AN ARCHAEOLOGICAL SURVEY FOR ABORIGINAL SITES

IN THE PNC EXPLORATION LEASE AREA OFFICER BASIN, GREAT VICTORIA DESERT

FOR PNC EXPLORATION (AUSTRALIA) PTY LTD

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SUMMARY

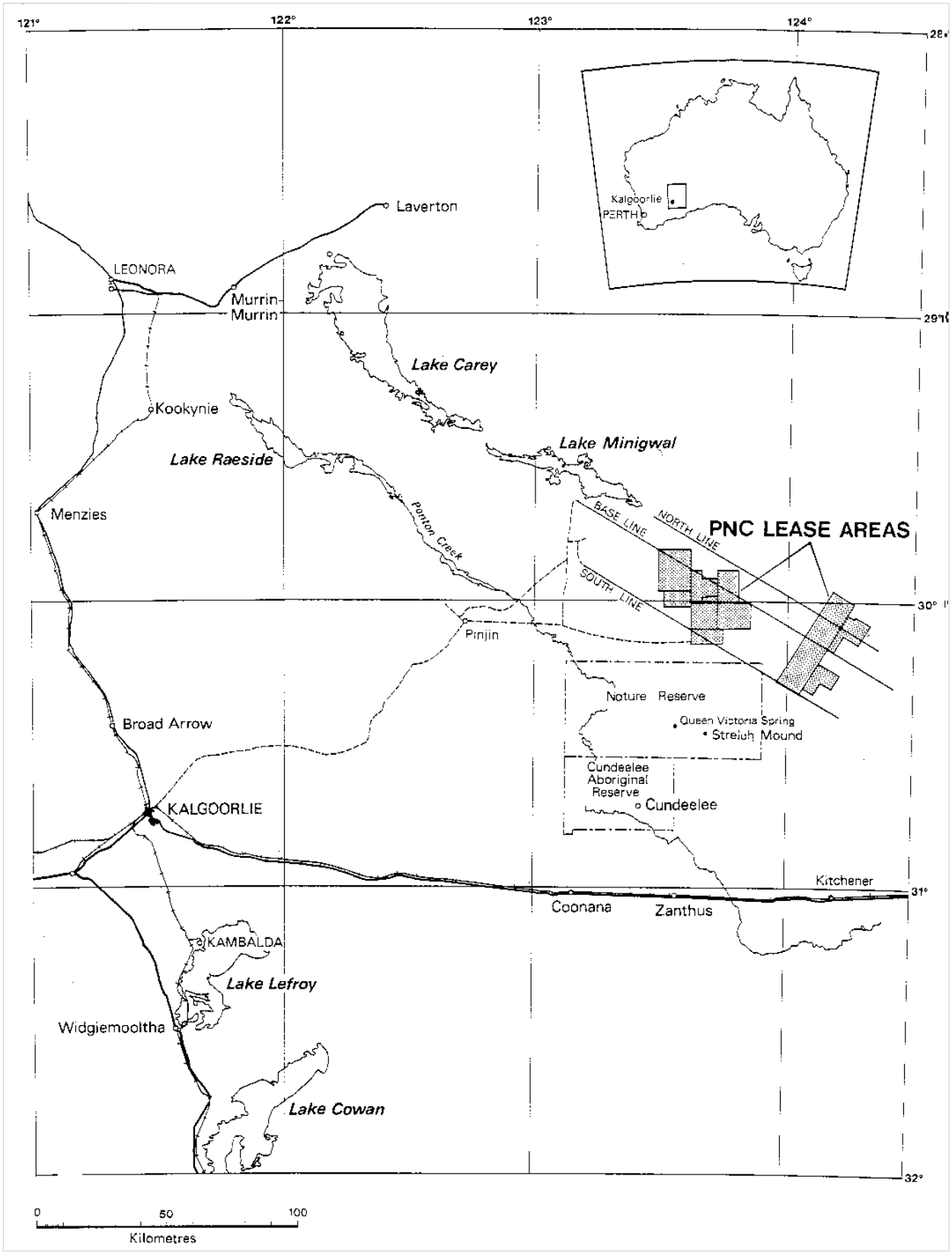
An archaeological survey was carried out in November and December 1983 for PNC Exploration (Aust) Pty Ltd. The company holds a lease area in the Officer Basin of the Great Victoria Desert, where they are engaged in uranium exploration (Fig. l).

A sample survey was undertaken within the areas targeted for open cut mining, and six surface scatters of stone artefacts were located. None of these sites are judged to have excavation potential. Only one site (W1178) is thought to be archaeologically significant, and this site lies outside the area presently designated for mining, should such proceed. Unless associated developments are planned for this area there should be no impact on this site.

The position of four of the six sites was found to coincide with the location of ephemeral water sources, and these appear to be the focus of prehistoric land use in the survey area. This pattern is supported by the ethnohistorical records. The other two sites were found in areas of 'kopi' (flour gypsum).

The low densities of all artefact scatters indicate frequent movement over the survey area. The sites are characterised by artefacts manufactured from raw materials close to the sites and the majority show no signs of secondary working. All formal tool types represented belong to the Australian Small Tool Tradition.

Figure 1 Location of Survey Area



INTRODUCTION AND OBJECTIVES OF THE SURVEY

This report describes the results of an archaeological survey carried out in November and December 1983, in a mineral exploration lease area held by P.N.C. Exploration (Aust.) Pty. Ltd. The lease area is within the Officer Basin, Great Victoria Desert (Fig. I). The survey was commissioned by P.N.C. The consultant's brief was to undertake a sample survey in two target areas most likely to be affected if mining proceeds; to locate any archaeological sites within this sample area; to assess how these might be affected by direct or indirect impact resulting from future exploration, mining or increased access to the survey area, and to provide recommendations, consisting of mitigation proposals and management alternatives. These are necessarily subject to approval by the Aboriginal Cultural Materials Committee. The consultant was also requested to contact the appropriate Aboriginal communities and inform them of the survey and to seek any further information pertaining to archaeological sites within the survey area.

On this basis a prediction of the type of sites likely to occur in the lease area and their archaeological significance was made.

The consultant was specifically required to investigate two discrete target areas covering 126 km^2 and 42.34 km^2 respectively (Fig. 3). These areas are thought by P.N.C. to be those most likely to be affected should mining proceed. Mining will be open cut and any sites located within these target areas will be destroyed.

By the time the archaeological survey was commissioned most of the exploration had been completed and parts of the environment already disturbed by a camp area, airstrip and construction and drilling camps and drill-lines. The results of the archaeological survey however indicate that none of these areas are likely to have contained sites.

REGIONAL ENVIRONMENT

The climate of the survey area may be described as arid, with mean annual rainfall of about 180 mm (Beard 1975: 6-11). Rainfall is fairly evenly distributed throughout the year, but is highly variable and long periods of drought are not uncommon. Summers are hot and winters cool. Daily maximum temperatures range from 35° in summer to 17° in winter (Beard 1975: 11).

The survey area lies within the geological area known as the Officer Basin in the Great Victoria Desert. The Officer Basin was uplifted and has been land since Late Cretaceous times. It is predominantly underlain by siliceous sediments which have been subsequently deep weathered, dissected and duricrusted (Beard 1975: 12; Bunting & Van De Graaff 1977; Bunting and Boegli 1977). Yellow quartz sands have formed and aeolian processes have developed these into sub-parallel seif dunes of a mainly east-west trend. The dunes vary between 5 and 15 metres in height and 1 and 4 km in length. The age of the dunes is not known. They are stabilised at present and comparison between aerial photos taken in 1961 and 1970 indicates no modification in dune shape. A Holocene date for the formation of the dunes has been postulated (Crocker 1946), but more recent research suggests relative climatic stability during this period and an earlier Quaternary date for dune formation (King 1960, Mabbutt 1971, Bowler 1982). Small areas of kopi (flour gypsum) are found in the survey area. There is little rock outcropping within the lease area but occasional low sandstone breakaways and granite outliers protrude above the surface, and several areas of outcropping silcrete were located.

Surface water is intermittent and is confined to rockholes and interdunal areas containing small claypans and soaks. These features are few in number and most are of limited capacity and dry quickly. The best known is Queen Victoria Spring which lies immediately south of the lease area, and is predictably the location of a large surface site (Carnegie 1898 : 39; Site Register files, Western Australian Museum Department of Aboriginal Sites).

The vegetation of the survey area has not been described in detail, although Beard (1975, see also 1974) has mapped the vegetation of the area to the north of the Queen Victoria Spring Reserve, which closely resembles that of the survey area. Plant specimens were collected during the course of the archaeological survey and where possible these have been identified. Malcolm Trudgen is responsible for all identifications. A list of identified specimens is presented in Appendix 1. Although the vegetation map provided by Beard is adequate as a general description of the community, plant specimens were collected as it was felt that some species which may be unimportant in the ecological community may have been important resources either for food or raw material to Aboriginal inhabitants of the survey area.

The vegetation of the dunes to the north of the Queen Victoria Spring Reserve is open woodland in which the upperstorey consists of bara or marble gum, *Eucalyptus gongylocarpa* to a height of 12 m. There is a scattered understorey to 5 m of *E. youngiana*, *E. platycorys*, *E. foecunda*, *Callitris preisii*, *Casuarina corniculata* and *Santalum acuminatum*. Scattered shrubs to 2 m of *Acacia* spp., *Grevillea didymobotrya* and *Leptospermum* sp. occur, especially on the flanks of the dunes and in the swales, and ground cover is chiefly spinifex, *Triodia* sp. although the sedge *Mesomelaena* sp. replaces the spinifex in places. Along the

tops of the higher dunes, shrubs of *Calothamnus quadrifidus* and occasional stands of grass trees, *Xanthorrhoea* sp. and *Banksia elderiana* occur on the gentler slopes. Mulga, *Acacia aneura*, is found on the colluvial or clay rich areas.

The vertebrates of the survey area are listed in Appendix 2. Most of these are inferred to be present on the basis of a survey of the adjacent Queen Victoria Spring Reserve by Burbidge et al. (1976). These authors listed 13 native and four introduced mammal species. The present survey confirmed the presence in the survey area of western gray kangaroo (*Macropus fuliginosus*) and European rabbit (*Oryctolagus cuniculus*), and in addition recorded short-beaked echidna (*Tachyglossus aculeatus*)(reported by a P.N.C. employee), dingo (*Canis familiaris*) and cat (*Felis catus*) (remains of poisoned animals). Before the effects of the European colonization of Australia impinged upon the area, through habitat changes and the arrival of introduced species, the local fauna probably included at least six additional medium-sized native mammal species (A. Baynes pers. comm.). Burbidge et al. (1976) recorded 24 birds, 16 reptiles and 1 frog species. In addition signs of emu (*Dromaius novaehollandiae*), and one goanna (*Varanus* sp.) were observed during the present survey.

All abundant mammals would have been important food resources, as would the emu and larger species of reptiles.

TRADITIONAL ABORIGINAL LAND USE AND ORGANISATION

Tindale (1974) provides a tribal boundaries map and a description of the territory of all Australian Aboriginal tribes. According to Tindale (1974 : 143), the survey area was occupied by a tribe calling themselves Tjeraridjal. Their main waterhole was Queen Victoria Spring whose Aboriginal name was 'Mun:u-'runa. Tindale's tribal boundaries for the Tjeraridjal and adjoining tribes in the Great Victoria Desert are shown in Figure 2.

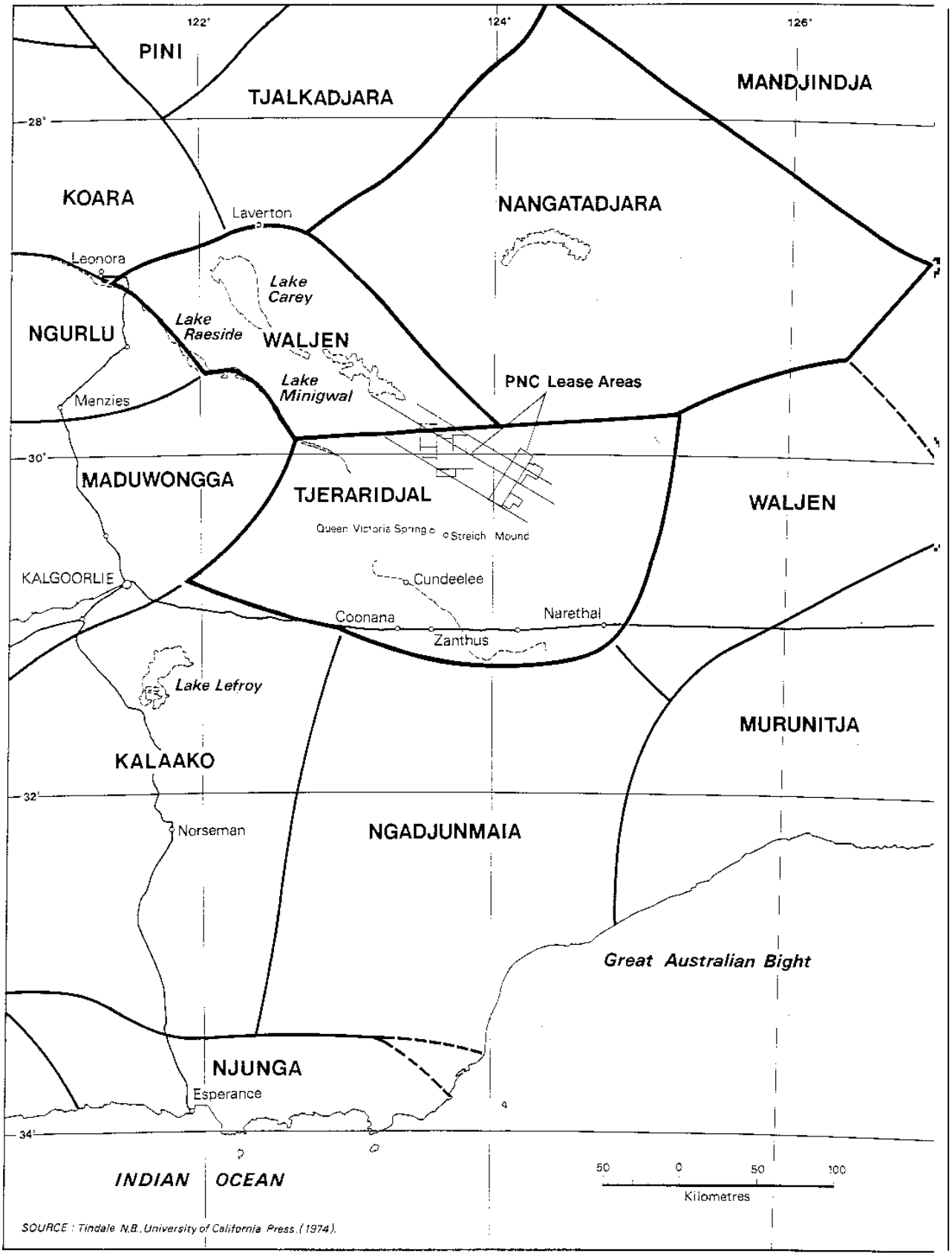
Berndt (1959 : 104-6) has criticised the rigidity of Tindale's tribal boundaries and has concluded that even the term 'tribe' may not be entirely applicable to the Western Desert. He emphasised that tribal boundaries in the Western Desert were far more flexible and overlapping than the discrete boundaries advocated by Tindale.

The Western Desert region, which includes the Great Victoria Desert, comprised one of the major cultural areas or cultural blocs in Aboriginal Australia of about 1,280,000 square km (Berndt 1959 : 84). Despite its size, the Western Desert was distinguished by an essential commonality of culture and social structure and it is possible to speak in broad terms of a Desert Culture.

It has been asserted that the Western Desert is one of the "most undependable and impoverished environments anywhere in the world that people have succeeded in living off the land" (Gould 1971 : 145). The harshness of the desert environment can, however, be overemphasised. Animal and plant species abound. It is the knowledge of the land and its resources that constitute the most essential item of desert technology needed to exploit this environment. Most crucial of all in this regard was a knowledge of the availability of water, the scarcest and most essential resource. The availability of water determined the pattern of land occupancy, movement and economic exploitation (Tindale 1974 : 68). The known and expected sources of water figures prominently in the mythology and ritual, and desert people even referred to their country as their *kapi*, or their water (Christensen 1981 : 46; Berndt 1959 : 97).

Early historical reports referring to the people of the survey area are few but all stress the importance of water in determining the exploitation of the Desert. Carnegie (1898) travelled from just south of Queen Victoria Spring directly north through the Great Victoria Desert and into the Gibson Desert by depending on Aborigines he captured to direct him to water sources. In view of the precarious nature of the water sources the Aborigines were often reticent about imparting this information, but Carnegie overcame this problem by depriving his captives of water for several days. Invariably his demands were met and the water supplies were exhausted by the camels and explorers (1898 : 47, 189).

Figure 2 Tindale's Tribal Boundaries



Giles (1889 : 212, 203), who in 1875 'discovered' Queen Victoria Spring, described a large number of Aboriginal wells dug into the slopes above the soak which all contained water. In April 1894 when Carnegie revisited the Spring he found both the soak and wells empty of water, but by digging wells into the soak in the same manner as the Aboriginals he was able to obtain water for his camels and party. He adds that

> "Numerous old native camps surrounded the water, and many weapons, spears, waddies and coolimans were lying about" (Carnegie 1898 : 39).

In the bush away from the soak Carnegie reported a cleared area eighty yards long and four yards wide with heaps of ashes at both ends. This feature he interpreted as a corroboree ground.

Given the arid nature of the region, the long periods of drought and the high summer temperatures it is predictable that water sources would have provided the focus for most Aboriginal activity and influenced site location. Even in times of severe drought, when superficially the country appeared a waterless wasteland, Carnegie (1898) states that the Aborigines were still able to obtain water by a knowledge of where to dig and of plants and animals that stored enough water to carry them over between more reliable sources. Carnegie (1898 : 17) refers to the use of *Chiroleptes platycephatus*, the waterholding frog, which, when surface water is plentiful, stores water in its body, and buries itself until the next heavy rains. This animal was dug from the soil and the water extracted. The mallee root, which was sucked to obtain moisture, is also mentioned as a stopgap against thirst. Many small piles of mallee root were found in the areas of 'kopi' country Carnegie passed through (1898 : 43).

Carnegie (1898 : 91) relates that an effective method of clearing the thick, muddy water in the claypans was by "dropping into it a sort of powdery gypsum, called 'kopi' by the natives, ... without which after a short time the water would be useless, becoming as it does red and thick".

Scant mention is made of the animals and plant resources exploited by Aborigines in the survey area. Slightly south of Queen Victoria Spring, Carnegie "noticed a large number of old brush fences … which the natives had set up for catching wallabies. The fences run out in long wings, which meet in a point where a hole is dug" (1898 : 36). He also comments on Aboriginal hunting of "the ubiquitous spinifex rat", which from his description is likely to be the macropod *Lagorchestes hirsuitus*, now locally extinct in the Great Victoria Desert (1898 : 179). Spinifex had multiple uses. It was fired to promote new growth and attract game to the area, the seeds were ground and made into flour and the plants uprooted and overturned to make windbreaks (1898 : 176, 177). Carnegie comments on the importance of *Acacia* sp. for the large bardie grubs that were obtained from the roots, and *Eucalyptus* sp. for the bark used for temporary coolimans.

Spinifex and *Acacia* sp. are likely to have had other uses, as they did in other parts of Australia. Spinifex when burnt produces a resin that was used in other parts of the Western Desert to haft stone implements. The superior resin of the *Xanthorrhoea* sp. was also used for this purpose (Tindale 1974 : 22, 23). The seeds of *Acacia aneura* or mulga were an important plant food in the Western Desert, and the galls of most species were eaten (Parker 1980 : 41). Hard-stemmed species of

Acacia were used in the Leonora area for making weapons and this is likely to apply equally to those of the survey area (Parker 1980 : 41). Sandalwood, *Santalum acuminatum*, which was identified by Malcolm Trudgeon from specimens collected from the survey area is said by people from Leonora to have multiple uses. The seeds were eaten (sometimes roasted), the wood was ground with the nut for medicinal purposes for "snakebite or for skin", and the wood was burnt for warmth and to ward off mosquitos (Parker 1980 : 40). Two separate specimens of *S. acuminatum* in the Western Australian Herbarium had the Aboriginal name 'Walku' attached. One was from Warburton and the other from 275 km south west of Warburton.

ABORIGINAL CONSULTATION

In 1982 an anthropological survey was conducted by Dr. Robert McKeich at the Cundeelee and Mt. Margaret Aboriginal communities. These surveys were commissioned by P.N.C. Exploration (Aust.) Pty. Ltd., and aimed to establish whether there were any Aboriginal sites of contemporary or traditional significance in or near the lease area. McKeich also enquired if there were any archaeological sites known to the communities.

McKeich (1982a, 1982b) met with and interviewed male elders of both communities. At Cundeelee, McKeich was told that "no one now living" at the community belonged to the "country" under survey or had ever been into the area, and this was also the case at Mt. Margaret. He concluded that none of those interviewed has any association with the target area, or knew of anyone who had any interests in this area. McKeich's report contains two major omissions. Firstly, he has ignored the role that women play in Aboriginal activities of a ritual or ceremonial nature. Secondly, he has neglected the role of custodianship in maintaining and sustaining religious and ritual life in Aboriginal communities today.

McKeich (1982a) states that only men were interviewed or were allowed to be present during discussions "to ensure that secret sacred information was not withheld", thereby passing over the fact that Aboriginal women also have sites which are significant and secret to women. As well as information about women's sites, they may also have locational information about men's sites, which is a necessity if these sites are to be avoided (Rowell 1983).

John Stanton, in a paper (1983) based on fieldwork conducted over a period of nine years at Mt. Margaret, has documented the process of serial migration by which the former mission came to be settled. He found that "the more recent inhabitants of the area have assumed the guardianship of sacred sites in the region that they have occupied" (Stanton 1983 : 160). Stanton (1983 : 167) states that many sacred sites in the northeastern goldfields are known to the present ritual leaders of Mt. Margaret who came from north of the Warburton Ranges, and some of the most sacred objects have passed into their custodianship. The present custodians have not visited many of the areas to which this information pertains. It is therefore, not inconsistent that people who have never lived in or been to the survey area may hold information pertaining to sites in it.

No formal Aboriginal consultation was undertaken during the course of the archaeological survey. It was felt that further ethnographic survey would be more appropriately undertaken separately. However, the consultant spoke to Morris Branley and Laurie Poland of the Department of Aboriginal Affairs in Kalgoorlie prior to conducting the survey, provided them with a map of the lease area, informed them about the work and requested that the information be passed on to the relevant communities. The consultant on return to the survey area 8 days later was informed that the information had been relayed.

Upon completion of the second stage of the survey, the consultant again visited the D.A.A. office, and spoke at some length to Laurie Poland about the sites that had been located during the survey. Again it was requested that this information be passed on. A copy of the report will be forwarded to the D.A.A. for distribution to the communities.

PREVIOUS ARCHAEOLOGICAL RESEARCH

No systematic archaeological survey has been undertaken in the vicinity of the lease area prior to this survey. Most of the lease area lies on the Minigwal 1:250,000 map sheet, and an examination of the site files in the Aboriginal Sites Department revealed no sites at all on this sheet. Sixteen archaeological sites are recorded on the Cundeelee 1:250,000 sheet. No sites are recorded within a radius of 25 km of the southern boundary of the lease area and approximately 45 km from the target areas. Most of the sites recorded on the Cundeelee 1:250,000 sheet are associated with water sources, and several of these sites are also of mythological significance to Aboriginal people.

On the basis of the sites previously recorded and what is known of the archaeology of arid areas in other parts of Western Australia, the following types of archaeological sites might be expected to occur in the survey area.

Burial Sites are localities containing human bone. In the survey area burials would be most likely to occur in the soft sand of the dunes.

Quarries are natural stone outcrops from which either stone has been extracted for the manufacture of artefacts, or ochre has been extracted for colouring rock surfaces or implements or for body decoration.

Stone Arrangements are patterned associations of stones which were constructed for both secular and sacred purposes and their form varies accordingly.

Surface Scatters of stone artefacts fall into two types,

(a) knapping floors, which are specialist stone working sites;

(b) occupation sites which consist of a general artefact scatter comprising flaked and/or ground stone artefacts. They may be associated with hearth stones or other features suggesting habitation.

Stratified Sites are sites where one or repeated occupations have been buried by sediments. They may occur either in shelters or out in the open, and where preservation conditions have been favourable may contain a wide range of organic material as well as stone.

Art Sites include both engraving and painting sites. Rock surfaces may also be artificially modified by the grinding of seeds and ochre or to channel runoff.

Isolated Artefacts are the most minimal indication of Aboriginal presence in the landscape.

SURVEY METHODS

Research in other parts of arid Australia indicates that the nature and distribution of archaeological sites in arid landscapes are very strongly influenced by environmental factors such as climate, landform, soils and associated vegetation, surface and sub-surface hydrology and bedrock geology (Hughes in Kinhill-Stearns Roger 1982; O'Connor and Veth 1983). These factors in turn determine the abundance and distribution of plant and animal resources, and the availability of water, suitable camping areas and raw materials for artefacts. Likewise, the visibility of archaeological remains is directly influenced by environmental factors such as the degree of vegetation cover and the extent of erosion. For this reason stratified surveys comprising different landscape units are commonly most informative, and an initial vehicle survey of 1½ days duration was undertaken in order to determine the extent of variation in surface topography and associated soils and vegetation.

The initial survey indicated that there was no strong patterning within the survey area which would facilitate its division into large landscape units. This factor plus the lack of sites previously recorded in or near the survey area excluded the formulation of predictive statements about the location of sites in the landscape. Traverses were therefore chosen as the most suitable survey procedure and an eight day field programme was undertaken.

In the *western target area* of 126 km^2 (Fig. 3) four traverses running parallel with the NW SE (120° mag.) running drill lines were walked. Three traverses were selected on the basis that the area receives a lot of vehicle traffic, the fourth as it was known to cross a large claypan. In the *eastern target area* of 42.34 km^2 a single traverse which in some places followed and some places intercepted the NW SE running drill lines was walked. The traverse corridor varied in width between 30 m and 250 m depending on ground visibility and relief. In areas where sites or isolated artefacts were located a larger area was surveyed. A conservative estimate of the area examined is 1% by ground search and 10% for features of both target areas. An area of 4.1 km^2 outside the target areas was also covered for comparison. Although the traverse corridors rarely intercepted the dunes, in most areas the dunes and interdunal swales were close enough together to be covered by the traverse corridor. The areas covered by the traverses are indicated on the accompanying map (Fig.3). As well as the areas covered by the traverses, silcrete outcrops known to the geologists were checked for signs of quarrying.

The likelihood of archaeological sites being detected by ground survey depends largely on the extent of vegetation cover and the degree of erosion. In most parts of the survey area there is little extensive erosion. The proportion of the ground surface which was obscured by vegetation was estimated and documented in the following classes: 0%, 1-25%, 26-50%, 51-75%, 76-100%. Visibility in both target areas was extremely good, and groundcover rarely exceeded 50% and was often closer to 25% (see Plates 1 and 3).

Six archaeological sites and 4 isolated finds were located during the survey. All of these sites were surface scatters of stone artefacts, although at Malcolm Soak there is also evidence of quarrying. No rock outcrops suitable for occupation shelters were found in the survey area, and an examination of the aerial photos failed to reveal any rock outcrops of a size large enough to contain shelters. All eroded areas on the sand-dunes were checked for burials, and while visibility was excellent, none were located (see Plate 1). The only rock surface located that was suitable for engraving or grinding patches, Malcolm Soak, (Wl178) showed no evidence of this activity.

SITE RECORDING METHODS

Sites were recorded in the following way. The area of the site was covered on foot in order to determine the perimeter of the site and any variation across the site in raw materials or artefact types. At the largest and densest sites sample areas that appeared to be representative were selected for on-site artefact recording. Following Hiscock and Hughes (1983 : 94) the sampled area was chosen on the basis of representativeness and to ensure that it included at least 30 artefacts. At Malcolm Soak (WI178) a larger area was sampled as a greater diversity of materials was represented. Any implements noted during the initial search of the site were also recorded. The 'kopi ' areas were extensive and artefacts were found throughout, although they were few in number and the scatters discontinuous. In these areas samples as recorded for the above three sites would not have been possible, as the sample area would have been so large and the artefacts so spaced as to be meaningless.

All artefacts were measured in their oriented plane. *Length* was measured as the maximum dimension in the plane perpendicular to the striking platform. *Width* was measured at right angles to the length and *thickness* was measured perpendicular to the plane of the other two dimensions. All artefacts were measured to the nearest 2.5 mm, as using a tape in the field made it impossible to achieve greater accuracy. Artefacts whose length and width measured less than 10 mm were simply recorded as being < 10 mm. Bipolar cores were measured in the same way as flakes, as crushing was easily distinguishable on the impact surfaces. On all other cores the longest flake was measured, following Hiscock and Hughes (1983 : 95).

The colour of the raw material was recorded but is not given in Appendix 3, as the colour of chalcedony was found to vary within a single nodule, and that of silcrete within an outcrop, and it is therefore not possible to source material on this basis. Sites have been given Aboriginal Sites Department (Western Australian Museum) numbers.

Isolated finds are reported in Appendix 4.

RESULTS OF SURVEY : SITE DESCRIPTIONS

Site W1178 (Map Sheet SH 51-11 1:250,000 Grid ref:1913 2590)

This site, which bears the local name *Malcolm Soak*, is concentrated around a small area of outcropping granite. The granite outcrops contain depressions which retain large pools of fresh water after rain (Plate 1). There is little vegetation around the granite outcrops, although some samphire (*Salicornia* sp.) grows around a small pan adjacent to the outcrops. The pan is covered in white salt crystals and even after heavy rain no water is retained. Mulga (*Acacia aneura*) grows on the gently rising sandy loam soils that surround the outcrops.

It is difficult to define the exact size limits of surface scatters such as Malcolm Soak. While the densest clusterings of artefacts are focussed around the granite outcrops, several large quartz and silcrete flakes were found on the surrounding loam rises. For convenience of recording, the limits of the site were arbitrarily set at a distance of 100 m in any direction from the last artefact. On this basis the site covers an area of c. 0.5 km^2 with the granite outcrops occupying an approximately central position. Artefacts are concentrated around the waterholes, and those outcrops containing thick quartz seams. Artefact density is variable across the site. Artefacts were recorded from a 10 m^2 in what was estimated to be one of the densest areas of the site. This area appeared to be representative of other areas with high artefact densities. 320 artefacts were recorded from this 10 m^2 sample within square metres. A complete list of all artefacts recorded is provided in Appendix 3. No formal implements were contained in the sample[1] apart from 1 tula slug, and 2 scrapers were observed elsewhere at the site.

Only three lithologies are represented in the sample, quartz, silcrete and chalcedony. Quartz is the predominant raw material, comprising 51.3% of the sample, chalcedony 24.7% and silcrete 24.1% (Plates 2 and 3). The large number of quartz artefacts can be explained by the fact that quartz has been quarried at the site. The area near the quartz seams in the granite contains almost exclusively quartz artefacts, including bipolar flakes and cores. A density count over an area of 2 m^2 at the base of one of these seams gave an average density of 30 artefacts per square metre. No sources of silcrete or chalcedony were found at the site.

Two basalt flakes were found at the site but neither were in the sampled area. This raw material is not available locally. There is, however, a source of basalt to the south of the Warburton Ranges, and it is possible that it was traded from this area. Only 1% of all artefacts examined from the 10 m^2 sample showed any signs of secondary working.

The largest artefacts were made on silcrete and the smallest on chalcedony (excluding flakes less than 1 cm x 1 cm). This is almost certainly due to the limitations of the raw material, chalcedony only being available as small nodules.

[1] Bipolar cores or fabricators are treated as residual cores not as implements.

Site W1179 (Map Sheet SH 51-7 Minigwal 1:250,000 Grid ref: 1428 2999)

This site is a small surface scatter of stone artefacts located on top of a low sandstone breakaway. It lies north of the Base Line approximately 200 m from drillhole 116 (Plate 4). There are thick stands of *Acacia* sp. and *Banksia* sp. at the base of the breakaway, and the site is not easily visible from the east-west running dune to the south of it. The western side of the breakaway is capped with laterite and vegetation is comparatively sparse. There are a few small rockholes on top of the breakaway. When the site was first visited immediately after heavy rain, two of these contained water to a depth of c. 10 cm.

Only 34 artefacts were located in the area. They consisted of 19 silcrete flakes, 11 chalcedony flakes and 4 quartz flakes. Visibility was about 50% and some artefacts may have been obscured by leaf litter. None of the artefacts displayed secondary working.

Site W1180 (Map Sheet SH 51-7 Minigwal 1:250,000 Grid ref's: Western 1466 2932, Centre 1472 2923, Eastern 1487 2921)

The grid references above delineate an extensive area of 'kopi' (flour gypsum) throughout which artefacts occur (Plate 5). The scatter of artefacts is not continuous, but neither are artefacts concentrated or patterned within this area. As single artefacts were usually more closely spaced than 100 m apart, I have for convenience treated the whole area as one site rather than a series of sites. The density of artefacts over the whole area was extremely low. Only in one area of the kopi were artefacts concentrated, and this was at the margin of a low SW-NE running kopi dune adjacent to a dry sandy pan. This comprised 19 silcrete flakes without secondary working, and one fine grained silcrete scraper. None were seen eroding from the dune. 69 artefacts were located throughout the kopi, most of which were single artefacts, and were not recorded in detail.

Site W1181 (Map Sheet SH 51-7 Minigwal 1:250,000 Grid ref: 1465 2935)

This site is a surface scatter of stone artefacts around the margins of a small claypan (Plate 6). The claypan is near drillhole 121 and is cut by the NW-SE drill line. To the south of the claypan is a flat area of kopi while to the north a red loamy dune rises steeply. Artefacts are densest on the eastern side of the claypan on both sides of the road (Plate 7). 34 artefacts from a 2 m^2 sample area on the north east of the claypan have been recorded. A description of the artefacts is contained in Appendix 3. One broken steep-edged scraper and a tula slug were the only formal artefact types seen at the site, and both were in the 2 m^2 sample. Silcrete was the dominant raw material in the sample area, which appeared to be representative of the rest of the site. A total of 168 artefacts was counted at the site. Of these, some were seen in the bulldozed sides of the road. They were not *in situ*, but had been scraped up with the soil during road building. Undoubtedly other artefacts are buried in the grader spoil piles. Six artefacts were seen on the flanks of the red loamy dune to the north of the claypan, but an inspection of the dune top failed to reveal any more. The artefacts do not appear to be eroding out of the dune but to have been discarded at the margin of the pan.

Site W1182 (Map Sheet SH 51-7 Minigwal 1:250,000 Grid ref: 1428 2922)

This site is a surface scatter of stone artefacts on the edge of a claypan. The claypan is located between drillholes 553 and 743. The claypan is approximately 100 m across and is intercepted by the drill line. Artefacts are densest on the south east side of the claypan (Plate 8). Artefacts were recorded from a 3 m^2 in this area of the site. A description of all artefacts recorded can be found in Appendix 3. Two backed blades and one small steep-edged scraper were recorded within the sample area. The backed blades were made on chalcedony and the scraper on very fine grained silcrete. Three other backed blades and 2 tula slugs were also noted at the site. These were the only formal artefacts represented. 6.8% of all recorded flakes had secondary working. Chalcedony was the dominant raw material and this material is available at the site. Chalcedony nodules are found in a silicified sandstone outcropping to the south east of the claypan, approximately 10 m from the margin of the pan. Several chalcedony flakes and cores were seen in and around this area. No silcrete of artefactual quality was visible on the surface of this outcrop.

The claypan is flanked by two seif dunes, the margins and tops of which were inspected for artefacts. No artefacts were present on the dune tops. The density of artefacts increased from the base of the dune to the margin of the pan, with by far the greatest concentration of artefacts around the pan itself. The artefacts do not appear to be eroding out of the dune onto the claypan.

The site was first visited after heavy rain, when the claypan contained water to a depth of c. 5-10 cm. Three days later the claypan was dry and it was possible to see that the artefacts extended about 5 m further toward the centre, below the previous water level. It was not possible to estimate accurately the number of artefacts at the site as many have been covered by the very fine clay sediment which has settled out of the water that stands in the pan after rain, but it would be in the order of magnitude of hundreds.

Site W1183 (Map Sheet SH 51-7 Minigwal 1:250,000 Grid ref: 1431 2882)

This site covers an area of approximately 100 m^2 to the north and south of the drill line between drillholes 925 and 135 (Plate 9). A total of 20 artefacts were located, fourteen on the southern side of the drill line and 6 on the northern side. A description of all artefacts is contained in Appendix 3. The artefacts were found on the low lying areas of 'kopi' close to the surrounding aeolian sand, but the artefacts appear to be *in situ* and none were seen weathering from the sandy margins. There did not appear to be any pattern in the distribution of the artefacts within this area. The greatest density of artefacts, 7 in 2 m^2, was found to the south of the drill line. Chalcedony, quartz and silcrete artefacts are represented, but no sources of these raw materials were found in the vicinity of the site. A complete search of the kopi was not attempted, but a roughly circular area about ½ km in diameter was covered on foot. Groundcover in the kopi areas is sparse (c. 1-25%) and visibility good. While it is possible that artefacts are eroding from the kopi, potential for excavation is low because of the low density of artefacts. One tula made on fine grained grey silcrete was found at the site. A description of all artefacts is provided in Appendix 3.

DISCUSSION

The results of the survey indicate that water sources even where ephemeral provide the focus for prehistoric movement and land use in the survey area. Site W1178, Malcolm Soak, is the only site that retains water for more than a few days. The results of the survey are collaborated by site surveys in other arid areas of Australia such as the findings of the Olympic Dam Project survey (Kinhill-Stearns Roger 1982). Hughes (in Kinhill-Stearns Roger 1982) found that the greatest frequency of sites occurred in the widely spaced dune fields where claypans were largest and most prolific. The frequency of sites declined with increasing dune density and decreasing frequency of claypans. Dunes in the survey area are for the most part very closely spaced and claypans rare with interdunal swales being predominantly sandy. The only water holding features found in the survey area all had artefactual material on their margins.

Few formal artefacts were recorded in the study area and the range of artefacts is small, only backed blades and tulas and scrapers being recorded. The number of flakes with secondary working are likewise poorly represented, comprising only 1.0% of all artefacts. Of those displaying retouch, the extent is usually minimal. Most artefacts were unmodified flakes. No grinding material was found on any of the sites in the survey area. Grinding material is often interpreted as an indicator of habitation sites where both males and females were present and where a general range of activities was carried out (Hallam 1981 : 56). The absence of grinding stones may have important implications for the subsistence economy of the inhabitants. In other parts of arid Australia, grinding material was used for grinding seeds such as *Acacia* and *Triodia* into flour. The lack of any such material possibly indicates that such resources were not heavily exploited in the survey area and that occupation of the sites was of a very short term and opportunistic nature.

Aside from two basalt flakes found at Malcolm Soak (not included in the described sample) the lithologies represented are all locally obtainable. Although no quarry sites for silcrete were found, several silcrete outcrops that were fine grained and highly suited for artefact production were examined. None of the sites located would be more than 5 km from suitable silcrete sources. Basalt is available in the southern part of the Warburton region (Beard 1975 : 13) and it is possible that this material was brought or traded in from this area.

Silcrete is the dominant raw material in the study area and is the most locally prolific. All large flakes and cores were made on silcrete. It is suggested that this is a function of the limitations of other raw materials. Chalcedony sources do not seem to be as wide spread and are nodular in form, enabling only small artefacts to be manufactured. The only site with any number of quartz artefacts is Malcolm Soak where quartz is available locally in thick seams in the granite and where it has been quarried from this source. The quality and colour of the silcrete and chalcedony varies within a single outcrop and it is not possible to source the artefacts in this way. While flakes seem to be manufactured on silcrete of variable quality all formal implements were made on very fine grained silcrete or chalcedony.

Where surface artefact scatters are the only evidence for Aboriginal occupation in an area, the only indicators of the age of sites are their stratigraphic positions and the presence of formal artefact types.

The latter may provide relative indicators of age based on correlations with other parts of Australia where they have been recovered from firmly dated sites. As already mentioned, there was no evidence at any of the sites that the artefacts were eroding out of the dune surfaces onto the claypans. In the absence of any geomorphic indicators to the contrary and on the basis of the artefact types recognised (although admittedly few in number) it is suggested that most of the archaeological material dates from the Holocene, and possibly the mid-to-late Holocene. While the implements comprise a very small proportion of the total assemblages, they provide the only indicator of the age of the sites. They are consistent with the Australian Small Tool Tradition. Although the dates are far from firm, backed blades in other areas of Australia are dated to between c 5000 and 1000 years ago, although in Western Australia there is some evidence that their production continues through to the present (Hallam 1981 : 58).

The appearance of these small tools is commonly accepted as indicating the beginning of hafting using resins (Gould 1969 : 233-4). Whereas the procurement of artefactual material requires relatively little effort where it is readily available, hafting and unhafting artefacts is relatively time consuming. Hafted artefacts such as tulas tend to receive substantial edge damage. Hayden (1977 : 179) in his work in the Western Desert noticed this discrepancy between hand held and hafted flakes. While flakes might be hafted to perform certain activities such as woodworking, where raw material is readily available most activities will be undertaken using a freshly struck flake which has the sharpest edge, and it will not be retouched. In the present study, the low density of all artefact scatters, the small proportion of formal tool types, the lack of grinding material and the location of the sites are all indicative of the economy of the people who occupied the area. All suggest short term opportunistic occupation of an area with very ephemeral water sources.

ASSESSMENT

Archaeological sites are assessed In terms of their *significance*. Archaeological significance has been most cogently defined as, on the one hand, the potential of a site to provide data which will answer "timely and specific research questions", and its "representativeness" on the other (Bowdler 1981 : 129; Shiffer and Gumerman 1977 : 241).

In an area such as this where no previous research or other archaeological work has been carried out, relevant research questions are of the most basic sort, and it might be argued that any site must be considered significant. It is, however, possible to assess the amount of information some sites are likely to yield whatever research questions might be asked, and clearly unstratified surface artefact scatters can only yield a very limited amount of information at the best of times.

Assessing the representativeness of sites in the survey area presents some difficulties, as no other sites are recorded from the immediate area with which they can be usefully compared. However, on the basis of the results obtained during this survey and the site location information from Sites Department records, some predictions about the likelihood of similar sites occurring outside the target areas can be made. It has been argued that the availability of surface water is the critical factor determining the pattern of Aboriginal movement and occupation in arid areas such as the Great Victoria Desert.
An examination of the air photos for the Cundeelee and Minigwal sheets illustrates that landscape features such as claypans are as common outside the lease area as within it and it is predicted that similar sites will be located on these features. In areas such as the Queen Victoria Spring Reserve they are also potentially better able to be managed.

Only one of the sites in the survey area, Malcolm Soak (W1178) which lies outside the target area, is thought to be of particular scientific significance. It is the largest of the sites located and displays the greatest diversity of activities and the broadest range of artefacts and raw materials. It is not thought that the salvage or preservation of the other 5 sites would add substantially to the information recorded during this survey or available from Malcolm Soak.

RECOMMENDATIONS

It is recommended that until such time as mining proceeds none of the sites be disturbed in any way. In addition it is recommended that P.N.C. Exploration (Aust) Pty. Ltd. advise all relevant employees and contractors working in the lease area of the location of the sites, and their obligation under the Aboriginal Heritage Act 1972-80. Specific recommendations follow.

1. It is recommended that Site W1178 (Malcolm Soak) be preserved, and that the access road that passes through the site should not be widened or upgraded. No earth moving or alterations which might disturb the site or site environment should proceed in this area.

2. Site W1179 lies north east of the *western target area* and therefore should not be subject to impact from any future mining. Although not threatened by direct impact, vehicle tracks were evident to the south east of the site and employees should be instructed to avoid the area.

3. Sites W1181 and W1182 (claypans) are within the western target area and may be subject to direct impact from mining. It is recommended that until such time as mining is approved these sites be undisturbed, and the roads that pass through the sites should not be widened or upgraded. Both sites are located on the margins of hard claypans that apparently provide convenient turning places for vehicles. It is therefore recommended that all relevant employees be instructed to avoid these sites. In the event of mining being approved the Company must apply to the Aboriginal Cultural Materials Committee for permission to disturb these sites.

4. Sites W1180 and W1183, both in kopi areas, exhibit a low density of artefacts and were not found to contain any artefact or raw material types not found at Malcolm Soak. Both sites are within the western target area. If approval for mining is granted which will be inimical to these sites the Company should apply to the Aboriginal Cultural Materials Committee for permission to disturb these sites.

5. It is recommended that any future development works and plant associated with exploration or mining (e.g. evaporation ponds) are situated away from the recorded Aboriginal sites and that where the associated developments are sited outside the two target areas, further survey should be undertaken.

6. The survey has provided a basis for framing predictions concerning the location of further Aboriginal sites in the lease area. The aerial photos encompassing the lease area illustrate other landscape features such as claypans which, it is predicted, will have associated surface scatters. In the event that mining is approved it is believed a systematic survey would not be necessary but further survey work should be undertaken to examine these features.

The above recommendations pertain only to the specified target areas.

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APPENDIX 1

Plant species identified from Study Area by M. Trudgeon

Acacia acuminata

Acacia fragilis

Acacia stowardii

Acacia sp. 1. (may be undescribed)

Acacia sp. 2.

Allocasuarina acutivalvis

Allocasuarina helmsii

Baeckea affin. *clavifolia*

Callitris columellaris

Callitris preissii spp. *verrucosa*

Calothamnus sp. (undescribed)

Cf. *Calytrix*

Dampiera oligophylla spp. *juncea*

Daviesia benthamii

Eremophila longifolia

Eremophila latrobei

Eremophila sp.

Eucalyptus sp. cf. *E. conglobata*

Eucalyptus cylindriflora

Eucalyptus youngiana

Gastrolobium sp.

Grevillea sp.

Leptospermum roei

Microcybe multiflora var. *baccharoides*

Newcastelia viscida

Phebalium tuberculosum

Pityrodia lepidota

Rulingia sp.

Santalum acuminatum

Westringia rigida

APPENDIX 2

Vertebrates of the survey area

Native Mammals:

**Tachyglossus aculeatus* short-beaked echidna

**Macropus fuliginosus* western grey kangaroo

Ningaui ridei wongai ningaui

Sminthopsis hirtipes hairy-footed dunnart

Sminthopsis ooldea ooldea dunnart

Notomys mitchellii Mitchell's hopping-mouse

Notomys alexis spinifex hopping-mouse

Pseudomys hermannsburgensis sandy inland mouse

Tadarida australis white-striped mastiff bat

Tadarida planiceps little mastiff bat

Nyctophilus geoffroyi lesser long-eared bat

Eptesicus pumilus little cave eptesicus

Chalinolobus gouldii Gould's wattled bat

***Nycticeius balstoni* western broad-nosed bat

Introduced Mammals:

Mus musculus house mouse

Camelus dromedarius Arabian camel

**Felis catus* cat

Vulpes vulpes fox

**Oryctolagus cuniculus* European rabbit

Additional Mammal Species Probably Originally Present:

#*Perameles eremiana* desert bandicoot

#*Dasycercus cristicauda* mulgara

#*Bettongia lesueur* burrowing bettong

#*Lagorchestes hirsutus* refous hare-wallaby

#*Leporillus apicalis* lesser stick-nest rat

#*Pseudomys* sp. (mid-sized) native mouse

Birds

**Dromaius novaehollandiae* emu

Anas gibberifrons grey teal

Falco cenchroides nankeen kestrel

Falco berigora brown falcon

Turnix velox little quail

Ardeotis australis Australian bustard

Peltohyas australis Australian dotterel

Barnardius zonarius Port Lincoln parrot

Psephotus varius mulga parrot

Ninox novaeseelandiae boobook owl

Podargus strigoides tawny frogmouth

Coracina novaehollandiae black-faced cuckoo-shrike

Smicrornis brevirostric weebill

Acanthiza uropygialis chestnut-rumped thornbill

Acanthiza chrysorrhoa yellow-rumped thornbill

Pachycephala rufiventris rufous whistler

Pachycephala inornata Gilbert whistler

Oreoica gutturalis crested bellbird

Meliphaga virescens singing honeyeater

Phylidonyris albifrons white-fronted honeyeater

Manorina flavigula yellow-throated miner

Acanthogenys rufogularis spiny-cheeked honeyeater

Strepera versicolor grey currawong

Cracticus nigrogularis pied butcher-bird

Cracticus torquatus grey butcher-bird

Reptiles

Gehyra variegata

Nephrurus laevissimus

Diplodactylus strophurus

Diplodactylus vittatus

Moloch horridus

Diporiphora reginae

Amphibolurus cristatus

Amphibolurus minor

Amphibolurus isolepis gularis

Amphibolurus fordi

Amphibolurus clayi

Ctenotus atlas

Ctenotus schomburgkii

Ctenotus quattuordecimlineatus

Ctenotus pantherinus ocellifer

**Varanus* sp.

Amphibians

Neobatrachus centralis

* Recorded during the present survey

** Modified from Burbidge *et al*. (1976)

A. Baynes pers. comm.

All other species inferred from Burbidge *et al*. (1976)

APPENDIX 3

(i) Site W1178: Artefacts from 10 m^2 recorded sample *

Square	Silcrete	Quartz	Chalcedony
10A	1 flake 20 mm x 10 mm x 2.5 mm	6 flakes < 10 mm x 10 mm 1 flake 15 mm x 10 mm x 5 mm	1 flake < 10 mm x 10 mm 1 blade 30 mm x 7.5 mm x 5 mm
10B	1 flake 20 mm x 20 mm x 5 mm 1 flake (broken along L) 15 mm x 10 mm x 5 mm	6 flakes < 10 mm x 10 mm	1 flake 20 mm x 35 mm x 5 mm 1 flake < 10 mm x 10 mm 1 flake 15 mm x 5 mm x 2.5 mm
10C	2 flakes < 10 mm x 10 mm	10 flakes < 10 mm x 10 mm	1 blade 40 mm x 15 mm x 5 mm with secondary working along left dorsal margin
10D	3 flakes < 10 mm x 10 mm	11 flakes < 10 mm x 10 mm	1 flake 20 mm x 10 mm x 5 mm 1 flake 20 mm x 10 mm x 2.5 mm
10E	1 flake 47.5 mm x 30 mm x 10 mm	1 bipolar flake 25 mm x 20 mm x 10 mm 2 flakes < 10 mm x 10 mm	1 flake 22.5 mm x 10 mm x 5 mm
10F	1 flake < 10 mm x 10 mm 1 flake 40 mm x 30 mm x 20 mm	1 bipolar core 30 mm x 30 mm x 20 mm 3 flakes < 10 mm x 10 mm	1 blade 32.5 mm x 10 mm x 5 mm 1 flake 20 mm x 10 mm x 5 mm
10G	1 flake 52.5 mm x 35 mm x 1.5 mm 2 flakes 10 mm x 10 mm	1 flake < 10 mm x 10 mm 1 flake 20 mm x 25 mm x 7.5 mm	3 flakes < 10 mm x 10 mm
10H	2 flakes < 10 mm x 10 mm	--	1 flake 25 mm x 37.5 mm x 10 mm
10I	1 flake 35 mm x 30 mm x 10 mm	--	--
10J	1 core 45 mm 1 flake 42.5 mm x 32.5 mm x 15 mm	1 bipolar flake 35 mm x 22.5 mm x 10 mm	1 blade 35 mm x 12.5 mm x 7.5 mm 1 flake 20 mm x 10 mm x 5 mm 1 flake < 1.0 mm x 10 mm
Totals	Primary flakes = 18 Cores = 1	Primary flakes = 41 Bipolar flakes = 2 Bipolar cores = 1	Primary flakes = 18 (incl. 4 blades) Flakes with secondary working = 1
	Total: 19	Total: 44	Total: 19
		TOTAL: 82	

* A grid was established numbered 1 - 10 (ranks) in one direction (SE to NW) and A - J (files) in the other (NE to SW).
The data are presented here according to their numerical rank.

Square	Silcrete	Quartz	Chalcedony
9A	1 flake < 10 mm x 10 mm	7 flakes < 10 mm x 10 mm	1 flake 10 mm x 15 mm x 5 mm 1 flake 15 mm x 10 mm x 5 mm
9B	1 rejuvenation flake 25 mm x 10 mm x 10 mm	5 flakes < 10 mm x 10 mm 1 bipolar core 20 mm x 27.5 mm	1 flake < 10 mm x 10 mm 1 flake 10 mm x 10 mm x 2.5 mm 1 flake 10 mm x 20 mm x 2.5 mm 1 flake 20 mm x 10 mm with cortex adhering to dorsal surface
9C	1 flake 20 mm x 10 mm x 5 mm 4 flakes < 10 mm x 10 mm	1 core made on split pebble 30 mm 12 flakes < 10 mm x 10 mm	1 flake 20 mm x 10 mm x 5 mm 1 flake 10 mm x 20 mm x 5 mm
9D	3 flakes < 10 mm x 10 mm 1 flake 40 mm x 30 mm x 15 mm	4 flakes < 10 mm x 10 mm	3 flakes < 10 mm x 10 mm 1 flake 22.5 mm x 10 mm x 5 mm
9E	--	1 bipolar flake 32.5 mm x 20 mm x 5 mm	1 blade 27.5 mm x 7.5 mm x 5 mm
9F	1 core 45 mm 1 flake < 10 mm x 10 mm	1 flake 20 mm x 10 mm x 5 mm 1 bipolar flake 40 mm x 22.5 mm x 12.5 mm 6 flakes < 10 mm x 10 mm	1 flake 20 mm x 10 mm x 5 mm 1 flake < 10 mm x 10 mm 1 flake 15 mm x 25 mm x 10 mm
9G	--	3 flakes < 10 mm x 10 mm	1 flake 32.5 mm x 20 mm x 5 mm
9H	1 flake < 10 mm x 10 mm	--	--
9I	1 flake 60 mm x 50 mm x 22.5 mm	1 flake 15 mm x 10 mm x 5 mm 3 flakes < 10 mm x 10 mm	1 flake < 10 mm x 10 mm
9J	1 flake 20 mm x 10 mm x 5 mm	1 flake < 10 mm x 10 mm	--
Totals	Primary flakes = 15 (incl. 1 rejuvenation flake) Cores = 1	Primary flakes = 43 Bipolar flake = 2 Bipolar core = 1 Core (pebble) = 1	Primary flakes = 18 (incl. 1 blade)
	Total: 16	Total: 47	Total: 18
		TOTAL: 81	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
8A	4 flakes < 10 mm x 10 mm	--	1 blade 25 mm x 10 mm x 5 mm with cortex adhering to the platform 4 flakes < 10 mm x 10 mm
8B	1 flake < 10 mm x 10 mm	1 bipolar flake 20 mm x 22.5 mm 1 flake 10 mm x 10 mm	--
8C	1 flake < 10 mm x 10 mm	5 flakes < 10 mm x 10 mm	2 flakes < 10 mm x 10 mm
8D	--	7 flakes < 10 mm x 10 mm	--
8E	--	2 flakes < 10 mm x 10 mm	1 flake < 10 mm x 10 mm
8F	1 flake 37.5 mm x 20 mm x 7.5 mm	--	--
8G	1 flake < 10 mm x 10 mm	6 flakes < 10 mm x 10 mm	--
8H	1 flake 35 mm x 20 mm x 7.5 mm	1 bipolar flake 35 mm x 22.5 mm x 10 mm 2 flakes < 10 mm x 10 mm	1 blade 30 mm x 10 mm x 5 mm
8I	--	--	--
8J	--	2 flakes < 10 mm x 10 mm	1 flake < 10 mm x 10 mm
Totals	Primary flakes = 9	Primary flakes = 25 Bipolar flakes = 2	Primary flakes = 10 (incl. 2 blades)
	Total: 9	Total: 27	Total: 10
		TOTAL: 46	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
7A	--	1 flake < 10 mm x 10 mm	2 flakes < 10 mm x 10 mm
7B	--	--	--
7C	6 flakes < 10 mm x 10 mm	--	--
7D	--	2 flakes < 10 mm x 10 mm	--
7E	1 flake < 10 mm x 10 mm 1 flake with secondary working on distal end 35 mm x 27.5 mm x 10 mm	--	1 blade 30 mm x 12.5 mm x 5 mm 1 flake < 10 mm x 10 mm
7F	1 flake < 10 mm x 10 mm	--	--
7G	1 flake 30 mm x 17.5 mm x 7.5 mm	1 bipolar flake 30 mm x 30 mm x 10 mm	1 flake 15 mm x 10 mm x 5 mm
7H	--	5 flakes < 10 mm x 10 mm	--
7I	1 flake 20 mm x 20 mm x 7.5 mm 2 flakes < 10 mm x 10 mm	1 flake < 10 mm x 10 mm	--
7J	--	--	--
Totals	Primary flakes = 12 Flakes with secondary workings = 1	Primary flakes = 9 Bipolar flakes = 1	Primary flakes = 5 (incl. 1 blade)
	Total: 13	Total: 10	Total: 5
		TOTAL: 28	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)

Square	Silcrete	Quartz	Chalcedony
6A	--	3 flakes < 10 mm x 10 mm	1 blade 22.5 mm x 10 mm x 2.5 mm with cortex adhering to dorsal surface
6B	--	1 flake < 10 mm x 10 mm	1 flake < 10 mm x 10 mm
6C	3 flakes < 10 mm x 10 mm 1 flake 12.5 mm x 10 mm x 2.5 mm	--	--
6D	--	--	1 flake 15 mm x 10 mm x 2.5 mm
6E	1 flake 45 mm x 30 mm x 17.5 mm	1 flake < 10 mm x 10 mm	--
6F	--	--	1 blade 20 mm x 7.5 mm x 2.5 mm
6G	--	1 bipolar flake 32.5 x 30 mm	--
6H	--	1 bipolar flake 25 mm x 30 mm x 10 mm 6 flakes < 10 mm x 10 mm 1 flake 15 mm x 10 mm x 5 mm	--
6I	--	2 flakes < 10 mm x 10 mm	1 flake < 10 mm x 10 mm
6J	--	--	--
Totals	Primary flakes = 5	Primary flakes = 14 Bipolar flakes = 2	Primary flakes = 5 (incl. 2 blades)
	Total: 5	Total: 16	Total: 5
		TOTAL: 26	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)

Square	Silcrete	Quartz	Chalcedony
5A	--	3 flakes < 10 mm x 10 mm	1 flake 20 mm x 10 mm x 5 mm with cortex adhering to dorsal surface
5B	--	--	--
5C	--	--	1 flake 12.5 mm x 10 mm x 2.5 mm
5D	--	--	1 blade core 20 mm
5E	1 flake 50 mm x 40 mm x 7.5 mm	--	1 flake 20 mm x 22.5 mm x 7.5 mm
5F	1 flake 20 mm x 20 mm x 7.5 mm 1 flake < 10 mm x 10 mm	1 flake < 10 mm x 10 mm	1 blade 22.5 mm x 10 mm x 5 mm 1 flake 10 mm x 10 mm
5G	--	--	--
5H	--	--	--
5I	--	1 flake < 10 mm x 10 mm	--
5J	--	--	--
Totals	Primary flakes = 3	Primary flakes = 6	Primary flakes = 5 (incl. 1 blade) Cores = 1
	Total: 3	Total: 6	Total: 6
		TOTAL: 15	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
4A	--	--	--
4B	--	--	--
4C	--	1 bipolar flake 20 mm x 10 mm x 5 mm	1 flake 25 mm x 15 mm x 2.5 mm
4D	--	--	--
4E	1 flake 62.5 mm x 35 mm x 17.5 mm	2 flakes < 10 mm x 10 mm	1 flake 20 mm x 20 mm x 5 mm 1 flake < 10 mm x 10 mm
4F	--	1 flake < 10 mm x 10 mm	--
4G	--	--	--
4H	--	--	1 flake 15 mm x 10 mm x 2.5 mm
4I	--	--	--
4J	--	--	--
Totals	Primary flakes = 1	Primary flakes = 3 Bipolar flakes = 1	Primary flakes = 4
	Total: 1	Total: 4	Total: 4
		TOTAL: 9	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
3A	--	1 flake < 10 mm x 10 mm	--
3B	--	1 bipolar flake 32.5 mm x 22.5 x 10 mm	--
3C	--	--	--
3D	--	--	--
3E	1 flake 20 mm x 25 mm x 7.5 mm	--	1 blade 22.5 mm x 10 mm x 5 mm
3F	--	--	1 flake 20 mm x 10 mm x 5 mm 1 flake < 10 mm x 10 mm
3G	1 flake 35 mm x 25 mm x 15 mm	--	--
3H	--	--	--
3I	1 flake 15 mm x 10 mm x 5 mm	--	--
3J	--	--	--
Totals	Primary flakes = 3	Primary flakes = 2	Primary flakes = 3 (incl. 1 blade)
	Total: 3	Total: 2	Total: 3
		TOTAL: 8	

(i) Site W1178: Artefacts from 10 m^2 recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
2A	--	1 bipolar core 20 mm x 30 mm	--
2B	--	1 flake < 10 mm x 10 mm	5 flakes < 10 mm x 10 mm
2C	--	--	--
2D	--	--	1 flake 20 mm x 15 mm x 7.5 mm
2E	1 flake 35 mm x 17.5 mm x 10 mm	--	1 flake < 10 mm x 10 mm
2F	1 flake 52.5 mm x 30 mm x 15 mm 1 flake < 10 mm x 10 mm	--	--
2G	1 flake < 10 mm x 10 mm	--	--
2H	--	--	--
2I	--	--	--
2J	1 flake 32.5 mm x 20 mm x 10 mm	1 bipolar flake 37.5 mm x 22.5 mm x 10 mm	--
Totals	Primary flakes = 5	Primary flakes = 1 Bipolar flakes = 1 Bipolar cores = 1	Primary flakes = 7
	Total: 5	Total: 3	Total: 7
		TOTAL: 15	

(i) Site W1178: Artefacts from 10 m² recorded sample * (continued)			
Square	**Silcrete**	**Quartz**	**Chalcedony**
1A	--	--	--
1B	--	--	--
1C	--	--	--
1D	--	--	--
1E	1 flake 22.5 mm x 30 mm x 10 mm	2 flakes < 10 mm x 10 mm	--
1F	--	--	--
1G	--	2 flakes < 10 mm x 10 mm	1 blade 32.5 mm x 7.5 mm x 2.5 mm 1 flake < 10 mm x 10 mm
1H	1 tula slug 15 mm x 30 mm x 12.5 mm	--	--
1I	--	1 bipolar flake 30 mm x 20 mm x 7.5 mm	--
1J	1 blade 37.5 mm x 12.5 mm x 7.5 mm	--	--
Totals	Primary flakes = 2 (incl. 1 blade) Flakes with secondary working = 1 (tula slug)	Primary flakes = 4 Bipolar flakes = 1	Primary flakes = 2 (incl. 1 blade)
	Total: 3	Total: 5	Total: 2
		TOTAL: 10	

Site W1178: Total for 10 m² recorded sample

Silcrete	:	77	:	24.1%
Quartz	:	164	:	51.3%
Chalcedony	:	79	:	24.7%
		320		
Primary flakes (incl. blades : 13)	:	298	:	93.1%
Flakes with secondary working (incl. 1 tula slug)	:	3	:	0.9%
Bipolar flakes	:	12	:	3.8%
Bipolar cores	:	3	:	0.9%
Cores	:	4	:	1.3%
		320		

(ii) Site W1181: Artefacts from 2 m^2 recorded sample

Square	Silcrete	Quartz	Chalcedony
1A	1 broken steep-edged scraper 32.5 mm x 15 mm x 12.5 mm 1 flake 25 mm x 20 mm x 10 mm 1 flake 10 mm x 15 mm x 5 mm 1 flake 30 mm x 22.5 mm x 20 mm 1 flake < 10 mm x 10 mm 1 broken flake (along L) 10 mm x 25 mm x 10 mm 1 flake with secondary working on lateral margins 42.5 mm x 30 mm x 12.5 mm	--	1 flake 35 mm x 25 mm x 5 mm
1B	1 flake 15 mm x 5 mm x 5 mm 4 flakes < 10 mm x 10 mm 1 flake 15 mm x 20 mm x 7.5 mm 1 flake 15 mm x 20 mm x 10 mm 1 flake 15 mm x 7.5 mm x 5 mm 1 single platformed core 42.5	1 bipolar flake 15 mm x 15 mm x 5 mm	
2A	1 flake with secondary working on left lateral margin 40 mm x 45 mm x 15 mm 2 flakes 10 mm x 10 mm 1 flake 42.5 mm x 35 mm x 20 mm 1 blade 25 mm x 10 mm x 12.5 mm		1 flake 15 mm x 10 mm x 5mm 1 flake < 10 mm x 10 mm 1 broken flake (along L) 20 mm x 7.5 mm x 5 mm
2B	1 flake 30 mm x 25 mm x 10 mm 1 flake 22.5 mm x 10 mm x 10 mm 1 flake 20 mm x 20 mm x 10 mm 1 flake 20 mm x 17.5 mm x 15 mm 1 tula slug 10 mm x 35 mm x 12.5 mm		1 flake < 10 mm x 10 mm 1 flake 15 mm x 20 mm x 10 mm 1 flake 30 mm x 10 mm x 5 mm
Totals	Primary flakes (incl. 1 blade) = 21 Flakes with secondary working = 4 Cores = 1	Bipolar flake = 1	Primary flakes = 7
	Total: 26 (76.5%)	Total: 1 (2.9%)	Total: 7 (20.6%)
		TOTAL: 34	

Site W1181: Total for 2 m^2 recorded sample

Primary flakes (incl. 1 blade)	:	28	:	82.4%
Flakes with secondary working	:	4	:	11.8%
Bipolar flake	:	1	:	2.9%
Cores	:	1	:	2.9%

(iii) Site W1182: Artefacts from 3 m^2 recorded sample

Square	Silcrete	Quartz	Chalcedony
SQ 1A	1 flake 15 mm x 10 mm x 5 mm 1 flake 45 mm x 30 mm x 20 mm 1 flake 42.5 mm x 40 mm x 7.5 mm 4 flakes < 10 mm x 10 mm	-- -- -- --	1 flake 12.5 mm x 5 mm x 2.5 mm 1 flake 15 mm x 10 mm x 5 mm 3 flakes < 10 mm x 10 mm 1 blade 25 mm x 10 mm x 5 mm
SQ 1B	1 flake 52.5 mm x 30 mm x 15 mm 1 flake 27.5 mm x 20 mm x 10 mm 1 flake < 10 mm x 10 mm 1 single platform core 40 mm	3 flakes < 10 mm x 10 mm -- -- --	1 flake 20 mm x 15 mm x 5 mm 1 flake 25 mm x 15 mm x 5 mm 1 backed blade 22.5 mm x 7.5 mm x 5 mm 6 flakes < 10 mm x 10 mm
SQ 1C	1 flake with secondary working on distal edge 42.5 mm x 39.5 mm x 12.5 mm 1 flake < 10 mm x 10 mm	1 bipolar flake 30 mm x 25 mm x 10 mm	1 flake 12.5 mm x 10 mm x 5 mm 1 blade 30 mm x 10 mm x 7.5 mm 1 flake 25 mm x 12.5 mm x 5 mm 6 flakes < 10 mm x 10 mm
SQ 2A	1 flake 50 mm x 30 mm x 22.5 mm	1 flake < 10 mm x 10 mm	1 flake 27.5 mm x 15 mm x 7.5 mm with secondary working on right dorsal margin 1 flake 15 mm x 10 mm x 5 mm 1 blade 30 mm x 10 mm x 7.5 mm 4 flakes < 10 mm x 10 mm 1 broken backed blade 12.75 mm x 5 mm x 5 mm
SQ 2B	1 flake 35 mm x 30 mm x 20 mm 1 flake 60 mm x 45 mm x 22.5 mm 1 flake 20 mm x 22.5 mm x 7.5 mm 4 flakes < 10 mm x 10 mm 1 core 47.5 mm	-- -- -- -- --	1 flake 12.5 mm x 12.5 mm x 2.5 mm 1 flake 20 mm x 10 mm x 7.5 mm 6 flakes < 10 mm x 10 mm 1 blade 32.5 mm x 10 mm x 7.5 mm 1 blade 27.5 mm x 12.5 mm x 5 mm with shallow secondary working on right dorsal margin 1 rotated core 20 mm
SQ 2C	3 flakes < 10 mm x 10 mm 1 steep-edged scraper 27.5 mm x 30 mm x 15 mm	-- -- --	1 flake 25 mm x 20 mm x 7.5 mm 1 flake 15 mm x 15 mm x 5 mm 3 flakes < 10 mm x 10 mm 1 blade 22.5 mm x 10 mm x 7.5 mm 1 blade 30 mm x 12.5 mm x 7.5 mm
SQ 3A	1 flake 42.5 mm x 30 mm x 12.5 mm 1 flake < 10 mm x 10 mm 1 single platform core 32.5 mm	1 flake < 10 mm x 10 mm -- --	1 blade 15 mm x 20 mm x 10 mm 1 flake 17.5 mm x 10 mm x 5 mm 1 flake 12.5 mm x 15 mm x 5 mm 1 flake 22.5 mm x 12.5 mm x 5 mm 1 blade 27.5 mm x 10 mm x 7.5 mm 2 blades < 10 mm x 10 mm

(iii) Site W1182: Artefacts from 3 m^2 recorded sample

Square	Silcrete	Quartz	Chalcedony
SQ 3B	1 flake 40 mm x 32.5 mm x 12.5 mm 1 rotated core 45 mm	-- --	1 flake 22.5 mm x 15 mm x 5 mm 1 flake 12.5 mm x 10 mm x 2.5 mm 4 flakes < 10 mm x 10 mm 1 blade 25 mm x 10 mm x 15 mm with shallow secondary working on distal end
SQ 3C	1 flake 15 mm x 15 mm x 10 mm 1 flake 27.5 mm x 30 mm x 15 mm 1 flake 25 mm x 15 mm x 10 mm	1 bipolar flake 30 mm x 22.5 mm x 12.5 mm	1 flake 12.5 mm x 10 mm x 5 mm 1 flake 17.5 mm x 10 mm x 2.5 mm 1 blade 20 mm x 7.5 mm x 5 mm 1 rotated core 22.5 mm 1 single platformed core made on split chalcedony nodule with cortex adhering and 1 flake removed
Totals	Primary flakes = 28 Flakes with secondary working = 2 Cores = 4	Primary flakes = Bipolar flakes =	Primary flakes = 61 (incl. 8 blades) Flakes with secondary working = 5 Cores = 3
	Total: 34 (30.9%)	Total:	Total: 69 (62.7%)
		TOTAL: 110	

Primary flakes	:	94	:	85.5%
Flakes with secondary working	:	7	:	6.4%
Bipolar flakes	:	2	:	1.8%
Cores	:	7	:	6.4%

(iv) Site W1183: All artefacts recorded

Silcrete	Quartz	Chalcedony
Artefacts recorded south of the NW SE drill line		
1 reduced tula made on fine grained silcrete with cortex attached to dorsal surface 22.5 mm x 35 mm x 20 mm 1 flake 20 mm x 10 mm x 10 mm 1 flake 50 mm x 30 mm x 20 mm with secondary working on distal end	1 bipolar core 30 mm x 20 mm x 22.5 mm 2 flakes < 10 mm x 10 mm	1 rejuvenation flake 27.5 mm x 12.5 x 10 mm 1 flake 10 mm x 15 mm x 5 mm 6 flakes < 10 mm x 10 mm
Artefacts recorded to the north of NW SE drill line		
1 flake 42.5 mm x 30 mm x 10 mm 1 flake 35 mm x 30 mm x 7.5 mm 1 flake < 10 mm x 10 mm 1 single platformed core 40 mm		2 flakes 10 mm x 10 mm x 2.5 mm
Totals: Primary flakes = 4 Flakes with secondary working = 2 Core = 1	 Primary flakes = 2 Bipolar flakes = 1	 Primary flakes = 10
Total: 7 (35%)	Total: 3 (15%)	Total: 10 (50%)
TOTAL: 110		

APPENDIX 4

Isolated Finds

Find 1	SH 51-7	Minigwal 1 : 250,000 Grid ref. 1428 2999 1 silcrete flake 50 mm x 35 mm x 15 mm
Find 2	SH 51-7	Minigwa1 1 : 250,000 Grid ref. 1488 2921 1 silcrete flake 45 mm x 30 mm x 10 mm
Find 3	SH 51-7	Minigwal 1 : 250,000 Grid ref. 1432 2883 1 white silcrete tula adze 32.5 mm x 20 mm x 12.5 mm with cortex adhering to dorsal surface.
Find 4	SH 51-7	Minigwal 1 : 250,000 Grid ref. 1431 2885 1 silcrete flake 50 mm x 32.5 mm x 15 mm

APPENDIX 5

Extracts from the Aboriginal Heritage Act 1972

An Aboriginal site is defined in the Aboriginal Heritage Act (1972), in Section 5 as -

" (a) any place where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;

(b) any place, including any sacred, ritual or ceremonial site, which is of importance or of special significance to persons of Aboriginal descent;

(c) any place which, in the opinion of the Trustees, is or was associated with the Aboriginal people and which may be of historical, anthropological, archaeological or ethnographical interest;

(d) any place where objects to which this Act applies are stored, or to which such objects have been taken or removed under the provisions of this Act."

Obligations relating to sites under the Aboriginal Heritage Act (1972) - Section 15

"Any person who has knowledge of the existence of any thing in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other place or thing to which this Act applies or to which this Act might reasonably be expected to apply shall report its existence to the Trustees, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place In question to be already known to the Trustees,"

Offences relating to Aboriginal sites - Section 17

"A person who -

(a) excavates, destroys, damages, conceals or in any way alters any Aboriginal site without the consent of the Trustees; or

(b) in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant Aboriginal custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site without the consent of the Trustees

commits an offence."

Aboriginal sites required for other purposes - Section 18

" (1) For the purposes of this section, the expression "the owner of any land" includes a lessee from the Crown, and the holder of any mining tenement or mining privilege in relation to the land on which the Aboriginal site is located.

(2) Where the owner of any land on which an Aboriginal site is located gives to the Trustees written notice that he requires to use the land for a purpose which would be likely to have a deleterious effect on the preservation of the site the Trustees shall within a reasonable time thereafter, evaluate the importance and significance of the site and thereupon the Trustees shall either -

(a) make recommendations for the declaration of the site as a protected area under Section 19 or Section 20; or

(b) give notice in writing to the owner of their consent to the use of the land or of such part of it as may be agreed, for the purpose required."

Plate 1 Site W1178, Malcolm Soak. Artefacts are densest on the loam soils surrounding the granite rockpools. *Acacia aneura* growing on the loam rises (background).

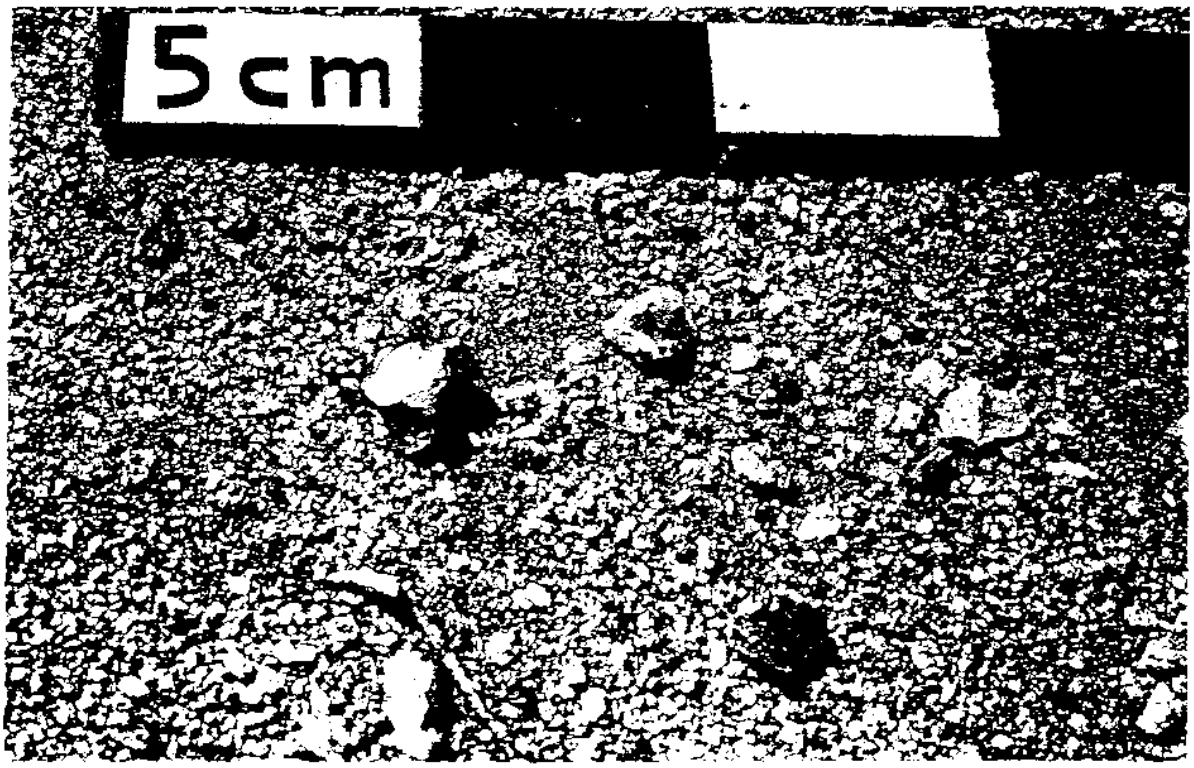

Plate 2 Site W1178. Chalcedony and silcrete flakes (not included in recorded sample).

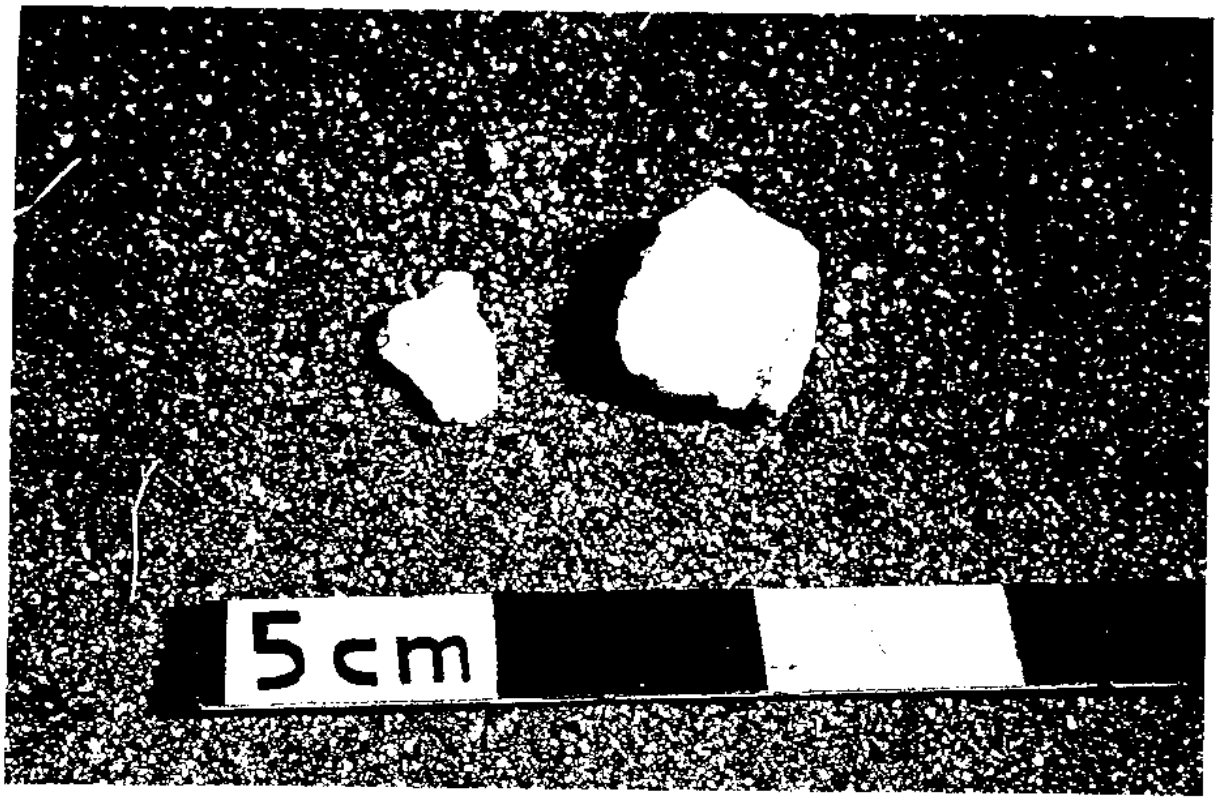

Plate 3 Site W1178. Quartz flake and core near quartz seam in granite.

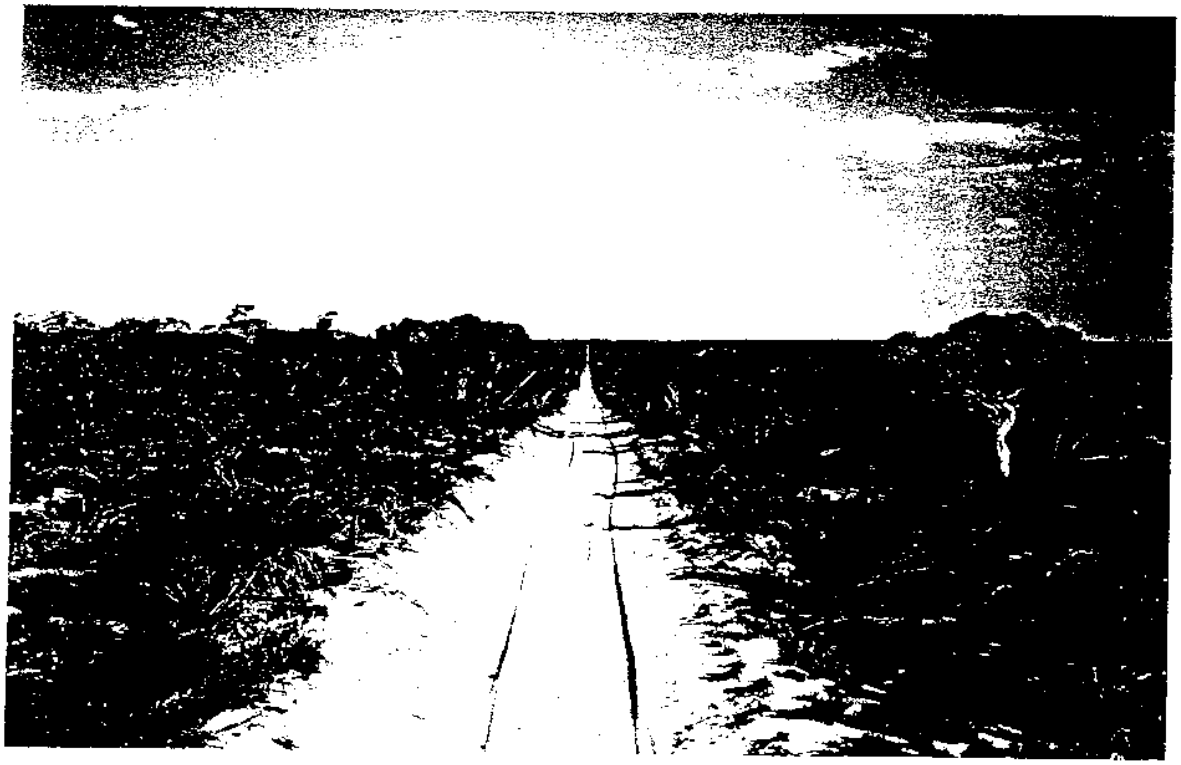

Plate 4 Photo taken from drillhole 116 to the south of site W1179, looking NWSE (120° mag.) towards the Basecamp.

Plate 5 Site W1180, 'Kopi' area. Artefacts discontinuously scattered throughout this area.

Plate 6 Site W1181. Photo taken looking NW. Artefact sample taken from NE side of claypan (forefront of plate).

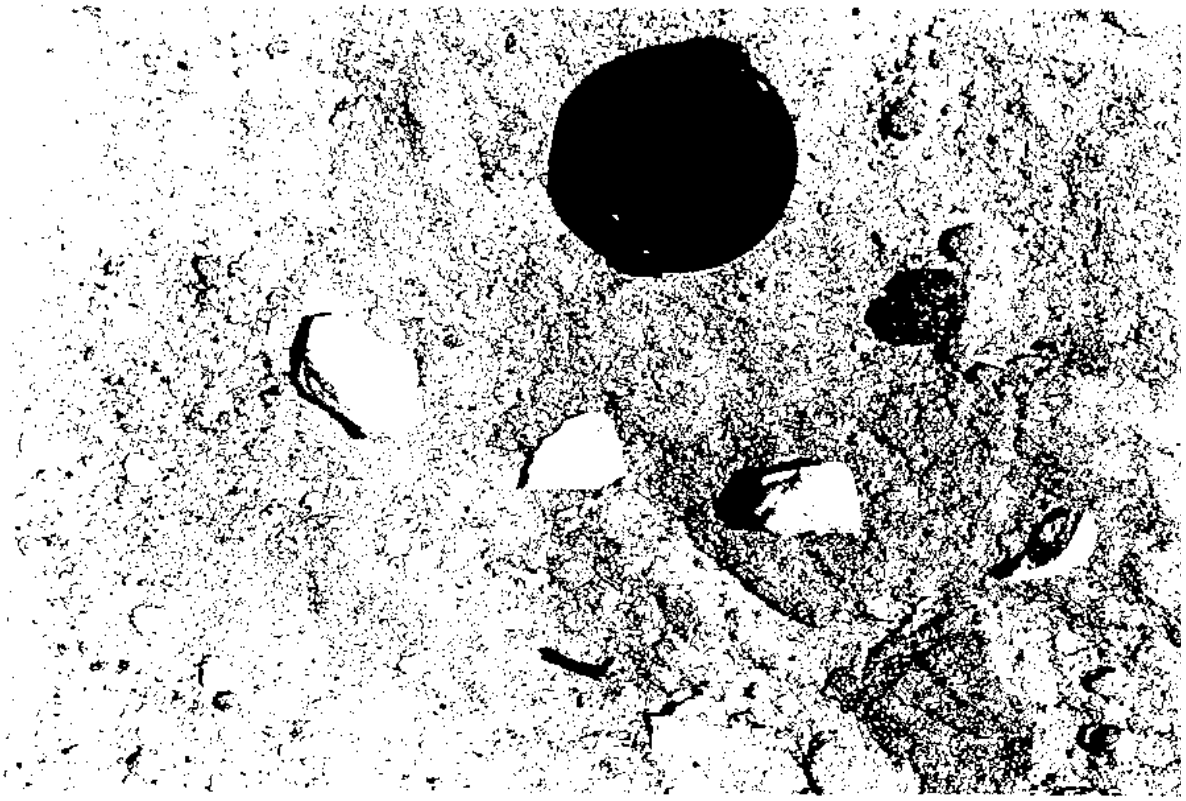

Plate 7 Site W1181. 1 Chalcedony and 4 silcrete flakes from south eastern side of claypan (not included in recorded sample).

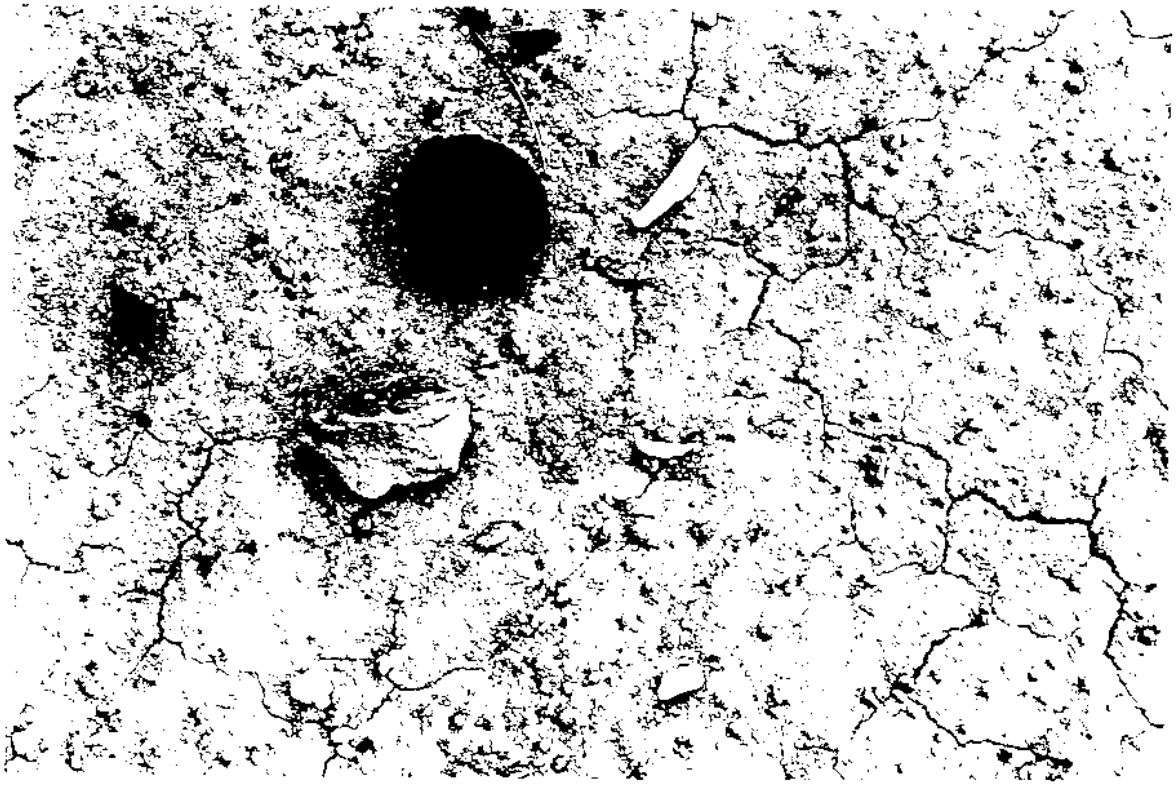

Plate 8 Site W1182. Artefacts from south eastern side of claypan. 5 chalcedony flakes, 1 silcrete core, 1 chalcedony backed blade (middle right). Not included in recorded sample.

Plate 9 Site W1183. Photo taken to the south of NWSE drill line. 14 artefacts found on lowlying areas of 'Kopi' (forefront of plate).

Plate 10 Typical erosion surface from dune top. Areas such as this were checked for eroding burials.

Figure 3 Survey Area and Archaeological Sites