WAMBO DEVELOPMENT PROJECT

Appendix D

Aboriginal Heritage Assessment D

ENVIRONMENTAL IMPACT STATEMENT

WAMBO COAL PTY LIMITED

APPENDIX D

VOLUME 3

ResourceStrategies

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WAMBO DEVELOPMENT PROJECT

ABORIGINAL HERITAGE ASSESSMENT

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D1 INTRODUCTION

D1.1 BACKGROUND

This report describes an archaeological Aboriginal heritage assessment of the proposed Wambo Development Project (the Project), in the Hunter Valley of New South Wales (NSW). The existing Wambo open-cut and underground mines are located on the west side of Wollombi Brook, about 7 km south-west of the confluence of Wollombi Brook and the Hunter River (Figures D-1 and D-2). Wambo Mine are proposing to expand their existing operations, including an additional open-cut and underground mining areas. The location of these proposed workings are shown on Figure D-3. This study is part of an Environmental Impact Study being prepared by Resource Strategies Pty Ltd on behalf of Wambo Coal Pty Limited (WCPL). Approval to proceed with the proposal will be sought as an integrated development application.

The study area is relatively large, covering approximately 60 km^2. It is located on the eastern edge of high sandstone country and adjoins Wollemi National Park. From the escarpment above 300 m AHD it extends eastward, dropping down into several creek valleys and onto Wollombi Brook at less than 60 m AHD. The study area sits at the interface of the Southern Mountains and Central Lowlands and may also have been located at the interface of three or more groups of Aboriginal people.

The study area takes in a section of Wollombi Brook, parts of Wambo, Stony and North Wambo Creeks, Splitters Hollow, parts of Waterfall and Redbank Creeks, an unnamed creek, and parts of several other unnamed creeks and their tributaries. Elevation varies considerably across the study area. The confluences of Wambo and North Wambo Creeks with Wollombi Brook are less than 60 m AHD, while high ground rises to over 200 m AHD. This higher ground takes in the eastern end of Jerrys Plains Ridge, the lower eastern end of Wambo Ridge, and part of a ridge between Wambo Creek and Hayes Creek to the south.

A detailed description of the Project is provided in Section 2, Volume 1, of the Wambo Development Project Environmental Impact Statement (EIS). Here it can be noted that the study area incorporates several proposed impact areas as well as land away from proposed impact which would not be affected by the proposal. The proposed development areas are shown on Figure D-3 and include the:

- Continued development of open cut operations within the existing Wambo Coal Pty Limited (WCPL) Mining and Coal Leases and into the Mining Lease Application area to the north-west;
- Selective auger mining of the Whybrow, Redbank Creek, Wambo and Whynot Seams up to 200 m beyond the open cut limits within WCPL owned land;
- Temporary stockpiling of soil from stripping campaigns;
- Continued placement of overburden and coarse rejects within a combination of in-pit and out-of-pit emplacements;
- Placement of tailings within mined-out open cut voids and capping with overburden and coarse rejects;
- An extension to the existing Wollemi Underground Mine Box Cut (within the limits of the proposed open cut mining area) to provide direct access for three underground longwall panels in the Whybrow seam;
- Underground mining of the Whybrow, Wambo, Arrowfield and Bowfield seams;
- Upgrade of the existing coal handling and preparation plant (CHPP) to facilitate increased coal production;
- Development of a water control system including construction of a water control structure across North Wambo Creek to allow the passage of flows from the water control structure to the lower reaches of North Wambo Creek around the open cut development;
- Construction of a rail spur, rail loop and train loading system to enable the transport of product coal by rail to market;
- Re-alignment of Wallaby Scrub Road and Jerrys Plains Road intersection;
- De-gazettal and potential closure of Pinegrove Road;
- Development of new access roads and internal haul roads; and
- Relocation of the administration area and site offices.

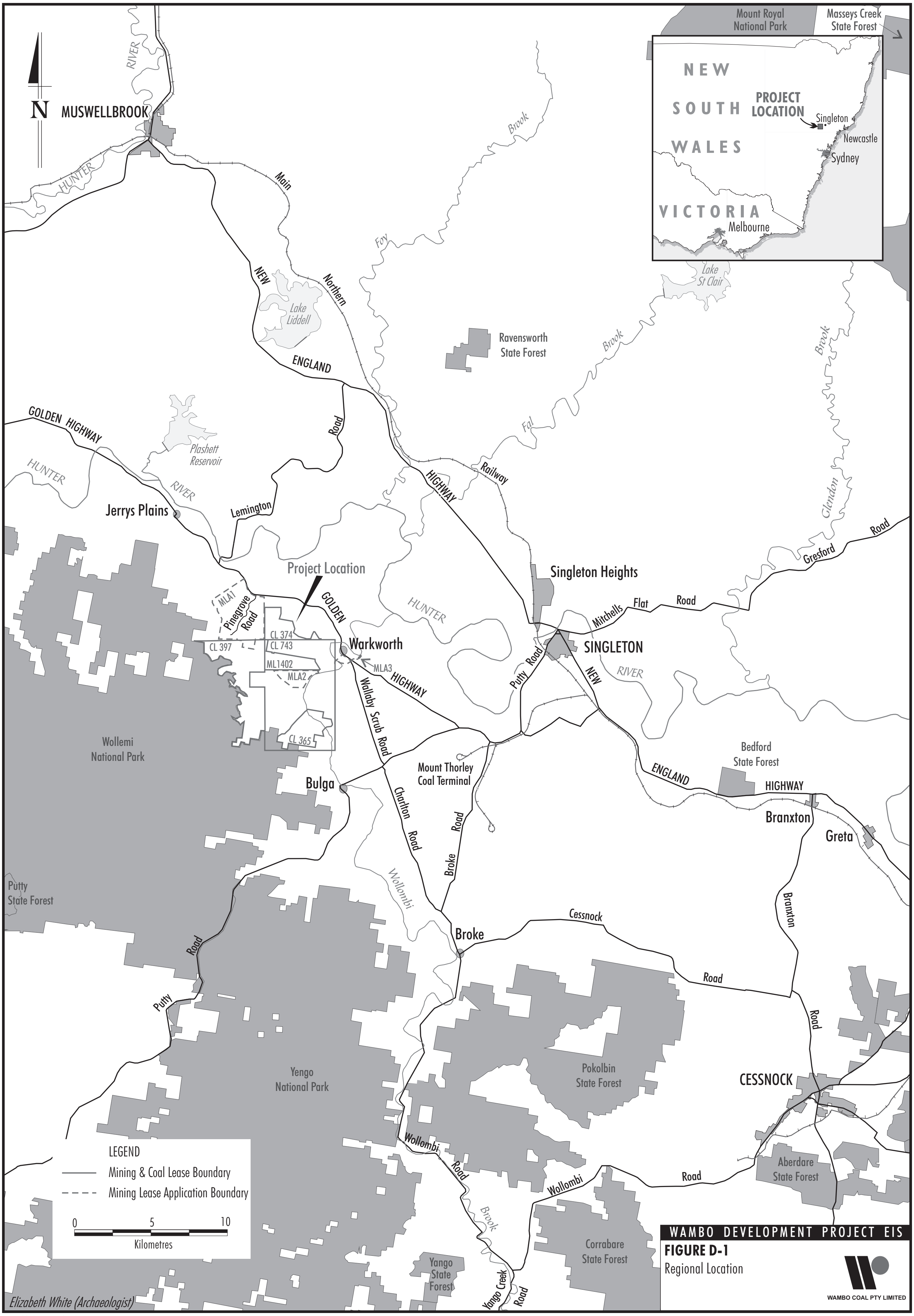

FIGURE D-1
Regional Location

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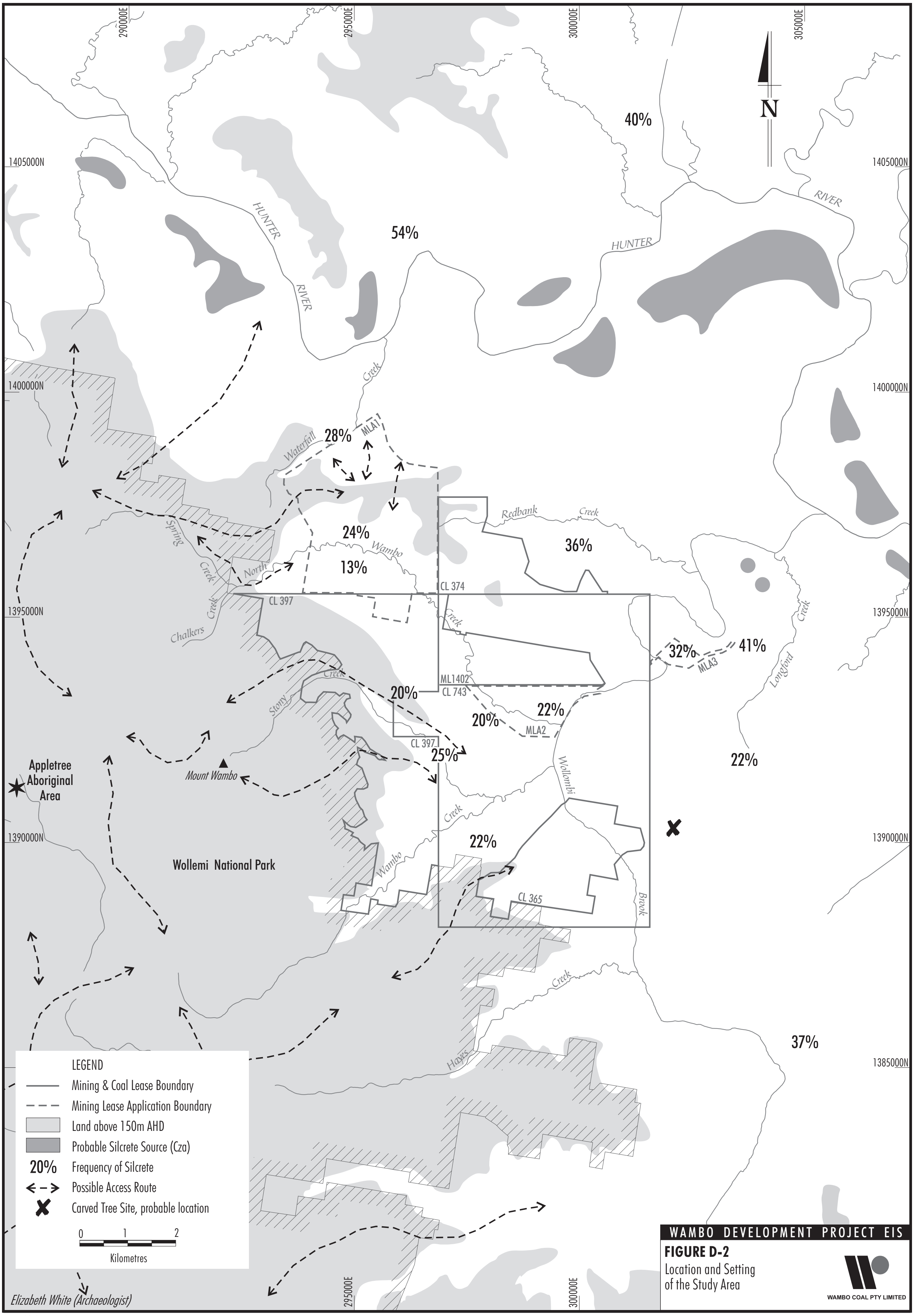

WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-2
Location and Setting of the Study Area

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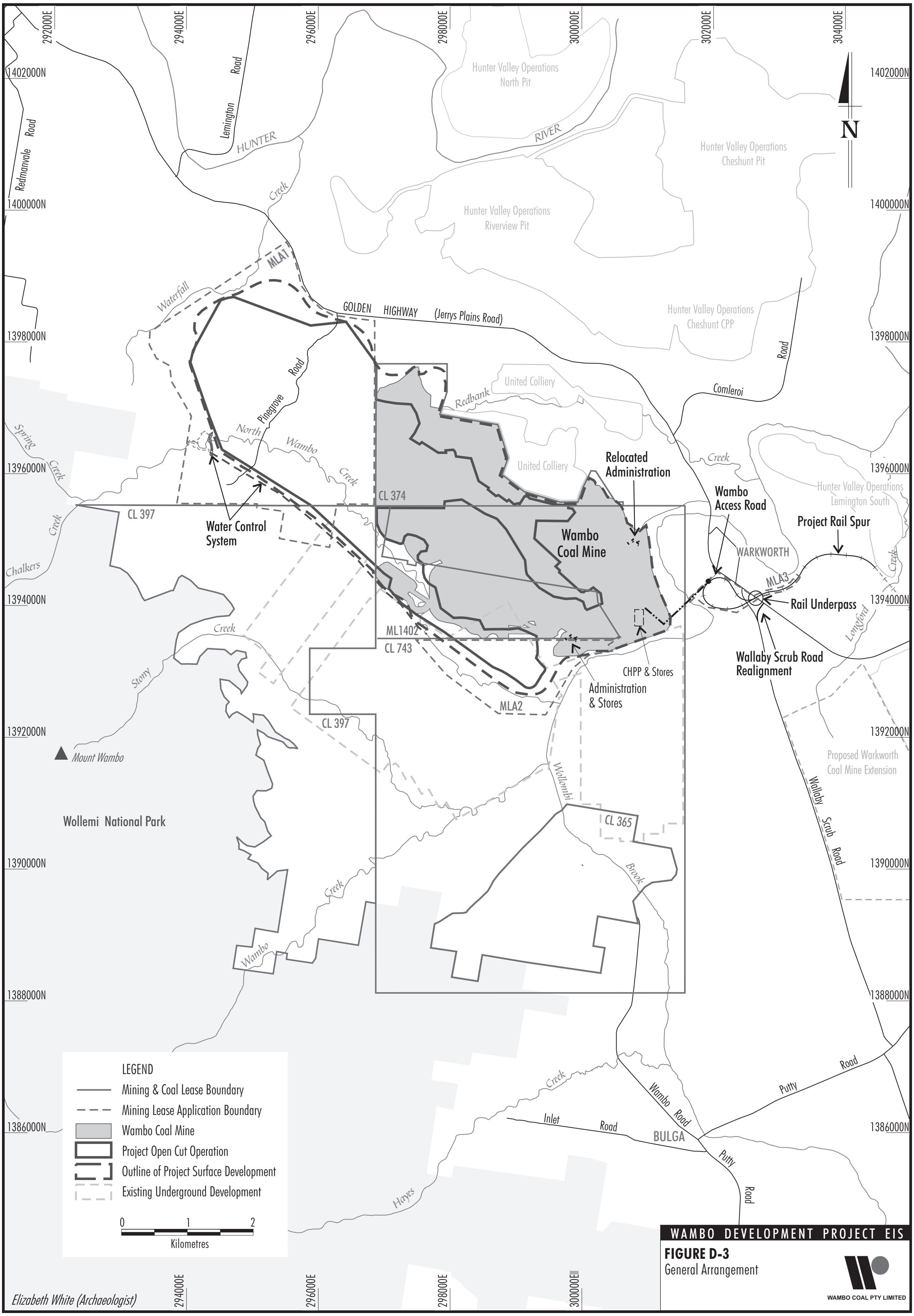

WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-3
General Arrangement

The proposed Project could affect Aboriginal heritage occurring within defined areas, being:

1. Extension of existing open-cut operations in the north-west part of the study area, to cover an irregularly shaped area approximately 4 km x 2.8-3.5 km, with a narrow area extending south east for about 2.6 km x 0.2-0.8 km. North Wambo Creek would be diverted around the area of these proposed operations. In this report this total area is referred to as the proposed surface impact area. This impact area takes in part of North Wambo Creek, Splitters Hollow and much of its catchment, an unnamed creek and all its catchment, a limited part of the upper catchment of Redbank Creek, and part of the catchment of Waterfall Creek. It also takes in the eastern extension of Jerrys Plains Ridge.

2. A proposed underground mining area located west of Wollombi Brook, and adjoining the south-east end of the proposed surface impact area. This is irregularly shaped and covers approximately 3.2 km x 2.1-3 km. In this report this proposed underground area is referred to as the middle underground area. This area takes in the lower reaches of North Wambo Creek, parts of the left hand bank of Wambo Creek, the lower reaches of Stony Creek and the lower part of Wambo Ridge between Stony and North Wambo Creeks. Underground mining has already occurred in this area.

3. A proposed underground mining area located about 300 m west of the middle underground mining area, and adjoining the proposed north-west surface impact area. This covers approximately 0.8 km x 2-2.2 km. In this report this proposed underground area is referred to as the western underground area. This area takes in part of Stony Creek, Wambo Ridge between Stony and North Wambo Creeks, and the slopes leading down from this towards North Wambo Creek.

4. A proposed underground mining area east of Wollombi Brook, which is irregularly shaped and covers approximately 3 km x 1.5 km. In this report this proposed underground area is referred to as the eastern underground area. This area takes in undulating land, often sandy, with few well defined landscape features.

5. A proposed rail spur, located just east of Wollombi Brook with a loop taking up 700 m x 300-500 m, and a line extending east-north-east for a distance of about 2 km. The surveyed route is located on a flat adjacent to Wollombi Brook then climbs over a low spur then down onto a low flat, touching onto the east bank of a deep meander of Wollombi Brook, then swings away from Wollombi Brook to undulating land above Longford Creek. A proposed alternative alignment has not been surveyed for this study. The intersection of Wallaby Scrub Road and Jerrys Plains Road (The Golden Highway) would also be moved to the east. This proposed realignment was not surveyed for this study but will need to be assessed.

The existing coal handling and preparation plant (CHPP) would be upgraded. The CHPP area has already been subject to surface developments.

Beyond the impact areas the study area also takes in extensive areas which would not be effected by the proposed Project, including slopes leading to the escarpment of the sandstone mountains west of the mine, parts of the lower slopes leading away from this escarpment, parts of Waterfall, North Wambo, and Wambo Creeks, and a section of Wollombi Brook. Approximately half the study area would not be impacted on by the Project.

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D1.2 STUDY OBJECTIVES

The primary objective of the study was to assess the impact which the Project would have on Aboriginal heritage. The study was carried out to meet requirements set out in the National Parks and Wildlife Service (NPWS) report writing guidelines (NPWS 1997a), guidelines pertaining to the mining industry (NPWS 1997b), guidelines relating to Integrated Development Applications (NPWS 2000), and the Director-General's requirements for the Project.

D1.3 STUDY PROGRAMME

Prior to the survey being conducted an extensive desktop analysis of the Project area was conducted. This information was compiled and used by the archaeological team to efficiently survey the Project area.

The survey programme used by the archaeological team for the study detailed:

- Land tenure and a day-by-day plan for surveying each property;
- Sites previously recorded in the area;
- Potential landscape features and raw material sources (water sources, soils and land use mapping and aerial photographs); and
- Details of previous archaeological studies and historical research.

Even though the survey was well planned, several constraints hindered the survey. Firstly, the size of the study area has meant that it has been physically impossible to examine all of it in the time available, so it has been necessary to survey samples of it. Secondly, access to some properties was limited by the requirements of land holders due to the threat of bushfires. Thirdly, practical constraints on the detection of archaeological Aboriginal heritage evidence have been caused by limited ground exposure and visibility (artefact scatters are usually found where the soil in which they occur has been exposed to view). Sites may be present in locations without ground exposure but remain buried and unfound. Fourthly, only limited historical and oral information on Aboriginal history and traditional use of the study area has so far come to light. Additional information may be found in the future which could influence the interpretation and assessment of the archaeology of the study area. Lastly, while most of the artefacts which were found during the present survey were recorded some artefact samples from some landscape settings are still too small for confident statistical analysis and this has hampered interpretation of the archaeology of the study area. This constraint applies particularly to analysis of the distribution of modified artefact types.

D1.4 SUMMARY OF RESULTS

A total of 292 sites have now been found in the study area or in proximity to the proposed rail line. Present on the eastern edge of the study area is the carved tree Site 2 (NPWS #37-6-56). While the trees have been destroyed since the site was recorded in 1918 the site is still of considerable value as a ceremonial area to the Aboriginal community and additional research has been carried out to locate the site more accurately (see Attachment D-1). Proposed underground mining has been withdrawn from the location where the site is thought to have been located.

Other site types occurring in the study area include grinding grooves (two sites and two other possible sites), a probable scarred tree, and two sites with glass artefacts (and two other sites may also include historical materials indicating they may be contact sites). Two locations have been identified as having potential for dateable geomorphic contexts, a red sand body on which Sites 30-31 have been found, and a yellow sand dune east of Wollombi Brook (see Attachment D-2). Proposed surface development has been drawn back to avoid these geomorphological sites.

The remaining sites are open artefact scatters and isolated finds. Open artefact scatters and isolated finds are defined for this study as being separate sites if artefacts are found more than 50 m apart, or if they occur on different landforms. Most of the artefact scatters are very small with 110 being isolated finds (finds of single artefacts). Another 69 sites consist of only 2-4 visible artefacts. Only 18 sites have more than 50 visible artefacts.

No burials have been reported in the study area. Burials are rarely found in the region. They may occur in sandy sediments which were easier to dig than the firm silts of most A horizon soils. Sandy soils occur east of Wollombi Brook but are fairly acidic with a pH of 5.9 (Resource Strategies 2003b) and skeletal remains are unlikely to have survived these conditions. Sandy alluvium occurs along the flat of North Wambo Creek and is more neutral with pH readings of 6.4 and 6.7 (Resource Strategies 2003b). However, the alluvium has been cultivated repeatedly and unless burials were very deep (if they were present at all) they are unlikely to have survived this disturbance.

Analysis of the recorded sites found that the biggest sites (those with more than 50 visible artefacts) occur below 125 m AHD and are preferentially associated with larger creeks (4th+ order streams) but not always so. Analysis of average surface artefact densities found that the most sensitive landscape settings (ie. those having the highest average artefact densities) are crests, simple slopes and waning lower slopes above 4^{th}+ order creeks, crests within 100 m of 2^{nd} order creeks, and simple slopes and waning lower slopes within 50 m of 2^{nd} order creeks. Creek flats are not particularly favoured locations in the study area, unlike other parts of the surrounding district. Based on the analysis of artefact distribution a total of 20 potential Aboriginal site locations (PADs) have been identified in areas at which Aboriginal sites have not been found either because of poor ground exposure or because those locations were subject to survey constraints.

Analysis of artefact assemblages found variation in the distribution of stone raw materials across the study area, particularly silcrete. Some variation in the use of silcrete could be related to stone rationing as people moved away from known silcrete sources near the Hunter River. Along the western part of North Wambo Creek, however, only 13% of recorded artefacts are of silcrete and this is the lowest frequency reported so far in the district (see Figure D-2). This low frequency of silcrete, at sites just 5-7 km from identified silcrete sources, cannot be explained as stone rationing due to great distance from sources. It appears that less silcrete was carried into the western end of the valley of North Wambo Creek. A social boundary or barrier may have existed.

Variation in the use of raw materials, especially silcrete, was also found within different parts of the study area, in relation to landscape variables such as stream order, distance from water and landform type. Silcrete is relatively more frequent amongst artefact assemblages from larger creeks, from sites close to water and (probably related to this) on flats, and waning lower slopes. Silcrete is also relatively more frequent at larger sites than smaller sites. Quartz and quartzite occur within the study area and, although generally little used, artefacts of these materials tend to be a little more frequent at sites associated with 1^{st} order creeks, and at sites more distant from water. These variations could be interpreted as variation in technological organisation across the landscape. The survey results indicate that silcrete was not often carried into hilly hinterland areas surrounding sites on bigger creeks.

In the southern part of the study area, along Wambo and Stony Creeks and along Wambo Ridge[1] these trends, particularly in the use of silcrete, did not occur. This part of the study area is most distant (8-10 km) from known silcrete sources yet silcrete makes up 23% of these assemblages (more than was found along the eastern end of North Wambo Creek (20%) which is closer to the silcrete sources). Further, the relative frequencies of silcrete artefacts in the southern part of the study area did not vary with stream order, and if anything, became more frequent at sites distant from water. In this southern area the relative frequencies of silcrete artefacts are also the same at sites, regardless of site size. In the southern part of the study area it seems that silcrete was carried equally across the landscape. It is possible that part of the reason for this is that Wambo Ridge and other ridges north and south of Wambo Creek could have been used as access routes by people travelling between the lowlands and the mountains. People could have carried silcrete with them on their trips, using it in a variety of landscape settings on the way.

Analysis of artefact size shows that sites in areas closest to the Hunter River and its stone sources tend to have larger artefacts than those further away; Site 13 at the eastern end of the rail spur and closest to the stone sources being an exception. Apart from Site 13, sites along Wambo and Stony Creeks and Wambo Ridge tend to have overall the smallest artefacts. This finding fits with the idea that stone in this part of the study area was transported the furthest distances.

Analysis of artefact types was constrained by limited sample sizes which is a particular problem when dealing with rare types such as grindstone, hammer-stones, axes and cobble tools. Summary analyses which have been conducted point to slightly increased discard of cobble tools at sites associated with 1^{st} order streams and at elevations above 95 m AHD. Backed artefacts are least frequent at sites associated with 1^{st} order streams and none have been found above 125 m AHD. Small tools (under 5 cm in size) are also least frequent above 125 m AHD. These variations also point to difference in the way stone technology was organised in relation to use of the landscape.

[1] That is, the ridge which separates Stony Creek from North Wambo Creek.

The results of the analyses can be interpreted in five ways:

1. General Use of the Landscape

Variation in site size and artefact density, raw material use and artefact types points to variation in the nature and/or repetition of artefact discard activities. Some of this variation could relate to the differing use of residential sites, use of meal-time sites and/or locations occupied by small numbers of people for over-night stays, resource processing sites and resource extraction (as generally proposed by Nightingale *et al*. 2002).

2. Change-over Time in Use of the Landscape

The survey data has revealed little dateable evidence, but more may be achieved by archaeological excavation (eg. which could provide statistically useful flake assemblages for detailed analysis - see Section D7.3). It is known that the study area was used in the historic period, as two sites (62 and 207) have flaked glass tools; and two others (Sites 17 and 31) have scatters of historic materials associated with stone artefacts and may also have been occupied in the historic period. The carved tree site (Site 2) was reportedly used in 1852. There is also a report that Aboriginal groups met in the historic period at the Greenhault house near Wollombi Brook. At this time, however, there is insufficient information to develop a land use strategy for the historic period.

It is also possible that the main phase of backed artefact production and use occurred during the Middle Bondaian phase, which dates to about 1,000 – 4,000 BP. While it is not possible to say that all backed artefacts were made in that period, it is probable that the majority were. Backed artefacts, and/or knapping floors on which this artefact type may have been produced, may relate to occupation within that phase.

Geomorphic contexts such as the red sand body on which Sites 30-31 are located, and the yellow sand dune east of Wollombi Brook (PAD D) might contain dateable materials.

3. Wambo Ridge as an Access Route

Wambo Ridge may have formed an access route from the lower valleys of Wambo, Stony and North Wambo Creeks and Wollombi Brook, into the higher sandstone country to the west of the study area. The eastern 2 km of Wambo Ridge, to c.220 m AHD, was walked (easily) during the present survey. At the western end of the surveyed section Site 89 was found in a saddle. This is the single largest site at higher altitude found during the survey. *Macrozamia* plants are abundant on the southern face of the ridge, with some plants growing on the site itself. The ridge was probably used as an access route, to foraging areas such as that presented by the *Macrozamia* plants and/or as a route into the sandstone mountains. Artefact density data and analysis of recorded stone artefacts (Section D9.5) support this theory. Other ridges south of Stony Creek might also have formed access routes but these were not able to be surveyed for the Project. Such access routes may have been important for people attending ceremonies such as that held at Site 2 (#37-6-56).

4. The Eastern End of Jerrys Plains Ridge

Jerrys Plains Ridge, like Wambo Ridge, leads into the sandstone mountains west of the study area. It forms the watershed between creeks flowing northwards into the Hunter River and creeks flowing southwards into North Wambo Creek. The eastern extension of this ridge falls within the proposed surface impact area. However, this section of the ridge is dissected and the highest parts are from 200 m to 230 m AHD, while the two lowest locations are at about 160 m AHD. To walk along this ridge involves several steep climbs[2]. The presence of a few scattered artefacts along the ridge top extension (very low average artefact density[3]) attests to Aboriginal use, but arguably to obtain local resources rather than use of this part of the ridge as a travel route. Jerrys Plains Ridge further west may well have been used for access into the mountains; but not this eastern extension.

The largest sites and highest density locations along the ridge extension are at the two low saddles or passes across this ridge. Several sites have been found on the north face of the pass between Splitters Hollow and Waterfall Creek which includes what is technically a waxing upper slope; the sites located here are 256 and 258-262. This area has a moderate artefact density, which is substantially higher than the artefact density along the ridge top itself. The second pass is a little further east and Pinegrove Road crosses through it. Sites 209-214 occur here. This pass is more narrow and the terrain leading to it is steeper.

[2] The top of the ridge was surveyed during the field survey.
[3] A total of 37 artefacts in 10,764 m^2 of coverage.

The artefact densities are very low which could be related to this area being less amenable, but also this location has been subject to long-term erosion, so some artefacts might have been washed away.

5. Low Frequency of Silcrete Along the Western Part of North Wambo Creek

The distribution of silcrete varies across the study area, most notably along the western end of North Wambo Creek where just 13% of recorded artefacts are of this raw material type. This relatively low frequency of silcrete is replicated at several medium and large sites, including Sites 168, 227 and 239, indicating that this is a general trend rather than a site-specific aberration.

Silcrete occurs naturally just 3-4 km north and north-west of the study area along the Hunter River and at Jerrys Plains. It could have easily been transported into the Waterfall Creek catchment where 28% of the artefacts are of this material. Access between Waterfall Creek and Splitters Hollow is through a pass discussed in point 4 above, and silcrete makes up 24% of the assemblage from Splitters Hollow. Splitters Hollow drains directly into the western section of North Wambo Creek yet Site 239, which is on a crest above the confluence, has just 12% silcrete artefacts. It might be suggested that the lower frequency of silcrete along the western end of North Wambo Creek simply represents declining use of the material with increasing distance from silcrete sources. However, other parts of the Wambo study area are further from silcrete sources yet they have higher frequencies of artefacts of that material.

Based on the available evidence it appears that some kind of “porous” social boundary existed in this part of the study area through which only limited amounts of silcrete was transported. One possible boundary is that of a local named group, as described in Section D6 of this report. If this is the case then the Comnaroy who occupied the Hunter River between the Goulburn River and Wollombi Brook, might have extended into the northern part of the Wambo study area. Other parts of the study area might have been within the territory of another group(s).

D1.5 IMPACT OF THE PROJECT

The Project has three main components which could affect Aboriginal sites: surface impact from proposed open cut mining and associated infrastructure, proposed underground mining (subsidence impact zones A, B1, B2 and C), and construction of a proposed rail line to transport the coal from the mine. These impact areas and recorded Aboriginal sites are shown on Figure D-4.

The proposed rail spur may affect three open sites, but the route has not been formally surveyed and it may be possible to avoid these sites. The surface impact would destroy 132 sites, all of which are open sites and one suspect grinding groove Site 159 (#37-5-31). Underground mining subsidence zone A includes 25 sites and a suspect grinding groove Site (#117). Underground mining subsidence zone B1 includes 48 sites, and subsidence zone B2 includes 13 sites. Underground mining subsidence zone C for which there is a risk of less than 10% subsidence impact on sites, has one recorded site (and see comments below). Nine sites overlie underground mining areas which are unlikely to have any subsidence impact, including the red sand body Sites 30-31 (31 being a possible contact period site), Site 32 which is the probable scarred tree, and other open sites. Another 61 sites have been recorded beyond underground mining areas, including the carved tree site and nearby open sites, and two grinding groove sites.

A more detailed discussion of the expected impact of the proposed Project on Aboriginal heritage is given in Section D11 of this report. Strategies for managing expected impact are also detailed in that section of the report and are summarised below.

D1.5.1 Managing Surface Impacts

The proposed surface developments, especially the proposed open cut mining, would disturb the land surface and all Aboriginal sites occurring on it. It would be necessary to apply for a s.90 Consent to Destroy in relation to sites which would be impacted by surface disturbance.

The impact of the proposed open cut mining could be off-set in part by setting aside an area with similar landscape features and setting and which arguably could have a similar archaeological record. The area immediately adjacent to the western side of the proposed surface impact area may be appropriate and would include the extensive Site 291 which occurs along Waterfall Creek.

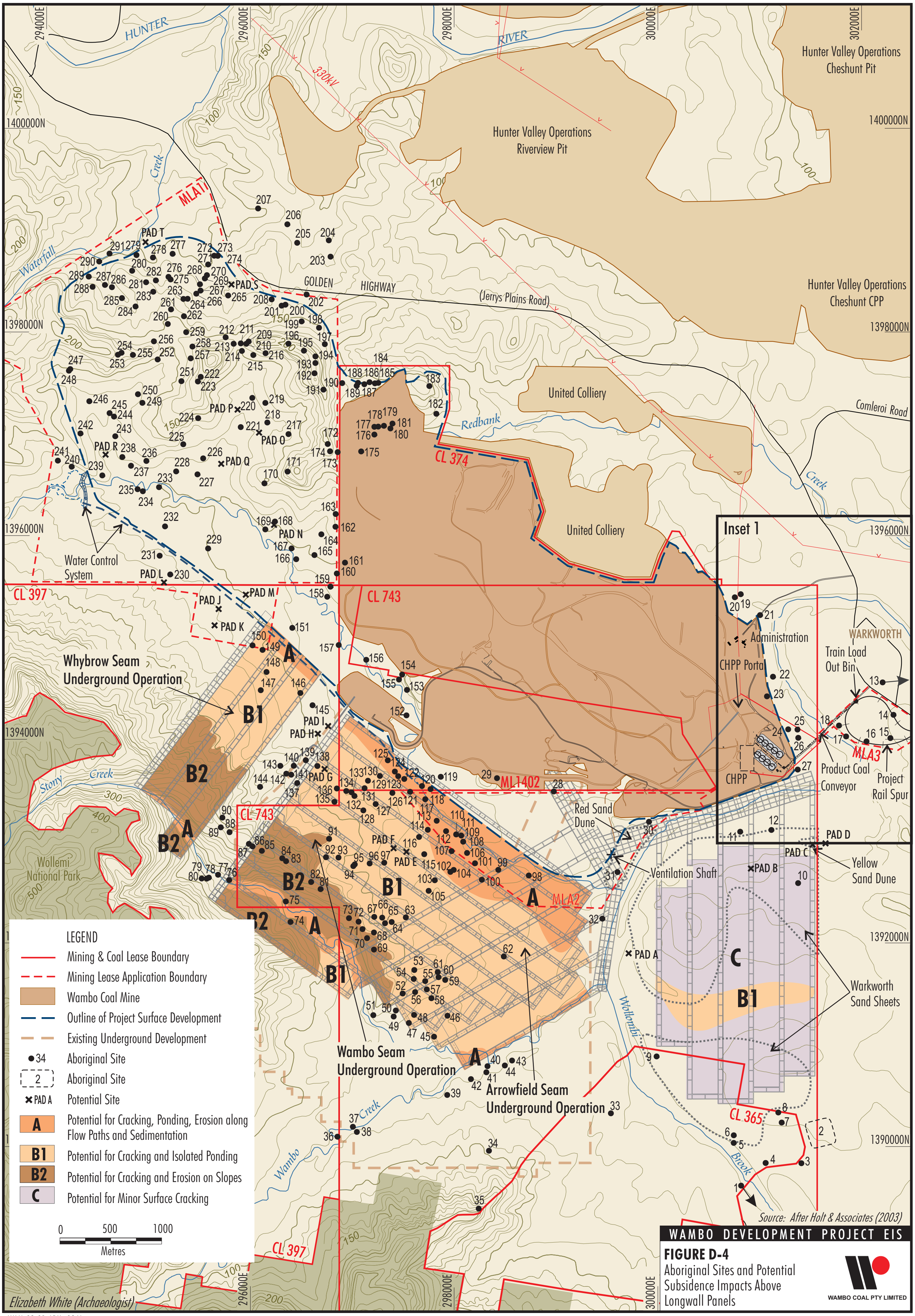

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FIGURE D-4
Aboriginal Sites and Potential Subsidence Impacts Above Longwall Panels

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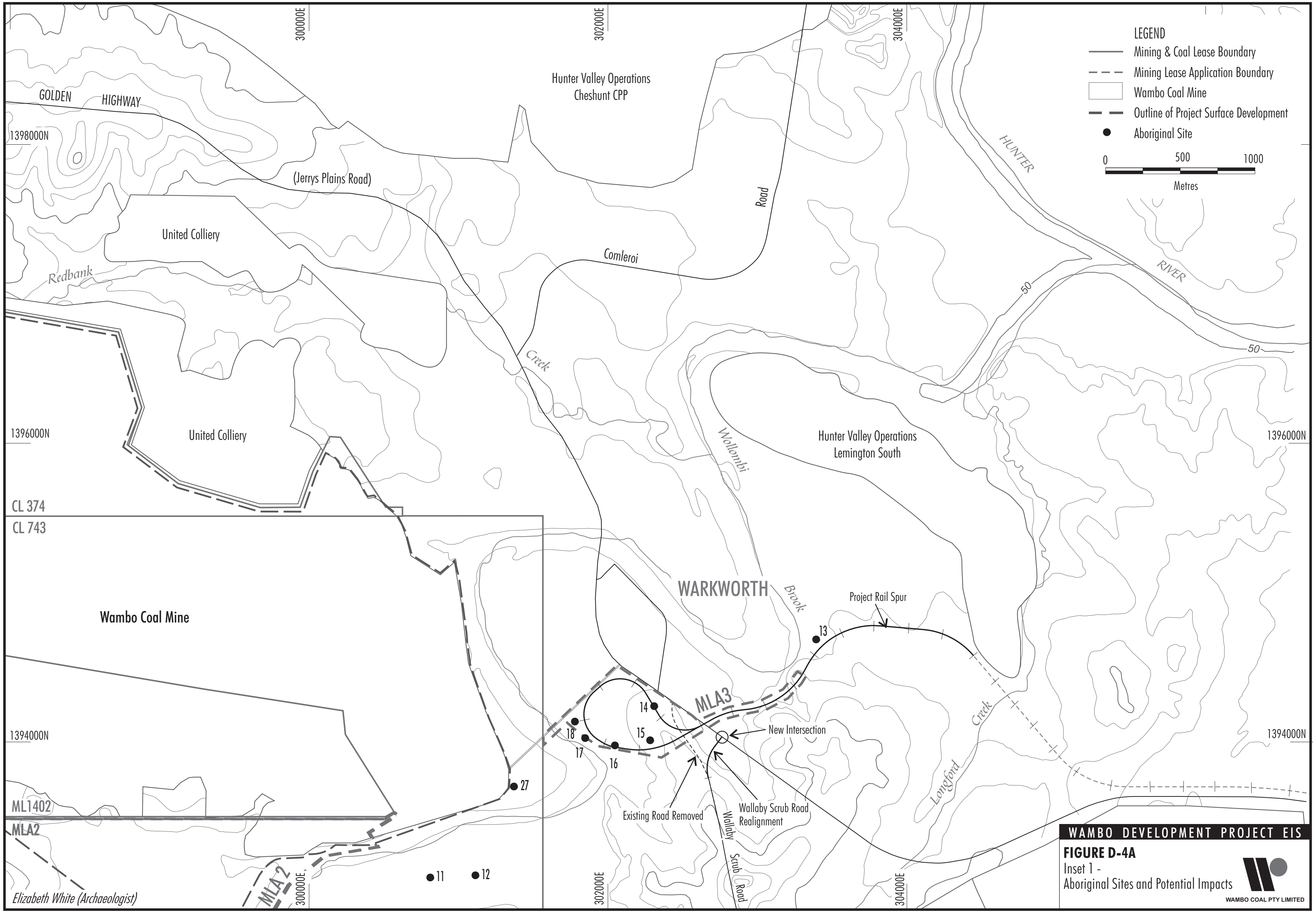

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FIGURE D-4A

Inset 1 -
Aboriginal Sites and Potential Impacts

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Some sites of archaeological significance occur within the proposed surface impact area and these sites cannot be avoided without jeopardizing the viability of the Project. It is proposed to carry out archaeological collections and excavations at Sites 154, 168 / PAD N, 239, PAD R, 247-248, 258-259, 263, 268, 286-287 to address issues relating to the use of different raw material types and the use of sites in different landscape settings. In addition, it is proposed that a representative sample of artefacts from other sites within the surface impact area should be collected, and recorded in more detail than was possible during the surface survey.

It has been possible to avoid some sites by modifying the design of the proposed development. With regard to the significant Sites 30-31 it is possible to route a proposed haul road to the west of the red sand body on which they occur. The proposed water control channel has been shifted north of Sites 122-125 and 231. Significant Site 291 and Waterfall Creek along which it occurs can be conserved around the north-west edge of the proposed impact area.

D1.5.2 Managing Subsidence Impacts

The underground mining areas have been zoned according to the effects which might occur to the ground surface (Figure D-4). It is considered that there is a risk of more than 10% that surface impacts on sites could occur in Zones A, B1 and B2. Zone A has the greatest risk for cracking, ponding, erosion and sedimentation. Zone B1 has some risk for cracking and isolated ponding, and Zone B2 has some risk for cracking and erosion on slopes. Zone C is considered to have less than 10% risk of surface impacts on sites. The National Parks and Wildlife Service (NPWS) has advised that where there is more than 10% risk of damage to sites occurring that proponents should apply for a s.90 Consent to Destroy. However, it is by no means certain that damage to the ground surface due to subsidence will or will not occur; and if the ground surface is damaged, it is not certain that Aboriginal sites would be damaged. It is possible that many of the sites within the areas proposed for underground mining will not suffer any adverse effects from subsidence.

A strategy for managing subsidence impacts on Aboriginal sites has been developed to deal with the uncertainties (refer to Section D11). This strategy will be formalised in the development of the Aboriginal Cultural Heritage Management Plan. The strategy has, as its basis, the idea that sites ought to be retained in their landscape setting as much as possible. Sites should only be subject to collection or excavation if it is certain that they would otherwise be lost. In the case of underground mining it is not certain exactly where subsidence damage will occur and the magnitude of the damage may be, so collecting or excavating sites before underground mining has occurred could itself damage sites which might not otherwise be affected. If any collection or excavation of artefacts or sites was to be carried out, their removal from their landscape setting should be seen as a temporary measure and materials should be returned to their original locations as much as is practical. With the aid of GPS technology, photography and site mapping it should be possible to return collected artefacts to their approximate locations. As discussed with Aboriginal Groups during consultation, the main components of the Aboriginal Cultural Heritage Management Plan are:

1. Apply for a s.90 Consent to Destroy to cover Zones A, B1 and B2, to meet legal requirements. This heritage impact permit should be issued to cover the life of the underground mining, so that ongoing site management and remedial works could be carried out as necessary.

2. Re-record sites in Zone A which were last recorded in 1990, to provide an up-to-date record of them, including GPS co-ordinates, photography, mapping and technological recording of artefacts.

3. Sites in Zones A, B1 and B2, and these areas in general, should be monitored for ground disturbance related to subsidence (eg. changing surface contours, ponding, cracking, erosion). Monitoring stations should be set up in areas which were not surveyed during the survey, in Zones A and B2 in the proposed western underground mining area and in Zone B1 in the proposed eastern underground mining area. If any ground surface damage occurs it should be assessed for its possible damage to Aboriginal sites (whether sites are known or not), with a view to either doing nothing, or carrying out further investigations, which may include temporarily retrieving artefacts and then replacing them again.

4. If subsidence or proposed mitigation works are likely to lead to damage to Aboriginal sites then it may be appropriate to temporarily collect artefacts (collect artefacts visible on the ground surface and/or conduct archaeological excavation), store the artefacts in a temporary “Keeping Place”, carry out remediation works, then return artefacts. The collection and return of artefacts should be supervised by an archaeologist. The process of temporary artefact collection, recording and return would need to be carefully documented so that in the long-term it would be possible to determine which artefacts and sites had been disturbed by these activities and which ones had not.

D1.5.3 Managing Land Use Generally

A number of sites occur outside the Project area. It is possible that other activities could cause ongoing damage to sites which might not otherwise be affected by the Project. Examples of this include cattle and trampling of artefacts and features on eroded areas, use and maintenance of existing infrastructure such as transmission lines, access roads or fire breaks. In some cases Aboriginal sites have been recorded in such areas and could be affected by ongoing activities. It is reasonable to expect that such activities, which are existing activities approved under development control processes, should be allowed to continue. They could however, have unwitting effects on Aboriginal sites. An Aboriginal Cultural Heritage Management Plan should be developed to allow ongoing use of existing facilities which could include collection of visible artefacts and their temporary storage at an onsite “Keeping Place”. The following sites may be relevant: 81, 91, 92, 118, 126, 127, 128 and 147-150.

Artefacts also occur along the road which runs parallel to North Wambo Creek, from Site 100 to Site 124. This area is archaeologically sensitive and consideration should be given to finding an alternative route for this road. The road which runs across the red sand body through Sites 30 and 31 should also be relocated, possibly to the west around the edge of the proposed surface impact area.

Cattle may also cause damage to open sites, particularly by trampling artefacts and features on existing erosion areas, or by eating vegetation which in turn could lead to soil erosion. Thought should be given to removing cattle from the proposed western and middle underground mining areas.

Some sites occur beyond the proposed development areas, on land in areas under private ownership, such as Sites 1-8 and 33-44. It is anticipated the existing land use practices and activities would be allowed to continue in relation to these sites. But any change in land use or activities should be assessed for their possible impacts on the sites and their landscape settings.

Carved tree Site 2 is of special significance to Aboriginal people. The site appears to be located land currently owned and controlled by Coal and Allied Operations (Warkworth Mine). Wambo Mine’s proposed development has been modified to ensure the location is not effected by the proposed eastern underground mining. The area of land adjacent to the site and which is owned by Wambo Mine will be fenced off and managed in a manner sympathetic to the Aboriginal values of the area. Sites 3-8, which are located between Site 2 and Wollombi Brook, are on land owned by a private land holder.

D1.5.4 Managing Retrieved Aboriginal Objects

Retrieved artefacts and other materials could be documented and stored at an onsite “Keeping Place”. Such a “Keeping Place” could be physically secure with the relevant Aboriginal groups having custody of keys and a sign-in/sign-out procedure. Materials collected temporarily during the management of subsidence impacts could therefore be readily accessible for return to sites on the completion of mitigation works.

It has been suggested that artefacts recovered during surface collection and/or excavations from the proposed surface impact area could also be relocated onto rehabilitated land surfaces, based on GPS positions. It must be realised, however, that the original landscape context of these artefacts (creeks, landforms and so on) will not exist any more. The utility of returning such items to ‘false’ landscape settings may need to be considered. In the interim, an on-site ”Keeping Place” would provide a local alternative to deposition in the Australian Museum in Sydney and allow Aboriginal groups to gain access to their actual heritage.

D1.6 RECOMMENDATIONS

The following recommendations are based on the information obtained during the survey and from previous archaeological studies in the area. It is recommended that Wambo Coal Pty Limited (WCPL) should:

1. Set aside an area to 'off-set' the loss of Aboriginal sites resulting from the proposed expansion of the open cut mine. The area immediately west of the proposed surface impact area may be appropriate as the landscape and its setting is similar to that within the proposed open-cut mining area.

2. Carry out an archaeological survey along the routes of the proposed rail line and Wallaby Scrub Road diversion once these have been formally surveyed. Any sites or potential site locations should be assessed. If it is not possible to avoid sites of heritage interest then it may be appropriate to conduct salvage investigations. Sites which are close to the proposed routes should be temporarily fenced to avoid accidental damage.

3. Apply for a s.90 Consent to Destroy in relation to Aboriginal sites within the proposed surface impact area. This Consent should be sought to cover the life of the mining operations in this area.

4. Provide for the excavation, analysis and reporting of Sites 154, 168/PAD N, 239, PAD R, 247-248, 258-259, 263, 268, 286-287, and collection of a representative sample artefact from other sites within the proposed surface impact area.

5. Apply for a s.90 Consent to Destroy in relation to Aboriginal sites within the proposed underground mining subsidence Zones A, B1 and B2. This Consent should be sought to cover the life of the underground mining, so that ongoing site management and remedial works could be carried out as necessary.

6. Provide for re-recording of sites in Zone A prior to underground mining to provide an up-to-date record of the sites.

7. Provide for monitoring of selected sites and areas in Zones A, B1 and B2, to assess ground disturbance related to subsidence (eg. changing surface contours, ponding, cracking, erosion). If any damage to the ground occurs it should be assessed for its possible damage to Aboriginal sites (whether sites are known or not), with a view to either doing nothing, or carrying out further investigations, which may include temporarily retrieving artefacts and then replacing them again.

8. Ensure that the process of temporary artefact collection, recording and return would be carefully documented so that in the future it would be possible to determine which artefacts and sites had been disturbed by these activities and which ones had not.

9. Ensure that subsidence mitigation works are carried out in a manner sensitive to the nature of the Aboriginal sites and their landscape settings, without causing undue damage to sites.

10. Consider setting up a secure 'Keeping Place' for Aboriginal artefacts and other materials recovered from the study area.

11. Consider the feasibility of an alternative route to the existing road which runs parallel to North Wambo Creek and through the area in which Sites 100-124 occur.

12. Consider closing the vehicle track along Wambo Ridge on which Sites 82 – 89 occur.

13. Consider closing the road which runs across the red sand body through Sites 30 and 31; an alternative route around the western edge of the sand body may be possible.

14. Consider removing stock from the vicinity of Sites 98-125 near North Wambo Creek.

15. Prepare an Aboriginal Cultural Heritage Management Plan which sets out how these recommendations or other management strategies would be implemented.

D2 LEGISLATIVE REQUIREMENTS

D2.1 THE NATIONAL PARKS AND WILDLIFE ACT

The *National Parks and Wildlife Act, 1974* (NPW Act) (as amended) is the primary legislation dealing with Aboriginal heritage in NSW. There have recently been some amendments to the NPW Act some of which are yet to be enacted.

The Director-General of the National Parks and Wildlife Service (NPWS) is the authority responsible for the protection of Aboriginal objects and Aboriginal places (s.85).

The term 'relic' has been replaced by 'Aboriginal object' (s.5). An 'Aboriginal object' means any deposit, object or material evidence (not being a handicraft made for sale) relating to the 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. Aboriginal objects are the property of the Crown (s.83). Objects which have been collected are to go to the Australian Museum for custody or control (s.88), although possession, custody or control may be transferred to Aboriginal owners or other persons (s.85A). Under s.91 a person who is aware of the location of an Aboriginal object must notify the Director-General of its location within a reasonable time (unless the person believes that the Director-General is aware of the location of the object).

'Aboriginal remains' are included in the definition of 'Aboriginal objects' but they do not include the body or remains of Aboriginal persons buried in a cemetery in which non-Aboriginal people are buried, or a body or remains to be dealt with under other State laws (s.5).

Aboriginal places are those which are or were of special significance with respect to Aboriginal culture. Places may be declared to be 'Aboriginal places' by the Minister by order published in the *Gazette* (s.84). It is my understanding that Aboriginal objects may not necessarily be present at Aboriginal places, but that a place's importance would need to be established before the Minister would make an order in the Gazette.

Areas of land may also be reserved as Aboriginal Areas and as Protected Archaeological Areas. Where these are not located on unoccupied Crown land the consent of the land owners is required. Aboriginal Areas reserve land "to identify, protect and conserve areas associated with a person, event or historical theme, or containing a building, place, object, feature or landscape (a) of natural or cultural significance to Aboriginal people, or (b) of importance in improving public understanding of Aboriginal culture and its development and transitions" (s.30). Additional provisions in the NPW Act deal with the reservation and management of Aboriginal Areas. Protected Archaeological Areas may be declared for land on which an Aboriginal object or Aboriginal Place is situated (ss.65-66).

Under s.86 it is an offence for any person to disturb or excavate land to discover Aboriginal objects, or to move or take Aboriginal objects occurring in National Parks or other reserved land, except in accordance with a permit issued under s.87. That is, archaeologists or Aboriginal people wishing to find buried objects, must first obtain a permit to carry out excavations.

Section 90 deals with the destruction of Aboriginal objects and places. Under s.90(1) a person must not destroy, deface, or damage, or cause or permit the destruction, defacement of or damage to, an Aboriginal object or Aboriginal place.

> It should be noted that changes to the NPW Act (Schedule 3, 2001) which could be enacted in the near future add an offence of "desecration" to s.90(1). The changes also provide for a defence of 'reasonable precaution' and 'due diligence'. Under ss.90(1B) and 90.(1C) it would be a defence if it could be shown that
> (a) a person 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 place.

Under s.90(2) the Director-General may issue Consent to damage, deface or destroy an Aboriginal object. If a person is refused a consent, or is dissatisfied with any conditions or restrictions attached to the consent, they may appeal to the Minister, whose decision is final and binding (s.90(4-5)).

Stop work orders may be made under s.91AA. These may be issued where the Director-General considers that any action is being or is about to be carried out the is likely to significantly affect Aboriginal objects or Aboriginal places. Orders may direct that actions are to cease for a period of 40 days (s.91AA(1)). There are various exception, such as actions authorised under the *State Emergency and Rescue Management Act 1989*, the *Rural Fires Act 1997* and others. Also excepted under s.91AA(4) is anything essential for carrying out development in accordance with a development consent within the meaning of the Environmental Planning and Assessment Act 1979 or an activity under Part V of that Act where the Act has been complied with. Further provisions relating to stop work orders are set out in sections 91BB-91FF.

Interim Protection Orders may be made under ss.91A-H. These are made by the Minister (s.91B) and may be applied to land which has natural, scientific or cultural significance (s.91A(a)). They may be in force for up to 2 years (s.91D(1)). Appeals against Interim Protection Orders may be made in the Land and Environment Court (s.91H). Other provisions in sections 91A-H also relate to Interim Protection Orders.

Conservation agreements may be made in relation to areas in which Aboriginal objects or Aboriginal places of special significance are situated (s.69C(1d)). They may be made between the Minister and land owners and tenants, with their agreement (s.69B(3)). Conservation agreements may contain terms relating to use of the area and activities which may be carried out and money to be paid (s.69C(2)), and requiring the Minister to provide financial or technical assistance or to carry out specified activities (s.69C(3). Conservation agreements run with land title (s.69E). Various other provisions in the NPW Act also relate to conservation agreements (ss.69A-69K).

D2.2 OTHER LEGISLATION

The *Aboriginal and Torres Strait Islanders Heritage Protection Act* 1984, as amended, is a Commonwealth Act and may override state provisions. It provides for protection of areas and objects of significance to Aboriginal and Torres Strait Islanders, when protection is not available at State level (Pearson and Sullivan 1995:52-53). The Act must be invoked by or on behalf of Aboriginal people (s.9). It enables immediate action for protection of threatened areas and objects by a declaration from the Commonwealth Minister or authorised officers. Emergency and longer term or permanent declarations may be made (ss.9-10). In most cases where disputes arise it has not been necessary to formally invoke the Act, since the possibility of government intervention has facilitated negotiated settlements (Pearson and Sullivan 1995:54-55).

The *Australian Heritage Commission Act* 1975, is also a Commonwealth Act which establishes the Register of the National Estate. Places listed on the Register of the National Estate are protected only in relation to actions proposed by the Australian Government. There are no direct legal constraints on private landowners or on state or local governments. However, listing confers prestige to places, and this may induce proper consideration of heritage values (Pearson and Sullivan 1995:48-49).

D3 PARTNERSHIP WITH ABORIGINAL COMMUNITIES

The NSW National Parks and Wildlife Service (NPWS) has adopted the following heritage management principles (NPWS 1997a:8-10):

- NPWS recognises that Aboriginal culture is living and unique and recognises the right of Aboriginal people to protect, preserve and promote their culture.
- NPWS recognises that Aboriginal people are the rightful cultural owners of Aboriginal cultural heritage information and Aboriginal sites and objects.
- NPWS encourages Aboriginal participation in assessment and salvage work, and supports direct negotiation between Aboriginal communities and developers.
- NPWS encourages Aboriginal communities to carry out their own assessments, including oral history and anthropology. The relevant community or communities are to be the primary determinants of the social significance of their cultural heritage.

With regard to Aboriginal heritage assessments in the mining industry, NPWS (1997b:4) has also stated

> Appropriate Aboriginal people will be involved in all phases of the exploration and mining assessment process, as appropriate. Their cultural knowledge, values and concerns will be fully considered and reported in the assessment process and recommendations.

In 2001 NPWS released its *Cultural Heritage Community Consultation Policy*. This policy includes:

- Recognition that within the Aboriginal community that organisations including, but not limited to, Native Title Claimants and Holders, Elder Corporations and Aboriginal Land Councils may have members who have information concerning the issue/item of the consultation.
- Identification of cultural heritage values within the landscape must include consultation with the community about their associations with the whole landscape as well as with particular items.

For the present Project the Director-General required that:

- Aboriginal community consultation was to be undertaken with all Aboriginal groups in the Hunter region (a list of which was attached) and that reporting was to be in accordance with the IDA Guidelines.
- The results of the survey and test excavations (if any) were to be incorporated with the outcomes of the Aboriginal community consultation to produce an integrated management strategy for Aboriginal heritage.

The IDA Guidelines (NPWS 2000) provide information on how Aboriginal heritage assessments can be conducted, and calls for preparation of an Aboriginal Cultural Heritage Assessment report. Such a report is being prepared for this Project. Here it can be noted that Aboriginal people have been involved throughout this Project. Prior to field work meetings were held with the Wanaruah Local Aboriginal Land Council, the Lower Wonnarua Tribal Council, and the Ungoroo Aboriginal Corporation, and the Upper Hunter Wonnarua Council (who also represent the Wonnarua Nation Aboriginal Corporation). Information about the Project was also sent to the Wonnarua Nation Aboriginal Corporation but they have not replied directly and are apparently represented by the Upper Hunter Wonnarua Council. Members of all four groups took part in the field work for this Project (see Section D4.3 below). Some of the groups have chosen to write reports and/or letters. All groups have been invited to attend meetings about the Project and all have been provided with copies of a draft summary archaeological report to assist them with their assessment of the Project and its impact on Aboriginal heritage.

Full details are available in the Aboriginal Cultural Heritage Assessment Report (Attachment D7).

D4 STUDY METHODS

D4.1 GENERAL

This study has endeavoured to bring together several sources of information which may help understand Aboriginal heritage within the study area.

Firstly, the carved tree Site 2 (NPWS #37-6-56) was, prior to the survey, thought to have been located east of Wollombi Brook and probably within the study area. The calculated AMG grid reference provided by NPWS's Aboriginal Heritage Information Management System (AHIMS) placed the site in Portion 12, while advice from a local informant suggested that it might have been located in Portion 98. The photos of some of the carved trees taken in 1918 show a post-and-rail fence which might indicate a property boundary. Two of the photos also show hills in the background. Using this information an unsuccessful attempt to locate the site was included in the field survey of the south-east part of the study area on the 15th November. Dr Helen Brayshaw then undertook further research to locate the site more accurately. Her research is detailed in Attachment D-1. Information on other carved tree sites in the region has also been compiled, along with a brief historical context. This information is presented in Section D5.

A preliminary model of Aboriginal social organisation, developed from historical sources, is given in Section 6 to provide a social context for the Wambo study area. It is likely that Aboriginal people now living in the Hunter Valley will have written and/or oral information relating both to traditional Aboriginal use of the region and to Aboriginal History. It is understood that some of the local Aboriginal organizations are gathering such information and alternative interpretations may be made when that research is available.

Several archaeological studies have been carried out in the Wambo study area and a large number of projects have been undertaken in the surrounding district. The results of those studies have not been summarised for the present Project, at the request of NPWS, but site information has been analysed to provide a context for the Wambo study area. This is discussed in more detail below.

Information has been collated on the physical landscape of the study area, and on possible food and other resources. Analysis of the landscape setting of sites within the Wambo study area is also discussed in more detail below, along with the survey strategy used for the present study.

D4.2 ANALYSIS OF SITES IN THE CONTEXT AREA

For this Project NPWS indicated the "archaeological context" should not summarise the results of previous studies carried out in the region, but should incorporate an analysis of the results of previous studies. Consequently, a landscape analysis of previously recorded sites has been carried out, and this is reported in Section 8. Some comments on the methods used for that study are provided here.

A search of the NPWS AHIMS (Aboriginal Sites Register) was carried out in October 2002 and all sites between 300000E to 320000E and 6380000N to 6405000N and south of the Hunter River are noted. Also noted are sites and isolated finds which have been included in reports but not included in the AHIMS. The sites are those which have been found by surface survey to provide comparable data to the sites found by surface survey in the Wambo study area. Sites found by test excavation of areas lacking surface artefacts are not included.

A database was established and all known sites within the designated AMG grid references were entered into it. Using the AMG co-ordinates the location of the sites were identified on 1:25,000 scale topographic map sheets and data collected on several landscape variables being elevation AHD, nearest stream and its order, distance to that stream, general gradient, and landform. However, each of these variables presented some difficulties which warrant comment.

Some of the problems surrounding site definition are discussed in Section D7.1.5. Each site is as defined by the person who recorded it, but qualified by the definition of a site provided by Dean-Jones (1992). That is, artefact locations less than 50m apart should be considered to be part of one site; those more than 50m apart should be recorded as separate sites. For this reason some "sites" in the database combine locations recorded as separate sites, and some locations recorded as one site have been subdivided into separate "sites".

The analysis relied on AMG grid references, but it is not certain that these are always accurate. Indeed, some clearly are not. In the analysis, landscape variables are kept fairly simple and this will allow for some discrepancy in AMG readings and site location on maps.

The identification of stream order is based on mapped streams only. In some cases it was apparent from the shape of contour lines that additional drainages are present but streams had not been mapped in them. To be consistent with the mapping only streams which are specifically shown on the maps are identified. Five categories of stream order have been used, being 1st, 2nd, 3rd, 4th+ (4th order and higher) and major rivers being Wollombi Brook and the Hunter River. Distance to water is actually distance to mapped water, and does not take into account the possible presence of unmapped streams or springs. Further, from the scale of the mapping the distance to water may be accurate only within 20m or more. In the analysis the sites are grouped into general distance categories which helps reduce inaccuracy.

Altitude is estimated from contour lines drawn at 10m intervals. Again, the data is inaccurate, but grouping the data into broad categories helps to reduce the problems inherent in this approach.

Gradient has rarely been reported on site recordings. Here, gradient categories are defined after Speight (1990), and described in Section D8.3.3. The classification of site gradient is made by reference to the distance contour lines are apart on the 1:25,000 scale topographic map sheets. This is an inaccurate but consistent way of determining gradient. The broad definition of gradient categories will help reduce error inherent in the approach.

Landform is also defined after Speight (1990) and described in Section D8.3.4. Landform settings of sites are identified from the shape of contour lines on the topographic maps. Some landforms, such as crests, are quite easy to identify but others are more troublesome. Sites close to streams could variously have been located on lower slopes, small flats or even within the drainage line itself. Wherever possible original maps at larger scales are checked.

Site type and the numbers of artefacts found at open sites (including isolated finds) are also noted in the database. It was also hoped to investigate artefact density but the inconsistent recording of the size of exposures and visibility on them meant that such analyses would have limited the number of sites which could have been used for that set of analyses.

The data was entered into a database and manipulated to identify patterns in landscape use. The results are reported in Section D7.2.

D4.3 SURVEY STRATEGY FOR THE PRESENT FIELD WORK

Previous archaeological investigations within the Wambo study area focussed largely on the major streams of North Wambo, Wambo and Stony Creeks (Brayshaw 1984; Corkill 1990; Dyall 1981; Rich (=White) 1991a, 1991b) with more limited survey away from these (Brayshaw 1981; Corkill 1990). The present survey sought broader coverage to obtain a much better understanding of Aboriginal use of the whole landscape, not just occupation associated with major creeks.

The Wambo landscape is diverse. The study area is located at the junction of the Hunter Lowlands and the Southern Mountains, and the landscape is internally diverse, including a major river (Wollombi Brook), substantial creeks (Wambo, North Wambo, Stony and Waterfall Creeks), minor 1st and 2nd order creeks, low gently undulating slopes, moderate and steep terrain, higher ridge tops including potential access routes into the Southern Mountains, and a sandy landscape east of Wollombi Brook. The field survey includes samples of all these landscape components to compliment the earlier work along Wambo, Stony and North Wambo Creeks.

From the outset it was recognised that there would be practical constraints on the extent to which the Wambo study area could be surveyed.

- Firstly, not all parts of the Wambo study area are equally exposed. Stone artefacts are usually buried below the ground surface, having been incorporated into the soil following discard by Aboriginal people. Stone artefacts are usually found during field survey when the soils in which they occur have been exposed by erosion or by ground disturbance. Air photos show some locations where soil has been exposed and artefacts could potentially be found, but substantial parts of the Wambo study area did not have exposures on which artefacts could be found if they were present. No matter how much of the Wambo study area was inspected it would not have been possible to find every artefact location. Field survey could only ever identify a sample of the artefact locations present within the Wambo study area.
- Secondly, the Wambo study area is very large. If people were to walk parallel transects say 10m apart to achieve very intensive coverage then the field survey would have taken a couple of months to complete. And in view of practical limits to the extent of ground exposure many such transects would have been through areas of very poor ground visibility and in practice would have been a waste of time. A practical solution was to intensively sample the landscape and target areas of ground exposure visible on air photos.
- Thirdly, there was only limited access to some of the properties which Wambo Coal Pty Limited did not own. In some cases farmers were very concerned about weather conditions and the risk of fire However, access was provided to all WCPL owned land.
- Lastly, day-to-day variables affected the logistics of the field survey. Some days were very hot (>40^{o}C) so cooler landscape settings were surveyed in the afternoons when possible. Permission to enter some properties was granted on only certain days and sometimes for only short periods (eg. an hour or two). To some extent the choice of survey transects, the intensity of field survey and the days on which certain areas could be inspected depended on factors which were beyond the control of project managers.

With these constraints it was necessary to sample the Wambo study area.

The field survey was carried in late 2002, out over nine days during November (11th – 21st) and another two days in December (12th and 13th) when access was gained to the north-west part of the study area. An initial project meeting and induction was carried out on the morning of the 11th November, followed by an inspection of several (previously recorded) sites on North Wambo Creek. People who participated in the survey are listed on Table D-1.

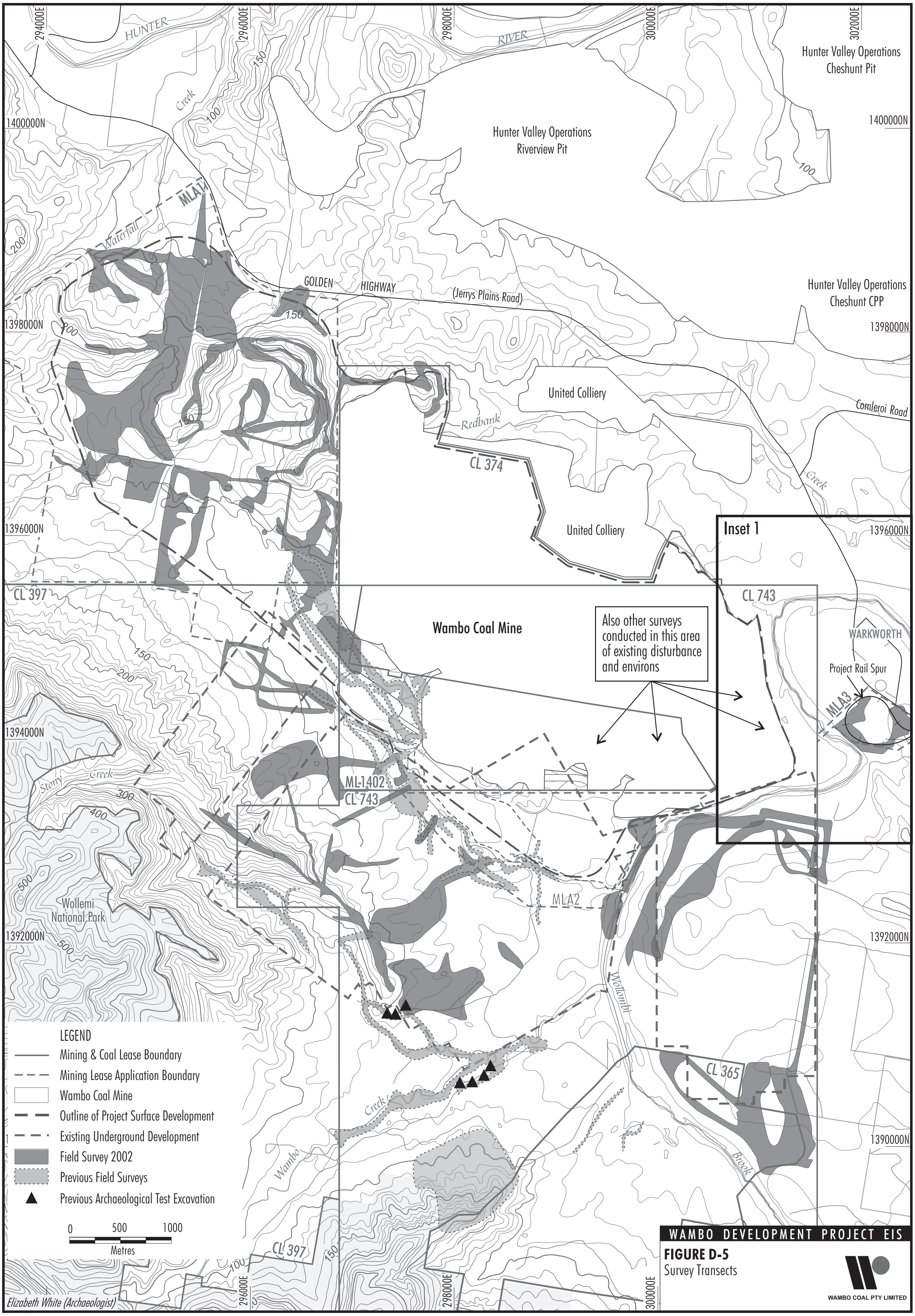
Table D-1
People Who Took Part in the 2002 Field Survey

Archaeological Team	Lower Wonnarua Tribal Council	Upper Hunter Wonnarua Council	Wanaruah Local Aboriginal Land Council	Ungoroo Aboriginal Corporation
Dr Helen Brayshaw	Mr Barry Anderson	Ms Georgina Berry	Ms Christine Mathews	Mr Chris Dallen
Ms Kerstin Calley	Mr Glen Miller	Ms Tracy Skene	Mr Rodney Mathews	Ms Rebecca Faulder
Dr Laila Haglund	Ms Marie Waugh		Ms Bev van Vleit	Ms Dahleen Hall
Ms Elizabeth White			Mr Larry van Vleit	Mr Allen Paget
				Mr Shaun Paget
				Ms Rhonda Ward

In addition, Dr Philip Hughes undertook a geomorphological study, and Ms Naomi Everett from Resource Strategies arranged access to properties and managed the field team.

The specific transects walked during this and previous surveys in the Wambo study area[4] are shown on Figure D-5.

4 So far as I have been able to ascertain from reports available.



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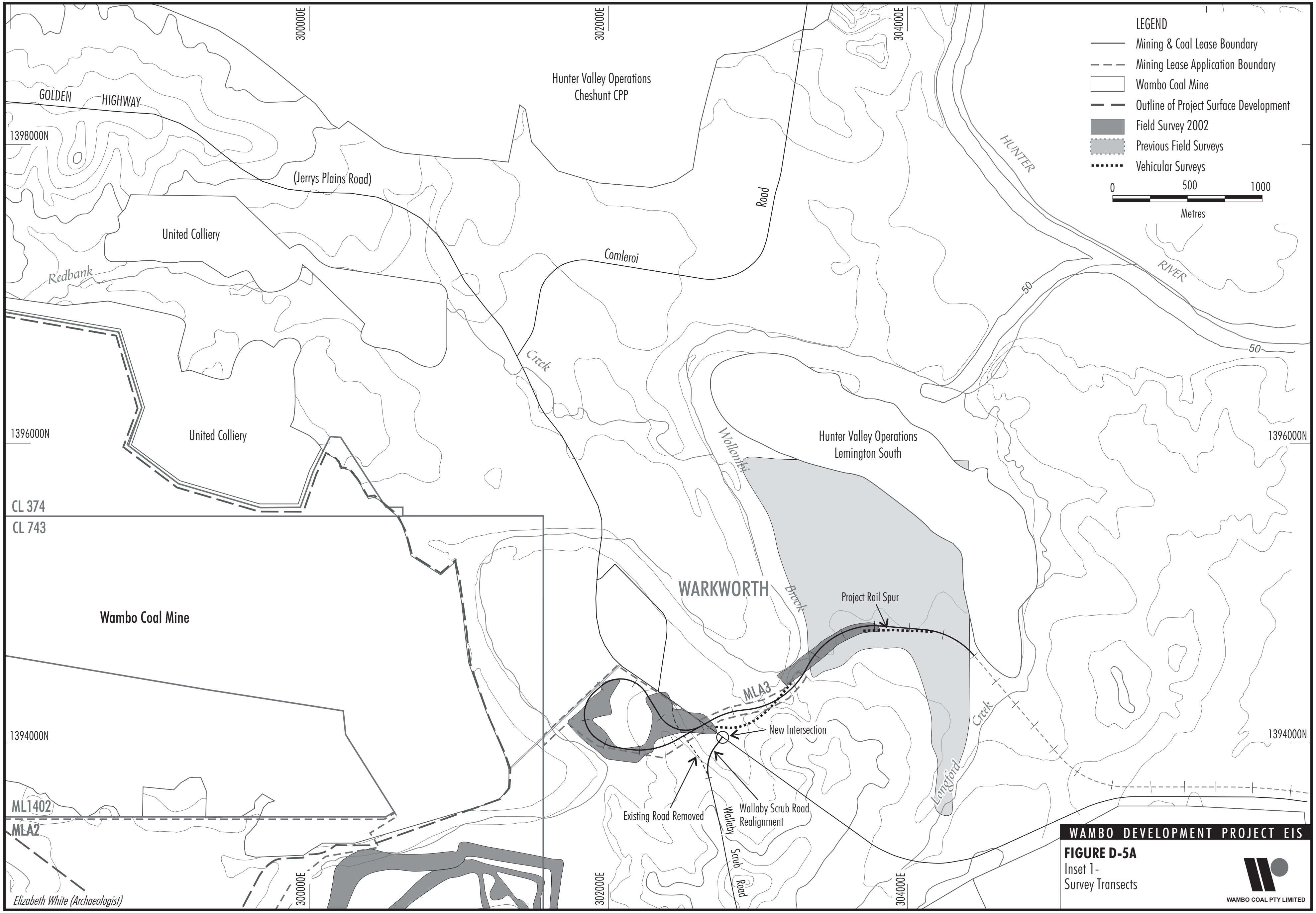

WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-5A

Inset 1-
Survey Transects

WAMBO COAL PTY LIMITED

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During the survey sites and isolated finds were recorded. To provide data to control for the practical limits on field survey, ground exposures without artefacts are also recorded. The exposure data is critical to this Project, as it provides a practical indication of the areas effectively sampled by the field survey. It also acts as a control data set for the distribution of artefact locations, that is, it is possible to analyse the distribution of artefacts taking into account ground exposure and visibility. Coverage data is incorporated into analyses in Section D9.4. The ground exposures searched during the present field survey, and by previous surveys where described, are shown on Figure D-6. Artefacts are also recorded to allow investigation of Aboriginal behaviour across the landscape.

Survey data is summarised on Table D-2. It incorporates information recorded during the present survey and during previous surveys where possible. 'Coverage' is the total area of each ground exposure multiplied by the visibility on each exposure. The coverage achieved (which takes into account the extent of ground exposure and the visibility on exposures) is high, totalling 22.4 ha – or 224,000m^2. '% area effectively surveyed' is 'coverage' divided by the total impact area. The data shows that the highest rate of effective coverage, at more than 1% is achieved for the surface impact area, and the surveyed route of the proposed rail spur. These higher rates of coverage are appropriate as ground disturbance in these impact areas would destroy any Aboriginal sites present in these areas. Coverage of 1% is also achieved for underground subsidence Zone C. Much of this area is located on a sandy landscape east of Wollombi Brook, mapped as Czb sand. This geological unit was identified by Nightingale *et al*. 2002 as being archaeologically sensitive, so particular attention is paid to this formation during the present study. But the finding of archaeological sensitivity for this unit as a whole is not repeated by the present survey.

For the underground subsidence zones less coverage of Zone B2 is in keeping with anticipated less severe subsidence damage.

Table D-2
Summary Survey Data

Impact area	Total area in ha	Area surveyed in ha	Area of ground exposures	Ground visibility	Coverage in m^2	% Area effectively surveyed	Total sites	Total artefacts
Surface impact	969	364	30.60	0-100%	106,190	1.1%	132	1,041
Underground A	159	32	2.336	0-80%	9,820	0.6%	25	1,116
Underground B1	503	108	8.771	0-90%	25,790	0.5%	48	256
Underground B2	192	17	1.008	0-80%	3,250	0.2%	13	58
Underground C	304	35	8.484	0-90%	31,540	1.0%	1	1
Underground no impact	276	37	7.770	0-80%	18,820	0.7%	9	298
Rail spur (surveyed route)	40	14	1.112	0-100%	4,740	1.2%	3	56
Beyond impact	-	181	11.179	0-90%	23,520	-	61	1,108

D4.4 ANALYSIS OF SURVEY DATA

The survey data is analysed in much the same way as the site data in the context area, but with more controls and in more detail. A relational database is used and two tables are established. In one table, data on all recorded sites and ground exposures is entered. Each ground exposure is given a separate entry, although extensive ground exposures are subdivided into smaller units where they cross over more than one landform, are more than 50m from mapped water, or climb onto higher altitudes. Sites are entered with the ground exposure on which they are located. To assist with data control each ground exposure was coded according to the person who recorded it and the date on which it was recorded. Several fields are established in the exposure table including AMG eastings and northings, exposure code, extent of exposure, visibility on exposure, coverage was calculated (see below), site name or field code, site type, number of artefacts, surface geology, altitude AHD, stream order, catchment, distance from mapped water, gradient category, landform, comments and general impact. Each site was given a project number running more-or-less in geographic order from south-east to north-west, so that readers would be able to locate individual sites on the maps if they need to.

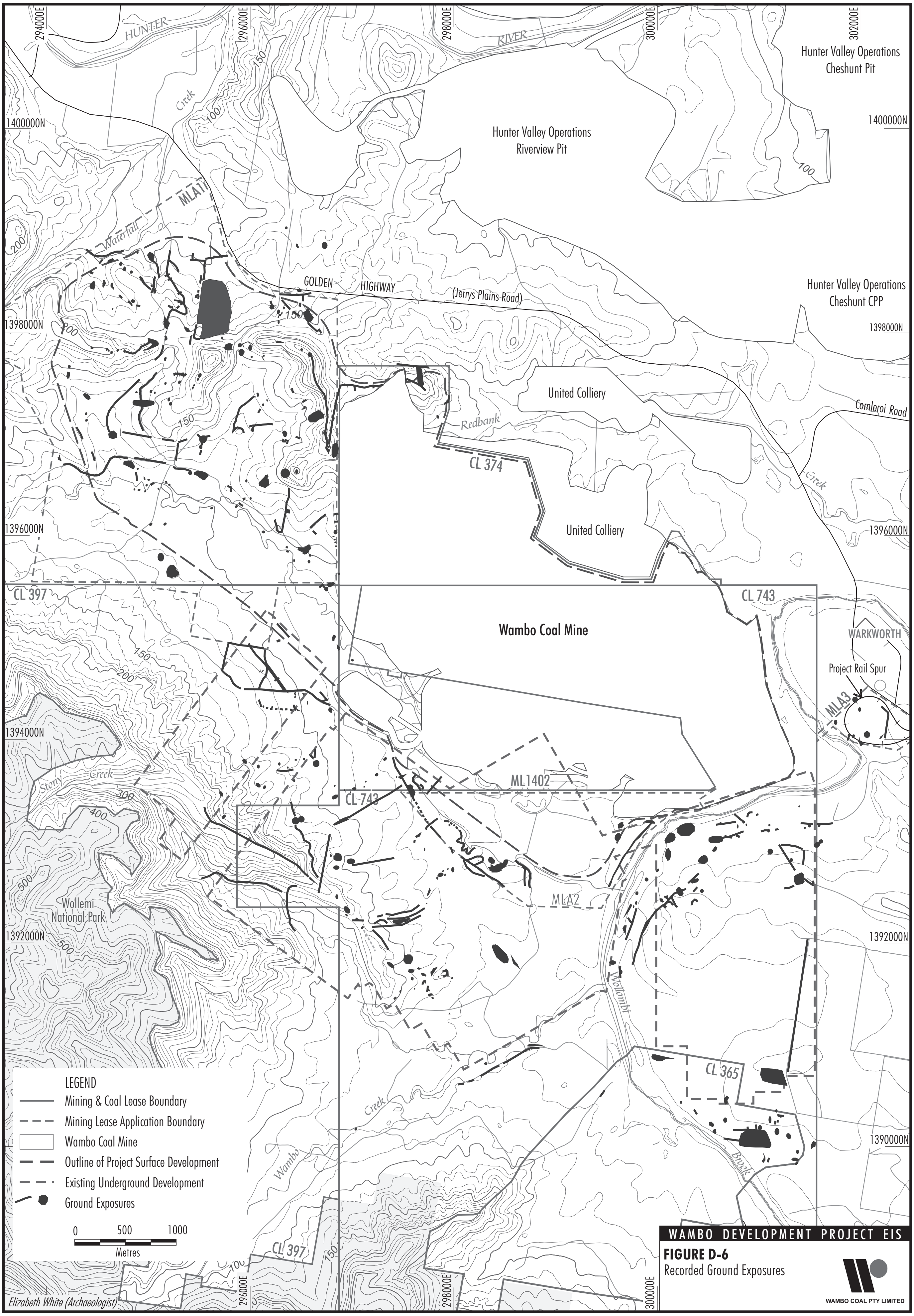

FIGURE D-6
Recorded Ground Exposures

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To analyse average surface artefact density the extent of exposures in m^2 are calculated. This area is multiplied by ground visibility to give “coverage” – which may be thought of the actual area of ground which might have been seen. Coverage takes into account large exposures with poor ground visibility and gives a more accurate indication of the area available for artefact detection. For example a track 100 m long x 3 m wide with visibility of 90% has a coverage of 270 m^2 which becomes statistically comparable to a grassy area 100 m long x 30 m wide with 10% visibility which has a coverage of 300 m^2. In practice, ground visibility varies on many ground exposures and in such cases the mid point of the visibility range is taken. For example, if visibility is given as 40-80% then 60% is used in the calculation of coverage.

In Section D9 coverage data is given for the full range of landscape settings so it is possible to see what kinds of settings have been sampled during the survey.

In the database a second table is established for artefact recordings. This is linked to the first table so that artefact assemblages could be analysed in relation to landscape variables. Stone artefacts included in this table are those recorded during the present survey as well as those recorded during previous projects (excluding excavated artefacts[5]). As the stone artefacts had been recorded at different times by different people and under different conditions the variables are kept simple – but still able to address the stone rationing issues raised in Section D7. The variables are limited to raw material type, artefact size, presence of cortex and artefact type, as several other variables would have been difficult to record under field conditions (see Table D-3).

The terms for raw material types are those commonly used in the Hunter Valley. Silicified tuff (S Tuff in the database) includes indurated mudstone (IM) and most of the fine grained glossy stone often identified previously as chert (unless qualified in reports) since it is now known that these are variations on silicified tuff, some possibly heat treated. For the Stony Creek sites Rich (1991a:74) noted that some of the artefacts were of “very fine, lustrous and translucent grey, black and red/brown materials. These cherts are locally available in Stony Creek, having come from the Widden Brook conglomerate which outcrops along the Wollemi escarpment.” These artefacts were identified on the recording sheets for Site SC2 in that report and have been entered into the present data base under the term “FGS” since they are not silicified tuff as it is usually now recognised.

Table D-3
Artefact Variables for Investigating Stone Rationing Strategies

Strategy		**Variables**	**Comments**
#1	Few types of light-weight tools	Tool types, numbers of tool types Tool size	
#2	Use locally available stone	Raw material type – quartz & quartzite	
#3	Prepare stone at source	Incidence of cortex Core body	But core body not consistently recorded
#4	Conserve available stone	Artefact size Incidence of cortex Relative frequencies of cores & tools	
#5	Increase tool maintenance	Retouch on working edges Evidence of hafting Amount of use measures	Data not available in previous studies & difficult to record under field conditions
#6	Recycle previously discarded artefacts	Reshaping of tools Less weathered scars intercept more weathered scars	Such observations not consistently noted
#7	Use good quality stone	Stone quality	Not previously recorded & difficult to control recorder variation under field conditions
#8	Reduce equipment, use curated tools	Identify long-life tools	Would require detailed tool use study

5 Excavated artefacts were excluded to ensure methodological comparability to artefacts recorded during surface surveys.

Artefact size is entered into the database in 1 cm size intervals, being recorded along the longest dimension of the artefact. Some artefacts had previously been recorded in three dimensions (length, width and thickness in mm) and these artefacts are assigned the 1 cm size interval of the longest dimension. Where the longest dimension is an integer (eg. 20 mm) the artefact is assigned to the interval 2-3 cm, since length width and thickness measures are normally block measures, and the longest dimension is usually a diagonal measure so such an artefact was probably a little more than 20 mm for its longest measure.

Cortex has variously been recorded as absent, present, in categories, or in much detail. For these analyses the lowest common denominator is taken – either present or absent.

Artefact type has been recorded in different ways, often with much attention to debitage categories. With regard to artefact type stone rationing is concerned with certain types of modification on artefacts. The final artefact type list used in the analysis includes grindstone, anvil, hammerstone, cobble manuport, cobble tool, large tool (more than 10 cm), medium tool (5-10 cm), small tool (<5 cm), core-tool, core, backed artefact, and unmodified debitage. No tulas or elouera were identified. Chopping tools are distinguished from other tools, and tools generally are subdivided into large, medium and small categories after Cole (1996). Cobble tools and tools more than 10cm in size could have been hand-held or hafted and used in chopping tasks. Smaller tools may have been finger-held or hafted and used in lighter-duty tasks such as scraping, shaving or incising; it not being possible to chop wood with small finger-held tools.

In Section D9 the data is analysed on a site basis, for comparison with analyses carried out in the context area. Average surface artefact densities are calculated for various combinations of landscape settings. Artefact assemblages are also analysed, although they are subject to constraints posed variously by small and uneven sample sizes.

D5 CARVED TREE SITE 2 (NPWS #37-6-56)

D5.1 SITE DESCRIPTION

A carved tree site was recorded by Australian Museum staff Anderson, Thorpe and Clutten in 1918, following information given to them by Mr A.N. Eather of Bulga. The site was thought to have been located in the south-eastern part of the Wambo study area, but only an approximate AMG grid reference was available, and the precise location of the site is now uncertain. Research to learn more about the site and to locate it has been carried out by Dr Helen Brayshaw and is detailed in Attachment D-1. It is concluded that the site is probably located on the boundary between Wambo Coal's mining lease and the neighbouring Warkworth Mine's mining lease. It is located in portion 17 east of the north-north-west easement which runs through the western half of this portion. Proposed underground mining has been pulled back from this location and is now about 400m north of the northern end of the probable site location.

It should be noted that the ceremonial site listed in the NPWS Site Register as #37-6-55 is the same site, according to the original informant. The following description of Site 2 (NPWS #37-6-56) is based on details collected by Dr Brayshaw and the NPWS site form for the site.

It appears that the trees have been destroyed since the site was recorded. In 1918 the trees were dead, and the NPWS site form indicates that there had been several bushfires since that time and the site had been destroyed. In the 1930s Mr Jim Eather visited the site and at that time only one stump remained, though several earth mounds apparently still survived (see Attachment D-1).

This site consisted, in 1918, of about 12 carved trees, clearing and intact mounds, and was described as a bora ground. The site was located in "open forest country on a slight eminence or plateau" and it was noted that "the ground is exceptionally level and sandy". A map sketched by Museum staff from memory shows it just east of a "stock route" and just north of a creek, which flows into Wollombi Brook to the west (Figure D-7). This stock route approximates the location of a surveyed easement shown on the 1912 Parish map (which would have been current in 1918) (Figure D-8).

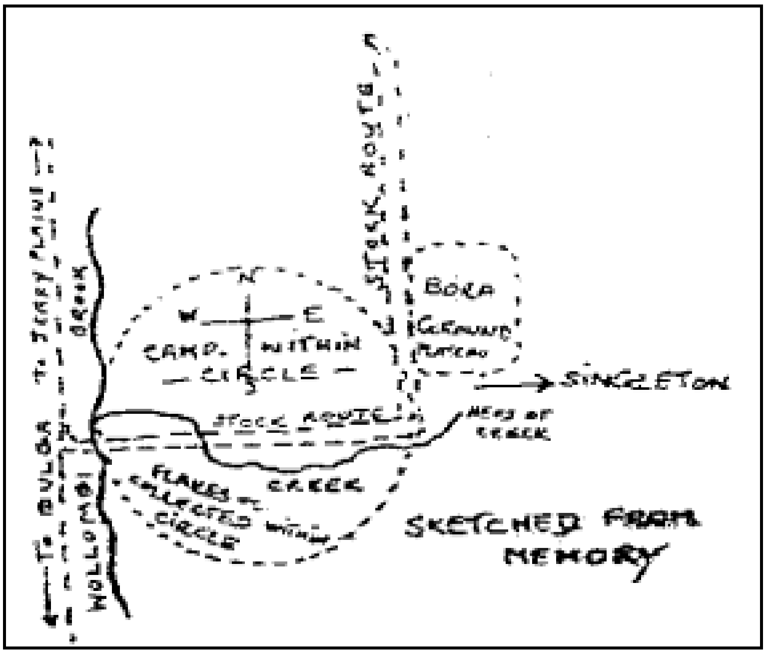


Figure D-7
Sketch Map Drawn by W. W. Thorpe Showing the Location of Site 2 (NPWS #37-6-56)

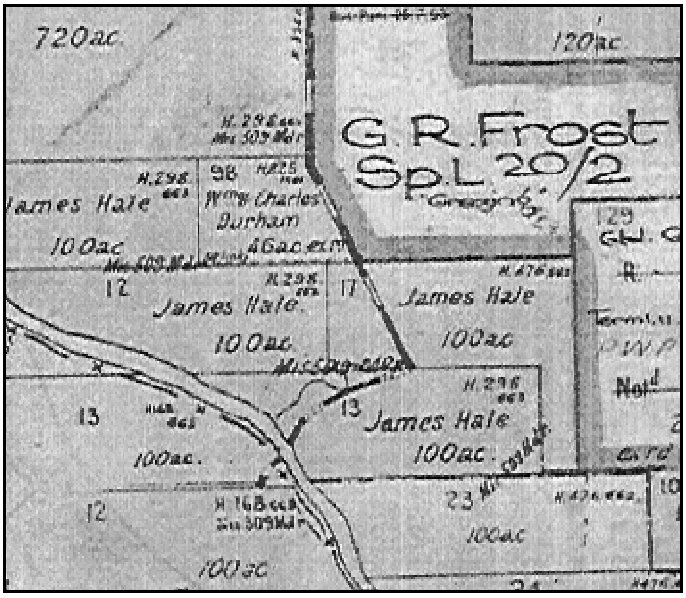


Figure D-8
Section of 1912 Parish Map

The carved trees were red gum and apple. The carvings had reportedly been made into the bark, but in 1918 marks in the sap wood were still clear, although they were drawn over in chalk to aid photography (Figures D-9 to D15). Four of the carved trees were photographed. Mounds of heaped earth were present amongst the trees, along with a crescent-shaped mound about 60cm (2 feet) high and 5m (15 feet) long.

At the time it was thought that the carvings had been carried out about 60 years earlier, dating the site to the late 1850s. An extract of an article written by Mr Alex Eather of Bulga and published in the December 1993 issue of the *Singleton Times Newsletter* states that

> *This Bora ceremony was held in the year 1852, and on reliable authority of residents of the locality was attended by between 500 and 600 aborigines from various tribes from as far as Mudgee and Goulburn.*

The Museum recording also notes the presence of a large “campsite” (see Figure D-7), and the sketch map made by Museum staff shows it on both sides of the creek, between the carved tree site and Wollombi Brook. Some 47 stone artefacts were collected from this site by W. W. Thorpe in 1918, including a small stone mortar and flakes with secondary chipping (tools). During the present survey several artefact locations (Sites 3-8) and an axe grinding groove site[6] (Site 4) are found within the approximate area shown as this campsite.

The general area of the carved tree site now appears secluded, being located in thick scrub 2 km west of Wallaby Scrub Road, and accessible only through locked gates. However, the surveyed easement which runs between the carved tree site and the camp ground is present on the earliest available Parish map (on the Land and Property Information web site as Image 10870501) and is linked to Wollombi Brook and places to the west by a track. Mr Stewart Mitchell of Bulga (local amateur historian) has indicated (personal communication) that this route has had a long history of use. The Eather family apparently used it as a stock route. If the ceremony which made use of the carved trees was held in the 1850s the general area of the ceremony may have been more accessible than it is now.

[6] A flake from an axe is also present on site 4 perhaps indicating flaking as well as grinding to sharpen axes.

Figure D-9
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

Figure D-10
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

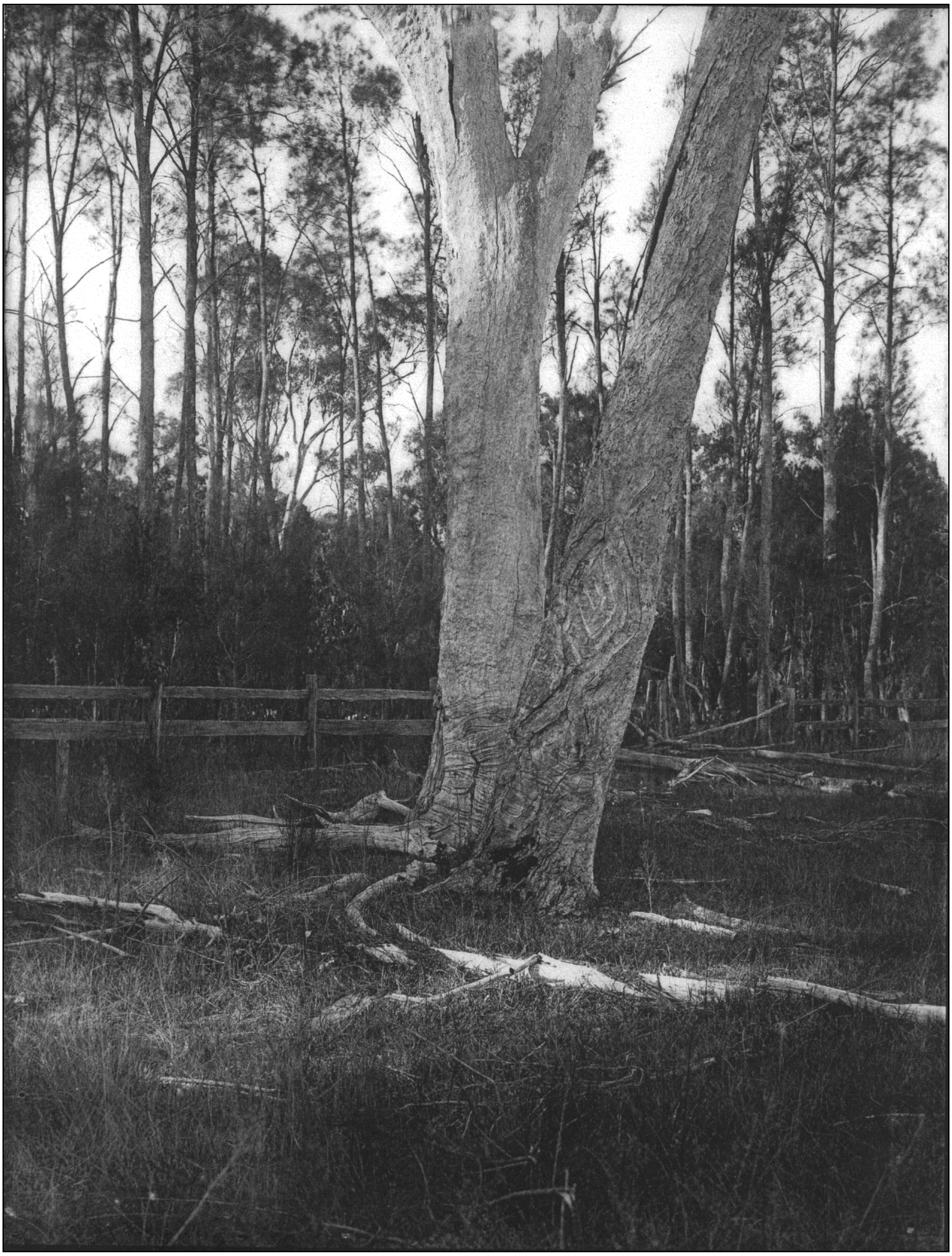


Figure D-11
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

Figure D-12
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

Figure D-13
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

Figure D-14
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

Figure D-15
Photo of Carved Tree, Taken by Australian Museum Staff in 1918

D5.2 OTHER CEREMONIAL SITES IN THE REGION

Some information is available on a few other ceremonial sites in the region and Brayshaw (1986) has collated information on these. The intention here is not to describe the details of the ceremonies themselves, but to draw attention to the kinds of physical evidence of the sites and their social and landscape settings.

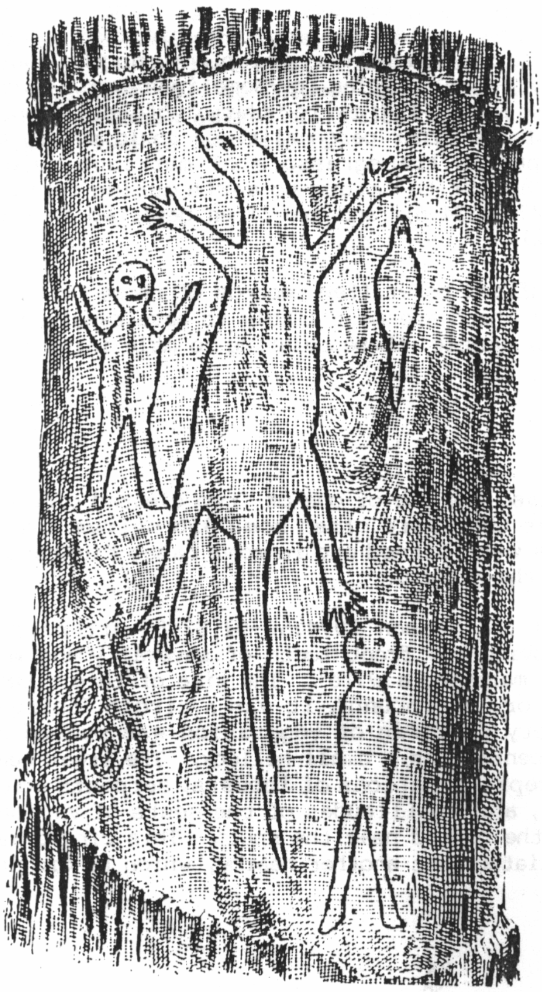
In 1825 on the coast Rev. Threlkeld attended an initiation ceremony in the Newcastle area. There were two earth circles, one public and one private. The initiations were carried out in the private circle which was cleared of vegetation and a small hillock was in the centre of the circle. Trees near the circle were marked with figures of locusts, snakes and other figures, and “similitudes of the nests of various quadrupeds (were) formed on the ground near the spot” (quoted by Brayshaw 1986:83). Brayshaw goes on to note that illustrations and descriptions of initiation circles and associated carved trees in the Gloucester – Dungog area are similar to that described by Threlkeld, except that earth figures or other features were not described as being present. According to Fawcett (1898) another ceremonial site apparently used by the Wonaruah did have earth figures. A site on a hill between Wallamba River and Minimbah Creek (close to Wallis Lake north of Port Stephens) a tree had a carved goanna and an earth circle was found “some distance from the tree” (Gilbert 1954:122). In the Upper Hunter two sites have been reported; one on the junction of the Page and Hunter Rivers and the other at the junction of the Isis and Page Rivers. Both sites apparently had one circle, and figures were carved into the trunks of trees. Earth figures were present at the site on the junction of the Isis and Page Rivers, along with “100 or 120 trees marked with the tomahawk” (Ridley 1864:156). Mathews considered that the creation of earth figures was a Kamilaroi practice (Brayshaw 1986:86).

The photos of the tree carvings at Site 2 (NPWS #37-6-56) (see above) are mostly diamonds and interlocking diamonds. Sketches of carvings on other trees have been published by Brayshaw (1986) and reproduced here as Figures D-16 and D-17. Some variety in depictions is evident but the depictions on the first row right hand side, second row left and centre, and third row centre, show similar interlocking diamond patterns. The depictions from the junction of the Page and Isis Rivers, bottom row in Figure D-17, are either more curved or have been drawn less precisely. A remnant section of carving on a fence rail from near the confluence of Wollombi Brook and the Hunter River, a few kilometres from Site 2 (NPWS #37-6-56), has been recorded as Site #37-6-113. This was photographed in 1980 and is shown here as Figure D-18. It also seems to show remnants of interlocking diamond pattern, possibly with a scroll at the end of one line. The recurrence of the interlocking diamond pattern suggests some continuity between different sites but the Gloucester trees show co-association of different carved forms.

Mathews (1896, 1897) has written detailed accounts of initiation ceremonies, including the Keeparra ceremonies on the coast and the Burbung of the Darkinung people. Enright’s (1899) account of the Keeparra is similar and Howitt (1904:570-571) and Fawcett (1898) have also made similar comments. Mathews’ accounts include details about how the local landscape was used during such ceremonies. From the descriptions it seems that ceremonial gatherings may have lasted more than a week, perhaps two (Enright 1899:124). At least two residential bases were occupied in that time, and one or more other camps were occupied by the men and novices during the ceremonies and later as mens’ camps. The following is a summary of Mathews’ (1896) account of the Keeparra, and additional details are available in the original publication. A total of five camps were variously occupied over the course of the ceremonies.

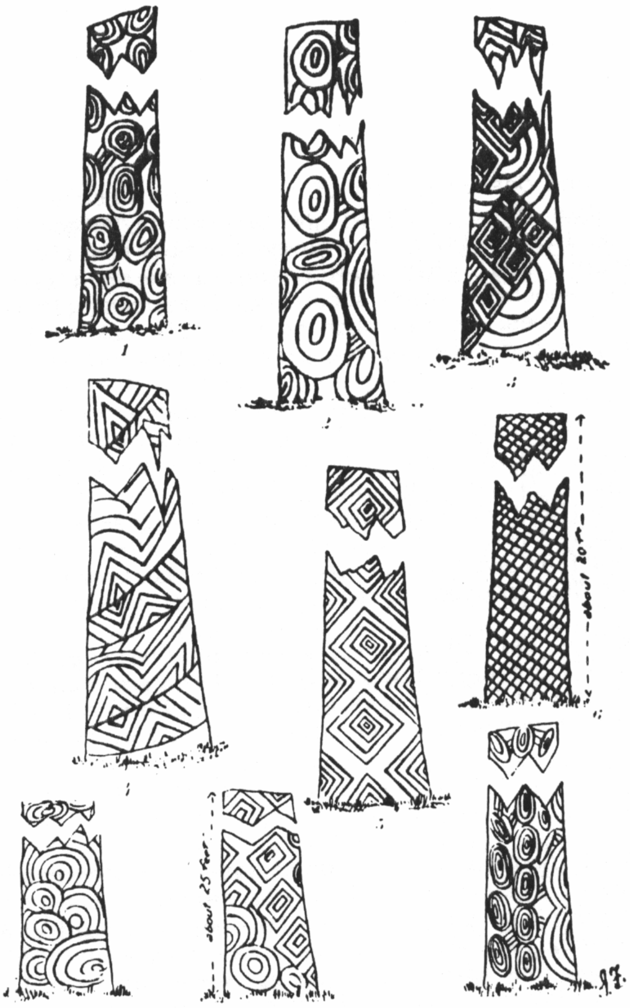
Invitations were initially sent out, and when they were accepted, the ‘headman’ selected a suitable area in some part of his own territory where game was sufficiently plentiful to provide food for his visitors. There he started to prepare the ground. A main camp was occupied by arriving groups, and a level patch of ground in a convenient part of the camp was cleared and made smooth for dancing on. On the evening of the day preceding the principal ceremony, all the groups removed their camps close to the public circle, where they remained for the night. Some of the men went to the private circle and camped there (Mathews 1896:326). Early during the ceremony, women, children and some men packed up their belongings, and went to another locality to erect a new camp. At this camp “...(T)he usual rule of each tribe camping round the local mob, each in the direction of their respective districts, was observed in the erection of this new camp. ...” Close to this new camp, on the side of it nearest the place to which the novices were to be taken by the headmen, a piece of level ground was selected, and cleared of all timber and loose rubbish, and a large fire kindled in the middle of it. Here the mothers and sisters of the novices assembled every day to sing and dance (Mathews 1896).

Figure D-16
Sketch of Carved Tree near Gloucester (from Brayshaw 1986:84)



Pl 17: Sketch of a Carved Tree near Gloucester (Etheridge 1918).

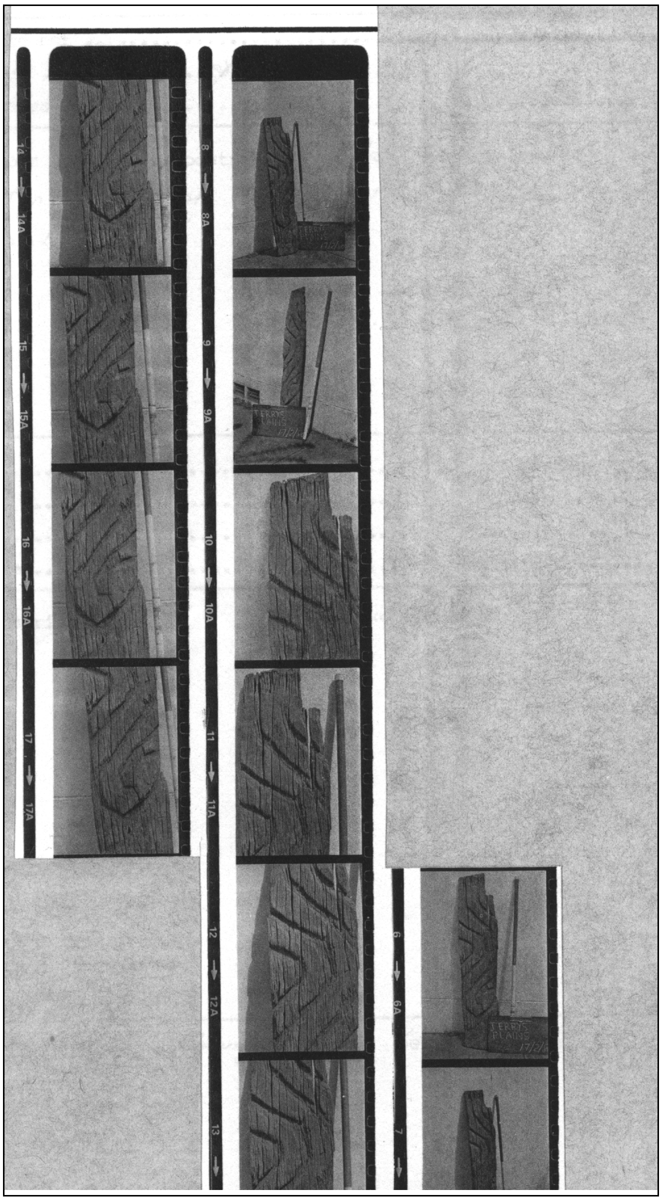
Figure D-17
Sketch of other Carved Trees near Gloucester and at the Junction of the Isis and Page Rivers
(from Brayshaw 1986:85)



Pl 18: Sketch of Carved Trees near Gloucester (Etheridge 1918).

Pl 19: Sketch of Carved Trees at the junction of the Page and the Isis Rivers (MacDonald 1878).

Figure D-18
Photos of other Carved Remnant on Fence Rail, NPWS Site 37-6-113 (from NPWS site form)



During the ceremony a separate camp was established by the men and novices several miles into the bush, consisting of a long, continuous gunyah. A row of fires were lit in front of this shelter, and beyond these fires the surface of the ground was cleared of all loose rubbish and grass for a distance of several yards, the rubbish forming a sort of embankment around the farther side of the cleared space. Such a camp would be formed on some tolerably level ground near a running stream or water-hole. During the early part of each day, the men would go out hunting. This camp was occupied for about a week or more then all return to the (third) main camp. On the return of the novices and men to the main camp, and after another part of the ceremony was performed, the novices were taken a short distance to another camp. The following day, the various groups began to return to their own districts. The local group would also move to another part of their own territory (Mathews 1896).

From descriptions of specific sites it seems that certain landscape settings were important for the conduct of such ceremonies. In these descriptions camps were established near small creeks and the private ceremonies were conducted a little further away in a location secluded from the main camp (eg. through a forest and/or on a hill). For the 1889 ceremony near the Manning River the site chosen for the general encampment was a short distance from the right bank of Stony Creek (not Stony Creek at Wambo), a small tributary stream on some level, thickly wooded country. Water for camp use was obtained from the creek referred to, and there was good hunting around the area. From the public circle (an oval space) bounded by a raised earthen embankment a narrow pathway led away through the forest for about 340 metres to another and larger oval enclosure with a number of marked trees (Mathews 1896:321-322).

At another Keeparra ground near Gresford the main camp was pitched in an open forest, on some gently sloping ground a few chains east of the left bank of a small tributary of the Allyn River. The public circle was on the eastern side of the camp, and a path led away from this, ascending some sloping ground to the private circle located some 350 m away on the crest of a low ridge. There were several marked trees around this circle, and further along the top of the ridge, were a few other marked trees (Mathews 1896:323).

The ceremony near Port Stephens carried out in about 1856 was performed on a “scrubby flat” (Scott 1982:29). Then, at “a much later date” Scott encountered another ceremony. The camp was located at the foot of a hill and was connected by a narrow path to another cleared space on top of a hill (Scott 1982:31).

The site between Wallamba River and Minimbah Creek was on a small steep hill about 30 m high (Gilbert 1954:121).

Howitt refers to Breton’s description of a “Kabbarah” ceremony at which the “Corborn Comleroi” were present along with the leading men of Port Macquarie. The summit of a low hill was chosen, the surface cleared and nearby trees were carved. (Howitt 1904:576-577). The ceremonial ground at the junction of the Isis and Pages Rivers was also located in a pleasant well-wooded glen at the foot of a high hill (Ridley 1875:156).

The area where the carved tree Site 2 (NPWS #37-6-56) may have been located would fit with the general model for the location of such ceremonial sites. The residential camps could have been located around the small creek with the carved tree site used for ceremonies being located 300-400 m away amongst wooded country on top of a slight hill.

D5.3 HISTORICAL CONTEXT

A brief historical context for the carved tree Site 2 (NPWS #37-6-56) is provided here. Although the period of contact between Aborigines and Europeans in the region was disastrous for Aboriginal people, they were able to maintain some aspects of traditional cultural, manifest in the performance of ceremonies at sites such as Site 2 (NPWS #37-6-56).

The effects of European invasion may have begun before face-to-face contact. The smallpox epidemic observed in Sydney in 1779 may have spread into the region, as in 1810 pockmarks similar to those left by smallpox were seen by Thomas Mitchell on Aboriginal people North of Murrurundi (Butlin 1983:24). Another epidemic took place in the early 1830s and was observed near Scone (Campbell 1985:338). Smallpox is a devastating disease, with fatality rates amongst groups exposed for the first time probably exceeding 40% and possibly as high as 70%. The disease particularly affects children under 10 and pregnant women, though survivors develop an immunity to the disease (Butlin 1983; Campbell 1985). It is likely that many people in the Hunter region died from the 1779 epidemic.

The Hunter region was officially opened for European settlement in the early 1820s and by 1825 more than 360,000 acres had been promised to European settlers and much of this had been occupied. In 1829 there were 46,800 cattle, 119,400 sheep and 11,300 acres under cultivation (Jervis 1953:114). This would have resulted in much loss of land, loss of resources and loss of habitat, so affecting Aboriginal peoples' abilities to continue to survive and practice a traditional lifestyle. An unknown number of Aborigines were killed in direct conflicts with European occupants and by 1826 a number of violent and fatal incidents were reported (Bramble 1981:49,55; Murray-Prior 1973:32ff). There are reports that Aborigines were massacred in the Gloucester area (Brayshaw 1966:8).

In following years Aboriginal people variously "came in" and settled on stations (Brayshaw 1966:8) and some European children mixed with Aboriginal children (Murray-Prior 1973:40); as with the Ogilvies at "Merton" (near Denman) and at Carrington near Port Stephens (Scott 1982). In the 1830s the government began distributing blankets to Aboriginal people in the Hunter region (Miller 1985:76). The blanket returns indicate people living at Lake Macquarie, Port Stephens, Gloucester, Stroud, Dungog, Williams River, Glendon, Patricks Plains, Wollombi, Fal Brook, "Merton"/Denamn and Scone (Brayshaw 1986:58). Some Aboriginal people had established jobs, working for European farmers and as drovers (Miller 1985:66).

In the more settled areas notes on blanket distributions in the 1850s and 1860s indicate that surviving Aboriginal groups focussed their occupation at Dungog, Paterson, Maitland, Singleton, Wollombi, Muswellbrook and Scone (Miller 1985:65). Brayshaw (1981:11) has noted that Aboriginal people were still living in the area east of Jerrys Plains and south of the Hunter River (Hobden Gully?) in the 1850s, and several Aboriginal people were buried in the small cemetery near "Barellan". A relatively large number of Aboriginal people may have survived in the mountains near Bulga until at least 1879 (Murray-Prior 1973:37). The art site at Appletree Aboriginal Area appears to have Aboriginal artwork dating to the historic period (report by Koettig held with the AHIMS site form).

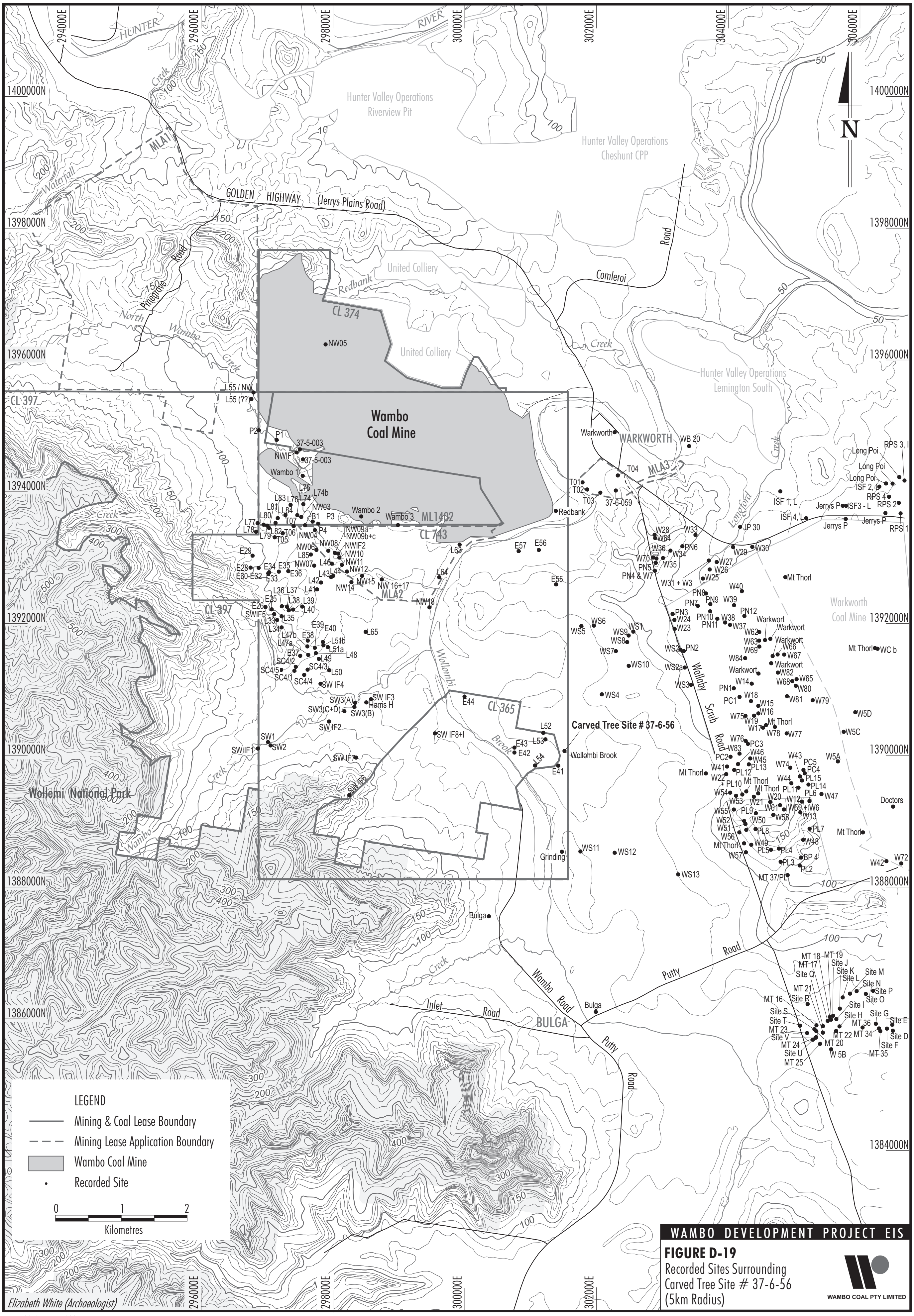
An Aboriginal community was present at St Clair in 1851 with additional references including the dates of 1877, and 1882. A formal reserve – also known as Mount Olive – was established here in 1890. An Aboriginal community was also established at Redbourneberry (Singleton) in about 1862 (Miller 1985:107).

In 1860 a major influenza epidemic affected Aboriginal groups in the Hunter region, and by the 1870s and 1880s some communities were too small to remain viable. By 1889 Redbourneberry at Singleton had become the focal point for Aboriginal occupation, with some people moving here from Scone and Paterson (Miller 1985:65-66, 107). In the 1880s the group from Gundy moved to Gowrie (Miller 1985:104).

There is some evidence that a number of initiation ceremonies were held in the Hunter region during this part of the historic period. Some of the ceremonial sites included one at Tinonee near the Manning River in 1889 (Brayshaw 1966; Mathews 1896:321), one near Gresford (Mathews 1896:323), and in the Port Stephens district about 1856 and another there at a "much later date" (Scott 1982:29). The historical context indicates that there were sufficient community groups for ceremonies to be viable. Such ceremonies would have been important for retaining traditionally-based contact between groups – which may have been especially important under the severe social and physical conditions brought about by European invasion. The report that Site 2 (NPWS #37-6-56) was used in the 1850s is in keeping with this context.

D5.4 ARCHAEOLOGICAL CONTEXT

The distribution of sites recorded within a 10 km^2 area surrounding the carved tree Site 2 (NPWS #37-6-56) is shown on Figure D-19 (at the specific request of the Wanaruah Local Aboriginal Land Council). The sites include five grinding groove sites and two other possible grinding groove sites. The grinding groove sites include #37-6-163 which is Site M within Warkworth West and which occurs as two separate locations, and Site PN10 also within Warkworth West. The fourth site occurs with an artefact scatter on the east (right hand) bank of Wollombi Brook about 1.5 km south of the carved trees and is Site 1 in the Wambo study area. The fifth site occurs about 500m south-west of the carved trees (Site 4 in the Wambo study area), on the bank of the tributary creek where the Australian Museum reported a campsite when they recorded the carved tree site (see Figure D-7). The two other possible grinding groove sites are located along North Wambo Creek and their authenticity is not certain.



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-19
Recorded Sites Surrounding Carved Tree Site # 37-6-56 (5km Radius)

WAM-02-01-ABH_030F

If the carved tree site dates to the historic period then the carvings would probably have been made with steel hatchets, rather than stone hatchets. The axe grinding groove sites in Warkworth West and in the Wambo study area were probably made by sharpening stone hatchets[7] and may not relate specifically to the tree carvings; unless earlier carvings dating to the pre-contact period were re-used. It is also possible that the carved tree site might have been located in an area with a long tradition of ceremonial use, and the grinding groove sites might be related to sharpening stone hatchets used in earlier activities. Or hatchets sharpened at these grinding groove sites might have been used in activities unrelated to ceremonies.

On the west bank of Wollombi Brook a scarred tree has been recorded as Site # 37-5-188. Site # 37-6-441 has been recorded near Bulga as an oven mound but no other information is available.

Most of the recorded sites within 5 km of the carved tree site are likely to be pre-contact in age, as they consist predominantly of stone artefact scatters. Two sites include glass artefacts. They are Site #37-6-846 found on The Salt Pan, and Site 62 on the west side of Wollombi Brook found during the present survey about 1 km south-west of the scarred tree. Two other sites in the Wambo study area have scatters of historical material (glass, ceramics) associated with stone artefacts. Of these, Dyall reported a glass artefact at Site 31 (#37-5-34) on the west bank of Wollombi Brook a bit more than 3 km north-west of the carved tree site. Site 17 found during the present survey also has scatters of historical material and is located on the east side of Wollombi Brook about 4 km north of the carved tree site. It is not certain, however, that the historical materials were actually used by Aboriginal people – spatial association might be coincidental.

Of the open sites (stone artefact scatters) east of Wollombi Brook it can be noted that most in the immediate vicinity of the carved tree site consist of small numbers of artefacts. During the present survey very extensive ground exposures north and west of the probable location of the carved tree site were searched with relatively few artefacts being found. However, as W. W. Thorpe collected nearly 50 stone artefacts in 1918, it is likely that artefact densities are higher than the visible archaeological materials indicate.

7 So far as I am aware no one has investigated how Aboriginal people might have sharpened steel hatchets but if they were sharpened in the same way as stone hatchets it could be expected that the grooves may have been of a different shape to grooves made by sharpening stone hatchets.

D6 TOWARDS A MODEL OF ABORIGINAL SOCIAL ORGANISATION

A social context for the Aboriginal sites which occur within the Wambo study area is provided in this section of the report. Stone artefacts – which form the bulk of archaeological evidence – were made, transported, used and discarded by people interacting in socially dynamic ways. The carved tree site (Site 2) is a specific example of such social interaction, but it may also be manifest in other ways such as raw material distributions. Archaeologists are still trying to develop theory and methods to pursue issues of social organisation in the archaeological record; so this section of the report is intended to provide a social context for the present Wambo study area, rather than develop specific hypotheses for testing.

In the Hunter Valley in the early historic period there were few systematic observations of Aboriginal people, with most being made in the lower Hunter region. Some observations for the central part of the Hunter Valley are available and it is likely that further research will identify more information. Available observations are collated here to provide a model of social organisation in the region. It is hoped that this model stimulates discussion and further research, and it is not intended that this should be a definitive account of Aboriginal social organization in the region.

The model identifies the area surrounding the confluence of Wollombi Brook with the Hunter River as sensitive and potentially a boundary between three (or more) groups of Aboriginal people. The sensitivity of this general area – previously identified by Dyall (1981) and Brayshaw *et al.* (1996) – is expressed by the carved tree site 2 (NPWS #37-6-56) located on the eastern edge of the present Wambo study area. In addition, Jerrys Plains Ridge, Wambo Ridge and others may have provided access routes between the lowlands and mountains and if so, these routes could have been used by visitors taking part in ceremonies and other group meetings. This possibility is dealt with in subsequent sections.

It should be noted that Aboriginal languages included sounds which do not have an equivalent in English, so some early writers spelt various Aboriginal names in different ways. In this section, the spellings used are those given by the original authors. It should also be noted that early writers often referred to local groups as “tribes” but this term has probably not been used in the way it has come to be used in more recent times.

D6.1 THE WONNARUA

The name “Wonnarua” and various spellings of this appears relatively late in the historic period; the earliest reference which has been located to date is the description by Miller (1887)[8]. Miller (1887), and Fawcett (1898)[9] in a long article, give views of Aboriginal life in the Hunter Valley.

Miller (1887) stated

> *... the Wonnarua tribe ... occupied the Hunter and all its tributaries from within ten miles of Maitland to the apex of the Liverpool Ranges, an area which he sets down at two thousand square miles.* (Miller 1887:353)

Fawcett’s (1898) description of Wonnah-ruah territory was similar.

> *The Wonnah-ruah tribe of aborigines inhabited the Hunter River district in New South Wales. Their tribal district had an area of upwards of 2000 square miles, and included all the country drained by the Hunter River and its tributaries. ... They had no permanent settlements, but roamed about from place to place within their tribal district, in pursuit of game and fish, which was their chief sustenance, making use periodically of the same camping grounds, generation after generation, unless some special cause operated to induce them to abandon them.* (Fawcett 1898:152)

Fawcett (1898) described the daily work of the men and women and listed the foods they ate, along with many other aspects of daily life.

The following section outlines other historical observations of Aboriginal people in the region, and suggests the general view of a single homogenous and unified tribe did not describe the dynamics and complexities of life in the Hunter lowlands in the early historic and late pre-contact periods.

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8 Miller did not settle in the Hunter River district until 1841 and lived there for “several years”.

9 Fawcett (1898:152) noted that most of his information came from correspondents and friends. It is difficult to assess the reliability of his information.

D6.2 NAMED TERRITORIAL GROUPS

The ethnohistorical evidence indicates that Hunter Valley people lived in named local groups, each of which had their own dialect, and spanned well-defined tracts of country. On the coast (eg. Port Stephens and Newcastle-Lake Macquarie) territories were fairly small, with references to areas perhaps 16 x 20 km. Inland, territories were larger covering areas perhaps 30 km x 50 km. The groups practiced exogamous marriage, and interacted via the movements of individuals between them. Miller (1985) thought of these groups as kinship groups.

Writing generally about the Bathurst and Hunter regions, Breton (1833) stated:

> *The tribes commonly … (have their) … own particular boundaries, which are seldom passed, except at the "corrobbories" ... The meeting at an end, they return to their respective hunting or fishing grounds, to pass which, at any other time, is considered an act of aggression, or a signal for war. ... Their grounds usually include a square of twenty or thirty miles* ... (Breton 1833:215-216)
>
> *With regard to their language, it is pretty certain that each tribe has a dialect more or less different from that of its neighbours - the difference being greater according to the distance the tribes are assunder.* (Breton 1833:243)

In his Reminiscences of 1825-26 Threlkeld stated:

> *A great variety of languages, differing from each other in some particulars, and peculiar to each tribe in the neighbouring districts, is, almost universally believed to exist ... It is true, that there are dialects*.... (Threlkeld in Gunson 1974:42)

Following a study over five months, covering "... a circuit of about 750 miles ...", Archdeacon Scott (1827) wrote that "... each Tribe occupies a Space from 20 to 30 Miles Square ..." (Scott 1827:57-58) (i.e. 30-50 km across). Allman (1826:621) was also of the opinion that Aboriginal people did not usually travel as far as 50 miles (80 km). Coastal territories appear to have been smaller than those further inland.

In the late 1820s at Port Stephens, Dawson reported

> *... they have a district of country which they call theirs, and in some part of which they are always found.* ... (Dawson 1830:63)
>
> *Each tribe is divided into independent families which acknowledge no chief, and which inhabit in common a district with certain limits, generally not exceeding above ten or twelve miles on any one side*. (Dawson 1830:326-327)

The spatial discreteness of these groups was also evident in

> *their extreme fears of meeting with various tribes, who always call strangers to severe account*. (Dawson 1830:103)

In his book Dawson describes various incidents which illustrate these general statements (eg. Dawson 1830:236, 245, 275).

At Raymond Terrace it was also noted that each "tribe" had designated land (Brayshaw 1966:9, quoting Emily Caswell).

The Awabakal at Lake Macquarie occupied an area from Reid's Mistake (the entrance to Lake Macquarie) northwards to Newcastle and the Hunter River. Their territory was about 14 miles (c.22.5 km) north-south and 13 miles (c.21 km) east-west. The "usual place of resort" of these people was Newcastle and Lake Macquarie (Threlkeld in Gunson 1974:241). Threlkeld was of the view that the Awabakal were distinct from the people of "Tahkahrah Beech" (Tuggerah Beach) (Threlkeld in Gunson 1974:226).

On the coast in the Newcastle area and northwards Mathews (1896:320-321) noted several dialects, and during several field trips to Port Stephens from 1896, Enright (1899, 1932) learned the names and burri (districts) of several groups, which he describes. Some other information on the names and locations of groups in the lower Hunter is available in other sources. The focus of the present study is on information regarding groups in the central Hunter Valley, surrounding the Wambo study area, so details of the coastal groups are not repeated here.

Threlkeld was of the view that people in the Maitland area spoke a dialect which differed from the Awabakal on the coast, and he noted that "... on the trial of an Aboriginal; the dialect spoken by the prisoner, was different from that which was previously understood ... (Threlkeld in Gunson 1974:271). Enright (1901) noted "... the Warrang-gine living about Maitland ..." (Enright 1901:80), while Mathews (1897:11-12) noted that the Darkingung extended "towards Maitland" and mentioned "Wannungine" as a dialect. Together Enright's and Mathew's statements suggest that Warrangine may have been the dialect spoken by the people living in the vicinity of Maitland, and/or in the sandstone country south of Maitland.

Howitt (1904) reported something of the Paterson River people and the Gringai:

> *To the north-east and adjoining the Geawe-gal were two tribes*[10]*, or perhaps two sections of a large tribe, one on the Paterson River and the other, to which my correspondent refers, being on the Williams and its tributary, the Chichester*[11]*. After careful inquiries I have not succeeded in learning the name of this tribe with certainty. ... There territory extended up the valley of the Williams and its tributaries to their sources, and southwards for about 8 miles below Dungog*. (Howitt 1904:85)

In 1826 Darling reported that *... the Upper Districts of Hunter's River (were) principally occupied by three Tribes* ..." (Darling 1826, quoted by Brayshaw 1986:47).

The Geawegal were located in the central Hunter:

> *The territory claimed by them may be defined as being part of the valley of the Hunter River extending to each lateral watershed, and from twenty-five to thirty miles along the valley on each side of Glendon*[12]. (Rusden 1880:279)

The Geawegal territory would have extended from Glendon east towards Maitland and westward to about the confluence of the Hunter River and Wollombi Brook, perhaps as far as west as Warkworth and Camberwell. It should be noted that Rusden's description of the extent of the Geawgal territory is similar to Breton's description (above), and larger than the territories indicated by Threlkeld and Dawson for coastal groups.

The earliest historical reports indicate that the area of the Hunter lowlands west of the Geawegal was occupied by "Comnaroy" people. Wood (1972:10-11) compiled this evidence which is summarised here. In 1819, John Howe explored an overland route from Windsor to the Hunter Valley, taking with him from the Hawkesbury area an Aboriginal man named Myles. From a point on the Hunter Range above Doyles Creek, Myles reported that fog-covered lower country to the east-north-east was "Coomery Roy". Rev. J. D. Lang apparently applied the name Comnaroy to Patrick's Plains (ie. the Singleton area) (Wood 1972:10). An article in the Australian on 29th August 1827 referred to "St Helier's in Comnaroy" (Wood 1972:11), suggesting that Comnaroy extended north of Muswellbrook. Another article in *The Australian*, of 21st September 1827, provides a more specific description

> *This is the country called by the natives, in their quick mode of pronunciation 'Comnaroy'. It extends along the main river 25 or 30 miles from the mouth of the Wollombi to the mouth of the Goulburn*. (Wood 1972:10)

Of interest, "Comleroi" is a locality shown on the modern Singleton 1:25,000 scale topographic map sheet about 1 km north of Wollombi Brook and 1.3 km west of the Hunter River. "Comeroi Road" runs through that area.

Comnaroy and its various spellings may relate to the larger language area of Kamilaroi, which extended over much of north-west NSW. The specific description for the Hunter Valley of Comnaroy extending from Wollombi Brook to the Goulburn River probably relates only to a particular group of Kamilaroi-speakers. Ogilvie's comment (see below) suggests that all the groups in the Scone area and surrounding district were "Camilarrai". Ridley stated that "...Kamilaroi is spoken ... on ... the Liverpool Plains and the Upper Hunter southward..." (Ridley 1864:15). Fraser writing late (1892) mapped the distribution of the "Kamalarai tribe" into the Hunter Valley as far as Singleton, and included Camberwell and Warkworth within its eastern boundary. Enright (1937:90) also stated that the Kamilaroi extended to Singleton, while Greenway was a little more circumspect saying

> *the Kamilary dialect, with little variation as spoken from about Patrick Plains or Singleton to Upper Barwun and Baroon Rivers. ...* (Greenway 1901:117)

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10 Howitt uses the term "tribe" to mean "... a number of people who occupy a definite tract of country, who recognise a common relationship and have a common speech, or dialects the same. The tribes-people recognise some common bond which distinguishes them from other tribes." (Howitt 1904:41).

11 Howitt gives Dr E. M. M'Kinley as his source for this information.

12 Glendon is about 9 km east-south-east of modern-day Singleton. It should be noted that Tindale (1976) mapped the Geawegal north of Muswellbrook.

The precise eastern boundary of "Comnaroy" is uncertain but the previous comments that Kamilaroi extended to Singleton were made relatively late and informants may have included displaced persons who had moved to Singleton from other parts of the Hunter Valley. In addition, Fraser and Greenway were concerned with large-scale language distributions and "about Singleton" may have been precise enough for their purposes. The specific description given in *The Australian* in 1827 is earlier – and potentially more accurate – than the later indications. That is, "Comnaroy" as a local territorial group, probably extended from the confluence of the Hunter River and Wollombi Brook west to the confluence of the Hunter and Goulburn Rivers.

In 1828 Francis Little provided a 'return' of Aboriginal people in the Scone area. He noted that the Tullong inhabited Dart Brook and the Murrawin occupied the Pages River (Little 1828, courtesy Dr Helen Brayshaw).

In 1854 near Scone, Edward Ogilvie (who grew up at "Merton" near Denman) met up with

> *an aboriginal, named Coolan, son of a chief of the once powerful tribe that dwelt in this neighbourhood ... He told how the once numerous tribes of the Camilarrai, who in his boyhood days roamed the plains, and camped in the valleys of this wide district, hunted the kangaroo, sat at the council fires, made war or peace, and were the proud, free masters of the land; how the war-like Marawancal, the Tooloompiklal, the Gundical, and the intelligent tribe of the Paninpikilal, to which he himself belonged, had all ... gradually disappeared...* (Ogilvie 1856:46-47)

Ogilvie's comment suggests that the Paninpikilal occupied the area in the vicinity of Scone which is at odds with Litte's report that the Tullong occupied Dart Brook. At the late time in the contact period it is possible that Coolan had been displaced from his original country and "this neighbourhood" may have referred to an adjacent territory.

Referring to Gammon Plains (the Merriwa district) Breton (1833:96) noted several groups, including the "Gullingal" which may be the same as "Gundical" reported by Ogilvie (1856:46-47).

Little is so far known of group affiliations within the sandstone country south of the Hunter Valley and inland from the coast. Threlkeld (in Gunson 1974:257) referred to the "Wallumbai", as did Breton ("Wallombi") (1833:90-91). Wood noted references to Aboriginal people from Wollombi and indicated that their territory extended as far west as Martindale Creek (Wood 1972:113-114,138). In 1845 Dunlop referred to the Wollombi, Elalong (located south of Cessnock) and MacDonald River "tribes" (Miller 1985:50).

Two other writers also suggest that there may have been a group of people in the sandstone country south of the Hunter River and west of the Wollombi group. During John Howe's 1819 expedition with the Aboriginal guide Myles Howe noted that when near Jerrys Plains Myles "... would go no further for fear of the strange blacks they had seen..." (Wood 1972:12). This comment suggests that Myles had entered the country of a substantially different Aboriginal group with whom he had no affiliation[13]. Additionally, Wood writes

> *On Howe's return to the Hawkesbury side of the watershed a native ... told him that Myles had taken them the difficult way. He said there was an easier way to Coomery Roy where the river was bigger and tidal ... there was a way through Wollombi and Wallis Plains*. (Wood 1972:12)

This route along Wollombi Brook may have been through country which Myles was not allowed to travel, so Wollombi Brook might have been in separate territory to Doyles and Martindale Creeks.

In 1825 Peter Cunningham noted that, following an Aboriginal attack on a hut on Martindale Creek, Aboriginal people visited their "kinsmen" of the Richmond "tribe", returning via Putty (Wood 1972:113-114). This comment suggests that people in the sandstone country of Martindale Creek were affiliated with other groups to the south.

In the late nineteenth century Mathews reported that Darkingung was a dialect of the area including Wollombi Brook, Putty Creek, and the Macdonald, Colo and Hawkesbury Rivers. He also stated that "...it is probable that in former times there were others ... which have entirely disappeared at the present day..." (Mathews 1897:1). This implies that there were several dialects within this extensive region of sandstone country, and if the model put forward here is correct, then this sandstone region may also have been occupied by several territorial groups.

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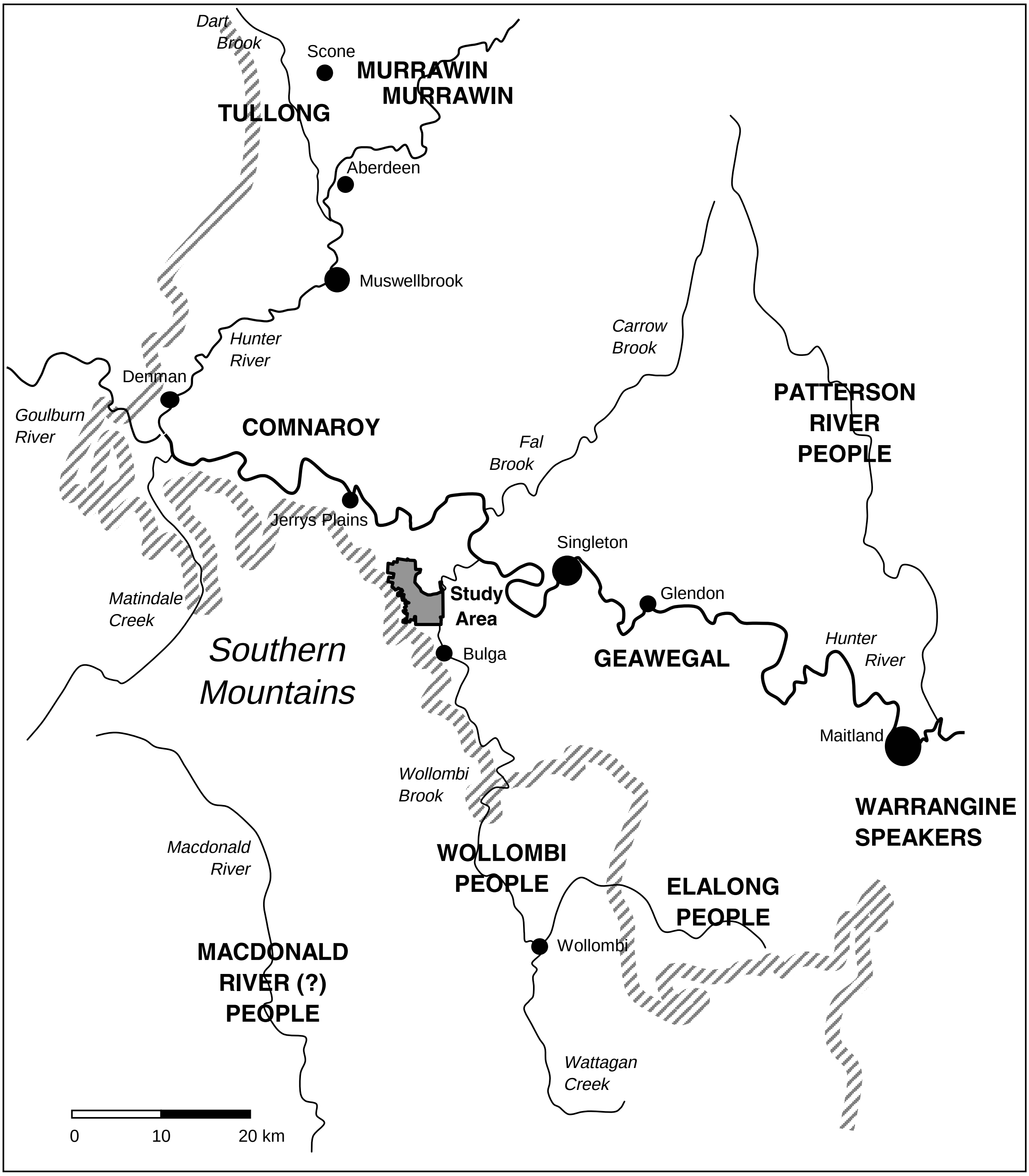
[13] In 1820 Howe and a party, along with Myles and another Aboriginal guide Mullaboy undertook another expedition, again via Putty and Howes track of 1819, but this time they branched off to enter the Hunter Valley via Bulga and the lower part of Wollombi Brook (Wood 1972:13). Myles participation in this expedition in country which he had not visited in his previous trip may have been due to the presence Mullaboy.

The evidence for the number and distribution of named territorial groups is not entirely clear. The best sense that can be made of the evidence is for several groups within the central Hunter region, as indicated roughly on Figure D-20. Evidence for the boundaries of these groups is even more tenuous. Of most interest for the present study, however, is the possibility that the lower Wollombi Brook and the Wambo study area may have been at the intersection of at least three groups: the Geawegal to the east, a Wollombi group to the south, and the Comnaroy to the west. A fourth group may have occupied the sandstone mountain country south-west of the Wambo study area.

Figure D-20
Approximate Locations of Territorial Groups



D6.3 GROUP COMPOSITION AND INTERACTION

Various comments indicate that the territorial groups were not strictly descent or clan groups, but variously included visitors from other areas. Following investigations at Karuah Aboriginal Reserve, Enright (1932:75) referred to these groups as "hordes". In the vicinity of Raymond Terrace McKiernan (1911) writing late stated

> *All the members of the tribe were apparently related to each other in some way, and called each other by terms of relationship denoting brothers, sisters, mothers, or fathers. What individuals were thus styled or whether all the members of the tribe came under one or other of these titles, my informants are unable to say for certainty. The terms were certainly wider than ours, as others were called fathers besides the real father, and so with the other terms. Whether any blood relationship existed between those so styled there is no information ...* (McKiernan 1911:886)

In the historical sources there are many specific examples of people moving from one area to another, including women (via exogamous marriage), messengers, and people travelled to attend ceremonies, to settle disputes, to teach songs and dances, and for other reasons.

In the Hunter region, Threlkeld noted of the Awabakal in the Lake Macquarie - Newcastle area

> *The natives here are connected in a kind of circle extending to the Hawkesbury and Port Stephens*. (Threlkeld in Gunson 1974:186)

Various groups also appear to have been linked via a more complex network extending along the coast, and also further inland into the valleys and ranges towards Barrington Tops, and along the Hunter River towards the Singleton area. Unfortunately, most of the observations were made for the coastal areas, and little information is currently available from further inland along the Hunter Valley.

Marriage was exogamous between the named groups, with women moving to live with their husbands (Breton 1833:202; McKiernan 1911:887; Miller 1887:353). Several observations were made about the movements of women between groups. The available observations indicate links between the people around Lake Macquarie, Newcastle area and Port Stephens, between Port Stephens/Raymond Terrace and Patterson River, between Patterson River and the Williams River and Gloucester area to the north.

Howitt (1904) reported that the people of the Williams and Chichester Rivers

> *intermarried with the people of the Paterson River on the one side, and those of Gloucester on the other*. (Howitt 1904:85)

Rusden reports that the Geawegal

> ... *spoke the language of, and intermarried with, those (people) of Maitland. Less frequently with those of the Patterson River, and rarely with those of Muswell Brook...* (Rusden 1880:279)

People travelled to attend ceremonies around the region (Howitt 1904:576-577; McKiernan 1911:888; O'Sullivan White 1934:223; Threlkeld in Gunson 1974:192,206). These observations support interaction between coastal groups and people from the Williams River and Gloucester areas; but there is a paucity of observations relating to the central and upper Hunter Valley.

Peterson (1986) pointed out that the use of messengers, who guaranteed safe passage when travelling into other groups' territories, was additional evidence for the discreteness of bands (local land-using groups). Messengers travelled throughout the Hunter region and were distinctly attired; several writers noted their presence, and/or described their appearance and behaviour (Howitt 1904:689; Mathews 1896:323, 1897:3-4; McKiernan 1911:888; Rusden 1880:283-284; Scott 1982:10-11; Threlkeld in Gunson 1974:98). Unfortunately, few writers detailed the travels of messengers; Threlkeld provided geographic information for only two instances on the coast (Threlkeld in Gunson 1974: 55, 98).

A number of observations indicated conflicts between groups and sometimes links between groups in the settlement of disputes (Dawson 1830:77, 132, 275; Scott 1982:8; Threlkeld in Gunson 1974:58, 104, 191, 201, 226, 255, 272; Warner in Gunson 1974:172 Endnote #48). Again, most observations relate to interactions between coastal groups, with the Wollombi people mentioned a couple of times: in 1833 a party from Illarong, and one from the "Wallombi" were on their way to wage war on another "tribe" (Breton 1833:90-91). In an another fight which took place on the Wollombi between two "tribes", four men and two women of the "Comleroy tribe" were killed (Breton 1833:203). In August 1835 the "... Wallumbai and Ravensdale ..." people intended to attack the Awabakal (Threlkeld in Gunson 1974:257).

Doctors, songwriters and dance instructors travelled widely (Scott 1982:14; Threlkeld in Gunson 1974:57).

> *There are poets among the Aborigines of New South Wales, who compose songs, which are sung and danced to, by their own tribe, in the first instance, after which other tribes learn the song and dance, being taught by itinerant professors, who go from tribe to tribe, throughout the country, until from the change of dialect, the very words are not understood correctly by distant blacks*. (Threlkeld in Gunson 1974:57)

Observations of various other travellers were made (Dawson 1830:159; Grant 1803:155-158; Threlkeld in Gunson 1974:47, 56, 97, 101, 159, 241). Most reports relate to the coast and confirm travel between different coastal areas within the region. Also noted are travellers from further away, including from the Sydney region and vice versa. A few observations relate to the central Hunter Valley: in the late 1820s, on the death of an old man, an Aboriginal from "... the upper part of the Hunter's River ..." visited Port Stephens (Dawson 1830:292); and in 1826 a number of people from the Mudgee area visited the central Hunter Valley (Scott and Macleod 1826:610). There was also a late report that Aborigines from the Singleton area visited Gosford on Brisbane Water, and neighbouring shores, for marine foods; they followed the Boree Track which traversed Wollombi Brook and the Macdonald River to Mangrove Mountain. The Gosford natives probably returned the visits (McCarthy 1939:407; Moore 1981:423).

The importance of inter-group contact was reflected in the exchange of material objects:

> *The grass-tree, which furnishes material for their spears, grows on the sea coast, whence large bundles of manufactured spears are sent into the interior; those who send them receiving in return hanks of line, spun by hand from the fur of animals of the oppossum tribe.* (Threlkeld in Gunson 1974:42)

"Opossum rugs" were also obtained from the interior (Threlkeld in Gunson 1974:61). Similar information was provided by Dawson at Port Stephens:

> *... exchange of articles sometimes took place between the coast-natives and those residing in the interior. Iron tomahawks, sea shells, with which they scrape and sharpen their spears, and pieces of glass, which they use for that purpose whenever they can get them, were frequently exchanged for opossum skins, and sometimes for the belts of yarn ready manufactured, as well as a small oppossum band of net-work …The oppossums are more numerous inland than they are near the coast, and this is the reason why such exchange takes place.* (Dawson 1830:135-136)

Long-distance exchange with people from the north-west was also noted:

> *The myall wood weapons made at Liverpool Plains were exchanged with the coast natives for others (myrtle, &c.) which were made on the Hunter* ... (Rusden 1880:280)

In the Scone area in 1828 Little noted "... a very strong tribe which we sometimes see belonging to the Liverpool Plains ..." (Little 1828, courtesy Dr Helen Brayshaw).

Wood was of the view that the area around Jerrys Plains/Wollombi Brook - the border between the Geawegal, Comnaroy and Wollombi people - was a place where groups met to 'trade' (Wood 1972:137). Mr Greenhault, who lived at Greenhault Farm for 86 years, reported that as a boy, he had heard the "old hands" state that the local tribe used to meet the coastal tribe outside the Greenhault house (134, 939) on the bank of Wollombi Brook, to barter and do battle (Dyall 1981:4). Brayshaw *et al.* (1996:21) also reported that Mr Puck King had ploughed up marine mussel shells on his farm – Appleyard Farm – about 2 km north-east of the Greenhault orchard. Mr King believed that these shells were brought from the coast as items for exchange; although this was not an independent idea, as Mr King had discussed this with Mr Greenhault.

D6.4 USE OF GROUP TERRITORIES

Within the defined territories it seems that the groups were "... divided into a number of local groups, living apart from each other in camps, scattered over the whole tribal territory..." (McKiernan 1911:886). Howitt (1904) reported something similar

> *the ... Gringai ... lived ... about Dungog*[14]*. They were distributed over the country in local groups called by them "Nurra". ... There were Nurras all over this district, at convenient distances apart, each of which consisted of six to nine huts, or families*. (Howitt 1904:85)

General descriptions of life-way hint at a forager organisation, in which people moved to live near available resources.

> *At one season of the year they assemble at a place where they can all procure oysters, and sometimes they meet, as they say, to "patter bungwall", or fern-root, at other times they meet where they can all feast upon menmy, or gigantic lilly, when in season, or upon the kangaroo.* (Dawson 1830:326-327)

Threlkeld too noted

> *...the employment of the natives, viz. hunting and fishing necessarily lead them to frequent change of place in search of sustenance.* (Threlkeld in Gunson 1974:42)

Writing generally of central-eastern NSW, Breton (1833) noted that

> *... Although each tribe is limited to its particular district, within that tract of country they are far from confining themselves to one spot, ... being compelled to move from one place to another in order to obtain subsistence ... (T)hey change their stations according as the season may answer for catching fish at the different places; their food also consists of kangaroos, opossums, guanas, snakes and a species of worm. ... While the natives on the coast subsist chiefly on fish, those in the interior are more expert at catching the various animals of the forest; but the root of the fern, called Bungwhaul, is eaten by them generally*... (Breton 1833:216-217)

Ebsworth noted change in use of resources when living in different areas

> *Their food consists of fish when near the coast, but in the woods of opossums, Bandicoots, and any other animal they may spear or catch, also of a kind of grub found in decayed wood. Should they perchance spear a kangaroo, they have a regular feast ...* (Ebsworth 1826:79-80; courtesty Dr Helen Brayshaw)

A third-hand suggestion of seasonal variation in the use of a group's territory is provided by Enright (1932)

> *... the late John Hopson stated that he had been informed by the late J. W. Boydell that in summer time the Paterson River blacks ascended the Barrington Tops via the Allyn River Valley...* (Enright 1932:76)

Some observations indicate that people had preferred locations, although it is possible that this could have been in part a response to the contact situation. At Lake Macquarie Threlkeld noted that the Awabakal occupied an area from Reid's Mistake (the entrance to Lake Macquarie) northwards to Newcastle and the Hunter River. However, within this territory the Awabakal's "usual place of resort" was Newcastle and Lake Macquarie (Threlkeld in Gunson 1974:241). This suggests that the Awabakal tended to focus residential occupation within specific locations, akin to "collectors" (see Section 6.2).

At Port Stephens, Dawson (1830:63) noted "... When away from this settlement, they appear to have no fixed place of residence ... " indicating that they were more sedentary in the vicinity of the European settlement. In rugged country north of Port Stephens Dawson found

> *At the foot of one of these hills, and at the margin of a brook, we met with a native encampment, consisting of eight or ten gunyers. ... (T)hey seldom, however, stay more than a few days at these places, frequently not more than one night. ... (T)he freshness of the embers, the bones of the kangaroos, and the pieces of recently broken spears which lay scattered about, convinced us that they must have inhabited only a few days before. We found a bundle of spears also standing against a tree, which was a strong indication that the tribe intended to return*. (Dawson 1830:171-172).

This description appears to be of a residential site occupied in a transient manner. For the Scone district, Bridges stated the people "... frequently shifted camp ... (Bridges 1959:130).

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[14] Howitt gives J. W. Boydell as his source for this information.

Even though there was a tendency for prolonged occupation of certain locations, there does not seem to have been continued occupation of individual residential sites. Of the Awabakal Threlkeld said

> *The natives have removed their camp a third time to a place a little more distant from our house; the reason why they are so continually on the shift is not easily assigned. One gave for a reason the quantity of fleas that accumulate when they continue long at one place*. (Threlkeld in Gunson 1974:89)

The period of time over which the three moves were made was not reported, but it may refer to the time which had elapsed between the 11th May and 29th May 1825 being the period from when Threlkeld returned from a trip to Sydney to the date of the report (ie. three moves within a period of 18 days or so).

Scott also reported

> *Sanitation was unknown to the tribe, with most unpleasant consequences when a camp had been established at one spot for some length of time. Any danger that might have arisen through residence in malodorous and unhygienic environment was avoided in a very simple and practical fashion. When the camp became so noisome that even the accustomed noses of the inhabitants revolted, the tribe would gather up lares and penates and move in a body to another site, distant beyond smell of the old homes. Nor would they return to the original spot for months*. (Scott 1982:13)

People also moved camp within their territories for other reasons; following a death at Lake Macquarie

> *At this moment, there is not a black within seven miles of us. One man died suddenly in the camp, the day before yesterday, and every one has fled for a short season*... (Threlkeld in Gunson 1974:97)

There is very little description of sites occupied during the course of day-to-day activities. Threlkeld reported details of a kangaroo hunt and the use of a day-time camp

> *...when the sun is fully up, the whole tribe prepares for the hunt by taking their spears, throwing sticks, hatchets, and fire-brands, proceeding to the hills, they scatter themselves so as to surround a valley, leaving the entrance guarded by several good marksmen armed with spears. The surrounding party then begin to enclose shouting with all their might, but still in regular time. The Kangaroos and other animals become alarmed and make towards the entrance of the valley, where a shower of spears transfix them in their endeavour to escape.*
> *... Having obtained a sufficiency for their craving appetite, a fire is kindled on the spot and the animals are grilled, and as the flesh becomes partially cooked it is torn off, and eaten ... and when the whole is devoured and the party gorged, they have a smoke[,] lie down and go to sleep*. (Threlkeld in Gunson 1974:46)

Between the Williams and Karuah Rivers Ebsworth encountered

> *a group of three women and two children ... They were eating fern root, which they call Bungwall, they roast it in the ashes and pound it between two stones; this forms a paste of which they are exceedingly fond ...* (Ebsworth 1826:70-71, courtesy Dr Helen Brayshaw)

In general, the above comments suggest that people in the Hunter Valley were essentially foragers, moving to new areas to obtain food and other resources. In some cases, however, it seems that some groups had preferences for certain locations and may have spent relatively more time at them, using hinterland areas in a more transitory manner.

D6.5 DISCUSSION

From the above information it is not possible to say which Aboriginal group/s might have had control over the Wambo study area. The boundaries of the territorial groups are not certain but it is possible that the Wambo study area is located near the borders of the Geawegal, Wollombi, Comnaroy and possibly the Macdonald River or other group occupying the sandstone country to the south-west. The area around the confluence of Wollombi Brook and the Hunter River would have been conveniently located for meetings of these groups.

It is likely that the Wambo study area (or much of it) fell within the territory of one of these groups and that it was occupied as part of the daily or seasonal round of the group. It would probably have supported a combination of transient residential sites as well as day-time sites; though the possibility of more sedentary occupation in certain favoured locations should not be discounted.

Based on the available evidence this social model applies to the Hunter Valley in the recent past. Changes over time in stone artefact assemblages have been documented at shelter sites in the sandstone mountains south and west of the Hunter Valley. These changes have been summarised as the Eastern Regional Sequence and while there has been debate about the timing of these changes there is an agreement that change occurred (Attenbrow 1987; McDonald 1994; White 1999b). The changes have been interpreted as a result of change in mobility arising from change in social organisation (Hiscock 1994; McDonald 1994). The social model indicated by historical observations could apply to the Late Bondaian phase immediately preceding European occupation of Australia. A different form of social organization could have applied during the Middle Bondaian and earlier times.

D7 ARCHAEOLOGICAL CONTEXT

D7.1 OCCUPATION MODELS

D7.1.1 Archaeological Models

In a recent survey within the adjacent Warkworth West area Nightingale *et al*. (2002) outlined a model of forager organisation, referring to the work of Foley (1981) and others. They argued that the model applied to the Warkworth West area.

Essentially, world wide studies have identified two kinds of hunter-gatherers: collectors who moved resources to people, and foragers who moved people to resources (Binford 1980). Collecting was appropriate where resources were concentrated in time or space, especially in cool temporate, boreal and arctic climates where there was increased dependence on animal and aquatic resources (Binford 1990). Collectors tended to live for extended periods at certain residential bases, and stored food for at least part of the year. They sent out special task groups to obtain particular resources located away from the residential base. These task groups set up field camps or stations from which field operations were planned. Food and other resources were obtained and processed, and sometimes temporarily cached or stored, before being taken back to the residential base (Binford 1980:10-12).

Foragers did not store food, but gathered this daily. Foraging was appropriate where resources were generally available but scattered, as in low latitude areas (equatorial and semi-tropical climates) where people had a higher dependence on plant foods (Binford 1990). Foragers occupied residential bases for short periods of time, foraging in the area surrounding the camp. As resources were depleted they shifted their residential camp and foraging area to a new part of their territory. Group size and the number of residential moves varied considerably, perhaps related in part to the nature and physical distribution of resources in the area (Binford 1980:5-7).

Witter has suggested a collector model for the Hunter Valley, with one or more base camps near the Hunter River or its major tributaries. He interpreted most open artefact scatters in the valley as being peripheral to these base camps, men having ranged widely from the base camps to hunt (Kuskie and Kamminga 2000:221). However, most writers who discuss occupation models for the Hunter Valley prefer a forager model to a collector model.

In the Warkworth West study a forager model was detailed. It suggested that residential sites would have been occupied for a few days at a time and tasks such as resource extraction would have been carried out at activity locations in the surrounding foraging area. Residential sites would have been located in parts of the landscape with good access to the widest range of subsistence resources and with the greatest amenity for camping in the local area. It was suggested that creek valleys with reliable fresh water offering protection from extreme weather conditions would be favoured; and that high order streams may have provided more reliable water and attracted more return visits than small low order streams. Residential sites would have been occupied for a few days until surrounding resources were depleted. The report authors argued that it should be possible to distinguish the two types of sites by the nature of their lithic assemblages and by the presence of features. In brief, residential sites should have diverse and rich assemblages because of the great range of activities carried out including tool production, while activity locations would have few artefact types as these sites served few and specific activities (Nightingale *et al*. 2002:25-28).

Ethnographic study amongst Aboriginal people in northern Australia (Meehan 1982, 1988) found that residential sites were places where people slept, ate breakfast and an evening meal. During the day, people who did not take part in foraging expeditions remained at the residential sites carrying out manufacturing and maintenance tasks, sleeping or caring for small children. However, people who went on foraging trips usually occupied 'dinner-time' sites. These were campsites occupied during the day when people were away from their residential sites, engaged in hunting and collecting trips, and at which people cooked and ate food that had been procured up until that time. Meehan notes that archaeologists have tended to dismiss such sites as small and of little value but in fact "... They were a well thought-out cog in a complex foraging strategy – not an isolated, random event." (Meehan 1988:171). While conditions in northern Australia will have differed from those in the Hunter Valley, non-residential day-time sites might have been important in settlement organisation.

Nightingale *et al.* (2002) argued that if creeks were the focus for residential occupation – or other day-time sites – then the sequential positioning of foraging areas along valleys over several millennia would have resulted in a continuous archaeological distribution close to creeks reflecting domestic and maintenance activities on residential sites. Archaeological evidence on the upper slopes, ridge lines and less domestically amenable areas up to several kilometres from residential sites would reflect activity locations. The commonly reported pattern of archaeological evidence in the Hunter whereby artefact distributions are concentrated close to creeks and highly dispersed away from creeks could be explained by this model. Apparent departures from the model were noted by the authors but they argued that such cases "present significant opportunities for research" (Nightingale *et al.* 2002:27).

Haglund (2001) has suggested of an "aggregation and dispersal" model (cf. Poiner 1976; Veth 1993). She noted that many of the creeks consisted of chains-of-ponds. During wetter periods (or good seasons) when small drainage lines were running and/or contained fresh water, and vegetation was abundant, family groups would have visited and camped at favoured locations. Moving meanders and new waterholes cut by erosion would have kept creating new opportunities for resource extraction. Women would have foraged for plants, small animals and raw materials (e.g. for dillybags), sometimes preparing resources at camp, while men might have made or repaired tools or went hunting. During dry periods surface water would have been scarce or absent along smallish drainage lines and what was present may have been brackish or salty. In really dry times potable water may have been available mainly in the major rivers, by digging into the sandy beds. During such dry times families and groups of families would have congregated and based themselves close to the rivers and their essential water supplies (described as "drought refuge water supplies" by Dean-Jones and Mitchell 1993:60). Smaller drainage lines would have been visited, probably briefly by small groups such as men's hunting parties or women's foraging groups. Their activities might have included procuring and preparing resources, waiting at hunting blinds or lookout spots, and a range of artefacts, raw materials and debris might have been discarded (Haglund 2001:43-44).

Each camp may have been fairly small in extent but as camps were sited in new locations, or occasionally overlapped with previous camp sites, they would have resulted in a semi-continuous spread of stone artefacts across the area. Re-use of locations for different purposes could have resulted in different types of artefact assemblages (Haglund 2001:43-44). Extensive sites on Doctors and Sandy Hollow Creeks – which are 3rd order streams – were interpreted by Haglund (1992) as having resulted from numerous brief visits by small groups of people, possibly spread over the past few thousand years. Thermoluminescence dating of valley fill sediments on these creek flats indicated that the present land surfaces formed during the Holocene and some may be only a few thousand years old (Haglund 1992:46ff; Fahey 1994:23f).

McDonald (1994) has argued that during the Holocene changes in stone artefact and art assemblages have been identified at many shelter sites in the sandstone country south and west of the Hunter lowlands. She argued that the changes reflected changes in peoples' mobility. During the Late Pleistocene and Early Holocene people were considerably more mobile and in the latest phase of prehistory – the last 1,000 years or so – people were residentially more sedentary. Hiscock (1994) has made a similar suggestion for much of Australia generally. The archaeological evidence on open sites might therefore have resulted from both recent and earlier forms of settlement organisation.

D7.1.2 Choice of Site Locations

The early historical evidence provides little information on the kinds of locations chosen for residential use. Dawson reported the locations of three residential sites. In rugged country north of Port Stephens he noted that a "native encampment" was located on the edge of a creek at the foot of a hill. Further on during the same trip and within rugged country another encampment was seen on top of a small rise (Dawson 1830:171-172, 182). In the Myall Lakes area Dawson noted another camp on the border of an extensive lake (Dawson 1830:245).

Nightingale *et al.* (2002:26) argued that residential sites were likely to have been located in parts of the landscape with good access to the widest range of subsistence resources, and with the greatest relative amenity for camping in the local area. They argued that people would have avoided cold air flow, while favouring protected sunlit locations, and be close to reliable and renewable resources, principally fresh water. Creek valleys would have been favoured over exposed floodplain and high riverbank locations for residential use. The degree of environmental reliability (eg. permanent water as opposed to intermittent streams) may have influenced the rate of return to sites and hence the complexity of evidence. They suggested that higher order streams may have offered more reliable resources attracting more frequent residential camping than intermittent creek valleys in extreme environmental conditions such as drought.

Nightingale *et al.* (2002:27) also suggest that upper slopes, ridge lines and less attractive areas up to several kilometres from residential sites would have been occupied briefly as activity locations.

In northern Australia Meehan (1988:172) noted that meal-time sites were usually located in pleasant places, with good shade, fresh water, a pleasant outlook, a gentle breeze, and access to certain types of food. However, the membership of foraging groups influenced the location form and content of dinner-time sites, and some occupied by women only could be located in stressful areas such as on sun-baked black soil plains far from home bases during the late dry season when it was very hot and fresh water was scarce (Meehan 1988:174).

Of the Redbank Creek archaeological survey (a 3rd – 4th order stream) Koettig and Hughes (1983:21) noted that 90% of sites were found along creeks and only four sites were more than 100 m from creeks and they were found on ridge top saddles. They also noted that the frequency of sites was much higher along Redbank Creek than along its smaller tributaries.

A general distribution pattern, of large sites along creeks was reported by Brayshaw and Haglund (1994:13). They noted that at Warkworth large sites were found along Doctors and Sandy Hollow Creeks (3rd order streams), occurring near the creeks, and extending away from them over adjoining flats, appearing to fade out at or just above the intersection of creek flat and footslope. Small sites consisting of a few artefacts were found in erosion scars on ridge tops, flanking the upper end of small gullies, and some on lower slopes, fairly close to water sources. Tiny sites occurred on slopes but only where the headwaters of a stream started to appear; ie. where some surface water was likely to have been available.

While the above models emphasise availability of fresh water, for the Lemington area Dean-Jones (1992) (Section 8.2) argued that site distribution and character related in part to stone material supply, not necessarily to distance from water supply. Other controlling environmental factors may have been gradient, aspect and substrate rather than distance from water (Kuskie and Kamminga 2000).

Dean-Jones and Mitchell (1993:59) noted that the distribution of archaeological evidence along creek lines appears to be virtually continuous, but (at that time) far fewer sites had been recorded on landforms remote from drainage lines. They noted that occupation could have been associated with ridgelines because they provide linkage routes across the landscape and elevated positions which may have been favoured for their sight lines (lookouts). They considered that steep side slopes may not have been used as occupation sites but there was no information on what a limiting angle might have been. Dean-Jones and Mitchell also considered that elevated terraces and other mid-slope positions might have been favoured over valley floor positions because of winter temperature differentials (cold air drainage and frost hollow effects), or because summer breezes may have reduced insect nuisance problems (Dean-Jones and Mitchell 1993:59) or provided relief in hot weather.

D7.1.3 Numbers of Artefacts and Activities

The occupation models (and some of the definitions for what constitutes a site) tend to relate large numbers of artefacts to residential sites and/or repeated visits, and small numbers of artefacts to non-residential activities carried out in surrounding foraging areas. It is likely that large numbers of artefacts will indeed indicate repeated or intensive occupation, but numbers of artefacts may also relate to the nature of the activities which were carried out; as well as to accidents of ground exposure and visibility (see below).

In a recent literature review and detailed analysis of a lithic assemblage White (1999a) investigated numbers of artefacts relating to different kinds of activities. Some activities resulted in the discard of very few artefacts while others resulted in many artefacts (Table D-4). Systematic core reduction, especially with backed artefact production, was the single most prolific producer of stone artefacts away from quarry sites.

It has generally been accepted that stone tool production (especially systematic core reduction on knapping floors) occurred on residential sites. However, this is by no means certain. Rich (1992a) argued that most knapping floors at Narama were close to major streams or close to waterholes along minor streams. Many knapping floors were so close to water that they were seen eroding from creek banks. Knapping floors include many sharp artefacts and it is highly questionable whether these kinds of activities would have been carried out in the midst of domestic areas used for cooking or sleeping. The apparently intact spatial structure of many knapping floors may be further indication that they were not located in areas which would have been subject to scuffage or swept clean of sharp debris. It is possible that knapping floor activities were carried out at pleasant spots (such as on creek banks), away from domestic areas.

Table D-4
Activities and Artefact Numbers (from White 1999a:49ff)

Activity	Range of artefact numbers in literature & on Site W2
Stone procurement	Highly variable, e.g. depending on whether bedrock was quarried or suitable cobbles carried away
Early stage reduction, including testing & preparation of cores	Highly variable depending on the shape of stone, its physical condition, its quality, required size etc.
Transport	Limited to what could be carried
Discard without on-site flaking	Limited by what could be carried, but also affected by on-site activities. Generally small numbers of artefacts
Limited stone reduction	One or a few flakes. 1 to <10 artefacts
Systematic core reduction	Numerous. >10 artefacts + small debitage. Sometimes several thousand on knapping floors.
Tool production	Variable, depending on type of tool being made.
Hafting	Few (?) stone tools used to process resins
Tool use	Variable
Tool maintenance	Few (?) flakes from sharpening tools
Storage or caching	Few

It should also be noted that knapping floors on which backed artefacts were made may have been relatively limited events in time. Analysis of dated shelter assemblages indicate that most backed artefacts were produced during the Middle Bondaian phase between 1,000 and 4,000 years ago (Jo McDonald CHM 2001:463-465). If this dating also applies to the open Hunter Valley then many of the knapping floors might have resulted from activities limited in time. Further, if changes over time in stone artefact assemblages related to change in social organisation (Hiscock 1994; McDonald 1994) then knapping floors could relate to a form of organisation which differed from that of more recent times.

Historical records indicate that at the time of European occupation much use was made of wood, bark, other plant materials and fur, to make string, containers, digging sticks, spears and clubs (Brayshaw 1986). Stone tools would have been used to make these wooden items, and perhaps to clean skins or to strip fur from animal skins. Most of the stone tools could have been made during limited stone flaking (reduction) and tools might have been maintained (retouched). Stones (such as cobbles with smooth cortical surfaces) might have been used to pound nuts or fern roots, and chopping tools could have been used to obtain wood. Very large numbers of artefacts like those produced on knapping floors would probably not have been discarded during such tasks.

D7.1.4 Stone Artefacts and Landscape Use

A body of theory that links stone artefacts with behaviour and use of landscapes has been discussed for some time, particularly in the overseas literature. Much of the discussion has been framed in terms of mobility and stone rationing strategies (how people organised their use of stone tools by considering how they moved around the landscape). Kelly (1992) has noted that there are different kinds of mobility which operate at different spatial scales:

- Off-site mobility - moves between residential sites and off-site activity locations.
- Residential mobility - moves from one residential site to another.
- In some circumstances, seasonal mobility - moves from one district to another to make use of seasonally-available resources.
- Long-distance trips, for example to attend ceremonies, to visit relatives and friends, etc..

In the Wambo study area several dimensions of human mobility may be relevant because:

- Residential sites may have been occupied (eg. along Wambo and North Wambo Creeks) and people may have made day-time trips into the adjoining hinterland to forage for resources or to carry out other tasks.
- People might have moved from one residential site (eg. on Wambo Creek) to another (eg. on North Wambo Creek).

- People might have moved in and out of the Wambo study area depending on the seasonal availability of resources such as cycad nuts and kurrajong seeds, or in response to good seasons or drought conditions.
- People might have travelled through the Wambo study area during long-distance trips to attend ceremonies in the area surrounding lower Wollombi Brook.

The kind and degree of mobility influenced how stone was used and discarded, through the operation (or otherwise) of stone rationing strategies. The way by which stone rationing strategies related to distance from stone sources, mobility and occupation of landscapes has received much attention in the literature (e.g. Bamforth 1986; Byrne 1980; Henry 1989; McNiven 1993; Morwood and L'Oste-Brown 1995; Newman 1994; Odell 1996; Stevenson *et al*. 1984; Summerhayes and Allen 1993). The following discussion is based on a recent review (White 1999b).

Procurement of stone raw materials was related to mobility, social and settlement organisation (Binford 1979; Lurie 1989). There might also have been social (or cultural) rules about who had access to certain stone sources and how stone could be distributed and discarded (cf. Paton 1994). Stone raw materials suitable for use as tools do not occur evenly across most landscapes, but had to be obtained from certain locations. The amount of stone which could be procured was limited by the amount available and the amount which people could carry at any one time. Stone raw materials could be obtained while carrying out some other activity in the vicinity of a stone source (embedded procurement), or by special-purpose trips to stone sources (logistical procurement) (Binford 1979). If people changed their mobility patterns then this could affect their access to stone sources (McNiven 1994). In the Wambo study area quartz and quartzite occur naturally in some locations, but silicified tuff and silcrete – the two main raw materials used – are sourced beyond the Wambo study area (Figure D-2). Not all parts of the Wambo study area are equally distant from the known sources of these latter materials, so access to these sources could have affected use of these materials within the Wambo study area.

In theory, if stone was available close to sites where tasks were to be carried out then short trips could be made and stone carried back as needed. On sites close to stone sources, stone of various flaking quality may have been readily obtained, often with cortex. There would have been relatively little need to conserve stone materials, and cores and tools with some further utility were often discarded (Byrne 1980). On the other hand, if stone sources were distant from task sites then more limited amounts could be carried back. Under these circumstances, transported stone may have been in the form of prepared cores, tool blanks or formal tools, and of good quality (Binford and O'Connell 1989), otherwise transported stone might be wasted during rough shaping of cores or tools. That is, under constraints imposed by distance from sources, stone materials were usually rationed (Byrne 1980).

People who made trips (either day-time trips away from residential sites, or residential moves) could carry only a limited amount of equipment. Hence, stone rationing was also important under conditions of high mobility; that is, when people made frequent residential moves, or made trips from residential sites to other locations in the landscape. When moving to new residential sites people had to be able to carry with them all the things they would routinely use and did not wish to replace immediately. When making trips from residential sites to locations in a foraging area the full suite of equipment did not have to be carried, but items needed to meet personal needs and to carry out the jobs at hand would have to have been carried. Depending on the kinds of jobs that were to be done, people might also have had to carry resources or items back to their residential base (Nelson 1991).

If mobility, social or settlement organisation changed, and people changed their access to stone sources, then the adoption of or changes in rationing strategies may have occurred. For example, logistically mobile people (that is, people making long-distance trips) might have been able to visit distant stone sources and obtain stone on a regular basis. But less mobile people, or people who permanently occupied areas distant from stone sources, may not have been able to make such trips as frequently. They may then have adopted various rationing strategies to conserve stone that was available.

In brief, a number of stone rationing strategies may have been used:

1. Have few types of tools, which were light-weight and multifunctional, and which were not bulky and could be carried easily. Hence, in Australia at the time of European contact, many Aboriginal groups were residentially mobile and had small toolkits and limited possessions (Mulvaney 1975:73).
2. People could have made more use of other types of stone, including poorer-quality local stone (Byrne 1980; McNiven 1993), heat treating it if necessary (Lurie 1989), and using raw materials only for special purposes (Byrne 1980).

3. Stone supplies (cores or tools) could have been prepared at or near stone sources, to reduce to a minimum the amount of stone that had to be carried. Cores could have been prepared ready to produce useable flakes, or tool blanks or finished tools could have been made for transport (Jones and White 1988).
4. Stone supplies could have been conserved by discarding less of the available stone. People could have made more tools than usual out of available stone, by extending reduction and/or making smaller tools (Morwood and L'Oste-Brown 1995). Cores and tools could have been discarded less often, or only when small (having no/little residual utility). These strategies would result in fewer artefacts, lower densities on archaeological sites, smaller artefacts and lower rates of cortex. More 'debitage' could have been used as tools; that is, expedient tools could have been drawn from left-over artefacts from other tool production activities, so the ratio of tools to debitage would be higher. People could have extended reduction by increasing core rotation to find new platforms, flaking cores to exhaustion, or by resorting to bipolar flaking (Morwood and L'Oste-Brown 1995; Odell 1996; Summerhayes and Allen 1993). More successful knapping strategies could have been used, including greater care in platform preparation, establishing core morphology and seeking predictable flake detachments (indicated by focal platforms). More cutting edge per given weight of raw material could be achieved by producing blades (Morwood and L'Oste-Brown 1995).
5. The life of tools could have been increased by increased maintenance (retouch) of working edges (Bamforth 1986; Byrne 1980; McNiven 1993; Morwood and L'Oste-Brown 1995; Odell 1996), by hafting small tools (Morwood and L'Oste-Brown 1995; Odell 1996), or by using tools with greater intensity (Odell 1996b). These strategies would have resulted in relatively higher rates of tools with retouched margins, hafted tools, more used edges per tool, and higher rates of broken tools.
6. Previously discarded materials could have been recycled (Bamforth 1986:40), and tools could have been reshaped to meet current needs (Odell 1996).
7. People could have made increased use of good quality stone, with predictable flaking qualities, so that time and effort wasn't wasted carrying poorer quality stone that would be discarded without use (Morwood and L'Oste-Brown 1995).
8. The materials to be carried from residential sites to foraging locations could be reduced by having tools made ready for use, so that component parts and the items needed to assemble them would not have to be carried as well. A number of archaeologists have argued that curated stone tools met constraints posed by portability. Curated tools were made in advance of use, transported, and maintained; they were long use-life items (Bamforth 1986; Nelson 1991; Odell 1996). Descriptions of the manufacture, use, transport and maintenance of tula adzes (Binford and O'Connell 1989; Gould 1980) indicate that they were curated items. Stone hatchets were also portable multifunctional tools; they were used to obtain and process various foods, to obtain wood, and were carried around (Barton 1992a; Brayshaw 1986; McBryde 1986).

The above points set out strategies for dealing with constraints posed by portability and stone shortages. But rationing was not a constraint where people were residentially more sedentary, or focussed their activities in a smaller area, and were able to acquire more equipment, have more specialised equipment, and stockpile larger quantities of materials (Lurie 1989). Large items, such as grindstones, could also have been stored at frequently visited places (Binford 1979; Gould 1980; Hamilton 1987; Nelson 1991; Webb 1993). Increased sedentism and focus on a smaller area may therefore be indicated by large numbers of tool types, specialised tools and large quantities of materials.

Torrence (1983) and Bamforth (1986) argued that for some activities it was critically important to have equipment ready beforehand. For example, if one was out hunting and saw game, there probably wouldn't be time to make or maintain hunting equipment before the animals escaped (referred to as "time-stress" by Torrence). The equipment would need to be made ready for use before going out to look for game - "scheduled gearing-up" (Baker 1992).

However, people might have routinely prepared equipment before going on resource procurement tasks otherwise they would have had to carry with them the materials needed to repair it or obtain these on the way. If people planned to collect kurrajong seeds from a high ridge top then they would probably take a dilly bag in good condition, rather than an old bag requiring repair, which would have to be mended along the way with bark or *Lomandra* leaves which in turn had to be obtained and spun into cord. If one was obtaining wood and an axe or chopper became dull then it could be resharpened during the task without risking the successful completion of the job – providing that a hammerstone was on hand to remove flakes to sharpen the working edge.

During large gatherings of people (eg. ceremonies) large amounts of food would have to be prepared in advance or obtained at the time from reliable sources. Under these conditions equipment would probably also have been made ready in advance of use.

The kinds of occupation or other activity sites found in a landscape will depend, in part, on how people scheduled their tool production and maintenance activities. While a wide range of stone-using activities were probably carried out on residential bases, different kinds of tool production or maintenance activities might have been carried out in other parts of the landscape subject to resources and when they needed to be obtained. Whether stone tools or other artefacts were discarded or not would depend in part on the kinds of activities carried out, as well as other factors such as whether stone was rationed or not – and whether or not there was any need to carry the stone tools to another place or back to the residential site.

It has been suggested (Nightlingale et al. 2002) that stone artefact assemblages on residential sites were probably more diverse than assemblages from other kinds of locations, because more and varied activities were carried out on residential sites. However, assemblage diversity could depend on the way that activities and tool discard were scheduled. Given the potential importance of dinner-time and resource processing sites a number of activities during which stone artefacts were made, used and/or discard might have been carried out away from residential sites. If plant foods were poisonous before treatment then processing might have occurred away from domestic areas. Processing otherwise toxic foods might also have been carried out away from populous locations. If *Macrozamia* seeds were soaked in a pond to remove toxins then a pond away from residences or frequently visited locations might have been used, otherwise people might have become ill from drinking contaminated water. If kurrajong seed pods were processed to remove the hairs from around the seeds an elevated location with a breeze blowing consistently in one direction might have been chosen – and again, such a location might have been away from congregations of people. Chopping tools could have been used to obtain wood, perhaps also in the hinterland away from domestic sites. Larger tools or potential raw material supplies could have been left in frequently visited or readily identifiable locations for use next time the place was visited (after Binford 1980; Webb 1993). If small assemblages (ie. with few artefacts each) from different locations were considered as a group, then collectively they could might be very diverse, because they could have resulted from a very wide range of tool use and discard activities.

While different factors affected how stone technologies were organised, we must not forget that stone tools were made to do particular jobs, and tools needed to have the right properties to meet task requirements (Torrence 1994). After all, it would be impossible to chop wood with a quartz chip. Different raw materials were suited to different kinds of tasks or tool forms. Fine-grained isotropic raw materials could be flaked to provide sharp cutting margins or points, and were used to produce finely-made flaked tools like backed artefacts and also other tools. Granular tough materials (including igneous and some metamorphic rocks) were suited to heavy-duty chopping tasks and were used to make axes and other large chopping or pounding tools. Large relatively heavy tools, hand-held or hafted, could be used for chopping wood while smaller finger-held tools might have been used to shave, scrape or incise wood (Cole 1996). Hard sandstone and quartzite were good for grinding and these rock types were used to make grindstones used to process seeds, nuts and other plant foods, for sharpening ground-edge axes, and also for use as hammers which in turn were used to flake stone. If skins were to be cleaned then a fine-grained stone with an even edge – but not too sharp or this could cut the skin – would be ideal – a possible function for apparently edge-ground Bulga knives.

D7.1.5 What is a Site?

There has been much discussion amongst archaeologists as to what constitutes a "site", however, much of what has been said has never made it into print.

In 1990 Koettig noted that during surface surveys open artefact scatters are only revealed through some form of ground disturbance which exposes artefact-bearing soils, such as that caused by erosion, tracks, ploughing and so on. The identification of sites in any one area might therefore relate to local conditions of ground exposure. As at 1990 Koettig noted that there had been very few attempts to systematically control for conditions of ground exposure and visibility during surveys. In areas where there is no ground exposure, sites may be present but not be detected during surveys (Koettig 1990:30-31).

Koettig also went on to discuss problems of site definition. She noted that in some cases individual exposures were recorded as sites and in other cases several exposures were grouped to make just one site. Some recorders used an arbitrary definition of "2 artefacts within 50 m of each other", while others defined sites on the basis of artefact density, e.g. more than 1 artefact in 10 m^2, with lower densities classed as "background scatter".

Variations in what constitutes a "site" might well lead to different interpretations of site densities within certain areas (Koettig 1990:31-32).

Dean-Jones (1992) noted that the definition of site boundaries had implications for analysis of site content, interpretation and management (Dean-Jones 1992 s.5.4). For example, if there are several artefact locations across a given land surface are they all separate sites or just "windows" into a single very large site? If the former then individual artefact locations might be interpreted as "background scatter" and dismissed as unimportant. If the area is interpreted as a single large site then it might be imbued with some significance as a favoured area of repeated visits or as an area occupied by a large group of people.

Dean-Jones went on to say

> *The problem of site definition revolves around surface visibility and site structure. ... (I)nvestigations have shown that occupation evidence in the Hunter Valley comprises distinct concentrations of artefacts set within a low density background. Neither the typical spacing of clusters, nor the factors affecting their distribution have been clarified. Nor is it known where and how the density of the background distribution varies. Unless there is 100% surface visibility, and the archaeological evidence is left as a lag on the top of a non cultural substrate after removal of the entire occupation matrix, it is not possible to define site boundaries which are accurate or archaeologically meaningful on the basis of surface survey. Site boundary definition is therefore arbitrary.*" (Dean-Jones 1992 Section 6.4)

At the time Dean-Jones was writing there had been several major excavation projects at Bulga and Camberwell (Koettig 1992, 1994), at Narama (Rich 1992a), and also that which Dean-Jones herself was conducting at Lemington. Those investigations on or near valley floors variously revealed high density artefacts concentrations (sometimes interpreted as knapping floors) in locations where high artefact densities were present on the ground surface but sometimes also buried adjacent to ground exposures where few artefacts were visible on the ground surface. The excavated artefact concentrations were impressive, sometimes containing several thousand artefacts within a few square metres. It was recognised that if knapping floors were exposed on an erosion scar then it might have appeared that a large site had been found. If very few artefacts were visible then it is possible that knapping floors were present but had simply not been exposed through some chance accident.

Dean-Jones offered a practical solution and suggested the following criteria to define sites and arbitrary site boundaries:

(a) Presence on the surface of flaked stone material.

(b) If only one piece of flaked stone is visible, and no other material is visible within 50m, the fragment is regarded as an isolated artefact. If a single piece of flaked stone is within 50m of other stone, the two areas are regarded as one open (camp)site.

(c) Where several concentrations of artefacts occur in close proximity, the continuity of occupation evidence is determined by the continuity of surface visibility. This means that the site boundary could be revised if subsurface data demonstrated lateral continuity. For surface survey, discrete clusters of artefacts are regarded as parts of a single larger site only if there is some occupation evidence between the clusters. If the concentrations are less than 50m apart the are part of the same site. ...If no evidence is visible between clusters more than 50m apart, the clusters are regarded as separate sites (Dean-Jones 1992 Section 7.4).

Dean-Jones' suggestions for site definition seem to have been followed by others, (eg. AMBS 2002). For a survey on The Salt Pan in 1994 Brayshaw and Haglund noted

> *This area was originally recorded as containing a large number of sites, some of them comprising a few, some numerous knapping events. The boundaries between the sites appear arbitrary, and dictated sometimes by lack of exposure, sometimes by apparent gaps in artefact distribution. We interpret the area as representing one or more extensive sites in the sense that each site constitutes a 'find area' separated from the others by expanses where artefacts appear to be absent or comparatively rare; these gaps cannot be verified except through surface investigations. Each find area comprises remains of numerous activity foci, including knapping floors, which may but need not be related in time.* (Brayshaw and Haglund 1994:1-2).

The definition of site suggested by Dean-Jones (1992) is a practical solution to the site-definition problem, but makes no reference to the underlying behaviour which resulted in sites being formed.

The scant references in the early historical records and few pictures of residential camps suggest that they were made up of several individual hearth groups, often family groups. Each hearth group had its area of land sometimes with a hut (gunyah) and usually with one or more hearths, and spatially separate from other hearth groups. A picture by Joseph Lycett (Brayshaw 1986 Plate 5) shows the camps of two hearth groups separated by many metres and at different elevations on a slope above the lower Hunter River. A picture by Augustus Earle (Brayshaw 1986 Plate 6) shows the camps of five hearth groups constructed in two rows with each hut separated by just a few metres. Just one hearth and hut is shown in Browne's picture (Brayshaw 1986 Plate 4).

Several observers made tantalising comments of residential sites which could be interpreted as scattered hearth groups. On the lower Hunter Threlkeld noted

> *The Native camp which surrounded our habitation gave a cheerfulness to the scene at night in consequence of the number of fires kept up by the families at the front of their respective sleeping places, which were mere erections of boughs of trees, or sheets of bark placed upright supported by stakes*. (Gunson 1974:45)

At Port Stephens

> *The Aboriginal Camp has a strange appearance during night. You are encompassed by twenty or thirty fires of which is attended by four or more natives according to the number of the family*. (Ebsworth 1826 in Brayshaw 1986:46)

In rugged country north of Port Stephens Dawson found "...a native encampment, consisting of eight or ten gunyers..." (Dawson 1830:171-172). On one of the Myall Lakes a a camp "... on the border of an extensive lake ..." which consisted of "... a fire and a row of gunyers ..." (Dawson 1830:245). The residential sites on the Williams and Chichester Rivers "... consisted of six to nine huts, or families..." (Howitt 1904:85). Near the reserve at Broke Felton Mathew, in February 1830

> *Visited the first camp of natives I have seen. There were about 60 men, women and children. I remained with them about an hour and saw them retire for the night, each party or family kindling its own separate fire apart from the others. The place they were camped in was a romantic spot on the bank of the Wollombi.* (Mathew 11.12.1830 in Brayshaw 1986:56)

Apart from the pictures of Aboriginal camps in the lower Hunter (which may not be accurate as to detail), we have no information on how far apart each of the hearth groups set their individual camps within the larger residential sites. Depending on social rules about the position and proximity of people within camps (Howitt 1904:774) some hearth groups may have been quite close together while others may have been many metres apart. Nor do we know for certain how big an area each hearth group took up. If each individual camp included a gunyah, a hearth, and other activity areas the camp might have been a few metres across. If each hearth group left its debris lying in the place at which it was used (which is not certain as people may have cleaned their camps) then an abandoned residential site might consist of several spatially discrete camps each a few metres across and some separated by unoccupied areas. The overall impression might be of an area with small spatially discrete activity areas. Over time, such an area may have been revisited and new camps occupied in the same area, perhaps partly overlapping the locations of previous camps.

The archaeological manifestation of such an area might be of some small, spatially discrete activity areas set within an area of low density and dispersed scatters (depending on the kinds of activities carried out). Such kinds of archaeological sites have been seen on the very extensive exposures at site WH on Doctors Creek. Here, knapping foci were seen, which tended to be technologically and/or spatially discrete events, sometimes the result of variations in backed artefact production strategies, sometimes making use of different raw material types, and sometimes to produce flake tools rather than backed artefacts (Rich 1992b). Much diversity in site content was also seen along The Salt Pan (Brayshaw and Haglund 1994). Such spatially and/or technologically discrete activity areas could have resulted from individual hearth groups within a larger residential setting.

In more recent times, NPWS has increasingly focussed on (e.g. 1997:15ff) consulting studies to conduct some kind of "landscape archaeology" as opposed to earlier site-based archaeology. Landscape archaeology, and how it should be conducted, remains poorly defined – indeed, recent texts on Australian archaeology (eg. Lourandos 1997; Mulvaney and Kamminga 1999) don't even mention the word "landscape" in their indexes. To some extent the AHIMS is also moving away from the old concept of "site" by coding recordings according to their content rather than "site type".

It seems to me that "landscape archaeology" should consider how evidence of human occupation is distributed across the entire land surface within a given area. The minimum unit of analysis should be those single items which people left behind during their use of the land. In the case of portable objects, such items would be single stone artefacts. As the detection of stone artefacts is vulnerable to accidents of ground exposure it would be necessary to control for those opportunities for detection by recording the presence of exposures, whether artefacts are seen or not. In theory, if the artefact is the minimum unit of analysis, and it is possible to control for their detection or otherwise, then the "site" debate becomes less critical – there are simply more or fewer artefacts in certain landscape contexts than in other contexts.

NPWS (meeting with E. White and M. Koettig, 2002 in relation to another project) has suggested that sites could be mapped as covering the entire landform on which they occur. That is, if stone artefacts were found scattered across a hill crest then they could be included within a single site. This approach could have a practical management outcome as new find locations could simply be added to a pre-existing site number. If a site covers an entire landform then this landform becomes the practical management unit. On the other hand, in areas where artefacts are sparsely scattered then artefact scatters may not occur across an entire landform, but have only a limited spatial distribution. If the entire landform is mapped as a site then the artefact scatter may appear much more extensive than it actually is – particularly if the artefacts occur in a small area only a few metres across.

Unfortunately, the site concept is deeply entrenched in both our thinking about areas of land, and in NPWS's management such as the AHIMS – known until recently as the Aboriginal Sites Register. NPWS assigns unique identification numbers to "sites" and in its application of the NPW Act it allows for the damage or destruction (or otherwise) of sites identified by their NPWS identification numbers. Any analysis of previously recorded archaeological evidence – such as that undertaken below – is constrained by the dominating site concept.

D7.2 PREVIOUSLY RECORDED SITES IN THE AREA SURROUNDING WAMBO MINE

D7.2.1 Introduction

A large number of archaeological surveys and more detailed investigations have been carried out in the vicinity of the Wambo study area, particularly within the adjacent United Collieries holdings on Redbank Creek, at Lemington and South Lemington, at Warkworth Mine and further south at Mt Thorley, and in the Bulga area. The Director-General's requirements for this Project indicated that the archaeological context for this Project should be analytical in its approach in relation to reviewing previous studies relevant to the area. As the overall emphasis of the Director-General's requirements for the present study has been for a landscape approach for the present study, the analyses for the "archaeological context" also takes a landscape approach. Initially it was intended to use the "artefact" as the basic analytical unit, but for various practical reasons (see below) this was not possible. Consequently, in the following analyses the "site" has been used as the minimum unit, with "numbers of artefacts" a variable to describe site size.

D7.2.2 The Context Area

A search of the AHIMS (NPWS Aboriginal Site Register) was carried out in October 2002. The following analyses are of sites south of the Hunter River between the following AMG references:

300000E to 320000E and 6380000N to 6405000N

This context area is 20 km x 25 km across. It encompasses a section of the high sandstone country west of Wambo mine, including Spring and Chalkers Creeks which are major tributaries of North Wambo Creek, and Horses Head Creek which is a major tributary of Wambo Creek, as well as the upper catchment of Wambo Creek itself, and Hayes Creek just to the south. This section of high country includes Jerrys Plains, Appletree, Wambo and Milbrodale Ridges. The context area also takes in lower country towards the Hunter River and Wollombi Brook, the confluence of those two major rivers and the interfluve between them, which has been subject to numerous archaeological studies. An area north (left bank) of the Hunter River also falls within the AMG search area, but sites from this latter area have been excluded from the present analysis.

Many sites from various Aboriginal heritage studies in the context area are included in the AHIMS but many additional sites have also been recorded which have not yet made their way into the AHIMS. Where possible, both registered and unregistered sites have been included in the current study where relevant information has been available.

It seems that most site recorders have tended to follow a general definition of a site similar to that discussed by Dean-Jones (1992:19) as outlined above. People have tended to record as separate sites, artefact locations more than 50m apart where there are no intervening artefacts or cultural features. For the present analysis, where artefact locations have been recorded as separate sites but are less than 50m apart and occur on the same landform, they are grouped to make one site. Likewise, locations more than 50m apart have been subdivided into separate sites where information permitted.

Site data has been entered into a database. Using AMG co-ordinates, landscape information has been compiled from the 1:25,000 scale Doyles Creek, Singleton, and Bulga topographic map sheets, augmented by the Howes Valley 1:100,000 scale map in the absence of a Parnell 1:25,000 scale topographic map. The landscape variables include: approximate altitude AHD (above height datum), distance to mapped water, stream order (of mapped streams), slope/gradient (after Speight 1990) and landform (also after Speight 1990).

Artefact counts were collected from the site forms and/or reports. It is generally considered that large numbers of artefacts on a site may indicate intensive activity or occupation and/or repeated occupation. Small sites with few artefacts are generally considered to indicate limited activity or occupation and/or one-off single events. Very small sites and isolated artefacts were, in the 1980s, often considered to be part of a "background scatter" of artefacts and were often noted only in passing, and sometimes not recorded at all. It is likely that many more very small sites were present within the context area but were simply not recorded. Information on the numbers of artefacts at open sites is available for 385 sites. Nearly two-thirds (62%) of the recorded sites have fewer than 15 visible artefacts and if isolated finds had been consistently recorded in the past the relative frequency of very small sites would probably be much higher. In the following analyses the sites are grouped to provide more comparable data sets.

It was hoped to include data on ground exposure and visibility, to take into account the accidents of artefact exposure. However, this information was so inconsistently reported that these variables were abandoned and the analysis has resorted to artefact counts; though it should be noted that information on visible artefacts was still incompletely reported.

The current Wambo study area, and sites within Wambo's mining lease but beyond the Wambo study area, were excluded from this context data base so that the Wambo sites could be independently compared to those within the context area.

D7.2.3 Site Types

A total of 434 sites and isolated finds have so far been reported in the context area (Table D-5).

Table D-5
Site Types in the Context Area

Site Type	Height AHD													Total Sites
	55-64	**65-74**	**75-84**	**85-94**	**95-104**	**105-114**	**115-124**	**125-134**	**135-144**	**145-154**	**155-199**	**200-299**	**>300**	
Open	23	73	71	43	50	28	16	12	7	2	1	1	4	331
Isolated Find	1	2	11	7	13	21	11	10	5	1	-	-	-	82
Open & Contact	-	2	-	-	-	-	-	-	-	-	-	-	-	2
Quarry	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Grinding groove	1	-	1	-	-	3	-	-	-	-	-	-	-	5
Carved Tree	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Scarred Tree	-	1	-	-	-	-	1	-	-	-	-	-	-	2
Contact Burial/s	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Mound (0ven)	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Shelter Art	-	-	1	-	-	-	-	-	-	-	1	3	1	6
Shelter art and contact	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Stone Arrangement	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Total sites	**25**	**79**	**87**	**50**	**63**	**52**	**28**	**22**	**12**	**3**	**2**	**4**	**7**	**434**

Open sites are the most frequent type (76%). Isolated finds are the next most frequent category, but as earlier studies often did not record isolated artefacts it is likely that this category is under-represented in the database. In the following discussion all open sites and isolated finds will be referred to collectively as “open sites”.

One stone quarry site at South Lemington has been recorded; another silcrete source was also included in the AHIMS (#37-6-625) but the site record notes that no artefacts were found so it is not included in the context database.

Five grinding groove sites have been reported in the context area. One consisting of 39 grinding grooves (#37-6-967) was found at Beltana along a minor creek some 2.5 km from Wollombi Brook. Another (#37-5-62) is along Hobden Gully and consists of three grooves with perhaps another three faint grooves. The three remaining sites occur within Warkworth Mining Lease, east of Wallaby Scrub Road and consist variously of 38, 9 and 4 grooves (Nightingale *et al*. 2002:55, 58).

Site #37-6-113 is a reference to a carved tree. The NPWS site form indicates that a fence rail near the confluence of Wollombi Brook and the Hunter River (at approximately AMG 314932 6397906) was made from a carved tree and retained a remnant section of carving. The rail was given to the Muswellbrook Historical Centre at the Muswellbrook & District Historical Society.

Two scarred trees have also been reported for the context area, although from personal observation of one at Warkworth Mine, and from evidence given with the other site record these trees are not convincingly authentic Aboriginal scarred trees.

An historic period burial (#37-6-54) was reported on Bulga Creek at Milbrodale. This burial of a woman reportedly took place in 1850. At the burial ground no grave was dug but the body was seated on a sheet of bark and this was laid on the bare ground. The men dug up the loose sandy soil around it and the others in the party raised a mound over the body. Logs and sticks from the surrounding area were then gathered and laid over the mound, then the party left.

Several shelter art sites have been recorded from the sandstone country. One of these (#37-5-3) at Appletree Aboriginal Area may include art work dating to the historic period (Koettig 2001, held with site record). Two other open sites also include flaked glass (#37-6-576 at Lemington and #37-6-846 on The Salt Pan). A possible stone arrangement has been reported at Kings Junction, in the sandstone country.

Most of the sites in the context area have been found at lower elevations, reflecting intensive survey by industry and a paucity of survey in higher sandstone country, especially within Wollemi National Park. In country above 155m AHD both open sites and shelters with art have been identified; several of the open sites have been found along the top of Jerrys Plains Ridge west and above the Wambo study area.

The apparent preference for site locations below 115 m AHD (82%) may also reflect the presence of more land surface under 115 m AHD than above 115 m AHD, although analyses below indicate that all larger sites occur at low elevations.

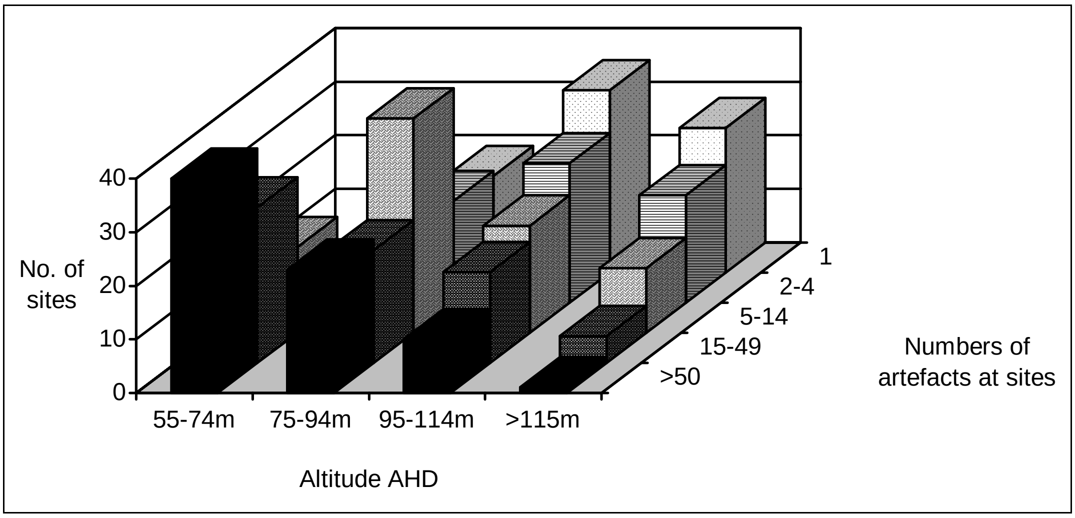
D7.2.4 Landscape Analysis

Data on the distribution of sites in relation to altitude by site size (numbers of artefacts) is given on Table D-6 and Figure D-21. Unfortunately information on the number of artefacts was not recorded for any sites above 200 m AHD. Isolated finds are most frequent around and above 100 m AHD, with 95-114 m being modal. Small sites of 2-4 artefacts are also most frequent at this elevation. Both very small sites and isolated finds are relatively rare below 75 m AHD. Larger sites show the opposite trend. The majority of sites with more than 50 artefacts, and also those with 15-49 artefacts occur below 75 m AHD. Just one site with more than 50 artefacts occurs above 115 m AHD – though only just at about 122 m AHD (Site #37-5-263). This data suggests that most intensive use and/or repeated use occurred at lower elevations, while less intensive and/or single-event use of the landscape occurred more often at higher elevations.

Table D-6
Altitude AHD and Numbers of Artefacts at Open Sites in the Context Area

Altitude AHD	Numbers of Artefacts at Open Sites					Total sites
	1	2-4	5-14	15-49	≥50	
≥115	27	20	12	5	1	65
95-114	34	26	20	17	10	107
75-94	18	19	40	21	23	121
55-74	3	4	16	29	40	92
Total sites	82	69	88	72	74	385

Figure D-21
Altitude and Numbers of Artefacts at Open Sites in the Context Area



Data on the spatial association of sites with nearest mapped water is given on Table D-7 and shown on Figure D-22. The majority of very small sites (2-4 artefacts and isolated finds) are associated with 1st order streams. Sites with 5-14 visible artefacts occur in similar frequencies regardless of stream order. Larger sites are associated with 2nd order and larger streams, with little to distinguish 3rd and 4th+ order streams from 2nd order streams.

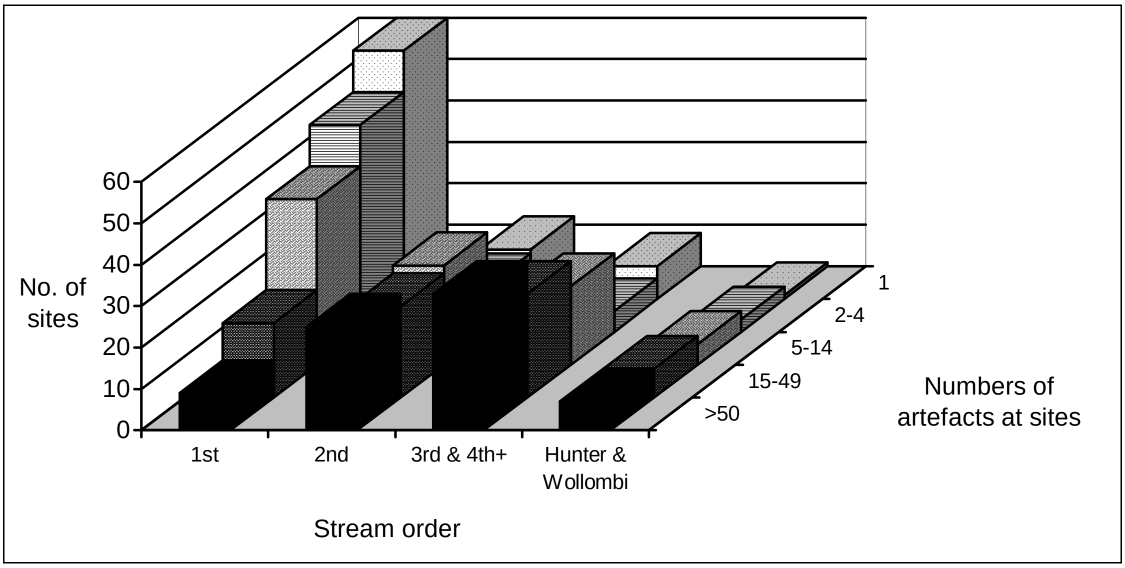
General observations of site distribution in relation to creeks in the context area are given in Section D7.1.1. Nightingale *et al*. (2002) had suggested that larger order streams would be more attractive for residential occupation than small low order streams. Site distribution data shown on Figure D-22 distinguishes 1st order streams from other stream sizes with 3rd & 4th order streams having only a slightly higher frequency of larger sites than 2nd order streams. Occupation of 2nd order streams was broadly similar to occupation of larger streams. It can be noted that eight sites had more than 1,000 artefacts and five of these were found on 2nd order streams and three were found on 3rd order streams.

The observations by Brayshaw and Haglund (1994) that small sites were found at the upper ends of small gullies and where the headwaters of a stream started to appear, tend to be supported by site data on Figure D-22. However, it can also be noted that three sites with more than 500 artefacts have been found associated with 1st order streams.

Table D-7
Stream Order and Numbers of Artefacts at Open Sites in the Context Area

Stream Order	Numbers of Artefacts at Open Sites					Total Sites	% Sites with 750 Artefacts
	1	2-4	5-14	15-49	7 50		
1st	61	50	40	18	9	178	5%
2nd	12	11	24	22	25	94	27%
3rd	5	2	7	12	19	45	42%
4th+	3	3	12	13	14	45	31%
Hunter R. & Wollombi Brook	1	3	5	7	7	23	30%

Figure D-22
Stream Order and Numbers of Artefacts at Open Sites in the Context Area



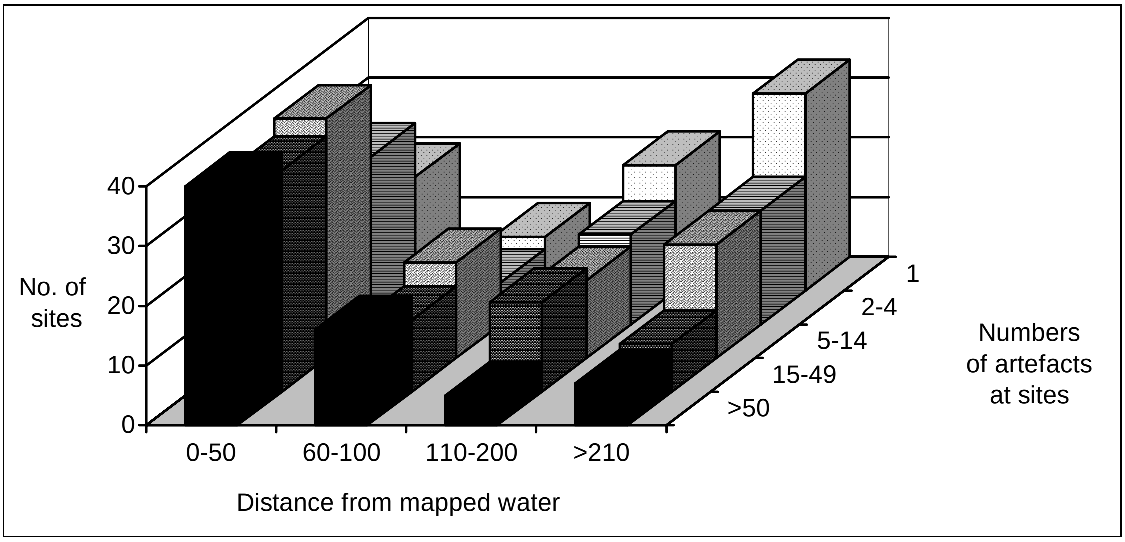
The majority of sites have been found within 50 m of mapped water (Table D-8, Figure D-23). The biggest sites tend to be closest to water although a few large sites have been found distant from water. Very small sites occur both close to and distant from water but two-thirds (66%) occur more than 100m from water.

There is a common perception that site tend to be found close to water and this is supported by the data; but sites have also been found distant from water, including a few large sites.

Table D-8
Summary of Distance from Water and Numbers of Artefacts at Open Sites in the Context Area

Distance From Mapped Water	Numbers of Artefacts at Open Sites					Total Sites
	1	2-4	5-14	15-49	750	
0-50	19	28	40	37	46	170
60-100	9	7	16	12	16	60
110-200	21	15	13	15	5	69
>200	33	19	19	8	7	86

Figure D-23
Distance from Water and Numbers of Artefacts at Open Sites in the Context Area

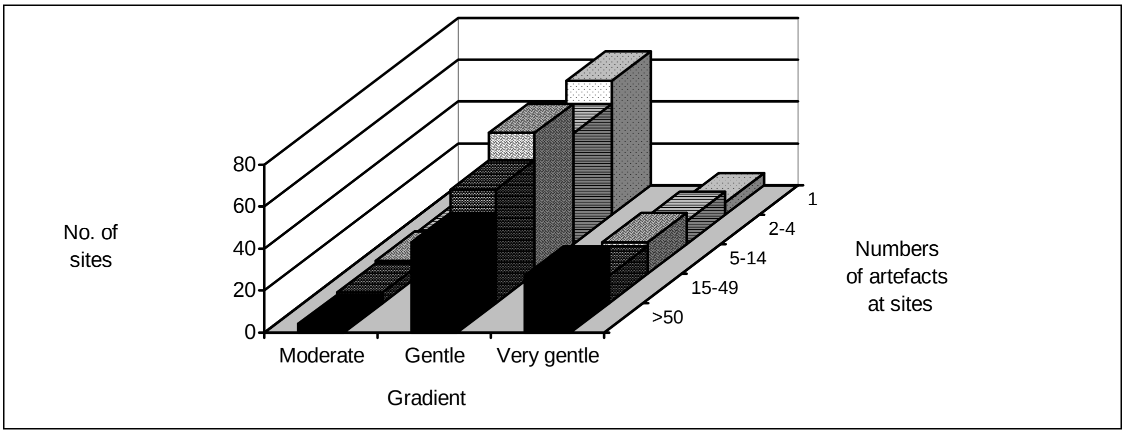


The majority of open sites occur on gentle gradients (Table D-9, Figure D-24). The only sites recorded on steep gradients are shelter sites. Of the sites on moderate gradients, half consist of four (4) or fewer artefacts, while only 4 sites have 50 or more artefacts. On very gentle gradients more than one-third (38%) of sites have 50 or more artefacts and isolated finds are uncommon.

Table D-9
Gradient and Numbers of Artefacts at Open Sites in the Context Area

Terrain	Numbers of Artefacts at Open Sites					Total Sites
	1	2-4	5-14	15-49	7 50	
Very gentle	6	11	15	13	27	72
Gentle	64	53	67	54	43	281
Moderate	12	5	6	5	4	32

Figure D-24
Gradient and Numbers of Artefacts at Open Sites in the Context Area



Most sites occur on crests, regardless of site size (Table D-10, Figure D-25). Simple slopes are also common site locations, but the preferential setting of small sites. Creek flats are the third most common landform setting with a strong preference for large sites. Several sites appear to occur in depressions, but this could be related to inaccuracies in the scale of the mapping and it is possible that some of these might occur on flats or lower slopes adjacent to creeks, rather than in the creeks themselves.

Figure D-25
Landform and Numbers of Artefacts at Open Sites in the Context Area

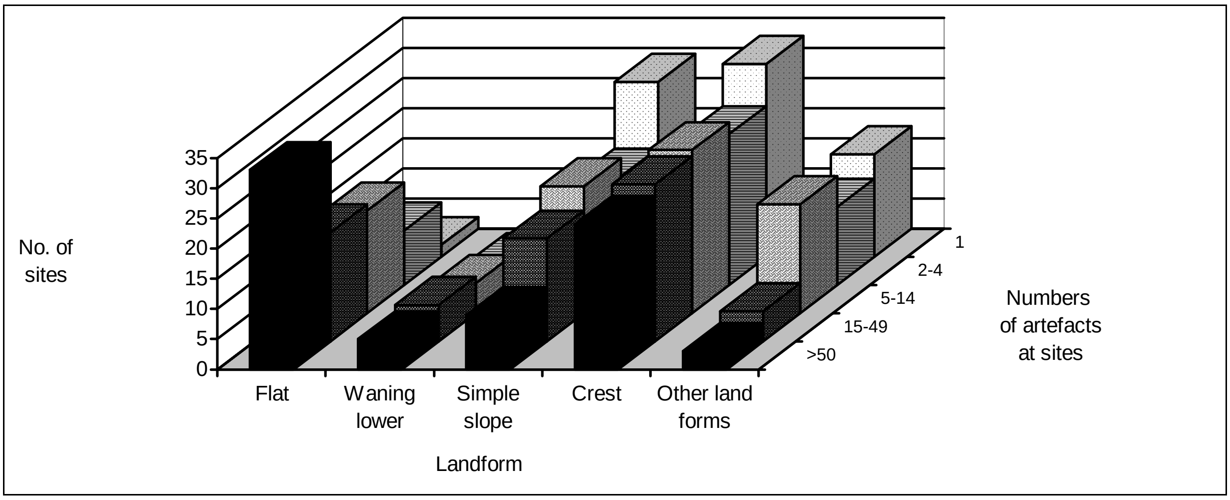


Table D-10
Landform and Numbers of Artefacts at Open Sites in the Context Area

Landform	Numbers of Artefacts at Open Sites					Total sites
	1	2-4	5-14	15-49	7 50	
Crest	32	25	27	26	24	134
Simple slope	29	18	21	17	9	94
Waxing upper slope	3	2	-	-	-	5
Maximal upper slope	6	3	3	1	-	13
Minimal mid slope	1	2	3	-	-	6
Maximal lower slope	2	1	2	1	1	7
Waning mid slope	4	4	4	1	-	13
Waning lower slope	2	4	5	6	5	22
Flat	2	9	17	18	33	79
Depression	1	1	6	2	2	12

The above analyses indicate that sites of different sizes tend to occur in different landscape settings, with all variables distinguishing trends. It is likely that some of these variables are interrelated; low altitudes are likely to occur along major (eg. 4th + order) streams where major creek flats are likely to have very gentle slopes. The following analyses therefore consider multiple variables to identify particularly sensitive settings.

The first of these relates stream order to elevation. It could be expected that highest elevations will be drained by small 1st and 2nd order streams, while lower elevations would include larger streams. The data (Table D-11) indicates very small sites of 2-4 artefacts and isolated finds dominate 1st order streams above 95 m AHD. Larger sites are modal along 3rd and 4th+ order streams, especially below 75m AHD. Sites of varying sizes occur along 2nd order streams at all elevations, with something of a preference for sites with more than five (5) visible artefacts below 95 m AHD. Along the Hunter River and Wollombi Brook the small sample of sites includes several large sites below 75 m AHD.

Table D-11
Stream Order, Altitude and Numbers of Artefacts at Open Sites in the Context Area

Stream Order	Altitude AHD	Numbers of Artefacts at Open sites					Total Sites	Overall Total Sites
		1	2-4	5-14	15-49	≥50		
1st	55-74	1	1	4	2	1	9	178
	75-94	9	9	11	5	3	37	
	95-114	25	21	14	7	4	71	
	>115	26	19	11	4	1	61	
2nd	55-74	-	1	1	6	13	21	94
	75-94	3	7	17	9	7	43	
	95-114	8	3	5	7	5	28	
	>115	1	-	1	-	-	2	
3rd & 4th+	55-74	2	1	8	15	22	48	90
	75-94	5	2	10	6	12	35	
	95-114	1	2	1	3	-	7	
Hunter River & Wollombi Brook	55-74	-	1	3	6	4	14	23
	75-94	1	1	2		2	6	
	95-114	-	-	-	-	1	1	
	≥115	-	1	-	1	-	2	

Data on the distribution of sites in relation to stream order and distance those streams is given on Table D-12. For 1st order streams sites variously occur close to and distant from water, whereas for 2nd order and larger streams sites tend to be concentrated within 50m of water, especially larger sites. With regard to the Hunter River and Wollombi Brook most sites tend to be more distant (more than 100 m) – perhaps to make use of elevated camping locations and/or to escape flooding.

Table D-12
Stream Order, Distance from Water and Numbers of Artefacts at Open Sites in the Context Area

Stream Order	Distance from Water	Numbers of Artefacts at Open Sites					Total Sites
		1	2-4	5-14	15-49	≥50	
1st	0-50	11	20	14	7	2	54
	60-100	7	4	7	3	3	24
	110-200	15	12	7	7	1	42
	>200	28	14	12	1	3	58
2nd	0-50	5	6	12	15	17	55
	60-100	2	3	7	6	6	24
	110-200	3	-	3	-	1	7
	>200	2	2	2	1	1	8
3rd & 4th+	0-50	3	2	14	14	27	60
	60-100	-	-	2	3	6	11
	110-200	3	3	1	6	1	14
	>200	2	-	2	1	-	5
Hunter River & Wollombi Brook	0-50	-	-	-	-	1	1
	60-100	-	-	-	-	1	1
	110-200	-	-	2	2	2	6
	>200	1	3	3	5	3	15

Data on the distribution of sites in relation to stream order and landform is given on Table D-13. Near 1st order streams artefacts occur on a wide variety of landform types, with isolated finds occurring preferentially on crests and simple slopes, while small sites tend to favour crests. The few larger sites also tend to favour crests over other landforms. Flats associated with 1st order streams are relatively uncommon site locations. Near 2nd order streams sites of varying sizes also occur on a variety of landform types, with larger sites strongly favouring flats. Near 3rd and 4th+ order streams isolated finds and very small sites (<5 artefacts) are less common than larger sites. Larger sites favour flats and crests over other types of slopes. Near the Hunter River and Wollombi Brook very small sites are also less common, and the (smaller sample of) sites strongly favour crests.

Table D-13
Stream Order, Landform and Numbers of Artefacts at Open Sites in the Context Area

Stream Order	Landform	Numbers of Artefacts at Open Sites					Total Sites
		1	2-4	5-14	15-49	≥50	
1st	Crest	24	20	16	8	6	74
	Simple slope	22	13	10	4	1	50
	Other	14	11	10	3	1	39
	Waning lower slope	1	1	2	2	1	7
	Flat	-	5	2	1	-	8
2nd	Crest	5	-	7	7	6	25
	Simple slope	4	4	5	5	3	21
	Other	2	2	6	-	1	11
	Waning lower slope	-	2	2	2	1	7
	Flat	1	3	4	8	14	30
3rd & 4th+	Crest	3	2	1	6	10	22
	Simple slope	2	1	6	7	4	20
	Other	1	-	2	1	1	5
	Waning lower slope	1	1	1	2	2	7
	Flat	1	1	9	8	17	36
Hunter River & Wollombi Brook	Crest	-	3	3	4	3	13
	Simple slope	1	-	-	1	1	3
	Other	-	-	-	1	-	1
	Waning lower slope	-	-	-	-	1	1
	Flat	-	-	2	1	2	5

Data on the distribution of sites on landforms within various gradient categories is given on Table D-14. On very gentle gradients sites show a strong preference for flats (75%), and nearly half of these have more than 50 artefacts. Smaller sites also favour flats. A few sites are found on crests and most of these are very small sites and isolated finds, although two larger sites have been found on crests.

On gentle gradients, sites show strong preferences for crests followed by simple slopes, with only 9% being found on flats. Sites of all sizes occur on crests, although sites with under 15 visible artefacts occur much more often on simple slopes than do larger sites. Waning lower slopes are not preferred site locations.

Smaller numbers of sites are found on moderate gradients. The single most common landforms are simple slopes and crests, but sites are also found on a wide range of other landforms, including maximal upper slopes (9 sites). Sites vary in size but tend to be isolated finds.

Table D-14
Gradient, Landform and Numbers of Artefacts at Open Sites in the Context Area

Gradient	Landform	1	2-4	5-14	15-49	>50	Total Sites
Very gentle	Crest	5	3	3	-	2	13
	Simple slope	1	-	-	-	-	1
	Waning mid slope	-	2	1	-	-	3
	Waning lower slope	-	-	1	-	-	1
	Flat	-	6	10	13	25	54
Gentle	Crest	25	20	24	24	21	114
	Simple slope	25	17	20	14	8	84
	Maximal upper slope	3	1	-	-	-	4
	Other	7	7	11	3	1	29
	Maximal lower slope	-	1	1	1	1	4
	Waning lower slopes	2	4	4	6	5	21
	Flat	2	3	7	5	8	25
Moderate	Crest	2	2	-	1	2	7
	Simple slope	3	1	1	3	1	9
	Maximal upper slope	1	2	2	1	-	6
	Maximal lower slope	2	-	1	-	-	3
	Other	4	-	2	-	1	7

D7.2.5 Summary Results

The above analyses have been of 'positive data' in the sense that they have been of what has been found and where it has been found, but without controls such as what artefacts have not been found. In Section D7.1.4 it was noted that the detection of sites generally, and of artefacts on sites, may be shaped in part by the presence of ground exposures on which sites and artefacts may be seen. Ground exposures without artefacts provide control data for where sites and artefacts do not occur. This issue is addressed later in the report in relation to the Wambo analyses, but could not be pursued here because of the inconsistency in the available exposure and visibility data within the context area.

It is likely that very small sites and isolated finds were dismissed in some earlier studies in the context area as "background scatter" and not recorded. For the data which has been available isolated finds make up 21% of all recorded locations and very small sites with just two to four (2-4) visible artefacts make up 18% of the sites – a total of nearly 40% of all artefact locations. It is possible that artefacts were discarded at these locations during activities of very limited flaking of cores, maintenance of tools during tasks, or tools might themselves have been discarded at the end of tasks to reduce the amount of materials that had to be carried (cf. Section D7.1.4). Locations with 1-4 visible artefacts occurred in all landscape settings but preferentially:

- in association with 1st order streams – 74% of all very small sites;
- at altitudes above 95 m AHD – 71% of all very small sites;
- on crests and simple slopes – 69% of all very small sites, and less so; and
- more than 100 m from mapped water – 58% of all very small sites.

Small sites with 5-14 artefacts have probably also resulted largely from small scale (limited) flaking, tool maintenance and discard (cf. Section D7.1.4) but with more individual activities either because more people carried out such activities and/or because locations were subject to repeat visits. Locations with 5-14 visible artefacts occurred in all landscape settings but preferentially:

- at moderate altitudes between 75 m and 114 m AHD – 68% of all small sites;
- in association with 1st, and less so 2nd, order streams – 73% of all small sites; and
- on crests and simple slopes – 55% (and less so on flats – 19%) of all small sites.

Medium sized sites with 15-49 artefacts may have resulted from repeated episodes of limited flaking, tool maintenance and artefact discard, and/or from one-off episodes of small-scale systematic core reduction and tool production (knapping floors) and/or from intense or concentrated activities only partially exposed by erosion. Locations with 15-49 visible artefacts occurred in many landscape settings and regardless of stream order but preferentially:

- at low altitudes, particularly below 95 m AHD – 69% of all medium-sized sites;
- on crests, simple slopes and flats – 85% of all medium-sized sites; and
- 50m or less from mapped water – 51% of all medium-sized sites.

Large sites with 50 or more visible artefacts make up one fifth (19%) of all sites. This group includes three very large sites with more than 3,000 visible artefacts and another five sites with more than 1,000 artefacts. These very large sites were found along 3rd order streams of Sandy Hollow Creek and Doctors Creek and on The Salt Pan which includes 2nd and 3rd order streams. The sites include knapping floors as well as a variety of artefact types and artefacts from more limited flaking episodes (Brayshaw and Haglund 1994; Rich 1992b; White 2001). Sites with 50 or more artefacts have been found at Lemington, on Hobden Gully, Redbank Creek, Longford Creek, and unnamed creeks as well as The Salt Pan. Locations with 50 or more visible artefacts occurred in many landscape settings but preferentially:

- at low altitudes, particularly below 95 m AHD – 85% of all large sites;
- in association with 2nd, 3rd and 4th+ order creeks – 78% of all large sites;
- within 50 m of mapped water – 62% of all large sites; and
- on crests and flats – 77% of all large sites.

D7.2.6 Discussion

Nightingale *et al.* (2002:27) suggest a general model of settlement organisation, in which residential sites were located along creeks – especially higher order creeks – and that resource extraction would have been carried out at activity locations in the foraging area surrounding these residential sites (see Section D7.1.1). They argued that artefacts concentrated close to creeks would have resulted from the sequential positioning of residential sites over time, and that dispersed artefacts away from creeks, on ridgelines and in less domestically amenable areas would have resulted from activity locations.

The results of the analyses conducted above could be summarised even further, for comparison with this model, to say that sites with 15 or more artefacts tended to be found:

- at lower altitudes below 95 m AHD (77% of sites with 15 or more artefacts);
- associated with 2nd, 3rd and 4th order creeks (72% of sites with 15 or more artefacts);
- within 100 m of water (76% of sites with 15 or more artefacts); and
- on creek flats and crests (69% of sites with 15 or more artefacts).

Very small sites and isolated finds with 1-4 artefacts tended to be found:

- at higher altitudes above 95 m AHD (71% of sites with 1-4 artefacts);
- associated with 1st order creeks (74% of sites with 1-4 artefacts);
- more than 100 m from water (58% of sites with 1-4 artefacts); and
- on crests and simple slopes (71% of sites with 1-4 artefacts).

These trends generally support the model suggested by Nightingale *et al.* (2002:27).

However, there are several difficulties with the general model which should be considered:

1. The sites do not fall neatly into categories of large and small sites. The sites vary in size from single artefacts (isolated finds) to very large sites with thousands of artefacts. The range of variation is continuous between these extremes.
2. The sites have been found in a variety of landscape settings and despite the general trends in site distribution there are exceptions, including: (a) 9 sites with more than 50 artefacts have been found on 1^{st} order creeks; (b) 12 sites with more than 50 artefacts have been found more than 100m from mapped water; and (c) 9 sites with more than 50 artefacts have been found on simple slopes.
3. While Nightingale *et al.* (2002:27) acknowledge that open sites will have resulted from palimpsests of occupation their general model does not allow for change in occupation strategies. It is realistic to expect that social organization and land use strategies will have changed over time, given the evidence embodied within the Eastern Regional Sequence. Knapping floors on which backed artefacts were made may have been part of social and land use strategies in place from 4,000 to 1,000 years ago, while the carved tree Site 2 (NPWS #37-6-56) might have been part of social strategies in place in the last few hundred years.
4. It is questionable whether labels such as “residential site”, “activity location” or even “dinner-time site” can be applied to sites on the basis of site size (such as artefact counts). Artefact numbers could vary with the nature of the activities that were carried out, the number of times such activities were repeated, and accidents of ground exposure. Nightingale *et al.* (2002:27) suggested that assemblage diversity (variety in artefact types) could be used to distinguish residential sites on the assumption that all stages of tool manufacture and maintenance were carried out at these kinds of sites. But this may not be a valid assumption. People may have scheduled their stone tool production and maintenance in different ways; such as the possibility that knapping floors, on which backed artefacts were made, could have been located away from domestic areas. Toxic plant materials might also have been processed away from domestic areas. Further, activities may have been scheduled differently in times of good rainfall compared to drought; as suggested by the aggregation and dispersal model outlined by Haglund (2001) (see Section D7.1.1).

The clinal nature of the archaeological record and the exceptions to general trends of landscape distribution of sites could hint at the complexity which is likely to be inherent in the open archaeological record.

From the analyses carried out above, and taking into account these observations some predictions could be developed to describe site distribution in the region:

1. Most intensive use and/or repeated use will have occurred in “domestically amenable areas” as suggested by Nightingale *et al.* (2002:27) particularly along creeks with available fresh water and with plant and animal resources in proximity. Very small sites and isolated finds will occur in the hinterland surrounding these areas. More specifically, site distribution in the Wambo study area could be expected to be similar as that in the surrounding context area.
2. There could, however, be site specific factors which attracted people to certain locations, for intensive and/or repeated use.
3. The archaeological record will include artefacts discarded during a variety of activities. It could be predicted that most tool production, maintenance and use activities will have been scheduled in the “domestically amenable areas” and/or in patterned ways but this is not certain. There should be no assumption that activity diversity equates with residential occupation.
4. The archaeological record will incorporate complexity arising from variable social and land use strategies and perhaps also change over time.

D7.3 POTENTIAL FOR DATEABLE MATERIALS

D7.3.1 Dateable Geomorphological Contexts

The Director-General's requirements for the present study included consideration of geomorphology. Essentially, stone artefacts can become incorporated into different kinds of geomorphic contexts which might contain dateable materials A geomorphological study was conducted for the Project area by Dr Phillip Hughes (Attachment D2).

The following provides a summary of some sensitive sites in the Hunter region where different geomorphologies have had different chronological outcomes.

1. Sand dune Site #37-5-166 adjacent to the Hunter River at Cheshunt, about 10 km north-east of Wambo. A rich site was found on the top of a source-bordering dune but the body of the dune was found to be more than 80,000 years old using OSL (optically stimulated luminescence); the upper sample of sand from 1.25 m depth was about 83,000 years old and the lower sample from 2.5 m was about 88,000 years old. Formation of the sand body predated Aboriginal occupation of the region and Hughes and Shawcross concluded that archaeological material deep within the dune had been displaced naturally from recent occupation of the dune surface by bioturbation (Nightingale *et al*. 2002:19).

2. On the other hand, Dean-Jones and Mitchell examined a vertical cutting about 4 m high through a sand dune adjacent to Wollombi Brook in Lemington South. Two or three buried topsoil layers were observed in the upper 1.5 m of the dune, indicating recent reworking or addition to the dune (Dean-Jones and Mitchell 1993:37). Such buried topsoils could potentially contain stratified archaeological materials.

3. Warkworth West sand sheet, within Warkworth Mine coal lease. This is mapped on the Singleton 1:25,000 scale geological map sheet as "Czb". A test excavation of this sand body was carried out by AMBS (Nightingale *et al*. 2002:49ff, 74ff). The sand body is an aeolian sand sheet overlying a lower gentle hillslope. Stone artefacts were found in all but one test pit, varying in density from no artefacts to 64 artefacts/m^2. While most of the artefacts occurred within the top five spits (above 50 cm depth) a couple of the test pits had deeper artefacts and showed a bimodal vertical distribution. Further, no silcrete artefacts were found below spit 6. A stratified site is indicated. Samples for OSL dating were taken but the results are yet to be reported. It was thought that the body of the sand sheet is old, and probably predates human occupation. However, it is possible that the sand sheet was initially occupied, and at some time after this sand upslope became unstable, burying the earlier evidence. The sand sheet was reoccupied by people making use of both silcrete and silicified tuff (Nightingale *et al*. 2002). These findings are of relevance to the present Wambo study area as sand deposits mapped as Czb occur within the Wambo study area, east of Wollombi Brook.

4. A late Pleistocene / Early Holocene site has been reported at Carrington Mine –Site CM-CD1 (#37-2-1877). It has been advised that artefacts were found in soil on a footslope, which had been overlain by perhaps 2m of alluvium (Dr Philip Hughes, *personal communication*). In the present Wambo study area alluvium occurs along North Wambo and Wambo creeks, but Dr Hughes advises that in the present Wambo study area older buried land surfaces are unlikely to be present.

5. Older sites have been reported, rarely, within alluvial terrace deposits. At Site SGCD15 on Fal Brook artefacts were found at a depth of 1m and small amounts of charcoal from a buried hearth was dated to more than 20,000BP. A nearby Site SGCD 16 may also contain early material (Koettig 1990:24). (Koettig 1986, 1987). More recently, artefacts have been found within the clay of a terrace adjacent to Wollombi Brook in Lemington mine. These artefacts may be between 18,000 and 30,000 years old (courtesy Wanaruah Land Council, on preliminary advice from Peter Kuskie).

6. Within the present Wambo study area alluvium occurs along both Wambo and North Wambo Creeks. However, Dr Hughes advises in Attachment D2 that in the present Wambo study area if the alluvium contained buried land surfaces these will have predated Aboriginal occupation of the region. The findings of the geomorphological study are detailed in Attachment D2.

7. Site L at Warkworth occurred partly on an alluvial flat and partly on an adjacent hillslope. On the alluvial part of the site a buried charcoal-rich horizon was found spread widely across the site and below a shallow A unit soil. The charcoal-rich horizon varied in thickness from 4 cm to 16 cm, and variously occurred 6 cm to 25 cm below the surface (Fahey 1992:17ff). Two charcoal samples were dated to c.830±60BP (Beta 54011) and 800±60BP (Beta 54012) (Haglund 1992 Volume 6, Appendix G). Artefacts were found within an A unit soil above this charcoal-rich horizon. Stratigraphically the occupation evidence must be younger than c.900 years BP. An independent technological analysis of flake debitage grouped the assemblage with others from the upper spits of the Sandy Hollow 1 and Kerrabee Dam 40 shelter sites (Baker 1992a:33-34), which have been dated to less than 700 years old (SH1 – 530±80BP (ANU-125) and KD40/7-10 – 605±70BP (Wk-1193) (Haglund 1989:18-19, Table 8). In the present Wambo study area no buried horizons such as that at Site L have been found.

8. Age of texture contrast soils, which occur widely across the Hunter Valley. There has been some debate about how and when texture contrast soils formed. Koettig (1990:25) suggested that the B horizon clays may have formed within the period of human occupation, and should be more intensively investigated. However, it has been argued recently that the B horizon (clay) of texture contrast soils must be at least 20,000 years old and may be very much older. Hughes considers that from the beginning of human occupation of the region artefacts of late Pleistocene and early Holocene age which were discarded would have become incorporated into soil profiles and have formed a lag (part of a stone layer) at or just above the junction between the A and B horizons, being incorporated into the basal levels of the present A horizon soils (Nightingale *et al*. 2002:21).

In summary, in the first case stone artefacts were found deep within a sand body but these were considered to be of recent age and had displaced vertically through the sand body by bioturbation. In the second case, the buried topsoils could contain stratified archaeological materials. In the third case an old sand body was found to have been reworked resulting in some stratification of archaeological materials. In the fourth case an early site was buried by more recent alluvium. In the fifth case old sites have been found within the bodies of Pleistocene age alluvium. In the sixth case it was possible to indicate a minimum date for an occupation site because alluvium underlying a recent land surface contained dateable charcoal. And finally, there has been debate about the age of texture contrast soils, though the most recent thinking appears to be that archaeological investigation of B unit clays is inappropriate.

D7.3.2 Approximate Chronologies – Flake Debitage

In the Hunter Valley some success has been achieved in dating flake debitage assemblages through detailed technological analyses. This approach was advocated by Hiscock (1986), reconsidered by Haglund (1989) and developed further by Baker (1992a, 1992b). In brief, various attributes on flake debitage have been recorded and multivariate statistical analysis has variously grouped assemblages with certain characteristics. When the modified approach was trialled on dated assemblages it successfully grouped assemblages of similar ages, and identified a separate 'Group 3' of knapping floor assemblages making use of heat treated stone (Baker 1992b). The method has the potential to provide an approximate chronology for assemblages where the sample of flake debitage is sufficiently large (preferably more than 100 flakes).

D7.3.3 Hearths, Pits and Ovens

Where features such as hearths have survived they could contain charcoal which could be dated by radiocarbon techniques. Heaths are sometimes found during archaeological excavations in the Hunter Valley (eg. Koettig 1992, 1994; Rich 1992b).

D7.4 PREVIOUS ARCHAEOLOGICAL WORK IN THE WAMBO STUDY AREA

Several archaeological studies have previously been carried out within and immediately adjacent to the Wambo study area. These include studies by Brayshaw (1981), Brayshaw *et al.* (1996), Corkill (1990), Dyall (1980, 1981), Effenberger (1992), ERM Mitchell McCotter (1999) (information on NPWS site forms), Kuskie (1998, 2000), Rich (1991a, 1991b), Silcox (1998), and Sutton (2002).

Dyall (1981), Brayshaw (1981) and Brayshaw *et al*. (1986) considered Aboriginal historical information. Dyall interviewed Mr Greenhault and identified the Wambo area as potentially being important for its Aboriginal history and as an area where group meetings were held. Brayshaw (1981) noted the presence of Aboriginal people just north of the present Wambo study area in the 1850s and raised the possibility of travel routes through the region (the Mitchell Line and another leading to the Hawkesbury River, probably via Wollombi Brook). Brayshaw *et al*. (1996) were also noted local historical information and oral tradition.

In 1991 Rich reported on test excavations carried out at two sites on Wambo Creek, both located on “spurs” above creek flats; at the time most excavations had investigated creek flat locations. Artefact densities were found to be low to moderate for excavated sites. One location, SW3A, was on a colluvial terrace with sediments 70cm deep and the possibility of stratified soil was indicated (Rich 1991b).

Most of the studies were carried out primarily to identify sites and provide management advice. Data recorded on these sites has been incorporated where possible into analysis of sites and assemblages in the Wambo study area carried out in Section D9.

D8 LANDSCAPE SETTING AND DESCRIPTION OF THE WAMBO STUDY AREA

D8.1 INTRODUCTION AND RESOURCES

The Wambo study area encompasses a diverse environment. It abuts the eastern edge of the sandstone escarpment of Wollemi National Park and extends east and north to take in the lower valleys of North Wambo Creek, Wambo Creek and Stony Creek. Stony Creek flows into Wambo Creek and both Wambo Creek and North Wambo Creek flow eastwards into Wollombi Brook; a section of which is included in the Wambo study area. The Wambo study area continues across Wollombi Brook to include an area of undulating sandy land, as well as a narrow corridor eastwards for the proposed rail line. In the north-west the Wambo study area also includes part of the upper catchment of Redbank Creek, and parts of the upper catchments of creeks flowing northwards into the Hunter River – Redmonvale and Waterfall Creeks, and an unnamed creek. The Wambo study area includes creek flats, and gently sloping land along lower valley slopes. It also includes higher moderate and steep slopes and several narrow ridge tops.

The NPWS Director-General's requirements for this Project stated:

> *Mapping and description of each of resources (sic) within the lease area needs to be provided (raw materials for manufacture of material items, plant and other food resources, water availability including consideration of springs etc, areas of complex/rich environments, location of suitable campsite locations based on slope gradient etc (using data from previous studies in the region) locations of extensive outlook, location and rating of creek confluences, unusual features, important landscapes, proximity of other significant resources such as the Hunter R., sandstone country immediately to the west, etc. These are essential for developing and supporting models of occupation to be provided for this study area. Each layer of information should be mapped separately and at the same scale.* (NPWS letter 19/12/02, p3).

In this section of the report several aspects of the physical environment are described and mapped, as requested by NPWS. The main sources of this information are the 1:25,000 scale topographic and geological map sheets of Doyles Creek and Singleton, observations made during the field survey, with additional advice from other specialists as necessary, and historical accounts where that information is available.

A resource is defined by the Australian Pocket Oxford Dictionary (1993) as

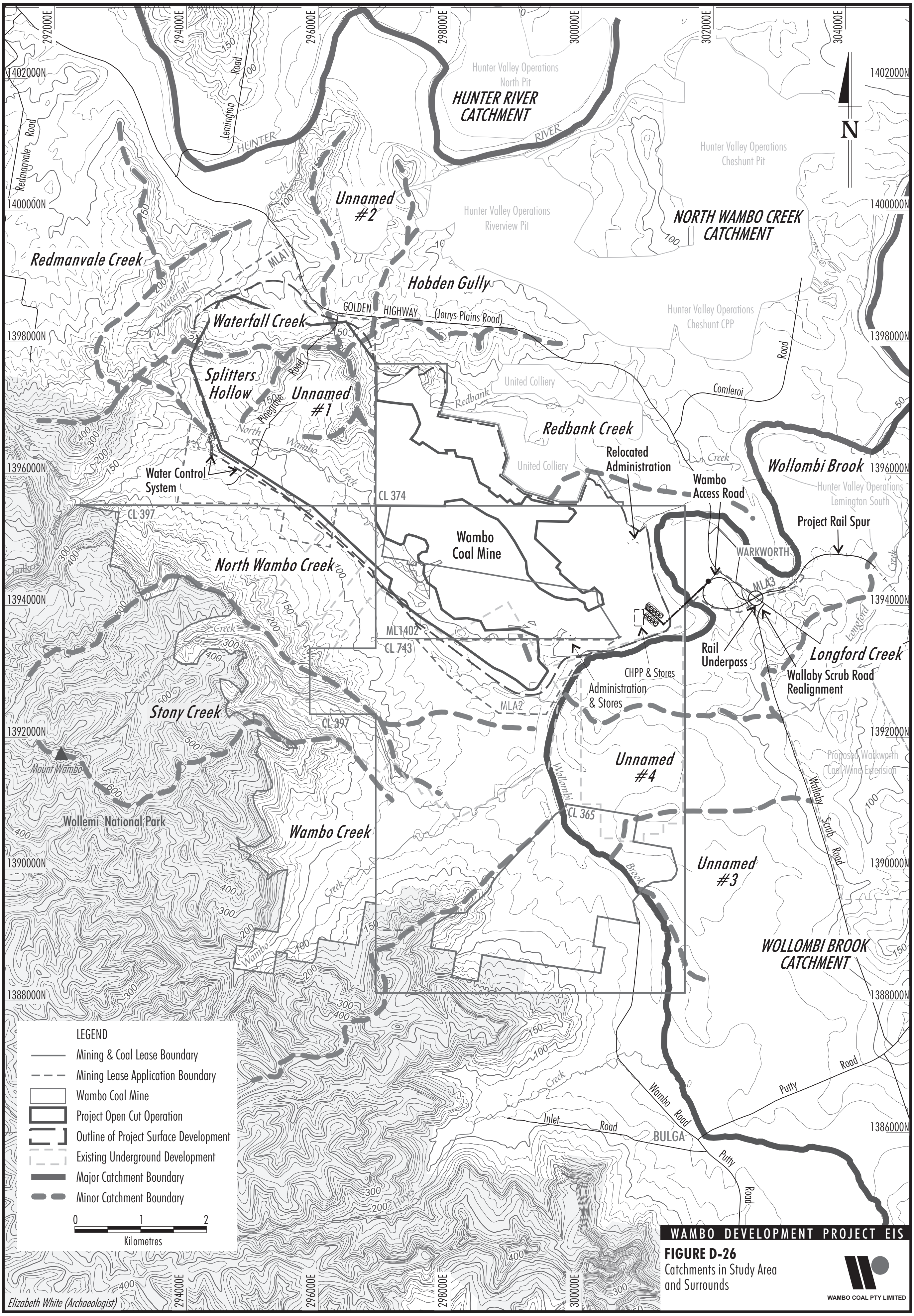
> – *n*. 1 expedient or device (*escape was their only resource*). 2 (often in *pl.*) means available; stock or supply that can be drawn on; as set. 3 (in *pl.*) country's collective wealth. 4 skill in devising expedients (*person of great resource*). 5 (in *pl.*) one's inner strength, ingenuity, etc.

The extent to which an element of the physical environment is a "resource", depends on the ingenuity of people to make it so (as identified by the Oxford dictionary). Many plants and animals were only food resources because Aboriginal people had developed the technology to capture and process them. Dr Helen Brayshaw (1986) has compiled early historical observations on the environment, the material culture (ie. physical cultural objects) and diet of Aboriginal people in the Hunter Valley. A few observations relate to the vicinity of the Wambo study area (eg. Jerrys Plains) or locations with similar environmental features (eg. Broke area).

Dean-Jones and Mitchell (1993) noted that, at a later stage of European settlement the Surveyor General apparently required surveyors to include notes about the nature of soils, water and vegetation on portion plans. Those which Dean-Jones and Mitchell examined from the 1850s include such information. However, the present Wambo study area was taken up early in the historic period. Plans which were examined for portions 12, 13 and 17 in the Parish of Warkworth (as part of research into the carved tree Site #37-5-56) revealed no useful environmental information. This avenue has not been pursued.

D8.2 WATER FLOWS, RAINFALL AND RESOURCES

The Wambo study area includes sections of five major streams being Wollombi Brook, Wambo Creek, Stony Creek, North Wambo Creek, and a short section of Waterfall Creek. Stony Creek is a major tributary of Wambo Creek, and both Wambo and North Wambo Creeks flow into Wollombi Brook, which in turn joins the Hunter River about 8 km to the north-east. Catchments in and around the Wambo study area are shown on Figure D-26 and details of mapped streams are given on Figure D-27.



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-26
Catchments in Study Area and Surrounds

WAM-02-01-ABH_043D

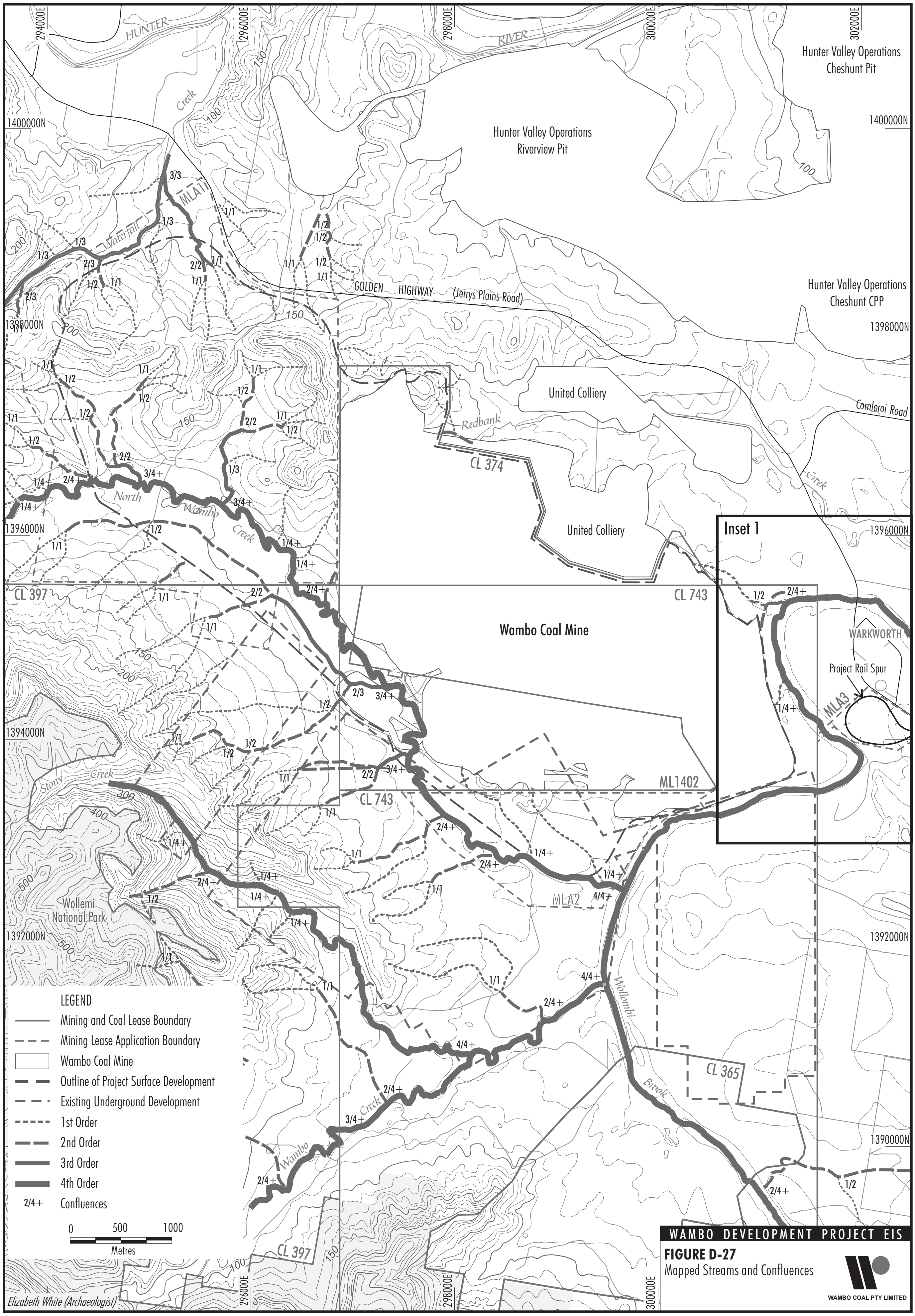
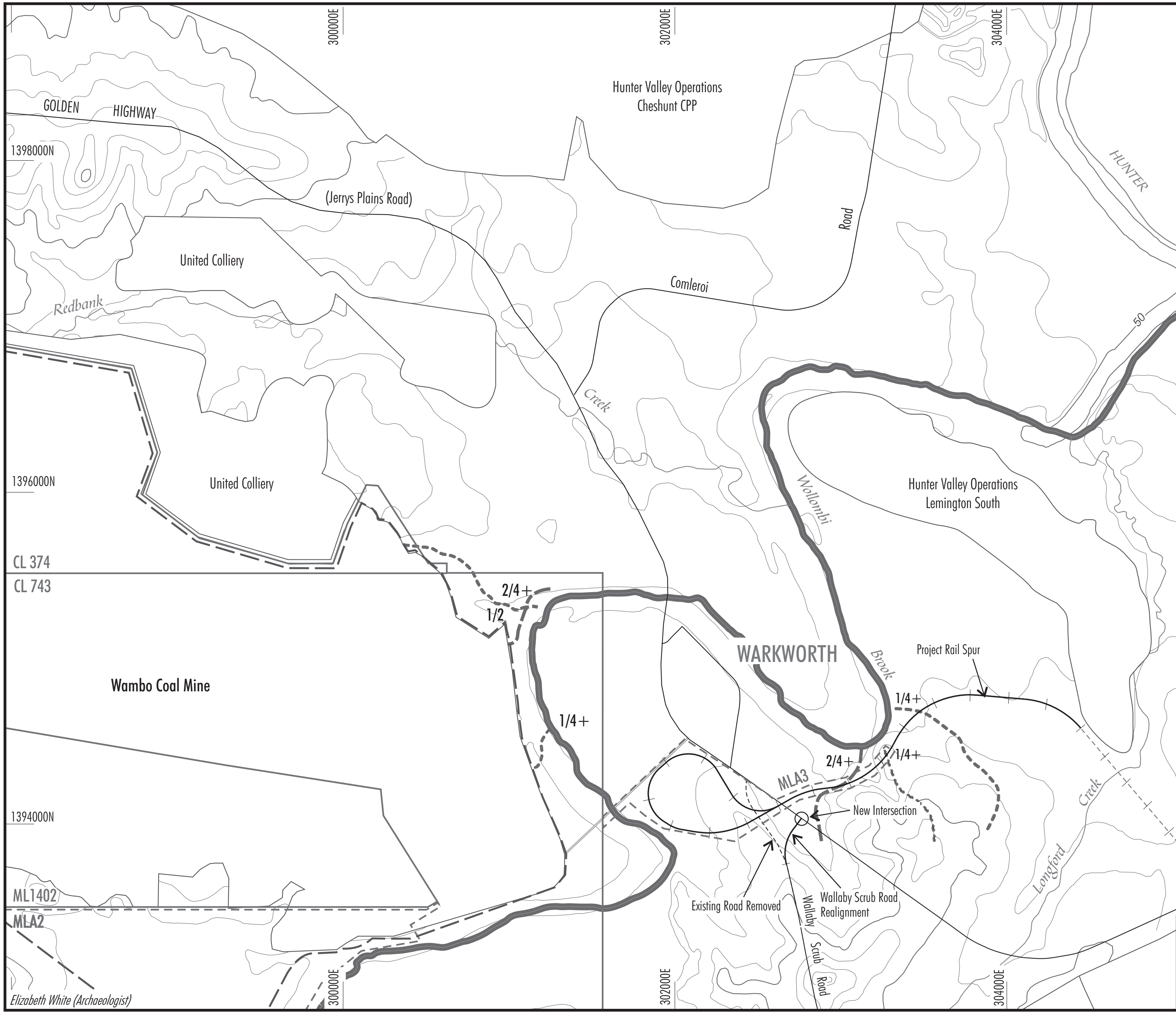


FIGURE D-27
Mapped Streams and Confluences

WAM-02-01-ABH_013E



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-27A

Inset 1 -
Mapped Streams and Confluences

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_021F

Wollombi Brook is a major river of the Hunter region. Stony, Wambo and North Wambo Cks are 4th order or higher streams (Figure D-27). Splitters Hollow and Unnamed Ck #1 are 3rd order streams which flow into North Wambo Ck. Waterfall Ck is also a 3rd order stream, becoming a 4th order stream beyond the Wambo study area. The Wambo study area also includes parts of the upper catchment of another creek flowing northward into the Hunter River (Unnamed #2), Redmanvale Ck, and part of the upper catchment of Redbank Ck; of these Redmanvale Ck catchment is entirely beyond the proposed impact area.

Most of the streams in the Wambo study area are minor 1st and 2nd orders. In the proposed underground mining area east of Wollombi Brook only one stream has been mapped on the 1:25,000 scale topographic sheet although topography and field observations indicate at least two other minor drainage lines. The western half of the proposed rail line is within an area draining directly into Wollombi Brook, while the eastern half variously crosses two minor 1st order and a 2nd order stream.

Upstream from the Underground Mine portal at about 3080E 639390N North Wambo Creek is relatively shallow and consists of a chain-of-ponds. Dr Philip Hughes advises that before European occupation the creek probably took this form (ie. chain-of-ponds) but that the current ponds are larger than they would have been in the past. Downstream from the Underground Mine portal North Wambo Creek has formed a deeply incised channel, which has cut into bedrock down stream from site. Dr Hughes is of the opinion that this section of the creek would also have been a chain-of-ponds and that the severe down-cutting occurred following European occupation. In support of this theory, Sir Thomas Mitchell's map of 1834 shows North Wambo Creek as "Wambo P.ds" which is likely to be an abbreviation for "Wambo Ponds". Ponds are also shown occurring here on Henry Dangar's 1828 map (Dean-Jones and Mitchell 1993 Figure D-2). Shaped sandstone blocks have been concreted onto sandstone bedrock at AMG 310300 6392820 and appear to be the remains of an old dam, so if down cutting occurred in the historic period it may have been fairly early in the historic period.

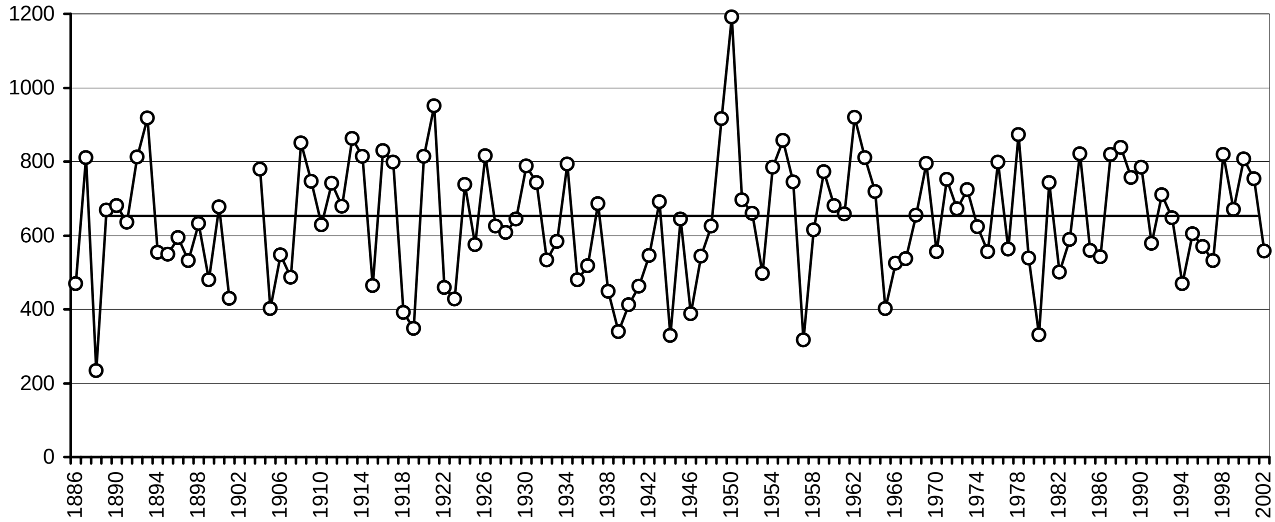
The present field work was carried out at a time of drought. Surface water was seen only in Wollombi Brook and in some farm dams, and rarely in ponds in North Wambo Creek upstream from the underground mine portal. Very limited surface water in North Wambo Creek may have come from a bore/pump at AMG 308900E 6394750N. The groundwater specialist (Errol Brieze - AGE) knows of no permanent springs in the Wambo study area. He indicates that the only water seepages in the area would come off the sandstone escarpment after rain. It is likely that water supplies suitable for human drinking would have been very limited in the Wambo study area during droughts. During previous archaeological survey conducted in late 1990 (Rich 1991a) after four years of good rainfall, Wambo, Stony and North Wambo Creeks all contained flowing water; in good seasons North Wambo Creek, and perhaps also Wambo Creek, probably contained numerous ponds, while Stony Creek may have been a flowing mountain stream.

An indication of the long term variability of rainfall (more than 100 years) can be seen from annual rainfall measured at Jerrys Plains (Figure D-28). While mean (average) rainfall is 640 mm, annual rainfall has been highly variable in historic times. The wettest year was 1950 while the driest year on record was 1888. Most years had between 400 and 800 mm, although there were 20 wetter years and 8 drier years. Aboriginal people would have had to develop economic, social and technological strategies for dealing with this variation.

Some comment on floods can be found in the early historical records. In 1825 on the lower Goulburn River Allan Cunningham observed flood debris 15-18 m[15] above the river level. Also in 1825, north-east of Mt Thorley stubble had been seen high in the trees indicating a great flood, larger in magnitude than any which had been known since Newcastle had been established (Brayshaw 1986:16). Major flooding occurred along Wollombi Brook in 1857 (Dean-Jones and Mitchell 1993), 1893, 1913, 1930, 1949 and 1955 (Brayshaw *et al*. 1996; Dames and Moore 1981; Erskine 1994:52). The 1949 flood destroyed the high-level road bridge at Warkworth (Erskine 1994:58). Erskine (1994:60-62) is of the opinion that floods up to 40% larger than the 1949 flood have occurred along Wollombi Brook during the Holocene. The floods of 1913, 1930, 1949 and 1955 had maximum levels of between 60 m and 62 m AHD (Dames and Moore 1981 Table 26). These levels would have been sufficient to back-flood tributaries of Wollombi Brook, and it could be expected that localised overbank flooding of creeks within the Wambo study area also could have occurred during heavy rain. Very low lying areas would have been inundated, but most archaeological sites in the Wambo study area would not have been flooded. Open sites under 62 m AHD which would have been susceptible include Sites 5, 17 and 27 (#37-6-595). The red sand body (Sites 30 and 31) adjacent to Wollombi Brook is generally 63-64 m AHD and the ground surfaces on which artefacts were seen would have been above these floods.

15 Reported as 50 to 60 feet.

Figure D-28
Annual rainfall at Jerrys Plains, 1886 to 2002 (except 1902 & 1903)
(Data from the Climate and Consultancy Section of the NSW Bureau of Meteorology)



Some comment on droughts in the Hunter Valley can also be found in the early historical records. In 1826 a severe drought began which apparently persisted for "several" years, with good rains not until August 1830. In Thomas Mitchell's opinion, however, "...the river, although occasionally stagnant, contains a permanent supply of water." (quoted by Brayshaw 1986:18). In February 1830 it was noted that the Hunter River downstream of the Wollombi confluence was "... nothing but a wide bed of sand and gravel, with here and there a dirty pool of stagnant water..." (Felton Mathew quoted by Brayshaw 1986:18). During another summer and drought the Hunter River at Singleton was "...perfectly dry as far as the eye could reach, with the exception of one pool of stagnant water... " (Henderson 1851 quoted by Brayshaw 1986:18Mitchell also noted, during a time of drought, a salt spring in the bed of Wollombi Brook (Brayshaw 1986:18).

D8.3 TOPOGRAPHY & LANDFORMS

D8.3.1 Possible Access Routes

The Wambo study area contains several topographic features, including creek valleys, hillslopes and ridge tops. One of the major ridges is Jerrys Plains Ridge which forms the top (northern edge) of the sandstone country above, and 5-8 km from, the Hunter River. It is continuous with a ridge in the present Wambo study area which forms the watershed between the catchments of streams which flow northwards into the Hunter River such as Waterfall and Redmanvale Creeks and those which flow to the south-east being North Wambo Creek, Splitters Hollow and Unnamed Creek #1. Jerrys Plains ridge provides a relatively easy and steady climb into the high sandstone country and could have provided a relatively easy access route between the mountains and the valley. Five sites have been recorded along it (Sites #37-5-35 to #37-5-39) varying from 200 m to 600 m AHD. A few very small sites were found during the present survey along the eastern end of this ridge.

Another potential access route into the mountains also starts within the Wambo study area, being the ridge formed by the watershed between Stony Creek and North Wambo Creek which becomes Wambo Ridge. Site #37-5-192 was previously found on the lower edge of this crest and additional sites were found along it at higher elevations during the present survey. Another accessible ridge line runs just south of Wambo Creek. Beyond the Wambo study area other potential access routes are also present, with one running south from Jerrrys Plains and others are probably present leading away from Wollombi Brook valley to the south.

D8.3.2 Altitude

Altitude across the study area varies considerably, from highs of more than 200 m AHD along ridge tops in the north-west and west, to about 60 m AHD adjacent to Wollombi Brook. Altitude is shown on Figure D-29. Most of the proposed surface impact area is above 100 m AHD. A high ridge separating the catchments of North Wambo Creek, Splitters Hollow and Unnamed Creek #1, from Waterfall Creek, Unnamed Creek #2 and Redbank Creek, rises in places to 200 m AHD. North Wambo Creek itself is mostly lower than 125 m AHD.

Altitude across the proposed underground mining areas west of Wollombi Brook varies from more than 200 m along Wambo Ridge to a low altitude of about 60 m AHD along Wambo and North Wambo Creeks near their confluences with Wollombi Brook.

The proposed underground mining area east of Wollombi Brook and the proposed rail line are entirely less than 100 m AHD.

D8.3.3 Gradient

Gradient has been mapped on Figure D-30. Four categories are used, based on those defined by Speight (1990): very gentle, gentle, moderate and steep (Table D-15). Level, very steep, precipitous and cliffed categories do not appear to be present within the proposed impact areas at the scale at which this mapping has been carried out.

Table D-15
General Gradient Categories (after Speight 1990:12)

Gradient	Range	Average	Approximate Expression on Topographic Map Sheet
Very gentle	$0^o45'$ to $1^o45'$	1^o	10 m elevation over 400 m or more distance
Gentle	$1^o45'$ to $5^o45'$	3^o	10 m elevation over 100 m to 400 m distance
Moderate	$5^o45'$ to 18^o	10^o	10 m to 30 m elevation over 100 m distance
Steep	18^o to 30^o	23^o	More than 30 m elevation over 100 m distance

In the north-west proposed impact area and in the proposed western underground mining areas steep gradients occur just below the high ridge tops. Moderate gradients generally occur below these steep gradients with gentle gradients along the lower slopes and flats of Waterfall Creek, North Wambo Creek, Splitters Hollow and Unnamed Creek #1. Gentle gradients also occur along the crests and saddles of the high ridges and catchment watersheds. In the upper catchment of Waterfall Creek gentle gradients also occur in elevated areas (eg. around AMG 307200 6397400).

While substantial parts of the proposed north-west surface impact area is taken up by moderate and steep gradients, much of the proposed underground mining area west of Wollombi Brook (especially the eastern of the two areas) is overlain by gentle gradients, with very gentle gradients near North Wambo Creek and on the Wambo Creek flat. Moderate and steeper gradients occur at higher altitudes, with Wambo Ridge top between North Wambo and Stony Creeks providing mostly gentle gradients.

The proposed underground mining area east of Wollombi Brook is overlain almost entirely by gentle and very gentle gradients. Small areas of moderate gradient occur in the centre-west of the area and the sides of the sand dune in the northern end of the proposed underground mining area are here mapped as locally steep.

The proposed rail spur and rail loop are routed across gentle gradients with moderate gradients above Wollombi Brook along the central part of the route.

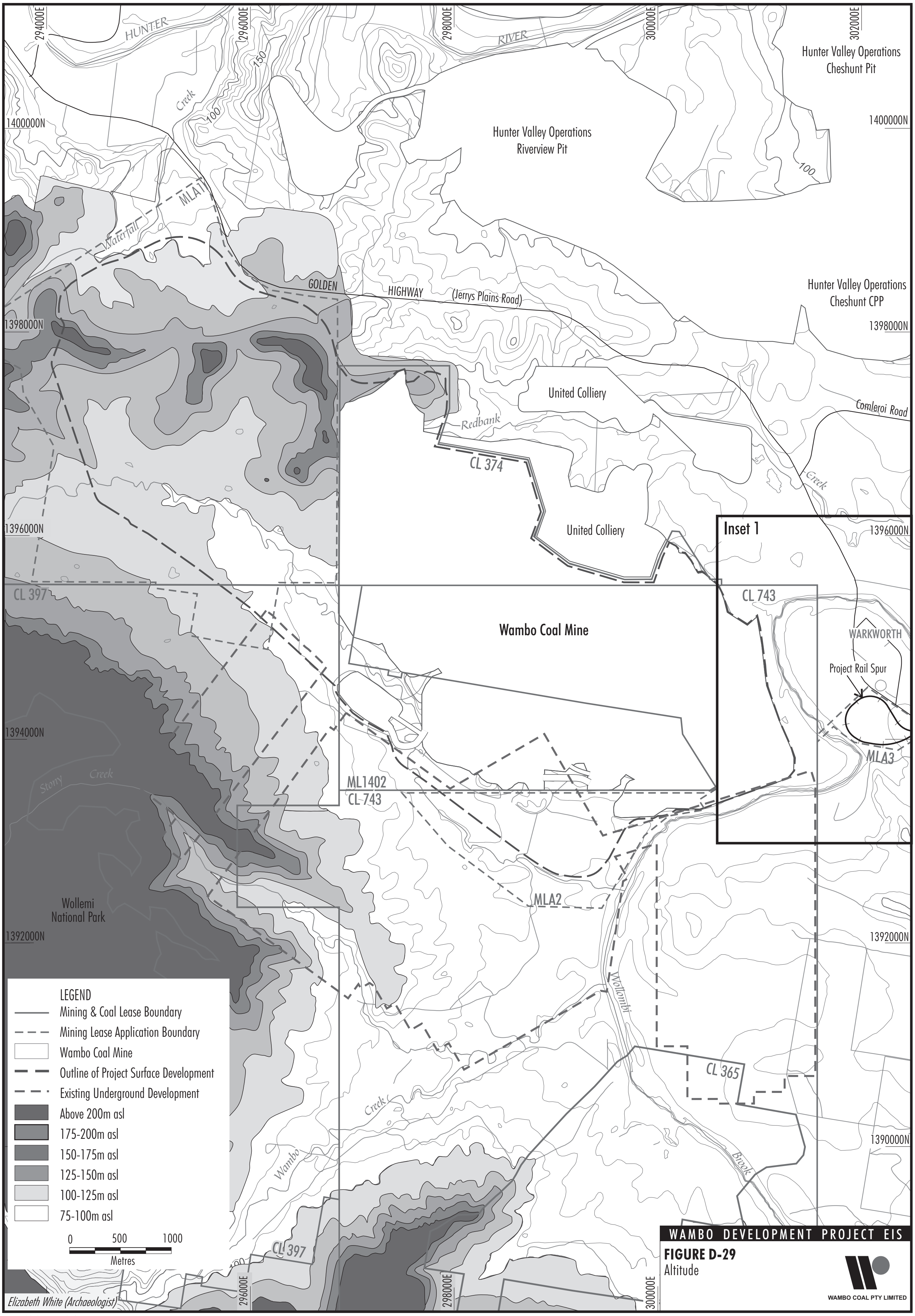


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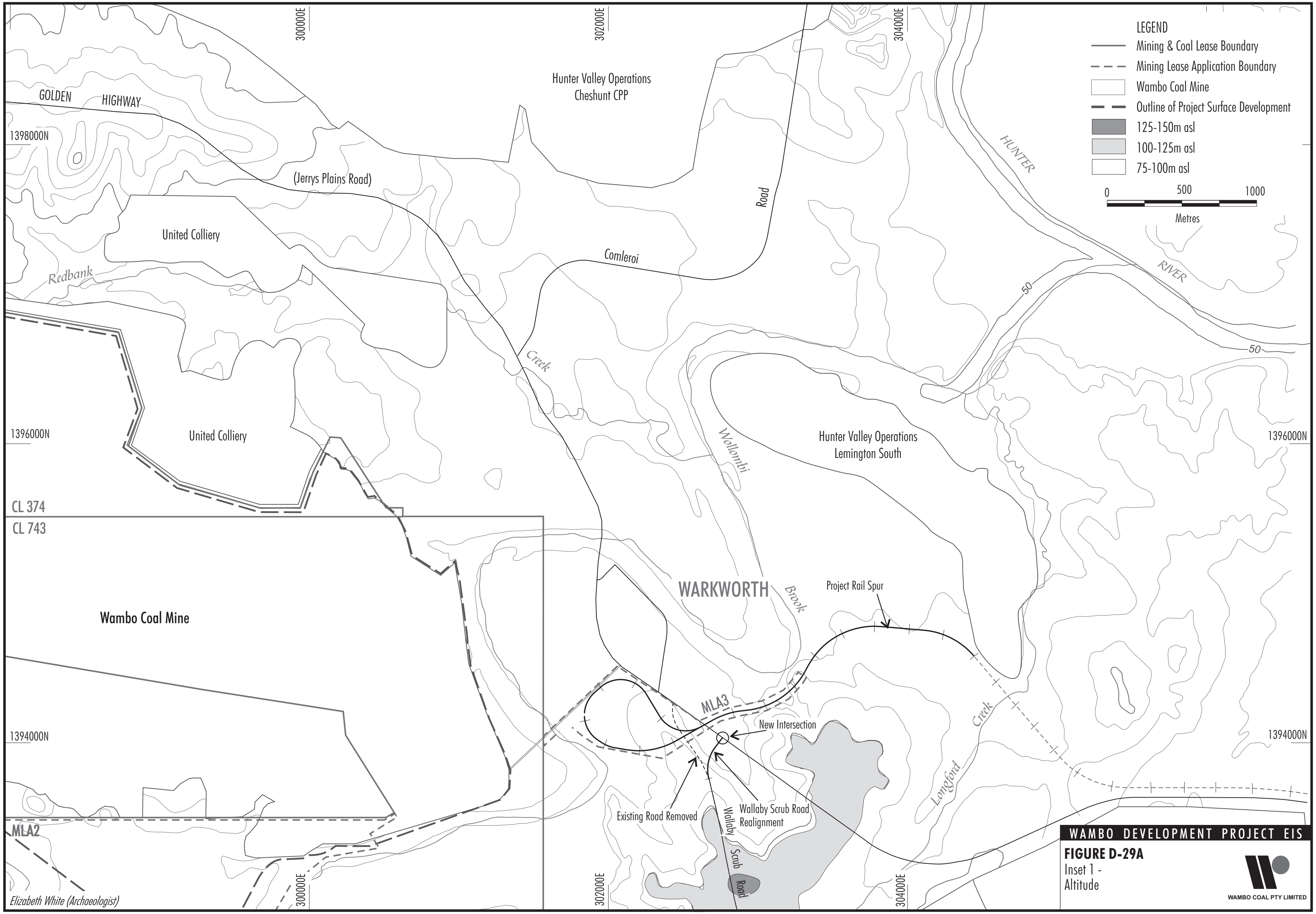
FIGURE D-29
Altitude

WAM-02-01-ABH_018F



WAM-02-01-ABH_022F

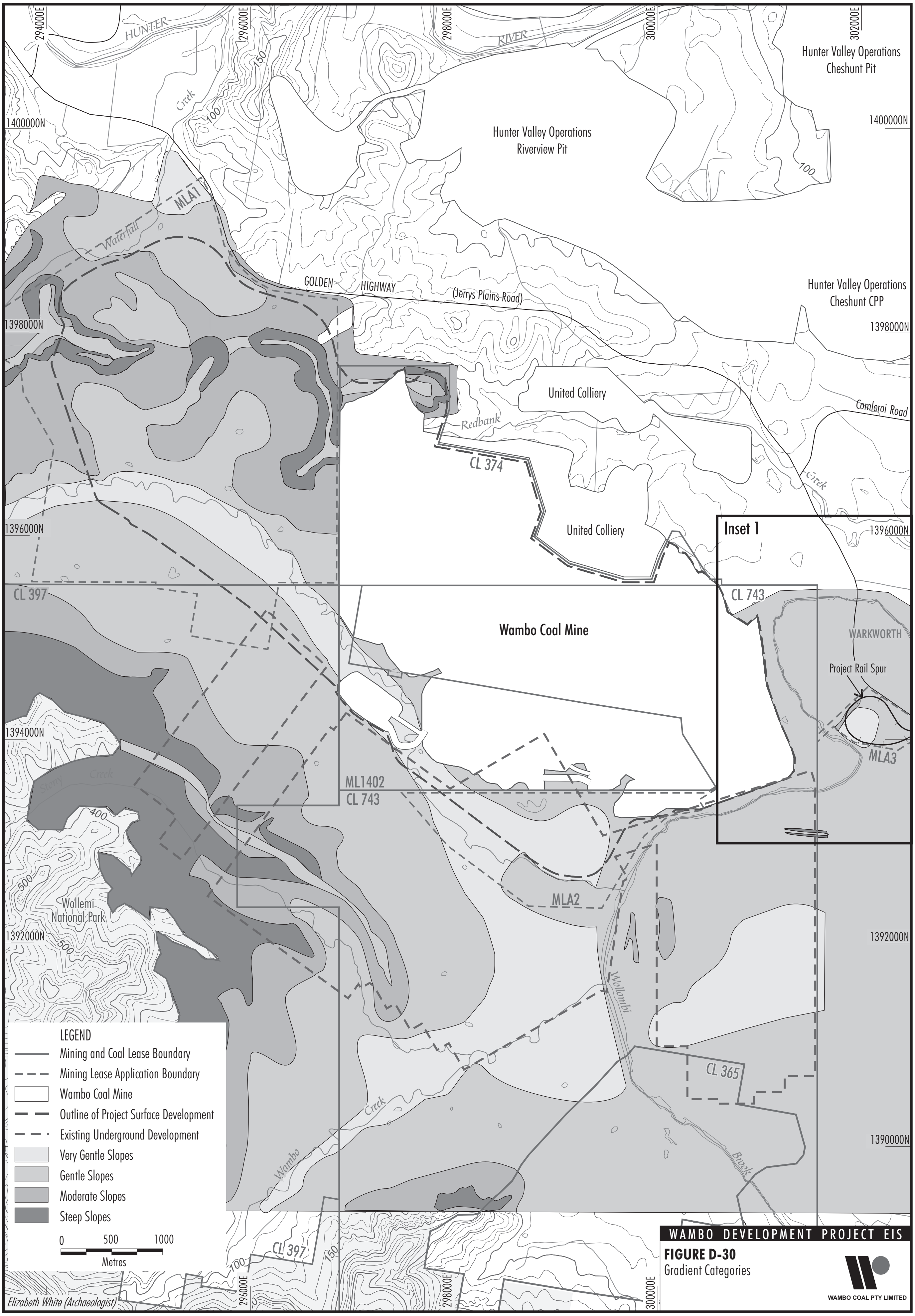
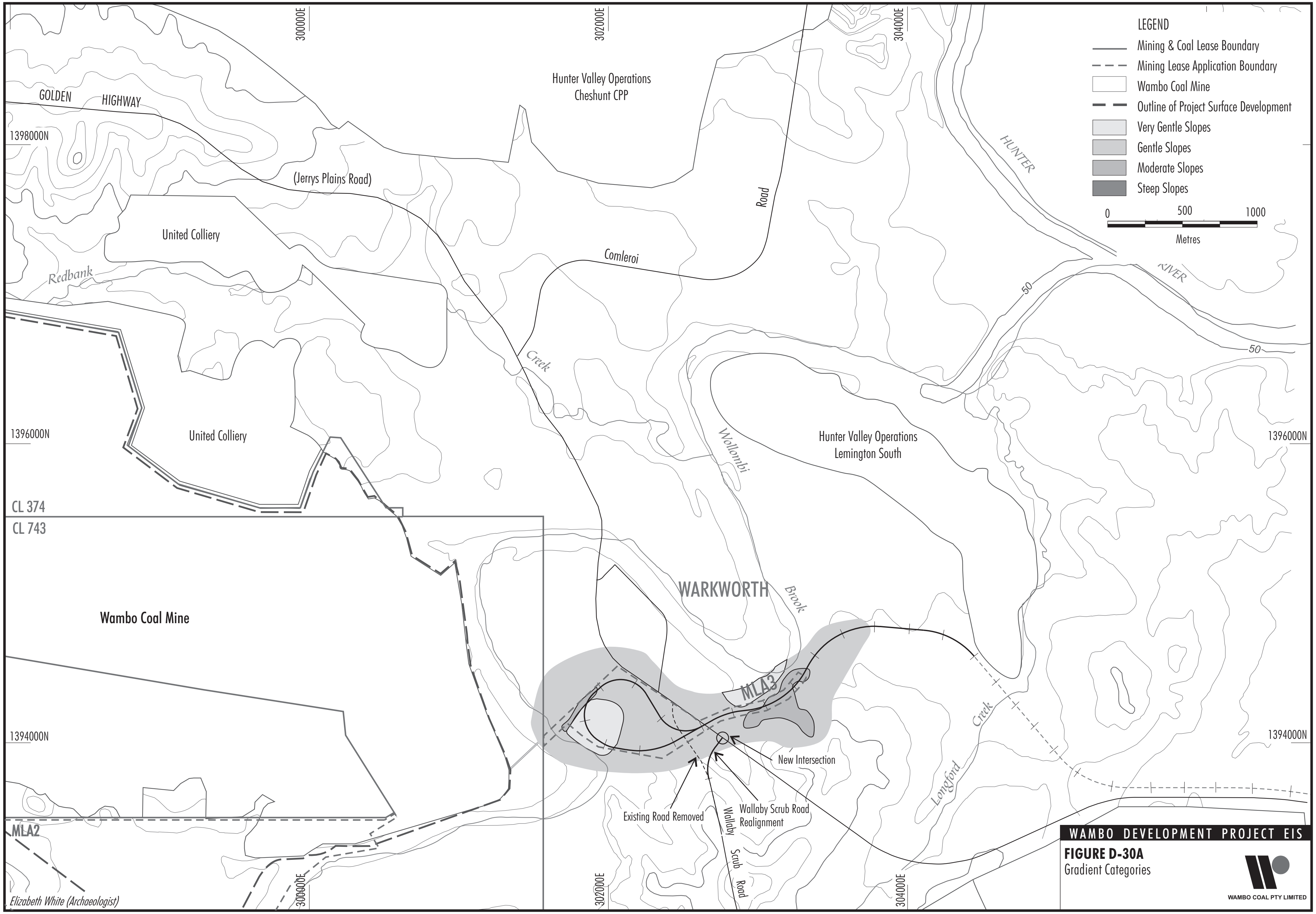


FIGURE D-30
Gradient Categories

WAM-02-01-ABH_016F



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-30A
Gradient Categories

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_023F

D8.3.4 Landform Elements

Landform types are those defined by Speight (1990). For the convenience of readers definitions and figures from Speight are reproduced here (Figures D-31 and D-32). While many different landforms may exist the following have been found within the Wambo study area and/or in the surrounding context area. The following definitions are given by Speight (1990:13-34) or compiled from definitions given:

- Crest: The highest landform element which stands above all or almost all points in the adjacent terrain. It is characteristically smoothly convex upwards in down-slope profile or in contour or both (Speight 1990:13).
- Crest ridge top: A ridge is defined as a compound landform element comprising a narrow crest and short adjoining slopes, the crest length being greater than the width of the landform element (Speight 1990:19). For this study Crest ridge top is meant as a single element being only the crest which occurs along a ridge top. They are distinguished from other crests because they include ridges which could have been used as access routes into the adjoining mountains.
- Depression: A landform element which stands below all or almost all points in the adjacent terrain. An open depression (the creeks observed in the Wambo study area) extends at the same elevation or lower beyond the locality where it is observed (Speight 1990:15).
- Flat: A planar landform element that is not a crest or a depression and is level or very gently inclined (Speight 1990:18).
- Maximal lower slope: A relatively steep slope below a more gentle slope and above a flat or depression.
- Maximal upper slope: A relatively steep slope below a crest, and above a more gentle slope.
- Minimal mid slope: A relatively gentle slope below a steeper slope and above a steeper slope.
- Simple slope: A slope which is adjacent to and below a crest and adjacent to and above a depression (Speight 1990:15); ie. a slope of the same gradient extends from a crest to a depression.
- Waning lower slope: A slope which is below a steeper slope and above a flat or depression.
- Waning mid slope: A slope which is below a steeper slope and above a more gentle slope.
- Waxing upper slope: A relatively gentle slope below a crest but above a steeper slope.

D8.3.5 Locations of Extensive Outlook

The Director-General's requirements called for mapping of "locations of extensive outlook". In the Wambo study area most elevated locations north of North Wambo Creek allow some kind of view, particularly of the sandstone escarpment to the south-west. However, many of these views are unhindered, because there are very few trees growing on the creek flats. Views prior to European occupation may have been more obscured by trees. We have John Howe's early (1819) comment that there was very little timber on high ground about 1 km back from the Hunter River in the vicinity of Jerrys Plains. If the timber was fairly light (eg. a few trees to the acre) then there may have been many views within the Wambo study area. On the other hand, Howe may have made his comment because the hilly country further away from the Hunter River (such as that in the present Wambo study area) had much thicker tree cover.

Figure D-31
Examples of Landform Elements Shown on a Contour Map
(from Speight 1990:17)

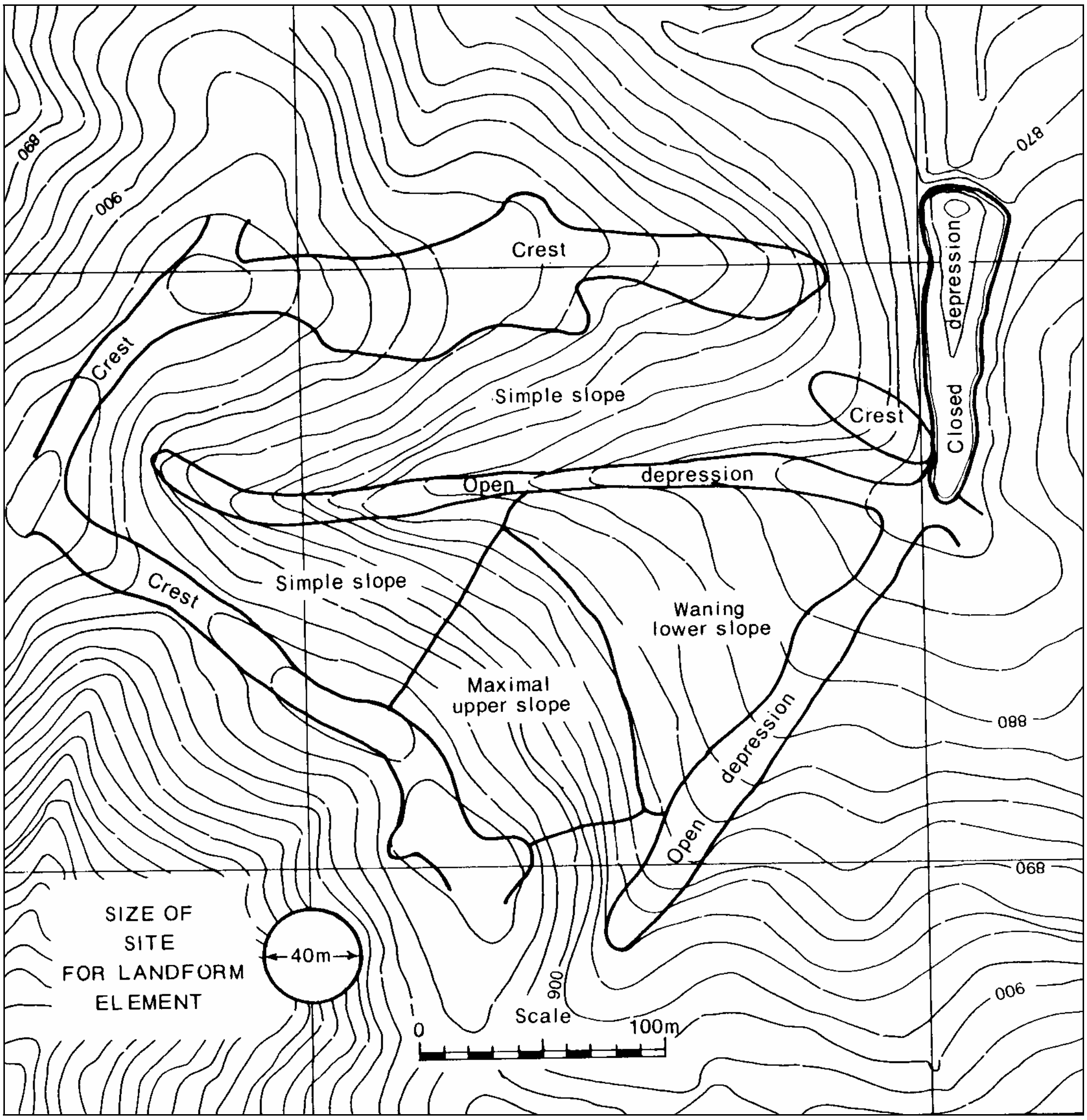
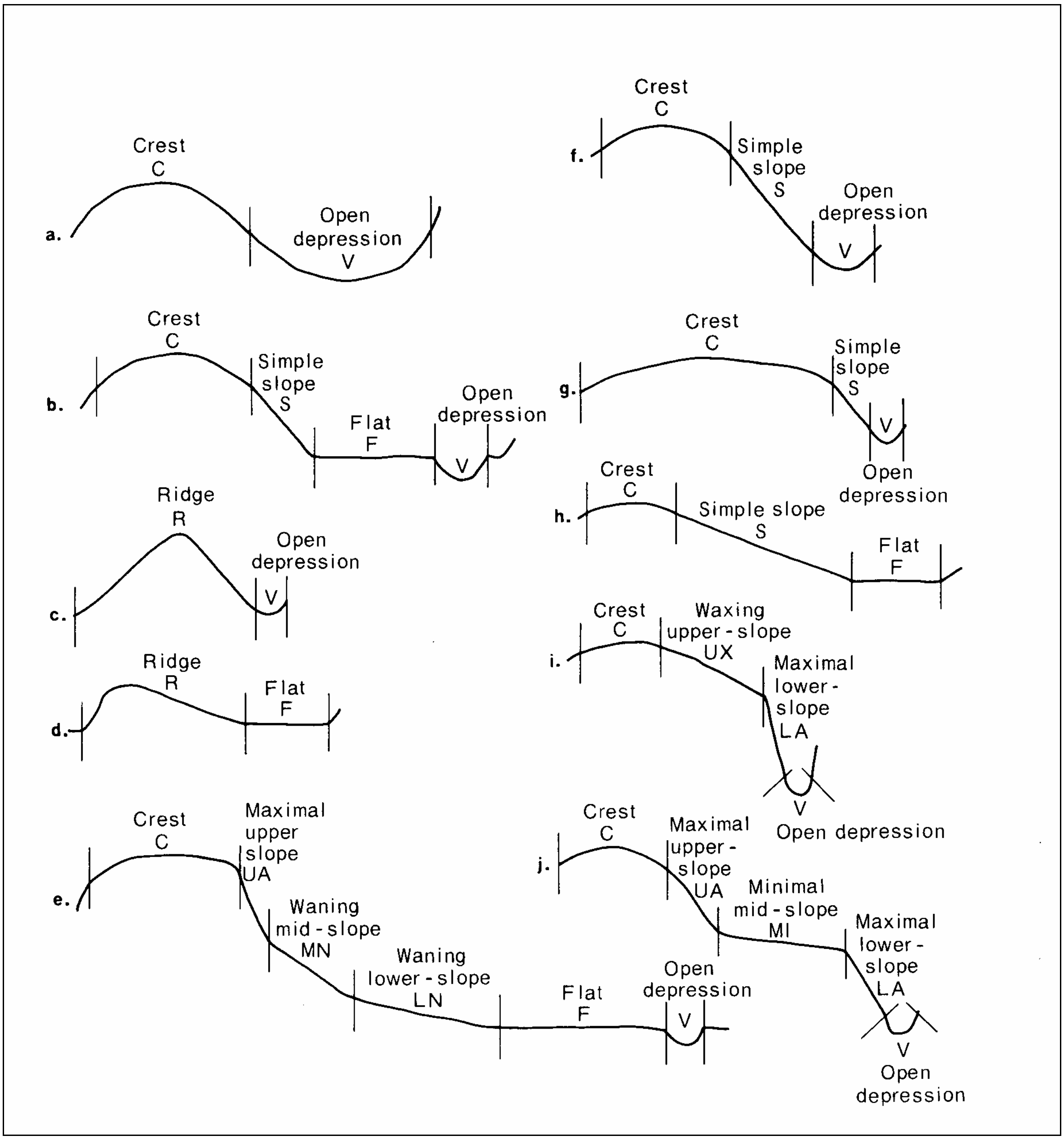


Figure D-32
Examples of Landform Elements Shown in Profile
(from Speight 1990:14)



An attempt has been made to identify locations of views within the areas which were surveyed for this Project (Figure D-33). Very extensive views across the Hunter Valley are present from high narrow ridge tops. Two such views are shown in Plate D-1 and D-2. Plate D-1 shows that trees growing on slopes below the lookout have not obscured the view, but trees on lower slopes would certainly have obscured animal movements; that is, kangaroos would probably not have been visible from such a lookout. The movements of people could have been tracked if they signalled with smoke. The view shown in Plate D-2 has been taken from a location fairly clear of timber. Thick shrubs on the left and right hand edges of the photo could have obscured the view into the valley of Splitters Hollow Creek. From this location the sandstone escarpment is clearly visible but the usefulness of this place for spotting the movements of people or macropods could have been limited. The location from which Plate D-3 has been taken could potentially have shown the movements of people and macropods, but only if the trees were more sparse than the dense timber shown on the right-hand side of the photo.

D8.4 GEOLOGY, GEOMORPHOLOGY AND STONE RESOURCES

D8.4.1 Surface Geology and Geomorphology

Surface geology varies across the Wambo study area. The various geologies as defined by the Singleton and Doyles Creek 1:25,000 scale geological map sheets are:

- Pswj – Jerrys Plains Subgroup of the Wittingham Coal Measures. The subgroup variously consists of coal seams with fine sandstone, siltstone and conglomerate, and tuffaceous claystones.
- Pswd – Denman Formation of laminite.
- Psls – Watts Sandstone, being massive medium to coarse grained quartz lithic sandstone
- Pslz – Undifferentiated Wollombi Coal Measures, consisting of coal seams with carbonaceous shale, siltstone, sandstone and tuffaceous claystone.
- Rna – Widden Brook Conglomerate of the Narrabeen Group, consisting of conglomeritic quartz sandstone and minor shale.
- Czb – Sand and coarse sand.
- Qha – Quaternary silt and sandy silt.
- Qhb – Quaternary silty sand and sand.
- Red sand body – previously unmapped fine sandy material.

Most of the proposed north-west surface impact area is underlain by Pswj – the Jerrys Plains Subgroup of coal measures (Figure D-34). Outcrops of Pswd, Psls and Pslz occur on the highest ridges. Qha (Quaternary alluvium) occurs along Wambo and North Wambo Creek. The proposed underground mining areas west of Wollombi Brook are variously overlain by Pswj, Psls, Pslz, Rna, Qha and Qhb. The previously undescribed red sand body occurs adjacent to Wollombi Brook, just north of North Wambo Creek. The proposed underground mining area east of Wollombi Brook consists of Pswj overlain by Czb sands. During the field survey the distribution of sand seemed more extensive than had been mapped on the Singleton 1:25,000 scale geological map sheet. The distribution of Czb sand shown on Figure D-34 is based on the mapping on the Singleton sheet, but modified by field observations. However, the distribution of sand may still not be accurate. The proposed rail line is located largely on Pswj, avoiding the remains of a Czb sand dune near the Wambo Mine access road.

Soils across most of the proposed surface impact and underground mining areas tend to be texture contrast with a silty A horizon overlying variously clay and stony B horizons. The A horizon soils are mostly shallow, often less than 20cm thick, and have no potential to contain stratified archaeological materials. Dr Hughes identified two geomorphological contexts with potential to contain stratified deposits: a red sand body on the west bank of Wollombi Brook and a yellow sand dune on the east side of Wollombi Brook (Attachment D-2). The Qha and Qhb alluvium are not considered by Hughes to be particularly sensitive. A sandy soil on Site 40 (#37-5-195) test excavated by Rich (1991b) occurs beyond the proposed middle underground mining area.

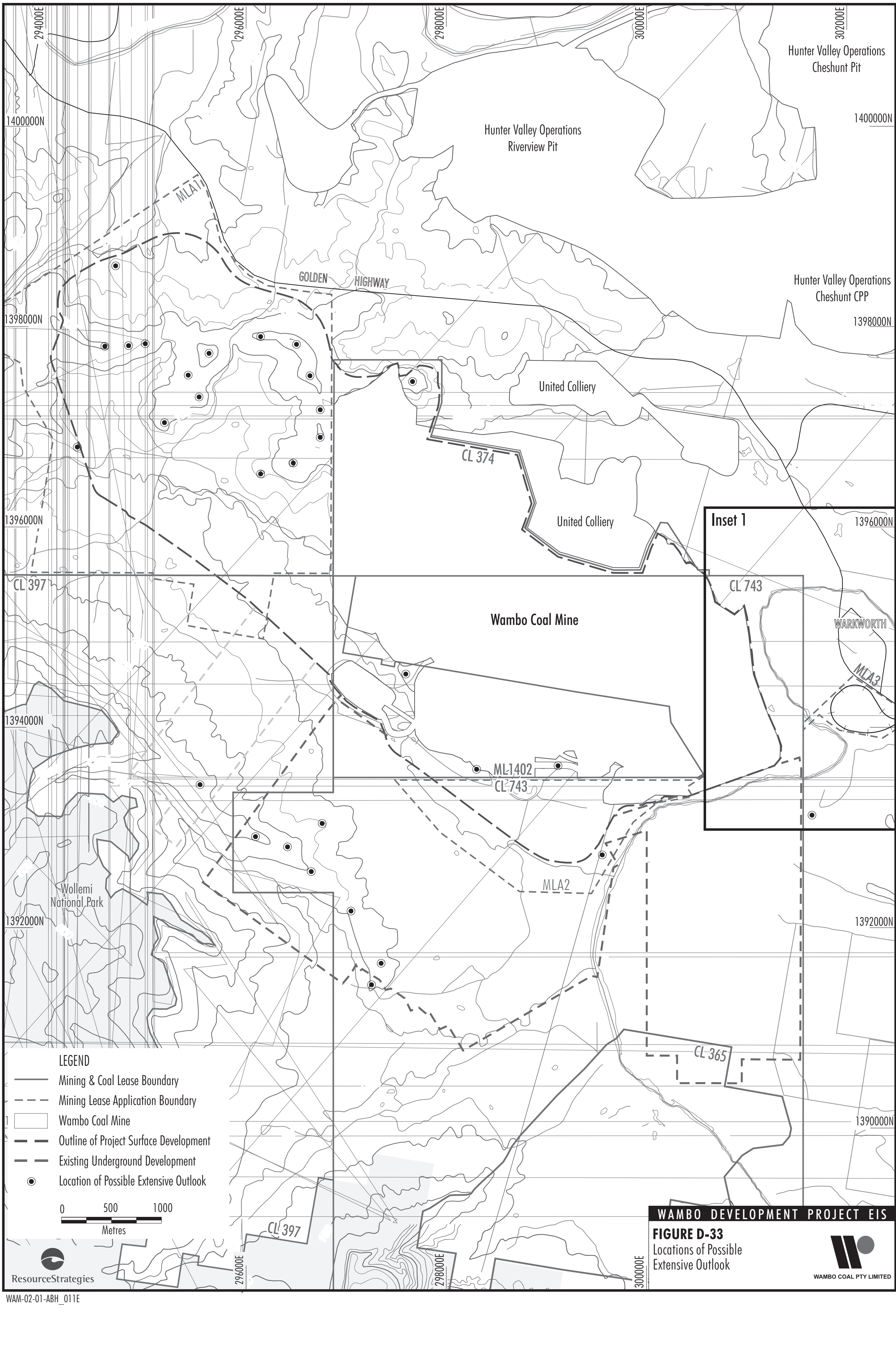


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FIGURE D-33
Locations of Possible
Extensive Outlook

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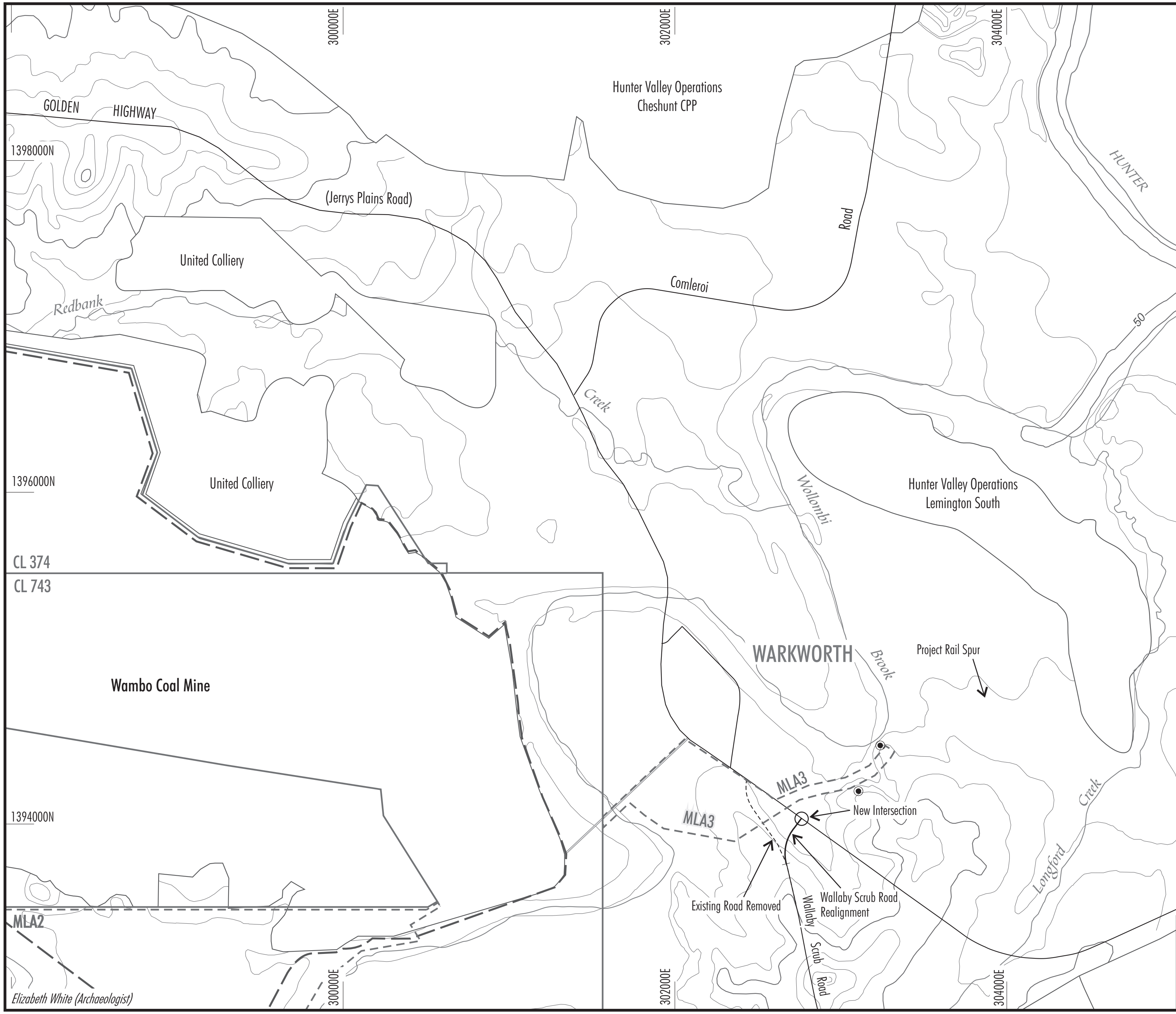

WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-33A

Inset 1 -
Locations of Possible
Extensive Outlook

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_012G

Plate 1: View from high ridge above Unnamed Creek #1. Taken at AMG 308270 6397230, camera facing the north-west.

Plate 2: View from high ridge above Splitters Hollow Creek. Taken at 307200 6397200, camera facing south-east.

Plate 3: View over North Wambo Creek, taken from AMG 308420 6395900, camera facing south-west.

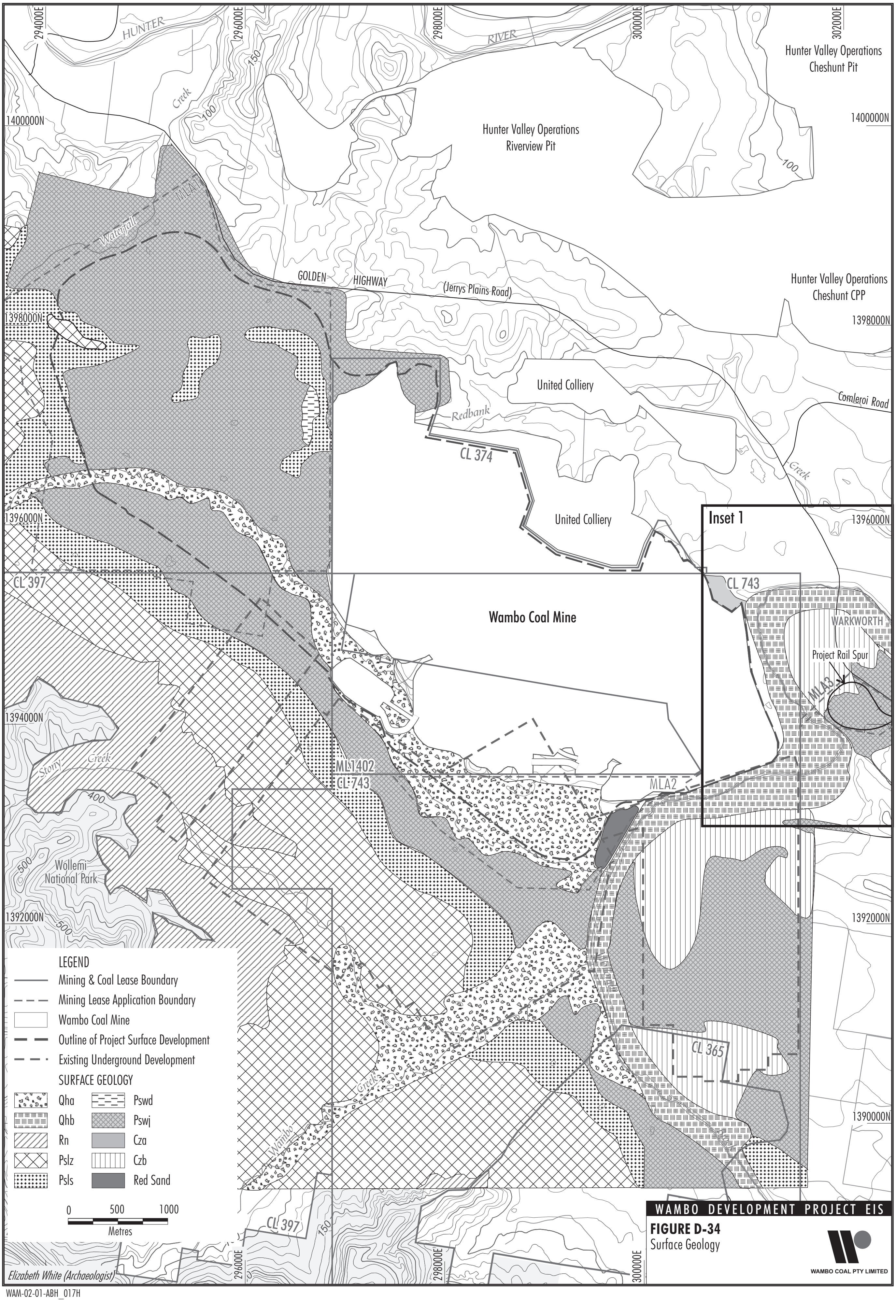

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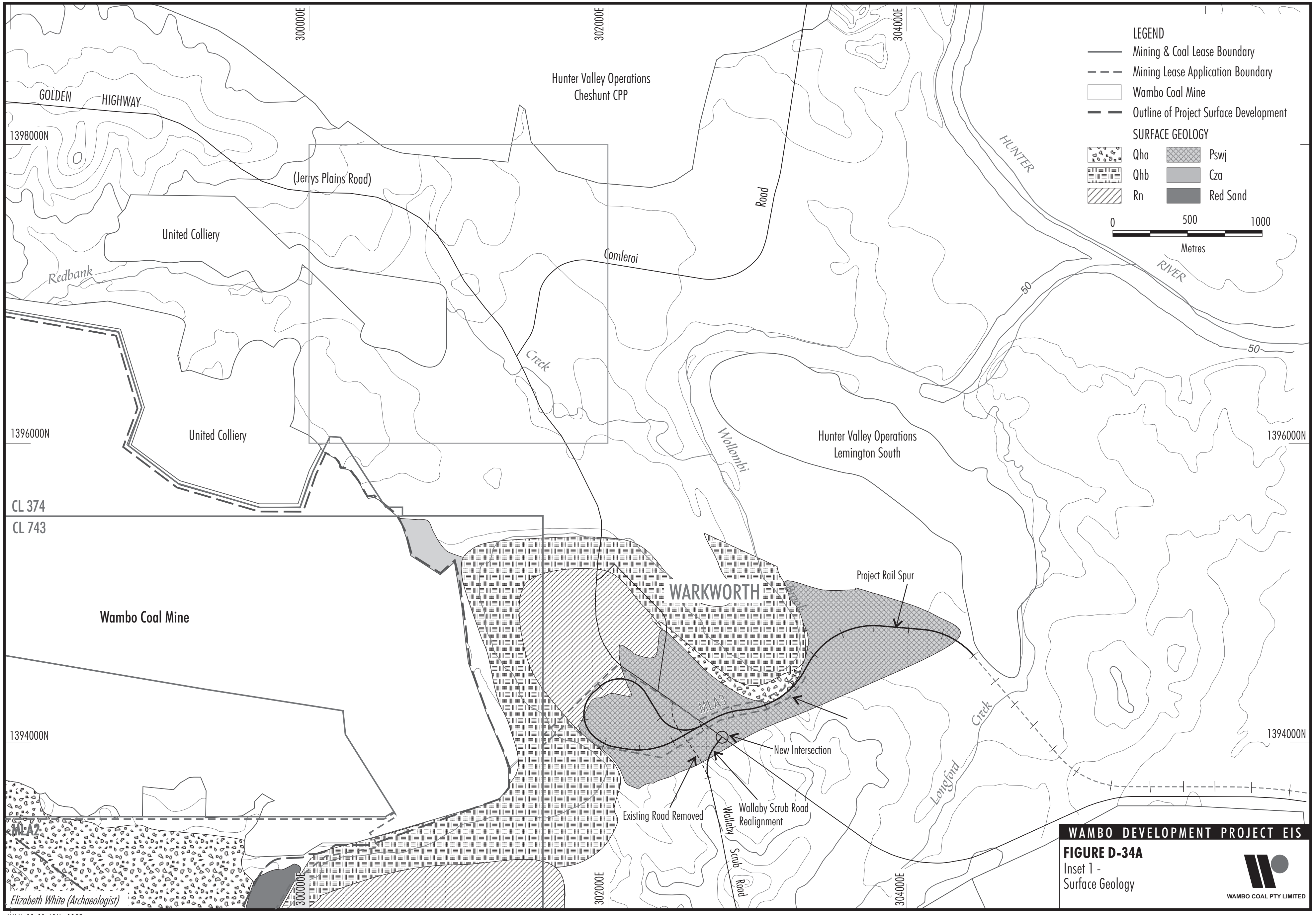
FIGURE D-34
Surface Geology

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_017H



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-34A

Inset 1 -
Surface Geology

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_025F

D8.4.2 Stone Resources

Historical records include very few comments on Aboriginal use of stone. On the coast, quartz (and glass in the historic period) was used on war spears, being stuck along the hardwood component to resemble the teeth of a saw. Glass was also used to sharpen spears. White and red pigment (clay and ochres) were used for decoration. Hatchets were made from heavy black stone (Brayshaw 1986:64, 66-67). Brayshaw noted the paucity of references to stone tools – apart from hatchets and quartz barbs – and suggested that there may have been little use of stone tools at the time of European contact, having been replaced by shell, wood or bone. Alternatively, stone tools may have escaped the notice or interests of early observers (Brayshaw 1986:68).

There are no local historical descriptions of how animal skins would have been cleaned and tanned. Dr Haglund (*personal communication*) has suggested that slightly rough stone, not too sharp, would be useful for cleaning fat and membrane from hides, whereas a flaked tool made of brittle isotropic stone may have been sharp and could have cut holes in the skin. Likewise, an implement (not too sharp) would have been needed to scrape possum fur from skins – and the historical records comment on the importance of possum skins and fur. Dr Haglund has suggested that the Bulga knives with their even smoothed edges and slightly coarse texture might have been ideal for such tasks. A possum and kangaroo skin rug housed at the Smithsonian Institution has an incised pattern (Brayshaw 1986, 69, 72) and an implement would have been needed to do this without cutting through the skin.

Koettig (1994:79-80) identified sandstone as a resource, eg. as exposures suitable for sharpening hatchets, and as portable stone useful for the construction of hearths, heat treatment pits and ovens.

During the present survey sandstone outcrops were seen around the upper edges of the highest ridges, both north and south of North Wambo Creek. These sandstone outcrops were too small to form shelters suitable for human occupation. The sandstone surfaces did not tend to have potholes capable of holding water after rain, and no grinding grooves were seen in these elevated contexts.

Sandstone bedrock was exposed in places along the deeply incised bed of North Wambo Creek, and along the edge of Wollombi Brook at about AMG 312000 6392190. The suspect grinding groove Site 117 (#37-5-173) was previously recorded in the bed of North Wambo Creek near an old stone dam. However, if North Wambo Creek consisted of a series of ponds this sandstone would not have been available to Aboriginal people in recent prehistory; the grooves, if they were made from grinding, may have been made in the historic period after the sandstone was exposed. Sandstone exposed in the bed of North Wambo Creek near the confluence with Wollombi Brook, and that in Wollombi Brook itself, may have been exposed after local scouring of the creek channels by floods in prehistory, though no evidence of Aboriginal use of the sandstone platforms was seen.

The Wambo study area is 1.5 km to 10 km from the Hunter River. The Hunter River gravels contain silicified tuff, silcrete, quartz, petrified wood and a wide range of other igneous and metamorphic rock types. The gravels were probably the main source of stone used for the production of stone tools. Silcrete outcrops occur on some high terraces above the Hunter River. The nearest known terrace silcrete sources are located at Lemington South (Brayshaw *et al*. 1996) and near Jerrys Plains (Raggatt 1938:320), 3 km to 7 km from the Wambo study area. These locations are shown on Figure D-2.

Fragments of “tuffaceous claystone” pebbles, reported to occur within the Pswj and Pslz geologies, occur within the study area but these do not appear to be of artefact quality.

A few good quality quartz pebbles, much lesser quality quartz, and some good quality quartzite cobbles were seen within an area mapped as Pswj near the watershed of Splitters Hollow and Waterfall Creek on Site 258. Small quartz pebbles, generally less than 2 cm in size, were also seen in areas mapped as Rna on the high ridge between North Wambo and Stony Cks. Quartzite pebbles, mostly of fairly poor quality, was seen widely scattered around the Wambo study area.

D8.5 VEGETATION AND PLANT RESOURCES

D8.5.1 Historical Comments

In late 1819 John Howe and party with an Aboriginal guide traversed the sandstone country from Windsor north to the Hunter Valley, dropping from the Hunter Range via Doyles Creek. On a tributary of Doyles Creek was "... a thick brush of pines on the banks of the creek, the trees seldom exceeding five or six inches through..." (Howe quoted by Brayshaw 1986:16). These were probably Casuarina species. Doyles Creek entered a widening valley of "fine country" and they saw many acres without a tree before coming upon the Hunter River. As Howe progressed down the right-hand side of Hunter River towards the area now known as Jerrys Plains he wrote:

> *Back ground very fine and little timber; only a few trees to the acre and some patches without. ... The high land appears to be threequarters of a mile back and very little timber on it, and grass very green."* (Howe, quoted by Wood 1972:12; also in Brayshaw 1986:12)

In early 1820 Howe returned and explored the river further downstream towards Wallis Plains. He noted that "... except a few places there is more timber than on the part that I made in November last..." (Howe, quoted by Brayshaw 1986:13).

In 1824 Henry Dangar noted of the Lemington area "... tollerable (sic) second class forest land[16], stiff soil, thinly timbered, small Box and Iron Bark." (quoted by Brayshaw 1986:13). On the left bank of Wollombi Brook not far above its confluence with the Hunter River, Dangar noted light alluvial soil close to the Brook and towards the south-east "... poor Tea Tree flat forest, ... good undulating second class forest land, stiff loam soil, light Box and Iron Bark Timber... " (quoted by Brayshaw 1986:13).

Of Broke on Wollombi Brook in 1830 Mathew reported that the country was picturesque but that a great part of the land was very poor and though flat abounded in Iron Bark and in some parts with Apple and Gum (Brayshaw 1986:26). Broke is on similar geology as some of the present Wambo study area[17], so these comments might also apply here.

D8.5.2 Food Resources

Historical references to dietary resources are also almost entirely for the coastal area. The roots of a fern (called Bungwall in the Dungog area) were eaten, probably *Blechnum sp*. Likewise a yam, possibly *Dioscorea transversa*, and the Giant Lilly *Doryanthus excelsa* (Brayshaw 1986:74), but these probably did not occur within the present Wambo study area.

During the survey, and in the vegetation report for this Project, several plants and trees were seen of types which could have been used as food sources.

Of particular note are kurrajong trees (*Brachychiton populneus*). This species was probably a very important food source, and in April 1825 in the Jerrys Plains area Allan Cunningham reported that the seeds were gathered by the Aborigines who roasted and ate them "after the manner of Maise". In 1937 Enright reported that a basalt grindstone found at Milgarra near Bunnan had been used to grind seeds including kurrajong seeds (Brayshaw 1986:74). The kurrajong trees bare seed pods, which when ripe crack to expose rows of starchy seeds encased in irritating yellow hairs. The seeds are nutritious comprising about 18% protein and 25% fat (Low 1989:27, 87). For kurrajong species growing in northern Australia (*B. paradoxum* and *B. gregorii*) the packing is poisonous and care is taken in the preparation of the food. If the pods are green they are collected and baked in ashes. The nuts pop out of the packing but the packing itself is poisonous and had to be thoroughly removed and the hands washed. If the pods are dull brown the nuts and their packing are extracted and baked together. The fire tenders sit to one side so that no smoke blows in their eyes. When baked the sandpapery packing is rubbed off the seeds between the hands, with the wind blowing the poisonous hairs away (Isaacs 1987:88-89). It is likely that such care was also required for *B. populneus*. While the seeds were probably an important food source, the roots of saplings were also eaten (Low 1989:27). Bark was used to make string, for fishing lines, nets and binding for spear shafts (Brayshaw 1986:61-63).

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16 Brayshaw notes that the term "forest land" probably meant land which was "outside" – that is, hitherto unsurveyed and unfenced land (Brayshaw 1986:14); rather than meaning a vegetation community with a particular structure.

17 Wollombi Coal Measures and Quaternary sand, silt and gravel on the Hunter Coalfield Regional Geology 1:100,000 sheet 1993

During the survey many kurrajong trees were seen and the ground beneath them was littered with opened seed pods. The vegetation report (Orchid Research 2003) notes the presence of kurrajong within vegetation communities #3 and #6. Community #3 occurs near Wollombi Brook, while community #6 is the most widespread in the Wambo study area, occurring on Permian clay soils, and on some steep stony slopes. Kurrajong trees were probably widespread in the study area at the time of Aboriginal occupation.

Macrozamia sp. were seen in two locations, on the high ridges in the north west part of the Wambo study area (eastern extension of Jerrys Plain Ridge) and on Wambo Ridge separating Stony and North Wambo Creeks. The vegetation report for this Project (Orchid Research 2003) identifies those on the northern ridge top as *Macrozamia concinna*. *Macrozamia* produce cones of bright red nuts which are poisonous unless well prepared. The seeds were collected, cracked, soaked, ground and then baked (Low 1989:84). The nuts are high in water, provide good energy and some protein, fat, fibre and trace elements (Isaacs 1987:225). On the Hunter coast at Newcastle seeds were soaked in swamps for a week or two, then pounded and roasted (Brayshaw 1986:74; Threlkeld in Gunson 1974:55).

Long-leaf mat rush (*Lomandra longifolia*) was seen in various places across the Wambo study area. The vegetation report notes its present within vegetation communities #1, #5, #6 and #13. These communities occur near Wollombi Brook, on the Warkworth Sands, on Permian clay soils, on some steep stony slopes and on the margins of Stony Creek (Orchid Research 2003) so long-leaf mat rush was probably widespread in the study area. The basal core of this plant could be chewed and apparently tastes like raw green peas. The flowers are also sweet to taste but on this species are guarded by pungent spines. The leaves could also be useful for making baskets (Low 1989:131, 174).

Native cherry (*Exocarpus cupressiformis*), along with kurrajong, was seen in 1825 by Allan Cunningham in forests in the Jerrys Plains area (Brayshaw 1986:74) and also occurs within the Wambo study area in vegetation communities #2, #3, #4, #6, #12 and #14. These communities variously occur near Wollombi Brook, on Permian clay soils, on some steep stony slopes, and in small areas in the north and south of the Wambo study area (Orchid Research 2003). It was probably widespread in the study area. The fruits of native cherry are small (Low 1989:46-50).

Sandy areas east of Wollombi Brook supported many banksias, identified as *Banksia integrifolia* (Orchid Research 2003), and bracken fern. The large blossoms of banksias carry copious nectar which people sucked straight from the flowers or soaked the banksia cones in bark troughs to make drinks (Low 1989:170). Bracken (*Pteridium esculentum*) was an important food in south-east Australia where the rhizomes (underground stems) were roasted and chewed to extract a bland white starch (Low 1989:107-108).

The vegetation study also identified Rusty Fig (*Ficus rubininosa*) on the margins of Stony Creek (Orchid Research 2003). Figs are edible (Low 1989:22), although in the study area they probably had a limited distribution.

Also present in the study area but limited in extent is an “unusual patch of Mulga (*Acacia aneura*)” which covers about 2ha (Orchid Research 2003). This occurs just east of Site 121 (#37-5-172) and which is one of the larger sites in the Wambo study area. Mulga are good food sources. The stems may support shiny red lumps which are the sugary shells of a sap-sucking insect, mulga lerp (*Austrochardia acaciae*). In the foliage mulga “apples” may be present which are actually small green galls formed by wasp larvae, which are slightly sweet and apparently taste a little like dried apple. On lower mulga twigs lumps of glistening gum may be found, which is hard outside and syrupy and sweet inside, and which oozes from mulga branches following insect attack. Mulga seeds are small but highly nutritious and could be pounded to make flour and baked as cakes; they comprised of 20% protein and nearly 10% fat (Low 1989:13).

It should be noted that the identification of so many plant foods is rarely made during archaeological surveys in the Hunter Valley and is probably due to the physical survival or regeneration of food plants in the study area, detailed identification of plant species by the flora study (Orchid Research 2003), observations during the archaeological survey, and the availability of publications on bush foods which could be used as reference materials.

D8.5.3 Other Resources and Equipment

Some historical references to the use of plant materials for equipment have been compiled by Brayshaw (1986). In the “Comleroi” district above the junction of Wollombi Brook and the Hunter River bark was cut from box or stringybark trees and straightened with fire, to make huts. Cunningham reported that paperbark (*Melaleuca quinquenervia*) was also used (Brayshaw 1986:59). Box trees and paperbark occur within the present Wambo study area. Paperbark (tea tree bark) was also used to make small baskets and drinking vessels (Brayshaw 1986:63). Bark, including that of kurrajong bark, was soaked and beaten with a wooden mallet, and twisted and rolled with the palm of the hand on the leg to make chord or string. This in turn was used for fishing lines, nets and bags, binding spear points to shafts (Brayshaw 1986:60,63). Wooden bowls or other vessels were made from large protuberances growing on trees (Brayshaw 1986:64). Clubs, swords, boomerangs, spear throwers and digging sticks were from hard wood such as ironbark. Wood and bark was used to make shields; bark for the shield, wood for the handle, soft tea tree bark to protect the knuckles (Brayshaw 1986:64-66). Spears on the coast were made from the flower stem of the grass tree *Xanthorrhoea australis* (Brayshaw 1986:65) but this does not occur within the present Wambo study area and spears were obtained as exchange items from coastal Aborigines (Dawson (1830:135-136; Threlkeld in Gunson 1974:42, 206).

People would also have used wood for their fires which were common features of camps (see Section D7.1.4).

D8.6 FAUNA AND ANIMAL RESOURCES

In 1825 in the Denman area Allan Cunningham noted that “Kangaroos and Emus particularly the former are abounding in every part of our Route...” (A. Cunningham quoted by Brayshaw 1986:19). Of the same area Peter Cunningham noted in 1827 that the thick grass on the flattened ridges made them “... the great resort of the kangaroos ... in the winter season ...” (P. Cunningham quoted by Brayshaw 1986:19). However, by 1831 on Wollombi Brook, Breton noted only 16 kangaroos where formerly a hundred might have been seen (Brayshaw 1986:19). It seems that macropods were once prolific but numbers declined after European settlement.

Early historical records indicate that Aboriginal kangaroo and wallaby hunting was a group exercise, in which some people drove the animals towards other people who ambushed them from “rocks or stumps, or any little eminence”, or encircled the animals which were speared as they fled (Brayshaw 1986:79). Grass was sometimes deliberately burned-off in certain areas about a month before a planned hunt, to attract kangaroos and wallabies to the place (Threlkeld in Gunson 1974, quoted by Brayshaw 1986:79).

Dawson (1830:191) reported that possums were more numerous inland than on the coast, and were captured by chopping holes in the hollow branches of trees (Brayshaw 1986:19, 80). In 1826 Biraban from the coast “... went to the mountains with upwards of 60 spears to exchange for opossum cord made of the fur...” (Threlkeld quoted by Brayshaw 1986:65). Possum skins and possum fur headbands were also obtained from the inland in exchange for metal tomahawks, shell scrapers, and pieces of glass as well as spears (Brayshaw 1986:67).

At Patricks Plains near Singleton, Peter Cunningham noted wild turkeys (P. Cunningham quoted by Brayshaw 1986:19). In 1819 upstream from Jerrys Plains Howe noted perch in the Hunter River (Brayshaw 1986:19). Goannas were eaten in the Port Stephens area, at Lake Macquarie and probably elsewhere (Brayshaw 1986:80).

The historical literature occasionally makes reference to the use of animal products in the tool kit. Again, these observations have been collated by Brayshaw (1986:65-67). Animal bone was sometimes used as prongs in fishing spears, and as awls for sewing, shell was sometimes used for scrapers, sinew was used for thread, and the skins of possum and kangaroo were used for cloaks.

During the survey many wallabies and goannas (and the tracks thereof) were seen, especially in timbered areas. Several large goannas were seen in various landscape settings including high ridge tops, moderate hill slopes and valley floors. Wombat burrows, and occasionally the wombats themselves, were also seen. Freshwater mussel shells were noted near Wollombi Brook. It could also be expected (after Brayshaw 1986) that eels and possums, and possibly emus, would have been taken in the Wambo study area.

D8.7 LAND DISTURBANCE

Much of the Wambo study area was taken up by James Hale in the 1830s and he bought other properties to increase his holdings. The homestead at Wambo appears to have been established from the mid-1830s with various subsequent additions. Apparently the property was used as a pastoral holding, although in 1844 the good condition of Hale's wheat was commented upon. After 1900 it was used as a horse stud and three dairies operated in the area. It was subdivided in 1908 (Collins 1994:5ff).

Indications of past land disturbance are given on Figure D-35. This mapping is based on field observations and analysis of air photos from 1963 (the earliest available for this area as held by the Department of Lands), 1979 and 2002 (Plates D4-D6).

Creek flats and some lower slopes along Wambo, Stony, North Wambo and Waterfall Creeks, and in places adjacent to Wollombi Brook, appear to have been cultivated repeatedly, including the red sand body. Some areas appear to have been ploughed less frequently, and/or early in the historic period – as along Splitters Hollow, an area of gently sloping land on the watershed of Splitters Hollow and Waterfall Creeks, along a tributary of Waterfall Creek, near Wollombi Brook between Wambo and North Wambo Creeks and further south, and east of Wollombi Brook in the area of the proposed rail spur. Elsewhere, relatively undisturbed archaeological materials have been archaeologically excavated from soils subject to shallow (12cm) ploughing (eg. Koettig 1989), and from sites where ploughing has extended into B-horizon clays but where only one or two episodes of ploughing occurred (eg. Rich and McDonald 1995). On the other hand, areas subject to repeated and deep cultivation would have adversely affected open sites, by displacing artefacts, disturbing and potentially destroying features such as hearths, and damaging and breaking stone artefacts. Limited ploughing might not have unduly damaged open sites but intensive and repeated cultivation would have.

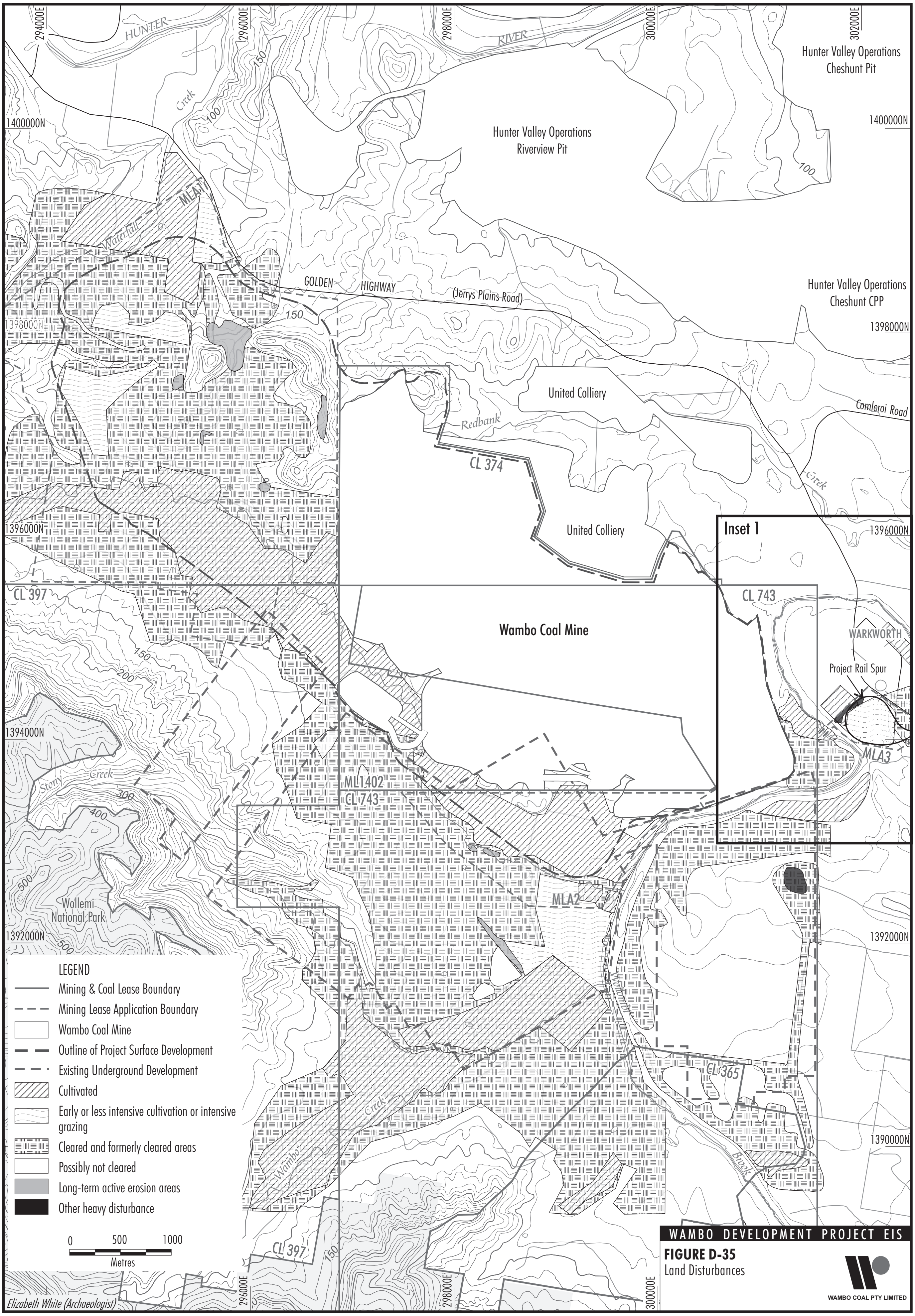
Much of the remainder of the Wambo study area appears to have been cleared of its original timber. Some areas which now support quite thick vegetation, such as the upper reaches of Redbank Creek, have been largely cleared in the past. Much of the catchment of Unnamed Creek #1 was vegetated in 1963, but was mostly clear of timber in 1979 to again be timbered in 2002. Modern mechanical methods of tree clearing appear to be more damaging to open sites because bulldozers or tractors dig into the ground surface and trees are pulled out or pushed out by the roots. Earlier techniques may have been less damaging, as trees were ringbarked and left to die and/or sawn off above ground level. Tree stumps were sometimes burned down and the lower part left in the ground, without large-scale displacement of soil around the stumps. Open sites may have been little damage by such methods. Of course, scarred or carved trees would have been lost by any form of tree removal.

Some areas may not have been cleared, particularly the dissected sandstone country bordering the south-west part of the Wambo study area, the watershed between Stony and North Wambo Creeks, and the high ridge forming the upper catchment of Unnamed Creek #1. An area below 130 m as at AMG 308100 6394100 also retains timber cover, which appears thick in the 1963 air photo. Other small stands south-east of this location are also present in the 1963 air photo; some such as that at AMG 310600 6391200 may be stands of Melaleuca. While some parts of the Wambo study area may not have been subject to recent large-scale clearing, it should be noted that very few large trees were seen; the ironbark recorded as scarred tree Aboriginal Site #37-5-188 is a fairly rare large tree.

Several relatively large areas of active ground erosion occur, particularly in the north-west part of the Wambo study area (see Figure D-35). Most notable is the exposure on which the remnant Site 213 (#37-5-40) occurs in a high saddle. This erosion area appears well established in the 1963 air photo and is still extensive and active in 2002.

Much of the proposed underground mining area east of Wollombi Brook is currently timbered, with the tree canopy varying from broken to unbroken. The 1963 air photo generally shows a more open canopy than the 1979 air photo. The 1963 air photo also shows that the entire area had been fenced into small paddocks, each less than 300 m across. Such close fencing implies some form of intensive land use. During the survey numerous rabbit and some wombat burrows were observed, and these have caused some ground disturbance; although no artefacts were seen in the spoil.

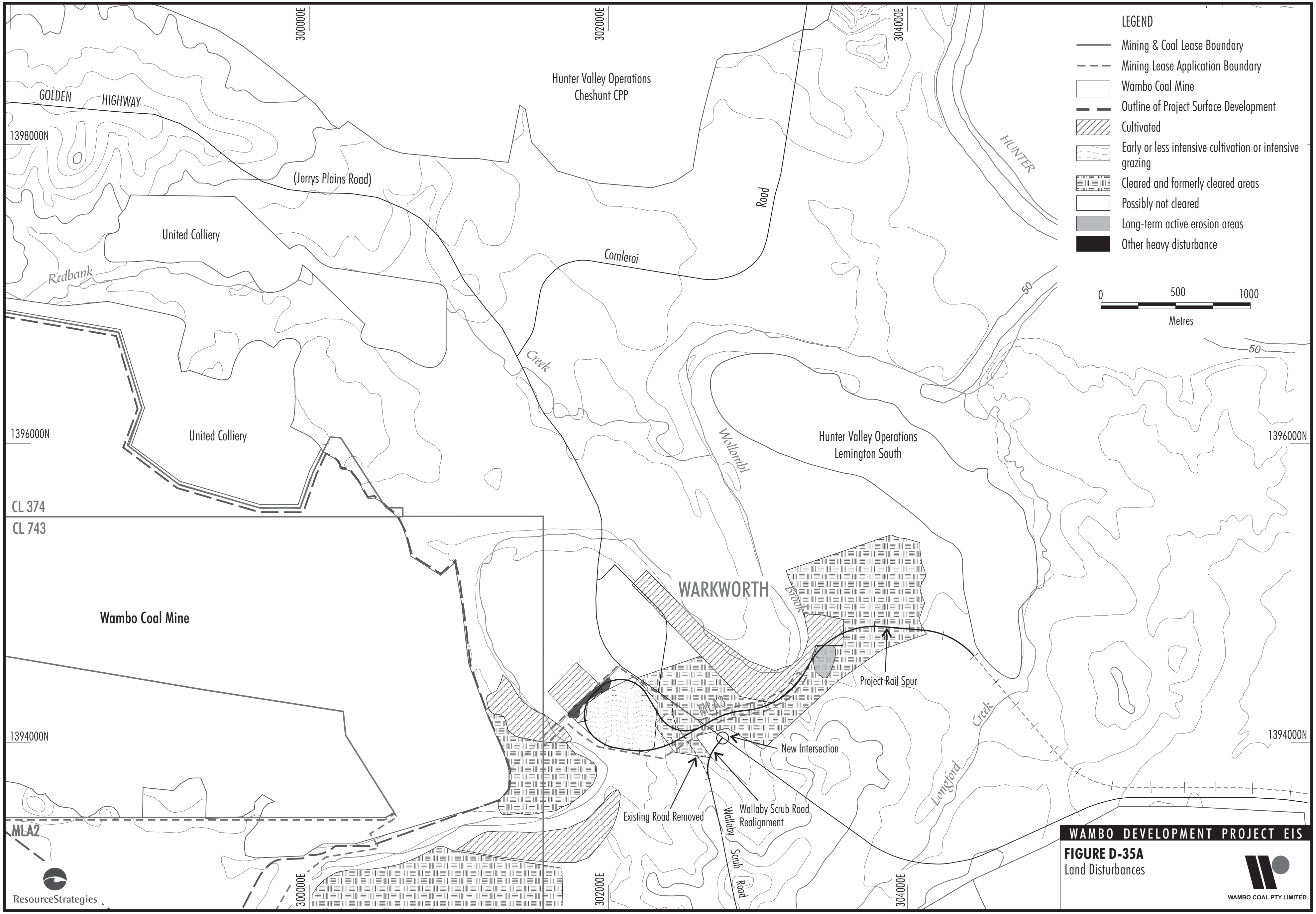
TOC HOME



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-35
Land Disturbances

WAM-02-01-ABH_015E



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WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-35A
Land Disturbances

WAMBO COAL PTY LIMITED

WAM-02-01-ABH_020E

Plate D-4
Aerial Photo of Wambo - 1963

Plate D-5
Aerial Photo of Wambo - 1979

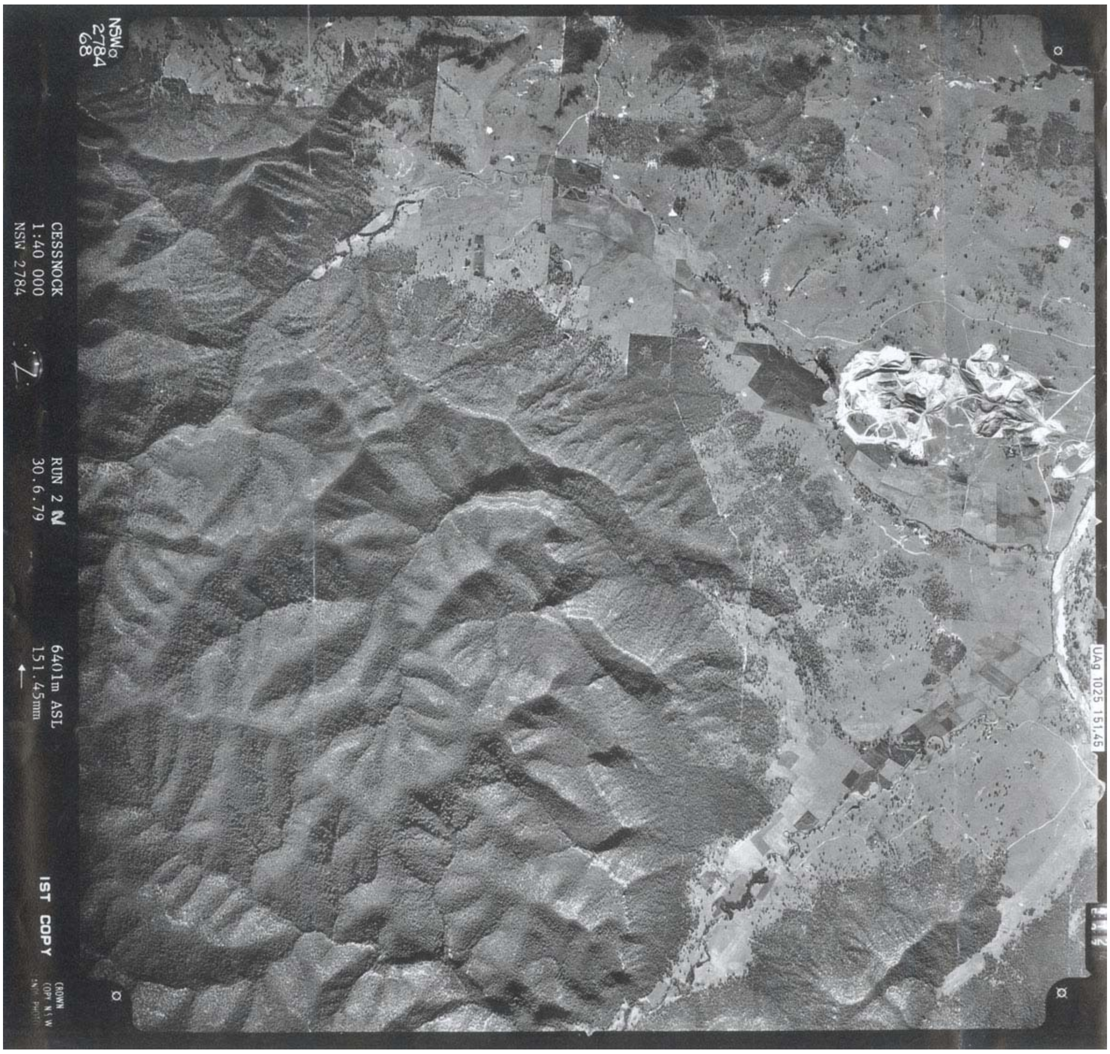


Plate D-6
Aerial Photo of Wambo - 2002

D9 WAMBO SITES AND DISCUSSIONS

D9.1 SITES IN THE WAMBO STUDY AREA

D9.1.1 Introduction

Most of the sites found within the Wambo study area consist of open artefact scatters and isolated finds (Table D-16). Also present is the site of reported carved trees (Site #37-6-56) discussed in Section D5, a probable scarred tree (Site #37-5-188), two (possibly four) grinding groove sites, and two sites with probable glass artefacts indicating use during the contact period. These latter sites occur at relatively low altitudes; all but two being below 75 m AHD.

Sites and possible sites (other than open artefact scatters and isolated finds) are discussed below. Analysis of the open sites and isolated finds follows, along with comparisons with sites in the surrounding context area.

Table D-16
Site Types in Wambo Study Area

Site Type	Elevation AHD of sites						Total sites
	55-74	75-94	95-124	125-144	145-174	175-225	
Carved Tree site	1	-	-	-	-	-	1
Scarred Tree	1	-	-	-	-	-	1
Grinding grooves & Open	2	1?	-	-	-	-	3
Grinding grooves	1?	-	-	-	-	-	1
Open & Contact	1 + 2?	-	1	-	-	-	4
Open	36	35	55	17	21	8	172
Isolated find	14	19	37	14	11	15	110
Total sites	**58**	**55**	**93**	**31**	**32**	**23**	**292**

D9.1.2 Scarred Tree Site 32 (#37-5-188)

A large ironbark growing near the west (left-hand) bank of Wollombi Brook was previously recorded by Rich (1991b). Scarred trees are notoriously difficult to identify. This particular tree has two scars, one on the west face being much larger than the scar on the east face. Both scars meet criteria for identifying Aboriginal scarred trees (Byrne 1997; Jo McDonald CHM 1999, NPWS nd), and most of the archaeologists and Aboriginal representatives who saw the tree during the present field work agree that there is a good possibility that the scars are of an Aboriginal origin. In particular:

- The tree is a large ironbark, native to the area, and appears old enough to have been useable at the time of traditional and semi-traditional Aboriginal occupation.
- Both scars are concave and symmetrical, typical of scars with an Aboriginal origin. Natural scars from fire, insect attack, birds or falling limbs are usually irregular in shape, may be ragged and have peaked ends. Tree limb scars will generally start at a high point and taper downwards. Lightning strikes typically cause long scars down the side of a tree, usually widening towards the base. Fire scars also tend to be wider at their base. The scars on this tree exhibit none of these features.
- Scars with an Aboriginal origin do not run down to the ground. Scars from fire and lightening almost always reach the ground; although bark removed for canoes sometimes demonstrate scarring to ground level. On the present tree the smaller scar is 63 cm above the ground. The larger scar reaches ground level but only at its bottom tip; the scar does not widen at the base as many fire scars do.

- Scars with an Aboriginal origin should be on a part of the tree, accessible by people standing on the ground; although people could have climbed trees to obtain bark from higher up. Natural scars may be "strangely" placed. Both scars on the present tree are in readily accessible positions.
- Scars with an Aboriginal origin may have axe, adze or wedge marks on the heartwood of the scar, especially around the edges of the scar from where the bark was removed. The presence of steel axe marks does not rule out an Aboriginal origin, as steel axes were present among Aboriginal groups often several years before face-to-face contact, and were used by Aboriginal people after contact. Metal-made cuts tend to be sharper and cleaner than stone-made marks, which are flatter and wider. In the present case, both scars have horizontal marks across the heart wood which appear to be axe marks. Those on the smaller scar are sharper than those on the larger scar but this could be related to weathering. It has been suggested that the marks could be from wire tied around the tree, but the marks on the two scars are not at the same heights.
- There is no reliable way to establish the age of scars. Fresh or recent scars exhibit rapid regrowth characterised by gum or sap seeping from the edge of the scar, thin bark at the scar margins, and what appear to be multiple stress or fracture lines on the bark characteristic of rapid growth. These features dissipate with age and slower regrowth. Small or narrow scars may actually grow over and will be visible only as a vertical line or indentation in the bark. Larger scars will remain visible as they are unlikely to be covered by regrowth. The surface of a scar will weather and become irregular with age, insect infestation, drying and splitting. Older scars may also become quite convex as the tree ages and grows around the scar. In the present case the scars have thick regrowth and both appear weathered, the larger more so than the smaller. The larger scar is on the west face of the tree and more exposed to weathering while the smaller scar is on the east face of the tree and less exposed to weathering.
- Eliminate other possible causes. Scars may have resulted from vehicles bumping into trees when using or maintaining adjacent tracks or roads. Scars may also have been made by surveyors. Surveyors' shields are usually a half oval or gothic arch, and often have a broad arrow or carved figures or letters. In the present case there is no evidence that the scars were caused by anything other than people. There is no evidence that they were made by surveyors.

The tree appears healthy and young trees are growing up around it and are likely to give it additional protection. The tree is located above the underground mining operations area but no subsidence is expected at this location.

D9.1.3 Grinding Groove Sites

Two (possibly four) grinding groove sites have been reported for the Wambo study area. Site 159 (#37-5-31) was first recorded by Dyall in 1980, inspected in 1990 by Rich (1991a:33-34) and reinspected for the present study. The site was originally recorded as a sandstone boulder (70 x70 x 20 cm) with two grooves (measuring 12 x 4 cm and 18 x 7.5 cm) and three small circular pits (8 cm across). During the present field work a second boulder was also seen with similar pits and grooves. The grooves are relatively narrow and do not have the appearance of axe grinding grooves. The pits appear to have been ground out, not used as anvil stones. All who saw both boulders and their markings grooves during the present field work agreed that the grooves and pits are unlikely to have a natural origin. There was also general agreement that it could not be certain they have an Aboriginal origin, but nor could an Aboriginal origin be ruled out.

Site 117 (#37-5-173) was originally recorded in 1990 by Rich (1991b:40-44). A total of 12 grooves were reported in three locations; two on sandstone bedrock which outcropped along the bed of the creek and a third group on an upturned boulder which had been used to construct a dam at the downstream end of the sandstone outcrop. During the present field work two grooves on the sandstone bedrock and the end of the upturned boulder were inspected. It was generally agreed that the first two grooves appeared from their shape to be axe grinding grooves. However, doubt was expressed about their authenticity, as their surfaces were not smooth the way that normal grinding grooves are smooth. Other nearby parallel weathered marks on the rock were noted and it was suggested that the grooves may have formed fortuitously by weathering of the sandstone. The markings on the upturned boulder may also have been from fortuitous weathering of the rock along its bedding planes.

The location of the largest group of six grooves was covered with sediment and the grooves could not be inspected. The photo in the 1991 report was examined and there was discussion about whether or not those grooves might have had an Aboriginal origin. It was noted that some of the grooves appeared elliptical like typical axe grinding grooves shapes, but one appears asymmetrical in cross-section. In the absence of reinspection the authenticity of this set of grooves cannot be assessed. If North Wambo Creek was a chain-of-ponds at the time of first European occupation then sandstone bedrock was probably not exposed. Conversely, the presence of the sandstone dam indicates that the creek has been eroded to this level for some time. Indeed, it is possible that the grooves relate to the construction or use of the dam and date to the historic period. The location has already been subject to underground mining and would be subject to further underground mining by the present proposal.

The other two grinding groove sites appear to be authentic. The first is Site 4 and was recorded during the present survey. It is located on the south (left-hand) bank of a 2^{nd} order creek on the east side of Wollombi Brook at AMG 313408 6389321. The grinding grooves are located about 500 m from the possible site of the carved trees (Site 2 or NPWS #37-6-56) and is in the same locality as the open site previously identified (and partly collected) by the Australian Museum in 1918. A total of nine grinding grooves were found in three locations on small patches of outcropping sandstone along the edge of the high creek bank. The site lies beyond proposed underground mining.

The last grinding groove site is east of, and close to, Wollombi Brook, at AMG 313840 6388020. The site is about 1.6 km from the possible location of the carved tree Site 2. The grinding groove site was found in 1997 by Dr Haglund, while carrying out field work for another project. Details of the site are not available but several axe grinding grooves were seen on sandstone bedrock on a lower slope above a flood channel adjacent to the main channel of Wollombi Brook. Stone artefacts were seen on the flatter hillslope above the site. The site lies on or just beyond the eastern edge of WCPL’s coal lease, and is well beyond proposed underground mining.

D9.1.4 Contact Sites

Two sites within the Wambo study area have flaked glass artefacts and two others have a scatter of material (glass and ceramics) from the early historic period and may also be contact sites. The first is Site 207 (#37-5-41 Malabar Site B) and was recorded by Dr Brayshaw in 1981 on a minor tributary of Waterfall Creek. The site is located at AMG 308250 6398600 and includes a flaked glass artefact along with two stone artefacts. The site lies beyond the proposed surface impact area.

Site 62 was found during the present field survey. It is located on the edge of a minor creek about 1 km west of Wollombi Brook, and between Wambo and North Wambo Creeks. A piece of black glass with a worked edge was found in an area where no other glass or ceramics were seen. This site overlies proposed underground mining.

Scatters of glass and ceramics which may date to the early historic period were also found on Sites 17 and 31. Site 31 is at AMG 311900 6392150 on an elevated red sand body on the west side of Wollombi Brook. This location overlies proposed underground mining, but will not be subject to subsidence affects. Site 17 is at AMG 314119 6393524, on the high east bank of Wollombi Brook within the area of the proposed rail spur. In both cases further investigation would need to be carried out to determine whether the historic material relates to Aboriginal occupation or whether the co-association of early historic material with stone artefacts is fortuitous.

D9.1.5 Open Sites

Open sites are analysed in detail in Sections D9.3 – D9.5. In the present section some sites are briefly discussed because they have unusual landscape settings and/or unusual content.

Sites 30 and 31 (#37-5-34) occur on the red sand body on the west side of Wollombi Brook. The AMG references are given as 312200 6392650 and 311900 6392150. However, artefacts are likely to occur along the entire length of the sand body over a distance of approximately 700 m. The artefacts at Site 30 occur on a creek bank exposure and on a track which continues southwards to North Wambo Creek. At the time of the survey the track had been graded superficially, only just exposing the topsoil, and was covered with fine “bull dust”. While there appeared to be a gap between the two sites it is likely that lower artefact densities were obscured by the dust. Site 31 (recorded at the southern end of the sand body) is impressive with the ground being littered with artefacts, along with a scatter of glass and ceramics which may date to the early historic period. It is a rich site.

In addition, the sand body is reddish in colour and of fine texture, and differs from other sand bodies associated with Wollombi Brook. Dr Hughes (Attachment D2) considers it is more like sand bodies associated with the Hunter River than those associated with Wollombi Brook and is uncertain as to its origin in this location. Due to the nature of its deposit, and its location adjacent a major river in the region, Dr Hughes considers it has the potential to contain old as well as recent archaeological materials, potentially in a stratified deposit. The surface of the sand body has been cultivated and surface materials will therefore be in disturbed contexts. However, deeper materials below the cultivation zone may be less disturbed. The top of the sand body is approximately 63-64 m AHD and would have been above the levels of highest floods recorded in the Twentieth Century.

Many small sites were found along the slopes and small creeks flowing into North Wambo Creek. Site #37-5-192 occurs on the crest at the end of the watershed between Stony and North Wambo Creeks. It is an extensive site and was recorded and subject to test excavation in 1990 (Rich 1991b). To be comparable with other site data it has been given Site numbers 47-51. Small artefact scatters occur around the slopes of this ridge and along the ridge top itself. Amongst these other sites the most notable is Site 89.

Site 89 is located at AMG 307998 6392516 on the ridge top watershed between Stony and North Wambo Creeks. At c.210 m AHD this is the highest, largest site recorded within the Wambo study area. This ridge top would have provided a good access route between the lower valleys and Wollombi Brook, and the higher sandstone country to the west. Very sparse artefacts, consisting of isolated finds and very small sites occur along this and other ridge tops, but Site 89 appears to be a particular focus. The site occurs on a slight saddle, about 30 m broad, and at the foot of a short steep climb. Some 18 artefacts are recorded and more are likely to be present amongst leaf and twig litter. Numerous *Macrozamia* plants are growing on the slope just below and west of the site and a few plants were seen on the site itself. Quartzite cobbles occur naturally on the slope just to the north and c.10 m below the site. A quartzite core was found on the site and another worked cobble (possibly tested for potential use as a core) was found amongst the quartzite cobbles below (Site 90). The headwaters of several small gullies also occur just below the ridge top and water seepage may have been present in favourable times. Depending on the thickness of surrounding vegetation the location has some view of the valley below and limited views of the sandstone escarpment to the south-west (on the southern side of Stony Creek). This open site is unlikely to be very large in comparison to open sites near valley floors elsewhere within the Wambo and surrounding areas but it does appear to have resulted from focussed occupation, or repeated stop-overs at a favoured location, with access to multiple resources. The location has been subject to underground mining without apparent affect, however cracking was observed further east along the ridge top. The site beyond any further underground mining.

Several large sites have been found along Wambo and North Wambo Creeks and have been reported elsewhere (Rich 1991a, 1991b). Of these, Site 106 (NW11 #37-5-181) was reinspected and many artefacts were seen. A hearth photographed in 1991 is almost unchanged, although other locations could not be recognised. Sites #37-5-186 and #37-5-187 (originally recorded in 1991 as NW 16 and 17) are re-recorded here as Site 98 . The track on which the site is exposed has been little used and ground visibility is now less than it was previously. Some of the artefacts were not found again, however additional artefacts are recorded. It is established that artefacts generally occur continuously across this crest and the two sites should be regarded as one large site. Site #37-5-183 (originally recorded as NW13) could not be recognised during the present survey. Instead, three spatially discrete sites, Sites 102, 103 and 104, are recorded along the equivalent section of creek.

Site 121 (NW3 #37-5-172) was reinspected during the present field survey. The condition of the site has not changed unduly, and hundreds of artefacts are still visible on the ground surface. Some artefacts previously recorded were found again, including the larger of the Bulga knives. It has been suggested by some archaeologists that Bulga knives are natural rocks not artefacts, so particular attention was given to the item found on this site. Those who saw it considered it to have a modified edge, and its suitability for cleaning animal skins was discussed. The possible sandstone features reported in 1991 were re-inspected, but it is considered that they may be natural features; though this could be determined with certainty only by archaeological excavation.

Site 180 occurs adjacent to Redbank Creek. It may be the previously recorded Site #37-5-29 judging from the mapped location of that site given in Koettig and Hughes (1983), although the AMG locations differ: 309590 6396465. A total of 42 artefacts occur on a disused track, and additional, spatially discrete artefact locations occur further upstream along the same track. Site 180 is the largest recorded during the present field work in the upper catchment of Redbank Creek, but it and the landform on which it occurs, is in poor physical condition and has little potential for archaeological excavation.

Two large sites occur adjacent to North Wambo Creek in the north-west part of the study area. Site 227 (AMG 307704 6395978) occurs on a waning lower slope on the north side of North Wambo Creek and west of the confluence of Unnamed Creek #1. The site is likely to be extensive and probably continues northwards on the same landform along Unnamed Creek #1. The site has been cultivated. A sample of 60 artefacts are recorded at Site 227 and the site undoubtedly has many more artefacts.

Site 239 (306770 6395950) occurs on the east face of a crest which slopes down towards North Wambo Creek, west of its confluence with Splitters Hollow. Approximately 150 artefacts occur on a track over a distance of 130 m. The site is likely to extend north and south beyond the track. As with Site 227 a wide variety of artefact types and sizes are present, including several cobble cores and tools.

Site 213 (Splitters Hollow #37-5-40) was recorded by Brayshaw in 1981. It is located at AMG 308035 6397267, and several other artefact locations occur nearby. Site 213 is located on the north-east facing slope of a pass between Waterfall Creek and Unnamed Creek #1, approximately 400 m east of Site 258. The site and other nearby artefact locations are situated on exposures which are very heavily eroded, and an erosion scar at Site 213 is prominent on a 1963 and more recent air photos. It is likely that artefacts have been washed from the site. Site 213 is of interest due to its location within the pass (deep saddle) and on a potential access route between Waterfall Creek and North Wambo Creek. However, the site's very poor physical condition reduces its research potential.

Sites 258 and 259 occur on a broad upper slope on the north face of the watershed between Waterfall Creek and Splitters Hollow (a ridge which is continuous with Jerrys Plains Ridge). The location of the sites forms a low pass between higher ridge tops and has been classified as a waxing upper slope which is an unusual landform in the Wambo study area. The two artefact locations are separated by ground with poor visibility and it is likely that a single continuous site is present. Sites 258 and 259 are exposed on badly eroded ground exposures but other artefacts are likely to be present in adjacent soil. Sites 256, 260 and 261 occur within 400 m and may be part of a complex of sites in this general area. Additionally, fractured quartzite cobbles and fragments occur at Site 258, along with a few flakes of the same grey fine siliceous quartzite. It is possible that locally-occurring quartzite cobbles were flaked here. It appears the area has been cultivated but perhaps infrequently.

Two other large sites occur within the Waterfall Creek catchment. Site 268 is at AMG 307693 6397845 on the west side of a 2nd order stream. Approximately 100 artefacts occur on an exposure adjacent to a minor creek and others were seen adjacent to the exposure in the grassy paddock. An array of artefact types and sizes are present. The site is likely to be much more extensive and contain many hundreds of artefacts. Site 291 occurs as a continuous scatter of artefacts along Waterfall Creek. Approximately 100 artefacts are recorded and many more are likely to be present. Several knapping floors are present, along with a variety of artefact types and sizes. This site lies beyond the proposed impact area.

D9.2 COMPARISONS BETWEEN THE WAMBO STUDY AREA & CONTEXT AREA

A total of 292 artefact locations have now been found within the Wambo study area, consisting of 110 isolated finds and 172 locations with two or more artefacts – two of which also have reported glass artefacts (contact sites). In this section of the report broad comparisons are made between the Wambo study area sites and those found in the surrounding context area (Section D7.2).

In both the Wambo study area and the surrounding context area open artefact scatters and isolated finds are the most common types of sites, together making up 98% of sites at Wambo and 96% in the context area (Table D-17). The Wambo study area has a higher frequency of isolated finds relative to open sites than the context area. This may be due in part to generally larger site size in the context area (see below) but may also be related to the nature of artefact recording since in the context area some isolated finds may have been thought of as background scatter and their locations not reported.

Other types of sites are relatively rare in both the Wambo study area and the context area. Two grinding groove sites (and another two suspect grinding groove sites) have been recorded in the Wambo study area. Five grinding groove sites have been recorded in the context area. At 1% or less of recorded sites, grinding groove sites are relatively rare. A carved tree/ceremonial site is located on the eastern edge of the Wambo study area, and another carved tree site has been reported near the confluence of Wollombi Brook and the Hunter River.

The trees have apparently been destroyed (though a fence rail with remnant carvings may still survive). A probable scarred tree occurs in the Wambo study area. Two other trees have been reported in the context area, but there is doubt about their authenticity. No other sites types have been recorded within the Wambo study area, but shelters with art have been reported in the sandstone country to the south.

Table D-17
Site Types in the Wambo Study Area and Context Area

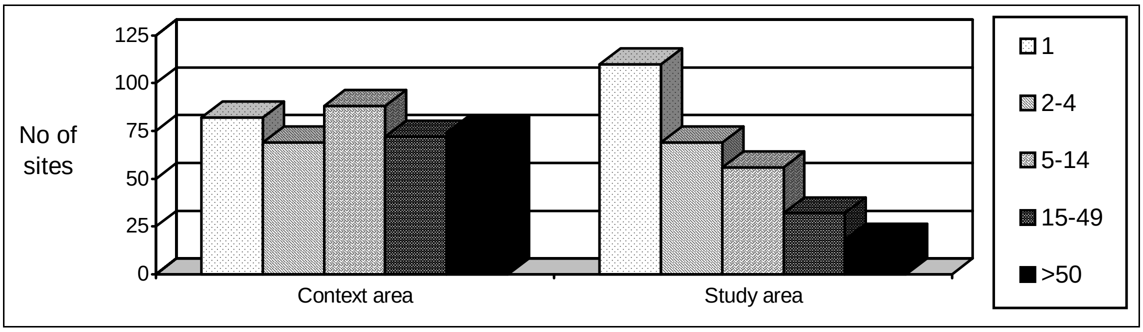
Site Type	Wambo Study Area		Context Area	
	No.	%	No.	%
Open artefact scatters	172	59%	331	76%
Isolated finds	110	38%	82	19%
Open & contact	2 + 2?	1%	2	0.5%
Quarry	-	-	1	<0.5%
Grinding grooves	1?	<0.5%	5	1%
Grinding grooves & open	2 + 1?	1%	-	-
Carved tree	1	<0.5%	1	<0.5%
Scarred tree	1	<0.5%	2?	0.5%
Contact/burial	-	-	1	<0.5%
Mound/oven	-	-	1	<0.5%
Shelter art	-	-	6	1%
Shelter art & contact	-	-	1	<0.5%
Stone arrangement	-	-	1	<0.5%
Total	292	100%	434	100%

For analysis of open sites and isolated finds within the context area (Section D7.2) sites were grouped so that there was generally an even number of sites within each category. This was done so samples would not be unduly biased (the range being 69 to 88 sites per category). For the Wambo study area, however, there are considerably more isolated finds (110) than any other category, and the present Wambo study area has relatively few large sites (Table D-18 and Figure D-36). It is possible that more isolated finds and small sites of two to four artefacts are present in the context area but left unrecorded as “background scatter”. However, the context area still has similar numbers of sites with ‘15 to 49 artefacts’ and ‘more than 50 artefacts’ indicating that the context area has relatively more larger sites than the Wambo study area.

Table D-18
Comparison of Site Size in the Study and Context Areas

Areas	Numbers of Artefacts at Open Sites					Total Sites
	1	2-4	5-14	15-49	>50	
Wambo Study area	110	69	56	32	18	285
Context area	82	69	88	72	74	385

Figure D-36
Comparison of Site Size Between the Study and Context Areas
(graph shows numbers of artefacts at sites)

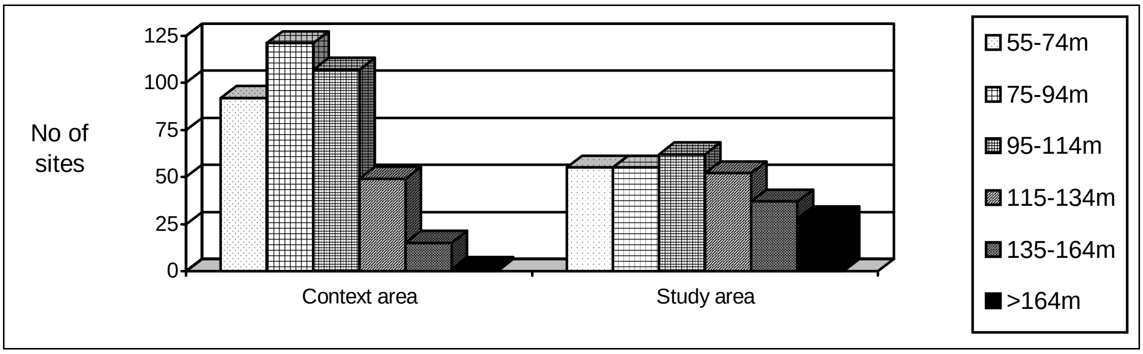


The context area has more sites at lower altitudes than does the Wambo study area (Table D-19 and Figure D-37). Despite the overall smaller number of sites in the Wambo study area, there are more sites above 135 m. Modal (most common) altitude of sites in the context area is 75-94 m but in the Wambo study area it is 95-114 m. The Wambo study area is sitting at a generally higher altitude than the context area.

Table D-19
Comparison of Site Altitude in the Study and Context Areas

Areas	Altitude AHD of Open Sites						Total Sites
	55-74	75-94	95-114	115-134	135-164	>165	
Wambo Study area	55	55	62	52	37	28	289
Context area	92	121	107	49	15	1	385

Figure D-37
Comparison of Site Altitude Between the Study and Context Areas

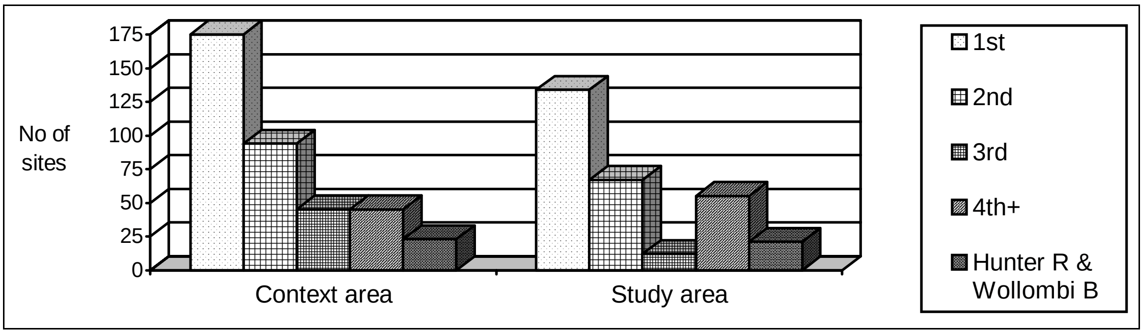


In both the context area and the Wambo study area the majority of sites are associated with 1st order streams, followed by 2nd order streams (Table D-20, Figure D-38). There are relatively few sites in the Wambo study area associated with 3rd order streams, probably because there are fewer 3rd order streams in the Wambo study area.

Table D-20
Comparison of Sites in Relation to Stream Order Between the Study and Context Areas

Areas	Stream Order					Total Sites
	1st	2nd	3rd	4th+	Wollombi Brook & Hunter River	
Wambo Study area	134	67	12	55	21	289
Context area	178	94	45	45	23	385

Figure D-38
Comparison of Sites in Relation to Stream Order Between the Study and Context Areas

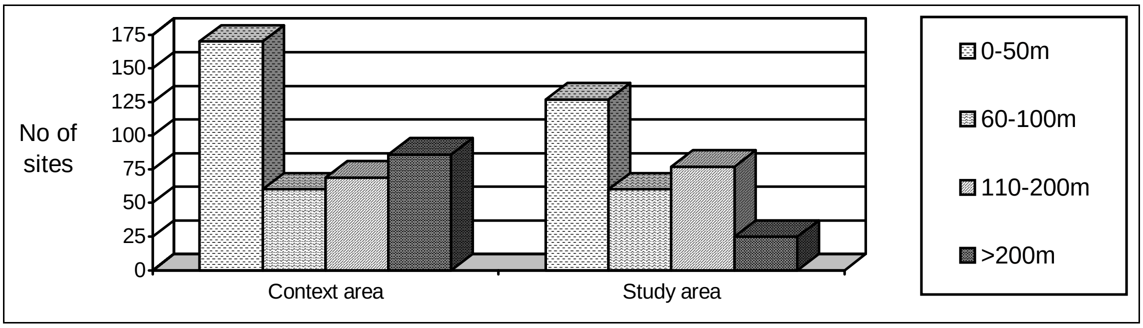


Sites tend to occur within 50 m of water in both the Wambo study area and the surrounding context area (Table D-21 and Figure D-39). In the context area, however, a greater proportion of sites (22%) occur more than 200 m from mapped water than in the Wambo study area (9%).

Table D-21
Comparison of Sites in Relation to Distance from Water Between the Study and Context Areas

Areas	Distance from Water				Total Sites
	0-50	60-100	110-200	>200	
Wambo Study area	127	60	77	25	289
Context area	170	60	69	86	385

Figure D-39
Comparison of Sites in Relation to Distance from Water Between the Study and Context Areas

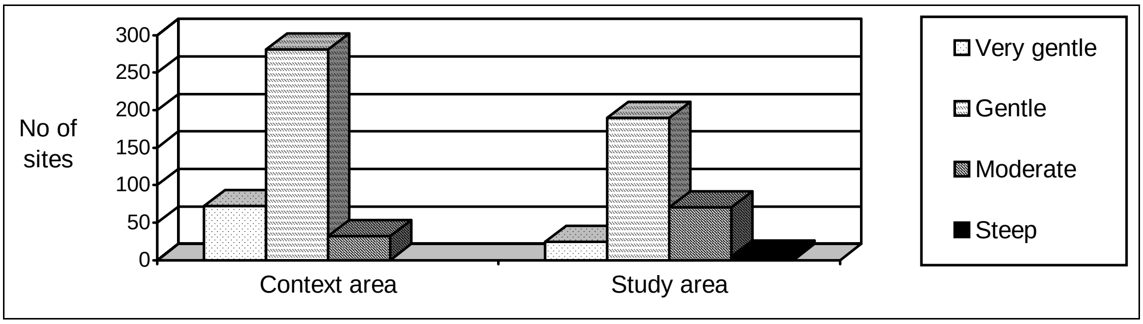


The majority of sites in both the Wambo study area and the context area occur on gentle gradients (Table D-22, Figure D-40). In the context area the number of sites located on very gentle gradients is greater than sites on moderate gradients. In the Wambo study area, the number of sites located on moderate gradients is greater than the number of sites on very gentle gradients. A few artefacts also occur on steep gradients in the Wambo study area. Overall, the Wambo study area are tends to be a little steeper than the context area.

Table D-22
Comparison of Sites in Relation to Gradient Between the Study and Context Areas

Areas	General Gradient of Open Sites				Total Sites
	Very gentle	Gentle	Moderate	Steep	
Wambo Study area	24	190	70	5	289
Context area	72	281	32	-	385

Figure D-40
Comparison of Sites in Relation to Gradient Between the Study and Context Areas

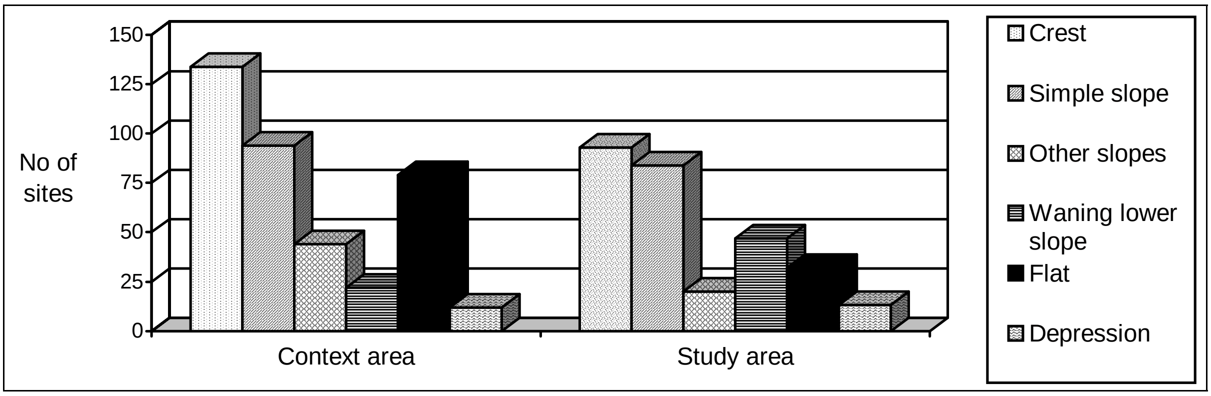


Within both the Wambo study area and the context area the greatest numbers of sites occur on crests and simple slopes (Table D-23 and Figure D-41). In the context area flats are also common locations for sites (21% of sites) but flats are less important in the Wambo study area (11% of sites). In the Wambo study area, waning lower slopes (16% of sites) are more frequently used for site locations than in the context area (6% of sites). In the Wambo study area it appears that people preferred to occupy landforms elevated above creeks and flats. It is possible that flats in the Wambo study area were less inhabitable (eg. wetter) than flats in the context area.

Table D-23
Comparison of Sites in Relation to Landforms Between the Study and Context Areas

Areas	Landforms of Open Sites										Total Sites
	Crest	Simple Slope	Waxing Upper Slope	Maximal Upper Slope	Minimal Mid Slope	Maximal Lower Slope	Waning Mid Slope	Waning Lower Slope	Flat	Depression	
Wambo Study area	93	84	2	7	3	-	8	47	32	13	289
Context area	134	94	5	13	6	7	13	22	79	12	385

Figure D-41
Comparison of Sites in Relation to Landforms Between the Study and Context Areas



Site distribution in the Wambo study area differs in relation to several variables from site distribution in the context area. While the context area was selected to encompass areas around the Wambo study area and similar settings, archaeological survey in the context area has been concentrated on the lowlands north and east of the sandstone country with little systematic survey on the edge of the sandstone escarpment or in the valleys draining immediately from it. The focus of site recording in the lowlands in the context are has resulted in different site distribution patterns. Relatively more sites have been found at low elevations, and there are a greater number of large sites which, as described in Section D7.2, tend to occur at low elevations. Relatively more sites occur more than 200 m from water, and relatively fewer sites occur on moderate gradients. While sites in both the Wambo study area and the context area favour crests and simple slopes, the context area has a higher frequency of sites on flats.

In the Wambo study area higher elevations have been systematically surveyed and relatively more small sites have been found, and with more sites at higher altitudes. The terrain tends to be a little steeper so there are relatively more sites on moderate gradients, and a few artefacts have been found on steep gradients. Increased gradients may have led to the formation of streams which are more closely spaced, so there are relatively fewer sites more than 200 m from water. Flats in the Wambo study area were sometimes occupied but preference was given to crests and slopes above these. The distribution of sites in the Wambo study area probably differs from site distribution in the context area because the nature of the landscape itself differs a little.

D9.3 LANDSCAPE ANALYSIS OF SITES IN THE WAMBO STUDY AREA

D9.3.1 Analyses

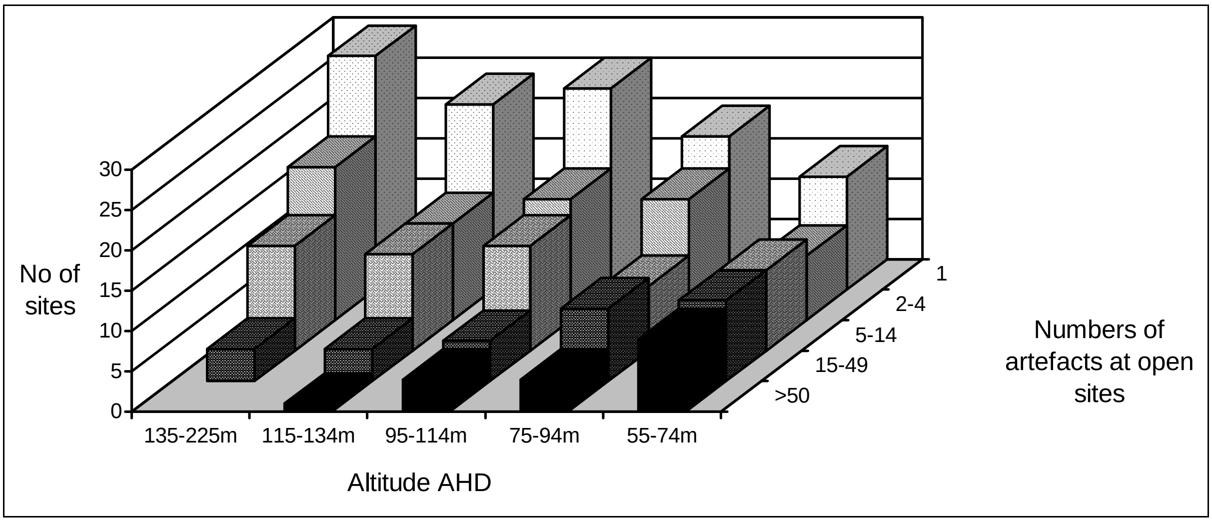
This section details the distribution of sites in the Wambo landscape by size (as defined by the numbers of artefacts present). The analyses are comparable to those carried out in Section D7.2 for the context area.

Data regarding the distribution of open sites by size in relation to altitude is given on Table D-24 and Figure D-42. All the larger sites, with greater than 50 artefacts, occur below 125 m AHD. All sites with 5-49 artefacts occur below 175 m AHD, except Site 89 at c.210 m AHD with 18 recorded artefacts (and potential for more). Site 89 is located along Wambo Ridge (between Stony Creek and North Wambo Creek), which would have provided an excellent access route into the higher sandstone country. Very small sites and isolated finds occur at all elevations.

Table D-24
Summary Altitude AHD and Site Size in the Wambo Study Area

Altitude AHD	Numbers of Artefacts at Open Sites					Total Sites
	1	2-4	5-14	15-49	≥50	
165-225	16	9	2	1	-	28
135-164	13	10	11	3	-	37
115-135	23	12	12	4	1	52
95-114	25	15	13	5	4	62
75-94	19	15	8	9	4	55
55-74	14	8	10	10	9	51

Figure D-42
Summary Altitude AHD and Site Size in the Wambo Study Area

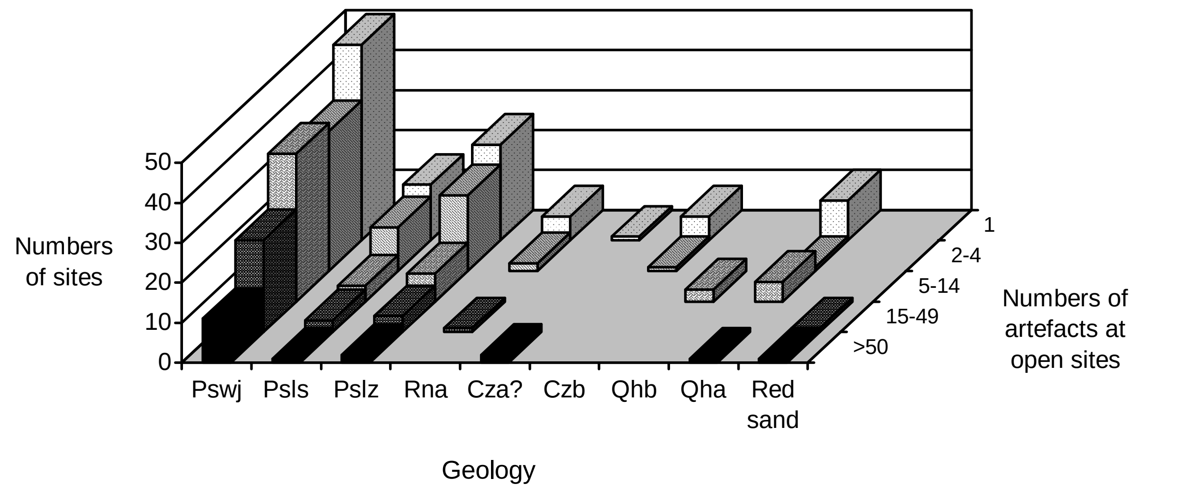


Data on site distribution in relation to geology is given on Table D-25 and shown on Figure D-43. Most sites occur on Pswj (the Jerrys Plains subgroup of the Singleton Coal Measures). Sites also occur commonly on Psls and Pslz (the Watts sandstone and undifferentiated deposits of the Wollombi Coal Measures). The distribution of sites by size (numbers of artefacts) on each of these three formations is in keeping with the distribution of sites by size generally; that is, surface geology does not appear to influence site distribution. The other geological formations have fewer sites and samples are inadequate to describe general trends of site distribution.

Table D-25
Surface Geology and Site Size in the Wambo Study Area

Surface Geology	Numbers of Artefacts					Total Sites
	1	**2-4**	**5-14**	**15-49**	**≥50**	
Red sand	-	-	-	1	1	2
Qha	10	1	5	-	1	17
Qhb	-	-	3	-	-	3
Cza(?)	1	-	-	-	2	3
Czb	6	1	-	-	-	7
Rna	6	2	-	1	-	9
Pslz	24	19	7	4	2	56
Psls	14	11	4	3	1	33
Pswj	49	35	37	23	11	155

Figure D-43
Surface Geology and Site Size in the Wambo Study Area

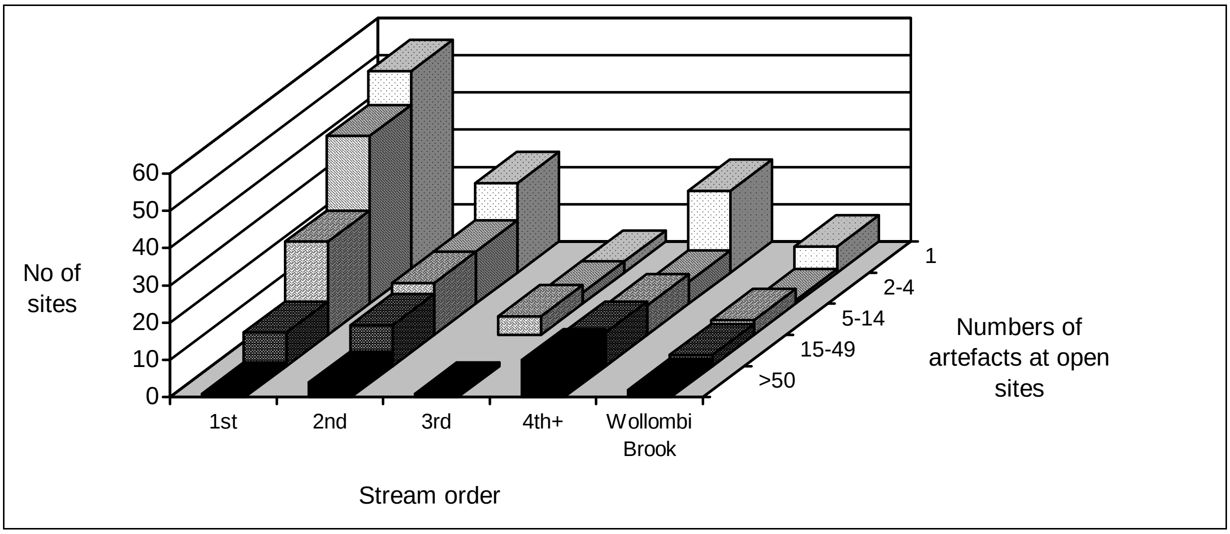


Data regarding sites in relation to stream order is given in Table D-26 and shown on Figure D-44. Isolated finds and very small sites are most frequently associated with 1st order streams. Only one site with 50 or more artefacts is associated with a 1st order stream and this is close to Wollombi Brook. More than half the sites with 50 or more artefacts are associated with 4th+ order streams. 2nd order streams have more small sites than 4th+ order streams (28 and 14 sites respectively with 2-14 artefacts).

Table D-26
Stream Order and Site Size in the Wambo Study Area

Stream Order	Numbers of Artefacts					Total Sites
	1	2-4	5-14	15-49	>50	
1st	54	45	25	9	1	134
2nd	24	14	14	11	4	67
3rd	3	3	5	-	1	12
4th+	22	6	8	9	10	55
Wollombi Brook	7	1	4	3	2	17

Figure D-44
Stream Order and Site Size in the Wambo Study Area

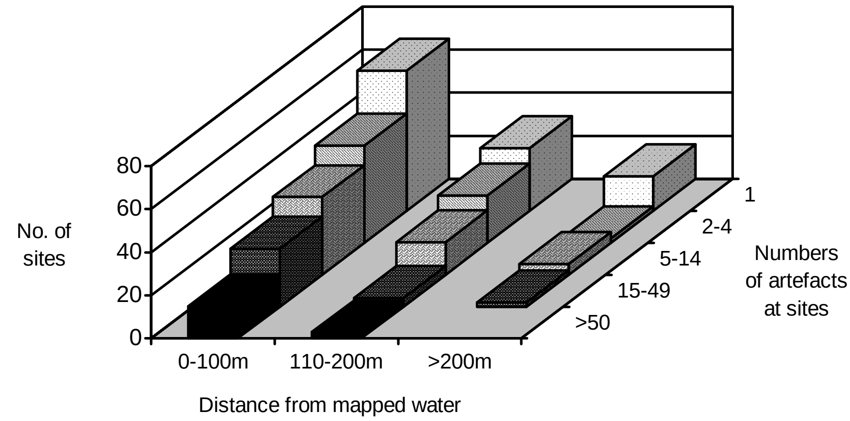


Nearly half the sites (45%) in the Wambo study area occur within 50 m of water and two-thirds (66%) occur within 100 m of water (Table D-27, Figure D-45). All but 4 sites with more than 50 artefacts occur within 100 m of water. Most of the site more than 200 m from water are isolated finds.

Table D-27
Distance from Water and Site Size at Sites in the Wambo Study Area

Distance from water	Numbers of Artefacts					Total sites
	1	2-4	5-14	15-49	>50	
0-50m	42	28	28	18	11	127
60-100m	23	17	8	9	4	61
110-200m	29	22	15	3	3	72
>200m	16	2	5	2	-	25

Figure D-45
Distance from Water and Site Size in the Wambo Study Area

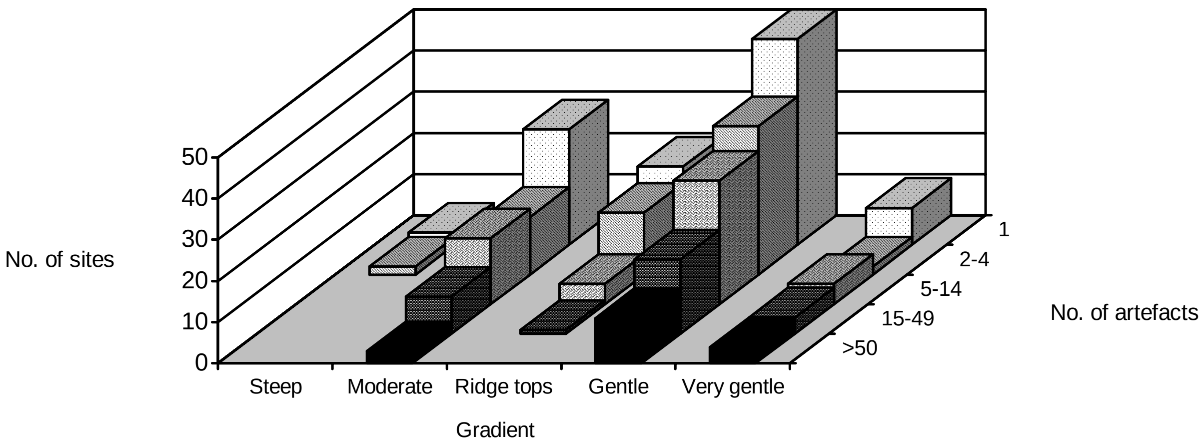


The majority of open sites, including most of those with 50 artefacts or more occur on gentle gradients (Table D-28, Figure D-46). Another 40 sites occur on high ridge tops which also tend to have gentle gradients. Only five sites occur on steep gradients, being three isolated finds and two very small sites; artefacts are heavily broken.

Table D-28
Gradient and Site Size in the Wambo Study Area

Gradient	Numbers of Artefacts					Total Sites
	1	2-4	5-14	15-49	>50	
Very gentle	9	2	5	4	4	24
Gentle	51	36	30	18	11	146
Gentle ridge tops	19	15	5	1	-	40
Moderate	28	14	16	9	3	70
Steep	3	2	-	-	-	5

Figure D-46
Gradient and Site Size in the Wambo Study Area

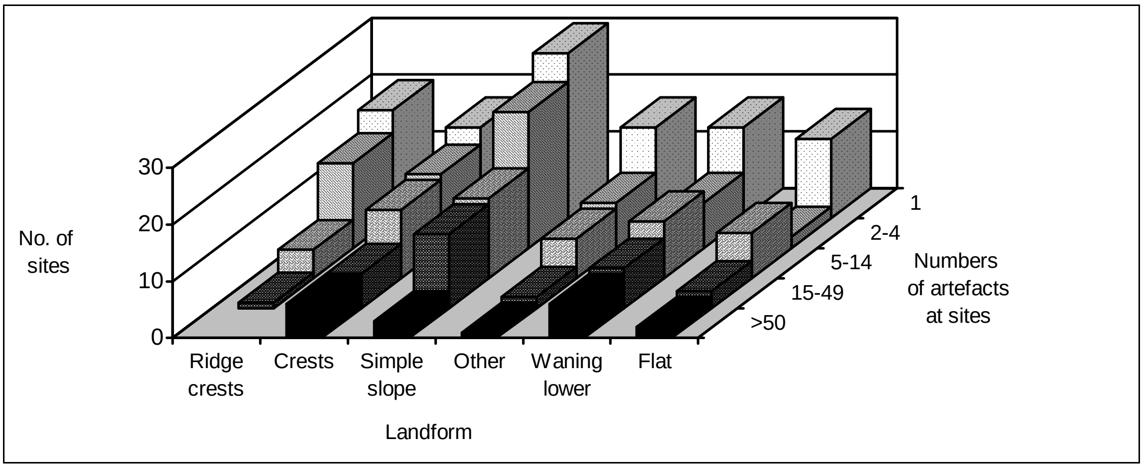


Sites occur on a variety of landform types (Table D-29, Figure D-47). Simple slopes have a higher frequency of very small sites (1-4 artefacts). Sites with 50 or more surface artefacts favour waning lower slopes and crests but not ridge top crests.

Table D-29
Landforms and Site Size in the Wambo Study Area

Landforms	Numbers of Artefacts					Total Sites
	1	2-4	5-14	15-49	>50	
Crest ridge top	19	15	5	1	-	40
Crest	16	13	12	6	6	53
Simple slope	29	24	14	13	3	83
Waxing upper slope	-	-	-	2	-	2
Maximal upper slope	5	1	1	-	-	7
Minimal mid slope	2	-	-	-	1	3
Waning mid slope	2	3	3	-	-	8
Waning lower slope	16	8	10	7	6	47
Flat	14	2	8	3	2	28
Depression	7	3	3	-	-	13

Figure D-47
Landforms and Site Size in the Wambo Study Area



The following analyses consider multiple variables to identify particularly sensitive landscape settings. Data on site size in relation to stream order and altitude is given on Table D-30. For 1st order streams most sites tend to be small and occur above 95 m AHD. For 2nd order streams most sites occur between 75 m and 134 m AHD with most of the larger sites with 15 or more artefacts below 115 m AHD. For 3rd and 4th+ order streams most sites occur below 115 m AHD and this is the case regardless of site size. The Wollombi Brook sites are almost entirely below 75 m AHD.

Table D-30
Stream Order, Altitude and Site Size in the Study Area

Stream Order	Altitude AHD	Numbers of Artefacts					Total sites
		1	2-4	5-14	15-49	≥50	
1st	165-225	16	9	2	1	-	28
	135-164	9	9	11	2	-	31
	115-134	12	9	6	1	-	28
	95-114	11	9	4	2	-	26
	75-94	5	7	1	2	-	15
	55-74	1	2	1	1	1	6
2nd	135-164	1	1	-	1	-	3
	115-134	8	2	5	3	-	18
	95-114	10	4	4	-	2	20
	75-94	4	4	4	5	1	18
	55-74	1	3	1	2	1	8
3rd & 4th+	135-164	3	-	-	-	-	3
	115-134	3	1	1		1	6
	95-114	4	2	5	3	2	16
	75-94	8	3	3	2	3	19
	55-74	7	3	4	4	5	23
Wollombi Brook	75-94	1	-	-	-	-	1
	55-74	6	1	4	3	2	16

Data on site size in relation to stream order and distance from mapped water is given on Table D-31. For 1st order streams sites tend to be widely spread, with 43% more than 100 m from water. However, most of the sites associated with 1st order streams are very small, and 8 of the 10 sites with 15 or more artefacts are found within 100m of water.

For 2nd order streams, in contrast, 72% of sites are within 50 m of water. Sites are found close to water regardless of site size. For '3rd & 4th+' order streams combined, nearly half the sites (48%) are within 50 m of water. A good proportion of sites (27%) are found more than 100 m from water, although most of these are fairly small sites with fewer than 15 artefacts. The small sample of sites associated directly with Wollombi Brook are scattered, although more than half of these are more than 100 m from the river. There are too few sites to consider site size and distance from the river.

Table D-31
Stream Order, Distance from Mapped Water and Site Size in the Wambo Study Area

Stream Order	Distance from Mapped Water	Numbers of Artefacts					Total Sites
		1	2-4	5-14	15-49	>50	
1st	0-50	15	13	10	5	1	44
	60-100	12	15	3	2	-	32
	110-200	21	17	10	1	-	49
	>200	6	-	2	1	-	9
2nd	0-50	17	9	10	8	4	48
	60-100	4	1	1	2	-	8
	110-200	2	3	2	1	-	8
	>200	1	1	1	-	-	3
3rd & 4th+	0-50	10	5	6	5	6	32
	60-100	6	1	4	4	3	18
	110-200	5	2	2	-	2	11
	>200	4	1	1	-	-	6
Wollombi Brook	0-50	-	1	2	-	-	3
	60-100	1	-	-	1	1	3
	110-200	1	-	1	1	1	4
	>200	5	-	1	1	-	7

Sites associated with 1^{st} order streams occur on a wide variety of landform types, with isolated finds and very small sites occurring preferentially on simple slopes and ridge top crests, and less so on other crests (Table D-32). Sites associated with 2^{nd} order streams occur preferentially on simple slopes, especially isolated finds and very small sites. The second most frequent landform is waning lower slope. Also notable is the increased proportion of sites with 15 or more artefacts (22%) compared to 1^{st} order streams (8%); although as with 1^{st} order streams these larger sites occur preferentially on simple slopes.

Near 3^{rd} and 4^{th}+ order streams the preferred landforms are lower waning slopes, flats and crests. Most of the sites with 15 or more artefacts occur on waning lower slopes followed by crests. Most of the sites on flats are isolated finds. In contrast to 1^{st} and 2^{nd} order streams only 9% of sites associated with 3^{rd} and 4^{th}+ order streams occur on simple slopes. There are too few sites associated with Wollombi Brook for statistical analysis.

Data regarding site size in relation to landforms and gradient is given on Table D-33. In very gentle terrain flats are the most common site location, however more than half of these sites are isolated finds. The equivalent data set for the context area shows a strong preference for larger sites on flats in very gentle terrain, but this is not the case in the Wambo study area.

On gentle gradients there is a strong preference for isolated finds and very small sites to occur on simple slopes and ridge top crests. Also of note is a preference, though less markedly, for waning lower slopes, followed by crests. Again, most sites are very small and isolated finds.

On moderate gradients crests and simple slopes are strongly preferred, especially for isolated finds and very small sites. Five sites occur in steep terrain and all have very few artefacts.

Table D-32
Stream Order, Landform and Site Size in the Wambo Study Area

Stream Order	Landform	Numbers of Artefacts					Total Sites
		1	2-4	5-14	15-49	≥50	
1st	Crest ridge top	19	15	5	1	-	40
	Crest	8	9	6	-	-	23
	Simple slope	13	13	7	5	1	39
	Waxing upper slope	-	-	-	2	-	2
	Maximal upper slope	4	1	1	-	-	6
	Waning mid slope	2	3	3	-	-	8
	Waning lower slope	5	2	1	-	-	8
	Flat	-	-	-	1	-	1
	Depression	3	2	2	-	-	7
2nd	Crest	2	2	2	1	1	8
	Simple slope	12	8	6	6	2	34
	Waning lower slope	3	3	5	2	1	14
	Flat	3	-	-	2	-	5
	Depression	4	1	1	-	-	6
3rd & 4th+	Crest	4	1	4	3	3	15
	Simple slope	1	3	1	1	-	6
	Maximal upper slope	2	-	-	-	-	2
	Minimal mid slope	1	-	-	-	1	2
	Waning lower slope	8	3	4	5	5	25
	Flat	10	2	4	-	2	18
Wollombi Brook	Crest	2	1	-	2	2	7
	Simple slope	3	-	-	1	-	4
	Minimal mid slope	1	-	-	-	-	1
	Flat	1	-	4	-	-	5

Table D-33
Gradient, Landform and Site Size in the Wambo Study Area

Gradient	Landform	1	2-4	5-14	15-49	>50	Total Sites
Very gentle	Crest	-	-	-	-	1	1
	Waning lower slope	1	1	1	3	3	9
	Flat	8	1	4	1	-	14
Gentle	Crest ridge top	19	15	5	1	-	40
	Crest	8	6	7	3	2	26
	Simple slope	18	19	9	9	3	58
	Waxing upper slope	-	-	-	-	-	2
	Maximal upper slope	1	1	-	-	-	2
	Minimal mid slope	2	-	-	-	1	3
	Waning mid slope	-	-	2	-	-	2
	Waning lower slope	11	6	7	2	3	29
	Flat	6	1	4	2	2	15
	Depression	5	3	1	-	-	9
Moderate	Crest	7	7	5	3	3	25
	Simple slope	10	4	5	4	-	23
	Maximal upper slope	3	-	1	-	-	4
	Waning mid slope	2	2	1	-	-	5
	Waning lower slope	4	1	2	2	-	9
	Depression	2	-	2	-	-	4
Steep	Crest ridge top	1	-	-	-	-	1
	Crest	1	-	-	-	-	1
	Simple slope	-	1	-	-	-	1
	Maximal upper slope	1	-	-	-	-	1
	Waning mid slope	-	1	-	-	-	1

D9.3.2 Summary

The following is a summary of preferred site settings, based on site size. The results can be compared with those given in Section D7.2.5 for sites in the context area.

Very small sites and isolated finds with 1-4 visible artefacts are the most frequent site sizes (63% of all sites) and occur in all landscape settings but preferentially:

- At altitudes above 95 m AHD – 69% of all very small sites (similar to the context area).
- In association with 1st order creeks – 55% of all very small sites (a lower frequency than in the context area).
- On simple slopes, ridge top crests and other crests – 65% of all very small sites (similar to the context area).
- Less than 100 m from water – 62% of all very small sites (whereas in the context area most very small sites. were more than 100 m from water).

Small sites with 5-14 visible artefacts are not particularly frequent, making up just 20% of all sites. They show no strong preferences for particular landscape settings, but here it can be noted that they tend to:

- be associated with 1st and 2nd order streams – 70% of small sites;
- occur within 50 m of water – 50% of small sites (and 64% are within 100 m of water);

- occur on simple slopes, crests (but not ridge top crests) and waning lower slopes – 64% of small sites; and
- they rarely occur at or above 165 m AHD – just 4% of small sites (and 7% of all sites at and above 165m).

Medium-sized sites with 15-49 visible artefacts are even less frequent in the Wambo study area, making up just 11% of all sites. They occur in all landscape settings but without strong preference. For comparison with the context area a similar set of data is given here:

- at low altitudes below 95 m AHD – 60% of medium-sized sites;
- within 100 m of water – 84% of medium-sized sites;
- on crests, simple slopes and waning lower slopes – 81% of medium-sized sites; and
- But without preference for creeks of certain sizes (stream orders).

Only 18 larger-sized sites, with 50 or more visible artefacts, have been found in the Wambo study area and they make up just 6% of all sites. They occur in all landscape settings but without strong preference. For comparison with the context area a similar set of data is given here:

- All occur below 125 m AHD and half (9 sites) are below 75 m AHD.
- More than half (10 sites) are associated with 4^{th}+ order creeks.
- More than half (11 sites) are within 50 m of water.
- More than half (12 sites) are located on waning lower slopes and crests (but not ridge top crests).

Some similarities and some differences are evident when these trends are compared to trends identified for the context area (see Section D7.2.5).

- The distribution of very small sites (1-4 artefacts) is similar except that in the Wambo study area most very small sites are less than 100 m from water whereas in the context area most very small sites are more than 100 m from water.
- In the Wambo study area flats are not preferred settings for sites, whereas in the context area flats are amongst the preferred landforms for small, medium and large sites.
- In the Wambo study area the few large sites show a preference for 4th+ order creeks but in the context area large sites are variously associated with 2nd, 3rd and 4th+ order streams.

The landscape of the Wambo study area differs in detail from those parts of the surrounding context area which have been subject to most intensive survey. The Wambo study area tends to be higher and it is possible that creeks are more closely spaced. Flats in the Wambo study area do not appear to have been favoured locations, as in the context area; rather preference has been given to landforms set above creeks, such as crests, simple slopes and waning lower slopes.

In Section D7.2.6 it was noted that site distribution in the context area generally supported a land use model proposed by Nightingale *et al.* (2002:27). Site distribution data from the Wambo study area also tends to support that model – with a few larger sites low down in valleys associated with larger creeks and small sites scattered in the surrounding hinterland. And this general agreement is reached despite variation in the details of site distribution in the Wambo study area. In Section D7.2.6 several additional comments were made about the nature of site distribution and some of the different factors which could have influenced in artefact discard. From the Wambo analyses it can also be noted that very general models such as that proposed by Nightingale *et al.* (2002) are not particularly helpful for understanding the details of site distribution data.

D9.4 ARTEFACT DENSITY IN THE LANDSCAPE

The previous analyses consider the distribution and size of sites in the Wambo landscape. Those analyses are carried out to enable direct comparisons with sites previously recorded within the surrounding context area. However, those analyses have not considered how site distribution may have been influenced by ground exposure. For the Wambo study all ground exposures encountered during the survey have been noted, including those on which artefacts are not recorded. This exposure data provides a control missing from the previous analyses.

For the present analyses a database is established and all sites, and exposures without artefacts, are entered in it. The extent of all exposures is calculated in m^2 and this area is then multiplied by the estimated ground visibility (the amount of the ground on the exposure which could be seen). This modified area is referred to here as "coverage". Total coverage is the sum of all coverage within the unit of analysis, and average artefact density is calculated by dividing total coverage by the total number of artefacts observed within the unit being analysed. For consistency, the data includes only those sites and exposures observed during surface surveys. Previously recorded sites which lack exposure data are not included; nor are data obtained from test excavations along Stony and Wambo Creeks.

The following sections set out summary analysis of coverage and artefact density in relation to single landscape variables, followed by more detailed analyses which consider multiple variables.

D9.4.1 Summary Analyses

Summary data on artefact density in relation to surface geology is given on Table D-34. Most effective survey (as indicated by coverage) has occurred on Pswj (Jerrys Plains subgroup), followed by Czb sand. The smallest amount of coverage is on Pswd (Denman formation) but this is a very small geological unit exposed only on an upper slope above Unnamed Creek #1. All other geologies have more than 1,000 m^2 of coverage.

Average surface artefact densities in relation to most geologies are of a similar magnitude, except that the relatively small red sand body has the highest average density of 1 artefact in 18m^2 of coverage, and the Czb sand has a very low average density at 1 artefact in 448 m^2 of exposure. No artefacts were found on Qhb alluvium, despite extensive exposure. Psls (Watts sandstone) has a slightly lower average density of 1 artefact in 70 m^2 compared to Pswj (Jerrys Plains subgroup) and Pslz (Wollombi Coal Measures) with 1 artefact in 52 m^2 and 46 m^2 respectively. Qha alluvium also has a relatively low average density of 1 artefact in 30 m^2.

The extremely low average artefact density on the Czb sand is of particular interest given a recent assessment of the potential significance of this unit at Warkworth West (Nightingale *et al.* 2002:98,103). The low artefact densities east of Wollombi Brook are perplexing in view of the proximity of Wollombi Brook which is a more-or-less permanent water source, the presence of other potential resources in the area (banksia flowers, bracken, wombats, macropods, goannas), and the assessment of the Warkworth West sand sheet as archaeologically significant. It is likely that the paucity of artefacts found on the Czb sand is related to several factors, including the lack of strong focal points in the sandy landscape, the possibility that artefacts have moved vertically downwards through the sand rather than staying on or near the ground surface, and in some places the sand may have been mobilised in recent times so burying artefacts which otherwise occurred near the ground surface.

Table D-34
Surface Geology and Artefact Density in the Wambo Study Area

Geology	Coverage in m^2	Total Artefacts	Average Density
Red sand	5,143	290	1/18 m^2
Qha	1,603	55	1/29 m^2
Qhb	8,527	0	-
Czb	44,737	10	1/448 m^2
Rna	1,357	28	1/48 m^2
Pslz	17,959	389	1/46 m^2
Psls	24,072	343	1/70 m^2
Pswd	300	0	-
Pswj	120,048	2,307	1/52 m^2

Data on stream order and artefact density is given in Table D-35. The largest total area of coverage is in relation to 1st order streams, but large coverage is achieved in relation to all stream orders. In analyses in Section D9.3 it is noted that the largest number of sites in the Wambo study area are associated with 1st order streams. But this is hardly surprising, as more exposed ground, which provides opportunities for site detection, is associated with 1st order streams rather than larger streams. The previous analyses show that most sites associated with 1st order streams are isolated finds and very small sites. This result is reflected here within very low average artefact densities recorded for 1st order streams. Highest average artefact densities occur in association with 4th order and higher streams, followed by 2nd order streams. Exposures in association with Wollombi Brook not on Czb sand reveal lower artefact densities than those associated with 4th+ order streams.

Table D-35
Stream Order and Artefact Density in the Wambo Study Area

	1st Order	2nd Order	3rd Order	4th+ Order	Wollombi Brook	Czb Sand
Total coverage in m^2	114,226	17,892	9,319	16,577	20,975	44,737
Total artefacts	582	512	154	1,648	516	10
Average artefact density	1/196 m^2	1/35 m^2	1/61 m^2	1/10 m^2	1/41 m^2	1/447 m^2

The greatest amount of coverage is within 100m of mapped water (Table D-36) so, again, it is hardly surprising that the majority of sites are also found fairly close to water. However, extensive coverage is also found more than 100 m from mapped water, providing opportunities for artefact detection. Artefact densities, taking into account variations in the amount of coverage, tend to be similar within 50 m of water, and 60-100 m from water (at 1 artefact/35-48 m^2 of coverage) but lower beyond this (at 1 artefact/98-104 m^2 of exposure). On Czb sand the highest densities occur within 50 m of mapped water, but beyond this distance surface artefact densities are negligible.

Table D-36
Distance to Water and Artefact Density in the Wambo Study Area

	0-50 m	60-100 m	110-200 m	>200 m	Czb 0-50 m	Czb 60-100 m	Czb 110-200 m	Czb >200 m
Coverage in m^2	67,821	48,338	51,609	11,221	310	2,912	2,995	38,520
Total artefacts	1,465	1,368	526	108	4	1	-	-
Average artefact density	1/48 m^2	1/35 m^2	1/98 m^2	1/104 m^2	1/78 m^2	1/2912 m^2	1/2995 m^2	1/9630 m^2

Data on coverage and artefact distribution in relation to altitude is given on Table D-37 and summarised on Table D-38. The most extensive ground coverage occurs at lower elevations, especially below 145m AHD.

Table D-37
Altitude and Artefact Density in the Wambo Study Area

Altitude AHD in m	Coverage in m^2	Total Artefacts	Average Density	Czb Coverage	Czb Total Artefacts	Czb Average Density
215-225	3,282	7	1/469 m^2	-	-	-
205-214	840	25	1/34 m^2	-	-	-
195-204	975	2	1/488 m^2	-	-	-
185-194	4,774	13	1/367 m^2	-	-	-
175-184	3,715	1	1/3,715 m^2	-	-	-
165-174	9,781	21	1/466 m^2	-	-	-
155-164	8,687	86	1/101 m^2	-	-	-
145-154	6,573	55	1/120 m^2	-	-	-
135-144	14,995	76	1/197 m^2	-	-	-
125-134	17,696	60	1/295 m^2	-	-	-
115-124	22,795	290	1/79 m^2	-	-	-
105-114	22,163	377	1/59 m^2	-	-	-
95-104	11,344	207	1/55 m^2	-	-	-
85-94	6,233	181	1/34 m^2	5,406	1	1/5406 m^2
75-84	7,546	727	1/10 m^2	18,258	-	-
65-74	22,092	957	1/23 m^2	18,806	6	1/3134 m^2
55-64	15,498	327	1/47 m^2	2,267	3	1/756 m^2

The largest numbers of artefacts also occur at lower elevations, partly reflecting greater opportunities for site detection afforded by increased exposure. However, average artefact densities, which take uneven coverage into account, show a marked change at c.125 m AHD. Above this altitude average densities are mostly less than 1 artefact in 100 m^2 of coverage and below this altitude average densities are better than 1 artefact in 80 m^2 of coverage.

Table D-38
Summary Elevation and Artefact Density in the Wambo Study Area

Altitude AHD in m	Coverage	Total Artefacts	Average Density	Czb Coverage	Czb Total Artefacts	Czb Average Density
165-225	23,367	69	1/339 m^2	-	-	-
135-164	30,255	217	1/139 m^2	-	-	-
125-134	17,696	60	1/295 m^2	-	-	-
115-124	22,795	290	1/79 m^2	-	-	-
105-114	22,163	377	1/59 m^2	-	-	-
95-104	11,344	207	1/55 m^2	-	-	-
75-94	13,779	908	1/15 m^2	23,664	1	1/23664 m^2
65-74	22,092	957	1/23 m^2	18,806	6	1/3134 m^2
55-64	15,498	327	1/47 m^2	2,267	3	1/756 m^2

The most extensive coverage occurs on moderate and gentle gradients, but gentle gradients have many more artefacts than moderate gradients (Table D-39). Ridge tops, which have predominantly gentle gradients, have much lower artefact densities than other gentle gradients. Average artefact densities on steep slopes are very low; the artefacts on steep slopes are much broken and it is likely that they have been washed or fallen into their present locations.

Table D-39
Gradient and Artefact Density in the Wambo Study Area

Gradient	Coverage	Total Artefacts	Average Density	Czb Coverage	Czb Total Artefacts	Czb Average Density
Very gentle	15,619	575	1/27 m^2	-	-	-
Gentle	66,390	1,912	1/35 m^2	44,110	10	1/4411 m^2
Ridge tops (gentle)	17,108	118	1/145 m^2	-	-	-
Moderate	69,641	802	1/87 m^2	627	-	-
Steep	10,232	5	1/2,046 m^2	-	-	-

Data on coverage and artefact distribution in relation to landforms (after Speight 1990) is given in Table D-40. The most extensive ground exposure is on simple slopes and crests; so it is hardly surprising that these landforms have the largest numbers of sites (Section D9.3.1), reflecting in part extensive opportunities for site detection. Very little coverage has been found on maximal and minimal mid slopes. Taking variation in coverage into account, the highest artefact density occurs on waning lower slopes with 1 artefact in 23 m^2 of coverage. This is followed by crests (but not ridge top crests) with 1 artefact in 31 m^2 of coverage, then waxing upper slopes with 1 artefact in 40 m^2 of coverage. Flats, with an average density of 1 artefact in 98 m^2 of coverage are definitely not favoured landforms. Aside from Czb sand the lowest average artefact densities occur on maximal upper slopes, which are relatively steep, with 1 artefact in >1,280 m^2.

Table D-40
Landforms and Artefact Density in the Wambo Study Area

Landform	Coverage	Total Artefacts	Average Density	Czb Coverage	Czb Total Artefacts	Czb Average Density
Crest ridge tops	17,108	119	1/144 m^2	-	-	-
Crest	34,806	1,129	1/31 m^2	11,481	5	1/1230 m^2
Simple slope	48,053	638	1/75 m^2	25,866	3	1/8622 m^2
Maximal upper slope	16,680	13	1/1,283 m^2	450	-	-
Waxing upper slope	2,600	65	1/40 m^2	-	-	-
Maximal mid slope	6	0	(-)	-	-	-
Minimal mid slope	142	79	(-)	4,062	1	1/4062 m^2
Waning mid slope	4,486	24	1/187 m^2	-	-	-
Waning lower slope	26,828	1,113	1/24 m^2	300	-	-
Flat	20,639	211	1/98 m^2	2,470	1	1/2470 m^2
Depression	7,641	21	1/364 m^2	108	-	-

The above analyses indicate that average artefact density is uneven across the landscape in relation to most of the variables, particularly stream order, distance to mapped water, altitude (particularly above and below 125 m AHD), slope, and landform, but less so in relation to geology except that the Czb sand east of Wollombi Brook has a particularly low average artefact density.

D9.4.2 Detailed Analyses

The large size of the database and utility of several of the above variables to distinguish differences in artefact density means that more detailed analyses are possible for some categories of information. In this section more detailed analyses are carried out, however as the Czb sand has such low surface densities, Czb data is excluded from these analyses. The categories used are the same as those used for the site analyses carried out above.

Data regarding coverage, numbers of artefacts, and average surface artefact density in relation to stream order and altitude is given on Table D-41. The largest amount of coverage is found above 95 m AHD in association with 1st order streams, and below 75 m AHD in association with Wollombi Brook. Average surface artefact densities are calculated for altitude categories with more than 1,000 m^2 of coverage. Highest average artefact densities are associated with 4th+ order streams below 95 m AHD, followed by 4th+ order streams 95-114 m AHD, 3rd order streams between 95-114 m AHD, and 2nd order streams 75-114 m AHD. 1st order streams have very low artefact densities, with the highest being at 75-94 m AHD.

A similar set of data, taking into account distance from mapped water rather than altitude, is presented in Table D-42. The largest amount of coverage is found within 200m of 1st order streams, with more than 110,000 m^2. The least amount of coverage is in association with 3rd order streams. Highest average artefact densities occur within 100 m of 4th+ order streams, followed by 60-100 m from Wollombi Brook, then within 110-200 m of 4th+ order streams, within 100 m of 2nd order streams and within 50 m of 3rd order streams, and more than 200 m from 1st order streams. Lowest average artefact densities occur within 200 m of 1st order streams, more than 200 m from 2nd order streams, more than 100 m from 3rd order streams and more than 200 m from Wollombi Brook.

Table D-41
Artefact Densities in Relation to Stream Order and Altitude (excluding Czb sand)

Stream Order	Altitude AHD in m	Total Coverage	Total Artefacts	Average Density
1st	165-225	23,367	69	1/339 m^2
	135-164	29,421	168	1/175 m^2
	115-134	27,790	87	1/319 m^2
	95-114	21,409	119	1/180 m^2
	75-94	4,837	113	1/43 m^2
	55-74	7,492	28	1/268 m^2
2nd	135-164	787	48	-
	115-134	6,591	103	1/64 m^2
	95-114	4,136	161	1/26 m^2
	75-94	4,051	146	1/28 m^2
	55-74	2,268	54	1/42 m^2
3rd	115-134	5,578	10	1/558 m^2
	95-114	3,661	141	1/26 m^2
	75-94	80	3	-
4th+	135-164	47	2	-
	115-134	532	150	-
	95-114	4,301	163	1/26 m^2
	75-94	1,782	646	1/3 m^2
	55-74	9,825	686	1/14 m^2
Wollombi Brook	75-94	2,970	0	-
	55-74	18,005	516	1/35 m^2

Table D-42
Artefact Densities in Relation to Stream Order and Distance from Mapped Water (excluding Czb sand)

Stream Order	Distance to Mapped Water	Total Coverage	Total Artefacts	Average Density
1st	0-50	45,671	246	1/186 m^2
	60-100	37,788	133	1/284 m^2
	110-200	29,006	150	1/193 m^2
	>200	1,851	54	1/34 m^2
2nd	0-50	9,991	400	1/25 m^2
	60-100	1,245	60	1/21 m^2
	110-200	4,611	39	1/118 m^2
	>200	2,045	13	1/157 m^2
3rd	0-50	3,370	129	1/26 m^2
	60-100	523	16	-
	110-200	5,298	8	1/662 m^2
	>200	128	1	-
4th+	0-50	8,667	625	1/14 m^2
	60-100	3,536	869	1/4 m^2
	110-200	3,377	144	1/23 m^2
	>200	907	9	-
Wollombi Brook	0-50	122	10	-
	60-100	5,246	290	1/18 m^2
	110-200	9,317	185	1/50 m^2
	>200	6,290	31	1/203 m^2

Data regarding gradient in relation to stream order is given on Table D-43. The most extensive coverage is on moderate gradients in association with 1st order streams, followed by gentle gradients in association with 1st order streams and Wollombi Brook. Relatively little coverage is on very gentle slopes associated with 2nd order streams and Wollombi Brook.

Very high average surface artefact densities of 1 artefact in less than 10 m^2 of coverage occur on gentle and moderate gradients associated with 4th+ order streams. Fairly high average density of 1 artefact 17 m^2 of coverage occurs on very gentle gradients associated with 4th+ order streams. Moderate densities of 1 artefact 26-37 m^2 of coverage occur on gentle gradients associated with 3rd order streams, and on gentle and moderate gradients associated with 2nd order streams. Average densities for 1st order streams are consistently very low, with just a slight but still low density on gentle slopes with 1 artefact 91 m^2 of coverage.

Table D-43
Artefact Densities in Relation to Stream Order and Gradient (excluding Czb sand)

Stream Order	Gradient	Total Coverage	Total Artefacts	Average Density
1st	Very gentle	5,600	20	1/280 m^2
	Gentle	23,287	256	1/91 m^2
	Moderate	58,090	184	1/316 m^2
	Steep	10,232	5	1/2,046 m^2
	Ridge tops (gentle)	17,107	118	1/145 m^2
2nd	Very gentle	710	20	-
	Gentle	13,323	358	1/37 m^2
	Moderate	3,859	134	1/29 m^2
3rd	Gentle	3,978	153	1/26 m^2
	Moderate	5,341	1	1/5,341 m^2
4th+	Very gentle	8,863	525	1/17 m^2
	Gentle	6,263	799	1/8 m^2
	Moderate	1,361	323	1/4 m^2
Wollombi Brook	Very gentle	446	10	-
	Gentle	19,539	346	1/57 m^2
	Moderate	990	160	-

Data regarding landform in relation to stream order is given on Table D-44. The most extensive coverage occurs on ridge tops, crests, simple slopes and maximal upper slopes in association with 1st order streams, followed by waning lower slopes associated with 4th+ order streams and flats associated with Wollombi Brook (excluding Czb sand flats). A number of landform types have insufficient coverage for confident statistical analysis (<1,000 m^2).

Very high average surface artefact density of 1 in artefact 6 m^2 of coverage occurs on crests associated with 4th+ order streams. Fairly high average artefact densities of 1 in artefact 11-13 m^2 of coverage occurs on waning lower slopes associated with 4th+ order streams, and on crests associated with Wollombi Brook. Moderate artefact densities of 1 artefact in 24-51 m^2 of coverage occur on waxing upper slopes associated with 1st order streams (Sites 258-259), crests, simple slopes and waning lower slopes associated with 2nd order streams, on flats associated with 3rd order streams, and on flats associated with 4th+ order streams. Average surface artefact densities are consistently low on landforms associated with 1st order streams, except for waxing upper slopes which have moderate average densities of 1 in artefact 40 m^2 of coverage.

Table D-44
Artefact Densities in Relation to Stream Order and Landform (excluding Czb sand)

Stream Order	Landform	Total Coverage	Total Artefacts	Average Density
1st	Crest ridge top	17,108	119	1/144 m^2
	Crest	21,804	66	1/330 m^2
	Simple slope	34,789	246	1/141 m^2
	Waxing upper slope	2,600	65	1/40 m^2
	Maximal upper slope	16,305	13	1/1,254 m^2
	Waning mid slope	4,486	24	1/187 m^2
	Waning lower slope	6,771	21	1/322 m^2
	Flat	5,600	20	1/280 m^2
	Depression	4,853	9	1/539 m^2
2nd	Crest	3,431	67	1/51 m^2
	Simple slope	7,792	307	1/25 m^2
	Waning lower slope	3,323	96	1/35 m^2
	Flat	717	30	-
	Depression	2,629	12	1/219 m^2
3rd	Crest	713	31	-
	Simple slope	136	2	-
	Maximal upper slope	225		-
	Waning lower slope	5,685	19	1/299 m^2
	Flat	2,401	102	1/24 m^2
	Depression	159		-
4th+	Crest	2,767	489	1/6 m^2
	Simple slope	644	53	-
	Maximal upper slope	150		-
	Maximal mid slope	6		-
	Minimal mid slope	142	79	-
	Waning lower slope	11,049	977	1/11 m^2
	Flat	1,729	49	1/35 m^2
Wollombi Brook	Crest	6,091	476	1/13 m^2
	Simple slope	4,692	30	1/156 m^2
	Flat	10,192	10	1/1,019 m^2

Table D-45 provides a more detailed breakdown of the artefact distribution data in relation to stream order, landform and distance from water, excluding the Czb sands. Average artefact densities are shown for landscape settings with more than 500 m^2 of coverage, with average densities given in brackets where smaller samples are available and the average density is consistent with adjacent artefact densities. The most sensitive landscape settings – those having the highest average surface artefact densities – are listed after Table D-45.

Table D-45
Artefact Densities in Relation to Stream Order, Landform and Distance from Water (excluding Czb sand)

Stream Order	Landform	Distance from Water	Total Coverage	Total Artefacts	Artefact Density	Sites
1st	Crest ridge top	0-50	49	2	-	253, 254
		60-100	8,145	12	1/679 m^2	88, 174, 188, 190, 191, 210
		110-200	8,726	104	1/84 m^2	69-72, 81-87, 89, 172, 173, 183-187, 189, 192-195, 206, 211, 213, 222, 223, 255
		>200	188	1	-	196
1st	Crest	0-50	712	13	1/55 m^2	137, 141, 165,201, 202
		60-100	19,327	29	1/666 m^2	54, 91-93, 100, 262, 275, 276,288
		110-200	1,571	19	1/83 m^2	56, 57, 90, 162, 256, 261, 277
		>200	194	5	-	260
1st	Simple slope	0-50	31,388	190	1/165 m^2	13b, 55, 61, 64-67, 105, 115, 139, 143, 144, 164, 168, 175, 217, 263, 266, 267, 278, 285-287
		60-100	2,775	19	1/146 m^2	58, 68, 163, 182, 264, 74, 282-284
		110-200	504	2	1/252 m^2	28
		>200	122	35	-	29, 58
1st	Maximal upper slope	0-50	300	-	-	-
		60-100	4,305	1	1/4,305 m^2	251
		110-200	11,570	11	1/1,052 m^2	170, 171, 280, 281
		>200	130	1	-	73
1st	Waxing upper slope	60-100	2,600	65	1/40 m^2	258, 259
1st	Waning mid slope	0-50	814	-	-	-
		60-100	306	2	-	209
		110-200	2,608	12	1/217 m^2	147, 199, 212, 257
		>200	758	10	1/76 m^2	52, 148
1st	Waning lower slope	0-50	1,955	12	1/166 m^2	214, 252
		60-100	330	5	-	145, 215
		110-200	4,027	2	1/2,014 m^2	146, 216
		>200	459	2	-	149, 150
1st	Flat	0-50	5,600	20	1/280 m^2	62
1st	Depression	0-50	4,853	9	1/539 m^2	53, 60, 63, 142, 265
2nd	Crest	0-50	880	7	1/126 m^2	181, 244
		60-100	528	47	1/11 m^2	176, 248
		110-200	2,010	13	1/155 m^2	219, 247, 249
		>200	13	-	-	-
2nd	Simple slope	0-50	3,664	275	1/13 m^2	3, 102-104, 116, 129-135, 138, 159, 160, 177, 218, 220, 240, 250, 268
		60-100	507	13	1/39 m^2	136, 140, 245, 272, 273
		110-200	1,589	6	1/1265 m^2	127, 128, 242
		>200	2,032	13	1/156 m^2	7, 8, 126
2nd	Waning lower slope	0-50	2,101	76	1/28 m^2	4, 113, 178-180, 232, 241, 246, 269-271
		60-100	210	-	-	-
		110-200	1,012	20	1/51 m^2	100, 231
2nd	Flat	0-50	717	30	1/24 m^2	94, 96, 97, 290
2nd	Depression	0-50	2,629	12	1/219 m^2	95, 159, 161, 230, 243, 289

Table D-45 (Continued)
Artefact Densities in Relation to Stream Order, Landform and Distance from Water (excluding Czb sand)

Stream Order	Landform	Distance from Water	Total Coverage	Total Artefacts	Artefact Density	Sites
3rd	Crest	0-50	490	23	1/21 m^2	237, 238
		60-100	223	8	-	236, 279
3rd	Maximal upper slope	60-100	75	-	-	-
		110-200	150	-	-	-
3rd	Simple slope	0-50	88	2	-	125
		>200	48	-	-	-
3rd	Waning lower slope	0-50	232	2	-	221
		60-100	225	8	-	229
		110-200	5,148	8	1/644 m^2	151, 226
		>200	80	1	-	225
3rd	Flat	0-50	2,401	102	1/200 m^2	291
3rd	Depression	0-50	159	-	-	-
4th+	Crest	0-50	1,554	231	1/7 m^2	44, 74, 76, 78, 167
		60-100	829	180	1/5 m^2	79, 98, 239
		110-200	346	73	(1/5 m^2)	49, 80
		>200	38	5	-	50
4th+	Simple slope	0-50	44	11	-	51, 77, 166
		60-100	600	42	1/14 m^2	41
4th+	Maximal upper slope	>200	150		-	
4th+	Maximal mid slope	110-200	6	-	-	-
4th+	Minimal mid slope	60-100	140	79	-	42
		110-200	2	-	-	-
4th+	Waning lower slope	0-50	6,236	354	1/18 m^2	75, 101, 106, 108-112, 169
		60-100	1,481	551	1/3 m^2	99, 121, 122, 124
		110-200	3,023	71	1/43 m^2	47, 107, 123, 227, 228
		>200	309	1	1/309 m^2	48
4th+	Flat	0-50	833	29	1/29 m^2	38, 40, 120, 155, 157, 235
		60-100	486	17	(1/29 m^2)	118, 156, 233, 234
		>200	410	3	-	46, 119
Wollombi Brook	Crest	60-100	4,690	290	1/46 m^2	30, 31
		110-200	1,016	185	1/6 m^2	13a, 16
		>200	385	1	-	14
Wollombi Brook	Simple slope	0-50	60	-	-	-
		60-100	486	-	-	-
		110-200	1	-	-	-
		>200	4,145	30	1/138 m^2	15
Wollombi Brook	Waning lower slope	0-50	750	-	-	-
Wollombi Brook	Flat	0-50	62	10	-	17
		60-100	70	-	-	-
		110-200	8,300	-	-	-
		>200	1,760	-	-	-

The most sensitive landscape settings with high average surface artefact densities of 1 artefact in 10 m^2 or less of coverage are:

- Crests within 200 m of 4^{th}+ order streams (and possibly further away but sample size is small).
- Waning lower slopes 60-100 m from 4^{th}+ order streams.
- Crest 110-200 m from Wollombi Brook.

Landscape settings with fairly high average surface artefact densities of 1 artefact in 11-19 m^2 of coverage are:

- Crests within 60-100 m of 2nd order streams.
- Simple slopes within 50 m of 2nd order streams.
- Simple slopes within 100 m of 4th+ order streams.
- Waning lower slopes within 50 m of 4th+ order streams.

Landscape settings with moderate average surface artefact densities of 1 artefact in 20-51 m^2 of coverage are:

- Waxing upper slopes associated with 1^{st} order streams (60-100 m being the only available sample).
- Simple slopes 60-100 m from 2^{nd} order streams.
- Waning lower slopes 0-50 m and 110-200 m from 2^{nd} order streams.
- Flats within 50 m of 2^{nd} order streams.
- Possibly crests within 50m of 3^{rd} order streams.
- Waning lower slopes more than 100 m from 4^{th}+ order streams.
- Flats within 100 m from 4^{th}+ order streams.
- Crests 60-100 m from Wollombi Brook (being Sites 25 and 26 on the red sand body).

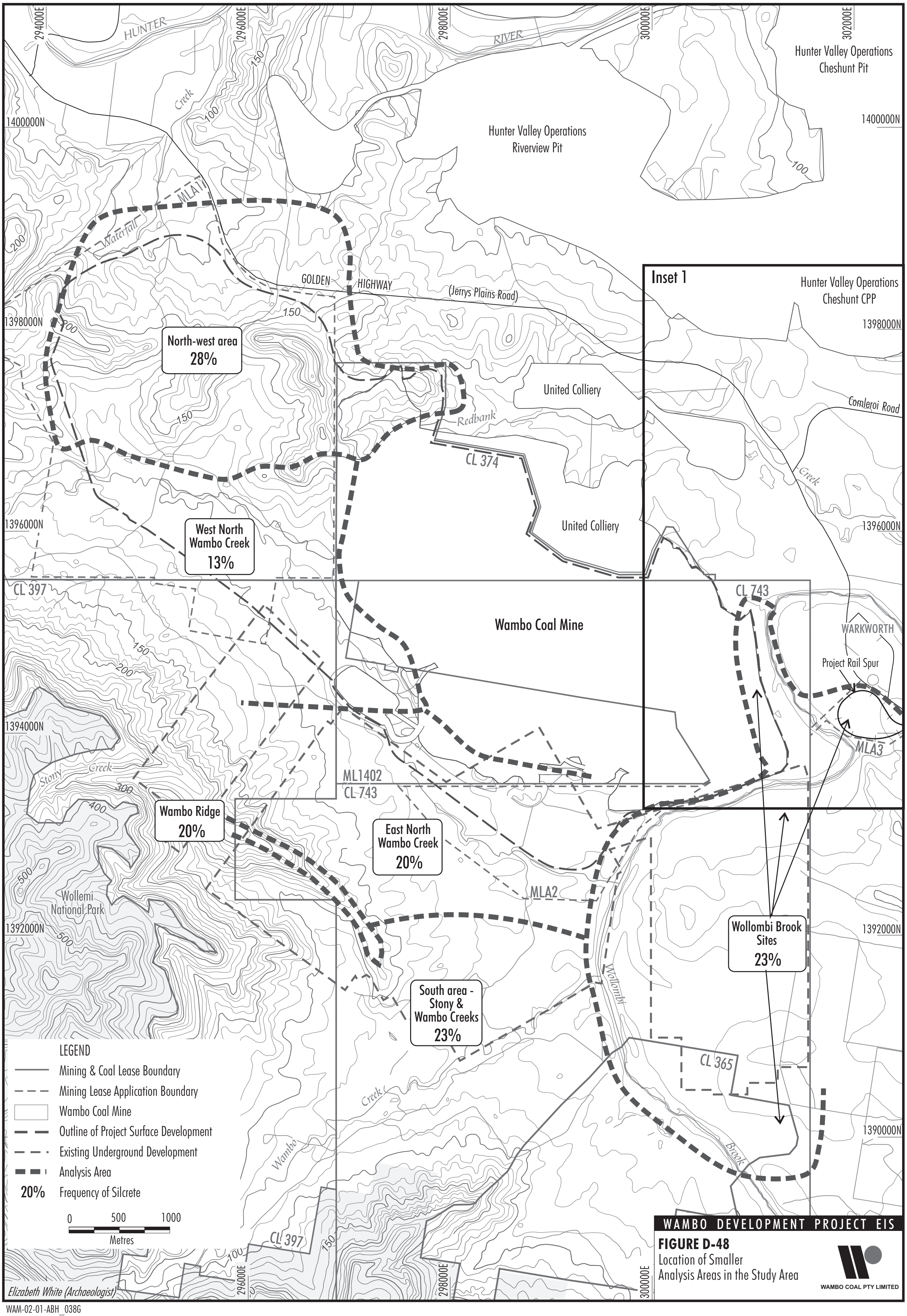
Landscape settings with low average surface artefact densities of 1 artefact in 60-100 m^2 of coverage are:

- Ridge top crests 110-200 m from 1st order streams.
- Crests within 50 m, and 110-200 m, of 1st order streams.
- And possibly waning mid slopes more than 200 m from 1st order streams, but sample size is limited.

All other landscape settings at this scale of division either have very low artefact densities or insufficient samples of coverage to enable description.

D9.4.3 Spatial Variation in Artefact Density

The above analyses have regarded the Wambo landscape as a single unit, but analysis of artefact assemblages below, indicates that different parts of the landscape may have been used in different ways. For the artefact analysis the study area has been subdivided into smaller areas, partly on the basis of catchments and partly on raw material distributions. Figure D-48 shows the location of smaller analysis areas in the study area.



WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-48
Location of Smaller
Analysis Areas in the Study Area

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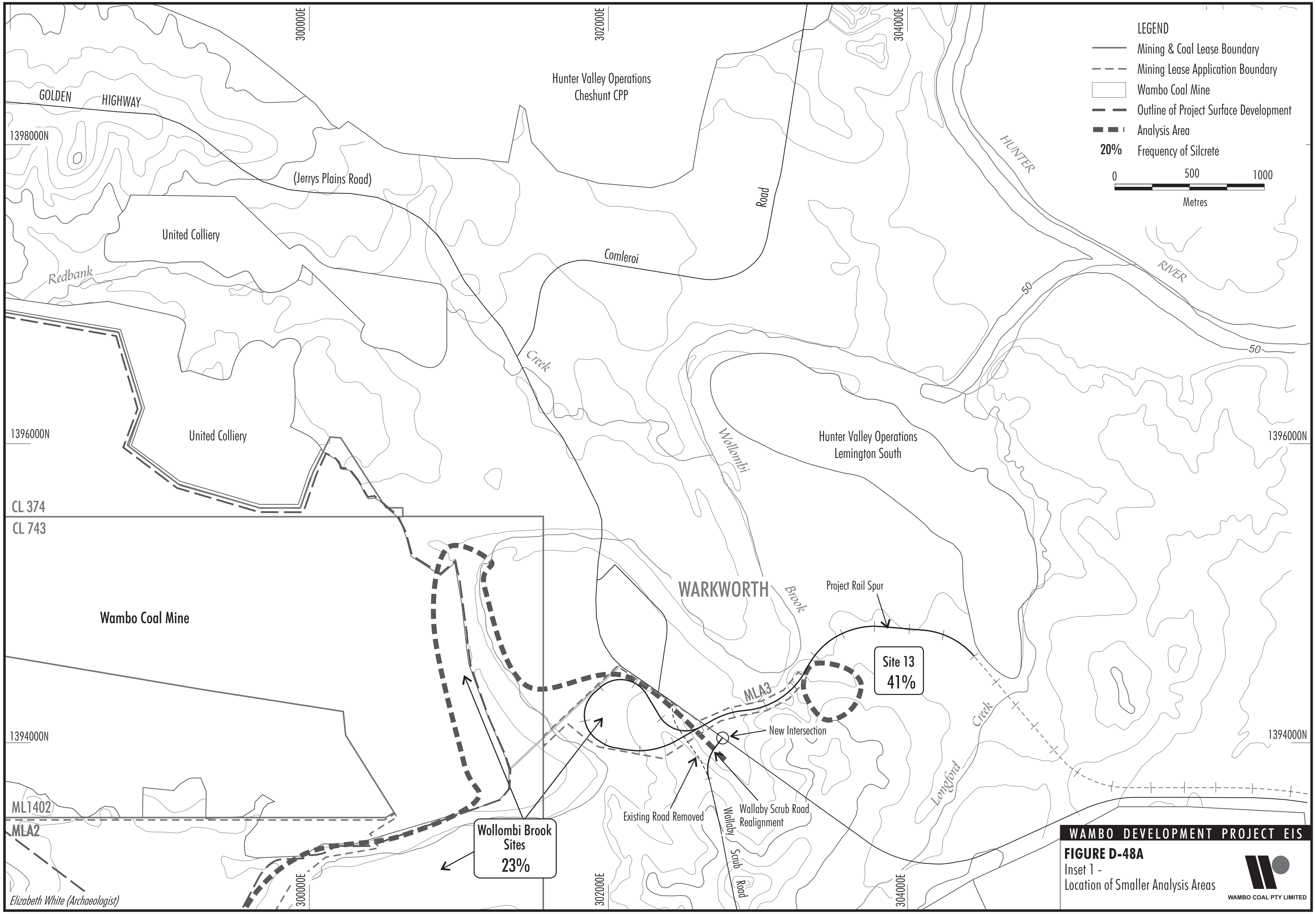

WAMBO DEVELOPMENT PROJECT EIS

FIGURE D-48A

Inset 1 -
Location of Smaller Analysis Areas

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WAM-02-01-ABH_039E

The north-west area takes in the catchments of Waterfall Creek, Splitters Hollow, Unnamed Creeks #1 and #2, and part of the upper catchment of Redbank Creek (Figure D-48). West North Wambo Creek takes in the catchment of North Wambo Creek north of a line running along AMG 6393500N which runs approximately through the existing underground mine portal. East North Wambo Creek takes in the catchment of North Wambo Creek south of that line. Wambo Ridge takes in the top of the ridge which forms the watershed between North Wambo and Stony Creeks. The south area takes in the catchments of Stony and Wambo Creek, Wollombi Brook takes in the immediate catchment of Wollombi Brook, the far east includes Sites 13a and 13b and other exposures at the eastern end of the rail spur. Significant assemblage variation occurs across the study area in relation to these areas (see Section D9.5). Here, artefact density in relation to these areas is considered.

High average surface artefact densities (of 1 artefact in $\leq$10m^2 of coverage) occur in association with 4th+ order streams along the eastern half of North Wambo Creek, in the southern part of the Wambo study area along Stony and Wambo Creeks, and in association with Wollombi Brook at the eastern end of the proposed rail spur (Table D-46). Fairly high average artefact density of 1 artefact in 19 m^2 of coverage occurs along the western end of North Wambo Creek. Moderate artefact densities of 1 artefact in 20-50 m^2 of coverage occur in association with 2nd order creeks, with the north-west area having a marginally higher average density than the western or eastern ends of the North Wambo Creek catchment. Wambo Ridge. which forms a possible access route into the mountains, has a moderate average artefact density of 1 artefact in 50 m^2 of coverage, which is considerably higher than most other areas drained by 1st order creeks; except 1st order creeks in the eastern part of the North Wambo Creek catchment which lead up to this ridge.

Generally, the data on Table D-46 indicates that average artefact density varies in relation to stream order; eg. 4th+ order streams have higher artefact densities than 1st order streams. Table D-46 also shows some variation between different parts of the study area where stream order is the same; eg. 1st order streams in the eastern half of North Wambo Creek catchment have artefact densities three times higher than 1st order streams in the north-west part of the study area.

Table D-46
Artefact Distribution in Relation to Stream Order Across the Wambo Study Area (excluding Czb sand)

Area	Stream Order	Coverage	Total Artefacts	Average density
North-west area	1st	78,988	304	1/260 m^2
	2nd	8,022	272	1/29 m^2
	3rd	8,436	135	1/62 m^2
West North Wambo Ck	1st	12,958	58	1/223 m^2
	2nd	1,805	40	1/45 m^2
	3rd	883	17	1/52 m^2
	4th+	4,326	230	1/19 m^2
East North Wambo Ck	1st	9,107	117	1/78 m^2
	2nd	6,598	190	1/35 m^2
	3rd	0	2	-
	4th+	8,972	925	1/10 m^2
Wambo Ridge	1st	2,486	50	1/50 m^2
South area	1st	8,925	49	1/182 m^2
	4th+	3,189	492	1/7 m^2
Wollombi Brook	1st	1,543		-
	2nd	1,408	10	1/141 m^2
	Wollombi Brook	19,880	356	1/56 m^2
Far east	1st	309	6	(1/52 m^2)
	Wollombi Brook	1,095	160	1/7 m^2

Data on coverage and average surface artefact density in relation to landforms in different parts of the study area is given on Table D-47. In the north-west part of the study area moderate artefact density (of 1 artefact in 23 m^2 of coverage) occurs on the flat along Waterfall Creek. A similar average density occurs on creek flats in the eastern part of North Wambo Creek (1 artefact in 33 m^2 of coverage); but otherwise creek flats in the Wambo study area have only low artefact densities. Also in the north-west part of the study area is a waxing upper slope with a moderate artefact density (of 1 artefact in 40 m^2 of coverage). This landform is located at the ridge top pass between Waterfall Creek and Splitters Hollow. All other landforms in the north-west part of the study area (as shown on Table D-47) have low to very low artefact densities.

Table D-47
Artefact Distribution in Relation to Landform Across the Wambo Study Area (excluding Czb Sand)

Area	Landform	Total Coverage	Total Artefacts	Average density
North-west area	Crest ridge top	14,712	71	1/207 m^2
	Crest	20,695	131	1/158 m^2
	Simple slope	28,539	238	1/120 m^2
	Waxing upper slope	2,600	65	1/40 m^2
	Maximal upper slope	10,895	6	Negligible
	Waning mid slope	949	9	1/105 m^2
	Waning lower slope	11,942	83	1/144 m^2
	Flat	2,404	103	1/23 m^2
	Depression	2,710	5	1/542 m^2
West North Wambo Ck	Crest	1,234	157	1/8 m^2
	Simple slope	2,595	56	1/46 m^2
	Maximal upper slope	5,200	6	Negligible
	Maximal mid slope	6	-	-
	Minimal mid slope	2	-	-
	Waning mid slope	3,473	14	1/248 m^2
	Waning lower slope	5,577	95	1/59 m^2
	Flat	787	10	1/79 m^2
	Depression	1,098	7	1/157 m^2
East North Wambo Ck	Crest	2,729	50	1/55 m^2
	Simple slope	9,842	238	1/41 m^2
	Maximal upper slope	305	-	-
	Waning lower slope	8,421	898	1/9 m^2
	Flat	1,480	45	1/33 m^2
	Depression	1,900	3	Negligible
Wambo Ridge	Crest ridge top	2,396	49	1/49 m^2
	Maximal upper slope	90	1	-
South area	Crest	4,057	315	1/13 m^2
	Simple slope	743	62	1/12 m^2
	Maximal upper slope	190	-	-
	Minimal mid slope	140	79	-
	Waning mid slope	64	1	-
	Waning lower slope	118	35	-
	Flat	5,776	43	1/134 m^2
	Depression	1,026	6	1/171 m^2

Table D-47 (Continued)
Landform Across the Wambo Study Area (excluding Czb Sand) (Continued)

Area	Landform	Total Coverage	Total Artefacts	Average density
Wollombi Brook	Crest	5,076	316	1/16 m^2
	Simple slope	6,170	38	1/162 m^2
	Waning lower slope	770	2	1/385 m^2
	Flat	10,192	10	Negligible
	Depression	623	-	-
Far east	Crest	1,015	160	1/6 m^2
	Simple slope	164	6	-
	Depression	225	-	-

In the western part of North Wambo Creek catchment a high average artefact density (of 1 artefact in 8 m^2 of coverage) is found on crests. Simple slopes have a moderate average artefact density (of 1 artefact in 46 m^2 of coverage), while waning lower slopes and flats have lower average densities than this.

In contrast the eastern part of the North Wambo Creek catchment has a high average density (of 1 artefact in 9 m^2 of coverage) on waning lower slopes, with moderate artefact densities (of 1 artefact in 33-41 m^2 of coverage) on simple slopes and creek flats. As noted above, Wambo Ridge also has a moderate artefact density (of 1 artefact in 49-50 m^2 of coverage), in contrast to ridge tops in the north-west part of the study area where average artefact densities are very low. In the southern part of the study area fairly high average artefact densities (of 1 artefact in 12-13 m^2 of coverage) are found on crests and simple slopes; and on crests above Wollombi Brook.

The average artefact density data on Table D-47 shows much variation on landforms from different parts of the study area. Variation is most evident for crests (both ridge top crests and other crests), simple slopes, waning lower slopes, and flats. It is likely that locally specific factors influenced site selection. In the case of creek flats drainage might have been a factor, depending on whether localities were visited during wet times or dry. In the eastern part of North Wambo Creek catchment waning lower slopes form gentle land surfaces adjacent to North Wambo Creek and have clearly been targeted for use. Crests above Wollombi Brook will have been elevated well drained locations above flood waters. The ridge top crest along Wambo Ridge leads into the mountains to the west of the study area, but the ridge top crest which separates Unnamed Creek #1 from Waterfall Creek and Unnamed Creek #2, although continuous with Jerrys Plains Ridge, would not have provided such a good access route. This part of the ridge is relatively high and steep, and is broken by a low pass (the waxing upper slope with Sites 258-259). Jerrys Plains Ridge might have provided a good access route into the mountains, but west of Sites 258-259; not along the ridge top to the east.

D9.4.4 Potential Site Locations and PADS

Within the Wambo study area there are many locations with potential for sites to be present but on which sites have not been identified, either because of poor ground exposure/visibility or because these locations were not specifically searched during the survey. The above analyses have identified the most sensitive landforms (highest average surface artefact densities) and those kind of settings could be used to predict the locations of sites which were not identified during the survey. Such potential site locations (PADs) are listed on Table D-48. It should be noted that many of the sites in the Wambo study area have potential to be more extensive than their surface manifestations, and in this sense many sites have PADs (areas of archaeological potential) associated with them. The PADs listed on Table D-48 are on landforms on which sites have not been identified. It should also be noted that only those locations which were viewed (eg. from a vehicle or from a look out point) during the present survey are included on Table D-48. Many other site locations may occur beyond the impact areas elsewhere in the Wambo study area.

For the area east of Wollombi Brook in the Wallaby Scrub it is difficult to predict site locations because observed artefact densities are very low, but it is hard to believe that sites are not present in this area. On Table D-48 PAD A is on a crest which seems to be a preferred type of landscape setting elsewhere above larger creeks. PAD B is on a flattish area, quite well defined, and above the 1:100 year flood level; ultimately as good a guess as any. PAD C is in a similar setting as PAD B but fronts onto a low drainage area which may have been swampy at times; this being in part a swale between this location and the dune identified as PAD D and below the 1:100 year flood level so it may at times have filled with flood waters.

Potential sites locations in relation to 3rd order streams are also difficult to predict, because the small number and extent of 3rd order streams has limited the total coverage and numbers of artefacts which were found in association with these. One potential area associated with a 3rd order stream is listed on Table D-48 being a waning lower slope, which in this case is continuous with the landform on which Site 227 occurs. Two other PADs have been identified within the catchment of Unnamed Creek #1, because they are locations adjacent to 2nd order streams and this setting has been identified as having fairly high average surface artefact densities. However, survey in these locations did not identify them as being particularly inspiring and so their archaeological potential has, on Table D-48, been downgraded to low.

Table D-48
Potential Site Locations (PADs)

Catchment	Impact Area	PAD Code	AMG E	AMG N	Landform	Stream Order	Distance from Water	Condition	Archaeological Potential
Wollombi Brook	Underground none	A	312030	6391350	Crest	Wollombi Brook	<200 m	Cleared	V. High
		B	313200	6395200	Minimal mid slope	Wollombi Brook	>200 m	Cleared	Low
		C	313800	6392440	Simple slope	1st, swamp?	80 m	Cleared	Moderate
		D	313900	6392550	Crest (dune)	Wollombi Brook, 1st, swamp?	400 m, 80 m	Cleared	V. High
North Wambo Creek	Underground B	E	309820	6392300	Crest	2nd	60-100 m	Cleared	Moderate
	Underground B	F	309700	6392340	Simple slope	2nd	0-50 m	Cleared	Moderate
	Underground B	G	309000 to 309500	6393100 to 6393210	Simple slope	2nd	0-50 m	Cleared	Moderate
	Beyond impact	H	308940	6393450	Crest	2nd	60-100 m	Cleared	Moderate
	Mostly beyond impact	I	308300 to 309020	6393290 to 6393520	Simple slope	2nd	0-50 m	Cleared	Moderate
	Beyond impact	J	307930	6394650	Crest	2nd	60-100 m	Cultivated	Low
	Beyond impact	K	307900	6394500	Simple slope	2nd	0-50 m	Cleared	Moderate
	Beyond impact	L	307400	6394900	Simple slope	2nd	0-50 m	Cleared	Moderate
	Surface	M	308200	6394800	Crest	2nd	60-100 m	Cultivated	Low
	Surface	N	308450	6395500	Crest	4th+	<200 m	Cleared	High
Unnamed #1	Surface	O	308300	6396400	Simple slope	2nd	0-50 m	Cleared	Low?
	Surface	P	308100	6396600	Simple slope	2nd	0-50 m	Cleared	Low?
	Surface	Q	307920	6396070	Waning lower slope	3rd	<200 m	Cleared	Moderate
Splitters Hollow	Surface	R	306800	6396150 to 6396480	Crest	2nd	60-100 m	Cultivated?	Low - moderate
Waterfall Ck	Surface	S	308000	6397840	Crest	2nd	60-100 m	Cleared	Moderate
		T	307150	6398250	Crest	3rd	60-100 m	Cultivated	Low

D9.4.5 Potential for Burials

No burials have been reported in the study area, and burials are not often found in the Hunter Valley. The "burial" made in the historic period at Site #37-6-54 was not a burial as such, but rather sand was used to form a mound over the body which had been placed on the ground surface. The available information notes specifically that the chosen spot was sandy.

Burials may occur in sand which is easier to dig than firm silty soils. Sandy soils occur east of Wollombi Brook but are acidic with a pH of 5.9 (Resource Strategies, 2003b) and Aboriginal remains are unlikely to have survived these conditions.

Alluvium along the flat of North Wambo Creek tends to be sandy in its upper 20-30 cm. The alluvium is more neutral than the Czb sands east of Wollombi Brook, with pH readings of 6.4 and 6.7 (Resource Strategies, 2003b). However, the alluvium has been cultivated repeatedly and unless burials were very deep (if they were present at all), it is unlikely they would have survived this disturbance.

The red sand body adjacent to Wollombi Brook might also have been suitable for burials, although the pH of this unit has not been measured. Again, this unit has been cultivated so any burials in the upper 20 cm or so would have been disturbed.

Overall, it is considered that the study area has a low potential to contain human burials.

D9.5 STONE ARTEFACT ASSEMBLAGES IN THE LANDSCAPE

D9.5.1 Introduction

The previous analyses consider the distribution of sites and artefacts (artefact density) in the Wambo landscape. Sites and artefacts are not evenly nor randomly distributed across the landscape but some landscape settings are particularly sensitive in so far as they have high average surface artefact densities. The issue to be addressed here is whether variations in site distribution and artefact density simply reflect variations in the amount of use (quantitative variation) or whether there was also variation in the way the landscape was occupied (qualitative variation). If the variation is quantitative then the lithic assemblages should be similar in different landscape settings, varying only in the quantity or density of material. On the other hand if people carried out different kinds of activities in different landscape settings, with particular distinction between domestic tasks and resource extraction or processing tasks, then there should be qualitative differences in artefact assemblages in different landscape settings.

The following analyses make use of stone artefacts recorded during the present field work and also recordings made by others where details are available. In the following analyses the total artefact counts vary as the kinds of data available vary. Note also that data in brackets indicates small sample size.

D9.5.2 Raw Materials

The raw material categories used here are those commonly used in the Hunter Valley. Silicified tuff includes indurated mudstone and "chert" as it used to be known. FGS (fine grained siliceous) includes a variety of fine siliceous materials such as chalcedony and agate, and other fine grained siliceous opaque and translucent materials which might be called "chert" by some recorders but which are not silicified tuff. The terms silcrete, quartz, petrified wood and quartzite are as commonly used in the region. Igneous materials include both fine and coarse grained materials of igneous origin, while "other" includes all other materials including metamorphic and unidentified materials.

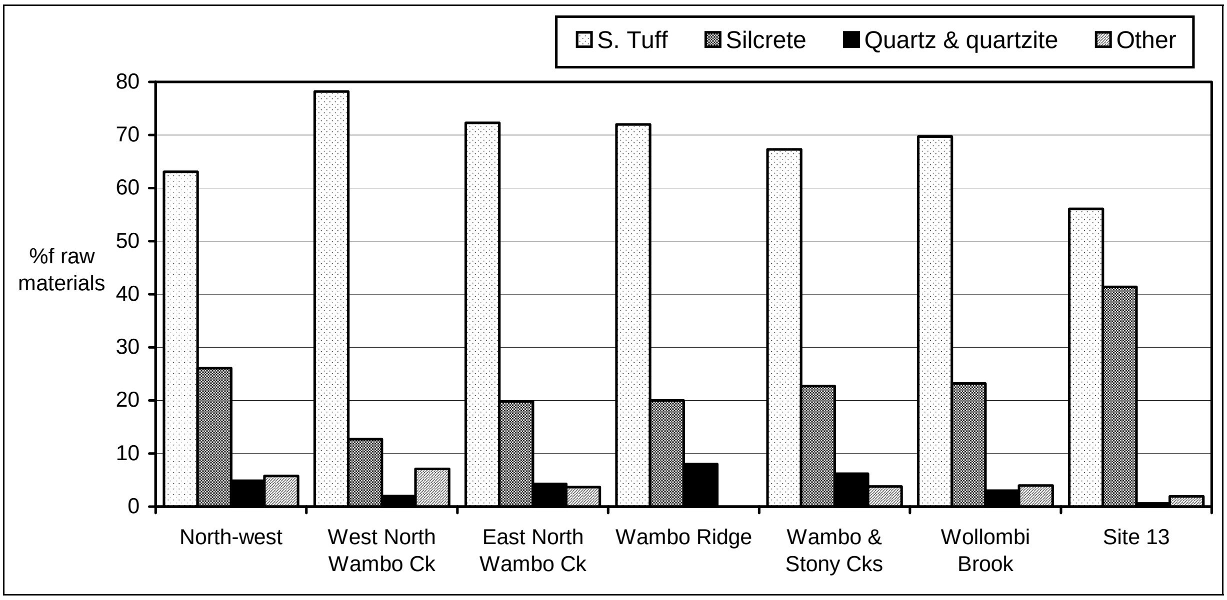
The predominant raw material overall is silicified tuff with 69% of all lithic items (Table D-49). This is followed by silcrete with 23%. Of the minor raw material types, quartz is most frequent with 3.4%. While silicified tuff is dominant across the entire study area, there appears to have been some spatial variation in the use of other raw material types (Figure D-49). Smaller areas within the study area are described in Section D9.4.3 and shown on Figure D-48. In the following analyses data for Wambo Ridge, and Stony and Wambo Creeks are listed separately, and combined on the graphs to make a 'south area' to increase sample sizes.

The highest frequency of silcrete occurs on Site 13a near the eastern end of the proposed rail spur – where 41% of the recorded artefacts are of silcrete. Site 13a is less than 2 km from a known silcrete source (Site WB8 in Lemington South) so the relatively high frequency of silcrete amongst its assemblage could reflect use of a locally available resource. The frequency of silcrete declines to 24% amongst the assemblages from the sites near Wollombi Brook within the study area, 5-6 km from the South Lemington source. Silcrete artefacts make up 23% amongst the assemblages from sites along Wambo and Stony Creeks, which are 8-10 km from the South Lemington silcrete source. Initially, this appears to reflect decreased use of silcrete with increased distance from known silcrete sources. However, the eastern part of the North Wambo Creek catchment is closer (6-8 km) to the same sources yet silcrete is less frequent at 20%.

Table D-49
Raw Materials in Different Parts of the Study Area

Area	S Tuff	Silcrete	Quartz	Quartzite	P. Wood	FGS	Glass	Igneous	Other	Total artefacts
North-west area	423	175	24	9	1	13	1	16	8	670
West North Wambo Ck	276	45	6	1	6	4	-	6	9	353
East North Wambo Ck	476	130	19	9	6	5	-	7	6	658
Wambo Ridge	36	10	2	2	-	-	-	-	-	50
Wambo & Stony Creeks	370	125	27	7	2	13	1	4	1	550
Wollombi Brook	207	69	9	-	2	3	-	1	6	297
Wollombi Brook Site 13	88	65	1	-	1	-	-	1	1	157

Figure D-49
Spatial Distribution of Raw Materials by % Frequency



The north-west part of the study area is fairly close to known silcrete sources along the Hunter River at Jerrys Plains and west of Lemington (see Figure D-2). Waterfall Creek catchment is 3-4 km from these sources and silcrete in that catchment makes up 28% of the assemblage. Access from Waterfall Creek into Splitters Hollow is relatively easy via a pass through the eastern end of Jerrrys Plains Ridge; and access into Unnamed Creek #1 is possible, though less easy, through another pass 500 m further east. It seems that silcrete was transported into Splitters Hollow as silcrete artefacts make up 24% of the assemblage from that catchment. (The sample size from catchment of Unnamed Creek #1 is too small for confident analysis.) Overall, silcrete artefacts in the north-west part of the study area make up 26% of the assemblages. However, the north-west part of the North Wambo Creek catchment is immediately adjacent, and only 5-7 km from those silcrete sources, yet just 13% of artefacts here are of silcrete. Indeed, the large Site 239 near the confluences of Splitters Hollow and North Wambo Creek has just 12% silcrete artefacts.

Based on the results of the various surface surveys it seems that less silcrete was transported into the North Wambo Creek catchment, and this is particularly evident in the western part of the catchment. It seems that some kind of social boundary or barrier existed which limited the use of silcrete in that area. Variations in the use of silcrete across the surrounding district is shown on Figure D-2. The western end of North Wambo Creek catchment has the lowest known frequencies of silcrete in this larger area.

Quartz is a minor raw material type used in the study area. It is most frequent along Stony Creek where 7.3% of artefacts are of this material; and 40% of artefacts are of quartz at Site 76 (previously recorded as Site SC2) which is the largest, most westerly site recorded along Stony Creek. Quartz was also used along Wambo Ridge where 4% of artefacts are of this material, and in Splitters Hollow and the upper catchment of Redbank Creek, where 5% of artefacts are of quartz.

Quartzite is relatively rare throughout, but it is quite possible that the use of quartzite is under-represented in the data. Quartzite cobbles, without apparent modification, were seen on several sites, and while they were not recorded as artefacts it is possible that these were manuports. On Site 258 on the northern face of the watershed between Waterfall Creek and Splitters Hollow many quartzite fragments and broken cobbles were seen, some of which appear to be of quite good flaking quality. Three definite flaked artefacts of this material were recorded, but other pieces may well have been broken flaked artefacts. It is possible that quartzite cobbles were flaked in this area to augment stone supplies.

Quartz and quartzite are locally occurring stone materials, in so far as they occur naturally within the study area, although they are not often artefact quality. Together, artefacts of these materials are most frequent (at 8.0% and 6.2% respectively) along Wambo Ridge and in the Stony and Wambo Creek catchments. The Stony Creek catchment also some FGS pebbles of artefact quality and Rich (1991a) suggested that they may have originated in the Widden Brook conglomerate. An array of other raw material types occur in various catchments, but the small numbers of recorded artefacts makes their relative frequencies difficult to assess.

The above analyses have identified large scale variation in raw material use across the study area; but might there have been variation in the way raw materials were used in relation to other environmental variables? Discussions in Sections D7.1.1 and D7.1.2 of this report suggest that people might have carried out different kinds of activities in different parts of the landscape. The most common model is for residential occupation near larger streams and resource extraction or processing activities, or day-time camps, associated with minor creeks and hinterland areas away from larger creeks. It was suggested in Section D7.1.4 that the way stone tools and materials were organised might have varied – so discarded artefact assemblages might also have varied. The null hypothesis to these propositions is that raw material use did not vary in relation to environmental resources and that artefact assemblages from different landscape settings will have been similar.

Data on the distribution of raw materials in relation to stream order, but taking into account differences in raw material distributions across each part of the study area, is given on Table D-50 and shown on Figure D-50 where sample sizes are sufficiently large. The higher frequency of silcrete in the north-west part of the study area is evident on Figure D-50. Nonetheless, the frequency of silcrete in both the north-west part of the study area, and in the east part of North Wambo Creek catchment, is lowest in association with 1st order streams then increases with stream order. Quartz and quartzite are minor raw material types but artefacts of these tend to be a little more frequent in association with 1st order streams than larger streams. In the southern part of the study area assemblages have been recorded from only 1st order creeks and from the larger creeks of Wambo and Stony Creeks. Unlike the other two parts of the study area the relative frequency of silcrete at sites associated with 1st order streams and the larger creeks does not vary, although there is more use of locally available quartz and quartzite associated with the 1st order streams.

The data on the distribution of raw materials in relation to stream order supports an interpretation of difference in behaviour in relation to water supply; but the southern part of the study area may be an important exception.

Data on the distribution of raw materials in relation to distance from water is given on Table D-51 and shown on Figure D-51. In the western end of North Wambo Creek the frequency of silcrete is low regardless of distance from water. In the north-west area and in the eastern end of the North Wambo Creek catchment silcrete is most frequent close to water and then declines in frequency with increasing distance from water. In addition, in these two areas quartz and quartzite tend to be a little more frequent with increasing distance from water. In the north-west area and in the western end of the North Wambo Creek all ‘other’ raw material types as a group are most frequent in assemblages more than 100 m from water.

In the southern area, Wambo and Stony Creeks and Wambo Ridge. silcrete is relatively more frequent more than 100m from water; the opposite trend to that shown by other parts of the study area.

Table D-50
Raw Materials and Stream Order in Different Parts of the Study Area

Area	Stream Order	S Tuff	Silcrete	Quartz	Quartzite	P. Wood	FGS	Glass	Igneous	Other	Total
North-west	1st	203	50	15	7	1	12	1	3	5	297
	2nd	141	79	8	1	-	1	-	5	3	238
	3rd	79	46	1	1	-	-	-	8	-	135
West North Wambo Ck	1st	47	4	2	-	2		-	2	1	58
	2nd	29	8	2	-		1	-	-	-	40
	3rd	11	4	-	-	1		-	1	-	17
	4th+	189	29	2	1	3	3	-	3	8	238
East North Wambo Ck	1st	95	13	5	2	-		-	-	3	118
	2nd	194	41	8	4	-	1	-	2	1	251
	3rd	2	-	-	-	-		-	-	-	2
	4th+	185	76	6	3	6	4	-	5	2	287
Wambo Ridge	1st	36	10	2	2	-		-	-	-	50
Stony & Wambo Cks	1st	31	13	5	-	-	1	1	-	-	51
	4th+	339	112	22	7	2	12	-	4	1	499

Figure D-50
Raw Materials and Stream Order in Different Parts of the Study Area by % Frequency

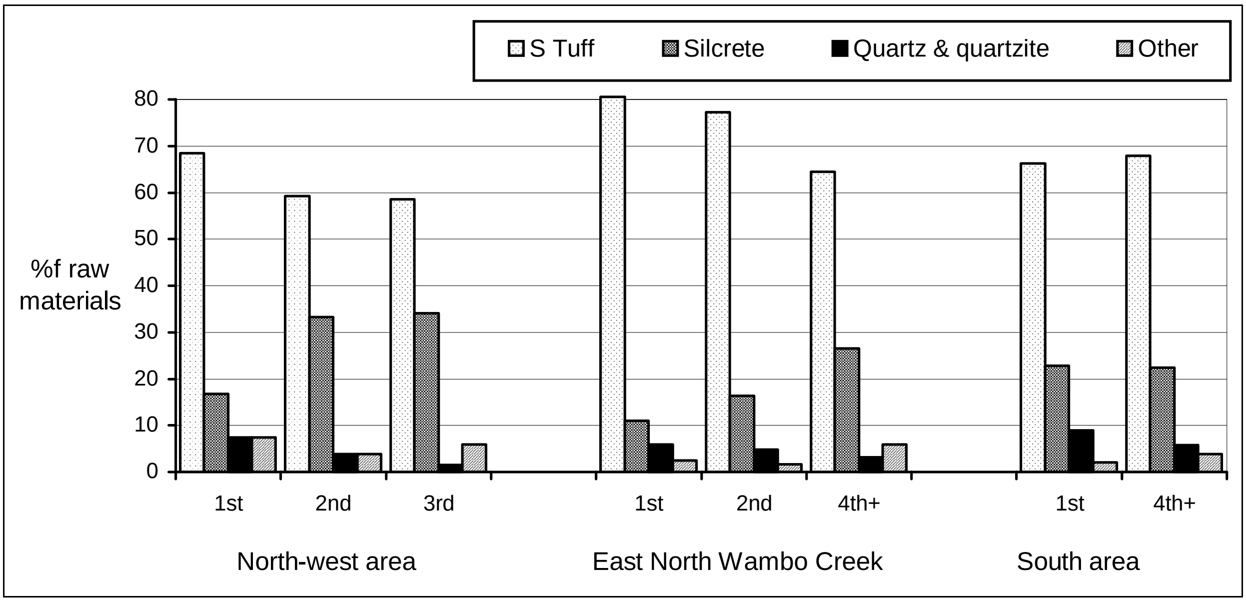


Figure D-51
Raw Materials and Distance from Water By % Frequency

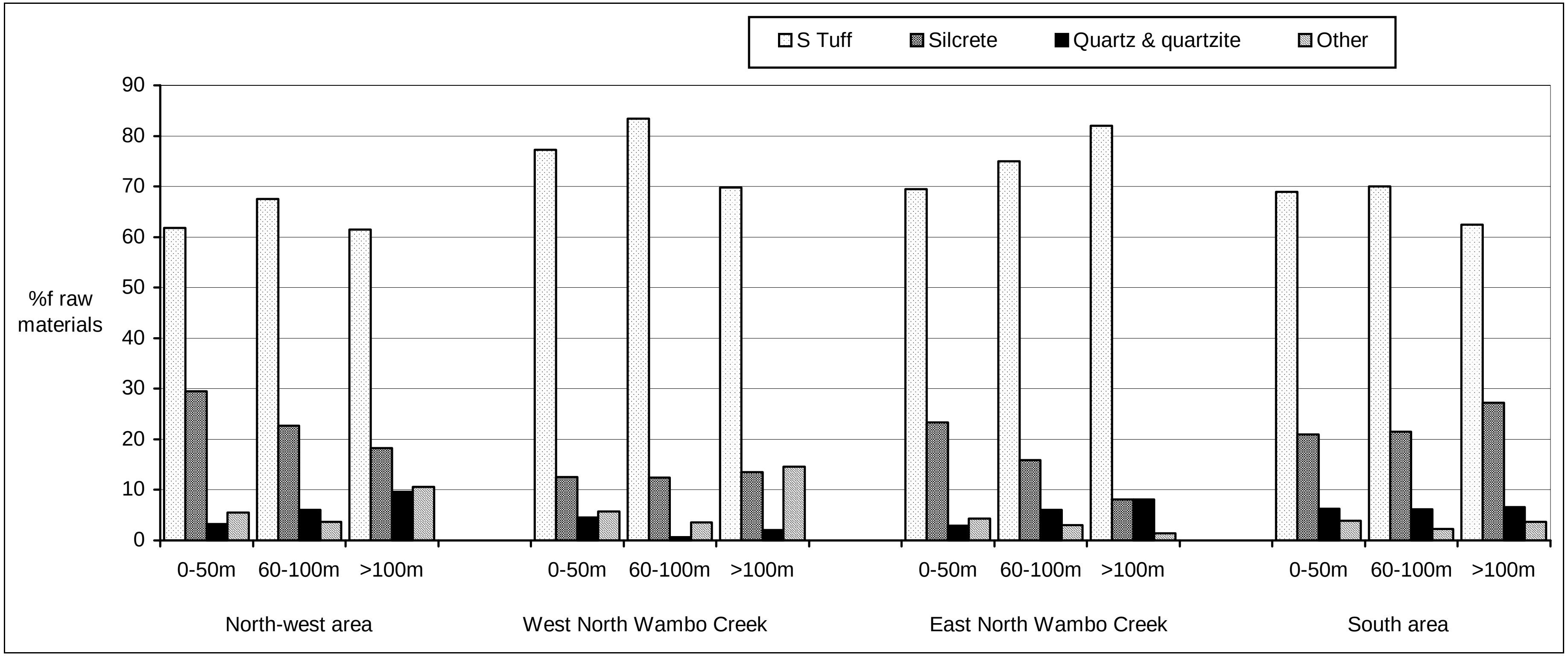


Table D-51
Raw Materials and Distance from Water

Area	Distance from water	S Tuff	Silcrete	Quartz	Quartzite	P. Wood	FGS	Glass	Igneous	Other	Total artefacts
North-west	0-50	249	119	11	2	-	7	1	11	3	403
	60-100	110	37	6	4	1	1	-	4	-	163
	110-200	60	18	6	3	-	5	-	-	5	97
	>200	4	1	1	-	-	-	-	1	-	7
West North Wambo Ck	0-50	68	11	4	-	-	1	-	2	2	88
	60-100	141	21	1	-	2	3	-	1	-	169
	110-200	58	13	1	1	2	-	-	3	7	85
	>200	9	-	-	-	2	-	-	-	-	11
East North Wambo Ck	0-50	292	98	8	4	5	3		6	4	420
	60-100	123	26	7	3	1	1	-	1	2	164
	110-200	25	2	2	1	-	-	-	-	-	30
	>200	36	4	2	1	-	1	-	-	-	44
Wambo Ridge	60-100	2	1	-	-	-	-	-	-	-	3
	110-200	33	9	2	2	-	-	-	-	-	46
	>200	1	-	-	-	-	-	-	-	-	1
Stony & Wambo Cks	0-50	230	70	19	2	2	5	1	4	1	334
	60-100	89	27	5	3	-	3	-	-	-	127
	110-200	50	22	2	1	-	4	-	-	-	79
	>200	1	6	1	1	-	1	-	-	-	10
Wollombi Brook	0-50	16	3	1	-	-	1	-	-	1	22
	60-100	163	49	7	-	2	2	-	1	5	229
	110-200	16	10	-	-	-	-	-	-	-	26
	>200	11	6	1	-	-	-	-	-	-	18
Site 13	110-200	88	65	1	-	1	-	-	1	1	157

Data on the distribution of raw materials across the study area in relation to landforms is given on Table D-52 and shown on Figure D-52. In the north-west area silcrete is least frequent on crests and most frequent on flats. In the North Wambo Creek valley silcrete in most frequent on waning lower slopes. Indeed, in the western part of North Wambo Creek 22% of artefacts on waning lower slopes are of silcrete, which is a relatively high frequency for this part of the study area.

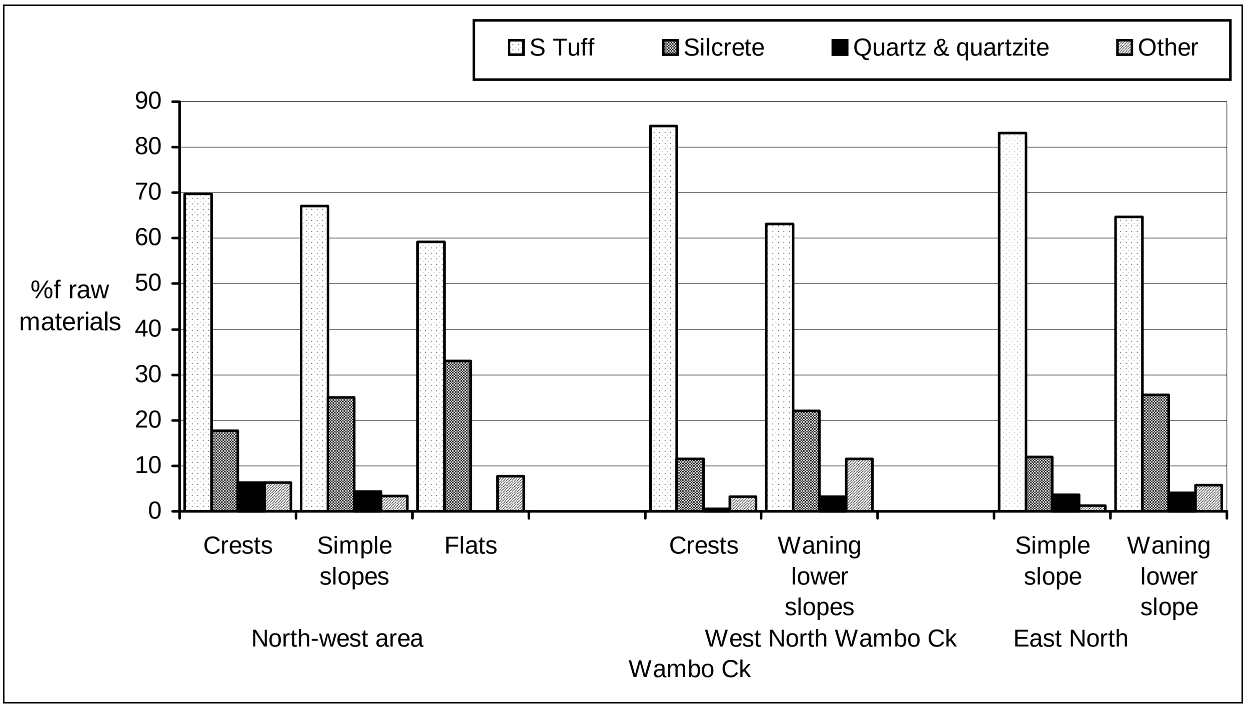
Raw material use varies across the study, probably varying in relation to distance from silcrete sources, but towards the western end of North Wambo Creek it seems that access to, or use of, silcrete was constrained by some kind of social barrier.

The data from within each part of the study area also indicates that there were subtle shifts in raw material use in relation to landscape variables such as stream order, distance from water and landforms. These variations point to differences in the way stone technology was organised in relation to peoples' day-to-day use of the landscape. In the north-west part of the study area and along North Wambo Creek (where sample sizes are larger) people tended to use more silcrete on sites associated with larger creeks and on landforms such as waning lower slopes or flats fairly close to water. They used relatively less silcrete on sites associated with smaller creeks, locations further from water, and landforms such as crests and simple slopes above or away from larger creeks. It seems that people carried little silcrete with them when they walked into the hinterland away from larger creeks. In the hinterland, stone supplies were sometimes augmented by use of locally available materials such as quartz and quartzite.

Table D-52
Raw Materials and Landforms

Area	Landform	S Tuff	Silcrete	Quartz	Quartzite	P. Wood	FGS	Glass	Igneous	Other	Total artefacts
North-west area	Crest ridge top	39	7	4	2	-	5	-	1	3	61
	Crest	95	27	5	1	-	1	-	2	-	131
	Waxing upper slope	38	20	2	3	1	-	-	1	-	65
	Simple slope	139	52	7	2	-	2	1	4	-	207
	Maximal upper slope	4	-	1	-	-	-	-	-	1	6
	Waning mid slope	7	2	-	-	-	-	-	-	-	9
	Waning lower slope	38	31	4	1	-	5	-	-	4	83
	Flat	61	34	-	-	-	-	-	8	-	103
	Depression	2	2	1	-	-	-	-	-	-	5
West North Wambo Ck	Crest	133	18	1	-	1	3	-	-	1	157
	Simple slope	50	4	3	-	-	-	-	2	4	63
	Maximal upper slope	5	1	-	-	-	-	-	-	-	6
	Waning mid slope	12	-	-	-	2	-	-	-	-	14
	Waning lower slope	60	21	2	1	3	-	-	4	4	95
	Flat	10	1	-	-	-	-	-	-	-	11
	Depression	6	-	-	-	-	1	-	-	-	7
East North Wambo Ck	Crest	36	9	1	2	-	-	-	-	2	50
	Simple slope	202	29	8	1	-	1	-	-	2	243
	Waning lower slope	205	81	7	6	6	4	-	6	2	317
	Flat	30	11	3	-	-	-	-	1	-	45
	Depression	3	-	-	-	-	-	-	-	-	3
Wambo Ridge	Crest ridge top	35	10	2	2	-	-	-	-	-	49
	Maximal upper slope	1	-	-	-	-	-	-	-	-	1
Wambo & Stony Cks	Crest ridge top	-	-	1	-	-	-	-	-	-	1
	Crest	206	71	19	4	2	9	-	4	1	316
	Simple slope	43	11	5	-	-	3	-	-	-	62
	Minimal mid slope	57	19	1	3	-	-	-	-	-	80
	Waning mid slope	-	-	-	-	-	1	-	-	-	1
	Waning lower slope	28	8	-	-	-	-	-	-	-	36
	Flat	35	12	-	-	-	-	1	-	-	48
	Depression	1	4	1	-	-	-	-	-	-	6
Wollombi Brook	Crest	181	59	8	-	2	3	-	1	5	259
	Simple slope	15	8	1	-	-	-	-	-	-	24
	Minimal mid slope	1	-	-	-	-	-	-	-	-	1
	Waning lower slope	1	-	-	-	-	-	-	-	1	2
	Flat	9	2	-	-	-	-	-	-	-	11
Site 13	Crest	88	65	1	-	1	-	-	1	1	157

Figure D-52
Raw Materials and Landforms by % Frequency



In the southern part of the study area along Wambo and Stony Creeks and along Wambo Ridge these trends do not occur. Silcrete seems to have been used equally, regardless of landscape setting. Silcrete was carried to sites distant from water and discarded in similar frequencies on sites associated with both large and very small creeks. One possible explanation for this is that sites distant from water and associated with small creeks were not necessarily occupied as 'hinterland' to larger domestic areas. Such sites may have been occupied in part by people travelling through the southern part of the study area on long-distance trips into the higher sandstone country, carrying silcrete with them.

As an adjunct to these findings it can be noted that the relative frequencies of various raw material types also vary in relation to the numbers of artefacts at sites in the north-west part of the study area and along the eastern part of North Wambo Creek (Table D-53 and Figure D-53). In these two areas (where sample sizes are larger) it seems that silcrete was used relatively more frequently at larger sites than at smaller sites. Quartz and quartzite was used a little more frequently at smaller sites than larger sites. Small sites may have resulted from limited discard during activities in the hinterland of larger sites, so these findings can be expected based on the previous analyses of raw material distribution in the landscape. Again, however, the southern part of the study area (including Wambo and Stony Creeks and Wambo Ridge) differs. Here, silcrete occurs in similar proportions regardless of site size. Quartz is more frequent amongst sites with 15-49 artefacts, reflecting the strong use of this raw material type at Site 76.

Figure D-53
Raw Materials and Site Size by % Frequency

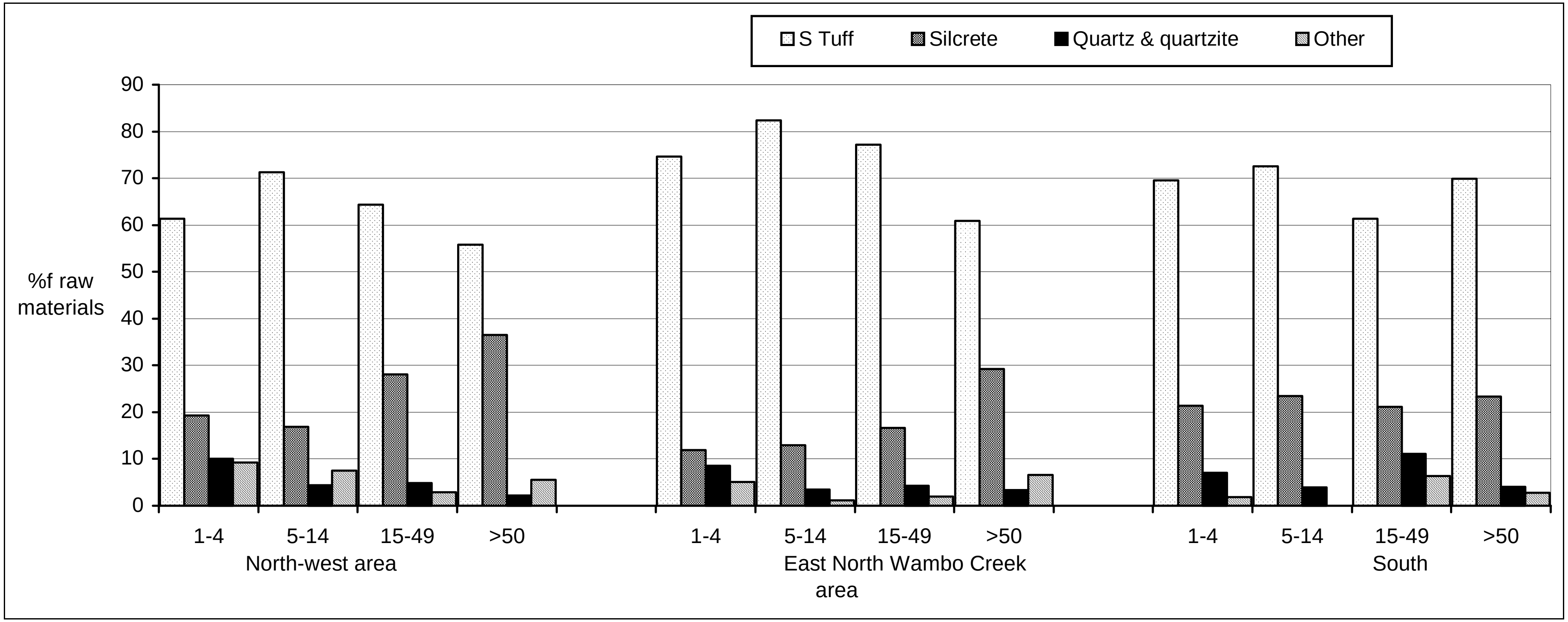


Table D-53
Raw Materials and Site Size

Area	Site size	S. Tuff	Silcrete	Quartz	Quartzite	P. Wood	FGS	Glass	Other	Igneous	Total artefacts
North-west area	1-4	73	23	11	1	-	1	1	6	3	119
	5-14	114	27	3	4	-	11	-	1	-	160
	15-49	135	59	7	3	1	1	-	1	3	210
	>50	101	66	3	1	-	-	-	-	10	181
West North Wambo Ck	1-4	22	4	-	-	-	1	-	6	-	33
	5-14	54	10	1	-	3		-	-	1	69
	15-49	34	3	3	-	-		-	1	2	43
	>50	166	28	2	1	3	3	-	2	3	208
East North Wambo Ck	1-4	44	7	4	1	-	-	-	3	-	59
	5-14	70	11	3	-	-	1	-	-	-	85
	15-49	233	50	11	2	1	2	-	1	2	302
	>50	129	62	1	6	5	2	-	2	5	212
South (Wambo Ck, Stony Ck & Wambo Ridge)	1-4	39	12	4	-	-	1	-	-	-	56
	5-14	37	12	1	1	-		-	-	-	51
	15-49	105	36	17	2	-	8	1	-	2	171
	>50	225	75	7	6	2	4	-	1	2	322
Wollombi Brook	1-4	15	4	2	-	-	1	-	1	-	23
	5-14	9	1	-	-	-	-	-	-	-	10
	15-49	37	18	-	-	-	-	-	4	-	59
	>50	146	46	7	-	2	2	-	1	1	205
Site 13	>50	88	65	1	-	1	-	-	1	1	157

D9.5.3 Cortex on Silicified Tuff and Silcrete

Cortex on artefacts has been used as one indication of intensity of stone flaking (reduction). In theory, artefacts with extensive cortex will have come from the outside part of a cobble and will have been removed early in a reduction sequence. Artefacts without cortex will have come from stone inside a cobble and will therefore have been removed later in a reduction sequence. For this set of analyses silicified tuff and silcrete have been used as these materials have the largest numbers of artefacts. Data on cortex has been inconsistently recorded during the various projects which this analysis uses, so only two categories of cortex are used here: present or absent.

Data on the distribution of cortex on silicified tuff artefacts is given on Table D-54. Some large-scale variation in the relative frequencies of cortical artefacts is evident with the highest frequency (38%) occurring in the north-west part of the study area, followed closely by the west end of North Wambo Creek (35%). The lowest frequencies of cortical silicified tuff artefacts are in the east part of North Wambo Creek catchment (27%) and in the Wambo and Stony Creek catchments (22%). It can be noted that the highest frequencies of cortical silicified tuff occur closest to the Hunter River (the primary source of this raw material type) and the lowest frequencies of cortical silicified tuff occur in areas furthest from the Hunter River.

Table D-54
Distribution of Cortical Silicified Tuff Artefacts

Area	Stream Order	No cortex	Cortex present	Total S. Tuff	% with cortex	% with cortex
North-west area	1st	123	79	202	39.1	38.4%
	2nd	89	52	141	36.9	
	3rd	48	31	79	39.2	
West North Wambo Ck	1st	34	11	45	24.4	35.5%
	2nd	21	8	29	27.6	
	3rd	5	6	11	-	
	4th+	116	72	188	38.3	
East North Wambo Ck	1st	72	23	95	24.2	26.7%
	2nd	142	52	194	26.8	
	3rd	1	1	2	-	
	4th+	134	51	185	27.6	
Wambo Ridge	1st	23	13	36	(36.1)	-
Wambo & Stony Creeks	1st	17	13	30	(43.3)	21.6%
	4th+	269	66	335	19.7	
Wollombi Brook	All	136	70	206	34.0	34.0%
Site 13	Wollombi Brook	61	27	88	30.7	30.7%

In different parts of the study sufficient numbers of silicified tuff artefacts to enable analyses of cortex in relation to stream order have been recorded for some stream orders in the north-west area and in the eastern end of North Wambo Creek. In the north-west area there is little difference in the incidence of cortical silicified tuff in relation to different stream orders, varying from 37-39% of recorded artefacts. In the eastern end of the North Wambo Creek catchment there is some slight variation in the incidence of cortex, with 24% of silicified tuff artefacts associated with 1st order streams having cortex, which increases to 27% at sites associated with 2nd order streams and 28% on sites associated with 4th+ order streams. This latter set of data suggests some slight use of rationing strategies in relation to stream order.

There are too few silcrete artefacts to confidently analyse the distribution of cortical artefacts in relation to stream orders within different parts of the study area. Overall, however, the highest frequencies of cortical silcrete artefacts occur at sites and in areas closest to the known silcrete sources. That is, the north-west area (16%), Wollombi Brook sites (16%) and Site 13 (which is closest to a silcrete quarry) has the highest frequency (22%). Wambo and Stony Creeks have the lowest frequency of cortical silcrete (9%) (Table D-55) and these catchments are most distant from the known silcrete sources.

Table D-55
Distribution of Cortical Silcrete Artefacts in Various Catchments

Area	No cortex	Cortex present	Total silcrete	% silcrete with cortex
North-west area	147	28	175	16.0%
West North Wambo Ck	40	5	45	-
East North Wambo Ck	111	19	130	14.6%
Wambo Ridge	10	-	10	-
Wambo & Stony Creeks	112	11	123	8.9%
Wollombi Brook	57	11	68	(16.2%)
Site 13	50	14	64	(21.9%)

D9.5.4 Artefact Size

Data on the distribution of artefacts by size is given on Table D-56 and shown graphically on Figure D-54. Overall, artefacts from sites in the north-west part of the study area and near Wollombi Brook tend to be the largest in size, with half of those recorded (50%) being more than 3cm in size; although this generalization does not include Site 13 where only 27% of recorded artefacts are more than 3cm in size. Artefacts from Wambo Ridge and from Wambo and Stony Creeks tend to be small in size, with none of the artefacts found being more than 10cm in size, and only 28-32% being more than 3cm in size. Apart from Site 13 it appears that artefact size could be related to distance from stone sources along the Hunter River (sites in the north-west area and near Wollombi Brook being closer to the stone sources and Wambo and Stony Creeks and Wambo Ridge being furthest away).

Table D-56
Artefact Size in Each Catchment

Area	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**>10**	**Total artefacts**
North-west area	10	111	221	139	80	92	11	664
West North Wambo Ck	14	108	101	47	35	35	10	350
East North Wambo Ck	21	157	234	122	61	56	4	655
Wambo Ridge	2	17	15	7	5	4	-	50
Wambo & Stony Cks	40	176	184	83	26	34	-	543
Wollombi Brook	7	69	73	69	32	41	5	296
Site 13	6	61	49	25	8	7	1	157

Data on the distribution of artefacts by size in relation to stream order is given on Table D-57 and shown graphically on Figure D-55. In the north-west part of the study area artefacts associated with 3rd order streams tend to be a little larger in size than those associated with smaller creeks. In the eastern part of North Wambo Creek catchment artefacts tend to be a little smaller at sites associated with 2nd order streams. In the southern part of the study area (Wambo and Stony Creeks and Wambo Ridge) artefacts tend to be smaller at sites associated with 4th+ order streams. The overall variation in artefact size between these three different areas is also evident on Figure D-54, with the southern area having the highest frequencies of artefacts 1-3 cm in size, regardless of stream order; and the north-west area having the lowest frequencies of artefacts 1-3 cm in size regardless of stream order.

Figure D-54
Artefact Size by % Frequency (artefacts >1cm only)

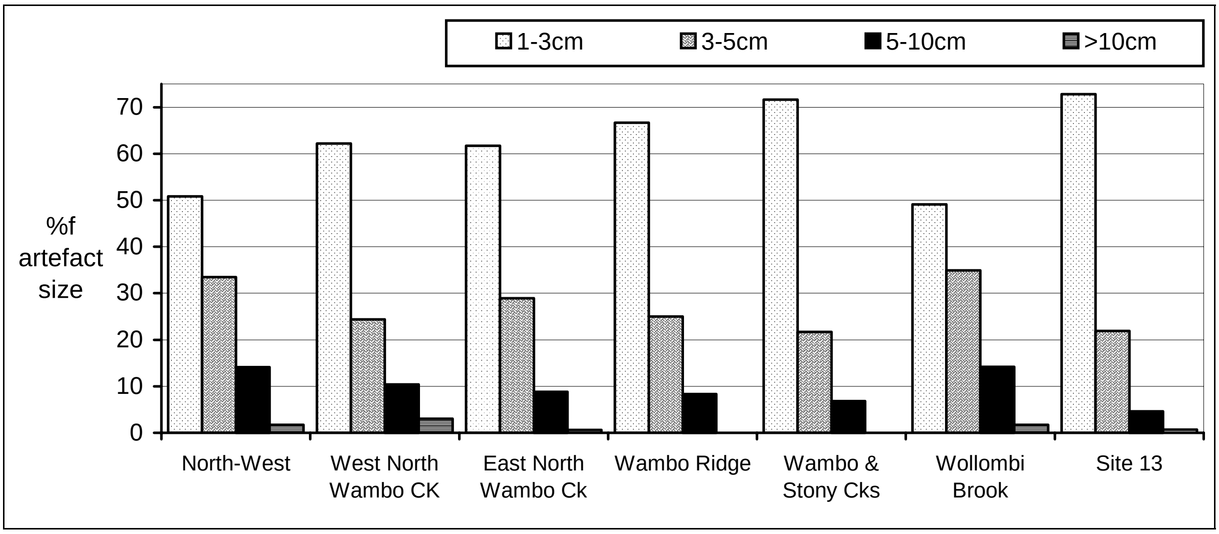
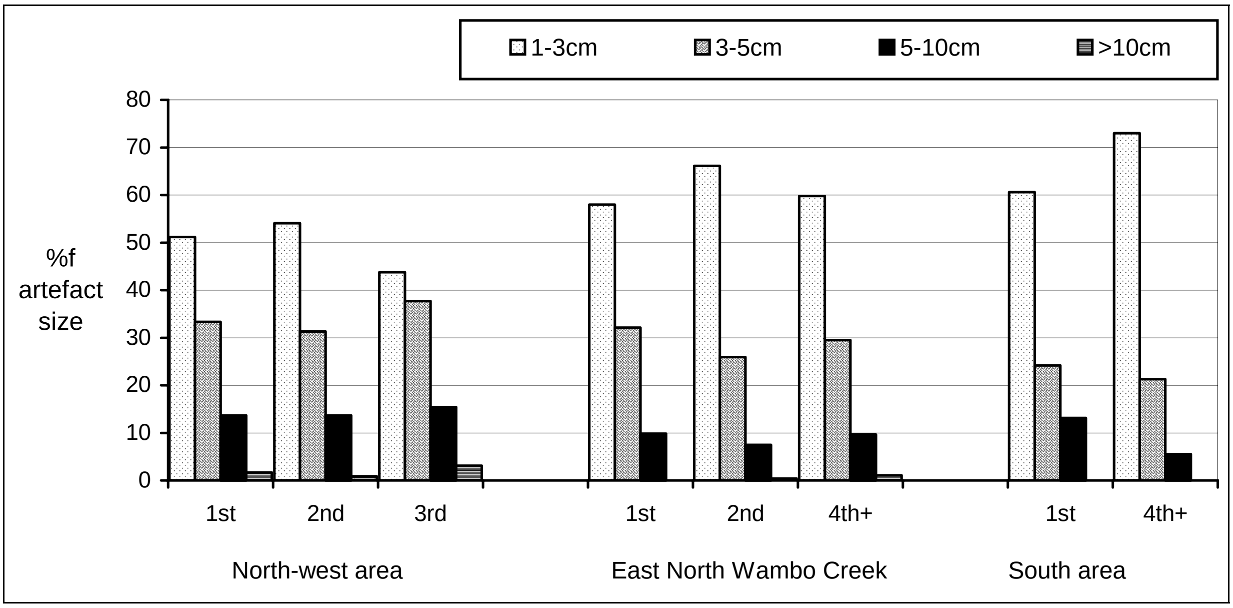


Table D-57
Artefact Size and Stream Order

Area	Stream Order	0-1	1-2	2-3	3-4	4-5	5-10	>10	Total artefacts
North-west area	1st	1	41	108	65	32	40	5	292
	2nd	4	43	83	43	30	32	2	237
	3rd	5	27	30	31	18	20	4	135
West North Wambo Ck	1st	-	18	17	11	4	3	2	55
	2nd	5	11	9	8	5	2	-	40
	4th+	9	78	66	26	23	26	8	236
East North Wambo Ck	1st	3	26	39	29	7	11	-	115
	2nd	12	63	95	40	22	18	1	251
	4th+	6	68	100	51	32	27	3	287
Wambo Ridge	1st	2	17	15	7	5	4	-	50
Wambo & Stony Creeks	1st	2	11	17	8	4	9	-	51
	4th+	38	165	167	75	22	25	-	492

The working model for the present study area is that people will have carried small light-weight tools away from domestic areas into the hinterland. In theory, sites associated with 1st order creeks should have smaller artefacts and sites associated with larger creeks at which domestic activities were carried out, and at which raw materials might have been stockpiled, should have had larger artefacts. Only in the north-west part of the study area is there some slight support for this theoretical distribution. Elsewhere, when samples are large enough for consideration, no clear trends are evident, or in the case of the southern part of the study area, the opposite trend in artefact size occurs; i.e. artefacts associated with 1st order creeks tend to be relatively larger than those associated with larger creeks.

Figure D-55
Artefact Size and Stream Order by % Frequency (artefacts >1cm only)



D9.5.5 Artefact Types

A fairly wide range of modified artefact types have been recorded in the study area, including a grindstone on a 2nd order stream in the North Wambo Creek catchment, an axes and fragments from two others, a couple of hammer-stones, five Bulga knives, cobble tools, and an array of flake tools, cores and backed artefacts. Unfortunately, artefact types which are quite rare are vulnerable to sample size affects (Leonard and Jones 1989). That is, the more total artefacts there are in a sample the more likely it is that rare items will be included. On Table D-58 the two smallest assemblages, with 50 and 157 artefacts each, have fewer artefact types than the larger assemblages. No single area has the full range of artefact types identified during the study. This means that analysis of the distribution of artefact types can only be carried out confidently at a summary level.

Here it can be noted that the southern part of the study area – Wambo and Stony Creeks and Wambo Ridge – has a relatively low frequency of cobble tools at just 0.3% of artefacts, despite about 600 artefacts having been recorded (Table D-59). This area also has the lowest frequency of cores, with just 4%, and the highest frequency of small tools with 13%. These results point to the use of stone rationing strategies with few large items, reduced discard of cores and more use of small tools.

The north-west part of the study area has the lowest frequency of backed artefacts, with just 0.3%.

Data on the distribution of artefact types in relation to stream order is given on Table D-60 and summarised on Table D-61. The largest numbers of artefacts have been recorded in association with 4th+ order streams, and a wide range of artefact types from 4th+ order streams could reflect the larger sample of artefacts. Of note, however, is that the single grindstone was found on a 2nd order creek, and axes have been recorded from 1st and 2nd order streams, and from Wollombi Brook, but not yet from 4th+ order streams. Based on artefact recording to date it seems that 4th+ order streams may not be the most frequent location of discard for all artefact types. Further, grindstones tend to be thought of as being left in residential contexts or in frequently revisited places (Gould 1980; Hamilton 1987). The presence of the grindstone on the 2nd order creek indicates that small creeks as well as large creeks were used for residential use, or that domestic activities may have been carried out in other social contexts or other landscape settings.

Other variations in artefact types also occur in relation to stream order (Tables D-60, D-61). Overall, cobble tools tend to be a little more frequent in association with 1st order creeks (1.2%) than larger creeks (≤0.9%). Backed artefacts are least frequent on 1st order creeks (0.7% compared to ≥1.1% for other stream orders). Cores are least frequent on 4th+ order creeks (4.4% compared to ≥7.2%). Bulga knives have been found only along North Wambo Creek.

Data on the distribution of artefact types in relation to altitude is given on Table D-62 and summarised on Table D-63. Cobble tools are relatively more frequent above 95m AHD where they make up 1.2% or more of artefacts. Below 95 m AHD cobble tools make up just 0.5% or less of assemblages. Small tools are least frequent above 125 m AHD (2.3%) and more frequent below 95 m AHD (6-12%). No backed artefacts have been found above 125 m AHD.

Data on the distribution of artefact types in relation to landforms is given on Table D-64. More than 100 artefacts have been recorded on only five landform types and these assemblages are summarised by % frequency on Table D-65. Ridge top crests have relatively high frequencies of axes, cobble tools and other pieces of cobbles; and relatively low frequencies of small tools and cores. Ridge top crests and simple slopes also have relatively low frequencies of medium-sized tools and backed artefacts. Waning lower slopes and flats have the lowest rates of unmodified debitage, and flats have the highest relative frequency of backed artefacts.

Data on the occurrence of artefact types in relation to site size is given on Table D-66. Isolated finds as a group have the highest rate of modified types; unmodified debitage making up just two-thirds (65%) of the artefacts. Cobble tools, cobble pieces, small tools, and cores are relatively more frequent than amongst other larger sites. And two backed artefacts have been found as isolated finds making this type also relatively frequent. These artefact types all occur on larger sites, but they show relatively high rates of discard as isolated finds.

Table D-58
Artefact Types, Arranged in Order of Sample Size (total artefacts)

Area	Anvil / grindstone	Hammer /anvil	Axe & flake	Bulga knife	Cobble tool & tools >10cm	Cobble core-tool	Medium tool	Small tool	Core	Core-tool	Retouched artefacts	Backed artefacts	Cobble	Debitage	Total artefacts
Wambo Ridge	-	-	-	-	-	-	-	3	1	-	-	1	-	45	50
Site 13	-	-	1	-	-	-	1	2	6	-	-	2	-	145	157
Wollombi Brook	-	1	1	-	2	-	7	12	28	1	2	3	3	237	297
West North Wambo Ck	-	-	-	3	5	-	6	7	15	2	2	7	3	299	349
Wambo & Stony Cks	-	-	-	-	2	-	9	72	22	1	1	8	1	433	549
East North Wambo Ck	1	1	-	2	5	2	8	56	49	-	-	8	-	526	658
North-west area	-	-	1	-	9	-	11	24	55	2	3	2	3	560	670

Table D-59
Distribution of Artefact Types by % Frequency

Area	Anvil / grindstone	Hammer /anvil	Axe & flake	Bulga knife	Cobble tool & tools >10cm	Cobble core-tool	Medium tool	Small tool	Core	Core-tool	Retouched artefacts	Backed artefacts	Cobble	Debitage	Total artefacts
North-west area	-	-	0.2	-	1.3	-	1.6	3.6	8.2	0.3	0.5	0.3	0.5	83.6	670
West North Wambo Ck	-	-	-	0.9	1.4	-	1.7	2.0	4.3	0.6	0.6	2.0	0.9	85.7	349
East North Wambo Ck	0.2	0.2	-	0.3	0.8	0.3	1.2	8.5	7.5	-	-	1.2	-	79.9	658
Wambo & Stony Cks & Wambo Ridge	-	-	-	-	0.3	-	1.5	12.5	3.8	0.2	0.2	1.5	0.2	79.8	599
Wollombi Brook	-	0.3	0.3	-	0.7	-	2.4	4.0	9.4	0.3	0.7	1.0	1.0	79.8	297

Table D-60
Artefact Types and Stream Order

Stream Order	Anvil / grindstone	Hammer /anvil	Axe & flake	Cobble tool	Cobble Core-tool	Bulga knife	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
1st	-	-	1	7	1	-	-	6	24	3	41	2	4	480	4	573
2nd	1	-	1	5	-	-	-	10	39	-	47	2	8	426	-	539
3rd	-	-	-	2	-	-	-	4	7	-	11	-	-	130	-	154
4th+	-	1	-	7	1	5	1	14	92	2	45	3	14	834	3	1022
Wollombi Brook	-	1	1	1	-	-	-	8	14	1	32	1	5	375	3	442

Table D-61
Artefact Types and Stream Order by % Frequency

Stream Order	Anvil / grindstone	Hammer /anvil	Axe & flake	Cobble tool	Cobble Core-tool	Bulga knife	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
1st	-	-	0.2	1.2	0.2	-	-	1.1	4.2	0.5	7.2	0.4	0.7	83.8	0.7	573
2nd	0.2	-	0.2	0.9	-	-	-	1.9	7.2	-	8.7	0.4	1.5	79.0	-	539
4th+	-	0.1	-	0.7	0.1	0.5	0.1	1.4	9.0	0.2	4.4	0.3	1.4	81.6	0.3	1,022
Wollombi Brook	-	0.2	0.2	0.2	-	-	-	1.8	3.2	0.2	7.2	0.2	1.1	84.8	0.7	442

Table D-62
Artefact Types and Altitude

Altitude AHD	Anvil / grindstone	Hammer /anvil	Axe & flake	Cobble Core-tool	Cobble tool	Bulga knife	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
175-225	-	-	-	-	2	-	-	1	-	-	2	-	-	42	2	49
145-174	-	-	1	-	2	-	-	3	2	1	12	2	-	139	1	163
125-144	-	-	-	-	1	-	-	2	6	1	12	1	-	113	-	136
95-124	-	-	-	1	10	-	-	11	41	2	55	3	14	690	3	830
75-94	1	-	-	-	2	5	1	9	63	-	42	-	8	403	-	534
55-74	-	2	2	1	5	-	-	16	64	2	53	2	9	858	4	1018

Table D-63
Artefact Types and Altitude by % Frequency

Altitude AHD	Anvil / grindstone	Hammer /anvil	Axe & flake	Cobble Core-tool	Cobble tool	Bulga knife	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
>125m	-	-	0.3	-	1.4	-	-	1.7	2.3	0.6	7.5	0.9	-	84.5	0.9	348
95-124	-	-	-	0.1	1.2	-	-	1.3	4.9	0.2	6.6	0.4	1.7	83.1	0.4	830
75-94	0.2	-	-	-	0.4	0.9	0.2	1.7	11.8	-	7.9	-	1.5	75.5	-	534
55-74	-	0.2	0.2	0.1	0.5	-	-	1.6	6.3	0.2	5.2	0.2	0.9	84.3	0.4	1,018

Table D-64
Artefact Types and Landforms

Landform	Anvil / grindstone	Hammer /anvil	Axe & flake	Bulga knife	Cobble tool	Cobble core-tool	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
Crest ridge top	-	-	1	-	3	-	-	1	4	-	6	1	1	91	3	111
Crest	-	2	1	-	3	1	-	17	54	3	58	4	12	911	4	1070
Simple slope	1	-	-	3	2	-	-	5	37	1	43	-	3	499	1	595
Waxing upper slope	-	-	-	-	-	-	-	2	-	-	3	-	-	60	-	65
Maximal upper slope	-	-	-	-	-	-	-	-	-	-	1	-	-	12	-	13
Minimal mid slope	-	-	-	-	-	-	-	3	16	-	-	-	1	61	-	81
Waning mid slope	-	-	-	-	1	-	-	-	2	1	2	1	-	17	-	24
Waning lower slope	-	-	1	2	9	1	1	9	53	-	39	2	7	406	2	532
Flat	-	-	-	-	4	-	-	5	10	1	19	-	7	172	-	218
Depression	-	-	-	-	-	-	-	-	-	-	5	-	-	16	-	21

Table D-65
Artefact Types and Landforms by % Frequency

Landform	Anvil / grindstone	Hammer /anvil	Axe & flake	Bulga knife	Cobble tool	Cobble core-tool	Large tool	Medium tool	Small tool	Core-tool	Core	Retouched artefact	Backed artefact	Debitage	Cobble	Total artefacts
Crest ridge top	-	-	0.9	-	2.7	-	-	0.9	3.6	-	5.4	0.9	0.9	82.0	2.7	111
Crest	-	0.2	0.1	-	0.3	0.1	-	1.6	5.1	0.3	5.4	0.4	1.1	85.1	0.4	1,070
Simple slope	0.2	-	-	0.5	0.3	-	-	0.8	6.2	0.2	7.2	-	0.5	83.9	0.2	595
Waning lower slope	-	-	0.2	0.4	1.7	0.2	0.2	1.7	10.0	-	7.3	0.4	1.3	76.3	0.4	532
Flat	-	-	-	-	1.8	-	-	2.3	4.6	0.5	8.7	-	3.2	78.9	-	218

Table D-66
Artefact Types and Site Size

a. Numbers of Artefacts						b. By % Frequency				
Artefact Type	**1**	**2-4**	**5-14**	**15-49**	**>50**	**% 1**	**% 2-4**	**% 5-14**	**% 15-49**	**%>50**
Anvil / Grindstone	-	-	-	1	-	-	-	-	*0.1*	-
Hammer /anvil	-	-	-	2	-	-	-	-	*0.3*	-
Axe & flake	-	2	-	-	1	-	*1.1*	-	-	*0.1*
Bulga knife	-	3	-	-	2	-	*1.7*	-	-	*0.2*
Cobble core-tool	-	-	1	1	-	-	-	*0.3*	*0.1*	-
Cobble tool	6	4	2	1	9	*5.6*	*2.2*	*0.5*	*0.1*	*0.7*
Large tool	-	-	-	-	1	-	-	-	-	*0.1*
Medium tool	1	6	7	10	18	*0.9*	*3.3*	*1.9*	*1.3*	*1.4*
Small tool	11	5	17	38	105	*10.3*	*2.8*	*4.5*	*4.9*	*8.2*
Core-tool	-	1	1	1	3	-	*0.6*	*0.3*	*0.1*	*0.2*
Core	14	12	23	53	74	*13.1*	*6.6*	*6.1*	*6.8*	*5.8*
Retouched artefacts	-	3	-	2	3	-	*1.7*	-	*0.3*	*0.2*
Backed artefacts	2	-	7	10	12	*1.9*	-	*1.9*	*1.3*	*0.9*
Debitage	70	145	317	659	1054	*65.4*	*80.1*	*84.5*	*84.3*	*82.0*
Cobble manuports	3	-	-	4	3	*2.8*	-	-	*0.5*	*0.2*
Total artefacts	**107**	**181**	**375**	**782**	**1,285**	**107**	**181**	**375**	**782**	**1,285**

Data on the raw materials of various artefact types is given on Table D-67. Of note is the presence of the grindstone, two hammers, three axes, five "Bulga knives", and 11 unworked cobble manuports or pieces (four of which are of silicified tuff). A total of 22 flaked cobble tools are of a variety of raw material types.

Table D-67
Artefact Types and Raw Materials

Artefact Type	**S Tuff**	**Silcrete**	**Quartz**	**P Wood**	**Glass**	**FGS**	**Quartzite**	**Igneous**	**Other**	**Total artefacts**
Anvil Grindstone	-	-	-	-	-	-	-	-	1	1
Hammer/anvil	-	-	-	-	-	-	1	-	1	2
Axe & fragments	-	-	-	-	-	-	-	1	2	3
Bulga knife	-	-	-	-	-	-	-	-	5	5
Cobble	4	-	-	-	-	-	1	2	4	11
Cobble tool	5	-	-	-	-	1	3	5	8	22
Cobble Core-tool	2	-	-	-	-	-	-	-	-	2
Large tool >10cm	-	1	-	-	-	-	-	-	-	1
Medium tool	26	10	-	1	-	-	3	2	-	42
Small tool	146	22	2	2	2	1	1	-	-	176
Core-tool	6	-	-	-	-	-	-	-	-	6
Core	103	54	6	-	-	6	5	2	1	177
Retouched	6	2	-	-	-	-	-	-	-	8
Backed artefacts	21	9	-	-	-	1	-	-	-	31
Debitage	1,566	521	80	15		29	14	23	8	2,256
Total	1,885	619	88	18	2	38	28	35	30	2,743

As noted above silicified tuff is the most common raw material type (69%) and this raw material dominates debitage (69%), large medium and small flaked tools (79%), cores (60%) and backed artefacts (68%) (but not cobble tools, at 29%). The proportion of flaked tools of this raw material type is much higher than the proportion of cores indicating that the rate of flaked tool production was relatively high for this raw material.

The equivalent frequencies for silcrete are 23% of artefacts overall, 23% debitage, but 15% for flaked tools, 31% cores, and 29% for backed artefacts. In contrast to silicified tuff the proportion of flaked tools of silcrete is lower than the proportion of cores indicating a lower rate to flake tool production using this raw material type.

For both silicified tuff and silcrete the proportions of backed artefacts are similar to the proportions of the raw materials overall.

D9.5.6 Knapping Floors

Analysis of the distribution of artefact types carried out in Section D9.5.5 found that backed artefacts tend to be found below 125 m AHD, along North Wambo Creek and in the southern part of the study area, in association with 2nd order and larger creeks, and on crests, waning lower slopes and creek flats. No backed artefacts were found above 125 m AHD and only two were found in the north-west part of the study area. Backed artefacts are infrequently associated with 1st order creeks and simple slopes.

Backed artefacts were usually made on knapping floors (locations where stone was systematically flaked). A total of 12 knapping floors have now been found within the Wambo study area (Table D-68). In the north-west part of the study area two knapping floors have been found, at Site 291 on Waterfall Creek, and at Site 287 on a tributary of Waterfall Creek. One knapping floor has been found on the western end of North Wambo Creek at Site 159. The remaining knapping floors have been found in the eastern part of the North Wambo Creek catchment. That at Site 97 appears to be a multiple activity area involving flaking of various raw material types, with systematic flaking of silicified tuff and heat treated silcrete.

The knapping floors are generally located close to water with Site 121 including a widespread of artefacts extending away from the creek bank. Two knapping floors are associated with 1st order creeks but most are found along larger creeks. A concentration of knapping floors close to larger creeks, or waterholes on small creeks, has previously been noted for the Hunter Valley (eg. at Narama, by Rich 1992b).

If most knapping floors date to the Middle Bondaian period, then the site occupation strategy at that time might have included a focus near creek banks, but without preference for either 2nd order or 4th+ order creeks (5 and 4 knapping floors respectively).

Table D-68
Knapping Floors

Area	Stream Order	Distance to water	Landform	S Tuff	S Tuff & Silcrete	Silcrete	Total knapping floors	Sites
North-west area	1st	0-50	Simple slope	1	-	-	1	287
	3rd	0-50	Flat		-	1	1	291
West North Wambo Ck	2nd	0-50	Simple slope	1	-	-	1	159
East North Wambo Ck	1st	0-50	Simple slope	1	-	-	1	115
	2nd	0-50	Simple slope	2	-	1	3	102
	2nd	0-50	Flat	-	1	-	1	97
	4th+	0-50	Waning lower slope	1	-	2	3	101, 111
	4th+	100		1	-	-	1	121

D9.5.7 Summary

There is evidence that artefact assemblages vary across the study area at two different spatial scales. Firstly, raw materials, artefact size and artefact types vary in different parts of the study area. Secondly, where there are sufficient numbers of recorded artefacts (sample sizes) assemblages vary within these smaller areas in relation to landscape settings such as stream order, distance from water and landforms, and in relation to site size.

Larger scale variation:

- The distribution of raw material types varies across the study area. Silcrete is most frequent (41%) at the eastern end of the rail spur on Site 13a (also known as Site WB20a), and least frequent in the western part of the catchment of North Wambo Creek (just 13%). Silcrete occurs naturally on terraces adjacent to the Hunter River north of the north-west part of the study area and east of the study area at Lemington south, less than 2 km from Site 13. It is likely that access to these silcrete sources has influenced raw material distributions within the study area. However, this is not the whole story because, firstly, it seems that silcrete used in the north-west part of the study area (including the catchment of Splitters Hollow) was not transported the extra few hundred metres down to the west end of North Wambo Creek, where only relatively low frequencies of silcrete were found. Secondly, the main source of silicified tuff also occurs along the Hunter River but this raw material type is strongly dominant across the study area. Thirdly, Stony Creek and Wambo Creek are as distant (or more so) from the known silcrete sources as is North Wambo Creek but Stony and Wambo Creek catchments have higher frequencies of silcrete (22-25%). Indeed the frequencies of silcrete in these two catchments are similar to the frequency of silcrete in proximity to Wollombi Brook (excluding Site 13). This suggests that people carried relatively more silcrete into Wambo and Stony Creek catchments via Wollombi Brook. The fairly small assemblage from Wambo Ridge (separating North Wambo and Stony Creeks) has a frequency of silcrete (20%) similar to that along the eastern end of North Wambo Creek. This ridge forms one of three possible access routes into the mountains around Stony and Wambo Creeks. It could be suggested that people have taken silcrete from the Wollombi Brook area into the mountains via Wambo and Stony Creeks, and along this and perhaps other ridges. Investigations in the higher sandstone country and in the adjoining Wollemi National Park would be of interest in this regard.
- Silcrete artefacts with cortex tend to be more frequent in the north-west part of the study area (20%) and along Wollombi Brook (18%); areas which are closer to silcrete sources. Silcrete artefacts with cortex are least frequent in the Wambo and Stony Creek catchments (9%). This decline in cortex is in keeping with increasing distance from sources and indicates the use of rationing strategies.
- Cortical silicified tuff varies from 38% in the north-west part of the study area, drops to 35% on the west end of North Wambo Creek, then down to 27% on the east end of North Wambo Creek, then to 22% on Wambo and Stony Creeks. This decline in cortical artefacts matches increased distance from the Hunter River and its sources of silicified tuff. Data on the distribution of cortical silicified tuff artefacts points to the use of rationing strategies across the study area for this raw material type.
- Artefact size varies across the study area at this large scale. In the north-west part of the study area and on sites close to Wollombi Brook (except Site 13) about half the surface artefacts are more than 3 cm in size. Only 28-32% of artefacts from Wambo Ridge and from Wambo and Stony Creek catchments are more than 3cm in size and none are more than 10cm in size. Again this points to more use of stone rationing in the southern parts of the study area.
- The relative frequencies of different artefact types also varies across the study area at this scale. In particular, backed artefacts are relatively rare in the north-west part of the study area, while small tools are relatively more frequent in the southern part of the study area (Wambo Ridge and Wambo and Stony Creeks); where cobble tools are rare.

Smaller scale variation is evident in the use of raw materials:

- In the north-west part of the study area and along the eastern part of North Wambo Creek silcrete is least frequent at sites associated with 1st order streams and becomes more frequent with increasing stream order (ie. as creeks become larger). Quartz and quartzite (locally occurring stone materials) are infrequent raw material types but tend to show the opposite trend with slightly higher frequencies at sites associated with 1st order creeks. However, the trend relating to silcrete was not observed in the southern part of the study area where silcrete was used equally on both 1st and 4th+ order creeks.

- In the north-west part of the study area and along the eastern part of North Wambo Creek silcrete is most frequent at sites within 50m of water and becomes less frequent with increasing distance from water. In the western end of North Wambo Creek this trend is not evident, perhaps because the frequency of silcrete is always relatively low. In the southern part of the study area silcrete is a little more frequent more than 100 m from water; ie. the opposite trend to that observed elsewhere in the study area.
- In the north-west part of the study area silcrete is most frequent on flats, and becomes less frequent on simple slopes and even less frequent on crests. In the western part of North Wambo Creek silcrete is more frequent on waning lower slopes than on crests, and in the eastern part of North Wambo Creek silcrete is more frequent on waning lower slopes than on simple slopes.
- In the north-west part of the study area and along the eastern part of North Wambo Creek silcrete is most frequent at larger sites and least frequent at small and very small sites. Quartz and quartzite tend to be a little more frequent at very small sites. In the southern part of the study area on Wambo and Stony Creeks and along Wambo Ridge silcrete occurs more-or-less equally regardless of site size. Most quartz occurs at Site 76, which is the largest site closest to the sandstone country.

Very detailed analysis of the landscape distribution of artefact types was not possible with the available recorded artefact samples. However, some indications of landscape variation is suggested by more general analyses:

- Cobble tools tend to be a little more frequent at sites associated with 1st order creeks than larger creeks. Backed artefacts are least frequent on 1st order creeks. Cores are least frequent on 4th+ order creeks. Bulga knives have been found only along North Wambo Creek.
- Cobble tools are relatively more frequent above 95 m AHD. Small tools are least frequent above 125 m AHD and more frequent below 95 m AHD. No backed artefacts have been found above 125 m AHD.
- Ridge top crests have relatively high frequencies of axes, cobble tools and other pieces of cobbles; and relatively low frequencies of small tools and cores. Ridge top crests and simple slopes also have relatively low frequencies of medium-sized tools and backed artefacts. Waning lower slopes and flats have the lowest rates of unmodified debitage, and flats have the highest relative frequency of backed artefacts.
- Isolated finds as a group have the highest rate of modified types. Cobble tools, cobble pieces, small tools, and cores are relatively more frequent amongst isolated finds than amongst other larger sites. Isolated finds include backed artefacts.

D9.6 DISCUSSION OF RESULTS

Archaeological evidence from the study area shows variation in human behaviour at two different spatial scales (and possibly other scales not investigated here).

Silicified tuff is predominant across the study area and appears to have been the preferred raw material type in all landscape settings. Silcrete however, has a more patchy distribution and it seems that access to this raw material type was shaped by factors other than just distance to the sources. There seems to have been some social reason for the low rate of import of silcrete onto the western end of North Wambo Creek; notable for the higher frequencies of this raw material type in the area immediately adjacent in the north-west part of the study area. The catchments of Waterfall Creek and Splitters Hollow have relatively high frequencies of silcrete at 28% and 24%, and are linked by a readily accessible pass through the high northern ridge; the fairly large Site 258-259 attests to the use of this pass. Despite this, relatively low frequencies of silcrete occur on adjacent sites on North Wambo Creek (just 12-14% at Sites 168, 169, 227, 228 and 233-239). If the people using Splitters Hollow also used this part of North Wambo Creek it seems that they brought little silcrete with them. And it may even be possible that the people who occupied Splitters Hollow did not occupy this part of North Wambo Creek.

Higher rates of silcrete in the Wambo and Stony Creek catchments indicate more transport of silcrete into that part of the study area. It is possible that this silcrete was obtained from sources to the north-east at South Lemington, rather than from sources to the north-west. It is possible that silcrete here may relate to use of that area during access into the mountains to the west. The silcrete which was taken into the southern part of the study area was subject to some stone rationing as artefacts here have relatively lower rates of cortex than silcrete artefacts elsewhere in the study area. Rationing strategies in the south are also evident in the higher frequencies of small tools and lower frequencies of large tools, lower debitage (waste discard) rates, and lower frequencies of silicified tuff artefacts with cortex.

There is evidence that different landscape settings within the study area were occupied in different ways. Analyses based on site size and average surface artefact density indicates that the largest sites and highest artefact densities occur at low elevations, particularly in association with 4th+ order streams and preferentially on slopes adjacent or above these. Small sites and lower artefact densities occur at all elevations and in association with all stream orders, but particularly associated with 1st order streams at higher elevations, on crests and simple slopes.

Are these small sites and low density locations simply smaller versions of larger sites, or do they different qualitatively from assemblages found on larger sites?

In Section D7.1.1 it was suggested that larger sites may have been occupied as residences and smaller sites might have resulted from activities carried out at off-site locations. In Section D7.1.4 it was suggested that mobility and portability constraints would have affected how people organised their use of technologies in such off-site activities, and that artefact assemblages would show evidence of stone rationing. If so, the assemblages from landscape settings used as off-site activity locations would be qualitatively different from those on residential sites. To address this issue assemblage data is summarised on Table D-69; though there is insufficient data to consider variation within the south area and Wollombi Brook and eastward.

Some variation between assemblages from different stream orders within each part of the study area is evident. In the north-west area, however, much of that variation does not conform to stone rationing strategies as defined in the literature. Only three of the eight variables are conclusively in favour of stone rationing, with four conclusively against rationing. In the North Wambo Creek catchment, however, five variables are in favour of stone rationing with only one against. Based on the surface evidence it seems that the North Wambo Creek assemblages generally fit the rationing model while the north-west assemblages do not.

Nightingale *et al.* (2002:27) suggest a general model of settlement organisation, in which residential sites were located along creeks – especially larger creeks – and that resource extraction would have been carried out at activity locations in the foraging area surrounding these residential sites (see Section D7.1.1). They argued that artefacts concentrated close to creeks would have resulted from the sequential positioning of residential sites over time, and that dispersed artefacts away from creeks, on ridgelines and in less domestically amenable areas would have resulted from activity locations.

Following a brief review of this model and analysis of sites within the context area it was concluded that the model proposed by Nightingale *et al.* (2002) is too general to usefully describe archaeological patterns and exceptions (Section D7.2.6). Analysis of the Wambo study area points to several behavioural processes which have influenced site distribution and the nature of stone artefact assemblages. These processes are discussed below.

<u>1. Day-to-day use of the landscape</u>

The Wambo study area contains much evidence for varying use of different landscape settings, evident in site size and artefact density data, and in the nature of stone artefact assemblages. Analyses are detailed in Sections D9.3, D9.4 and D9.5.

In the Wambo study area average artefact densities vary widely from high to low, and in some landscape settings they are so low as to be negligible. Variations in artefact density could be due to variation in the nature of artefact discard activities and the numbers of times discard activities were carried out. High average artefact densities point to intensive discard and/or multiple discard activities. The artefact density data discriminates between 1st, 2nd and 4th+ order streams[18] which points to variation in the nature and/or repetition of artefact discard activities. In short, landscape settings associated with 1st order streams have low average densities of surface artefacts (with exceptions discussed below), 2nd order streams have moderate average artefact densities within 100m of creek channels, while 4th+ order streams have high and/or fairly high average artefact densities within 100m of creek channels.

18 There are fewer artefacts and/or less exposure (smaller samples) from 3rd order streams and Wollombi Brook so these are not considered here.

Might these higher densities and wider spread of artefacts indicate increased use of areas associated with larger creeks, or might large and small creeks have actually been used in different ways? One possibility is that large residential camps were established along larger creeks with some hearth groups close to water and some further away. Smaller 2nd order creeks might have been used during resource extraction or processing tasks, for dinner-time sites, and/or for overnight stays by small groups of people. Locations around 1st order creeks, where average artefact densities are very low (with exceptions) might have been used primarily as resource extraction sites and processing sites, with occasional dinner-time use, and perhaps even limited overnight stays on odd occasions (as generally proposed by Nightingale *et al*. (2002)).

Analysis of artefact assemblages (raw materials and artefact types) indicate that variation in artefact density was not just a matter of more or fewer artefacts, but there is some qualitative variation between different kinds of landscape settings. The southern part of the study area and Wambo Ridge are exceptions and these are discussed below. The north west part of the study area and the eastern part of North Wambo Creek catchment have larger sample sizes in various landscape settings. For the north-west part of the study area silcrete is most frequent in association with 2nd and 3rd order creeks, and is least frequent on areas drained by 1st order creeks. For the eastern end of North Wambo Creek catchment silcrete is most frequent along the 4th+ order creek, declines in frequency along 2nd order creeks, and occurs in very low frequencies on areas drained by 1st order creeks. In both parts of the study area quartz and quartzite are more frequent along 1st order creeks than larger creeks.

In both the north-west part of the study area and along the eastern part of the North Wambo Creek catchment silcrete is most frequent within 50m of water then becomes less frequent with increasing distance from water. Quartz and quartzite show the opposite trend becoming more frequent with increasing distance from water.

Cobble tools tend to be a little more frequent on landscape settings associated with 1st order creeks, while backed artefacts are least frequent in these settings. Cores are least frequent on settings associated with 4th+ order creeks, while small tools (<5 cm in size) are most frequent. The single grindstone occurs on a 2nd order creek, perhaps used to process materials away from a residential area.

The survey data indicates that both quantitative and qualitative variation occurs in relation to different landscape settings and that variation is probably related to the way day-to-day foraging, hunting, processing and other domestic tasks were scheduled in the landscape.

In Section D7.1.4 it was suggested that mobility and portability constraints would have affected how people organised their use of technologies in various contexts, and that artefact assemblages would show evidence of stone rationing where stone was transported long distances and/or when it was transported from residential (or frequently used) sites to activity locations away from residential sites. To address this issue in terms of the discussion outlined in Section D7.1.4 assemblage data is summarised on Table D-69 where sample sizes are sufficiently large.

Some variation between assemblages from different stream orders within each part of the study area is evident. In the north-west area, however, much of that variation does not conform to stone rationing strategies as defined in the literature – only three of the eight variables are conclusively in favour of stone rationing, with four conclusively against rationing. In the North Wambo Creek catchment, however, five variables are in favour of stone rationing with only one against. Based on the surface evidence it seems that the North Wambo Creek assemblages generally fit the rationing model while the north-west assemblages do not.

<u>2. Change over time in use of the landscape</u>

In the absence of statistically useful artefact samples from dated contexts or large samples of flakes suitable for technological analysis (see Section D7.3) it is difficult to investigate potential for change over time in the use of the Wambo landscape.

It is known that the study area was used in the historic period, as two sites (62 and 207) have flaked glass tools and two others (Sites 17 and 31) have scatters of historic materials associated with stone artefacts and may also have been occupied in the historic period. The carved tree site (Site 2) was reportedly used in 1852. There is also a report that Aboriginal groups met in the historic period at the Greenhault house near Wollombi Brook. At this time, however, there is insufficient information to develop a land use strategy for the historic period.

Table D-69
Assessment of Rationing Strategies

Strategies	Indicators	North west area				North Wambo Ck				South area	Wollombi Brook & east
		1st	2nd	3rd	Criteria met?	1st	2nd	4th+	Criteria met?	4th+	4th+
1. Few types of small tools	a. No. of tool types	8	6	4	No	5	5	10	Yes	6	9
	b. Small tools	2.1%	5.0%	3.7%	No	3.1%	1.8%	2.4%	Yes	13.8%	3.2%
2. Use local stone	c. Quartz &	5.3%	3.4%	0.7%	Yes	4.6%	3.2%	1.9%	Yes	4.4%	2.0%
	d. Quartzite	1.2%	0.4%	0.7%	Yes	1.5%	0	1.1%	Yes?	1.4%	0
3. Prepare stone	e. Cortex on S. Tuff	39%	37%	39%	No	30%	26%	33%	Yes?	20%	32%
	f. Cortex on silcrete	20%			-	(20%)			-	9%	18%
4. Reduce stone discard	g. Artefact density	1/260 m^2	1/29 m^2	1/62 m^2	Yes?	1/125 m^2	1/31 m^2	1/12 m^2	Yes	1/7 m^2	1/42 m^2
	h. Debitage rates	87%	79%	84%	No	78%	87%	85%	Yes	79%	85%
	i. Artefact size 1-3cm	52%	55%	37%	Yes?	59%	70%	65%	No	73%	58%
	j. >5cm	14%	14%	25%	Yes	11%	6%	13%	Yes?	6%	12%

In recent prehistory, and perhaps extending back to 1,000 years BP – equivalent to the Late Bondaian phase – the Hunter region may have been occupied by named local groups, as described in Section D6 of this report. Stone raw material sources along the Hunter River might have fallen under the control of certain groups, such as the Comnaroy who occupied the Hunter River from the confluence of the Goulburn River to the confluence of Wollombi Brook. The Geawgal might have controlled stone sources further down stream along the Hunter River (see Figure D-19). There were apparently, strict rules concerning the movements of people between the territories of such groups. Groups whose territories did not include stone sources might have had limited access to stone supplies, or they may have negotiated access to supplies and/or obtained stone by negotiated exchanges. Shifts in raw material use over time could reflect such changes in access to materials. The "porous boundary" in silcrete distribution along North Wambo Creek (see point 5 below) could be related to limited access to sources of this raw material.

It is also possible that the main phase of backed artefact production and use occurred during the Middle Bondaian phase, which dates to about 1,000 – 4,000 BP. While it is not possible to say that all backed artefacts were made in that period, it is possible that the majority were. Backed artefacts, and/or knapping floors on which this artefact type may have been produced, have been found associated mostly with 2nd order and larger creeks and mostly within 50m of creeks. Whether production sites (knapping floors) were located close to water because occupation activity was focussed close to water in those times, or whether this was simply the preferred location of potentially hazardous knapping, is uncertain. A couple of backed artefacts occur as isolated finds, indicating that they were on occasion discarded away from intensively or repeatedly visited locations.

3. Wambo Ridge as an access route

Wambo Ridge may have formed an access route from the lower valleys of Wambo, Stony and North Wambo Creek and Wollombi Brook, into the higher sandstone country to the west of the study area. Other ridges south of Stony Creek might also have formed access routes but these were not surveyed for this Project.

The eastern 2 km of Wambo Ridge, to c.220m AHD, was walked (easily) during the present survey. At the western end of the surveyed section Site 89 was found in a saddle. This is the single largest site at higher altitude found during the survey. *Macrozamia* plants are abundant on the southern face of the ridge, with some plants growing on the site itself. The ridge was probably used as an access route, to foraging areas such as that presented by the *Macrozamia* plants and/or as a route into the sandstone mountains. Artefact density data (Table D-46) and analysis of recorded stone artefacts (Section D9.5) support this theory.

That section of Wambo Ridge surveyed for the present study, has a moderate average density of surface artefacts, with 1 artefact in 50 m^2 of coverage. Other ridge tops in the north-west part of the study area have much lower average artefact densities, of 1 artefact in 207 m^2 of coverage. Wambo Ridge is drained directly by 1st order streams. Artefact densities in other areas within the study area drained by 1st order streams also tends to be very low, at 1 artefact in 260 m^2 of coverage in the north-west part of the study area, 1 artefact in 223 m^2 of coverage in the western part of North Wambo Creek catchment, and 1 artefact in 182 m^2 of coverage in the southern part of the study area. Only areas drained by 1st order streams in the eastern part of North Wambo Creek have average artefact densities approaching those along Wambo Ridge, at 1 artefact in 78 m^2 of coverage. Relatively higher average artefact densities along Wambo Ridge point to more intensive use and/or repeated use.

Analysis of the raw materials from which stone artefacts were made indicate difference in the transport and discard of raw materials in the southern part of the study area. Along Wambo Ridge, and in other locations drained by 1st order streams – mostly around the south-east slopes of Wambo Ridge, 20-26% of artefacts are of silcrete. This frequency of silcrete is much the same as that found along the larger creeks (Wambo and Stony Creeks) where 22% of artefacts are of silcrete. However, in the north-west part of the study area and the eastern end of North Wambo Creek the relative frequency of silcrete is much lower in areas drained by 1st order streams than larger (especially 4th+ order) creeks. In the other parts of the study area relatively little silcrete was carried away from larger sites on larger creeks, into the hinterland drained by 1st order streams. However, Wambo Ridge does not fit this pattern and it appears that silcrete was carried equally between large and small sites. This could have been the case if people carried silcrete with them on their journey from lower valleys into the higher sandstone country.

In the recent past (if not in the more distant past) people could have used ridge top access routes to travel between the sandstone country and the lowlands along Wollombi Brook and the Hunter River confluence to attend ceremonies such as that carried out at Site 2 (NPWS #37-6-56).

4. The eastern end of Jerrys Plains Ridge

Jerrys Plains Ridge, like Wambo Ridge, leads into the sandstone mountains west of the study area. It forms the watershed between creeks flowing northwards into the Hunter River and creeks flowing southwards into North Wambo Creek. The eastern extension of this ridge falls within the proposed surface impact area. However, this section of the ridge is dissected and the highest parts are from 200 m to 230 m AHD, while the two lowest locations are at about 160 m AHD. To walk along this ridge involves several steep climbs[19]. The presence of a few scattered artefacts along the ridge top (very low average density of 1 artefact in 291 m^2 of coverage[20]) attests to Aboriginal use, but arguably to obtain local resources rather than use of the ridge as a travel route.

The largest sites and highest density locations are at the two low saddles or passes across this ridge. Several sites have been found on the north face of the pass between Splitters Hollow and Waterfall Creek which includes what is technically a waxing upper slope; the sites here are 256 and 258-262. This area has a moderate artefact density (1 artefact in 42 m^2 of coverage[21]) which is substantially higher than the artefact density along the ridge top itself. The second pass is a little further east and Pinegrove Road crosses through it. Sites 209-214 occur here. This pass is more narrow and the terrain leading to it is steeper. The artefact densities are very low (1 artefact in 155 m^2 of coverage[22]) which could be related to this area being less amenable but also this location has been subject to long-term severe erosion, so some artefacts might have been washed away.

5. Low frequency of silcrete along the western part of North Wambo Creek

The distribution of silcrete varies across the study area, most notably along the western end of North Wambo Creek where just 13% of recorded artefacts are of this raw material type. A relatively low frequency of silcrete is replicated at several medium and large sites, including Sites 168, 227 and 239, indicating that this is a general trend rather than a site-specific aberration. The lower frequency of silcrete is unexpected.

Silcrete occurs naturally just 3-4 km north and north-west of the study area along the Hunter River and at Jerrys Plains. It could have easily been transported into the Waterfall Creek catchment where 28% of the artefacts are of this material. Access between Waterfall Creek and Splitters Hollow is easy through the pass discussed above, and silcrete makes up 24% of the assemblage from Splitters Hollow. Splitters Hollow drains directly into the western section of North Wambo Creek yet Site 239, which is on a crest above the confluence, has just 12% silcrete artefacts. It might be suggested that the lower frequency of silcrete along the western end of North Wambo Creek simply represents declining use of the material with increasing distance from silcrete sources. However, other parts of the Wambo study area are further from silcrete sources yet they have higher frequencies of artefacts of that material.

Based on the available evidence it appears that some kind of "porous" social boundary existed in this part of the study area through which only limited amounts of silcrete was transported. One possible boundary is that of a local named group, as described in Section D6. If this is the case then the Comnaroy who occupied the Hunter River between the Goulburn River and Wollombi Brook, might have extended into the northern part of the Wambo study area. Other parts of the study area might have been within the territory of another group(s).

19 The top of the ridge was surveyed during the present field work.
20 A total of 37 artefacts in 10,764 m^2 of coverage.
21 A total of 88 artefacts in 3,669 m^2 of coverage
22 A total of 31 artefacts in 4,808m^2 of coverage

D10 ABORIGINAL HERITAGE SIGNIFICANCE

The NPWS Report Writing Guidelines (NPWS 1997a) identify two streams in the assessment of significance of Aboriginal sites, places and objects: their cultural or social significance to Aboriginal people and their scientific or archaeological significance.

D10.1 ABORIGINAL SOCIAL OR CULTURAL SIGNIFICANCE

This field of assessment relates to the importance of an area to Aboriginal people. Places may be of traditional significance, being places associated with traditional practices, beliefs or values. They may be of historical significance, being places important in the lives of people in more recent times, such as massacre sites and missions. Previously unknown archaeological sites may also take on contemporary importance as places which demonstrate past Aboriginal links with land or which acknowledge a past Aboriginal presence in an area. It is recognised that the reasons for a place being of Aboriginal heritage importance may vary widely. It must be stressed that only Aboriginal people can assess the significance of sites or areas to themselves. For this reason, Aboriginal social or cultural significance is not assessed here, but a description is included in the record of community consultation.

D10.2 ARCHAEOLOGICAL SIGNIFICANCE

D10.2.1 Criteria for Archaeological Assessment

Archaeological significance is based on two factors: the representativeness of heritage sites or landscapes, and the potential of heritage sites or landscapes to provide information relevant to archaeological research. The NPWS Report Writing Guidelines (NPWS 1997a) provide some advice on the assessment of representativeness and research potential. These matters are addressed below.

The Integrated Development Assessment information (NPWS 2000:8) notes that significance criteria and attributes need to be fully supported by the information presented on the archaeological and landscape context of the site/s (eg. representativeness, items and landscape elements considered to be rare, information potential, social/historical values – ie. to Aboriginal communities). The criteria for assessment need to be measurable.

The Director-General’s requirements for this Project also indicate that assessment needs to be supported by a clear set of criteria and measurable attributes, derived from the regional overview (Section D7). Accordingly, criteria developed for this Project are based on measurable attributes, being the variables used for site analysis.

Rarity (and Representativeness) is an assessment of how rare or common a site or landscape is. In theory, heritage items may be determined to be significant because they are rare forms, or they may be considered to be very good typical forms.

Whether items are of rare or common forms will depend to some extent on the variables used to distinguish them. Open sites, for example, may be distinguished from grinding grooves or scarred trees according to the general type of evidence present (eg. stone artefacts distinguishable from trees with marks or rock platforms with grooves). The NPWS has long used a list of types for classifying sites and these are in common usage. Ultimately all sites and/or their landscape settings may differ in some respect. To assess rarity and representativeness, NPWS (1997:28-29) suggests that site type be used initially, then this category subdivided until a satisfactory level of (dis)similarity is achieved.

Within the general group “artefact scatters” sites may be distinguished according to other variables. The analyses carried out in Section D9 distinguish big sites (many visible artefacts) from small sites (few visible artefacts). Some open sites may be distinguished by the presence of features such as hearths. Open sites with diverse content (eg. knapping floors, grinding stones, hatchets, cobble tools, variety of stone materials) may be distinguished from sites with limited content (few artefact types, few raw material types), though this variable is highly susceptible to sample size so is not considered here as a separate variable.

Sites may be distinguished according to their landscape setting – either because they occur in an unusual setting or because they have some unusual trait in that kind of landscape setting (eg. a big site on a ridge top). In Section 9 landscape settings were analysed according to both visible site size and average surface artefact density.

Technically, an assessment of representativeness should identify both what is typical or common as well as what is rare. It is relatively easy to identify those sites which are rare according to the variable used to distinguish them. This can be done by determining the number of sites with the specified variable and their relative frequencies (% frequencies), both within the study area and in the surrounding context area. Assessing representativeness, however, is another matter, because representative sites are those which are common or typical and will, by definition, be those which are "left over" in such an analysis. Ultimately all sites would be judged to be significant.

The idea of 'representativeness' relates to the identification of a 'representative sample'. That is, the issue is whether or not a certain set of sites is typical of another set of sites. 'Representativeness' is not actually a category of significance, but rather it is a management tool. As NPWS (1997:27) notes it is meaningful only in relation to a conservation objective, that if a sample of sites is representative of another set which might be destroyed then they representative sample could be considered for conservation; though of course many other factors might also influence a conservation outcome. For the present study area the question arises as to the representativeness of sites which would be destroyed: whether or not they might be represented by other sites in or beyond the study area. As this is a matter relating to the impact of the proposed development it is dealt with in Section 11.

Variables for assessment of rarity for this Project include:

(1) Site type.
(2) Site size (number of visible surface artefacts) – which also relates to research potential (see below).
(3) Landscape setting and artefact density in relation to this.
(4) Stone artefacts – raw materials.
(5) Stone artefacts – artefact types.

Research potential is an assessment of the ability of a content, site or landscape to provide information to answer questions about the past. NPWS (1997:27) suggests three criteria:

(6) Its physical condition. Sites and landscapes in good physical condition are generally able to provide information on spatial relationships between (for example) stone artefacts, other remains, chronological units if present, and landscape settings.

(7) The connectedness of individual sites or landscapes – is the content, site or landscape part of a complex of related sites or landscapes.

(8) The potential of a site or landscape to provide a chronology extending back into the past, particularly if that chronology can be dated.

To these three criteria could be added another, the ability of the site or landscape to provide a large sample size (large numbers of stone artefacts, art motifs, grinding grooves etc) about which statistically significant statements can be made. This criterion relates to site size, and can therefore be included in #2 above.

For this Project there are a large number of individual artefact locations (referred to here as 'sites') and eight criteria for significance assessment. To assist with assessment of such a large data set a table has been developed with each site assessed according to each variable, and assigned points for how it rates. The points given are three (3) for highest, one (1) for lowest, two (2) for in-between. For the eight variables the maximum number of points which a site could score is 24 and the minimum is 8. In the present study area the most points scored by a single site is 20, while several sites score only 8 or 9 points. The sites and their scores for each variable are listed on Table D-70. Some sites, such as the carved tree Site #2, the grinding groove Sites #1 and #4 and the probable scarred tree Site #32 are not dealt with well by this assessment process, but given the relative rarity of these types of sites they should be considered to be significant. Some of the open sites are missing certain information so it has not been possible to assess them either. Nonetheless, the process is useful for distinguishing between most of the open sites and can be used to assist with site management recommendations.

The variables used in the assessment of archaeological significance are discussed below.

Table D-70
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
1	3	-	-	-	-	2	1	1	High	High
2	3	-	-	-	-	-	3	3	High	High
3	1	1	2	1	2	3	3	1	14	Moderate
4	3	1	1	1	3	2	3	1	15	Moderate
5	1	1	1	1	1	3	3	1	12	Low
6	1	1	1	1	1	3	3	1	12	Low
7	1	1	1	1	1	3	3	1	12	Low
8	1	1	1	1	3	3	3	1	14	Moderate
9	1	1	1	1	2	3	1	1	11	Low
10	1	1	1	1	1	3	1	1	10	Low
11	1	1	1	1	1	3	1	1	10	Low
12	1	1	1	1	2	3	1	1	11	Low
13	1	1	2	3	1	3	1	1	13	Moderate
13	1	3	2	3	3	2	1	2	17	High
14	1	1	1	1	2	2	2	1	11	Low
15	1	2	1	3	1	1	2	1	12	Low
16	1	2	2	3	2	2	2	1	15	Moderate
17	2	1	2	3	2	2	2	2	16	Moderate
18	1	1	1	1	1	1	2	1	09	Low
19	-	-	-	-	-	-	-	-	-	Moderate
20	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	Moderate
22	-	-	-	-	-	-	-	-	-	Low
23	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	1	-	-	-	Moderate
25	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-
27	1	1	1	1	-	-	1	1	-	(Low)
28	1	1	1	1	1	1	1	1	08	Low
29	1	2	1	2	2	1	1	1	11	Low
30	1	2	3	3	3	2	1	3	18	High
31	2	3	3	3	3	2	1	3	20	High
32	3					3	1	3	High	High
33	1	1	1	1	1	3	1	1	10	Low
34	1	1	1	1	1	3	1	1	10	Low
35	1	1	1	1	1	3	1	1	10	Low
36	1	1	1	1	1	1	1	1	08	Low
37	1	1	1	1	1	1	1	1	08	Low
38	1	1	2	1	2	1	1	1	10	Low
39	1	1	1	1	1	3	2	1	11	Low
40	1	1	2	3	2	3	2	2	16	Moderate

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
41	1	2	1	3	2	3	2	1	15	Moderate
42	1	3	2	3	2	3	2	2	18	High
43	1	1	1	3	2	3	2	1	14	Moderate
44	1	3	2	3	2	2	1	2	16	Moderate
45	1	1	1	1	1	1	2	1	09	Low
46	1	1	1	1	1	2	2	1	10	Low
47	1	1	2	3	1	2	2	1	13	Moderate
48	1	1	1	3	1	2	2	1	12	Low
49	1	3	2	3	2	2	2	1	16	High
50	1	1	1	3	2	2	2	1	13	Moderate
51	1	1	1	3	1	2	2	1	12	Low
52	1	1	1	1	3	3	2	1	13	Moderate
53	1	1	1	3	2	3	2	1	14	Moderate
54	1	1	1	3	1	3	2	1	13	Moderate
55	1	1	1	3	2	2	2	1	13	Moderate
56	1	1	1	3	2	3	2	1	14	Moderate
57	1	1	1	3	2	3	2	1	14	Moderate
58	1	1	1	3	1	3	2	1	13	Moderate
59	1	1	1	3	1	2	2	1	12	Low
60	1	1	1	3	2	2	2	1	13	Moderate
61	1	1	1	3	2	3	2	1	14	Moderate
62	3	2	1	3	3	1	1	3	17	High
63	1	1	1	2	1	3	2	1	12	Low
64	1	1	1	2	1	3	2	1	12	Low
65	1	1	1	2	2	3	2	1	13	Moderate
66	1	1	1	2	1	3	2	1	12	Low
67	1	1	1	2	1	3	2	1	12	Low
68	1	1	1	2	1	3	2	1	12	Low
69	1	1	3	2	1	3	3	1	15	Moderate
70	1	1	3	2	1	3	3	1	15	Moderate
71	1	1	3	2	2	2	3	1	15	Moderate
72	1	1	3	2	1	3	3	1	15	Moderate
73	1	1	3	2	1	3	3	1	15	Moderate
74	1	2	2	3	2	2	1	1	14	Moderate
75	1	2	1	3	2	2	1	1	13	Moderate
76	1	2	2	3	2	3	2	1	16	Moderate
77	1	1	1	1	2	3	2	1	12	Low
78	1	1	2	1	1	3	2	1	12	Low
79	1	1	2	1	1	3	2	1	12	Low
80	1	1	1	1	2	3	2	1	12	Low
81	1	1	3	3	1	3	3	1	16	Moderate

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
82	1	1	3	2	1	3	3	1	15	Moderate
83	1	1	3	2	1	3	3	1	15	Moderate
84	1	1	3	2	1	3	3	1	15	Moderate
85	1	1	3	2	1	3	3	1	15	Moderate
86	1	1	3	2	1	3	3	1	15	Moderate
87	1	1	3	2	1	3	3	1	15	Moderate
88	1	1	3	2	1	3	3	1	15	Moderate
89	1	2	3	3	2	3	3	1	18	High
90	1	1	1	1	2	3	2	1	12	Low
91	1	1	1	2	1	3	1	1	11	Low
92	1	1	1	2	3	3	1	1	13	Moderate
93	1	1	1	2	1	3	1	1	11	Low
94	1	1	1	1	2	3	1	1	11	Low
95	1	1	1	1	2	1	1	1	09	Low
96	1	1	1	1	2	3	1	1	11	Low
97	1	2	1	3	2	3	1	1	14	Moderate
98	1	2	2	3	3	2	2	1	16	Moderate
99	1	1	2	3	2	1	2	1	13	Moderate
100	1	2	1	1	2	2	2	1	12	Low
101	1	3	1	3	2	2	2	2	16	Moderate
102	1	2	2	3	2	3	2	1	16	Moderate
103	1	2	2	3	3	2	2	1	16	Moderate
104	1	2	2	3	2	3	2	1	16	Moderate
105	1	1	1	2	1	3	2	1	12	Low
106	1	3	1	1	3	2	2	2	15	Moderate
107	1	1	2	3	1	2	2	1	13	Moderate
108	1	1	1	3	1	3	2	1	13	Moderate
109	1	1	1	3	1	3	2	1	13	Moderate
110	1	3	1	3	2	2	2	2	16	Moderate
111	1	2	1	-	-	3	2	1	-	-
112	1	2	1	3	3	2	2	1	15	Moderate
113	1	1	1			3	2	1	-	-
114	1	3	1	3	3	3	2	2	18	High
115	1	2	1	2	2	3	2	1	14	Moderate
116	1	1	2	1	2	3	2	1	13	Moderate
117	2		1			2	2	2	-	(Low)
118	1	1	1	3	2	1	2	1	12	Low
119	1	1	1	1	1	1	1	1	08	Low
120	1	1	2	1	3	1	2	1	12	Low
121	1	3	2	3	3	2	2	2	18	High
122	1	2	2	3	2	3	2	1	16	Moderate

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
123	1	1	2	3	1	3	2	1	14	Moderate
124	1	2	2	3	2	3	2	1	16	Moderate
125	1	1	1	1	1	3	2	1	11	Low
126	1	1	1	1	1	3	2	1	11	Low
127	1	1	1	1	2	3	2	1	12	Low
128	1	1	1	1	1	3	2	1	11	Low
129	1	1	2	3	1	3	2	1	14	Moderate
130	1	1	2	3	1	3	2	1	14	Moderate
131	1	1	2	3	1	3	2	1	14	Moderate
132	1	1	2	3	2	3	2	1	15	Moderate
133	1	1	2	3	2	3	2	1	15	Moderate
134	1	1	2	3	1	3	2	1	14	Moderate
135	1	1	2	3	1	3	2	1	14	Moderate
136	1	1	1	3	2	3	2	1	14	Moderate
137	1	1	1	2	1	3	1	1	11	Low
138	1	1	2	1	1	2	1	1	10	Low
139	1	1	1	1	2	3	1	1	11	Low
140	1	1	1	1	1	3	1	1	11	Low
141	1	1	1	2	2	3	1	1	12	Low
142	1	1	1	2	1	3	1	1	11	Low
143	1	1	1	2	1	3	1	1	11	Low
144	1	1	1	2	1	3	1	1	11	Low
145	1	1	1	1	1	3	1	1	10	Low
146	1	1	1	1	1	3	1	1	10	Low
147	1	1	1	1	2	3	1	1	11	Low
148	1	1	1	1	2	3	1	1	11	Low
149	1	1	1	1	1	3	1	1	10	Low
150	1	1	1	1	1	3	1	1	10	Low
151	1	1	1	1	1	2	1	1	09	Low
152	1	1	1	1	2	1	1	1	09	Low
153	1	1	1	1	3	1	1	1	10	Low
154	1	3	1	-	-	1	1	1	-	-
155	1	1	2	1	1	1	1	1	09	Low
156	1	1	1	1	1	1	1	1	08	Low
157	1	1	2	1	1	1	1	1	09	Low
158	1	2	1	-	-	1	1	1	-	-
159	2	2	2	2	1	2	1	1	13	Moderate
160	1	1	2	1	2	2	1	1	11	Low
161	1	1	1	1	1	3	1	1	10	Low
162	1	1	1	1	2	2	1	1	10	Low
163	1	1	1	1	1	2	1	1	09	Low
164	1	1	1	1	1	3	1	1	10	Low

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
165	1	1	1	1	1	1	1	1	08	Low
166	1	1	1	3	2	2	1	1	12	Low
167	1	1	2	1	3	3	1	1	13	Moderate
168	1	2	1	2	2	3	1	1	13	Moderate
168	-	-	-	-	-	3	-	-	-	(High Potential)
169	1	1	1	1	1	3	1	1	10	Low
170	1	1	1	1	2	1	1	1	09	Low
171	1	1	1	1	1	1	1	1	08	Low
172	1	1	1	1	3	3	1	1	12	Low
173	1	1	1	1	1	1	1	1	08	Low
174	1	1	1	1	1	2	1	1	09	Low
175	1	1	1	1	2	2	1	1	10	Low
176	1	1	2	3	1	2	1	1	12	Low
177	1	2	2	3	1	1	2	1	13	Moderate
178	1	1	1	3	2	2	2	1	13	Moderate
179	1	1	1	1	2	2	2	1	11	Low
180	1	2	1	1	2	1	2	1	11	Low
181	1	1	1	1	1	2	1	1	09	Low
182	1	1	1	1	2	3	1	1	11	Low
183	1	1	1	1	1	3	1	1	10	Low
184	1	1	1	1	1	3	2	1	11	Low
185	1	1	1	1	3	3	2	1	13	Moderate
186	1	1	1	1	1	3	2	1	11	Low
187	1	1	1	1	2	3	2	1	12	Low
188	1	1	1	1	2	3	2	1	12	Low
189	1	1	1	1	2	3	2	1	12	Low
190	1	1	1	1	1	1	2	1	09	Low
191	1	1	1	1	1	1	2	1	09	Low
192	1	1	1	1	1	2	2	1	10	Low
193	1	1	1	1	1	2	2	1	10	Low
194	1	1	1	1	2	2	2	1	11	Low
195	1	1	1	1	1	2	2	1	10	Low
196	1	1	1	1	1	2	2	1	10	Low
197	1	1	1	-	-	-	1	1	-	-
198	1	1	1	-	-	-	1	1	-	-
199	1	1	1	1	1	3	1	1	10	Low
200	1	1	1	1	1	3	1	1	10	Low
201	1	1	1	1	2	3	1	1	11	Low
202	1	1	1	1	2	1	1	1	09	Low
203	1	1	1	-	-	1	1	1	-	(Low)
204	1	3	1	-	-	1	1	1	-	-

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
205	1	2	1	-	-	1	1	1	-	-
206	1	1	1	-	-	1	1	1	-	(Low)
207	3	1	1	1	2	1	1	3	14	Moderate
208	1	1	1	-	-	2	1	1	-	-
209	1	1	1	1	1	1	2	1	09	Low
210	1	1	1	1	1	1	2	1	09	Low
211	1	1	1	1	2	1	2	1	10	Low
212	1	1	1	1	2	1	2	1	10	Low
213	1	1	1	1	3	1	2	1	11	Low
214	1	1	1	1	2	1	2	1	10	Low
215	1	1	1	1	2	2	1	1	10	Low
216	1	1	1	1	3	2	1	1	11	Low
217	1	1	1	1	3	3	1	1	12	Low
218	1	1	1	1	1	3	1	1	10	Low
219	1	1	1	1	2	3	1	1	11	Low
220	1	1	2	1	1	3	1	1	11	Low
221	1	1	1	1	2	2	1	1	10	Low
222	1	1	1	1	1	2	1	1	09	Low
223	1	1	1	1	3	2	1	1	11	Low
224	1	1	1	-	-	3	1	1	-	-
225	1	1	1	1	1	3	1	1	10	Low
226	1	1	1	1	1	3	1	1	10	Low
227	1	3	2	3	3	1	1	1	15	Moderate
228	1	1	2	1	3	1	1	1	11	Low
229	1	1	1	1	1	1	1	1	08	Low
230	1	1	1	1	1	2	1	1	09	Low
231	1	1	1	1	2	3	1	1	11	Low
232	1	1	1	1	2	1	1	1	09	Low
233	1	1	1	1	1	1	1	1	08	Low
234	1	1	1	1	1	1	1	1	08	Low
235	1	1	2	1	2	1	1	1	10	Low
236	1	1	1	2	2	2	1	1	11	Low
237	1	1	1	3	2	2	1	1	12	Low
238	1	1	1	3	1	2	1	1	11	Low
239	1	3	2	3	3	2	1	2	17	High
240	1	1	2	1	2	1	1	1	10	Low
241	1	1	1	1	2	2	1	1	10	Low
242	1	1	1	1	1	3	1	1	11	Low
243	1	1	1	1	2	3	1	1	11	Low
244	1	1	1	1	1	3	1	1	10	Low
245	1	1	1	1	1	2	1	1	09	Low

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
246	1	1	1	1	2	3	1	1	11	Low
247	1	1	1	3	2	3	1	1	13	Moderate
248	1	2	2	3	2	3	1	2	16	Moderate
249	1	1	1	3	2	3	1	1	13	Moderate
250	1	1	2	3	2	3	1	1	14	Moderate
251	1	1	1	1	1	1	1	1	08	Low
252	1	1	1	1	2	2	1	1	10	Low
253	1	1	1	1	1	2	1	1	09	Low
254	1	1	1	1	1	2	1	1	09	Low
255	1	1	1	1	1	2	1	1	09	Low
256	1	1	3	1	1	1	3	1	12	Low
257	1	1	1	1	3	2	1	1	11	Low
258	1	2	3	3	2	2	3	1	17	High
259	1	2	3	3	2	2	3	1	17	High
260	1	1	3	3	1	2	3	1	15	Moderate
261	1	1	3	3	1	2	3	1	14	Moderate
262	1	1	1	3	3	2	3	1	15	Moderate
263	1	2	1	3	1	3	3	1	15	Moderate
264	1	1	1	3	1	3	3	1	14	Moderate
265	1	1	1	1	1	3	1	1	10	Low
266	1	1	1	1	1	2	3	1	11	Low
267	1	1	1	1	1	2	3	1	11	Low
268	1	3	2	3	3	1	3	1	17	High
269	1	1	1	1	3	3	3	1	14	Moderate
270	1	1	1	1	1	3	3	1	12	Low
271	1	1	2	1	2	3	3	1	14	Moderate
272	1	1	1	1	1	3	1	1	10	Low
273	1	1	1	1	1	3	1	1	10	Low
274	1	1	1	1	1	3	1	1	10	Low
275	1	1	1	1	1	1	1	1	08	Low
276	1	1	1	1	1	2	1	1	09	Low
277	1	1	1	1	1	1	1	1	08	Low
278	1	1	1	1	1	1	1	1	08	Low
279	1	1	1	1	2	3	1	1	11	Low
280	1	1	1	1	1	2	1	1	09	Low
281	1	1	1	1	1	2	1	1	09	Low
282	1	1	1	1	1	2	1	1	09	Low
283	1	1	1	1	1	2	1	1	09	Low
284	1	1	1	1	1	2	1	1	09	Low
285	1	1	1	3	1	3	2	1	13	Moderate
286	1	2	1	3	2	3	2	1	15	Moderate

Table D-70 (Continued)
Assessment of Site Significance

Project ID	Type (Rarity)	Size	Landscape Setting	Raw Materials	Artefact Types	Condition	Connect-edness	Chronology	Total Score	Significance
287	1	1	1	3	1	3	2	1	13	Moderate
288	1	1	1	1	1	2	2	1	10	Low
289	1	1	1	1	2	3	2	1	12	Low
290	1	1	1	1	2	3	2	1	12	Low
291	1	3	1	3	3	3	2	2	18	High
PAD A	-	-	-	-	-	3	-	-	-	High potential
PAD B	-	-	-	-	-	3	-	-	-	Low potential
PAD C	-	-	-	-	-	3	-	-	-	Moderate potential
PAD D	-	-	-	-	-	3	-	-	-	High potential
PAD E	-	-	-	-	-	3	-	-	-	Moderate potential
PAD F	-	-	-	-	-	3	-	-	-	Moderate potential
PAD G	-	-	-	-	-	3	-	-	-	Moderate potential
PAD H	-	-	-	-	-	3	-	-	-	Moderate potential
PAD I	-	-	-	-	-	3	-	-	-	Moderate potential
PAD J	-	-	-	-	-	1	-	-	-	Low potential
PAD K	-	-	-	-	-	3	-	-	-	Moderate potential
PAD L	-	-	-	-	-	3	-	-	-	Moderate potential
PAD M	-	-	-	-	-	1	-	-	-	Low potential
PAD O	-	-	-	-	-	3	-	-	-	Low potential
PAD P	-	-	-	-	-	3	-	-	-	Low potential
PAD Q	-	-	-	-	-	3	-	-	-	Moderate potential
PAD R	-	-	-	-	-	2	-	-	-	Moderate potential
PAD S	-	-	-	-	-	3	-	-	-	Moderate potential
PAD T	-	-	-	-	-	1	-	-	-	Low potential

D10.2.2 Assessment of Rarity (and Representativeness)

Summary comparisons between the Wambo study area and the surrounding context area are compiled in Section D9.2.

Criterion 1 – site type.

In both the Wambo study area and the surrounding context area open artefact scatters and isolated finds are the most common types of sites, together making up 97% of sites at Wambo and 95% in the context area. Such sites can be regarded as common and representative at this broad scale of assessment.

Other types of sites are relatively rare in both the Wambo study area and the context area. A carved tree/ceremonial site was located on the eastern edge of the Wambo study area (Site 2 which is NPWS #37-6-56) and another carved tree site has been reported near the confluence of Wollombi Brook and the Hunter River (NPWS #37-6-113). The trees have apparently been destroyed (though a fence rail with remnant carvings may still survive). The rarity of carved tree sites imbues them with significance, aside from their cultural significance to Aboriginal people.

A probable scarred tree occurs in the Wambo study area (Site 32), previously recorded as NPWS #37-5-188. Two others have been reported in the context area, though I am sceptical as to their authenticity. The Wambo scarred tree is probably significant by virtue of the rarity of this type in the area.

Two grinding groove sites (Sites 2 and 4) and another two suspect grinding groove sites (117 and 159) have been found in the Wambo study area. Five grinding groove sites have been found in the context area. At 1% or less of recorded sites, grinding groove sites are relatively rare and should therefore be considered to be significant.

Glass artefacts have been found at two sites in the Wambo study area (Sites 62 and 207) and two others may also have materials from historic-period occupation (17 and 31). The carved tree Site 2 is also reported to date to the historic period. Sites dating to the contact period are rarely reported, with only two others from the context area. By virtue of their rarity, sites dating to the contact period should be regarded as significant, aside from any cultural values which Aboriginal groups may hold for them.

No other sites types have been found within the Wambo study area. There is limited potential for them to be present, but this is not impossible. If they were found they would be significant because of the rarity of this type of site; they would probably also be of significance to Aboriginal people.

On Table D-70 under the criterion of site type, three points have been assigned to Sites 1, 2, 4, 32, 62 and 207, and two points assigned to sites which may be of rare types, being Sites 17, 31, 117 and 159. All other sites receive one point.

Criterion 2 – site size.

Data on site size (numbers of artefacts) is given in Section D9.2. The majority of open sites in the Wambo study area are very small. Sites with just 1-4 artefacts make up 64% of artefact locations so far found in the study area; compared to 39% in the context area. Sites with 50 or more artefacts make up 5% of artefact locations in the Wambo study area; compared to 19% of sites in the context area. Very small sites are common in the Wambo study area; large sites are not common.

The largest sites in the Wambo study area, having more than 50 visible surface artefacts are Sites 13, 31, 42, 44, 49, 101, 106, 110, 114, 121, 154, 204, 227, 239, 268 and 291. On Table D-70 these sites are assigned three points. Sites with 15-49 visible artefacts are assigned two points, being Sites 15, 16, 29, 30, 41, 62, 74-76, 89, 97, 98, 100, 102-104, 111, 112, 115, 122, 124, 158, 159, 168, 177, 180, 205, 248, 258, 259, 263 and 286. All other open sites receive one point.

It should be noted that large sites are more likely to be able to provide statistically useful numbers of artefacts for analysis and that this criterion doubles for assessment of rarity and assessment of research potential.

Criterion 3 – landscape setting.

The analyses carried out for the present study have described landscape setting in terms of several variables including surface geology, elevation, stream order, distance from water, gradient and landform. Analyses of site size and average surface artefact densities are given in Sections D9.3 and D9.4. The study area, being located where the mountains and the lowlands meet, has diverse landscape settings.

Ridge top crests are drained by 1st order streams. Those in the north-west part of the study area have very low average surface artefact densities of 1 artefact in 300m^2 of coverage. In contrast the Stony Creek – North Wambo Creek watershed (the lower part of Wambo Ridge) has average surface artefact densities of 1 artefact in 50m^2 of coverage. This average surface artefact density is notably higher than all but one other landform type associated with 1st order streams, and is similar to crests associated with 2nd order streams. The average surface artefact density of the Stony Creek – North Wambo Creek watershed indicates more use of this landscape setting than other catchment watersheds, and more use than most other landforms associated with 1st order streams. The recorded sites are: 69-73, and 81-89. These sites are given three points on Table D-70. Archaeological material appears to be discontinuous along this ridge, given the presence of some ground exposures without artefacts, but more sites and artefacts than those recorded are likely to be present along it.

The other landform associated with 1st order streams which stands out for its increased artefact density is the waxing upper slope on the north face of the watershed between Waterfall Creek and Splitters Hollow. This area forms a natural pass or gap in the high ridge which is continuous with Jerrys Plains Ridge to the west. The presence of a fairly large Site 258-259, and several other smaller sites (256, 260, 261) attests to Aboriginal use of this area. It is highly likely that archaeological materials will be much more extensive on this landform than indicated by the surface evidence. These sites have been assigned three points on Table D-70.

The red sand body on which Sites 30 and 31 have been recorded is also an unusual landscape feature in the study area and these sites also receive three points on Table D-70.

Several other landscape settings within the study area have relatively high average surface artefact densities, with 1 artefact in less than 15m^2 of coverage (Section D9.4.3). Sites in these settings include: 3, 13a, 16, 17, 38, 40, 42, 44, 47, 49, 74, 76, 78, 79, 80, 98, 99, 102-104, 107, 116, 120-124, 129-135, 138, 155, 157, 159, 160, 167, 176, 177, 220, 227, 228, 235, 239, 240, 248, 250, and 268. These sites have been given two points on Table D-70.

Criterion 4 – raw materials.

Analyses in Section D9.5 show that raw material discard across the study area varied, with the lowest rates of silcrete discard in the north-west part of the North Wambo Creek catchment. Silcrete distributions seem related to access to stone sources, but access seems to have been affected by both distance and social considerations. This is discussed in Sections D9.5.7 and D9.6.

Within different parts of the study area there are also subtle variations in raw material use. In both the north-west part of the study area and in the North Wambo Creek catchment silcrete is most frequent close to water and becomes less frequent away from water; occurring more often on waning lower slopes and flats than other landforms in both parts of the study area. Quartz and quartzite are not common raw materials in the study area but both were discarded a little more often near 1st order streams than larger streams in both the north-west part of the study area and in the North Wambo Creek catchment. These variations indicate some shift in technological strategies in relation to stream order, arguably related to differences between domestic occupation near large creeks and off-site activities at locations in the hinterland of those residential sites. Assemblage differences are subtle but it appears that larger sites may not simply be more populous versions of small sites.

Sites meeting this criterion should be those that demonstrate the trends, but taking into account sample size, as sites must have sufficient artefacts to be able to show the trends. This presents a difficulty for sites associated with 1st order streams at most consist of few artefacts. For this reason spatially related sets of sites are also considered to meet this criterion.

In the north-west part of the study area the 1st order creek sites are identified as 258-264, and 285-287. The 2nd order creek sites are identified as 176-188, 247-250 and 268. The 3rd order creek sites are 237, 238 and 291. These sites are given 3 points on Table D-70.

For the north-west part of the North Wambo Creek catchment the 4th+ order creek sites showing trends in raw material use are 166, 227 and 239. These sites are given 3 points on Table D-70. The 1st, 2nd and 3rd order creek settings in this part of the study area are not typical in so far as Sites 159, 168, and 236 are associated with 1st, 2nd and 3rd order creeks but are located close to North Wambo Creek which is a 4th+ order. These sites, not being in typical landscape settings for this issue, are given two points on Table D-70.

For the south-east part of the North Wambo Creek catchment the following sites are associated with 1st order creeks but because of the small number of artefacts (limited sample sizes) they are assigned two points on Table D-70: Sites 29, 63-68, 91-93, 137, 141-144. Sites 105 and 115 have larger numbers of artefacts but are located further downstream closer to North Wambo Creek, so they too are given 2 points on Table D-70. The following sites on 2nd, and 4th+ order creeks in this part of the study area are given 3 points for this criterion: 97, 102-104, 114, 129-136, and 98, 99, 101, 107-112, 118, and 121-124.

In the southern part of the study area sites which demonstrate shifts in raw material use include 40-44, 47-51, 53-62, and 74-76. Here it can be noted that Site 76 on Stony Creek has the single highest frequency of quartz artefacts in the study area. These sites have all scored three points.

The Wambo Ridge sites (between Stony and North Wambo Creeks) may be significant in relation to questions about the transport of raw materials within and through the study area so Sites 81 and 89 have scored three points while the smaller sites of 69-73 and 82-88 score two points.

Sites along Wollombi Brook which demonstrate changing frequencies in the use of silcrete are 13a, 15-17, and 30-31. Again these sites score three points.

All other sites score one point, except the following sites which lack information on raw materials: 1, 2, 19-27, 32, 113, 117, 154, 158, 197, 198, 203-206, 208 and 224.

Criterion 5 – artefact types.

It has been difficult to analyse and interpret assemblage data on the distribution of artefact types, because many types are so rare. For the purpose of significance assessment in relation to this criterion it is this rarity which is assessed here. In short, sites with rare types of artefacts, being grindstones, hammers, axes and pieces thereof, Bulga knives, cobble tools, other large tools (more than 10cm in size) and core-tools score three points. These sites are 4, 8, 13, 30, 31, 52, 62, 92, 98, 103, 106, 112, 114, 120, 121, 153, 167, 172, 185, 213, 216, 217, 223, 227, 228, 239, 257, 262, 268, 269 and 291.

Sites with other modified artefacts, being cores, other tools, backed artefacts and other retouched artefacts score two points. These sites (not including any which might have rarer items and which score three points) are: 3, 9, 12, 14, 16, 17, 29, 38, 40-44, 49, 50, 53, 55-57, 60, 61, 65, 71, 74-77, 80, 89, 90, 94-97, 99-102, 104, 110, 115, 116, 118, 122, 124, 127, 132, 133, 136, 139, 141, 147, 148, 152, 160, 162, 166, 168, 170, 175, 178-180, 182, 187-189, 194, 201, 202, 207, 211-212, 240, 241, 243, 246-250, 252, 258, 259, 271, 279, 286, 289 and 290.

All other sites score 1 point except those lacking information on artefact types being Sites 1, 2, 19-27, 32, 111, 113, 117, 154, 197, 198, 203-206, 208 and 224.

D10.2.3 Assessment of Archaeological Research Potential

Criterion 6 – physical condition.

Much of the study area has been subject to land uses which will have disturbed archaeological sites (cf. Figure D-35). Creek flats and some gently sloping areas have been cultivated, some repeatedly. Most of the lower slopes have been cleared, including some areas which now support quite thick timber. Most sites have been found because they have been exposed by some form of ground disturbance. In that sense all sites could be considered to be in poor or only moderate physical condition. On the other hand the ground adjacent to some exposures could be fairly undisturbed so that if sites are more extensive than the parts exposed they could retain archaeological materials in better or even good physical condition. For this assessment of physical condition, the site as a whole, not just the area of exposed ground is considered.

As a general guide sites score one point if they have been subject to heavy ground disturbance, have been cultivated repeatedly or occur within areas of long-term erosion. The artefacts at such sites and any buried archaeological materials around them would have been displaced from their original locations. Sites which might have been disturbed but artefacts might have remained more-or-less in their original locations would score two points. Sites could score three points if they had been cleared of timber but not cultivated or if they had not been cultivated. For some particular sites, however, they and their immediate environs might have been more or less disturbed than the mapping on Figure D-35 might indicate. Comments on the physical condition of sites are included in the site records.

Criterion 7 – connectedness.

Some sites have been identified for having spatial connections to other sites, so that they might be able to add to the story of those sites or the landscape. That is, for any given area the overall story (interpretation) may be greater than the sum of stories (individual interpretations) told by the individual sites. This is not necessarily an easy criterion to assess, since all sites may be connected to other sites by different stories.

Here, three points are given to those sites which spatially link other sites already assessed as being significant in some way. Two points are given to sites which occur close together and form a group in a related landscape setting, and other sites receive one point.

Three points are given to the carved tree Site 2 and those sites in proximity to it, being Sites 3-8.

Three points are given to those sites in the Waterfall Creek catchment which connect the large Site 268 adjacent to a 2nd order stream below 110 m AHD to the Sites 258 and 259 located at 150-170 m AHD at the pass between the catchments of Waterfall Creek and Splitters Hollow. The sites which receive three points are 256, 258-264, and 266-271.

The other group of sites which receive three points for their connectedness are the sites along Wambo Ridge between Stony and North Wambo Creeks. This ridge could have been occupied as an access route, either into the higher sandstone country to the west or to access cycads growing in the vicinity of Site 89. The sites here are 69-73 and 81-89.

The following groups of sites are linked via their spatial proximity and cohesive landscape settings:

- Sites 14-18 on the east side of Wollombi Brook.
- A group of sites on hillslopes above Wambo Creek being Sites 39-43.
- Two groups of sites on the south-east face of Wambo Ridge being Sites 45-61 and Sites 63-86. Site 90 is also close to Site 89.
- Sites clustered along North Wambo Creek and along tributaries close to this being Sites 98-118 and 120-136.
- Sites 177-180 adjacent to Redbank Creek.
- Sites 184-190 on the ridge top north of Redbank Creek.
- Sites 191-196 on the high ridge top between the catchments of Unnamed Creek #1 and Redbank Creek.
- Sites 285-291 on Waterfall Creek and smaller tributaries leading away and upslope from this.

Other sites receive one point.

Criterion 8 – chronology.

Few sites and geomorphic contexts have been identified with potential to provide a chronology of occupation. One is the red sand body adjacent to Wollombi Brook on which Sites 30 and 31 have been found. Air photos show that the site has been cultivated but sediments containing artefacts may extend below the plough zone. Dr Hughes is of the opinion that "... deep windblown sand deposits such as this have the potential to contain stratified and possibly dateable archaeological deposits ...". It must, however, be noted that the sand body has not been investigated so it has only the POTENTIAL to provide a chronology of occupation, but this has not actually been established. PAD D is located on a sand dune east of Wollombi Brook and also has POTENTIAL to contain stratified deposits and hence potential to provide a chronology of occupation.

The probable scarred tree Site 32 could be dated by dendrochronology; although doing so would damage it. The two sites with glass artefacts (Sites 62 and 207) contain dateable materials – the glass artefacts – and are known to have been occupied in the historic period, so they also score three points.

Test excavation at Site 40 has indicated some deep soil with partially intact profile and this has POTENTIAL to contain stratified deposits (Rich 1991b). As test excavation has been carried out but did not actually demonstrate this potential, however, it has been assigned two points rather than three. Two points are assigned to the possible contact period Sites of 17 and 31; except that the latter has already scored three points. Two points have been given to the suspect grinding groove Site 117 as the grooves probably date to the historic period after down-cutting of the stream bed.

Some success has been achieved in roughly dating artefact assemblages by analyzing flake debitage (Baker 1992a; Haglund 1989; Hiscock 1986). If excavation was carried out at large sites sufficient numbers of flakes might be recovered for such techniques to be applied. Sites with some potential to provide such assemblages include 13, 42, 44, 101, 106, 110, 114, 121, 239, 248, 258, and 291. These sites also score two points.

Hearth remnants have been noted at some of the North Wambo Creek sites but these do not retain dateable charcoal. Hearths could contain charcoal could occur at almost any open site, but it is not possible to predict their locations. Hence, all other sites score one point.

Criterion 9 – sample size.

The importance of having statistically useful sample sizes has been highlighted by the difficulties of conducting the artefact analyses for the present study (Section D9.5). Sites may occur in unusual landscape settings or have other unusual features, but if they are not able to produce large enough numbers of artefacts for analysis they will be very limited in their ability to provide useful archaeological information. Criterion #2 is based on site size, but in that case large sites are highlighted for their relative uncommonness in the study area. For criterion #3 certain landscape settings have been identified by data on artefact density, with attention given to those settings which have the highest average surface artefact densities in their landscape context. Large sites and landscape settings with the highest artefact densities have the best potential for providing statistically viable samples. As these criteria have already been considered sample size is not specifically pursued here.

D10.2.4 Archaeological Significance of the Wambo Study Area

As shown on Table D-70 the significance of individual archaeological sites within the Wambo study area varies from high to low. However, collectively, the sites contribute to an understanding of how the Wambo area was occupied by Aboriginal people. The archaeological evidence points to some complexity in behavioural processes. Large scale variation in the transport and use of different stone raw materials appears to have occurred. On the one hand there may have been a “porous” social barrier around the western end of North Wambo Creek; and on the other hand, a transport corridor across a pass between Waterfall Creek and Splitters Hollow, and another transport corridor along Wambo Ridge between Stony and North Wambo Creek. Smaller scale variation in the way the landscape was used is evident with both quantitative and qualitative variation in assemblages from large and very small creeks, from low and high altitudes, and in relation to different types of landforms. This smaller scale variation may have related to the way day-to-day activities were scheduled in the larger landscape. Additional complexity in the archaeological record may have arisen from change over time in the way the landscape was occupied. The carved tree Site 2 (NPWS #37-6-56) and a few others may date to the historic period, while a tradition of ceremonial use of sites undoubtedly dates back to the recent past preceding European occupation (ie. the Late Bondaian phase, if not earlier times). Backed artefacts and knapping floor assemblages might be of any age within the last several thousand years but it is likely that some – if not most – will date to the Middle Bondaian phase when backed artefact production peaked. The Wambo study area has potential to provide additional information with techniques such as archaeological excavation.

The archaeological information gained by the survey and analysis prepared for this report, and any information which might be gained through excavation, is related to several factors, including the large size of the study area, the attention given to field recording, the landscape emphasis given to the analyses, and attention given to documenting a social Aboriginal context for the study. It is also likely that the landscape setting of the study area has physically contributed to the archaeological complexity, by providing transport corridor(s), and allowing for the development of diverse plant resources and vegetation communities. It is difficult to assign an overall level of archaeological significance to the Wambo study area as a whole, because at least some of the information which the present study has been able to achieve is methodological, and some of it relates to the inherent archaeological record of the area.

D11 IMPACT OF THE PROPOSED DEVELOPMENT

D11.1 GENERAL IMPACT

The proposed development has three components: surface impact from proposed open cut mining and associated infrastructure, proposed underground mining (zones A, B1, B2 and C), and construction of a proposed rail line to transport the coal from the mine (refer to Figure D-4). A list of sites within each impact area is given on Table D-71, along with sites recorded beyond these impact areas. The proposed rail spur may affect three open sites, but the route has not been finalised and it may be possible to avoid these sites. The surface impact would destroy 132 sites, all of which are open sites and one suspect grinding groove Site 159 (#37-5-31). Underground mining subsidence zone A includes 25 sites and the other suspect grinding groove Site (117). Underground mining subsidence zone B1 includes 48 sites, and subsidence zone B2 includes 13 sites. Underground mining subsidence zone C which for which there is a risk of less than 10% damage, has one recorded site (and see comments below). Nine sites overlie underground mining areas which are unlikely to have any subsidence impact, including the red sand body Sites 30-31 (31 being a possible contact period site), Site 32 which is the probable scarred tree, and other open sites. Another 61 sites have been recorded beyond underground mining areas, including the carved tree site and nearby open sites, and two grinding groove sites.

Table D-71
Recorded Sites in the Proposed Impact Areas

Impact	Project site number	Total sites	Total PADs
Rail spur	14, 15, 16	3	-
Surface impact area	28, 29, 119, 151-201, 208-229, 232-239, 242-289; PADs M-S	132	7
Underground A	75, 76, 98-102, 104, 106-114, 117, 118, 120-125	25	-
Underground B1	45-48, 50, 52-67, 92-97, 103, 105, 115, 116, 126-136, 138, 146-150; PADs E, F & G	48	3
Underground B2	68-74, 81-85, 91	13	-
East Underground C	10	1	-
Underground no impact	11, 12; 30-32, 86, 87, 137, 139; PADs B, C & D	9	3
Beyond impact	1-9, 13a, 13b, 17-27, 33-44, 49, 51, 77-80, 88-90, 140-145, 202-207, 230, 231, 240, 241, 290, 291, PADs A, H-L, T	61	7

The sizes of open sites in relation to the proposed development impact are given on Table D-72. The proposed rail spur could affect three sites, one of which is an isolated find, and two moderate-sized sites, although it may be possible to route the proposed rail spur to avoid some of these sites.

Table D-72
Size of Sites in the Proposed Impact Areas

Impact areas	1	2-4	5-14	15-49	≥50	Sites without recorded artefacts	Total sites
Rail spur	1	-	-	2	-	-	3
Surface impact	53	34	30	11	4	-	132
Underground A	3	2	4	10	5	1	25
Underground B1	20	15	9	4	-	-	48
Underground B2	5	5	2	1	-	-	13
Underground C	1	-	-	-	-	-	1
Underground no impact	5	1	-	1	1	1	9
Beyond impact	22	12	11	3	8	5	61

The proposed surface impact area would affect 132 recorded sites (Figure D-4). Of these, 53 (40%) are isolated finds, and 34 (25%) have only 2-4 recorded artefacts. Four of the sites (3%) are relatively large, including 154, 227, 239, and 268.

A total of 25 sites occur in areas zoned as subsidence impact A and it is predicted that there may be a probability of surface cracking, ponding, erosion along flow paths and sedimentation. Underground subsidence zone A occurs largely along North Wambo Creek, with a little additional land along Wambo and Stony Creeks. The zone includes five larger sites, three of which have more than 100 recorded artefacts including Sites 106, 110 and 121 (formerly recorded as Sites NW11, 9 and 3 respectively).

A total of 48 recorded sites occur in areas zoned as subsidence impact B1. For this zone it is predicted that there may be a probability of surface cracking and isolated ponding. Expected impact being less than might occur in Zone A. In zone B1 most of the recorded sites are very small, with 35 (73%) having just 1-4 surface artefacts. None of the recorded sites have more than 50 artefacts.

A total of 13 recorded sites occur in areas zoned as subsidence impact B2. For this zone it is predicted that there is a probability of surface cracking and erosion on slopes. In zone B2 most of the recorded sites are very small, with all but three having just 1-4 surface artefacts. None of the recorded sites have more than 50 artefacts.

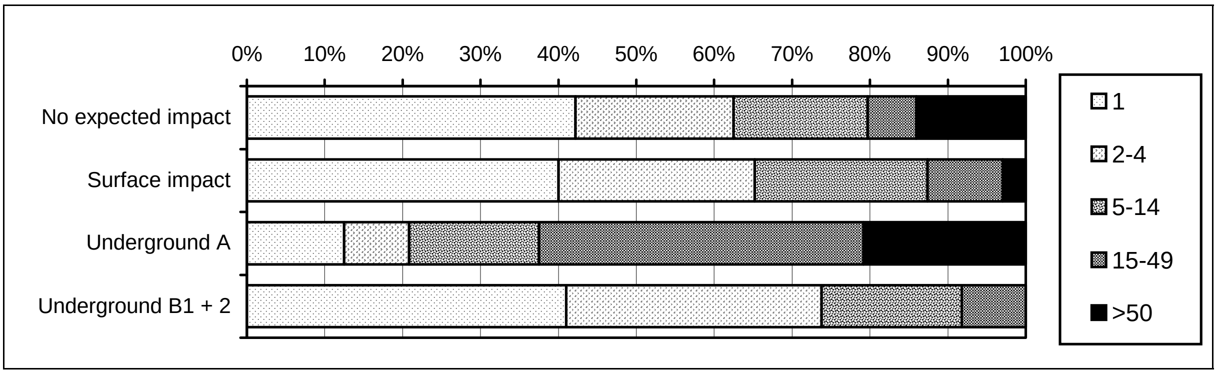
One site has been recorded in areas zoned as subsidence impact C – that is, in areas where it is predicted that there is only a low potential for surface cracking to occur. The expected impact is considered to be negligible. No sites have been found within zone C in the proposed western underground mining area. However, as the predicted subsidence impact on site is <10%, the lack of survey is not considered to be problematic. Only one artefact was found within zone C east of Wollombi Brook, despite good survey coverage.

Some 61 sites have been recorded beyond the proposed impact areas – and those sites recorded in areas of underground mining which would not be affected by subsidence could also be added to this category, bringing the total recorded sites not expected to be effected to 70. These sites are predominantly isolated finds and very small sites, but eight sites have more than 50 artefacts. Also included in this category are the carved tree site, the probable scarred tree, two grinding groove sites and the red sand body Sites 30-31.

The size of sites in relation to the various categories of impact, except the proposed rail spur and proposed underground subsidence zone C which have few recorded sites, are shown on Figure D-56. The size distribution of recorded sites which are not expected to be impacted upon by the proposed development is very similar to those which would be affected by the surface development, except that those which would not be effected include relatively more sites with more than 50 artefacts. Underground subsidence zone A has relatively more large sites than the surface impact areas, underground subsidence zones B1 and B2, and sites which are not expected to be effected.

While it is likely that some, and perhaps most, of the sites in underground subsidence zone A would not be effected the disproportionate number of larger sites suggests that some mitigation measure(s) should be considered for this zone.

Figure D-56
Size of Sites in the Proposed Impact Areas (graph shows numbers of surface artefacts at sites)



Data on average surface artefact densities in relation to the impact areas is given on Table D-73. It should be noted that this data set includes only those sites and ground exposures for which the extent of exposure, ground visibility and numbers of artefacts have been reported. Sites such as 203-205 for which such information is not available are not included in this data set. Overall, average artefact densities are highest in the areas surveyed in subsidence zone A, in proposed underground mining areas where no impact is expected, and in areas surveyed beyond the rail spur and beyond the underground mining areas. The surface impact area has, on average, quite low surface artefact densities.

Table D-73
Artefact Density in the Proposed Impact Areas

Impact	Total Coverage	Total Artefacts	Average artefact density	Czb coverage	Czb artefacts	Czb artefact density
Rail spur	3,138	56	1/56 m^2	1,600	0	-
Surface	106,191	945	1/112 m^2	-	-	-
Underground A	9,817	1,055	1/9 m^2	-	-	-
Underground B1	25,793	255	1/101 m^2	-	-	-
Underground B2	3,253	58	1/56 m^2	-	-	-
Underground C	3,510	-	-	28,026	1	Negligible
Underground none	13,791	296	1/47 m^2	5,025	2	Negligible
Beyond impact	13,437	748	1/18 m^2	10,086	7	Negligible

From these comparisons of the impact areas and sites beyond these it is considered that the proposed surface impact area has relatively fewer large sites and overall artefact densities are fairly low. On the other hand, the proposed surface impact area does include a large number of known sites (136), and recorded artefacts (>1,000). It also includes the north-west part of the study area, and some of the western end of North Wambo Creek, which are found in Section D9 of the report, to differ from other parts of the study area, particularly in the use of raw materials. In broad terms the proposed surface impact would not destroy a unique suite of sites but it would result in a loss in terms of quantity and also some qualitative information. It is considered that salvage of suitable samples of the area's archaeology should be carried out if the Development Project proceeds.

Impact on archaeological materials and their landscape setting in the areas overlying proposed underground mining is difficult to predict and may variously include localised damage to no damage (see Section D11.2). Here it can be noted that the proposed underground mining area (zone A), which has the greatest threat of possible damage, differs from other areas in that it has a relatively high proportion of larger sites (particularly those having more than 15 artefacts). Overall the recorded average surface artefact density is high at 1 artefact in just $9m^2$ of coverage. While only 26 sites have been recorded in zone A as many artefacts have been found as occur in the entire proposed surface impact area. While all the archaeological materials in zone A are unlikely to be lost, some may be lost and it is considered that some mitigation 'just in case' is appropriate if the proposed underground mining proceeds.

The proposed underground mining area zoned B1 and B2, which has some risk of damage, has more recorded sites than zone A but these are mostly small. Overall, the recorded average surface artefact density is variable but low, at 1 artefact in $<50m^2$ of coverage. The archaeological materials and their landscape settings in these zones are unlikely to be lost if the development proceeds, but if some damage should occur it is considered that significant items would not be destroyed; the grindstone which is of a rare artefact type is too large to fall down any anticipated cracks.

Underground mining zone C has less than a 10% risk of damage, and this should be regarded as negligible for the purposes of impact assessment.

D11.2 MANAGING SURFACE IMPACTS

The proposed surface developments, especially the proposed open cut mining, would impact the land surface and all Aboriginal sites occurring on it. It is anticipated that topsoil stripping would precede mining, and any artefacts or hearths would be stripped away with this. While some artefacts might survive the soil stripping process they would be moved from their original locations and associations between artefacts would be lost.

It would be necessary to apply for a section 90 Consent to Destroy in relation to sites which would be affected by surface impacts.

NPWS policy is to prevent the destruction of significant Aboriginal sites wherever possible, to minimise site loss generally, and to offset development impacts by positive conservation actions where possible. Where an Aboriginal site is judged as being significant, a consent for destruction will only be issued for damage or destruction where such impacts are, for all practical purposes, unavoidable. In such cases mitigation could be achieved in part by proposing salvage works where this would significantly increase understanding of Aboriginal heritage at the local or regional scale (NPWS 1997b:17).

Within and adjacent to the proposed surface impact area several sites have been identified as being of archaeological significance. With regard to the significant Sites 30-31 it is possible to route a proposed haul road to the west of the red sand body on which they occur. This red sand body should be fenced. A proposed creek diversion has been shifted north of Sites 122-125 and 231. Significant Site 291 and Watefall Creek along which it occurs can be conserved around the north-west edge of the proposed impact area.

Some sites of archaeological significance, however, occur within the proposed surface impact area. Of high archaeological significance Sites 239, 258-259 and 268; and of moderate archaeological significance Sites 167, 168, 227, 247-250, 260-264, 269 and 285-287. Conservation of these sites is not possible if the development proceeds. It is proposed to carry out archaeological collection and excavations at Sites 154, 168 / PAD N, 239, PAD R, 247-248, 258-259, 263, 268, 286-287 to address issues relating to the use of different raw material types and the use of sites in different landscape settings. In addition, it is proposed that artefacts from other sites within the surface impact area should be collected, and recorded in more detail than was possible during the surface survey. Suitable artefacts from both the surface collections and the excavations should be included in a tool usewear study.

A ‘Keeping Place’ could be set up as a temporary storage facility for artefacts that have been collected and retrieved.

NPWS also encourages developers to identify ways where unavoidable loss could be offset through conservation of similar or otherwise significant sites within the lease or adjacent area (NPWS 1997b:5). The area immediately west of the proposed surface impact area could be considered as a possible suitable off-set, based on its landscape composition and setting. The area is about 4 km and more from silcrete sources at Jerrys Plains, and includes the upper catchments of Waterfall and Redmanvale Creeks which flow northwards into the Hunter River, several 1st and 2nd order creeks as well as Waterfall Creek which is a 3rd order stream, and ground which varies in elevation but includes high ground above 200m AHD. If this off-set area was to continue southwards over Jerrys Plains Ridge then it could take in a section of possible access route into the high country. If it was to include “Pinegrove” and a section of North Wambo Creek then the full range of landscape settings could be represented in it. While very little Aboriginal sites survey has been carried out within this area it could include Sites 290 and 291 along Waterfall Creek (291 being judged to be of high archaeological significance) and Sites 240 and 241 just west of Splitters Hollow. It is highly likely that other sites will be present within this general area.

D11.3 MANAGING SUBSIDENCE IMPACTS

Proposed underground mining areas have been zoned according to the possible effects which might occur to the ground surface (Figure D-4). It is considered that there is a risk of more than 10% that damage to sites could occur in Zones A, B1 and B2. Zone A has the greatest risk for cracking, ponding, erosion and sedimentation. Zone B1 has some risk for cracking and isolated ponding , and Zone B2 has some risk for cracking and erosion on slopes. Zone C is considered to have less than 10% risk of damage to any sites that might be present.

NPWS has advised that where there is more than a 10% risk of damage occurring proponents should apply for a s.90 Consent. However, it is by no means certain that damage to the ground surface will or will not occur; and if the ground surface is damaged, it is not certain that Aboriginal sites would be damaged. It is possible that most of the sites within the areas proposed for underground mining will not suffer any adverse effects from subsidence; but they might.

Subsidence damage is unlikely to be total or complete. If the ground surface cracks it is possible that artefacts might fall down the cracks if the cracks are wide enough. But damage to sites is more likely to be linked to erosion which would occur some time after subsidence, to changes in the landscape setting of sites caused by ponding, or to remedial works to rectify subsidence damage. If ground subsidence and its actual effects on land surfaces, and on Aboriginal sites, are monitored then a more realistic assessment of damage to sites could be made.

In addition, there can be no assumption that the locations of all sites within the possible subsidence areas have been identified. Sites might be present which were not found during the field survey.

The following management strategy could be developed to deal with these uncertainties.

The management strategy has, as its basis, the idea that sites ought to be retained in their landscape setting as much as possible. Further, sites ought to be left in their landscape settings and only subject to collection or excavation if it is certain that they would otherwise be lost. In the case of underground mining it is not certain that subsidence damage would occur so collecting or excavating sites before underground mining has occurred could itself damage sites which would not otherwise be effected. If any collection or excavation of artefacts or sites was to be carried out, their removal from their landscape setting should be seen as a temporary measure and materials should be returned to their original locations as much as is practical. With the aid of GPS technology, photography and site mapping it should be possible to return collected artefacts to their approximate locations.

1. Apply for a s.90 Consent to Destroy to cover Zones A, B1 and B2, to meet legal requirements. This Consent should be issued to cover the life of the underground mining, so that ongoing site management and remedial works could be carried out as necessary.

2. Zone A may be at greatest risk of ground surface damage. This zone contains a number of sites which are considered to be of moderate and high archaeological significance. Most of the sites within Zone A were recorded largely in 1990, but since that time site and artefact recording techniques have changed. Sites in Zone A should be re-recorded in detail to provide an up-to-date record of them, including GPS co-ordinates, photography, mapping, and technological recording of artefacts.

3. Sites in Zones A, B1 and B2, and these areas in general, should be monitored for ground disturbance related to subsidence (eg. changing surface contours, ponding, cracking, erosion). Monitoring stations should also be set up in areas which were not surveyed during the present field work, in Zones A and B2 in the proposed western underground mining area and in Zone B1 in the proposed eastern underground mining area. If any ground surface damage occurs it should be assessed for its possible damage to Aboriginal sites (whether sites are known or not), with a view to either doing nothing, or carrying out further investigations, which may include temporarily retrieving artefacts and then replacing them again.

4. If subsidence or proposed mitigation works are likely to lead to damage to Aboriginal sites then it may be appropriate to temporarily collect artefacts (collect artefacts visible on the ground surface and/or conduct archaeological excavation), carry out remediation works, then return artefacts. The collection and return of artefacts should be supervised by an archaeologist. The process of temporary artefact collection, recording and return would need to be carefully documented so that in the long-term future it would be possible to determine which artefacts and sites had been disturbed by these activities and which ones had not.

   Subsidence mitigation works could depend on several factors including the nature and severity of the ground surface damage, and the nature, density and significance of the Aboriginal sites and objects.

The following hypothetical cases may give some guidance as to possible impacts and actions:

- Small scale or limited damage could occur which has no appreciable effects on Aboriginal sites. For example, if a crack 5mm wide develops only very small artefacts could fall down it. On a site with few artefacts or where artefact densities are low such a crack might have minimal effect, especially if the site is vegetated and the risk of soil erosion is low. Such damage might be considered to have had minimal impact on the site.
- If soil erosion was to occur then stone artefacts and other features might be displaced from their original locations, and if erosion was severe they might even be washed away. Remedial works to repair the erosion might include grading to level the ground surface, scarification of the ground surface or tree planting – activities which could in turn lead to further displacement of artefacts and damage to the site. If this occurred in an area or on a site with high artefact densities or which was assessed as being of some significance, then recording and perhaps temporary collection of artefacts could occur, with a view to replacing artefacts once the works to repair the subsidence damage had been carried out.
- An extreme case of damage could be a pond forming, with cracking and soil erosion around its edges. Artefacts could be displaced by erosion and a wetland form within the pond, so changing the landscape setting of the site. If this pond was to be filled with clean soil/sand then artefacts on the floor of the pond would be buried. In this case the site would suffer considerable damage. Remediation work might include controlled excavation of the site, back filling the pond with soil, then returning the excavated materials to the newly made ground surface.
- If remedial works are to be carried out then adjacent unaffected areas or sites might be temporarily fenced for the duration of the remedial works to prevent inadvertent damage to other sites or land surfaces.
- If the location of the remedial works is judged to be particularly sensitive then it may be appropriate to have a person skilled in heritage identification and management present to ensure that the remedial works are carried out in a manner consistent with the areas' sensitivity.

To implement this strategy monitoring stations could be set up at various scattered locations and in different subsidence zones. The monitoring stations should be integrated with other subsidence monitoring objectives, and the following locations are suggestions to be considered. The suggested sites are those with larger numbers of visible artefacts (to maximise the potential to assess damage), and/or sites with higher significance scores, or otherwise where sites are known:

- In Zone A at the North Wambo Creek Sites 98-104, 106-115, 117 and 121-125.
- In Zone B1 at Sites 50, 55, 62, 97, and 132, 133 and above the proposed western underground mining area at Sites 147-148.
- In Zone B2 at Sites 70, 71 and 81.
- In Zones A and B2 on Stony Creek at Sites 74-76.
- In Zone C in the proposed eastern underground mining area at Site 10.
- In Zone B2 above the proposed western underground mining area to be determined and subject to access constraints.

D11.3.1 Monitoring and Mitigation Measures

Monitoring of the ground surface above underground mining areas would be carried out (Holt & Associates 2003). This should include monitoring of known sites to assess actual subsidence effects. It should also consider any proposed mitigation strategies and the effects which they might have on Aboriginal sites.

If ground surface damage occurs as a result of subsidence (eg. cracking, ponding, flooding, erosion) it has been proposed that appropriate remediation measures would be applied to minimise such effects. Measures may include filling of minor cracks with fill to avoid the creation of drainage channels, re-grading of isolated hollows or highpoints, or smoothing of nicks to avoid potential erosion impacts (Holt & Associates 2003). In this context the possible effects of the remediation measures themselves must include an assessment of their impact on Aboriginal sites. That is, 'appropriate' measures must also be appropriate for Aboriginal sites.

It should also be noted that subsidence might have effects which in themselves would not effect Aboriginal sites, but the remedial works could be adverse. An example of this could have been past repair to Wambo Creek, which it was believed leaked into the previous underground mining area (PPK 1999). Whether or not the creek leaked into the mine workings would not have affected the Aboriginal open sites on the ground surface (except perhaps to the landscape setting re: a decrease in water flow along the creek). However, remedial works to line the creek and construction a coffer dam might have involved ground disturbance to the creek banks and to open sites which might have been present in those locations (though so far as I am aware in this instance no sites had been reported).

D11.4 MANAGING LAND USE GENERALLY

A number of sites are now known in areas away from areas of proposed surface and underground development. It is possible that other activities could cause ongoing damage to sites which might not otherwise be affected by the proposed development. Examples of this include cattle and trampling of artefacts and features on eroded areas, excavation along an existing water pipeline, or maintenance of transmission lines, access roads or fire breaks. In some cases Aboriginal sites have been recorded in such areas and could be affected by ongoing activities. It is reasonable to expect that such activities, which are existing activities approved under development control processes, should be allowed to continue. They could however, have unwitting effects on Aboriginal sites. A protocol, or other long-term management strategy, could be developed that allows ongoing use of existing facilities which could include collection of visible artefacts and their temporary storage. The following sites may be relevant here: 81, 91, 92, 118, 126, 127, 128 and 147-150.

Artefacts also occur along the road which runs parallel to North Wambo Creek, from Site 100 to Site 124. This area is archaeologically sensitive and consideration should be given to finding an alternative route for this road.

The road which runs across the red sand body through Sites 30 and 31 should also be removed, possibly to the west around the edge of the proposed surface impact area.

Cattle may also cause damage to open sites, particularly by trampling artefacts and features on existing erosion areas, or by eating vegetation which in turn could lead to soil erosion. While existing ground exposures along North Wambo Creek could be fenced care would need to be taken to ensure that fencing did not unduly disturb artefacts. Thought should be given to removing cattle from the proposed western and middle underground mining areas, and from the narrow strip between these proposed areas.

Land use practices east of Wollombi Brook, particularly in the area beyond the proposed underground mining area and around Sites 2-8 need to be considered for their potential disturbance to Aboriginal sites, especially in relation to the carved tree Site 2. Some longer-term management strategies may need to be put in place for this area.

Some sites occur beyond the proposed development areas, on pastoral land in areas under private ownership, such as Sites 33-44. It is anticipated the existing land use practices and activities would be allowed to continue in relation to these sites. But any change in land use or activities should be assessed for their possible impacts on the sites and their landscape settings.

D11.5 MANAGING RETRIEVED ABORIGINAL OBJECTS

Retrieved artefacts and other materials could be documented and stored at an onsite “Keeping Place”. Such a ‘Keeping Place’ could be physically secure with the relevant Aboriginal groups having custody of keys and a sign-in/sign-out procedure (necessary anyway, as part of mine entry requirements). Materials collected temporarily during the management of subsidence impacts could therefore be readily accessible for return to sites on the completion of mitigation works.

Some Aboriginal artefacts will probably be present within topsoil collected during topsoil stripping. Any artefacts in this topsoil will remain with the stockpiled soil until the topsoil is returned during the Project rehabilitation programme. The topsoil and any Aboriginal artefacts contained within this material will be returned as close as possible to the areas of collection in accordance with the wishes of local Aboriginal groups.

It has been suggested that artefacts recovered during surface collection and/or excavations from the proposed surface impact area could also be relocated onto rehabilitated land surfaces, based on GPS positions. It must be realised, however, that the original landscape context of these artefacts (creeks, landforms and so on) will not exist any more. The utility of returning such items to 'false' landscape settings may need to be considered. In the interim, an on-site 'Keeping Place' could provide a local alternative to deposition in the Australian Museum in Sydney.

D11.6 MANAGING 'UNKNOWN' OBJECTS

It must be noted that, while many Aboriginal sites have been recorded within the Wambo study area, there can be no assumption that all sites are known. Indeed, it is highly likely that other unrecorded sites are present. The absence of site locations on a map cannot be taken to indicate a real absence of Aboriginal sites from an area.

In the proposed surface impact areas this means that application for a s.90 Consent to Destroy would be worded so that it includes Aboriginal objects which may be present within the entire area of proposed impact, as well as a list of sites which are known.

For the proposed underground mining areas and other areas under the control of WCPL, all land surfaces should be treated as if Aboriginal objects might be present, even if no sites are known. In the case of subsidence zones A, B1 and B2 application for a s.90 Consent to Destroy should also be worded so that it includes all Aboriginal objects within those zones, as well those sites which are known.

D11.7 MANAGING SUBSIDENCE IMPACT

As discussed in Section D11.2 it has not been possible to predict precisely where underground mining might result in ground surface subsidence, or if so, whether or not there might be damage to Aboriginal sites and their landscape settings. It is suggested that a precautionary approach be taken. Such an approach could have several components: detailed recording, monitoring of subsidence condition, temporary retrieval of artefacts, and return of artefacts after remediation works.

Subsidence zone A is at most risk from post-mining damage and this zone includes an atypical set of sites. It is more than 10 years since most of the sites in Zone A were recorded and in that time information about the landscape settings of sites and artefact recording schemes have changed. It is considered that a detailed surface recording using more recently defined variables, and GPS technology, could update existing information about the sites overlying the underground mining areas, and provide additional baseline information of use in a monitoring programme. Sample recording of previously recorded sites in zone B1 could also be carried out as that zone also is at risk.

Monitoring of the physical condition of the sites and their landscape settings is also recommended. Monitoring should lead to an assessment of the actual impact which underground mining might have had on Aboriginal sites and their settings. This programme should also include consideration of remedial actions to correct subsidence damage. The full strategy is outlined in Section D11.3.1. Here it can be noted that all land surfaces within Zones A, B1 and B2 should be treated as if Aboriginal objects might be present, regardless of whether they have been recorded or not.

D11.8 RECOMMENDATIONS

The following recommendations are based on the information obtained during the survey and from previous archaeological studies in the area. It is recommended that WCPL should:

1. Set aside an area to 'off-set' the loss of Aboriginal sites resulting from the proposed expansion of the open cut mine. The area immediately west of the proposed surface impact area may be appropriate as the landscape and its setting is similar to that within the proposed open-cut mining area.

2. Carry out archaeological survey along any revised routes of the proposed rail line and Wallaby Scrub Road diversion. Any sites or potential site locations should be assessed. If it is not possible to avoid sites of heritage interest then it may be appropriate to conduct salvage investigations. Sites which are close to the proposed routes should be temporarily fenced to avoid accidental damage.

3. Apply for a s.90 Consent in relation to Aboriginal sites within the proposed surface impact area. This Consent should be sought to cover the life of the mining operations in this area.

4. Provide for the excavation, analysis and reporting of Sites 154, 168 / PAD N, 239, PAD R, 247-248, 258-259, 263, 268, 286-287, and collection of artefacts from other sites within the proposed surface impact area.

5. Apply for a s.90 Consent in relation to Aboriginal sites within the proposed underground mining subsidence Zones A, B1 and B2. This Consent should be sought to cover the life of the underground mining, so that ongoing site management and remedial works could be carried out as necessary.

6. Provide for re-recording of sites in Zone A prior to underground mining to provide an up-to-date record of the sites.

7. Provide for monitoring of selected sites and areas in Zones A, B1 and B2, to assess ground disturbance related to subsidence (eg. changing surface contours, ponding, cracking, erosion). If any damage to the ground occurs it should be assessed for its possible damage to Aboriginal sites (whether sites are known or not), with a view to either doing nothing, or carrying out further investigations, which may include temporarily retrieving artefacts and then replacing them again.

8. Ensure that the process of temporary artefact collection, recording and return would be carefully documented so that in the future it would be possible to determine which artefacts and sites had been disturbed by these activities and which ones had not.

9. Ensure that subsidence mitigation works are carried out in a manner sensitive to the nature of the Aboriginal sites and their landscape settings, without causing undue damage to sites.

10. Consider setting up a secure 'Keeping Place' for Aboriginal artefacts and other materials recovered from the study area.

11. Consider the feasibility of an alternative route to the existing road which runs parallel to North Wambo Creek and through the area in which Sites 100-124 occur.

12. Consider closing the vehicle track along Wambo Ridge on which Sites 82 – 89 occur.

13. Consider closing the road which runs across the red sand body through Sites 30 and 31; an alternative route around the western edge of the sand body may be possible.

14. Consider removing stock from the vicinity of Sites 98-125 near North Wambo Creek.

15. Prepare a Plan of Management which sets out how these recommendations or other management strategies would be implemented.

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ATTACHMENT D-1

BORA GROUND REPORT

Looking for the Bora Ground in the Wallaby Scrub near Bulga NSW

Helen Brayshaw

March 2003

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Helen Brayshaw

Introduction

The former presence of a Bora Ground with carved trees, somewhere between Wollombi Brook and Wallaby Scrub Road in the Hunter Valley, is mentioned in heritage reports and local history publications, and was to be investigated as part of my continued research into Hunter Valley post-contact Aboriginal history. What evidence there was indicated the site to be similar to another higher up the valley, of which I had recently made a study [Brayshaw in prep]. The investigation relating to the Bora Ground in the Wallaby Scrub became more urgent as it appeared that its suggested location of this site, which was likely to be of considerable significance to the Aboriginal community, could be affected by proposed expansion of mining at Wambo Mine. This paper describes an attempt to augment the available documentation and locate the site as accurately as possible, even though it was understood that no physical evidence of it remained.

The Aboriginal Heritage Information Management System maintained by the NSW National Parks & Wildlife Service [NPWS] contained site forms relating to two sites of interest indicated to be present within the Wambo mining lease. These were NPWS sites #37-6-55, listed as a Ceremonial Ground, and #37-6-56, listed as Carved Trees and a Ceremonial Ground. The former noted the source as oral information from D. Eather of 'Milgarra', Bunnan, but contained no other information. The site forms had been completed around 1980 as part of a NPWS project relating to carved trees [Bell 1982].

The #37-6-56 site form stated that information from local residents was that the site had been destroyed, although its exact location could not be determined. There had been about four trees, but the area had been the scene of at least three bushfires in recent memory. The site form contained copies of photographs of four carved trees taken by staff of the Australian Museum in 1918 [Plates 1-7]. The tentative grid reference given for the site, AMG 140 900, was within Portion 12 of the Parish of Warkworth, on the eastern side of Wollombi Brook, about two kilometres south east of the Wambo Creek junction and within 300 metres of the Brook. The NPWS site form quoted Ian Eather of Bulga and David Eather of Bunnan as local sources of information, Ian Eather indicating that the site was used for one of the last ceremonies in the Hunter Valley.

Initial Enquiries

A telephone call to David Eather [31.10.02] revealed that there was only one site, that as described on the #37-6-56 site form, known as the Bora Ground, in the Wallaby Scrub area. It was concluded that #37-6-55 was the same site, erroneously suggested to be two kilometres further south. David had not seen the Bora Ground, though he had looked for it in vain with his brother Jim in the early 1980s. His brother Jim had seen it many years ago, and said when he saw it the bark was removed from the trees and the marks cut into the wood. The trees were probably red gum. As far as David could remember it was on the eastern side of the stock route, and he placed it on a map 1.4km north of the NPWS position, about 300 metres from Wollombi Brook, in Portion 3030-20. He said that his uncle Alex [A.N.] Eather [died 1956] had taken a museum party to the site and that photographs had been taken. Alex had lived at Bulga, the Eather family being the first Europeans to settle in the area in the early 19th century. David, Jim and Ian had been brought up there, and David had been living at Bunnan since 1944.

Prior to the field investigation at Wambo Mine, enquiries had been made regarding sources of information about post contact Aboriginal history in the Wambo area. Barry Anderson, of the Lower Wonnarua Tribal Council, suggested Stewart Mitchell of Bulga as a possible source of information, because of his family's long residence there and his current involvement in the compilation of a local history.

I contacted Stewart Mitchell and information exchanges took place on two occasions in the 'Cockfighters Tavern' at Bulga. Stewart had never seen the site himself, but his late father Les Mitchell had. Stewart provided a copy of a photo [Plate 8] taken by his father of one of the trees [apparently not one of those photographed by the Australian Museum]. He believed that the photo was taken in the early 1920s because of the age of Don Roser, who was in the photo and about the same age as his father, who was born about 1902. Stewart believed the site to be about 450 metres north of the NPWS location, in Portion 98.

Ian Eather, now living near Maitland, said that he had not seen the site [26.11.02]. He remembered that his uncle had said that a lot of the trees had fallen over. The implication of this was that there may have been more than the five trees now known to have been photographed. As to the location of the site - 'Uncle never said it was right on the Brook, just in the sandy area between Wallaby Scrub Road and Wollombi Brook'.

Jim Eather, also living near Bunnan, said he saw the site in the late 1930s [2.12.02]. At that time there were only the remnants of one stump 4-5 feet high with carvings made into the wood. There was no bark on the stump. There were several earth mounds up to about a foot high, and the soil was very sandy. There was a post and rail fence on the northern side of the site. The site was 150-200 yards from the stock route, on the eastern side of it. It was not especially close to the Cockfighters [Wollombi Brook].

Alex Eather of Bulga, uncle to Jim, David and Ian, who asked the Museum to send someone to record the Bora Ground, wrote various short pieces under the title 'A History of Bulga'. An extract from this, entitled 'The last great Bora Ceremony in the Hunter Valley', was published in the December 1993 issue of the *Singleton Times Newsletter*, the journal of the Singleton Historical Society. Local Aboriginal place names are listed, and 'beautifully made stone implements' described.

> Here also is to be seen the remains of an ancient Bora ground with its sacred circles still defined by small mounds of earth and a ring of carved trees still bearing the curious emblematical devices which marked this strange and mystical ceremony of initiation of the young men of the tribe to tribal rites.
>
> This Bora ceremony was held in the year 1852, and on reliable authority of residents of the locality was attended by between 500 and 600 aborigines from various tribes from as far as Mudgee and Goulburn.

Beneath the extract is a photograph of Aboriginal people standing with spears by earth figures on the ground. Jennifer Scholes of the Singleton Historical Society indicated [27/11/02] that she had included the photograph as a general illustration, but that it was unrelated to the site and not from the Hunter region.

Records of the Australian Museum

Parallel to these enquiries, Jan Brazier, archivist at the Australian Museum, was asked if she could look for any information in the Museum records which might indicate the location of the site. Also, Phil Gordon, Manager of the Aboriginal Heritage Unit at the Museum, and Acting Head of the Anthropology Division, was asked to check whether any of the trees had been retrieved and taken to the Museum after the 1918 visit.

The outcomes of these enquiries were that no trees from the site were in the Museum collections, but Museum records of the visit did provide some detail about the site, and an important clue to its location.

A Minute Paper indicates that A.N. Eather called in to see Ethnologist W.W. Thorpe, Assistant Curator, with an additional parcel of Aboriginal siliceous flakes on the morning of April 13, 1918. 'He mentioned that he had located an old Bora-ground, 17 miles from Singleton, with Carved Trees, clearing and mounds still intact'. He offered to conduct any visitors from the Museum to the site, and offered to accommodate them at his home, 2 miles from the site. The Museum Director and Curator of Ethnology, Robert Etheridge, strongly supported the proposed expedition and its estimated cost of £8. 'It is most desirable to obtain a plan & serial photos of the carved trees at this Bora ground, which from description appears to be practically intact. I only know of one published illustration of a Bora ground, in any way appertaining to accuracy – that near Glo'ster'. He recommended that a party of three go, two 'to make a compass and tape survey', the other 'to photo the Ground and surroundings'.

On May 2, 1918, Etheridge received a letter from A.N. Eather of 'Meerea', Bulga, discussing aspects of the proposed expedition, and in response to the question asked by Mr Thorpe, 'How many trees are there in the grove?' replying 'there are about a dozen marked trees' [Letters Received 1889-1926 Series 9, E8/1918]. The party was to travel to Singleton on May 13th, stay the night and visit the site on the morning of the 14th, and stay the next night at 'Meerea' if required.

Thorpe's report of the endeavour to Etheridge [18/5/1918] is at once informative and tantalising.

> Sir,
>
> I have the honour to report as follows:-
>
> The party was duly conducted to the Bora Ground, the position of which will be fixed later, as the site [is] possibly in another Parish other than that of the map provided. Observations and measurements were made, showing the position of each tree. This will be diagrammatically portrayed by Dr Anderson.
>
> The trees, [Red Gum & Apple], were carved in the bark, with a short bladed tomahawk sixty years ago, and the bark being absent it was necessary to reconstruct the different patterns of the carvings in chalk, from well-defined scars made on the sapwood. None of the trees are worthy of removal.
>
> Associated with the trees and intercalated more or less regularly with the same, are a number of mounds of heaped earth. These will also be shown on the plan. There is also, in the north-eastern corner of the Bora Ground, a crescentic mound 2 feet high by 15 feet greatest length. Two of the smaller variety and the crescentic mound were cut through and bottomed on sandstone at a depth of about four feet. They contained nothing of an aboriginal character. The site is in open forest country on a slight eminence or plateau. Four of the trees were photographed; those carved all around were taken from different views. The ground is exceptionally level and sandy.
>
> On Thursday, Dr Anderson and Clutton proceeded in another direction to photograph some rock paintings, which I believe are exceptionally fine. I spent the day collecting flakes and other Implements at the camp site in the Bora Ground vicinity.
>
> In conclusion I would like to place on record the hospitality afforded us by Mrs Eather and her family, a fact which we will always remember with pleasure and mention with gratitude.
>
> Yours respectfully
> W.W. Thorpe
> Ethnologist

A note was added by Etheridge to the effect that the above was tabled at a committee ‘in anticipation of a full Report’. The Australian Museum Annual Report 1917-18 [Appendix 1 p10] noted that it was ‘intended, as soon as circumstances permit, to publish an illustrated description and plan of this initiation ground’.

The Register of Ethnology lists 47 stone artefacts collected by Thorpe. The provenance is described as ‘On stock Route [Site of Aboriginal Camp, associated with Bora Ground] out along Creek East of Wollombi Brook Pa. Warkworth, Bulga Dist., New Sth. Wales’. Beside this description of the location is a map drawn from memory, and measuring 4 x 3 centimetres, reproduced [and enlarged] below.

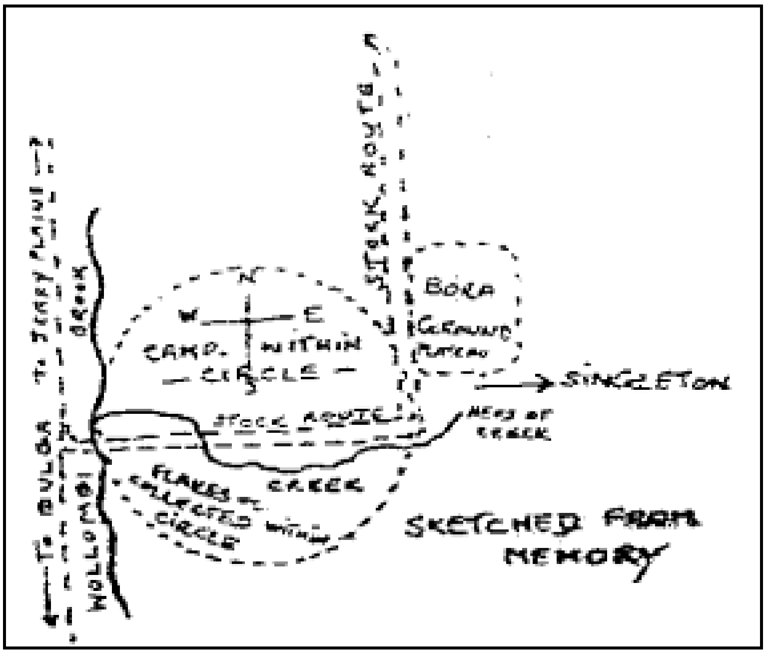

Figure 1: Extract from Australian Museum Register of Ethnology E8/1918

As the Museum records suggested that a detailed report and site plan were to be completed, a further check was made of archival material. Museum correspondence for 1918, the Curator’s and Assistant Curator’s Reports for 1918 and the General Reports for 1918 were all searched, but nothing further was found. Nor has any published document relating to the Bora Ground been found.

Etheridge’s monograph ‘The dendroglyphs or carved trees of New South Wales’ came out in *Memoirs of the Geological Survey of New South Wales Ethnological Series No 3* during 1918, but it contains no reference to the Wallaby Scrub Bora Ground. It can only be concluded that the information came too late for it to be included. His monograph does contain [Plate XVIII] an 1878 illustration of carved trees at a Bora Ground near the junction of the Page and the Isis Rivers which appear to have patterns very similar to those in the Museum photographs. Earth mounds or figures also occur at this site and another on the Hunter River near the junction of the Page [McDonald 1878]. Such similarity suggests cultural continuity between the central and upper Hunter Valley at that time and it has been argued that these common elements at Bora Grounds were a reflection of the cultural influence of the Kamilaroi Aborigines [Mathews 1896:322, Brayshaw in prep].

The Stock Route

The location of the Bora Ground seemed to be tied to the stock route. Jim and David Eather had said it was east of the stock route, which was confirmed by Thorpe's map. On seeing this map, Jim Eather reiterated that he thought the site was 150-200 yards east of the stock route, and he remembered young apple trees in the area [16/12/02]. He also thought he might have looked too far north when trying to relocate the site with his brother David. He was keen to look again.

There was a road easement indicated on the Singleton 1:25,000 map, and it was thought that this might have been the stock route. Enquiries were made of the Manager of Stock Routes at the State Council of the Rural Lands Protection Board in Orange. No evidence of a stock route was found, but the Hunter office of the RLPB at Singleton was recommended as the best source of information. Jerrod McGloughlin, the Ranger responsible for managing stock routes in the district, pursued the matter, and responded that the easement marked on the map may have been an old crown road, but there was never a formal travelling stock route [TSR] there.

The 1912 Warkworth Parish Map [Image 1087031 www.lpi.nsw.gov.au] indicated the easement to be a surveyed road. At the Plan Room of the Land & Information Office the original road plan [394A 1603 Sheet 2] was examined, and the road revealed to have been surveyed in 1864. The road may have been along a route already in use as a travel and stock route. Certainly the Eather family used the route to transfer their stock between their holdings at Bulga and at Bunnan. The formal status of the thoroughfare may have been that of a road, but its identity in the minds of the Eathers, and therefore of Museum Ethnologist Thorpe, was that of a stock route.

Thorpe's map indicates the stock route to run due east from Wollombi Brook and then turn a right angle to the north. On the 1912 Parish Map the surveyed road has a right angle, although it is not exactly east-west or north-south. However, as indicated below, its relation to the creek east of Wollombi Brook is clearly similar to that depicted from memory by Thorpe.

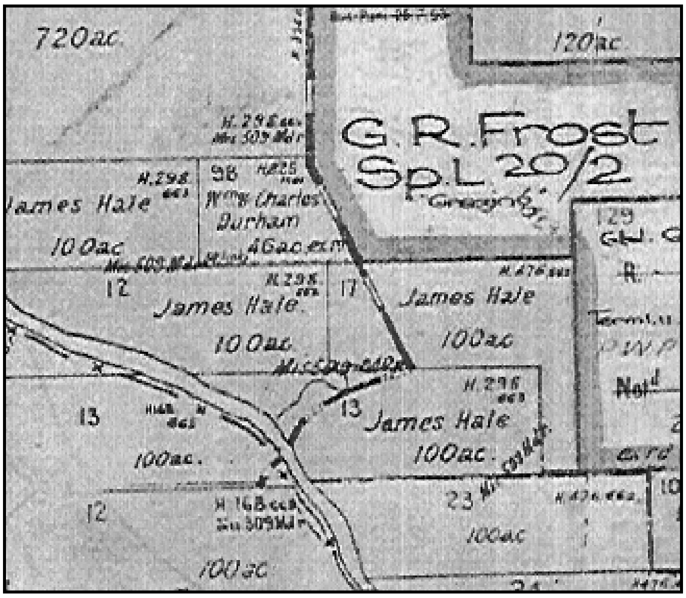

Figure 2: Extract from 1912 Warkworth Parish Map
[Image 1087031 www.lpi.nsw.gov.au]

In Figure 3 Thorpe's sketch map made from memory [Figure 1] was enlarged and overlain to scale on the Singleton/Bulga 1:25,000 topographic maps. From this it can be concluded that the Bora Ground was east of the road/stock route, and probably within Portion 17. The post and rail fence north of the tree stump that Jim Eather saw, and which is shown in Plate 2, was most likely along the northern boundary of Portion 17.

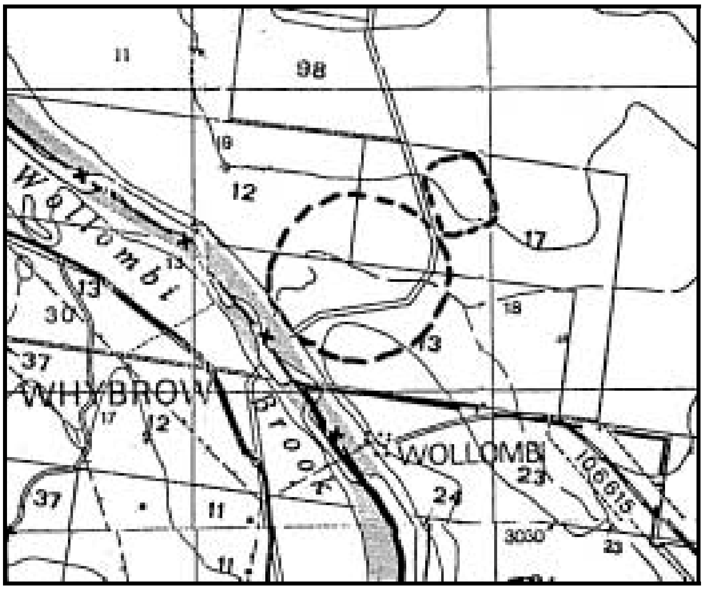

Figure 3: Thorpe's sketch map made from memory [Figure 1] overlain on the Singleton/Bulga 1:25,000 topographic maps [9312-IV-N and 9312-IV-S First Edition].

The original annotated Plans for Portions 11, 12 and 17 in the Parish of Warkworth were examined to see if there was any reference to carved trees. Reference on these plans is made to Field Book 448. George Boyle White surveyed some of these portions in 1836 and others, including Portion 17, in February 1838. Field Book 448 [SR 2/5065 CGS 13889] and associated letters received by the Surveyor General from surveyors [SR 21590A Reel 3096] were examined, but George White made no reference to carved trees in either the field book or his correspondence. The carving on the tree in Plate 2 faced away [south west] from the portion boundary and fence line, so it may be that the tree was there and not seen by George White, or it may be that the tree carving was carried out after 1838, ie especially for the ceremony which was held in 1852.

Eathers and Aborigines Return to Bulga

Jim Eather appeared to be the only living person who had actually seen the carved tree site, so an approach was made to get him back to the area and see if he remembered anything of the place. I wrote to Coal & Allied requesting them to allow him onto their land for this purpose, and that it be done soon in view of his age. They responded promptly, and the visit was arranged for Thursday 20th February, which as it turned out was very timely, since the following Monday Jim was to go into hospital for surgery on his ankle which was expected to put him out of action for an extended period.

On the appointed day Jim Eather, his wife Marjorie, two of his sons, Alan and Bruce, and his brother David drove down from Bunnan for this purpose [Plate 9]. Coal & Allied personnel present were Sarah Fish, Mick Lovely, Dianne Markham and Adam Schultz. Helen Brayshaw was accompanied by archaeologist Dr Laila Haglund, who had been involved in two investigations in the area where the location of the Bora Ground had been an issue, and had been party to some of the discussions with Stewart Mitchell.

Access to the stock route was via Wallaby Scrub Road. There is presently a wire fence along the northern boundary of Portion 17, and a vehicle track along the northern side of the fence. Along the western side of Portion 17 is the remnant of a wire fence which would have been the eastern side of the stock route, and there is a parallel wire fence on the western side of the stock route.

At the north western corner of Portion 17 a remnant post from a post and rail fence along the northern boundary was still standing [Plate 9]. There are two or three other similar posts lying beside it on the ground. This was seen as an important clue, as Jim Eather remembered a post and rail fence north of the tree stump that he saw, and the Museum photograph V5314, taken from the south west of tree No 5, showed a post and rail fence in the background, which would place the tree just south of this fence – about 20 metres, estimating from the photograph [Plate 2]. A possible anomaly is that the post and rail fence in the photograph seems to have had two horizontal rails while the remnant posts had three. The third hole in the existing posts may have related to reinforcing, since they are located at the section. Fencing with three rails generally predates the use of two, and Jim Eather commented that two rails were sufficient for horses and cattle [Connah 1988:88-89, Birmingham *et al* 1979].

In order to familiarise himself with the area, Jim went down around the corner of the stock route to the creek, and then came back north, up the stock route. He was comfortable that the burnt stump of the carved tree he had seen was no further north, but adjacent to the portion 17 boundary.

A search was made within Portion 17, extending some 300 metres south of the fence and up to 400 metres east of the stock route. About 200 metres east of the stock route were features which accorded with Jim's memory, level sandy ground, rough barked apples [*Angophora floribunda*], blady grass [*Imperata cylindrica*] and bracken [*Pteridium esculentum*]. There were also Black Pine trees [*Callitris* sp] to the east of this point. Such a tree is visible in Plate 6.

On March 7th another opportunity to visit the site arose, this time with members of the local Aboriginal community. Representatives of several groups were present, the Wanaruah Local Aboriginal Land Council, the Ungooroo Aboriginal Corporation, the Lower Wonnarua Tribal Council, the Combined Council of Hunter Valley Traditional Owners, and the Upper Hunter Wonnarua Council, who also represented the Wonnarua Nations Aboriginal Corporation. Also present were representatives of both Wambo Mine and Coal & Allied, since the site appeared to straddle the boundary between two mining leases, and Elizabeth White, who directed the associated archaeological assessment at Wambo Mine.

Down to Detail

This second visit enabled a closer inspection of the area and comparison with Museum information and the Museum photographs.

Thorpe mentioned mounds of heaped sandy earth amongst the trees some of which were dug into and found to be about four feet deep. No earth mounds show up in any of the Museum photographs, but disturbed exposures of deep sand were visible close to the northern boundary of Portion 17 [314030E 6389730N - estimated from nearby hand held GPS reading]. With his letter of December 18, 2002, Jim Eather had provided a sketch of the carved tree stump and low sandy earth mounds which he had seen in the late 1930s. The mounds were about a foot high, one to two metres long, and indistinct by then. The tree which he saw was probably No 5, since he remembered the post and rail fence just to the north of it.

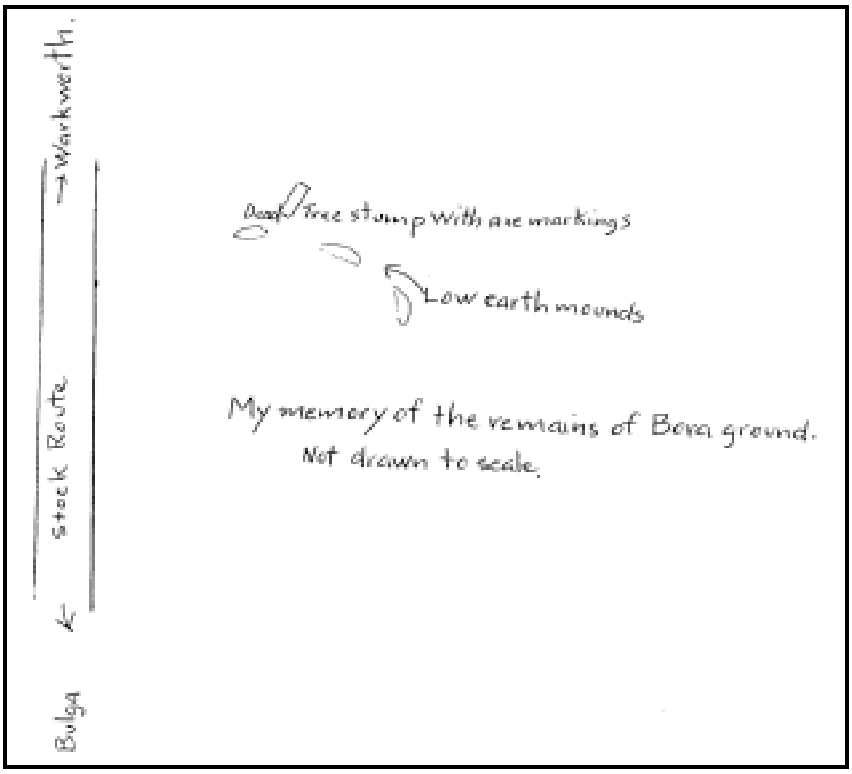

Figure 4: Sketch by Jim Eather 18/12/2002

The Museum photographs were studied very closely to see if they gave any clues which would enable the location to be pinpointed. To this end images were obtained direct from the Museum to maximise visible detail.

There appear to be some discrepancies in the Museum information in relation to the photographs. First, the markings on tree No 9 are shown in V3515, V3516 and in V3519 [Plates 3, 4 and 7]. The image V3515 received from the Museum for this project, corrected here [as in NPWS site form #37-6-56], was in reverse, as indicated by the visible part of the image number at bottom left. Then, looking at the markings and the trees in the background, it is apparent that V3519, which the notation in the Register of Negatives says was taken due east from No 1, must in fact be *from* due east.

The notation in the Register of Negatives also indicates that V3519 [Plate 7] is of 'Aboriginal Carved Trees Nos 1, 8, 9 & 10 (Due E. from No 1)'. If the picture is taken due east [or in reality west] from No 1, it is unlikely to include No 1. Tree No 8 could be in the picture, but in the background, or it could be a dead tree to the left of and behind Tree No 9, or a tree nearby lying on the ground, since Ian Eather mentioned his uncle Alex had said some of the trees had fallen over. In his report of 18th May 1918 W.W.Thorpe noted that 'four of the trees were photographed', ie 1, 5, 9 and 10.

Thorpe also noted that, as the bark was absent from the trees, ‘it was necessary to reconstruct the different patterns of the carvings in chalk, from well-defined scars made on the sapwood’. Only on one tree [Plate 2] are the scars really clear. Chalking has obviously also been done in the photo taken by Les Stewart [Plate 8]. It could be noted here that the photographs show all of the carved trees to have been dead in 1918. Other dead trees in the photograph have been ringbarked, but none of the carved trees. Two of the photographs show mountains in the background, V3513 [Plate 1], towards the south, and V3517 [Plate 5], towards the west. At present there are too many trees to get a good view of the mountains in either direction, although they clearly conform to the horizons shown in the photographs.

The Museum description referred to the site being on a slight plateau or eminence, and exceptionally level. The locally highest point in the landscape is at 313904E 6389609N [hand held GPS reading] but a shallow hollow formed in the ground surface by a fallen tree showed the soil to be stony with only a few centimetres [eg - up to 5cm] of sand on top. Also the vegetation is largely casuarina and ironbark, without the bracken, rough-barked apple and *Callitris* sp shown in the photos of the carved trees taken in 1918. To the south west of this high point the land begins to slope quite steeply. The area just east of the high point has the correct array of tree species as well as blady grass and bracken, and is sandy as described by Thorpe in 1918.

The change in vegetation between ironbark – casuarina and the more mixed community was recorded near a tree stump at AMG 56 313969E 6389673 [reading - High Accuracy NTv2 method provided by Nic Gardner, Survey Projects Manager, Co-Resources Pty Ltd]. The combined factors of depth of sand and vegetation composition suggest that the carved trees can have been no further west than this. About 70 metres east of this point *Callitris* begin to appear, and there is a very large, dead, rough barked apple just to the south east. The exposures of deep sand observed on the day of the Eathers’ visit, which could have been near tree No 5 as sketched by Jim Eather [Figure 4], were about 90 metres north east of the stump. On the basis of all the available evidence therefore, it seems most probable that the carved trees were east of the stump, north of the apple and south of the northern boundary of Portion 17. This places the trees at the north eastern edge of the area as described by Thorpe [Figure 5].

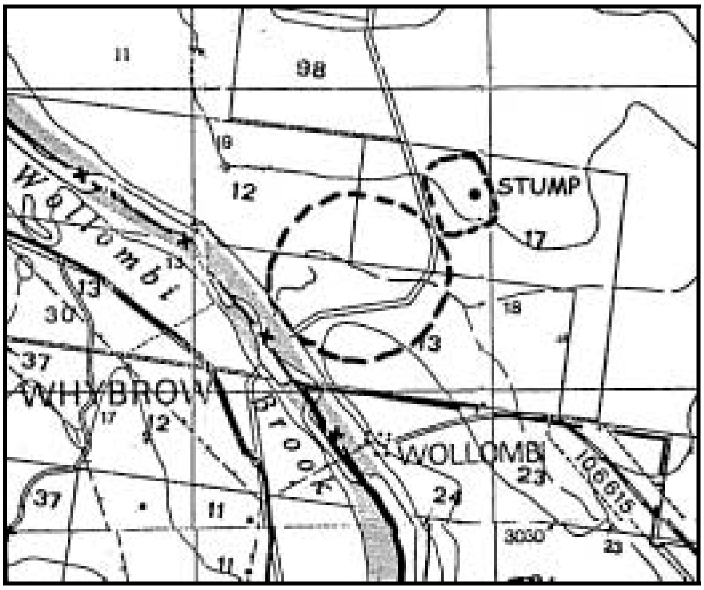

Figure 5: Location of tree stump on edge of vegetation change, with increased depth of sand occurring to the north and east.

Based on a study of the Museum photographs a reconstruction of the relative position of the trees has been attempted [Figure 6]. The position of trees No 5 and No 1 in relation to each other, including the distance between them, is unknown. The distances between tree Nos 1, 9 and 10, and between tree No 5 and the fence has been estimated from the photographs. The approximate angles of each photograph is indicated. The fact that the trees are referred to by number clearly indicates that a plan was drawn.

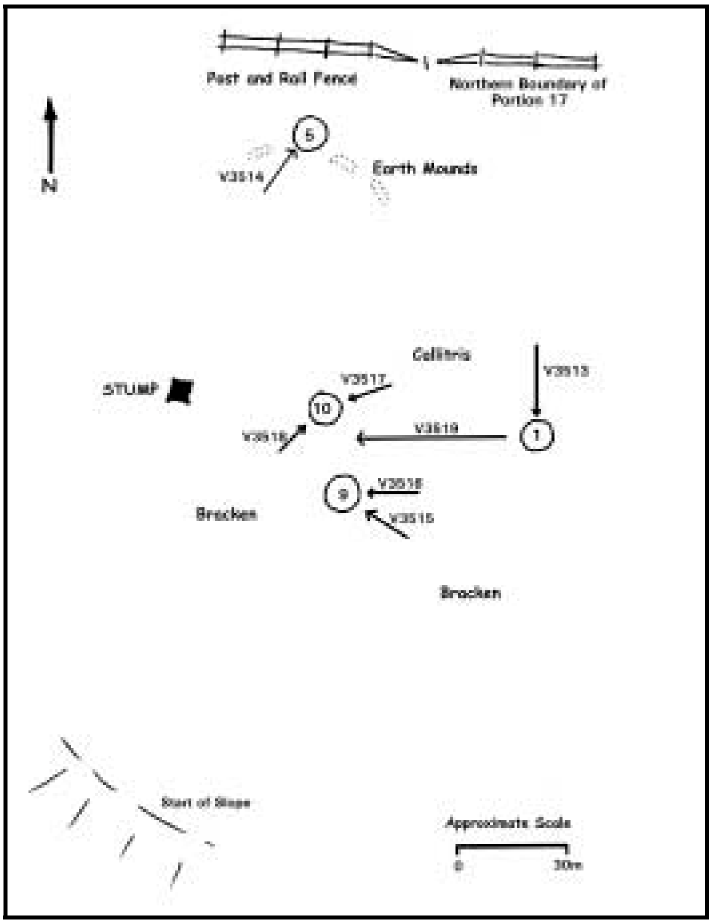

Figure 6: Reconstructed Site Plan

Conclusions

Thorpe's map sketched from memory establishes beyond doubt that the Bora Ground is located in the vicinity as indicated on Figure 3. He reported Alex Eather as saying that his home, 'Meerea', was 2 miles from the site. The location of the carved trees, as suggested in Figures 5 and 6, is 3.25 kilometres or 2.03 miles from 'Meerea'. There is no other association of creek and stock route with Wollombi Brook, as described, for which it could be mistaken.

Jim Eather's memory has been vital in pinpointing the location more closely and placing some of the earth mounds. The Museum photographs were helpful in locating the site, but changes in vegetation over time made it impossible to be precise. What a difference Dr Anderson's diagrammatic portrayal would have made. Nevertheless, with the evidence available and Jim Eather's assistance, it has been possible to locate and to some degree characterise the Bora Ground in the Wallaby Scrub.

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Plates

Plate 1: Australian Museum Photograph Archives
V5313 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 1 from due North.

Plate 2: Australian Museum Photograph Archives
V5314 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 5 from W., 29^{o} South

Plate 3: Australian Museum Photograph Archives
V5315 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 9 from E., 37^{o} South

Plate 4: Australian Museum Photograph Archives
V5316 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 9 from due East

Plate 5: Australian Museum Photograph Archives
V5317 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 10 from E., 18^{o} North

Plate 6: Australian Museum Photograph Archives
V5318 - May 1918. C. Clutton Photographer
Aboriginal Carved Tree No 10 from W., 40^{o} South

Plate 7: Australian Museum Photograph Archives
V5319 - May 1918. C. Clutton Photographer
Aboriginal Carved Trees Nos 9 & 10 From due E. of No 1.
Caption modified from Museum notation of
'Aboriginal Carved Trees Nos 1, 8, 9 & 10 (Due E. from No 1)'.

Plate 8: Carved Tree and Don Roser, taken by Les Mitchell early 1920s
Photograph supplied by Stewart Mitchell of Bulga

Plate 9: Post of post and rail fence [arrowed] near north western corner of Portion 17, camera facing south east.

Plate 10: Alan, Bruce, Marjorie, Jim and David Eather [L to R] on the stock route near the north western corner of Portion 17, camera facing south.

ATTACHMENT D-2

GEOMORPHOLOGICAL REPORT

A GEOMORPHOLOGICAL ASSESSMENT OF THE WAMBO DEVELOPMENT PROJECT AREA, WARKWORTH, NSW

A report to

Elizabeth White, Archaeologist
12B Heathcote Street, Picton NSW 2571

Prepared by:

Philip Hughes

April 2003

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1 TASKS

The consultant (Philip Hughes) was required to undertake a geomorphic assessment of the Study Area, particularly concentrating on the possible contexts in which early Holocene and late Pleistocene deposits containing stratified or dateable materials might occur.

The fieldwork was undertaken over a two day period (11-12 December 2002) by Philip Hughes and Elizabeth White. The archaeological field survey had been largely completed by this time and the consultant concentrated on areas of potential geomorphic interest identified during the archaeological field survey. The consultant was provided with geological and topographic maps at a scale of 1:25,000, and with colour and black and white airphotos.

The following localities were specifically examined in the field and are described and discussed below (the numbers in brackets refer to features marked on Figure 1):

1. The colluvial footslopes with duplex/texture contrast soils south of North Wambo Creek (1).
2. Wollombi Brook and its banks (2).
3. The remnant of the Tertiary river terrace deposits and associated silcrete mapped as Cza on the geological sheet (3).
4. North Wambo Creek and its associated valley fill, mapped as Qha on the geological sheet (4 and 5).
5. A prominent unmapped reddish sand rise on the west side of Wollombi Brook north from its confluence with North Wambo Creek (6).
6. Colluvial deposits and associated soils in the steep catchment of Unnamed Creek #1 to the west of North Wambo Creek (7).
7. A deep well-defined channel joining Wollombi Brook from the east (8).
8. Extensive sand sheets on the eastern side of Wollombi Brook (mapped as Czb on the geological sheet) (9).
9. A well-defined but unmapped sand dune on the eastern side of Wollombi Brook (10).

The Study Area is underlain by a range of Permian sedimentary rocks (mainly sandstones) which are capped in places by the Tertiary, Pleistocene and Holocene deposits which are the focus of this assessment.

2 COLLUVIAL DEPOSITS WITH DUPLEX SOILS

On the southern side of North Wambo Creek the very gently sloping (~1:100) footslopes of the steep sandstone hills to the south are capped with stony weathered mottled colluvium (particularly well exposed in a long open trench) capped in turn by a thin (usually less than 250 mm) layer of sandy topsoil. The sandy topsoil constitutes the A horizon of a duplex or texture contrast soil and the underlying weathered stony colluvium the B horizon and even deeper, the parent material. The presence of sandstone outcrops along the western bank of the creek in this area indicates that the thickness of colluvium is likely to be less than 2 m over most of the area.

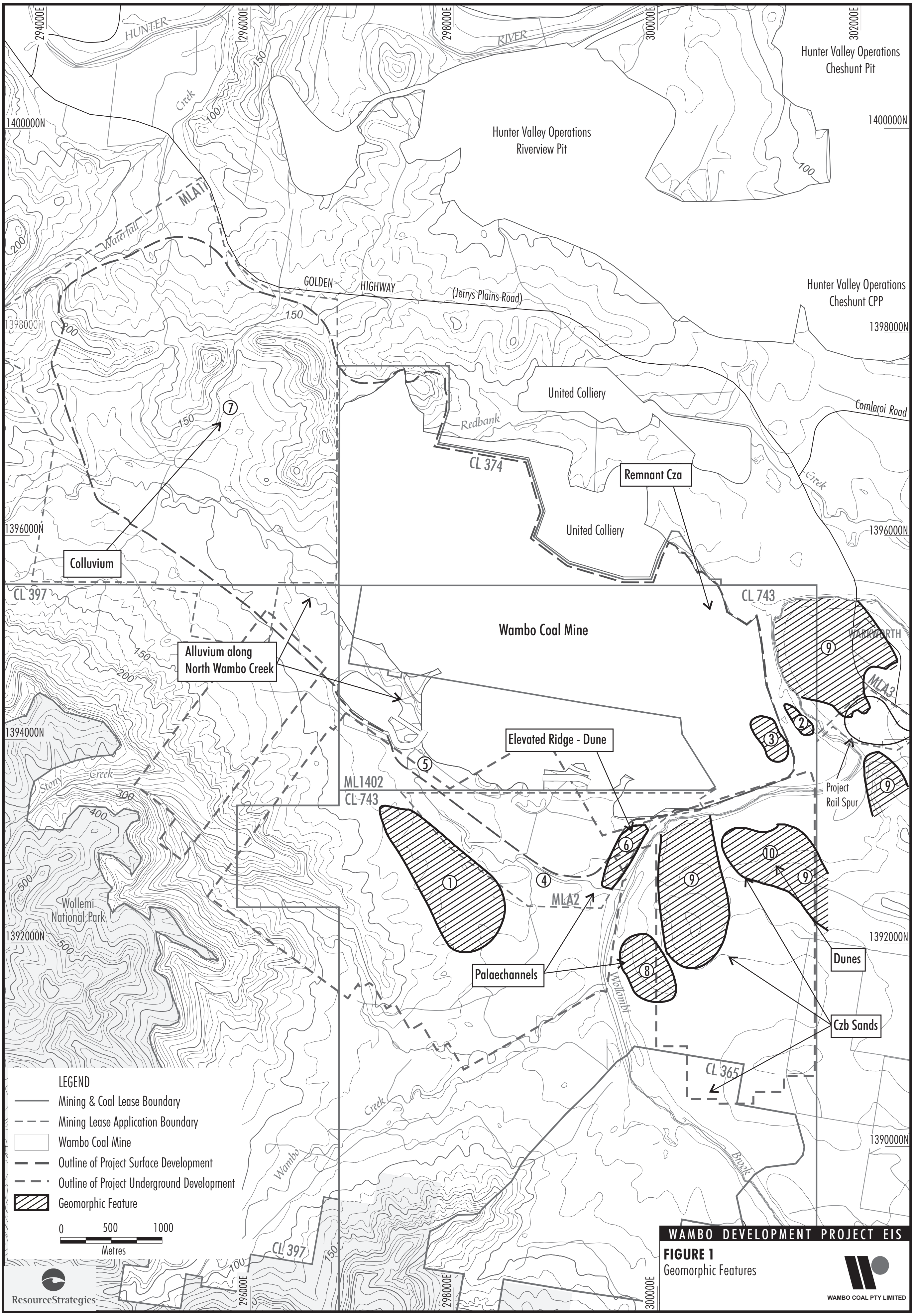

FIGURE 1
Geomorphic Features

WAM-02-01-ABH-AttD2_001C

Following on from the work of Mitchell and his colleague on the origin of hillslope duplex soils in the Sydney Basis, Dean-Jones and Mitchell (1993: Section 4.1) consider that in the Hunter region duplex soils are the result of superposition of two unlike materials through the action of contemporary lateral movement of sediments down the slope under the influence of bioturbation and slope wash. Fluvial hillslope processes create the discontinuity present between the A and B horizons which are in effect two distinct strata, which are time transgressive rather than genetic soil horizons.

Numerous artefacts were recorded on this sandy topsoil in this part of the Wambo landscape, especially where it was eroded. As is the case elsewhere throughout the Hunter region, because of their thinness and the degree of ongoing disturbance the potential for these duplex soils to contain stratified, dateable archaeological deposits is extremely low. The likelihood that they contain identifiable early Holocene or late Pleistocene archaeological materials is even lower.

1. The A horizons of the duplex soils in this area are generally thin (<250 mm) and therefore given disturbance and mixing of sediments during their lateral movement there is limited possibility that any older archaeological materials (artefacts and charcoal) that might be present can be distinguished from younger materials.
2. The B horizons of these duplex soils have negligible potential to contain Pleistocene archaeological materials. The colluvial parent materials of the B horizons are likely to have been in place since before the last glacial maximum (about 20,000 years ago) and may well predate human occupation of the Hunter region (see Section 5.1 below for further discussion of the age of these deposits).

3 WOLLOMBI BROOK

3.1 Context

The Study Area is split by Wollombi Brook, a major tributary of the Hunter River and whose channel at Warkworth is about 100 m wide and 7 m deep (Erskine 1994, Figure 5). According to Erskine (1994) the channel morphology is still recovering from the 1949 flood, which was the largest flood on Wollombi Brook since European settlement. The flood caused massive river bank erosion, substantial sand deposition in the river bed and on the flood plain and the destruction of extensive riparian vegetation. The flood peak was almost 27 times greater than the mean annual flood but had a return period of only 87 years on the annual maximum series. Furthermore, Erskine and his colleague present evidence that palaeofloods up to 40% larger than the 1949 flood have occurred during the late Holocene.

Long periods of low or zero flow interrupted by short periods of high discharge characterise the Wollombi Brook system. Since 1908, annual flow has fluctuated from less than 2% to more than 550% of the mean annual flow (Dames & Moore 1981). Flood data recorded at Warkworth has been used by Dames & Moore (1981) to estimate flood heights since 1908 on Wollombi Brook at its junction with North Wambo Creek (Table 1)

Table 1: Maximum Flood Heights at Warkworth

Date of Peak Flow	Maximum Flood Height (m above AHD)
16 May 1913	60.4
18 June 1930	60.4
18 June 1949	61.8
25 February 1955	61.4

The 1:25,000 topographic sheets show that apart from very limited areas of low-lying floodplain immediately behind the Wollombi Brook levee banks either side of the river, virtually the entire Study Area (including the floor of North Wambo Creek) is 62 m above AHD or higher and therefore would not have been directly inundated by water from the river during these major floods.

Along its lower reaches (including in the vicinity of Wambo) the channel is partially confined by bedrock and coherent terrace deposits so the degree of bank erosion was less than in its upper reaches. Since the late 1950s partial channel recovery has occurred by bed degradation excavating the flood-deposited sand and by in-channel bench formation contracting the channel.

Floods of this magnitude and frequency undoubtedly would have affected the nature (and survival) of any archaeological materials associated with alluvial deposits in the flood zone. However, as discussed above, at least during the historical period most of the Study Area has not been inundated with flood waters, so flooding is unlikely to have had a major impact on the archaeological record.

3.2 Field Inspection

The banks of Wollombi Brook were inspected at two localities: (i) adjacent to the prominent reddish sand rise on the west side of Wollombi Brook, and (ii) immediately northwest of the bridge crossing. At the first locality about 4-5 m of probable aeolian sand (see below) was found resting on sandstone bedrock which itself was 2 m above the bed of the creek. These sediments are discussed in Section 6 below.

At the second locality (2 on Figure 1) on the 7 m high levee bank of the river, exposures along deep erosion rills revealed river gravels capped with 2 m of loamy brown and yellow sand with declining content of fine gravel upwards. No artefacts were observed in our cursory examination of the ground surface. These alluvial deposits were comparatively uncompacted and unweathered and are probably Holocene rather than Pleistocene in age. The surface was slightly higher close to the river where the levee bank was most developed and there was well defined shallow back channel against the bedrock hillslope to the west.

There was a continuous low alluvial bench of unconsolidated yellow sand inset in the channel below the high bank. This is the bench described by Erskine (1994) as having formed since the early 1950s.

4 TERTIARY RIVER TERRACE DEPOSITS (INCLUDING SILCRETE)

On the 1:25,000 geological map sheet extensive outcrops of silcrete associated with Tertiary river gravels are mapped on the west bank of Wollombi Brook and downstream of the bridge. Most of these deposits have been removed by mining operations. The consultant inspected a small quarry in the area where these deposits were mapped as occurring. A highly disturbed layer of river gravels and cobbles up to 1 m thick overlying sandstone was observed on the Brook side of the quarry. These are almost certainly the tiny remnant of the former mapped Tertiary river gravels. There was no associated silcrete outcrop.

Because all the silcrete and almost all of the river gravels have been removed it is now not possible to assess whether silcrete was indeed present or not, and if so whether this silcrete occurrence may have been used as a source of raw material for artefact manufacture.

5 NORTH WAMBO CREEK AND ITS ASSOCIATED VALLEY FILL

5.1 Lower Reaches (4 on Figure 1)

For its first 1.5 km upstream from its confluence with Wollombi Brook the channel is entrenched to a depth of up to 4 m. The cross-section profile is U-shaped and the channel is on average about 20 m wide. Exposed in the creek banks are up to 3.5 m of alluvial/colluvial sediments capping sandstone. In some places the bed of the creek has cut up to 1 m into the underlying sandstone. All but the top 1 m or so of the bank sediments consist of weathered, mottled gravels and sandy gravels with frequent well-defined lenses of gravel. Where dry, these sediments are rock hard. The poor degree of sorting and the angularity/roughness of much of the gravel indicates that these deposits are largely colluvial in original. However the gravel lenses indicate that some of the sediment is alluvial in origin, which is to be expected given the channel was probably always located more or less along the centre of the valley floor. As discussed below, in the one place where there was deep exposure right across the valley floor to its eastern margin these weathered gravelly sediments were shown to occur continuously.

The deposition of these coarse gravel-rich colluvial/alluvial deposits must have occurred under climatic conditions very different from those of today. Modern rivers carry and discharge during floods mainly sand-sized and finer materials and large scale deposition of colluvial gravel is not occurring at present on the gentle footslopes of the hills in the area. The consultant considers that the deposition of these coarse deposits took place under conditions analogous to those described for the lower Nepean River district near Sydney by Gerald Nanson and his colleagues (e.g. Nanson and Young 1988). Their investigations have yielded evidence of exceptional fluvial activity in lowland basins in southeastern coastal Australia well before the last glacial maximum.

The most recent dating (as yet unpublished) indicates that this fluvial episode (the 'Cranebrook Pluvial') commenced more than 100,000 years ago and may have been completed by 50,000 years ago. Nanson and Young (1988: 58) could find no alluvium that could be ascribed to the period of maximum glaciation (about 20,000 to 18,000 years BP).

Although not stated directly by these researchers, the implication is that any major stripping of unconsolidated hillslope deposits (including soils) to provide the massive amounts of sediment transported during this pluvial event must have occurred during or prior to the event, i.e. at least 50,000 years ago. Their conclusions are at odds with the proposal that the main period of alluvial deposition in coastal valleys in southeastern Australia was triggered by widespread slope instability during the last glacial maximum. The data they presented suggests the glacial was a cool dry period of relatively little fluvial activity in basins not affected by glaciation.

Given their close proximity and similar environments, the Hunter Valley probably would have experienced similar climatic regimes through the late Pleistocene and Holocene as the lower Nepean region, with broadly similar geomorphic consequences. On balance, it would seem likely that the bulk of the gravel rich clayey sediments which form the North Wambo Creek valley alluvial/colluvial fills and the associated footslope colluvium (and which provided the parent material for the duplex soils B horizons) accumulated during this pluvial period before about 50,000 years ago. If so, these materials largely, if not entirely predate human occupation of Australia.

Along the creek banks these earlier, weathered, gravel-rich sediments are capped with up to 1 m of soft, brown, organic, gravelly loamy sand with small lenses of fine gravel. Occasional stone artefacts were observed on the surface of these sediments, suggesting their accumulation largely if not entirely predated European settlement of the area. At one point a 2 m wide, 0.6 m deep water pipeline trench had been cut right across the valley floor from its eastern side, across the creek and then across the colluvial footslopes on the western side. This open trench provided an excellent exposure of the underlying sediments. As discussed above, weathered basal gravelly deposits were observed along the entire length of the trench. These were capped with 100-300 mm of loamy pale grey-yellow sand which, except for the first 20 m east of the creek, contained no gravel. This sand merged laterally with the thicker, more gravel rich sediments described above as occurring extensively along the creek banks. A small number of stone artefacts was observed in the sandy upcast along the length of the trench. This indicates that most, if not all, of this sand was deposited before European settlement.

This sand is almost certainly flood alluvium from North Wambo Creek, although some of it could have been deposited by Wollombi Creek floodwaters.

Given the thinness of the sand and the apparent scarcity of stone artefacts in it, this alluvium would appear to have very little potential to contain concentrations of stone artefacts in stratified, dateable contexts. According to Elizabeth White, records of the land use history of the area show that these flats have all been cultivated repeatedly, so most of this upper sandy alluvium has been heavily disturbed over the past 170+ years or so.

5.2 Middle Reaches (5 on Figure 1)

Upstream to about 4 km from the confluence the channel becomes increasingly shallow and further upstream to about 6 km (as far upstream as inspected by the consultant) it is only very shallowly incised (~0.5 m) and the bed is stable and grassed. The main channel meanders markedly, as do the smaller channels of tributary creeks which appear to join the main creek at very acute angles.

Because of the generally close cover of grass and lack of erosion exposure of the underlying sediment is limited. The banks of the creek and the adjacent floor of the valley have the same sequence of duplex soils formed on colluvium observed along the western side of the lower reaches. Occasional artefacts were seen on or eroding out of the sandy topsoil, suggesting these sediments are pre-European settlement in age.

In the middle reaches (i.e. between about 1.5 km and 4 km) there is a well developed inset terrace or bench about 1 m below the level of the surrounding valley floor. This bench consists of loose loamy sand and by analogy with its equivalent along Wollombi Brook it probably formed after the 1949 and 1955 floods.

5.3 Evolution of the Channel

Dean-Jones and Mitchell (1993, Chapter 3) undertook a field examination of a number of creeks in Central Lowlands. Their general conclusions of the geomorphic histories of these creeks are relevant to understanding the history of North Wambo Creek. Dean-Jones and Mitchell argued that most creek catchments in the region have had a recent history of catchment destabilisation and stream incision, related in part at least and probably largely to European land use patterns. Their regional historical review indicates that the extensive gullied/incised stream networks and associated sheet eroded slopes which characterise many of the modern creeklines in the region did not exist or were very limited in extent before European settlement (Dean-Jones and Mitchell 1993:28-32). Rather, historic descriptions of the valley floors of 2nd and 3rd order streams refer commonly to the existence of ‘grassy or swampy meadows’ and ‘chains of ponds’ (see for example Eyles 1997).

It would appear from this description that the stretch of North Wambo Creek between 4 km and 6 km upstream of the confluence with Wollombi Brook more closely resembles what might have been the ‘natural’ state before European settlement than does most creeks in the region. It appears from the lack of post European sedimentation (except for the inset benches) that this valley was only minimally affected by the changes wrought by European land use. Elizabeth White has studied an early map “Map of the Colony of New South Wales” drawn by Thomas Mitchell (then Surveyor-General) that notes “Wambo p.ds” (probably Wambo ponds) along what is now known as North Wambo Creek. This proves support for this interpretation.

At its junction with Wollombi Brook North Wambo Creek would always have been entrenched to the same depth as the bed of the river. Whether the deep U-shaped channel always extended upstream as far as it currently does, or whether it was extended by land use-induced changes to the hydrology of the creek is not known.

6 REDDISH SAND RISE ON WEST SIDE OF WOLLOMBI BROOK

6.1 Morphology and Stratigraphy of the Feature

A prominent reddish sand rise occurs on the west side of Wollombi Brook north from its confluence with North Wambo Creek. This rise is approximately 750 m long north south and ~100 m wide. It forms the locally highest point in the landscape, being at 1-2 m higher than the levee banks along Wollombi Brook to the south and even higher (2-3 m) above the valley floor of North Wambo Creek to the west. To the north it ends at a small entrenched drainage line that runs along the base of the bedrock slope further to the north. To the south it ends at North Wambo Creek. Although mapped as Qha, it is clearly different in several respects from the alluvial/colluvial fill of North Wambo Creek valley to the west and the alluvial levee banks of Wollombi Creek to the north and south. It is also archaeologically very different in that it has a relatively dense and diverse assemblage of archaeological materials across its surface. Two spot heights are presented of detailed mine topographic plans. They are 63 m and 64 m above AHD respectively, i.e. during the major floods described in Section 3 above which peaked at less than 62 m above AHD, this feature would have protruded 1-2 m above the water level.

The sediment consists of slightly loamy/clayey fine sand with a distinctive deep red colour that is totally different from the yellow-brown-grey colours of the surrounding alluvial and colluvial sediments, including the yellow sand in the bed of Wollombi Brook. During dry and windy conditions vehicle traffic along the track across this feature produces clouds of 'bulldust'. The only deep exposure through these deposits was at the point an old vehicle track across Wollombi Brook cuts through the 6-7 m river bank. The upper 3 m or more consisted of red loamy fine sand overlying 1 m of mottled weathered clayey sand, the whole sequence resting on 2 m of sandstone. There appeared to be no gravel in the sand.

The morphology of feature and the texture of its sediments indicates that it is a sand dune. Its form, stratigraphy and the colour of the sand (red) most closely resembles the late Pleistocene Cheshunt dune on the southern bank of the Hunter River 8 km to the north excavated by Hughes and Shawcross (2001). The Cheshunt dune formed some 84 to 88,000 years ago. The Wambo dune is also stratigraphically similar to the sand sheet excavated by Hughes and the AMBS team at the Warkworth coal mine about 6 km to the east (AMBS 2002).

6.2 Possible Origin of the Sand

Its position in the landscape close to and parallel to Wollombi Brook indicates at first glance that it is a source bordering dune, with the sand being blown up from the bed of Wollombi Brook. However two characteristics of the dune strongly indicate that this is not the case. Most other sand bodies associated with Wollombi Brook, especially upriver of where it enters the Hunter River plain (a) lie to the east of the river, and (b) consist of greyish yellow or yellow sand[1].

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[1] Elizabeth White pointed out to the consultant that further down-river at the Lemington mine, Site WB6 occurs on a sand body (from photos of the feature probably a dune) on the eastern side of

In the CSIRO Land Systems Report (Story *et al*. 1963) the sand dunes associated with the Hunter River and Wollombi Brook were mapped as part of the Warkworth Land System (Galloway 1963). As a group their morphology was considered by Galloway (1993) to be consistent with the sand and dust having blown up from the exposed beds of the Hunter River and Wollombi Brook by northwest winds. The Wambo dune lies on the upwind side of Wollombi Brook and is apparently the only such feature to do so along this stretch of the river. The red colour is consisted with the Hunter River being the ultimate origin for the sand. The sands of features associated with the Hunter River are usually red or reddish in colour, indicating they contain a high proportion of minerals other than quartz. The headwaters of the Hunter River catchment from which these sediments were derived contain large areas with basalt and other volcanic rocks, as well as a wide range of metamorphic rocks. In contrast, the catchment of Wollombi Brook consists largely of Triassic quartzose sandstone, which give rise to quartz rich yellowish sediment.

6.3 Unnamed Creek #1 Catchment as a Possible Source

If the sand ultimately blew in from the Hunter River, then it is difficult to explain how it crossed the range of hills between the two rivers and why the dune formed precisely along the banks of Wollombi Brook. A possible alternative source of the sediment was the same range of hills to the north of North Wambo Creek and about 6 km northwest of the dune. A brief examination was made of the soils developed on mainly Permian sandstones exposed on the steep colluvial slopes in the Unnamed Creek #1 catchment. These soils are red, sandy and relatively erodable. According to Elizabeth White, soils of the kind we inspected occur widely throughout the catchment and therefore could in the right circumstances have provided an ample supply of windblown sediment. The problem still remains as to how (and when) the sand made its way across the broad valley floor and why it accumulated precisely where it did. The stratigraphic relationship between the sand dune and the adjacent North Wambo Valley fill is unknown and could only be assessed by systematic geomorphological excavations.

6.4 Archaeological Potential

The results of the Cheshunt dune (Hughes and Shawcross 2001) and Warkworth sand sheet (AMBS 2002) investigations show that deep windblown sand deposits such as this have the potential to contain stratified and possibly dateable archaeological deposits.

The Cheshunt dune was very similar to the Wambo sand body in terms of its morphology (both are dunes), location close to a major river and colour (and by inference mineralogy). However, the Cheshunt dune had on average less that 1 m of uncompacted, unweathered sand overlying the compacted weathered core.

Wollombi Brook within a deeply entrenched meander curve. It was described as having ‘reddish-brown’ sandy silty topsoil (Brayshaw et al. 1996:28). In colour copies of the photos the sand at WB6 is reddish, and Elizabeth White’s recollection of the sand at this site is that it was more reddish than the Wollombi sand sheets at Wambo, but perhaps less reddish than the Wambo sand body under consideration in this study. Site WB6 is located at the western edge of the Hunter River Quaternary alluvial and aeolian plain and therefore the sandy body could contain sand derived from the Hunter River as well as Wollombi Brook.

Artefacts were found through the upper sand in high densities (on average about 75/m^2) and a few (including a European artefact) were recovered from the core of the dune subsequently dated to beyond the accepted age of Aboriginal settlement of Australia. This site had clearly been severely disturbed by land use activities and bioturbation.

The Warkworth sand sheet is different from the Wambo sand body in its location, morphology and by inference, its mineralogy, but the two are very similar in having thicker covers of uncompacted, unweathered sands over their compacted, weathered cores. In the Warkworth sand sheet artefacts were found through the upper sand (although in smaller numbers at depth), and there was some evidence that the site is stratified to some extent (AMBS 2002, 81-83).

7 CHANNEL JOINING WOLLOMBI BROOK FROM THE EAST

A deep channel was noted by the archaeology field team at approximately AMG 312150 6391400. The possibility that this might be a palaeochannel of Wollombi Brook was investigated. In the field it was evident that this channel was simply the lower reaches of the otherwise unchannelled drainage system draining the broad, low catchment to the east. A channel has formed where the drainage line has been incised through alluvium down to the level of the bed of Wollombi Brook where the two join. A high levee bank of Wollombi Brook separates the two channels. It is likely that during major floods in Wollombi Brook water backs up in this tributary channel. When flood levels recede water draining from flooded land to the east flows as a concentrated body along this tributary channel, keeping it scoured open.

8 SAND SHEETS ON THE EASTERN SIDE OF WOLLOMBI BROOK

8.1 Context

Extensive tracts of sand sheet are mapped on the 1:25,000 geological sheet (Czb). These extend eastward into the Warkworth coal mine area, where they were investigated by AMBS (2002). Elizabeth White and the archaeology field team noted that there was not always a close correspondence between the mapped distribution of sand and its actual distribution on the ground.

The archaeology field team searched about 45,000m^2 of ground on which artefacts could have been detected if present, to find just 10 artefacts. They paid particular attention to rabbit and wombat holes, and other deeper disturbance, in case the artefacts were all at lower levels, but none were found in such contexts.

It is possible that the surface of the sand sheets close to Wollombi Brook are mantled with recent blown up from floodplain sediment after the big floods of 1949 and 1955. However there is no evidence the consultant is aware of that any where in the Central Lowlands in historical times there has been appreciable movement of windblown from river beds and flood plains onto adjacent higher ground.

The complex of sand sheets on the Wambo lease extend southwest into the Warkworth coal mine area. During the Warkworth coal mine investigation the consultant noted the same lack of correspondence between the mapped and actual distribution of sand (AMBS 2002: 15). Sub-Unit 8c of Survey Area 8 (Undulating Terrain), was described by the consultant as having an extensive but patchy cover of loose windblown sand. An extensive Cainozoic sand sheet is mapped as occurring adjacent to the Wallaby Scrub Road in this area. Initially this mapped occurrence of sand was designated as a separate Landform Zone. However in the course of fieldwork it was found that this sand sheet was discontinuous, with large areas of the underlying bedrock and soils cropping out in areas mapped as being covered with sand. Conversely, extensive patches of loose sand up to 0.5 m thick were noted in areas to the north and south of the mapped occurrence of sand.

The frequency of occurrence of artefacts in Survey Area 8 as a whole was very low at 1 artefact per 1,250 m^2 of effectively surveyed area (AMBS 2002: Table 12). The sample size of archaeological find spots and of stone artefacts was too low to allow meaningful analysis at the Sub-Unit level, however the frequency of occurrence of finds spots in Sub-Unit 8c was no higher than in the other Sub-Units (compare Figures 4 and 8 in AMBS 2002), indicating that these diffuse sand sheets had not acted as a focus for Aboriginal occupation and use of the landscape.

8.2 Field Inspection

The consultant drove along the extensive network of vehicle tracks crossing the area where the sand sheets occur and making numerous spot checks. The area was very similar to the equivalent area on the Warkworth coal mine. Because of the lack of exposure other than along vehicle tracks it was not possible to assess variations in the depth of sand across the area.

8.3 Archaeological Potential

The results of the Warkworth sand sheet investigation (AMBS 2002) show that where windblown sand deposits such as these are deep they have the potential to contain stratified and possibly dateable archaeological deposits. The limited archaeological investigations of sand features in the Hunter to date indicate that discrete, well defined features that can be defined as sand dunes tend to have higher densities of artefacts than sand sheets. Examples of the former are the Cheshunt dune Site I (NPWS 37-5-0166) (Hughes and Shawcross 2001) and the Hunter Valley 1 dune site (NPWS 37-5-0063) (Hughes 1997, Hiscock and Shawcross 2000). Both of these sites had artefact densities exceeding $100/m^2$ in places. The only sand sheet excavated to date has been that at Warkworth. This feature was atypical in that it is discrete in area, separated from the nearest sand body by almost 1 km, and abuts a major creek (Sandy Hollow Creek). The density of artefacts recovered from the excavations in the 'richest' part of the site ranged from 17 to $64/m^2$.

Given the semi-continuous nature of the sand sheet complex at Wambo (and in Sub-Unit 8 at Warkworth) its is likely that the density of sub surface artefacts will generally be much lower than in the excavated Warkworth sand sheet unless areas which might have acted as a focus for repeated occupation can be surmised.

9 UNMAPPED SAND DUNE EAST OF WOLLOMBI BROOK

The consultant was shown a large dune parallel to the Wollombi Brook alluvial terrace/levee bank on its eastern side. This feature is not shown on the geological sheet and only partially overlaps one of the areas mapped as Czb sand. The yellow sand dune is several hundred metres long, up to 100 m wide and at its highest point has a local relief of more than 10 m. Its location parallel to and on the eastern side of Wollombi Brook indicates it is a source bordering dune, the sand having been blown up from the river. There is no exposure of the core of the dune, so its age cannot be inferred from the field evidence. Morphologically it is very like the Cheshunt dune excavated by Hughes and Shawcross (2001). The Cheshunt dune and the sand sheet at Warkworth excavated by AMBS (2002:79) had weathered clay sand cores and were interpreted as having accumulated in the late Pleistocene, almost certainly before Aboriginal settlement of Australia. Deep excavations would be required to determine the stratigraphy and possible age of this sand dune.

There is evidence of recent movement of sand in a southeasterly direction across the crest of the dune. There has been a build up of sand on the western side of a netting fence and an old fence pot has been substantially buried by sand.

This dune would have provided a highly suitable ‘campsite’ location adjacent to Wollombi. Although virtually no artefacts were observed on the limited surface exposures, there is a high probability that artefacts occur beneath the surface, perhaps in large numbers. Whether this is the case, and whether any such archaeological deposits are in stratified, relatively undisturbed and dateable contexts could only be tested by controlled geoarchaeological investigations.

At the Cheshunt dune site (NPWS Site No.37-5-01166) very few stone artefacts were observed on surface exposure yet in the excavations the densities along the ridge crest (the optimal location) varied between 40 and 170 artefacts/m^2 (Hughes and Shawcross 2001, Appendix D). Most of the artefacts were in the upper soft A horizon sands which was up to 650 mm thick. Some artefacts were found in the weathered and compact B and C horizons, but it was argued that in all such cases the likely explanation was that they were Holocene artefacts derived from the soft relatively thin A horizon sands and moved down the profile by bioturbation (for which there was abundant evidence). Optically simulated luminescence (OSL) dates subsequently obtained for the weathered core of this dune of 84-88 thousand years old (i.e. well before accepted time of initial human occupation of Australia) supported this interpretation.

In the Warkworth sand sheet where the soft A horizon sands were thicker (up to 1,500 mm), despite the observed and inferred mixing effects of bioturbation and other processes, there was some evidence that the site is stratified to some extent (AMBS 2002, 81-83).

10 SUMMARY OF THE POTENTIAL FOR IDENTIFYING STRATIFIED, DATEABLE ARCHAEOLOGICAL SITES AT WAMBO

The only such context identified in this study at Wambo are the three areas where sand bodies occur.

The two dunes adjacent to the Wollombi Brook have the highest potential as they are well defined features adjacent to the major regional water body (the river) and hence would have been a focus for repeated use and occupation. The reddish western sand dune is known to be thick (at least 3m of unweathered sand over 1 m of weathered sand). The morphology of the eastern feature suggests that the sands are likely to be of a similar or even greater thickness there.

The sand sheet complex east of Wollombi Brook has more limited potential because artefacts densities are likely to be very much lower.

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ATTACHMENT D-3

GLOSSARY OF TERMS

GLOSSARY OF TERMS

AMG grid reference: Australian Metric Grid reference. The system of co-ordinates in use by the Aboriginal Heritage Information Management System, NSW National Parks and Wildlife Service.

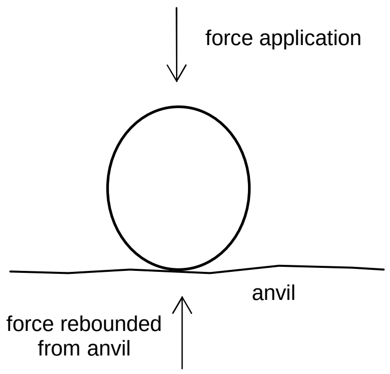
Anvil: A flat stone with pitting on its surface. In bipolar flaking a core is rested on a stone anvil. Some of the force applied to the core is transmitted to the anvil, which results in the pitting wear.

Artefact: An item whose origin can be attributed to Aboriginal people. This definition includes heat shattered pieces of stone which occur on Aboriginal occupation sites where the stone was clearly transported by human effort, even though the individual pieces of stone may have been broken unintentionally.

Attribute: A physical characteristic of an artefact (Hiscock and Koettig 1985:71), eg. the weight of a flake.

Backed artefact: A flake or piece of a flake with blunting (vertical) retouch along one margin. The retouch must have occurred after the flake was struck from its core (so excluding ridge straightening flakes). Backed artefacts occur in various shapes such as Bondi points (long narrow forms), geometrics (triangular to trapezoidal), or as amorphous backed flakes.

Bipolar: A reduction technique whereby the core is rested on an anvil and force applied to it an angle close to 90^{o}, towards the core's contact with the anvil (Hiscock and Koettig 1985:71). Force passes through the core and bounces back from the anvil. The resulting flakes and core may show crushing at the end which was struck by the hammerstone and at the end which was in contact with the anvil. The bipolar flakes may also have sheared or compressed bulbs of percussion (Cotterell and Kamminga 1987:688,698, 699-700).



Broad platform: A platform whose area is more than twice the area of the ringcrack. Where the ringcrack is not clearly visible the platform should be more than 2mm across.

Broken flake: The proximal end of a flake. It must have a platform, point of force application and a Hertzian cone or bulb of percussion. Broken flakes usually also have ripple marks, but margins are broken (see "Flake" below)

Carved tree: A tree with markings carved into it, usually on its trunk. The carvings are usually made into the wood of the tree. The markings may be geometric shapes or figures. Carved trees usually indicate ceremonial sites or burials.

Cobble: A lump of stone 6-26cm in size, with cortical surfaces.

Cone-split broken flake: A broken flake which had broken vertically through the cone, often through or close to the point of impact.

Core: A piece of stone which was flaked to produce flakes (broken flakes, flake fragments or flaked pieces) which could potentially have been used as tools. The piece of stone may have originally been a cobble, a flake, a broken flake, a flake fragment, a flaked piece, a heat shatter or a naturally broken rock (after Gorman 1992:156).

Core-tool: A core which was also used as a tool.

Cortex: Weathered surface on a piece of stone, here used to identify surfaces with accurate or smooth formed through mechanical and/or chemical weathering associated with fluvial transport. Cortex on artefacts is usually regarded as indicating the extent of reduction of a cobble or pebble; artefacts with extensive cortical surfaces are thought to have been struck early in the cobble's reduction, while artefacts without cortex must have come from stone inside the cobble and therefore late in its reduction.

Coverage: As used in this report, this is the total area of each ground exposure multiplied by the visibility on each exposure.

Crenated fracture: see heat shatter. The term crenated fracture is used where it is not certain that heat has caused this type of breakage.

Crest: The highest landform element which stands above all or almost all points in the adjacent terrain. It is characteristically smoothly convex upwards in down-slope profile or in contour or both (Speight 1990:13).

Crest ridge top: A ridge is defined as a compound landform element comprising a narrow crest and short adjoining slopes, the crest length being greater than the width of the landform element (Speight 1990:19). For this study Crest ridge top is meant as a single element being only the crest which occurs along a ridge top. They are distinguished from other crests because they include ridges which could have been used as access routes into the adjoining mountains.

Curation: A strategy of caring for tools or materials that included advanced manufacture, transport, resharpening and caching or storage. A key feature was the preparation of raw materials in anticipation of inadequate conditions (materials, time or facilities) under which tools could have been made at the time and place of their use (Nelson 1991:63).

Debitage: The unused, waste stone artefacts.

Depression: A landform element which stands below all or almost all points in the adjacent terrain. An open depression (the creeks observed in the Wambo study area) extends at the same elevation or lower beyond the locality where it is observed (Speight 1990:15).

Discard episode: A single stone-using event which resulted in the discard of artefacts. The artefacts must have come from a single core or tool or be represented by a single tool. For example, a horizontally associated silcrete knapping floor, a silicified tuff backed artefact and a quartzite hammerstone would be counted as three discard episodes, even though the discard of these artefacts may have been contemporary and functionally related (eg. the knapping of silcrete backed artefacts to replace a used silicified tuff item). The concept of a discard episode is useful where it cannot be assumed that artefacts were contemporary of functionally related, as on open sites with overlapping activities from different occupations.

Dorsal: The outside or back of a flake. The surface may have cortex on it, a heat shattered surface, or the negative scars of flakes previously struck from a core.

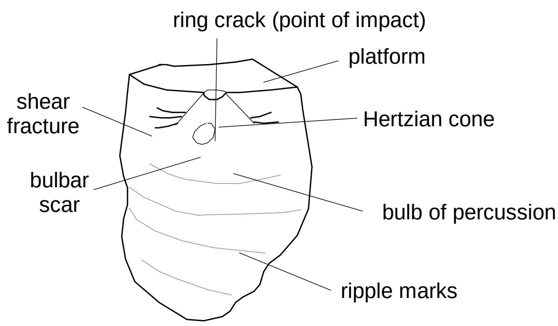
Elongate: A flake at least twice as long as it is wide.

Expediency: A strategy in which tools were made and used in the same place with minimal effort under highly predictable conditions. Expediency depended on available raw materials (eg. through stockpiling or storage), time to make the tools and long or regular occupation of a place so as to take advantage of the stockpile or store (Nelson 1991:64).

Exposure, ground exposure: An area of ground clear of grass or other ground cover plants, and on which it is possible to see soil. Exposures of soils are important for the detection of stone artefacts.

Faceted: The removal of numerous small flakes (<5mm) from the surface of a platform, as a core preparation technique.

Flake: A piece of stone struck from a core. It has a series of characteristic features such as a platform, a point of impact (force application), Hertzian cone, bulb of percussion, ripple marks and may have a bulbar scar (also called erraillure scar) and lines of shear fracture (Speth 1972:35).



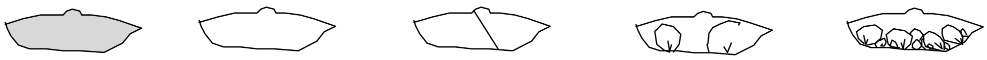
Flake fragment: A piece of a flake not having a proximal end. They have identifiable bulbar or ventral surfaces, and ripple marks may be present. It must be possible to orient flake fragments towards their missing points of force application (point of impact).

Flake platform surfaces: The surface characteristics of flake platforms may vary depending on the nature of the core platforms from which flakes were struck. Several categories have been identified for this project: cortex, plain (being a smooth plane from a non-cortical surface), ridged (having the margins of a previous flake removal on the platform surface), scarred (having one or more negative scars where the previous flake removals were initiated on the dorsal edge of the platform surface), faceted (numerous small scars on the platform surface), and focal (being less than twice the area of the ringcrack; the surface characteristics of these flakes were often difficult to identify due to small platform area). These types of platform surfaces relate to variations in flaking pattern and core rotation.

<u>Types of flake platform surfaces</u>

	Cortex	**Plain**	**Ridged**	**Scarred**	**Faceted**

ventral



dorsal

flaking pattern	**unifacial**	**unifacial with or without core rotation**	**unifacial with core rotation, or bifacial**	**bifacial & sometimes asymmetric alternating**	**asymmetric alternating**

Flake shape: The shape of the ventral surface of a flake. Elongate flakes are twice as long as they are wide, or more than twice as long as wide; other flakes may be wider than long or longer than wide.

Flaked piece: A flaked artefact which could not be defined as a flake, broken flake, flake fragment, a core or retouched item, but which showed features diagnostic of the flaking process. Heat shatters and naturally spalled pieces were not counted as flaked pieces.

Flaking pattern: The manner in which force is applied to cores to remove flakes. Reduction may make use of unifacial, bifacial (symmetric alternating), asymmetric alternating and bipolar techniques.

Flat: A planar landform element that is not a crest or a depression and is level or very gently inclined (Speight 1990:18).

Focal platform: A platform whose area is less than twice the area of the ringcrack. Where the ringcrack is not visible the platform should be less than 2mm across.

Gradient: An indication of the slope of the land surfaces. Four categories are used for this study, based on those defined by Speight (1990:12): very gentle, gentle, moderate and steep. They are described as –

Gradient	Range	Average	Approximate Expression on Topographic Map Sheet
Very gentle	$0^{o}45'$ to $1^{o}45'$	1^{o}	10m elevation over 400m or more distance
Gentle	$1^{o}45'$ to $5^{o}45'$	3^{o}	10m elevation over 100m to 400m distance
Moderate	$5^{o}45'$ to 18^{o}	10^{o}	10m to 30m elevation over 100m distance
Steep	18^{o} to 30^{o}	23^{o}	More than 30m elevation over 100m distance

Grinding grooves, axe grinding grooves: Usually eliptical-shaped or relatively long and narrow grooves ground into the surface of stone, usually sandstone. Such grooves were made during sharpening stone hatchet heads, although very narrow grooves might have been made from sharpening spears or digging sticks.

Hammerstone: A stone used to strike a core. Hammerstones retain pitted wear on a narrow margin or point.

Heat shatter: A piece of stone which has been broken by heat. They may be rounded to elliptical pot lids (flat on one surface and dome-shaped on the opposite surface), or pieces with potlid scars. Some heat shatters have rough and crenated surfaces, like crumpled alfoil (Gorman in Baker and Gorman 1992:158)

Heat treatment: The intentional use of heat to improve the flaking qualities of stone. Silcrete changes colour from yellow to red, brown or purple after heating, and when flaked the artefact surfaces may be lustrous. Artefacts flaked then subject to heating are not recorded as being struck from heat treated stone. They may be distinguished by having dull surfaces although they may be red, brown or purple in colour. The identification of heat treatment through the use of colour and texture is not entirely accurate and may have an error rate of <10-20%. Errors in identification may arise through the incomplete heating of silcrete before flaking, weathering of artefacts after flaking, and because some silcrete maybe naturally lustrous, regardless of whether it has been heated or not.

Knapping floor: A place at which a core was systematically flaked. On the Cumberland Plain and in the Hunter valley systematic core reduction was usually associated with the production of backed artefacts. In the usual use of the term there is no assumption that an actual 'living floor' has been identified, as artefacts were probably displaced vertically, and perhaps also horizontally, by soil processes.

Manuport: An unmodified lump of rock, occurring beyond its natural context and assumed to have been carried to its location by Aborigines.

Maximal lower slope: A relatively steep slope below a more gentle slope and above a flat or depression (Speight 1990:15).

Maximal upper slope: A relatively steep slope below a crest, and above a more gentle slope (Speight 1990:15).

Minimal mid slope: A relatively gentle slope below a steeper slope and above a steeper slope (Speight 1990:15).

Opportunism: A response to immediate unanticipated conditions (Nelson 1991:65); situational variation (Binford 1989a). Tools were made from whatever materials were available at the time and place of need, using reduction techniques appropriate to the materials and tasks at hand (Binford 1979;264,266-267).

Pebble: A rock with weathered cortex, less than 6cm in size.

Plain platform: The surface of the platform of a flake or broken flake is smooth.

Platform: The surface of a core which was struck to remove a flake. The surface on a flake (or broken flake) which was struck to remove it from a core.

Procurement: The process of obtaining resources. In the case of stone raw materials this may have involved picking up stone from a source, digging for stone or quarrying the stone. It also includes decisions about the suitability of stone and may include preparation of raw materials for transport.

Proximal end: The platform end of a flake.

Quarry: A place from which naturally-occurring stone was obtained/extracted. The evidence for extraction should include: a source of artefact quality raw material, and artefacts - surrounding rubble - created during fragmentation. Pits or depressions and spoil heaps or mined bedrock may also be present (Hiscock and Mitchell 1993:13-14). The nature and quantity of the evidence may vary considerably.

Raw material: The stone from which artefacts were made, eg. silcrete, silicified tuff (also called indurated mudstone in some studies), quartz, quartzite.

Recycle: Convert waste to reusable material (Australian Pocket Oxford Dictionary 1993). Recycling may have been part of an expedient technological strategy which regarded any stone as potentially useable or multifunctional.

Reduction sequence: A description of the order in which reduction occurred within one block of stone (Hiscock 1993:65).

Reduction strategy: “The guidelines used by knappers to enable them to apply their skills” (Hiscock 1993:65). “The process of how a particular core is reduced: the strategy employed to remove flakes from a block of stone (Koettig 1994 Vol 5:4). This term is in common usage but there seems to be some confusion surrounding the meaning of the term. Hiscock (1993) described the Redbank A Strategy of reduction and backed blade production, providing a generalised step-by-step sequence which resulted in a particular type of core. Koettig (1992, Figure 1.43) also described several reduction sequences but referred to them as reduction strategies. Koettig (1994, Figure 1.10) describes the sequence of reduction of individual cores as reduction strategies, and a generalised overview of reduction processes as reduction sequences, and refers to single reductions and multiple reductions. Nelson (1991:57) defined strategies as guides which balanced tool design, manufacture, use and discard in response to resource conditions and other economic and social strategies.

Retouched items: The negative scars from flaking were struck from surfaces in such a way as to indicate that the retouching was more recent in a reduction sequence than the item being retouched. For example, retouching scars may have been struck from or intercept with the ventral surface of a flake (or broken flake or flake fragment) or the formation surfaces of a flaked piece or heat shatter. The scars were generally too small for the retouching flakes themselves to have been used as tools (e.g. <1.5cm in size). Retouched artefacts may have been core or tool blanks, prepared for some task but never completed or used.

Retouched/used tools: Artefacts whose retouched margins also exhibit usewear, such as rounding or striations.

Retouching flake/debitage: These are artefacts which were struck from used tools and had usewear on the dorsal margins of their platforms and/or dorsal surfaces.

Ridged platform: The surface of the platform has one or more ridges across its surface, resulting from the margin of a previous flake removal during reduction from some other platform. It indicates core rotation.

Ridge-straightening: Small flakes removed to straighten a ridge on a core. Irregularities in the shape of ridges can disrupt the flow of force through a core and flakes of irregular shape may be removed. Ridge-straightening may have been used in blade production to ensure that long thin flakes with parallel margins were produced.

Ringcrack: This is a circular shallow crack on the platform surface at the point of the hammer stone’s impact. It is about 20% larger than the radius of the contact circle (Speth 1972:35,38).

R/U tool: Any artefact with obvious evidence of tool use. May have retouched margins.

Scarred platform: The surface of the platform has one or fewer than 5 scars across its surface, the initiation point of those scars being the dorsal edge of the platform. This indicates alternating or bifacial reduction, or platform preparation (eg. to set up a ridge to define the next point of force application).

Scarred tree: A tree from which bark has been removed, the bark having been used for containers, canoes or for shelter.

Silcrete: A very hard rock consisting largely of silica. Essentially, a sedimentary rock is indurated with silica which cements the rock particles. The appearance of silcrete will be influenced by the nature of the parent material, which may vary from very fine grained (fine sand) to coarse grained (conglomerate).

Silicified tuff: A hard siliceous stone usually fine-grained and often banded. It was formed when volcanic ash fell into calm water, or was washed from land surfaces into calm water. Silica may also have been remobilized to indurate the stone (Fahey 1994).

Simple slope: A slope which is adjacent to and below a crest and adjacent to and above a depression (Speight 1990:15); ie. a slope of the same gradient extends from a crest to a depression.

Site: A location or place with physical evidence for human activity, such as stone artefacts, scarred trees, grinding grooves and so on. For this study the definition proposed by Dean-Jones (1992) is adopted and if evidence of human activity is located more than 50m from other evidence and/or it is on a different landform then it is recorded as a separate site.

Stream order: A system of categorizing streams to indicate something of stream size. A stream without any tributaries is a 1st order stream. When two 1st order streams come together they form a 2nd order stream. When two 2nd order streams come together they form a 3rd order stream. When two 3rd order streams come together they form a 4th order stream and so on.

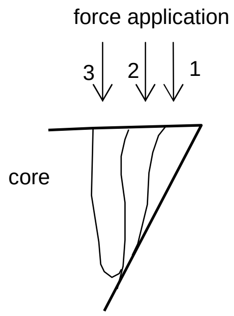
Technological organisation: The study of the selection and integration of strategies for making, using, transporting and discarding tools and the materials needed for their manufacture and maintenance (Nelson 1991:57).

Technology: The knowledge or use of the mechanical arts and applied sciences (*The Australian Pocket Oxford Dictionary* 1993:1091). The total sum of stone knapping knowledge possessed by a group of knappers and demonstrable from the end-products of their knapping behaviour (Flenniken and White 1985:131).

Termination: The distal end of a flake; the margin opposite the platform (proximal) end.

Tool retouching flake/debitage: See Retouching flake/debitage: above.

Unifacial flaking: Reduction from a plain smooth platform. Plain smooth platforms (i.e. without flake removals or preparation of the platform surface) may be cortical surfaces of cobbles or the ventral surfaces of large flakes when used as platforms for further reduction. Note that Baker (1992a and other reports) used the term 'unidirectional' when referring to a unifacial flaking pattern.



Ventral surface: The surface of a flake which joined onto the core; the 'front' of the flake. This surface has the Hertzian cone, bulb of percussion, ripple marks, shear fracture (Speth 1972:35). See diagram accompanying the definition of "flake" above.

Visibility: An estimate of the amount of soil (including clay and/or bedrock) which can be seen on a ground exposure, or within a defined area more generally.

Waning lower slope: A slope which is below a steeper slope and above a flat or depression (Speight 1990).

Waning mid slope: A slope which is below a steeper slope and above a more gentle slope (Speight 1990).

Waxing upper slope: A relatively gentle slope below a crest but above a steeper slope (Speight 1990).

ATTACHMENT D-4

LIST OF SITES

AVAILABLE ON REQUEST

ATTACHMENT D-5

NON-SITE EXPOSURES

AVAILABLE ON REQUEST

ATTACHMENT D-6

ARTEFACT RECORDINGS

AVAILABLE ON REQUEST

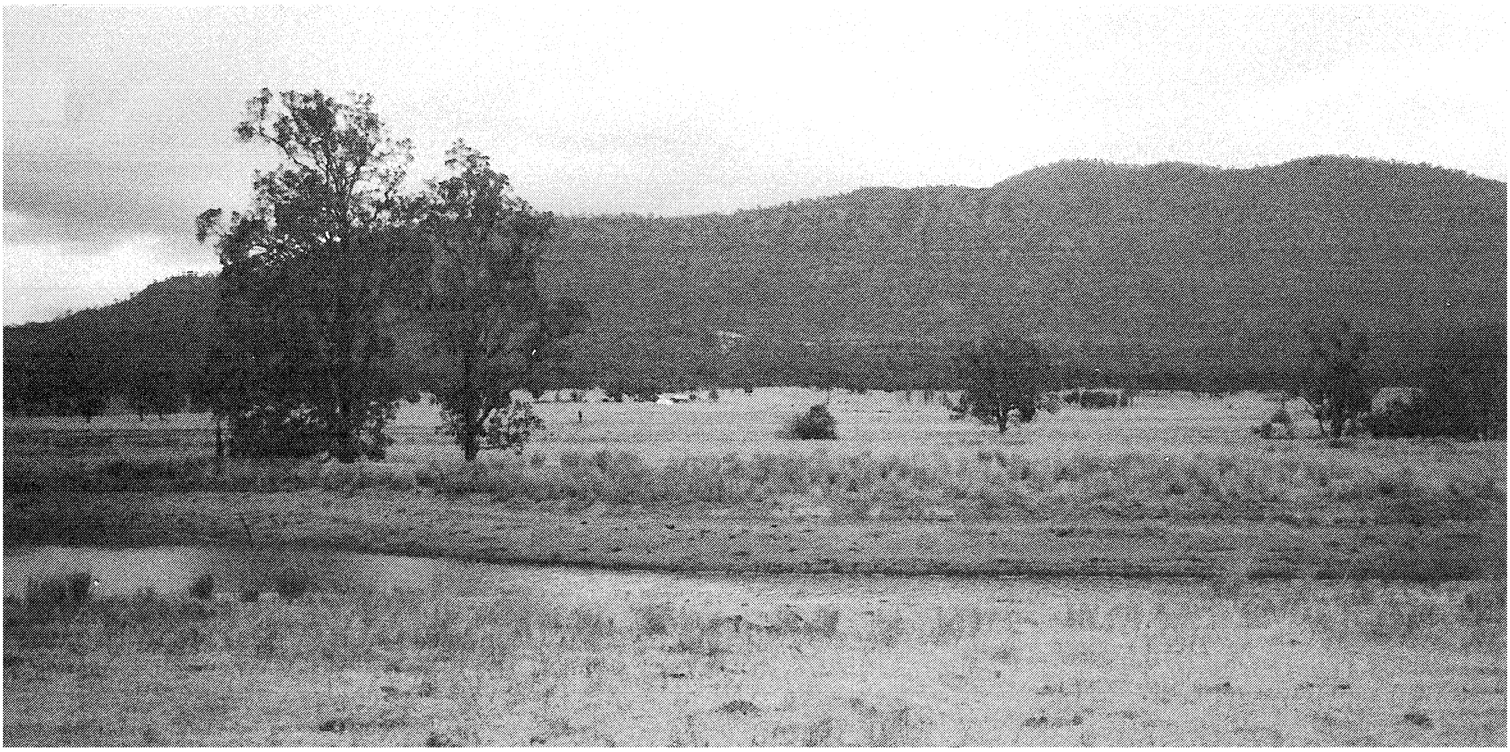
ATTACHMENT D-7

ABORIGINAL CULTURAL HERITAGE REPORT

Aboriginal Cultural Heritage Assessment

for

WAMBO MINE PROPOSED EXTENSION



Upper Hunter Valley Region, NSW
February 2003

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INTRODUCTION

The Upper Hunter Wonnarua Council were contacted by Consulting Archaeologist through Resource Strategies to be involved in an Aboriginal Cultural Heritage Assessment for the Wambo Mine Expansion project.

The parent company Wambo Coal Pty Ltd is seeking to develop land adjacent to its current working.

Wambo Coal Mine is owned by WCPL which is a subsidiary of Hunter Coal Pty Ltd

Wambo Coal Mine is one of the oldest mines with its first development consent issued in 1972. The current operations are both underground and open cut therefore the extension will prolong the life of both strategic interests.

The present day Wonnarua people still have a connection with their History and Land.

Heritage Sites are a part of History and represent to us a Physical and Visual Connection to our Tribal Ancestors.

Aboriginal people are still involved in the Consultation Process of this type of Major Development with this in mind the Upper Hunter Wonnarua Council will provide the following;

1. Effective Survey of the of the Study Area.

2. Identification of all Aboriginal Sites, Places, Artefacts or Camping Areas.

3. Meet all requirements of the NPWS ACT.
   Guide Lines for Aboriginal Heritage Consultants.

4. Help in the Management of any affected Aboriginal Places and Recorded Sites.

COMPLIES WITH THE N.P.W.S ACT AND EP & A ACT.

NATIONAL PARKS AND WILDLIFE SERVICE ACT 1974

The National Parks and Wildlife Service Act 1974 provides statutory protection;

*For Aboriginal Relics and Places under Section 90 of the Act

*Provides for the Declaration of Aboriginal Places under Section 84 of the Act

The protection provided to the Aboriginal Relics applies to all Sites irrespective of the level of Significance or Land Tenure.

Landscape features and areas can be gazetted as Aboriginal Places if the Minister is satisfied that sufficient evidence exists to demonstrate that the area was or is of Special to the Local Traditional Land Owners or Indigenous Community.

It is expected that a revision of the Act will change the wording to exclude *Knowingly* from the ACT.

It is an Offence to Damage or Destroy Aboriginal Objects or Relics or Aboriginal Places without the permission of the Director General of the National Parks and Wildlife Service.

ENVIRONMENTAL PROTECTION & ASSESSMENT ACT

The Environmental Planning and Assessment Act 1979 and it's regulations, schedules and associated guidelines requires that environmental impacts are considered in land use planning and decision making. Environmental impacts are interpreted in NSW in the broadest sense, including impacts on Aboriginal Cultural Heritage. The EP & A Act has three main parts of relevance to Aboriginal Heritage:

- Part (3) governs that preparation of planning instruments:
- Part (4) relates to development assessment process for local Government (Consent Authorities) and
- Part (5) relates to activities and approvals by Government (determining) Authorities (N.P.W.S 1997:1).

1.1 DESCRIPTION OF THE SURVEY AREA

The Study area is located 15kms West of the township of Singleton in the Hunter Valley Region of New South Wales.

The landscape is undulating with slopes and mountains to the South inter crossed with a ridgeline or two.

The Wollombi Brook is the main water source for the area with small tributaries running from the near by mountains into Wollombi Brook.

Since European Colonization the landscape has naturally been changed to resemble the English Farming mindset, cleared green open pastures and fence lines etc.

Some Native plant species have survived this change in some areas and could be present in the study area.

Parts of the study area have been left alone as Habitat Islands for the Native Animals, but I suspect only because the top-soil is no good for ploughing or cattle grazing.

Overall these is evidence of top soil erosion although not as bad as other landscapes further up the Hunter Valley.

1.2 DESCRIPTION OF IMPACT

The method of open cut mining results in total damage to the Natural Environment, therefore any extension of this type of operation will have a negative affect on the environment.

Underground mining although invisible to the eye still carry's a cost to the environment by way of long wall cracking on the surface etc. There is also surface infrastructure which changes the landscape.

Both forms of development have a detrimental affect on the environment. Never the less approval of coal production will allow existing resources to be recovered in this region.

2 QUALIFICATIONS / RELEVANT EXPERIENCE

QUALIFICATIONS

The Wonnarua people have fully endorsed the consultant Mr. Victor Perry to act as independent consultant on behalf of the Traditional Owners and to provide input from the local Koori people.

The primary consultant Victor Perry has already completed 48 reports on behalf of the Wonnarua People;

1998

- Hunter Valley Mine - The Mining of Site 37 - 5 - 63
- Ethno Historical Report for Bengalla Mine
- South Lemington Open cut Mine Extension

1999

- Lower Hunter Water Pipeline
- The Olive Fruit Processing Plant
- Mt Thorley Cultural Heritage Assessment
- DLWC Merriwa River, Coulsons Creek Bank Rehabilitation Works

2000

- Carrington Mine Cultural Heritage Assessment
- Ellerston Property Cultural Heritage Assessment
- Inglewood Vineyards Pty Ltd Cultural Heritage Assessment
- Broke Water Pipeline Cultural Heritage Assessment
- AGL Gas Main Extension Cultural Heritage Assessment
- DLWC Wallis & Nerone Creeks Cultural Heritage Assessment
- Lot 1 DP 628392 Sub-Division Cultural Heritage Assessment
- Mt Owen Mine Water Storage Dam Cultural Heritage Assessment
- Hunter Valley South Pit Extension Cultural Heritage Assessment
- Highfield Way Sub-Division Cultural Heritage Assessment
- Dartbrook Extended Cultural Heritage Assessment

2001

- Jerrys Plains Coal Terminal Rail Spur Cultural Heritage Assessment
- Cumnock No1 Coal Extension Cultural Heritage Assessment
- "Poggy" Sandstone Quarry Cultural Heritage Assessment
- DLWC Pages, Isis & Hunter Rivers Cultural Heritage Assessment
- Liddell Extension Cultural Heritage Assessment
- Ashton Mine Cultural Heritage Assessment
- Klaudios Sand & Gravel Quarry Cultural Heritage Assessment
- Drayton Coal Lease Renewal Cultural Heritage Assessment

2002

- Dartbrook Mine Kayuga Access Slot Cultural Heritage Assessment
- DLWC South Arm Wollombi Brook & Stockyard Creek CHA
- Singleton Army Base Rehabilitation
- Muswellbrook Coal No 1 Cultural Heritage Assessment
- Abbey Green Cultural Heritage Assessment
- Mt Owen / Bettys Creek Cultural Heritage Assessment
- United Collieries Emplacement & Extension CHA

- Warkworth Mine Extension Cultural Heritage Assessment
- Singleton Shire Council Stage 9 / 10 Cultural Heritage Assessment
- DLWC Paterson, Allyn, Flood Mitigation CHA
- DLWC Williams, Paterson, Chichester Natural Disaster Relief CHA
- DLWC Hunter River Cultural Heritage Assessment
- Bloomfield Colliery Industrial Sub-Division CHA
- Black Hill Community Centre Cultural Heritage Assessment
- Lot 223 Sub-Division Cultural Heritage Assessment
- South Bickham Coal Mine Cultural Heritage Assessment
- Carrowbrook Road Re-Alignment Cultural Heritage Assessment
- Cumnock Stage 3 Coal Mine Cultural Heritage Assessment
- Muswellbrook Gravel Quarry Cultural Heritage Assessment

2003

- Redbank Power Station II Cultural Heritage Assessment
- Cranky Corner Coal Lease Cultural Heritage Assessment
- Broken Back Resort, Broke Rd, Pokolbin Cultural Heritage Assessment

Victor Perry

- NATIONAL PARKS AND WILDLIFE SERVICE

  Victor Perry has worked in partnership with the NPWS in relation to protection and management of Wonnarua Heritage and Culture during the past 19 years.

- FIELD EXPERIENCE

  Victor Perry has over 15 years practical experience working for the Local Aboriginal Community on Aboriginal Archaeological Site Surveys and Salvage Excavations. Mr Perry has worked with consultant archaeologists including Haglund, Rich, Baker, Kuskie, McDonald, Stuart, Keottig, Kelly, Hardy and other well known archaeological consultants in the Hunter Valley.

- WONNARUA CULTURAL HERITAGE

  Victor Perry gained Aboriginal Cultural training through his family's knowledge of Aboriginal History and Customs. This knowledge and its associated customs have been passed down through the generations. Victor Perry has endorsement from the present day Wonnarua Aboriginal People and Native Title Claimants in the Hunter Valley. Victor Perry is employment with the Upper Hunter Wonnarua Council as the Aboriginal Cultural Heritage Manager.

- WANARUAH LOCAL ABORIGINAL LAND COUNCIL MEMBER

  Victor Perry worked with the Wanaruah Local Aboriginal Land Council. During this time he managed the Wanaruah LALC Aboriginal Heritage Unit.

COMMUNITY ENDORSEMENT

The Wonnarua people fully endorse Victor Perry to carry out Cultural Heritage Assessments within their Tribal Boundaries.

Cultural Heritage is gaining recognition compared to archaeology or scientific studies and the local communities are best placed to undertake these surveys.

In this way Aboriginal people become the Consultant for their Heritage, for their people.

KNOWLEDGE AND HERITAGE LEGISLATION

Victor Perry has a working knowledge of the Heritage Legislation (NPWS Act 1974) Section 90 which provides statutory protection for Aboriginal Relics, states that it is an offence to damage or destroy Aboriginal Relics without the Minister's Consent. The Environmental Planning and Assessment Act 1979 (EP & A Act) provides regulated guidelines to assess the environmental impact that developments would have on land and water etc. The EP & A Act also incorporates impacts on Aboriginal Heritage, within it's guidelines

3 ABORIGINAL CULTURAL VALUES ASSESSMENT

The Wonnarua people consider that all Sites within their Traditional Homeland are of high importance and are in need of proper care and protection.

The land and water running through it are the lifeblood of their culture. The hills and plains, the forest and mountains provided people in past generations with the resources needed to survive.

Camping and tool making sites found today remind people of their forefathers, the original inhabitants of the land.

The Wonnarua wish to protect their history and culture wherever possible, and maintain a connection with the land by providing recommendations in regards to Wonnarua Koori Heritage.

The land and its stories were passed down from father to son over 200 generations before the arrival of Cook from England.

According to Tribal Law the local family group of Wonnarua people were obligated to care, maintain and protect this part of the Country.

The Wonnarua people of today are still obligated to care for the environment as their ancestors did in the past, although they can no longer enforce Traditional Law for its protection.

Aboriginal Cultural Assessments can look at many things. Local Aboriginal people are attached to the land through physical, spiritual and visual connections.

Important areas include any combination of certain Aboriginal Cultural Places such as Bora Grounds, Spiritual Teaching Areas, Stone Arrangements, Traditionally visited Camping Areas, Dreamtime Sites and Song Lines as well as Scared Trees for

Ceremonial and War Shields, Cultural Assessments includes consideration of all these things

At this point in time, in the central lowlands of the Hunter Valley over three thousand (3000) Wonnarua Cultural Heritage Sites have been destroyed by open cut mining, which means that the remaining Sites are becoming rare and more valuable to the community.

4 DOCUMENT OF CONSULTATION

The Upper Hunter Wonnarua Council considers that adequate consultation has occurred with the known Traditional Land Owners who have the Knowledge and Cultural Awareness for this area within the Hunter Valley Region.

National Parks and Wildlife Service has an Internal Policy that recognizes Indigenous Participation in Resource Developments within the State of New South Wales.

5. METHODOLOGY

5.1 PRE-FIELDWORK

The Upper Hunter Wonnarua Council was contacted by Consulting Archaeologists working for Resource Strategies who asked us wether the Upper Hunter Wonnarua Council would like to be involved in an Aboriginal Cultural Heritage Assessment of the proposed Wambo Open Cut and Underground Mine Extensions.

The Upper Hunter Wonnarua Council agreed to take part in the survey and to provide two representatives for the work.

The field work date was agreed upon and the study took place at the end of 2002.

Under the National Parks and Wildlife Service Guidelines for Aboriginal Heritage Consultants a Minark Data Base Search of the Bulga, Doyles Creek, Parnell and Singleton 1;25,000 Topographical Map's has been completed and will be included in this report. *Please see Table 1*

5.2 FIELDWORK

The field survey of the study area was conducted during the following 11 days starting on the 11th of November 2002 to the 15th of November 2002 then from the 18th of November to the 21st of November 2003 and finishing the last two days on the 12th and 13th of December 2002.

The Archaeologists involved were Elizabeth White, Helen Brayshaw, Laila Haglund and Kerstin Calley.

There were four Aboriginal groups present during the survey as well and their representatives were;

1. ***Upper Hunter Wonnarua Council***
   Tracey Miller-Skene — Georgina Berry

2. ***Lower Wonnarua Tribal Council***
   Maree Waugh — Glenn Miller

3. ***Ungaroo Corporation***
   Alan Paget — Rhonda Ward
   Chris Paget — Shaun Dallan

4. ***Wanaruah Local Aboriginal Land Council***
   Christine Mathews — Beverly Van Vielt
   Rodney Mathews — Larry Van Vielt

The Study area was covered by two survey teams. They investigated the re-locations of pre-recorded Aboriginal Sites and recorded all new Aboriginal Sites found within both the Open Cut and Underground Extension areas including a possible new Rail Loop Area.

The survey was conducted on foot and by vehicle with every team transecting different landform units flagging Sites and Recording them as they proceeded.

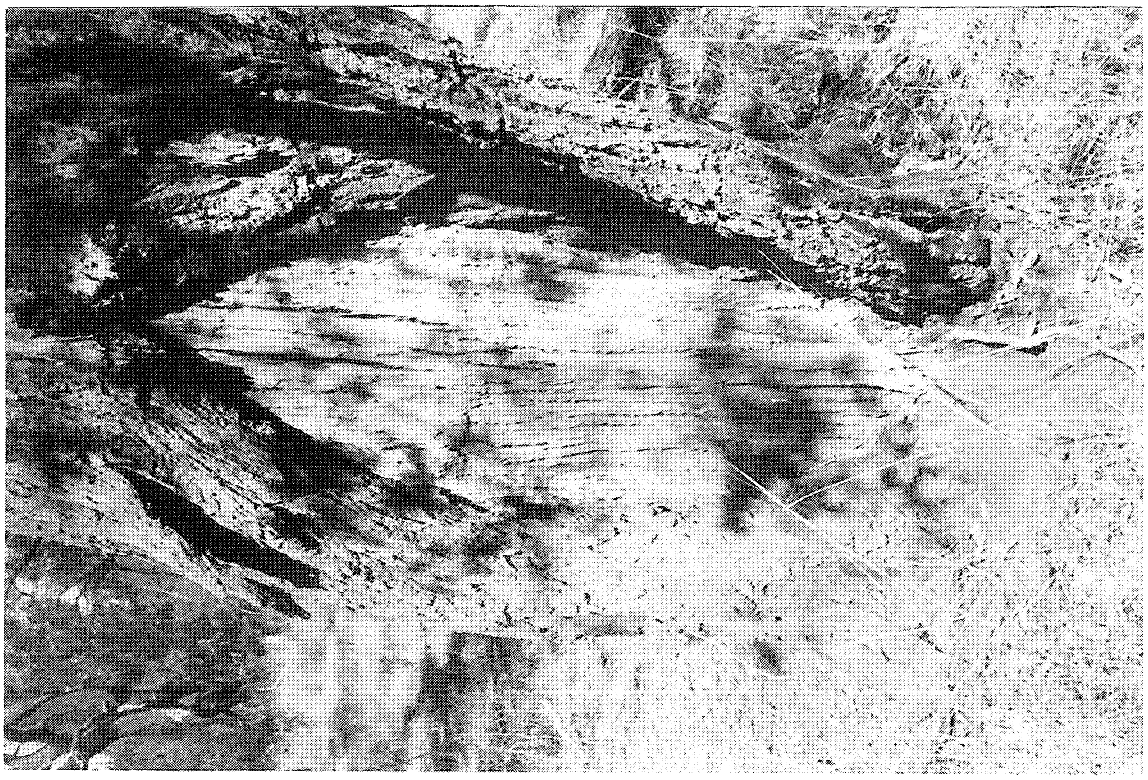
Please note that the present day Native Title Claimants consider this Region to be a part of the Wonnarua Tribal Homelands therefore any or all the new evidence of Stone Tool Making recorded in this study area would have been more than likely been produced by Ancestral Wonnarua Tribal People.

6 PHOTOGRAPHS

The following photographs show a wide range and different types Aboriginal Artefacts and Aboriginal Sites located and recorded over the landscape

LARGE CORE AT SITE E45

I AM NOT CONVINCED THAT THESE ARE SCARED TREES



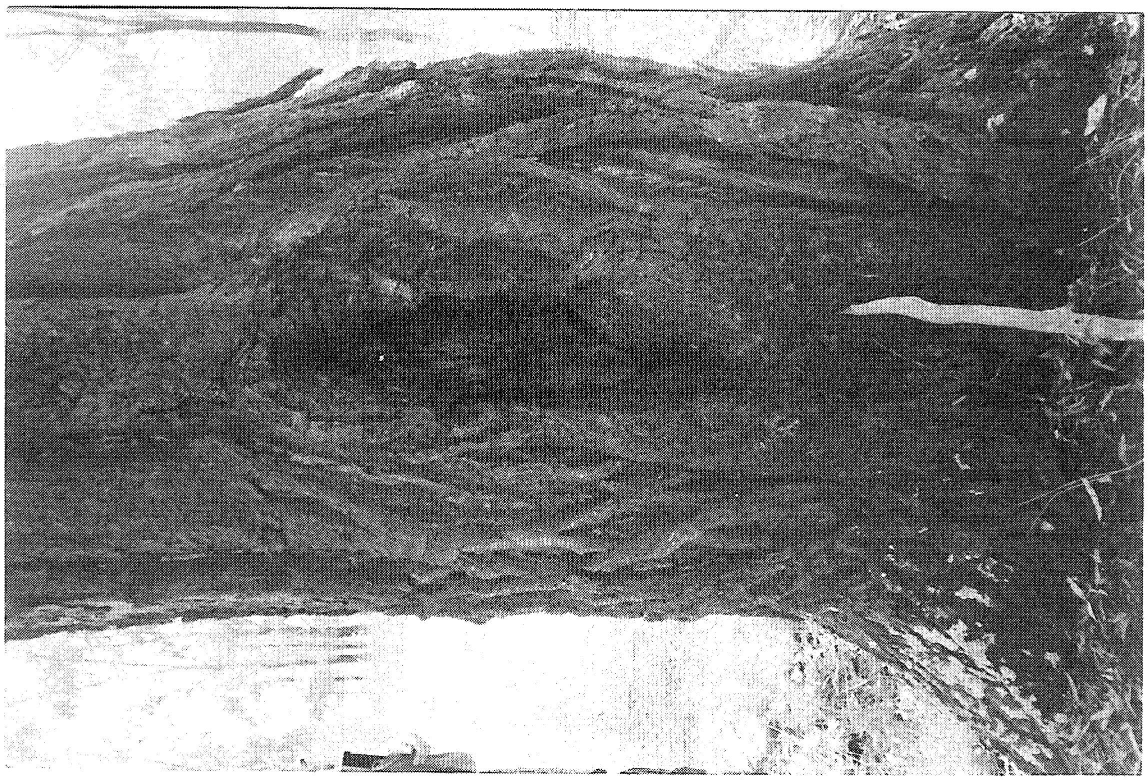
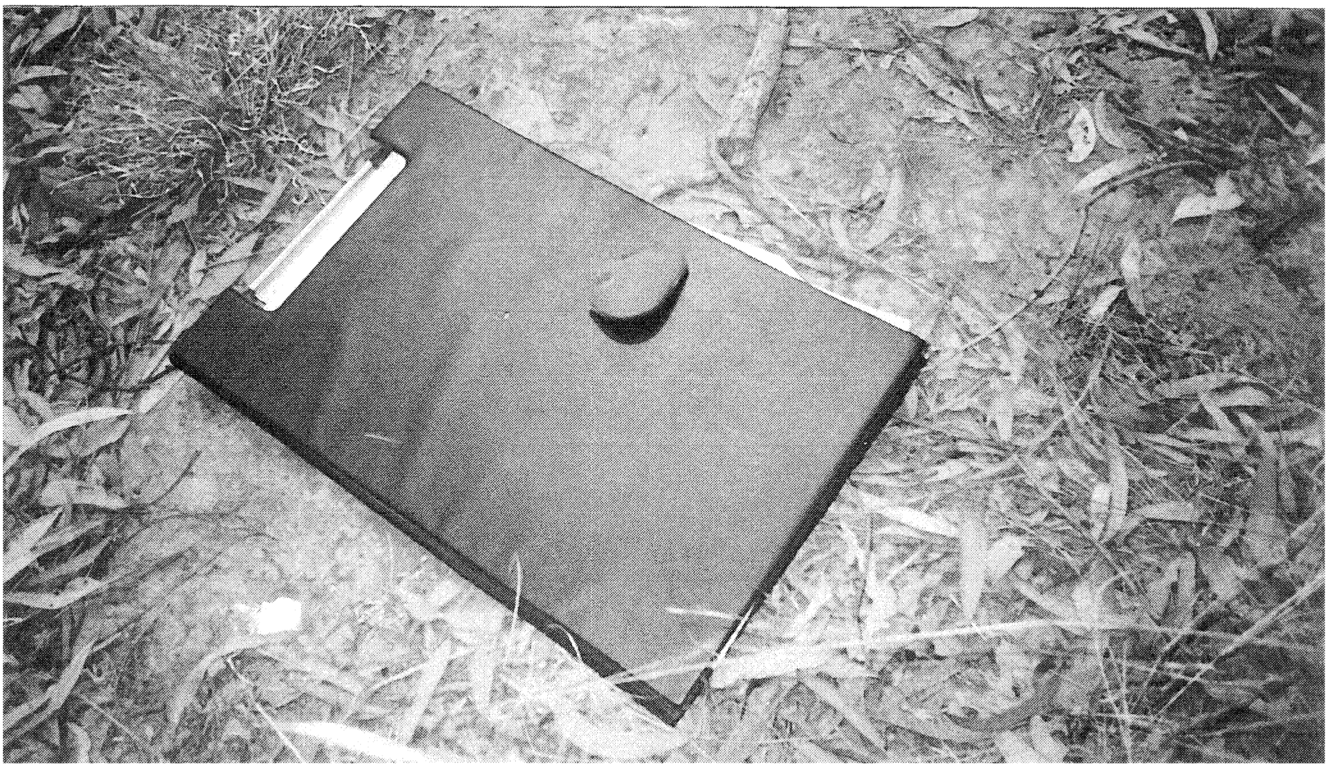


PHOTO OF SITE L 4

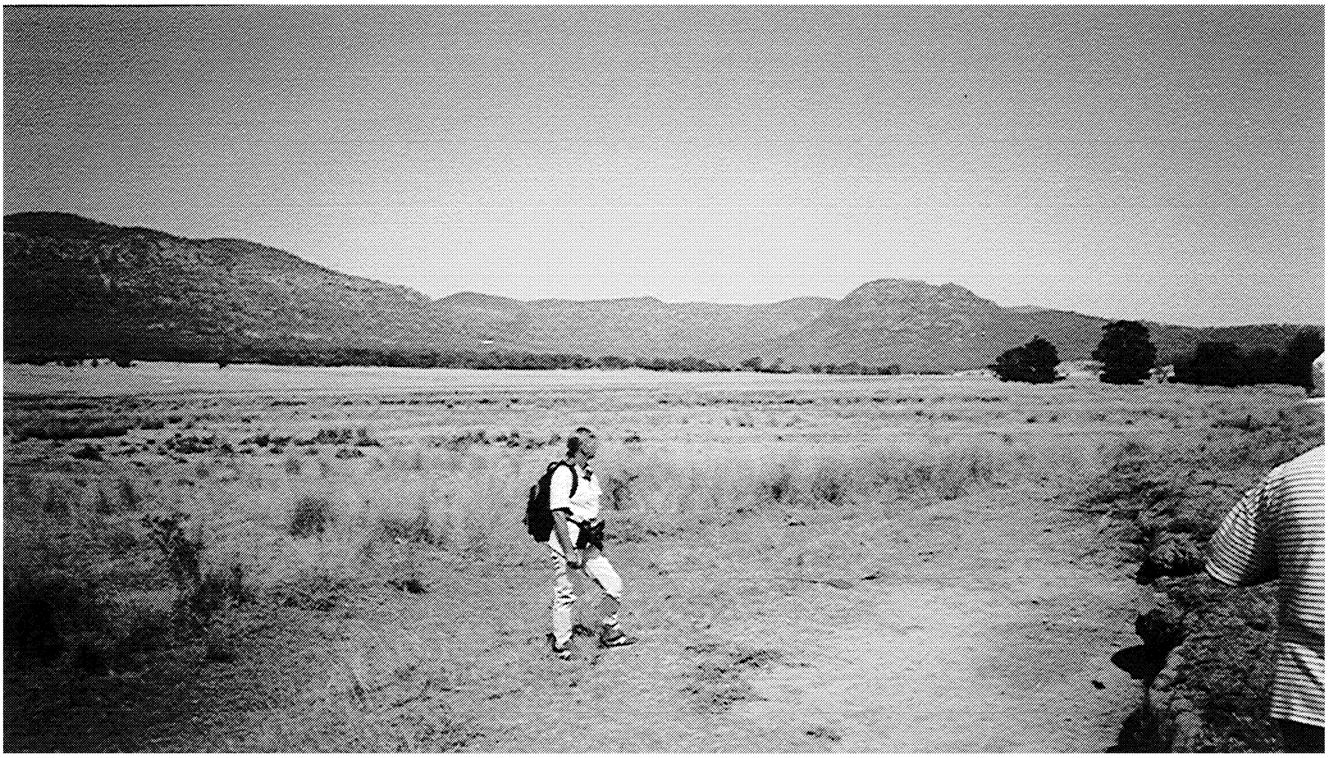
ARTEFACT AT SITE L 21



A RANGE OF ARTEFACTS AT SITE L 1

LARGE PIECE AT SITE L 3

FLAGGING OF SITE E 46



FLAGS AT SITE L 64

AREA OF SITE L 32

RE-LOCATED SITE 65

RECORDING OF SITE L 30

AREA OF SITE L 4

INVESTIGATING SITE H 17

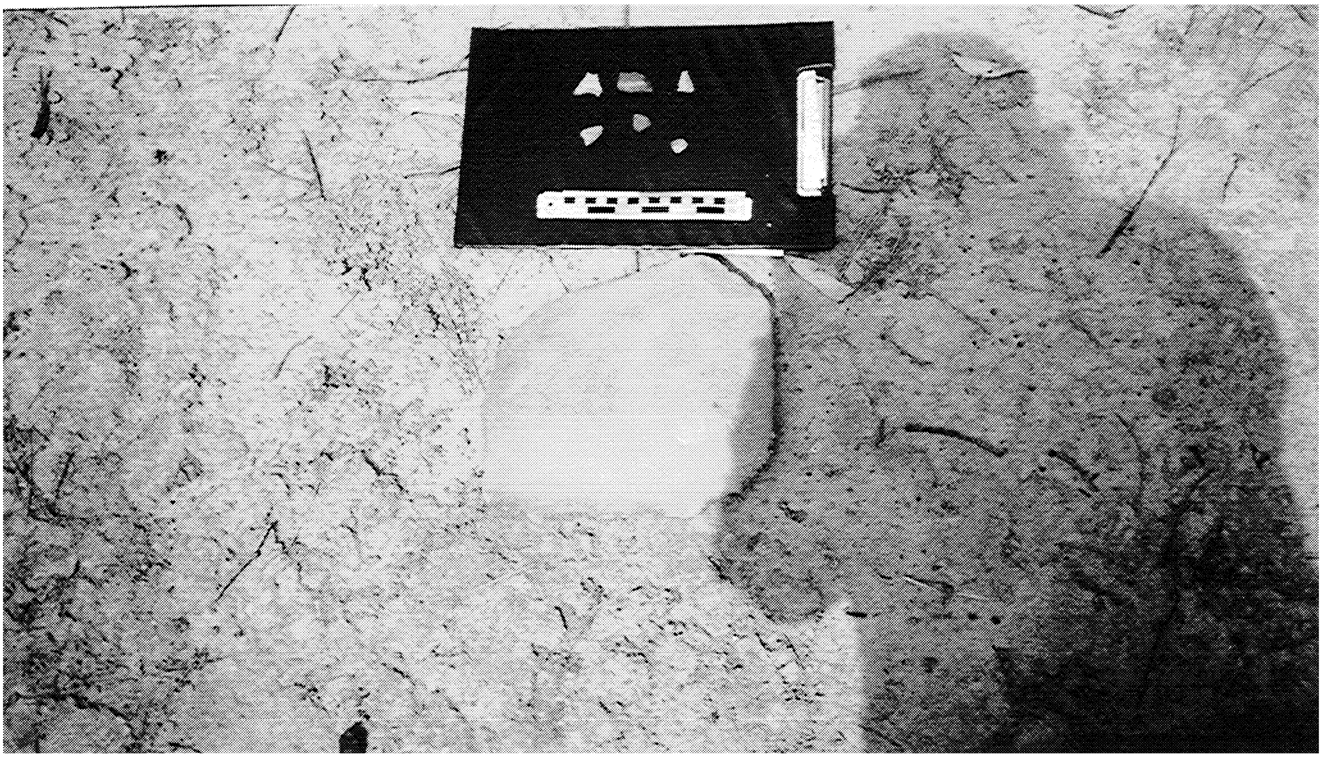
GRINDING GROOVES AT SITE NW 4

RECORDING OF SITE L 1

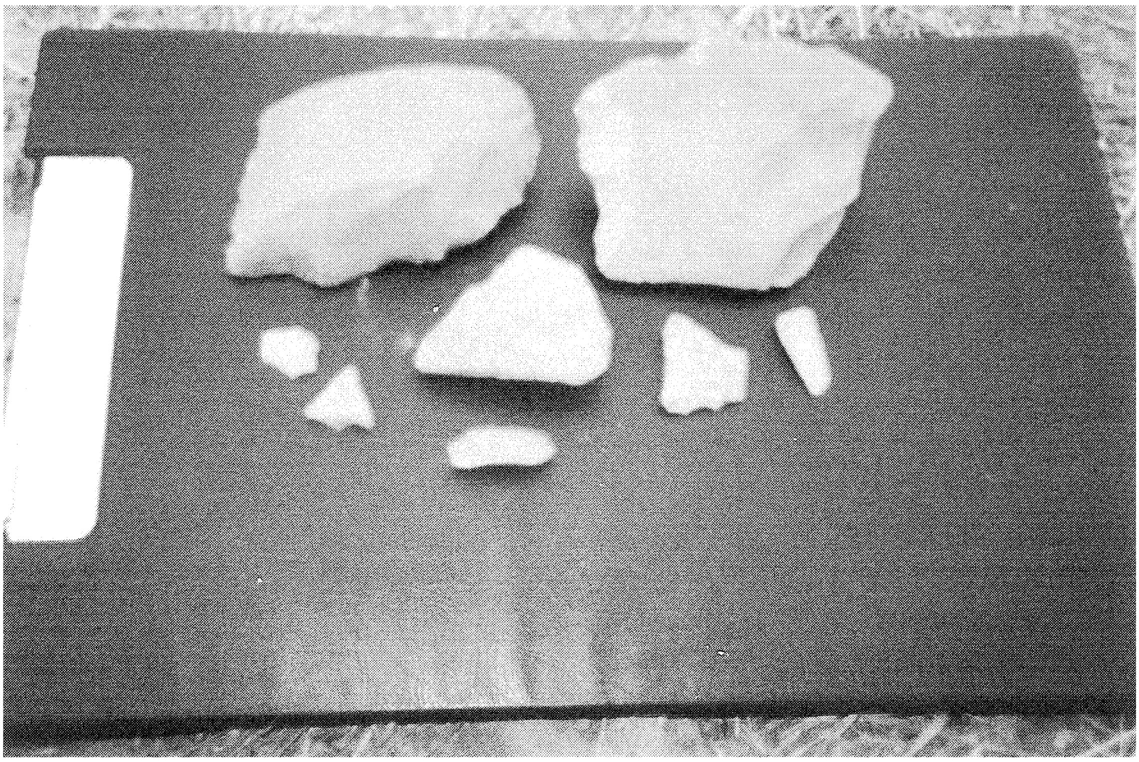
AREA PHOTO FO SITE NW 16

AREA PHOTO OF SITE NW 3

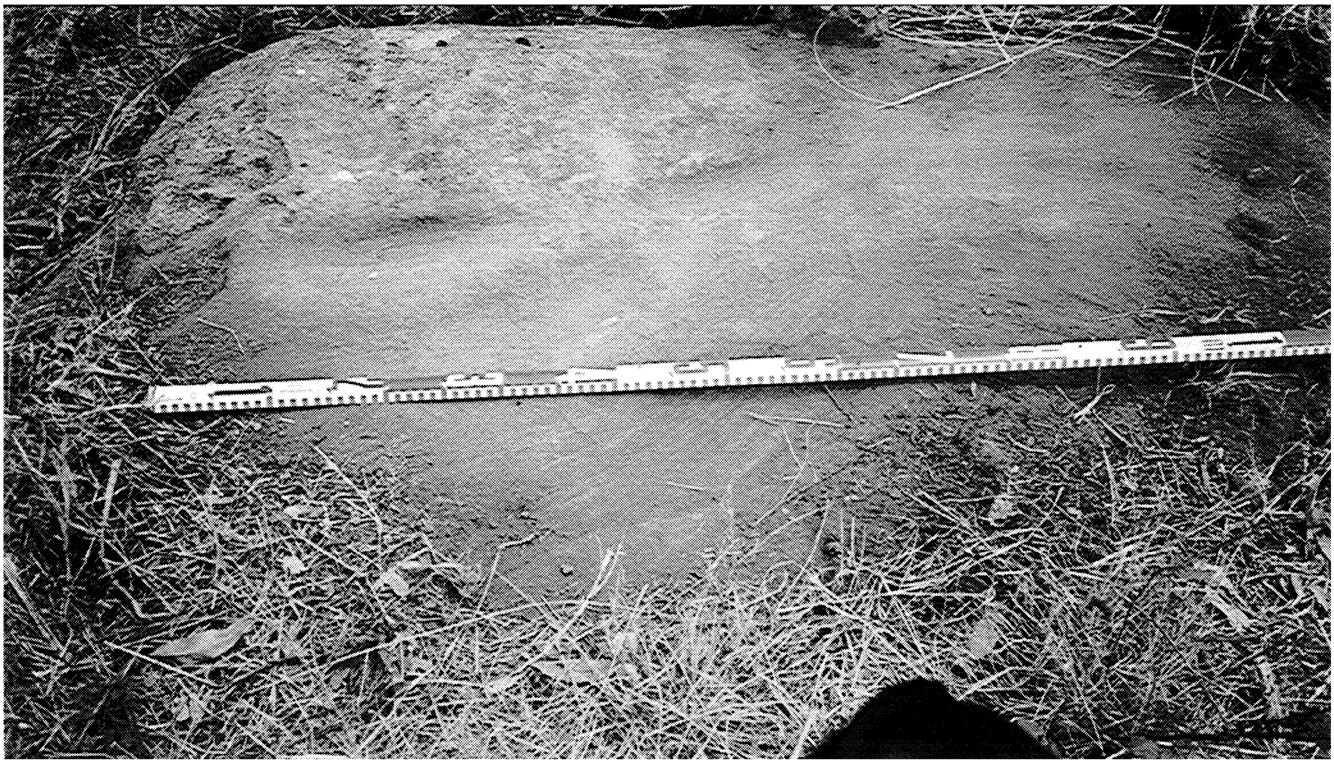
DIFFERENT SIZES AT SITE L 42



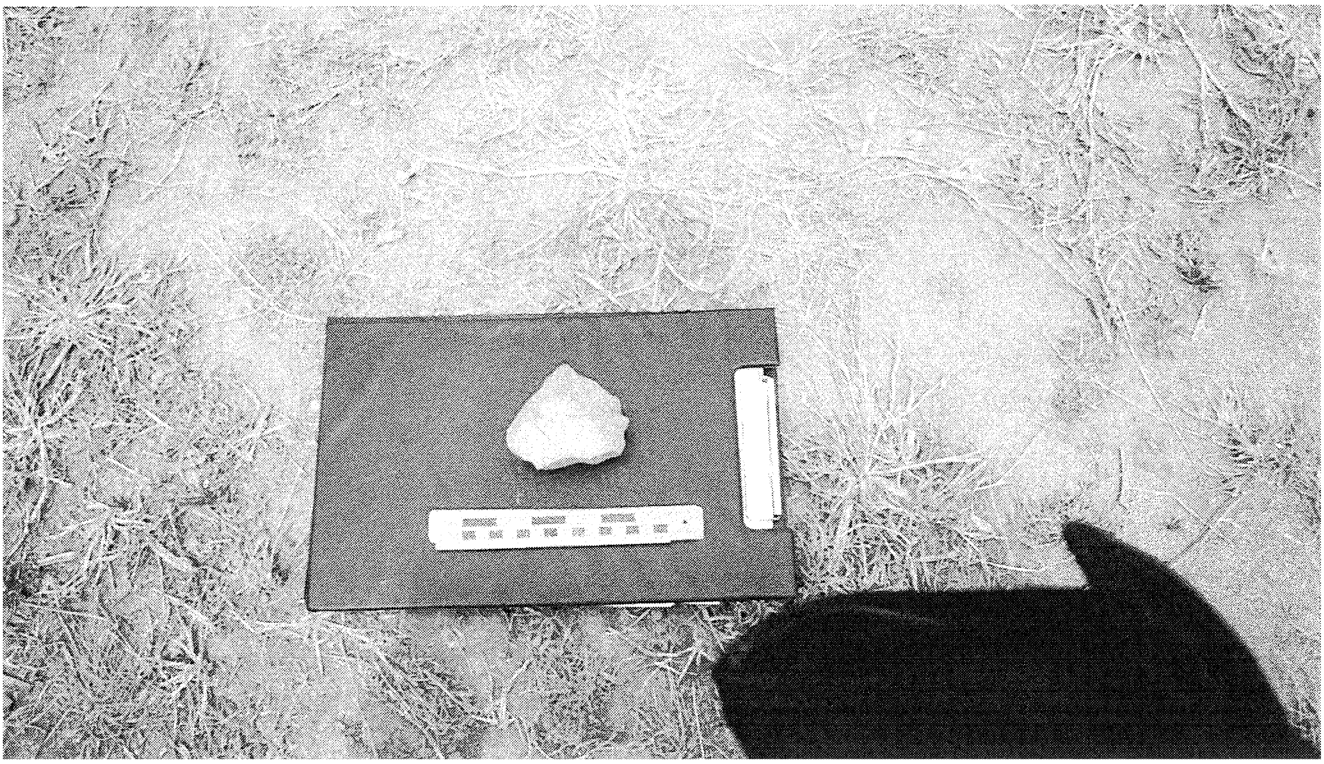
ARTEFACTS AT SITE T 19



TWO PHOTO'S OF GRINDING GROOVES LOCATED NEAR WOLLOMBI BROOK



ARTEFACT AT SITE L 29



7 RESULTS

7.1 DOCUMENTING WHAT WAS FOUND

The two representatives of the Upper Hunter Wonnarua Council report that in consultation with the Archaeologists and the other three Aboriginal groups, that no less than 170 Aboriginal Cultural Heritage Sites recorded within the study area. These sites range between Isolated Finds, Axe-Grinding Grooves, Small Scatters to Large Assemblages and Tool Making Areas including possible Scared Trees.

The main water source located in the area is the Wollombi Brook which runs inland and into the Hunter River a few miles above the study area near Lemington Mine.

170 Aboriginal Cultural Sites is a very large number of places to locate in a study area. Our representatives also noted that there were a small number of (PADS) or Potential Areas of Deposits located across the study area.

This is an interesting point which needs to be analysed and taken into consideration by the Upper Hunter Wonnarua Council when understanding what will happen to this area if approval to the mine is granted.

The Upper Hunter Wonnarua Council's point of view is that we believe it is of great importance to fully understand what was happening Culturally within this Zone. The location of the Recorded Objects can help us understand Wonnarua Land Use Practices that occurred at least 180 years ago which is now only just outside living memory.

A Full Recording of the Artefact Location Names and the Assemblages would be included in the Archaeologists Text of the Environmental Impact Statement

Site No	Material	Type Artefact	Length	Width	
L1	2 Silcrete	No records	-	-	
	7 mudstone	No records	-	-	
	2 chert	No records	-	-	
L2	2 Silcrete	No records	-	-	
	1 I gnious	No records	-	-	
L3(IF)	Ignious	Flaked pebble	-	-	
L4	N/A	N/A	-	-	
L5 (IF)	Silcrete	Broken flake	2	3	
L6 (IF)	mudstone	Mod flake	2	3	
L7 (IF)	Silcrete	F/fragment	2	3	
L8	2 Mudstone	-	-	-	
L9 (IF)	1 Silcrete	-	-	-	
L10 (IF)	1 Ignious	-	-	-	
L11	2 mudstone	-	-	-	
	2 Silcrete	-	-	-	
L12	1 Ignious	-	-	-	
	2 mudstone	-	-	-	
	2 Silcrete	-	-	-	
L13 (IF)	1 Mudstone	-	-	-	
L14 (IF)	1 Mudstone	-	-	-	
L15	No records	No records	No records	No records	2 artefacts
L16	No records	-	-	-	diff/team
L17	No records	-	-	-	diff/team
L18	No records	-	-	-	diff/ team
L19	Silcrete	Flake	-	-	
	Silcrete	F/piece			
L20	-	-	-	-	2 artefacts
L21	Basalt ?	Axe blank	-	-	
L22	7 mudstone	-	-	-	
L23	Mudstone	rot/core	-	-	
	2 mudstone	-	-	-	
L24 (IF)	Silcrete	core	-	-	
L25	mudstone	core	-	-	
	Quartz	Flake	-	-	
L26	-	-	-	-	
L27	-	-	-	-	
L28	Mud stone	-	-	-	
	Pebble	tool	-	-	peck/ground
L29	Mudstone	Large Flake	-	-	
L30	Mudstone	F/piece	-	-	
	Silcrete	Flake	-	-	

Site No	Material	Artefact type	Length	Width	
L31(IF)	Mudstone	F/piece	-	-	
L32	4 mudstone	Flakes	-	-	
	P/wood	Flake	-	-	
	Silcrete	B/Flake	-	-	
	Silcrete	Core/frag	-	-	
	Ignious	Flake	-	-	
L33	Mudstone	Flake	-	-	
	Mudstone	B/Flake	-	-	
L34	Mudstone	F/piece	-	-	
	Mudstone	F/piece	-	-	
	Mudstone	F/piece	-	-	
L35 (IF)	Mudstone	Flake	-	-	
L36 (IF)	-	-	-	-	
L37	Mudstone	B/Flake	-	-	
	Silcrete	-	-	-	
L38	Mudstone	Rot/core	-	-	
	Mudstone	B/Frag	-	-	
	Mudstone	Flake	-	-	
L39	2 Mudstone	Flakes	-	-	
L40 (IF)	Mudstone	B/Flake	-	-	
L41 (IF)	Mudstone	B/Flake	-	-	
L42	Mudstone	B/Flake	-	-	30 + L/slope
	30 + silc/mud	-	-	-	
L43	22				22/ L/slope
L44	24				24/L/slope
L45(site 12)	300				
L46	Mudstone	Flake	-	-	
	Mudstone	B/Fake	-	-	
	2 Mudstone	F/pieces	-	-	
	1 Mudstone	Flaked/core?	-	-	
L47 (IF)	Mudstone	F/Frag	-	-	
L48	Mudstone	Mod Flake	-	-	
	Mudstone	Flake	-	-	
	Silcrete	Rot/core	-	-	
L49 (IF)	Quartz	Flake	-	-	
L50	2 artefacts	-	-	-	No records
L51	Mudstone	B/Flake	-	-	
	Silcrete	Flake	-	-	
	Quartz	B/Flake	-	-	
	Silcrete	core	-	-	

Site No	Material	Type artefact	Length	Width	
L52	Mudstone	B/Flake	-	-	
	Mudstone	B/Flake	-	-	
	Mudstone	Chopper	-	-	
L53 (IF)	Quartz	Flake	-	-	
L54	2 artefacts	-	-	-	2a/gg
L55	2 Mudstone	Flakes	-	-	
	Quartz	Flake	-	-	
	Mudstone	B/Mod.Flake	-	-	
L56 (IF)	Mudstone	B/Flake	-	-	
L57	2 Mudstone	Flakes	-	-	
	Silcrete	F/Frag	-	-	
L58	2 Mudstone	Flakes	-	-	
	Mudstone	B/Flake	-	-	
	Mudstone	Rot/core	-	-	
L59 (IF)	Mudstone	Flake	2	3	
L60	4 Mudstone	Flakes	-	-	
	2 Mudstone	B/Flakes	-	-	
	1 Mudstone	Mod/Flake	-	-	
L61 (IF)	Mudstone	Flake	-	-	
L62	P/Wood	B/Flake	-	-	
	P.Wood	B/Flake	-	-	
L63	Silcrete	Flake	1	2	
	Mudstone	Flake	3	4	
L64	200/all mat	-	-	-	Large scatter
L65	21+ artefacts	All materials	-	-	
L66	2 Silt stone ?	B/flake-c	(3) (6)	(4) (7)	
	Silcrete	F/Frag	2	3	
L67	Silcrete	Flake	4	5	
	Mudstone	B/Flake	1	2	
	Mudstone	Flake	3	4	
L68 (IF)	Mudstone	Flake	2	3	
L69 (IF)	Silcrete	core	5	6	
L70	8 Mudstone	B/f -f-			
	quartz	Flake	3	4	
L71 (IF)	Quartz	Flake	2	3	
L72	Silcrete	B/Flake	3	4	
	Mudstone	Flake	2	3	
	Silt stone?	npfd	3	4	
L73 (IF)	-	-	-	-	
L74 9IF)	-	-	-	-	

Site No	Material	Type artefact	Length	Width	
L75	Mudstone	Flake	2	3	
	Mud stone	Core	3	4	
	Quartz	Flake	2	3	
	Mudstone	Flake	2	3	
	Mudstone	B/Flake	2	3	
	Silcrete	core	4	5	
	Mudstone	Flake	2	3	
	" "	-	2	3	
	" "	-	2	3	
	" "	-	3	4	
	" "	-	1	2	
	" "	-	2	3	
	Silcrete	B/Flake	2	3	
	mudstone	f	2	3	
	quartz	f	0	1	
	quartz	f	2	2	
	silcrete	b/f	2	3	
	p/wood	f	1	2	
	mudstone	b/f	1	2	
	silcrete	f	2	3	
L76	Mudstone	Flake	2	3	
	mudstone	b/flake	3	4	
L77 (IF)	mudstone	core	3	4	
L78	mudstone	f/frag	2	3	
	mudstone	f	2	3	
	mudstone	f	1	2	
	Mudstone	f	4	5	
L79	m/s	f	3	4	
	m/s	b/flake	2	3	
	m/s	f	1	2	
	m/s	b/flake	2	3	
	m/s	f	2	3	
	m/s	f	2	3	
	m/s	f	2	3	
	m/s	f	2	3	
	m/s	f	2	3	
	m/s	core	4	5	
	silcrete	f	1	2	
L80	-	-	-	-	small scatter
L81	m/s	core	2	3	

Site No	Material	Type artefact	Length	Width	
L81 ctd	m/s	f	3	4	
	m/s	f	3	4	
	m/s	-	2	3	
	m/s	f	3	4	
	silcrete	f	2	3	
	silc	-	2	3	
	silc	-	2	3	
	m/s	f	4	5	
	m/s	-	2	3	
L82	m/s	f	2	3	
	m/s	-	2	3	
L83 (IF)	m/s	f	1	2	
L84 (IF)	m/s	f	2	3	
L85	m/s	f	4	5	
	m/s	f	4	5	
	m/s	f	3	4	
	m/s	f	0	1	
	m/s	f	2	3	
	ms	b/flake	2	3	
	m/s	f	4	5	
	m/s	f	3	4	
	m/s	f	3	4	
	m/s	f	2	3	
L86	m/s	f	2	3	
	m/s	mod/piece	9	10	
	m/s	f	4	5	
	m/s	f	3	4	
	m/s	f	2	3	
	m/s	f	2	3	
L87 (IF)	m/s	f	2	3	
L88	m/s	f	5	6	
	m/s	f	2	3	
	m/s	f	1	2	
	m/s	f	2	3	
	m/s	mod piece	7	8	
L89 (IF)	m/s	f	5	6	
L90 (IF)	m/s	f	1	2	
L91 (IF)	m/s	core	4	5	
T1	quartz	f	1	2	
	f/g/s	f/frag	3	4	

Site No	Material	Type artefact	Length	Width	
T1 ctd	m/s	f	3	4	
T2	m/s	core	5	6	
	m/s	b/backed/b	1	2	
	m/s	f/frag	1	2	
	silc	flaked cobble	8	9	
	m/s	f/frag	1	2	
	glass	-	-	-	
	m/s	b/flake	2	3	
	m/s	core/frag	6	4	
	m/s	f.frag	2	3	
	m/s	f	2	3	
	9 pieces/glass	-	-	-	
T3(L.Dyall	relocated	-	-	-	
T4(IF)	m/s	f	3	4	use wear
T5	m/s	f	1	2	
	m/s	f/frag	0	1	
T6	quartz	f	-	-	use wear
T7	m/s	f	6	7	
	m/s	b/flake	1	2	
	m/s	b/flake	1	2	
	m/s	f	1	2	
	m/s	f	1	2	
	m/s	b/flake	4	2	
	m/s	b/flake	3	4	
	m/s	b/flake	2	3	
	quartz	f/frag	4	5	
T8	m/s	f/frag	3	4	
	m/s	f	4	3	
	m/s	f	2	8	
T9	4 pieces	f/p	4 ?	5 ?	cojoin
T10	m/s	b/f	4	5	
	m/s	f	3	2	
T11	m/s	b/f	1	2	
	m/s	f/frag	-	-	
	silc	f/frag	6	5	
T12	m/s	b/frag	2	3	
	silc	f/frag	2	3	
	m/s	f	1	8	
	quartzite	core	7	8	
	silc	b/flake	1	2	

Site No	Material	Type artefact	Length	Width	
T12 ctd	silcrete	b/flake	1	2	
	silc	f/frag	1	2	
	m/s	f/frag	1	2	
	m/s	f/frag	0	1	
	quartz	f/frag	1	2	
T13 ((IF)	-	-	-	-	not recorded
T14	silc	f	5	4	
	m/s	f	3	8	
	m/s	f	2	6	
	m/s	f	2	3	
	silc	f/frag	2	3	
	m/s	f	5	6	
	m/s	f/frag	1	2	
	m/s	b/flake	2	3	
T15	m/s	f/frag	-	-	
	2 m/s	b/flake	-	-	
	silc	b/flake			
	silc	f/frag	-	-	
T16	m/s	f/frag	2	3	
	m/s	f/frag	0	1	
	m/s	f/frag	1	2	
	silc	f/frag	1	2	
	m/s	f/frag	1	2	
T17(IF)	m/s	scrapper	-	-	re/new/retou
T18	quartz	f/frag	1	2	
	silc	f/piece	3	4	
	silc	backed	1	2	rough mat
	silc	f	4	3	
	silc	b/flake	1	2	
	silc	f/frag	1	2	
	m/s	f/frag	3	4	
	silc	f	3	4	
T19	150	all mat			large site
E0	IF	-	-	-	
E1	9 artefacts	-	-	-	diff/team
E2 + E3	2 artefacts	-	-	-	diff/team
E4	IF	-	-	-	diff/team
E5	IF	-	-	-	diff/team
E6 +E7	2 artefacts	-	-	-	"
E8	IF	-	-	-	"

Site No	Material	Type artefact	Length	Width	
E9	3artefacts	-	-	-	diff/team
E10	IF	-	-	-	"
E11	IF	-	-	-	"
E12	IF	-	-	-	"
E13 + H10	6 artefacts	-	-	-	"
E14	2 artefacts	-	-	-	"
E15 + E16	2 artefacts	-	-	-	"
E17	IF	-	-	-	"
E18	7 artefacts	-	-	-	"
E19	9 artefacts	-	-	-	"
E20	IF	-	-	-	"
HI	5 artefacts	-	-	-	"
H2	42 artefacts	-	-	-	"
H3	IF	-	-	-	"
H4	5 artefacts	-	-	-	"
H5	15 artefacts	-	-	-	"
H6	2 artefacts	-	-	-	"
H7	IF	-	-	-	"
H8	IF	-	-	-	"
H9	>60 artefacts	-	-	-	"
H11	IF	-	-	-	"
H12	27 artefacts	-	-	-	"
E25	IF	-	-	-	diff/team
E26	IF	-	-	-	"
E27	9 artefacts	-	-	-	"
E28	7 artefacts	-	-	-	"
E29	2 artefacts	-	-	-	"
E30 -E32	3 artefacts	-	-	-	"
E33	IF	-	-	-	"
E34	IF	-	-	-	"
E35	IF	-	-	-	"
E36	27 artefacts	-	-	-	"
E37	IF	-	-	-	"
E38	3 artefacts	-	-	-	"
E39	11 artefacts	-	-	-	"
E40	3 artefacts	-	-	-	"
E41	4 artefacts	-	-	-	"
E42	IF	-	-	-	"
E43	IF	-	-	-	"
E44	IF	-	-	-	"

Site No	Material	Type artefact	Length	Width	
E45 (IF)	Cobble	Tool	-	-	worked/end
E46	2 m/s	f/pieces	-	-	
	m/s	f	-	-	
E47	silcrete	f	-	-	
E48	m/s	core	-	-	
E49	3 m/s	b/flake	-	-	
	2 m/s	f/piece	-	-	
	m/s	f	-	-	
E50 (IF)	f.g.s	bondi point	2	3	b/tip
E51(IF)	m/s	f	8	9	
E52	2 m/s	f/frag	0.8	0.4	
E53	2 m/s	fragment	2	1	
E54	silc	f	5	6	
	m/s	f	2	3	
E55	-	-	-	-	p/scar tree

7.2 DOCUMENTING SIGNIFICANCE to the ABORIGINAL COMMUNITY

Although New South Heritage Legislation does not recognize Aboriginal Ownership of our Cultural Heritage Material Objects, the National Parks and Wildlife Service who administer the Aboriginal Relics Act, Section 90, has an un-definable Policy that insists on a broad consultation process.

Therefore any interested party or community group can put their hat in the ring to be consulted on any project without providing any proof of who they are in relation to what Connection to the Country they have, Nor Suitable Qualifications regarding Cultural Understanding or Knowledge for the area in question.

The Upper Hunter Valley has at least four to five (4 - 5) Aboriginal Groups identified or having an interest in Aboriginal Cultural Management Issues. This position is becoming a problem to the Local Community which could prove to be a point for Legal Action by any of the competing groups if there is any disagreement between the parties.

The Upper Hunter Wonnarua Council has had 15 years experience in Cultural Heritage Management and has been providing Aboriginal Cultural Heritage Assessments since 1998 and our community's significance for the area is as follows:

Tribally and Culturally this area is of great significance to the Wonnarua people and their Descendants based on the fact that as well as the known Open Camp Sites of which there are 160 Sites, there is also a well documented and recorded Ceremonial Ground and its location can be found in the vicinity of the South East Corner of the Proposed New Lease Boundary for the Underground Coal Mine .

The Ceremonial Ground has been well documented and is known by the present day Descendants of the Ancestral Wonnarua people.

The English Land Owner recorded the last Initiation Ceremony back in 1853.

We believe that this is a very serious issue and we would not like to see the Ceremonial Ground impacted by any coal mining operation within at least a 2 km diameter of this area.

Further discussion is needed between the developer, Upper Hunter Wonnarua Council and National Parks & Wildlife Service is needed with regards to our concerns over this highly significant area.

Therefore the following recommendations and our conditions of management are based on what we have learnt during the field survey. What the developer is intending to do to the land and our collective conscious with dealing with our own Cultural Heritage Places.

8 RECOMMENDATIONS

The following Recommendations and Conditions have been based on a clear understanding of this development, taking into consideration what Aboriginal Cultural Heritage Objects were recorded inside of the mining lease boundary and having a full understanding of what will happen to this landscape and our Material Heritage if this development is given approval by the Department of Planning.

Recommendation 1

The Upper Hunter Wonnarua Council and the Wonnarua Nation Elders are very concerned with the Southern Lease Development area, mainly because of the of the known Ceremonial Area that exists in the vicinity.
We strongly recommend that the Ceremonial Area is not impacted upon in any way by any type of mining or surface activities within a 2km diameter of this Site as stated on page 34, paragraph 8 of Chapter 7. Documenting Significance to the Aboriginal Community .

The Upper Hunter Wonnarua Council and the Wonnarua Nation Elders the Developer and National Parks and Wildlife Service Unit managed by the State Government need to hold an urgent meeting to discuss the Protection of these issues as soon as possible.

No Aboriginal Heritage Sites is to be impacted upon within this zone.

Recommendation 2

The Upper Hunter Wonnarua Council and the Wonnarua Nation will not object to the impact of our Heritage in the planned open cut extension on the condition that 2 representatives from each group are fully employed in all the archaeological work within this proposed area.

Also we would like to see all the Material Objects placed in care of the Sydney Museum as per the National Parks and Wildlife Service ACT.

Recommendation 3

That the Upper Hunter Wonnarua Council and The Wonnarua Nation would not object to the impacts to the surface of the underground mining operations areas on the condition that 2 representatives from the Upper Hunter Wonnarua Council and the Wonnarua Nation are employed during all proposed archaeological / monitoring work that will be carried out on this area.

As stated both groups would like to make it clear that where ever possible Aboriginal Sites that are not in any danger of disturbance by surface work are to be left in their natural state and not collected or re-moved during the life of both the open cut and underground mine works.

Recommendation 4
The Axe Grinding Grooves, East of Wollombi Brook are not to be impacted upon by the surface or underground coal mining practices within an area agreed to by the Upper Hunter Wonnarua Council and the Wonnarua Nation as well as the developer.

Recommendation 5
Finally we believe that more discussion concerning the development of an Aboriginal Cultural Heritage Management Plan needs to be agreed upon as soon as possible, before the proposed development begins other wise we will withdraw our support.

Also that the developer needs to understand that this area is of HIGH SIGNIFICANCE to the Wonnarua people and that care and consideration needs to be given on both sides of this proposed development.

9 BIBLIOGRAPHY

- Wambo Development Project
  Planning Focus Document
  Resource Strategies

  Proj No; WAM-02-01
  Doc No; R001-D

  November 2002

TABLES AND APPENDICES 1 TO 4

AVAILABLE UPON REQUEST

ATTACHMENT D-8

RECORD OF CONSULTATION WITH ABORIGINAL GROUPS

ABORIGINAL GROUP CONSULTATION PROCESS

Presented below is a chronological summary of consultation between Local Aboriginal groups and Wambo Coal Pty Ltd (WCPL):

- November 2002: Individual meetings with the Lower Wonnarua Tribal Council (LWTC), the Upper Hunter Wonnarua Council (UHWC) (representing the Wonnarua Nation Aboriginal Corporation [WNA]), the Wanaruah Local Aboriginal Land Council (WLALC) and the Ungooroo Aboriginal Corporation (UAC) to present a Project description and an invitation to be involved in the survey work.
- 11-21 November 2002: Members of the LWTC, the UHWC (also representing the WNAC), the WLALC and the UAC participated in field survey work at Wambo.
- 4 December 2002: An invitation was extended to all Aboriginal groups to attend the Planning Focus Meeting.
- 12-14 December 2002: Second component of field survey work conducted. Members from the LWTC, the UHWC (representing the WNA), the WLALC, and the UAC participated in the survey work.
- 14 February 2003: Director Generals Requirements for the Project were issued to WCPL outlining the Aboriginal groups WCPL were required to consult with.
- 24 February 2003: Consultation meeting was held in Singleton.
- 13 March 2003: Summary report was written for the Aboriginal groups and a survey of the probable location of Site 2 (ceremonial ground) was conducted.
- 17 March 2003: Consultation meeting with Aboriginal groups, WCPL and Coal & Allied at Wambo.
- 4 April 2003: Site 2 information (aerial photographs) and employment prospects letter provided to Aboriginal groups.

This consultation process commenced in late 2002 and involved a series of formal and informal meetings with Aboriginal groups in the local area. It was recognised at the outset that engaging all Aboriginal groups was vital to ensuring that the consultation process was inclusive as possible and that wide-ranging views could be canvassed in relation to the management of Aboriginal cultural heritage at the site.

Meetings were initially held with:

- Lower Wonnarua Tribal Council (29 October 2002 in Maitland);
- Wanaruah Local Aboriginal Land Council (29 October 2002 in Muswellbrook);
- Ungooroo Aboriginal Council (30 October 2002 in Singleton);
- Upper Hunter Wonnarua Council (30 October 2002 in Singleton) (the WNAC was to be represented by the UHWC).

The purpose of the above meetings was to provide each group with a preliminary Project description, maps of recorded sites in the Project area, and a description of the Aboriginal heritage cultural surveys to be conducted for the Project. Each group was asked to provide their input and views as to how the surveys should be conducted and what issues were important to be covered by the Aboriginal heritage assessment.

WCPL and Elizabeth White endeavoured to consider all views and requests and incorporate these into surveys, consultation meetings and subsequent assessment.

Representatives from the LWLC, UHWC (also representing the WNAC) and WLALC participated in a site visit and induction programme on 11 November 2002. Aboriginal groups were given the opportunity to meet employees of WCPL and learn more about the company. Archaeologist Elizabeth White took individuals to look at sites previously recorded in the Project area. This was done with the aim of putting survey findings into context.

The field surveys were conducted during two periods: 11 to 21 November 2002 and 12 to 14 December 2002. Four consultant archaeologists and two representatives from each Aboriginal group conducted the surveys each day (Table 1 outlines the survey participants).

Table 1
People Who Took Part in the 2002 Field Survey

Archaeological Team	Lower Wonnarua Tribal Council	Upper Hunter Wonnarua Council	Wanaruah Local Aboriginal Land Council	Ungoroo Aboriginal Corporation
Dr Helen Brayshaw	Mr Barry Anderson	Ms Georgina Berry	Ms Christine Mathews	Mr Chris Dallen
Ms Kerstin Calley	Mr Glen Miller	Ms Tracy Skene	Mr Rodney Mathews	Ms Rebecca Faulder
Dr Laila Haglund	Ms Marie Waugh		Ms Bev van Vleit	Ms Dahleen Hall
Ms Elizabeth White			Mr Larry van Vleit	Mr Allen Paget
				Mr Shaun Paget
				Ms Rhonda Ward

Open invitations were extended by WCPL to the Aboriginal groups to attend a Planning Focus Meeting (along with NSW government departments and other stakeholders) at Wambo on 4 December 2002. The purpose of the meeting was to provide a detailed Project description and canvas the views and requirements of all stakeholders.

The DGRs for the Project were received by WCPL on 14 February 2003. The National Parks and Wildlife Service (NPWS) outlined their requirements for the assessment of Aboriginal cultural heritage and provided a list of Aboriginal groups who NPWS required to be consulted. One group on this list, Combined Council of Hunter Valley Elders (CCHVE), had formed after the field survey and Planning Focus Meeting. WCPL and their consultants brought the CCHVE up to date with the Project. All other groups had been involved in the process to date.

WCPL invited the LWTC, UHWC (WNAC), WLALC, UAC and the CCHVE to attend a consultation meeting at the Francis Phillip Motor Inn at Singleton on 24 February 2003. All attendees were provided with a summary table outlining all sites found in the study area, management and mitigation measures proposed by Elizabeth White and WCPL and accompanying figures. It was the intention that management/mitigation proposed would be discussed at the meeting, however, it came to light through the course of the discussions that the groups present felt the Bora ground (Site 2) issue was of utmost importance and were unwilling to discuss management measures for other sites on Wambo land until resolved. It was agreed that another survey to search for the Bora ground (Site 2) should be conducted.

A survey was conducted on 13 March 2003 to search for the Bora ground. Representatives from all Aboriginal groups, WCPL, Coal & Allied and consultant archaeologists, Elizabeth White and Helen Brayshaw, were present. Participants searched the area, identified by comprehensive research (refer Attachment D-1), however, no physical remains of Site 2 (the Bora ground) were identified.

Meeting at was held at Wambo with Aboriginal groups, Coal & Allied and consultant archaeologists on 17March 2003. The results of the Site 2 (Bora ground) survey were discussed and Wambo committed to providing the groups with the Bora Ground Report (Attachment D-1) and aerial photos of the site from 1963, 1979 and 2002. WCPL also agreed to provide the Aboriginal groups with a letter outlining employment opportunities at Wambo. In addition, management and mitigation measures for all sites at Wambo (excluding site 2) presented in Table 2 were discussed during the meeting. The Aboriginal groups stated that all sites were significant to Aboriginal people. No concerns in relation to the proposed mitigation and management measures were raised by the representatives from the Aboriginal groups. However, the Aboriginal groups indicated further discussion would be conducted during the formation of an Aboriginal Cultural Heritage Management Plan.

Table 2
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
1	Several grinding grooves on sandstone bedrock adjacent to Wollombi Brook.	High - Type	No Impact.	
2	Carved Trees/Ceremonial Area on eastern side of Wollombi Brook.	High - Type - Connectedness - Chronology	No Impact.	
32	Scarred Tree located adjacent to the western bank of Wollombi Brook.	High - Type - Condition - Chronology	No Impact.	• Fence Scarred Tree.
30 & 31	Open sites located to the west of Wollombi Brook on the red sand body (estimated to be 700 m in length). Both sites are open sites. Site 31 may be a potential contact site.	High - Size - Landscape setting - Raw materials - Artefact types - Chronology	No Impact.	• Relocate road around Red Sand Body. • Fence Red Sand Body.
114	Large open site located south of North Wambo Creek.	High - Size - Raw materials - Artefact types - Condition	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Detailed analysis. • Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at “Keeping Place”). • Section 90 Consent to Destroy.
291	A continuous scatter of artefacts located along the banks of Waterfall Creek. Over 100 artefacts were recorded.	High - Size - Raw materials - Artefact types - Condition	No Impact.	• Fence site. • Monitor.

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
121	Large open site located south of North Wambo Creek.	High - Size - Raw materials - Artefact types	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Detailed analysis. • Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
89	Open site located on the ridge top watershed between Stony and North Wambo Creeks. Highest recorded site in study area.	High - Landscape setting - Raw materials - Condition - Connectedness	No Impact.	
268	100 artefacts were recorded on an exposure within the Waterfall Creek catchment adjacent to a 2nd order stream.	High - Size - Raw materials - Artefact types - Connectedness	Located within proposed open cut mining area.	• Section 90 Consent to Destroy. • Salvage and Collection of objects (including excavation if required). • Retrieved/collected objects to be documented and stored at "Keeping Place".
258 & 259	Open sites located on a broad upper slope on the north face of the watershed between Waterfall Creek & Splitters Hollow. The 2 sites are separated by ground with poor visibility, so may be one continuous site.	High - Landscape settings - Raw materials - Connectedness	Located within proposed open cut mining area.	• Section 90 Consent to Destroy. • Salvage and Collection of objects (including excavation if required). • Retrieved/collected objects to be documented and stored at "Keeping Place".
239	Open site located on the east face of a crest sloping down towards North Wambo Creek. 150 artefacts were recorded on a track over a distance of 130 m.	High - Size - Raw materials - Artefact types	Located within proposed open cut mining area.	• Section 90 Consent to Destroy. • Salvage and Collection of objects (including excavation if required). • Retrieved/collected objects to be documented and stored at "Keeping Place".

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
110	Large open site located south of North Wambo Creek.	High - Size - Raw materials	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Detailed Analysis. • Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
101	Large open site located south of North Wambo Creek.	High - Size - Raw materials	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Detailed Analysis. • Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
62	Open site located on edge of minor creek 1 km west of Wollombi Brook and between Wambo and North Wambo Creeks. Piece of glass with a worked edge.	High - Type - Raw materials - Artefact types - Chronology	Located within proposed underground mining areas. Zone B1 – potential for cracking and isolated ponding.	• Detailed Analysis. • Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
42	Large open site located south of Wambo Creek.	High - Size - Raw materials - Condition	No Impact	
13	Large open site located adjacent to the proposed rail spur south of Wollombi Brook.	High - Size - Raw materials - Artefact types	Located within proposed rail spur footprint.	• Monitor. • Fence site.
98-99, 102, 104, 106-109, 112, 122-124	Open sites located within subsidence zone A.	Moderate - Raw materials - Artefact types - Condition	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy. • Temporary fencing of sites from creek diversion during construction.

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
47, 50, 52-61, 65, 92, 97, 103, 115, 116, 129-136	Open sites located within subsidence zone B1.	Moderate - Raw materials - Artefact types - Condition	Located within proposed underground mining areas. Zone B1 – potential for cracking and isolated ponding.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
81-85, 69-73	Open sites located within subsidence zone B2.	Moderate - Landscape setting - Condition - Connectedness	Located within proposed underground mining areas. Zone B2 – potential for cracking and erosion on slopes.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
75, 76	Open sites located within subsidence zone A adjacent to the bank of Stony Creek.	Moderate - Raw materials - Condition	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
74	Open site located within subsidence zone B2 on the southern side of Stony Creek.	Moderate - Raw materials	Located within proposed underground mining areas. Zone B2 – potential for cracking and erosion on slopes.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
185	Open site located north-west of Redbank Creek.	Moderate - Raw materials	Located within proposed open cut mining area.	• Section 90 Consent to Destroy. • Collection. • Retrieved/collected objects to be documented and stored at "Keeping Place".
167, 168, 227, 247-250, 260-264, 269, 271, 285-287	Open sites located south of Golden Highway and south-east of Waterfall Creek.	Moderate - Raw materials - Artefact types - Condition - Connectedness	Located within proposed open cut mining area.	• Section 90 Consent to Destroy • Collection. • Retrieved/collected objects to be documented and stored at "Keeping Place".

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
207	Open site located north of Golden Highway and east of Waterfall Creek.	Moderate - Type - Chronology	No Impact.	
16, 17	Open sites located adjacent to the proposed rail spur east of Wollombi Brook.	Moderate - Raw materials	Located within proposed rail spur footprint.	• Section 90 Consent to Destroy. • Collection. • Retrieved/collected objects to be documented and stored at "Keeping Place".
3, 4, 7, 8	Open sites located on the eastern side of Wollombi Brook.	Moderate - Type - Artefact types - Condition - Connectedness	No Impact	
40-41, 43-44	Open sites located on the southern side of Wambo Creek.	Moderate - Size - Raw materials - Condition	No Impact	
49	Large open site located on the northern side of Stony Creek.	Moderate - Size - Raw materials	No Impact	• Monitor.
86-88	Open sites located north of Stony Creek.	Moderate - Landscape setting - Condition - Connectedness	No Impact	• Monitor.
10	Open site located on the southern side of Wollombi Brook within subsidence Zone C.	Low - Condition	Located within proposed underground mining areas. Zone C – potential for minor cracking.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
11 & 12	Open sites located on the southern side of Wollombi Brook.	Low - Condition	No impact	

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
5, 6, 9	Open sites located east of Wollombi Brook.	Low - Condition - Connectedness	No impact	
33	Open site located on the western side of Wollombi Brook.	Low - Condition	No impact	
34 & 35	Open sites south-east of Wambo Creek.	Low - Condition	No impact	
36-39	Open sites adjacent to Wambo Creek.	Low - Condition	No impact	
51	Open site on the northern side of Stony Creek.	Low - Raw materials	No impact	
45-46, 48	Open sites located within subsidence zone B1 on the northern side of Stony Creek.	Low - Raw materials	Located within proposed underground mining areas. Zone B1 – potential for cracking and isolated ponding.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
63, 64, 66-68, 93-96, 105, 126-128, 138	Open sites located within subsidence zone B1.	Low - Condition	Located within proposed underground mining areas. Zone B1 – potential for cracking and isolated ponding.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.
100, 118, 120, 125	Open sites located within subsidence zone A.	Low - Raw materials - Artefact types - Condition	Located within proposed underground mining areas. Zone A – potential for cracking, ponding, erosion along flow paths and sedimentation.	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy. • Temporary fencing of sites from creek diversion during construction.
91	Open site located within subsidence zone B2.	Low - Condition	Located within proposed underground mining areas. Zone B2 – potential for cracking and erosion on slopes	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at "Keeping Place"). • Section 90 Consent to Destroy.

Table 2 (Continued)
Wambo Development Project
Aboriginal Cultural Heritage – Proposed Mitigation and Impact Measures

Site	Description	Scientific/Archaeological Significance	Potential Impact	Proposed Management Measure
146-150	Open sites located within subsidence zone B1.	Low - Condition	Located within proposed underground mining areas. Zone B1 – potential for cracking and isolated ponding	• Subsidence Management and Monitoring (Collection and replacement of objects if necessary. Collected objects to be documented and stored at “Keeping Place”). • Section 90 Consent to Destroy.
77-80, 90, 137, 139, 140-145	Open sites located north of Stony Creek.	Low - Condition	No impact	
151-159	Open sites located adjacent of the northeastern side North Wambo Creek.	Low - Artefact types	Located within proposed open cut mining area	• Section 90 Consent to Destroy. • Collection of Grinding Grooves. • Retrieved/collected objects to be documented and stored at “Keeping Place”.
162-166, 169-172, 174, 182, 183	Open sites located within proposed open cut mining area.	Low - Condition	Located within proposed open cut mining area	• Section 90 Consent to Destroy. • Collection. • Retrieved/collected objects to be documented and stored at “Keeping Place”.
190-196, 199-201, 208-223, 225-226, 228-229, 232-238, 242-246, 251-257, 265-267, 270, 272-284, 288- 289	Open sites located south to southeast of Waterfall Creek.	Low - Raw materials - Artefact types - Condition - Connectedness	Located within proposed open cut mining area.	• Section 90 Consent to Destroy. • Collection. • Retrieved/collected objects to be documented and stored at “Keeping Place”.

WAMBO COAL PTY LIMITED

ABN 13 000 668 057

JERRY'S PLAINS ROAD, WARKWORTH, VIA SINGLETON NSW 2330
PMB 1 SINGLETON NSW 2330
TELEPHONE: 02 6570 2200
FAX: 02 6570 2290

4 April 2003

Ungooroo Aboriginal Corporation
PO Box 3095
SINGLETON NSW 2330

Attention: Graham Ward

Dear Mr Ward

RE: Employment Opportunities for Aboriginal People at Wambo Coal Mine

As discussed at our meeting held on Monday 17th March 2003, we are pleased to outline the employment opportunities for Aboriginal people from the Singleton Region at the Wambo Development Project.

At the Wambo Development Project, the following employment opportunities would be provided to Aboriginal people:

- Aboriginal site monitors would be employed over the mine life, in a capacity to be outlined in the Aboriginal and Cultural Heritage Management Plan.
- Interviews for mining related positions would be made available to Aboriginal people. Where individuals demonstrated the appropriate qualifications and experience for the positions employment offers would be made.
- Aboriginal people would be invited to tender for land management contracts related to the Project.

We believe that the above employment opportunities would be beneficial to the local Aboriginal community as well as the Wambo Coal Mine.

Yours faithfully
Wambo Coal Pty Ltd

WAMBO COAL PTY LIMITED

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TELEPHONE: 02 6570 2200
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4 April 2003

Lower Wonnarua Tribal Council
31 Andrew Street
MAILTLAND NSW 2320

Attention: Barry Anderson

Dear Mr Anderson,

RE: Employment Opportunities for Aboriginal People at Wambo Coal Mine

As discussed at our meeting held on Monday 17th March 2003, we are pleased to outline the employment opportunities for Aboriginal people from the Singleton Region at the Wambo Development Project.

At the Wambo Development Project, the following employment opportunities would be provided to Aboriginal people:

- Aboriginal site monitors would be employed over the mine life, in a capacity to be outlined in the Aboriginal and Cultural Heritage Management Plan.
- Interviews for mining related positions would be made available to Aboriginal people. Where individuals demonstrated the appropriate qualifications and experience for the positions employment offers would be made.
- Aboriginal people would be invited to tender for land management contracts related to the Project.

We believe that the above employment opportunities would be beneficial to the local Aboriginal community as well as the Wambo Coal Mine.

Yours faithfully
Wambo Coal Pty Ltd

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FAX: 02 6570 2290

4 April 2003

Combined Council of Hunter Valley Traditional Owners
17-19 Maitland Street
MUSWELLBROOK NSW 2333

Attention: Margaret and John Matthews

Dear Mr and Mrs Matthews,

RE: Employment Opportunities for Aboriginal People at Wambo Coal Mine

As discussed at our meeting held on Monday 17th March 2003, we are pleased to outline the employment opportunities for Aboriginal people from the Singleton Region at the Wambo Development Project.

At the Wambo Development Project, the following employment opportunities would be provided to Aboriginal people:

- Aboriginal site monitors would be employed over the mine life, in a capacity to be outlined in the Aboriginal and Cultural Heritage Management Plan.
- Interviews for mining related positions would be made available to Aboriginal people. Where individuals demonstrated the appropriate qualifications and experience for the positions employment offers would be made.
- Aboriginal people would be invited to tender for land management contracts related to the Project.

We believe that the above employment opportunities would be beneficial to the local Aboriginal community as well as the Wambo Coal Mine.

Yours faithfully
Wambo Coal Pty Ltd

WAMBO COAL PTY LIMITED

ABN 13 000 668 057

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PMB 1 SINGLETON NSW 2330
TELEPHONE: 02 6570 2200
FAX: 02 6570 2290

4 April 2003

Upper Hunter Wonnarua Council
PO Box 184
SINGLETON NSW 2330

Attention: Laurie Perry

Dear Mr Perry

RE: Employment Opportunities for Aboriginal People at Wambo Coal Mine

As discussed at our meeting held on Monday 17th March 2003, we are pleased to outline the employment opportunities for Aboriginal people from the Singleton Region at the Wambo Development Project.

At the Wambo Development Project, the following employment opportunities would be provided to Aboriginal people:

- Aboriginal site monitors would be employed over the mine life, in a capacity to be outlined in the Aboriginal and Cultural Heritage Management Plan.
- Interviews for mining related positions would be made available to Aboriginal people. Where individuals demonstrated the appropriate qualifications and experience for the positions employment offers would be made.
- Aboriginal people would be invited to tender for land management contracts related to the Project.

We believe that the above employment opportunities would be beneficial to the local Aboriginal community as well as the Wambo Coal Mine.

Yours faithfully
Wambo Coal Pty Ltd

WAMBO COAL PTY LIMITED

ABN 13 000 668 057

JERRY'S PLAINS ROAD, WARKWORTH, VIA SINGLETON NSW 2330
PMB 1 SINGLETON NSW 2330
TELEPHONE: 02 6570 2200
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4 April 2003

Wanaruah Local Aboriginal Land Council
17-19 Maitland Street
MUSWELLBROOK NSW 2333

Attention: Noel Downs

Dear Mr Downs,

RE: Employment Opportunities for Aboriginal People at Wambo Coal Mine

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19 MAITLAND STREET,
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ABN 33 251 730 169

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(02) 6543 1962
FAX: (02) 6542 5377
EMAIL:wanaruah@hunterlink.net.au

Bora Ground at Bulga, Hunter Valley NSW

It is well documented and recorded that an Aboriginal Ceremonial Ground (known as a Bora Ground) exists on the Singleton side of Wollombi Brook approximately 5km north of Bulga Village. It is recorded with NSW NPWS as site 37-6-0056. It's believed location is on or near the junction of the 313256 Easting and the 6389643 Northing.

The Bora Ground is sacred ground and is of the upmost significance to the Aboriginal people. Bora rings can not be destroyed, but they can be vandalised (subjected to physical damage) and desecrated (treated without respect). It is impossible to over-emphasise the continued significance, sacredness and relevance of this site to the Aboriginal people in the area.

Wanaruah Local Aboriginal Land Council, Ungooroo Aboriginal Corporation, Lower Wonnarua Tribal Council, Combined Council Hunter Valley Aboriginal Corporation and Upper Hunter Wonnarua Council were invited to meet at 2 pm on the 13th March 2003 at Ungooroo Aboriginal Corporation Office in Singleton, so that those stake holders with an interest could discuss the importance of this ground to their communities and formulate a united position.

The resultant unanimous outcomes of this meeting are:

1. We are dedicated to the protection of sacred ground, the associated features and sites.

2. We support the Exclusion zone that Wanaruah Local Aboriginal Land Council have place around the site. *(Wanaruah Local Aboriginal Land Council place an exclusion zone (for development of any nature) with a radius of four thousand meters around NSW NPWS site 37-6-0056. The centre of this exclusion zone being the junction of the 313256 Easting and the 6389643 Northing. This exclusion zone will be in force until Wanaruah Local Aboriginal Land Council removes it).*

3. We are of the opinion that the grinding grooves within 4 kilometres of the Bora Ground are associated with the Bora Ground. Our reasoning behind this belief is that these grooves would have been initially made to carve the now destroyed markers and after that used during preparation for ceremonies. The sites are in separate groups to accommodate space between Elders and other attendees.

4. We are of the opinion that other sites within 4 kilometres of the Bora Ground are also associated with the Bora Ground. Each site will be judged and gauged by potential activity link.

5. We want well-planned formal search enabled. The aim would be to identify the exact location of the Bora ground if possible. If necessary we would require the involvement of recognised experts in this field. The planning will involve the sourcing of original maps, recording information, photos and current and past aerial photos of the area. The search is not to be limited within the exclusion zone.
6. No further actions or decisions will be made until we are satisfied that all possible search options have been exhausted.

NOEL DOWNS
for
Carl Hedges 14/3/03.
Secretary

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Barry Anderson
LWTC

C:\Documents and Settings\AHO User\My Documents\Bora Ground at Bulga2.doc

UNGOOROO
ABORIGINAL CORPORATION

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Graham Ward
CEO

Allen Paget
Director