetary offset to go to the Hunter Aboriginal Cultural Heritage Trust Fund.

First, waterways within the Hunter are incredibly significant to the Aboriginal people, since these were the main routes between inland and the coast, often called “Song lines”. Mount Owen Coal Mine was proposing to impact several of these waterways, specifically Betty’s Creek. This study reveals that the proposed development will not directly impact any major waterways within the study area, although initial and ongoing concern has been raised over any impacts to Glennies Creek, which is another of these significant “Song lines”. At this stage, there is no evidence that Glennies Creek will be impacted, should this situation change, consultation with the Aboriginal communities should be undertaken as a matter of priority. Discussions with the Aboriginal communities on site revealed that few concerns were felt for any of the drainage lines on the site, since many were clearly formed through recent erosion.

The native title claim has been discussed in **Section 2** and reveals that no evidence to support this potential claim could be identified. The claimant group is presumed to come from the Lake Macquarie region some distance from the Hunter Valley. It seems unlikely that any claim made by groups outside of those currently operating in the Hunter Valley, specifically the Wannaruah (and to a lesser extent Kamilaroi) people, would be endorsed by Native Title Services, who are intimately familiar with the ongoing issues in the Hunter. Furthermore, since the group has yet to have a Native Title Claim over the area at the instigation of this project and has not contacted HLA regarding the project, despite public announcement, there seems little issue with their current absence in the consultation process.

With regard to the monetary offset of \$50,000 for the destruction of Aboriginal objects within the Mount Owen Project Site, this process is quite common in the Hunter Valley. HLA has been involved in many projects where the client wishes to provide some contribution to the Aboriginal communities and often stops the need for large amounts of irrelevant archaeological work prior to development. Instead, the funds can go towards preservation and/or investigation of more relevant and significant Aboriginal sites elsewhere. A similar process may be sought from the communities here. However, the funds should only go to a fund that demonstrates and can prove the use of the funds for Aboriginal communities and archaeological research. The reason for this criterion is that it is alleged (and is currently being investigated by the Wannaruah LALC) that the Hunter Aboriginal Cultural Heritage Trust Fund is actually largely a private fund for one of the Aboriginal groups in the area, and few of the funds deposited there ever reach the community. If ICO wish to make a contribution to the Aboriginal communities, HLA would be willing to help facilitate this process and ensure complete transparency in the donation and use of the funds.

Following a change in the shape of the study area in 2006, additional survey work was undertaken over the areas to the west of Possum Skin Dam in March 2006. HLA was advised that new areas included which run along the north and north-eastern edge of the study area are to be left as a conservation area, and as such will receive no impact (**Figure 3**). Given this area is the closest part of the study area to Glennies Creek, a significant Aboriginal transport line, no impacts should be undertaken on this area until a full Aboriginal heritage survey has been undertaken upon it. More recently, additional areas have been incorporated into the study area, specifically Proposed Coal Haul Roads D and E, and the Camberwell Coal Handling and Preparation Plant (CHPP). These areas have not been investigated, but HLA has been advised they are existing infrastructure, and as such have been previously heavily impacted.

One further condition that this report recommends placing in the Statement of Commitments regards the protection of any Aboriginal skeletal remains, which are protected under the *National Parks and Wildlife Act 1974*. The condition should state that if skeletal remains are identified during the works, then all works must stop and contact with the NSW Police, Department of Environment & Climate Change and the NSW Coroners Office must be made immediately. The subsequent management of any Aboriginal skeletal bodies found, should be developed in conjunction with DECC, the Aboriginal communities and trained archaeologists. Management options should include preservation *in situ*, or detailed excavation and recording followed by retrieval. In relation to the latter, consideration of the ultimate location of the remains should also be decided prior to retrieval.

RECOMMENDATIONS

The **Statement of Commitments** prepared for the proposed Glennies Creek open cut mine should include the following commitments.

- No impacts should be undertaken to the north and northeastern areas of the Project Site (as shown in **Figure 3**) until an Aboriginal heritage assessment has been undertaken.
- Aboriginal sites GC1 to GC19 (inclusive) should be recorded and collected in consultation with the Aboriginal communities (specifically those outlined in **Section 2** of this report) prior to the proposed development occurring.
- Discussions with the proponent and the Aboriginal communities should be undertaken prior to the collection, to identify an appropriate “keeping place” for the artefacts associated with sites GC1 to GC19 (inclusive).

- Any further Aboriginal sites identified during the course of the proposed works, should be dealt with in a similar manner to those outlined for GC 1 to GC 19 (inclusive) above.
- Where Aboriginal sites are discovered that cannot be relocated or collected (such as rockshelters, grinding grooves and engravings), consideration should be given first to preservation *in situ*, then to detailed recording and investigation by professional archaeologists in conjunction with the communities. Similarly, agreement with the level of investigation and eventual location of all artefacts and object recovered, should also be decided in conjunction with the Aboriginal communities prior to the investigation commencing.
- Aboriginal skeletal remains are highly significant and are protected under a variety of criminal State legislation. Should remains be found, work should cease immediately and consultation with the DECC, NSW Police, NSW Coroners Office and the Aboriginal communities should be undertaken immediately to decide on the best course of action. If Aboriginal remains are discovered, these actions should include either 1) the preservation of the remains *in situ*, or 2) the detailed recording and recovery of the remains by qualified personnel in conjunction with the Aboriginal communities. The latter should also seek agreement on the subsequent location and/or re-burial of the remains prior to their removal.
- Should the Aboriginal communities decide that further cultural salvage of the study area would not be required (beyond the protection of known sites), a cultural 'off-set' could be negotiated between ICO and the Aboriginal communities that would benefit the Aboriginal communities in general and promote Aboriginal heritage and culture in the wider community.
- No further archaeological work is required in areas of low sensitivity.
- All contractors should be made aware of these Recommendations prior to commencing site works.

1 INTRODUCTION

Integra Coal Operations Ltd (ICO) proposes to develop the Glennies Creek Open Cut Coal Mine, 12km north of Singleton in the Hunter Valley, NSW. ICO through R.W Corkery & Co. Pty Limited is preparing an *Environmental Assessment* (EA) required under the *Environmental Planning and Assessment Act* (1979) for this proposed development. Since an integral part of an environmental assessment is the Aboriginal heritage, HLA Envirosciences Pty Ltd (HLA) has been commissioned to undertake a comprehensive Aboriginal heritage assessment of the proposed impact zone, hereafter referred to as the study area.

This assessment is in response to the requirements of the Department of Environment and Climate Change's (DECC) in relation to the development of this project. The DECC specific requirements in relation to Heritage are outlined below with the corresponding sections of this report relevant to them identified.

Government Authority	Paraphrased Requirement	Relevant Section
HERITAGE		
Department of Environment and Conservation (22/12/04)	Provide a detailed assessment of Aboriginal heritage including: - an archaeological assessment in accordance with the NPWS IDA Guidelines for Aboriginal Cultural Heritage; - an Aboriginal cultural heritage assessment in accordance with the NPWS IDA Guidelines; - details (as indicated in the IDA Guidelines) of inclusive consultation with the local Aboriginal community;	Entire Report
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	Detail on a plan Aboriginal objects and places of significance.	Figure 5
	Prepare a contingency plan that details the measures to be taken in the event that Aboriginal objects are discovered.	Section 6
	Provide details of extensive consultation with the local Aboriginal community as per the then DEC <i>Interim Community Consultation Requirements for Applicants</i> .	Section 2

1.1 Project Description

The proposed development would entail an open cut mine for access into three coal seams; Middle/Lower Liddell, Barrett and Hebden. Open cut mining would require the removal of topsoil and subsoil, overburden, coal and interburden using dump trucks and excavators with blasting required throughout mining activities to break overburden and interburden.

It is understood, the overburden and interburden would be placed both in-pit and out-of-pit to the proposed open cut and blended with the rehabilitated slopes of Camberwell's former overburden emplacement (**Figures 1 and 2**).

This report aims to identify the archaeological sensitivity of the proposed disturbance area for the open cut proposal, and if necessary, develop an appropriate impact mitigation strategy. The archaeological sensitivity of the area was assessed on two criteria: the presence or absence of archaeological materials on the ground surface, and the probability (low, moderate or high) of buried archaeological materials occurring. These criteria were addressed through a literature review of previous archaeological and environmental research conducted within the region and an archaeological survey of the proposed impact zone, including the proposed open cut, out-of-pit overburden emplacement and associated locations.

The scope of works is based on the professional standards outlined by the NSW Department of Environment & Conservation's (formerly National Parks and Wildlife Service) *Aboriginal Cultural Heritage Standards and Guidelines Kit* (1997) and *Interim Community Consultation Guidelines for Applicants* (2005).

Following new Department of Environment and Climate Change (DECC) consultation guidelines, an extensive consultation process was undertaken for this project to ensure appropriate Aboriginal stakeholders were informed and included.

1.2 Study Area

The proposed open cut coal mine and associated disturbance area is located north and adjacent to the operational Glennies Creek Coal Colliery, 12km north of Singleton (**Figure 1** and **Plate 1**). The specific area of development is approximately 376 hectares, with the open cut accounting for around 90 hectares and the out-of-pit overburden emplacements some 41 hectares (**Figure 2**). The remaining area of impact will be disturbed through the associated and ancillary activities typical in a working coal mine, such as offices, facilities, conveyors, fuel storage, car parks, services, etc.

It should be noted that the original Camberwell North Pit, now backfilled, ran along much of the southern side of the study area in an east-west orientation. Therefore, the area under and to the south of the current Camberwell overburden emplacement was considered heavily impacted before the survey was undertaken (**Figure 2**). Existing infrastructure areas, previously impacted, have recently been included in the study area, including the Proposed Coal Haul Roads D and E, and the Camberwell Coal Handling and Preparation Plant (CHPP).

1.3 Study Team

The survey was undertaken by Alan Williams, Archaeologist, Jakub Czastka, Senior Archaeologist, and Emma Harrison, Archaeologist between the 14 to 16 March 2005. Additional areas were surveyed by Alan Williams on 7 March 2006. All are personnel of HLA. Jakub Czastka provided technical review, Michael England undertook Peer Review with administrative and drafting support from Kim Wilkinson and Tim Osborne.

1.4 Report Structure and Limitations

The report structure relates the sections of the report and their contribution to the study.

Section 2.0 of this report outlines the Aboriginal community consultation and involvement undertaken for the project. **Section 3.0** summarises the regional archaeological and environmental context for the assessment of the study area. This review specifically targets known sites within the area, past reports and landscape evolution. **Section 4.0** outlines the methods and results of the archaeological survey and assessment of the study area. **Section 5.0** combines the results of the background research and site survey and provides a predictive model of archaeological sensitivity for the site. **Section 6.0** discusses the sensitivity model and provides recommendations and management options, based on the statutory controls relevant to the project. This management strategy also identifies any additional issues raised by Aboriginal community group representatives, and incorporates these issues where possible.

A summary of the statutory requirements regarding Aboriginal heritage is provided in **Section 6.2**. This is based on experience with the heritage system in NSW and does not purport to be legal advice. It should be noted that legislation, regulations and guidelines change over time and users of the report should satisfy themselves that the statutory requirements have not changed since the report was written.

1.5 Limitations

This assessment is based on the existing environmental and archaeological knowledge of the study area, within the larger context of the Hunter Valley. If previously recorded surface archaeological materials are found within the immediate locality, they are identified and discussed. This discussion has been based on the reports prepared by others (as cited in this report) and HLA has relied on these reports and has not sought to independently verify the results and interpretations in these reports.

Predictions have been made about the probability of subsurface archaeological materials occurring within the study area. It is possible that materials may occur in any landscape context, and the assessment of subsurface materials refers to the likelihood of occurrence based on surface indications and environmental context.

HLA has undertaken a search of the Aboriginal Heritage Information Management System (AHIMS) held within the Department of Environment and Climate Change (DECC). The search results are provided in **Appendix B**.

As stated in the qualifying letter from the Acting AHIMS Administrator, Register searches are constrained by the amount of data in the register and the quality of that data (for example grid references can be inaccurate). Large areas of NSW may not have been systematically searched and may contain Aboriginal objects and other heritage values not recorded on AHIMS.

Additionally, the AHIMS reports database can only be searched by the title of the report, which may not indicate the geographical location of the area covered. This means that it is possible that some known sites and some reports may have been omitted from this study. Sites and reports are added and removed from AHIMS and therefore the accuracy of information provided from AHIMS is only valid on the day the register is searched and to the nature of the search.

A summary of the statutory requirements regarding Aboriginal heritage is provided in **Section 6**. This is provided based on experience with the heritage system in NSW and does not purport to be legal advice. It should be noted that legislation, regulations and guidelines change over time, and users of the report should satisfy themselves that the statutory requirements have not changed since the report was written.

2 ABORIGINAL COMMUNITY CONSULTATION

In response to two recent Land and Environment Court (LEC) rulings (*Carriage v Stockland Development Pty Ltd (No 4)* [2004] NSWLEC 3553 and *Williams v The Director General of the Department of Environment and Conservation v Ors* [2004] NSWLEC 613) the then Department of Environment & Conservation (DEC) has developed the *Interim Community Consultation Requirements for Applicants* (DEC, 1 January 2005). These new requirements have expanded and developed on the current guidelines (*Aboriginal Cultural Heritage Standards and Guidelines*, DEC 1997), making the consultation process longer and more thorough.

For this reason HLA undertook the following steps with regard to this project.

- Contacted the DECC's Executive Director Operations, Cultural Heritage Division.
- Contacted the DECC northeast Environment Protection and Regulations Division (EPRD) to advise on the relevant Aboriginal stakeholders.
- Contacted Glen Morris of DECC to identify relevant Aboriginal stakeholders.
- Contacted the Wanaruah Local Aboriginal Land Council (LALC) to identify their interest in the project and any relevant Aboriginal groups.
- Contacted Singleton Council.
- Searched the Native Title Tribunal to identify possible Native Title holders.
- Searched the Office of Registrar of Aboriginal Corporations.
- Advertised in the *Singleton Argus* and *Muswellbrook Chronicle* newspapers between Friday 11 February and Monday 21 February 2005, allowing 10 days for registrations of interest.

HLA was already aware of many of the Aboriginal groups in the Hunter Valley, routinely undertaking work in the area. For this reason, many of the relevant groups were contacted at the instigation of the project on the 7 February 2005 to attend a community meeting on the 11 February 2005 to discuss the project with a number of other HLA projects being undertaken at the same time, pre-empting the searches and media response. It was felt to streamline the process, other groups or individuals that became apparent after this meeting could be consulted either via telephone or e-mail or another meeting at a slightly later date.

The meeting held on Friday 11 February 2005 was held at the HLA Offices in Singleton and was attended by the following Aboriginal groups (brackets indicate representative present).

- Wanaruah Local Aboriginal Land Council (Janelle Risby).
- Lower Wonnarua Tribal Consultancy Pty Ltd (LWTC) (Barry Anderson).
- Upper Hunter Wanaruah Council (Rhoda Perry).
- Ungooroo Aboriginal Corporation (UAC) (Rhonda Ward).
- Combined Council of Hunter Valley Aboriginal Corporation (John Matthews).
- Wanaruah Nations Aboriginal Corporation (Luke Hickey & Robert Lester).
- Yarrawalk Enterprises (Scott & Tom Franks).
- Wanaruah Custodians (Barbara Foot).

- Upper Hunter Aboriginal Corporation (Margaret Matthews).
- Wattaka Wonnarua C.C. Service (Des Hickey & David Murray).
- Valley Culture, Wonnarua Cultural Heritage (WCH) and Hunter Valley Cultural Consultants (HVCC) sent their apologies.

The last three groups, Wonnarua Cultural Heritage, Valley Culture and HVCC were unable to attend the meeting, but were contacted following the meeting to advise of the project and future fieldwork and seeking to identify their interest. HVCC provided a positive response on the 28th February 2005, while the WCH responded on the 14 February 2004 and Valley Culture on the 20 February 2005. At this meeting, the proposed excavation methodology was distributed for the groups to provide comment upon. They were advised that 21 days would be allocated, as specified by DECC guidelines, for comments to be received.

Only minimal comments were received in reference to the methodology with only two issues being raised by the UAC and the LWTC. The former identified a lack of cultural significance assessment outlined in the methodology, which typically HLA does not comment on, since only Aboriginal people may comment on their cultural heritage. The latter identified the need for the whole site to be surveyed rather than just transects. An argument was made that transects are scientifically accepted across the world, while surveying the whole site was financially unviable. However it proved an ongoing issue throughout the consultation phase. This is an issue not only with this project, but multiple others across the Hunter being run by a variety of consultants. This issue was addressed, discussed and resolved in this project (see below for details).

No additional groups were identified during the local media advertising phase (namely an advertisement in the *Singleton Argus* and *Muswellbrook Chronicle* between 11 to 21 February 2005), although a number of groups already invited still registered their interest following the meeting, despite advice at the meeting that it was not required.

No additional Information was revealed by the Native Title Search, while no response was received from the DECC (although a letter was received on the 18 March 2005, some 6 weeks after the request and after the completion of the physical survey) nor the Registrar of Aboriginal Corporation. The DECC letter did not outline any relevant groups that were not encompassed within the initial meeting nor within the distribution boundaries of the local newspapers. The DECC letter did however outline a number of other Aboriginal groups (some 8 others) for the Hunter Valley that were not contacted. Clearly many of these are actually based in Lake Macquarie or east of the Barrington ranges and were therefore considered not relevant to the project in question and were not contacted.

R.W. Corkery & Co. Pty Limited have identified that a Native Title Claim was being undertaken in the area by Mimaga Wajaar Traditional Custodians. The only reference HLA could find of this group was Mimaga Wajaar Pty Ltd and this group is located south of Newcastle in the Lake Macquarie region, and were therefore not considered relevant to the Upper Hunter.

A further meeting was undertaken on the 7 March 2005, with the groups outlined above and two additional groups in attendance – Valley Culture (Michael Stair) and Giwirr Consultants (Rodney Matthews). This meeting was undertaken to advise the groups of a number of HLA projects and to outline the methodology comments and survey details of this project. They were advised that they would need to supply written confirmation of attending the physical inspection, and also agree to HLA's Standard Terms of Engagement. These terms are simply a list of requirements that ensure Occupational Health and professional conduct is maintained at all times on the survey.

All groups that had registered an interest in the project were again informed by telephone or fax on the 10 March 2005 advising them of this written confirmation requirement (which also required the inclusion of a copy of the group's insurances). All were received by the 11 March 2005.

The fieldwork was undertaken on the 14 and 15 March 2005. Despite speaking with Gordon Griffith of the WCH on Sunday 13 March 2005, no representative from their group attended the survey, while the Wanaruah LALC representative only participated on the second day due to transport issues. The following groups attended the survey (brackets indicate representatives) (**Plate 2**).

- Wanaruah Local Aboriginal Land Council (Kylie Griffith).
- Lower Wonnarua Tribal Consultancy Pty Ltd (Barry Anderson).
- Upper Hunter Wanaruah Council (Tracey Skene).
- Ungooroo Aboriginal Corporation (Rhonda Ward).
- Combined Council of Hunter Valley Aboriginal Corporation (John & Margaret Matthews).
- Wanaruah Nations Aboriginal Corporation (Joshua Hickey).
- Yarrawalk Enterprises (Tom Franks).
- Upper Hunter Aboriginal Corporation (Darrell Matthews).
- Wattaka Wonnarua C.C. Service (Des Hickey).
- Valley Culture (Michael Stair).
- Hunter Valley Cultural Consultants (Trevor Archibold).
- Giwirr Consultants (Rodney Matthews).

Due to the initial issues with the methodology (whole site versus transects), at the end of the second day all groups were asked if they were happy with the coverage of the survey undertaken – all groups agreed that the coverage was adequate.

Issues were raised by the Aboriginal groups over the installation of Possum Skin Dam to the northeast of the proposed impact zone (**Plate 3**). This dam was installed in early 2005 and it was believed no survey was carried out. Although not part of this project, the groups wanted this issue clarified before they would endorse the Proposed Glennies Creek Open Cut Coal Mine. Therefore HLA has been working with ICO to identify the origins of the dam and any impacts that occurred. Research reveals that the dam was surveyed in the late 1980's and endorsed by DECC, and that no breach of the *National Parks and Wildlife Act* (1974) has occurred. This issue is currently ongoing between ICO and the communities, with HLA facilitating the process, but this is irrelevant to this project – the dam basically being a pre-existing impact.

Following a change in the shape of the study area in March 2006, a further process of consultation and fieldwork was undertaken to investigate a proposed haul road running to the east of Possum Skin Dam. Each of the groups that registered their interest at the start of the project were invited to participate in this additional fieldwork, but only Yarrawalk (Scott Franks) and WNAC (Robert Lester) sought interest and subsequently attended the field investigation on the 7 March 2006.

Details of all community consultation that was undertaken as part of this project can be found in **Appendix A**.

3 BACKGROUND RESEARCH

Background research into the environment forms the basis for assessing the regional archaeological context and predictions for site distribution in the study area. It is generally assumed by archaeologists that Aboriginal settlement patterns are related to the environment and that areas of similar environment will have similar site distribution. Thus, understanding the environment of a study area assists comparative analyses.

Secondly, understanding something of the environmental background also assists in assessing the conditions for site preservation or destruction. This is important in interpreting the results of archaeological surveys and in developing management strategies for protection of sites.

This section has been split into the following areas: environmental context, geology, soils, vegetation, landforms, historical overview, previously recorded sites, geotechnical context and regional archaeological context.

3.1 Environmental Context

3.1.1 Geology

Identification of the underlying geological formations of the landscape is important in order to understand the natural resources within the study area. Resource availability influences the nature and intensity of human activity throughout the landscape. In particular, the procurement of raw material for flaked stone artefact manufacture is a major influence on the distribution of Aboriginal sites. Regional geology can also point to areas that have potential for subsurface archaeological remains.

The geology of the study area has been mapped on the Camberwell Geological Series Sheet 9133 1:100000 map (1991) as being situated entirely over the Vane (Plv) subgroup. The Vane subgroup is within the broader Wittingham coal measures and is defined as coal seams, siltstone, lithic sandstone, shale and conglomerate. The nearby creeks, Fal Brook, Glennies Creek and Station Creek (it seems likely that Station Creek was destroyed during the creation of the Camberwell mine, since the mine is only a few years old, many maps have not been updated and still show this creek) are all surrounded by Quaternary alluvium deposits. None of these appear to fall within the study area, aside from the possible exception of Station Creek alluvium, however at this time the creeks original exact location is unclear.

3.1.2 Soils

Soils form through a variety of processes, predominantly diagenesis (the breakdown of bedrock into soil) and pedogenesis (the development of diagenetic material into soils), but can be highly diverse due to varying conditions such as climate, topography, parent material, organisms and time. The natural chemical and physical constitution of the soil is also impacted by the underlying rock, with grain size, clay minerals, plant nutrients, and the retention capacity of the soil affected. Soil characteristics such as depth and erodibility, as well as the natural processes that affect these features, impact upon the detection of archaeological evidence within the landscape.

Soil analysis has important ramifications for archaeological research through the potential impact of different soils on human activity (such as agricultural exploitation) and the impact of the soils on archaeological evidence (such as post-depositional movement). The soils known to occur throughout the study area are identified here in order to delineate their nature and impact on the survival and location of archaeological material.

In the *Soil Landscapes of the Singleton 1:250,000 Sheet* (Kovac and Lawrie, 1991), the whole study area was mapped as the Sedgefield Soil Landscape. This soil landscape is characteristically associated with undulating low hills north of Singleton. The main soils are yellow Soloths on the upper mid slopes, with yellow Solodic soils on lower slopes and drainage lines. Occasionally black Soloths are also present within seepage zones.

These types of soil are typically found in areas with low hills of 60m to 170m and very gentle long slopes of around 6% leading into drainage channels. Typically, these types of soils and landforms will undergo severe rill erosion and sheet wash on many slopes and drainage channels, Soloths being a particularly dispersible soil.

Of note is the Soloth's structure, generally a brown or black sandy loam topsoil overlying a yellow brown or orange clayey subsoil (**Plate 4**). If the soil profile is in situ, the change between these two layers will be quite gradual with minerals being moved through the profile. However in many cases recorded by Kovac & Lawrie (1991), the contact is clear and sharp indicating many of them are unlikely to be in situ profiles.

Other soils in the general area, particularly around the creek lines on the Quaternary alluvium are Hunter (hu) soils. These soils are found only on flat alluvial terraces and plains and consist of Brown Clays and Black Earths. Other soils pertinent to this study area are the Roxburgh (rx) soils, which are located to the southwest of the study area. These soils consist of Yellow Podsolc, red Solodic, Lithosols, and Yellow Soloth soils.

3.1.3 Vegetation

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

The study area has experienced widespread changes in vegetation during the past century, with the original vegetation essentially removed (for pastoral grazing), resulting in a mainly open area with minimal extant vegetation. Typically Sedgefield soils are dominated by an Ironbark community of narrow-leaved red ironbark (*Eucalyptus crebra*), grey box (*E. moluccana*), red ironbark (*E. tricarpa*), broad-leaved red iron bark (*E. fibrosa*) and smooth bark-apple (*Angophora costata*) (Kovac and Lawrie 1991).

Due to extensive clearance, the study area now consists of a dense grass cover with limited tree and shrub vegetation, although abundant forest regrowth (trees that have grown back following mass clearance in the recent past) is evident along the northwest side of much of the study area (**Plate 5**). Grazing has also resulted in a substantive change in the form of grass cover, with grazing stock preferring the introduced grasses over native grasses.

Discussions with the Aboriginal community reveal that the area was heavily pastoralised in living memory of many of them and their parent's generation indicating that much of the vegetation is unlikely to be under a 100 years old, limiting the potential for scarred trees and other similar archaeological sites.

3.1.4 Landform

Landscape analysis is an important part of an archaeological survey. The topographic features of the study area are discussed to identify features directly relevant to occupation and land use across the landscape. It is assumed that Aboriginal groups will have used various landforms differently in the past; therefore a background understanding of these landforms within a study area is necessary for the development of predictive models detailing site location and site types.

Two different models of landform are widely referenced and applied in the Hunter Valley, that of Christian & Stewart (1953) and Storey et al. (1963). These models were largely constructed using aerial photography and mapping similar characteristic patterns and shapes. For this reason, the landform system is only a general model that can be applied to any location. Forty three land systems were mapped within these studies for the Hunter Valley.

The study area lies within the broad physiographic area known as the Central Lowlands. The general characteristics of the Central Lowlands are essentially undulating to gently hilly slopes, with slopes rarely exceeding 15%. Alluvial flats extend from the Hunter River and its major tributaries throughout the Lowlands. Bounding the Lowlands are abrupt transitions to steeper country on either side. The study area is located close by the northeastern edge of the Central Lowlands (Storey et al. 1963).

The study area lies in land mapped as part of the pioneering study of the lands of the Hunter Valley (Storey et al. 1963). The wider creek valleys were mapped as part of the Killarney Land.

The Killarney Land System is the dominant land system of the Central Lowlands, and occupies the majority of the study area. The characteristic features of this land system are outlined below.

1. Undulating lowlands with widely spaced, broadly shallow valleys. Slopes are generally less than 10%. Occasional rock outcrops are concentrated near hilltops. Up to 10ft of stony colluvial fill is found in valley heads. Considerable sheet and gully erosion. 75% of area.
2. Undulating lowlands with closely spaced, small shallow valleys. Slopes are generally less than 10%. Frequent outcrops and stony surfaces, with little or no colluvial fill. Very active sheet erosion. 20% of area.
3. Terraced alluvium in main valleys, consisting of sand, silt and clay, sometimes overlying coarse ironstone gravel. Up to ¼ mile wide. Under 5% of area.

Generally, the landform units are less steep than those of the adjacent Glendower Land System.

The Glendower Land System also occurs throughout the Central Lowlands (and is found in some areas of Glennies Creek and parts of the study area) and shares characteristics with the Killarney Land System. Four landform units have been defined and mapped as being characteristic of the Glendowner Land System.

1. Moderately steep rounded hills. Frequent outcrops of sandstone or conglomerate. Gullying and sheet erosion common. 65% of area.
2. Moderately steep hills composed of lime-rich sandstone or shale. Exhibit either rounded slopes or tabular hills with undulating summits bounded by steep slopes. Includes low sandstone cliffs, gentler foot slopes. 20% of area.

3. Undulating areas in major valleys, no rock outcrops. 10% of area.
4. Alluvium in valley bottoms, dominantly sandy but some clay. Terraced areas, subject to flooding. Under 5% of area.

As part of the assessment process a division of landforms was designed to identify landform units within each Land System. This was in order to provide a landscape framework within which any archaeological material or areas of significance could be placed. The landform units were based on McDonald *et al.* (1998), which is a standard guide for describing landform divisions.

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

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

3.1.5 Post-Contact Land Use

Post-contact settlement in the Central Lowlands of the Hunter Valley began in the early 1820s when the valley was opened for settlement. Settlers typically moved from existing settlements at Newcastle, and overland from Sydney. The best agricultural land was granted in a period from 1823-1827 when approximately 25% of the land was converted to freehold title by grant (Robinson & Burley 1962). The initial pattern was for freehold estates to be established along the major tributaries of the Hunter and for the Crown Land in between to be grazed (legally or by squatting). These estates formed the base for squatting settlement of the Liverpool Plains and New England.

The Parish map of Broughton from the 1820s show that the study area was over a series of estate boundaries, encompassing Robert Lethbridge's property adjacent to Glennies Creek and Edward Drake. The former being one of the leading figures in the area and a participant in the infamous Ravensworth massacre of 1826 (Williams & Czastka 2005). One hundred years later, the property borders are almost identical, although Edward Drake's land has been partially sold to Simon Richards. The main road to Muswellbrook ran several kilometres further to the west than the present route. Thus, the study area was off the beaten track, although Stony Creek Road did exist in the 1820s and was most likely used for access in these remote areas.

The impact of the establishment of these estates on the environment was initially comparatively minor as they were largely grazing sheep and cattle, and cropping was found lower down in the Hunter Valley on the flats near Maitland. There was, however, some impact from the construction of infrastructure such as fences, houses and farm buildings and small gardens to supply farm workers.

Major clearing would have occurred after the land was subdivided in the late 1870s. The Great Northern Railway reached Muswellbrook in 1869 increasing the numbers of people moving through the Hunter Valley. The primary impact of clearing would have been erosion and changes in hydrology as more sediment was dumped into the system. It is likely, following Prosser (1991), that the impacts would build up with little apparent evidence of change followed by a single catastrophic event during which there would be a period of rapid erosion and degradation. The erosion would continue unless the catchment reached equilibrium.

The general area around Glennies Creek was developed into small dairy farms of probably 50-150 acres supplying dairy factories in the major towns such as Muswellbrook or Singleton. After the First World War the larger properties were broken up into smaller farms with dairying supplanting wool and wheat. Many of the larger rural properties were broken into smaller farms, and dairying replaced wool and grazing for meat as the main rural industry.

It seems likely that in the study area there was a period of increased erosion after subdivision and clearing for small scale farming but that this would have stabilised over the next 100 years as grass production was promoted as part of grazing.

It seems that the land was used for grazing and dairying until the Camberwell Coal Mine was constructed in the 1980s. Other coal mines also developed in the areas, such as the Ashton Coal Mine, all of which would contribute to the decline in pastoralism and the rise in extractive industries in the Hunter Valley.

The post-contact impacts on the environment of the study area consisted mainly of clearing and erosion, followed by some stabilisation. It seems possible that there will be erosional and depositional features that relate to this activity within the study area.

The extent of the impact of 170 years of post-contact settlement on Aboriginal sites is an important question. The major impact would probably have been on carved and scarred trees, which would have been removed as part of clearing. However, the experience from other parts of the Hunter is that many Aboriginal sites survive long periods of sustained grazing provided that erosion is controlled.

Construction of infrastructure such as buildings, earthworks, roads, and railways is likely to have had an impact on any Aboriginal sites in their vicinity, but some of these impacts may be superficial as the actual impact on the ground may be comparatively small and shallow.

3.2 Archaeological Background

The archaeological background section outlines the known Aboriginal sites and other studies undertaken in the area. This section will then provide site predictions for the study area in question.

3.2.1 Known Sites within the Study Area

HLA undertook a search of the AHIMS for all sites within a 10km rectangular zone encompassing the study area on the 2 March 2005. This revealed a total 154 previously recorded archaeological sites within the area (see **Appendix B** for site details provided by DECC). Approximately 96% of the recorded sites are defined as open camp sites comprising stone artefact scatters. The few remaining archaeological site types are recorded as isolated artefact finds, scarred trees and oven mounds.

To provide a more comprehensive review of the nature of the local archaeology in the region a summary of previous archaeological investigations undertaken within the vicinity of the study area is provided.

A search of the Archaeological Reports database held by the DECC recorded a number of reports on previous studies undertaken in the immediate and surrounding vicinities of the study area. All reports were related to archaeological consultancies undertaken prior to developments in the region. Based on the availability of these reports and cross matching with the AHIMS site search conducted by DECC, a number of them have been selected to provide the archaeological background to the study area (see **Table 1**). A summary of the methodology, survey coverage and results of these studies are presented below.

Table 1
Regional Studies within the Hunter Valley

Author (date)	Scope	Study Area
Koettig (1986)	Archaeological survey	Singleton to Glennies Creek
Stuart (1999)	Archaeological survey	Camberwell
Witter (2002)	Archaeological assessment Environmental Impact Statement	Ashton
Brayshaw (1986)	Archaeological survey	Glennies Creek
Umwelt (2004)	Archaeological assessment	Glendell
Dowling (1991)	Archaeological survey	Glennies Creek
Dallas and McDonald (1986, 1987)	Archaeological survey	Singleton

3.2.2 Stuart (1999): Camberwell

As part of a Statement of Environmental Effects, Stuart (1999) undertook an Aboriginal archaeological sites survey of an area of the Camberwell Coal lease, located within the Glennies Creek catchment. The study area terrain was described as comprising alluvial flats draining into undulating ridges.

As indicated by a summary of Stuart's (1999:9) coverage analysis of landforms provided in **Table 2**, survey of the study area was severely hindered by low visibility (due to grass coverage) thereby limiting effective survey coverage.

Table 2
Summary of Coverage Analysis for Camberwell (Stuart 1999)

Landform Description	Total Area (m²)	Visibility (%)	Survey Area (m²)	Effective coverage (m²)
Terraced alluvium of undulating lowlands with widely spaced broad, shallow valleys and slopes of <10%	93979.97	0.5	7950	3975
Hillcrests on undulating lowlands with closely spaced small, shallow valleys	77077.60	0.5	1800	900
Hillslopes on undulating lowlands with closely spaced small, shallow valleys	1448108.11	0.1	28200	2820
Bottom of closely spaced small, shallow valleys of undulating lowlands	328402.96	0.01	4050	40.5
Total	1815868.07		42000	7735.5
% of Camberwell Assessment Study Area			2.31	0.43

A total of 19 Aboriginal archaeological sites and one historic archaeological site were recorded during the survey. Of the Aboriginal sites, 16 (84%) are described as isolated finds, comprising one or two flaked stone artefacts, while only three sites (16%) are defined as open artefact scatters consisting of between 4 and 15 stone artefacts. A total of 40 stone artefacts were identified, comprising predominantly indurated mudstone and silcrete flakes and flaked pieces, although three cores and one pebble scraper were also recorded.

Unfortunately Stuart (1999) failed to classify the recorded sites according to the landform units described above. Based on the limited site descriptions provided, it appears that the majority of sites were located on eroded creek banks, with sites on hillcrests or slopes and disturbed areas caused by farming or vehicle tracks being considerably less common. Stuart (1999:11) suggested, however, that as eleven of the recorded sites consist of isolated finds in eroding creek beds, that the artefacts have moved downslope from sites on ridges and hillcrests. It was concluded that the archaeological significance of the majority of the recorded sites was low, reflecting both the eroding condition and poor archaeological integrity of the study area. Poor ground surface visibility was also considered an influential factor in the archaeological assessment of the study area.

3.2.3 Dowling (1991): Glennies Creek Colliery

Dowling (1991) conducted a reassessment of seven Aboriginal archaeological sites recorded in an area along Glennies Creek, 12km north of Singleton by Lilley (1987) in relation to the proposed underground mining operation at Glennies Creek by Maitland Main Collieries. One of the major aims of the re-assessment was to determine the potential impact of underground mining subsidence on archaeological sites in the study area.

Five of the seven original sites were relocated and examined. Only Site 6 recorded the same number and type of stone artefacts present, while Sites 1, 2, 3 and 5 recorded a greater number of stone artefacts than previously recorded, resulting in new interpretations for several of the sites. Dominant stone artefact raw materials recorded during both investigations were mudstone and silcrete, with the majority of artefacts being unretouched flakes and flaked pieces. Artefact density at each site is evidently very low. **Table 3** provides a summary of the original and reassessed site attributes and interpretations.

In his assessment of the archaeological significance of the study area Dowling (1991) considered the impact of mine subsidence on site integrity. It was concluded that the most likely effect of mine subsidence caused by the proposed Glennies Creek Colliery operation would be a trough-shaped depression above extraction areas. Based on the archaeological data for the region available at the time, Dowling (1991:6) stated that as the majority of archaeological sites have been located within 100m of water courses or creeks, it is these areas where mine subsidence would have the greatest impact upon sites. It was suggested that subsidence trough erosion may threaten both surface and sub-surface archaeological contexts, and cause the widening and deepening of creeks channels thereby threatening archaeological deposits located in these areas (Dowling 1991:7).

Table 3
Summary of Glennies Creek Sites Artefact Distributions and Interpretation based on Lilley (1987) and Dowling (1991)

Site	Lilley (1987)	Dowling (1991)	New site interpretations
1	1 polished sandstone grindstone, 6 mudstone flakes, 2 silcrete flakes, 1 mudstone core	5 mudstone flakes, 2 mudstone cores	Possibility of sub-surface artefacts noted
2	1 mudstone core	1 mudstone flake, 1 mudstone core	Interpretation consistent with Lilley (1987)
3	2 flaked pebbles	1 mudstone flake 2 mudstone flaked pieces	Interpretation consistent with Lilley (1987)
4	2 flaked pebbles	Not inspected	-
5	2 silcrete flakes, 1 mudstone flake	5 mudstone flakes, 2 mudstone flaked pieces, 4 silcrete flakes, 1 silcrete flaked piece	200m apart from Site 6, located 2-3m from erosion channel on elevated ground, interpreted as knapping area
6	1 silcrete flake, 1 mudstone flake, 1 silcrete core	same	As per Site 5
Site	Lilley (1987)	Dowling (1991)	New site interpretations
7	1 mudstone flake	Not inspected	-

3.2.4 Umwelt (2004): Glendell Mine Lease

An archaeological assessment of the Glendell Mine Lease (Glendell ML), located approximately 16 km northwest of Singleton and incorporating sections of Bowmans Creek, Swamp Creek and Betty's Creek was recently conducted by Umwelt (2004). In addition to identifying Aboriginal archaeological sites within the mining lease area, environmental and geomorphological studies were undertaken. The aim of these investigations were to identify areas of Aboriginal resources such as fresh water supplies, faunal prey, food and medicine plants and stone artefact raw material, as well as locating the landscape contexts with the greatest potential to reveal buried soil horizons containing artefactual material (Umwelt 2004:3).

Glendell ML is dominated by a north-south aligned ridge with several east-west orientated spurs running down to the floodplain of Betty's Creek and Swamp Creek. The Glendell study area is also patterned with numerous other ridges, crests, spurs and drainage depressions, allowing the distinctive geological terrain characteristics to be easily divided into terrain units. Terrain units were further divided into sub-catchments based on areas similar in morphology, and were further delineated into riparian zones (associated with drainage lines) or non-riparian zones (associated with topographic features).

Within the Glendell ML soil erosion was identified as the major agent of geomorphological disturbance (Umwelt 2004:5.1). Vegetation clearance, cultivation and intensive use of the area for stock grazing have caused soil erosion through slope wash, scouring, slumping and gullyng. Each of these processes has led to downslope movement of Horizon A materials, allowing for the possibility of both horizontal (downslope) and vertical displacement of artefactual remains leading to the loss of archaeological site integrity. The floodplains within the Glendell ML are also identified as areas of soil aggradation resulting in the possible burial and/or re-deposition of archaeological remains by both slope colluvium and water-borne alluvium.

Three terrain areas identified as potential locations of early Holocene or late Pleistocene stratified deposits within the study area are floodplains, the alluvial fans at the junction of ephemeral tributaries and floodplains and areas along the floodplain/terraces boundary that may contain interwoven deposits of colluvial and alluvial deposits.

Archaeological Investigations

Within the boundaries of the Glendell study area the entire lengths of both sides of the three major creek lines (Betty's Creek, Swamp Creek and Bowmans Creek) were surveyed. At 250 – 500 m intervals along the creeklines, detailed recordings of landscape features and resources were made. Within the sub-catchments at least one catchment section (ie. slope, crest, ephemeral creek or drainage depression) was intensively surveyed. Within each sub-catchment the entire length of both sides of all ephemeral creeks and drainage depressions were sampled, along with observations of upper slopes, midslopes, lower slopes and if present, alluvial fans. Within the Glendell ML visibility is described as poor with areas of erosion along drainage lines and disturbances on slopes and crests allowing for the location of archaeological sites (Umwelt 2004:7.4). Ground surface visibility was only recorded at sample points, however, due to thick pasture grass coverage survey coverage of the study area is regarded as low. A summary of the sites located on terrain units for each of the major creek catchments within the Glendell ML is provided in **Table 4**.

The highest density of archaeological sites was located along the Betty's Creek catchment, with the greatest number of sites located on the banks of minor tributaries followed by floodplain and alluvial flats. Swamp Creek recorded the second highest number of sites, with the majority located on footslopes and lowerslopes, after which the banks of minor tributaries were the most common terrain unit containing archaeological sites. Bowmans Creek recorded only five sites, most of which were located on floodplains and alluvial flats. Throughout the entire Glendell ML the greatest number of recorded archaeological sites were distributed evenly on the banks of minor creek tributaries and floodplains/alluvial flats. Of the total number of recorded sites, 64% were located <30m from a water course, 26% at between 30-100m from a watercourse, while the remaining proportion of sites were evenly distributed between 100-200m and >200m from a watercourse (Umwelt 2004, Table 7.5). It was recognised, however, that the distribution of site locations in the Glendell ML was biased due to varying levels of ground surface, with visibility often greatest along the banks of minor watercourses due to erosion, and lowest on alluvial flats and floodplains (Umwelt 2004:7.8).

Table 4
Summary of Archaeological Sites based on Landform/Terrain units within Glendell ML (after Umwelt 2004).

Creek catchment	No. of sites	Site Types	% distribution of sites in terrain units
Betty's Creek	22	4 isolated finds 18 artefact scatters	9% ridge crests 14% footslopes/lower slopes 36% banks of minor tributaries 18% creek banks 23% floodplain/alluvial flats
Swamp Creek	9	3 isolated finds 6 artefact scatters	11% upper slope 33% footslope/lower slope 22% banks of minor tributaries 11% creek banks 22% floodplain/alluvial flats
Bowmans Creek	5	4 artefact scatters 1 quarry	20% ridge crest 20% banks minor tributary 60% floodplain/alluvial flats
Bowmans Creek/Swamp Creek shared floodplain	1	1 artefact scatter with associated buried soil profile	100% shared floodplain/alluvial flats
TOTAL	37	29 artefact scatters 7 isolated finds 1 quarry 1 buried soil profile	11% crests and upper slopes 16% footslopes/lower slopes 30% banks of minor tributaries 13% banks main creek channel 30% floodplain/alluvial flats of main creek

A total of 78% of the archaeological sites recorded were defined as artefact scatters, 19% as isolated finds, with one quarry site comprising the remaining proportion. The dominant size of the stone artefact assemblages was <10 artefacts (67%), followed by sites with between 10 and 20 artefacts (16.5%), with only 9.5% of sites containing between 20 and 50 artefacts and 7% containing greater than 100 artefacts (Umwelt 2004: Table 7.6, Table 7.7). Flakes, broken flakes and flaked pieces of small size (<3cm) comprised the major artefact categories, with mudstone and secondly silcrete as the dominant raw materials.

Geomorphological Investigations

A major focus of the geomorphological investigations conducted in the Glendell ML was a 300m long diversion trench excavated across the second and third terraces between Swamp Creek and Bowmans Creek around 15 years before the Umwelt (2004) study. The trench was investigated as it offered an opportunity to determine the nature of buried soils in the area and to identify the absence/presence of Aboriginal archaeological remains. Additional backhoe pits, blade scrapes and auger holes were made along the trench to further investigate the nature of cross-valley stratigraphy.

Although evidence of a Pleistocene aged buried land surface was identified, the lack of soil development and its likely marshy surface meant that it would have been an unattractive location of Aboriginal camp sites. No cultural material was located within this buried land surface. The following summary provides details of the number of stone artefacts located during the trench investigations.

- Eastern face of diversion trench – 401.
- Vertical scraping of trench banks – 14.
- Western face of diversion trench – 17.
- Exposures of removed trench material – 80.
- Backhoe pits – 12.

All stone artefacts originated from the A Horizon, while 61% and 27% comprised of mudstone and silcrete artefacts respectively, with the majority being flakes and broken flakes (78%) followed by flaked pieces (15%) and cores (3%). The results of the analysis of the stone artefact assemblage recovered from the trench diversion are interpreted as fitting comfortably within archaeological expectations for the area (Umwelt 2004:8.5).

As part of the geomorphological investigation a number of auger holes were also drilled in the area of a spring located on the bank and terrace of Bettys Creek. The aim of this investigation was to determine if the water source had been available to Aboriginal people. Based on the results of augering and the absence of evidence for Aboriginal occupation in the vicinity of the spring, it was concluded that this feature was not of Aboriginal cultural heritage significance.

Aboriginal Resource Distributions

By taking into consideration recorded site locations in relation to Aboriginal resource zones, it was demonstrated that ‘the most common site location was in close proximity to fresh water in an area of low gradient suitable for camping with abundant economic food plants’ (Umwelt 2004:5). Both the proximity to stone resources and excellent outlook appeared to be of secondary consideration based on recorded site distribution.

3.2.5 Witter (2002): Ashton Coal Mine Project Site

As part of an EIS, Witter (2002) undertook an intensive survey of the proposed Ashton Coal Mine Project Site, located 14km west of Singleton. The area is bordered by Bowmans Creek, Glennies Creek and Betty’s Creek and covers approximately 1100 ha. The study included relocating and re-recording sites previously recorded, and using aerial photography to locate areas of exposure that were then surveyed on foot.

The study area was divided into five basic geographic divisions: Betty’s Creek Valley, Bowmans Creek Valley, Glennies Creek Valley, Hunter River Valley and Ashton Ridge. The survey methodology employed focused on exposures within each geographic division, which were subsequently identified according to landform (ie. ridge crest, spur crest, tributary margin etc.). This method of survey coverage was interpreted as providing optimal visibility conditions (>10%) and quantifiable results in terms of artefact densities (Witter 2002:32). Surface types (alluvium, A, B, talus, other) in all exposures were also recorded.

A total of 285 exposures were surveyed, of which 102 (35%) contained isolated stone artefacts and were classified as EWAs. Sites were defined as clusters of EWAs or areas of numerous stone artefacts – 18 of these were recorded in the study area, comprising 6% of the area investigated within the broader study area. In addition to surface exposures a total of 14 sandstone outcrops were located and surveyed within the study area. Six sets of grinding grooves were recorded. **Table 5** provides a summary of the results of the archaeological survey according to landform, exposure area and number of stone artefacts in each of the geographical divisions within the study area.

Table 5
Summary of Site Characteristics According to Landform, Area, Visibility and Number of Artefacts for the Ashton Coal Mine Project Site (after Witter 2002)

Landform	Surface	Exposure Area (sq m)	Effective Visibility (sq m)	No. of Artefacts
Bowmans Creek Valley				
Valley bottom and terraces	Alluvium B, gravel (A)	790 354	148 73	23
Tributary valley	A only B, gravel (A) talus	400 902 6625	80 255 699	183
Valley slope	B, gravel (A)	11250	8476	250
Glennies Creek Valley				
Valley bottom	alluvium	200	100	15
Tributary valley	talus	50	40	13
Valley slopes	A only B, gravel (A) talus	103 12667 255	11 7296 21	227
Bettys Creek Valley				
Tributary valley	A only	903	91	50
Valley slope	A only B, gravel (A) other	400 625 160	200 250 32	45
Hunter River Valley				
Valley bottom		0	0	
Tributary valley		0	0	
Valley slopes	B, gravel (A)	114	61	110
Ashton Ridge				
Ridge crest	A only B, gravel (A)	30 3270	17 999	57
Spur crest	A only B, gravel (A) Talus other	>1 4486 300 130	>1 1766 150 70	166
Ridge slope	A only B, gravel (A) talus	1600 4455 2850	800 2280 570	39

From these results it is clear that the majority of stone artefacts within Bowman Creek, Betty's Creek and Glennies Creek valleys were located on slopes, including upper and lower spur crests. Valley bottom and tributaries within valleys recorded generally similar, but lower numbers of stone artefacts. For Ashton Coal Mine Project Site ridge the majority of stone artefacts were located on spur crests. A breakdown of the recorded site attributes within each geographic division provided in **Table 6** further supports the interpretation that the greatest number of stone artefacts recorded were located on valley slopes and high crests of the Ashton Coal Mine Project Site ridge.

Table 6
Individual Archaeological Site Data for the Geographic Divisions within the Ashton Coal Site
(Witter 2002)

Site	Landscape type	Total exposure area (m ²)	Visibility (%)	No. of artefacts	Artefact density per m ²
Bowmans Creek Valley					
Waterhole site	Valley lower slope and creek channel	25000	50	256	0.01
Bridge site	Valley bottom terrace	20400	10	21	0.001
Oxbow site	Lower tributary valley	60000	10	204	0.003
Bruckers Lane site	Terrace	40	20	11	0.27
Farm Road site	Tributary bottom	30	80	8	0.26
Glennies Creek Valley					
Glennies Creek site	Valley lower slopes and creek channel	240000	20	298	0.001
Glennies Bluff site	Slope	210	80	8	0.03
Glennies Flats site 1	Gentle slope	2500	10	13	0.005
Glennies Flats site 2	Tributary bottom	50	80	13	0.26
Bettys Creek Valley					
Railway site	Lower slopes and tributary valley	4000	10	35	0.008
Tributary site	Tributary margin	200	20	48	0.24
Slope site	Tributary slope and bottom	400	50	8	0.02
Ashton Ridge Top					
Ridge top site	Broad ridge crest	30000	10	22	0.0007
Fire break site	Spur crest	120000	20	30	0.0002
TSR site	Upper slope Tributary	40000	20	19	0.0004
High ridge site	Ridge shoulder	60000	10	19	0.0003
Ridge peak site	Crest peak and ridge	80000	10	34	0.0004
High spur site	Spur crest	20000	20	142	0.007

Based on the calculations provided in **Table 6**, artefact density at all sites appears to be very low. However, three sites (Waterhole, Oxbow and Glennies Creek site) are considered very large, each containing over 200 stone artefacts (Witter 2002:1). Although the landscape context for each of these sites is different, a similarity is that they are each located close to creek channels and the lower valley slopes. It is concluded that these hydrological and strategic factors made these locales optimal resource zones for trapping fish during times of floods (Witter 2002:116).

Dominant raw materials of stone artefacts at each of the sites within the four geographic divisions were mudstone followed by silcrete, and much smaller numbers of quartz, quartzite, chert and volcanic artefacts. Flakes, broken flakes and flaked pieces comprise the dominant artefact types, with small numbers of cores also present. Detailed attribute analysis of a large sample of artefacts from each site was undertaken, demonstrating a high degree of modification throughout the study area. Stone technology across the three largest recorded sites was remarkably similar, although at the Waterhole site the analysis indicated a higher proportion of microblade production (Witter 2002:116). It is suggested that this may be the product of both fish trapping at the site and the presence of long term water at the site.

3.2.6 Dallas and McDonald (1986, 1987): 'Retreat' and 'Wattle Ponds'

Dallas and McDonald (1986) conducted an archaeological survey of two proposed subdivision sites in the foothills north of Singleton. Collectively the study areas comprised 580ha of undulating land, which is characterised by numerous spurs, gullies and numerous creeklines. The authors noted that the area had been subject to a number of post-European disturbances including clearing, fencing, damming and other earthworks. Deflation, sheetwash, and gullying across the study area was extensive, providing good surface visibility.

The western study area was subject to a full comprehensive survey due to the nature of housing development already underway. Approximately one third of the eastern study area was comprehensively surveyed. This area demonstrated a high proportion of degraded surfaces and subsequently a high frequency of archaeological sites (16 in less than 1 km sq) (Dallas and McDonald 1986:14). The survey area was determined to be representative of landscape areas in the non-surveyed eastern portion, with the results predicting similar nature and frequency of archaeological sites. Consequently, additional survey of the area was undertaken (Dallas and McDonald 1987).

During the two investigations a total of 41 archaeological sites were recorded across the two study areas. A summary of the site details according to landform, exposure area, artefacts and nature of disturbances is provided in **Table 7**.

The majority of the recorded sites are defined as open artefact scatters, located predominantly in close vicinity to creeks and on spurs or ridges. A smaller proportion of sites were located on slopes and in areas of disturbance such as roads or dams. Artefact densities were generally low, although at several larger sites artefact counts of 1mx1m sample squares revealed densities of between 5-11 per m² (Dallas and McDonald 1987). Various forms of erosion were noted as affecting the majority of sites throughout the study area.

Table 7
Summary of Archaeological Sites Located in 'The Retreat' and 'Wattle Ponds' Subdivision Sites
(after Dallas and McDonald 1986, 1987)

Landform	Number of recorded sites	Total Area of Exposure (m ²)	No. of artefacts	Artefact density (m ²)	Disturbance
Slope	4	4349	94	0.02	Sheetwash
Creek bank (eroded)	13	15316	213	0.01	Erosion, gullying, sheetwash
Creek confluence	3	1825	171	0.09	Erosion, gullying,
Landform	Number of recorded sites	Total Area of Exposure (m ²)	No. of artefacts	Artefact density (m ²)	Disturbance
Spur/ridge	10	9909	89	0.008	Sheet wash
Road exposures	4	8608	38	0.004	Road construction, scours
Dam embankment	1	20000	8	0.0004	Construction
Other	8	12440	90	0.007	Stock grazing, vehicle tracks

The results obtained from artefact analyses conducted as part of both investigations indicate that 50% of the artefacts are of mudstone raw material, followed by silcrete (approximately 15%) as the next most dominant raw material (calculated from Dallas and McDonald 1986, Table 1, Dallas and McDonald 1987:28-34). Smaller proportions of several other raw materials, including porphyry, quartz and quartzite were also identified. Unmodified flakes and flaked pieces comprised the dominant artefact type throughout the study area, while several implements identified as choppers, blade and scrapers were also recorded.

3.2.7 Brayshaw (1986): Glennies Creek Coal Mine

Brayshaw (1986) conducted a study of the Glennies Creek Authorisation Areas 81 and 308 as part of an EIS for the Glennies Creek coal mine project. The Authorisation Areas investigated cover approximately 1200 ha and are located 7km north of Singleton.

The study area is defined as intersected by a number of creeks and tributaries, the most dominant of which extend from Station Creek in the northern section of the study area and Martin's Creek in the east. A ridge (>100m asl) marked the northern boundary of the study area, while two spurs of similar elevation were located in the centre of the study area. Landscape relief ranged from 121m asl on the northern ridge to below 80m asl along Station Creek and its tributaries near the western boundary of the study area. Two land systems comprised the study area, and were identified as (1) rounded hills and open valleys with solonchic and podzolic soils, earths, skeletal soils with some cracking clays and degraded black earths, and (2) undulating lowlands with mostly podzolic and polonchic soils, smaller patches of shallow earths, skeletal soils, cracking clays and degraded black earths (Brayshaw 1986:2).

Based on site predictions constructed from existing regional and archaeological information, survey within the study area focused on all major and most minor creek lines along with ridgetops, hillslopes and spurs. Of the total number of sites recorded, 28 artefact scatters were located within 100m of a creek line, while three sites were located on hillslopes within the study area. Two scarred trees were also located. Site distribution within the study area was defined as uneven, with the highest densities of recorded sites occurring along the eastern extension of Martin's Creek and the northern section of Station Creek and its southernmost tributaries.

A summary of the total area surveyed, number of recorded sites, artefact densities and raw material distributions is provided in **Table 8**. The majority of stone artefacts were less than 3cm in size, with 3-5cm being the second most dominant size category. Stone artefact densities were low with the majority of sites displaying less than one artefact per m². Approximately 15% of the recorded sites had stone artefact densities of 6-16 artefacts per m² being identified as knapping floors (moderate to high density). Three of the sites recorded comprised hearth features with associated background stone artefact scatter.

Table 8
Summary of Archaeological Sites Recorded within Glennies Creek Coal Mine Area (after Brayshaw 1986)

Total area surveyed (m ²)	No. of sites	% site type distribution	Artefact density (artefact/m ²)	% stone artefact types	% raw material types
7345	31	75% artefact scatters 16% artefacts scatters with hearths 9% artefact scatters as knapping floors	- Low - Moderate to high - Moderate to high	62% flakes 30% flaked pieces 8% cores	61% mudstone 34% silcrete 1% chert 1% quartzite 1% quartz 1% volcanic 1% porphyry

3.2.8 Koettig (1986): Singleton to Glennies Creek

Koettig (1986) undertook an archaeological survey of a 25km long pipeline route from Obanvale to St Clair south of Glennies Creek and north of Singleton.

The area surveyed along the pipeline route was a minimum of 5m wide, and up to 60m wide where ground surface exposure provided for a broader area to be investigated. The pipeline route was divided into several sections based on landform characteristics, such as relief, geology and vegetation (Koettig 1986:16-18).

Within an area of 3415m² of exposures surveyed along the pipeline route, a total of 11 open sites defined as artefact scatters were recorded. All sites were located within the southern section of the study area in the Glendower Land System. No sites were identified on ridge tops, with the location of the 11 sites virtually evenly distributed between hillslopes and creek banks. Seven sites were located at less than 100m from a creek, while only one site was located at a distance of >200m from a water source. Erosion in the form of either sheet wash or gullyng affected all sites, resulting in the absence of Horizon A soils at 90% of recorded sites. Exposed areas where surface visibility permitted stone artefact identification varied from a minimum of 3m² to a maximum of 1000m² throughout the study area. Artefact density within exposed areas was low (in most cases <1/m²), and the majority of artefacts comprised flakes and flaked pieces of mudstone, followed by silcrete. Three cores were identified across three sites. Artefacts of chert, quartz, quartzite and basalt occurred in very low numbers at all sites. Although Koettig (1986) failed to identify recorded sites in relation to the defined pipeline sections based on landform characteristics, she concluded that areas of high archaeological potential in the region were areas located within approximately 100m of creeks, and on creek banks or low, level spurs adjacent to creek banks.

3.3 Synthesis and Archaeological Predictions

From the details of the archaeological investigations provided above, a synthesis on the nature of the archaeological context of the greater Glennies Creek area can be constructed. Archaeological characteristics such as location and distribution of sites within landscape units, site type, site integrity, stone artefact attributes including raw material, implement type and density can be deduced. These features are necessary for determining the survey methodology to be undertaken, and for predicting the nature of site types and site distribution within the study area.

The greatest majority of identified sites within the local area are located <100m from creeks or watercourses. However, a high proportion of sites may also be located on footslopes and lower slopes of hills, as well as a smaller number of sites located on ridges and crests. It is recognised that the previously recorded site distributions within the local area reflect both archaeological sampling bias, as well as the likely downslope movement of archaeological remains from higher slopes into lower lying catchment areas. Downslope movement in the area is primarily caused by erosion processes (sheetwash, gullying and scouring), resulting in the removal of Horizon A sediments and the in situ archaeological remains. The end result of this process is the location of archaeological artefacts, such as stone artefacts, in lower areas amongst disturbed Horizon A and B sediments. Floodplains and alluvial flats have also been demonstrated as potential locations of archaeological sites within the area. However, the results of geomorphic investigations in the area to date have indicated the shallow nature of localised buried soil deposits and the likelihood of the re-deposition of archaeological remains by colluvial and alluvial processes in these areas.

Archaeological sampling methods that primarily focus surveys along major creeks and creek tributaries appear to be an apparent reflection of a lack of surface visibility in the area. Exposed and eroded areas along creeks seem to provide areas with optimal visibility making artefact identification possible. Although vegetation clearance in the area has contributed to erosion processes, the nature of the contemporary vegetation coverage (predominantly consisting of weed and pasture grasses) severely inhibits surface visibility throughout most of the area. The nature of previously recorded sites in the area indicates that, where visibility conditions permit, survey of hillslopes, crests and ridges may yield significant numbers of archaeological sites in similar if not higher proportions to sites located along creek lines and catchments.

The most dominant type of archaeological site within the study area is likely to be stone artefact scatters of relatively low density, although grinding grooves and scarred trees are also archaeological features of the region. Artefact density may be higher in locations where sites occur in close proximity or range to environmental resource zones, such as fresh water sources and terrain that offers flat, comfortable and dry areas for Aboriginal campsites. The dominant raw material for stone artefact production in the local area is clearly mudstone and secondly silcrete. Much smaller proportions of stone artefacts from raw materials including quartz, quartzite, porphyry and a fine grained volcanic stone (basalt) are also present. Stone artefact assemblages in the area comprise significant proportions of small amorphous flakes, flaked pieces and broken flakes. Cores are recorded as present in much lower numbers. Other implements defined as blades, axes and scrapers occur in negligible quantities throughout the local area.

4 ARCHAEOLOGICAL SURVEY & ASSESSMENT

This section details the field methodology employed and the results of the survey and analysis.

4.1 Survey and Terrain Mapping Methodology

The aim of the field survey was to identify the archaeological sensitivity of the study area. This assessment was determined by the criteria outlined below in **Section 4.2**.

The presence or absence of archaeological materials and the terrain features and integrity of sites were documented using a specifically designed recording form (see **Table 9**). A range of environmental attributes affects the detection of archaeological material during site surveys. Some of these features are vegetation cover, soil type and presence of naturally occurring surface rock. Ground surface visibility is also a major influence of artefact detection. The nature (i.e. size, colour, material type) of the archaeological material also affects the effectiveness of the field survey.

To assess the reliability of the survey results the following features were recorded for the site.

- Landform unit.
- Environmental setting within landform unit.
- Fall of slope along transect.
- Type of vegetation cover.
- Visibility levels measured as percentage of soil surface visible per transect.
- Type of ground exposure i.e. erosion or disturbance from mining activities.
- Frequency of exposures i.e. number in each transect.
- Size of exposures.
- Depth of soil erosion.
- Soil type and profile level exposed.
- Evidence of downslope movement of soil and rock particles.
- Presence of naturally occurring rock suitable for artefact production.
- Presence of archaeological material.

The range of attributes relating to each of these environmental features across the site is reproduced in **Table 9**. Terminology for all landscape descriptions was obtained from McDonald *et al* (1990).

Photography was also used to document the environmental and archaeological features of the survey area.

Most of the categories on the recording sheet are self-explanatory with the exception of levels of disturbance and fall of slope, which require a key to the rating system. Levels of disturbance and fall of slope were classified according to the criteria listed below. This key along with the following guide to the soils in the local landscapes was printed on the reverse of each recording form to assist with consistency in the identification of these features.

Table 9
Terrain Recording Form

Survey Area									
AMG Reference	Start.....					End.....			
Landform Unit	Crest		Ridge			Hillock			
	Simple Slope		Upper Slope			Mid Slope			
	Lower Slope		Flat			Open Depression			
	Closed Depression		Stream	1 st	2 nd	3 rd	4 th		
Slope	Level		Very Gently Inclined			Gently Inclined			
	Moderately Inclined		Steep			Very Steep			
Exposure	Eroded		Aggraded			Human Action			
Geomorphological Agent	<i>Gravity:</i>		Collapse			<i>Particle Fall</i>			
	<i>Precipitation:</i>		Soil Creep			Mass Movement		Sheet Wash	
	<i>Stream Flow:</i>		Overbank			Channelled		Flood	Watertable
	<i>Biological</i>		Human			Animal			
Human Action:	Road	Residential	Earthworks			Industrial	Pastoral		
	Other.....								
Level of Disturbance	1	2	3	4	5	6	7	8	
Exposure	No. of exposures.....					Exposure area.....			
Soil Type	I								
Soil Profile Exposed	Exposed:	A	A2	B	C	Vertical Profile:	Yes	No	
Geology									
Locally Available Material	Silcrete	Mudstone	Quartz			Tuff	Quartzite		
	Chert	FGS	Pet Wood			Sandstone			
Vegetation	Tall = trees>10m		Mid= shrubs+trees<10m			Low= grasses			
Groundcover	Dense= 70%		Mid-dense=30-70%			Sparse=10-30%			
	Very sparse= 10%		None						
Stone Artefacts	Absent	Present	Number.....						
Raw Materials Used	Silcrete	Mudstone	Quartz			Tuff	Quartzite		
	Chert	FGS	Pet Wood			Sandstone			

Level of Disturbance Criteria

- 0) No effective disturbance
- 1) No effective disturbance except for hoofed animals
- 2) Limited clearing
- 3) Extensive clearing
- 4) Complete clearing: pasture but not cultivated
- 5) Complete clearing: pasture cultivated at some stage
- 6) Cultivation, rain fed
- 7) Cultivation, irrigated
- 8) Highly disturbed, eg. mining, urban development, road

Fall of slope criteria

A guide to the slope classes covered by the landform units present in the study area can be obtained from McDonald *et al* (1990:37).

- Moderately inclined slopes = 10% to 32% range
- Gently inclined slopes = 3% to 10% range
- Very gently inclined slopes = 1% to 3% range
- Level <1%

Summary

The aim of the survey and recording methodology was to divide the surveyed site into landscape zones and areas of land use that reflect the potential for archaeological material to exist in these sections. This data would then be able to be assessed against the background information on the site and used to produce archaeological sensitivity areas for the site (see **Section 5**).

4.2 Assessment of Archaeological Sensitivity

The archaeological sensitivity of the study area was assessed on four criteria: the presence of known surface archaeological materials, the probability of undetected surface archaeological materials, the probability of subsurface archaeological materials, and the terrain integrity of each transect area. The presence or absence of surface archaeological materials and the level of effective ground surface visibility were documented during the field survey. The probability of additional surface artefacts occurring was based on these attributes. The assessment of the subsurface archaeological potential of the study area was based on the known patterning of archaeological materials in the Glennies Creek area and field observations of the environmental characteristics and terrain integrity. These characteristics included the availability of stone materials, proximity to water resources, soil depth and landform unit.

A summary of the data recorded for each transect is presented using the following categories.

- Variability of landscape (low, medium or high).
- Visibility levels (low, medium or high).
- Conditions for artefact detection (low, medium or high).

- Effectiveness of surface survey (low, medium or high).
- Availability of raw materials (present/absent).
- Degree of ground disturbance from human activities (low, medium or high).
- Presence of flaked stone artefacts (present/absent).
- Potential for subsurface artefacts (low, medium or high).

Comparison of these categories enables an analysis of the features exhibited within each transect, facilitating an assessment of the overall archaeological integrity and potential of each area.

Based on the results of this analysis of environmental and archaeological features a rating of low, moderate or high archaeological sensitivity was assigned to each portion of the site. The definition of these categories is as follows.

Low Archaeological Sensitivity: Areas where archaeological materials are not likely to occur, as a result of removal or disturbance from land use history. Some indication of the natural soil profile or natural terrain remains, but is limited and not likely to contain archaeological materials.

Moderate Archaeological Sensitivity: Areas where archaeological materials may occur. Some indication of the natural soil profile or natural terrain remains, but where high site or artefact density is unlikely to occur.

High Archaeological Sensitivity: Areas known or likely to contain surface or subsurface archaeological materials. The natural soil profile or natural terrain is evident, and sites and artefacts are known to occur in this context.

4.3 Survey Results

The archaeological field survey of the proposed Glennies Creek open cut Coal Mine study area was conducted on 14 and 15 March 2005, by Jakub Czastka (HLA), Alan Williams (HLA), Emma Harrison (HLA) and representatives from 12 Aboriginal groups (see **Section 2**). Additional fieldwork was undertaken on the 7 March 2006 by Alan Williams (HLA) and two Aboriginal representatives.

A systematic survey was undertaken, which covered the whole study area, excluding those areas that were considered to heavily impacted (such as the current Camberwell North Pit for example). The study area was some 320 hectares in size, and was therefore split into representative transects that were manageable to record. The survey covered the whole study area (aside from obviously disturbed contexts or existing infrastructure) and recorded all information on a survey recording sheet as described in **Section 4.1** and on base maps of the site provided by R.W. Corkery & Co. Pty Limited. The results are presented in **Table 10**.

The study area was split into 24 transects (**Figure 3**), which were separated through landform type or some other relevant geographical change. Each transect was individually described for potential surface and subsurface archaeology. The start, end and any other relevant features were located with GPS, while multiple photographs across each transect were undertaken.

Table 10
Survey Result Summary

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Transect	1	2	3	4	5	6
Approximate Transect Area	62,800m ²	114,120m ²	180,000m ²	234,000m ²	146,880m ²	198,000m ²
Geological Unit	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup
Soil Landscape	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils
Terrain Unit	Open Depression	Simple slope	Ridge, crest	Simple slope	Simple slope	Ridge, crest
Slope	Level, very gently inclined	Very gently to gently inclined	Level, very gently inclined	Very gently inclined	Very gently inclined	Level, very gently inclined
Geo. Agent	Soil Creep, mass movement, human, animal	Soil creep, mass movement, human	Soil Creep, mass movement, human	Soil creep, mass movement, channelled, human	Soil creep, mass movement, sheetwash, human	Mass movement, human
Human Action	Earthworks, road	Earthworks	Earthworks	Earthworks	Earthworks	Earthworks, road
Erosion Action	Colluvial, deflation	Colluvial	Colluvial	Colluvial – rilling	Colluvial	Colluvial
Level of Disturbance	8	8	8	8	8	8
Exposure Area	43,960m ²	34,236m ²	117,000m ²	210,600m ²	58,752m ²	188,800m ²
% of Transect Exposed	70	30	50 - 80	90	40	60
Visibility (%)	80 (highly variable)	50 (highly variable)	80	100	80	90
Soil Profile	A, C (orange clay)	A, C	Oa, B, C	Oa, B	B	B
Vertical Profile	Yes	No	Yes	Yes	Yes	No
Vegetation	Low	Low	Low	Mid	Mid	Low
Groundcover	Sparse to mid dense	Mid dense	Sparse to mid dense	Sparse to mid dense	Very sparse to sparse	None to sparse
Artefacts/Sites	GC1	GC2	GC3, GC4	GC5, GC6	GC7	GC8

Table 10 (Cont'd)
Survey Result Summary

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Transect	7	8	9	10	11	12
Approximate Transect Area	66,060m ²	116,100m ²	108,360m ²	120,240m ²	116,280m ²	29,250m ²
Geological Unit	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup
Soil Landscape	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils
Terrain Unit	Open Depression, simple slope	Simple slope	Simple slope	Ridge, simple slope	Simple slope	Simple slope
Slope	Very gentle to level	Very gently inclined to level	Very gently inclined to level	Very gently inclined to level	Very gently inclined to level	Very gently inclined to level
Geo. Agent	Soil Creep, mass movement, sheetwash, channelled, human	Soil creep, mass movement, sheetwash, animal, human	Soil Creep, sheetwash, human	Soil Creep, human	Human	Human, soil creep, sheetwash
Human Action	Earthworks	Earthworks	Deforestation	Deforestation	Earthworks, deforestation	Deforestation
Erosion Action	Colluvial – rilling	Colluvial	Colluvial - rilling	Colluvial		Colluvial
Level of Disturbance	8	8	7	7	8	8
Exposure Area	39,636m ²	104,490m ²	43,328m ²	72,144m ²	46,416m ²	48,960m ²
% of Transect Exposed	60 (highly variable)	90	40	60	40	40
Visibility (%)	80	60 (heavy leaf coverage)	40 (heavy leaf coverage)	80	10	60
Soil Profile	Colluvium, B, C	Oa, Colluvium, B	O, B	O, B	B	B
Vertical Profile	Yes	Yes	No	No	No	No
Vegetation	Mid	Mid	Mid, low	Mid, low	Low	Low
Groundcover	Very sparse	Very Sparse	Sparse to mid dense	Sparse	Dense	Mi dense
Artefacts/Sites	GC9	GC10	Absent	Absent	GC11	Absent

Table 10 (Cont'd)
Survey Result Summary

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Transect	13	14	15	16	17	18
Approximate Transect Area	138,420m ²	54,720m ²	86,220m ²	58,860m ²	112,680m ²	125,820M ²
Geological Unit	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup
Soil Landscape	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils
Terrain Unit	Ridge crest, simple slope	Ridgecrest, simple slope	Open depression	Simple slope	Ridge	Ridge crest, simple slope
Slope	Gentle, very gently inclined to level	Very gently inclined to level	Level	Moderate	Level	Very gently inclined to level
Geo. Agent	Soil Creep, mass movement, sheetwash, human	Soil creep, human	Human	Soil Creep, mass movement	Human	Human, soil creep
Human Action	Roads	Earthworks	Earthworks (possum skin dam)	Roads, earthworks, pipe easements	Roads	Earthworks
Erosion Action	Colluvial	Colluvial		Colluvial		Colluvial
Level of Disturbance	8	8	8	8	8	8
Exposure Area	96,894m ²	16,416m ²	86,220m ²	41,202m ²	78,876m ²	113,238m ²
% of Transect Exposed	70	30	100	70	70	90
Visibility (%)	90	30	100	80	80	90
Soil Profile	O, B	B, C	B, C	B	B	B
Vertical Profile	No	No	Yes	No	No	No
Vegetation	Mid	Low	Low	Low	Low	Low
Groundcover	Mid dense	Dense	None to very sparse	Mid dense	Mid dense	Sparse
Artefacts/Sites	Absent	Absent	GC12	Absent	Absent	GC13, GC14

Table 10 (Cont'd)
Survey Result Summary

Transect	19	20	21	22	23	24
Approximate Transect Area	72,180m ²	115,920m ²	60,120m ²	216,000m ²	252,000m ²	29,250m ²
Geological Unit	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup	Vane Subgroup
Soil Landscape	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils	Sedgefield soils
Terrain Unit	Hillock	Open depression	Simple slope	Simple slope, open depression	Simple slope	Hillock, simple slope
Slope	Gently inclined	Level	Gently inclined	Gently inclined to moderate	Gently to moderately inclined	Gently to moderately inclined
Geo. Agent	Soil creep, mass movement, sheet wash, human	Human	Soil creep, mass movement, human	Soil Creep, mass movement, sheet wash, human	Soil creep, mass movement, sheetwash, erosion gullies, human	Soil Creep, mass movement, sheet wash, human
Human Action		Earthworks (possum skin dam)	Earthworks	Earthworks, road, remediation works	Earthworks, remediation works	Earthworks, road, remediation works
Erosion Action	Colluvial		Colluvial	Colluvial, erosion gullies	Colluvial	Colluvial
Level of Disturbance	7	8	8	8	8	8
Exposure Area	57,744m ²	115,920m ²	36,072m ²	108,000m ²	201,600m ²	11,700m ²
% of Transect Exposed	80	100	60	50	70	100
Visibility (%)	90	100	70	50	80	100
Soil Profile	B	B, C	O, B	B	B, C	B, C
Vertical Profile	No	Yes	No	No	No	Yes
Vegetation	Low		Low	Low	Low	
Groundcover	Sparse	None	Mid dense	Dense	Sparse to mid dense	None
Artefacts/\Sites	GC15	GC17	Absent	GC18	GC19	GC17

Following guidelines for site surveys as required by NSW National Parks and Wildlife Service (now DEC), Table 11 has been presented to show the available exposure and detection of the survey.

Table 11
Survey Coverage of the proposed Glennies Creek Open Cut Coal Mine

Transect no.	Landform unit.	Total Area of Terrain unit (m ²)	Exposure (%)	Area of Exposure (m ²)	Visibility %	Area available for detection (m ²)	% of landform available for site detection
1	Open depression	62,800	70	43,960	80	35,168	56
2	Slope	114,120	30	34,236	50	17,118	15
3	Ridge	180,000	65	117,000	80	58,500	33
4	Slope	234,000	90	210,600	100	210,600	90
5	Slope	146,880	40	58,752	80	47,002	32
6	Ridge	198,000	60	118,800	90	106,920	54
7	Slope	66,060	60	39,636	80	31,709	48
8	Slope	116,100	90	104,490	60	62,694	54
9	Slope	108,320	40	43,328	40	17,331	16
10	Ridge, slope	120,240	60	72,144	80	57,715	48
11	Slope	116,280	40	46,412	10	4,641	4
12	Slope	122,400	40	48,960	10	4,896	4
13	Ridge, slope	138,420	70	96,894	90	87,205	63
14	Ridge, slope	54,720	30	16,416	30	49,248	90
15	Open depression	86,220	100	86,220	100	86,220	100
16	Slope	58,860	70	41,202	80	32,962	56
17	Ridge	112,680	70	78,876	80	63,101	56
18	Ridge, slope	125,820	90	113,238	90	101,914	81
19	Hillock	72,180	80	57,744	90	51,970	72
20	Open depression	115,920	100	115,920	100	115,920	100
21	Slope	60,120	60	36,072	70	25,250	42
22	Slope	216,000	50	108,000	50	54,000	25
23	Slope	252,000	80	201,600	80	161,280	64
24	Slope	29,250	40	11,700	60	7,020	24
AVERAGE		121,141	64	79,258	70	62,099	51
TOTAL		2,907,390		1,902,200		1,490,384	

Despite survey visibility being quite poor in some areas, this was more than compensated by the large number of people on the survey. With 12 Aboriginal community members and 3 HLA members standing roughly 10 metres apart, transects were typically 180 metres or so wide (**Plates 6 and 7**). In some cases this was less and in others more, depending on the landform and access. However, in general the site was comprehensively covered due to these high numbers of personnel. As can be seen in **Table 11**, over 51% of the total area surveyed (290 hectares - equivalent to 2,907,390 m²) had good visibility and was available for archaeological detection, equating to an area of some 149 hectares (equivalent to 1,490,384 m²) out of a possible 320 hectares for the entire study area. It must also be considered that much of the southern area of the site and other areas were heavily disturbed, so the potential area for in situ archaeological deposits was always likely to be less than 320 hectares, increasing the effectiveness of the survey.

Although the entire site was surveyed, the focus of the physical inspection was on the proposed open cut and out-of-pit overburden emplacement footprint since these areas would be the most affected and from aerial photographs appeared the least disturbed. This provides some explanation as to the location and orientation of many of the transects discussed below. Transect 1 was undertaken along an open depression in the centre of the overall proposed development but specifically skirting the southern boundary of the proposed open cut footprint. This transect was similar to many of the transects undertaken revealing skeletal soils of thin Oa (organic topsoils) situated over B horizons (orange clay with polyhedral peds) or sandstone bedrock (**Plate 8**). The contacts between the units suggest few of them are in situ. This particular transect had a drainage channel cut through it, most likely to aid water movement from the remediated slopes to the south. The exposure in these areas, as with much of the site, was highly variable, was under 10% in some places while 100% in others. In general, however, even where dense grass occurred, the land surface was still largely visible. This transect revealed that the general landscape was heavily impacted, being generally uneven and “hummocky” in many places, while roads, erosion gullies and broken bedrock (with evidence of machine damage) occurring across the site. Within this transect most of these impacts were visible. Despite this, a scattered site was discovered with two areas of concentration and was identified as GC1.

Transect 2 continued along the southern border of the open cut in an east-west orientation up a gentle to moderate slope. The western most end of this transect was on the boundaries of the proposed open cut and in the edge of the study area. This slope exhibited massive erosion gullies and the occurrence of human earthworks in the form of dams, roads and broken bedrock. The exposure, again, was highly variable with some areas at 100% while others were densely covered in low vegetation. One site was identified, GC2 on a level area near the dam about half way up the initial slope in this area.

Transect 3 continued to run along the same orientation to transects 1 and 2, the aim being to reach Stony Creek Road and work back along the site for logistical reasons. Transect 3 encompassed a ridge line eventually turned into a very gentle incline towards Stony Creek Road. The easternmost end of the transect revealed clear evidence of massive earthworks having been undertaken with spoil and overburden type deposits being evident (**Plate 9**). Towards the western end of this transect and the study area in general was thick forest regrowth. Most of the trees were some form of Sheoak (*Casuarina* type), clearly not that old. On the edges of this ridgeline was evidence of massive erosion gullies, which had been aggravated through rain splash erosion and other runoff (**Plate 10**). There was also evidence of exposed flat sandstone bedrock along many of the drainage line, although no grinding grooves or engravings were identified. Furthermore, the soil profile directly behind these exposures revealed that much of the slope material was not in situ, no evidence of a BC or in situ B horizon being present (**Plate 11**). If this is the case then the 50 or so centimetres of slope material, at least around Transect 3 and most likely across the study area, has all moved downslope through a colluvial mechanism. Therefore all sites are most likely going to be found in the drainage lines at the base of slopes and rarely in situ, furthermore all sites found above these sediments are likely to have been post European clearance and relatively recent. Two sites were identified on this transect, GC3, which was located at the easternmost end of the transect and GC4 on the crest of the ridge in a nearby location. Both sites were situated on man-made overburden heaps.

Transect 4 ran along the westernmost edge of the study area encompassing the part of the proposed project site, overburden emplacement and open cut. The transect was in a southeast – northwest orientation following a very gentle slope rising to the north. The southern and northern areas were heavily covered in regrowth forest (which actually reduced dense groundcover), while the middle of the transect retained a low dense grass cover (**Plate 12**). Soil profiles and erosion gullies along the route identified colluvial activity, with out of situ topsoil deposits truncating the orange B horizons beneath. Two sites were identified, GC5 and GC6. Both were located surrounding an artificial dam and associated erosion gullies.

Transect 5 was undertaken from the northeast corner of the study area to the eastern end of Transect 1, the reason for this transect was largely a logistical one, the group having to relocate their base camp. Parts of this transect were undertaken again in later transects undertaking this entire area in more detail. The transect was characterised by undulating low hillocks and open depressions in a generally downward gradient towards the end of Transect 1. The exposure was variable but visibility was good, due to the sparse vegetation generally, and revealed mostly B horizon deposits directly beneath very thin Oa horizons. One site, GC7 was located on this transect, two artefacts resting directly on the B horizon and clearly not in situ.

Transect 6 ran along the road running east - west through the middle of the open cut to the north of Transect 1. Since the previous transects had surveyed the area to the south of this road, at least with regard to the open cut, this transect formed the southern limit of the subsequent four transects running north-south across the proposed open cut in this area (**Plate 13**). The eastern section of Transect 6 orientated more towards the northeast, in attempt to reach a large amount of exposures visible on the aerial photograph. The transect was largely on a ridgeline or crest taking a gradual drop towards the northeast, exposures were good (less than the aerial photograph suggested but still abundant) and visibility high. The visibility revealed that the area was largely only retaining a truncated B horizon with some areas retaining colluvial material above. GC3 was located along the road, but despite the good coverage, no sites were found along the remainder of the transect.

Since Transect 6 reached parts of Transect 4 at the northeastern edge of the site, Transect 7 was orientated north – south, running from the end of Transect 6 and parallel with Transect 4. Transects 7, 8, 9 and 10 were all orientated north – south and ran from the north boundary of the site to the road (Transect 6). This approach allowed coverage of most of the eastern side of the proposed open cut, that was not surveyed by previous transects, particularly Transects 1 to 6. These transects, which will be discussed together, encompassed a number of undulating hillocks and slopes in this area, mostly covered by mid to tall vegetation. Although the vegetation was sparse and exposures were high, the dense leaf coverage restricted the visibility in some areas. Investigations revealed, however that much of the slope material had been eroded, into the drainage lines, evidence of colluvium and truncated B horizons in most locations. This was confirmed by an abundance of erosion gullies and rills in many areas of the site revealing sections of colluvium above the orange clayey B horizon. Two sites were located in these areas, GC9 was located on a large scoured surface in Transect 7, while GC10 was located on the crest of a small hillock at the start of Transect 8.

Transects 11, 12, 13 and 14 were undertaken from the site office depot in a north-south zig zag pattern to the south edge of Possum Skin Dam (**Plate 14**). The transects ran from the road leading along the edge of the box cut and eventually joining Transect 1 to an arbitrary line indicating the north end of the study site. This overall area encompassed a long gentle to moderate slope from the site office in the west leading up to a ridgeline (with a north – south orientation) in the east. The ridgeline was largely encompassed by Transect 13. From the ridge, there is a gentle to moderate incline down to the edge of the dam encompassed by Transect 14. Transect 11 was undertaken through dense waist high grass reducing visibility to 10% or less in most cases, a number of dams were evident within this section with exposures of 100%, but no sites were discovered. One site was located, GC11, in Transect 11, but it proved to be just outside the actual impact zone.

Transects 12 and 13 were undertaken on the more moderate parts of the slope leading up to the ridgeline in this area. Visibility was still quite low towards the lower end of the slope encompassed by Transect 12, but large areas of exposure, particularly under the dense forest regrowth was relatively high. Clear evidence of clearing, either from the mine or the pastoralism before it was evident with partially cut down trees and tree stumps lying across the landscape. Multiple roads were also dominant in this area, most likely due to the access between the dam and the mine. Transect 14 ran from the road to the south down to the edge of Possum Skin Dam, it had similar attributes to Transects 12 and 13. All transects in this area revealed only a thin cover of Oa or organic material before coming onto the orange clayey unit identified as the B horizon within this study area. No sites were identified on any of these transects.

Transects 15 and 20 ran along the edge of Possum Skin Dam (**Plates 3 and 15**). This large dam was built in early 2005 following approvals being done as part of the EIS in the early 1990s. Although a contentious issue as outlined in **Section 2**, within this study it was considered as a pre-existing impact. Transect 15 ran along the western and southern border of the dam, while Transect 20 undertaken later completed the eastern and southern side. It seems clear from the landscape that this area was originally a long slope leading to the down to the floodplain of Fal Brook and Glennies Creek on the other side of Middle Falbrook Road, however the dam had caused immense impact in this location leaving it as more of a large open depression. Large drainage channels (in excess of 3m wide by 2m deep) surrounded the dam, which was only partially full. A survey of the periphery and dried out areas within the dam revealed a heavily disturbed B horizon situated over exposed bedrock. Due to the high visibility and exposure and the likely origin of many of the original sediments coming from the base of the surrounding slopes (an ideal location for artefact accumulation – see **Section 4.5.1**), a number of sites, GC12, GC16 and GC17, were located along the edge and within the dam within the two transects. All of these sites were resting on the road or within the dam itself and are unlikely to be in situ. Two other sites are believed to have been in the north end of the dam that were inundated during its construction, NPWS nos. # 37-1-0190 and # 37-1-0191, although arguably they are still there undisturbed, they are most likely outside the proposed zone of impact.

Transect 16 ran up along the moderate slope opposite the dam towards the overburden to the south. This transect revealed this area to be heavily disturbed, most likely due to the construction of the nearby dam. Furthermore, services were evident throughout this section of the proposed open cut mine. The visibility was high and revealed a “hummocky” B horizon, itself probably not in situ. No sites were found.

Transect 17 ran along the access road to the site and its surrounding verges in an east to west orientation. This area had been heavily impacted and modified by abundant mine machinery and vehicle use. No sites were located.

Transect 18 was in a similar location to Transect 16 and was undertaken on the slopes surrounding the southeastern edge of the dam. Exposures and visibility in this location was good and another site was located on the fringes of the dam, GC13. Furthermore, however it did reveal heavy impact most of the way upslope relating to the construction of the dam.

Transect 19 was undertaken between Transects 10 and 18 in the wooded undulating hillocks and slopes typical of this part of the site. The visibility and exposure was reduced but a site, GC14, was still identified. Transect 21 was undertaken between Transect 16 and 18, since it was felt the space between them was too wide not to have surveyed. Therefore, Transect 21 was undertaken on the southern slopes around the dam. Similarly to Transects 16 and 18, this area showed clear evidence of heavy disturbance and modification, despite having relatively poor visibility.

Transects 1 to 19 comprehensively recorded much of the west, north and east side of the study area, which included the proposed open cut, parts of the project site and the north portion of the overburden emplacement. The southern side of the site was clearly heavily modified – in the southwest corner the existing Camberwell North Pit is used as the Glennies Creek Colliery portal (**Plates 1 and 16**), while much of the south is taken up by the associated overburden emplacement. Furthermore, it was known that the original Camberwell Coal mine north pit had been orientated in a north-south orientation in this area. Its exact impacts and overburden locations were not known, however walking and driving over much of the south and southeast quadrants of the study area revealed that most of the area has been remediated to some degree or another, indicating it most likely impacted the entire area (**Plate 17**).

Two transects were undertaken in the south and southeastern quarter of the site. Transect 22 ran much of its length in an east west orientation. Moderate to steep undulating slopes and open depressions with multiple dams and exposures revealed little of the landscape was natural or undisturbed. A site was located, GC18, on top of one of the ridgelines in this area, but the heavily damaged isolated find was clearly sitting on some form of slag deposit.

Transect 23 was undertaken running along the east and southeast border of the site and part way into some of the cleared areas of the southeastern corner. Large erosion gullies and dams revealed that in this location some natural profile was retained with colluvium above B horizon. Furthermore, upslope evidence of sandstone bedrock was evident, however the depth of soil above these exposures indicated the potential for subsurface deposits was relatively low in this area. This area was similar in both type and location of Transect 3, however unlike Transect 3, which had clearly delineated slopes, this area was far more undulating and level along the southern areas of the site, and seems to indicate areas of previous over burden and remediation. A site was found, GC19, on the berm of one of the dams on the very edge of the eastern study area boundary in this transect.

Transect 24 was undertaken in March 2006 after a change in the proposed study area. This section incorporated a hillock to the east of Possum Skin Dam. The transect began at Stony Creek Road and finished due south at the edge of the proposed impact zone and the current open cut. The area had been extensively impacted with clear evidence of natural and man made erosion. A number of roads had been pushed through the area for access to Possum Skin Dam, as well as other human structures, such as fencing. While visibility and exposure was generally good in this area, no sites were identified.

In summary, nineteen areas have been highlighted by this survey to either contain or have the potential to contain archaeological deposits. The remainder of the survey revealed the proposed development will generally be placed straight into bedrock or into modified and disturbed areas, reducing the possibility of survivable archaeological objects.

4.4 Sites Identified

Nineteen areas were identified as either containing or having the potential to contain archaeological deposits. All these areas have been identified as areas of high sensitivity in **Figures 4 and 5**.

GC1 was located within Transect 1. It consisted of four isolated artefacts some 50 or so metres apart. The artefacts were all found along the edge of the main access road in this location and were clearly surface isolated finds. The artefacts were as follows.

- The northern artefact adjacent to a large drainage ditch consisted of a red silcrete flake (20 x 5 mm), most likely a decortification flake due to the lack of dorsal scarring.

- A red grey tuff broken flake with a transverse snap and unidirectional dorsal scarring was located about 50 metres from the first on the southern edge of the access road in this location.
- A red tuff broken flake was found between these two artefacts, not far from the northern edge of the access road. This flake, most likely a macro or linear flake revealed a plunging or “outrepassé” termination with cortex and unidirectional scarring on the dorsal side.
- Red silcrete broken flake with a medial transverse snap and unidirectional scarring on the dorsal surface (35 x 34mm) was located some 70 metres to the west of the other artefacts on the southern edge of the road.

All of these isolated finds are situated in highly disturbed contexts, none of which contained any topsoil. Generally in this area, the topsoil has been removed or eroded away and only left the truncated B horizon in place, leaving a very low potential for subsurface deposits in these areas. This is consistent with most of the sites identified and discussed here.

GC2 was identified on a benched area part way up the slope in Transect 2. The site consisted of 2 artefacts c.40m apart.

- A red brown tuft multi-platform core (turned more than twice), measuring 45 x 34 x 24 mm.
- A light grey mudstone flake (broken) with a plain (broken) platform, unidirectional dorsal scar pattern measuring 26 x 25mm.

GC3 was an isolated artefact situated on a man made spoil heap on the ridgeline of transect 3. GC3 was an orange brown Fine Grained Siliceous (FGS) thick broken flake with hinge termination (43 x 28mm).

GC4, similar to GC 3, was an artefact scatter situated on a manmade spoil heap on the ridgeline of Transect 3. GC 4 consists of eight artefact scattered over about 15 metres, all situated on the “hummocky” human modified landscape of this area. The artefacts were as follows.

- Orange tuff broken flaked piece (17 x 11 mm).
- Light grey tuff broken flake (21 x 15 mm).
- Orange brown tuff/FGS broken flake with uni directional dorsal scars (19 x 16 mm).
- Yellow grey tuff flaked piece (16 x 5 mm).
- Light grey tuff with hinged termination. Evidence of rolling and heavy edge damage, distal end shattered (35 x 27 mm).
- Brown mudstone flake, most likely a decortification flake due to over 50% cortex on the dorsal scar (52 x 53 mm).
- Light grey tuff flake with unidirectional flaking on the dorsal scar and evidence of rolling (21 x 20 mm).
- Red silcrete flake with uni directional flake scars and over 50% cortex on the dorsal side (20 x 23 mm), most likely a decortification or macro flake.

The potential for any in situ subsurface deposits in the areas around GC3 and 4 is very low, due to clear evidence of human created impact, not to mention the high amount of natural erosion that has occurred in these areas. The spoil heaps that these artefacts are located on appear to be generally out of situ colluvial and B horizon deposits, the A horizon have been eroded downslope and into the drainage lines most likely during the pastoral period of the site in early European times.

GC5 was located on the edge of a dam within an erosion gully in the northeast of the study area (Transect 4). Similar to other sites found, this site consisted of two isolated finds situated on subsoil deposits. It consisted of large red/pink silcrete flake with a longitudinal break, (a plunging flake), and a dorsal with 100% cortex (85 x 55 mm). The artefact has a partially hinged termination and evidence of retouch or usewear. The second artefact was a pink grey tuff flake with plain platform, unidirectional scarring on the dorsal side, and evidence of a longitudinal break (54 x 41 mm).

GC6, found slightly further upslope from GC5 also in disturbed contexts, consisted of two artefacts. One was a red/brown FGS core with over 50% cortex on all platforms (64 x 55 x 35 mm). The core had clearly been turned once exhausted core flaking angles were untenable, most likely a stage 2 or 3 core. The second artefact was a reddish brown tuff pebble core tool, which was bifacially retouched however although this retouch was invasive it did not cover the low angled scaled retouch. Evidence of usewear and crushing was found on the distal end (**Plate 18**).

GC7 was identified within Transect 5 resting on a heavily eroded slope of thin Oa deposits above the B horizon. The site consisted of two artefacts some distance apart, one was a primary red FGS decortification flake with cortex on the platform and dorsal surface – evidence of usewear or retouch was evident on the right lateral margins (41 x 41 mm). The other artefact was a chalcedony broken microlith (18 x 4 mm) with abrupt semi parallel backing retouch.

GC8, located along the northern edge of the main access road of the site within Transect 6, was four isolated finds spread some 100 metres apart. The artefacts were as follows.

- Brown mudstone broken flake with a medial transverse snap (21 x 22mm), a plain platform with some possible preparation and unidirectional scarring on the dorsal surface.
- Yellow mudstone flaked piece (6 x 8 mm).
- Yellow mudstone flaked piece (24 x 19 mm).
- Red tuff broken flake with plain platform and unidirectional scarring on the dorsal surface (37 x 24 mm).

GC9 was found adjacent to a manmade dam and multiple erosion gullies within Transect 7. The artefact was located on an exposed area consisting largely of colluvium overlying truncated subsoil deposits, so the potential for in situ archaeology in this location is minimal. The site consisted of one artefact, a yellow/grey silcrete flake with a shattered platform.

GC10 was found about 150 metres to the north of GC9 on the rise of a small hillock in the area. This was considered to be the very edge of the study area in this location. The site was situated on truncated subsurface deposits. GC 10 consisted of one artefact, a primary decortification flake with a cortical prepared platform with some shattering, the dorsal scarring present was all unidirectional (41 x 40 mm).

GC11 was an isolated find found outside the study area. The boundary in this location, although formalised on paper, is not very clear on the ground, therefore the survey in this area exceeded the required coverage and located GC11. This site is directly north of the site buildings, some 100 metres or so from the northern boundary of the study area and consisted of a red decortification flake with a cortical platform and cortical dominated dorsal surface (50 x 38mm).

GC12 was a number of isolated artefacts situated along the southwestern edge of Possum Skin Dam. All the artefacts identified were surface finds along a heavily disturbed benched area, some 150 metres long. The artefacts found were as follows.

- Red/brown mudstone decortification flake with plain platform and cortex on the dorsal surface (31 x 40 mm).
- Red/brown mudstone flake shatter with hinge termination (6 x 8 mm).
- Mudstone/tuff flaked piece, most likely flake shatter, some evidence of unidirectional scarring on the dorsal surface (9 x 16 mm).
- Yellow silcrete proximal flaked piece with shattering (6 x 8 mm).
- Yellow/grey mudstone flaked piece (8 x 7 mm).
- Brown mudstone flake with hinged termination, plain platform and unidirectional dorsal scarring (18 x 22 mm). This artefact reveals evidence of a longitudinal break.
- Yellow mudstone broken decortification flaked piece (28 x 29 mm).
- Brown mudstone core edge rejuvenation flake with simple faceted platform and unidirectional dorsal scarring (34 x 29 mm).
- Two tuff flaked pieces, most likely from same core (45 x 28 and 42 x 30 mm).
- Yellow mudstone blade with bipolar flaking on the dorsal surface, simple faceted platform and hinged termination (58 x 24 mm). This artefact has evidence of rolling.
- Yellow mudstone flake with a plain platform and unidirectional dorsal scarring (25 x 21 mm).
- Red mudstone flaked piece (18 x 13 mm).

GC13 was situated over a wide area on the edge of the access road and drainage gullies to the southeast of Possum Skin Dam. The site consisted of three artefacts.

- Brown mudstone fragmented microlith with abrupt semi retouch on the left lateral margin (14 x 11 mm).
- Red/brown broken flake with plain platform, heat damaged and unidirectional dorsal scarring (21 x 21 mm).
- Red silcrete flake with feather termination, plain platform and over 50% cortex and two negative scars on its dorsal side – most likely a stage 2 of 3 flake. This artefact also has evidence of longitudinal break.

GC14 was similarly located on the edges of the disturbance southeast of Possum Skin Dam within Transect 18. The site consisted of three isolated artefacts within about 20 metres of each other. The artefacts were as follows.

- Red/orange mudstone broken proximal flake with shattered platform and unidirectional scarring and some cortex on the dorsal surface – most likely a stage 3 flake (23 x 21 mm). This flake also had a transverse snap.
- Yellow mudstone broken proximal flake with plain platform and unidirectional dorsal scarring (21 x 28 mm).
- Red mudstone flaked piece (15 x 4 mm).

GC15 was identified on a north facing slope not far from Possum Skin Dam in Transect 19. An unconvincing isolated artefact – a grey FGS flake with plain platform and two notches in the dorsal distal end (35 x 22 mm).

GC16 was another of the many sites found skirting the heavily disturbed areas around the edge of the dam. This site was located on the eastern side of the dam, not far from the northern boundary of the proposed pit. The site consisted of an isolated find – a red brown mudstone broken flake (platform shattered) with a unidirectional dorsal scar pattern, measuring 50 x 39mm.

GC17 was a low concentrated scatter of artefacts found along the edge of the current waterbody within Possum Skin Dam. This site is within the high water mark of the dam, which is currently at a very low level, so these artefacts are likely to get submerged on a semi regular basis. The site was some 200 metres long with artefact concentrations, around 30m, in three locations. The landform that these sites rested on was clearly artificial being part of the south berm of the dam. The artefacts found and recorded were:

- red/brown mudstone broken decortification flake with distal end missing and over 50% of cortex on the dorsal surface (24 x 17 mm);
- yellow mudstone broken flake with plain platform (13 x 15 mm). artefact transversely snapped at medial;
- distal end of flake with hinged termination, unidirectional dorsal scars (31 x 13 mm);
- brown mudstone flake with heavy edge damage, shattered platform, and unidirectional dorsal scarring (29 x 30 mm);
- red mudstone flaked piece (23 x 9 mm);
- grey mudstone flake with hinged termination, plain platform and cortex dominated dorsal surface (22 x 33 mm);
- yellow mudstone flaked piece (22 x 6 mm);
- orange/yellow mudstone flaked piece (9 x 8 mm);
- flaked piece with longitudinal and transverse breaks with bipolar dorsal scarring (25 x 15 mm);
- pink fgs core edge rejuvenation flake with unidirectional dorsal scarring (37 x 23 mm);
- yellow/brown mudstone flake (distal end only) with transverse break, simple faceted platform and overhang trimming (25 x 15 mm);

- pink fgs flaked piece (26 x 17);
- red/yellow mudstone flaked piece (20 x 17 mm);
- orange/red mudstone flaked piece (22 x 13 mm);
- red/brown mudstone flake with plain platform, unidirectional dorsal scarring and distal end broken off (24 x 23 mm);
- cream mudstone distal flake with transverse snap and broken dorsal surface (25 x 19 mm);
- red/brown tuff flaked piece with unidirectional scars on the dorsal surface (51 x 30 mm);
- red/brown mudstone broken flake (15 x 10 mm);
- red/brown mudstone flaked piece (22 x 16 mm);
- red/brown mudstone broken flake (29 x 19 mm);
- yellow mudstone flake with plain platform, unidirectional dorsal scarring and hinged termination (18 x 12 mm); and
- red/brown mudstone flaked piece (25 x 15 mm).

GC 18 was located on a ridgeline to the south of the study area within Transect 22. Clearly this area had been remediated, with little evidence of natural soil being present. The artefact was an isolated find situated on a subsoil type unit. The artefact was a grey tuff flake with a plain platform and unidirectional dorsal scarring (43 x 29 mm).

GC19 was located on the berm, composed of B horizon deposits, of a dam within Transect 23 and consisted of a yellow mudstone flake with a cortical platform, a hinged termination and unidirectional scarring (22 x 36 mm).

Overall the sites discovered were generally isolated finds or low concentration artefact scatters, generally containing less than 10 artefacts. They were all found in disturbed contexts - either natural (colluvium, eroded landscape, deflated) or man made (roads, dams, drainage, remediation). Therefore the potential for subsurface deposits is minimal as will be explored further in **Section 4.5.1**.

With regard to the overall assemblage, there is a high diversity of material ranging from chalcedony to mudstone to FGS to tuff. However, the types of artefacts are generally quite similar. In many cases flakes revealed a high amount of cortex either on the platform or dorsal surface, which indicates that many of these artefacts are primary decortification or early stage flakes in the reduction sequence (after Flenniken & White, 1985)¹. The remainder of the assemblage indicates some dorsal scarring, which can be interpreted as being secondary flakes, most likely in stage 3 or 4 of the reduction sequence. The termination of the majority of the flakes recovered were hinged, which usually reflects increasing platform thickness (Holdaway & Stern 2004). This could imply a number of possibilities, but most likely relates to the continued use of cores beyond an ideal size and shape, due to a lack of specific raw materials in the area.

¹ A reduction sequence is simply a term given to the process of turning a natural stone or pebble into a useable tool. Typically, the process will involve the continual knapping or breaking off of stone or flaked pieces from a block of raw material. A primary or early stage flake indicates a flake that was removed from the original stone or pebble at an early stage in the reduction sequence, versus a stage 3 or 4 flake, which is typically one of the final flakes produced from a piece of raw material.

The high occurrence of transverse snaps² within the assemblage also implies heavy disturbance of the sites through cattle and human factors. Typically this type of snap occurs through trampling and crushing of the artefact by something heavy. The few longitudinal snaps recorded are normally related to technological issues during knapping².

In summary, the sites found were all surface scatters in many cases sitting above colluvial and mine re-mediation and therefore either very recent or moved from their original location. The assemblages themselves are typical of the Hunter Valley, i.e. low concentration artefact scatters or isolated finds. Technologically, the assemblage is not unique, most cases revealing debitage that is unlikely to ever have been used; furthermore, evidence of breakages is very high.

4.5 Interpretive Framework

One of the greatest drawbacks in consultancy based archaeology is that the level of interpretation provided for individual development driven projects is limited. This is due to the obvious constraints imposed by time and finances on most projects, but also the absence of rigorous regional or local archaeological studies funded by government bodies, which would act as research frameworks archaeologists could work within. The result is a distinct lack of cohesion or connectedness across archaeological studies, where interpretations are often 'isolated' in their relevance to a particular study area only. The following section makes an attempt to address this issue. It does so by providing a model of regional archaeological structure based on a model developed by Foley (1981a; 1981b), at the same time providing further interpretive resolution by assessing site formation models. Although by no means the last word on the subject, it at least provides a framework in which to attempt the interpretation of archaeological versus natural patterning for the study area itself, as well as addressing the nature of the original archaeological patterning. The authors will seek to develop this 'model' approach in subsequent studies and the ensuing section should be viewed with this in mind.

4.5.1 Site Formation and Integrity

Observations during the survey attempted to create a geomorphological model of the landscape in order to better understand the age and formation processes identified in the survey and their potential to retain archaeological deposits. This section aims to develop on **Section 3.3.3** which used previous studies to form site prediction.

Exposures identified on many of the slopes revealed a texture contrast or duplex soil, specifically a thin silty coarse sand Oa or A1 onto a well developed clayey B horizon or bedrock. This discrepancy in sediment grain size indicates that the O/A horizon does not belong to the B horizon and combined with the sharp contact between the two, indicates that the O/A1 is of colluvial origin and comes from upslope. The original topsoil has most likely been eroded into the drainage lines and river systems.

Examples of this colluvial activity can be seen on many of the slopes along the route, although good examples include Transect 7 (see **Plate 19**) and Transect 5 (see **Plate 20**). The processes of this downward movement, sheetwash, soil creep and mass movement, can also be seen on the survey route, such as transect 3 (see **Plates 21 and 22**). This type of geomorphological activity essentially deposits archaeological material at the base of slopes and within alluvial flats. These types of sites can be considered to represent lag gravels, which include artefacts and natural gravels, rather than in situ knapping floors (single events) or knapping locations (multiple knapping events superimposed/overprinted over one another).

² A transverse snap is a break that follows the short axis of a flaked piece and typically occurs from trampling of the artefact. Rather than a longitudinal snap, which occurs down the long axis of the flake and occurs normally during its creation.

The concentration of archaeological material in these locations therefore, represents natural accumulation (patterning) rather than archaeological accumulation. The authors suspect (based on multiple personal observations in the Hunter Valley) that much of the 'archaeological' site patterning recorded for the Hunter Valley actually represents natural site formation processes – a fact previously noted by Margrit Koettig's model for the Hunter Valley (Koettig 1985, Koettig *et al* 1992 - see **Figure 6**).

Due to these processes, which are accelerated through deforestation and development, areas such as ridgelines and crests will be almost devoid of sediments, these having slipped downslope. Indeed large areas of bedrock can be seen along the survey route on slopes and crests, exposed through the movement of sediments. While erosion, such as sheetwash (massive amounts of sediments being fluvially transported downslope with surface flow) and deposition of sediments, is promoted by the exposed land surfaces along the survey, and is clearly evident throughout the study area (**Plates 4, 8, 10, 11 and 23**).

Plates 3, 8, 10, 11 and 13 show that many of the transects are simply resting on an indurated C horizon. Other areas only have a very small amount of topsoil, with 10cm or less before this same C horizon is reached (**Plates 19, 20, 21 and 22**). In other locations only the truncated B horizon remains (**Plate 24**). The reason for this is the heavily eroding nature of the landscape (see **Figures 7, 8, 9 and 10** in particular). For this reason, attempts at subsurface investigation are likely to be quite unsuccessful in these places, particularly in regard to archaeological integrity.

Another interesting observation within this study area was that in areas of exposed sandstone bedrock, particularly on the slopes such as within Transect 3, the soil profile is clearly was not in situ (**Plates 11 and 25**), if in situ a BC horizon or regolith like material should be just above the bedrock. However, in this location the sandstone is beneath a clayey loam with abundant sub angular and angular stones, almost certainly colluvium from upslope. This indicates that the entire soil profile on these slopes has been eroded downslope at some point in the past, leaving very little potential for any archaeologically significant deposits to remain beneath.

It should also be noted that sections across this landscape revealed that most of the soil profiles were very thin before reaching bedrock (**Plates 11, 20 and 25**), this means that even if in situ profiles were located, they would most likely be disturbed throughout by bioturbation, root action, and other biological activity. Typically, these types of activity, which can exceed to a metre below the surface, will move artefacts and stones to particular depths, completely destroying their archaeological integrity (**Plate 26**).

Furthermore within this study area large areas have been previously impacted through the long use of the site for pastoralism and mining. For this reason much of the vegetation is recent regrowth, while very little topsoil is present in many locations. With regard to the southern border of the site, investigations into transect 23 reveal that there is evidence of a ridgeline in this area that most likely relates to the higher areas to the north of the study area (specifically transect 3 areas). However unlike the northern areas, which have gentle slopes, the southern area either does not have slopes (ie. continues into the current overburden tailings) or has very steep slopes, which indicates that much of this area is likely to have been heavily modified and re-mediated as part of the original Camberwell mine in the area. The extent of this mine and its activities is still not defined, but landforms to the south of the study area, clearly do not mimic the undulating low hills to the north of the study and the wider region in general (**Plates 16 and 17** for example).

In summary, exposed areas along the survey, particularly on ridgelines and slopes, reveal a typical pattern of downslope erosion through mass movement, soil creep and more extreme sheetwash. These deposits are deposited at the base of slopes and in creek catchments. Therefore a common pattern can be seen across the study area of exposed bedrock and lower soil horizons on crests and slopes following the erosion of their upper soil unit (following deforestation and clearing) downslope. These latter deposits accumulate at the base of slopes and in creek catchments and become integrated in the pedogenesis of these areas, often leading to the translocation and subsequent void filling of clay through the profile, promoting localised flooding in these areas. Within this study area, these topsoil deposits are likely to have eroded into the drainage lines of the site, which would have ended up in either the (now gone) Station Creek to the south or Fal Brook/Glennies Creek to the north. Since this site is some 2 km or so from the Fal Brook and given the height and relief of the area it seems likely that they signify the edge of the catchment. If this is the case, then most in situ archaeological deposits would have eventually eroded into the drainage lines and creeks and ending up in the nearby Hunter River.

4.5.2 Archaeological Models

Models represent simplified representations of a more complex reality (Shaw and Jameson, 1999: 403). They can be used to tackle 'tactical' issues such as the break-up of stone artefacts, to larger 'strategic' problems such as the spread of microlith industries across Australia. Further, the model known as the 'statistical cycle' (after Orton, 1980) is an expression of the way that archaeologists interact with their material in a research (or consultancy) setting. This sees the relationship between theory and data as mediated through models, which vary in their complexity and expression. The distinct advantage of this approach is that it does not confine the archaeologist to any particular paradigm of research.

As indicated in **Section 4.5**, the basic model that will be utilised here to look at 'archaeological structure' (simply the way that artefacts are distributed across the landscape) is based on the work of Foley (1981a; 1981b). At a simplistic level, **Figure 8** (left image) graphically expresses what is considered to be a fair representation of the distribution of activities within a home range (the area in which resources are exploited), whilst **Figure 8** (right image) graphically expresses the subsequent pattern of artefacts. This model is based on the concept that archaeological data relates primarily to long term, gross behavioural characteristics (Foley, 1981a: 1). The 'home range' is not tied in to any precepts concerning the short, medium, or long-term 'settlement' of a particular area. The home range concept can also be likened to 'site catchment analysis', a phrase first explicitly coined by Higgs in the 1970s (Vita-Finzi and Higgs, 1970), which refers to the evaluation of the natural resources within an easily exploitable distance of a given settlement or site. The limits of the model are (after Foley, 1981a: 1) "(a) that it applies primarily to small scale, mobile societies, principally hunter-gatherers; (b) that it is predominantly useful for populations using a lithic technology, and treats lithic artefacts only; and (c) that it is most appropriate in stable or degrading, moderately uniform landscapes with good surface visibility".

The basic hypothesis outlined by Foley (1981a:2) was that the archaeological record is spatially continuous and the nature of the distribution should be viewed in terms of a variable artefact density across the landscape (what he called the "regional archaeological structure"). From the authors' general experience within NSW, it is **rare** that any given location within the landscape does not contain some evidence of Aboriginal archaeology – and only then because it has been disturbed or deposits removed or destroyed.

Foley (1981a:2) considered that spatial continuity resulted from the operation of three processes: behaviour and discard (i.e. human activities such as making tools or gathering food-stuffs); accumulation (i.e. the archaeological record usually reflects repeated events 'superimposed' over one another such as a knapping location); and post-deposition (i.e. processes that occur after a site has been abandoned such as burial, slope wash or ploughing). This is the theoretical basis of Foley's now famous (to archaeologists) "off-site" archaeological model. For the purposes of this study, post-depositional processes form the focus of assessment, since for many of the landforms present (particularly slopes and to a lesser degree alluvial terraces/flats), natural and post-Contact man-made processes have either created or exaggerated 'archaeological' patterning.

With the arrival of Europeans in Australia and the introduction of farming and the development of urban centres and associated infrastructure, the Australian landscape was (and continues to be) put under a variety of processes detrimental to the stability of land surfaces, particularly soils. In effect, a landscape that was *relatively* stable (except at times of climatically introduced stress - e.g. the absence of vegetation due to smaller water budgets during the Last Glacial Maximum between c.27,000 – 17,000 years Before Present (BP) or, localised cycles of erosion/deposition and soil formation within particular catchments) for long periods of time has, in the space of a just over 200 years, been subject to problems of slope instability and the subsequent erosion of soil mantles. These processes serve to alter the archaeological patterning of objects and sites, which includes processes that alter horizontal and vertical site integrity, in addition to removing and/or destroying Aboriginal sites. From the perspective of *archaeological* significance (cultural significance is different because Aboriginal people consider all Aboriginal objects and sites, regardless of condition, as significant), the study area has been markedly affected by deforestation, various slope processes, the action of water (rilling, gullying etc) and direct human impacts like the construction of roads and dams. Furthermore, long term pastoral practices have served to erode, destroy or rework archaeological artefacts and sites.

Figures 7, 8, 9 and 10 illustrate these processes in 'schematic' form. However, the general post-depositional processes indicated by these models are reasonably accurate (qualitative) representations of what happens to soil mantles (and the artefacts on and within them) when surface vegetation is removed or stressed and when soil mantles are eroded and/or reworked. There are techniques (largely borrowed and adapted from sedimentology and geomorphology by archaeologists) to ascertain the main post-depositional processes that have affected sites and artefacts. These range from specific archaeological techniques like the refitting of artefacts, to plotting 'rose' diagrams using orientation and dip data taken on artefacts.

4.5.3 Discussion

The study area falls within the catchment of the Hunter River, and more locally within Fal Brook/Glennies Creek and (the now destroyed Station Creek). The study area includes slopes, relatively flat spurs, and benches.

With our current understanding of general Aboriginal settlement patterns within the Hunter Valley, Aboriginal people are known to have been living in the area since at least the Last Glacial Maximum (c.27,000 – 17,000 years BP) and probably much earlier. The most common site type encountered is the shell midden and open artefact scatter, although isolated finds, scarred trees, burials, rock art, axe grinding grooves, ceremonial and mythological sites are also present.

Based on archaeological surveys (and more limited test excavations) in the general areas surrounding the study area (see **Figure 1**), some basic conclusions can be reached concerning the nature and distribution of Aboriginal archaeological sites. Firstly, it can be concluded that all landforms surveyed have provided evidence of Aboriginal sites, including alluvial terraces and flats, slopes, benched areas, spurs and ridgelines. This picture is somewhat biased towards archaeological sites adjacent to creeklines and the time of year and density of vegetation cover encountered at the time of the archaeological surveys (affecting visibility and hence detectability of archaeological sites). Furthermore, because of these issues of detectability, Aboriginal sites are usually most visible in areas experiencing erosion. It is true to say that the ability to detect Aboriginal sites is largely influenced by this fact, in the absence of subsurface testing programs. The density of Aboriginal sites, however, varies according to landform. Taking into account Foley's model outlined above (see also **Figure 8**), this is to be expected.

One of the most obvious aspects of the general landscape context of the study area is the overall condition of the land. In most areas surveyed, topsoils were observed to be minimal (e.g. **Plates 2 and 7**) and/or reworked from elsewhere. Furthermore, previous pastoralism and mining had caused immense impact to the large areas of the current study area reducing the survivability and integrity of any potential archaeology.

In terms of general archaeological patterning (regional structure), the continuous exploitation of an area over time by hunter-gatherers leads to an increase in the absolute density of artefacts and the effects of blurring are seen ('accumulation' process described above). Hunter-gatherer people set up camps (be they short, medium or long-term) based on the habitat context (Foley, 1981b: 159), rather than the exact location of any particular settlement (for example, pastoralists re-using huts in upland pastures grazed only during the summer months). This is true of creeklines in general, where repeated visitation over very long periods of time can create a very dense archaeological pattern of stone artefacts (although the erosion and deposition of artefact concentrations by fluvial processes have to be considered and 'filtered' out). Conversely, sites on slopes, breaks of slope and footslopes are often the result of slope processes (water, gravity) and concentrate artefactual material to resemble sites (discussed in **Section 4.5.1** above). Finally, the more recent human actions (such as drainage excavations, dam construction etc) can expose sites. Other detrimental processes such as salt scalding that cause and intensify the erosion of soil mantles, are also present within the survey area.

5 ASSESSMENT OF ARCHAEOLOGICAL SENSITIVITY

The assessment of the archaeological sensitivity of each survey unit is based on the following three criteria (following the discussion in **Section 4.2**).

Criterion 1 The presence of known surface archaeological materials.

The known locations of previously recorded archaeological sites within the study area have been plotted on the topographic map of the region (**Figure 1**). A review of archaeological work in the region and the AHIMS site cards, as well as the archaeological survey and assessment have identified that a number of previously recorded sites are near the study area.

154 known sites are located within 5 to 10km of the study area, 96% of these are artefact scatters or isolated finds. During this study 19 sites were identified, of which 100% were artefact scatters or isolated finds. The geomorphology indicates that these sites are unlikely to be more than surface manifestations situated on highly disturbed deposits.

Criterion 2 The probability of undetected surface archaeological materials.

The probability of undetected surface materials occurring within the study area is assessed on a number of characteristics. These include:

- the analysis of effective ground surface visibility within the study area; and
- the terrain context and integrity of areas.

Ground surface visibility is the most common obstacle in the detection of archaeological material. Low, dense vegetation limits effective survey coverage to a low, or moderately low level. The likelihood of detecting surface archaeological materials in these densely vegetated areas is low. Therefore, this assessment relies on the terrain context and the level of landscape integrity within each transect.

The terrain integrity within the study area has been documented to identify whether archaeological material could still be found in those areas, or whether they would have been removed as a result of past disturbance. The probability (classified as low, moderate or high) of surface archaeological materials occurring within specific landscape contexts may then be considered.

In general, exposure was very good, in excess of 80%, largely due to the abundant trees reducing low dense groundcover and the high areas of human modifications that have been undertaken in the area. Visibility and effective coverage was somewhat lower but still 52%, which is high for this type of assessment. Human disturbance within the proposed study area was high, including structures, roads, artificial dams, remediated overburden and previous open cut mine impacts, and underground services. In most locations it seems unlikely that surface material would have survived, where it was not already discovered. However, it should be noted that in almost all areas, clear evidence of erosive and aggrading processes were occurring, implying materials are most likely accumulating at the base of slopes and hills through geomorphological processes. Typically, the areas of accumulation are outside of the study area, which is basically multiple slopes at the edge of Fal Brook and Station Creek's catchments.

Criterion 3 The probability of subsurface archaeological materials.

The assessment of the subsurface archaeological potential of the survey area is based on a number of criteria, including:

- the known patterning of surface and subsurface archaeological materials throughout the local region; and
- the terrain characteristics of known archaeological (surface and subsurface) sites.

The field survey examined terrain contexts where subsurface archaeological materials may have occurred in currently uncleared land, such as in upturned tree bowls or exposed sections, but failed to find any evidence. This information allows the probability (classified as low, moderate or high) of subsurface archaeological materials occurring within specific landscape contexts to be established.

Existing levels of terrain integrity and the demonstrated patterns of the surface and subsurface distribution of archaeological materials in the study area were used as the main evidence in the following evaluation. As there is no evidence of buried archaeological material in the immediate area, this evaluation is based upon the potential for intact natural soils to exist. Following geomorphological models (see **Section 4.5.1**), no areas were highlighted to have the potential to contain potential archaeological deposits. There is no evidence of aggrading environments within the area, the site being dominated by slopes and ridgelines. Furthermore, there was no observation of any intact soil profile across the whole survey. Therefore, the potential for subsurface archaeological deposits in this area is considered very low.

5.1 Sensitivity Rating

Zones of archaeological sensitivity can be delineated on the basis of this assessment of the probability of additional archaeological material occurring in the study area. This assessment relates to the probability of material occurring and does not address scientific significance or the cultural significance of the material to Aboriginal community members.

Low or Nil Archaeological Sensitivity

The areas indicated on **Figures 4** and **5** that are impacted by mining, demolition fill, services, residential, and/or roads are assessed to be of low or nil archaeological sensitivity where archaeological material is unlikely to occur as the terrain has been significantly altered.

Moderate Archaeological Sensitivity

No areas were considered to retain in situ soil profiles within the study area. For this reason there is unlikely to be in situ sub surface deposits or PADs, which are typically allocated as moderate sensitivity until their archaeological content can be proven or disproven. For this reason no areas have been allocated a moderate sensitivity.

High Archaeological Sensitivity

Areas that have known or recently discovered Aboriginal sites have been identified as being of high sensitivity and are shown in **Figures 4** and **5**. In this study, nineteen sites have been identified as highly sensitive purely due to their protection under the *National Parks & Wildlife Act 1974*, rather than their archaeological integrity.

5.2 Summary of Results

The archaeological survey and assessment divided the survey area into areas of low, moderate or high archaeological sensitivity. This assessment was based on three criteria: the presence of known surface archaeological materials, the probability of undetected surface archaeological materials, and the probability of subsurface archaeological materials. This assessment was therefore based on the results of the field survey, within the broader framework of the archaeological understanding of site distribution within this region.

In summary, there is a low to nil potential for in situ archaeological material to occur in the areas currently covered by previous development (ie. mining), roads, man made fill, service trenches, buildings and paved areas. These areas cover the entire survey area aside from those areas outlined as high sensitivity below.

No areas have been identified as of moderate sensitivity, since the geomorphological modelling of the study area reveals little potential for any subsurface deposits to remain. Furthermore, where there are soil profiles, they are generally less than 50cm deep, indicating that bioturbation and other soil processes would have removed or impacted upon any deposits that may be retained.

Nineteen Aboriginal sites were located, GC1 to GC19, and have been identified as of high sensitivity. This assessment is made purely on the basis that they are Aboriginal objects and therefore protected under the *National Parks & Wildlife Act* (1974) rather than on their archaeological integrity. Geomorphological interpretations highlight that these sites are situated on relatively recent soils and man made deposits.

Table 12 lists the archaeological sensitivity of all transects recorded and areas examined and **Figures 4 and 5** illustrates these locations.

Table 12
Archaeological Sensitivity of Areas Examined

Low or Nil Archaeological Sensitivity	Moderate Archaeological Sensitivity	High Archaeological Sensitivity
The entire study area aside from those areas outlined as of high sensitivity.	No areas were considered of moderate sensitivity.	GC1 to GC19 are considered of high sensitivity.

6 IMPACT ASSESSMENT

This section discusses the proposed development, the statutory controls relating to Aboriginal heritage and proposes a management strategy including appropriate mitigation measures.

6.1 Proposed Development

This section outlines the proposed development and associated impacts for the Study Area.

The proposed development includes the installation of an open cut coal mine running in an east west orientation from Possum Skin Dam to Stony Creek Road, with associated overburden emplacements and other ancillary infrastructure related to the operation of a large coal mine.

Specifically, ICO is aiming to develop an open cut project area of 320 ha, incorporating a 90 ha mine area with an overburden of around 41 hectares. The former will be situated in the northern section of the study area, while the latter will combine with the current overburden in the southern section of the study area. Associated with this open cut will be the required ancillary infrastructure for successfully operating the mine, including roads, structures, drainage, and services.

The proposed open cut coal mine development involves the following activities (**Figure 2**).

- Construction of a site access road off Middle Falbrook Road.
- Construction of facilities (contractor office, amenity buildings and workshop) adjacent to the proposed open cut.
- Coal mining by open cut methods within a pit shell covering approximately 90ha (7.7Mt reserve).
- Transport of mined coal to the Camberwell CHPP for washing via internal haul roads, currently identified as Proposed Haul Roads D (100 metres wide x 1400 metres long) and E (40 metres wide x 2700 metres long).
- The integration of the existing Camberwell CHPP into the approval.
- Temporary stockpiling of ROM coal, as and when required, at a temporary ROM coal stockpile area located at the top of the open cut ramp or at the existing RL100 Stockpile Area, with subsequent transport to the CHPP.

- Highwall / auger mining. During the course of the proposed open cut mining, there may be opportunities to undertake mining from the northern highwall using either highwall or auger mining to extract additional coal.
- Programmed placement of waste rock materials from the open cut, initially to an out-of-pit emplacement, with subsequent placement out-of-pit as well as in-pit in areas where mining has been completed. The proposed out-of-pit emplacement has a disturbance footprint of approximately 41ha.
- Progressive reshaping and rehabilitation of all areas of mining-related disturbance. Overall, the total disturbed area to be rehabilitated is approximately 124ha (7.7Mt reserve).
- Implementation and maintenance of comprehensive systems to manage noise, vibration, air quality, visibility, surface water, groundwater, flora and fauna.

The formation of the open cut will completely remove and destroy all topsoil, subsoil and much of the upper exposed bedrock within the open cut footprint, through blasting and excavation. The overburden will not require any initial major impacts to the current land surface, however the volume and mass of the tailings that will be produced will severely impact any in situ soil profiles beneath.

A series of recommendations to mitigate against the potential impacts to these areas has been formulated. These are based on the statutory controls affecting the management of archaeological materials. These controls, and the recommendations developed, are outlined below.

6.2 Statutory Controls

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

COMMONWEALTH

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) requires the approval of the Commonwealth Minister for the Environment and Heritage for actions that may have a significant impact on matters of National Environmental Significance (NES).

As of 1 January 2004 the EPBC Act also provides for the identification, conservation and protection of places of national heritage significance as a matter of NES. In addition the EPBC Act provides for the management of Commonwealth heritage places and establishes the Australian Heritage Council.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Heritage Protection Act) is the principal Commonwealth legislation protecting Indigenous heritage. The Act complements state/territory legislation and is intended to support state/territory laws and processes.

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

Since the passage of this legislation:

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

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

NEW SOUTH WALES

National Parks and Wildlife Act 1974

The National Parks and Wildlife Act (1974) was amended in 2001 and some of the terms relating to Aboriginal archaeology have changed and the provisions have been tightened.

Under the provisions of the National Parks and Wildlife Act 1974, Aboriginal archaeological sites are defined as Aboriginal objects (formerly called relics). Aboriginal object "means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains".

It should be noted that this definition technically would seem to exclude PADs as they are clearly not deposits, objects or material evidence; rather they are potential aboriginal objects.

The most relevant section of the legislation is section 90, which deals with the destruction of Aboriginal objects and is reproduced below.

90 Destruction etc of Aboriginal objects or Aboriginal places

- (1) A person must not destroy, deface, damage or desecrate, or cause or permit the destruction, defacement, damage or desecration of, an Aboriginal object or Aboriginal place.

Maximum penalty: 50 penalty units or imprisonment for 6 months, or both (or 200 penalty units in the case of a corporation).

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

- (1B) Subsection (1) does not apply with respect to an Aboriginal object or Aboriginal place that is dealt with in accordance with a heritage impact permit issued by the Director-General.
- (1C) It is a defence to a prosecution for an offence against subsection (1) if the defendant shows that:
 - (a) he or she took reasonable precautions and exercised due diligence to determine whether the action constituting the alleged offence would, or would be likely to, impact on the Aboriginal object or Aboriginal place concerned; and
 - (b) the person reasonably believed that the action would not destroy, deface, damage or desecrate the Aboriginal object or Aboriginal place.
- (2) The Director-General may issue a heritage impact permit subject to such conditions and restrictions as are specified therein.
- (2A) The Director-General may take action under subsection (2) in relation to an Aboriginal object or Aboriginal place listed on the State Heritage Register (within the meaning of the Heritage Act 1977) only after consulting the Director of the Heritage Office.
- (3) A person whose application for a heritage impact permit is refused, or who is dissatisfied with any condition or restriction subject to which the a heritage impact permit is given, may appeal to the Minister.
- (4) The Minister:
 - (a) may refuse to grant the appeal; or
 - (b) may grant the appeal wholly or in part, and may give such directions in the matter as seem proper.
- (5) The decision of the Minister on the appeal is final and is binding on the Director-General and the appellant, and shall be carried into effect accordingly.
- (6) Where the regulations prescribe:
 - (a) the manner in which an appeal is to be made under this section—the appeal shall be made in that manner; or
 - (b) the period within which an appeal is to be made under this section—the appeal shall be made within that period.
- (7) Where the Director-General fails to grant an application (other than an application for approval in respect of integrated development within the meaning of section 91 of the *Environmental Planning and Assessment Act 1979*) for a heritage impact permit, the application shall, for the purposes of this section, be deemed to be refused upon the expiration of:
 - (a) subject to paragraph (b)—7 days after the application was received by the Director-General; or
 - (b) where the regulations prescribe some other period—that other period.

- (8) If a court finds a person guilty of an offence under subsection (1), the court may, in addition to or in substitution for any pecuniary penalty for the offence, direct the person to take any action to mitigate the damage to, or to restore, the Aboriginal object or Aboriginal place concerned or to take such other action in relation to the Aboriginal object or Aboriginal place as the court considers appropriate in the circumstances.
- (9) The court may specify the actions to be taken to mitigate the damage or to restore the Aboriginal object or Aboriginal place under subsection (8) and may order the person to provide security for the performance of any obligation imposed under that subsection.

It should be noted that section 90 applies to all Aboriginal objects irrespective of whether they are considered to be disturbed or not. The issue is whether reasonable precautions and due diligence was exercised to determine whether an Aboriginal object or place was going to be destroyed, defaced, damaged or desecrated or not. Thus if an area was identified as having archaeological potential and was disturbed or destroyed the defence of reasonable precautions and due diligence would not be available.

Section 87 of the Act covers permits to allow certain actions under section 86. This includes disturbing or excavating any land, or causing any land to be disturbed or excavated, for the purpose of discovering an Aboriginal object.

Note, that this project is being undertaken under Part 3A of the *Environmental Planning and Assessment Act 1979* (as amended), which has implications on the requirements of obtaining permits under the *National Parks and Wildlife Act 1974*.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that consideration be given to environmental impacts as part of the land use planning process. In NSW environmental impacts are interpreted as including cultural heritage impact. Three parts of the EP&A Act are most relevant to Heritage. Part 3 relates to planning instruments including those at local and regional levels, Part 4 controls development assessment processes and Part 5 refers to approvals by determining authorities.

The recent NSW planning reforms have seen Part 3A introduced to the EP&A Act which provides a new approvals regime applying to all major projects. Major projects are defined under State Environmental Planning Policy (Major Projects) 2005 (SEPP 2005). It also applies to those projects which the Minister believes are required to deliver particular government plans or programs, known as critical infrastructure projects.

The new Part 3A applies to all projects where the Minister has the approval role. Under Part 3A, the Minister can issue a project approval or a concept approval. Both maintain the requirement for consultation with the community and relevant State Government agencies, however the requirement for certain other permits and licences is removed under Part 3A.

Section 75B(2) of the EP&A Act makes provision for 'major projects' to be identified through various means, including by way of declaration as a listed project in State Environmental Planning Policy (Major Projects) 2005 (SEPP 2005), or by notice in the Gazette.

Schedule 1 of SEPP 2005 identifies classes of development which are major projects. This includes works for the purpose of a mining that is a coal mine or that has a capital investment of more than \$30 million.

The proposed project comprises the development of a new open cut coal mine at Glennies Creek and is therefore classified as a 'major project' under SEPP 2005 and the Minister for Planning is the approval authority.

Importantly for this study, under Section 75U (1) (d) of Part 3A, the proponent is not required to obtain certain permits under the *National Parks and Wildlife Act 1974*, specifically.

- (1) The following authorisations are not required for an approved project (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):
 - (d) a permit under section 87 or a consent under section 90 of the *National Parks and Wildlife Act 1974*

Instead of obtaining permits under the *National Parks and Wildlife Act 1974*, the proponent is required to prepare a Statement of Commitments, in accordance with the Director General's Environmental Assessment Requirements (EARs). Recommendations of this report will be inserted into the Statement of Commitments.

6.3 Management Strategy

Despite the high impact that has been proposed for the study area, specifically the complete destruction of 90ha and other associated impacts of about 50ha (excluding areas of existing infrastructure, such as the Camberwell CHPP), the site has already been highly modified by current and past land use in the area. The previous existence of the Camberwell North Pit, the current open cut and Possum Skin Dam, as well as pastoralism have left an area that retains little archaeological material.

Nineteen areas have been highlighted by this survey to contain Aboriginal objects or sites (**Figure 4**). In all cases these are either artefact scatters or isolated finds situated on disturbed or heavily eroded contexts. These areas have been highlighted as of high sensitivity. However, it should be noted that this allocation of sensitivity was based purely on the fact that Aboriginal objects are protected under the *National Parks & Wildlife Act* (1974), regardless of their specific location. No evidence was found to suggest these sites were surface manifestations of a larger buried archaeological deposit.

Geomorphological evidence reveals that the deforestation of the area in the recent past has allowed heavy erosion of the slopes and ridge crests into the drainage lines and creeks (**Plate 10**). However, since the majority of the study area is on the edge of the Fal Brook catchment, there are few areas that can be considered accumulation zones, the most likely being the area now encompassed by Possum Skin Dam (**Plate 3**), although now completely modified – this area was where a large concentration of artefacts was found, adding to this hypothesis. In general, the surface and sections revealed a soil profile of truncated B horizon with modified colluvium above (**Plates 19 to 23** inclusive), the former consisting of an orange clay with polyhedral peds, while the latter is a light brown sandy loam with abundant sub angular and angular stones. As can be seen from this brief description here, the two soil units are unlikely to be from the same location due to the evident differences in their composition. Furthermore, the soils in most locations were generally quite shallow before bedrock was reached, typically under 50cm (**Plates 11 and 25**). The potential, therefore, for substantial in situ subsurface deposits (considering bioturbation can exceed 1 metre) is minimal across the study area.

For these geomorphological reasons, aside from the nineteen sites, the study area has been given a low sensitivity rating in terms of archaeology and requires no further archaeological investigation. However, two other issues that need to be considered are the large areas of exposed bedrock along the drainage lines and the previous sites that still exist within Possum Skin Dam.

During the survey, a large number of flat exposed sandstone outcroppings were evident across the site, but particularly within the northern area of the proposed open cut. Although no engravings or axe grinding grooves were evident during the survey, the geomorphology reveals that these areas may have subsequently been buried by colluvium from upslope. For this reason all personnel should be advised of the potential risk of finding Aboriginal sites within the sandstone surfaces, and the appropriate steps that should be undertaken if this occurs. Specifically, to stop work and contact the DECC Northeast EPRD regional archaeologist for discussion.

Two sites were identified in the late 1980s during the original survey for the current Glennies Creek Colliery (Lilley 1987). These sites, National Parks and Wildlife Service (NPWS) numbers # 37-3-0188 and # 37-3-0189 were submerged within Possum Skin Dam during its construction. Although not relevant to this study, HLA has pursued the issue of these sites and the survey for the dam, and has currently found no fault with Glennies Creek mine and their management of the process. The submergence of sites, while not common, does not constitute a “disturbance” under the Act and for this reason is perfectly acceptable. The location of these two sites could not accurately be determined, aside from within Possum Skin Dam, and therefore may be impacted by this project. Therefore, since these sites are largely small artefact scatters – most likely similar to the ones identified in this study, any approval to disturb artefacts should incorporate them as well. The logistics of how these would be relocated and recovered following approval will need to be addressed early in the planning stages.

As stated in **Section 6.2**, this project has been declared as a Major Project and as such, falls under Part 3A of the *Environmental Planning and Assessment Act 1979* (as amended). Therefore, it does not require permits under the *National Parks and Wildlife Act 1974*. Hence, the management of the nineteen sites, considered surface scatters with no evidence of subsurface deposits, should be to record and collect them in consultation with the Aboriginal communities prior to the proposed development proceeding. An Agreement between the Aboriginal stakeholders regarding who retains the collected artefacts would need to be negotiated prior to any collection.

The collection of these sites in conjunction with the Aboriginal communities should be made a requirement in the Statement of Commitments prepared for the project.

A number of matters were highlighted in the requirements of the DECC for this proposal that are required to be included in this report, specifically issues of the Aboriginal community over the destruction of waterways in the Hunter Area, the native title claim of Mimaga Wajaar Traditional Custodians and the DIPNR requirement of the Mt Owen Project for a monetary offset to go to the Hunter Aboriginal Cultural Heritage Trust Fund.

First, waterways within the Hunter are incredibly significant to the Aboriginal people, since these were the main routes between inland and the coast, often called “Song lines”. Mount Owen Coal Mine was proposing to impact several of these waterways, specifically Betty’s Creek. This study reveals that the proposed development will not directly impact any major waterways within the study area, although initial and ongoing concern has been raised over any impacts to Glennies Creek, which is another of these significant “Song lines”. At this stage, there is no evidence that Glennies Creek will be impacted, should this situation change, consultation with the Aboriginal communities should be undertaken as a matter of priority. Discussions with the Aboriginal communities on site revealed that few concerns were felt for any of the drainage lines on the site, since many were clearly formed through recent erosion.

The native title claim has been discussed in **Section 2** and reveals that no evidence to support this potential claim could be identified. The claimant group is presumed to come from the Lake Macquarie region some distance from the Hunter Valley. It seems unlikely that any claim made by groups outside of those currently operating in the Hunter Valley, specifically the Wannaruah (and to a lesser extent Kamilaroi) people, would be endorsed by Native Title Services, who are intimately familiar with the ongoing issues in the Hunter. Furthermore, since the group has yet to have a Native Title Claim over the area at the instigation of this project and has not contacted HLA regarding the project, despite public announcement, there seems little issue with their current absence in the consultation process.

With regard to the monetary offset of \$50,000 for the destruction of Aboriginal objects within the Mount Owen Project Site, this process is quite common in the Hunter Valley. HLA has been involved in many projects where the client wishes to provide some contribution to the Aboriginal communities and often stops the need for large amounts of irrelevant archaeological work prior to development. Instead, the funds can go towards preservation and/or investigation of more relevant and significant Aboriginal sites elsewhere. A similar process may be sought from the communities here. However, the funds should only go to a fund that demonstrates and can prove the use of the funds for Aboriginal communities and archaeological research. The reason for this criterion is that it is alleged (and is currently being investigated by the Wannaruah LALC) that the Hunter Aboriginal Cultural Heritage Trust Fund is actually largely a private fund for one of the Aboriginal groups in the area, and few of the funds deposited there ever reach the community. If ICO wish to make a contribution to the Aboriginal communities, HLA would be willing to help facilitate this process and ensure complete transparency in the donation and use of the funds.

Following a change in the shape of the study area, additional survey work was undertaken over the areas to the west of Possum Skin Dam in March 2006. However, HLA was advised that new areas included which run along the north and north-eastern edge of the study area are to be left as a conservation area, and as such will receive no impact (**Figure 3**). Given this area is the closest part of the study area to Glennies Creek, a significant Aboriginal transport line, no impacts should be undertaken on this area until a full Aboriginal heritage survey has been undertaken upon it. More recently, additional areas have been incorporated into the study area, specifically Proposed Coal Haul Roads D and E, and the Camberwell CHPP. These areas have not been investigated, but HLA has been advised they are existing infrastructure, and as such have been previously heavily impacted.

One further condition that this report recommends placing in the Statement of Commitments regards the protection of any Aboriginal skeletal remains, which are protected under the *National Parks and Wildlife Act 1974*. The condition should state that if skeletal remains are identified during the works, then all works must stop and make contact with the NSW Police, Department of Environment & Climate Change and the NSW Coroners Office must be made immediately. The subsequent management of any Aboriginal skeletal bodies found, should be developed in conjunction with DECC, the Aboriginal communities and trained archaeologists. Management options should include preservation *in situ*, or detailed excavation and recording followed by retrieval. In relation to the latter, consideration of the ultimate location of the remains should also be decided prior to retrieval.

6.4 Recommendations

The **Statement of Commitments** prepared for the proposed Glennies Creek open cut mine should include the following commitments.

- No impacts should be undertaken to the north and northeastern areas of the Project Site (as shown in Figure 3) until an Aboriginal heritage assessment has been undertaken.

- Aboriginal sites GC1 to GC19 (inclusive) should be recorded and collected in consultation with the Aboriginal communities (specifically those outlined in Section 2 of this report) prior to the proposed development occurring.
- Discussions with the proponent and the Aboriginal communities should be undertaken prior to the collection, to identify an appropriate “keeping place” for the artefacts associated with sites GC1 to GC19 (inclusive).
- Any further Aboriginal sites identified during the course of the proposed works, should be dealt with in a similar manner to those outlined for GC 1 to GC 19 (inclusive) above.
- Where Aboriginal sites are discovered that cannot be relocated or collected (such as rockshelters, grinding grooves and engravings), consideration should be given first to preservation in situ, then to detailed recording and investigation by professional archaeologists in conjunction with the communities. Similarly, agreement with the level of investigation and eventual location of all artefacts and object recovered, should also be decided in conjunction with the Aboriginal communities prior to the investigation commencing.
- Aboriginal skeletal remains are highly significant and are protected under a variety of criminal State legislation. Should remains be found, work should cease immediately and consultation with the DECC, NSW Police, NSW Coroners Office and the Aboriginal communities should be undertaken immediately to decide on the best course of action. If Aboriginal remains are discovered, these actions should include either 1) the preservation of the remains in situ, or 2) the detailed recording and recovery of the remains by qualified personnel in conjunction with the Aboriginal communities. The latter should also seek agreement on the subsequent location and/or re-burial of the remains prior to their removal.
- Should the Aboriginal communities decide that further cultural salvage of the study area would not be required (beyond the protection of known sites), a cultural ‘off-set’ could be negotiated between ICO and the Aboriginal communities that would benefit the Aboriginal communities in general and promote Aboriginal heritage and culture in the wider community.
- No further archaeological work is required in areas of low sensitivity.
- All contractors should be made aware of these Recommendations prior to commencing site works.

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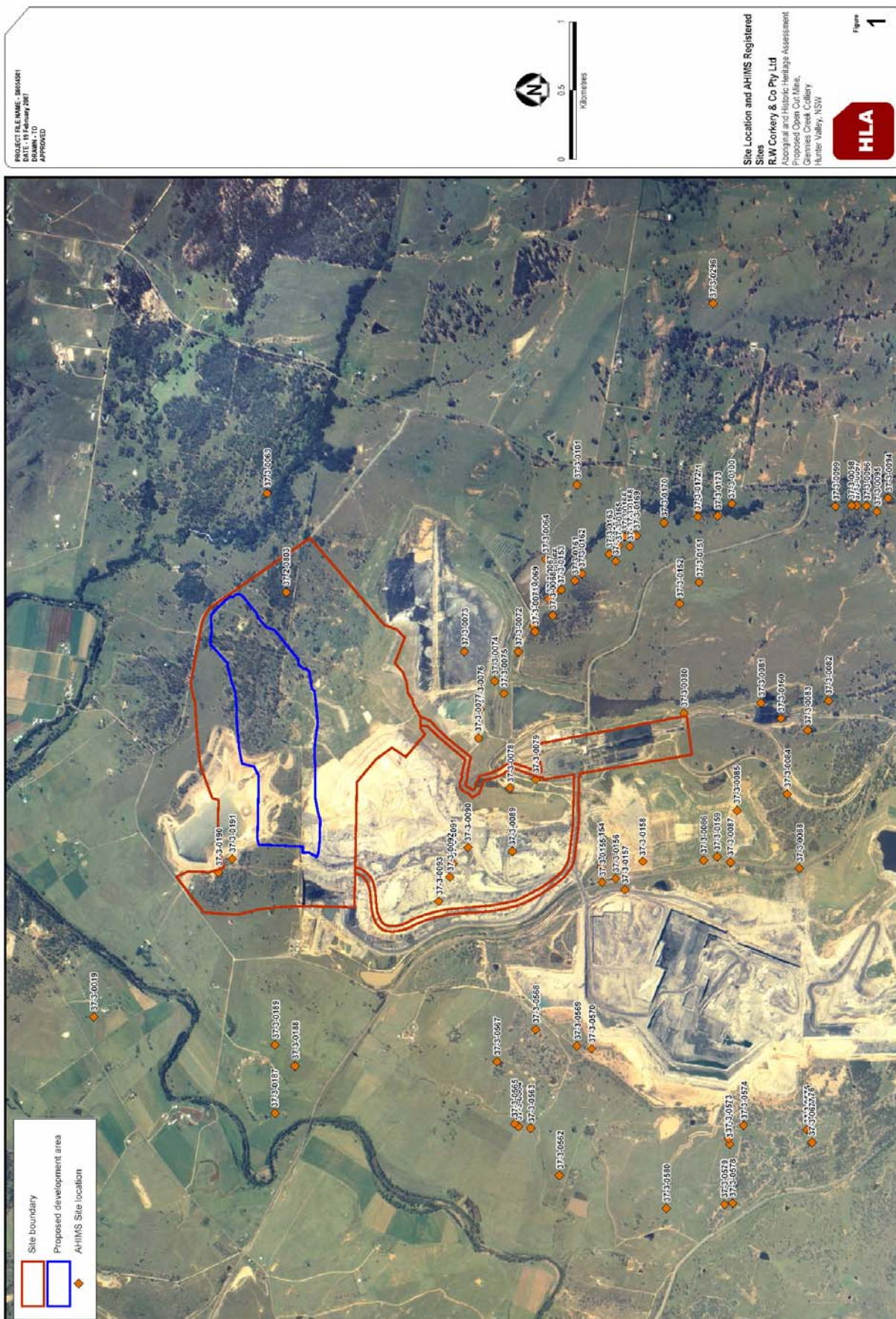
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Figures

(Note: All Figures are presented in colour on the Project CD)



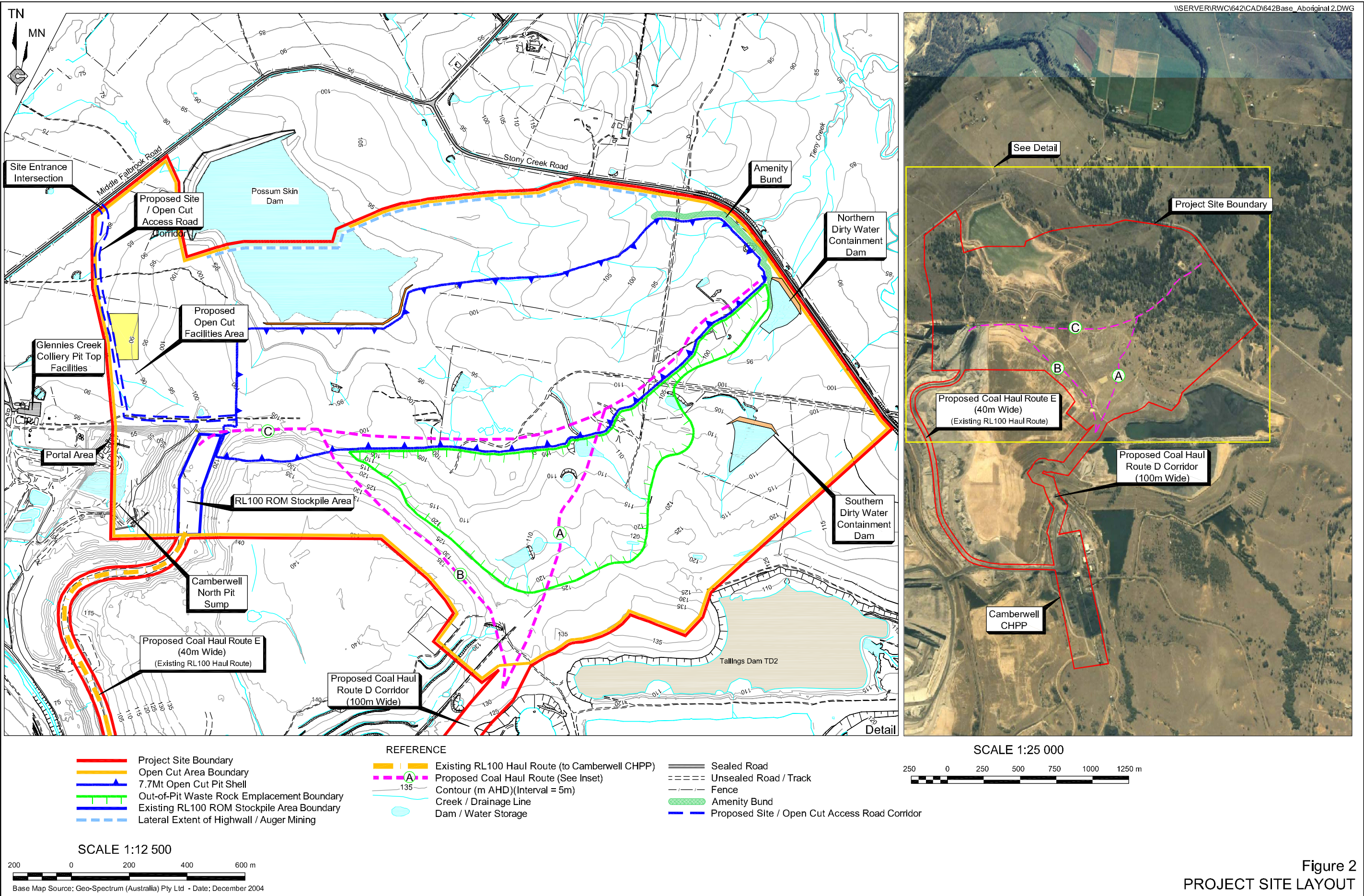
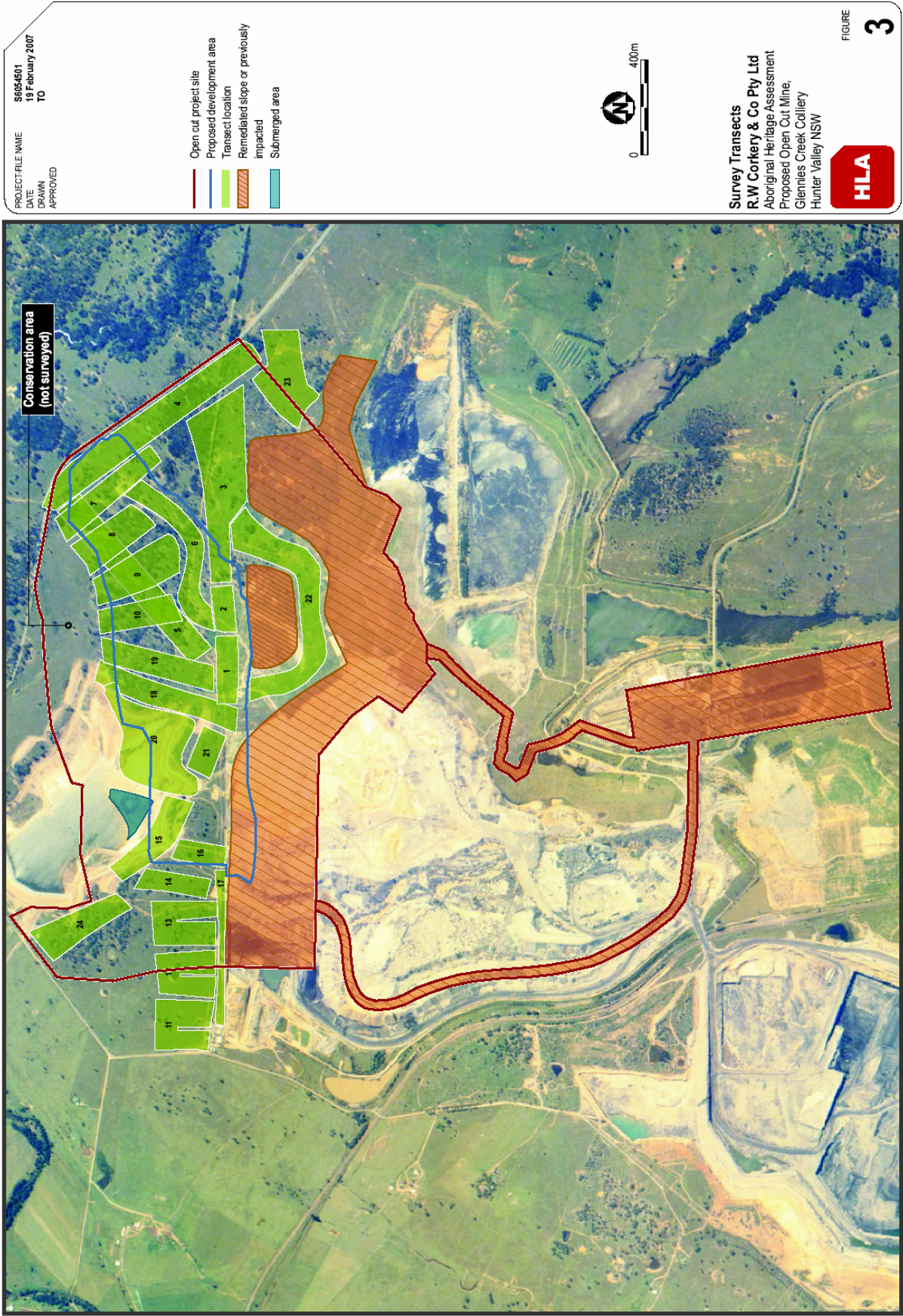
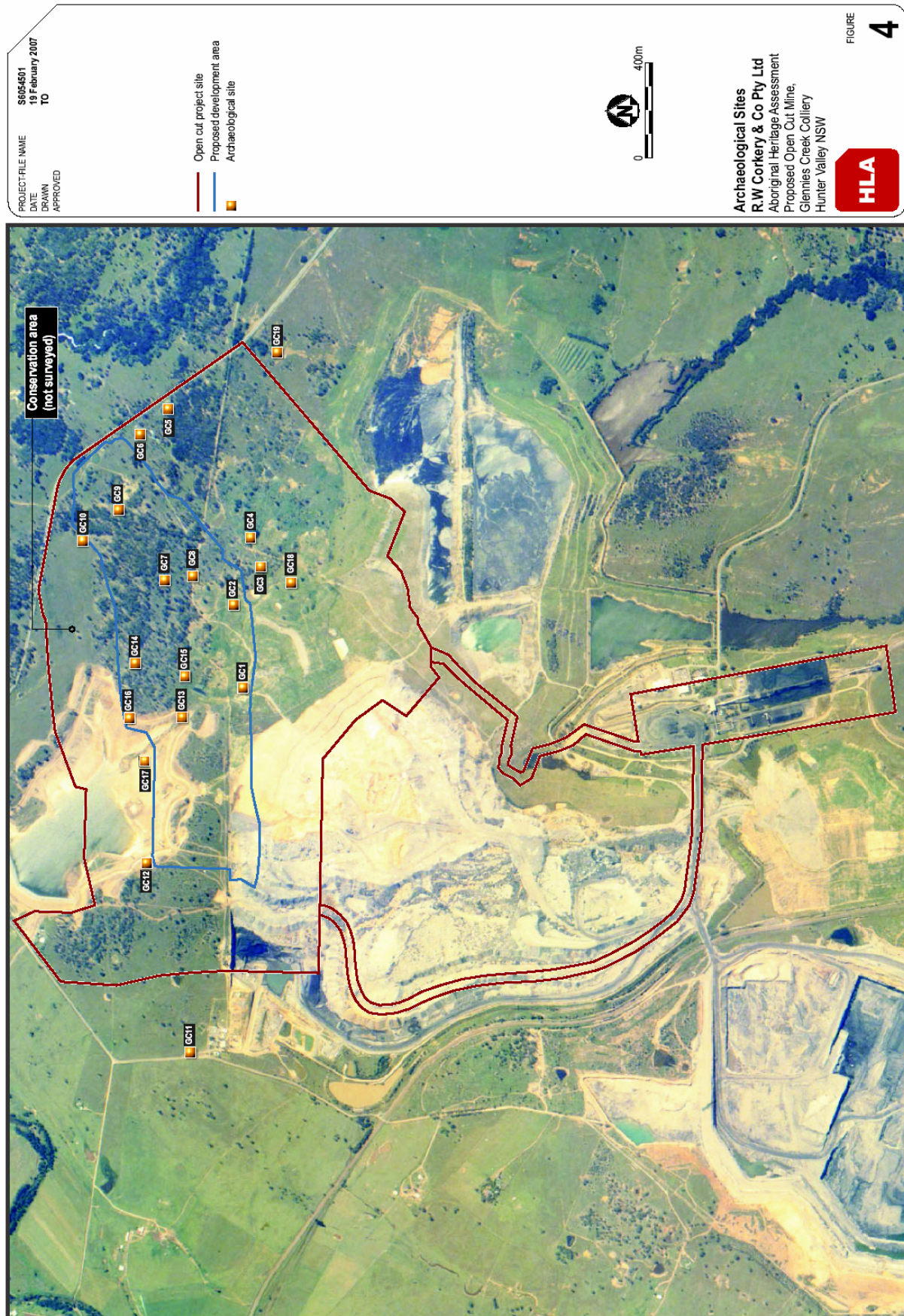
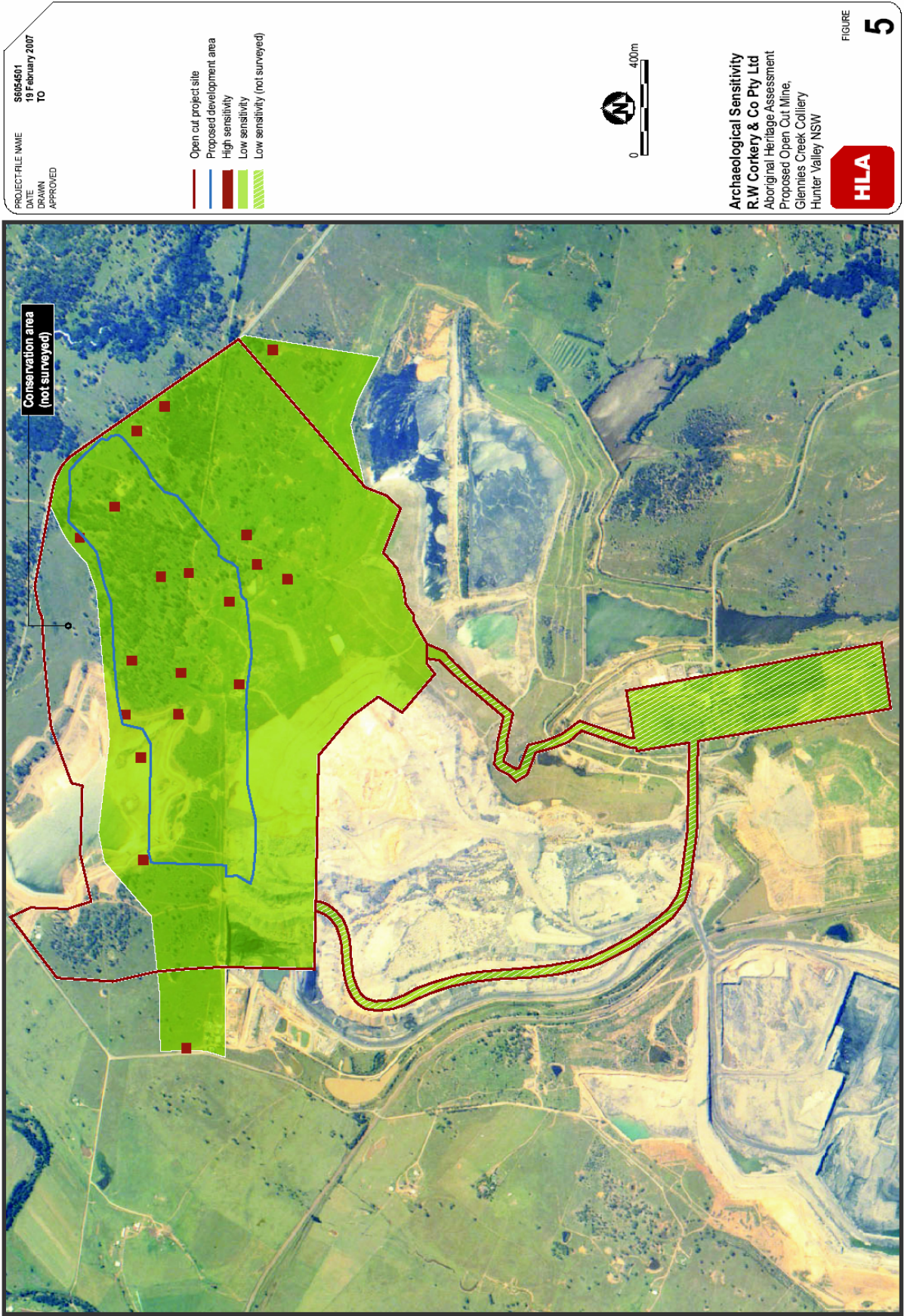
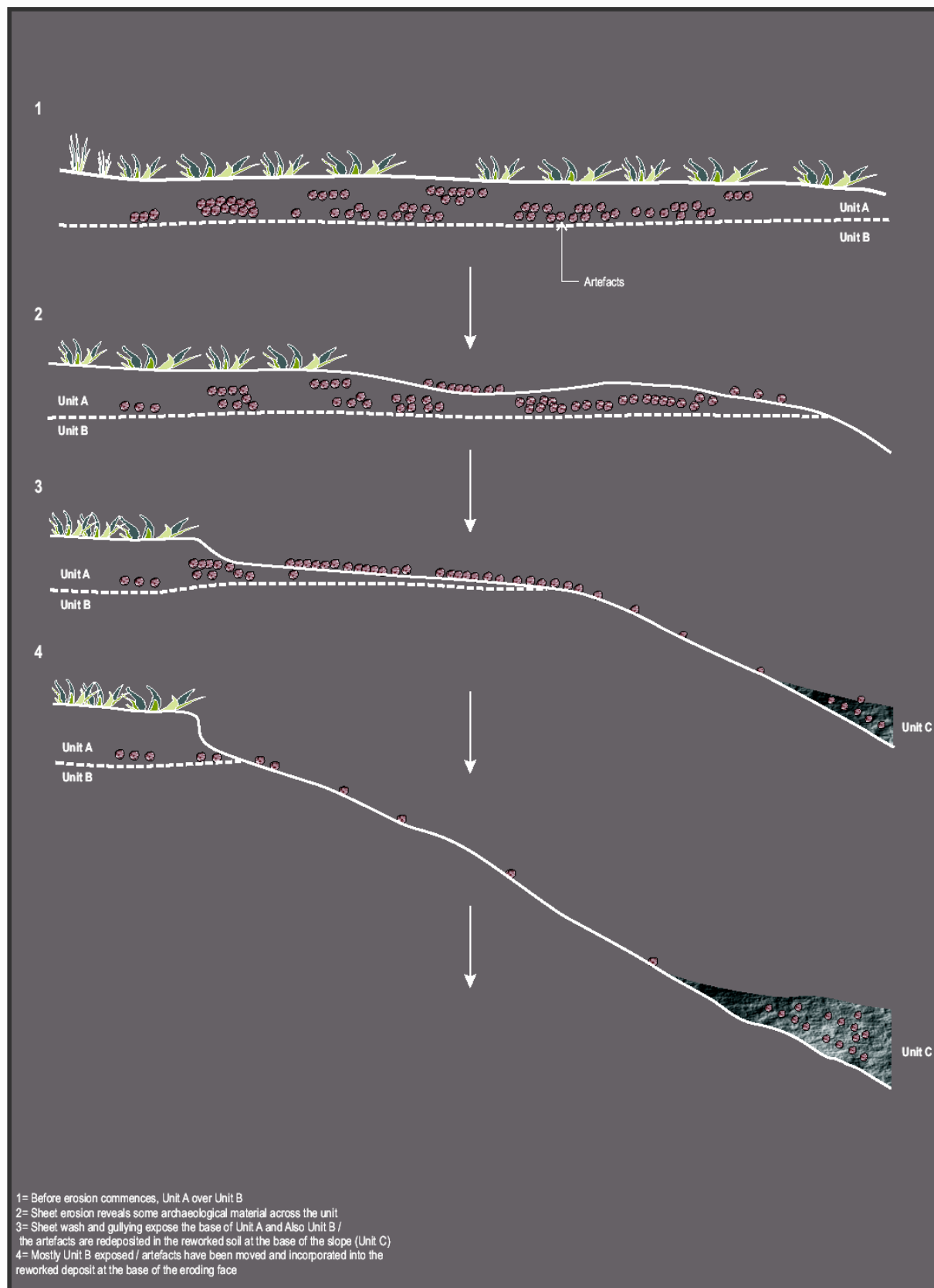


Figure 2
PROJECT SITE LAYOUT





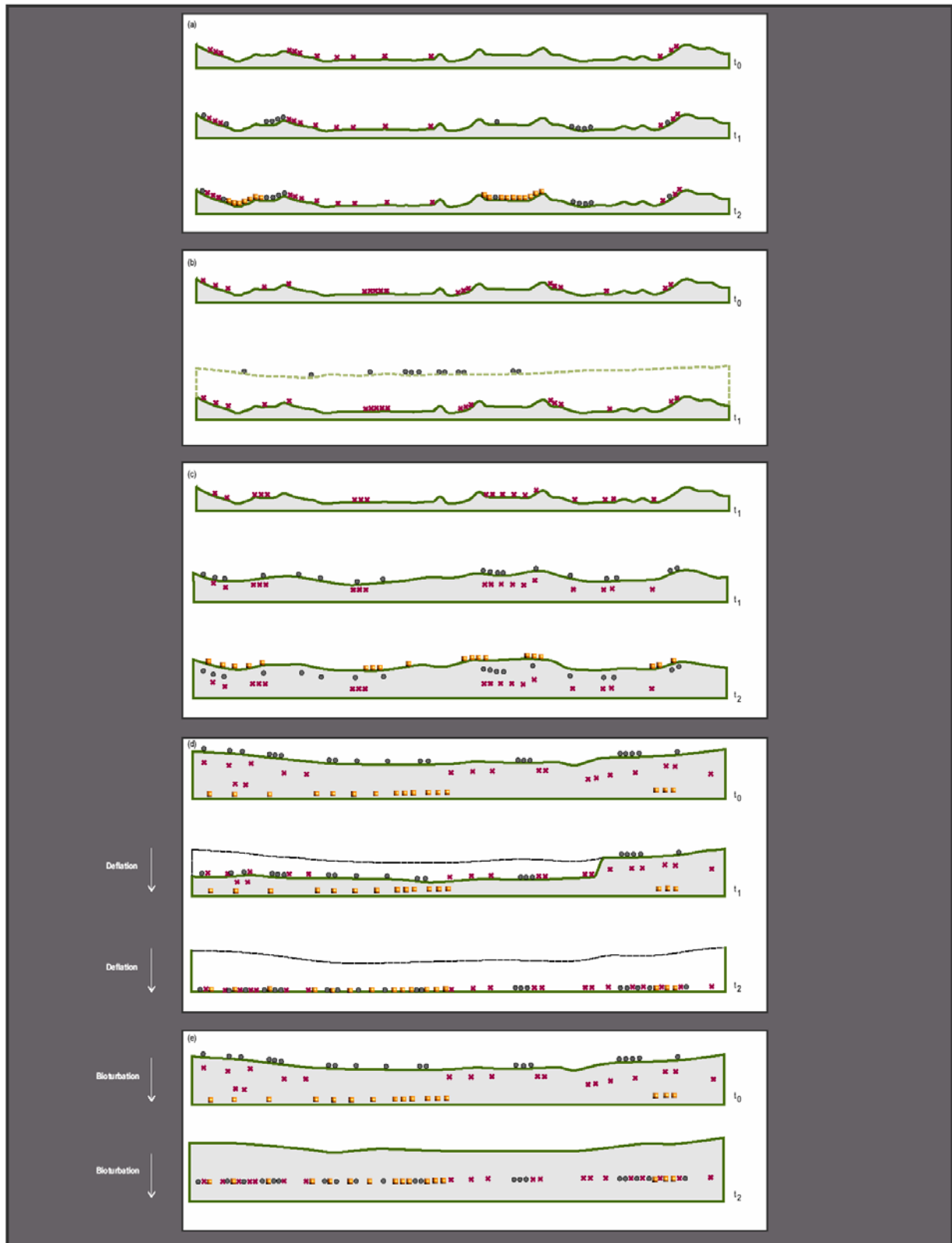




Koetigg's Model of Site Formation and Post - Depositional Processes
(Koetigg et al 1985)
R.W Corkery & Co Pty Ltd
Aboriginal Heritage Assessment: Proposed Open Cut Mine,
Glennies Creek Colliery
Hunter Valley NSW

FIGURE

6



Cumulative Effects of Artefact Discard and Site Formation
(After Foley, 1981b)
R.W Corkery & Co Pty Ltd
Aboriginal Heritage Assessment: Proposed Open Cut Mine,
Glennies Creek Colliery
Hunter Valley NSW

a Cumulative effect of simple artefact discard
b Cumulative effect of artefact discard on landscape suddenly buried
c Cumulative artefact discard on a gradually aggrading landscape
d Effect of gradual exposure on artefact distribution
e Effect of bioturbation on artefact distribution
t0, t1, t2 Increase in time
x First archaeological deposit
o Second archaeological deposit
□ Third archaeological deposit

FIGURE

7



**Modelled Distribution of Activities within Home Range (Left)
and Consequent Patterning of Artefacts (right) (after Foley, 1981a)**
R.W Corkery & Co Pty Ltd
Aboriginal Heritage Assessment: Proposed Open Cut Mine,
Glennies Creek Colliery
Hunter Valley NSW

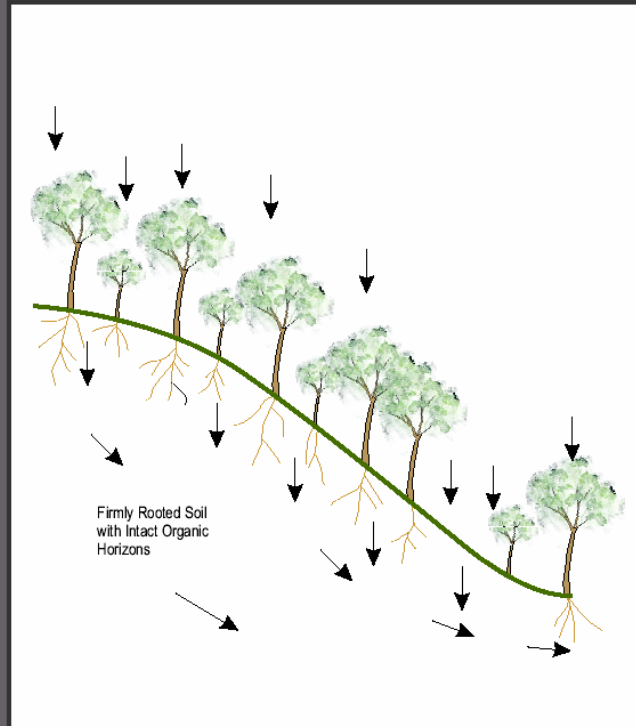
- Temporary camps
- Lithic source
- Animal migration
- Swamp

FIGURE

8

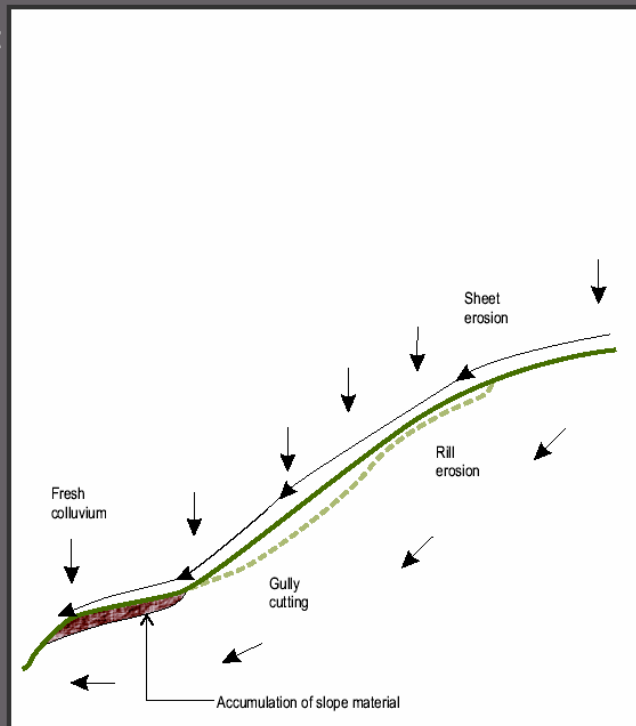
WOODED SLOPE

- Considerable interception
- Maximum infiltration
- Throughflow
- Retarded runoff and protracted seepage



OPEN FIELD/CLEARED SLOPE

- No interception
- Rapid, unimpeded runoff
- Limited infiltration

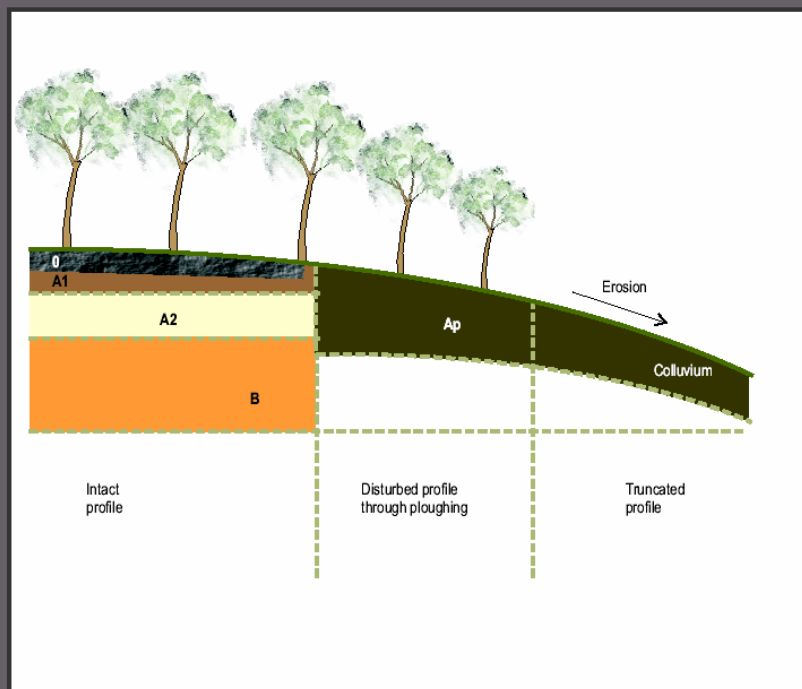


**Contrasting Run-Off and Infiltration
on Wooded Slopes and Cultivated Slopes (after Butzer, 1976)**
R.W Corkery & Co Pty Ltd
Aboriginal Heritage Assessment: Proposed Open Cut Mine,
Glennies Creek Colliery
Hunter Valley NSW

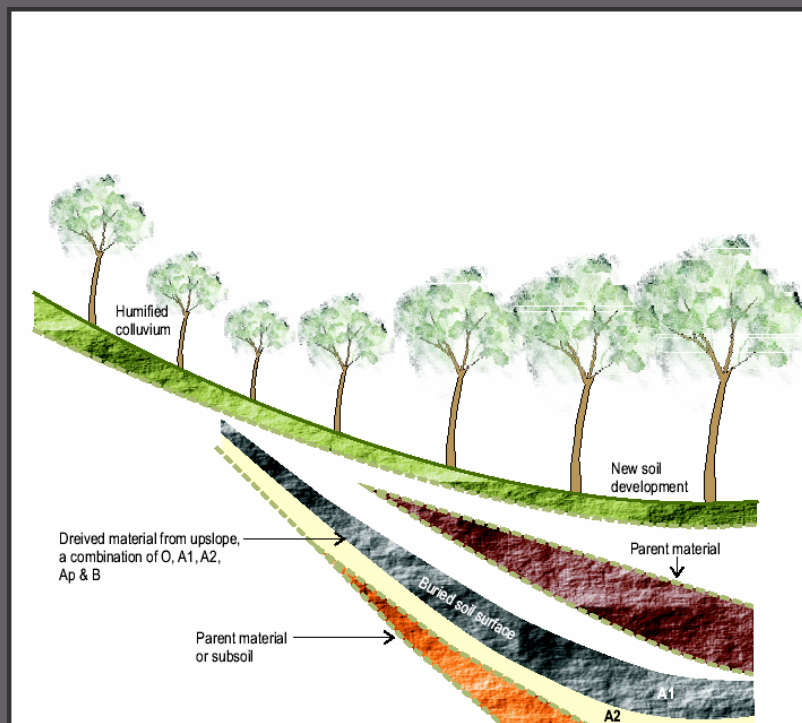
FIGURE

9

UPSLOPE



DOWNSLOPE



Upslope Soil Disturbance or Truncation,
and Downslope Colluvial Deposition of Soil (after Butzer, 1982)
R.W Corkery & Co Pty Ltd
Aboriginal Heritage Assessment: Proposed Open Cut Mine,
Glennies Creek Colliery
Hunter Valley NSW

FIGURE

10

Plates

(Note: All Plates are presented in colour on the Project CD)

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Plate 1 The current Camberwell North Pit looking northwest. This area is technically part of the study area, although for obvious reasons was not investigated



Plate 2 Photograph of all the Aboriginal representatives and HLA personnel who took part in the survey



Plate 3 The northwest corner of Possum Skin Dam looking south. Note the massive disturbance throughout the area. The section in the foreground, although disturbed reveals that geological B horizons and bedrock are reached not far from the surface – this is most notable to the right of the shot with the exposed sandstone beneath a pale B horizon beneath a dark man made layer



Plate 4 An example of a Soloth and Solodic soil, basically a texture contrast soil with an upper layer of sandy loam (dark layer partially undercut) with a clayey unit beneath (partially collapsed). The difference between Solodic and Solothic soils is largely to do with soil chemistry, specifically pH, not something undertaken as part of this survey



Plate 5 Example of forest regrowth from transect 3 looking south. Predominantly Casuarina type species, these trees are small and narrow, and hence being interpreted as relatively recent



Plate 6 Photograph of a typical transect towards the south end of the study area, this being transect 12. Note the wide distribution of the Aboriginal and HLA personnel in this area revealing how wide a transect can be



Plate 7 Photograph of a dam in transect 11, looking east. Similar to Plate 6, note the wide distribution of the Aboriginal and HLA personnel increasing the transect coverage considerably



Plate 8 Transect 1 looking south. This shot shows a typical transect with evidence of disturbance and variable land cover. The group of people to the right of the shot are surrounding GC1, while transect 6 and 7 are encompassing the left background of the photograph



Plate 9 Transect 3 looking south. The flag in the foreground indicates GC3. Note the disturbed ground covered by man made spoil heaps – these bumps occur across this entire ridgeline



Plate 10 Transect 3 looking west. Note the erosion gullies developed in the foreground revealing a profile of truncated B horizon (pale yellow clayey layer) with some colluvium (pale brown/grey sandy layer) above. Also note the hummocky landscape in the background, indicative of human disturbance



Plate 11 Soil profile near transect 3. Note the exposed sandstone bedrock (foreground) near the surface and the clearly **colluvially** derived brown sandy loam above (background). Plate 25 provides a similar comparison



Plate 12 Photograph of transect 5 looking east revealing some of the poorer surface coverage of the survey. Again note the forest regrowth in this area – no evidence of established woodland was found during the survey



Plate 13 Transect 6 looking south. Note the orange colour of the road indicating a truncated B horizon. Outside of the road, this truncated B horizon is still prevalent across much of the study area, albeit under thin layers of vegetation in many places



Plate 14 Typical landscape of the area to the north of the site structures. This is a photograph of transect 12 looking southeast. Note the poor exposure in these areas, however dams, tree stumps and ripped out trees, all revealed a picture of intense use and disturbance in these areas. The study are continues up over the hill to **the** right (transects 13 and 14) before reaching Possum Skin Dam just beyond



Plate 15 Transects 15 and 20 looking east. This photograph shows Possum Skin Dam and the immense amount of disturbance surrounding the dam, severely reducing the archaeological integrity of the areas in these locations



Plate 16 Transects 14, 16 and 17 were undertaken in this general area directly west of the dam. This photograph looking west **reveals** the heavy disturbance and impact that current mining has caused the general area



Plate 17 Transect 22 **looking** northwest. The southern area of the site has been completely re-mediated following the disuse of the Camberwell mine north extension in this general area. Note the grassed overburden replacement in the left background (considered part of the study area) and experimental re-mediation practised on its slopes (grey strip of land)

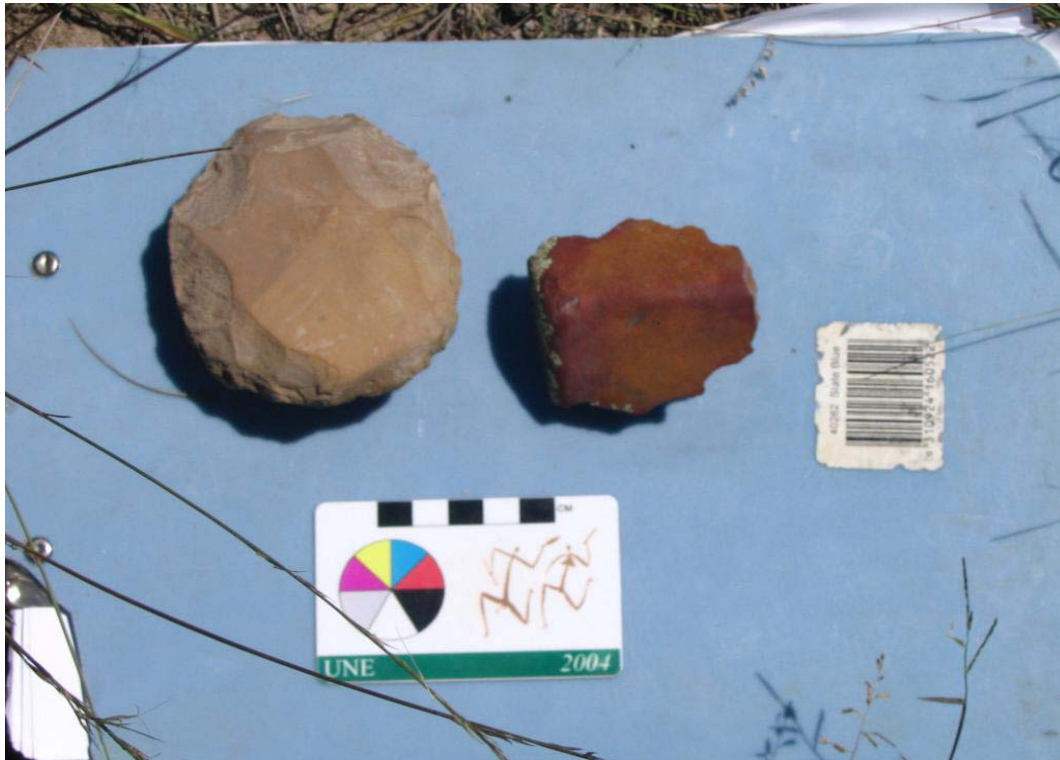


Plate 18 Artefacts identified at GC7. To the left is a bipolar pebble core tool, while to the right is a decoritification core tool



Plate 19 Transect 7 looking west. Note the sharp contrast between the yellow clay units beneath the pale grey sandy loam above. This upper layer is considered to be colluvium, which has truncated the subsoils beneath – the original A1 horizon having been eroded down the gully channels as shown here to areas of accumulation downslope. The upper layer is evident by its blocky ped structure and the easier erosion of the clayey materials beneath leaving an overhang type appearance in many locations



Plate 20 Detailed section of Plate 19. Note the difference in large rectangular ped structure of the upper brown colluvium truncating (sharp boundary) the yellow B horizon with small polyhedral peds, indicating a higher clay content. Also note the talus (or scree) at the base of the section revealing sub angular and angular stones washed out of the colluvium, typically these stones are only found in colluvial deposits in this area



Plate 21 Northern end of transect 3, looking south. The person in the foreground (Barry Anderson) is standing on bedrock. Behind him is a thick layer of colluvial material (seen in section) that is moving downslope as one entity, in the form of soil creep or mass movement (largely defined by the speed in which the colluvial moves – not possible to tell here). Note site GC 3 was located on the spoil heaps to the right of this photograph



Plate 22 Another example of colluvial material, the upper brown sandy loam unit with poor ped definition, truncating the B horizon, a pale yellow/orange clay with small polyhedral ped structures. The sharp boundary between the two reveals that this is most likely colluvially derived and can be identified as a Soloth or Solodic soil. Note the transversely snapped FGS flake in the foreground, probably relating to GC3 or 4



Plate 23 Transect 7 looking east. The pink flag in the foreground is GC9. Note the large exposures here of B horizon (an orange colour) with no evidence of an organic or A1 horizon above. This lack of vegetation or topsoil promotes large gully erosion that can be seen to the right of the photograph



Plate 24 Although taken in transect 7, this form of coverage and visibility is common across the study area. Note the orange colour and quasi pavement appearance (which relates to the ped structure) of the land surface beneath the grass, implying a truncated B horizon rather than an O or A1 horizon is the land surface in these locations



Plate 25 Similar to Plate 11, this photograph shows little evidence of in situ soil with colluvial, sandy loam deposits directly over the sandstone bedrock. Although in this location, the deteriorating sandstone stones in the centre of the photograph imply some form of BC horizon may exist in to some extent in this location



Plate 26 This photograph is taken from excavations undertaken elsewhere in the Hunter Valley by HLA and is used as an example. Note the thin horizontal layer of stones some 40 to 50cm from the top. It is commonly found that bioturbation moves stones in a sedimentary unit to the base of the level undergoing this type of activity, therefore here bioturbation is occurring to depths of about 40 or so cm, and all the stones in the upper 40cm are progressively moving down the sequence to the base of this bioturbation. Therefore, any artefacts on the surface or within the upper unit are likely to end up within this layer and technically out of situ

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