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of Western Australia

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Water Resources Planning Branch

Next Major Public Water Supply Source for Perth (post 1992)

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Stage 1: Evaluation of Alternatives

Supporting Document

A Report on the Significance of Aboriginal Archaeological Sites at the Mundaring, Canning, North Dandalup and South Canning Dam Sites

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The Water Authority acknowledges the work of the Consultants for the efficient manner in which they undertook their investigations and provided their advice to the Authority.

A REPORT ON THE SIGNIFICANCE OF ABORIGINAL ARCHAEOLOGICAL SITES AT THE MUNDARING, CANNING, NORTH DANDALUP AND SOUTH CANNING DAM SITES

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FEBRUARY 1987

Prepared for the Water Authority of Western Australia, Perth.

TABLE OF CONTENTS

		Page No.
1.0	INTRODUCTION	1
2.0	ACKNOWLEDGEMENTS	4
3.0	SITE RECORDING METHODOLOGY	5
4.0	CANNING DAM	7
	4.1 Summary of Sites	8
5.0	MUNDARING DAM	18
	5.1 Summary of Sites	18
6.0	SURVEY RESULTS FROM NORTH DANDALUP AND SOUTH CANNING	26
7.0	BACKGROUND TO ARCHAEOLOGICAL INVESTIGATIONS IN THE JARRAH FOREST	29
8.0	SIGNIFICANCE OF SITES	31
9.0	DISCUSSION	34
10.0	CONCLUSIONS	38
11.0	RECOMMENDATIONS	39
12.0	REFERENCES	40
	PLATES	43

1.0 INTRODUCTION

The Water Authority of Western Australia is currently investigating four alternative sources of supply to meet the anticipated water demand of the Perth-Mandurah Region in the early 1990's. These all lie within the jarrah forest of the Darling Range although the Mundaring site is an ecotone within the eastern wandoo woodland. Options include the construction of a dam at either North Dandalup or South Canning, or raising either the eastern Mundaring or Canning Dam (see Figure 1). A review of environmental factors at the four localities has been commissioned by the Water Authority and the present report (in addition to an ethnographic report) forms a component of this review.

The *consultancy brief* states that the significance of (cultural) resources from the four alternative water sources is to be assessed so that a hierarchy can be established.

Comprehensive archaeological surveys have already been completed at North Dandalup and South Canning (Anderson 1981, 1982a and 1982b) and discussed in a regional context for the jarrah forest zone (Anderson 1984). Additional site data, including assessment of sites for excavation potential, has been provided for these two areas by Anderson.

The Mundaring and Canning Dam areas were surveyed in detail by the consultant using a comparable methodology to that used previously by Anderson for the North Dandalup and South Canning surveys.

The first part of this report deals with newly discovered sites in the vicinity of the *full supply level* (f.s.l.) which would result from the raising of the Mundaring and Canning Dams to their economic optimum. The second part will present data from Anderson's previous surveys and detail other archaeological research in the jarrah forest. The arch-

aeological data from the four impact areas will then be evaluated in terms of its relevance to regional research questions such as the land-use model recently proposed by Anderson (1984: 36-38) in what can be termed a problem-oriented approach (cf. Bowdler 1981: 130).

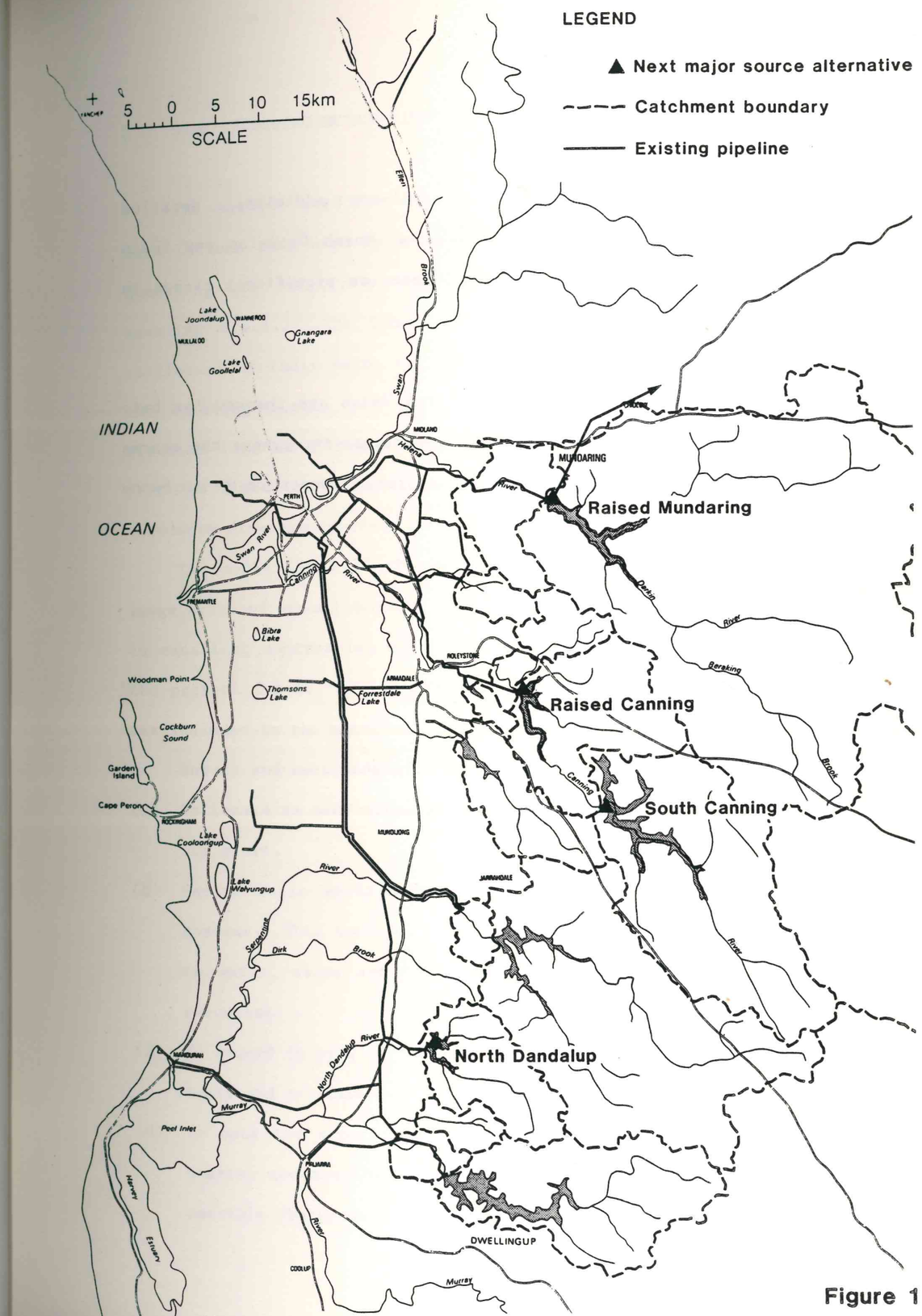

Figure 1
Alternatives for the next major water supply source for Perth

2.0 ACKNOWLEDGEMENTS

June Anderson is thanked for supplying additional detailed information for previous work carried out at North Dandalup and South Canning. She has also provided detailed notes on significant trends in jarrah forest archaeology.

Susan O'Connor, Brett O'Brien and Fiona Walsh are thanked for help in the survey work. Ian Pound provided assistance throughout the course of the project. Jo Havel is also thanked for comments on disturbance factors at Mundaring and Canning catchments.

3.0 SITE RECORDING METHODOLOGY

The methods used for recording sites and relevant environmental data follows that used by Anderson. The impact areas at Canning and Mundaring are relatively small as they involve the raising of the existing f.s.l.. The Canning and Helena Rivers and the points of confluence of their major tributaries are permanently inundated within the existing f.s.l. and therefore this survey largely focusses on elevated land at a remove from the main water courses which existed prior to flooding. Exceptions include the portion of the river to be inundated directly upstream from the existing f.s.l.

The water level of the dams is low at present thereby exposing large areas of ground denuded of vegetation. Visibility in these areas is excellent contrasting with the dense forest/understorey cover above the present f.s.l.. This margin of "cleared" ground below the f.s.l. was included in the survey.

Survey and recording procedures aimed to cover the following:

(a) To locate as many sites as possible using closely spaced traverses 50m apart.

(b) Record basic environmental data at each site to place them in context. This included soil type, vegetation and % cover, distance to water, slope and topography, rock types and obvious economic resources.

(c) To record *in situ* artefact numbers (approximate for larger sites), types and relative densities in addition to site dimensions.

(d) To note the occurrence of lithic sources, such as dolerite and quartz, and the ease with which artefacts could be discerned from possible "background noise".

(e) To note human disturbance such as inundation, road making and logging.

(f) To assess the excavation potential of all sites located.

4.0 CANNING DAM

The present f.s.l. of Canning Dam is shown in Figure 2. The proposed aerial extension through inundation covers an area of 3.8 square kilometres. The dam is located approximately 10 km east from the Darling Scarp. It is surrounded by State forest except for a block around the dam wall described as cleared land (McArthur and Mulcahy 1980). The area is comprised of Archaean granite, coarse grained and igneous rocks with an extensive cover of laterite. The northern reaches of the dam lie in a zone of migmatites (Biggs et al. 1980). The dam lies in the Murray landform/soil unit characterised by deeply incised valleys with red and yellow earths on the slopes and narrow alluvial terraces. To the north of the dam the Dwellingup unit is marked by a gently undulating landscape with duricrust on ridges and sands and gravels in shallow depressions (Churchward and McArthur 1980). With a mean rain- fall of 1200mm Canning Dam lies within the Murray vegetation zone of open forest *Eucalyptus marginata - E.calophylla* with fringing woodlands of *E.rudis - Melaleuca rhaphiophylla* on the valley floors (Heddle et al. 1980).

The main logging phase at Canning occurred approximately 50 years or more ago with varying degrees of logging disturbance. Disturbance is less than at South Canning where extensive areas have undergone salvage logging within the last decade. The pattern of firing is also varied in that gently sloping uplands are more efficiently and frequently burnt and consequently have a more open understorey than steeper areas associated with the drainage courses. Firing is carried out on a seven year cycle. Drainage characteristics are likely to have been altered in areas of Canning due to the presence of dieback and a concomitant

increase in water discharge. Observations about water permanency and period for which streams are active cannot be directly interpolated to traditional times. It is clear, however, that rocky pools such as Turtle Pool and at Sites 5 and 6, are likely to always have been permanent (J. Havel, pers. comm.).

4.1 Summary of Sites

A total of nine archaeological sites were located during the survey. All of these comprised surface scatters of stone artefacts. Using the site classification of Anderson (1984: 20) five of the sites are minor (less than 50 pieces), one intermediate (50 to 500 pieces) and three major (over 500 pieces). The three major sites are the first such sites recorded in the near scarp jarrah forest. All previously recorded sites in the near scarp jarrah zone evidence almost exclusive use of quartz as the raw material for artefacts with the occasional use of silcrete and chert. Two of the major sites have implements manufactured from locally available dolerite as well as the occasional piece in mylonite and one in fossiliferous chert. The significance of these large sites is discussed in more detail later in the report.

All of the sites have a boundary located within 50m of a water source. These sources could still provide water at the time of the survey (early to middle January) and it seems likely all bar two (at Sites 7 and 9) would be permanent.

Visibility in the survey area is extremely low and virtually restricted to tracks, borrow areas, granite outcrops and areas subject to inundation. Areas of more open jarrah forest have a leaf litter which effectively covers the ground. Sites 1 and 2 are located on graded tracks, Sites 3, 7 and 8 adjacent to granite outcrops and Sites

4, 5, 6 and 9 on slopes subject to inundation. All of the major sites are situated, at least partly, within areas denuded of vegetation through periodic inundation.

No grinding material was located during the survey. This is consistent with the results of other surveys in the near scarp forest (Anderson 1984: 36). While the occasional backed blade has been located in these surveys, none were located at Canning.

Four types of implement were noted at Canning. Most common were flakes with retouch to one or both lateral margins followed by thick flakes with steeply angled working edges. One small flat flake with retouch to all but the proximal margin as well as one horsehoof core were noted.

The potential for stratified cultural material at the sites is low. Sites 1, 2, 3, 5, 7 and 8 are located either on laterite or thinly developed soils next to granite outcrops. They have nil potential for excavation. While sections of the scatters of Sites 4, 6 and 9 lie on thick alluvial deposits they are of a low density and do not aggregate in possible activity areas. A high density cluster of artefacts does occur at Site 6 amongst granite boulders above the alluvial deposits, however. It might be possible that artefacts have become incorporated into the alluvium through displacement from the granite platform situated upslope.

Site 1

Pinjarra, SI 50-2, Edition 1, WATMAP

Grid Reference: MK424 432

The site is located on a graded laterite track directly north from a bridge crossing of the river. The laterite is shown in section at the

bridge crossing and appears to have little sand cover. The site context is the flat surface of a valley floor adjacent to permanent pool water. Vegetation either side of the track is extremely dense and leaf litter totally obscures the ground surface. Quartz does not naturally outcrop here.

A total of seven artefacts were noted within an area of approximately 4m diameter. Artefacts included three flakes, one fragment, two single platform cores and a core with crushing to one margin. All artefacts are in quartz.

Site 2

Pinjarra, SI 50-2, Edition 1, WATMAP

Grid Reference: MK424 433

Site 2 is located adjacent to the eastern bank of Turtle Pool (Figure 1). Turtle Pool is a large, permanent pool surrounded in part by sedges and where the site is located is enclosed by smooth, granite bedrock. The site lies on a gently sloping laterite clearing marking the end of several tracks from the eastern side of the catchment. Visibility is restricted to the tracks and the clearing.

The cleared area measures 21m N/S and 15m E/W with artefacts dispersed over most of this. A total of 35 artefacts were noted with a density count of 11 for a 10m square quadrat at the downslope section of the clearing. Artefacts included flakes, fragments, two single and one multiplatform core, one bipolar core and a flake with retouch to its left lateral margin.

The west bank of the river at this point has a densely vegetated alluvial terrace that might provide conditions suitable for stratified cultural material. Other areas further downstream, such as the loop

identified as A1 in Figure 1, are also likely to have this potential, especially given the presence of permanent water (see Plates). The undergrowth is so thick, however, that it is impossible to assess the surface expression of any previous occupation. These areas would warrant further examination after firing.

Site 3

Pinjarra, SI 50-2, Edition 1, WATMAP

Grid Reference: MK423 434

This scatter of eight artefacts is located on the downslope portion of a large granite outcrop directly east from the Canning River. The site is situated approximately 50m from permanent pools on a medium grade slope. It lies on the north-west margin of the granite outcrop in a shallow depression filled with natural quartz pieces and coarse sands. Visibility over the granite slopes and the poorly developed soils adjacent to outcrops is high. Artefacts include seven flakes and a multiplatform core (all in quartz) over an area of 5m diameter. Thin soils rule out the possibility of excavation.

Site 4

Pinjarra, SI 50-2, Edition 1, WATMAP

Grid Reference: MK421 434

This site is located on the southern bank of a major tributary of the Canning at the southernmost part of the present f.s.l.. The creek has well developed alluvial terraces over laterite which is exposed in places. The site is restricted to a margin of flat ground next to the creek at the base of the minor valley slopes. These creek margins are inundated during higher water levels in the dam and may also be

inundated with winter discharge from the creek. Visibility along the inundation areas is high, however drops rapidly to near nil on the gravelly slopes away from the creek. There are large permanent pools in this section of the creek with remains of freshwater mussel on the banks.

A scatter of approximately 250 quartz artefacts extends along the southern bank for approximately 200m. No clustering of artefacts occurs along this bank section which varies in width from 5m to 15m. Artefacts noted include flakes, chips, single and multiplatform cores and two flakes with retouch on their lateral margins. Quartz occurs naturally amongst the laterite exposed along the banks and tends to be in the form of small, rounded and weathered lumps. The density of artefacts is extremely low at the site, that is, one piece per 10 square metres. While the depositional environment may be conducive to stratified remains there is no tangible surface evidence of more intensive use of any particular point along the bank.

Site 5

Pinjarra, SI 50-2, Edition 1, WATMAP

Grid Reference: MK420 440

This extensive site is located on the western bank of a tributary which joins the Canning River East Branch at the present f.s.l.. The low angled banks of the tributary are comprised of laterite with a light silt overburden. In a few places weathered outcrops of dolerite form slightly raised crusts on high points of the bank. Quartz occurs naturally across these slopes mainly as small and rounded fragments. A large assemblage of quartz artefacts can be clearly discerned amongst the background scatter in addition to occasional pieces in dolerite,

mylonite and one piece in fossiliferous chert. The scatter covers an area of 250m N/S and 100m E/W. This area is inundated during high water levels in the dam and is consequently devoid of vegetation. The vegetation above the present f.s.l. is dense forest with heavy ground litter. The site extends in places up to this boundary and no doubt does continue further uphill in areas presently having nil ground visibility.

The silty course of the tributary at this point contained water by late January and a series of rocky pools slightly upstream (the focus of Site 6) probably retain permanent water.

Two 10 x 10m sample quadrats yielded density counts of 34 and 72 artefacts, respectively. Quadrat 1 contained 15 flakes, 12 fragments, two single platform cores, two multiplatform cores and three chips, all in quartz. Quadrat 2 contained nine flakes, 34 fragments, six single platform cores, five multiplatform cores, three flakes with retouch on one lateral margin, and 14 chips, all in quartz. A single platform core made from dolerite was also noted. A conservative extrapolation of these densities using the lower figure gives a population of 8,500 pieces. Other implements noted at the site include two multiplatform cores in mylonite (with some edge crushing), a dolerite flake with extensive retouch to one margin, three dolerite steep-sided scrapers and one dolerite horsehoof core.

Abundant remains of freshwater mussel cover the bank. Yams and zamia occur locally (Havel, pers. comm.), aquatic birds and macropods are present and the water supply appears permanent. This location, and the creek banks further upstream, are likely to have been favoured habitation areas which could potentially have been used through Spring and into the Summer months.

Site 6

Pinjarra, SI 50-2, Series R502, Edition 1

Grid Reference: MK420 439

This site is comprised of three broad clusters of stone artefacts, all on the east side of the tributary running into the Canning River East Branch. The first cluster is located on a laterite rise flanked by the tributary and another smaller drainage line to the north. The laterite rise is largely devoid of vegetation being within the inundation zone. A total of 82 quartz artefacts were recorded over an area of 60m N/S and 50m E/W. Several tabular granite pieces were located over the site and while none had evidence for grinding one piece had evenly spaced pitting on a slightly concave surface. Granite boulders at the base of this laterite rise contain milky quartz veins.

Walking approximately 300m south along the creek bank the occasional quartz artefact was noted as well as two large quartz cores. At a loop in the tributary a heavily silted area is covered by a low density scatter of quartz artefacts. Over an area of approximately 50m N/S and 40m E/W lie several hundred artefacts comprising flakes, chips, fragments and several cores. The silted depression is flanked to the east by granite outcrops which again contain quartz veins. Freshwater mussel shells are numerous here.

Moving further south a flat, well drained slope is encountered. It lies between granite rises to the east and boulders to the west. Situated 20m away from rock pools the area is largely clear of vegetation as it is subject to inundation. Its surface is comprised of flat granite platforms with depressions filled by natural quartz and coarse sands and these are both surrounded by gently sloping silty surfaces. Quartz veins and their associated detrital material are common over this

area. The artefact scatter is densest around the granite and the high points of the silted slopes and decreases in density downslope to the creek. The scatter covers an approximate area of 150m N/S and of 20m to 50m variable width. Four 1 x 1m density counts were carried out and figures ranged from five to 30 pieces. Dolerite artefacts occur over the cluster boundary in low numbers and include three steep-sided scrapers and two retouched flakes. Three pieces of mylonite, one a scraper, were recorded.

Density counts and field observations indicate that this cluster may contain over 10,000 pieces. Anderson has visited this site, as well as Site 4, and notes that the inherent qualities of the quartz used for artefacts at Canning provide more controlled conchoidal fractures and consequently are more readily identified than at South Canning and North Dandalup (pers. comm.). The full range of artefacts located at the other sites occur here.

Site 7

Pinjarra, S I50-2, Series R502, Edition 1

Grid Reference: MK421 440

This site is located on the southern bank of the Canning River East Branch outside the present f.s.l.. The river loops at this point around low lying granite outcrops. The river is approximately 3m wide with water flowing slowly between a series of rocky pools. Pockets of thinly developed soil occur in depressions amongst the granite outcrops and visibility is generally high. Naturally occurring quartz is extremely dense along the granite banks creating a very strong "background noise". A total of 10 quartz artefacts were identified over an area of approximately 30m diameter.

Site 8

Pinjarra, S150-2, Series R502, Edition 1

Grid Reference: MK420 442

This site is similar to Site 7 in its context. A cluster of seven quartz artefacts occurs over an area of approximately 30m radius. These comprise six flakes and one single platform core. The site is located on the north bank of a granite flanked tributary which flows into the Canning River East Branch. A number of small rock pools still contain water although the water does not appear to be flowing.

Site 9

Pinjarra, SI 50-2, Series R502, Edition 1

Grid Reference: MK420 443

The site is located on both banks (west and east) of Death Adder Creek where it meets the northern f.s.l. of Canning Dam. The extensive site is located predominantly on flat to gently sloping silty/laterite soils which are inundated during high water levels. The site extends from the present f.s.l. continuing for approximately 400m downstream. Vegetation above the f.s.l. is extremely dense, especially along the drainage course, and visibility restricted to the inundation zone. Soakage appears to be available in the creek, however water did not appear to be flowing at this time of year.

The silty banks of the creek below the f.s.l. are covered by a low density continuous scatter of quartz pieces of mainly flakes, fragments and cores. Further downstream the silty banks give way to more steeply inclined laterite slopes which have a higher density of quartz pieces and some retouched/utilised items. Quartz naturally outcrops on the laterite slopes. Four 10 x 10m density counts over the laterite slopes

yielded figures of 3, 9, 7 and 2 pieces. An accurate assessment of the population of quartz artefacts on the naturally quartz-strewn laterite slopes would require more time than available during this survey. A conservative estimate would place the artefact population above 500 pieces.

5.0 MUNDARING DAM

The present f.s.l. of Mundaring Dam and its surrounds are shown in Figure 3. the proposed dam raising would inundate an additional area of 5.5 square kilometres. The dam is located approximately 11 km east from the Darling Scarp.

The land surrounding the dam is comprised of State forest inclusive of timber reserves. Areas of pine plantation flank the eastern side of the dam with one smaller area on the west (McArthur and Mulcahy 1980). The area is comprised of Archaean granite and has a partly eroded cover of laterite (Biggs et al. 1980). The landforms and soils fall into the Murray system of deeply incised valleys with red and yellow earths on slopes and narrow alluvial terraces (Churchward and McArthur 1980). Mundaring lies within the 1,000 isohyet and is classed in the Murray and Bindoon complex of low to medium rainfall. Vegetation ranges from open forest of *Eucalyptus marginata - E.Calophylla* to woodland of *E.wandoo* with *E.rudis* and *E.patens* on valley floors (Heddle et al. 1980).

5.1 Summary of Sites

A total of six archaeological sites were located during the survey. Five of these comprised surface scatters of stone artefacts. One is a possible stone arrangement with several artefacts in association.

A search of the Site Records of the Department of Aboriginal Sites, Western Australian Museum, for an area encompassing a 2 km margin surrounding the proposed new f.s.l., revealed two previously recorded sites; one archaeological and the other ethnographic.

The archaeological site was recorded by Bill Ferguson in 1977 during an inspection of three survey areas on the eastern side of the dam.

Site 1 (S0061)

Pinjarra, SI 50-2, IMP.

Grid Reference: 425 041

This site consisted of an assemblage of 13 quartz and dolerite artefacts. Ferguson noted a dolerite steep-sided scraper eroding from a creek bank at approximately 5-15cm below surface level. Artefacts were collected from the surface and bank section. The site was located on the southern bank of the Little Darkin River in an area inundated during high water levels.

These artefacts are now held in the Archaeology Department of the Western Australian Museum under Accession Number B4499. The collection, in addition to the steep-sided scraper, includes two amorphous dolerite pieces, one dolerite flake, five quartz flakes and four quartz cores.

The site was revisited and the position carefully checked against Ferguson's plans in the site files. At this location artefacts are presently eroding from an alluvial deposit on the southern banks of the river. These artefacts include three large single platform cores in dolerite, two of which have undercutting along their margins and crushing. The largest core/implement measures 12 x 8 x 5cm on its longest axes. Twenty-six quartz flakes and three cores are eroding from the same depositional feature at this site. There would appear to be charcoal in this unit. Approximately 75m west along the bank a similar collection of artefacts are eroding from the same alluvial unit. The stratigraphy for the site is given on p. 21.

Water is pooled in this section of the river (granite basement is exposed in some sections of its course) and provides a habitat for numerous tortoise and mussels.

The ethnographic site was recorded by R. O'Connor in 1986 during a

wider survey of the Metropolitan area.

Site SO2148

Pinjarra, SI 50-2, IMP.

Grid Reference: 428 044

This ethnographic site is classified as a ceremonial, mythological and repository site. It registers a portion of the course of the Helena River; specifically the swamps and pools located in the deep valley inundated by Mundaring Dam. This was the place of residence of a powerful Waugal associated with rainmaking. The site is discussed in detail in the ethnographic report to the present project.

Of the six artefact scatters located during the recent survey by the author, including SO0661, four of these are minor (less than 50 pieces) and two are intermediate (50 to 500 pieces). No major sites were located. Quartz has been used predominantly at Mundaring with the occasional implement made from dolerite. No artefacts from mylonite or fossiliferous chert were noted.

While all of the sites are located near water courses none of these were flowing or appeared to contain free-standing water (for example, Hay Creek, Pickering Brook and Manns Gully) apart from the Little Darkin River.

As in the Canning survey, visibility is extremely low and largely restricted to tracks, granite outcrops and areas subject to inundation. All of the sites recorded at Mundaring are below the present f.s.l. and are periodically inundated.

Most of the artefacts located at the sites are pieces of debitage. Exceptions include steep-sided scrapers in dolerite at Site 1, a backed piece (lunate) at Site 5 and a flake with retouch to one lateral margin

at Site 7. No grinding material was located.

Quartz occurs all over the Mundaring catchment in various forms ranging from well-defined veins and nodules through to highly weathered fragments scattered on laterite. Dolerite is also common as dykes often striking from one bank of the dam to reappear on the opposite bank.

The potential for stratification is low for all the sites except Site 1. They are located either on thin sands overlying granite or on silt-covered laterites in low densities.

The southern bank of the Little Darkin River, where Site 1 occurs, is steeply sloped being neatly cut by water action during high water levels. This area is periodically inundated. The surface comprises a fine-grained organic rich alluvium several centimetres in thickness. This overlies an alluvial deposit of 20-30cm depth which is weathered and appears to contain no organics bar charcoal. All of the artefacts eroding from the southern bank appear to be coming from within or lying on this surface. The unit, in turn, overlies a harder yellowish unit comprised of laterite pisolites within a fine-grained matrix. No artefacts occur within this unit. The surface alluvium extends some distance back from the bank, however it is only at the shoulder of the bank where it is stripped away that the artefacts occur. The same pattern continues further west along the bank where another assemblage is eroding out. This site would appear, therefore, to have excellent excavation potential.

The topography and rainfall characteristics of Mundaring are significantly different to those at Canning. Mundaring is in a lower precipitation area with some plant species indicative of more restricted rainfall. The nature of inundation along the Helena River has also totally covered previously existing pools which probably provided permanent water to both Aborigines and European settlers alike (see ethnographic report). In contrast, Canning has many rock bars and pool systems which have not been obscured through construction of the dam.

Mundaring had intensive clearing carried out during the early years in an effort to increase run-off. With increasing knowledge of salinity problems these areas were subsequently planted with pine. Parts of the catchment above the f.s.l. are therefore extensively disturbed.

Site 2

Perth, SH 50-14, Edition 1

Grid Reference; MK426 460

The site is located 25m to the south-east of a small gully on a flat area of pale gritty soil. No water remains in this small drainage course. Large granite boulders with quartz veins outcrop on the opposite side of the gully although no reduction areas in the vicinity were noted. A total of 15 quartz artefacts were noted in an area measuring approximately 20m NW/SE and 5m NE/SW. These artefacts comprised unmodified flakes, chips and two multiplatform cores.

Site 3

Perth, SH 50-14, Edition 1

Grid Reference: MK424 462

This site is located on the southern bank of Pickering Brook below

the f.s.l.. The gently sloping laterite surface has a light silt overburden. An assemblage of 23 quartz flakes and two cores were recovered in an area extending 40m parallel to the creek and 15m deep. Quartz is naturally exposed along the bank as weathered pieces usually with rounded edges. Large granite outcrops mark the eastern edge of the site.

Site 4

Perth, SH 50-14, Edition 1

Grid Reference: MK424 463

The site consists of a possible stone arrangement on the west bank of the Manns Gully tributary now part of the dam. Three circles of granite rocks have been placed in a line on a gently sloping sheet of granite. Directly upslope of the arrangement are fine-grained alluvial soils over which the occasional quartz/dolerite flake can be found. A total of six artefacts were located within a 100m radius.

Site 5

Perth, SH 50-14, Edition 1

Grid Reference: MK463 421

The site is situated on the west bank of Hay Creek. The gently sloping laterite has a silty surface derived from alluvial sediments. The silts here appear to be a combination of creek drainage and sediment movement through wind/wave action. A long stretch of bank is exposed on which a scatter covers an area of approximately 90m N/S and 30m E/W.

A 10 x 10m sample quadrat in the densest part of the site gave a total of 31 pieces. At a conservative estimate the assemblage contains over several hundred pieces. Artefacts are all in quartz and include

flakes, single and multiplatform cores and one backed piece or lunate. The crescentric-backed quartz piece is one of only a few backed implements recorded for the whole of the jarrah zone (Anderson 1984: 36).

Site 6

Perth, SH 50-14, Edition 1

Grid Reference: MK463 422

The site is located on a depression between two granite knolls on the southern bank of the Helena River, within the present f.s.l.. Poorly developed pale gritty sands cover the area between the knolls which is covered, in parts, by a scatter of naturally occurring quartz pieces. A total of 12 artefacts were recorded over an area of 20m E/W and 10m N/S. Artefacts include nine quartz flakes and three dolerite cores. Two cores are multiplatform while the other is single platformed, discoidal in section.

Dolerite outcrops to the west of the site as a small strike. As with the site at Hay Creek (Site 5), a reworked sediment has been deposited by wind-induced currents in the reservoir in the form of small wave formed terraces. Artefacts in this context are likely to have been laterally displaced to a greater extent than those affected solely by sediments borne in creek discharge.

Site 7

Perth, SH 50-14, Edition 1

Grid Reference: MK463 421

This site is located to the south of a small drainage course which enters the f.s.l. 500m north from Hay Creek. The ground is gently

sloping and comprises mainly laterite gravels with some areas of silt close to the drainage line. An assemblage of approximately 100 artefacts was recorded in an area measuring 25m E/W and 20m N/S. Artefacts noted include flakes, two single and three multiplatform cores and one bipolar core, all in quartz. No retouched/utilised items were recorded. As with some of the other sites on laterite substrate a considerable amount of natural quartz occurs, mainly in rounded weathered form.

6.0 SURVEY RESULTS FROM NORTH DANDALUP AND SOUTH CANNING

North Dandalup

The survey at North Dandalup (Anderson 1981) focussed on a dendritically shaped area of 8 square kilometres. A total of 10 surface scatters of stone artefacts were located giving a site density of 1.3 per square kilometre. The dam now proposed has a surface area of approximately 5 square kilometres and all sites located by Anderson fall within this area. Eight of these sites were minor (less than 50 pieces) and two were intermediate (50 to 500 pieces). The total number of artefacts recorded was 600, giving a density figure of 75 artefacts per square kilometre. All artefacts were manufactured from quartz bar three in glass. Only 0.65% of all artefacts, or four pieces, were classed as retouched/utilised.

Only two sites (S1662 and S1660) were considered to have any excavation potential. A test pit at S1662 (Anderson 1982) yielded ony one flake and 21 chips in the top 10 centimetres. These artefacts were in a doubtful context given their proximity to a graded track. A test pit was also carried out at Site S1660 where several small concentrations of quartz artefacts are located around the inner circumference of a loop in the river. Fifty-six quartz artefacts (including flakes, flaked pieces, chips and a flake scraper) were recovered from the river bank sediments. Four retouched/utilised items were noted. The deposit continued to a depth of 45cm with a charcoal sample taken at 15-20cm below ground surface giving a date of 1,280 ± B.P. More than 50% of artefacts occurred below the charcoal. The surface scatters of quartz are only two to three metres in diameter and therefore not indicative of a more extensive site (Anderson, pers. comm.).

South Canning

A total of 20 archaeological sites were located at South Canning. Nineteen of these sites were located in the 25 square kilometres f.s.l. of South Canning, giving a site density of 0.76 per square kilometre. Nineteen sites are surface scatters of stone artefacts and one a possible stone arrangement. Seventeen of the artefact scatters ar eminor and three are intermediate. The total of artefacts is 1,300 or 52 pieces per square kilometre. Retouched/utilised implements comprise 0.6% of all artefacts and include an adze slug, four flake scrapers and two steep-sided scrapers. One example of silcrete and fossiliferous chert was also noted.

South Canning has been extensively logged and Anderson argues the lower site and artefact density figures, in comparison to North Dandalup, are the result of site attrition due to logging disturbance (1984: 33). This trend has been noted in the Wandella Dampier - Five Forest surveys on the eastern coast of Australia (Byrne 1983a, 1983b).

Nineteen of the sites are located within 150m of the river, the stone arrangement is situated high above the river, 300m distant. Visibility is extremely restricted at South Canning. Twelve sites are located in logging bays, three in logging disturbances and four are affected by road or bridge construction.

Site S1783 is the only site with some excavation potential (Anderson 1982a, and pers. comm.). The site is located on a 45 degree slope on the western bank of the South Canning River. It is situated to the south-east and adjacent to a bridge over the river. Anderson notes that the ground in the vicinity of the bridge has been disturbed by construction activities. The site covers an area of 120 x 100m and comprises 37 flakes, 29 chips, four flaked pieces, one bi-polar core,

117 lumps and 30 fragments, all in quartz. The site occurs on laterite soils however downslope changes to sands vegetated by wandoo. There is some possibility of cultural material on this flat area however no surface indications as to where to look. The excavation potential of the site surrounds must therefore be seen as low.

7.0 BACKGROUND TO ARCHAEOLOGICAL INVESTIGATIONS IN THE JARRAH FOREST

The four dam sites all lie within the jarrah forest; North Dandalup in the central, South Canning in the north central, Canning further northwards and Mundaring in the northern jarrah forest. All of the survey areas are within 30 km east of the Darling Scarp. North Dandalup is the closest (2-3 km) and is characterised by rugged terrain and deeply incised valleys. Topography changes with distance east to become more undulating.

Previous surveys in the jarrah forest include two in the Boddington and Collie area (Pearce 1981a, 1981b) and one at the Harris River, north of Collie (Veth et al. 1983). All the archaeological data from jarrah forest surveys has been synthesised by Anderson (1984) and compared to data from the Swan Coastal Plain (Anderson 1983a, 1983b; Hallam 1983) and from the Plateau at Lake Yealering. Environmental, archaeological, ethnohistorical and ethnographic data has been drawn together to present a land-use model for these three zones. The survey results of the four proposed dam locations are discussed in the context of these three zones.

The density of sites and artefacts varies significantly across these zones. The densities of sites for the Swan Coastal Plain are 6.5 and 3.0 per square kilometre. For the jarrah forest they are 0.8, 1.3, 2.0, 5.0 and 0.8 per square kilometre and for the Plateau the figure is 1.7. Artefact densities show similar trends with figures of 50,000 artefacts per square kilometre for the Swan Coastal Plain; 52, 75, 24 and 190 (max) for the near scarp forest and 4,000 per square kilometre at Boddington in the eastern jarrah forest. The figures for the Plateau are undetermined although lie broadly within the plain and forest

figures. The data from Boddington is treated separately by Anderson as it is considered to be a transition zone from jarrah forest to more open wandoo woodland. The density of major sites varies significantly across the zones also. One major site occurs every square kilometre on the Swan Coastal Plain, 0.06 sites for the Boddington forest woodland and 0.1 for the Yealering district. There are no major sites previously recorded from the near scarp jarrah forest. The percentage of minor sites is in fact highest in the jarrah forest. Other unique features of previously recorded sites in the near scarp forest include the absence of grinding material and almost total reliance on quartz with the rare exception of silcrete and chert.

On the basis of relative proportions of major and minor sites and associated artefact densities Anderson argues that a greater exploitation, both spatially and temporally, has occurred in the coastal environments than either the forest or Plateau (*ibid.*: 34).

In summary, a land-use model for the three zones is given by Anderson:

> The Swan Coastal Plain had the food resources to maintain a relatively large population for most of the year, which would explain the existence of the major sites found there. During winter and early spring, these resources were reduced precisely at the time when the denser forest area beyond the scarp had sufficient food and water resources to support small mobile groups whose presence would result in the scattered minor sites encountered today.
>
> (1984: 35)

Three sites have been dated from the jarrah forest near Collie and Boddington (5,810 ± 330 B.P. and 3,230 ± 170 B.P.) and at North Dandalup (1,280 ± 80 B.P.). A cultural/technological sequence has not been established yet from these limited test pits or from analysis of surface scatters of artefacts (Anderson 1982a, and Pearce 1982).

8.0 SIGNIFICANCE OF SITES

In attempting to evaluate the significance of sites at the four dam localities it is important to define timely and relevant research questions for the jarrah forest zone, and given the discussion above, within the context of the contiguous Plain and Plateau zones.

In the context of the land-use model presented above, relevant questions will include:

(a) Do the sites of the jarrah forest have any similarities to those on the Coastal Plain or those east of the forest?

(b) Do site densities, artefact numbers, types and raw materials vary within the jarrah forest (including the more open jarrah/wandoo woodland to the east)?

(c) Leading on from question (b), can these differences or similarities be explained in terms of variations in environment within the jarrah forest?

(d) Is the evidence for the use of the jarrah forest by small mobile groups sustained or is there evidence for more permanent use of sites or perhaps by a greater number of people?

(e) Is this zone used only during winter months or is it possible it may be used during spring and even into summer?

Other questions will focus on the problem of establishing a cultural chronology for the jarrah forest. Relevant questions will include:

(f) Do any sites show potential for stratified cultural remains?

(g) In the case of the two test pits already carried out at North Dandalup, have these excavations identified any cultural/technological patterns and do they help date the occupation of this zone? Do they have the potential for extension in order to increase the

data base?

(h) Do sites contain chronological markers such as backed blades and fossiliferous chert?

(i) Do the sites contain assemblages capable of undergoing technological analysis (after Hiscock 1986)?

Before these questions can be addressed there are a number of limitations in comparing the four different survey areas which should be considered.

The dendritic shaped survey areas of North Dandalup and South Canning focus on the main river course and its tributaries. In contrast, the survey areas of the existing dams at Mundaring and Canning comprise a thin belt, or margin, around the existing f.s.l.; that is at some distance from the main river course. On the basis of other surveys in the jarrah forest the likelihood of sites is greater in near proximity to a major water course. Therefore a bias exists in the representativeness of the two types of survey configuration.

The low water levels presently observed at Mundaring and Canning have exposed considerable areas of land periodically inundated within the f.s.l.. These areas are bare of vegetation thereby providing excellent ground visibility. Some sites do survive inundation; as noted above all the major sites at Canning and all of the sites at Mundaring occur within inundation areas. This improved visibility biases towards greater site recovery.

Lastly, to what extent do inundated sites retain spatial integrity and does silting obscure sites? This is a complex question which would require detailed work at each site. It is relevant to note, however, that numerous artefacts have been recorded lying on alluvial sediments and do appear to cluster at some sites in a pattern suggestive of human

activity areas such as at Site 6 on Canning.

In an attempt to control for the bias in carrying out surveys focussed entirely along water courses a number of large blocks at a distance from water were surveyed. These are shown in Figures 2 and 3 as blocks A, B and C. These survey areas include medium to steep slopes and more gentle sloped uplands. No sites were located within these survey blocks.

9.0 DISCUSSION

As noted in the background discussion the patterning of sites for the *near scarp* jarrah forest is of small to intermediate sites with assemblages almost exclusively from quartz. Lower site and artefact densities, a restricted range of lithics and lack of grinding material make these sites significantly different to those within the adjacent zones.

North Dandalup, South Canning and Mundaring have similar site patterning to the two survey areas further south (in the Collie district) in that all five areas contain minor to intermediate sites focussing on ephemeral river and creek courses. The three major sites at Canning Dam are unique for the near scarp zone in that they have assemblages of greater than 500 pieces, use a wider range of lithics such as dolerite and mylonite and focus on permanent water sources. These major sites show similarities to those recorded at Boddington in size and the range of implements and lithologies noted. The high retouched/utilised percentages Pearce recorded for Boddington (33.5%) do not occur in the Canning catchment. The site density for Canning is higher than at Boddington (2.4 versus 0.8 per square kilometre), however artefact densities are similar (3,373 versus 4,000 per square kilometre).

Perhaps most significantly, the density of artefacts is higher at Canning than at any other near scarp survey area by a factor of 15x (see Table 1).

The higher artefact densities at Canning and Boddington within the jarrah forest are likely due to two different factors. Anderson has argued that Boddington is located well east from the dense forest of the

TABLE 1: Comparison of site data (after Anderson 1984: 20, 25)

Survey Area	Area (km^2)	Site Density (km^2)	Site Size (%) Major	Intermediate	Minor	Artefact No. (est.minimum)	Density (km^2) (est.minimum)
Near Scarp							
Canning	3.8	2.4	33	11	56	12,817	3,373
Mundaring	5.5	1.3	0	33	67	435	79
South Canning	25	0.8	0	15	85	1,305	52
North Dandalup	8	1.3	0	20	80	600	75
Collie (Pearce)	25	2.0	0	0	100	605	24
Collie (Veth et al.)	10	5.0	0	25	75	1,900 (max.)	190 (max.)
Transitional							
Boddington	255	0.8	7	2	91	1,020,000 (max.)	4,000 (max.)
SWAN COASTAL PLAIN							
Perth Airport	6	6.5	5	21	74	750,000	50,000
Plateau							
Yealering	10	1.7	6	18	76	Undetermined	Less than Airport More than Scarp

scarp where jarrah is dominant. The Boddington district is more open and is characterised by wandoo woodland. She sees this area as a transitional zone from the patterning of sites from the near scarp to Lake Yealering on the Plateau (1984: 21).

The Canning survey area is unique from all the other near scarp localities in that it combines high rainfall with a topography and landscape features (such as rock bars) capable of storing water. Canning was the only locality where a considerable number of large pools were noted and creeks were still flowing into mid-Summer. The high site and artefact densities noted are likely to be an underestimate given that the most favourable sites for occupation are now likely to be permanently inundated. The pools presently contain freshwater mussel, tortoise, freshwater crayfish, lillies and are used by waterfowl and macropods. The surrounding slopes yield yams, zamia and other edible foodstuffs (Havel, pers. comm.).

The Mundaring, North Dandalup and South Canning evidence supports a model for use of the jarrah forest by small mobile groups, probably on a seasonal basis. The major sites at Canning, focussed on resource-rich permanent water bodies, open the possibility of more lengthy occupation and/or use by larger numbers of people. Occupation of the jarrah zone in this area during at least part of Spring and Summer would appear to be viable.

Only one of the two test pits (S1660) carried out by Anderson at North Dandalup contained cultural material *in situ* (1982a). Artefacts continued to a depth of 45cm below surface level; a date of 1,280 B.P. was given by a sample of charcoal nodules from 30-35cm below surface level. Artefacts from the site are typical of those found in quartz-rich assemblages in the Southwest however excluded the types which might

indicate a timespan such as backed blades or a high proportion of quartz.

The surface of the site consisted of only a small scatter of quartz pieces over an area of two metres square. The subsurface expression of this small site is considered to be limited and unlikely to provide a substantial body of material capable of answering more detailed questions other than date of occupation.

Site 1 at Mundaring has good potential to yield *in situ* stratified cultural material, possibly over a considerable area. Two concentrations of dolerite and quartz artefacts, including retouched/utilised items, are eroding from a weathered alluvial unit on the southern bank of the Little Darkin river.

Only one site in each of the four survey locations has artefacts that may act as chronological markers. These comprise one fossiliferous chert flake in South Canning, three glass flakes in North Dandalup, one quartz backed piece at Mundaring and one fossiliferous chert flake from Canning. The presence of these temporal markers in such small numbers makes their application to questions about changing cultural/technological patterns meaningless, however, at present.

A recent approach by Hiscock (1986) utilises the comparison of debitage from surface sites to technologically significant changes in debitage observed in stratified deposits. Such an approach, while able to incorporate smaller sites, would yield more statistically significant results when used with the sites classified as intermediate to major in this report. The presence of the dense sites at Canning and the stratified site at Mundaring should be considered significant in the potential application of such an approach.

10.0 CONCLUSIONS

Both the Canning and Mundaring survey areas are considered to be highly significant for different reasons.

The unusually high artefact densities at Canning reflect more intensive use of this section of the near scarp jarrah forest than any of the survey areas to the south and at Mundaring. The possibility of occupation in the Spring and Summer months is raised. The size and complexity of the major sites adds a new variable to the land-use model proposed by Anderson which predicts small, quartz-rich assemblages. These large surface scatters are likely to yield more data on technology and economy than the surface sites at Mundaring, South Canning and North Dandalup.

Site 1 at Mundaring appears to have excellent excavation potential with indications that stratified cultural material may be extensive. This site has the potential to answer questions on cultural/technological change or stability in the jarrah forest. Given its possible large size and clear stratigraphic context it is also a unique feature in the jarrah forest.

Both North Dandalup and South Canning survey areas are considered to be of minor significance. The stratified site (S1660) has been argued to be of limited value in answering more complex questions other than date of occupation. Taken individually, the sites have relatively small numbers of artefacts with few modified or formally recognizable specimens. None of the individual sites has the potential for more intensive research. The sites collectively, however, document a record of usage for the near scarp zone reflected in all other areas except for Canning.

11.0 RECOMMENDATIONS

The Canning and Mundaring survey areas have been argued to be highly significant; the North Dandalup and South Canning survey areas to be of minor significance.

A decision by the Water Authority of Western Australia to further develop either Canning or Mundaring dams would require detailed work to mitigate the loss of unique archaeological data. In the event of deciding to proceed to raise Canning it is *strongly recommended* that all of the major sites (Sites 5, 6 and 9) should be recorded and analysed in detail. In the event that Mundaring Weir should be chosen for development it is *strongly recommended* that extensive excavation should be carried out at Site 1 on Mundaring, preferably in several portions of the southern bank of the Little Darkin River. Excavation data would necessarily be tied into data from surface scatters within Mundaring.

Due to the similarity of the individual sites at South Canning and North Dandalup preservation of a small number at either location would satisfy the requirements for representativeness.

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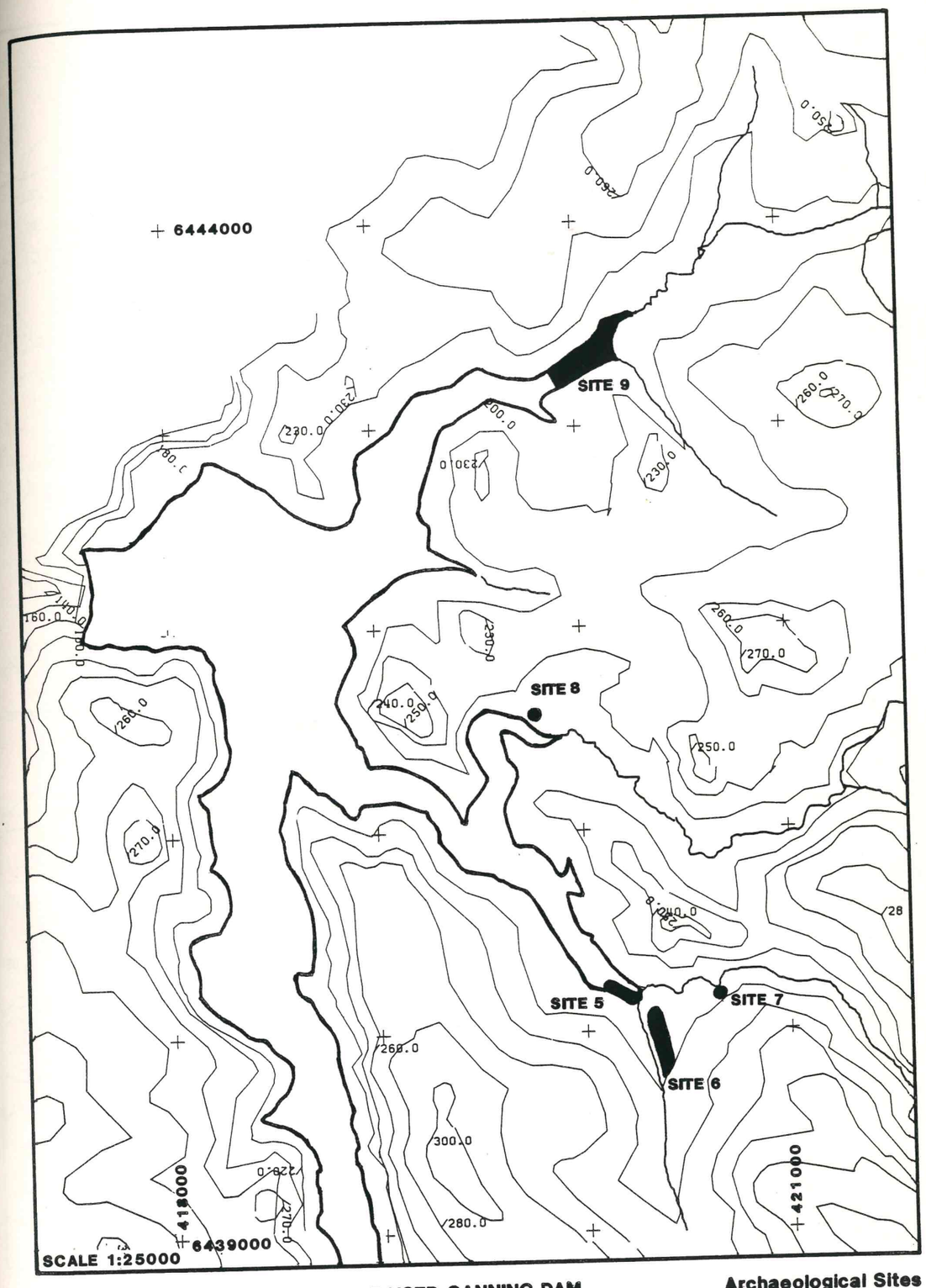
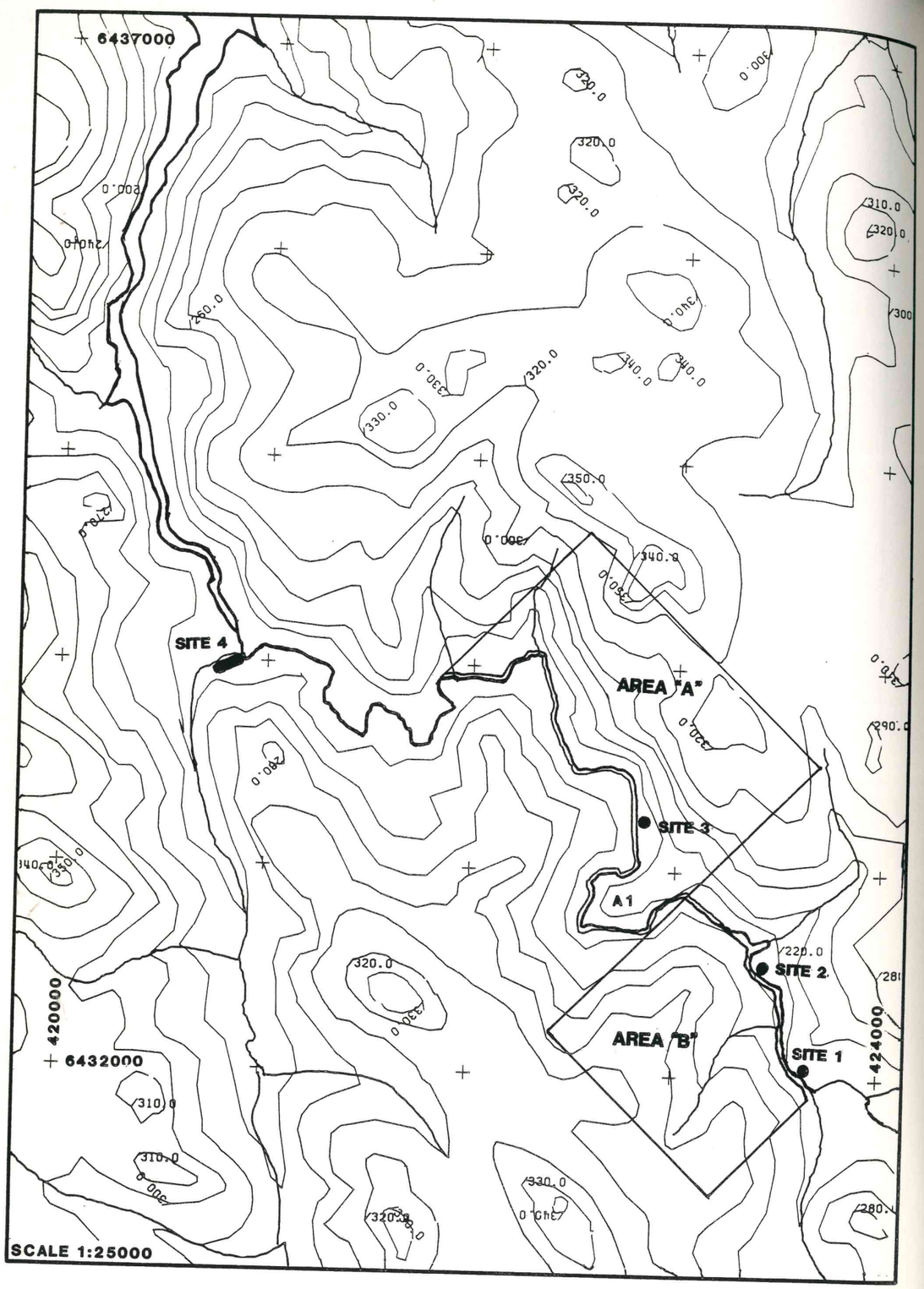


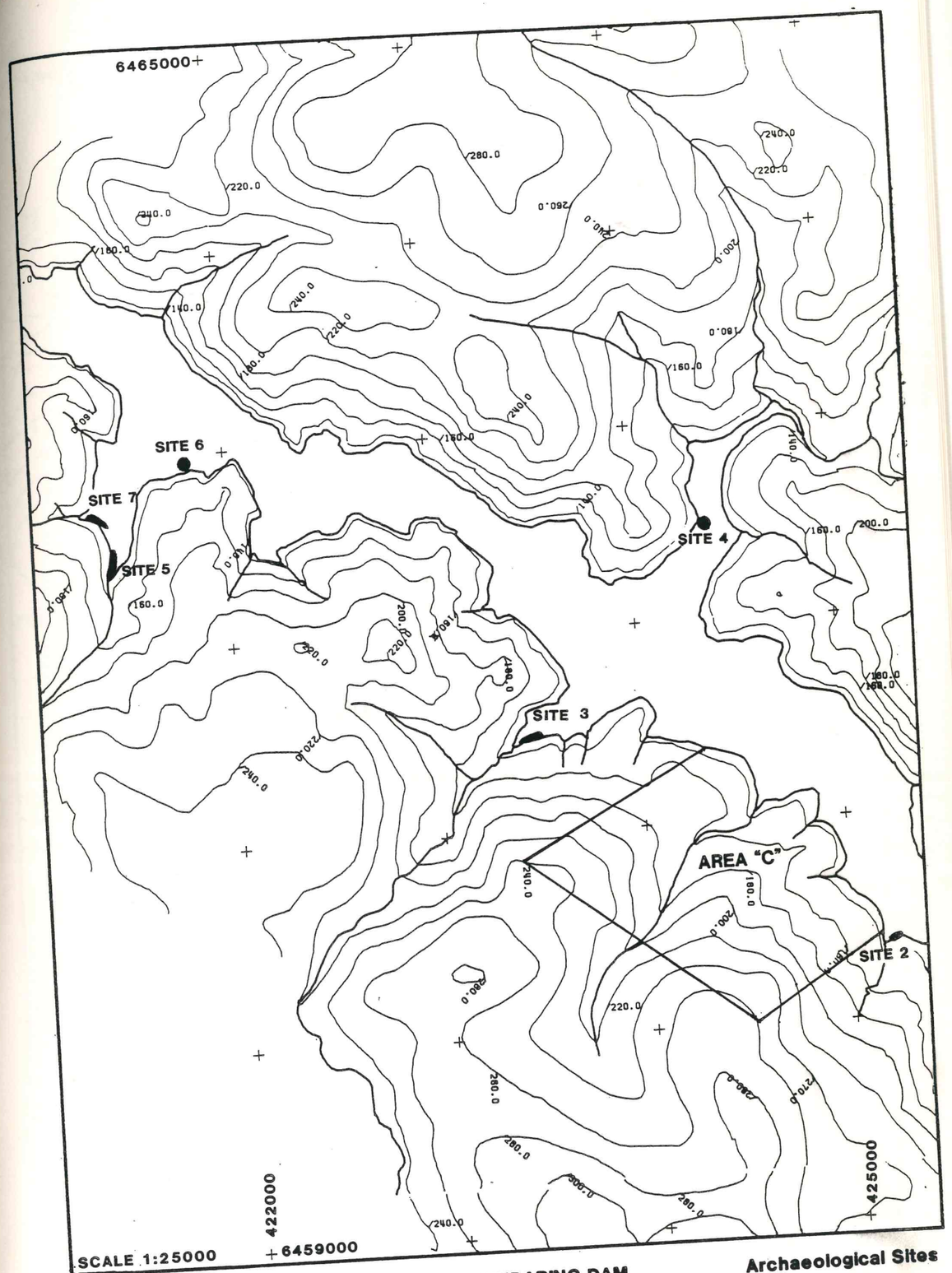
FIGURE 2A



RAISED CANNING DAM

Archaeological Sites

FIGURE 2B



RAISED MUNDARING DAM

Archaeological Sites

FIGURE 3A

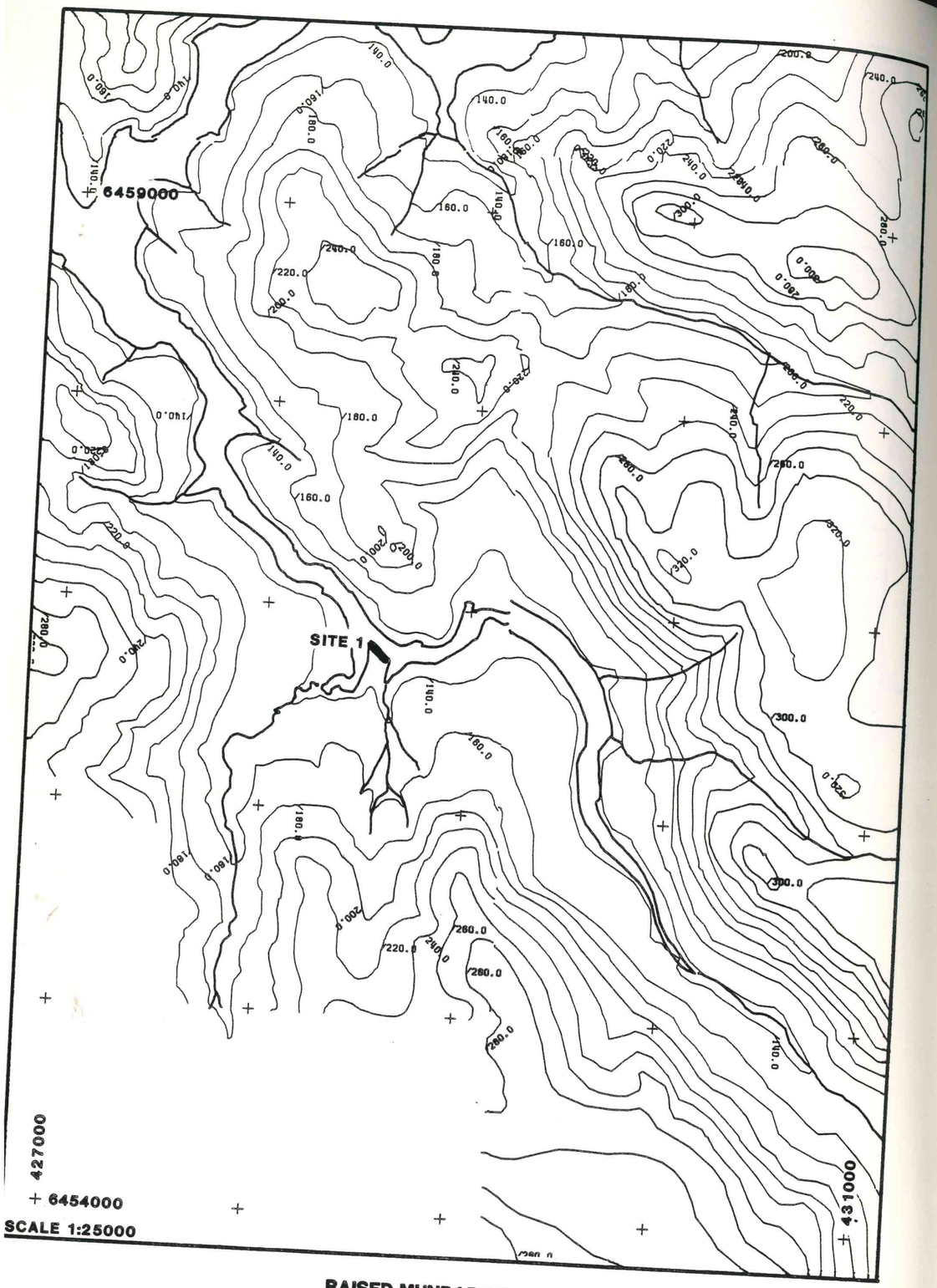


FIGURE 3B

Plate 1: View of Turtle Pool facing north.

Plate 2: View of cleared laterite slope at Site 2 (Canning); Turtle Pool in background.

Plate 3: View of Site 3 (Canning) looking west. Note soils and lichen in in depression of granite outcrop.

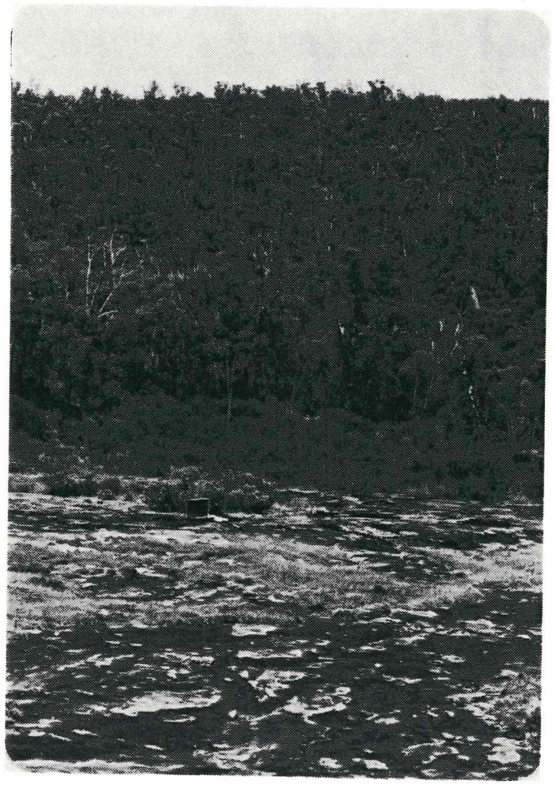


Plate 4: Granite slopes typical of survey block A (figure 1).

Plate 5: Graded track and bridge at which Site 1 occurs. View looks south.

Plate 6: Inundation zone at northern portion of Site 5 (Canning), looking north-east.

Plate 7: View of inundation zone from southern portion of Site 5 looking south east.

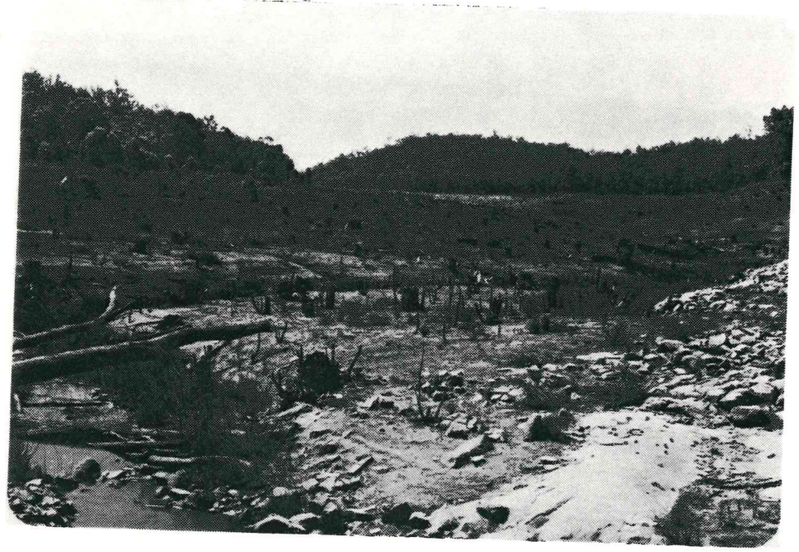


Plate 8: View of alluvial deposits and pools at Site 6, looking north.

Plate 9: Major pools around which Site 4 focusses.

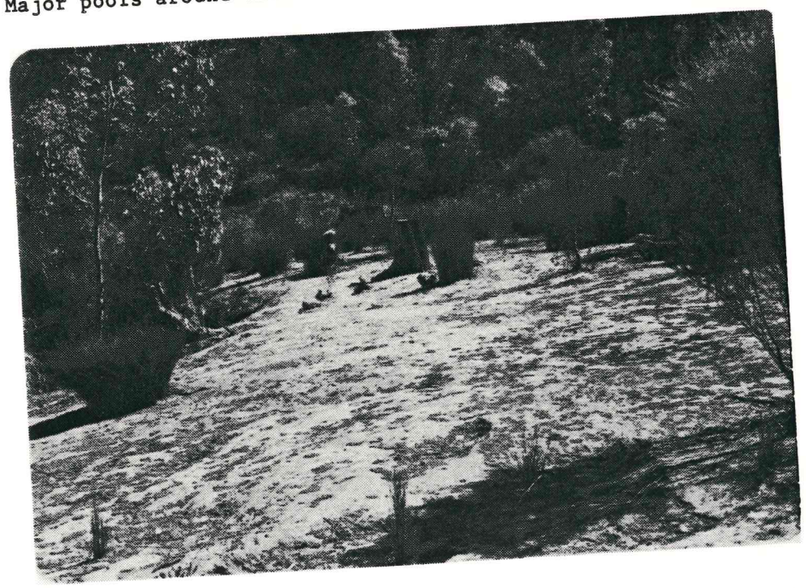


Plate 10: Deposits of alluvium on laterite slopes of creek shown in Plate 9. Dense forest growth above the f.s.l. in the background.