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Late Holocene Occupation of the Central Murrumbidgee Riverine Plain

August 1998

Jan Maria Klaver

A thesis submitted for the degree of Doctor of Philosophy in the Department of Archaeology and Anthropology of the Australian National University

For Robert and Margaret Klaver

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Abstract

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The archaeological record of southeastern Australia, from the Pleistocene to the mid-to-late Holocene, is seen to reflect a transition from dispersed Aboriginal land use patterns to those of increasingly populous, sedentary and socioeconomically complex hunter gatherers. This unilinear development model is nevertheless based on broad trends in rates of site formation and intensity of use, limited dating and functional analysis of spatially patterned evidence, and scarce data for the comparative complexities of the Pleistocene cultural environment. The present study reviews assumptions and evidence underlying this model, and contributes the results of a new large scale sample survey, and excavation program, in the Central Murrumbidgee Riverine Plain. The regional study enables a reformulation of the Holocene land use model, especially for riverine plains environments, and identifies avenues for further investigation.

A major weakness underlying the population-sedentism model is the inadequate understanding of the definition, formation processes, functions and dating of the 'mound' sites which are common in some southeastern Australian environments. These were therefore a special focus of the research. The vast majority of such sites in the study region were formed as a result of the operation of earth ovens. Multiple dates from individual oven mounds demonstrated the very long periods over which they were revisited and used. Such use highlights the caution required in interpreting their surficial groupings, and relationship to proximate artefact scatters and other sites, as contemporaneous settlement patterns. Their formation, even in large groupings, is argued to be well within the capability of a population of modest densities within a regime of seasonal or semi-sedentary usage.

The unilinear development model is also found to inadequately appreciate the degree to which Aboriginal peoples reorganised their regional land use pattern at different times within the Holocene. The major Pleistocene-Holocene environmental transition has been a moment of expected cultural change, whilst intra-Holocene change has been more readily interpreted as a result of a socioeconomic transition. Nevertheless, Holocene environments underwent punctuated localised change. These are important parameters in explaining the archaeological record. Such change was managed through complex and flexible subsistence patterns, and elaborate technology and socioeconomic organisation, which characterised the hunter gatherer societies of Aboriginal Australia from the mid Holocene to the 19th century. It is argued, for the Central Murrumbidgee Riverine Plain, that this process did not necessarily involve dramatic population increases, demographic pressures, or a substantial adoption of the strictures of sedentism.

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Chapter 1
Research Framework

1.1 The Identification of Change over time in Australian Hunter Gatherer Economies

On a global scale there has been increasing acknowledgment of the range of variation within past 'hunter gatherer' societies. This has been based upon changes in perceptions of their social and economic complexity, as well as the reduction in emphasis of evolutionary perspectives in the study of modern societies (Bettinger 1991; Binford 1983; Cohen 1977; Price and Brown 1985). In common with many parts of the world, early studies of hunter gatherer peoples in Australia characterised them as living representatives of relatively unchanged cultures. In some models (e.g. Birdsell 1953), their past was viewed more from the perspective of natural history rather social history. The vast chronological depth and regional variation in the archaeology of Aboriginal societies subsequently emerged through the excavation of stratified deposits and radiocarbon dating.

With the gradual addition of palaeoenvironmental, archaeological and biological studies, changes have been identified over time in subsistence, material culture, social organisation, settlement patterns, and demography throughout most Australian environments since Pleistocene times. Holocene change in dietary patterns commonly includes an increased focus upon lower levels in the food chain (Hayden 1981). This is reflected in the development of technology for mass capture of small animals that have a capacity for rapid seasonal regeneration, like possums, fish and shellfish, as well as an increased reliance upon plant foods which require proportionately more effort to exploit. The technology for elaborate processing of otherwise toxic or indigestible foods may also have become more widespread (Beaton 1982:56).

Widespread change in stone artefact traditions is also evident in many regional sequences (Hiscock 1986; Lourandos 1983; Morwood 1981; Mulvaney 1975). The development and increase in use of cemeteries as opposed to isolated individual burials (Pardoe 1995), studies of precontact health and demography (Webb 1984), as well as early ethnohistoric accounts (Lourandos 1980;1983:86; Williams 1987;1988) have been used to infer large Holocene population levels and increased social complexity in some Australian environments. In southeastern regions, increases in rates of site establishment and rates of deposition within stratified cultural deposits in rock shelters and middens, have been cited as evidence of increasing durations of site occupation and higher populations, as has the occupation of new areas (Lourandos 1980; but *cf.* Godfrey 1989). Particular site types, such as 'mounds', have been interpreted both as evidence of semi-sedentary

occupation and of technological innovation, enabling increased utilisation of marginal resource zones, particularly wetlands (Lourandos 1983:86).

The archaeological correlates of such demographic and socio-economic change thus include increased rates of deposition in sites (Attenbrow 1982; Hughes and Lampert 1982; Lourandos 1980), increased establishment of sites (Godfrey 1989; Ross 1981), development of sedentary occupation sites (Lourandos 1980; Williams 1988), occupation of 'marginal' environments (Lourandos 1976; Ross 1981; 1985), evidence of resource specialisation and adoption of new foodstuffs (Allen 1974; Lourandos 1983), technological change (Hiscock 1986; Morwood 1981; Lourandos 1976:80) and evidence of regionally distinct social, economic and artistic practices (McBryde 1979b; Morwood 1981; Pardoe 1988; Webb 1984).

Some aspects of change, particularly the presence of new types in stone artefact sequences, were initially attributed to factors including the diffusion of technology and the entry of new populations into the continent (Mulvaney 1961[1990]; 1962[1990]:56; Mulvaney and Joyce 1965). Elements of these factors have persisted (Morwood 1981) although they are now less emphasised in favour of regionalised internal developments, including population pressure. Whilst aspects of change have been identified within regional archaeological studies, their timing and characteristics display considerable regional variation. Cultural change has also been modelled according to a range of articulating or underlying processes, such as population growth, environmental change, and economic and social dynamics.

Some studies suggest there was a surge of late Holocene cultural change, considered to be set in motion at approximately 4000 BP (Lourandos 1983:86; Williams 1988). Other researchers recognise incipient evidence of change in the Pleistocene, citing its visible archaeological 'signature' by at least 7000 BP (Pardoe 1995:696; Taçon and Brockwell 1995:677). Others also consider Pleistocene cultural systems as dynamic, or potentially so, in light of the available evidence (Bird and Frankel 1991a, 1991b; Davidson 1989).

1.2 Modelling Change

In considering the archaeological evidence, particularly from southeastern Australia, several perspectives on change commonly emerge. These seek explanations within evolving regional social and environmental spheres.

Model of Sociodemographic Change

The model of sociodemographic change contends that Australian Aboriginal economy and society experienced a long period of Pleistocene stability, followed by mid-to-late Holocene change. Change, as characterised by increases in site establishment, deposition

rates and site complexity, the development of new technologies and utilisation of marginal environments, was taken to be indicative of increases in social and technological complexity and population growth (Lourandos 1976; 1983; 1985; Lourandos and Ross 1994; Webb 1984; Williams 1988). Regional variations in these characteristics were seen as the result of differing regional population levels, and social organisation, rather than the result of environmental transitions, since identified trends of change seemed to run contrary to established patterns of climatic amelioration.

Model of Localised Environmental Change

The model of localised environmental change posits that some change occurred, but largely as a cultural response to more localised environmental events, rather than solely as the result of increases in population or complexity of social behaviour (Bird and Frankel 1991a; 1991b; Frankel 1995; Head 1983). It has been argued that any perceived long period of Pleistocene cultural stability is more likely a result of the lesser knowledge of the Pleistocene, due in part to the differential preservation of very old archaeological materials and contexts. The identified period of mid-to-late Holocene change may also be seen as a product of the increased rate of survival of more recent archaeological materials. This model accepts that overall patterns of change could vary considerably in regional and chronological terms.

Model of Long Term Climatic Change

The model of long term climatic change model holds that the archaeological evidence interpreted as indicative of mid-to-late Holocene change represents a culmination of events beginning in the terminal Pleistocene, and that this major, earlier period of environmental change was in fact catalytic (Pardoe 1995; Taçon and Brockwell 1995). The overall trajectory of change is seen as very long and the 'dynamism' of Pleistocene cultures as potentially great .

Model of Population Growth

The population growth model focuses on the possible patterns of long term continental population growth occurring since the initial colonisation of Australia. It suggests that the expansion of the archaeological record, particularly from the mid-to-late Holocene, could be the outcome of normal conditions of demographic growth, and hence that there is no requirement to draw in other explanatory mechanisms such as social, climatic and economic change (Beaton 1983:96; 1985:17; 1990).

1.3 Change in Environments

On a continental scale, environmental change marking the beginning of the Holocene occurred approximately between 12,000 and 9000 BP, yet its impact upon Aboriginal societies is unclear. Major change in subsistence and settlement strategies, indicated by apparent increases in rates of site formation and occupation of previously little used environments (Beaton 1983; 1985; Lourandos 1983; Ross 1981), lag until the mid-to-late

Holocene, generally until around 4000 BP and with increased expression at about 3000 to 2000 BP.

The stabilisation of sea levels and increased availability of resources in coastal regions were not immediately accompanied by increased use of these areas (Beaton 1985). Instead, population growth appears to have lagged for a considerable period (Beaton 1985:5). In other regions there appear to have been more obvious correlations. At South Alligator River, in northern Australia, newly formed mid Holocene estuarine coastal morphologies appear to have been more promptly utilised by the regional population (Woodroffe *et al* 1988:102). Significantly, however, the earliest evidence of this estuarine utilisation was deeply buried within recently deposited mud. The impact of post depositional processes upon the character of the archaeological record within different regions is thus an important issue.

The fact that post-Pleistocene changes in the archaeological record occurred in varied environments, in different ways, and at different times, has provided indirect support to protagonists of social and population change models. The nature of more localised events of environmental change, and their relation to changing settlement patterns, are important matters for resolution in regional research.

1.4 Change in Settlement Patterns

The different models of cultural change have greatly stimulated Australian archaeological research, since the examination of their component arguments has required more detailed regional field research. It has expanded the conventional definitions and boundaries of hunter gatherer societies and increased focus upon the interaction of environmental, social and political phenomena. Certain issues, largely absent from early Australian archaeological syntheses, such as transitions to sedentism and development of complex social and economic systems, have become much more prominent. Whether some regional populations were undergoing transitions to more sedentary lifestyles, has emerged as a substantial research issue.

Fundamental to all of the preceding models concerning cultural change are the concepts of 'intensity of site usage' (Lourandos and Ross 1994:58) and increasing rates of overall site establishment. Analysis of rates of site establishment and deposit accumulation in Australian circumstances has largely relied upon interpretation of coastal midden sites and stratified shelter deposits. However the 'mound' is another site type, identified as part of the body of evidence for overall change, that also lends itself to this type of analysis. With exceptions (Coutts *et al* 1976; 1979; Berryman and Frankel 1984), previous studies of mounds have tended to rely greatly on assumptions of contemporaneity and function, so as to articulate such sites into social arrangements, such as villages (Williams 1984;

1985) or territorial units (Craib 1991), rather than analysing their rates of formation and potential functional variability.

Archaeological interpretation is typically complicated by uncertainty as to whether large sites or complexes of sites are the product of simultaneous formation by large groups, or continual, periodic, or episodic use by small groups, or all, or various combinations of the above.

> "Size, and a veritable arsenal of other archaeological measures and techniques have been proposed as criteria of sedentary occupation. I would suggest that although measures have proved fairly effective in judging the relative intensity of a site's use, a major difficulty remains in distinguishing between large sites made up of multiple short occupation events, and similarly-sized sites resulting from continuous occupation. ... Even though clear breaks in occupation can sometimes be discerned in archaeological deposits, it should be stressed that at present there is no definitive or clear-cut way to distinguish deposits resulting from sedentary occupations from those produced by continual, intermittent occupations." (Edwards 1989:15)

The explanation of processes underlying the development of sedentism have been a major focus of archaeological research throughout the world. Environmental or climatic change, population increase, social change and economic innovation are all factors which have been proposed as the catalyst for radical changes in settlement patterns (Bender 1978; Childe 1951; Cohen 1977). The development of criteria for the archaeological recognition of a populations' settlement mobility from the material record is also a major issue.

Kent (1991:37) developed a hierarchical typology based upon observed frequencies of residential shifts. People who resided in localities for less than three months were classified as 'nomadic'. 'Semi-sedentary' status was attributed to people who shifted residence every three to six months. 'Sedentary' occupation entailed occupations in excess of six months duration and a term of 'suprasedentary' or 'hypersedentary' was applied to populations who occupied a site continuously for generations. Variations were noted to occur within these classes, including some indisputably sedentary groups that moved settlements at ten to thirty year intervals Kent (1991:37).

The degree to which Aboriginal populations approached sedentism has been difficult to establish, and most studies have relied upon combinations of ethnohistoric and archaeological data (Hallam 1984; Lourandos 1980; Williams 1988). A detailed assessment of archaeological evidence interpreted as indicative of sedentism, and analysis of site formation processes, is required to evaluate the likelihood of such change.

1.5 Southeastern Australian Regional Perspectives

Southwestern Victoria

Lourandos (1983:92; 1997) concluded from his study in the south western districts of Victoria, that at contact Australian Aboriginal economies were populous, socially and technologically complex, semisedentary and positioned on the cusp of true sedentism but for the intrusion of Europeans in the 18th century. This area was further investigated by Williams (1988) and was thematically integrated with investigations of nearby regions (Ross 1981; Lourandos and Ross 1994). Williams (1988:222) also identified highly sedentary settlement patterns but went further to suggest a possible trajectory towards agriculture.

Lourandos' (1976:174) initial research on the Western Districts of Victoria set out to "...construct a model of Aboriginal subsistence and settlement, using both ethnographic and environmental evidence, and then to test certain aspects of it by archaeological investigation." He interpreted early ethnohistoric records and archaeological survey data as indicative of the presence of high population densities, large seasonal concentrations of people, semisedentary settlement patterns and the increasing use and development of water controls (1976:176). Such water controls, later termed 'energy harnessing techniques' (Lourandos 1980:245), included eel fisheries. These consisted of extensive networks of channels and drains, connecting and extending natural waterways, through which eels migrated. It was argued that they not only eased the capture of eels but also increased their range and hence their overall productivity.

Semi-sedentism or possible annual usage of sites was related by Lourandos (1976:178; 1983:88) to the seasonal abundance, reliability and ease of procurement of resources most commonly associated with such wetland environments. The archaeological correlates of these semi-permanent occupation sites were argued to include mounds. For instance, Lourandos (1976:180) noted that "As archaeological markers they (mounds) could serve as settlement units and be used in determining patterns of land usage." He also saw mounds as extending access to wetlands at times when they were 'marginal' due to limited access to their resources (1983:86-97).

Lourandos (1997:306) thus interpreted the mid-to-late Holocene as a time of increasing human territoriality, increasingly intensive intergroup relations and more 'logistical' settlement strategies (characterised by a pattern of increasing use and establishment of sites as well as the development of larger and more complex sites). He did not propose a "...unilinear or necessarily deterministic trajectory..." and accepted that "...a patchwork of patterns may have appeared in time and space." (1997:306). The evidence from south-western Victoria was presented as typical of the broader pattern:

> "In south-western Victoria the latter trend, of increasing establishment and use of archaeological sites, is evident especially during the last 2000 years, when marginal environments (wetlands, rainforests) are more intensively occupied, and new site forms (earth mounds as habitation sites) begin to appear in quantity in association with wetlands..." (Lourandos 1991:158).

His estimates of the precontact and contact Aboriginal population were based on the journal entries of G.A. Robinson, Protector of Aborigines, who was charged with the task of obtaining census information by the Governor of that part of the Colony in the early 1840s. He estimated that the contact population would have been in the vicinity of 8000 individuals within an area of 28,500 square kilometres. Explaining high population density became the focus of Lourandos' research and, while he allowed that the environmental richness of the region was contributory, he maintained that the development of the energy harnessing techniques and environmental controls, such as eel management, were fundamental and reflective of a more general cultural trend. Lourandos (1976:177) tended to discount the impact of environmental pressures on these populations, and considered that the considerable seasonal variation in resource types did not necessarily lead to resource shortages.

A problem with the semi-permanent or village occupation model is the imprecise consideration of the range of types and functional interpretation of mounded deposits indicated by archaeological and ethnohistorical studies. Mounds have been used as a discrete unit for the purposes of analysis, whilst the descriptions of oven mounds or *mirrnyong* heaps give them varying nuances of meaning. They are presented as the "Archaeological expression of ... semi-permanent basecamps" (Lourandos 1976:180), as "...artificial camping mounds ranging in sizes up to c.10m. in diameter and 2 m. high." (Lourandos 1980:250) and as "domestic earth mounds" (Lourandos 1991:153) or "...earth mounds in wetlands..." which are included in semi-sedentary base camps (Lourandos 1983:88). These have different connotations of formation and usage and give rise to potentially different meanings within settlement patterns. A more detailed analysis of the archaeology of mounds and their formation processes is warranted.

Mounds FM/1, Corra 3, Corra 2, Chatsworth 1 and MK/1, which had been recorded and excavated by the Victoria Archaeological Survey (VAS), emerge in a synthesis as 'aquatic adaptations' (Lourandos 1983:86). However, it is apparent from the original site descriptions that these mounds had different functions. FM/1, Corra 3, Corra 2 and Chatsworth 1 contain evidence of generalised occupation, whereas MK/1 is clearly an oven mound (Coutts *et al* 1976; 1979; Coutts and Witter 1977). None present evidence of an artificial, underlying, built-up platform. Small amounts of sediment accumulated in FM/1, Corra 3, Corra 2 and Chatsworth 1 are consistent with the collapse of substantial Aboriginal dwellings in the context of generalised occupation sites. The status of mounds

as technological adaptations to wetlands thus requires clarification on the basis of research into their formation processes.

Subsequent research by Williams (1988) identified a range of mound functions from ethnohistoric sources. Her excavations identified oven mounds, as well as other mounds whose formation processes were less clear, but which appeared to include the collapse of dwellings and general occupation. Dates obtained by Williams (1988:93-95) did not support the continuous intensive build up of mounded deposits, and considerable occupation hiatuses were evident within individual deposits. However, she still linked them with sedentary settlement patterns (Williams 1988:216).

The extrapolation of population density from Robinson's records across the Western Districts has been criticised for not taking into account the sub-regional environmental variation which may have influenced population levels differentially (Critchett 1990:75). Critchett (1990:71) also points out that there are great difficulties in accurately interpreting Robinson's own figures due to the many repetitions, omissions and inaccuracies in his notes. However, by tallying Robinson's records of named individuals, and making conservative estimates of areas omitted from his records, Critchett arrived at an estimate of about 3500 people present in 1841. Further, she calculated that the actual land area involved was more in the order of 44,538 square kilometres. Hence, population density was much lower than presumed, although there could still have been interregional variation dependent upon available resources (Critchett 1990:75). A further concern is whether the descriptions of the contact period settlement pattern and concomitant subsistence practices of the Western Districts may have reflected an environment already heavily influenced by European occupation (Clarke 1994).

Some critiques suggest that whilst culture change may not correlate with broad palaeoclimatic change, there are significant correlations between Holocene social change and localised climatic events (Frankel 1995; Head 1983). There are also likely to be inaccuracies in the identification of increases in rates of site establishment and formation (Bird and Frankel 1991b), particularly where inferences of continuous occupation are made when only basal dates have been obtained for the sites in question. The lack of comparable data for preceding periods is also a weakness underlying inferences of change.

Murray River

Studies of subsistence and settlement patterns along the Murray River Valley have presented suites of evidence, which are similarly interpreted to suggest high population levels and semi-sedentary lifestyles. Mound sites are also prolific in the region. Human biological studies and the analysis of burial practices from the Lower and Central Murray

regions, and wider Murray Darling Basin, have been interpreted to indicate of increased population densities and concomitant social change (Pardoe 1988; nd; Webb 1984). However, Pardoe (1995) is more inclined to view the patterns as products of longer term accretionary processes.

Detailed research from the Murray River and surrounding regions to the north of the Western Districts has also focused upon the role of mounds in settlement patterns (Berryman and Frankel 1984; Coutts *et al* 1979; Simmons 1980). These patterns were interpreted as possibly semi-sedentary (Coutts and Witter 1979:86), involving established seasonal schedules for exploitation of riverine resources. Attempts were made to relate mound site distribution patterns to synchronous and complex territorial patterns (Craib 1991), however these interpretations were based only upon surficial survey and remain inconclusive. Webb (1984:170) found evidence in skeletal remains characteristic of nutritional stress, which he suggested was likely to be the result of conditions experienced by a large and sedentary population.

Variations in mound site structure and sedimentology have been identified in the region, but the majority of site formation episodes are attributed to the operation of earth ovens within general encampments. Interesting correlations between oven mounds and topographic positions within riverine floodplains were also made, leading to the interpretation of certain sites as base camps (Coutts *et al* 1979). The possibility that mounded oven sediments were deliberately accumulated to facilitate exploitation of wet areas was also suggested (Coutts *et al* 1979:86). However, these interpretations generally contrast with the model including earthen platforms or domestic dwelling mounds proposed to explain sites in the Western Districts (Lourandos 1997).

Dating of mound deposits from the Murray Valley indicates their mid-to-late Holocene origin (Downey and Frankel 1992:35). However, this must be considered in light of their potentially young alluvial formation contexts, which effectively limit the ability to seek evidence of longer term change. The apparently 'late' appearance of surficial mound sites, in such circumstances, is to be expected.

Darling River Basin

Allen (1974) carried out comprehensive survey and ethnohistorical research in his investigations of late Holocene settlement and subsistence along the Darling River in western NSW. He developed a model involving semi-sedentary occupation patterns but found much lower overall population densities in comparison to the Murray River and Victorian regions. Groups subsisted in accord with the seasonal variations in riverine resource availability. They formed more permanent summer aggregations along the river, triggered by seasonal increases in stream flow. For the remainder of the year they

practised a dispersed mode of settlement, where groups split into smaller units and foraged more widely throughout the plains hinterland areas.

Subsistence strategies were focused upon grass seed staples and aquatic resources, and population levels were largely constrained by the overall aridity and uncertainty of their environment. Nevertheless, the analysis of Aboriginal subsistence practices showed evidence for change, to 'intensified' subsistence in the mid-to-late Holocene, with a special focus upon grass seeds (Allen 1974). The adoption of grass seed staples, identified by the presence of grinding stones, was initially interpreted as occurring at the terminal Pleistocene period (c.12 000 BP), when a major environmental change to more arid conditions could have required the diversification of the resource base (Allen 1974:315-6). Debate over the function of the earliest grindstones (Smith 1989) has led to a revised date, in the mid-to-late Holocene, for this subsistence change. Regional population increase was cited as a likely cause. The adoption of grass seed subsistence strategies on the Darling River falls neatly into the overall trend of change. However, despite the presence of similar floodplain environments, and occupations including semi-sedentary settlements, mounds have not been reported as part of the suite of occupation evidence.

1.6 Research Issues

Several avenues of research present opportunities for reviewing and improving the models of change. There is a need to explore the potential effects of smaller scale environmental change upon Holocene settlement and subsistence patterns. There is also a requirement for more detailed consideration of site formation processes and dating. A regional survey of archaeological evidence, and its correlation with localised environmental change, as well as excavations and dating to understand site formation, are essential to enable explanations of archaeological patterns in terms of demographic change, settlement reorganisation, or other socioeconomic parameters.

Postulated phenomena, such as 'increasing site establishment rates', and the development of 'new site types' in the late Holocene have tended to consolidate themselves. 'Mounds' tend to be presented as a significant unitary phenomenon with a tardy development in Aboriginal settlement history. It is yet to be ascertained to what extent they represent new technology, whether they are composites of smaller units of deposition, and how complex their use histories are. It is unclear to what extent they may represent a change in discard patterns, or whether they merit a special role as analytical units in spatial studies of settlement and land use.

The reuse of sites also poses a difficulty in interpreting features which might otherwise be considered as temporally discrete loci of group behaviour. Site reuse may be an important factor, underlying site size and morphology:

> "[site reuse] means that variability in the amount of space occupied by a site, a property normally recorded by archaeologists, would not be due to differences in the size or social organisation of the group who resided there, but would merely reflect the degree of repetitiveness in the way the landscape was used by the same mobile band." (Binford 1983:113).

Interpretations of Holocene settlement patterns may have been weakened by an insufficiently detailed understanding of the functions, formation processes and dating of mound sites. What mounds represent in terms of duration and density of occupation or population size, remains unclear. The significance of the appearance of mounds at a particular stage in the past, and their use as an indication of particular aspects of prehistoric change, is also uncertain. A poor understanding of site function leads to special problems in the study of prehistoric change because as Parsons (1972:142) observed "...we are often unable to tell whether a substantial change in number of sites from one period to another implies a significant change in population size, or a major change in settlement system or both."

The questions relating to mounds include their typology and function, formation rates, relationship to social and economic organisation, significance of spatial patterning, chronology of development, as well as their broad pattern of distribution in Australia. It remains to be determined whether variation within the class of mounded cultural deposits of the mid-to-late Holocene, is restricted to the difference of formation processes of occupation sites or oven sites. It also needs to be clarified whether the mounded sites of Western Victoria (Lourandos 1985; Williams 1988) are similar to those encountered in studies from the Murray River regions (Berryman and Frankel 1984; Coutts *et al* 1977).

These questions require further examination before it can be said that the appearance of mounds throughout regions of southeastern Australia represents the development of new technology, spurred by increasing regional population densities, to enable access to marginal resource zones, or represents increased or more sedentary use of sites.

1.7 Research Approach

The models of socioeconomic change have largely stemmed from previous research in southeastern Australia and it is appropriate that a proximate regional archaeological field study address them. A regional scale should reduce bias from sub-regional variation and enable recognition of larger scale patterns of behaviour. The selection of a relatively little studied field area enables a fresh perspective on the nature of the archaeological evidence

and simplifies analysis by reducing the quantity of secondary site information requiring interpretation.

This Central Murrumbidgee Riverine Plain contains a suite of archaeological evidence including mounds, and has a history of pronounced environmental change which would have had a considerable effect upon the distribution of resources within the landscape. It thus facilitates a detailed examination of the effect of environmental variation, and the effect of differential post depositional formation processes, upon the character of the archaeological record. It enables a more thorough understanding of mound site morphology and function, an understanding of their context within overall settlement evidence, as well as a reexamination of the chronologies of site establishment, formation and patterns of use. The data may additionally enable an archaeological examination of the major tenets of various models of culture change.

The archaeological recognition of a transition from mobile to sedentary settlement patterns requires an ability to identify and discriminate between residues left by people with high mobility and those left by longer term fixed occupations. Previous archaeological studies have combined the tenets of 'optimal foraging theory' and concepts of 'archaeological diversity' to make such distinctions. The assumptions are that it is environmental conditions which fundamentally permit peoples' settlement options, that they will 'maximise' the resources available to them, and that characteristics of settlement residues, such as settlement size, settlement diversity and material cultural diversity, differ as a direct result.

Elements of environmental determinism implicitly underwrite the forager/collector model since it assumes that it is people's response or adaptation to the environment, and the way in which available resources are distributed in space and time, that govern their overall occupation strategy. There is clearly great cultural, spatial and temporal variation in the concept of what is 'maximal' or optimal exploitation of an environment. However, it is necessary to understand potential environmental influences on occupation patterns in order to identify cultural parameters which are involved. Modelling and characterising environmental resources in terms of richness, spatial distribution, and seasonality, and comparatively examining evidence for a population's use of that environment, is an important step in this analysis.

In seeking clarification of some of the current issues through field analysis, against a background of ethnohistoric information, the proposed research is in many respects a middle range theoretical contribution (Binford 1980). Middle range theory is succinctly described by Bettinger (1991:62) as "...an enterprise devoted to the assigning of meaning to empirical observations about the archaeological record." As a means of approach to

questions concerning the role and influence of environmental factors in mid-to-late Holocene economies, it further contributes to optimal foraging theory (Bettinger 1991).

It is recognised as critical in this explanatory approach to take the processes directly influencing the formation of the archaeological record into account (Bettinger 1991:62). Further meaningful interpretation of the static archaeological record is often informed by understandings of historically documented or extant cultural systems, although the validity of any analogy between past and present societies is a complex matter. This is especially so when potential differences between ancient and recent hunter gatherers are key research issues. However, as a source of developing models for past activity patterns, the contribution of historical anthropological research is well acknowledged.

Optimal foraging theory assumes that hunter gatherers will 'maximise' their exploitation of a given environment, and that their subsistence and settlement patterns will be heavily influenced by the distribution, richness and reliability of resources. Such studies have developed a 'continuum' of settlement mobility which may be conveniently represented by a dichotomy between 'foragers' and 'collectors'. Where environments are characterised by an even and relatively reliable distribution of resources, hunter gatherers tend to adopt a 'forager' subsistence strategy, whereas when resources are patchy, or highly seasonally variable, a 'collecting' subsistence strategy may prevail (Binford 1980:10).

Foragers have high residential mobility and locate strategically with respect to the resources they are exploiting. Their pattern of annual movement across the landscape generally does not exhibit marked differences between seasons (Bettinger 1991:66). It generally involves short term 'residential bases' (Binford 1980) around which resources are exploited followed by relocation to a new 'patch' when resources are depleted. The exploitation sites formed by foragers contain evidence of short term activities, such as plant harvesting, processing of hunted foods and procurement of other materials such as stone, ochre and wood.

Forager residential base camps are predicted to contain broad suites of material culture, generated by processing, maintenance, manufacture and discard, although there would be general differences based upon the number of occupants and the length of time taken to exploit particular resource patches. Because foragers have a higher degree of residential mobility, it is more likely that the material they leave behind at sites reflects the activities specific to that location and its resources (Bettinger 1991:67). This pattern may be reinforced over time if people return to areas and repeat activities.

Collectors are characterised by low residential mobility (Binford 1980:10). Rather than moving camps from patch to patch, a collecting strategy moves resources from diverse patches and locales of seasonal abundance back to long-term base camps. Their strategies may include the more intensive and or bulk collection of staple resources and the formation of more permanent and centralised places for occupation. To cope with potential resource deficiencies, it is envisaged that some storage strategies will be practised. This may ultimately require the bulk processing of materials. Hence, it has been suggested that collectors will develop, and invest in, sophisticated technology in order to facilitate the capture of bulk resources. Such technological items or infra-structure (e.g. nets and fish traps) are typically labour intensive in their production and intensively curated by their owners. Periods of resource deficiency may also lead to task forces being dispersed to retrieve and process more remotely located resources.

Detailed analysis of mounds may assist the characterisation of Aboriginal settlement and subsistence strategies in terms of settlement mobility. A less sedentary settlement system could be predicted to result in oven or dwelling mounds which have built up intermittently in the short-term residential base locations which were repetitively occupied. Such repetitively visited camps would be expected in proximity to favoured resource zones.

Mounds associated with more sedentary collector base camps would be predicted to build up rapidly and continuously, to be located in areas which offer proximity to a range of resources, and to be associated with a diverse range of material culture, reflective of the processing of materials from spatially separated sources. House mounds, oven mounds within occupation sites or resource processing sites, and artificial mounds in swamps, could be part of such a settlement system.

A model which overlays resource patterns and archaeological patterns makes a series of assumptions, including:

1. that the environment experienced by prehistoric groups is able to be reconstructed;
2. that evidence of patterned exploitation of resources (resource scheduling) will be archaeologically visible;
3. that the material culture deposited within the archaeological record is sufficiently diverse in order to enable the detection of differences between sites, for example, that it will be possible to distinguish between longer term residential base camps, and shorter term or specialised processing or extraction sites; and
4. that function-specific activity is detectable, through the presence of particular patterns of evidence, artefacts or component types.

A characterisation of regional environment and palaeoenvironment in terms of resource distribution and seasonality is thus a prerequisite for the Central Murrumbidgee research.

Interpreting the material archaeological record to detect functionally diverse assemblages may not be straightforward. For example, technological specialisation and function specific artefacts may be rare or non existent. The presence of curated items of material culture may also complicate matters, insofar as items of material culture may be present at sites but have not been used at them. There may be important activities which do not leave an archaeological trace or which are inherently less detectable. Ethnohistoric and ethnographic accounts may assist the modelling contact period subsistence strategies, material culture functions and settlement patterns. However, their reflection back in time is problematic.

Dating and analysis of site formation processes are critical to this research to deal with the question of contemporaneity of sites and whether they pertain to the same system of settlement. Such control is needed to examine the evidence for change in Holocene settlement patterns, and to identify trends, such as increasing site formation rates and increasingly sedentary site usage. The relevant data are available through judicious site excavation programs, involving dating of sequential site usage, identification of site types or geomorphologies with particular chronological implications, and through field survey.

Formation processes also have implications for the internal integrity of sites, and any subsequent interpretations based upon the apparent diversity or complexity of their components. The reoccupation of site areas may blur their distinguishing features, involve the recycling or reuse of material culture, and lead to changes in site function over time. Criteria must therefore be devised for recognition of multiple deposition events, use patterns and post depositional processes, which affect the integrity of archaeological materials.

The Central Murrumbidgee Riverine Plain is considered to present a sufficiently large regional area in which to examine a prehistoric land use system in its cultural context. By setting up a broad environmental model, and examining the archaeological and historic record for past subsistence strategies, it aims to contribute to several interrelated themes of research:

1. The nature and function of the mound site within a larger matrix of evidence;
2. The role of regional environmental conditions in influencing late Holocene settlement patterns;
3. Identification of any changes to settlement patterns in the Murrumbidgee Riverine Plain within the mid-to-late Holocene time period;
4. The assessment of factors which may preclude the recognition of localised or longer term processes of change; and

5. A comparison of this region's late Holocene settlement pattern with some neighbouring parts of the Murray-Darling river system and the Central and Western Districts of Victoria.

The following chapter presents a detailed examination of the mound as a site type and reviews its occurrence in settlement systems throughout the world. It considers the range of prehistoric activity which gave rise to mounded residues. It establishes a typology of mounded sites within Australian situations, and criteria for their archaeological recognition. Previous interpretations of mounds in southeastern Australia are reconsidered. The status of mounds as settlement units is analysed, and the implications of their presence in regional archaeologies, in terms of settlement mobility and subsistence practices, are discussed.

Chapter 3 reviews available environmental data pertaining to the Central Murrumbidgee Riverine Plain in order to establish likely environmental conditions experienced by mid-to-late Holocene groups. Available information regarding Aboriginal material culture, subsistence practices and population levels, as reflected in historic records and existing archaeological studies, is also presented.

Chapter 4 discusses the field survey methodology, whilst Chapter 5 describes and analyses the excavation results. The interpretation of original and subsequent formation processes underlying mound formation in several sample study areas is presented. A sequence of radiocarbon dates from their deposits is presented. The implications of these dates for mound establishment and formation rates, and the contemporaneity of adjacent mounds, are identified.

Chapter 6 explores the intra-site and inter-site diversity of surface lithic sites recorded during the survey, with the aim of identifying subsistence strategies. It discusses the regional distribution of lithic materials and the formation processes affecting these sites. It outlines trends in the distribution and use of lithic raw materials, and interprets them in terms of the perceived patterns in their availability. The relationship of lithic materials with other occupation evidence, particularly mounds, is analysed with a view to identifying activity sets which are specific to occupation sites.

Chapter 7 discusses the scarred trees recorded during the field survey. It assesses their potential as a chronologically defined body of evidence, and presents a model for determining significance in activity patterns, based upon scar dimensions and morphology. The significance of their association with other occupation evidence is also examined.

Chapter 8 analyses the distribution and composition of archaeological sites in the region. It focuses upon the spatial distribution of evidence and its relation to microtopography and resource zones. It considers the differential impact of post depositional processes between major environmental categories and their potential impact upon the visible archaeological record. The spatial relationships between mounds are also examined, as is their relationship to other settlement evidence.

The final chapters present a model of settlement patterns, subsistence activities and population levels for the late Holocene period in the Central Murrumbidgee Riverine Plain. The results are then used to reflect upon current interpretations of change in late Holocene Aboriginal landuse and economy, and the interpretations of mounds, in comparable areas of the Murray-Darling basin and the central and western districts of Victoria.

"In utter desperation I cease to trouble myself about their origin, and call them 'inexplicable mounds'"
(Forshey in Foster 1873:121-122)

"Burnt mounds are, individually, among the most boring sites with which a field archaeologist must deal. Apart from a new date and a new spot on the distribution map, individual sites have little to contribute to our understanding of the past."
(Russell-White and Barber 1990:59)

Chapter 2
The Nature of Mounds

2.1 Introduction

Anthropogenic mounds are a salient archaeological feature of some Australian cultural landscapes. More than 1800 mounds have been recorded within the southeastern areas of Australia, the majority located in areas of poorly drained plains and riverine floodplains (e.g. Hiscock and Mitchell 1993; Klaver 1990). They comprise approximately 1% of all registered archaeological sites in New South Wales and 12% of registered sites in Victoria. Some 1500 mounds are recorded in Victoria alone. Mounds have also been recorded in the Northern Territory (Brockwell 1996; Peterson 1973). None have been recorded within South Australia, Western Australia, Tasmania or Queensland.

Twenty mound sites have been excavated in areas near the Murray River, in NSW and in the Central and Western regions of Victoria. Comparisons of the dimensions of a sample of 824 mound sites located within the Murray Basin, which included mounds from both Victoria and New South Wales, indicate that the modal diameter of mounds lies in the 11 to 20 m range (approximately 50 % of cases). Diameters of those recorded range up to 150 m, although the percentage of extremely large mounds is small, with only 6% exceeding 40 m in diameter (Klaver 1990:15).

Mounded sites, by virtue of their number and form, are visually suggestive of the intensive occupation of a landscape. However, there have been varying functional and behavioural interpretations of these archaeological sites. Many aspects of their functional interpretation have been based upon 19th century ethnohistoric and proto-archaeological accounts, although modern archaeological investigations have also made a substantial contribution. They have been interpreted variously as occupation residues on already elevated ground surfaces, general purpose camp sites, discard/refuse heaps associated

with campsites, ovens, artificial earth mounds, deliberately constructed hut foundations, garden locations and village sites. Mounded archaeological features have been included in a corpus of 'type sites' whose appearance and formation rates have figured prominently in syntheses of late Holocene settlement patterns in Southeastern Australia. Nevertheless their role in settlement patterns has been interpreted somewhat differently in different regions.

It has been suggested that there are significant differences between mound sites of the Western Districts of Victoria and those of other regions. Western District mounds have been postulated as resulting either from artificial earth construction underlying ovens or dwellings, the operation of ovens, or the long term use of domestic fires within dwellings, and the existence of mound clusters has been taken to infer contemporaneous grouped settlements (Williams 1985; 1988). Mounds from the Central Districts of Victoria, Murray River regions, and elsewhere have primarily been interpreted as a product of the use of ovens, in the context of general habitation camps. The observed differences in mound typology have served to differentiate these regions in overall syntheses of settlement patterns and social complexity, since the existence of mounds and mound clusters, ostensibly formed from the occupation of 'permanent' dwellings, implies differences in settlement sedentariness, population levels and social complexity. However the degree to which mounds from the Western Districts are, in fact, different, and why this may be so, are issues which require clarification.

This chapter reviews existing sources of information regarding mound sites from other parts of the world in order to establish the range of types of mounded cultural archaeological features which may occur within settlement patterns. It then reviews Australian ethnohistoric, ethnographic and archaeological studies in order to determine the range of types present. It develops criteria for their archaeological recognition and considers the ways in which these sites may elucidate subsistence activities and settlement patterns. Mounds from the Victorian and the Murray regions are then reconsidered in light of the potential typology. Unresolved issues and further avenues for this research are then identified.

2.2 World Perspectives on Mounds

2.2.1 Non-Cultural and Semi-cultural mounds

Mounds produced by soil processes, such as 'prairie mounds', 'pimple mounds', 'sand mounds' and 'prairie blisters' (O'Brien *et al* 1989; Rich 1934:576), often mimic cultural features and become objects of archaeological investigation (Foster 1873:121-22). Nevertheless, such natural features could be attractive for settlement or use, and be overlain by cultural materials. In the Mississippi valley in southeastern Missouri, for

instance, O'Brien *et al* (1989:83-92) found that prairie mounds formed prior to human use (c. 5000 to 3000 BP). They were later utilised as swamp islands to provide access to inundated areas for exploitation of aquatic animals and plants.

An early Spanish Colonial Report dated to 1767 also noted the usefulness of these natural mounds:

> "Extraordinary features of this plain are flat-topped mounds, from four to six varas* in diameter and from one to two in height, which nature has scattered about in great number making it passable. Rising above the surface of the water they serve as a resting-place for the people who often have to carry their goods on their shoulders because the beasts become worn out, or lack food. On these mounds they can keep their feet dry while packing the loads which otherwise would be almost impossible." (in Aten and Bollich 1981: 1376). [*one vara= 0.85 m]

Aten and Bollich (1981:1375-6) noted that the stratigraphy of these mounds indicated a natural origin, with later accretions of cultural deposits sandwiched between recent flood alluvium. Thus, mounds produced by soil processes may be generally distinguished through their spatial characteristics and investigation of their soil composition (Rich 1934:583).

Fallen and burnt trees encourage the formation of mounded features which may be confused with cultural deposits (Sullivan and Buchan 1980; Tongway, Ludwig and Whitford 1989). Lumps of clay adhering to burnt tree roots sometimes appear similar to baked clay used for heat retainers in oven mounds, but can generally be distinguished upon closer examination due to the presence of interstitial spaces, and lower density. Where trees growing in silica or sand rich soils have been struck by lightning, fulgurite (fused soil) is often present. This may also appear similar to some baked clays. Termites often later colonise dead trees and add quantities of sediment. Mounded termite nests burnt in bush fires may also mimic cultural features. Tree features ought to be distinguishable by soil property analysis and a lack of regular pit features, substantial ashy sediment and items of material culture, but they may require test excavation. Locationally such features would be restricted to areas which were wooded.

2.2.2 Anthropogenic Mounds and their Evidence in World Archaeology

Dwelling Mounds

Mounds interpreted as dwelling mounds are also common features in some southern regions of the USA. Cyrus Thomas (1894:198) reported on numerous mounds located in lands bordering the Mississippi River reaching into lower Arkansas. These regions were characterised as:

"...broad bottom lands interrupted in places by swamps, sloughs and wet prairies, through which, or separating which, are generally low broad swells or ridges (as they are called, though of but few feet in height) of rich sandy loam heavily timbered." (1894:198).

In 'bottom lands', the flat basal river valley areas subject to flooding, mounds were generally between 6 and 15 m in diameter and up to 1.2 m high. Several of Cyrus Thomas's accounts provide descriptions of their contents. In Butler County he observed that:

"... the uniform result [was] to find the main portion [of the mounds] composed of very hard clay with charcoal and ashes mixed in greater or less quantities and frequently, but not always, fragments of very rude pottery and rude stone scrapers or skinners." (Thomas 1894:194).

In Clay County he observed:

"The small circular mounds were composed chiefly of sandy soil similar to that of the surrounding surface, but the fire beds, burned clay, stone chips, and bones discovered in them render it evident that they had been used as dwelling sites ..." (1894:199)

Whilst Thomas demonstrated that the mounds had, at some points in time, functioned as occupation sites, his conclusions did not adequately resolve the issue of how these mounds formed. It is unclear whether there were dwellings positioned upon them, whether they were natural elevations, or whether they were artificially elevated constructions, which were later occupied.

Dwelling platforms are known in many flood prone areas. Moore and Gazco (1990) describe low constructed mounds associated with formative settlements along the Chiapas coast of Central America. Sigler-Eisenberg (1988) recorded the use of mounded shell living-site foundations amongst the Ais Indian settlements of East Central Florida. Powell (1894:XLVI-XLVII) observed dwellings constructed on low earthen mounds in the Mississippi River floodplain, although, the formation processes of the underlying mounds were not ascertained.

With regard to an overwhelming tendency for the Mississippian mounds to be located in flood prone areas, Thomas (1894:626) commented that it appeared as though they could have been built for the purpose of raising the dwellings of the inhabitants above the floods. He then quoted Garcilaso de la Vega as stating:

"...During similar inundations or risings in the great river, the Indians contrive to live on any high or lofty ground or hills, and if there are none they build them with their own hands ..."

It is apparent that Thomas based his explanation upon his, and other interpretations of the appearance of these mounds, rather than direct observation of their build up.

The development of dwelling platforms has been tied to decreased settlement mobility, detectable, and distinguished from simple ruined structure mounds through the positions and complexity of associated artefactual materials (Moore and Gazco 1990; Sigler-Eisenberg 1988).

Oven Mounds

With the exception of Clark and Barbetti (1982), there has been relatively little written about cooking technologies, the variety of hearths, ovens and fireplaces in Australian Aboriginal economies and their particular functional, social or other significance. There is a gross morphological distinction, between open-structure or hearth fires, and closed-structure or oven fires. Within these broad categories numerous other distinctions may be made such as size, use of heat retainers, type of heat retainers (stone, clay, earth clod, termite nest), positions of heat retainers and internal features (Clark and Barbetti 1982). Heat retainers, as the name suggests, store heat from their direct exposure to fire and then release it slowly over a long period of time if sealed and insulated within a pit. Further distinctions may be sought which may shed light on functional variations, materials that may have been processed and activities that might have been occurring concurrently.

The use of degradable heat retainer material, generally baked clay, earth clods, or ant bed in Australia, and the sealing of an earth oven with sediment, may account for the rapid build up of the mounded deposit, along with ash, charcoal and economic remains. Use of clay rather than stone heat retainers is generally restricted to landscapes devoid of suitable stone. The formation of mounded deposits may not be as rapid where stones are employed as heat retainers, although the use of lithologies that shatter profusely with temperature change will go on to form substantial deposits.

As Barfield (1991:111) noted, the classification of hearths is rendered difficult by such factors as their secondary or multiple use and the duration of their use. In many cases classification is made upon characteristics relating to the last use of the feature. This latter point is of particular relevance to the Australian evidence where oven mounds have been also interpreted on the basis of their usefulness as elevated camping places.

Earth or pit oven technology and mounded archaeological sites resulting from its use occur throughout parts of Europe and Great Britain, North America, South America, the Pacific Islands, Papua New Guinea and New Zealand. 'Burnt mounds' in the West Midlands of England generally consist of accumulations of over-fired quartzite cobbles and charcoal with occasional internal features such as hollows, stakeholes and pits (Hodder 1990:110). Groups of such mounds occurred in the meanders of small streams, and were spatially distinct from settlement sites. It was concluded, however,

that associated settlements were most likely situated on nearby elevated lands (Hodder 1990:111).

According to Barber (1990), Scottish burnt mounds, and a continuum of evidence from their use, occurred in several situations. Mounds isolated from settlement sites occurred throughout the landscape and were interpreted as hunting-station sites, indicative of exploitation of the 'wildscape' (Barber 1990:99) or perhaps the equivalent of medieval 'logistic' foraging. Groups of mounds were interpreted as the major form of midden deposit related to settlement sites.

A survey in southwestern Wales identified two types of burnt mounds. One type was found in association with other settlement debris, whilst the other appeared to represent

> " ... activity peripheral to the main settlement pattern, this being suggested by their occurrence on marginal land and by the lack of associated settlement evidence." (Williams 1990:137).

Investigations in Wales provided support for the explanation of burnt mounds as primarily cooking places, used from the early Bronze Age to historic times (Kelly 1990:123). Isolated mounds in Scotland were dated primarily to the Bronze Age, whilst sites associated with settlements were Medieval (Barber 1990). Radiocarbon dating indicated virtually contemporaneous usage of the West Midlands sites (Hodder 1990:110).

In a review of British evidence, Barfield (1991) argued that there were varied functions for burnt mounds. Whilst some contained food remains, such as bone, others were devoid of such remains. As the acidity of their deposit was not high, he suggested that the different remains reflected different purposes. A feature common to nearly all of the burnt mound sites was their proximity to water, and some were subject to inundation in wet periods. In such circumstances, alternative proposed uses, such as steam and sweat baths, were plausible (Barfield and Hodder 1987). On the other hand, Jeffery (1991:97) raised the possibility of the use of burnt mounds in the production and cleaning of early textiles. Activities, such as felting, fulling, dyeing and laundering, all required a combination of warm and cold water.

Further uses known for hot stone technology include heating, beer making, canoe making, food drying, fumigation, butter production, pottery firing, leather preparation, metal working, steam for birthing, grease rendering, salt production and steam for bending timbers (Barfield 1991:62). As Barber (1990:101) noted:

> "There is no reason not to assume that some burnt mounds were used for bathing, washing, saunas and sweathouses and a range of semi-industrial functions of which we have as yet little indication ...[however] ... That hot water has many uses and that steam extends the range of

possible uses even further should not obscure the rather obvious fact that cooking is likely to have been by far the most common use and the major source of burnt mound material.".

Other European mound sites share a tendency for location near water and are generally not found in association with other settlement evidence (Ramseyer 1991). Archaeological sites found throughout France demonstrate the use of earth ovens, varying in shape from round, square, and rectangular to trapezoidal. They ranged in length between 1.83 m and 11.3 m and in width between 1.3 m and 2 m with depths of between 0.3 m and 0.6 m (Ramseyer 1991). French oven sites occur in groups in open country with proximity to water and are spatially quite distinct from major settlements (Ramseyer 1991:88). That they are always found in groups, aligned and quite close to one another, was interpreted as indicating their contemporaneous usage (Ramseyer 1991:87).

Large mounded earth ovens also occur in Switzerland, Germany, Italy and Spain and are thought to represent some specialised use (Ramseyer 1991). In Switzerland, low mounds of carbonised wood, burnt earth and heat fractured stones and cobbles overlay approximately rectangular cooking pits ranging between 1.6 m and 3 m in length, and 0.75 m and 1.5 m in breadth and 0.2 m to 0.25 m in depth (Ramseyer 1991:71-77). Associated finds included bone fragments and pottery. Most of the Swiss sites returned Iron Age dates, ranging between 3290 BP and 2070 BP.

Homogeneous burnt mounds composed of fire-cracked rock, burnt black soil, charcoal and organic-rich soil, and ranging from 3 to 15 m in diameter and between 0.3 and 2.5 m in height, are recorded in Sweden. The average Swedish site measures 10 m by 10 m and is 0.7 m high (Larsson 1990:148). They rarely contain features such as pits (Steensberg 1980). These burnt mounds primarily date to the Bronze Age (Larsson 1990:142). Old Norse Icelandic accounts apparently recount the operation of cooking pits adjacent to cooking vessels filled with water heated by hot stones (*ibid*:204).

A Danish earth oven, excavated in the Medieval site of Store Valby (Steensberg 1980:202), comprised a roughly rectangular pit of approximately 0.20 m depth which was full of heat affected stones, charcoal and fragments of firewood as well as fragments of charred bone. Steensberg (1980:204) also excavated a settlement site which contained piles of fire cracked stones and piles of charcoal, suggestive of the operation of nearby earth ovens. It appeared that separate discard areas for the fire cracked stones and charcoal were created.

The burnt mound sites found in Europe are primarily composed of fire-cracked rocks, clay, sediment and food remains located directly in association with cooking pits

(Ramseyer 1991). Earth ovens were generally found to occur either within settlement structures, as part of a larger occupation area, or divorced from general settlement. Factors noted to influence their specific siting include proximity to resources and proximity to suitable heat retainers. Their appearance in the archaeological record is fairly circumscribed to the last three millennia before present. In many cases however, the specific causes underlying the appearance of burnt mounds were unable to be resolved. Researchers have queried whether the differences in Scandinavian mound sizes reflected differing population densities or differing durations of site usage (Larsson 1990:146).

Earth ovens and oven mounds feature in many early North American historic accounts. Along the Mississippi River, and in Obion County near Reelfoot Lake, Thomas (1894:257,279) recorded small low mounds composed of ashes, charcoal, food remains and artefacts. Regional archaeological surveys employed in analysis of Hohokam agriculture revealed low mounds formed by the continued operation of roasting pits. They were composed of ash and fire cracked rocks and associated with dense stone artefact assemblages (Fish *et al* 1990). A description of some of the finds is as follows:

> "... The largest excavated pit was 35 m in diameter and 1.5 m in depth. In this and similar instances, the term roasting area is probably more correct. Discrete pit shapes could not be easily distinguished among the intrusions and accretion of seasonal reuse over many years. Smaller, well-defined pits occurring almost exclusively at small fields were less than 3m in diameter." (*ibid*:207)

It is widely accepted that the Pacific Northwest Coast (USA) mound sites were accumulations of debris related to the use of earth oven cooking technology, using either dry heat, steam or boiling methods. Other activities which were postulated to result in the production of fire cracked rock include sweat lodges, heating of dwellings, decomposition of materials for pottery temper and the burning of structures in which stone was a construction material (Latas 1992:212). Although not specifically mentioned, the heating of lithic materials to alter flaking properties might also be considered.

In North America, Latas (1992:211) commented:

> "Fire-cracked rocks are probably the most common artifact in Pacific Northwest sites. In fact, many sites appear to be composed of four primary constituents: fire cracked rock, shell, bone, and lithic artifacts."

In the same region, earth ovens ethnographically identified with *camas* lily (*Camassia esculenta*) cooking were found to typically constitute circular basins with a low earthen rim, ranging from 0.5 to 3 metres in diameter (Latas 1992:213). The contents of these structures generally comprised fist-sized fractured rocks, chipped stone artefacts, milling

artefacts, ash, charcoal, carbon stained sediment, and food remains including bone, shell, seeds, nuts and roots. The degree of disarticulation of the fractured stone material suggested the multiple usage of the oven and concomitant mixing of the deposit (*ibid*:213).

A similar description of the archaeological investigation of an earth oven in British Columbia, dated on charcoal to 2250±150 BP (uncalibrated) is given by Campling (1991). Superficially the feature comprised a semi-circular rim and pit feature with associated surface scatters of stone artefacts. Excavation of the site revealed a deposit of fire cracked rock and charcoal rich soils which contained stone debitage and stone pestles. Ethnographic accounts from the region indicated the use of earth ovens with pits from 2 to 4 m in diameter and 0.5 to 1 m in depth (Campling 1991). The site was thus interpreted on the basis of ethnography as an earth oven.

Such sites were well recorded in early North American accounts, ranging from 2-4 m in diameter and 0.5 to 1.0 m in depth. They were used for the baking and steaming of starchy root plants. Campling (1991:95) concluded:

> "...earth ovens were a simple, effective, fundamental and enduring response to the problems of collecting and processing food. These structures formed a seasonal focus for group activities. Earth ovens helped with the scheduling of food procurement activities; food could be left to cook slowly, safe from animals while other food resources were obtained. Ovens extended the range of exploitable resources in habitats that were often marginal. Clearly, earth ovens and hot rock technology in general are a part of the cultural repertoire of humans, occurring in different periods, places and cultures to deal with different problems."

Earth oven mounds in North American archaeology share a tendency for location adjacent to water sources, but their archaeological expression varies between floodplain and other regions. In floodplain areas they are subject to inundation and often appear to be mounded earthen features. In such stone-poor areas, baked clay pellets, with formal stylised designs, were manufactured (and commonly retrieved from old ovens) for use as heat retainers. Archaeological investigation of sites in these regions tends to suggest broad spectrum exploitation of the surrounding environment. In upland regions stone is available and is carefully selected (often from old sites) for heat retainer use. The dominant use for these sites appears to be the specialised processing of particular food and fibre plants such as *camas* and *agave*, although minor components of other foodstuffs are also found. Some large mounds are thought to have been communally used.

The use of cooking mounds has been ethnographically observed and recorded from areas of South and Central America. In Mexico the baking of fibre-producing plant materials

is carried out in earth ovens. An indigenous ethnography of the Nahnu [Otomi] Indians of Hidalgo, Mexico, (Bernard 1989:322) describes such methods for processing various fibre producing plants. The baking of certain fibres was undertaken to reduce the toxicity of saps which would otherwise irritate the skin. Baking also appeared to produce a softer fibre, improving the quality of the final article (Bernard 1989). The ovens tended to be located near to water sources and locally available stones were used for heat retainers.

In Fiji earth ovens are a common currently employed technology. Their usual components include charcoal, soil, charred vegetation and burnt stones. Fires for heating the stones are often constructed adjacent to the actual cooking pit and the stones are transferred into it when hot (Aalbersberg 1990:156). The resulting debris from the use of the oven would include fire blackened and/or broken cobbles, a hearth and oven pit and a pile of ashy sediment (Hurl 1990:154). Ovens used in Alipe, Papua New Guinea, also involved the preheating of stones adjacent to the pit. The cooking pits themselves were small, averaging about 0.5 m in diameter and 0.2 m deep (Steensberg 1980:210).

Also in Papua New Guinea, Hurl (1990) noted that the incorporation of food remains into an earth oven site would depend upon the position of the oven in relation to the settlement or festivity. Often foods would be removed and consumed some distance away. Some of these ovens were large:

> "On certain occasions, such as marriages and semi-ritualised combats, they dig large cooking pits, up to 130m^2 and 0.3m deep, though smaller versions, c. 1m, are used on a daily basis. They build two fires, one in the pit, which they sometimes line with wood, and one beside the pit, both of which are used to heat stones. A layer of banana and kapiak leaves and ferns is laid across the hot stones in the pit and covered with vegetables, such as yam and taro, as well as greens. Hot stones from the neighbouring fire, wrapped in more leaves, form the next layer mixed with meat from butchered pigs and more greens. Finally the whole pit is covered again by leaves and sealed with a capping of earth, retaining the heat and steam generated by the stones in proximity to the vegetables and meat" (Hurl 1990:154).

The operation of an earth oven in Papua New Guinea is illustrated in Sillitoe (1983:Plate 13) and demonstrates a choice of elevated ground for the construction of a pit of some 2 m in diameter. A fire is laid in the base of the pit and piles of stones are accumulated beside the pit in readiness for heating. Steensberg (1980:201) described the use of an earth oven in Alipe:

> "In this case a pit was made, about 50 cm in diameter and 20 cm deep, lined with leaves of cordyline and wild fig. The sweet potatoes and taro tubers to be cooked were put in the pit and on these was placed a layer of hot stones. These had been heated on a fire at the edge of the pit ...

> The hot stones were covered with leaves of cordyline and some aromatic plant, pitpit was piled up above these and finally grass turfs were laid on top and pressed down to prevent the steam inside from escaping."

Earth ovens in dwellings in Papua New Guinea are often excavated adjacent to the domestic hearth to facilitate the preparation of preheated stones (Steensberg 1980:202). Earth ovens are also found inside women's dwellings in Irian Jaya, where part of the cooking process involves the addition of water to create steam (Steensberg 1980:204).

As noted by Leach (1982:151), in Polynesian households:

> "Apart from grilling of items such as fish, all cooking was done in the earth oven, a round shallow hole dug in the earth in the open end of the cooking house. It might be lined with stones to prevent the earth falling in. It was heated with red-hot stones pre-heated in a wood fire adjacent to or within the pit itself. The food was separated from the stones and also covered over by large leaves sewn together. Earth was placed over the leaves to seal in the food while it was cooking."

Old Samoan mounds, found in association with settlement sites and with specific resource locations, have been interpreted as the remains of ovens used for cooking the roots of the cabbage tree (Cox 1982:395). The size of the mounds varied and larger ones were interpreted as those used for the preparation of food for large gatherings of people.

The stone heat retainer system was also used in Hawaii:

> "The Hawaiian oven followed the basic Polynesian pattern with the stones heated in the pit and covered with leaves and sometimes also with grass. The food which was chiefly root crops and breadfruit, was packed in and covered with more leaves, and an outer layer of old mats and tapa cloth. In order to cook the meat thoroughly, a pig carcase cooked in the oven might also have red-hot stones placed inside the body cavity ... Broiling or grilling on hot coals was a method ... [used] ... when only small meals were being prepared or the family was working in gardens some distance from the settlement." (Leach 1982:152).

New Zealand earth ovens (*umu-ti*)were used for processing *Ti* (*Cordyline* spp, or cabbage tree). A long period of cooking is required to convert its various starch components to more palatable and digestible sugars. These oven pits vary in shape from round to oval and oblong and often have earthen berms. In size they range from 3 to 30 square metres (Fankhauser 1986). Their deposit comprises ash, charcoal, sediment, fired clay and fire cracked stones. Excavation often reveals a very mixed stratigraphy which Fankhauser (1986) interpreted as indicating their multiple reuse. Radiocarbon dates indicate a period of *umu-ti* use between AD 1227 and AD 1613 (Anderson 1985:27).

Many *umu-ti* sites are located in the southern island of New Zealand, most in the downlands of south Canterbury and north Otago, along the Otago coast and in western Southland (Anderson 1985:27). They occur in clusters of from two to seven and are always located adjacent to a water supply (Fankhauser 1987:150). Knight (1966:338) observed that the large ovens attributed to *ti* processing are more commonly found in isolation from other settlement structures, whereas multiple small ovens are generally found near settlements. *Umu ti* were generally located in proximity to the cabbage tree resource locations, although specific locational correlates also included proximity to water and to sources of heat retainer stones (Knight 1966:336).

In early periods of New Zealand prehistory, earth ovens were a common feature of archaeological sites associated with the intensive exploitation of the moa (Anderson 1985:12):

> "The most spectacular of these was at Waitaki Mouth where a site more than 70 hectares in area once existed. Investigations of this site, mainly between the 1920s and 1950s showed that it was not, as one might have supposed, a permanently settled village. The basic organisation seemed to have consisted of hundreds of ovens in groups of about two to five each. There was very little evidence of houses, of activities except moa butchery, or of the various kinds of tools and ornaments normally associated with village settlements (although adzes were unusually common). Waitaki Mouth seems to have been a place to which moa hunters came temporarily but frequently."

Dates obtained for large oven technology suggest that *ti* processing, in combination with fishing, became increasingly relied upon as these earlier game resources declined (Anderson 1985:27).

Ovens/Heat Retainers as Resources

The abundance of potential heat retainers as an attraction for the siting of earth ovens was noted in North America. According to Latas (1992:213):

> "... research also suggests that access to a nearby, abundant rock supply was a major constraint on the spatial distribution of camas ovens in Calispell Valley. In a field experiment, Thoms found that a 2.0 metre diameter oven required nearly 295 kg of rock and that gathering of this rock was labor intensive. Ethnographic descriptions indicate that intensive rock gathering was minimized wherever possible by using rocks from old ovens."

Fankhauser's (1987:150) *umu ti* research likewise found evidence of preferences for stones of particular sizes and lithologies, leading to the expense of labour in the transportation of stone from greywacke outcrops some 0.8 km from the oven site. Scottish sites also demonstrated the use of rock types which were deliberately chosen and for which selection might involve considerable effort. As Russell-White noted (1990:87), with regard to sites in the Outer Hebrides:

> "The greater part of the islands' bedrock is Lewisian Gneiss, which is reduced to a coarse granular mass by heating and quenching. Virtually 100% of the burnt stone comes from the less than 5% of the bedrock which is not Lewisian Gneiss."

Particularly hard lithologies, such as rhyolite, were found in 47% of Welsh burnt mounds, whereas less durable materials occurred in decreasing frequencies (Kelly 1990:117). In South-West Wales mounds were preferentially located in Old Red Sandstone or granite geological zones (Williams 1990:130).

In Sweden, Larsson (1990:142) also found a correlation between large accumulations of burnt mound material and particular geological formations. He hypothesised that, in areas where rock types occurred which were less resistant to heating and cooling (gneiss and gneiss-granite), there would be large accumulations of waste contributing to the mound formations. In areas where tougher rock types occurred, accumulations of fire cracked material would be slower and less obvious.

In North America, baked clay heat retainers were found in areas either devoid of stone, such as riverine floodplains (similar to Australia) or areas where the locally available rock fractured excessively with the application of heat. Many were highly formalised in manufacture, with distinctive markings (Ford and Webb 1956; Hunter 1975; Small 1966; Webb 1982). The making of identifiable marks upon heat retainers may have been a way of indicating personal or group use of such ovens.

Old ovens also permit the reuse of heat retainers as Hunter (1975:69) noted:

> " It is not out of the question to suggest that the Indians periodically gathered these artifacts from abandoned earth oven areas for re-use. Gathering would be much simpler than manufacturing objects, especially at the larger sites such as Poverty Point where abundant supplies were readily at hand. It seems only logical to postulate that these objects were used repeatedly, as logical as suggesting that the Indians re-used pots after each meal rather than discarding a serviceable vessel and manufacturing a similar article. The occurrence of whole objects in the midden can be attributed to loss and discard when an Aboriginal family relocated"

Dietary Implications of Oven Technology

The processing of materials with the application of heat is generally done for one or a combination of reasons (Farb and Armelagos 1980:51). Heat treatment results in substantial moisture loss which may facilitate longer-term storage. It can hasten the breaking-down of substances into their constituent parts, such as the separation of starch and fibre or unpalatable outer skins or husks. It can also result in beneficial chemical changes, such as breaking down cellulose and the conversion of starches to more digestible sugars (as in the case of *ti* processing in New Zealand). Heat may also improve the palatability of the product. Cooking can also assist in the destruction of

toxins, bacteria and parasites in foods, as well as rendering the proteins in meat and fish more digestible. Heat treatment of foodstuffs falls into the major categories of dry heat (roasting, parching), moist heat (boiling, steaming, simmering), and hot oil cooking (frying).

Earth ovens can be used for both dry baking or steaming. The loss of moisture in dry cooking results in a reduction of bulk, which means foods become more nutritious proportional to volume, whilst moist cooking also has benefits. As Stahl (1989:181-2) observed:

> "Moist heat appears to enhance digestibility to a greater extent than does dry heat. Cooking of starchy foods in the presence of a large volume of water permits swelling of the starch granules, increasing their solubility in the digestive tract ... [whereas] ... prolonged dry heat (12h) served to liberate starch from fibre better than did moist heat.".

Ovens offer nutritional advantages over alternative rapid cooking methods such as open hearths. Some plant foods require long periods of baking in a pit or oven structure before they can be efficiently digested by people. The carbohydrate content of many plants includes types of starches and sugars which are readily digestible as well as others which are not. Many of the latter convert to more readily digestible forms after lengthy exposure to enclosed moist heat. The carbohydrate content of roots or tubers exploited by many Native North American groups is largely composed of inulin (a form of fructan). The earth oven processing of the *camas* lily (Latas 1992) converted the inulin to fructose, a readily absorbable sugary substance. Wandsnider (1997:8) observed that this type of heat processing would yield up to a hundred percent increase in the energy otherwise obtainable by consuming these plant foods.

In Australia, the daisy yam (*Microseris scapigera*) also known as *muurnong* or *myrnong* contains substantial proportions of inulin and is one plant food recorded as a staple food intensively gathered by Aboriginal people and baked in pit or earth ovens (Dawson 1981[1881]; Gott 1982). Oven mounds were in fact called *myrnong* heaps by many early observers in the Western Districts of Victoria (Dawson 1981[1881]). It could be suggested that pit baking and the conversion of inulin to fructose was an Aboriginal technology which substantially increased the efficiency of exploitation of these plants.

The pit baking of other plants containing carbohydrate in the form of starch would have also had advantages. *Typha* sp is another plant food which appears to have been a staple component of the Aboriginal diet in some regions. The rhizomatous root contains valuable quantities of starch (up to 21%), protein (up to 3.5%) and sugars (up to 3%), although these will vary according to the stage of growth (McNaughton 1966:310-11). The maximum quantities will be stored in roots prior to the vegetative growth period,

particularly preceding flowering (Boyd and McGinty 1981:298). The energy advantages obtained by baking as opposed to boiling or steaming of starchy root materials, can be up to 30% (Bradbury *et al* 1988:340). In addition, the reduction of moisture bulk coupled with energy availability and digestibility make baked foods particularly suitable for young children (*ibid*:341).

Earth ovens are also ideal for the preparation of fibre. Used properly they do not subject materials to a naked flame, so the risk of charring is reduced. Ethnohistorical accounts in Australia note the use of the earth oven for the cooking of *typha* which was utilised as a food and a fibre source. According to these accounts, cooking enabled the farinaceous material to be shaken, beaten and/or chewed out from the pith, and the pith was stored for production of twine (Krefft 1866).

According to Stahl (1989), food processing technologies are often considered in ways which ignore the complex relationships between the ways foods are processed and their dietary quality. Food preparation itself is thus a potential avenue for 'intensification' of resource use.

> "It may be postulated, therefore, that the increased availability of nutrients in processed versions of otherwise fibrous foods offsets the costs of processing, and, further, that increased extraction of nutrients becomes more critical with increased specialisation on these high fibre resources. ...Elaboration of processing can provide an avenue for intensification of subsistence pursuits that is quite apart from the adoption of agricultural technology. ... the application of elaborate food-processing technologies to a wide range of wild species by both hunter-gatherers and plant cultivators may well represent intensification of subsistence efforts that took other than agrarian directions" (Stahl 1989:184).

Leach (1982:153) noted several advantages of earth oven technology, including the enabling of processing large quantities of plant foods that would otherwise require labour intensive manipulation in open fire situations, the ability to cater for very large gatherings, and the ability to cook particularly thick or tough foods for periods of up to 48 hours (1982:154). Campling (1991) interpreted pit-oven use in Northwest-coast American sites as the application of a specialised technology which enabled the exploitation of particular resources, like *camas* root, which would otherwise be of marginal dietary importance. Twelve hours of cooking, soaking and drying was employed for processing the otherwise poisonous fruit of the karaka (*Corynocarpus laevigatus*) in New Zealand, and for later eating they were softened by steaming in an oven (Leach 1982:153). Earth ovens may thus enable an expansion of potential plant food sources.

Earth ovens would offer little advantage for the processing of some plant foods. Leach (1982:155) observed that there would be insufficient steam generated to swell the grains of certain starchy cereals. Preparation of these foods may therefore entail additional stages, including, roasting, parching, grinding and drying, before recooking in a moistened caked form. Consequently, their pit baking may be less likely to occur.

The Social and Economic Interpretations of Ovens

A distinction has been suggested between the hearth and the earth oven, as a specialised site type intended to cater for large groups of people, perhaps in a festival or special occasion. Ramseyer (1991:88) made this point when he noted:

> "... in the regions where these ovens are found, it is more common to find the traditional circular hearth, dished or flat than the Earth Oven and that these were used by the same people ... The former type, being the simplest type of hearth, are for multipurpose use...".

Some authors attribute the use of Hohokam roasting complexes to communal use:

> "While such features show repetitive use, excavation produced little evidence of discrete, small firings. It appears that numbers of cultivators roasted their harvests together." (Fish *et al* :1990:211).

Such practices required a degree of organisation since the postulated use, of agave processing, requires certain pre harvest preparation of the plants. Noted benefits of communal production include the efficient usage of fuel and social security. Winterhalder (1990:78) described communal cooking as a social redistributive mechanism to minimise individual risk through the pooling of spatially separated harvests.

Archaeological Recognition of Oven Mounds

The use of an earth oven involves a sequence of activities which may include, the excavation of a pit, preparation of fires, preparation or collection of heat retainers, placement of foodstuffs, sealing of the pit, cooking, removal of foodstuffs, and raking out of the oven pit for reuse. The formation of an oven mound is the result of multiple repeats of such a sequence. Single or multiple oven pits may be placed within an oven mound and periods of reuse may entail the reuse of identical pits, or the digging of new ones. New pits may completely remove or truncate old pits or not disturb them at all. Each use of an oven pit results in an inversion of deposit as the oven contents are raked out.

Archaeologically, oven mounds have diverse morphologies and compositions. Some comprise homogenous deposits of mixed fire cracked rock, burnt sediment, charcoal and food remains. In others, features such as fire pits, stake holes and underlying stone lined pits are present. Scottish burnt mounds include isolated kidney shaped mounds

and clusters of amorphous-shaped mounds, as well as dedicated middens of burnt mound material and localised deposits of burnt material in combination with other settlement debris (Barber 1990).

Mounds formed by the continued operation of an earth oven could be archaeologically recognised by their inclusion of large quantities of heat retainers, quantities of charcoal and ashy sediment, food remains, discarded artefacts or artefacts related to food processing. Features such as oven pits might also be discernible, particularly at basal levels in less reworked and more compact deposits, and where cut into underlying strata.

Locationally, oven mounds could be predicted to occur in association with other settlement evidence and/or in relation to particular resources that might have been targeted by Aboriginal groups. Mounds produced by *in situ* earth ovens have a distinct archaeological expression and can be predicted to occur most visibly in areas where the use of baked clay heat retainers leads to rapid build up, where starchy plant foods are important, and where settlement patterns involve a level of sedentism, or repeated use of such facilities at resource foci or especially favoured camp sites.

Mounds and Ash Hills

The accumulation of occupation debris into mounded formations through the periodic clearance of ash from hearths is well documented in intrasite settlement studies from around the world (Kent 1984, 1987). Ash hills were characteristically located in areas less desirable for occupation or at the margins of a settlement, and often contained incidentally incorporated artefacts (Bartram *et al* 1991:97). Reasons for such disposal areas range from comfort to reduction of dangerously large fireplaces (Bartram *et al* 1991:97; O'Connell *et al* 1991:67).

The size of ash hills is often interpreted as a function of occupation duration, and the most intensively used areas often demonstrate the most orderly organisation of refuse areas and camping areas. Such spatial patterning is not observed to occur in short term occupation sites (Bartram *et al* 1991:118; Binford 1983:190). The exact position of many ethnographically observed dumps was also deliberately selected. In some cases multiple refuse middens accumulated in an occupation area and eventually necessitated the relocation of the camp. Successive occupations of a camping area were found to result in the partial overlap of old and new ash dumps (Bartram *et al* 1991:98).

In Sweden, refuse dumps are a common form of settlement 'residue' indicating food processing, but tend to lie some 10-30 m away from houses (Larsson 1990:144). Rather than representing the primary location of cooking pits, they were centralised locations for the discarded ash, soil and stones. This accounted for their mixed deposit and general

lack of stratigraphy (Larsson 1990:146). Other Scandinavian evidence also interprets burnt mounds as spatially separated loci of oven debris, which are found within larger site complexes.

The archaeological expression of ash hills or refuse mounds would be substantial deposits of ash, charcoal, clay or stone heat retainers (if heat retainers were employed), food remains and other mixed economic debris with little internal structure. Lenses, however, might be produced by individual cleaning events. It is conceivable that refuse might be sited upon abandoned oven locations, where substantial fired refuse might already have accumulated, on abandoned dwelling structures or on otherwise 'marginal' settlement space.

Deliberately Constructed Garden Beds

Other cultural mounds are formed by the construction of raised fields and garden mounds. This technology is a common adaptation to poor drainage and frost (Arnold and Prettol 1988:457; Denevan 1970:647; Denevan and Turner 1974:26; Eidt 1959; Waddel 1972). Such mounds are commonly composed of soil incorporating vegetable material (West 1959:281), sludge, grass and vegetable mulches (Pospisil 1963:124), sand, vegetable mulch and animal manure (Wilken 1969:226), uprooted vegetation (Sillitoe 1983) and burnt grass (Allen 1949:53-5). The secondary use of old house mounds and ant-hills for garden beds has also been recorded (Allen 1949:55; Sillitoe 1983:198). Raised beds are commonly used for root vegetables such as yams and manioc (Denevan 1966:122; Sillitoe 1983).

Raised earthen mounds attributed to garden construction were prolific in the Mississippi Valley. Veatch (1966:35), quoted the following description by De Nadaillac [1895]:

> "...Between Red River and the Wichita they (the Indian garden-beds) can be counted by thousands. ... they consider that these embankments were used for nothing but cultivation, and that they are intended to counteract the humidity of the soil, still the greatest obstacle with which the tillers of the soil of the plains of the Mississippi Valley have to contend."

The archaeological expression of garden mounds would consist of raised soil features present as individual mounds, clusters of mounds, methodically laid out fields of individual mounds or linear ridges (Denevan 1970:647; Sillitoe 1983:199-211) with evidence of burnt vegetation and high organic content. Raised garden mounds are well evidenced in a range of floodplain, hillside, swamp and grassland locations. Locationally they could be predicted to occur in a range of topographic situations where poor drainage otherwise impeded plant growth, such as riverine floodplains, poorly drained valley bottoms, seasonally inundated grasslands, swamps and marshlands.

2.3 Historic and Early Archaeological Investigations of Australian Mounds

There are numerous early ethnohistoric and ethnographic studies involving the characterisation of, and attribution of function to, mounded sites in Australia. The quality of historical records is notoriously variable. Some consist of first-hand observations by individuals with differing observational expertise, motivation and knowledge of indigenous cultures. Others are selective compilations of information from secondary sources, collected for varying purposes. Without detracting from the utility of such records, it is clear that there should not be an expectation of complete overlap between them and the range of evidence encountered archaeologically. A range of ethnohistoric descriptions of mounds from southeastern Australia is presented in Table 3.1.

The problems arising from the use of these types of information in reconstructing past lifestyles are commonly acknowledged:

> "The ethnographic [and ethnohistoric] record is a collection of texts varying immensely in the manner of observation and description. At one extreme we have the reports of early explorers, settlers and missionaries, often with imperialist and racist views self consciously imposed. At the other we have recent anthropological studies ... with paradigmatic or theoretical views subtly embedded in their text." (Mithen 1990:53)

2.3.1 Central and Western Districts of Victoria: Ethnohistory of Mounds

European settlement in this region was early and thorough, resulting in compilation of considerable historical records. Some were the result of direct, or well-provenanced indirect, and relatively benign observations of remaining indigenous groups (Dawson 1981[1881]). Others were compilations of information drawn from varied sources (Brough Smyth 1878 Vols.I:II; Chauncy 1878; Etheridge 1893). Some may be described as early 'archaeological' investigations, since they attempted to ascertain mound functions on the basis of excavated physical evidence (Dawson 1981 [1881]; MacPherson 1884; Soilleux 1891; Spencer 1918).

Two main types of occupation mounds are referred to in early accounts of these regions. Mounds attributed to ovens occur throughout both the Central and Western Districts. Mounds attributed to dwelling sites are also referred to, although their distribution appears focused within the Western Districts. A description of mounds provided by Chauncy in his correspondence with Brough Smyth (1878:Vol. II:232-3) is typical of the numerous observations made during this period:

> "These ash-heaps vary in size from ten to one hundred feet in diameter, and from a few inches to eight or ten feet in height, depending on their age, the frequency of their use, and the number of persons resorting to them."

Location	Number	Height	Size	Contents	Interpretation Comments	Reference	Account
Victoria							
Western Districts	numerous	1 to 5 feet	up to 65' in diameter	ashes, tiny stones, saucer shaped fireplaces, charred wood, earthy lenses, skeletons	Remains of permanent dwellings	Dawson 1981[1881]:10 3-4	Interviews with old Aboriginal people c. 1840-1870
Geelong, half a mile from bay	several			fragments of shell		MacPherson 1884:55	Physical Investigation
Mortlake District	one			Human skeleton under 3 stones	wood charred around body - cremation?	MacPherson 1884:56	Physical Investigation
Mortlake District	one	4 feet	long axis 60 feet	Human remains underneath a hard brick like cap, loose ashes beneath		MacPherson 1884:55	Physical Investigation
Mortlake, generally around lakes	numerous	10 feet max	up to 79 feet	Some have stones, others don't, all contain ash	Some mounds side by side. Had heard reports of some 100' in diameter but could only find ≤79'.	MacPherson 1884:53	Physical Investigation
South of Mortlake, a quarter mile sw of lake, sw of Shadwell	one	7 feet	large	Human remains, tomahawks, grindstones, stones,	human remains in upright sitting position	Soilleux 1891:41	Field observation
Half a mile south of South Shadwell			smaller	Human remains, small stones		Soilleux 1891:41	Field observation
Lake Connewarren	five (4 meas)	6-8' 5' 3' 2'	102x 90' 104x99' 96x84' 87x75'			Chauncy in Brough Smyth 1878Vol.II: 232-3	
Lake Purrumbete nr Camperdown	numbers			Five or six skeletons found in one mound		Chauncy in Brough Smyth 1878Vol.II:234	Field observation
Hopkins River	one		medium			Soilleux 1891:42	Field observation
near Hopkins River	one		small	Skulls and bones		Soilleux 1891:42	Field observation
Fresh Lake	six	largest 6 feet high	largest 39 feet, 1500 cubic feet	Two skeletons in one mound, ash, blackand red earth lenses,tomahawks, grindstones		Soilleux 1891:42	Field observation
Sth end of Fresh Lake	four			Skulls, bones, stones		Soilleux 1891:42	Field observation
Winnidad Creek, one mile from Fresh Lake	five		small			Soilleux 1891:42	Field observation
Hexham Pk Estate, Hopkins R and Salt Ck	many			Ash, human remains, small stones, layered deposit with thin red and yellow strata amidst dark ashy soil	oblong in shape due to wind action	Soilleux 1891:42	Field observation
Between Moorabool and Meredith				Coarse conglomerate red shale used for heat retainers	local stone available	MacPherson 1884:53	Physical Investigation
Meredith, within a 14 by 10 mile area	>40			remains of reptiles, fish, birds, mammals, shells		MacPherson 1884:55	Physical Investigation
Meredith District, generally along small creeks	numerous	1 - 2 feet	20 - 30 feet diam, 100-500 cubic feet	Oven pits, stones, charcoal, ash, some multiple ovens, others none visible	Oven pits average 6 feet diam. but range between 4 and 9 feet. Ovens located near ephemeral and permanent water sources. Small ovens intermingle and form large deposit, then used as mound with multiple oven pits.	MacPherson 1884:51	Physical Investigation
Meredith	two					MacPherson 1884:49	Physical Investigation
Moorabool				Silurian slaty shale	ued for heat retainers	MacPherson 1884:53	Physical Investigation

Table 2.1 Historic Accounts of Mound Usage in Southeastern Australia

Location	Number	Height	Size	Contents	Interpretation Comments	Reference	Account
Meredith, Native Hut Creek	one	1.5 feet	19.25 by 19.25 feet	Ash, stones, stone circle, oven pit	oven pit 6.5 feet in diameter, ashes extend beneath oven, shallow excavations surround mound	MacPherson 1884:53	Physical Investigation
Bruces Creek, near Lethbridge	numbers			Powdery black ashes		MacPherson 1884:49	Physical Investigation
Cowies Creek, on break of slope	one					MacPherson 1884:49	Physical Investigation
Near Meredith on bank of Woodbume Creek	numbers			Ashes		MacPherson 1884:50-51	Physical Investigation
Near Meredith on stony ground along Woodbume Ck	one					MacPherson 1884:50	Physical Investigation
Near Woodbume Lagoon	one					MacPherson 1884:50	Physical Investigation
Woodbume Station,near dam on Meredith to Cargerie Rd	one example			Upper layer contains stones, lower levels are ashy, stones are greasy and calcined		MacPherson 1884:52	Physical Investigation
Cargerie, near ephemerally filled depressions	one		9 x 5 feet	Large stones	Stones for steaming, water available nearby in wet weather	MacPherson 1884:49-51	Physical Investigation
Cargerie Creek				Volvanic lava	local source of oven stones	MacPherson 1884:53	Physical Investigation
Cargerie Ck, 150 yds from	one	1 foot	14 x 13 feet	Oven 5.5 feet diam, stone ring surrounding 18 feet diameter	oven comprised 60 fist sized stones	MacPherson 1884:54	Physical Investigation
Coolebarghurk Creek				Volcanic lava	local source of stone	MacPherson 1884:53	Physical Investigation
?	numerous			6 stone ovens in circle about 1 central oven		MacPherson 1884:54	Physical Investigation
Mortlake, Lake Webster	one	5 feet	79 feet diam	Stone, ash, charcoal, earth		MacPherson 1884:55	Physical Investigation
Lakes west of the Leigh River Plains	numerous		large	Peat used for fuel		MacPherson 1884:57	Physical Investigation
Edward River Moolpa Stn	several			ash, bones	cooking ovens	Pulteny Mein 1897 :letter to H.C Russell 21 Sept 1897.	Direct observation
River Plenty, Darebin Ck and Merri Ck	numerous	12 feet	40x100 feet average	Skeletal remains, basalt fragments, greenstone, tomahawks, ash, burnt clay, charcoal, burnt and unburnt bone	oval in shape	Spencer 1918:116	Field account
Victoria	numerous		≥20 feet diameter	Heaped stones, earth	used for roasting meat	Mathew 1889:396	probable observation
Victoria - interior	numerous, pr	12 feet	40 x 100 feet	Skeletal remains, stones, food remains	Found on river margins, creeks, lakes and lagoons	Chauncy in Brough Smyth 1878:Vol.II:232-3	Compiled account
Victoria	hundreds	5 feet	79 yards in circumfere nce	Human skeletons, ash, stones, burnt clay, mussel shell	Eight large mounds recorded around one lake, located near to water, some have trees growing in them, last in use 20 years ago	Bonwick 1870:19	Compiled account
Murray River							
Murray River-Koondrook	numerous, ten examined	≤ 5 feet	20 to 40 feet diam.	Loose soil, lumps of earth, human skeletons in 5 mounds, turkey bones	deposit built up on original ground surface	Spencer 1918:117-118	Field account
Moama to Wentworth	numerous			Calcined clay, ash, burnt earth	formed from build up of oven rakeout, clay pits often adjacent to mounds, mounds larger and more numerous on floodplains	Beveridge 1883:37	Direct observation of use

Table 2.1 Historic Accounts of Mound Usage in Southeastern Australia

Location	Number	Height	Size	Contents	Interpretation Comments	Reference	Account
Moama to Wentworth	one		3000 cubic yards	Human skeletons	smallpox epidemic graveyard	Beveridge 1883:39	Direct observation of use
Swan Hill -Nyah	numerous	≤ 5 feet		Human skeletons, water worn stones, mussel shell		Harris 1952:582	Field account
Benjeroop - Swan Hill	a great many			Aboriginal skeletons	ovens	French 1889:98	Field account
Swan Hill	many			bricks, earth, ashes	ovens	Tully 1897:84	Direct observation of use
Murray River	numerous		large	no stone, coarse baked clay balls instead		MacPherson 1884.53;57	Physical investigation
Lower Murray - Lake Boga to Moompa Lakes				clay pellets	oven pits using hot clay for steaming meat	Beveridge 1861:17	Direct observation
Southern Mallee	numerous			Ash, stone chips, clay, grindstones and mortars in vicinity		Hofmaier 1961:70	Field account
South Australia							
Northwest bend of Murray River - Morgan SA	numerous		oval up to 100 feet long	Soil, burnt clay, heaps of stones, tomahawks, stone chips, oven pits, ash, charcoal, bone awls		Etheridge 1893:22	Field account
Lower Nth South Aust				Oven pits, charcoal, ash	used for steaming cress and rushes, oven pits 3' deep and 3' diam.	Harris Browne 1897:72	Direct observation
Tasmania							
Tasmania, Port Phillip and Rockingham Bay				Earth, stones, charcoal, likened to those from Victoria		Bonwick 1870:19	Compiled account
Murrumbidgee and Lachlan Rivers							
Murrumbidgee and Lachlan Rivers	numerous		>20 feet diam	Oven pits - 15-20 feet diam and 3-4 feet deep	Used for steaming up to half a ton of typha, 3 days to cook	Mathew 1889:396	witnessed operation
Lachlan River	numerous					MacPherson 1884:57	Quoting Mitchell, explorer in region
General							
South eastern Australia	numerous			Debris and waste from cooking	formed from secondary accumulations of cooking ovens	Kenyon 1912:98-101	compiled account and observation

Table 2.1 Historic Accounts of Mound Usage in Southeastern Australia

James Dawson was initially resident in the Western Districts in the early 1840s, although his treatise on Aboriginal lifestyles was not compiled until some 30 years later, being published in 1881. Whilst his information is extremely detailed, and was obtained directly from Aboriginal people, he applied his own perspectives and some knowledge of Aboriginal languages to its interpretation. Critchett (1980) notes that Dawson took considerable pains to emphasise the strengths of Aboriginal cultural practices in comparison to European culture and was already observing an extremely disrupted version of 'traditional' lifestyles.

> "When possible he [Dawson] pointed to Aboriginal customs that were superior to those of white society..."(1980:intro I); and
>
> "He [Dawson] was an amateur ethnographer working at a time when the tribal culture of the Western District Aborigines was already 'a thing of shreds and patches'." (Critchett 1980:intro II).

Dawson (1981 [1881]) attributed mounds in the Western Districts to occupation mounds built up through continued operation of domestic camp fires.

> "Native mounds, so common all over the country ... were the sites of large, permanent habitations, which formed homes for many generations. The great size of some of them, and the vast accumulation of burnt earth, charcoal and ashes which is found in and around them, is accounted for by the long continuance of the domestic hearth, the decomposition of the building materials, and the debris arising from their frequent destruction by brush fires. They never were ovens ... " (Dawson 1981[1881]:103).

Dawson's account of mounds as relating to domestic fires within dwellings was based upon interviews with Aboriginal informants, some early archaeological investigations he carried out in mound sites, as well as information he compiled from other informants.

However, James Dawson arrived too late to actually witness the development of mound sites (Critchett 1990:60). He may have observed penultimate or final episodes of their use but his accounts are actually interpretations based upon his understanding of his informants and the information he obtained from excavations. Given his efforts to present Aboriginal culture in the most positive and acceptable light, amidst prevailing negative 19th century European social perceptions, it is conceivable that Dawson might have recognised and described these sites as evidence of permanent and organised settlements to demonstrate their level of 'civilisation'. Identifiable characteristics of civilised settlement, according to European tenets of the time, would have revolved around the presence of substantial houses and village layouts.

Dawson (1981[1881]:104) provided a detailed description of the stratigraphy evident in one excavated mound:

> "On opening a very perfect circular mound, sixty-five feet in diameter and five feet high, ... Layers of yellow ashes, mixed with small pieces of charred wood, alternated with the earth debris of the

> old dwellings; and the numerous saucer-shaped, ashy hollows in the strata of the mounds showed where the fires had been. No stones larger than a walnut were found; which is another proof that the fireplaces were never used as ovens. Several mounds, not more than a foot high ... showed the remains of only one fireplace. " (emphases mine).

Aboriginal dwellings recorded from the Western Districts included substantial earth and sod constructions and were considered 'permanent' by many early observers (Critchett 1990:59-61). However, interpretation of the word 'permanent' requires caution, since it could have been applied to describe the apparent solidity of the structure and not necessarily to the mode of its occupance. The decay of such huts could certainly contribute to mounded features, as previously noted by Bird and Frankel (1991a:187). Dawson's description of other mounds, not more than a foot high, with the remains of a single fireplace, could well relate to such features.

Soilleux (1891:41;42) described a mound, seven feet in depth, as containing ash and numerous small stones with a layered stratigraphy. Another mound, six feet deep, contained loose black earth, ashes and red earth. Others were noted to generally contain rich black earth, interspersed with thin yellow or red strata, and to have small stones throughout.

Small stones were present in common in these sites. It is not clear whether these could have been broken down stone or even baked clay heat retainers. It is also known that fired earth clods were used as heat retainers. Dawson also maintained that the use of ovens always necessitated the digging of an oven pit (1981[1881]:103). Contrary to this, Kenyon (1912:101) commented:

> "Not all the ovens, correctly so called, were excavations. For shell fish and smaller meats the hole was dispensed with: heated stones or clay balls were piled up in alternate layers ..."

Dawson's interpretative description could be accounted for by the repeated use of already elevated oven mound deposits for camping and hut construction. A letter written to Dawson by a European informant refers to an Aboriginal account of mounds as being:

> "... the remains of old mia-mias and the accumulations of ashes." (in Williams 1988:11)

Whilst such a statement could easily be taken to infer an underlying causal relationship between the huts and the ashes, it is equally possible that it refers to two formation processes, one involving the occupation of huts, the other a previous accumulation of ashy debris from the operation of ovens.

Kenyon (1912), who based his opinions on field examination of abandoned materials, disputed the *in situ* 'oven' function of some mounds and instead interpreted them as secondary accumulations of tidied waste or as hut platforms.

"The mounds of our aborigines are generally known as 'ovens' - 'blackfellows' ovens' - but they occur in many forms to which the term is not at all applicable. In fact, the majority of the old camping places called ovens are nothing of the sort; it may even be shrewdly conjectured that they are rudimentary foundations for huts or artificial hills to avoid floods and dampness."(Kenyon 1912:97)

"It is clear that these mounds are not ovens but the debris and waste material from cooking. They are only formed on wet or hard ground unsuitable for camps. At the main camps on sandy ground, no care is taken to heap up the waste material from cooking in circular mounds, it being scattered all over the place..." Kenyon (1912:101).

Heat retainers were a major component of the mounds recorded in early accounts, and their presence would indicate the use of ovens. In areas where stone was available they were invariably stone, whereas in stone-poor regions they consisted of hard baked clay pellets. There were various opinions regarding the reuse of heat retainers:

"When a company of natives returns after a day's hunting and foraging, the women take a fresh supply of firewood and stones. These last are sometimes found on the 'ovens' in localities remote from where any stones are known to exist. Thus, in the course of centuries, they become large mounds, affording comfortable camping-places as compared with the often wet and scrubby ground around. There they bake their opossums, kangaroos, lizards, fish, frogs, roots, and whatever else they may have taken during the day." (Chauncy in Brough Smyth 1878:Vol.II:232-3).

MacPherson (1884:51-52) studied mounded sites in the Central Districts of Victoria, and excavated some deposits to elucidate their formation. He differentiated between oven mounds, ovens and the patterns of mound accumulation. Whilst oven mounds consisted of large accumulations of oven debris, he drew attention to the fact that the actual 'parent' oven was much smaller, averaging 1.8 m in diameter (ranging from 1.2 to 2.7 m). The heat retainers employed in these ovens appear to have been stones. He noted that a large stone was often centred in the operational oven pit and interpreted it as a means of generating steam. He characterised these ovens as having 'regularity of formation', but also noted the coexistence of others that:

" ... present the appearance of a mere promiscuous collection of stones. These little heaps have sometimes been made so near each other that, in the course of time, the ashes of the different heaps have co-mingled and formed one irregular oven mound ...".

Descriptions of excavated ovens that employed stone heat retainers might also indicate the reuse of oven stones. MacPherson (1884:53) noted an absence of stones from lower levels of a mound. This might suggest their continual salvage and reuse, causing many larger or intact examples to remain at the operational level of the oven. MacPherson also described his 'archaeological' investigation of an oven mound. In the upper layers he found large stones, some overfired, amidst various ashy lenses. Beneath the oven

stones he recorded a uniform layer of ashes without stones which he attributed to a previous episode of use. In his attempt to dissect another mound, which contained human remains, he (1864:55) commented on the surface having attained a 'brick-like' consistency.

MacPherson (1884) considered it to be a natural necessity for mounds to be adjacent to water sources, since they were used for cooking, but noted that their sheer numbers meant that one could always be found in a suitable place ready for reuse. Overall he found:

> "That taking one locality with another, ovens are to be found in all positions between these two extremes - the lowest and highest points. They are found, as just shown, on the very brink of a creek, or a few yards from it, or in an angle, or on a gently rising slope, or on a steep brow with volcanic rocks cropping out close by, and on the flat ground or heights beyond ... [in] cases in which ovens are found at considerable distances from permanent water. They were used during the wet season, when water could be got readily in what are locally called crab-holes and in small depressions on the surface of the ground." (MacPherson 1884:50-51).

Whilst there are references to varied foods being processed in earth ovens in these districts, there are also references to specialised pit-baking of particular plants. Dawson (1981[1881:20-1) recorded that some root plants were baked over long periods:

> "Of roots and vegetables they have plenty. The muurang, which somewhat resembles a small parsnip, with a flower like a buttercup, grows chiefly on the open plains. It is much esteemed on account of its sweetness, and is dug up by the women with the muurang pole. The roots are washed and put into a rush basket made on purpose, and placed in the oven in the evening to be ready for next morning's breakfast. When several families live near each other and cook their roots together, sometimes the baskets form a pile three feet high."

Mounds were also used as places of interment. Soilleux (1891:43) commented that nearly every mound he knew of in the Hopkins River area, in central Victoria, contained human remains. Dawson (1981[1881]:103) also encountered burials in some mounds in the Western Districts, but added that they were only placed in abandoned sites. Many accounts regarded interment as largely a post-contact use of the mounds (Soilleux 1891; MacPherson 1884; Chauncy in Brough Smyth 1878; Spencer 1918; Bonwick 1870; Harris 1952). This would be consistent with the restriction of Aboriginal access to the burial places in their country caused by the extent of European settlement. The occurrence of epidemic diseases, substantially post contact events (Dowling 1990), are also suggested as a cause of hasty and uncharacteristic placement of burials (Massola 1966:132).

2.3.2 Murray River Regions: Ethnohistory of Mounds

Beveridge was resident in the lower Murray River district and his accounts were based upon direct observation of local Aboriginal populations. Beveridge (1883:37) attributed mound location to local availability of food resources:

> "Blackfellows' ovens are not by any means misnomers, as to all intents and purposes they are essentially genuine cooking-places, or cooking-places and kitchen middens combined, and the following is the manner of their formation:- A family, or perhaps several families, as the case may be, select a site for their camp, where abundances of game and other sources of food obtain and are procurable with the least expenditure of time and labour."

The Curr family was resident in the central to upper Murray region. Detailed published recollections are attributed to Edmund Curr (1886). The accounts state that mounds resulting from ovens comprised accumulations of ashes, stones or lumps of burnt clay and food debris. They also describe the variety of foods cooked in ovens as including kangaroo, emu, 'opossums', crabs (yabbies), yams and other roots (Curr 1886:675).

Substantial evidence from early accounts along the Murray River indicates that mounds formed from the *in situ* operation of earth ovens. Some ethnohistoric accounts mention subtle differences in cooking methods which may influence the finer details of mound formation. Tully (1897:85) described the excavation of a shallow hole and it being lined with clods of earth. A fire was then kindled and the clods heated. The fire was removed and food, surrounded and covered in reeds cut from the riverbank, was placed upon the heat retainers. Layers of dried grass were then placed over the food and it was then covered in earth. Tully (*ibid*) commented upon the 'cone-like shape' of the operational oven. When the sides had been sufficiently built up a stick was inserted into the top of the mound. More soil was then added around the stick until there was a layer of earth approximately 0.30 m thick overlying the food. The stick was then gently moved backwards and forwards before being withdrawn to create a hole down which water was poured. The hole was then sealed. This water created immense quantities of steam and after an hour or so the food was cooked.

The mounded formation of the ovens was attributed to the continual wearing out and replacement of heat retainers and addition of soil and ash, resulting from repeated usage. The process is quite similar to that recounted by MacPherson (1884) in the Western Districts of Victoria, except that he records the use of stone heat retainers. It is important to note that the decay of earth heat retainers could contribute a great deal to mound deposits without retaining an archaeologically recognisable form like baked clay or stone.

Beveridge (1883) observed that the plants processed within mounds were not utilised for food alone. The preparation of plant fibre was apparently one of the major functions of

ovens used by populations dwelling in riverine environs, although similar uses are not specifically documented for mounds in the Western Districts of Victoria. Soaking and slow steaming were necessary to extract the fibre from some of the tougher plant species:

> "Boongoor, a fibre rush, is another plant from which they procure flax. This plant grows at the bases of sandhills, but not so low down as to impinge on the flooded ground on which the sandhills usually abut, but still near enough thereto to receive the benefit of the water by capillary attraction. As it grows, this rush is a rigid harsh-looking plant, without the flexibility common to rushes which grow in moist situations.
>
> In preparing fibre from this plant, they cut it as close to the ground as is possible, so that the flax may be of a fairish length; it is soaked in water for two days. When the soaking has been properly effected, it is placed in an oven and baked for four hours - it is then in a fit condition for the next process, which is scraping. The scraping is done with the view of removing the husk and pithy matter; the instruments used in this operation are mussel shells. Whilst the scraping is in progress the rushes are continually being dipped into water, the softening properties of which aid materially in the proper cleansing of the flax. When it is quite finished it is laid on the grass to dry... " (Beveridge 1881:42-43).

This fibre was used to manufacture lines and nets for fishing, and nets for catching ducks. A coarser fibre was produced from the giant mallow (*Lavatera sp*?) to make nets for capturing larger terrestrial prey such as emu. The production process described was similar to that described for *boongoor* flax, with the exception that the fibrous stalks were pounded on stones before being scraped and washed (Beveridge 1883:42-4). Mitchell (1965 [1839]:II:80-81,134) observed mounds on river floodplains covered by reedbeds and suggested that they were associated with the processing of bulrushes (*balyan*), for food and fibre.

At the confluences of the Murray River, and of its tributaries, *Typha* was frequently mentioned as a plant extensively procured and processed by the Aboriginal population. Both the vegetative shoots and the rhizome were collected and consumed by riverine populations (Beveridge 1883; Krefft 1866; Mathew 1889). Mathew (1889) described its group-harvesting and bulk processing in large earth ovens, which, considering the quantities of plant material and water requirements, would suggest oven placement in proximity to these resources:

> "Along the marshy grounds of the Murrumbidgee and Lachlan Rivers a plant grows profusely which is locally known as 'combungie' or 'wangle'. The plants attain a height of seven or eight feet. They have a tap-root a foot or eighteen inches in length. These roots used to be pulled up and collected by the women of a small community. An excavation of circular outline was made in the ground, averaging three to four feet deep and fifteen to twenty feet across. Half a ton of roots might be gathered for a large oven and placed in the centre on a great pile of dry wood. On the surface were strewn layers of long grass and light sticks. Then the combustibles were kindled

and the excavated earth returned as a covering. The time required for cooking depended on the size of the oven, and might be several days. When the 'wangles' were thoroughly done, water was continuously baled on to the oven until the whole mass was cooled. It was then opened and the food came out almost as white as snow and not unlike parsnips or potatoes cooked." (1889:396).

Harris Browne (1897:72) provided detail on the use of earth ovens for steaming fibre plants as well as food preparation along the Murray River in South Australia:

"A circular hole was dug in the ground, two feet deep by three feet diameter, and into the bottom of the hole large pebbles were placed; a fire was kindled and kept burning until the stones were red hot. The embers were then taken out and sticks laid across the hole; on these a layer of reeds or damp grass was placed, and on them the cress in concentric layers, the root-ends to the outside; over the cress another layer of grass was laid and more grass around the outside of the heap. A "yam" stick was then thrust through the heap from the top, and when withdrawn water was poured down the hole thus made; this reaching the hot stones, came up in steam that permeated the whole heap, more water was added from time to time when necessary. In about an hour the cress was well cooked, and the oven ready for another fire as before.

Rushes were steamed in the same manner. They were kept warm in the heap, and taken two at a time by the women and chewed from end to end to break up the pith; they were then allowed to dry, when the pith was separated from the fibre by combing it with the fingers. The fibre was then rolled up in to twine, by the men, by twirling it with the hand on the naked thigh. The twine thus made was used for making nets for fishing and for catching emu and kangaroo; for the latter the twine was about the thickness of a "sash cord".

The chewing process was a very severe task for the women, and while young their splendid teeth were worn down to the gums."

A further function for ovens, analogous to the sauna interpretation in Europe, was recorded by Beveridge (1861:20):

"For pulmonary affections and rheumatism, they make use of the vapour baths. This they construct after the fashion of their ovens, and the patient is walled up much in the same manner as a joint about to be cooked. They receive great benefit from this system, but only make use of it in extreme cases, as it takes a great deal of trouble and toil to prepare it."

Beveridge (1883:31) later provided an account of the operation of such a facility. A pit large enough to contain a person, and about 18 inches (0.45 m) deep was first excavated. A fire was then lit within the pit, burnt down and the ashes scraped out. The pit was then filled with damp native pine needles and the patient placed inside. The steam and vapours were sealed in with possum-skin cloaks and earth.

Various secondary functions are noted for mound deposits. As in the Western Districts, burials were sometimes placed in disused oven mounds (Curr 1886:676). Larger

mounds also provided an elevated camping place during wet periods, Curr (1886:676) recounted:

> "In other districts, however, when the ground was wet, the Blacks used sometimes to camp as well as cook on their ovens or ash-heaps."

Beveridge (1883:39) noted that, at least in the lower Murray/Murrumbidgee River area where he was resident, the oven mounds commenced as specific function sites, that is as ovens for cooking, and became multipurpose sites once they had reached a size sufficient to remain above flood level:

> "As a general rule, the aborigines do not erect their loondthals (huts) on those cooking mounds; an exception to this exists however, on the extensive reedy plains of the lower rivers, which are annually inundated, remaining so for at least five months in the year.
>
> On these wide-spreading reed-beds blackfellows' ovens are much larger in size and vastly more numerous than they are in any other portion of the Colony...
>
> These oven islands the Aborigines utilise in the flood season, for camp sites, conveying their firewood and other requirements over miles of water in their canoes. An encampment will frequently remain on one of these tiny islands for a whole month."

Curr (1965 [1883]:108) also attributed the build up of large mounds to the use of small ovens over long periods of time. According to Curr (1886), oven pits were excavated directly into the existing mounded deposit, and any clay heat retainers found would be reemployed. If none were uncovered, fresh clods would be excavated nearby. He noted that, in his time of residence (ca.1840 - 1880s), mounds were rarely found in groups, except in favoured camping places, and he had never observed adjacent ovens in use. However, such observations might be the result of disturbed settlement patterns and diminished population densities following European settlement.

Beveridge (1883:38) similarly supposed that entire mounds built up gradually, although individual occupation periods might substantially add to the deposit:

> "When the cooking has been completed, the covering is scraped off, and this debris, consisting of calcined clay, ashes, and burnt earth, becomes the nucleus of a blackfellow's oven, such as are to be seen at the present day. This process being repeated at short intervals, over a series of years, perhaps indeed for centuries, results in the mounds which are in reality blacks' ovens.
>
> As long as the camp remains in the same position the original hole is used for baking; and when it is understood that at least a barrowful of fresh clay is required every time the oven is heated, to replace the unavoidable waste by crumbling, which is by no means inconsiderable, in consequence of the clay being used in an unwrought state, it will readily be seen how these mounds gradually but surely increase; bones too of the animals they use as food, charcoal & etc, tend materially to hasten this growth."

The accounts by Krefft (1866:361) of group-'harvesting' of *Typha* and the communal processing of the baked roots around a single large oven suggest the likelihood of such activity being logistically located near to the resource's origin. Beveridge's (1883) generalised account also refers to the communal cooking of the day's 'catch' in a single oven. These ovens were small, however, with the pits generally measuring just over a metre in diameter. Both accounts also note that the processed materials were gathered and returned to the general camp location. Curr (1886:676) also commented that foodstuffs were not always consumed in the vicinity of the oven, but might be removed to a general camp up to 180 m distant.

Beveridge (1883:37) attributed the use of certain earth ovens to the communal processing of the general range of food resources found in the local environment, and provided detail on possum cooking:

> "Towards the middle of the afternoon the hunters drop into camp, with the result of the day's industry, consisting in all probability of all sorts and sizes; for my present purpose however I shall consider the game to consist of opossums only.
>
> When the hunters have seated themselves comfortably, they set to work at once skinning the opossums whilst several of the lyoors (women) go off with their yam-sticks; when they reach the spot selected for the purpose, they begin with a will to excavate a hole, about 3 feet in diameter and nearly 2 feet deep; during the digging of the hole any pieces of the clay which they chip out, in size similar to ordinary road metal, are placed carefully on one side with a view to their future use.
>
> When the hole has been dug sufficiently deep, it is swept or brushed out with some boughs or a bunch of grass; it is then filled to the top or a little above it with firewood, which the lyoors had previously collected and prepared for that purpose. On the top of the firewood the selected pieces of clay are carefully placed, the wood is then ignited, and by the time it is all burned the clay nodules have become baked until they are exactly similar to irregular sections of well burnt brick; of course they are red hot. When this result has been properly achieved, the hot clay is removed from the hole; for this purpose they use two pieces of stick about 8 inches long, holding them both in one hand and working them deftly, even as a cookmaid uses a pair of tongs. .....
>
> After the hot clay is removed from the hole the ashes are carefully swept out, and a thinnish layer of slightly moistened grass is placed over the bottom and round the sides, upon which the prepared opossums are nicely packed and covered over with more damp grass; the hot clay nodules are them spread evenly over the top of the grass, and over these the finer earth which originally came out of the excavation is spread.
>
> Should this final covering be too thin to keep in the steam, it is supplemented by earth dug in immediate proximity (this supplemented soil fully accounts for the depressions always found about the bases of these ovens; ashes are never employed for the outside covering, nor is sand, because being so fine they would be apt to percolate through the interstices of both grass and clay nodules, thereby adding an amount of grit, which would not improve either the flavour or

appearance of the food. Before the heat in the clay nodules and the hole itself has become exhausted the opossums are beautifully cooked."

2.3.3 Northern Australia: Ethnography

There is considerable diversity in the composition of cultural mounds in northern Australia. In some cases the processes resulting in the formation of mounded deposits from the operation of earth ovens have been ethnographically observed. These accounts suggest the 'logistic' location of oven mounds close to exploited resource zones and the use of the sites by small specialised groups such as hunting parties (Peterson 1973). Earthen mounds in Arnhem Land are typically less than 12 m in diameter and less than 1.2 m in height (Peterson 1973:175). They are located around swamp margins and along stream channels, in clusters of from two to twenty (*ibid*:176).

As in southern Australia, the mounds were formed primarily from the operation of earth ovens and later became useful in their provision of elevated camping grounds for contemporary Aboriginal people during the wet season (Brockwell 1996:55; Cribb 1991; Peterson 1973:177;186). Nodules of termite nest were commonly used for heat retainers. Peterson (1973:179) observed a cultural preference for nests of particular species which produced more durable ant-bed, although those of other less favoured species, such as *Amitermes meridionalis*, were commonly employed due to their prevalence in the landscape. Peterson observed that the use of the less durable ant-bed would result in a far more rapid build up of mounded oven material.

Camping over oven mounds would produce a site structure comprising an underlying layer of compacted oven waste material with an overlying stratum of mixed cultural remains which may contain dwelling post holes, levelled areas or other remains, artefacts, ovens, ash and charcoal. Stone artefacts would be more likely to be heat affected in repeatedly used oven mounds, than in overlying occupation strata. Use in this fashion should be determinable by excavation and sedimentological analysis.

In northern Australia Peterson (1973:179) also noted the use of natural mounds, whose foundations related to termite activity, for Aboriginal campsites:

> "The large cathedral mounds of *Nasutitermes tridiae* are not used in cooking, mainly it appears because they are a considerable effort to break up. However, they were probably the genesis of some mounds since when they decay they leave behind a hard raised area 1 ft. [0.30 m] or so above the surrounding ground. One such area was seen in the Nukukadambal cluster ... Even a slight elevation provided freedom from dampness several weeks before the surrounding ground dries out. This advantage would have been quickly noted by men out spear-fishing in the swamp wanting a place to cook their catch close by. They could have destroyed standing cathedral mounds to form the base of a house mound."

Some oven mounds and dwelling mounds in northern Australia were found to be based upon a thick deposit of deliberately assembled 'packed earth'.

> "The mounds represent a deliberate construction later added to by the making of ovens. Generally it seems a hut occupied the whole of a mound. During the daytime people would make a shade on an adjacent mound and cook the day's catch there. Cooking is carried out in termite bed ovens. ... Each area where the mounds are located is one where it is desirable to camp when the streams on the plateau have stopped running but where the ground is either flooded or remains muddy and damp under foot for several months. By the height of the dry season all the clusters of mounds are high and dry with no water close by. ... ...the people recognise the mounds as isolated patches that remain dry in areas that flood ...They do not recognize them as being made by man, assuming them to be natural in this area." Peterson (1973:177,186).

Another type of combined natural-cultural mound, differentiated by its composition of shell, but not considered wholly as a shell midden, is typically found on flood prone salt flats between mangrove and woodland areas (Peterson 1973). Such mounds are of similar dimensions to the earthen mounds found elsewhere in Northern Australia. These were used as the closest dry short term camps enabling the targeting of shellfish resources on tidal mud flats.

In the ethnographic present, in the Northern Territory, Walters (1988:216) has noted a process similar to the formation of ash hills documented in other parts of the world.

> "People at Utopia would, from time to time, use a shovel to fill a flour drum with the ashy contents of their home hearths and dump these at the perimeter of their living area. In this way a cluster of ash dumps would accumulate. Over time and with deflation these would come to look like old hearths. This effect would no doubt be accentuated in situations where these ash dumps were covered with sediment. Cleaning out would leave the original hearth site as a hollow in the ground which would then be filled with kindling and the hearth reconstituted in a pit-like situation. At Utopia, hearths were mobile, but those in use for periods as short as a few weeks needed cleaning of the ash which clogged good fire production. The ash dumps produced by this cleaning may have been mistaken for hearths."

2.3.4 Archaeology of Ethnohistoric and Ethnographic Mounds

The ethnohistoric accounts suggest that most cultural mounds of southeastern Australia are basically attributable to the operation of earth ovens. However there are considerable variations in formation processes indicated. Some mounds formed from the *in situ* and repeated use of an earth or pit oven. These ovens were used for either cooking combinations of foods, amounts of a single type of food, as well as for cooking plants in a stage of plant fibre processing. Ovens employed dry heat or steam, when water was added to the cooking process. The basic unit of addition to the site was thus the burnt

remains of ash, soil, crumbled heat retainer and perhaps oven linings and food remains from the operation of successive oven pits.

Other accounts also suggest that mounds were indirectly attributable to earth ovens insofar as the waste ash, soil and clay was removed from the oven and deposited into nearby ash hills. The oven pit remained in use but without its directly associated matrix. Within this category there were suggestions that, whilst some accumulations were randomly positioned clean-out piles, others were deliberately positioned so as to be useful for camping on at a later date. In this case, there were also mounds whose primary function was to elevate camp sites. Mounds were considered by some sources to have accumulated as a result of the proximity of multiple small pit ovens. Other sources attribute them not to cooking ovens but to individual domestic camp fires contained within shelters or huts of long term use. Many of these accounts are basically interpretations, which draw on compilations of evidence including field observation. However, they still provide a useful array of features which may be sought archaeologically.

Archaeologically there should be distinguishable qualities between these sub categories. Mounds formed by the *in situ* repeated use of an earth oven would be characterised by their composition of ash, sediment, crumbled baked clay, or stone, and perhaps food remains. Structurally, they should contain a foundation oven pit. There should also be an archaeologically detectable stratigraphic build up of the site matrix, with some evidence for inversion and disturbance as the oven pits were redug. In section, old complete or partial pits should be evident. The larger and useful heat retainers might be concentrated in the upper levels in association with the final used oven pit.

Mounds formed by the continued operation of an earth oven within a general occupation context would be predicted to occur in association with other related evidence, such as campfires, structural features, stone artefacts, food remains and evidence of local subsistence activities. Mounds formed by the continued operation of an earth oven which was situated with respect to particular plant resources could be predicted to have a less diverse range of associated materials. Debris relating to general occupation, such as structures, other camp fires and other food remains might be absent. A higher proportion of functionally specific implements might be found in association with them. For instance, stones for pounding plant fibres and stone or shell implements for cutting and scraping plant fibres might be left at the site.

Mounds accumulated as ash hills, from the clean out of small pit ovens, may lie upon sterile ground without any initial oven pit or pits. It is possible that an old oven location might have formed the locus of an ash hill, in which case archaeological investigation should reveal a lower stratum with an oven pit. Nevertheless the site matrix should

generally be distinguished by a lack of oven pit features. There would be dumping lenses and might be horizontal variation in the deposit structure, if waste was added adjacent to, rather than on top of, the accumulated pile. Overall, the deposit should be mixed. In cases where the ash hills were accumulated for the purposes of camping, there may be later additions of material culture items in more level upper strata and on the surface of the site.

If there is a different class of mound which only accumulated from the long term operation of domestic fires, as Dawson (1981[1881]) suggested for the Western Districts of Victoria, it should also be archaeologically distinguishable. Whilst they would be composed of accumulations of ash and sediment, they would presumably lack any deep oven pit structures or heat retainers. This would suggest a slower rate of deposit accumulation. Furthermore, fires lit for warmth and open cooking would produce a higher proportion of ash and less charcoal as a result of the open air burning of fuel. Incidental incorporation of food remains and other domestic debris in their deposits would be expected. The associated occupation evidence with these types of mounds could be quite diverse consistent with occurrence in a general camp situation. Evidence of ovens, other structures, stone artefacts and associated subsistence activities could be predicted to occur in the same general location.

Mounds which formed from the *in situ* operation of ovens were also noted to be secondarily found useful for camping on, forming circumscribed site areas in localities which were prone to inundation. Oven mounds which were later camped upon would have added stratigraphic complexity relating to an intense and circumscribed use of their surface deposits. Depending upon the nature and materials of the dwelling structure erected upon the mound, there could be a considerable addition of cultural material. These deposits would probably become scuffed and mixed. Material culture relating to general camping activities might be added to the surface layers. Alternatively debris relating to specific functional use of the site might be deposited. For instance, in wetland situations people might have made use of the mounds in the context of the concentrated seasonal procurement of specific resources such as water birds, and eggs.

Oven mounds were also found to contain human burials, although in cited examples this appeared to have been the last phase of site use. The existence of other types of mounded formations has also been noted in early Australian ethnohistoric accounts. The preparation of low earthen mounds of particular forms in connection with ceremonial grounds was often recorded (Howitt 1904; Kenyon 1930:72; Mathews 1897). Burial tumuli were also noted by early explorers and travellers (Sturt 1963 [1829]; Mitchell 1965 [1839]). Depending on the nature of particular ceremonies, it is possible that fired materials and artefacts may have been incorporated into such features, but they would be

expected to predominantly consist of sterile sediment. Furthermore they may be located with associated features, such as pathways, stone alignments, earth rings and carved or scarred trees.

2.4 Modern Archaeological Investigations of Mounded Sites

2.4.1 Central and Western Districts of Victoria

The initial modern archaeological definition of a oven mounds was provided by Coutts and Witter (1977:50) based upon their investigations in the Western Districts of Victoria:

> "Oven mounds or myrn-yongs usually contain black soil with charcoal in it. They are mound or platform shaped ranging from 3-20 m in diameter but are usually within the range of 5-15 m in diameter. Their height varies from 0.2-0.5 m, they are circular to elliptical in plan and they may have a depression in the centre. They may contain chipped stone, burnt stone or clay, bone, freshwater shell (mussel), hearths, post holes, fire pits or burials. The mound is usually composed of black soil, has a base of buckshot gravel or has a core of large stones."

Archaeological field survey within this region resulted in the recording of numerous mound sites (Coutts *et al* 1976; Lourandos 1976, 1980; Williams 1988). A survey coordinated by the Victoria Archaeological Survey (VAS) covered 247,000 ha, within which 207 mound sites were recorded (Coutts *et al* 1976:9,19). As in the Murray River regions, the sites were predominantly situated near to watery environments, such as swamps, lakes, creeks and areas prone to inundation (*ibid*:19). Spatial analysis suggested that approximately 45% of the sites occurred in pairs or groups of three, although larger groups of up to six mounds were also located (*ibid*:13). In western Victoria the VAS excavated Site McKendrick 1, Chatsworth 1, Corra 2, Corra 3, FM1 and KP1 (Coutts *et al* 1976; Coutts and Witter 1977). Also in the Western Districts, Williams (1988) excavated Sites McArthur Creek 5, McArthur Creek 6, Montrose Mound 1, Montrose Mound 2, and Morass Mound 33.

Coutts *et al* (1979:1) reported upon investigations undertaken on mound sites by the VAS. Mounds in the western districts of Victoria were interpreted as occupation sites, containing pits, hearths and ovens as well as various economic and technological debris. Larger mound sites were often subsequently used as burial sites. An excavated mound located in the Grampians region of Victoria, McKendrick 1, was found to be composed only of one homogeneous layer of charcoal, clay and burnt clay. It contained no food remains, pits or artefactual debris (Coutts *et al* 1979).

Mounds, Chatsworth 1, KP1, FM1, Corra 2 and Corra 3, in the Western Districts of Victoria were also excavated by the VAS. The bulk of the deposits were composed of quantities of burnt rock, sediment and charcoal. They also contained a wide range of

faunal food remains from diverse microenvironments. In addition, some sites contained pits and hearths, post holes, stone artefacts and one contained human burials (Coutts *et al* 1976:1, 21, Coutts and Witter 1977). The sites appeared to represent several phases of occupation. Burials were interpreted as later features of the sites. In Site KP1 a burial area was found to be sealed with a 'hard clay-like cap' (Coutts and Witter 1977:63), much like that in the ethnohistoric description provided by MacPherson (1864:55).

In their determination of likely mound functions Coutts and Witter (1977:63) surveyed historical accounts in which styles of Aboriginal dwellings were described. They concluded that:

> "None of these descriptions mentions mounds, and the only possible connection appears to be the rare occurrence of mounds linked with stone arrangements ... One might cautiously conclude then, with the possible exception of some mounds in the region of the Murray River which may have been occupied during flood periods, that the mound sites in Victoria were not being used as habitation sites by Aborigines at contact." (Coutts *et al* 1976:8)

Whilst a parsimonious explanation for post holes in mounds would be as evidence of supports for dwelling structures, the historical record points to a number of alternatives. These include structures erected over graves to mark where bodies had been interred into abandoned mounds, racks for the drying of foodstuffs, and hut-like structures which were in fact used to protect fires from wind (Beveridge 1889).

Lourandos (1976:180) also recorded mounds in the south-western districts of Victoria. He found them to be associated with permanent waterways within swampy coastal plains. Seven mounds, in two pairs and a group of three, were recorded along the margins of a stream. Lourandos' research did not involve the excavation of mounds, but it was followed up by Williams' (1988) programme of survey and excavation. She (1988:12) surveyed an area of 80 km^2 and recorded 117 mounds as well as associated artefact scatters. The mounds were located in groups, pairs, and as individual sites.

Averaged (length + width/2) diameters of 110 of the mounds recorded by Williams (1988) at Caramut and Bessiebelle in the Western Districts of Victoria indicate a modal diameter of 11-20m , ranging between 4 and 22.5 m. The modal class comprised 87% of these mounds compared to the Murray Valley figure of 50%. Mounds in the Western Districts of Victoria were generally smaller and more standardised in size than those of the Murray Valley.

Baked clay pellets were not recorded in the Victorian mounds excavated by Williams. However, many of these sites contained basalt heat retainers (Williams 1988:155, 207-8). The use of locally available stone would logically result in the more gradual formation of a mounded deposit (no accumulation of distintegrated clay or earth clod heat retainers)

and may be one explanation for the differences found by Williams (1988:207-209) in average mound sizes between Central Victoria, the Wimmera and stone deficient areas such as the Murray Valley.

Several of the sites excavated by William appeared to have formed as a result of the continued operation of earth ovens, since they contained both abundant charcoal and heat retainers (Williams 1988:135;186). They returned dates of between 850±20 BP and 1600±220 BP (Williams 1988:156, 186). On the basis of their location, on swamp margins of the Eumeralla River, Williams (1988:158) suggested that the Montrose mounds were ovens used for the specialised exploitation of aquatic tubers. Montrose 2, measuring approximately 10 x 8 m, was found to be a low mounded deposit composed of charcoal rich soil, which contained basalt heat retainers, stone artefacts and oven pits. It dated to 1600±220 BP and continued to be used (at an unspecified rate) until 410±100 BP. An adjacent site, Montrose 1, was dated to at least 1270±100 BP.

Williams (1985, 1988) also ascertained the general locations of some mounded sites with the assistance of historical evidence dating to the 1840s which documented the presence of an Aboriginal "village". These mound sites were found to consist of shallow deposits with little internal evidence of cooking activities, although small open hearths (rather than pit structures) were present. In one mound post-moulds were uncovered which appeared to indicate that a structure or hut had been constructed on the area. Pits related to cooking activities were located in areas between mounds. Dates obtained for the structures and sites were modern (Williams 1988:84-91). Deposits immediately underlying the historic materials, and interpreted as unrelated evidence of general camping activity, predated the hut by periods of 450, 760 and 1580 years BP (Williams1988:95). These sites may simply represent people camping in historical times upon old campsites. It is unclear whether the settlement of Aboriginal people in this type of encampment reflected pre-contact patterns or was a function of their increasing circumscription by Europeans. In any case, the hut remains are very different to the remains of oven mounds.

The archaeological evidence from the Western Districts of Victoria suggests the presence of at least two types of mound. Williams interpreted the mounds with a high proportion of burnt sediment, oven stones and pits as steaming ovens for the processing of swampy plant foods, an explanation consistent with their context adjacent to small swampy areas (1988:158). There are few data as to whether oven mounds in the Western Districts formed rapidly, or gradually over long periods of time.

Frankel and Bird (1991a:8) suggested that the variety of mound composed of mostly unburnt sediment could have formed due to the collapse and decay of small turf and sod dwellings, such as were recorded in the ethnohistoric literature of the region. It is likely

that the low mounds recorded throughout the Western Districts which do not contain substantial deposit or quantities of heat retainer material are mounds resulting from the decay of substantial dwellings. Such deposits may accrue on the surface of existing mounds, just as residues from relatively insubstantial dwellings were noted to accrue on the surface of mounds in the Murray Regions. It is likely that this was the type of large mound excavated by Dawson.

2.4.2 Murray River Valley

Systematic archaeological surveys floodplains and surrounding lands of the Murray River and its associated river and creek systems located numerous mound sites as well as a variety of other archaeological evidence (Buchan 1980; 1983; Coutts 1980; Craib 1991; Lane 1980; Simmons 1980). The other site types included scarred trees, freshwater shell middens, stone artefact scatters and isolated stone artefacts, human burials and individual ovens and hearths. In some surveys deposits containing 'mound-like' materials were located on the crests of river terraces.

Several detailed analyses involving excavation of mound sites have also been undertaken in the Murray River region. Along the Parne Milloo Creek, the VAS excavated six sites: DP1; DP2; DP5; DP6; DP7; and DP8 (Coutts *et al* 1979, Coutts 1980). Along the Wakool River, Berryman and Frankel (1984) excavated a further three mounds: F3; M1; and Q7.

The identification of characteristic differences in sedimentary composition has been a common result of many mound excavations in southeastern Australia (Berryman and Frankel 1984; Coutts *et al* 1979; Coutts 1980). Three main sedimentary variations have been identified: 'core' deposits; mixed soft deposits; and core deposits overlain by mixed soft deposits.

Mounds consisting of 'core' deposits or Type 'A' Mounds (Coutts *et al* 1979:15) appear as an extremely compacted homogeneous sedimentary unit composed predominantly of highly fragmentary fired clay heat retainers, in a matrix of burnt soil (composed to a large degree of totally fragmented heat retainer), containing ash and small particles of carbon. They may contain minute quantities of other materials, such as stone artefacts, mussel shell or bone, but commonly contain none. There is a general trend for core deposits to have a slightly acidic pH (Sullivan 1980). Small thin lenses of soil may also be encountered within the deposit. Sometimes they are underlain by shallow pits and dark sediment suggestive of localised burning.

Twenty nine of a series of 54 mounds recorded along a section of the Parne Milloo Creek were identified as type 'A' mounds. Excavated examples of such mounds include DP2,

DP3, DP5 and Q7 (Berryman and Frankel 1984; Coutts *et al* 1979; Coutts 1980). The excavation of sites DP2 and DP3 revealed them to be composed of homogeneous layers of baked clay heat retainer rakeout material similar to the basal layers of site DP1 (Coutts *et al* 1979:85).

As a general rule Type 'A' mounds are smaller in size, than other types. They are located in a range of topographies and are generally associated with a water source which might be quite ephemeral. Many of the sites appear to have been sited above major flood levels (Coutts *et al* 1979:30). They have been interpreted as dumps of oven rakeout resulting from the operation of small ovens in the vicinity, around which Aboriginals probably camped (Coutts *et al* 1979:85). This interpretation is similar to the ethnohistoric descriptions of Kenyon (1912). However, large scale excavation of site DP2 and its surroundings failed to find evidence of such surrounding features.

Mounds consisting of softer mixed sediments overlying the previously described core deposits were termed Type 'B' mounds (Coutts *et al* 1979). Excavated examples include DP1, DP6, DP7 and F3 (Berryman and Frankel 1984:26-27; Coutts 1980; Coutts *et al* 1979). The Type 'B' mounds recorded by Coutts *et al* (1979:15) in the Nyah Forest in Victoria were found to be large with upper layers consisting of sediment, burnt clay pellets, charcoal, mussel shell and animal bone overlying a more compacted deposit predominantly composed of clay pellets. Skeletal remains were also recovered from the excavation of DP1, a type B mound (Coutts *et al* 1979:68-69). The bones were stained with ochre and some had been cremated. There was a suggestion that the corpses indicated secondary burial practices, since the bodies appeared to have been desiccated prior to interment. However their burial position and condition suggests that they are more likely to have been primary burials (Littleton pers comm). The burials appeared to be late events in the site history and were only associated with the looser upper sediments characteristic of type B mounds.

The compacted bottom 'core' layers of Site DP1 contained less ash than the overlying layers, consistent with the loss of ash incurred by the transfer of sediments from adjacent or nearby cooking pits. The looser, ashier layers overlying these were interpreted to be the result of later construction and use of oven pits on the actual mound site rather than adjacent to it. Coutts *et al* (1979:69) noted that fired heat retainer fragments from DP1 were baked very hard and were a reddish colour, indicating their firing in an open oxidising situation. Lenses of sand encountered during excavation of the mound core were interpreted as stockpiles of material for tempering the clay heat retainers. Coutts *et al* (1979) attribute the extreme degrees of fracturing of heat retainer pellets within the core deposits (most less than 12 mm in diameter) to their being fired in a wet state, although in an appendix to the report (Segnit 1979) suggested that the air drying of the pellets

occurred prior to heating. Experimental simulation of the firing of heat retainers suggested that the heat retainers in the core of DP1 were tempered with sand (Coutts *et al* 1979:70). However there is no clear distinction between naturally and deliberately tempered clays.

A temporal break between the two phases of occupation indicated by the consolidated 'core' overlain by softer sediments in site DP1 was suggested and seems likely, although dating of the site unfortunately proved inconclusive on this point (Coutts *et al* 1979:83). Use of the site as a whole occurred between 1375±130 BP and 960±80 BP (a minimum period of 205 years or a maximum period of 525 years). DP1 was interpreted to have two, or possibly three, main phases of formation (Coutts *et al* 1979:80-81). Initially it is thought to have been a refuse heap, or 'ash hill' of oven rakeout from the operation of nearby earth ovens, although no associated oven pits were located (Coutts *et al* 1979:78). This phase was tied to non-flood periods of the Murray River. The next postulated phase entailed the *in situ* construction and use of oven pits upon the mounded deposit. It was suggested that the mound functioned as an elevated camp site during this period. Such usage would be logical during periods of riverine flood, or immediately after the recession of floodwaters when surrounding areas were still partially inundated.

Small excavations were undertaken in two mounds (F3 and Q7) along the Wakool River in NSW by Berryman and Frankel (1984:26-27) . They were found to be composed of a mixed deposit of heat retainers and ashy sediment overlying a thin blacker lens. F3 was interpreted as a Type 'B' mound and Q7 as Type 'A', although the authors noted that the sites could

> "...be viewed as essentially similar with some minor differences attributed to their siting and non-cultural processes" (Berryman and Frankel 1984:28).

Coutts *et al* (1979:33) noted a tendency for type 'B' mounds to be situated on relatively elevated ground surfaces although, in many cases, they were still subjected to flood inundation. During periods of riverine flooding some of the larger Type 'B' mounds became islands, and it was suggested that they may have been deliberately built up to be camped upon at such times (Coutts *et al* 1979:30,85). Ethnohistorical accounts also indicated that large mounds within floodplains were often utilised as islands and camped upon. In many cases Type 'B' mounds were found to be associated with "satellite" Type 'A' mounds (Coutts *et al* 1979:85). However this terminology assumes contemporaneous use of the features, which has not been demonstrated archaeologically.

A third category of mound was also identified on sedimentary grounds. Type 'C' mounds are very large and consist entirely of soft deposits, without any core materials. Excavated examples include DP8 (Coutts 1980). The deposits are generally associated

with considerable quantities of artefacts and faunal remains. Coutts (1980:36) suggested that these represent a more intensive, base-camp type of occupation. DP8 was located above the river flood zone.

Further variations on the theme include occurrences of aggregated multiple oven uses. Mound site M1 excavated by Berryman and Frankel (1984) consisted of a series of cooking areas and discarded heat retainers, situated upon a mounded black soil unit on an area of natural elevated ground. Its formation was suggestive of two stages of site use (Berryman and Frankel 1984:27-29).

Buchan (1980:47) noted that certain mounds had formed due to a combination of both natural and cultural processes. In some cases cultural deposit had accumulated upon existing elevated microtopographic features and in others, natural sediments had been deposited over cultural materials. Burnt and decayed trees formed a further category of mounded deposit which in many cases were difficult to distinguish from cultural deposits (Sullivan and Buchan 1980).

Artificially raised mounds are well recorded as a means of exploiting landscapes which are otherwise too wet to occupy. This function had been proposed for certain occurrences of mounds in Australia. Resolution of this hypothesis has been confounded by difficulties in locating recognisably deliberate and distinct formation episodes in mound structure (Coutts 1980; Berryman and Frankel 1984). Such difficulties have also been compounded by the alluvial depositional nature of their surrounding terrain, which may result in the addition of flood lain sediments.

All of the excavated Murray Valley mounds contained substantial quantities of fired clay pellets. These heat retainers were mostly composed of sediments sourced to the immediate mound surroundings. Heat retainers ranged from fragmentary to entire, and were occasionally uncovered as features suggestive of *in situ* piles of oven rakeout (Berryman and Frankel 1984), and oven-pit bases. Whilst such features were often encountered, the majority of heat retainer material was extremely fragmentary.

Some of the baked clay heat retainers also contained carbonised fragments of plant materials. These provided indications of the contemporary micro environments as well as some indications of the temperatures reached in their firing. Effective temperatures for the complete burn-out of organic matter are generally between 700°C and 800°C (Johnson *et al* 1988).

There also appeared to be characteristic patterns in the range and distribution of archaeological evidence in the Murray River region. Mounds were strongly associated

with floodplain areas. In particular, they were sited upon natural levees, on areas of higher ground along the floodplain margins, as well as on the margins of lagoons and swamps within floodplains (Coutts 1980:23,26,29). Simmons (1980:70) also emphasized the apparent relationship between mounds, aquatic resources and floodplain environments. Survey of Lake Coomaroop, a shallow lake connected to the Murray River, found that mounds occurred in spatially separated groups and were consistently located at the first break of slope rising above the flat areas of the floodplain at distances between 0.5 and 1.0 km away from the river channel (Buchan 1980:46).

Coutts *et al* (1979:30) plotted the heights of mound site locations against maximum riverine flood levels. The results indicated that many of the sites, including most of the type 'B' sites, were subject to inundation. Their occupation and use was therefore suggested to have occurred during non-flood periods. A high proportion (70%) of type 'B' mounds were spatially associated with smaller mounds, and type 'B' mounds generally appeared to favour elevated ground (Coutts *et al* 1979:33).

2.4.3 Northern Australia

Cribb (1991:24) also carried out some archaeological investigations in northern Australia describing the mounded sites commonly encountered as:

> "... low and flat-topped, located on a silt substrate and containing a high proportion of ant-bed. They may have a thin surface scatter of shell and other archaeological material such as stone flakes. Such features represent many centuries of earth-oven building, the ant-bed being employed as a heat-retainer."

He also noted that their high proportion of termite nest reflected the usage of ant-bed for heat retainers in small ovens.

The nesting activities of animals and birds, such as mallee fowl, bettongs, termites, pebble-mound mice and stick-nest rats may also produce mounds (McBrearty 1990:132; Noble 1993). In some cases, such mounds also come to incorporate cultural remains leading to dispute over the responsible agency (Bailey 1991; Cribb 1991; Stone 1989).

2.4.4 Northern New South Wales

Balme and Beck (1996) recorded mound sites in the Macquarie Marshes in northern New South Wales. On the basis of tenuous archaeological evidence and a selective interpretation of historical accounts they interpreted their field evidence and all other Australian evidence, as indicating that Australian mounds result from gardening.

> "We suggest that the mounds were originally built for a single purpose, and that purpose can only be identified by explaining their similarities...none of the functions so far suggested can explain the consistencies between the mounds. This means that the mounds either had no single original function or the original function is one that has not been suggested before. There is one other

function which could explain the consistent presence of baked clay, charcoal and burnt sediment. That is the use of mounds as places for growing plants observed by Batey [n.d] and Thomas [1906:113]" (Balme and Beck 1996:45).

Their search for a single cause of origin for all mounds analysis demonstrates a poor understanding of the significant range of differences between mounds to be found in previous archaeological and ethnohistoric evidence. A more tenable hypothesis would have been that, based upon certain documentary evidence, some garden mounds could well have existed, to model the likely composition of these and then to seek appropriate archaeological evidence. A fundamental weakness in their argument attributes the presence of quantities of baked clay heat retainers within the mounds, to the heating of soils during the initial clearing and burning of woodland areas, which they claim would be required before garden mounds could be established.

Detailed studies of the effects of bushfires upon soil temperatures in a range of comparable firing situations are unanimous in their finding that soil temperatures do not exceed 100 degrees celsius at depths exceeding 2 cm (Bradstock and Auld 1995:77; Bradstock *et al* 1992:437; Raison *et al* 1986:37). Mean temperatures within combusted fuel at the soil surface in intense forest fires reached only 452 degrees celsius. Analysis of baked clay pellets from the Murray River determined their firing temperatures to lie between 700 and 800 degrees celsius (Segnit 1979:115). Surface and subsoil temperatures related to surface clearance and burning are thus insufficient to generate the heat required for the formation of baked clay heat retainers.

If high-temperature firing of the clay substrate did occur under exceptional circumstances, it would be in a closed, oxygen free or *reducing* atmosphere and the resultant clay lumps would be white, grey or black (Colton 1953:23). Colours of the burnt clay found on the surfaces of mounds in the Macquarie Marshes were noted to be grey black on the outside, but significantly, with orange interiors (1996:41) suggestive of firing in an *oxidising* atmosphere. Detailed descriptions provided by Coutts *et al* (1979:69 and Appendix 3) on the fired clay pellets found in the VAS mound excavations also indicated their firing in oxidising atmospheres, or open fire pits .

The authors suggest that a range of activities may have been carried out on mounds after their original use as garden beds, hence accounting for the pits, hearths and other occupational evidence documented in previous archaeological research. There is then a necessity to explain the 'foundation' of oven pits overlain by mixed mounded material recorded by Coutts *et al* (1979:53:Figure 30). Williams also presents basal oven pit features in her excavation of the Montrose mound site (1988:157:Figure 7.10). The authors fail to explain away the well documented presence of such oven pit features and

heat retainer rakeout found in many excavated mounds (cf Coutts *et al* :1979 and Berryman and Frankel:1984) simply by suggesting they are later additions to the sites.

Balme and Beck (1996:46) model their proposed garden mounds upon those documented in Papua New Guinea. They suggest that one potential advantage is the high fertility of mound deposits. They account for this as a result of the deliberate incorporation of organic compost during formation of the mound, and subsequent high levels of nitrogen. An analysis of the potential agricultural fertility of Aboriginal mound sites was published by Batten (1975). He found that available phosphate levels were between 10 and 20 times higher than those of surrounding soils, but attributed this to the effects of burning and human occupation residues. As noted by Bakkevig (1980:74;79), the chief contributing sources of organic phosphate accumulated at sites are bones, meat, fish, plants and areas of concentrated burning such as fireplaces .

High phosphate and nitrogen levels would not necessarily benefit all plants. High nitrogen levels in raised garden mounds in Papua New Guinea, for instance, cause tuber crops to run to vine at the expense of roots (Sillitoe 1983:20). Similarly, when grain crops are planted in paddocks containing mounds the plants rapidly run out, achieving height and leafy growth at the expense of strength and seed (Batten 1989 pers comm and pers obs). A careful study of the effects of particular soil properties on indigenous plants proposed for cultivation is needed.

2.4.5 Murrumbidgee River

Both natural and cultural mounds are known in the Murrumbidgee River region (Klaver 1987). The natural gilgai formations, which appear as expanses of mounds and depressions, are found throughout the world are also common in Australia, particularly in areas with heavy textured grey and brown earths (CSIRO 1960:4). Larger gilgai formations would provide acceptable 'staging posts' for Aboriginal exploitation of swampy areas. If utilised in this way, they would appear as elevated deposits of endemic cracking clays overlain with occupation debris which could include artefacts, food remains and ovens with associated ash and rakeout materials.

A previous survey along the Murrumbidgee River located 112 mounds, interpreted from surface evidence as oven mounds. The use of clay heat retainers, necessitated by the stone-poor nature of the riverine plains of southern Australia, obviates the need to locate ovens near stone sources. However a related development may have been the tendency to relocate near old mounds, in part because they became a source of reusable heat retainers (Klaver 1987).

2.4.6 Discussion of Archaeological Studies

Archaeological evidence indicates the presence of several types of mound. It mostly concurs with the ethnohistoric record and adds to it. For instance, Type 'A', 'B' and 'C' mounds are distinguished on sedimentological grounds. The type recorded by Berryman and Frankel (1984:27-29) comprised mixed debris from multiple small ovens upon a black, probably cultural soil, overlying a natural elevation. Those recorded by Buchan (1980) consisted of cultural materials overlying natural elevations. There are variations between the use of stone and baked clay heat retainers, and evidence of diverse food and artefactual remains. In some cases there is evidence of post holes, pits and distinct ovens or shallow fireplaces. Human remains were occasionally recorded and interpreted as the final episode of site use. The archaeological investigations also indicate that some mounds underwent lengthy and multistaged formation processes, during which their function varied.

There is general concurrence that mounded sites are part of general occupation sites. However, Bird and Frankel (1991a:187) consider that the evidence for the deliberate construction of all mounds as hut foundations (*cf* Williams 1988) is tenuous, and that the use of oven mounds as living surfaces is likely to be a secondary function, although they predict the existence of a type of mound which could form around ruined turf huts. Such features would be expected to contain evidence of occupation, including post holes, artefacts, food residues and perhaps minor quantities of hearth and oven materials. These would have to be considered as a separate type to the oven mound as defined by Coutts and Witter (1977:50). Such sod/turf dwellings were documented in early historic records describing Aboriginal settlements (Bird and Frankel 1991b:8). Their occurrence may be restricted to regions with cooler, wetter climates, such as in the Western Districts of Victoria. In the drier interior regions, such as along the Murray and Murrumbidgee rivers, huts and shelters were noted to be made of more perishable materials, such as bark.

Some studies have suggested that mounded sites were deliberately raised dwelling platforms made to escape damp ground surfaces (Coutts 1980; Lourandos 1980; Williams 1988). One source postulates that they represent the gradual accumulation of ordinary occupation and campfire debris (Dawson 1981). Many sites have been interpreted as resulting from the operation of earth ovens. Whilst some mounds have been viewed in the context of occupation encampments (Beveridge 1883), others were thought to be spatial segregated (Curr 1886). Most agree that mound sites are associated with water resources, particularly wetlands, and apparently developed from about 3000 years BP (Bird and Frankel 1991a, 1991b).

As a consequence of their dating, mounds have become strongly identified with postulated social and economic processes of change in mid-to-late Holocene Australian hunter gatherer economies. In the Western Districts of Victoria, for example, they have been interpreted as representative of increasingly sedentary occupation, and as indicators of the intensification of landuse by facilitating the occupation of otherwise 'marginal' resource zones (Lourandos 1980; Williams 1988). Their links with increases in social complexity and population size have been archaeological corollaries.

2.5 A Typology of Mounded Sites for Australia

It is clear from the preceding glimpses of the archaeological and ethnohistoric record that there are several different types of mounded occupation sites in Australia and that there are various means to explain them. The review of formation processes responsible for each mound type and modelling of their archaeological correlates and function, or functions, enables their use as an interpretative element within the context of broader settlement patterns. On the basis of evidence so far collated, it would appear that mounds could to be typologically ordered into at least nine classes:

1. **Oven Mounds** formed*in situ,* due to the continued operation of earth ovens, over various time frames. It is likely that there are variants within this category, reflecting the duration of use, social contexts, location and purpose of the ovens. Further variants result from the reuse of old oven mounds as camping areas and burial sites. A sub-class of **Incipient Oven Mounds** may consist of multiple ovens which had not yet produced substantially mounded deposits.
2. **Ash dumps or Ash hills** composed of secondary accumulations of oven waste. They include ash dumps which are strategically positioned and others which are incidentally positioned. They may be reused as campsites.
3. **Domestic Hearth Mounds** formed from the continued operation of campfires rather than pit ovens in a settlement context.
4. **Dwelling Platforms** deliberately accumulated to provide elevated living spaces.
5. **Garden Mounds.**
6. **Ceremonial Mounds**
7. **Burial Mounds or Tumuli.**

More complex subcategories may also occur if these change in function over time. For instance, burials may be interred in the floors of old oven mounds. Studies from other parts of the world also raise the possibility that occupation mounds may be recycled as garden beds.

8. **Semi-Cultural Mounds** comprise natural mounds which are later occupied and are thus composed of the basic natural foundation, be it soil, bird nests, anthills or other materials to which occupation evidence has been added.

9. **Non-Cultural Mounds** are natural features with apparently similar composition to cultural mounds. Examples include burnt tree stumps and burnt termite nests.

In Australian contexts the majority of mounds appear to derive from the operation of earth ovens, as the bulk of their deposit is composed of burnt materials such as ash, charcoal and baked clay heat retainers. Other mounds remain ambiguous since they consist of lesser proportions of burnt materials.

2.6 Research Issues

This review of mound sites demonstrates the dominance of pit oven technology as an underlying factor leading to their formation. The basic unit of mound accretion appears to be the pit oven rakeout, consisting of ash, soil, heat retainers and food remains. It is also apparent that there was a range of uses to which these deposits may subsequently have been put. Some mounds represent variations in expression of the intersections of a two ranges of activities relating to the operation of pit ovens and dwellings. Several factors appear to underlie their accumulation: the use of pit ovens, the repetition of this use, minor variations in the accumulation of discard from this activity and the adaptive reuse of the accumulated sediment.

In the Western Districts of Victoria there is a regional variation as these factors are added to by the presence of additional mounds relating to more solid dwellings, these contribute concomitantly more physically substantial evidence when they relate to similar episodes of adaptive reuse of underlying deposits.

Where mounds occur in riverine regions there is a common tendency for them to be located on existing and circumscribed areas of natural elevation. In these situations they appear to reflect settlement strategies which are highly sensitive to the flooding of landscapes. Thus rather than being deliberately built up, their tendency to accumulate may be more a product of the limited general availability of elevated microtopography and the repeated usage of these areas.

The formation of oven mounds is common to a wide variety of occupation patterns, ranging from mobile hunter gather bands, to semi-sedentary, sedentary and 'suprasedentary' populations. They are formed by a range of group sizes, from individual family units, to small groups, communities and large aggregations. These sites thus require detailed analysis before they can be drawn in as indicators of degrees of settlement sedentariness, or group size and population levels.

Oven mounds occur within occupation sites, and peripheral to occupation sites. Sometimes they are formed as outliers, nearby to particular resources, or to combined factors such as heat retainer sources combined with available resources. Mounds thus require context within particular settlement patterns before they could begin to be considered as 'settlement units'.

Mounds are products of varied subsistence strategies and could equally be resultant of people practising residentially mobile 'forager' or logistically mobile 'collector' economic regimes, or combinations of these strategies. Hence their presence within a regional archaeology does not necessarily have connotations of sedentariness. There are some hints, however, that certain larger oven mounds with bigger underlying oven pits, used for the bulk processing of *Typha*,were used by groups practising, at least partially, a 'logistic' foraging strategy

The linking of mounds with the 'intensification' of resources, in a primary capacity as artificial platforms facilitating physical access to resources is not demonstrable. Mounds within swamps, composed purely of artificial constructions of earth have not been evidenced. However, natural elevations in these locations could have been used. Oven mounds could also have built up in these locations following lengthy reuse and been utilised as 'staging posts'.

The development of oven mounds in their capacity as pit oven technology may however, have potential linkage with an intensification of resource use. Pit baking could have increased the range of, and efficiency of utilisation of particular foodstuffs. In some regions it would have been an essential process for the manufacture of fibre used for other technological items, such as nets, which in turn may have enabled intensified subsistence practices. The use of steaming, as opposed to dry baking cooking processes may technically enable the distinguishment of ovens used for the processing of foodstuffs rather than plant fibre, however, the archaeological detection of these differences may prove difficult. Whether these developments are part of a suite of mid-to-late Holocene developments however, is unclear. Pit oven technology has been demonstrably present in Australian cultures at least since the late Pleistocene (Clark and Barbetti 1982).

The significance of recurrent patterns of compositional variation between mound sites and the implications of these in terms of formation process or function remains unresolved. The reason for the chronological circumscription of mounds to the mid-to-late Holocene period is also still poorly understood.

Substantive research issues which remain focus upon several questions. Why do mounds resulting from the use of pit-ovens appear to develop in the mid-to-late Holocene period? Why do they appear in some riverine regions but not in others? Are these characteristics a function of mid-to-late Holocene population increase and its regionally variable occurrence? Alternatively, are there other factors which ought to be brought to account?

Mounds are by definition large and obtrusive archaeological elements within a landscape. They are also found to be a site type commonly situated within depositional environments such as wetlands and floodplains where they, and other archaeological materials, are undergoing a constant process of slow burial. Whilst they appear to be a prolific and obvious residue of activity in these landscapes over the past 3000 years, might this be an exaggerated product of their size and inherent survival potential? Are older mounds likely to be buried more deeply within these depositional environments. To what extent is their apparent commencement in modern riverine environments at approximately 3000 BP a product of their context within prevailingly recent environments?

This research plans to follow up aspects relating to these issues by focusing on an intermediate regional study area, the Central Murrumbidgee Riverine Plain. It includes a detailed analysis of mound sites. It aims to determine their individual function and rates of formation. Assessment of the contemporaneity of grouped mounds, via sequential dating, is also an issue for resolution. The detailed dating of mound deposits is thus a major research aim. The study aims to place mounds within a settlement context by analysing their potential relationships to other regional site components and their distribution. Their status as settlement units within a regional pattern will then be assessed. This analysis of mounds will then be employed to develop a model of Aboriginal settlement and subsistence for the region. This research will also draw upon analogy from other archaeological interpretations, from the ethnohistoric record and from ethnography, in keeping with its explicitly middle range theoretical perspective.

Chapter 3
The Murrumbidgee Riverine Plain - Environment, Aboriginal History and Archaeology.

3.1 Introduction

The Central Murrumbidgee Riverine Plain is an area of 15,000 square kilometres lying alongside, and south of, the Murrumbidgee River (Figure 3.1). The Murrumbidgee River is a major tributary of the Murray River system, and lies between the Murray and Darling River Regions. The study area presents strong contrasts between river and creek corridors with their associated billabongs and swamps, and extensive, flat and usually dry hinterland areas. Seasonal variations in riverine hydrology exert a strong influence upon resource availability throughout the region.

The region is comparatively warmer and more arid than the Central and Western Districts of Victoria, and lacks the broad distribution of perennial waterways and swamps evident in the latter. Its environment is generally comparable to the Murray River region, although the Murray is a much larger river with a concomitant increase in the reliability and quantity of associated wetland resource systems. The Murrumbidgee region is also not as hot and arid as the Darling River region. All of these regions have some factors in common however, in that they all experience considerable seasonal variation in the availability and distribution of resources. Mound sites are common to all but the Darling river region. The investigations relating to mound sites carried out along the Wakool River, an anabranch of the Murray river, by Berryman and Frankel (1984) are the closest to the study area.

Little previous archaeological research has been undertaken in the Murrumbidgee river region and historical records describing Aboriginal lifestyles at the time of contact are distinguished by their paucity. This study represents a fresh opportunity to examine mounds and current models of late Holocene Aboriginal economy from an archaeological perspective, with particular reference to postulated Late Holocene socioeconomic change.

3.2 Evidence for Past Climatic Change

3.2.1 Early Holocene Environmental Conditions

Climatic regimes, in combination with the physical features of a region, may have a major influence upon settlement systems, influencing available food and water resources, suitable occupation areas, the need for shelter, as well as long-term annual or seasonal variations in land use. Although setting a ceiling upon absolute settlement capacity, the effects of such natural systems may be over-ridden or moderated by cultural factors. In

order to model human cultural strategies, a knowledge of broad environmental conditions experienced in this region during the Holocene period is a desirable baseline.

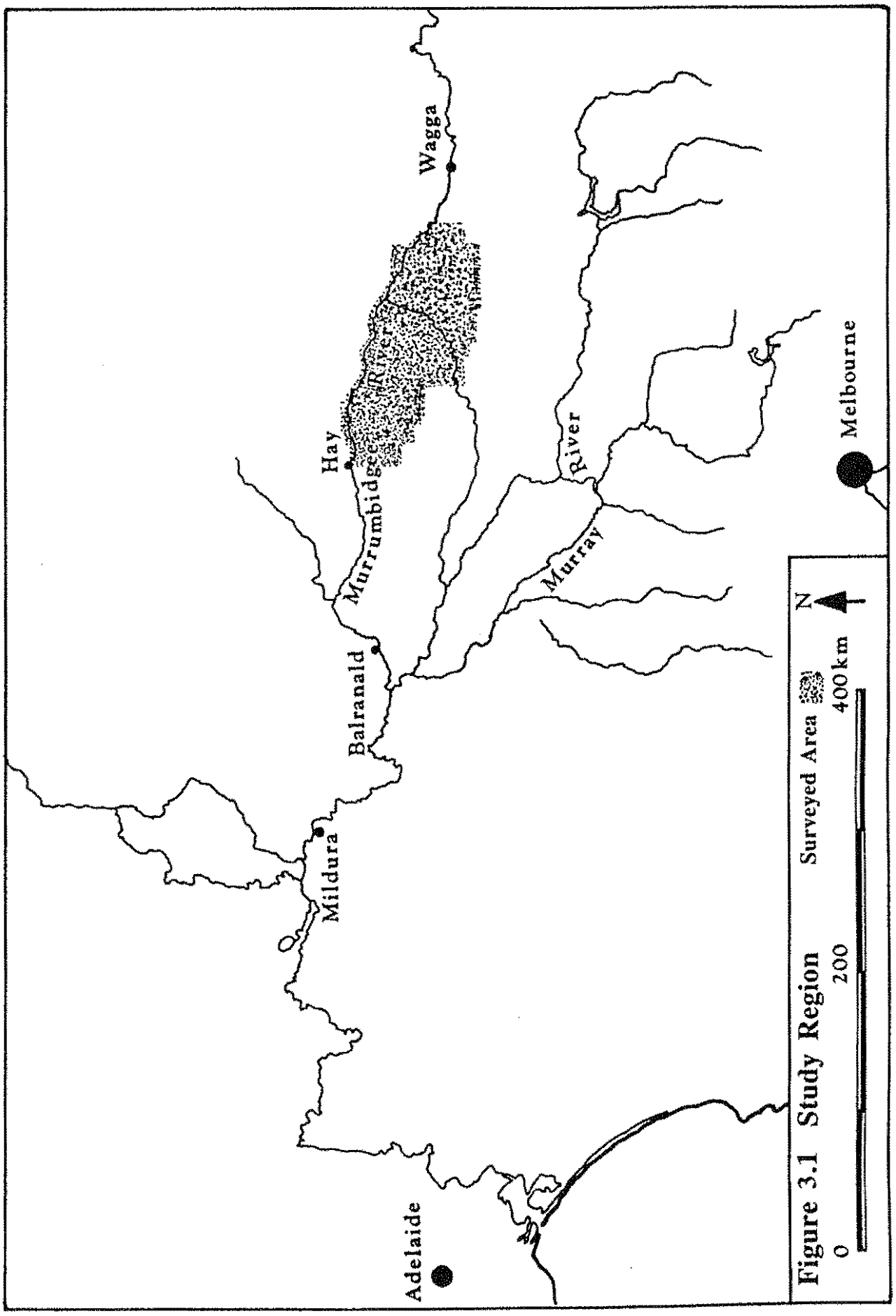
Palaeoclimatic evidence is limited for this section of the Riverine Plain. Pollen evidence is often used to reconstruct vegetation patterns which may then be used to infer likely rainfall and temperature patterns, as well as available plant resources (Head 1983). However, pollen is best preserved in permanently wet sites and conditions west of Narrandera have been too arid to form good pollen records (Porteners 1993).

Effective rainfall, when rainfall exceeds evaporation, is determined by the combined effects of total precipitation, temperature, soils, vegetative covering and wind. Past levels of effective rainfall, and factors contributing to them, may be estimated by calculation of past lake levels (Bowler and Jones 1979). This type of palaeoclimatic research has not occurred within the region. The estimations of lake levels in other regions of southeastern Australia, such as those from Victoria, demonstrate some broad patterns which may be analogous at a general level.

Geomorphological analysis of landscapes, particularly in depositional areas such as floodplains, may also provide indications of past climatic conditions. Examination of pluvial deposits distributed across the riverine plain reveal that Pleistocene and early Holocene streams differed greatly from those currently present. Palaeochannels (also referred to as 'prior streams', 'ancestral streams' and 'ancestral rivers') are the physical traces of very old (dated to between c. 100,000 to 10,000 years ago and beyond) stream courses from which the modern river systems have derived (Page, Nanson and Price 1991; 1996). They are evident as formations of channels and levees often built up above the surrounding plains and have characteristic soil associations (Bowler 1978:106).

Such palaeochannels spread across the riverine plain in a vast network of distributary and tributary streams, unlike the confined channels of their modern counterparts (Langford-Smith 1960:370). They are mostly inactive under current flow regimes, although some are filled during major riverine flooding. They also conduct water following local rainfall. Such streams may be classified as intermittent (those that flow seasonally) or episodic (those that flow only after unpredictable rainfall events) (Boulton and Suter 1986:314).

Figure 3.1


Wagga
Hay
Murrumbidgee River
Balranald
Mildura
Murray River
Melbourne
Adelaide
N
Surveyed Area
0
200
400km
Figure 3.1 Study Region

The transition from Pleistocene to Holocene periods coincided with a period of increased aridity and higher temperatures which ultimately restricted the flow of these palaeochannels. They seem to have mostly ceased to flow by the terminal Pleistocene or early Holocene period. The onset of a modern drainage regime for the Riverine Plain is estimated to have occurred at between 15 000 and 10 000 years ago (Page *et al* 1991:18; 1996: 311) although it is unclear how long the transitional period may have lasted. Evidence of the earliest palaeochannel courses has been subsequently buried beneath alluvial and reworked sediments.

Over the past 10,000 years the Murrumbidgee river corridor has incised itself within and across these ancestral floodplains. The modern stream channel occupies a fraction of their original extent but still makes some use of relict palaeochannel courses as drainage distributaries. Depending upon depth and context, floodplain alluvium related to the modern stream course may date from approximately 10 000 years ago up until recent times. Early Holocene climatic conditions in south eastern Australia ranged between wet and moist. Particularly wet periods have been identified between 8000 and 5000 years BP (Nanson *et al* 1993:69; Ogden 1993:74).

The transition from palaeochannels to modern streams would have greatly altered the configuration and composition of resources in the riverine plain, with the massive contraction of stream corridor environments. In human terms, the change may have been perceived as relatively gradual, since some stream courses would have been episodically reactivated, and others would have remained active during the succession of modern streams. However the overall trend of change could be predicted to have had considerable influence upon the distribution of population through the landscape.

Broad trends in vegetation structure for the eastern part of the Riverine Plain from the Pleistocene to Holocene periods have been summarised on the basis of pollen records and climatic data (Dodson *et al* 1992:121-2;figs.6.1-6.3). These data suggest that the Central Murrumbidgee region would have experienced an eastern expansion of a forest dominated vegetation structure at approximately 25 000 ±3000 years ago, followed by shrubland and woodland at approximately 18 000±3000 years ago. The latter persisted until approximately 10 000±2000 years ago. At about 7000 ±2000 forest again characterised the region, persisting up until the present. The transition from palaeochannel to modern drainage regimes broadly correlates with a change in overall character of vegetation patterns from shrubland and woodland to more forested lands.

Modelling the potential effects of such overall change upon the archaeology of the region depends to a certain extent upon terminal Pleistocene population densities. There is no *a priori* reason to assume that these were any lower than subsequent Holocene levels. The

underlying tenets of optimal foraging theory, however, would suggest that such a change in drainage regimes could have resulted in a gradual reorganisation of population distribution within the landscape. Focus may have developed upon the increasingly restricted Holocene riverine drainage systems. Indications of population levels and settlement patterns of Pleistocene populations are sketchy. Hearths and pit baking fireplaces which employ baked clay heat retainers, although in smaller concentrations than in similar Holocene sites, are well documented throughout the late Pleistocene occupation of western new South Wales (Clark and Barbetti 1982:144), although an associated subsistence pattern is poorly understood.

The corollary for archaeological survey is that, if Pleistocene populations were economically focused upon palaeochannel resources, then evidence of their occupation may potentially have been deposited over a much more extensive area. Consequently, the frequency of site reoccupation could be predicted to be lower than the ensuing Holocene periods. Evidence of Pleistocene and even early Holocene occupation would not be expected to follow the modern stream corridors. Even where modern streams follow old courses, patterns of reworking and redeposition would be predicted to bury or destroy earlier occupation evidence. Early occupation evidence would be predicted to occur in relation to the position of palaeochannel courses, although post depositional processes of erosion and sedimentation, and possibly the accretion of later occupation evidence may impede its detection.

3.2.3 Mid to Late Holocene Environmental Conditions

A pattern of long term stability of floodplain morphology, demonstrated in sites within the Murray Valley, has been interpreted as indicative of stable mid- to late-Holocene climatic conditions (Bowler 1978:105). The absence of major periods of erosion and subsequent deposition is suggested to be a result of the continual presence of woodland vegetation in both catchment and stream channel locations. Holocene climatic change appears to have been minor, in comparison to the preceding glacial and deglacial periods between 18,000 and 9000 years BP (Bowler 1978).

From the beginning of the Holocene there appears to have been a trend of increasing aridity, punctuated by minor wetter and drier fluctuations, including a dry phase between 3000 and 2000 years BP, a wet phase possibly at around 3500 years BP (Langford-Smith 1960:373), and a secondary wetter period which commenced approximately 2000 years BP. It did not, however, approach the magnitude of the earliest Holocene moisture levels (Kershaw 1995; Nanson *et al* 1993:69; Ogden 1993:74). This pattern, of punctuated aridity, established from about 3000 to 3500 years BP, appears to have persisted through to European contact. Ogden (1993) dated infilled sediments from currently cut-off meanders in the Upper Murray River area to between 2000 and 1000

years BP. This implies the existence of regionally similar flow regimes and stream channel locations over at least that period of time. Such evidence suggests relatively stable river flow and climatic regimes which would have brought about only minor annual and episodic variation in resource distribution and characteristics, rather than significant change.

These data permit the view that regional conditions experienced for the past 3000 years were fairly similar to those experienced during the latter half of the last century. Consequently, the latter patterns of vegetation distribution, as well as rainfall and temperature regimes, could be considered broadly analogous to those exerting influence upon late prehistoric occupation and land use. Whilst specific compositions and locations of vegetation communities may have altered slightly, broad patterns of occurrence would have been similar. There may have been micro-environmental changes resulting from the overall climatic trend towards increased aridity, and small shifts in resource distribution patterns resulting from continual evolution of river and smaller stream channels, and the formation and stabilisation of cut-off meanders or billabongs. These could be predicted to affect patterns of human occupation at a local level and could potentially be seen as microcosms of factors influencing of settlement patterns since Pleistocene times.

3.3 The Current Environment

3.3.1 Landscape

The Central Murrumbidgee regional landscape is one of low general relief, but of considerable and significant variety in microrelief. It is crossed east-west and north-south by modern stream channels flowing within a gently graded belt of alluvium of between 1.5 and 5 km wide, the surface of which lies only a few metres below the surrounding plain (Butler *et al* 1973:9; Page *et al* 1991:14). The eastern boundary of the region coincides with the head of the Riverine Plain, between Narrandera and Wagga Wagga. Gradients in the eastern plains average 0.5 m per km, decreasing to 0.25 m per km in the west (Van Dijk and Talsma 1964).

Composed of alluvial sediments, the plain is largely devoid of lithic materials. With the exception of some small areas of gravelly soils, the remainder comprises sand, loam, clay-loam and clays (Butler 1950:233). In the eastern section of the study area, between the upland Devonian rock outcrops and the Riverine Plain proper there are limited exposures of Tertiary sediments, which may be characterised, in section, by kaolinitic clays overlying pisolitic ironstone, overlying poorly cemented coarse grey sandstone. Old lunette formations in these areas are characterised by their composition of kaolinitic clays and may be capped with laterite (Pels 1969:504). Exposures of lateritic crust are

sometimes reasonably siliceous and may have provided stone suitable for the production of implements.

Near Lake Urana, tertiary sediments, including quartzitic pebbles of up to 60 mm in diameter are exposed in borrow-pits and quarries or are close to the present ground surface. They may also be exposed in shallow gullies and creek beds throughout the local area. Reef quartz, associated with gold bearing deposits was recorded at Brookong, nearby (Bayley 1959). The cliffed western and southern shore of Lake Urana also displays bedded pebble deposits reworked by wave action and quartz pebbles attaining a maximum dimension of 40 mm are abundant in redeposited shoreline sediments (Page *et al* 1994:39;42).

The region is thus largely devoid of siliceous stone resources, except for minor occurrences of quartz and possibly suitable laterite in the southeastern parts, near Urana. The pebble beds and reef quartz (Bayley 1959) in the Urana locality would be one of the most proximate and easily accessible regional sources of stone. It is likely, although not demonstrated, that these exposures of potentially suitable lithic materials would have been utilised by Aboriginal people. If they made use of local sources, then quartz materials would be predicted to be relatively more prolific within archaeological sites in this locality.

Potentially useful Devonian quartzitic materials also occur to the north and east of the region. Quartzitic conglomerates and pebbles have been observed in the Cocoparra Ranges to the north of the region (Gollan 1982; McKeown 1929; White 1986). An Aboriginal quarry was recorded in a pebbly Devonian sandstone near Wilbriggie, south east of Griffith. Utilised materials included quartz, quartzite, a siliceous chert-like stone, fine grained greenstone and basaltic rock (Gollan 1982:15).

Several minor Devonian hilly areas occur in the region, the largest being Mt Galore, which rises approximately 340 m above the surrounding sloping plains. Other minor landscape features occur sporadically throughout the region. Elevated dunes and sandsheets (source bordering dunes) are located adjacent to the Murrumbidgee River, Yanco Creek and palaeochannel systems on the western plains. They formed between 30,000 and 15,000 years BP during colder periglacial climatic conditions characterised by reduced stream flows, high winds and slope erosion (Bowler 1978:104).

Substantial changes in microtopography have occurred in the region following European settlement. Tree clearance, overgrazing and agricultural practices have resulted in the destabilisation of many ground surfaces. Land levelling for irrigation agriculture has removed many surficial microtopographic features (Klaver 1987; Mengerson and Toohey

1979). The combination of seasonal aridity and texture contrast soils (Butler *et al* 1973) has led to considerable wind erosion throughout the region, characterised by the formation of scalds. These comprise impermeable exposures of the clay subsoil which may pond water for lengthy periods, depending upon evapotranspiration rates (Houghton and Charman 1986). Whilst present erosion patterns are concatenations of modern surface destabilisation it is likely that similar features would have been present throughout the regional history.

Early colonial clearance of mature *Callitris* forest from source bordering sand dunes abutting the Murrumbidgee River has hastened bank erosion in many areas (Sharland 1947) and led to more rapid alteration of meander courses than is likely to have occurred in the past.

3.3.2 Temperature and Rainfall

The Central Murrumbidgee Region may be split into two broad climatic zones with the Yanco Creek as the divide. The Köppen Climatic Classification for the area east of the Yanco Creek is a Warm Climate with Uniform Rainfall and Hot Summers (Cfa). West of the Yanco Creek the climate is classified as Semi Arid with Uniform Rain and Cool Mean Annual Temperatures (BSfk) (GHD 1970).

Annual rainfall ranges between 300 and 500 mm, decreasing from east to west across the region. Five hundred millimetres fall at the far east of the region, decreasing to 400 mm along the Yanco Creek, 350 mm in the vicinity of Carrathool to 300 mm west of Hay. As noted by Low (1990:230-231), mean annual rainfall conditions may be poor indicators of life conditions within a region since living organisms react to, and are generally in balance with, the extremes in climatic conditions as well as with the predictability of those extremes. The region experiences considerable seasonal and inter-annual variability in rainfall and rainfall conditions.

Maximum precipitation occurs in winter, with more than 25% of rain falling from June to August (Lawrence 1937:4-5). Effective rainfall is also experienced during winter, the result of continental patterns of cold fronts and depressions (Porteners 1993), although its duration decreases from east to west. The maximum effective rainfall is experienced at the eastern boundary of the study region, generally lasting four months, between May and August. This declines to three months, June to August, for the remainder of the eastern area extending west of the Yanco Creek to Carrathool. Further west, effective rainfall reduces to two months, generally June and July (Davidson 1934). A subsidiary wet period may also occur in late October (Van Dijk and Talsma 1964), but summer evaporation rates often mean that it is of little value to plants. Anderson (1976:58) dwelt

near Jerilderie, to the south of the region, in the 1880s, and noted that the climate had hot summers, and that the months from October to February were droughty.

Rainfall is at its most unreliable from January to March when it generally occurs in the form of brief, but heavy, thunder storms (Porteners 1993; Van Dijk and Talsma 1964). Due to its brevity and violence, this type of rainfall is ineffective, tending to be lost in run-off and rapidly evaporated pondages. Annual variations in total and effective rainfall are also common. Rainfall records spanning 35 years, from 1900 to 1935 demonstrate that Narrandera experienced 15 dry years, although no desert years. Hay, at the western boundary, experienced 19 dry years and three desert years (Lawrence 1937:22). Conditions of water over-abundance are also episodically experienced. Localised floods resulting from falls of up to 150 mm over a period of several days have also been recorded (Walker 1941).

Water availability throughout the region from local rainfall is thus seasonally, annually and episodically variable, with its effect becoming more pronounced in the west of the area. The growing season is short, and dry summers may result in little surface water in the plains areas during this season. Dry spells and drought are also frequent and may render large areas unsuitable for longer term occupation. Conversely, when heavy rains fall and prolonged wet spells occur, large tracts of land become inundated, forming vast swamplands. These may last for up to four months under present conditions (A. Gooden pers comm 1987; C. Heckendorf 1989 pers comm) even with modern drainage controls in place. In the past therefore, such swamp systems would have been even more durable. They are particularly common in the south east of the region, although substantial swamps also form in the west, along palaeochannel systems and in old lake beds.

Climatic data thus highlight the variability of the region in terms of local water supply and emphasise the degree to which Aboriginal settlement patterns may have been influenced by patterns of water availability. It is equally apparent, however, that the region offers many areas apart from the river channel itself where water would be retained for lengthy periods. It is important to note, however the dual nature of the regional water supply. Climatic events outside the region govern the riverine hydrology but local conditions make a major contribution to the distribution of water across the landscape. In addition, local rainfall patterns may ameliorate deficiencies in the river flow, or exacerbate flood conditions.

If Aboriginal people were highly dependent upon water availability (including its effect upon the presence or distribution of certain resources) to facilitate their occupation throughout the region, then their resultant patterns of occupation may exhibit variation on seasonal, annual and longer term time frames. It could be predicted that, over time,

relatively more substantial occupation, reflected by the presence and characteristics of archaeological sites, may occur in the areas where water availability (and concomitant resources) are more durable and dependable.

3.3.3 Hydrology

The major drainage system of the region is the westerly flowing Murrumbidgee River (Plate 1) and southerly flowing Yanco Creek, with their associated tributary and anabranching streams such as the Colombo (Plate 2), Billabong (Plate 3) and Old Man Creeks, and billabongs. Billabongs may be permanent or semi-permanent, and comprise remnant meanders, which, although no longer part of the current channel, still fill with water during high river levels. Subsidiary drainage systems also exist throughout the western plains in the forms of palaeochannels and non-riverine swamplands. Other regional water resources include ground water supplies which are largely independent of, although supplemented by, local rainfall.

A large proportion of water conducted through the Murrumbidgee River emanates from seasonal snow melt in the Eastern Highlands. The volume of water directed into the system results in flooding. Flooding may occur once, several times a year, or not at all. Flooding may occur from high rainfall and snow melt in the headwaters, whilst dry conditions are being locally experienced. Alternatively, localised wet conditions may escalate into flood events despite dry conditions within the eastern catchment (Sinclair, Knight and Partners 1977).

Flooding was a major difficulty for early European settlement. Records maintained since 1887 indicate that the majority of floods in the region occur during winter and spring, although flooding may occur in any month of the year. In October 1849 Surveyor Larmer wrote to Surveyor Townsend confirming that flooding in the Murrumbidgee River was preventing his mapping of features (Larmer 1859 Document 58). Mackenzie (1852:113) noted that creeks in the south of the region tended to overflow during the months of August and September.

There is some question as to the precontact incidence and severity of riverine flooding. Under present conditions of managed riverine flow and the presence of flood mitigation levees the effects of major flood events are directed into particular areas. Past conditions would certainly have included similar floods, but with a reduced frequency and an overall more dispersed effect. Normal conditions along much of the riverine corridor are therefore more likely to be those related to minor and moderate overbank flooding resulting in inundation of lower lying areas. During such events it is likely that many riverine levee areas remained accessible, although circumscribed by wet groundsurfaces.

Flooding occurs both as direct overbank flow adjacent to the river channel and as a spread of waters to the outer floodplain by filling anabranches, swamps and old stream systems which then in turn may overflow. Between Wagga Wagga and Hay, the northern floodplain of the Murrumbidgee river is abruptly confined by a steep bank relating to palaeochannel activity (Sinclair Knight and Partners 1977:27). This effectively reduces the spread of floodwaters northwards. Areas south of the river are thus more affected by flooding, and a much broader floodplain has formed. Low-lying and poorly drained areas south of the Murrumbidgee River towards Lockhart become severely affected by flooding and may constitute inundated swamplands for months following a flood event.

Damming of the upper Murrumbidgee catchment was completed by 1912 (Walker 1941) and the periodicity of flooding became regulated, reducing the incidence and severity of minor to moderate floods in areas downstream of Wagga Wagga (Sinclair, Knight and Partners 1977). The construction of levees has also produced minor local variations in the distribution of floodwaters, although their broad spatial occurrence still follows previously established patterns (GHD 1970:figure 1.8).

The unreliability of flow conditions within the Murrumbidgee River, and consequently within its southern distributaries, was noted in the recent past. It ceased to flow altogether following drought conditions, exhibiting a dry sandy bed as far west as Hay (Gipps 1884:136). Early settlers in the region describe periods of up to 12 years (between 1832 and 1844) when river levels were insufficient to flow into the Yanco and Colombo Creeks (Baylis 1927:255). Water retreated to deeper waterholes, and associated lagoons dried up.

European settlement countered the regional irregularity in water availability, to some extent, by constructing dams across smaller stream courses, and sinking wells. The earliest European settlement in the Colombo Creek area, prior to the canalisation of the Yanco Creek, relied upon small dams to extend the distribution of water. Anderson (1976:54) observed that due to the flatness of the land, a small bank of about 1.5 m in height, positioned across a watercourse, resulted in the backing up of waters for several miles. It is probably significant that at this time it was noted that the most efficient method of siting a dam was to find an extant Aboriginal dam and to build over it (Gilmore 1986). Strategies to increase the amounts of water directed south from the Murrumbidgee River included deepening creek confluences, the cutting of a canal into the Yanco Creek and the removal of sand-bars within creek beds to prevent water from being retained in deep water-holes (Baylis 1912a; 1912b, Jerilderie Herald, June 24th, 1913).

Modifications to the regional hydrology have thus changed some of the patterns likely to have influenced Aboriginal settlement. Whereas European settlement preferred flowing

water, rather than waterholes, and drained swamplands, it is likely that these previously localised, but more reliable features, would have been a considerable asset in Aboriginal settlement. The increase of flow in creek systems present today would also give a false impression of the uniformity and reliability of these systems during the past when in fact, apart from the waterholes, they were of lesser utility.

Plains east of the Colombo Creek are poorly drained and water is not directed into the creek, but to isolated small swamps and depressions (Plate 4). These generally form extensive expanses of swampland which last for months, particularly if coupled with local wet conditions. Swamplands also occur in former Pleistocene lake beds, such as Lake Urana and Lake Cullival, south of the river (Page *et al* 1994) and Lake Coolah, to the north, although they are generally not as reliable. Several small creeks drain into Lake Urana and it generally contains some surface water in late winter and early spring. However, it has only filled to capacity four times since 1848 (Page *et al* 1994:38). Its extensive areas of inundated woodland and marsh understorey provide good migratory bird habitat. Lake Coolah is the overflow depression for Mejum Swamp (Lake Midgeon in early literature), the former drainage terminus for the Mirrool Creek prior to flow diversion. Old records indicate that conditions in Lake Coolah were also extremely episodic. Between 1951 to 1958, water only flowed into it for approximately six weeks in 1956 (Whiteman 1958).

Between Narrandera and Darlington Point a proportion of the river discharge is spent recharging shallow groundwater aquifers (Woolley and Williams 1978). Groundwater is present throughout the region, although mostly at depths over 10 m. Nevertheless, there are localised occurrences of shallow groundwater which would require little effort to exploit. At Cedar Grove, in the far west of the region, water occurs about 1.8 m beneath the ground surface and surface soakages are also present (Milliken pers comm 1989).

Consideration of regional hydrology suggests two main influences upon potential patterns of Aboriginal occupation. These relate to water deficit due to seasonal drought which may necessitate physical relocation to areas with proximity to water sources, and water surplus, due to flooding, which, whilst seasonally increasing the quantity of exploitable resources, physically reduces the extent of habitable lands.

To survive during conditions such as these Aboriginal people may have developed highly efficient mechanisms for using available water sources. Records from proximate regions note extensive knowledge and use of water retentive vegetation and native wells accessing groundwater supplies (Cairns 1858; Maiden 1901). Extensive reciprocal social networks permitting people to physically relocate to an area where conditions were less harsh, may also mitigate the effects of climatic extremes. Such a pattern might have been

contributory to observations made by Sturt (1963 [1829]:46), who passed through the region in a period of lengthy drought and noted a great disparity of population between the dry Murrumbidgee region and areas downstream approaching the Murray River. Reciprocity in the form of hosting 'feasts' during the initiation of young men, and socially motivated barter involving the exchange of identical articles was also noted by Mathews (1897:151), in addition to the other exchanges of articles deficient in the region.

Observations made by George Augustus Robinson concerning Aboriginal occupation along the Murray River suggested that subsistence became difficult immediately following flooding (Mackaness 1941:344). For Aboriginal occupation along the Murrumbidgee river, an immediate effect of major flooding would have been the reduction of access to riverine resources. The extent of inundation may have pushed people out of most of the river corridor to the southern plains and floodplain margins, or to areas of higher ground within the floodplain, such as elevated dunes and sand sheets.

Creek and river levees often remain habitable during minor flooding (Plate 3) and are among the first areas to become accessible following the recession of floodwaters. If Aboriginal settlement patterns were closely tied to the spread and recession of flooded areas then these areas may have been important occupation zones. Some minor elevated areas are provided by hummocky microrelief (Plate 4) although their utility for longer term occupation is questionable. They may have served as short term activity sites or refuges (O'Brien *et al* 1989). People may also have adopted a strategy of spreading south to areas of plains until the wetland areas stabilised. Some support might be given for this latter pattern by the observation of Gallop (1886) who mentioned that whilst riding in the outer parts (distant from the Murrumbidgee River) of the stations at the end of July he encountered groups of Aboriginal people.

3.3.4 Vegetation Patterns

Regional vegetation structure is generally described in terms of plant alliances or communities. An alliance is characterised by the dominant species, and includes all minor elements associated or occurring as an understorey. Major changes have occurred to the distribution and composition of regional vegetation alliances since European settlement. The current vegetation structure of the Riverine Plain is best described as composed of disclimax communities, i.e. plant communities affected by European settlement.

The reconstruction of past broad patterns of alliance occurrence and composition has been assisted by the location of various relict plant populations, and the observations of early explorers, government surveyors and settlers. Government Crown Land Surveyors were commissioned to record plant resources from 1864 up until 1963 (Jeans 1978). Early

botanists also sought indigenous plants with economic potential (Maiden 1899; Turner 1893), often indicated by their Aboriginal utilisation.

Survey reports relating to the region were examined to obtain information on historic vegetation patterns (Larmer 1847-50, 1848, 1849, 1851; Townsend 1848, 1849a, 1849b, 1849c, 1851, 1852, 1853; Twynam 1859; Woolrych 1848). As a rule the information obtained was of a general nature indicating the community structure i.e. forest, woodland, scrub or plain. Accounts are rarely species-specific beyond observations of generic terms, such as oak, gum, box, wattle scrub, saltbush, salsolacious plants, polygonum, weeping willow, pines, thistles and reeds. However, the relationship between microtopography and vegetation community was often indicated.

The spatial distribution of potentially useful plants is a further way of considering the region from a perspective which aims to identify possible patterns of Aboriginal landuse. On the basis of reconstructed patterns, the study region can be divided into six phytotopographic zones where different vegetative alliances were present. Substantially different communities occur within the riverine and creek corridors, swamplands, palaeochannel and plains country. There is reduction in the woodland component of plains vegetation from east to west, reflecting the increasingly arid climatic conditions. Minor subgroups or 'patches' of plants may also have existed within these broader areas, although estimation of their specific composition and location is beyond the scope of this description.

1. Stream Corridor Forests - *E. camaldulensis* (River Red Gum) alliance.
The Murrumbidgee riverine corridor would originally have comprised a narrow floodplain dominated by *E. camaldulensis* alliance forest and fringed with *E. largiflorens* woodland. Moore (1953) calculated that the *E. camaldulensis* alliance contained at least 29 associated species and the *E. largiflorens* alliance contained 38. Associated understorey vegetation would have included *Atriplex nummularia* and *Kochia ciliata.* Early records indicate the extensive use of bark and wood from *E. camaldulensis* and *E. largiflorens* by Aboriginal people.

The alluvial valley plains surrounding the south flowing creeks were also characterised by communities dominated by *E. camaldulensis and E. largiflorens.* No associated tree species or shrubs are specifically documented for the alliances in these locations, the recorded understorey being predominantly composed of seed bearing grasses and herbs. Plants providing prolific and edible seeds included *Hordeum leporinum, Bromus rigidus, B. mollis, Vulpa bromoides, Danthonia* spp, *Trifolium glomeratum, Medicago denticulata, Erodium moschatum* and *Amphibromus neesii* (Moore 1953:513). Leafy

green plants such as *Tetragonia tetragoniodes* (warrigal spinach) were also widespread throughout these areas following rainfall (Leigh and Mulham 1977:254).

Forested areas suffered heavy initial impact following early European settlement. Station infrastructure was fuelled by local wood and bark supplies, and scrub cutting and ring-barking of trees was an early form of land improvement (Anderson 1976:57; Crombie 1927). Much of the mature timber quickly disappeared from the area. Native Pine (*Callitris* sp) (Plate 5) was particularly valued for its white-ant-resistant timber and was used for telegraph poles, buildings and fence posts (Sharland 1947:40). Only remnant sections of riverine corridor retain Eucalypt forest and associated woodland, although understoreys have been altered by forest grazing leases.

Sub-alliances of aquatic plants also occurred within the riverine and creek floodplains, within swamp and billabong environments (Hillman 1986:462) and would have provided many useful and edible roots, seeds and leaves. Potential staple plant foods would also have been prolific within the riverine corridor. Prolific seed bearing grasses were noted on the level alluvial plains and the swampy wetlands were dominated by reeds, such as *Typha* and *Phragmites.*

2. Plains Woodlands - i - *E. microcarpa* (Grey Box) alliance woodland present on undulating areas of the eastern plains; ii - *E. largiflorens* (Black Box) alliance woodland occurring on heavy soils fringing floodplains within the riverine corridor; iii - *E. melliodora /Callitris columellaris* (Yellow Box/Pine) alliance woodland common on sandy areas, particularly source bordering dune systems flanking the river and palaeochannel systems.

The undulating sloping plains in the east of the region, now heavily cleared (Plate 6), would have been predominantly vegetated with a *E. microcarpa* woodland alliance interspersed with areas of *A. pendula* and *A. nummularia* shrub woodland. The *E. microcarpa* alliance contained at least 203 associated species and the *Acacia pendula - Atriplex nummularia* alliance 134 associated species (Moore 1953). Moore (1953:486) noted early surveys which suggest that these woodland areas were originally open, with *Themeda australis* as the dominant understorey. The *E. microcarpa* alliance is characteristically found on heavier textured red-brown earths, although it is also found on heavy self-mulching grey clays in the eastern Bullenbung Plain vicinity (Moore 1953:507-8).

The source bordering dune systems which sporadically flank the forested riverine corridor are vegetated with a mixed *E. melliodora/Callitris* woodland alliance, associated species included *Casuarina* . The understorey of this community was noted to be

composed of vast expanses of 'forest grass' probably *Themeda or Danthonia spp* and honeysuckle scrub (Sturt 1963).

Palaeochannel features in plains west of the Yanco Creek were vegetated with *E. largiflorens* woodland, with localised occurrences of *Callitris* sp on sandy levees. A *Eucalyptus melliodora - Callitris glauca* association was also found in well drained sandy areas. Examples from within the study areas are from the Bublebundie Sandhills, in the far west of the region, and near Morundah, in the centre (Moore 1953:509). The understorey woodland alliances in these areas would have provided many useful and edible plant species, particularly those with edible underground roots and tubers such as the *Liliacaea*. Several potential staple foods are also present, notably *Microseris scapigera* and *Convolvulus erubescens*. Perennial grassland understoreys could also have been of economic importance and would have occurred in sufficiently large areas to encourage their exploitation by Aboriginal people.

Woodland areas which once supported grassland understoreys, would also have altered drastically following the introduction of grazing animals. Holland and Olson (1989:5) noted that after several years of grazing by sheep, *Themeda australis* and other palatable native grasses began to disappear. *Vulpa bromoides* commonly replaced *Themeda australis* and it in turn was replaced by winter growing, arid species. Increased grazing pressure encouraged the spread of native perennial composites. Currently the practice of phosphate topdressing and pasture improvement maintains the dominance of exotic species.

3. Eastern Hilly Woodland - *E. albens* (White Box) alliance.
The tall woodland dominated by the *E. albens* alliance is typically found on the poorer hilly podsolic soils in the east of the region. It is not found on the more prevalent red brown earths which are dominated by *E. microcarpa* (Moore 1953:509). Associated tree species include *Brachychiton populneus* (Kurrajong) as well as various *Casuarina* and *Acacia* species, all of which contain useful parts. The understorey was noted to be dominated by seed bearing grasses most likely including *Stipa falcata, Danthonia* spp, *Panicum effusum, Chloris truncata* and *Sida corrugata*. Associated useful herbs and bulbs included *Oxalis corniculata* and *Dianella laevis* (Moore 1953:511).

4. Rocky Outcrop Woodland - *E. sideroxylon /E. dealbata* (Red Ironbark) alliance.
Dominant tree species in woodland communities on rocky outcrops within the region vary between *E. sideroxylon* and *E. dealbata* depending upon soil and slope conditions. *E. dealbata* occupies the more extreme rocky conditions and is associated with species such as *Callitris glauca, Brachychiton populneus, Casuarina stricta* and *Exocarpus cupressiformis*. The grass and herb understorey would form only small, probably

uneconomic, patches amidst rocky outcrops, although useful plants likely to be present would have included *Stipa falcata* and *Danthonia* spp. *E. Sideroxylon* becomes dominant as soils deepen downslope and again the understorey is poorly developed and unlikely to have presented useful quantities of seed or root bearing plants.

5. Shrub/woodlands - *Acacia pendula/Atriplex nummularia* (Boree/saltbush) alliance. McKeown (1929) described the vegetation of the plains lands as composed of grasses, everlasting daisies, Darling Pea, and sparse trees, including *Hakea* (needle wood), *Eucalyptus* spp (box), *Acacia pendula* and *Callitris* sp. Anderson (1976:36), in a letter dating to the 1880s, also described species found in plains vegetation communities:

> "The trees of the district are Red Gum, Box, Willow, Peppermint, Myall, Boree, Pine, She Oak, Honeysuckle, Quondong, Dogwood, and perhaps others I have not seen ... The names of the scrub trees most frequently seen, are the Ti-tree, Cuba, and Hopbush. (Herbs and Weeds) ... this class of stuff is pretty numerous and consists of - Salt Bush, Coton Bush, Lignum, Marsh mallow (or I believe more properly Wild Geranium), Wild Camomile, Wild Peppermint, Darling Pea, Pie Melon, Chinese Melon, Bathurst Burr, Trefoil Burr, Cockspur, Sow Thistle, Thistles - various, Penny Royal, and many more whose vulgar names I can't find out .. Marsh Mallow and Sow Thistle or Warrigal Cabbage are sometimes used as bush vegetables when better cannot be had ".

At the western boundary of the Bullenbung Plain a mixed community of *E. microcarpa* and *A. pendula* occurs (Moore 1953:526). Areas west of the Bullenbung Plain and extending to the west of the Yanco Creek are thought to have been populated with a shrub woodland dominated by *A. pendula* and *A. nummularia*. These two species would have occurred in varying combinations and concentrations. Associated fruit and seed bearing understorey plants would have included various *Chenopodiaceae* as well as *Rhagodia spinescens, Enchylaena tomentosa* and *Kochia aphylla. Nitraria billardierei* could have constituted a major food resource in these areas. It occurs in extensive and dense stands amidst shrub lands adjacent to riverine and black box woodlands (Porteners 1993). Maiden (1899:126) mentions the importance of this, and of *Mesembryanthemum* sp (pig-face) to Aboriginal people during summer.

> "This fruit is ... found also in the plains bordering upon the lower parts of the Murrumbidgee... To the natives these berries are an important article of food at this season (summer), and to obtain them and the fruit of the *Mesembryanthemum* they go to a great distance, and far away from water."

Seed bearing grasses, such as *Danthonia* spp, *Stipa falcata, Stipa aristiglumis* and *Panicum prolutum,* would also have occurred as understoreys. Extensive areas of *Microseris scapigera* (daisy yam) were also initially present throughout the plains lands. During the initial development of irrigation lands at Coleambally, west of the Yanco Creek, daisy yams were numerous in ploughed lands (pers obs). Leigh and Mulham (1977:280) note that they are still locally common on lightly grazed grassland and

saltbush communities on clay and loam soils of the central and southern parts of the riverine plain.

A major change in the structure of plains vegetation has been the conversion of shrublands to grasslands, with concomitant loss of associated plant and animal species. The loss of *Atriplex* as an understorey was mostly due to the combined influences of the introduction of sheep and drought experienced during initial European settlement. When *Atriplex* became unavailable, settlers felled the remaining *A. pendula* (boree) for stock feed. Anderson (1976:56) observed that myall, boree and dogwood were often cut for stockfeed in dry seasons, and areas which now appear to have never had a tree upon them would previously have been quite well wooded with thick scrubby understoreys, to the extent that a horse and rider could hardly force a passage.

Westwards toward Carrathool the woodland structure became even more open, although it remained dominated by *Acacia* species with understoreys of *Atriplex nummularia*. West of Carrathool, woodland and shrubland vegetation structures merged with Chenopod shrublands, of which *Atriplex vesicaria* was a noted component (Porteners 1993). Potential important or staple foods in the plains lands would have been various seed bearing grasses, seeds of various saltbush species, *Nitraria billardierei* and *Mesembryanthemum* sp as well as root vegetables such as *Microseris scapigera* and members of the *Liliaceae*.

6. Swamps and Wetlands - consisting of *Eragrostis australasica/Muhlenbeckia cunninghamii* (Canegrass/Lignum) alliances in closed swamplands throughout the plains lands. These may also occur as sub-alliances within riverine forest and shrub woodlands. Areas of reed (*Typha* sp) dominated swamplands occur prolifically throughout the riverine corridor. They often formed vast reedbed understoreys, within areas of eucalypt forest, in particularly poorly drained areas within the floodplain, such as stream confluences and braided channels.

Swamplands have been progressively drained throughout south eastern Australia, since initial European settlement (Mitchell 1986). Many riverine swamps within the study region have been isolated from their water supplies by the construction of levees and dams. A major reed (*Typha* sp) swamp along the Old Man Creek in the eastern part of the region is currently drained and cropped. The current distribution of reed swamps has been dramatically reduced. In the initial period of settlement and overlanding, reedbeds were the focus of cattle fattening efforts (Chesterfield 1986; Williams 1962:419). Chesterfield (1986:12) noted the likelihood that the reedbeds observed in the Riverine Plain early in its European settlement would have been composed of *Typha* sp and *Phragmites* sp. Following the introduction of cattle, the distribution of such reedbeds

would have contracted to areas of poor drainage and species of Giant Rush *Juncus ingens* may have colonised remnant areas (*ibid*:14). Introduced bottom feeding fish, such as carp have also been responsible for a continual decrease in the distribution of *Typha* (*ibid*).

Closed swamplands dominated by *Eragrostis australasica* and *Muehlenbeckia cunninghamii*, alliances also occur within the plains landscape. The particular combinations of plant species found in these types of swamplands varied greatly, depending upon factors such as water depth, length of inundated period, and whether inundation is due to localised catchment or river flooding (Stanley 1982:59). Associated species often encountered included *E. largiflorens*, *E. camaldulensis*, *Typha* sp, *Chenopodium nitrariaceum*, *Maireana aphylla*, *Atriplex* spp and *Scierolaena quinquecuspis* (Moore 1953:509; Porteners 1993; Stanley 1982:59).

Aquatic plants such as *Typha*, produce edible and useful substances practically year round. *Typha* is a tall species of reed, standing up to 1.6 m high, which flourishes in swamp or marsh environments (Plate 2). It acts to extend its environment by its reduction of surface evaporation (Sainty and Jacobs 1981:419). The vegetative element is produced from a carbohydrate rich rhizome which constitutes up to 50% by weight of the living matter of the plant and which remains viable for up to 22 months before commencing to decay (Dickerman and Wetzel 1985:36). Most parts of the plant are useful or edible at some stage in the growth cycle. The rhizome contains a high proportion of edible starch, concentrated during periods of winter senescence and limited quantities of protein, as well as tough interior fibre. The young emergent shoots also contain some protein (McNaughton 1966:320).

The pollen obtained from the flowering heads of the reed is also edible and can be gathered in large quantities. In India and New Zealand there are records of gathering sufficient pollen to bake into small cakes and the young female flowers are also edible and can be eaten straight from the flower spike (Cribb and Cribb 1974:163). *Typha* obviates the need for human food storage strategies since the plant itself operates as an inherent food store (Deacon 1976:97). The rhizome contains the peak amount of stored carbohydrate during its winter dormancy, between April and August, although the roots could be gathered throughout a year.

Typha responds readily to attempts to control its various growth phases. In a northern hemisphere study, stands of *Typha latifolia* were experimentally subjected to varied management techniques (Krusi and Wein 1988). Some were burnt at different seasons to coincide with different developmental stages and some were cultivated in an absence of standing water. The study indicated the tenacity of the species. It was able to withstand

drainage for up to two seasons, even when combined with burning of the leafy components. These abilities indicate its potential dependability in a region which is characterised by episodic water deficits.

The availability of the various vegetative parts of *Typha* (Table 3.1) could be organised by burning of the reed beds. The plant's response to burning is to undergo a stimulated period of growth. It would thus be possible for Aboriginal groups to counteract the natural seasonal variations in *Typha* availability by burning stands differentially in phase. The variety of materials available in rhizomes, shoots and stems could then be maintained for longer periods of time. Alternatively, firing could simply be used to stimulate the plant and enhance early spring growth following winter senescence. Burning may also be desirable to maintain some open water conditions.

Table 3.1 Potential *Typha* Schedule:

Summer:

December: Young shoots available, no point in burning, starchy matter in rhizome transferring to vegetative component so starch depleted, fibre available.

January: Young shoots still available, bad time to burn, rhizome starch matter depleted, fibre available and flowerheads forming.

February: Young shoots available, rhizome at its worst for starch content, fibre still available, flower stems green, flowers and pollen available.

Autumn:

March: Young shoots available, good vegetative growth so rhizome receiving nutrients and commencing dormancy and starch storage good, good fibre available, good time to burn, dry flower stems and fluffy seeds available.

April: Plant finishing vegetative stage, no young shoots, vegetation contributing to rhizome storage, useful to burn stand and collect dry flower stems.

May: Plant finishing vegetative stage, no young shoots, rhizome good, fibre good, useful to burn stand or collect dry stems.

Winter:

June: Plant senescent, no young shoots, rhizome fully stocked, fibre available, stems available, no point in burning.

July: Plant senescent, no young shoots, rhizome fully stocked, fibre available, stems available, no point in burning.

August: Plant senescent, no young shoots, rhizome fully stocked, fibre available, stems available, good time to burn to clear old vegetative growth

Spring:

September: Plant shooting for first growth phase, young shoots available, good to burn to delay crop, synchronise stand and release nutrients to promote growth, rhizome good, fibre good.

October: Plants shooting, young shoots available, possible to still burn to delay and synchronise growth, rhizome good, fibre good.

November: Plant still in first growth phase, young shoots available, rhizome at worst, fibre available, no point in burning at this stage.

The most efficient times of the year to fire *Typha* would be autumn and spring. An autumn burning would cause little damage to the plant because the winter senescence would already be setting in, and it would clear away dead plant material creating more favourable conditions, enabling efficient penetration of radiant energy, for the next period of spring growth. Burning in spring could be undertaken before the major shooting

phase when only a few emergent shoots were visible. This would synchronise and stimulate the plant as well as provide nutrients for further growth. Summer burning would damage a *Typha* stand since most plants would be in a vegetative state and rhizomes would be in a state of relative depletion. If burnt at this time, the plant would be unable to store sufficient nutrients for the following season, and the stand would reduce in vigour.

There are numerous historical references to the Aboriginal utilisation of *Typha* collected from swamp lands in Southeastern Australia (Beveridge 1861:15; Blandowski 1857:136; Krefft 1866:361; MacPherson 1884:36; Mitchell 1965 [1839]; Wilhelmi 1869:167). Shoots were collected and eaten in August, or when the weather 'started to warm up' (Cairns 1858), and flower stems were eaten in spring (MacPherson 1884). The starchy roots were dug up in summer, and in some areas, comprised the main vegetable part of the Aboriginal diet for several months (Krefft 1866). The roots were steamed in earth ovens, after which they would be chewed to extract the starch. The fibrous pith was then stored for manufacturing twine, nets and bags, which figured prominently in regional exchange networks (Krefft 1866; Wilhelmi 1869). Krefft (1866:362) noted that the nets made for catching waterfowl were of considerable size, and their possession was considered as a fortune to the owner. He also noted that the availability of twine from the European settlements meant that no further *Wongal* articles were being produced. The processing of up to 'half a ton' of *Typha* at a time was observed in some instances (Mathew 1889).

In Western Australia practices suggestive of the Aboriginal management of *Typha* were observed. Grey's early accounts dating to 1841, from the Swan River region, include the observation that the natives burnt 'flag' to improve its quality and conclude that their behaviour constituted a kind of cultivation (Hallam 1973:57). Such practices might also be indicated in the observation made by Curr (1965 [1883]:78) in the Moira Marshes, on the Murray River:

> "A sea of reeds, of several miles in extent, as far in fact as the eye could reach, met our view on two sides...The reeds were by patches and strips of different hues and growth, in accordance with their ages and the periods at which they had last been burnt."

Although Curr does not specifically state that the reed beds were burnt by Aboriginal people, his observation was made in the early 1840s during his initial search for land. This was prior to other European settlement or stocking of the region. If burning was due to natural causes, the differences in age of particular patches, would probably not take on such a regular appearance. Of course, there might also be reasons for burning, such as to clear waterways to facilitate passage (Gott 1982).

The observations made by Cairns (1858:35) concerning *Typha* might also indicate the burning of reed beds, since he makes a point of mentioning that the *Typha* rushes turned brown after being frosted, and continued to remain so if not destroyed by fire. The firing of reedbeds elsewhere in Southeastern Australia was also observed by Eyre (Gott 1982:61).

It is interesting to note that most collection of the *Typha* roots was observed to occur in the summer, a time when the starch content of the rhizome would be at its lowest level (Table 3.1). This seems like a relatively inefficient use of the plant for food. Such collection strategies could have resulted from several factors. Summer tends to be the period when water levels are lowest and the roots would have been most accessible. There may have been little other plant food available during these periods, hence people may have resorted to *Typha*, although Pardoe (1995:708) attributes the winter exploitation of *Typha* as the obtaining of 'famine food'.

O'Connell and Allen (1995:858) surmised, on the basis of evidence from North America, that *Typha* is an 'expensive' resource to exploit, in terms of nutrient return for effort, although this is debatable (cf. Dickerman and Wetzel 1985; McNaughton 1966). If all products of *Typha* are considered, such as the fibre used for the production of nets, noted to be the mainstay of existence for the Riverina tribes (Newland 1899), then the relative expense of its procurement would diminish. The observation of Krefft (1866:361), that he believed that it was on account of the fibre that *Typha* was made an article of food, may be pertinent:

> " In this part of the country [Lower Murrumbidgee] where extensive reed beds are of common occurrence, the natives live for several months during the year on 'Typha roots', or Wongal (Typha shuttleworthii); at a certain period, I believe January or February to be the months, the women enter these swamps, take up the roots of these reeds, and carry them in large bundles to their camp; the roots thus collected are about a foot to eighteen inches in length, and they contain besides a small quantity of saccharine matter, a considerable quantity of fibre. The roots are roasted in a hollow made into the ground, and are either consumed hot or taken as a sort of provision upon hunting excursions; they are at the best a miserable apology for flour, and I almost believe that it was more on account of the tough fibre thus obtained that these roots are made an article of food. As soon as a sufficient quantity of 'Wongal' had been roasted, the whole tribe settled around the improvised oven, every body chewing the roots most vigorously; the lumps of rejected fibre were afterwards collected by the women, and spun into threads from which their fishing-nets and other domestic utensils were manufactured, these nets forming the staple article of barter between the tribes inhabiting the reed-beds and those parts where no Wongal was produced."

The utilisation of wetland food resources may be inferred from the apparent importance of such environs in settlement patterns interpreted as embodying conservation strategies. Gilmore (1935:viii) recounted observations made by early European settlers that Aboriginal groups exploiting these types of swamplands near Jerilderie, in the south of the region, alternated their annual camping areas in order to enable species to recover. She also described the reservation (perhaps 'harvest rotation') of certain parts of resource-rich areas such as swamps where birds bred.

> "The law of sanctuary in regard to large or wide breeding-grounds, such as Ganmain and Deepwater, where once there were miles and miles of swamps ... was that each year a part of the area could be hunted or fished, but not the same part two seasons in succession." (Gilmore 1986:140).

The potential for Aboriginal manipulation of plant resources in these riverine landscapes cannot be over emphasised, although the archaeological correlates of such activities may be very difficult to detect. The degree of vegetational and landscape change following the introduction of livestock and the subsequent agricultural development of floodplain areas has also served to obliterate any evidence. Plants could have been subject to considerable management although the methods may have appeared unorthodox in terms of European perceptions of what agriculture or cultivation should look like, hence early records are unlikely to contain references to these activities.

In some instances, the plains vegetation patterns seemed unusual to the early observers, some early surveyors' maps in the region displayed circumscribed areas of 'open plains' (Townsend 1848, Larmer 1848) within otherwise wooded areas. They were not explicable in terms of differences in water availability or soils and were commonly adjacent to more permanent water sources, such as deep water holes. It is possible that These areas reflected practices of landscape firing by Aboriginal people.

Aboriginal people were well acquainted with the use and effects of fire on the landscape. Their skilful manipulation of bushfires through effective back burning was noted in early accounts (Gilmore 1986). The use of fire for short term effects such as to clear vegetation, encourage new vegetative growth, attract and/or flush game has been well discussed, although the longer term impacts of Aboriginal burning regimes are debatable (Horton 1982; Jones 1969).

Regardless of arguments concerning the cultural creation of entire ecosystems by such burning regimes (Horton 1982; Jones1969), it is clear that there is great potential for management of smaller microenvironmental components. The ability to stage the life cycles of certain potential staple plant foods particularly *Typha*, but also perennial grasses and 'geophytes' by judicious use of fire, is a practice noted in various ethnohistoric accounts from other regions . Studies from other parts of the world have also noted the

potential of burning practices to extend or delay production of underground roots and corms, which are prolific in such shrub woodland alliances, thus increasing their value as staple foods (Deacon 1993).

Plants and Subsistence Technology

Plant resources were also used for the manufacture of many items of material culture. The fibrous parts of *Typha, Olearia pimeloides, Linum marginale, Lavatera plebeia, Abutilon theophrasti, Abutilon halophilum* were used to manufacture twine for nets and bags (Maiden 1889; Mitchell 1982:315). Netting was a major method of communal procurement of animal foods, and nets were specialised for different purposes (Beveridge 1883:45). Newland (1899:39) remarked that the Riverina tribes were expert hunters with nets. The manufacture of nets was observed to be a group activity (Krefft 1866), and associated evidence of net manufacture included earth ovens used for steaming fibre plants, and stones used to pound and soften the fibre. Fibre processing locations were often situated near water in order to ret the plant stems (Beveridge 1883).

Other plants were used as fish poisons and as medicines, for example *Centipeda cunninghamii* (common sneezeweed) (Leigh and Mulham 1977:277). The use of seed grasses in the region is well attested to, by the presence of numerous elongate seed mullers and grinding stones in museum and private collections (Klaver 1987). Other plants known to have provided fibre, wood and bark, include *E. largiflorens, E. camaldulensis, E. microcarpa, Brachychiton, A. pendula* and other hardwood species (Beveridge 1883; Cairns 1858; H.P. 1896, 1897a, 1897b, 1897c; Maiden 1899; Newland 1899). Canoes were composed of bark from several species of Eucalypt (Matthews 1908:4-6). Poles for propelling canoes had three spikes attached to one end, made of fire-hardened wood and kangaroo bone, for spearing fish (Beveridge 1883:41). The use of reed spears for hunting, and a heavier article for fighting, was also noted by Sturt (1963:Vol.II:54). Gilmore (1986:146) recounted that carved wooden artefacts made by Aboriginal people in the Murrumbidgee River district were chiefly made from *Acacia pendula* wood. An informant from the Lachlan River district also noted the importance of wood obtained from this species in exchange networks (H.P 1896:18). Such woods are extremely dense and durable, developing an attractive colour and polish when worked (Hall *et al* 1972). In addition, their habitat is restricted to the drier plains regions.

Patterns of Plant Availability

Despite the massive historic alteration of vegetation patterns, it is still possible to infer potentially exploitable plant resources and their likely distribution during Aboriginal occupation. Of particular interest are the potential *staple* plant foods which might have existed in the region, although other secondary plant foods and plants utilised for other purposes are also relevant. Plant foods recorded as notable Aboriginal staples in other

regions of southeastern Australia include *Typha*, various *gramineae* and succulents, and roots such as *Microseris scapigera* (Beveridge 1883; Gott 1982).

The majority of grass and herb growth in the region occurs from June to September in response to the winter rainfall regime (Porteners 1993), although localised flushes of plant growth may occur following rainfall, in all seasons (McKeown 1929). The period of maximum availability of ripe grass seeds would be from late spring to late summer (Turner 1893). The productivity of other seed bearing plants also peaks during summer.

There is little documentation on the ethnobotany of the region, so the relative importance of particular vegetation alliances and their likely influence upon settlement patterns is difficult to assess. Table 3.2 lists plants recorded as used by Aboriginal people in southeastern Australia which are found within this region. By analogy with other nearby regions it is possible to suggest that there were several major groups of plants which were likely to have been heavily exploited for food. These include reeds such as *Typha*, *Compositae*, such as *Microseris scapigera*, various succulents, and seed-bearing grasses.

Two major factors which would influence exploitation of particular plants, apart from the knowledge and desire to do so, include their seasonal availability and spatial distribution. Gott (1982:60) suggests that 'root' plants which store starches sugars and carbohydrates in underground organs display less seasonal variation than plants exploited for their leaves and fruiting parts, such as seeds and berries and that consequently they are more appropriately considered as staples. Although the species found in woodland and plains environs would be largely invisible during their winter dormancy, when their underground tubers contain their maximum reserves, this would present little obstacle to people with an intimate knowledge of their environment. Other root species such as *Typha* which are circumscribed by their water supply would be even more obvious in the landscape.

The data on *Typha* indicate the year round availability of some part of the plant, the often large quantities of the plant gathered, the means by which the material was processed and the products other than food which it produced notable twine for nets. Indeed it is possible that *Typha* stands had been managed by Aboriginal groups (Curr 1965). The significance of *Typha* management and fibre production technology may have been substantial not only in producing vital subsistence equipment but in the context of exchange networks into which these products entered, and their ensuing economic and social advantages.

SPECIES	COMMON NAME	USE	SEASON	HABIT	Alliance								
					E.camaldulensis	*E. largiflorens*	*E. melliodora/ C. columellaris*	*E. microcarpa*	*E. Albens*	*E.dealbata/ E.sideroxylon*	*A. pendula / A. nummularia*	*E. australasica/ M. cunninghamii*	
Marsiliaceae													
Marsilia drummondii	nardoo	roots pounded baked, seeds		Waterplant	x	x		x	x	x	x	x	
Gramineae													
Agopyron scabrum	common wheat grass	seeds	December to March		x	x		x	x	x			
Agrostis avenaceae	Blown grass	seeds				x			x		x		
Amphibromus neesii	Swamp Wallaby Grass	seeds	Summer and Autumn after wet conditions		x			x			x		
Aristida behriana	Spear Grass	seeds			x			x	x	x			
Bothriochlia ambigua	Red Leg Grass	seeds						x	x	x			
Chloris acicularis	Curly Windmill Grass	seeds						x	x		x		
Chloris truncata	Windmill grass	seeds	Summer and Autumn after wet conditions		x			x	x	x	x		
Danthonia caespitosa	Wallaby Grass	seeds						x					
Danthonia divaricatissima		seeds						x					
Danthonia sanguinalis		seeds						x					
Eragrostis lacunaria	Purple love grass	seeds	perennial, summer and sutumn					x	x	x	x		
Eragrostis parviflora	Weeping Love grass	seeds						x	x	x	x		
Eragrostis eriopoda	Woollybutt grass	seeds staple	October to November, possible second crop in Autumn after wet conditions	light soils	?			x					
Eragrostis elongata	Clustered lovegrass	seeds		sandy soils	?			x					
Panicum decompositum	Native millet	seeds staple	October, November, December, second season in Autumn following wet conditions	moist areas	x	x		x		x			
Panicum effusum		seeds staple	perennial, Summer growth after wet conditions	moist areas	x	x		x		x			
Panicum profutum		seeds			x	x		x	x	x	x		
Panicum whitei		seeds		drainage lines and depressions	x	x		x					
Poa australis		seeds	perennial, Summer and Autumn			x	x	x	x	x			
Sporobolus caroli	Fairy grass	seeds						x	x				
Stipa aristiglumis	plains grass	seeds				x		x	x		x		
Themeda australia	Kangaroo grass	seeds staple	December to March, later if conditions are wet				x	x	x	x			

Table 3.2 Useful Plants in Alliances in the Central Murrumbidgee Riverine Plain

SPECIES	COMMON NAME	USE	SEASON	HABIT	*E.camaldulensis*	*E. largiflorens*	*E. melliodora/ C. columelliaris*	*E. microcarpa*	*E. Albens*	*E.dealbata/ E.sideroxylon*	*A. pendula / A. nummularia*	*E. australasica/ M. cunninghamii*
Juncaceae												
Juncus bufonius					x			x	x		x	
Juncaginaceae												
Triglochin procera	Water ribbons	seed tubers on roots		wetlands	?							
Eleocharis												
Eleocharis acuta	common spike rush	edible tubers		wetlands	?							
Eleocharis pallens	pale Spike rush	edible tubers		wetlands	?							
Eleocharis pusilla	Small spike rush	edible tubers		wetlands	?							
Liliaceae												
Anguillaria dioica	Early nancy	edible tubers	Spring flowering but underground parts are best in Autumn-Winter				x	x	x	x	x	
Arthropoium milleflorum	Pale Vanilla Lily	edible tuberous roots	Spring flowering but underground parts are best in Autumn-Winter		?	x	x	x		x	x	
Arthropodium minus	Small vanilla lily	edible roots	Spring flowering but underground parts are best in Autumn-Winter				x	x		x	x	
Bulbinopsis bulbosa	Native leek	edible tubers	Spring flowering but underground parts are best in Autumn-Winter	grassy woodlands			x	x	x		x	
Bulbinopsis semibarbata	Leek lily		Spring flowering but underground parts are best in Autumn-Winter		?	x	x	x			x	
Dichopogon strictus	Chocolate lily	rootspounded roasted	Spring flowering but underground parts are best in Autumn-Winter					x	x	x	x	
Dichopogon fimbriatis	Nodding chocolate lily		Spring flowering but underground parts are best in Autumn-Winter		?	x	x	x			x	
Dianella laevis	Pale flax lily	blue berries and roots	Summer for berries, underground parts best in Autumn and Winter		?	x	x	x			x	
Thysanotus patersonii	twining fringe lily	roots and base of stem cooked	Spring flowering but underground parts are best in Autumn-Winter		?	x	x	x			x	
Amaryllidiceae												
Calostemma purpureum	Garland lily		Spring flowering but underground parts are best in Autumn-Winter					x		x	x	
Hypoxis pusilla	Star grass		Spring flowering but underground parts are best in Autumn-Winter					x		x	x	
Santalaceae												
Exocarpus cupressiformus	cherry ballart	small fruit	winter fruit red						x	x		

Table 3.2 Useful Plants in Alliances in the Central Murrumbidgee Riverine Plain

SPECIES	COMMON NAME	USE	SEASON	HABIT	*E.camaldulensis*	*E. largiflorens*	*E. melliodora/ C. columellaris*	*E. microcarpa*	*E. Albens*	*E.dealbata/ E.sideroxylon*	*A. pendula / A. nummularia*	*E. australasica/ M. cunninghamii*
Santalum acuminatum	Quandong									x		
Chenopodiceae												
Atriplex leptocarpa	Long fruited saltbush							x		x		
Atriplex nummularia	Old Man Saltbush	seed ground and baked	spring autumn					x			x	
Atriplex semibaccata	Creeping saltbush							x		x	x	
Chenopodium atriplicinum	Purple goosefoot							x		x	x	
Enchylaena tomentosa	Ruby saltbush										x	
Kochia excavata	Bottle Blue bush							x			x	
Rhagodia nutans	Climbing saltbush							x	x		x	
Rhagodia spinescens	Thorny saltbush										x	
Amarantaceae												
spp					x			x	x	x	x	
Nyctaginaceae												
Boerhavia diffusa	Tar Vine	edible root high carbohydrate						x	x		x	
Portulacaceae												
Portulaca oleraceae	pigweed	succulent leaves, seeds baked						x				
Cruciferae												
Lepidium hyssopifolium	Pepper cress	leaves, stems	drought food					x	x		x	
Roseacea												
Acaena ovina								x	x			
Leguminosae												
Acacia spp					x			x	x	x		
Acacia oswaldii								x				
Acacia salicina	Native willow	stun fish						x				
Geraniaceae												
spp	crowfoot	roots			x			x	x	x	x	
Linaceae												
Linum marginale	native flax	fibre, small seeds eaten						x	x			
Euphorbiacea												
Euphorbia drummondii	flat spurge	medicinal			x			x	x	x	x	
Malvaceae												
Lavatera plebeja	Tree mallow	fibre						x		x		
Myrtaceae												

Table 3.2 Useful Plants in Alliances in the Central Murrumbidgee Riverine Plain

SPECIES	COMMON NAME	USE	SEASON	HABIT	*E.camaldulensis*	*E. largiflorens*	*E. melliodora/ C. columellaris*	*E. microcarpa*	*E. Albens*	*E.dealbata/ E.sideroxylon*	*A. pendula / A. nummularia*	*E. australasica/ M. cunninghamii*
Eucalyptus largiflorens		bark			x				x			
Umbelliferae												
spp		seeds						x	x	x	x	
Gentianaceae												
spp		seeds						x	x	x	x	
Solacaceae												
Solanum esuriale	native currant	fruit						x		x		
Compositae												
Microseris scapigera	Daisy yam, murnong	edible root	summer	loam and clay soils saltbush assoc.		x		x			x	
Polygonaceae												
Polygonum aviculare					x			x	x		x	
Sterculiaceae												
Brachychiton populneus	black kurrajong, yam tree	young roots, gum, seeds						x	x	x		
Centipeda												
Centipeda cunninghamii	sneezeweed	medicinal										
Typhaceae												
Typha orientalis	Combungi	food, fibre - staple	spring summer	wetlands	x	x		x			x	x
Typha domingensis		food, fibre - staple	spring summer	wetlands	x	x		x			x	x
Aizoaceae												
Tetragonia tetragoniodes	Warrigal greens	leaves	Spring, Summer, grows best in hot weather	moist areas	x	x						
Diphysma clavellatum	emu bush	flowers eaten							x	x	x	
Geraniaciaea												
Geranium solanderi	native carrot	large edible root	summer autumn	damp sandy loam soils		x	x	x			x	
Hypoxidaceae												
Hypoxis pusilla		small fleshy tubers	Spring flowering but underground parts are best in Autumn-Winter				x	x				
Mimosaceae												
Acacia aneura	mulga	seeds roasted ground	summer	arid plains					x	x	x	
Acacia stenophylla	cooba	seeds roasted	summer	arid plains					x	x	x	
Acacia victoriae	prickly wattle	seeds roasted	summer	arid plains					x	x	x	
Pittosporaceae												

Table 3.2 Useful Plants in Alliances in the Central Murrumbidgee Riverine Plain

SPECIES	COMMON NAME	USE	SEASON	HABIT	E.camaldulensis	E. largiflorens	E. melliodora/ C. columellaris	E. microcarpa	E. Albens	E.dealbata/ E.sideroxylon	A. pendula / A. nummularia	E. australasica/ M. cunninghamii
Bursaria spinosa	Australian blackthorn	nectar	spring summer	loamy soils	x	x						
Convolvulaceae												
Convolvulus erubescens	Australian bindweed	roots eaten	winter staple	grasslands open timber		x	x	x			x	
Cyperaceae												
Cyperus spp	nut grass	bulbs	Spring flowering but underground parts are best in Autumn-Winter			x	x				x	
Dactolenium												
Dactolenium radulans	Button grass	seeds	late summer	light soils widespread		x	x	x			x	
Oxalidaceae												
Oxalis corniculata	sour grass, wood sorrel	small leaves raw		moist shady sites		x	x					
Orchidaceae												
Caladenia dilatata	spider orchid	tubers roasted	Spring flowering but underground parts are best in Autumn-Winter					x	x		x	
Microtis unifolia	onion orchid	tubers roasted	Spring flowering but underground parts are best in Autumn-Winter					x	x		x	

References: Leigh and Mulham 1977;Maiden 1899;1901;Moore 1953; Mulham and Jones 1981; Porteners 1993

Table 3.2 Useful Plants in Alliances in the Central Murrumbidgee Riverine Plain

Many potential staples occur throughout the major vegetation alliances and could be considered ubiquitous through the region. Others, whilst occurring in obvious concentrations related to microenvironmental conditions, are nevertheless commonly distributed. If plant rich environments were influential in determining where people resided, then attractive locations exist fairly evenly dispersed along the riverine corridor and throughout the shrub and woodland plains. Seasonal variations in overall resource availability would be more pronounced in dry land species which rely upon (often unreliable) rainfall for establishment and growth. The differences in total productivity and resource dependability between wetland and terrestrial environments would suggest that desirable occupation locations would comprise ecotones between the two .
Attractive locations would be ecotonal situations comprising strips of *E. largiflorens* woodland coincident with floodplain and swamp margins and lying between riverine floodplain resources and those of the adjacent plains. More dispersed patches of particular plant resources would also remain within range of these localities. Similar ecotonal positions also occur amidst plains lands around localised swamplands. These would also allow simultaneous exploitation of wetland resources and patches of shrubland species. Overall, the importance of these ecotonal positions as foci of Aboriginal settlement and exploitation would be predicted to be reflected by proportionately greater rates of site formation in these areas.

3.3.5 Animal Resources

Table 3.3 includes a range of potential faunal resources found within the region. A wide range of animal foods were consumed by Aboriginal groups in the region, although their relative contributions to overall diet is unclear. Studies in other riverine regions of southern Australia have used analysis of human biological material to infer the proportions of particular foods in Aboriginal diets. Analysis of late Holocene skeletons from Roonka, along the lower Murray River, indicated that adult males had diets with greater proportions of terrestrial herbivore meat whilst females and subadults apparently consumed greater proportions of vegetable foods, fish, molluscs and crayfish (Pate 1997:112). It is possible that consumption of species varied within, as well as between, social groupings since taboos and restrictions on consumption also existed (Howitt 1904). There are cautionary implications in such details. The mere presence of a particular species does not indicate its use, and patterns of microenvironmental exploitation may vary depending upon gender and age structure of Aboriginal populations.

Faunal resources available in the past would have been vastly different to present conditions. Many of the animal species originally present in the region were wiped out by hunting, trapping, competition from sheep, cattle and rabbits, and the introduction of predators such as dogs, foxes and cats, and the reduction and removal of habitat.

Vertebrate species numerous in the stream corridors would have included possums, frogs, goannas, snakes, turtles, waterfowl and water rats (McKeown 1929:420). Alteration of flow regimes in the river systems has resulted in increased flows of cold water which inhibit fish breeding cycles (Lake nd:26). The introduction of competitive exotic species, such as European carp, has also led to the decline of many native species.

Numerous fish species occur within the Murrumbidgee River including Pigmy Perch, Silver Perch, Murray Cod, Freshwater Catfish and Smelt. Species of freshwater crayfish, shrimps and yabbies and freshwater mussels would also have been prolific (MDBMC 1987). Aquatic resources, such as fish, become dispersed after flooding, and many species migrate to the outermost shallow flooded areas in order to spawn (MDBMC 1987). At such times they would present easy targets for spearing. Other species prefer mainstream habitats, although still waters, such as billabongs, provide protection from predators and are also used as resting areas. When river levels fall, fish retreat to deeper pools and effectively become trapped (Hillman 1986:465). Modern observations on populations of fresh water mussels have concluded that they would be more difficult to collect between the months of May and July, since they respond to falling water levels and winter temperatures by aestivating in deep mud deposits (Walker 1981:47). Billabongs may also contain different species of freshwater mussels than those found in fast flow conditions of river channels (Hillman 1986).

Gallop (1886:230) provided some information on the landscape of the western part of the region in May 1886:

> "The plains ...are suffering from want of rain & are of a very brown papery appearance ... Kangaroo, Emu Brush Turkeys & Native Companions abound, also rabbits ... I have had Emu and K (---) & Brush Turkey shooting: the latter are very good eating. Emu eggs are just being found"

He also mentioned an abundance of fish and crayfish to be found in the Murrumbidgee river in that month. Between May and July Gallop (1886:230) observed large lagoons abounding with bird life. Anderson (1976:55) observed that whilst the black swan was migratory, large flocks occupied all of the southern plains swamps in the winter time. Le Souëf (1901:3) observed that the swamps in the Riverina were full of young birds in December. Plains near Jerilderie abounded in kangaroo, wallaby, pademelon, wombat, dingo, 'opossum' and 'porcupine' (Anderson 1976). Gibson (1852:363) indicated that Bilbies were apparently numerous throughout the northern parts of the region prior to the coming of the rabbit, soon after which they died out. There were also two types of native cat, pademelons, kangaroos, emu, mallee fowl, bower birds and plains turkeys.

Resource	Monthly Availability of Resources											
	September	October	November	December	January	February	March	April	May	June	July	August
Typha see also Table 3.2												
Shoots	x	x	x	x	x	x	x					
Root carbohydrate	x	x										
Root fibre	x	x	x	x	x	x	x	x				
Stems									x	x	x	
Geophytes												
Microseris scapigera	x flower	x	x	x	x	x	x	x under ground	x under ground	x under ground	x under ground	x under ground
Liliaceae	x flower	x	x	x	x	x	x	x under ground	x under ground	x under ground	x under ground	x under ground
Geranium solanderi				x	x	x	x	x	x			
Convulvulus erubescens									x	x	x	
Seeds												
Perennial Grasses		x	x	x	x			x				
Annual Grasses				x	x	x		x				
Chenopods	x	x	x				x	x	x			
Dactyloneum radulans						x	x	x				
Fruits												
Santalaceae									x	x	x	
Exocarpus cupressiformis									x	x	x	
Acacia seeds				x	x	x						
Small animals												
Native rats and mice	x	x	x	x	x	x						
Possums												
Bilbies	x	x	x	x	x	x	x	x	x	x	x	x
Native Cats	x	x	x	x	x	x	x	x	x	x	x	x
Larger Animals												
Wombats	x	x	x	x	x	x	x	x	x	x	x	x
Pademelons	x	x	x	x	x	x	x	x	x	x		x
Kangaroos	x	x	x	x	x	x	x	x	x	x	x	x
Flocking Birds												
Parrots, Pigeons	x	x	x	x	x	x	x	x	x	x	x	x
Other Birds												
Brolga, Plains Turkey	x	x	x	x	x	x	x	x	x	x	x	x
Emu	x	x	x	x	x	x	x	x	x	x	x	x
Migratory Birds												
Swans	x	x	x	x	x				x	x	x	x
Geese	x	x	x	x	x							x
Ducks	x	x	x	x	x	x						x
Birds Eggs												
Migratory birds' eggs	x	x	x	x				x	x	x		
Emu eggs								x	x	x		
Reptiles												
Lizards/Snakes	x	x	x	x	x	x	x					
Turtles	x	x	x	x	x	x	x					
Fish												
Weirs	x	x	x	x	x	x						x
Nets	x	x	x	x	x	x						x
Poisons				x	x	x						
Diving/Spears	x	x	x	x	x	x	x	x	x	x	x	x
Mussels		x	x	x	x	x						x
Crayfish	x	x	x	x	x	x	x					
Insects												
Ant eggs	x	x	x									
Grasshoppers		x										
Caterpillars	x											x

Table 3.3 Seasonal Character of Major Subsistence Resources

Along creeks in the south of the region Mackenzie (1852:120) observed that possums and fish comprised a major proportion of the diet, fish were obtained in large quantities with nets, as well as speared. He also noted the consumption of native turkeys, wild ducks, bronzewing pigeons, wild geese, teal, parrots, musk ducks, native companion (Brolga), cockatoos, 'opossums', bandicoots, kangaroo rats, flying squirrels and wombats (Mackenzie 1852:82-120). Reptiles such as lizards, snakes and turtles, and their eggs would also have been available.

Broughton (1847:181) also noted that fish were a principal item of food. He commented that he often encountered old brush dams across billabongs and creeks which were at that time (just after March) dry. Gilmore (1986) also recounted finding numerous structures in dry creek beds, which she was told were Aboriginal fish traps. Kenyon (1930:75) indicated the general use of weirs along the Murrumbidgee River:

> "On the Murray and Murrumbidgee, weirs were built with stakes and brush when the swamps and reed-beds began to drain back after flood times. Fish were caught in enormous quantities."

Townsend (1848) sketched in a 'fish dam' on his crown lands survey of the Old Man Creek. It was positioned across a side branch of the creek amidst a very extensive area of *Typha* swampland.

Whilst interpreted simply as means of trapping fish when waters recede, such facilities would not only concentrate resources such as fish, but would also extend periods of water availability, and lengthen the availability of aquatic plants. Their overall effectiveness would be contingent upon their precise placement in suitable microtopographic configurations..

If staple animal foods exerted a major influence upon Aboriginal settlement patterns then certain environments could be seen as more attractive for residence. The *E. camaldulensis* forests and fringing *E. largiflorens* woodlands of the riverine and creek corridors would provide the densest possum populations. These areas would also provide fishing areas. Birds would be prolific in concentrated areas, either within the sub-alliance swamps within the river and creek corridors or the more isolated swamps found throughout the southern plains lands.

This broad spatial distribution would be further influenced by seasonal factors. Major flooding would eliminate residential access to much of the river and creek corridors for lengthy periods, although people would still be able to gain access to these areas with watercraft. However as noted previously flooding disperses fish populations, initially making them more difficult to obtain. The recession of floodwaters was noted to provide optimal conditions for trapping fish in weirs and nets. Population structure and size would also have had a major effect upon any proposed pattern involving alternation

between spatial occurrences of resources, since it assumes that access between these riverine and hinterland environments was not restricted by population density.

Birds would be able to colonise swamps in spring for breeding purposes when there would be large quantities of eggs and young available, although this would be largely dependent upon the prior riverine floods for activation of the swamplands. Likewise the plains swamps would require previous wet conditions, although once filled they could last for extended periods, and early observers did note that abundant bird life was still present in them throughout winter months. Other aspects of animal life cycles might also influence Aboriginal exploitation. For example observations collated in Brough Smyth (1878:Vol.I:142) described the collection of waterfowl during spring when they were incapacitated by moulting.

If people's movements were largely dictated by combined optimal plant and animal resource availability (Table 3.3) and accessibility to some landscapes was dictated by flood patterns, then broad seasonal patterns of regional exploitation could be suggested. These would become complicated but not invalidated by episodic events such as drought or irregular floods. As noted earlier, historic records suggest that major flood incidence occurred during winter and early spring. This would initially render the river corridor areas less attractive for occupation and might lead to the dispersal of populations to woodland and plains country, and perhaps to focus upon swamplands in these areas. Root bearing plants in these areas would then be at their maximum storage capacity prior to spring growth.

As floods recede, anywhere between late spring and summer the river corridor would provide attractive opportunities for mass capture of aquatic species. At this time *Typha* in riverine swamps would be commencing its growth cycle and providing edible shoots as well as the starchy roots. Previous staged burning of senescent patches would be a means of extending the availability of various parts of this species. As summer progressed, higher temperatures and rates of evaporation would dramatically reduce the availability of surface water throughout the region. People might then be drawn to focus upon waterholes in major creeks, or to the river, and then if conditions deteriorated, to deeper waterholes within the river channel.

During non-flood years settlement patterns might not extend to the plains lands. Not only would riverine habitats remain accessible, but plains swamps may not be activated. As dry summer conditions set in people would remain in the river corridor, in proximity to more permanent water resources. At such times collecting expeditions might be undertaken to retrieve fruits and seeds available in the western plains lands. The

occurrence of local rainfall could facilitate movements through these more arid areas at these times.

3.4 Aboriginal History

3.4.1 Introduction

Problems with the use of ethnohistoric data to reconstruct 'traditional' patterns of land use, likely population numbers and population densities are well discussed (McBryde 1979a) and are compounded when such patterns are reflected back in time (Frankel 1995). The short time period during which ethnohistoric observations were made, coupled with the usually limited ranges of activities observed, generally means that the representativeness of such observations of behaviour or settlement pattern cannot be assessed. This is particularly so for populations living in seasonally and episodically variable environments, such as the Murrumbidgee Riverine Plain.

3.4.2 Identity

At the time of European arrival the Murrumbidgee River frontage and southern hinterland between Jugiong and Hay was recorded as occupied by a division of the Wiradjury language group (Mathews 1897:112). A distinction between the population along and south of the river and groups north of the Murrumbidgee was reinforced by observations made by the Crown Surveyor of the period (Woolrych 1890:70:figure). According to Baylis (nd:1):

> "The Waradgery Tribe roamed along the Murrumbidgee River from about Jugiong and Tumut in the East to the junction of the Lachlan and Murrumbidgee Rivers in the West, while the former river was their northern boundary and the Billabong Creek their Southern boundary."

According to Howitt (1904:53) the Wiradjuri were bounded to the south-west by the *Baraba-Baraba* who occupied lands:

> "...from Mathoura between Deniliquin and Moama on the south to Jerilderie or Narandera (sic) on the east, to Moulamein on the south-east, and Dry Lake on the north-east.".

At the western end of the survey region Howitt (1904) placed the boundary of the *Ita Ita* . His descriptions differs slightly to those of Tindale (1974) who defined a boundary between the Wiradjuri and the *Baraba-Baraba* running from Gunbower at the southeast to Conargo, Coleambally, west to Eurolie and southwest to beyond Kerang. Tindale (1974) placed another tribal boundary, that of the *Narinari,* to the west, between Carrathool and Hay.

Hostility between Narrungdera people and another group to the west, which may have indicated an inter-group boundary was recorded in 1844, at Uroly (Eurolie) Station (Wall 1845). Presumed inter-group conflict was also noted in the vicinity of Uardry Station.

The daughter of Henry Angel, one of the first settlers along the river, commented that she had often witnessed fights between numbers of Aboriginal people (from 1840 onwards), resulting in bad spear wounds (Hurst 1968:37). There are difficulties with accepting European descriptions of conflict as representative of 'tribal wars' at face value. Many Wiradjuri ceremonial activities, for instance, involved mock battles (Howitt 1904, Mathews 1898). In addition many acts of retribution were directed at individual level, although it may have appeared that whole groups were involved (Mathews 1904). However, Wall's (1845) description of intergroup fighting was obtained by interviewing the Aboriginal people involved. Intergroup conflict at this period could have been due to the displacement of population by European settlement, as much as to any preexisting rivalries. Its coincidence with supposed tribal boundaries, however, remains of interest.

Aboriginal people living along the Murrumbidgee River appeared to have strong connections to people from the Lachlan River. There is some evidence of assistance provided by Lachlan tribes to Murrumbidgee tribes in order to prevent European occupation (Gammage 1983). Surveyors' references to conversations with Aboriginal people indicated the latter's knowledge of this northern landscape. For example, an Aboriginal informant indicated that the Mirrool Creek had its termination near a specific head station, some hundreds of miles distant. The man's account was later corroborated in field survey (Larmer 1847-1850:141). Such familiarity with the course of Mirrool Creek might reflect that it was a route through the waterless plain, as it would have provided ponded water and soakages even in times of no-flow.

3.4.3 Population Levels

Continental estimates of the precontact Aboriginal population of Australia, whilst varying between 150,000 and 1,000,000 people, have remained unresolved (Beaton 1990; Butlin 1983; Kefous 1988; Pardoe 1995). Regional population estimates are similarly imprecise and are largely based upon unsatisfactory counts occurring years after European disruption of settlement patterns and the introduction of diseases such as influenza and smallpox (Dowling 1990). Estimates of the population of the Murrumbidgee Riverine Plain at the time of contact are characteristically limited. Crown Lands Commissioner Bingham estimated in 1843, whilst carrying out surveys to establish pastoral rents, that there were 2000 Aboriginal people residing in the Murrumbidgee Pastoral District (Gipps 1844:1191). One hundred and fifty individuals were supposedly resident in the Uranna (Urana) district in 1845 (HRA 1845:268).

Sturt passed through the region prior to widespread European settlement, and remarked upon the apparent absence of Aboriginal people until he reached the lower stretches of the river (1963 [1829]:50-51).

> "We fell in with two or three natives before we halted, but the evident want of population in so fine a country, and on so noble a river, surprised me extremely" (Sturt 1963 [1829]:39).

However, there were indications of Aboriginal presence. The countryside showed evidence of having been recently fired, and fires, presumably in connection with Aboriginal camps, were often sighted in the distance during the evening (Sturt 1963 [1829]:42).

Sturt's non-observance of people could have related to seasonal patterns of landuse as well as local politics. Sturt travelled along the river in winter when, as previously suggested, on the basis of resource distribution, occupation may have been more dispersed through the landscape. The avoidance of European travellers by the Aboriginal population would not be unexpected since Sturt was passing through that country during a time of heightened tension between Aboriginal groups and initial settlers (Gammage 1983:5). Further east, where European settlement had already become established, substantial conflict had developed between the Aboriginal and European population (Fry 1993).

In 1839, ten years after Sturt's journey, McLaurin (1839; nd) passed along the Murrumbidgee River overlanding cattle. He noted many abandoned selectors' huts, reasoning that Aborigines had driven people off the land. Conflict was certainly common in the early days of settlement along the middle reaches of the Murrumbidgee River. "War zones" had been declared by Bingham, Commissioner of Crown Lands (Gammage 1983:3). To all accounts the Aboriginal population was able to organise widespread defensive cooperation with neighbouring Aboriginal people:

> "Indeed in July 1839 a Commissioner of Crown Lands believed that Murrumbidgee Aborigines were being assisted in battle by men from beyond both the Murray and the Lachlan" (Gammage 1983:4).

McLaurin (1839) also recounted having to be extremely vigilant to prevent the cattle being speared. On Devlin's run at Ganmain there had been a white man speared just prior to the party's passing through. Along the first stretches of his journey McLaurin (1839) rarely recorded any physical encounter or sighting of Aborigines, which may be a real reflection of the immediate absence of population since the overlanding party feared attack and thus had a heightened sensitivity to any Aboriginal presence. Watches were mounted every night and the potential for encounter frequently noted.

As the party moved westward along the Murrumbidgee River little was observed in the way of an Aboriginal presence. However, along its lower reaches towards the junction with the Murray River, this pattern of observation, like that of Sturt some ten years previous, altered dramatically. Frequent references were made to groups of 200 or more

Aboriginal people. McLaurin's diary tends to lend support to the oft-mentioned relatively low population levels along the upper to middle reaches of the Murrumbidgee River. The question remains, however, as to whether this was a reflection of a different seasonal economy or already a reflection of the impact of contact in this zone.

Scarce direct, albeit impressionistic, observations on population numbers do occur in later years. For example, in the west of the survey region, towards Hay, a workman on Uardry Station observed that there were 'plenty' of Aboriginal people along the river in 1844 (Hurst 1968:34). In 1844 Wall (1845) observed a group of 200 Aboriginal men women and children, who had travelled down from the Lachlan River on Mrs Jinkins (Jenkins) station. (Buckingbong was originally taken up by the Jenkins family in 1832 and sold in 1880, and Gillenbah was also owned by the Jenkins family (Irvin 1959:49)). Wall later noted that the tribe from the Lachlan only remained for a week. Aside from this observation, he also noted that local Aboriginal people were already in the 'employ of settlers':

> "... the chief thing that settlers employ them at is grindeing (sic) their wheat - and bringing water for which they get the wheat siftens - and they seem perfectly satesfied (sic) with."(Wall 1845:31).

Before and during 1840, Aboriginal people were also employed on Tubbo Station to strip bark, wash sheep, reap crops and shepherd stock (De Serville 1982:34-5). Aborigines were still peacefully resident on Tubbo Station in September 1844, when Wall (1845:31) attempted to obtain Aboriginal guides to assist his passage up the river, but was unable to persuade people to leave:

> "I made all sorts of promises to the Blacks but it was to no purpose not one would leave the tribe this is a very bad time as they ar [sic] to [sic] much fed with Mutton to think of leaving ..."

It was a typical response of the time to assume that such unwillingness to travel stemmed from laziness or the availability of food. Similar reluctance for Aboriginal people to act as guides was experienced by other explorers and travellers who attributed it to the justifiable fear of entering lands to which they had no right, and could probably be in danger (Critchett 1990).

In 1872 a camp of between 40 and 50 Aboriginal people were observed living in a camp near Buckingbong homestead, between the vineyard and the river (Freeman 1982:19; Gammage 1986:57). An anonymous observer on a trip by paddle steamer down the Murrumbidgee in 1875 saw Aborigines living along the river near Kerarbury Station, although he did not quantify his observations (Irvin 1959:24).

In contrast to the riverine corridor, other diaries, written by people situated further away along the southerly flowing creeks, tend to note an originally large Aboriginal presence (McLaurin nd). These areas were less attractive to, and less populated by, the initial

European selectors, due to their lack of permanent water. However even in these areas the Aboriginal population had been rapidly reduced by the 1840s. In 1846(?) McLaurin (nd:114) recorded that young Aboriginal men had been rounded up and taken north for a native police force. This, in combination with deliberate campaigns by squatters, caused cultural devastation. Incidents of stock spearing were a common occurrence up until 1848.

After 1848 McLaurin (nd:114) observed that Aboriginal people were more likely to be found congregated around homesteads and liquor sources than in their traditional camps. From the mid 1840s, Aboriginal people were thus employed as stockmen and farm labourers and there are occasional references, in written memoirs and anecdotes, to their assistance in crossing rivers and as guides through the countryside (Broughton 1847). By this time there was a new order in settlement pattern along the Murrumbidgee River:

> "Whereas in the '40s the Wiradjuri called on stations only when it suited them, in 1854 Commissioner Beckham observed that they now resorted to European establishments in winter, and only in Spring followed traditional hunting and gathering." (Gammage 1986:57).

McLaurin (nd) noted several methods by which groups were reduced or moved on. 'Scare' attacks, we are told, were mounted against them in retaliation for the spearing of stock and their deliberate herding of cattle away from waterholes. Aboriginal people were not allowed to remain in one place for any length of time, rather they were kept on the move, and shot over if they tried to settle around their usual permanent waterholes which coincided with settlers' establishments. Their numerous camp-dogs were shot or poisoned, again a factor which kept groups on the move and at the periphery of prime water sources.

Massacres also reduced population levels. Probably the most infamous incident was that in the reed beds surrounding Murdering Island in the Murrumbidgee River just east of Narrandera, and which local accounts suggest involved the slaughter of 60 to 70 Aboriginal people (Baylis 1927). Poisonings were also common and the impact of introduced diseases was severe (Dowling 1997). In 1847 Beckham noted the outbreak of influenza amongst the Wiradjuri with a concomitant decline in numbers (*ibid*:37). The overlanders also took their toll on the population (Dowling 1990:136), both directly and by deflecting Aboriginal energies from the conflict with settlers (Gammage 1983:15).

One sketchy indication of group size and territorial area is provided in an account of an early settler, David Mackenzie, in 1852. Mackenzie described his selection of land as being midway between the Murrumbidgee and Murray Rivers, probably with frontage to the Billabong Creek (Bayley 1959:27):

> "...I was visited by a party of fifty or sixty blacks, one of whom, an old man named 'Jacky Jacky', stated that I was on his ground, over which he and his family always hunted. I said I would buy it from him .... thirty square miles." (Mackenzie 1852:74-75).

It is precarious to over-interpret this statement, although it is possibly useful in its indication of group size, of between 50 and 60 people, and mobility. The cited territory of 48 km^2, or one person per square kilometre, would be an abnormally high density for this type of environment. Averaged Australia-wide estimates vary between 7.5 and 51 km^2 per person (Beaton 1990). Kefous (1988) presents some support for relatively lower population densities in the Riverine plains, considering that population sizes were likely to have been regulated by episodic deficits in water and food resources. She reasons that likely densities for riverine areas of western New South Wales, would be in the vicinity of one person per 7.8 km^2. Eastern areas of the Murray Valley probably supported one person for between 6.5 to 7.8 km^2 (Kefous 1988:234).

As late as 1886 small groups of Aboriginal people were still encountered about the landscape, although their children had been removed to missions such as Warangesda, along the Murrumbidgee River near Darlington Point (Gallop 1886). Uardry, along with some other stations along the river, apparently provided some refuge for the Aboriginal population. Angel (1985:30) recounted that young Aboriginal women helped with child care on the station and noted their happy and pleasant manner. Relations between the early owner of Uardry Station and the Aborigines were apparently good (Angel 1985:30):

> "Henry [Angel] with his wife Mary, must have been some of the first pioneers to live in the lower Murrumbidgee,...While at Uardry he obviously was a capable gentleman in dealing with Aborigines. They would come and ask him which beast they could kill for food and they repaid his kindness and understanding by not interfering with his stock or property. However this was not the case with other landholders who had cattle speared or killed, but not one was ever speared or killed on property owned by Henry and Mary Angel."

It is fairly clear that by the early 1840s the primary pattern of Aboriginal settlement was disrupted. Unfortunately this preceded the making of any comprehensive historic descriptions of their population, subsistence and landuse. Notebooks, traverse field books and surveyed plans pertaining to the earliest crown lands surveys undertaken along the Murrumbidgee, held by the Archives Office of N.S.W., were thoroughly examined for casual observations on Aboriginal settlement or population. During the 1840s and 1850s, government survey of settlement along the Murrumbidgee was implemented to determine the extent of selection and the boundaries of land holdings. The nature of their work took surveyors across the Riverine Plain and along the creek systems flowing north and south of the Murrumbidgee River (Larmer 1847-50, 1848, 1849, 1851; Townsend 1848, 1849a, 1849b, 1849c, 1851, 1852, 1853; Twynam 1859; Woolrych 1848).

Their observations are useful for reconstructing landscape features such as settlers huts, vegetation, geological features, soils and the presence or absence of water. Surveyors Larmer and Townsend spent months plotting the Murrumbidgee River and its surroundings. It is possible to reconstruct the present day locations of their traverses in relation to the present stream channels, by converting their chain measurements and comparing their descriptions of river channel morphology to those currently evident. In addition, many of their references to the names of early selectors' establishments and Aboriginal toponyms are still detectable in the landscape today.

The field notebooks of Larmer and Townsend provide limited indications of Aboriginal occupation as incidental recordings to their descriptions of landscape and vegetation. Emphasis was given, in instructions to the early surveyors by the then Surveyor General, to the recording of Aboriginal place names and to specifically asking Aboriginal groups about place names. It is tantalisingly apparent that they sought information from the Aboriginal population, since Aboriginal place names and their meanings are noted in fly leaves of notebooks as well as on the actual traverse sketches. Larmer (1847-50:141) may have travelled with an Aboriginal person from the area, since in some notes he quotes his informant as 'Jemmy' whose father 'claimed' the lower Mirrool Creek.

Patterns emerge in the notation of Aboriginal place names. Bursts in the recording of toponyms occurred as surveyors approached homesteads. Whilst it is possible that homestead owners related the place-names they had previously collected from Aboriginal people, it may indicate that the agglomeration of Aboriginal people around particular runs had already occurred. If so, even the Crown Land Surveyors were too late on the scene to observe much of the traditional pattern of Aboriginal occupation. Nevertheless, some relict features of recent Aboriginal occupation were noted. Features, such as 'ovens', 'fish dams', 'native circles' and 'native graves' were recorded. More ambiguous descriptions, such as 'lines of rocks across the river' and 'gunyahs', were also noted. It is possible that Surveyor Townsend made a distinction between Aboriginal and European settlement, with his constant references to 'huts' versus 'gunyahs' (1849: not numbered). Townsend also mentioned 'ruined settlers huts', 'frameworks for huts' and established 'houses'. This suggests that 'gunyah' was not merely adopted as a term to describe a settler's bark hut. Instead 'gunyah' seemed a deliberate choice of the Aboriginal term, at least in the case of this surveyor.

Given that minor landscape features such as 'gunyahs', Aboriginal 'graves' and Aboriginal 'ovens' were documented in the traversed areas the non-observance of sizeable populations and built settlements is considered significant. Traces of abandoned settlements would have been clear enough to be detected, since it was probably only ten

years since they would have been in use. Descriptions of the organisation of a *Burbung* or initiation ceremony along the central Murrumbidgee at the turn of the century hint that settlement patterns may have been fairly mobile, within a well known range (Mathews 1897). Preparations for the ceremonies involved the establishment of a new general camp for the hosts some days prior to the activities. The location of the ceremonial ground was determined by the presence of abundant food, water and fuel in a particular patch of the host group's territory. Mathew's (1897) account also indicated the dispersed nature of Aboriginal encampments during certain larger gatherings, with different areas occupied by particular social divisions. Such observations suggest that the residues left by such short term influxes of larger groups would not be highly visible.

The early surveyors were thus about 10 to 25 years too late to witness pre-contact Aboriginal lifestyles in the Central Murrumbidgee region. They were already traversing a transformed cultural landscape, finding only dispersed groups across the plains and other groups aggregated by necessity around station runs, and they occasionally recorded landscape features that spoke of not-long-past Aboriginal use, such as ceremonial grounds, graves, ovens and fish traps. Whilst the evidence that they did record does not imply high population densities, as stated earlier, it may be that they were too late on the scene.

It is likely that competition over traditional Wiradjuri resources led to the large scale conflict. Stations were founded on sections of the major rivers and creeks where water supplies were most consistent. Woolrych (1890) mentions the latter practice for areas along the Lachlan in commenting on the Aboriginal toponyms still prevalent in the landscape.

> "When the white settlers overran the country they appropriated all the finest waterholes for their head stations, consequently these occupy what were at that time the chief camping grounds of the blackfellow and therefore possessed of native names."

It is also likely that their aggression related not only to the appropriation of water, but also its associated wetland resources. It is notable that many of the documented instances of conflict, cattle spearing and altercations with settlers took place near reed beds (Baylis 1927; Gammage 1986). This may reflect not only that reeds provided concealment, but also that these resource zones were where people were concentrated, and that consequently they were defended.

In summary it would appear that the paucity of people and the lack of Aboriginal settlements recorded along the Murrumbidgee River is likely to be an artefact of climatic conditions and European presence. The European settlement of the Riverina occurred rapidly, commencing in the mid 1830s. The attributes that settlers favoured in the

landscape, permanent water, good grasses, timber and natural fords, may have also been features of prime Aboriginal settlement locations. This may explain how European settlement of the area so rapidly disrupted the primary Aboriginal settlement pattern, although the effects of introduced disease precursing physical settlement must also be considered (Dowling 1990; 1997).

3.5 Material Culture

Information from the NPWS site register and previous archaeological surveys demonstrate the presence of a broad range of archaeological evidence in the central Murrumbidgee region. Site types recorded include mounds, small ovens, hearths, lithic scatters, middens, scarred trees, quarries, burials and ceremonial grounds. The previous section suggests that there are further types yet undocumented by field investigation, including fish traps, fish dams and gunyahs. The historic record also indicates potential problems for the archaeological detection of much of the settlement evidence of the Aboriginal people since much of the material culture was extremely perishable and potentially dispersed.

Art sites, rock shelters with occupation deposits, quarries, stone sources and carved trees have been recorded in regions immediately north and east of the Murrumbidgee, however none are known for the area under investigation. No sites within the area have previously been radiocarbon dated, although sediments surrounding an individual human burial at Lake Urana were dated to between 20,000 and 30,000 years BP (Page *et al* 1994:43). General patterns of the occurrence of archaeological materials have been indicated by previous site surveys, mostly undertaken in the context of brief consultancy reports produced for environmental impact assessment (Gollan 1982; McIntyre 1977; McIntyre 1987; Thompson 1982; Witter 1982; Wood 1992). Incidental observations about archaeological materials have been also made in the course of geomorphological investigations (Pels 1964).

An undergraduate thesis was written on site occurrence in an area in the east of the region (Klaver 1987) which located mounds, scarred trees and lithic scatters focused upon an area of drained swampland along the Old Man Creek floodplain, an anabranch of the Murrumbidgee River. On the basis of surface archaeological evidence mounds were interpreted as the product of earth ovens, rather than deliberately raised living surfaces. A small number of sites closest to the creek corridor might later have became useful for elevating living conditions above wet ground surfaces . Most were located on the basal break of slopes surrounding the swampy areas and a requirement for drier substrates would have been satisfied by a move upslope of only a few metres. Analysis of climatic conditions in the area suggested that conditions of localised rainfall and minor riverine

flooding would have been normal conditions. Only very few, very large mounds would have remained accessible during moderate to severe flood conditions.

Gollan (1982) surveyed a 120 km x 90 m wide transect south of the Murrumbidgee River. His survey area commenced at the Murrumbidgee River, near Hay, then ranged between 10 and 20 km south of, and approximately parallel to, the riverine corridor, before terminating once again on the river, near Darlington Point. The landscapes he investigated included open plains, prior stream channels (palaeochannels) and associated levees and low dune systems, as well as the immediate floodplain and channel of the Murrumbidgee River. He (1982:15) interpreted his findings as being indicative of the presence of four distinct stone industries within the region. They involved the production of quartz flakes and blades, the manufacture of geometric microliths and unretouched flakes from other siliceous lithologies, the use of ground stone implements for food processing, and the use of edge ground hatchets. Apart from the necessary import of volcanic materials used for hatchets, he attributed all other materials to local stone sources and local manufacture (Gollan 1982:15).

> "In summary, the survey finds that the basic extractive toolkit of the Riverina groups is locally produced, and is in technological conformity with the widespread quartz and 'silcrete' industry of western N.S.W." (Gollan 1982:16).

Langford-Smith (1960:389) noted the tendency for modern roads and dwellings to be located on prior stream (palaeochannel) levees, due to their superior drainage, tree cover and frequent association with underground aquifers. Whilst undertaking geomorphological research, Pels (1964) also noted a similar tendency for evidence of Aboriginal occupation. He found chips of stone, old fires containing charcoal and bones and nodules of fired clay on the scald-eroded levees of old stream channels:

> "Quartzites and other rocks with conchoidal fracture are abundant on the scalded surfaces. These are in the form of sharp edged rock 'chips', which are undoubtedly artifacts (sic) representing waste from aboriginal implement making. ... Another form of stone common on the scalded levees consists of a burnt clay which has a blackened red appearance. This stone is derived from old aboriginal fires and according to the stage of erosion is either scattered or occurs as preserved mounds of hard burned clay protruding from the scalded areas. Charcoal and bones are common in these old fires which appear to have been buried in the levee deposits prior to exposure by deflation. The large number of relic fireplaces on the levees flanking the prior streams and their absence in the streambeds suggest that although the system of prior streams may have been at least seasonally inactive at the time of habitation, surface water occurred possibly in the form of lagoons" (Pels 1964:112).

There are ethnohistoric indications that the regional deficiency of tough volcanic stone used for hatchets and of suitable grinding stone materials was addressed through

exchange with people from other regions. Mathews (1894:305; 1897:151) observed in the central Murrumbidgee district that, some time following initiation ceremonies, it was customary for people to gather together for the purpose of exchange. Items that were commonly involved included hatchets, whetstones, wood for spears and other weapons, coloured clays, skins, string, feathers and reeds for spears.

> "Hatchets, and the stone for making them, as well as sharpening stones and millstones, were amongst the articles of barter at the great meetings which were held for the initiation of the youths of the tribes. At the conclusion of these ceremonies, before the people dispersed, a kind of fair was held, when natives in whose country stone was plentiful would barter those things with other people for reeds for making spears, rich plumage of birds, &c, usually found in the level country where suitable stone is scarce..." (Mathews 1894:305).

Beveridge (1883:20) also listed the following exchange items:

> "The articles of commerce which the aborigines exchange with each other consist of reeds for spears, red ochre and chalk for painting purposes, stone for tomahawks, fibre for nets and cord, opossum cloaks, wood for weapons, &c."

An account closer to the Lachlan River, to the north of the study region, mentions similar exchange practices:

> "The blacks used to trade from tribe to tribe for stone tomahawks, boomerangs, and other weapons made of Boree wood..." (H.P. 1896:18).

Exchange networks have been further elucidated by modern petrological analysis of stone materials present in sites and collections throughout southeastern Australia, including some from within the region (McBryde 1978). A sample of 41 ground edge artefacts from the Old Man Creek area, at the east of the survey region, revealed varied and widespread sources. Five amphibole schist artefacts have been sourced to Mt William, (Victoria), one amphibole hornfels to Mt Camel, (Victoria), and another to either Mt Camel or Tumut (NSW). Two artefacts were composed of pelitic hornfels likely to have originated from granite contact zones some 50 miles north of Narrandera. Seventeen were composed of greywackes of uncertain origin, whilst others were composed of dacite, andesite, dolerite and altered basalt (McBryde personal communication). The social and economic ramifications of participation in such exchange systems has been explored by McBryde (1979b). It appears that at least one function in this region was to mediate the regional deficiency of volcanic stone.

Early accounts also indicate the use of materials other than stone. Beveridge (1883:46-7) recorded the use of baked clay heat retainers in place of stone net weights. Beveridge (1883:42-3) noted the use of scrapers made of freshwater mussel shell for the preparation of *Typha* and rush fibres after baking the plants in an earth oven. Oxley (1964:77) also recorded the use of mussel shells for scrapers near the Lachlan River:

"These shells are used as knives, being ground very sharp against the rocks, and certainly for a scraper they may answer very well."

Collections in the Australian Museum (White 1986) indicate a wide range of wooden implements in use along the Murrumbidgee River. These include spear throwers, parrying shields, broad shields, clubs, shovels and throwing sticks/clubs. White notes that whilst some are obviously post contact productions (containing nails and tooled with metal) they are nevertheless executed in otherwise traditional styles. Pre-contact decorated wooden artefacts from the Murrumbidgee and Lachlan River districts were documented as having been engraved by the use of possum mandibles (Rowlison *et al* 1981:84).

The prominence of wooden and bark materials, as composing weapons, domestic containers and implements, as well as shelters and canoes, may have increased the necessity to obtain the tough volcanic stone hatchet materials required for their manufacture. Shell and wood would have obviated the necessity for softer flakeable siliceous stone materials, although there may still have been a desire to obtain them from other regions.

Discussion

The initial sections of this chapter outlined environmental zones which, by virtue of resource richness, reliability of water supply, or ecotonal quality, might potentially have attracted the most Aboriginal settlement evidence. This appears to be supported by ethnohistoric descriptions, although the sketchy and transitory nature of early records must be considered. It is clear that some of these rich areas, for instance around Uardry Station, were the last to be departed by Aboriginal people. It is also apparent that wetlands and reedbeds were noted as 'defended' against early selectors and their stock, and travellers. Some archaeological studies also indicate dense occupation evidence in these ecotonal locations, in particular large numbers of mounded cultural deposits have been found to occur in these situations (Klaver 1987).

Most of the previous archaeological studies have been small scale and have not been aiming to identify the extent of regional diversity in site types or occupation intensity. Even so they reflect the Aboriginal use of varied environments throughout the region. The material cultural record, as recorded in surveys and collections, is also rich. Exploitation of varied plant and animal resources is suggested by functional interpretations of the morphology of various stone implements. Yet, evidence of perishable material culture items, such as nets, said to be the mainstay of existence of the riverine tribes (Newland 1899) are unlikely to be encountered archaeologically.

The recorded diversity of site 'types' recorded for the region does suggest possibilities for the archaeological determination of subsistence and settlement patterns however. The range of site types and environmental situations is apparently similar to areas further south along the Murray River, and there are apparently common elements of material culture and site morphology between the Western Districts of Victoria and areas further west towards the Darling River (Allen 1974, Lourandos 1985, Williams 1988). Elaborations of subsistence and settlement patterns in these latter areas have benefited greatly from the existence of a rich ethnohistoric record from which models have been facilitated (Allen 1974) and functional interpretations have, in some cases, been more easily attributed to sites (Williams 1985). Despite this, varied interpretations of the archaeological evidence from these regions do remain, particularly in relation to the use of particular occupation sites, notably mounds, as indicators of occupational intensity, and also in relation to the very long-term regional trends characterising and underlying these Aboriginal occupation patterns.

The review of the regional environment suggests that there are several major environmental factors notably, seasonality in the availability of resources, aridity, and flooding which may have governed patterns of landuse. Historic and archaeological evidence highlights the potential importance of wetlands and raises the possibility of microenvironmental management. The relatively even distribution of potential resources across wide tracts of land, and the presence of attractive ecotones lining the river corridor and surrounding plains wetlands suggests a broad based sample survey coverage including areas from major landscape divisions may be an appropriate general strategy. The regional environmental history suggests that a search for evidence of change in settlement pattern would not be not necessarily be addressed by survey focused upon the modern configuration of stream corridor and wetland environs. Accordingly, areas with potential to have undergone environmental change ought to be included within the sample coverage.

Chapter 4
Research Methodology

4.1 Introduction

This chapter sets out to explain the rationale behind the field study. It explains the selection of the field area, the manner of sampling that area, the choice of survey method and the criteria for site recognition and recording methods. It discusses why certain site types were chosen for more focused study.

4.2 Study Scale

Surveys which are regional in scale are generally thought appropriate for archaeological research, since human behaviour tends to be regionally circumscribed (Binford 1964). The importance of regional survey in Australian archaeology has been well demonstrated (McBryde 1974, Morwood 1981, Allen 1974). These types of investigation are broadly stratified in their implementation. That is, a particular survey strategy or range of evidence leads to the development of a landuse model, which may be further examined by excavation and refined as a result. There are problems in defining appropriate boundaries for regions, although the use of drainage basins and language areas have been conventional approaches (O'Connell and Allen 1995:859, Peterson 1976).

The choice of a language area for this research was not considered practical since the Wiradjury occupied one of the largest geographic areas in eastern Australia and the diversity of material culture and environmental conditions across 'Wiradjury country' suggests that this grouping may have incorporated several regional traditions (White 1986). Likewise the riverine plain south of the Murrumbidgee River is so flat that determination of the region on drainage characteristics would also result in a similarly large area. Flow reversal in many creek systems following flooding also extends the conventional drainage area definitions.

The region defined for this research as the Central Murrumbidgee Riverine Plain is a wedge shaped tract of land covering 15,000 km^2. The definition of the study region was based on several factors. In the east it is bounded by changes in topography coincident with the start of the Riverine Plain, to the north by the Murrumbidgee River, and to the south by the Urangeline and Billabong Creeks (which define a language boundary). To the west it is defined upon a more arbitrary basis since to extend further would have been impractical in terms of the size of survey areas to be covered. The survey thus terminated at the Cobb Highway. The study region contains the southernmost extent of Waradjery language groups recorded historically (White 1986).

The position of this survey area was deliberately chosen. The Yanco Creek bisects the region from north to south and is considered a major 'divide' of the area, separating east from west. It is the last major tributary/distributary stream connecting into the Murrumbidgee River before its westerly junction with the Lachlan River. From east to west there is thus a climatic and topographic gradient, of increasing aridity and flatness. This is reflected in soils, vegetation, animal resources and in the type and reliability of water sources. Whilst the eastern section is drained by an extensive and variably dependable system of creeks, with waterholes and swamps, the western area is crossed by an extensive network of drainage lines and swamps which are at best ephemeral. From north to south there is a further contrast between riverine and hinterland environments. The region thus presents some environmental diversity to enable examination of environmental parameters in conjunction with variations in cultural adaptation as revealed by the material cultural record.

4.3 Formation Processes and Spatial Analysis

Some of the main issues for this research involve assessment of rates of site formation and evaluation of the capacity of site distribution patterns to provide information about change over time, in late Holocene landuse patterns. The recognition of a range of regional formation processes is thus an implicit component in the recording of sites. Formation processes influence the representative nature of the archaeological record, and these may vary considerably between different environmental zones.

Geomorphological formation processes, particularly erosion and deposition, influence what is visible in the landscape at any point in time. The study region encompasses highly depositional alluvial landscapes, as well as more arid parts which are prone to cyclical erosional processes, thus acknowledgment and assessment of bias in the apparent distributions of surficial archaeological evidence, is a necessary part of the analytical process.

Other formation processes have a more cultural foundation. Visible established occupation evidence may influence later site location choices. Further archaeological problems relate not so much to the attrition of evidence but to the discernment of additions of occupation residues to those already extant in the landscape. The reuse of places must be considered in interpreting features which might otherwise be regarded as temporally and behaviourally discrete loci of related activity. As Dunnell (1992:31) noted:

> "...archaeologists want to and usually do interpret sites as if they were occupations ...occupations can actually be distinguished only rarely if at all."

Binford (1983) observed that descriptions of 'sites' or spatially related components, in terms such as size, artefact densities and features, are often interpreted in terms of group

size, interrelated organisation and settlement pattern. For instance, large sites are often interpreted as representative of sedentary occupation (Craib 1991). In fact, there are few criteria which may effectively discriminate between sites which are large due to intensive continuous occupation, or large as a result of accumulated, and possibly unrelated, brief events (Edwards 1989). Distinguishing between such sites is difficult in any case, as Allen (1996:144) noted:

> "In hunter-gatherer archaeology, where permanent houses are generally absent, single occupation sites are likely to be archaeologically invisible, while multiple occupations might make the isolation of single households impossible."

Ethnoarchaeological studies have been brought to bear upon these problems. These suggest that reoccupied sites would be more visible in the archaeological record than ephemeral camps, and as Kent (1991) notes, this could lead to considerable misinterpretation of data in terms of likely population increases. Consequently she queries:

> "Are we seeing more sites in the Neolithic when there was a shift to horticulture because there was a shift to anticipated longer site occupations? In other words, is the increase in sites the result of changed mobility strategies that emphasized longer habitations rather than the result of a population increase?" (Kent 1991:55).

The size of sites may thus be more a result of the repetitive use of a landscape, than a reflection of the size, organisation or activities performed by the resident group of people (Binford 1983; Pardoe nd). By way of example, Ebert (1992) suggested, that if a hypothetical base-camp covered 250 m^2, then in an area of 1 km radius, there would be approximately 12,000 possible separate occupation sites before any occupation need overlap. Over time, he posited, the complete overlap of sites would be as unlikely as a total lack of overlap, and even if occupations were randomly located, some overlap would be likely to occur. Since campsite location is generally not random, with regard to features within the landscape (Stark and Young 1981), considerable degrees of overlap may be predicted to ensue. Determination of the degree to which such occupational overlap is random, as opposed to a reflection of cultural choice, or other factors, remains an important issue for investigation during this research.

The parameters of spatial patterning are in both environmental and cultural domains. People's arrangement in space and the resultant archaeological residues cannot be understood apart from social context (Agorsah 1988). This is not to deny the importance of natural resources in determining where in the landscape people position themselves. The simple availability of particular resources will not mean that groups will locate exclusively with regard to them. Other operative factors may include their relationship to other groups within the landscape, or their social perception of the landscape.

Guccione *et al* (1988) suggest influential environmental parameters which may also affect where people reside. They include availability of water, safety from hazards such as flooding or predators, food resources, comfort, availability of construction materials and availability of firewood. The boundedness of an environment will also influence the position of people within it. Such boundedness may be determined by the spatial occurrence of resources which people choose to exploit. Equally it may depend upon the amount of habitable land present, which may vary seasonally (Peterson 1973). Ecotones, or junctions between resource zones, are particularly productive areas, since they enable exploitation of coincident microenvironments (Epp 1984:327). Those situated between terrestrial and aquatic resources are often linear features (Price 1981).

Gould and Yellen (1987) outline some of the various social factors affecting the spacing of occupation sites, including levels of food sharing, genetic relatedness of occupants, the numbers of people present, and the anticipated occupation duration. There may be regulatory or desirable spacings between old and new habitations or there may be other distance proscriptions for spacing in proximity to other occupied sites.

Social and cultural factors may influence choices about reoccupation of areas. Some characteristics of previous settlement residues may not encourage reoccupation, such as decreased site hygiene and resource depletion (Dewar and McBride 1992:232-3), or may create cultural taboos on place, such as burials (Pardoe nd). Equally, there may be features of past use, such as 'site facilities' (Binford 1983:145), which actively encourage the specific reoccupation of landscapes. For example, the reuse of pit ovens near or within old sites is often attributed to their incorporation of reusable heat retainers and the consequent reduction of effort in reestablishing the facility (Chauncy in Brough Smyth 1878; Hunter 1975; Klaver 1987:117; Latas 1992:213). Similarly the elevated morphology of old mounds is often useful for camping (Beveridge 1883), even when they are conceptualised as natural rather than cultural features (Peterson 1973).

Once lithic scatters have become incorporated into the archaeological record, they may undergo transformation into potential lithic procurement areas, and in doing so influence the degree of area reuse (Camilli and Ebert 1992:117). The scavenging and reutilisation of lithic material in campsites is likely to occur in sites where occupation is long term, or repetitive (Chatters 1987:345) and it may be more likely to occur in stone-poor regions. The identification of such reuse of lithic material may be difficult, although individual artefact attributes, such as differentially patinated flaked surfaces, and changes to artefact context may be useful indicators.

In this context, existing sites in the landscape can be viewed as part of the general suite of environmental resources. Apart from having social meaning as indicators of prior occupation, their abandoned materials may constitute reusable and locationally attractive resources. The extent to which sites represent reusable capital investments in the landscape must therefore be assessed. The type of occupation under question thus also requires analysis in terms of the durability of site features. The types of post-depositional processes acting upon sites should also be considered, in terms of their capacity to remove or obscure evidence of previous activities.

Interpretation of the configuration of sites within landscapes is a complicated process, since there are many contributing factors which may not be archaeologically apparent. It is generally accepted, given certain assumptions, that the arrangement of sites in space is a meaningful reflection of causal processes and, further, that various forms of spatial analysis may elucidate these processes (Kintigh and Ammerman 1982). As Epp (1984) observed, the distribution of archaeological sites within a landscape may be posited to be non-random, reflecting concentrations in areas which best suit contemporary settlement strategies. Spatial analysis involves the identification of spatial patterns, their interpretation in terms of behaviour, and the assessment of their significance. Various levels of spatial analysis may be employed in the establishment or testing of archaeological hypotheses ranging from regional, to inter-site and intra-site.

At a regional level spatial analysis will be employed to detect patterns in locational relationships between sites and environmental factors such as topography, proximity to water and other resources. Inter-site analyses concentrate on the positions of sites relative to one another, and intrasite analysis focus upon relationships between components within identified sites or site complexes (Hodder and Orton 1976). Various statistical methods have been devised for detecting patterns in site arrangement which may be meaningful in cultural terms. Of these, Chi Squared and Nearest Neighbour analyses are simple methods which may be employed to test for non-random frequencies of site occurrence within landscape categories and regularity in site spacings.

4.4 Sampling Strategy

The study area comprises a substantial tract of land, covering some 200 km east-west by 120 km north-south. In order to collect information concerning the distribution, variability and organisation of artefact and settlement residues, a range of environments and depositional regimes was determined to be examined. A method of field sampling was therefore required, in order to obtain a manageably smaller, yet still meaningful, body of data from an inherently large original data set. There is a diverse literature regarding the achievement of representative sampling for archaeological purposes and three main methods of sampling: judgemental, haphazard and probability (Redman 1974)

are commonly employed. Probability based sample area selection is generally found appropriate for archaeological investigations (Binford 1972:135).

A simple form of probability sampling may be carried out by numbering sample areas and then selecting a proportion of them by randomly generated numbers. Various degrees of complexity may be introduced by stratifying sample units. Stratification operates on the basis that the population to be sampled may be separated into internally homogeneous parts, and each of these respective parts may then be sampled. Sampling may then be undertaken in proportion to the frequency of each stratum within the whole population. Further versions of random sampling may be employed. A systematic random sample, for instance, defines a starting point by random number selection but then selects further units by reference to fixed intervals from that initial point (Redman 1974:12).

Landscapes may be sampled simply by examining proportions of each major landform unit (Foley 1981). There will, however, be considerable bias in the discovery of archaeological materials introduced by geomorphic processes such as erosion and deposition, and by current landuse practices. Byrne (1983) highlights the importance of investigating relatively undisturbed landscape areas to negate the effects of post-European site destruction, although ironically it is often the impact of European land use that results in sites becoming visible.

No claims are being made for the absolute statistical rigour of the form of sampling employed. In this study sample units were selected on a range of criteria. The primary aim of the survey was to encompass the range of major variations in the landscape. Further aims included the exclusion of lands affected by types of European land use which result in the severe distortion or removal of archaeological evidence. In contrast, areas which were simply eroded were sought. Additional factors involved the inclusion of several areas which were already known to contain sites.

The region was divided into 150 units of 10 km^2 based on the 1:250,000 topographic grid. Fifty of these units were selected for examination, eight on judgemental grounds, on the basis that some knowledge of sites existed and 42 by the use of a random numbers table. Areas of public land, such as Crown Lands and Travelling Stock Reserves were targeted for survey within the units. Such reserves are regularly located across the landscape, at between 9 and 10 km apart due to the minimum mandatory distances stock are permitted to travel daily (Anderson 1976:59). Since they are not used for agricultural pursuits and are not cleared, it is likely that they present relatively less altered patterns of site distribution. In addition, their regular occurrence across the landscape was consistent with a regulated sampling strategy. When selected squares did not contain such reserves arrangements were made to survey private land. In several instances, where site

complexes continued from reserved lands into private lands, survey was also extended. Within the 50 grid squares, 55 survey areas were examined (Figures 4.1 and 4.2). A description of each is contained within Appendix II. Fifty one of these were located within the randomly selected 10 km grids. They covered a total of 222 km^2 and constitute the database from which discussion of regional patterns of site occurrence is generated, although data collected from the other survey areas is also discussed. A summary of their site contents and density of archaeological components is contained in Table 4.1.

4.5 Site Recording and 'Site' Definition

Chapter 2 characterised the environment and resources of the Central Murrumbidgee Riverine Plain in order to develop a simple environment and resource model of Aboriginal settlement patterns, which could be tested through a programme of field survey. It predicted that whilst human settlement patterns would be expected to change concomitantly with broad environmental variation, ecotones between environmental zones which contain the most desirable resources such as food, water and shelter, would be the areas most heavily occupied. The specific configuration of occupation within these areas would be constrained by the influence of flooding. Where the settlement intensity or pattern is not as predicted on the basis of these factors the model seeks other explanations, such as in the cultural sphere.

Testing the model hinges upon the assumption that relative degrees of occupation intensity will be directly indicated by the material record of human activity within environmental zones and that the effects of differential formation processes are accountable. It makes the further assumption that activity patterns will be archaeologically detectable through the presence of a range of physical archaeological evidence, traditionally termed 'sites'. The model also requires that the material culture used and discarded is sufficiently diverse to enable recognition of activity specific data sets, and hence may enable the characterisation of subsistence and settlement regimes in terms of 'foragers' and 'collectors'.

The limitations of this type of research are considered. No archaeological survey of a region, however thorough or validly sampled, could detect the full range of activities carried out by past human groups and there are some components of human occupation systems which do not leave residues. Furthermore, as raised in Chapter 2, there are cases where material culture is perishable. Post-depositional processes within the region also vary considerably between landscapes, leading to potential bias not only concerning the types of sites incorporated within the archaeological record, but also with regard to the parts of that record subsequently visible during field survey.

Figure 4.1

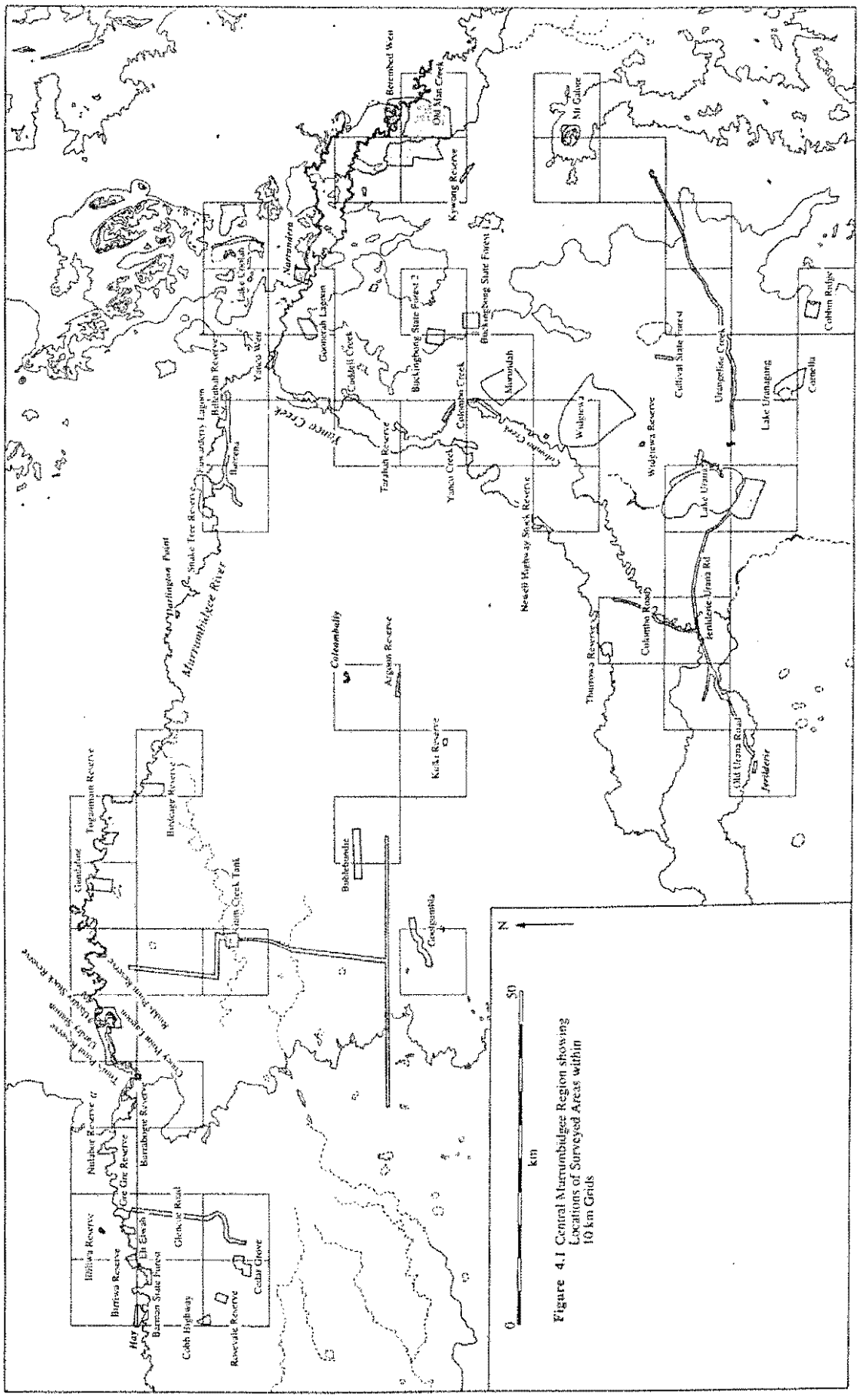


Figure 4.1 Central Murrumbidgee Region showing Locations of Surveyed Areas within 10 km Grids

Figure 4.2

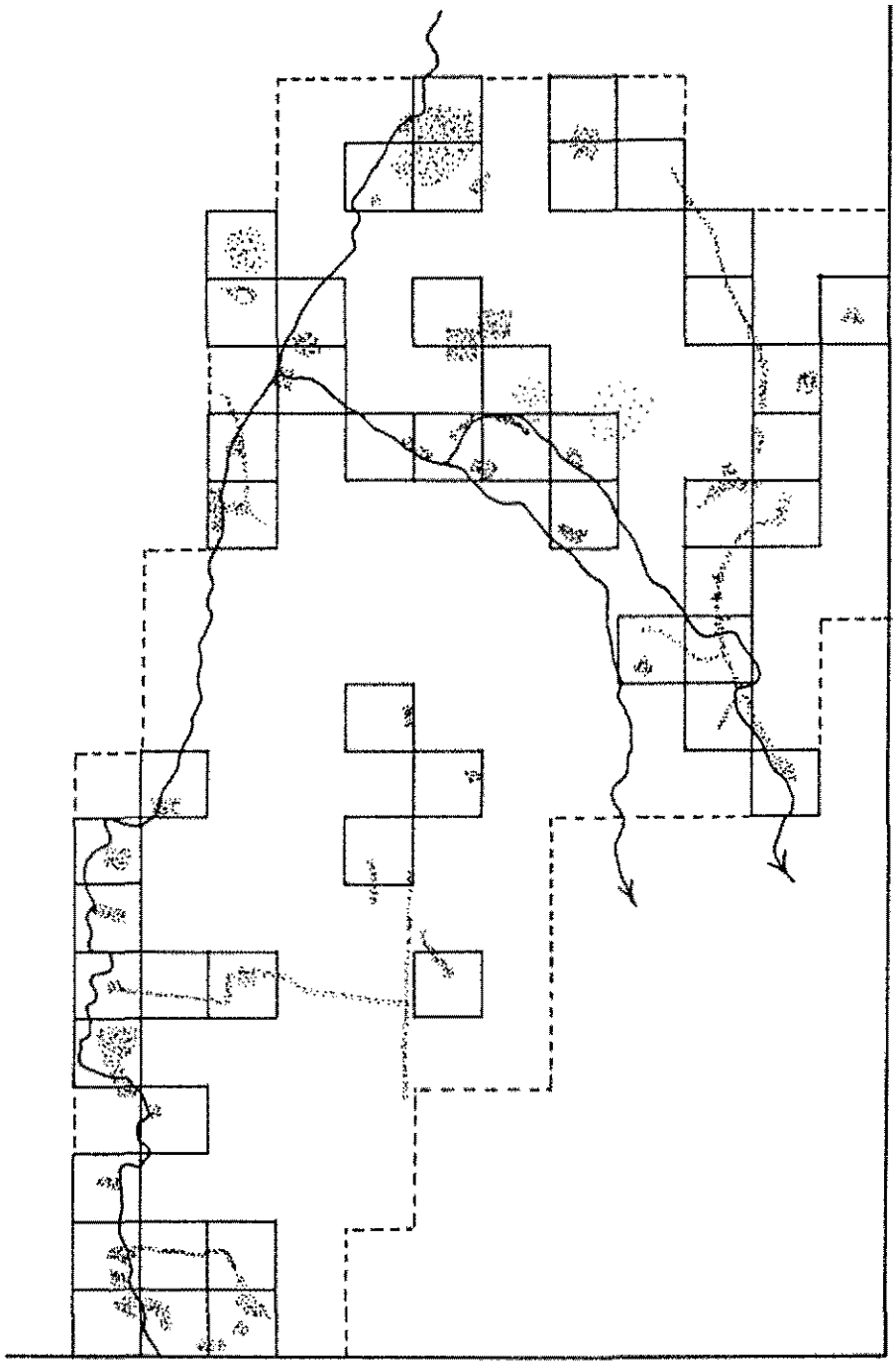


Figure 4.2 Schematic Map of Surveyed Areas

No	Survey Name	km2	Water Source	Landform	Minor Landscape	Vegetation	Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
1	Mt Galore	6	Ephemeral Creek	Eastern Sloping Plains	Slopes, ridges, valleys	E.Dealbata, E.sideroxylon	Reserve	2	5						2	117		3 shelters	Cfa	600	MJJA
2	Old Man Creek	45	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain, levees, Dunes	E.camaldulensis E.largiflorens, Callitris sp	Freehold	115	119	112					3	576	4	3 collections	Cfa	500	JJA
3	Cobbin Ridge	5	Ephemeral Swamp	Eastern Sloping Plains	Slopes, swamp margins	E.microcarpa	Freehold	2	4	2					1	16	1		Cfa	500	MJJA
4	Lake Coolah	(2)	Ephemeral Swamp	Eastern Sloping Plains	Lake margins	E.australasica	Reserve												Cfa	500	JJA
5	Buckingbong State Forest	4	Nil	Eastern Sloping Plains	Slopes, ridges	E.microcarpa	State Forest	1	2						1	4	1		Cfa	500	JJA
6	Buckingbong State Forest	4	Nil	Eastern Sloping Plains	Slopes, ridges	E.microcarpa	State Forest		6							6	6		Cfa	500	JJA
7	Comella	3	Ephemeral Swamp	Eastern Sloping Plains	Sandsheet, swamp margins	A.pendula, A.nummularia	Freehold	5	5	4					1	157			Cfa	500	MJJA
8	Lake Uranagong	2	Ephemeral Swamp	Eastern Sloping Plains	Dunes	A.pendula, A.nummularia	Reserve		0										Cfa	500	MJJA
9	Urangeline Creek	2.3	Permanent Creek	Eastern Sloping Plains	Creek levees floodplain, ptains	A.pendula, A.nummularia	Reserve	7	13		6				7	1697			Cfa	500	MJJA
10	Goonerah Lagoon	7.5	Ephemeral Swamp	Eastern Alluvial Valley Ptains	Slopes, plains	E.camaldulensis Callitris sp	Reserve	1	8		7				1	416			BSfk	400	JJA
11	Widgiewa	[9]	Ephemeral Swamp	Eastern Sloping Plains	Plains, swamp margins	A.pendula, A.nummularia	Freehold	[10]	[10]		[10]								Cfa	500	JJA
12	Morundah	[20]	Ephemeral Swamp	Eastern Sloping Plains	Plains, swamp margins	A.pendula A.nummularia	Freehold	[2]	[2]										Cfa	500	JJA
13	Colombo Creek	3.8	Permanent Creek	Eastern Alluvial Valley Plains	Levees, flood plain	E.camaldulensis	Reserve	2	49	6	37	4			1	1846		1 burial	Cfa	500	JJA

Table 4.1 Survey Areas Summary

No	Survey Name	km2	Water Source	Landform	Minor Landscape	Vegetation	Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
14	Billenbah	1.8	River	Eastern Alluvial Valley Plains	Dunes, plains	E.camaldulensis	Reserve	1	4					1		3	3		Cfa	500	JJA
15	Cuddell Creek	1.3	Permanent Creek	Eastern Alluvial Valley Plains	Creek bank, slopes	E.camaldulensis	Reserve	1	2			1			1	10			Cfa	400	JJA
16	Tarabah	1.3	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain, dunes	E.camaldulensis	Reserve	2	3	2					1	64			Cfa	400	JJA
17	Yanco Creek	5	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain, levees	E.camaldulensis	Reserve	7	7	7						68			Cfa	400	JJA
18	Widgiewa Reserve	[0.6]	Nil	Eastern Sloping Plains	Plains	A.penduta, A.nummularia	Reserve	[1]	[2]		[1]				[1]				Cfa	400	JJA
19	Lake Urana	3.8	Ephemeral Swamp	Eastern Eastern Sloping Plains	Lake margin, dunes	E.australasica, E.camaldulensis,	Reserve	1	2		1				1	9			Cfa	500	JJA
20	Thurrowa	2.5	Permanent Creek	Eastern Sloping Plains	Creek bank floodplain levees	E.camaldulensis	Reserve	3	3	3									Cfa	400	JJA
21	Bareena	8.8	Nil	Western Alluvial Valley Plains	Floodplain, plains	E.camaldulensis	Reserve	2	3					2		1	1		Cfa	400	JJA
22	Euwarderry Lagoon	14	River	Western Alluvial Valley Plains	Floodplain, lagoon, levees, dune	E.camaldulensis	Reserve	11	14		1		1	8	1	44	2	Burial?	Cfa	400	JJA
23	Newell Highway	3	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain, dunes	E.camaldulensis	Reserve	1	4						4	57			BSfk	400	JJA
24	Snake Tree Reserve	0.3	River	Western Alluvial Valley Plains	Floodplain, plains	E.camaldulensis	Reserve	34	34		1			33					Cfa	500	JJA

Table 4.1 Survey Areas Summary

No	Survey Name	km2	Water Source	Landform	Minor Landscape	Vegetation	Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
25	Jerildene-Urana Rd	9	Ephemeral Creek	Eastern Sloping Plains	Creekbank, levees, plains	E.microcarpa, A.pendula, A.nummularia	Reserve	7	16		8				7	547	1		Cfa	500	JJA
26	Colombo Road	3.8	Permanent Creek	Eastern Sloping Plains	Creekbank levees floodplain plain	E.camaldulensis	Reserve	1	2						1	3	1		Cfa	500	JJA
27	Old Urana Road	4.3	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain levees	E.camaldulensis A.pendula, A.nummularia	Reserve	4	13	3	7				1	6	2		Cfa	500	JJA
28	Birdcage Reserve	2.7	Ephemeral Creek	Western Plains	palaeochanne levees, plain	E.camaldulensis A.pendula, A.nummularia	Reserve	31	40	20	4			10	1	30	5		BSfk	400	JJA
29	Toganmain	2	River	Western Alluvial Valley Plains	Levees, floodplain, swamp, plains	E.camaldulensis A.pendula, A.nummularia, Typha	Reserve	21	24	4	7			10	1	16	2		BSfk	400	JJA
30	Bublebundie	3.8	Ephemeral Creek	Western Plains	palaeochanne l levees, dunes	A.pendula, A.nummularia	Freehold	8	12	4	4			3	1	105			BSfk	350	JJA
31	Gundaline	6.3	River	Western Alluvial Valley Plains	Levees, floodplain, swamp, plains	E.camaldulensis A.pendula, A.nummularia, Typha	Reserve	43	55	2	12 (10)			37		4	4		BSfk	350	JJA
32	Goolgumbla	6.3	Ephemeral Creek	Western Plains	palaeochanne l levees, dunes	A.pendula, A.nummularia	Freehold	3	4	1	1				2	21			BSfk	400	JJA
33	Gum Creek Tank	3	Ephemeral Creek	Western Plains	palaeochanne l plains	E.camaldulensis, A.pendula, A.nummularia	Reserve	4	4					4					BSfk	350	JJ
34	Rudds Point	1.3	River	Western Alluvial Valley Plains	Floodplain	E.camaldulensis	Reserve	0	1							1	1		BSfk	400	JJ
35	Uardry Stock	3	River	Western Alluvial Valley Plains	Levees, floodplain, plains	E.camaldulensis	Reserve	23	48	16	3		1	21	7	48			BSfk	350	JJ
36	Coogy Point	6	River	Western Alluvial Valley Plains	Levees lagoon floodplain plain	E.camaldulensis	Reserve	131	135	55	8 (4)		5	65	1	322	1		BSfk	350	JJ

Table 4.1 Survey Areas Summary

No	Survey Name	km2	Water Source	Landform	Minor Landscape	Vegetation	Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
37	Uardry Station	5	River	Western Alluvial Valley Plains	Levees, lagoons, floodplain	E.camaldulensis	Freehold	43	44	32	1		8	3		2			BSfk	350	JJ
38	Tom's Point	1.5	River	Western Alluvial Valley Plains	Levees, floodplain, lagoon	E.camaldulensis	Reserve	3	3	3									BSfk	350	JJ
39	Burrabogie	1.8	River	Western Alluvial Valley Plains	Levees, plains	E.camaldulensis	Reserve	5	9	3	5 (2)		1						BSfk	350	JJ
40	Nulabor	2.5	River	Western Alluvial Valley Plains	Levees, floodplain, lagoon	E.camaldulensis	Reserve	6	6	3			1	2		4			BSfk	350	JJ
41	Gre Gre	2.5	River	Western Alluvial Valley Plains	Levee palaeochannel sandsheet	E.camaldulensis	Reserve	4	5	2	1		1			3	1		BSfk	350	JJ
42	Glencoe Road	7.5	Nil	Western Plains	Plains sandsheet dune	A.pendula, A.nummularia,E. microcarpa	Reserve	1	2					1		1	1		BSfk	350	JJ
43	Eli Elwah	1.3	River	Western Alluvial Valley Plains	Levee, floodplain, meanders	E.camaldulensis	Freehold		0										BSfk	350	JJ
44	Illiliwa	1	River	Western Alluvial Valley Plains	Plains	E.camaldulensis	Reserve	1	8		7				1	5			BSfk	350	JJ
45	Cedar Grove	5.6	Nil (Soak?)	Western Plains	Plains	A.pendula, A.nummularia	Freehold	2	8		5				2	6		Soak?	BSfk	350	JJ
46	Birriwa	2.5	River	Western Alluvial Valley Plains	Levee, floodplain, plains	E.camaldulensis	Reserve	7	9		6 (4)		1			3	2		BSfk	350	JJ
47	Rosevale	0	Ephemeral Creek	Western Plains	palaeochannel, sandsheet	A.pendula, A.nummularia, E.australasica	Reserve	1	8	7					1	19			BSfk	350	JJ
48	Cobb Highway	3.8	Nil	Western Plains	Plains	A.pendula, A.nummularia	Reserve	2	12		10				2	26			BSfk	350	JJ

Table 4.1 Survey Areas Summary

No	Survey Name	km2	Water Source	Landform	Minor Landscape	Vegetation	Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
49	Barman State	0.6	River	Western Alluvial Valley Plains	Levees, floodplain	E.camaldulensis	Reserve	28	28	20	3		1	2	1	4	1		BSfk	350	JJ
50	Cullival SF	[1.25]	Nil	Eastern Sloping Plains	Slopes, sandhills	E.microcarpa, Callitris sp	State Forest	0	0										Cfa	500	JJA
51	Kulki Reserve	2.5	Nil	Western Plains	Plains	E.largiflorens, A.pendula, Atriplex nummularia	Reserve	1	1										BSfk	400	JJA
52	Argoon Reserve	1.8	Nil	Western Plains	Plains	E.largiflorens, A.pendula, Atriplex nummularia	Reserve	0											BSfk	400	JJA
53	Yanco Weir	2.5	River	Eastern Alluvial Valley Plains	Dunes, Floodplain	Callitris sp, E.largiflorens, E.camaldulensis	Reserve	3	3					3					Cfa	500	JJA
54	Berembed Weir	4	River	Eastern Alluvial Valley Plains	Dunes, floodplain	E.camaldulensis Callitris sp	Reserve	0											Cfa	500	JJA
55	Kywong Reserve	0.5	Permanent Creek	Eastern Alluvial Valley Plains	Floodplain, levee	E.largiflorens, A.pendula, Atriplex nummularia	Reserve	0											Cfa	500	JJA

Table 4.1 Survey Areas Summary

Evidence which may be interpreted to give insight into patterns of Aboriginal land use and settlement consists of diverse accumulations of a limited range of materials relating to various activities. The fundamental unit of analysis has generally been the 'site', described in qualitative and quantitative terms. Underlying site recording and interpretation by archaeologists is a premise that a site represents a discrete material entity which is culturally, behaviourally and chronologically meaningful. However, sites observed by archaeologists are creations of that very act of observation (Dunnell 1992:27). Dunnell's (1992:23) concept of the 'site' is useful since he considers it as a place "...that is distinguished from other places by the presence of artifacts (sic)." rather than as the artefacts themselves. He further notes, after Binford, that sites need not be internally homogeneous since they may be composed of functionally different areas.

So many difficulties have arisen due to use of the concept of archaeological 'site' that there have been suggestions that its use as a unit of archaeological analysis, be abandoned altogether (Cherry and Shennan 1978:17; Ebert 1992:17). The main methodological weakness in the use of the term 'site' is the considerable variation in the way in which this entity has been defined and used by researchers, and this may be overcome to some extent by simply and clearly redefining it, and applying the definition with rigour and consistency (Dunnell 1992). Special difficulties arise when 'sites' take on interpretative characteristics and are used to compare activities within different geographic areas. This may essentially involve the comparison of entities which are not alike in terms of their function or capacity to represent occupational intensity. Hence there is a further requirement to carefully define the concept 'site' and its constituent parts and to carefully assess any potential functional qualities, in order to make these types of comparison valid.

There are certainly difficulties in determining the intensity of use of a landscape by the number of archaeological 'sites' present. Nevertheless it is clear that particular types of sites, for example mounds, may be potentially more informative about intensity of occupation, even whilst they exhibit considerable functional variation. Even comparison between ostensibly similar entities, such as lithic scatters, is difficult without determining further characteristics. The presence of variable stone reduction strategies may produce quite different residue in terms of artefact numbers, densities and sizes. A site area which by virtue of its component artefact density suggests a high level of occupational intensity may simply be a product of reduction strategies producing high numbers of waste materials. In stone poor environments the traditional indicators of occupational intensity, lithic scatters, are only partially informative, since many items of material culture were composed of alternative perishable materials.

The problems with the definition and use of 'site' also affect the ability to draw upon previous archaeological studies within the region. Most studies either do not present a

discussion of their basis for site definition, or use definitions which are insufficiently clear or are inadequate for the purpose of comparison beyond very general terms. As a result it is necessary for this research to reach its own characterisation of the archaeological evidence in the region.

In presenting a summary of the evidence for Aboriginal occupation throughout the various landscapes of the Central Murrumbidgee Riverine Plain the difficulties that are thus recognised with the use of the 'site' are considered. In this investigation, sites are initially considered as geomorphic units within the landscape in which archaeological components are present, rather than as behaviourally discreet entities.

The determination of site boundaries in the types of landscapes investigated may still present difficulties during field survey. The important factor is the choice of a site definition which has utility as an analytical unit. The delineation of sites during this study was made on arbitrary characteristics, based upon ground surface visibility, component density and the particular nature of features. Some 'sites', such as occupation areas containing artefact scatters, may contain thousands of morphologically diverse components (see Chapter 6). In order to organise this component type into a more useful analytical unit, individual stone artefacts within scatters are treated as sub-components, and a scatter with clearly distinguished boundaries is classed as a component of the site. At this stage, however, there are no interpretations made as to the contemporaneity or other relatedness of their sub-components.

Other sites by virtue of their ostensible or actual isolation from other sub-components, are composed of single components. For unobtrusive site sub-components, such as flaked stone artefacts, a radius of 50 m between artefacts (artefactual density of less than c.1/160 m^2) was chosen as a bounding distance for organising sub-components into components when there were no otherwise bounding landscape features. A sub-component could thus be synonymous with site component, or even site, dependent upon archaeological context. For example isolated artefacts and scarred trees could be sites in themselves (see Chapter 7).

Ideally, for the purposes of distinguishing settlement activity within different environmental zones, comparison would be based upon the presence or absence, or relative numbers, of particular types of occupation residues composing sites. Difficulties would arise if seemingly disparate occupation residues were in fact resultant of similar activity, but at different scales of intensity. For example a comparison could be made between areas which contained mound sites and an area which did not, but which contained evidence of small pit ovens. An easily drawn conclusion could be that essentially quite different activities were occurring. However if the mound was

established to be an earth oven mound, then the differences might relate more to the overall intensity of site formation within that environment, rather than purely functional differences. It is important to develop acceptable means of comparing ostensibly different site components, and if possible characterising them as resultant of a range of likely formation activities.

To facilitate comparison with previous studies carried out in the region, the evidence recorded during survey is also presented interpretatively with the use of names, for example midden, mound and so on. These are, however, defined specifically on the basis of their constituent components, as explained in the following sections.

4.6 Component Classification

Site components considered within the field survey are as follows:

Fired clay refers to lumps of fired clay or earth. Commonly they are approximately fist sized, although they may range from small pellets less than 0.5 cm in diameter to large pieces of about 15 cm in diameter. They range in colour through red, orange, brown, black and grey. They exhibit some variation in sediment composition and durability which is in general conformity with the amount of clay present in the surrounding subsoils. Some exhibit remnant pedal structure with plant material impressions.

They are interpreted as **heat retainers** used in pit ovens based upon comparative ethnohistory and ethnography. Their colour range may be interpreted to indicate final firing temperatures and conditions of oxygen availability i.e. whether heated in open hearths or closed pits. Their degree of fragmentation may be interpreted in terms of their reuse, as implied by comparative ethnohistory and ethnography, and in terms of post depositional damage. As discussed in Chapter 3, they are distinguishable from naturally fired clay, such as that found at the bases of burnt trees.

Where they occur in aggregations but without associated in-ground pits some may be interpreted as heat retainers used in **above ground oven structures** based upon comparative ethnohistory and ethnography. Their colour range may indicate open firing temperatures and conditions.

Fired clay lumps most commonly occur in aggregations averaging about one metre in diameter. Aggregations may also occur in closely or loosely associated groups. These are interpreted as the rakeout piles of heat retainers used in small **pit ovens** (Plate 7). Occasionally the outline of a small pit or depression is spatially associated with a rakeout pile, in which case it may be interpreted as the oven pit, from which the rakeout was

removed. Baked clay lumps may also occur individually scattered across groundsurfaces and may then be interpreted as post depositionally disturbed heat retainer rakeout.

Baked clay lumps may also occur as grouped aggregations embedded in darker soil and with thickly scattered surficial lumps over an open area. In such situations they are interpreted as evidence of use of **multiple pit ovens** which may have been reused or post depositionally disturbed by later occupation activity. They may also be considered as **incipient mounds** (see below).

Heat retainers may also occur in a mounded matrix which may additionally include ashy sediment, charcoal, fragments of bone, freshwater mussel shell and stone. These accumulations are on average between 10 and 20 m in diameter, although they may reach 50 to 60 m in diameter. They may be compact or soft deposits. They may be level with the surrounding ground surface or a metre or more at apex height. In section their stratigraphy may display layered saucer shaped features of charcoal and heat retainers, which is interpreted as evidence of sequential use of oven pits throughout the site formation. This particular mixture of components is termed an **Oven Mound** and is interpreted as the accumulation of sediment and waste resulting from repetitive use of one or more small pit ovens (Plates 8,9,10,11). This interpretation is based upon comparative ethnography and ethnohistoric accounts.

Individual lumps of baked clay and aggregations of baked clay lumps may also occur within a matrix composed predominantly of fragmentary freshwater mussel shell and organic dark soil. Such evidence is interpreted as the *in situ* or disturbed remains of heat retainers employed in pit ovens within **midden** deposits.

Fired clay may also occur in the surface levels of mounded deposits which have formed through natural processes, such as gilgais, or mounds produced by insects, birds and other animals. These are interpreted on the basis of ethnographic accounts as **utilised natural mounds**.

Ashy sediment accumulations are mixed deposits of soil and ash. Their formation may be attributed to several activities, based upon associated archaeological materials and comparative ethnographic and ethnohistoric information. They are generally interpreted as mixed groundsurfaces incorporating ash from domestic fires in the context of Aboriginal occupation locations. Spread over large and irregular areas, without evidence of post depositional disturbance, they are interpreted as **occupation 'floors'** relating to general camping activity and often contain stone artefacts and scattered baked clay lumps. Where they are confined within natural rock overhangs they are termed **shelter**

deposits. Spread over large and irregular areas where ground surfaces have suffered post depositional disturbance, such as ploughing or grading they may in fact be **disturbed oven mound** deposits. Discrete and mounded ashy sediment accumulations in association with baked clay lumps, sometimes including mussel shell and artefacts, are interpreted as **oven mounds**. If discrete and mounded in formation but without a high proportion of baked clay lumps or other features, as outlined above for oven mounds, then they may be considered to be **occupation or domestic hearth mounds.**

Charcoal and ash concentrations are small, less than 1 m in diameter, accumulations of charcoal, charcoal stained soil and ash. Their interpretation as culturally formed is based upon associated archaeological materials. They are functionally interpreted as **open hearth camp fires**. Where hearths are continually operated in one location, for instance in the context of a hut or other dwelling, their deposit may accumulate into a mounded formation which may eventually form the basis of the occupation floor, this type of deposit is interpreted as an **occupation or domestic hearth mound**. Over time it may incorporate items of material culture relating to loss or in-house maintenance or manufacture. Food remains have great opportunity to become incorporated into such a deposit. Depending upon the nature of the associated dwelling, post holes or other structural features may also be closely associated with the deposit.

Earth Features may be of varied dimensions and are cultural accumulations of more or less sterile sediment. The basis for their recognition as deliberate cultural formations lies largely within ethnography. They are also represented to some extent in archaeological studies, however their recognition is often problematic and heavily reliant upon associated archaeological contextual evidence such as the incorporation of cultural residue within or around their deposit. Depending upon their size, position, composition, shape, and associated materials they have been interpreted as elevated dwelling mounds, burial mounds, ceremonial mounds or even garden mounds. Earth lenses may also occur within other cultural matrixes. When they occur within oven mounds, they have been interpreted as stockpiles of earth either for manufacturing clay heat retainers or as sediment accumulated in order seal the surface of the pit oven. When they occur within occupation mounds, they have been interpreted as representing deliberately built up floors, a;though an equally probable explanation is that they could represent collapsed structural materials relating to particular types of substantial dwellings.

It is clear that some aspects of the previous component categories may be difficult to clearly categorise at initial field survey observation. Where components have

accumulated into mounded formation, it is strongly suggested by previous ethnohistoric, ethnographic and archaeological studies that component functions may have changed over time. Furthermore, post depositional formation processed may have partially buried or otherwise obscured pertinent features. At the first level of analysis therefore, these site components are recorded as **mounds**. Detailed recording of their constituent components and archaeological contextual evidence would be drawn into a further level of discussion.

Freshwater mussels (*Velesunio sp*) are endemic throughout the Murray-Darling river system. They are also able to colonise water bodies remote from flowing systems, since their larvae can be transported on the feet of waterbirds (Walker 1981). Ethnographic and ethnohistoric records indicate that they were consumed by Aboriginal people, and that their sharpened shells, ground on stone, were often used as cutting implements. Dense accumulations of mussel shell in a matrix of organic soil are interpreted as **middens** (Plate 12), they may also include baked clay lumps, aggregations of baked clay, charcoal, bone and stone artefacts. Mussel shell is quite porous and following burial becomes quite soft and fragmentary. Where very small quantities of individual mussel shells or nacreous fragments are present within other cultural matrixes, such as oven mounds and occupation mounds, they are interpreted as the likely remnants of shell implements.

Excavated pits are features which may range in size up to several metres in diameter and up to half a metre deep. Their general cultural attribution is based upon comparative ethnographic and ethnohistoric records. Their specific functional interpretation is based upon the nature of any other closely associated archaeological components. For instance small surficial pits of less than one metre in diameter and up to half a metre in depth, in association with baked clay lumps are interpreted as small **oven pits**. Charcoal and other artefacts and components may also be spatially associated in the context of general camping activity. Pits may also underlie deposits previously characterised as oven mounds, in which case the oven mound may be termed an ***in situ* oven mound** since the matrix has built up over the formative oven pit. If the formative pit was several metres in diameter, it could be interpreted, on the basis of comparative ethnohistoric records, as either catering for large groups of people or for processing large quantities of materials or food. The bulk plant food processing function would be suggested particularly if the pit/mound was closely associated with a plant resource zone, such as a *typha* swamp.

Pits of up to several metres diameter located between groups of mounds or immediately adjacent to a mound are interpreted as **borrow pits.** These are the excavations made in the course of extracting clay from the subsoil in order to manufacture baked clay heat

retainers. Pits, which contain articulated human skeletal material, are interpreted as **burial pits**. They may also occur within mound deposits. Ethnohistoric accounts suggest burial may be a final reuse for oven and occupation mounds.

Stone artefacts comprise humanly modified stone material. They may occur as isolated finds, as variably dense scatters across large areas, (e.g. Plate 13) or within the matrix of mounds and middens. Based upon comparative ethnographic and ethnohistoric records they may be associated with extractive, processing, manufacturing and maintenance activities, as well as ceremonial activities, and may occur in association with varied other site components. Depending upon their specific lithology they may also be used to infer patterns of exchange since the region is largely stone poor. Specific formal types of stone implements may also be used to reveal stone reduction methods, and some have functional connotations as well, although these are largely based upon analogy with ethnography, ethnohistory and archaeological studies in other regions.

Artefacts may also occur in the surface levels of mounded deposits which have formed through natural processes. These are interpreted on the basis of ethnographic accounts as **utilised natural mounds**.

Human bone is a fairly self evident category of material residue. However there are a number of ways in which it may be manifest in archaeological sites throughout southeastern Australia. The skeletal remains of an individual occurring in a pit or other cultural matrix such as a midden or a mound, is interpreted as a **single burial**. The presence of more than one burial relating ostensibly to one episode of interment is interpreted as a **multiple burial**. If there was evidence for repeated episodes of human interment within a cultural matrix, such as a mound, then it might also be considered as having a later use as a cemetery.

Where there are multiple burials and the wider site area fulfils criteria established by Pardoe (1988; nd), most importantly, the exclusivity of burials in relation to other contemporary occupation materials, then the components and the wider site area are interpreted as a **cemetery**. There are other archaeological contexts for human skeletal remains, including within hollow trees, and underneath artificial earth features. The latter are characterised by the presence of human remains and a pit underlying the mound and are distinguishable from other mound types by their lack of heat retainer and cooking pits, and general sterility of the mounded earth, although some fires may be associated with the interment procedure. Human bone lacking the context of a pit or other place of interment is simply recorded as **skeletal material.** There are other cultural attributes relating to burial procedures and ultimate site morphology including cremation, secondary burial practices, orientation of the body, and presence of other related features

such as associated material culture, interpreted as **grave goods** and **grave markings**, which may also be recorded.

Sources of lithic material are sites from which a range of lithic materials are extracted for use. Where the source material is composed of bedrock, large boulders or buried stone, methods of removal may leave evidence in the form of pits and excavations, interpreted as **quarry pits**, fractured stone material interpreted as evidence of **stone reduction and** artefacts interpreted as **hammerstones.** Other sources may simply be gathered from surficial or loosely consolidated deposits, such as pebble beds. These may present little evidence of extractive activity and are simply referred to as **potential stone sources.** Other materials which may have been quarried or collected include clays and ochres.

Utilised pigment, such as haematite or iron oxide, is generally termed ochre and its occurrence in ground palettes, or within the matrix of other site components, is taken as evidence of its Aboriginal use. Its occurrence in the study region may be used to infer exchange activity, since it is not endemic. Although it often has connotations of ceremonial usage, it was also a utilitarian substance noted to be incorporated with animal fat and rubbed on the body as mosquito repellent in ethnohistoric accounts (Chauncy in Brough Smyth 1878:Vol II:238).

Animal Bone is given a cultural connotation by its association with other site components or incorporation into a component matrix such as that of an oven, mound or midden. It may be interpreted as the remnant of a consumed animal, and determination of the species may indicate patterns of landscape exploitation, seasonality of occupation and so on. Bone may also be recycled as fuel for fires and for utensils, such as fastenings, body decorations and awls. Animal bone may also become incorporated into cultural deposits when a level of commensalism occurs, or post-depositionally, such as is the case with rabbits.

A **Rock overhang** is a natural rock feature providing shelter. One which contains sedimentary deposit may be recorded as a **potential archaeological deposit**. If cultural materials such as lithic artefacts are present then it is recorded as a **rock shelter** site (Plate 14).

Scarred Trees are those which have had piece/s of bark removed by cutting or chopping (Plate 15 and 16). They are interpreted as representing Aboriginal activity on the basis of comparative ethnography and ethnohistory. Scarred trees are generally the remnant of an extractive activity, since it was most commonly the piece of bark removed that was used. In these cases, the morphology of the scar is often interpreted along

functional lines, again, based upon comparative ethnography and ethnohistory. (This is discussed in depth in Chapter 7). Ethnohistoric records also indicate that some scarred trees were not extractive sites, since their bark was removed to mark the tree.

Scarred trees are locationally fixed. However in archaeological terms, they have a relatively short lifespan, measurable in the hundreds of years, and will eventually die, decay and fall or be burnt in bushfires. Historic patterns of land clearance have also reduced their number. Attributes to be recorded include the tree species, the potential age of the tree, judged by girth, height, health and situation, and the attributes of the scar, including dimensions, extrapolated by length, breadth, shape and position. Scar attributes may then be interpreted functionally and, at least, include **canoes**, **shelters**, **containers**, **pegging boards** and **shields**.

4.7 Recording Lithic Materials

Sites were recorded in a number of ways dependent upon their spatial extent and density. Boundaries were determined by combined factors of ground visibility and component or artefact density. Where site boundaries were difficult to discern an artefact/component density of greater than 1 per 160 m^2 was considered to constitute a site or scatter. Less definite boundary delineation sometimes occurs when components are present in all areas of clear ground and the edge of their definition is coincident with the end of the scald or erosional feature which afforded the visibility. In these instances, there is potential for the scatter to be larger.

Raw material categories included quartz, quartzite, silcrete, chert, chalcedony, sandstone and volcanic materials. Within the category of quartz there were several variants including crystalline quartz, an opaque 'milky' quartz and a veined quartz with massive internal fractures stained with oxides. A granular 'sugary' quartz was also recorded. Distinctions between pebble and reef origins was also noted according to the presence of cortical material.

Quartzite is also essentially a form of quartz. It is a siliceous, but often coarse-grained, metamorphosed sedimentary material. It was identified by the size and degree of melding of its component grains. Quartzite fractures around individual grains which may then reflect light, leading to a characteristic sparkle. Silcrete and quartzite materials may be confused, as they form a geological continuum, however for this study silcrete was consistently recorded as the more siliceous of the two materials. Silcrete fractures through its component grains which are poorly distinguished from their matrix. Chert was recorded as material which exhibited a further degree of metamorphic alteration. It is a dense, opaque, sometimes brittle and more siliceous material than silcrete. No

component grains are visible to the naked eye. Chalcedony is a yet more highly siliceous material, often with a glassy quality, and may be translucent.

Sandstone comprised a poorly cemented, non-siliceous stone in which individual sand grains could be easily identified. A coarse conglomerate variety was also noted, which included individual grains of variable sizes, sometimes including small pebbles. All volcanic materials were recorded as a single category, and included materials with flow banding or vesicular clasts.

Flaked stone artefacts were recorded as cores, flakes or blades, flaked pieces and chips. Within these categories a major distinction was made on the basis of further modification in the form of retouch or usewear. Non-utilised flaked material was broadly classified as debitage. Cores were defined by the presence of a striking platform, and one or more negative flaking scars. The exception to this was in the case of split pebbles when only a platform was identified by the presence of crushing. Further attributes, such as the number and position of platforms, were also noted in order to enable recognition of the variation in reduction styles, such as bipolar flaking. Bipolar cores were defined by the presence of opposing platforms which exhibited crushing.

Flakes were defined by the presence of a platform and a bulb of percussion. They were recorded as blades if length equalled or exceeded twice the width and if a dorsal ridge, indicating deliberate core preparation, was present. Without this feature elongate flakes were recorded as 'bladelike'. Broken flakes or blades were noted to have an incomplete dimension.

Flaked pieces were those artefacts without identifiable platforms, complete negative scars or bulbs of percussion, but which were obvious products of the flaking process. Split pebbles without an identifiable platform were also recorded in this category. Chips consisted of small angular pieces without other features. The presence and type of cortex on artefacts was also recorded. It was quantified as an estimated percentage of surface area and its location was noted.

Artefacts with usewear or retouch were recorded under their primary classification, that is as flakes, blades, flaked pieces, cores or chips, with additional descriptions of the nature and location of modification. Technically, hammerstones, grindstones and ground stone implements such as hatchets may also fall into this category although, for analysis, they were considered as a separate class. The distinction between such used or maintained implements and all other materials (considered as waste) provides a major division for analysis. By definition, debitage or waste included all unmodified flakes and blades,

flaked pieces, split 'cores' without platforms and chips. Exotic stone materials present on sites, but without any apparent modification were recorded as manuports.

Hatchets were defined as implements with ground edges and are usually manufactured from tough stone materials such as volcanic lithologies (Plate 17). Hatchet preforms were defined as pieces of suitable lithology which had been roughly shaped by flaking or pecking but which had not been ground to provide an edge (Plate 17: specimen on far left top). Smaller and thinner flakes of similar volcanic material which had ground edges were termed chisels (Plate 18). It is probable that hatchets and chisels were composite artefacts, hafted onto wooden handles. Hatchets are also likely to have been multifunction implements since many exhibit rounded pits on their flat surfaces, suggestive of their use as hammerstones and 'anvils' (Plate 17: centre bottom row). Hammerstones and anvils (Plate 19) are interpreted as implements used for the crushing of materials, particularly for the bipolar reduction of siliceous stone, but also for the processing of foodstuffs.

Various stones were used for the grinding and crushing of materials and their definitions are interpretive. Generally a top stone or 'muller' (Plate 20) was used to grind materials upon a basal grindstone. Their specific morphology varies but includes grindstones with oval or rounded grooves and depressions (Plate 21). The mullers generally develop the reverse profile of the basal stone and consequently a range of shapes may be present. Amorphous grindstones (Plates 22,23) are those other than seed grinding stones, whose patterns of usewear indicate diverse activities, including the sharpening of bone and wood points, and preparation of ground stone edges. Stones used for crushing substances generally have flat or depressed circular working surfaces and may exhibit pitted surfaces. The basal stone is termed a mortar and the upper, a pestle.

All measurements were taken in millimetres. Where platform features were present, such as with flakes, blades and cores, dimensions were measured axially (Witter 1990). Length was the longest dimension perpendicular to the platform; width, the maximum dimension at right angles to this; and thickness the maximum measurement perpendicular to the latter two. Debitage was measured in 'block' dimensions, since there were no orientating features. Thickness measurements were reordered for plotting on the reduction charts so that thickness was always the minimum recorded dimension (Appendix II).

The first level of recording an artefact scatter includes inspection of the site, notation of number of artefacts visible, the estimation of artefact density across the area, and notation of the range of raw materials. Features such as apparent association with other site components such as ovens, hearths or mounds were also recorded. The second

recording level involved full recording of artefacts with either a data sheet or weatherproof notebook, calliper measurement of each artefact to the nearest millimetre, notation of the raw material, any modification, cortex, patination or other special characteristics, and drawing of the artefact if features required further description.

Recording also included an estimation of the density of artefacts across the site, and a sketch plan with tape and compass or pace and compass measurements indicating the layout of features within the site. Smaller, but denser, scatters are well suited to off-set-line surveys, involving full artefact recording as above plus the laying of tape lines across the site and tape measurement (at right angles to the base tape) of the artefact's position. The recording of extensive and dense sites was carried out with a theodolite and electronic distance measurer and involved the recording of each artefact within the site, completion of ground plans delineating erosional and other surface features as well as complete recording of the relevant characteristics of each artefact. This recording level facilitated most further analyses, particularly those of a spatial nature.

All artefact recording took place under field conditions. Prior to field survey recording forms were drawn up to facilitate the quick notation of artefact features. Analytic dimensions included for analysis were designed to enable description on technological rather than typological grounds. This description encompassed the type of reduction debitage represented: flake, blade, flaked piece, chip, flake core, blade core; as well as formal categories: grinding stone, hammerstone, anvil, hatchet and manuport. The dimensions of length, breadth and maximum thickness and edge angle, where applicable, were recorded to enable a simple method of size comparison between artefacts.

The type of raw material was recorded, as were subjective indications of colour and flaking quality. Irregularities such as inclusions and cleavage planes were also noted. Patination and weathering on artefact surfaces were noted. Such features may indicate post depositional site conditions, relative artefact ages, the reuse of 'old' materials as well as their geological origins.

The recorded artefact features included the presence or absence of cortex and its type and location. The presence of cortex may be an indicator of early stages of stone reduction, in addition to providing an indication of the origin of the raw material. Platform features such as stepping, crushing, or other indications of preparation were noted. The number of platforms and their orientation was also recorded for cores. Modification to artefacts in the form of retouch or usewear was recorded. The type, location and extent of such modification was noted. Any other uncategorised features were also recorded if present.

4.8 Site Excavation

The excavation of cultural deposits from some sites within the survey region was an initial part of the overall research strategy for several reasons. Excavation was initially planned with the aim of elucidating upon the chronology of mound development within the region. It was also intended to ascertain the function of the mounded deposits by comparison to the criteria developed in Chapter 2. The relationship between mounded deposits and smaller oven deposits also required investigation. The excavation of proximate mounds and other site components, where available, was also planned in order to gauge their degree of contemporaneity and hence their potential to reflect social arrangements within habitation sites. The obtaining of multiple dates from the sites was a further priority, aimed at determining mound formation rates and continuity of use. Excavation of a rock shelter site from the region aimed to establish an independent occupational sequence for the region.

The choice of sites for excavation was not made until all the field survey had been completed and considered in the light of the predictive model developed in Chapter 3. In Chapter 3 the potential for environmental change following the cessation of prior stream activity was raised. The circularity in seeking mound 'origins' in recent landscapes was also raised. It was thus decided that some sites chosen for excavation should relate to microenvironments which encompassed areas relating to relatively stable late Holocene processes. Hence, an area close to the Murrumbidgee River, ostensibly within recent alluvium would be selected. Ideally, this would be contrasted with sites from an area which may have undergone earlier processes of stream channel change, and microenvironmental change. This suggested the choice of a site from an area with some evidence of older stream activity.

After the field survey was completed the aims for excavation remained essentially similar, although somewhat better informed. It became apparent that the choice of suitable sites for excavation was limited by the effect of post depositional formation processes, particularly the effects of erosion. Some effects of European landuse had also extended throughout the reserve lands, although sites in these areas were in a far better state of general preservation. Ploughing for firebreaks, formation of access tracks and the spread of an exotic species, rabbits, had resulted in localised site disturbance. The excavation of sites chosen for analysis is described and discussed in Chapter 5.

Chapter 5
Archaeological Excavations at Colombo Creek, Cooey Point Lagoon and Mt Galore

5.1 Introduction

Four mounded sites, a shell midden and two smaller ovens from two large site complexes at Colombo Creek and Cooey Point Lagoon were chosen for excavation. A test excavation was also carried out in a small rock shelter on Mount Galore (Plate 14). Despite the discovery of surface artefactual material in a smaller nearby shelter, this excavation struck massive rock fall and produced no cultural materials (See Appendix II).

Three mounds and a shell midden were chosen from the Cooey Point Lagoon area, which fulfilled the requirement for an extensive array of archaeological material related to late Holocene processes around the Murrumbidgee River. One mound and two small ovens were selected within the Colombo Creek site complex, which was considered to have potential as an area which had experienced past localised effects of environmental change. A potential drawback of the selection of this site area was its degree of differential erosion. However, rather than seeing the erosional processes as totally negative in terms of site destruction, it was decided to employ the heavily eroded areas within the site as a complementary exposure akin to an open area excavation.

Since the major aims of excavating the sites related to issues of chronology and site function, it was considered that the excavated areas required within mounded deposits would be small. A site section approach was considered ideal in order to gain information about the rates of deposit build up and stratigraphy, as well as to sample their contents. A particular objective was to obtain accurate and detailed carbon sequences in order to date any stages in deposit formation. The mound excavations thus consisted of the placement of a 0.5 m wide strip which sectioned the sites. This was removed in 1.0 x 0.5 m grid units. A maximum of 2 m^2 was planned for removal from each site. Appropriately smaller areas were excavated from the small ovens. Likewise, only a small sample pit was placed in the shell midden. Sites were excavated by hand with trowels, using a combination of stratigraphic and arbitrary levels. Arbitrary levels, stratigraphy and other features were continually plotted with a theodolite and electronic distance measurer (EDM).

Soil test pits were also dug at the Colombo Creek site in order to elucidate the general depositional context of the site microenvironment. They were also employed to aid identification of the stratigraphic relationships between sites, in terms of their relative positions within identifiable soil units.

Excavated materials were sieved through 2 mm mesh in order to retrieve maximum cultural remains, and the sieve residue was sorted in the laboratory. Charcoal was bagged immediately upon removal from its context. Samples selected for dating were all single pieces of carbonised wood. Samples were not submitted from sieved material nor were samples combined to augment sample weights. This method was deemed vital to avoid the consequences of the likely admixture of material through such sites. An unfortunate consequence of this method was that Mound CC31 at Colombo Creek was able to be dated on only one sample. Insufficient carbon was otherwise present in the deposit. Whilst a sample could have been submitted using all fragments from one stratum, a derived date risked being a meaningless average of a lengthy period of site use.

Soil samples were taken from the top of each excavated level, and column samples were removed from a section wall once the excavation ceased. Sites were backfilled with the sieved sediment and this was supplemented with sterile soil.

5.2 Colombo Creek

Three sites at the Colombo Creek locality were selected for excavation. These comprised a large mounded deposit, CC31, and two smaller ovens, CC32 and CC36. Soil test pits were also placed in an uneroded section of the site as well as immediately adjacent to the sites. CC32 and CC31 were located in proximity to one another and CC36 was situated approximately 350 metres north (Figure 5.1).

5.2.1 Excavation of Colombo Creek Mound Site 31

Colombo Creek site 31 was first observed as an accumulation of baked clay and dark sediment of indeterminate size eroding from the lower/basal edges of an erosion residual in 1987. Its condition was observed on several successive visits and it was noted that whilst the residual continued to reduce in circumference it revealed oven material around its entire perimeter. It became apparent that this site was of an order of magnitude far greater than most of the small surrounding ovens. The question of its relationship to the surrounding smaller sites became of great interest.

Prior to excavation the site was mapped with the theodolite and EDM. A grid was pegged out across the site, and a central 1 m^2 was selected for excavation. A larger strip or open edged excavation may have destabilised the residual. (Field-checking of the site confirmed that the excavated section had re-stabilised and was well-vegetated three months after the excavations). The approximate centre of the site was chosen for excavation to determine whether the cultural deposit was continuous underneath the residual and, assuming it was, to maximise the opportunity to examine its entire depth of deposit. It was also intended to identify and record the nature of any underlying features, such as pits. (Plate 24).

Figure 5.1 Colombo Creek Site Plan

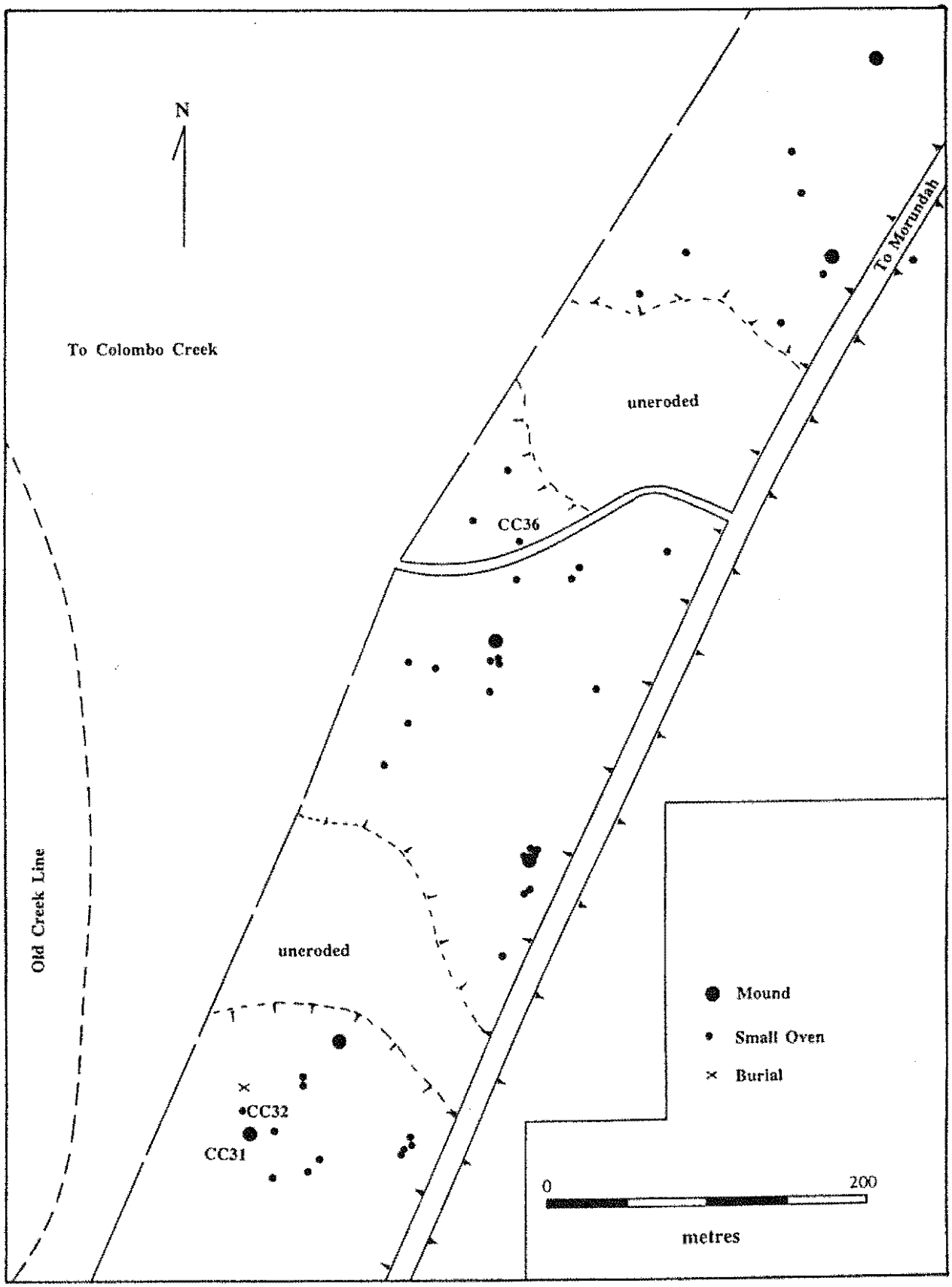
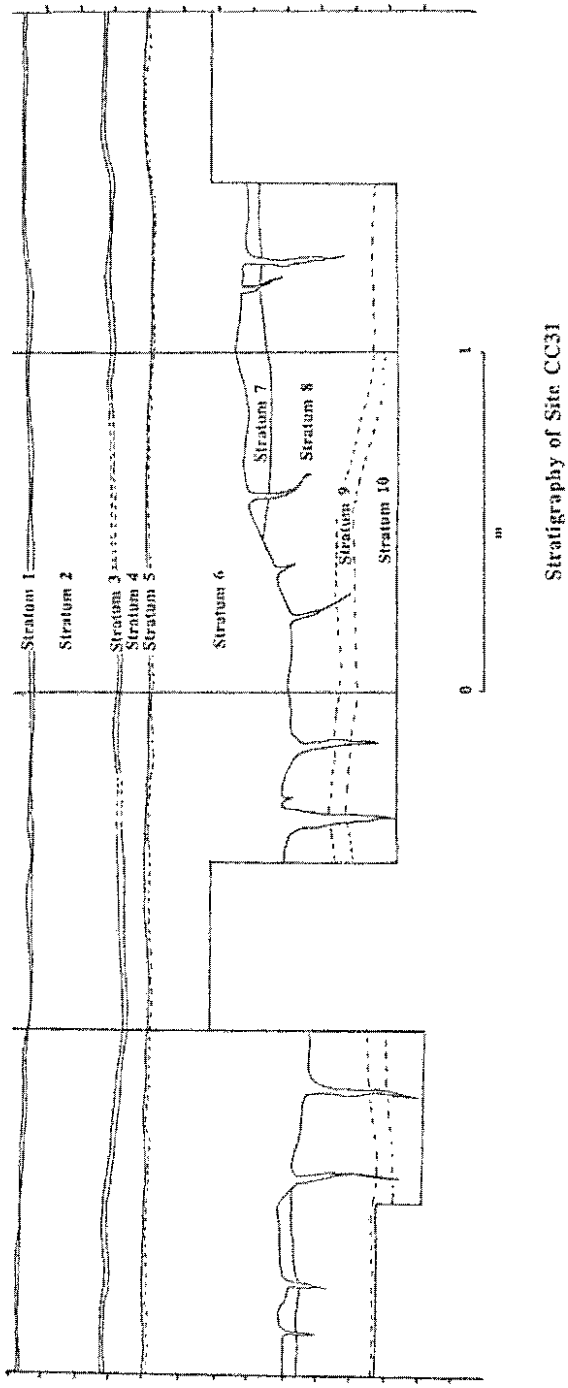


Figure 5.2 Stratigraphy of CC31



The site was well vegetated with dried-off annual summer grasses and herbaceous plants. The upper levels of the residual were composed of aeolian sand. Once the vegetation was removed, the deposit was removed in a series of 20 units, using a combination of both stratigraphic contexts and intermediate arbitrary spits. The 20 excavated units are summarised below in terms of 10 observed strata (Plate 25 and Figure 5.2).

Stratum 1 (Excavated Unit 1)

Stratum 1 consisted of recent windblown sand, humic material, insect remains, dried grasses and roots. It was between 20 and 40 mm thick. This unit also contained wind sorted fragments of baked clay heat retainer of less than 5 mm diameter and worn quartz gravels.

Stratum 2 (Excavated Units 2 and 3)

Stratum 2 consisted of a thick band of slightly compact and bleached pale orange to red sand. Tiny worn quartz gravels and one quartz artefact were recovered from this unit. No bedding was evident in the deposit.

Stratum 3 (Excavated Unit 4)

This stratum comprised a pale indurated sand. It was continuous across the square but varied in thickness between 10 and 20 mm. Tiny baked clay fragments had collected at the surface of this feature. It was also a zone of concentrated insect activity.

Stratum 4 (Excavated Units 5 and 6)

Stratum 4 consisted of a compacted pale red sand with some clay content. Tiny fragments of baked clay were still dispersed through the deposit. Three quartz chips, a retouched quartzite flake and one silcrete artefact were recovered from this unit. Two individual heat retainers were also recovered.

Stratum 5 (Excavated Unit 7)

Stratum 5 comprised a thin layer of admixture between the overlying sand and the underlying mound deposit. Its compacted grey sandy sediments displayed fine pedal cracking on the surface.

Stratum 6 (Excavated Units 8,9,10,11,12,13 and 14)

Stratum 6 was the mound deposit. It was an asphalt-like mixture of decomposed baked clay heat retainer, ashy sand with dispersed, rounded and dense red and grey heat retainers. A carbon sample was obtained from excavation unit 11. It returned a date of 2520±70 BP (ANU-8610). This age was calibrated with the CalibETH program resulting in a median date of 634±106 BC. The calibrated age ranges from cumulative probability to two sigma (ie. a 95.44 % probability) indicate a date between 806 BC and

462 BC. Minor sandy lenses, of less than 5 mm thickness, occurred discontinuously through the cultural unit.

Stratum 7 (Excavated Units 15 and 16)

Stratum 7 consisted of a grey sandy clay with massive calcareous concretions. It was a very tough, pedal and cracked deposit which was discontinuous across the excavation since it had been cut into by the base of the mound.

Stratum 8 (Excavated Units 17 and 18)

Stratum 8 was a thick layer of mottled yellow-brown clay with coarse sand. It was dissected by massive interpedal cracks which were filled with leached grey material from the overlying mound deposit.

Stratum 9 (Excavated Unit 19)

Stratum 9 comprised a band of greyish-yellow columnar calcareous clay sand. It was dissected by the bases of massive interpedal cracks which were filled with leached grey material from the overlying mound deposit.

Stratum 10 (Excavated Unit 20)

Stratum 10 consisted of mottled yellow-brown clay with some sand. It contained abundant iron pisolites and was culturally sterile.

Soil samples were column-sampled from the complete profile in 0.05 m vertical units and pH values were measured. The cultural levels were slightly acidic to neutral ranging between 6.5 and 7.5.

Discussion

CC31 was an homogeneous mixture of typical mound materials, attaining a maximum thickness of 0.40 m. No identifiable faunal remains were recovered from the excavation. The extremely compacted nature of the deposit was unexpected. The lowest cultural levels required slow removal with the aid of a crow bar. The entire deposit was overlain by a soil unit averaging 0.35 m in depth which displayed a typical upper profile for Cobram Sandy Loam which is known to form on the crest of stream levees and as an undulating soil unit adjacent to major stream systems (Stannard 1970:9). The development of the indurated layer (Stratum 3) indicates that there was a considerable period of *in situ* soil formation postdating the mound's formation.

The deposit is comparable to the Type 'A' mounds recorded in the Murray River region in its compactness, and lack of substantial faunal remains. The presence of thin lenses of sandy soil is also a feature held in common, although the lenses reported in the Murray

mounds such as DP2, DP3 and DP5 appear to have been more substantial features. The presence of an underlying shallow pit is also consistent with some of these sites.

The type 'A' mounds along the Murray were interpreted as ash dumps or piles of heat retainer refuse, fuelled by nearby smaller ovens (Coutts *et al* 1979:85). However, such associated small pits were not able to be located. Conversely, whilst this explanation might have applied to CC31, since there is ample evidence of surrounding pits, the closest such pit not only predated the mound by a considerable period of time, but was also situated on a completely underlying ground surface. A causal relationship between the two types of site was thus not able to be demonstrated in this instance either.

5.2.2 Colombo Creek 32

The excavation of Colombo Creek site 32 involved the sectioning of a small oven. The total site area measured 1.8 x 1.8 m and consisted of two surface exposures of buff and grey heat retainers and charcoal pieces. These were bisected by a small, eroding gully draining south from a large clay pan (Plate 26).

Prior to excavation the site was photographed and surface features plotted with the theodolite and EDM. A surface sweep was then carried out on the 0.5 x 0.5 m area to be excavated. This removed loose buff and grey heat retainers and surficial charcoal fragments. It exposed a relatively hard sandy grey sediment with dark carbon staining in several areas. The excavated materials were removed in 5 excavated units which may be summarised in terms of 4 strata (Figure 5.3).

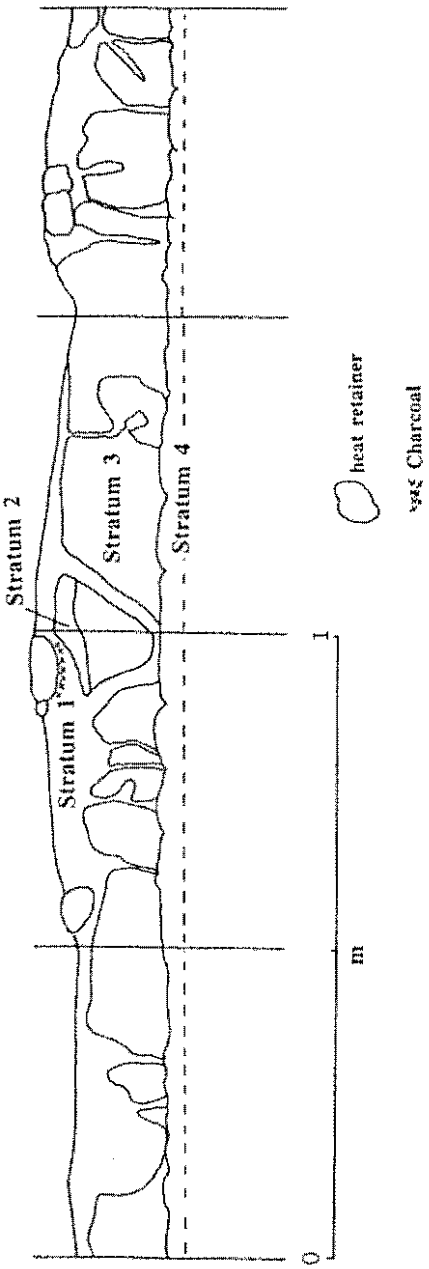
Stratum 1 (Excavated Unit 1 and part Units 2 to 5)

This unit mostly consisted of the fill of ashy sand within a small depression which was interpreted as the original oven pit. Several large buff and grey heat retainers were set into the surface of this unit. A concentration of carbonised wood was located underneath one patch of heat retainers. Large pieces of carbon were present throughout the unit. Carbon was collected from beneath the heat retainers and submitted for analysis. It returned a radiocarbon age of 2940±170BP (ANU-7881). This age was calibrated with the CalibETH program resulting in a median date of 1167±196 BC. The calibrated age ranges from cumulative probability to two sigma (ie. a 95.44 % probability) indicate a date between 1565 BC and 821 BC.

Stratum 2 (Context which formed part of Excavated Unit 2)

This was a discontinuous soil unit which had been dissected by the excavation of the oven pit. It was composed of pale, white to yellowish cemented sandy clay.

Figure 5.3 Stratigraphy of CC32



Stratigraphy of Site CC32

Stratum 3 (Context within Excavated Units 3 to 5)

This unit was an original subsoil consisting of mottled pedal red clay. It had a massively cracked structure and leached carbon from the overlying oven had filled and stained the interpedal cracks.

Stratum 4 (Context within Excavated Level 5)

This consisted of an indurated pale columnar clay with some sand content. The excavation ceased upon its surface (Plate 27).

Discussion

In accordance with its surface appearance, CC32 probably represents the short term use of a small earth oven. A shallow pit was excavated and a wood fire constructed within it. Clods of clay soil were then fired and used to conduct heat. Following the use of the oven it was abandoned, with heat retainers remaining in small concentrations within and beside the original pit. No food remains or other evidence was available to suggest the type of substances processed.

5.2.3 Excavation of Oven Site Colombo Creek 36

Colombo Creek site 36 was situated 350 m northwest of CC31 and CC5. It was a small raised feature of compacted soil and baked clay heat retainer rakeout piles. A grid was strung across the site and surface features plotted by coordinate points read from tapes along the x and y axes. The positions of all surface heat retainers and the extent of charcoal staining in the surrounding sediments were drawn. A surface contour-plan of the site was then plotted with the theodolite and EDM (Figure 5.4).

A one metre square was swept with a soft brush to remove loose material from the surface of the area to be excavated. A 1.0 x 0.5 m area was then removed, using a combination of arbitrary spits and stratigraphic levels. Nineteen units were removed, including some culturally sterile deposits underlying the site. The 10 uppermost excavated units contained cultural materials. The structure of the site is summarised in terms of 6 strata (Plates 27 and 28, and Figure 5.5).

Stratum 1

This consisted of wind deposited mixed aeolian sand and charcoal.

Figure 5.4 Surface Plan of CC36

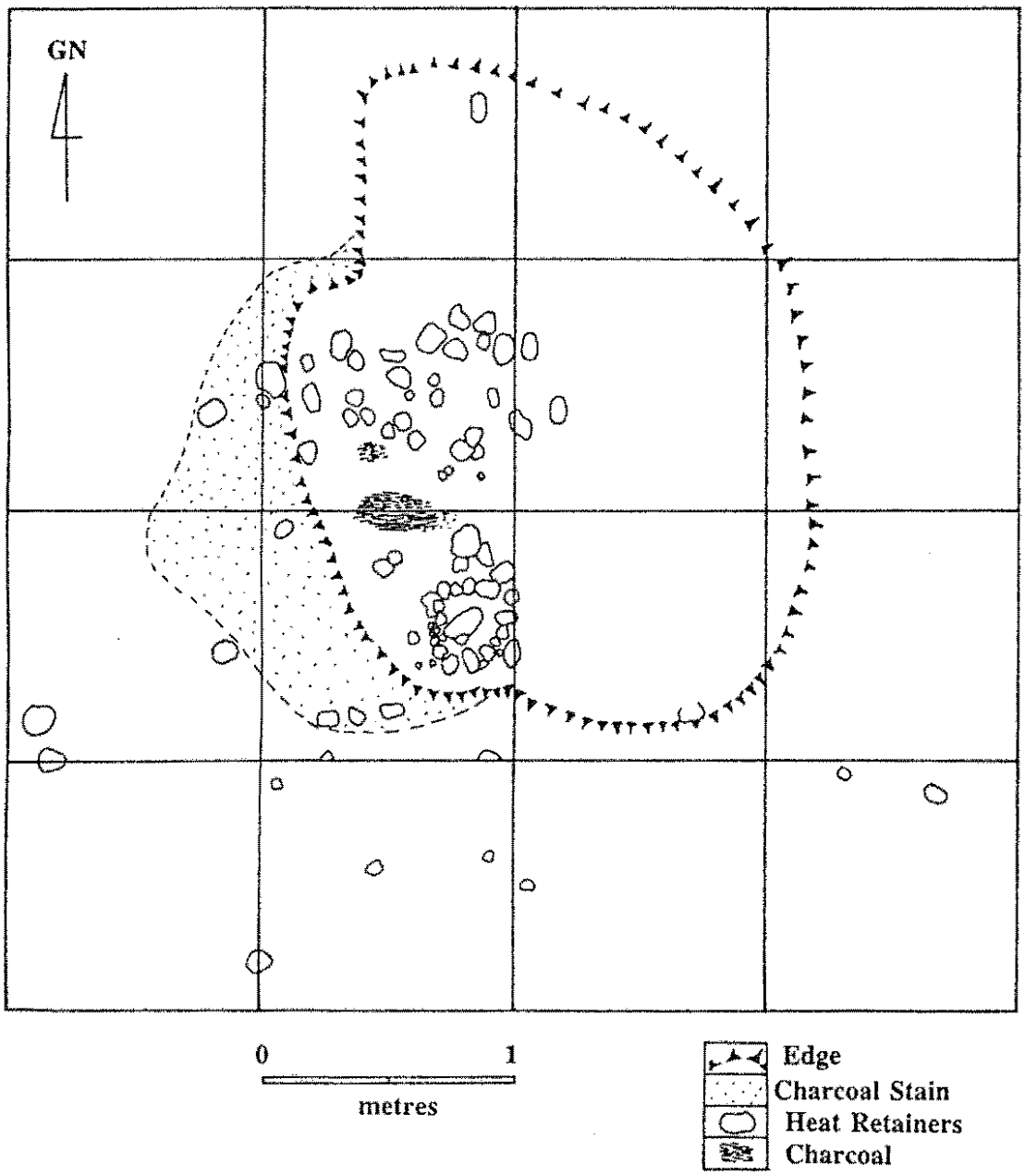
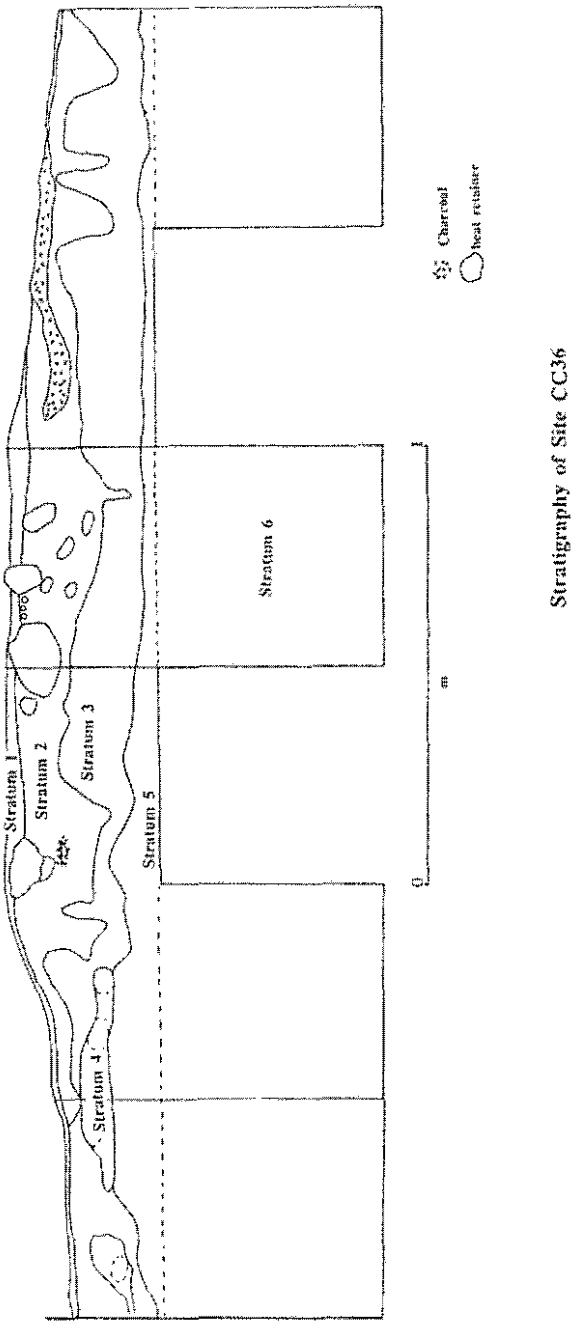


Figure 5.5 Stratigraphy of CC36



Stratum 2

This unit was the oven pit fill and consisted of an extremely compacted sediment which contained heat retainers and was rich in charcoal. It varied in thickness from 0.02 m thick at the edges of the oven, to 0.20 m thick at the centre of the trench. The base of the fill was a mixed deposit of sediment, baked clay and carbon. Two whole pieces of carbonised wood were collected from above and within the mixed fill for dating. One returned a radiocarbon age of 2890±90 BP (ANU-7880). Calibration of this age with the CalibETH program returned a median date of 1105±124 BC. The calibrated age ranges from cumulative probability to two sigma (ie. a 95.44 % probability) indicate a date between 1365 and 872 BC. The other sample returned a radiocarbon age of 2720±90 BP (ANU-7879). Calibration of this age with the CalibETH program returned a median date of 908±100 BC. The calibrated age ranges from cumulative probability to two sigma (ie. a 95.44 % probability) indicate a date between 1142 and 667 BC.

Stratum 3

This unit comprised a mottled red-orange and grey-black highly pedal soil. It was interpreted as a mixed soil consisting of the surrounding parent material which had been disturbed when the oven pit was constructed. It subsequently had the oven material leach down and infiltrate between peds and cracks resulting in columnar mottling. This layer varied between 0.03 and 0.15 m in thickness.

Stratum 4

This was a discontinuous soil unit present only at the western edge of the excavation. This material was missing at the centre of the spit, presumably having been dug through and removed when the oven pit was formed. It consisted of a concreted pale sand with some clay content and formed a discontinuous lip or rim of pale concreted sandy sediment. It was extremely indurated and contained hard sandy peds. It appears to have constituted the original ground surface when site formation began, since some excavated clay peds rest upon it. It varied between 0.04 and 0.065 m in thickness.

Stratum 5

This unit appeared to be an old compacted subsoil of orange sand and clay. It contained platy iron concretions interpreted as relating to periods of soil waterlogging. It was devoid of cultural materials.

Stratum 6

This unit consisted of non-cultural soil stratigraphy underlying the site to a depth of 0.83 metres. In general the subsoil comprised red clays interspersed with concreted pale bands, pisolites and calcareous concretions. A description of these soils is contained in Appendix II.

Soil samples were taken from the complete profile in 0.05 m samples and pH values measured. The entire site was alkaline, ranging between 8.5 and 9.0.

Discussion

CC36 also appears to represent the use of a small earth oven. The base of a shallow pit was uncovered, surrounded by raked out baked clay heat retainers. The pit appeared to have been shallowly excavated into a compact calcareous soil unit. Several unfired clay peds were situated on this surface, beneath raked out deposit. No faunal remains or stone artefacts were recovered from within the deposit, although several were present on the surface of unexcavated sections. It would appear that they postdate the site and are present as a lag deposit upon its surface.

5.2.4 Soil Profile Test Pits

Excavation 4: Soil Profile Test Pit adjacent to Excavation CC31

A 0.5 m^2 soil test pit was excavated adjacent to Colombo Creek Oven Mound Site 31 in order to articulate the site deposition with the present clay pan surface. Three excavation units were removed.

Stratum 1 (Unit 1 swept)

This was a thin layer of loose aeolian sand which was swept off and bagged. It revealed the current claypan surface of whitish crusted sand.

Stratum 2 (Excavated Unit 1)

This consisted of the thin current crusted claypan surface.

Stratum 3 (Excavated Units 2 and 3)

This unit was composed of a layer of cracking mottled sandy clay. There was a slight degree of carbonate flecking in the soil but no pisolitic formations were encountered. No cultural materials were recovered.

Stratum 4

This unit consisted of a pale carunculated columnar indurated sandy clay. The test pit was terminated upon reaching this level. The base of the excavation was surveyed in with the theodolite and EDM, and soil samples were bagged for analysis.

Excavation of Colombo Creek Location 3 - Residual Soil Test Pit

An off-site area was excavated near site CC31 with the purpose of determining whether a related occupation level could be discerned i.e. the living surface that would have been

exposed during the formation of the mound. Due to the severity of erosion in the locality remaining off-site areas were evident as residual pillar formations. The residual was mapped and profiled with grid points obtained with the theodolite and EDM. Stone artefacts were eroding from the sides of the residual and their positions were also plotted.

The test pit was dug in a series of stratigraphic and arbitrary levels and particular attention was paid to changes in soil colour, texture and hardness which might denote changes relating to the nearby use of ovens, such as the incorporation of windblown ash, the presence of stone artefacts and weathered soil surfaces. Soil samples for sedimentary analysis were column sampled from the complete excavated section.

The residual was excavated in 15 spits, using a combination of stratigraphic and arbitrary levels. These may be summarised in terms of 9 strata (Plate 30 and Figure 5.6).

Stratum 1 (Excavated Unit 1)
This unit consisted of approximately 0.05 m of loose aeolian coarse red sand, vegetation and roots, composing the topsoil of the residual. No artefacts, baked clay or carbon were recovered.

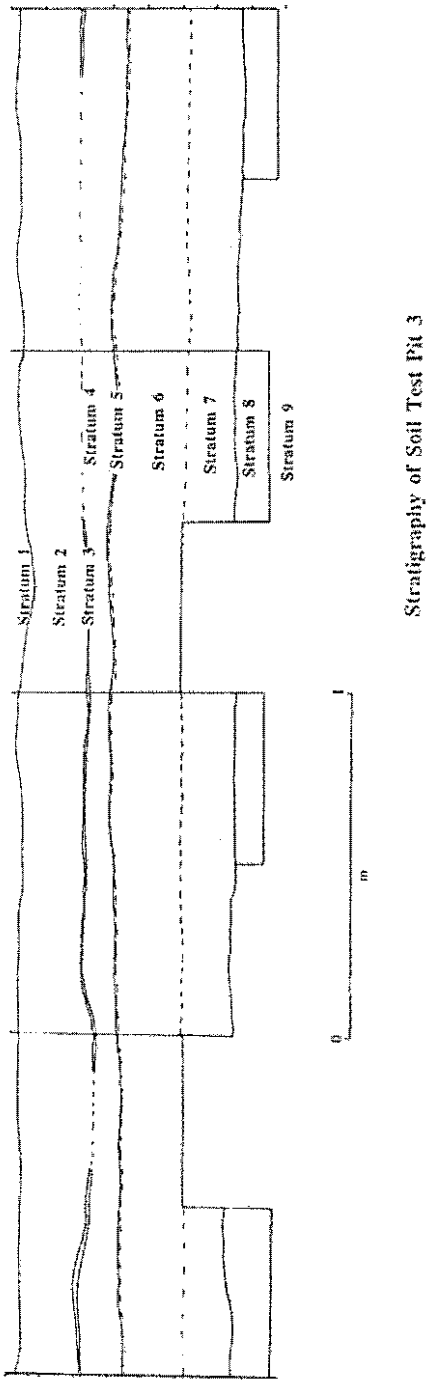
Stratum 2 (Excavated Units 2, 3, 4)
Stratum 2 consisted of coarse red sand with the addition of small worn quartz gravels, minute worn fragments of baked clay and dispersed stone artefacts. In the upper section of the unit some fine rootlets were still apparent and a small toad-burrow was also uncovered. Lower in the unit the remains of burrowing insects' pupae cases were recovered.

Stratum 3 (Excavated Unit 5)
This consisted of a thin band of concreted sediment otherwise similar to Stratum 2. Gravels had accumulated in the top of this unit.

Stratum 4 (Excavated Unit 6)
This unit consisted of similar but less concreted sand. It contained minute worn fragments of baked clay and well rounded quartz gravels of less than 2 mm in diameter.

Stratum 5 (Excavated Units 7 and 7a)
This unit consisted of a more compact layer of greyer sand and contained a substantial quantity of very small, fragmentary heat retainer material. This overlay level 7a which continued to consist of this compact grey sand. It was approximately 20 mm thick.

Figure 5.6 Location 3 Soil Test Pit - Stratigraphy



Stratum 6 (Excavated Unit 7b)

Level 7b was composed of a very hard orange clayey sand and varied between 10 and 20 mm thick.

Stratum 7 (Excavated Units 7c-d, 8, 9, 10 11 and 12)

This consisted of a softer grey sandy layer with numerous small wind-rounded heat retainers and specks of carbon. It developed fine cracks and became slightly concreted with depth.

Stratum 8 (Excavated Units 13, 14 and 15)

This unit consisted of a light coloured, indurated pale sandy deposit. Insect holes with cemented spoil heaps adjacent to them were revealed on the surface of this hard layer. This suggested exposure of this surface at some stage, in order for the spoil heaps to form. It is interpreted as an old ground surface. The deposit was extremely difficult to sieve, containing calcareous concretions and platy clay-rich clods. No artefacts and no carbon fragments were recovered from this level. The base of this unit required loosening with a crow bar, before removal.

Stratum 9 (Excavated Unit 16)

This unit consisted of a compacted mottled red and yellow sandy clay. It also required loosening with a crowbar before trowelling out and sieving.

Discussion

There was a clear indication of nearby oven activity within Stratum 7. This thick layer of sandy sediment was rich in ash and specks of carbon. Heat retainer fragments were also numerous. The stratum overlay what appeared to be an old ground surface of light coloured sandy clay. Stratum 7 was effectively 'sealed' by a thin crusted soil unit, identical to that located in the overburden profile of CC31. Whilst some fragments of heat retainer and a few artefacts were recovered from the levels above this, they were small and displayed wind rounding, suggesting their transport within aggraded sediment following the relatively recent erosion of the site.

Excavation 6: Soil Profile Test Pit adjacent to Excavation CC36

A soil test pit was excavated in the vicinity of Colombo Creek Site 36. It was undertaken to confirm the nature of the soil into which the oven site was constructed. Only one level was removed and it comprised a thin surface encrustation overlying a pedal red clay soil. Soil samples were taken of both the surface crust and the underlying soil.

5.2.5 Discussion

Stratigraphy Across the Site

Comparison of site stratigraphy indicates features which can be correlated across the Colombo Creek site complex (Figures 5.7 and 5.8). Features which are considered sufficiently distinct to be used as seriated points of reference include:

1. The cemented cap within the soil units overlying CC31 and Soil Test Pit 3.
2. The upper calcareous band located beneath cultural deposit in sites CC31 and Soil Test Pit 3 (not present in the CC32 or CC36 profiles).
3. The lower calcareous band present in the soil profiles underneath CC31, CC32 and CC36.
4. The pisolitic soil stratum underneath CC31 and CC36 and present as a lag surficial material in the vicinity of CC31 and CC32.

Correlation of these features suggests a sequence of site formation. Sites CC32 and CC36 are situated on the lower calcareous band. Site CC31 and the stratum composed of an admixture of soil and windblown carbon and heat retainer in Soil Test Pit 3 are both situated above the upper calcareous band. Soil profiles thus suggest the formation of CC32 and CC36 prior to CC31.

The presence of an *in situ* but exposed burial in the vicinity of sites CC31 and CC32 also suggests multiple use of the site. The burial is currently exposed at approximately the same level as CC32. Considering that it must have been buried, it therefore cannot have been interred from the same living surface as CC32, but from a later overlying soil unit.

Dating of the sites would appear to support this interpretation. The dates obtained for CC32 and CC36 overlap at one standard deviation. The date for CC31 however is considerably younger and does not overlap with the other two at one standard deviation (Figure 5.9). It should be clarified that the date obtained from CC31 originated within the cultural deposit and was not a basal date. Charcoal was not present in sufficient quantity to date the basal levels. However, soil stratigraphy is still sufficiently clear to separate it from some earlier sites.

Consideration of radiocarbon dates to one standard deviation suggests a continued use of the site environment for a long period of time. The widest range in the uncalibrated dates obtained indicates a possible 660 years of occupation between approximately 3110 and 2450 BP. The narrowest interpretation would allow a period of approximately 210 years between 2800 and 2590 BP. Use of calibrated dates suggests and a maximum of 835 years, between 1363 and 528 BC and a minimum period of 241 years, between 981 and 740 BC.

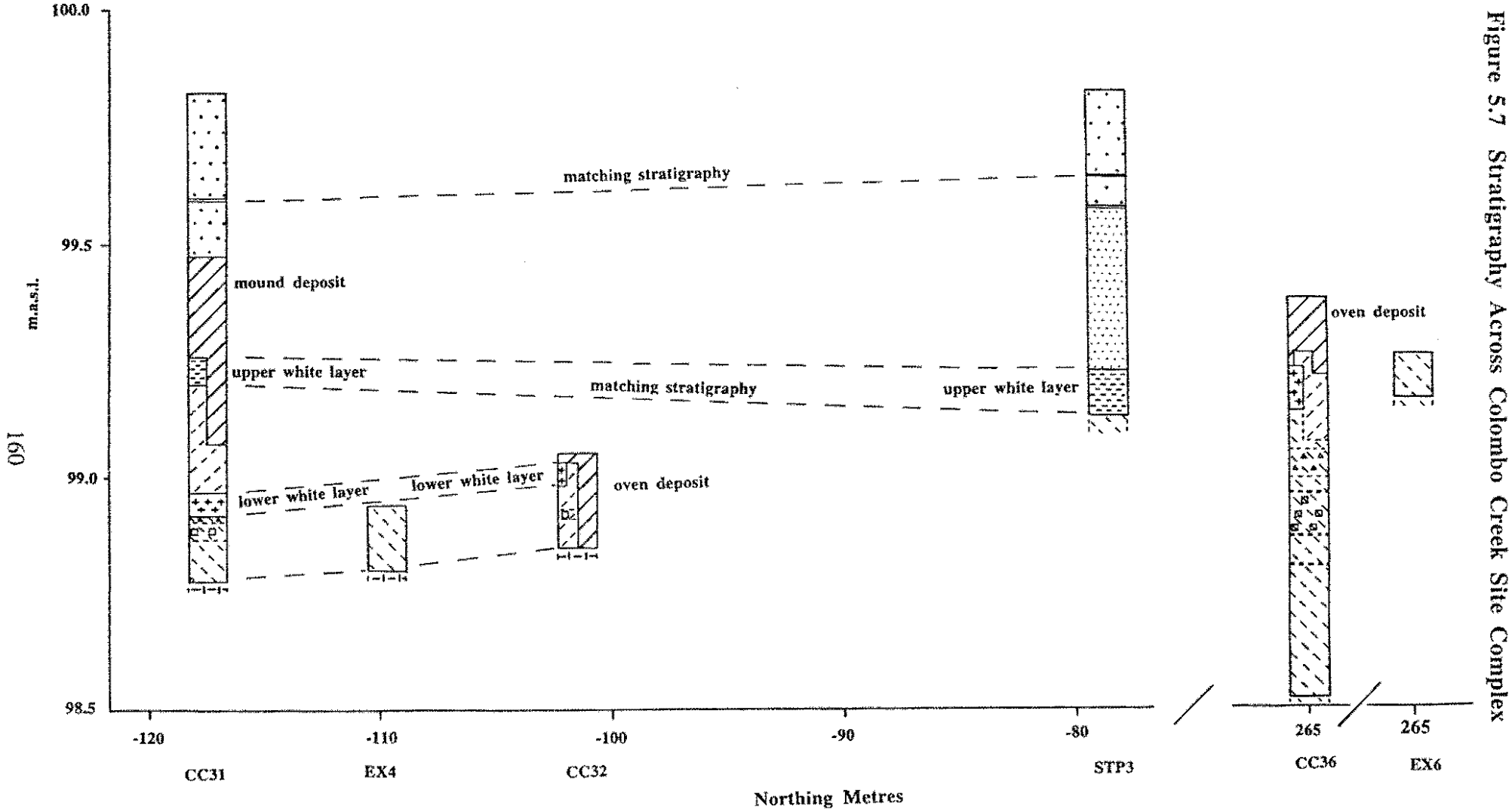


Figure 5.7 Stratigraphy Across Colombo Creek Site Complex

Figure 5.8 Profile between CC31 and Residual Soil Test Pit 3

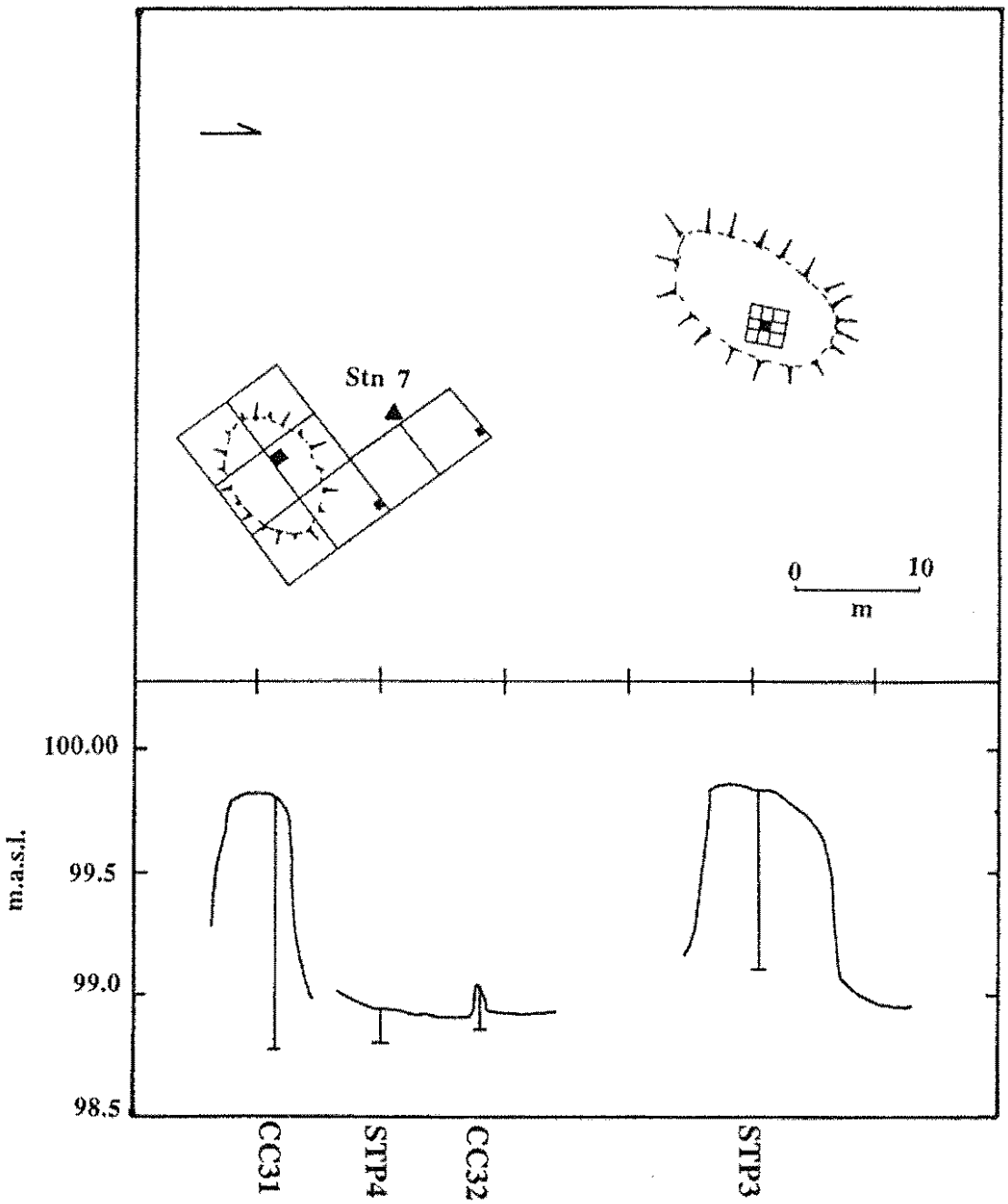


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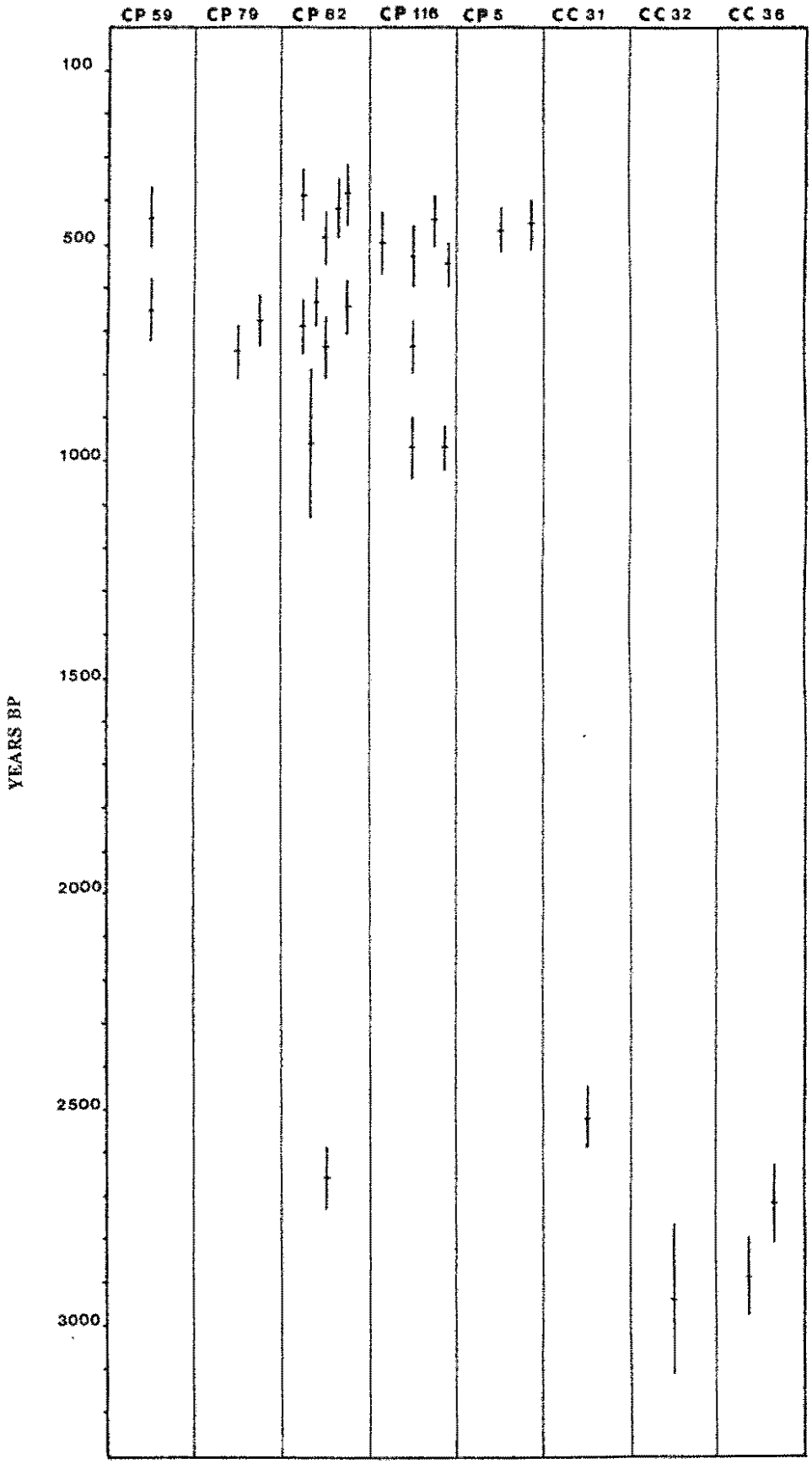
Figure 5.9 Radiocarbon Dates Obtained from Excavated Sites (Uncalibrated).



The question remains, however, whether the nature of occupation changed during this period. On face value it might be suggested that small ovens predate larger mounded formations. Further analysis of the site stratigraphy may shed some light on this.

From east to west the site complex is not level. There are two major areas of uneroded soil forming north south bands across the site. Ignoring these, and concentrating on exposed claypan surfaces, a slightly dished profile is apparent from east to west. If this dished profile is considered as a datum 'horizon' and applied across the site, then the position of sites with respect to it may be determined.

Comparison of claypan heights beside sites suggests that CC32 and CC36 occur in a similar stratigraphic position (which could also be predicted in accordance with their dates). Relative to these two sites and the extrapolated horizon at their level, other sites occur above and below. Individual small ovens occur both beneath and above this level. Pairs of ovens occur above and below. Large mounded features occur on or above this level.

This pattern may be interpreted as representing a lengthy period of site occupation. It commenced upon compact texture-contrast soils of the Colombo Creek levee with the use of individual or grouped small ovens. These were shallow cooking pits of approximately 0.5 m or less in diameter. They are currently evident as small accumulations of heat retainer material and are explicable as discrete rakeout events relating to the final use of the small cooking pits situated beneath and adjacent to them, as demonstrated with the excavation of CC32 and CC36. Remnant charcoal stains evident beside other such sites (eg. sites CC25, CC26 and CC29) are interpreted as associated open hearths which may have been used to preheat the clay heat retainers. The degree of surface erosion may have obliterated evidence of this activity in other areas of the site.

Continued reuse of the site area resulted in the continual formation of new small ovens and a certain degree of reuse (either deliberate or coincidental) of old locations of small ovens. A proportion of the sites would continually fall out of use. As time progressed this pattern became increasingly defined due to the repeated use of a circumscribed landscape unit, the elevated levee deposit. There is thus not necessarily any substantial increase in numbers of sites formed over time. Similar patterns in long term site accumulation, and the need for recognition that many large open sites result from sequential occupation, and are thus not necessarily easily explicable in behavioural terms, have also been discussed by Edwards (1995) and Stern (1995).

At the same time, although apparently not contemporary with the very earliest use of the area, there was also a use of ovens with substantially larger underlying pits (1.0 m or more in diameter). Their method of use resulted in the fragmentation of much of their component heat retainer material and the resultant deposit was substantially greater than that of the smaller ovens. Their use did not replace the smaller ovens. These continued to be formed throughout the history of the site. Proportionally, however, there appear to be fewer of these larger sites in comparison to the smaller ones. Current exposure of features across the site suggests a ratio of approximately 1:6.

The period of use of the larger ovens (and later use of the small ones) seems to have been accompanied by a build up of a thick cultural sand deposit containing carbon and heat retainer fragments. This is revealed in corresponding strata of the residual Soil Test Pit 3. It suggests that the occupation continued for a considerable period, and formed a completely cultural soil unit.

Cessation of major use of the site area is also indicated by its subsequent burial in aeolian sand, free of carbon or significant quantities of heat retainer fragments. This overlying soil unit had developed over a period of time sufficient to form typical pedogenic characteristics (Stannard 1970). This occurred well prior to the overgrazing and European destabilisation of the landscape which resulted in Colombo Creek becoming a revealed succession of several hundred years of activity.

A change in landscape formation processes has also occurred. As many of the currently exposed sites were formed, they became incorporated within the calcareous levee formations. These levees would have been forming whilst the Colombo Creek followed a more easterly course. The original (and now infilled) channel is evident, and also appears on aerial photographs of the area (SI5510 Narrandera 207-263 CAC 2632). Whilst migration of the stream course in a westerly direction would have altered gross patterns of water availability to the site area, it would have also influenced the type of water body present, and subsequently, any associated resources. It is probable that such changes could be broadly summarised as a sequence from a confined flowing stream channel with creek resources, to an infilling and swampy still-water area, succeeded by the eventual cessation of water flow through the area except in periods of exceptional flooding. The latter conditions would be those present at the time of initial European settlement of the area. Changes in available resources would have been from a reliable water supply and associated species contained in flowing streams, presumably fish and water mammals to a less reliable water supply, with associated swamp species, such as reedy plants, notably *Typha* sp, as well as fish, mammals and birds. This process of change would have culminated in more frequent episodic drying of the water source and

finally the eventual disappearance of the associated resources. In short, a substantial change in available biomass and in living conditions would have occurred.

In this window of microenvironmental evolution the patterns of archaeological site formation become quite interesting. Small ovens appear to have been related to the formation of the levee deposits. They are, in fact, inter-fingered with successive levees. Whilst these levees were forming it is likely that their conditions for longer term habitation were relatively poor, due to their potential for inundation. However, they would have been optimum short term locations, providing relatively elevated and dry camping areas. Studies of occupation patterns in similar environments in North Eastern Louisiana, USA (Kidder and Saucier 1991) and the upper Mississippi River valley Stafford *et al* (1992:311) found that during initial stages of development, levees comprised periodically unattractive occupation sites due to their poor drainage, risk of flooding and rate of sedimentation. As they became more substantial their attractiveness for occupation increased. Once they were in decline or channels had migrated elsewhere, their occupation again became limited to smaller groups or shorter-duration settlement. However, at a critical intermediate point in such a cycle they provided optimum conditions which encouraged intensive human exploitation.

When levee formation ceased at Colombo Creek, small ovens continued to be used, and a variant appeared, in the form of larger oven pits and associated mounded deposit. This is interpreted as coincident with the change to a swampy environment. At this point the locality would present a rich resource base which would be likely to encourage more frequent and repetitive site visits. If the larger mounded sites represent the agglomeration of cooking activities related to repeatedly used ovens then they may be indicative of this more intensive stage of site usage. The evident eventual cessation of site use may consequently be interpreted as resultant of the third phase, the drying of the area, as the creek completed its move eastwards. Alteration of stream flow conditions is thus considered to have had a considerable impact upon the settlement pattern. This interpretation is consistent with the change in local resources at the site. The mounded site postdates the period of active levee formation, sitting above the calcareous soils. Hence, it is suggested that its formation coincides with the change to swamp environs, and the concomitant availability of water plants, such as *Typha* .

The overall pattern demonstrates that use of such environments is highly sensitive to any change which they undergo. An aspect for further consideration would be the degree to which these microenvironmental changes resulting from reduced stream flow might reflect broader regional patterns of increased aridity and whether these archaeological trends indicate larger scale shifts in regional settlement strategies.

The compacted deposit characteristics of the larger oven sites like CC31 still remain to be more fully accounted for. It is reminiscent of the 'core' deposits of sites recorded in the Murray Valley and Central and Western Districts of Victoria (Coutts 1980). Some further consideration of the deposit characteristics of CC31 are therefore warranted, before concluding any functional interpretations.

5.2.6 Soil Reaction Trends

Soil structures are classified in terms of horizons. The A horizon is characterised as an eluvial sedimentary layer affected by leaching. The B horizon is characterised as illuvial, enriched by soil components leached from the A horizon (Shackley 1981:7). The underlying layers are generally derived from bedrock. As Shackley (1981) further notes, the characteristics of buried soils ultimately depend upon the depth to which a soil has been buried and the characteristics of any overlying sediments.

Soil reaction trends (after Northcote 1979) were carried out for the excavated profiles of sites and soil test pits. Trends down the soil profile may be characterised as:
Strongly acid - Surface soil pH > 7.0 Deep subsoil pH < 6.5
Acid trend - Surface soil pH <7.0 Deep subsoil pH < 6.5
Neutral trend - Surface soil pH 5 to 8 Deep subsoil pH 6.5 to 8
Alkaline trend - Surface soil pH>5 Deep subsoil pH >8.0

Batten (nd:3) recorded much higher pH levels within mound deposits along the Murrumbidgee River (pH neutral to alkaline) as compared to surrounding soils which were acid at the surface tending to neutral in the subsoil (neutral trend). Sullivan (1980) noted differences in soil pH levels and colouration between 'core' type deposits and overlying softer sediments. Core deposits tended to be acidic and softer deposits alkaline. The overlying softer deposits also tended to be lighter in colour. This was attributed to their being drier, due to their relative aeration, which facilitated percolation of water through the deposit. After air drying Sullivan (1980:49-50) found the colour differences to be negligible. She concluded that the differences in soil pH levels were probably due to differences in mound construction rather than post-depositional changes.

The consistent pattern of acidity within the core deposits is nevertheless interesting. It may be explicable as a result of normal soil processes acting upon the particular characteristics of these materials i.e. high clay content, density of finely fragmented fired clay and relatively low position in later soil profiles. Johnson *et al* (1988:404) observed, in the context of habitation sites, that ceramic materials within deposits tended to absorb humic acids and organic matter.

Fired clay heat retainer fragments would approximate such ceramic materials. The core deposits would therefore retain moisture for relatively longer periods of time, due to their density and position. In addition, over time, they may assume the role of a B-soil horizon in which case they would become zones of enrichment from the leaching of overlying soil. Soil profiles away from mound sites along the Old Man Creek tended to be acidic (Batten nd). Similarly, the testing of complete soil profiles nearby to Colombo Creek 31 demonstrated a generally acid tendency for the A horizon, whilst basal deposits were heavily calcareous and alkaline.

Their component quantities of ash, charcoal and decomposed shell would contribute to the aeration of the soft mound deposits. Decomposed shell would also largely explain their alkaline pH. Sullivan (1980) noted that whilst the acidic nature of the core deposits could explain their negligible bone and shell content, had shell been initially present it would be likely to reduce acidity and enhance further preservation of bone and shell. It therefore seems likely that the core deposits were not generally related to the processing of shellfish, nor were bones and shells apparently discarded within them.

The lack of clear stratigraphic features is also problematic. One explanation could have been that the deposit was formed by the secondary deposition of baked clay heat retainers, like an ash hill. However, this is not supported by the earlier dates obtained from small ovens in the vicinity, and their stratigraphic position relative to the mounded deposit. The presence of an underlying pit is also less characteristic of ash hills. although it may simply reflect the degree of reuse of the site.

There are several other formation processes which, alone or in combination, could have contributed to the relatively featureless nature of the deposit. A high degree of site reuse may have resulted in the obscurement of previous features such as oven pits, and resulted in the extreme fragmentation of heat retainers. The latter period of the site build up may have coincided with a period of drier and perhaps windier regional climatic conditions, when accompanying formation of mounded deposits would have resulted in much of the finer ashy sediment being winnowed out of the deposit. The effects of wind erosion upon exposed mound deposits were noted by 19th century observers (Soilleux 1891:42). The presence of drier conditions is certainly indicated by the microenvironmental change identified at the locality. Over time, finer sediments may also have percolated through to the lower levels of the deposit. Evidence of such a process is demonstrated by the fine compacted ashy soil contained within major inter-pedal cracks, underlying the site.

The degree of deposit compaction is most likely explicable as a combination of age and soil pedogenesis. Most of the Type A deposits are relatively old, the youngest being the

underlying strata of Site DP1 dated to 1290 BP (Coutts 1980). An analysis of soil forming factors in Indian Effigy Mounds in Iowa, USA, may contain some clues (Parsons, Scholtes and Riecken 1962). The Effigy Mounds studied were formed shortly after 3000 BP and displayed distinct pedogenic trends. It was found that the mounds developed their own soil profiles over time, separating into A and B horizons. There was a gradual increase in clay content with depth, due to water percolation and consequent illuviation from the upper layers. The base of the mounds were situated on truncated B horizons, much the same as soil horizons under the Australian mounds might be truncated by the excavation of a large oven pit. Water which did percolate through an overlying deposit would pool temporarily at this level, (Sullivan (1980) noted the increased moisture content of the compact layers), resulting in the precipitation of the clays as it dried. The process has been summarised as follows:

> "Therefore, the B horizon would generate from the bottom upwards with time and the older the profile, the greater would be the expression of an A2 and a B horizon." (Parsons *et al* 1962:493).

This process was found to have detectable expression in mounds between 1000 and 2500 years old (cf DP1 at 1290 BP). From this, and further reaction trend analysis, it was suggested that soil formation in the mounds occurred rapidly during the first 1000 years and then reached an equilibrium (*ibid*:496). Whilst the degree to which soil processes in the Australian situation could be deemed analogous is open to question, in both situations the subsoils are similarly calcareous.

The characteristics of Type A materials in mounds may be resultant of a combination of factors. The hardness of their deposit however, would appear to be a post depositional effect, resulting from the combined factors of burial and age, contingent upon particular soil conditions. The extreme degree of fragmentation of the basal layers of heat retainers could simply reflect the degree of reuse of the heat retainers.

Regardless of cause, soil reaction trends in combination with sediment analysis, would appear to present a simple test to determine whether a mound is likely to be Type A, B, or C and could be carried out on small diameter core samples.

5.3 Cooey Point Lagoon

Detailed research was focussed upon an area which, in light of the wider survey, appeared to demonstrate archaeological material typical of the riverine floodplain environs. Cooey Point Lagoon is considered representative of the most detailed pattern of riverine occupation in terms of the types and variety of site components recorded, the spatial association between site components and microtopography and overall component densities. The locations of excavated site components at Cooey Point Lagoon are shown in Figure 5.10.

5.3.1 Excavation of Mounded Deposit at Cooey Point Lagoon 116.

This site was a low mounded feature of compact sediment and surficial concentrations of baked clay heat retainers (Plate 31). The mound measured approximately 10 x 14 m and was roughly oval in shape. It was situated on the immediate margins of Cooey Point Lagoon, with its long axis perpendicular to the break of slope. A site plan was drawn using a theodolite and EDM and a 0.5 m wide strip crossing the site was selected for excavation. The strip was marked off in 1 m intervals. These were coded D1 to D5, and four of these sections D1, D3, D4 and D5 were excavated to sterile ground. The site was excavated in a series of 12 units. These constituted a series of 7 strata (Figure 5.11), which are described as follows :

Stratum 1

This unit comprised the humic upper topsoil.

Stratum 2

This unit consisted of the present subsoil of heavy silty brown clay loam.

Stratum 3

This unit was a uniformly more compacted deposit of ashy silt and fragmented heat retainers. Its compaction was similar to that of Stratum 4, but it was of a darker colour.

Stratum 4

This unit was a localised minor unit concentrated in Section D4. It had the same basic components but was slightly more compacted. It overlay the pit location.

Stratum 5

This unit consisted of a pale grey homogeneous mixed deposit of ashy silt and crumbled heat retainer. It filled the pit feature and was discontinuous across the site, forming an undulating tapering lens. It was not present in Section D1.

Figure 5.10 Cooey Point Lagoon Site Complex

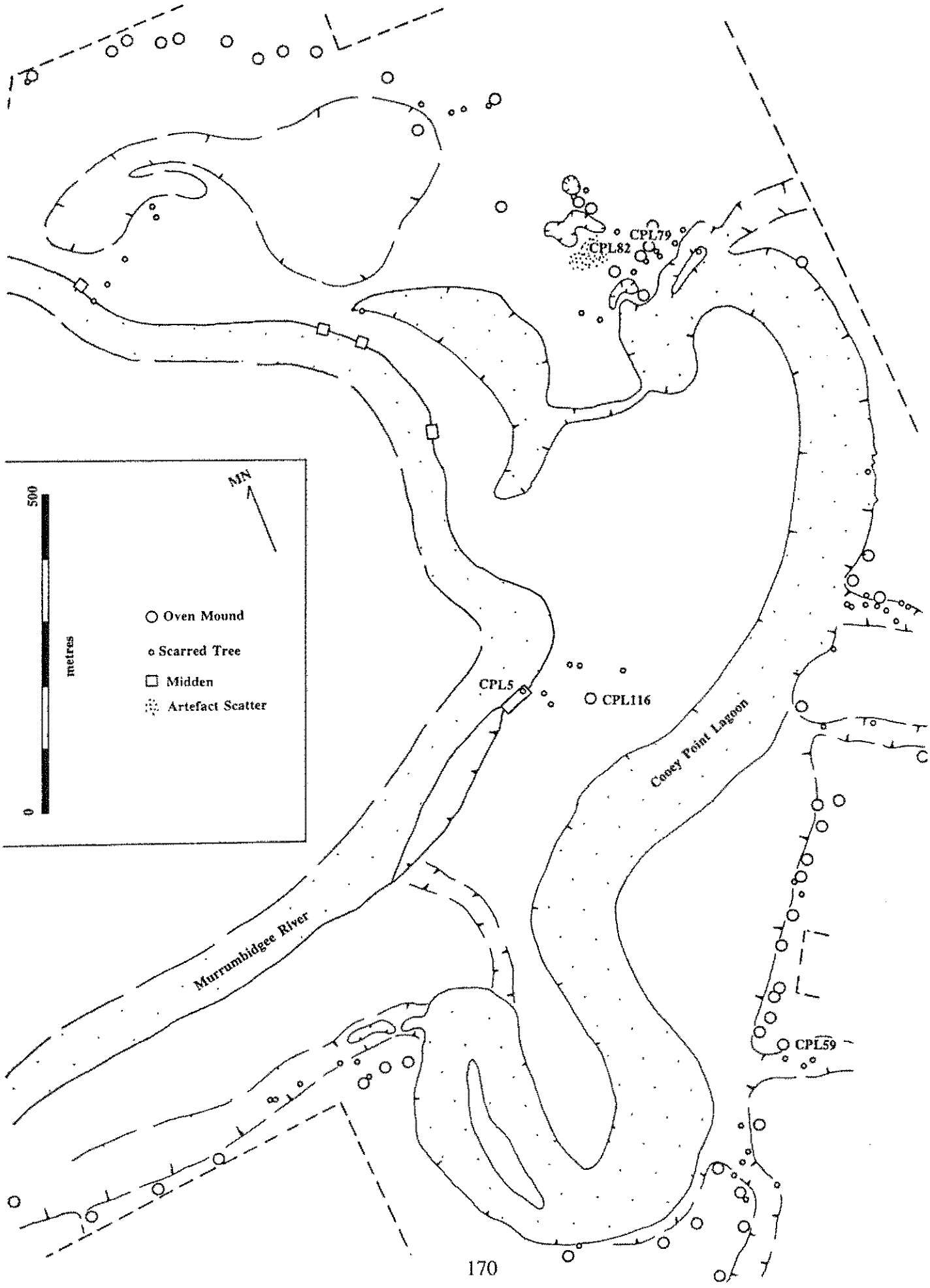
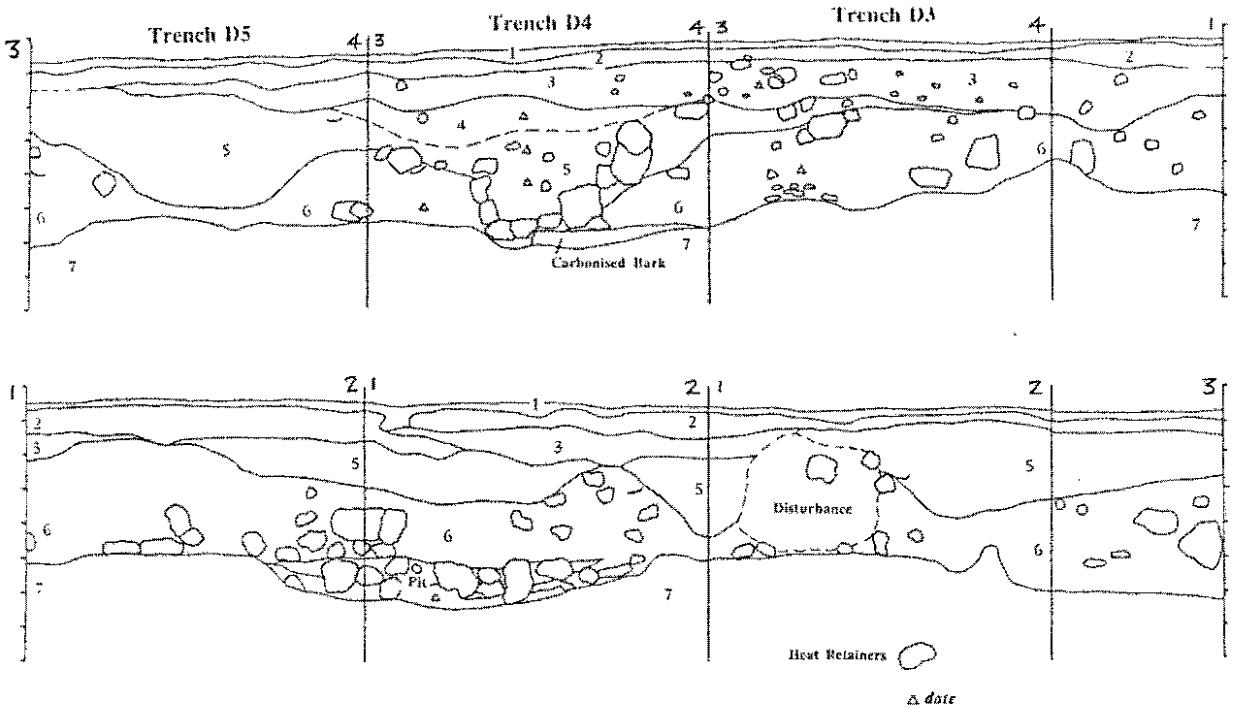
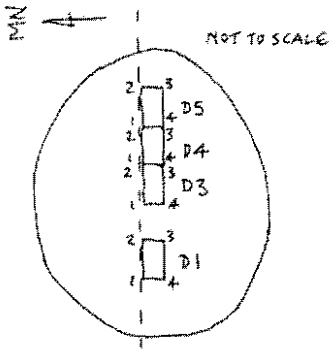
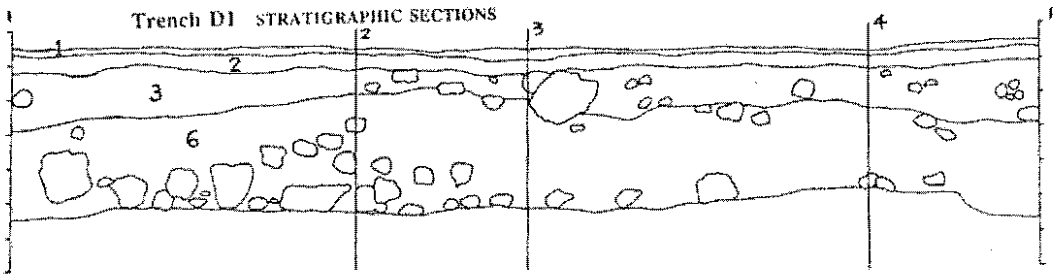


Figure 5.11 Stratigraphy of CP116





SECTION LOCATIONS CP116



Stratum 6

This unit was an homogeneous mixed deposit of loose dark grey ashy silt and crumbled heat retainer. Some large compact heat retainers were dispersed through the unit. Some areas adjacent to the pit feature in Sections D4 and D3 had slight evidence of bedding, as though material had been raked out from the pit. This unit was not present within the pit, and appeared to have been replaced with sediment from Stratum 5. Most of the large heat retainers in the site were located in this stratum.

Stratum 7

This consisted of underlying sterile yellow silty clay.

Feature 1 Oven Pit

This feature was a shallow circular pit which had been cut into Stratum 7. The base of the pit was covered with a sheet of carbonised bark. The bark demarcated the boundary between the pit dug into sterile soil and the cultural deposits above. A layer of wood ash was also present discontinuously across the pit base. Heat retainers were concentrated within the base of the pit (Plate 32 and 33).

Feature 2 - Section D5 - Disturbance

The northeastern end of Section D5 showed limited but perplexing evidence of burrowing animal activity particularly in the basal clays which underlie the deposit. The effect of rabbit burrows on mound deposits is well recorded, however, these features could not be related to the upper layers of the site from examination of the excavated section, nor was evidence of rabbit disturbance encountered during the excavation of the upper layers. Nor was there evidence of old or collapsed burrows in the general area surrounding the deposit. Whether rabbits had penetrated the site from a more distant location, or whether the burrows were formed by native species contemporary with earlier stages of the site formation was unable to be resolved at this stage. The potential for animal commensalism within mound sites has not been raised in earlier accounts of their excavation. The disturbance did not extend further into other excavated parts of the site. In any case, no materials were submitted for dating from Section D5.

Discussion

The excavation results depict the initial use of the site as an earth oven. The sections of the site CP116 indicate that it commenced with the operation of at least one shallow cooking pit. This pit was lined with a sheet of bark. This provides one explanation for scarred trees in oven vicinities. The pit was not totally cleaned out after this usage, although it does appear to have been reused. That is, other pits were evident during the excavation of overlying levels (Plates 33 and 34). It subsequently became filled in with

mixed fired debris. The quantity of loose oven matrix (heat retainers, ash and ashy soil) suggests concurrent or serial operation of other pits within the site.

This repeated usage resulted in the accumulation of crumbling heat retainer material, ash and food remains, ultimately leading to the formation of a typical mounded deposit. At no stage in the stratigraphy was the oven sealed with flood lain silt, despite its proximity to the lagoon. This suggests that its periodic reuse managed to mix the deposits resulting in the complete incorporation of any silt deposits.

There appear to be three relatively distinct stratigraphic layers within the site. A dark, in places compact, layer of ashy soil and heat retainers directly overlying the oven pit. A paler grey layer overlying this and a band of dark sediment with tiny fragments of heat retainer partially overlying this. A minor feature of ashy sediment with larger consolidated heat retainers occurs between the latter two layers, but it is a relatively minor lens. The majority of stratigraphic variety occurs in direct association with the oven pit location. Away from the pit there are only two main sedimentary layers. A lower one with large heat retainers and an upper one with smaller fragmented heat retainers.

Cooey Point 116 is thus explicable as a deposit resulting from the *in situ* operation of an earth oven. This is demonstrated by the oven pit found at the basal level of the site. The overlying soft mixed sediment is interpreted as that resulting from its function and the intermittent reuse of the site as an elevated location for the construction of an oven. Discrete lenses of ashy material probably relate to these individual periods of use, but have been truncated by the digging of oven pits, the raking-out of heat retainers and general site disturbance.

Very little in the way of faunal remains were recovered from the excavation. Species that were able to be identified included freshwater mussel (both burnt and unburnt shells were present, although only two umbos were recovered) highly fragmentary small bird bone, otherwise unidentifiable, and marsupial mouse.

5.3.2 Excavation of Mounded Deposit at Cooey Point Lagoon 82

Cooey Point Lagoon Site 82 was a compact, mounded oval deposit of dark soil with heat retainers, mussel shell and stone artefacts exposed on the surface. It formed a continuous exposure of oven material with two other nearby concentrations recorded as CP80 and CP79 (Plate 35). It was situated in an area prone to flooding and the surrounding sediments were predominantly flood lain silts and clays. The surface of the site was slightly scoured by previous flooding and a proportion of the topsoil had been removed. Grazing in the area had also depleted the ground cover and, in combination with dry conditions, had resulted in the continuing wind erosion of fine ashy dust from the surface

of the site. That CP82 was not further eroded was probably a result of its densely packed surface of heat retainer material which formed a pavement of consolidated baked clay.

Prior to excavation, a large artefact scatter surrounding the site was recorded with a theodolite and EDM. The surface contours of the site were also plotted and a grid was strung out across the surface of the site. A maximum of 4 areas (each measuring 1.0 x 0.5 m) were anticipated to be dug, although the aim was to obtain as much information on the site's structure from a minimum of excavated material. Ultimately the excavation of three staggered sections (4A, 6D and 3BB) gave a good exposure of the site structure and contents, and the fourth was removed from an associated area at the margins of the site, CP79.

CP82 demonstrated a complex stratigraphy, which can be summarised as a series of strata (Figure 5.12). These were not continuous across all excavated sections. The continued operation and construction of oven pits within the deposit had resulted in truncation of some earlier pit features (Plate 36).

Stratum 1

This unit comprised humic topsoil, heat retainers and surficial artefacts and it was continuous across the site.

Stratum 2

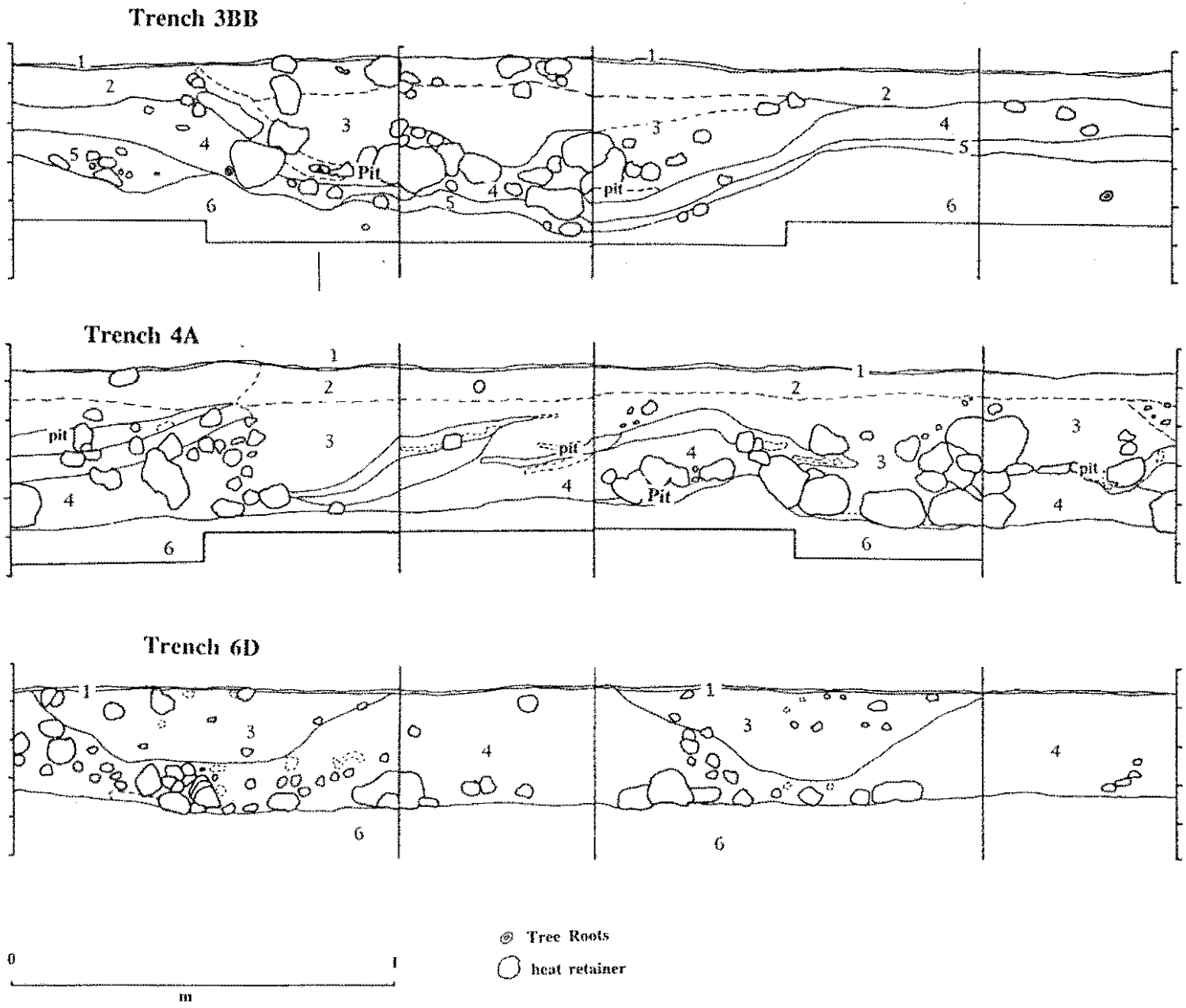
This unit consisted of brown silty topsoil and plant roots, it was continuous across most of the site, but very thinly spread over section 4A, which was the highest part of the site.

Stratum 3

This unit contained of a mixed deposit of ashy silt as well as degraded and fragmentary heat retainers.

Stratum 4

This unit was also a mixed deposit of ashy silt and heat retainers but generally contained larger heat retainers than those of Stratum 3. In Section 3BB some dense well fired orange and buff heat retainer fragments were also evident. They were not present in Sections 4A or 6D.



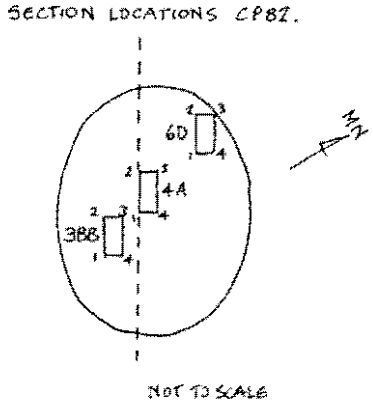


Figure 5.12 Stratigraphy of CP82

Stratum 5

This unit consisted of an extremely compacted thin layer of dark oven deposit which was flecked with buff, orange and white heat retainer fragments. It was only present in Section 3BB and was cut by the excavation of an oven pit. Some very dense orange heat retainers were also present. Loose heat retainers of a similar dense composition appeared to have been reused in the intrusive oven pit. These heat retainers appeared water worn. They were very rounded and some displayed potholed impressions as if softer components had been eroded out.

Stratum 6

This unit comprised the underlying clay subsoil. It was very compact and dense with calcareous inclusions.

Discussion

CP82 is interpreted as initially constituting a low concentration of discarded heat retainers and oven refuse. A radiocarbon date indicates its likely formation at somewhere between 2600 and 2700 BP. The abrupt change in deposit characteristics between this layer and subsequent material deposited at the site is interpreted as a discontinuity in site formation. A hiatus in deposit build up then occurred until approximately 1000 years BP when it was reutilised as an elevated location for the construction of oven pits. Rakeout features were present throughout the excavation (Plate 38).

The hiatus probably occurred in response to minor environmental change and redistribution of flood waters following the cut off of the meander and the initial formation of the Cooey Point Lagoon. Similar events in floodplain histories have been reported from the Upper Murray River, where Ogden (1993:74) analysed infilled sediments from cut-off meanders and found them to date to between 1000 and 2000 years before present. The underlying layers thus appear to have been deposited on to a levee adjacent the original river channel, now cut-off and evident as Cooey Point Lagoon. Later reoccupation of the area was probably focussed upon the lagoon environment, and settled on the particular spot to take advantage of a useful exposure of baked clay heat retainers.

Hence, this location then once more became the location of earth oven operations and a similar pattern of usage continued for a further 600 to 700 years.

No faunal remains were recovered from the compact basal deposit. The overlying strata contained fragments of marsupial mouse bone and freshwater turtle carapace, as well as unidentifiable <5mm burnt fragments of small animal bones. Several heat retainers presented smoothed triangular indentations suggestive of the imprint of a digging stick. Such marks would be explicable in the levering out of clods prior to their use in an oven.

5.3.3 Mound Materials adjacent to CP82: CP79.

CP79 was a barely-apparent low grassed area of undulating soil. It formed part of a virtually continuous exposure of artefacts and oven material with CP82 and CP80. A small test excavation was planned to determine its relationship to the remainder of the exposure. It also exhibited surface evidence of rabbits having burrowed through the deposit.

Prior to the excavation the deposit was photographed and a theodolite and EDM plan of the area was plotted. An ants nest covering an area of approximately 1 x 1 m had also colonised the southern section of the site. The deposit consisted of four strata (Figure 5.13).

Stratum 1

This unit consisted of a thin layer of surface vegetation and humic topsoil. Small subangular heat retainer fragments and pellets of rabbit dung were found throughout this unit.

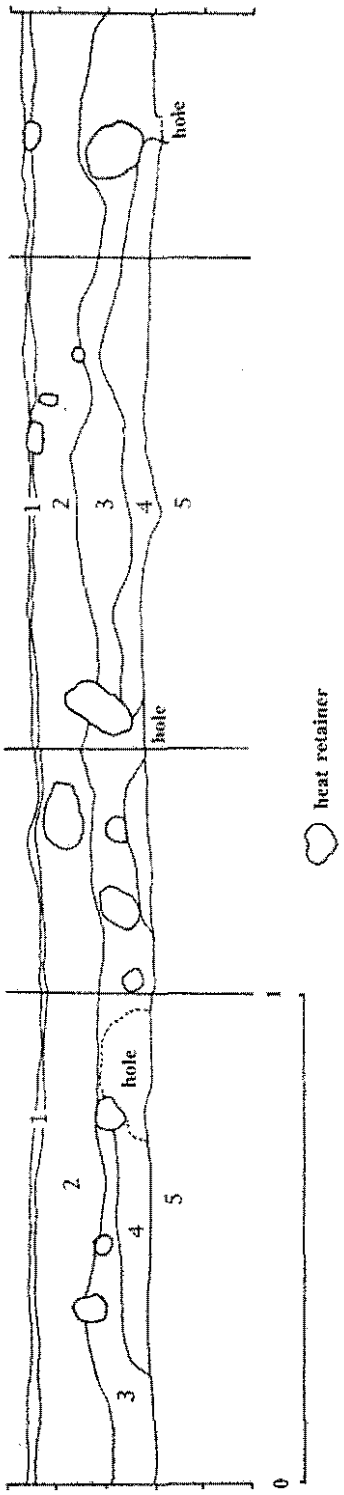
Stratum 2

This unit was primarily composed of thoroughly mixed oven material. It was dark in colour and contained fragmentary charcoal. A darker soil feature appeared towards the top of the level but this did not extend to any depth. It formed a thick diagonal band across the excavation and was characterised by a decreased heat retainer and carbon content. It apparently traced a collapsed rabbit burrow. No mussel shell, bone or artefactual remains came from this unit.

Stratum 3

This unit consisted of an underlying dark loamy soil studded with small fragments of orange and white-grey heat retainer material. Patches of concentrated heat retainer occurred through the unit but were not in an original context due to the profound rabbit disturbance. A carbon sample was obtained from charcoal in a section wall. It returned a date of 750±60 BP (ANU-8604). Calibration of this date with the CalibETH program returned a median date of AD 1253. The age ranges calculated from cumulative probability to two sigma (95.44 %) are between AD 1113 and AD 1373. A further piece of charcoal returned a date of 680±60 BP (ANU-8605). Calibration of this date with the CalibETH program returned a median date of AD 1310. The age ranges calculated from cumulative probability to two sigma (95.44 %) are between AD 1233 and AD 1396.

Figure 5.13 Stratigraphy of CP79



Stratum 4

This unit consisted of a pedal, compact soil and still showed evidence of rabbits having tunnelled through the deposit. Very little heat retainer material came out of this level. It lay upon a hard sterile pedal clay where the excavation ceased.

Stratum 5

This unit was not dug into and appeared as an original pedal clay subsoil.

Discussion

This section of the overall site area appears to be a mixed cultural soil, containing quantities of fragmentary baked clay heat retainers. It was formed as an occupation surface surrounding the locations of operating earth ovens such as CP82. No specific features, such as pits or lenses of deposit relating to cooking activities, were evident. Rabbit activity had profoundly affected the site structure, and remnant sections of intact deposit were still shallow and featureless. No faunal remains were present in the excavated section.

5.3.4 Excavation of Mounded Deposit at Cooey Point Lagoon 59

Cooey Point 59 was evident as a low circular exposure of dark soil and heat retainers. It was situated approximately 1 km south of CP82 and 600 m southeast of CP116. The site was surveyed with a theodolite and EDM prior to commencing excavation and a metre grid was placed across the exposure. A 1.0 x 0.5 m area was selected for test pitting. This was dug using a combination of stratigraphic and arbitrary units. Seven units were excavated, which may be summarised in terms of 5 strata (Figure 5.14).

Stratum 1 (Excavated Unit 1)

This unit comprised a thin layer of thickly grassed humic topsoil.

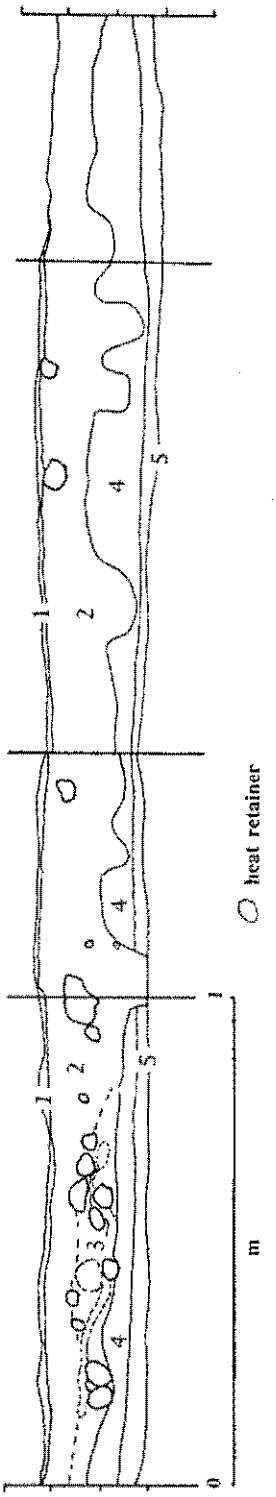
Stratum 2 (Excavated Unit 2)

This consisted of a dark clay rich topsoil with profuse heat retainer material. The deposit was damp, due to heavy rain prior to the fieldwork, and the soil formed balls in the sieve. The material was then taken down to the lagoon and wet sieved. No mussel shell or faunal remains were evident.

Stratum 3 (Excavated Unit 3)

This unit consisted of a dark loamy soil in which were interspersed thin lenses of brown loam, and patches of paler brown sediment. These areas of introduced sediment related to rabbit activity. Plant roots still penetrated to this level. Fragments of mussel shell and baked clay heat retainers were dispersed through the deposit. A lens of heat retainers and carbon occurred at the base of the unit.

Figure 5.14 Stratigraphy of CP59



Stratum 4 (Excavated Units 4, 5 and 6)

This unit consisted of an underlying mottled soil of predominantly orange sandy loam interspersed with dark oven material. Plant roots followed the top of this level. The bases of old rabbit burrows were evident on this surface. Carbon samples were collected from within the mottlings of oven mound material. Towards the base of the unit the mottled earth developed a blocky pedal structure and cracks. Small fragments of heat retainer and specks of charcoal occurred within the crack crevices.

Stratum 5 (Excavated Unit 7)

This unit consisted of a reddish clay soil incorporating whitish calcareous concretions and small gravel inclusions. The soil structure was still heavy and pedal with darker staining in the cracks leached from the overlying oven material. A small feature, consisting of a pocket of termite nest, was uncovered in the eastern half of the spit. The excavation was terminated at the base of level 7 and brushed clean to reveal a surface of the same heavy pedal carbonate flecked clay. A network of dark staining from leached carbon was still apparent on the surface. Surface levels were recorded with a theodolite and EDM.

Discussion

Even allowing for the disturbance afforded by rabbit activity, this section of the deposit displayed no features consistent with the *in situ* operation of an earth oven. There were no oven pits, no large quantities of soft ashy sediment and little carbon. It was predominantly composed of sediment and heat retainers. No faunal remains, apart from a few fragments of mussel shell, were recovered.

Charcoal analysed for dating subsequently returned ages of 440±70 BP and 650±70 BP. This placed the formation of this site within the span of site use indicated by CP82 to the north. It is possible that it was also a general living surface with related cooking activities. Evidence for oven pits may have been concealed in unexcavated parts of the site. The degree of rabbit disturbance, however, precludes much further comment.

5.3.5 Excavation of Freshwater Shell Midden Cooey Point 5

CP5 was located in proximity to CP116 (Plate 39). Excavation of this site aimed to determine whether there was chronological overlap between the two sites and hence ascertain the scope for synchronic comparative or sequential analyses. Examination of the eroding bank of the river revealed midden fallout in several zones, suggesting a total site length of approximately 50 m. Points at either end of the exposures were pegged and the upper ground surface was carefully examined for surface exposures of shell. None were found. The ground surface was then auger tested to detect the maximum extent of the midden.

A series of twenty auger holes were placed along a 10m by 10m grid. Augering was conducted by working from the outer edges of the area towards the river bank. As soon as the deposit was reached augering ceased. Small soil samples were bagged in 0.04-0.06 m increments, the remainder was replaced within the auger holes. The soil samples were analysed for their pH levels to determine through extreme alkalinity the presence of decomposed shell not visible to the eye. The combination of augering, visual examination and pH testing enabled the present extent of the midden to be mapped. Altogether, it appears to have been a substantial deposit of some 140 m^2. Considering the current rate of bank erosion, it must have originally been much larger.

A 1 m^2 test square was excavated into the site. It was dug in a combination of stratigraphic and arbitrary units. Units were recorded with a theodolite and EDM. Levelling was carried out on the top of each successive spit and features were also plotted as they were uncovered.

Deposit Characteristics

The deposit was removed in 7 excavated levels, which may be summarised into 4 strata (Figure 5.15).

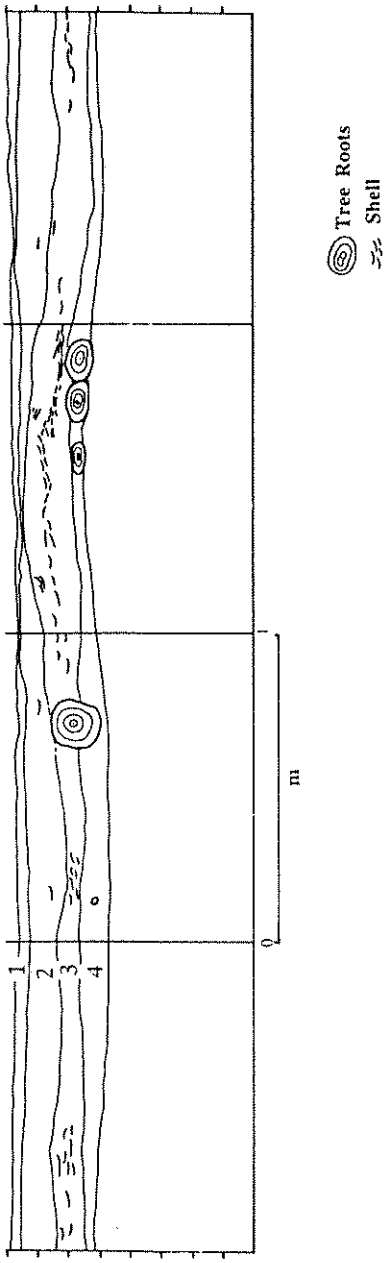
Stratum 1 (Excavated Unit 1)

This unit comprised a thin waterwashed clay topsoil, damp and full of roots, plant remains, decaying gum leaves and small nacreous fragments of shell.

Stratum 2 (Excavated Unit 2)

This consisted of a uniform brown clayey pedal soil speckled with charcoal, fragments of shell and tiny pieces of burnt clay. The shell was in reasonably good condition and whole umbos were present. During the digging of this unit a variation of deposit occurred across the spit. The northwest corner developed into a darker more organic and shell rich deposit in comparison to the other two thirds of the exposed surface which, although full of shell traces, was paler and not as soft and friable. It probably still related to the site overburden rather than the cultural deposit.

Figure 5.15 Stratigraphy of CP 5



Stratum 3 (Part Excavated Unit 2 and Units 3,4,5 and 6)

This stratum was rich in shell, ash and organic matter and constituted the body of the midden deposit (Plate 40). Fish and other small mammal bones were recovered. Some lumps of baked clay were also present. A charcoal sample was taken from the upper section of the stratum (Unit 3). It returned a date of 460±60 BP (ANU-8606). Calibration of this date with the CalibETH program returned a median date of AD 1443. The age ranges calculated from cumulative probability to two sigma (95.44 %) are between AD 1326 and AD 1615. Unit four was cleaned off to the level of the top of a large root which crossed the pit.

A carbon sample was also collected from the lower part of the stratum (Unit 5). It returned a radiocarbon date of 470±70 BP (ANU-8607). Calibration of this date with the CalibETH program returned a median date of AD 1438. The age ranges calculated from cumulative probability to two sigma (95.44 %) are between AD 1313 and AD 1618.

A small feature of compact clay soil with some baked clay embedded within it, and a concentration of orange clay clods were recorded at the base of the unit.

Stratum 4 (Excavated Unit 7)

This unit consisted of silty pale grey-brown soil but no shell was recovered. Small nodules of burnt clay and specks of carbon were distributed throughout the deposit. This layer was the final level and was sterile at the base.

Discussion

Although the site appeared focussed upon freshwater mussels (*Velesunio* sp) it was interesting to find that it also contained fragmentary faunal bone suggestive of a more general range of foods consumed. In addition, the presence of baked clay heat retainers suggested the cooking of foods in the immediate vicinity. A small quartzite muller was recorded within the site where river bank erosion had sectioned the deposit. The site was within the range of use indicated by radiocarbon dating of CP116, located only 80 metres to the east.

5.3.6 Search for Buried Materials

The mounds in these riverine environments were not particularly prominent features and it was considered possible that continued deposition of flood lain sediment may have resulted in the burial of some sites. Such patterns have been widely observed in floodplain environments.

During a survey for Hohokam sites in the Mississippi River Valley, Waters (1988:214) noted that:

"A thin, 0.5 m thick, layer of historic alluvium overlies the floodplain; as a result, prehistoric sites are not visible at the surface of the floodplain (except in areas that are bioturbated or dissected by erosion)...".

Coutts *et al* (1979) found that 40% of mound sites recorded along the Parne Milloo Creek system in the Murray Valley, Victoria, were buried in alluvium, to depths of up to 0.75 m. Deposition has certainly buried many floodplain sites in Northern Australia, Allen (1989) found 6200 year old midden sites under 3 m of mudflats and estimated that further sites could lie beneath up to 18 m of Holocene sediments.

The Murrumbidgee River cannot pretend to deposition rates of such magnitude. However it is still likely that much evidence of occupation has been buried. A limited search was made for buried archaeological materials between CP116 and CP5. A series of auger pits were bored at 10 m intervals. The maximum depth reached was 0.2 m and no buried materials were encountered. However, since the basal depth (and occupation ground surface) of CP116 was later ascertained during survey to be 0.4 m beneath the current ground surface, it can be assumed that the auger series did not reach sufficient depth to accurately test for inter-site materials.

Similar testing for buried materials was also carried out in the northern section of Cooey Point Reserve, between Survey Stations 19 and 20, where there was a noted absence of occupation sites. Nine auger holes were made to a depth of 0.3 m. Augering here also failed to reveal any buried archaeological evidence although the efficacy of the method employed must be similarly dismissed as too shallow.

5.3.7 Discussion

In their entirety, the sites recorded at Cooey Point Lagoon demonstrate an enduring pattern of a repetitive and ordered use of the landscape. The sites at Cooey Point Lagoon may be interpreted as demonstrating the long-term repetitive use of settlement space. This is evident in the use of general purpose, small individual, and clustered ovens which, over time, tended to become agglutinated mounds of occupation and oven debris. Much of such occupation would have taken place following seasonal flooding, activating the various floodplain resources. Year long or sedentary occupation of the mounds recorded would not have been possible, since many are prone to complete inundation during moderate flooding.

Whilst further dating of sites would clarify this hypothesis, it appears that this style of semi sedentary seasonal occupation has been practised at least since the formation of the lower levels of CP82 at approximately 2600 to 2700 years ago. Similar agglomerations of camping discard and oven materials also appear to be present at sites CP59 and CP79 which are dated at between approximately 800 BP and 350 BP. The majority of the dates

obtained from site components in this locality are considered to reflect a period of microtopographic landform stability. That is, the settlement pattern has been in response to features such as river channels and lagoons which have been present or have formed since that time. The basal stratum of CP82 is an exception to this, and is suggested to relate to a prior microtopographic conformation.

A secondary form of site use could constitute the reoccupation of 'sites', during or following periods of major riverine flooding when surrounding ground surfaces remain wet. The construction of earth ovens in already mounded deposits is argued to represent a separate but related part of the same overall settlement strategy. At these times mounds would approximate staging posts between existing base camps located close by and the wetland resources. The wet season use of mounds recorded ethnographically in Arnhem Land by Peterson (1973) is similar. When soils are wet, it makes reasonable sense to be reusing relatively drier, elevated ovens and to be recycling heat retainers which are already fired. Earth ovens do not operate efficiently in wet ground, since most of the heat generated is wasted in the heating of soil moisture.

5.4 Mound Formation Rates

The excavation results highlight the difficulties that these sites present for analysis of rates of site usage over time, and consequently for interpretations of changes in land use intensity. Ordinarily, the build-up of thick cultural deposits may be dated sequentially, enabling volumetric estimation of rates of accumulation over time. Hence, indications of relative intensity of site usage for particular time periods are obtained. The continued use of earth ovens, however, results in the continual mixing and inverting of datable materials.

CP116 consists of approximately half a metre of occupation deposit, with a clearly basal date of 970±70 BP on a carbonised bark pit-lining. The most recent date for the deposit is 450±60 BP. This date however comes from charcoal which is stratigraphically beneath dates of 530±70 BP, 550±50 BP and 740±60 BP. In their entirety, the dates suggest that the site has taken between 400 and 600 years to form. Whether the deposit was built up by consistent and low rates of use or by fewer more intensive usages over this period is not possible to determine, particularly since only a section of the site was excavated. It is possible that features such as oven pits may exist in other parts of the sites relating to intermediate periods which are not reflected in the current dates. However, the general stratigraphy away from the oven pit, for example in Trench D5, indicates only two mixed strata resulting from a limited number of periods of usage.

It is considered that such intermediate periods of oven use would be likely to be represented at nearby sites. CP116 appears to equate with the Type 'C' mounds, such as

DP8, excavated in the Murray River region, which were composed entirely of mixed soft sediments relating to the operation of earth ovens (Coutts 1980). Coutts (1980:36) suggested that Type 'C' mounds represented base camp occupation. This is considered tenable for at least part of its history, but only if it is seen as part of such a camp, which also has as components the adjacent shell midden (CP5), scarred trees and shelter/habitation areas. CP5 was contemporary with the upper levels of Site CP116, and provides evidence of the broader use of the area.

Hypotheses about rates of deposit build up relative to intensity of site usage are thus hard to evaluate. Whilst it appears that CP116, operating as an *in situ* earth oven, has taken between 400 and 600 years to accumulate, Site CP82 has a thin basal layer predating distinctly different upper layers by some 2000 years. CP82 is thus directly comparable to the type 'B' mounds recorded in other regions of southeastern Australia, which contain core deposits, composed of compacted clay pellets, overlain by softer upper sediments. The clear temporal gap between the core of CP82 and its upper section suggests that such temporal gaps may also be represented in similar sites excavated along the Murray River, such as DP1, DP6, DP7 and F3 (Berryman and Frankel 1984:26-27; Coutts *et al* 1979; Coutts 1980). Support is lent to the veracity of the underlying date by its identical composition and contemporaneity to mound deposits excavated at Colombo Creek.

5.5 The Chronology of Mounds in the Central Murrumbidgee Region

In total, seven mound and oven sites in the study area were excavated and dated. Four from Cooey Point Lagoon and three from Colombo Creek (Table 5.1). An explicit aim of the excavations was to obtain basal dates, a range of dates throughout the deposit sequences, as well as dates on apparent features.

Ten dates were obtained for Cooey Point Lagoon 82, the largest number of dates from any investigated Australian oven mound. The base of the deposit consisted of a thin layer of sediment akin to the 'core' deposits found throughout the Murray Valley mounds. It was extremely compacted and contained very dense and worn fired heat retainers. They were predominantly yellowish to orange in colour. Charcoal from this unit returned a date of $2660^{\pm}70$ BP, and this is considered to be a basal date indicating the initial use of the site. It was only found at the western side of the base of one of the trenches, Trench 3BB, and appeared to have been cut into by a later period of oven usage (Plate 37).

There was a very clear stratigraphic break between the core materials and the overlying sediments. The overlying deposit appeared quite alien to the latter, being very soft, ashy and with numerous large heat retainers of predominantly grey colouring. Some very hard whole and fragmentary orange heat retainers, apparently originating from the underlying core layer, appeared to have been recycled into the lower levels of this soft deposit.

Charcoal at the base of a partially intact lens of charcoal within the soft layer, interpreted as indicative of the use of a shallow oven pit, returned a date of 960±70 BP.

Given the specific position of the sample for this date, it appears temporally inverted. This is probably due to the fact that the unit from which it derives has been raked out over younger sediments during a more recent firing event. The lower section of the unit can be traced to underlie the younger deposits. The specific sample was selected due its being a large single piece of carbonised wood. This date was interpreted as indicating the commencement of a new phase of site use. Dates from five separate lenses of charcoal, at the bases of individual truncated remnant saucer-shaped oven pits, returned dates of 740±70 BP, 650±60 BP, 640±60 BP, 420±70 BP and (from one level) 390±60 BP and 390±70 BP (Plate 30). Dates were also obtained from charcoal within two major sedimentary units in an adjacent trench, which lacked clearly defined oven pits. These dated to 690±60 BP and 490±60 BP and were in stratigraphic sequence.

The partial remnants of oven pits identified throughout the sequence may indicate 'last use' pits for each period of activity at the site. In the small 0.5 m^2 trench, 3BB alone, there is a sequence of 5 pits, overlying the initial evidence of site reuse, as described above. Without such obvious relation to individual firing events, dates occupying such tight clustering could be interpreted as the same event. Further support for separate periods of site use is also indicated by the fact that some dates do not overlap at one standard deviation. What appears to be demonstrated by the stratigraphy at this site is periodic bursts of activity, involving multiple uses of the oven, separated by short time periods.

Error margins may be introduced by the burning of old dead wood, which could be common in areas with violent flood deposition. As noted, radiocarbon dating methods embody an assumption that the age of the wood is not likely to exceed the error margin attributed to the date (Turner 1984:81). In many cases the carbon samples found throughout these sites consisted of thin sections of carbonised branch, or twigs, which tend to suggest the use of recently grown material. Additional support for the use of materials contemporary to the occupation comes from the base of Cooey Point 116 where a date was obtained on carbonised bark, which could be assumed to have been freshly stripped at the time of use.

Table 5.1 Radiocarbon and Calibrated Ages for Excavated Sites

Site/Sample	Age BP	Calibrated Age (CaliBETH)	ID
CP59/4/B	650±70	1333±45 AD	ANU-8609
CP59/4/a	440±70	1484±74 AD	ANU-8608
CP79/3/A	750±60	1250±53 AD	ANU-8604
CP79/3/B	680±60	1319±46 AD	ANU-8605
CP116/D4/7	450±60	1468±65 AD	ANU-8616
CP116/D4/5	550±50	1369±42 AD	ANU-8614
CP116/D4/6	530±70	1384±56 AD	ANU-8615
CP116/D4/9	970±50	1075±57 AD	ANU-8612
CP116/D4/11/12	970±70	1076±73 AD	ANU-8603
CP116/D3/3	740±60	1260±53 AD	ANU-8613
CP116/D3/8	500±70	1412±66 AD	ANU-8611
CP82/3BB/7/J	640±60	1338±40 AD	ANU-8618
CP82/3BB/1-2/H	420±70	1504±71 AD	ANU-8617
CP82/4/2-3/B	740±70	1257±66 AD	ANU-8621
CP82/4/1-2-3/C	960±170	1047±155 AD	ANU-8622
CP82/4/1-2/D	390±70	1528±72 AD	ANU-8623
CP82/3BB/6/K	2660±70	840±79 BC	ANU-8619
CP82/4/4-1/A	390±60	1525±64 AD	ANU-8620
CP82/4/6/E	650±60	1334±41 AD	ANU-8624
CP82/6D/7/F	690±60	1312±48 AD	ANU-8625
CP82/6D/2/G	490±60	1419±57 AD	ANU-8626
CP5/A2/5/a	470±70	1448±74 AD	ANU-8607
CP5/A2/3ab	460±60	1456±64 AD	ANU-8606
CC31/1	2520±70	634±106 BC	ANU-8610
CC5/Lev1	2940±170	1167±196 BC	ANU-7881
CC36 Lev 4	2720±90	908±100 BC	ANU-7879
CC36 Lev2/d	2890±90	1105±124 BC	ANU-7880

5.6 Chronology of Mound Formation in Southeastern Australia

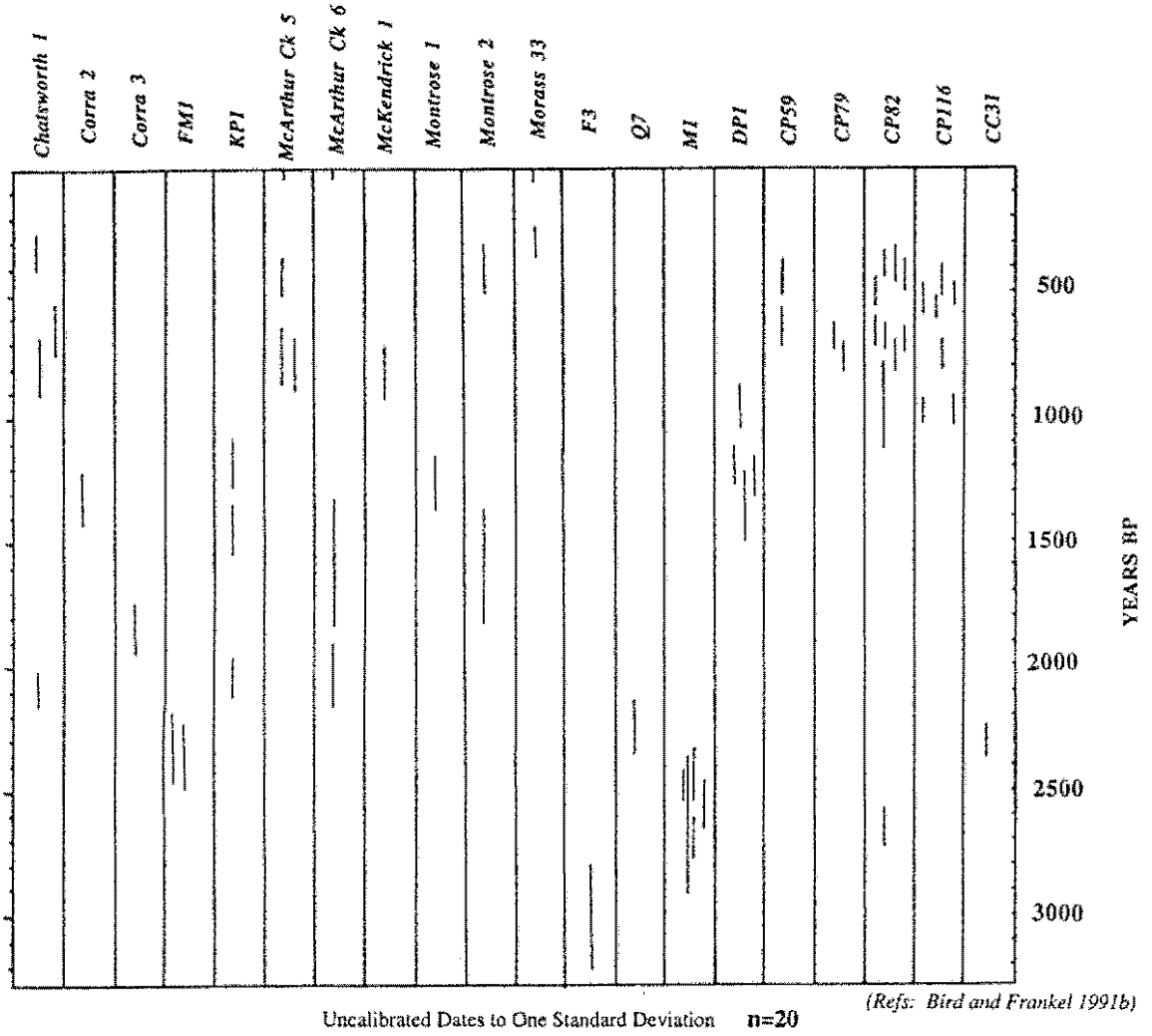
Mounds do appear to occur relatively late in the archaeological record. As noted previously this may in part be a combined product of post depositional processes and their presence within recently evolved landscapes. Excavations of 15 mounds located in southwestern Victoria and the Murray Valley have produced 35 dates, 34 using radiocarbon and 1 using thermoluminescence. These have indicated that the sites do not predate 2990±100 BP (Bird and Frankel 1991b; Coutts *et al* 1979, Coutts 1980; Downey and Frankel 1992; Williams 1988). The latter date was obtained for Barham F3, situated along a tributary of the Murray River, in NSW (Berryman and Frankel 1984; Downey and Frankel 1992:35). A further 20 dates obtained from 5 mound sites in the Murrumbidgee Riverine Plain in the course of this research are consistent with this.

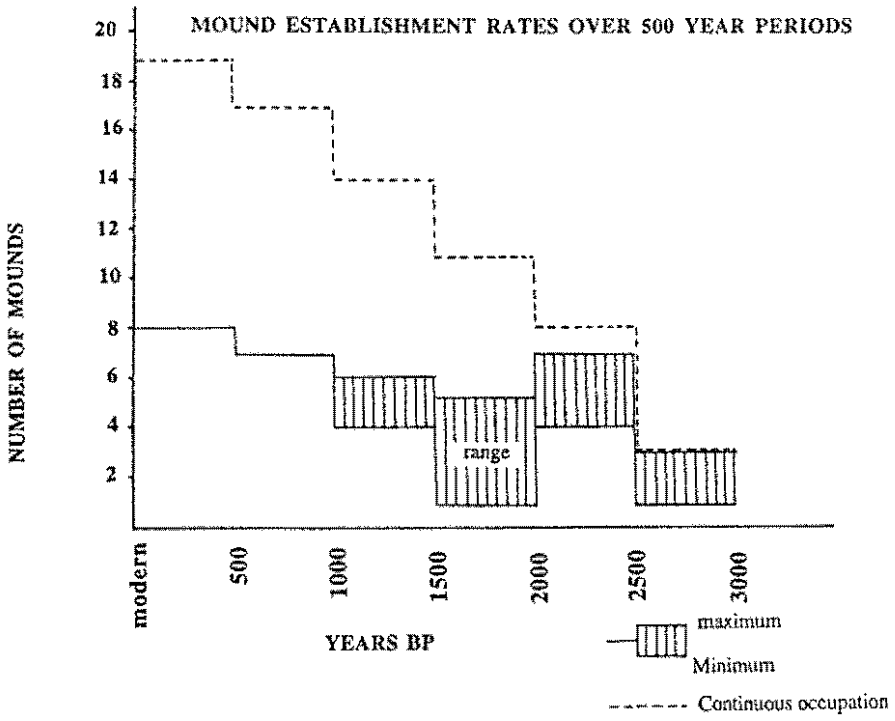
Bird and Frankel (1991a, 1991b) have emphasized that much of the interpretation of mounds within settlement patterns has relied on either a few dates or a single basal date for each site. They note that when only basal dates are obtained, there is often an implicitly inferred continuity of occupation from that date to the modern period (Bird and Frankel 1991a:185-6, 1991b:4-5), although Coutts *et al* (1979) do mention a lack of evidence for modern occupation of the upper layers of Mound site DP1. Where more than one date is available, occupation is often similarly inferred to be continuous between those periods. This pattern of inference itself tends to make the identification of increases in site numbers over time more or less a certainty, since it neglects to identify which sites, if any, fell out of use over that same time period.

Analysis of dates now available for 20 mound sites throughout southeastern Australia (Bird and Frankel 1991b; Coutts *et al* 1979; Coutts 1980; this research) shows that it is possible to arrive at quite different interpretations of chronological patterns in site numbers, depending upon whether or not continuous contemporary occupation/use of mound sites occurred from the basal date.

A schematic representation of mound establishment over 500 year periods, according to published data combined with the present research data, was tabulated (Figure 5.16). If sites are considered to be continuously occupied following their establishment, without any falling out of use, a steady increase in numbers of sites over time results. Consideration of directly dated periods of use, however, reveals a somewhat different pattern. Whilst there is still an overall trend for increased rates of site establishment, it is nowhere near as pronounced, nor is it necessarily a steady trend. Between 1500 and 2000 years BP, for example, there is an apparent decrease in the number of sites established. After 1500 years BP, site formation increases but at a reduced rate. The

Figure 5.16 Mound Formation Rates in Southeastern Australia.





importance of obtaining dates throughout a mound deposit cannot be overstated if the data are to be used to discuss rates of site establishment.

Dates obtained in this study, combined with stratigraphic information, suggest that site usage was not always continuous. Site CP82, for example, demonstrates a clear discontinuity in use. The stratigraphy of Site CP116 is suggestive of limited periods of intensive usage. It is argued that Site CC31 fell out of use altogether, prior to the later periods of mound use evidenced elsewhere in the region.

The timing of the apparent decrease in mound formation, suggested by the aggregate data of the 20 excavated and dated mounds at about 2000 BP, is approximately coincident with a wet climatic phase evident in lake-level reconstructions (Ogden 1993:74). The sample of dated mounds is small and further research is obviously required, but it is possible to postulate a relationship between these data for further investigation. It may be that wet conditions facilitate broader and more extensive land use patterns which result in the dispersal of oven related activities. The formation of mounds in areas where they are currently common, concentrated and visible, may thus have occurred at a slower rate at these times.

The site complex at Colombo Creek demonstrates the onset of mound producing activity following and, it is argued, as a result of micro-environmental change. Mounds in this landscape appear tied to the occurrence of swamp and still-water areas. Likewise, mounds in the Cooey Point area appear to be focussed upon lagoons and depressions. Dates from these sites still indicate the appearance of this site type after 3000 years BP. Assuming that the localised development of these sites is tied to landscape change, it is necessary to assess the degree to which their visibility in the landscape, and apparent encapsulation in time, is also a function of landscape process.

Evident patterns of human occupation in alluvial environments are certainly products of the biases of geological preservation. As noted by Waters (1988:213):

> "During periods of floodplain stability, characterised by intervals of minimal erosion and deposition and potential soil formation, repeated occupation of an area will become compressed onto a stable surface. A surface of stability and associated artefacts may later become buried."

The patterns of site presence along the Murrumbidgee River currently, are probably resultant of such periods of floodplain stability.

If only short periods of channel instability, erosion and degradation, occurred in the Murrumbidgee River floodplain, prior to 1000 years BP, then evidence of earlier human settlement is likely to be patchily preserved. Periods of active floodplain development, resulting in the migration of stream channels and erosion of sediment, not only remove

previously deposited sites, but are also periods when accompanying occupation evidence will not be preserved in deposited sediments.

The excavation of oven mound site CP82 revealed a basal layer with distinctly different sedimentary structure dated to between 2600 and 2700 years BP. It is argued that the underlying layer represents an early phase of oven use from which heat retainer debris was accumulated into a mounded formation. At a later stage this deposit was truncated, probably by flood scouring. It is argued that there was a hiatus in use of the site until approximately 1000 years BP when heat retainers, apparent on the site surface, may have been opportunistically reutilised. The heat retainers at the basal levels of the site are extremely indurated and display rounding, probably from a combination of repeated use and water washing.

The extremely compacted nature of the underlying deposit of CPL82 is attributed to its age, and probable burial prior to erosion and reutilisation. This deposit is mirrored in the excavated mound site at Colombo Creek, CC31, which is of a similar age. The latter site was buried underneath a layer of at least 0.35 metres of overburden, and would have remained concealed but for the pattern of differential erosion throughout the entire site complex. The combined influences of age, the weight of overburden, deposit composition, and soil processes would have acted to solidify the deposit into a coherent mass.

Mounds recorded in low lying swampy areas, such as along the drainage courses of palaeochannels are similarly attributed to the operation of earth ovens. Examples include those recorded at Birdcage Reserve. In many cases they appeared to occupy small areas of existing elevation, although in some cases they had reached such a size that any such features were obscured. Based upon the surficial similarity of their contents and deposit to the other sites excavated during this research, they would also appear to be the result of long term operation of earth ovens. In their final state they would certainly be of use in providing access to vast areas of surface inundation. However, rather than enabling access to these areas, they appear to be a result of the previous long term use of such rich environments.

5.7 Mound Typology

The review of previous research undertaken in Chapter 2 indicated systematic attributes of Australian mound sites. It could be suggested that the previous typology be compounded and interpreted on the basis of likely functional differences between sites. Type 'A' mounds may be generally characterised by their compact core deposits, the proportion of fragmented heat retainer and the general lack, or low density of, associated

cultural materials such as artefacts and food remains. They are often associated with larger site complexes.

Type 'C' mounds are characterised by a soft deposit which generally incorporates quantities of larger heat retainers. It is suggested that these sites result from the recurrent usage of individual or multiple small earth ovens which predominantly utilise dry heat for the cooking of various foodstuffs. Type 'C' deposits are not tied to water availability in as specific a manner as Type 'B' mounds. Type 'C' mounds may be seen as the end product of a progression from individual small ovens, to aggregated locations of cooking activity, and thence to mounded aggregations. In a sense, the series of cooking areas, Site M1 recorded by Berryman and Frankel (1984), could be regarded as an incipient Type 'C' mound. The numerous deflated agglomerated oven mound sites recorded at Cooey Point Lagoon are also considered to be of this site type.

Type 'B' mounds may be considered as a combination of Types 'A' and 'C'. Type 'C' may overlie Type 'B' deposits for a number of reasons. Firstly the extant deposits may contain some quantities of reusable fired heat retainers which enable more rapid establishment of cooking ovens (Klaver 1987). In stone-poor alluvial regions the acquisition of heat retainers would be an important factor in the location of sites, and existing heat retainers would constitute a valuable resource. Comparable studies of oven mound formation from around the world confirm the major influence that the obtaining of heat retainers may exert upon subsequent oven siting (Larsson 1990; Latas 1992; Russell-White 1990; Williams 1990). Secondly, if ground surfaces are wet, these deposits will provide relatively drier elevated sites for the operation of ovens. As argued previously, wet ground surfaces would not enable efficient operation of small ovens since the stored heat in the heat retainers would be rapidly dissipated into the surrounding soil and its water content.

Small low mounds with hut features, such as those recorded by Williams (1988), do not readily fit into the above typology and should be considered a separate site type altogether. No evidence was forthcoming in this survey to support the theory that mounds constituted deliberately elevated features. The sites recorded as such by Lourandos (1980) would thus appear to be in a similar position to those recorded by Williams (1988), remaining, enigmatically, endemic to the southwestern districts of Victoria.

Without dates for the occupation of sites, opportunities for potential misinterpretation of 'large' mound sites throughout southeastern Australia are prevalent. Craib (1991:135), for example, identified base camps among mounded 'cultural deposits', purely on the basis of size:

> "Unlike other studies where mounded cultural deposits have been recorded, only two, widely segregated, size classes have been identified within the study area [Barmah-Millewa forests]; mounds having an area of about 400 m^2, or less, and those mounds with an area in excess of 1000 m^2. Given the tremendous disparity in size and that very few large mounds exist, these large mounds are tentatively identified as base camps."

Rowley-Conwy (1983:120-4) notes that site size is often employed to distinguish between permanent and temporary settlements, but suggests more useful interpretative models. Temporary camps would tend to display evidence of economic specialisation, and seasonal camps may occur in 'specialised' localities, reflecting concentration upon particular resources. Permanent camps would be expected in more 'generalised' locations, within easy reach of a broad spectrum of resources. He also notes the possibility that temporary and specialised camps may have been systemically integrated with permanent camps.

The interpretation of only the largest mounded 'cultural deposits' as reflecting a base camp type of occupation, and exclusion of the smaller, otherwise similar, sites from the base-camp category, simply on the basis of size is debatable (*cf* Craib 1991). Evidence of activity diversity, rather than scale of activity, may be a more appropriate criterion (Rowley-Conwy 1983:122-4), particularly when there is no assessment of likely time depth. The results of these site excavations demonstrate that most of the mound sites in this study region have an equal potential to have been associated with base camps. The following chapters consider the other common site components found in the region, lithic scatters and scarred trees, with regard to the possible identification of base camp activities.

"...one cannot find a stone the size of a marble wherewith to break a window, in the whole district, unless among the hills." (Anderson 1976[1880]:54).

Chapter 6
Lithic Technology

6.1 Introduction

Lithic scatters were recorded in detail from survey units across the region in order to characterise regional stone technologies and identify possible adaptive subsistence strategies applied within the region. Detailed examination of individual artefacts also provided information about the natural and cultural formation processes operating upon sites.

Detailed artefact recording was thus carried out to establish:

- whether there were any broad trends in raw material distributions evident across the region, which might indicate the use of local materials;
- whether there were obvious changes in assemblages from east to west which might reflect coping strategies for the decrease in available stone resources;
- whether assemblage diversity or specialisation could be correlated with activities, as a means of identifying multipurpose ('base camps') or single purpose ('processing') sites according to the forager and collector subsistence strategies outlined in Chapter 1;
- whether stone artefact discard patterns mirrored those of mounds and ovens, thereby giving some support to the interpretation of mounds and ovens as representatives of differential patterns of intensities of site use; and
- whether the lithic scatters have potential as chronological indicators of site usage.

The formation of lithic scatters and the character of their assemblages can be attributed to four fundamental stages in the use of stone materials. These are the obtaining of raw material, the manufacture of implements, the use of implements and their discard. The obtaining of the raw material in stone-poor alluvial areas, like that of the study region, is a difficulty which could be culturally addressed through a number of creative strategies. Where scarce, stone may be substituted with shell, bone, clay or dense wood, if these are suitable and available. Stone may be a major object of trade or exchange, obtained from other regions in return for some local specialty. Technologies may be developed for the use of otherwise intractable or poor quality local materials. The obtaining of stone may become of less importance through the change of activity patterns or through the development of non-lithic technology for many resource extractive and manufacturing activities.

If stone implement production strategies are heavily influenced by stone shortages the development of specific reduction strategies to deal with poor quality materials, strategies

to prolong the use or maximise efficiency of stone materials may also be predicted to occur. Thus, minor variations in reduction strategies may occur across a region which are determined more by the morphology and availability of raw materials than by intended function or cultural differences. The efficient use of stone may also result in the development of multipurpose stone implements.

Stone scarcity may also influence regional formation processes, in its capacity to encourage strategies of artefact rejuvenation, conservation and recycling, and the use of old archaeological sites as sources of raw materials. It may also influence patterns of discard in terms of artefact sizes, and the recycling of stone materials into other use contexts, such as oven stones. If occupation patterns were repetitive then there may also have been a stage of 'semi-discard', involving the caching of useful implements for use upon return to a site. Stone scarcity may also encourage development of alternative non-stone technologies resulting in little overall discard of stone for a given range or number of activities. As a consequence such discard patterns may not have direct bearing upon the intensity of use of various landscapes, nor will they indicate the full range of activities present. Regional scarcity of stone materials may thus profoundly affect the visible archaeological record and its subsequent interpretation in terms of subsistence practices and intensity of landscape usage.

The study area encompasses lands which are transitional between eastern sloping plains, containing some stone resources, although of poor quality, to stone-poor western plains. It is thus well positioned to detect whether there are substantial changes in stone assemblages correlated with the increasing deficiency in lithic resources. Survey ranged over a variety of ground surface conditions, including depositional alluvial plains and extensive scald eroded areas.

6.2 Assemblage Diversity

The diversity of stone assemblages between sites and between environmental zones is an aspect of comparison which may assist in the characterisation of Aboriginal subsistence strategies. Gould (1977:168) proposed several 'cross-cultural' generalisations concerning lithic assemblages, including that habitation sites will exhibit the most diverse artefact types and raw materials. Furthermore, it has been predicted, with certain qualifications outlined above, that the use and discard of stone materials may directly correlate with the intensity of site usage. Thus, according to a resource-related occupation model, the richest environments ought to contain the most habitation or base camp residues as well as the largest and most diverse lithic scatters.

It is also proposed that the relative diversity or uniformity of artefacts within sites may aid in the discrimination of subsistence strategies which trend towards either 'forager' or

'collector' models. 'Forager' strategies involve high levels of settlement mobility and the targeting of particular resources (Binford 1980). Hypothetically, artefacts deposited at sites by people with a forager strategy would reflect activities specific to the locality. The pattern would be reinforced over time if people returned to the area and repeated activities. Sites formed by foragers ought, therefore, to exhibit less intra-site diversity. 'Collectors' are less mobile and tend to occupy longer term residential camps (Binford 1980). People move out from these camps to resource patches and return with the resources, although additional specific processing sites may also be formed near the resource patches. The residential camps of collectors may therefore contain a suite of material culture which is not just representative of activities undertaken at that location. Sites formed by collectors would therefore be expected to exhibit greater intra-site diversity.

There are several major reservations upon the use of lithic scatters as an interpretative tool in this analysis. Prevalent formation processes may result in lithic scatters approximating conflated occupation events which lead to an exaggerated impression of contemporary occupation intensity, as well as a reduction in their ability to reveal activity patterns. They may also reduce the archaeological visibility of stone materials in some environments. Differences in reduction strategies may also lead to false impressions of occupation intensity based upon artefact numbers. For example, bipolar technology which results in the crushing of stone raw materials may produce far more debitage than controlled flaking techniques. The stone-poor nature of the study region may also introduce a range of biases. Potentially these include the replacement of stone with other materials, the development of a range of multipurpose implements which blur functional interpretations and the practice of recycling or reuse of artefactual materials from lithic sites.

6.3 Artefact Functions

In the identification of activity patterns responsible for site formation certain artefact types may be particularly informative. Various functions have been attributed to particular implements based upon comparative ethnohistory and ethnography. Hatchets, for example, are generally linked to extractive or processing activities such as the stripping of bark for the construction of shelters, canoes and domestic artefacts.

Grindstones are a class of artefact for which a range of functions have been defined based upon specific morphology (Smith 1985;1986). Large grindstones, often with elongate ground grooves, have been identified with the 'wetmilling' of grass seeds (Brough Smyth 1878:Vol.1:214; Tindale 1977:347). These were generally associated with a specifically shaped topstone or muller. Amorphous grindstones (Smith 1986) are generally smaller and have a range of functions attributed to them, including the sharpening of implements, grinding of ochre, as well as processing of various seeds. Grinding stones may also develop other functions, such as anvils for crushing materials,

and they may have been recycled into other forms as they wore. Pieces of basal grindstone may have served as mullers following their breakage. Early accounts indicate that small flat grindstones and round stones were often found upon oven mound sites, and that they were used for grinding seeds and pounding roots respectively (Brough Smyth 1878:Vol.1:209;214).

Stones used for striking or crushing substances, often termed hammerstones, could also be multifunction implements. They were documented as used for bipolar reduction of stone, pounding ochres, breaking bones to extract marrow, opening shellfish crushing hard vegetable foods, and softening of fibres (Chapman 1978:73; McCarthy 1976:55).

6.4 Analysis of Artefact Scatters

Fifty artefact scatters and forty nine isolated finds were located. Each of their total of 4279 stone artefacts was fully recorded. Artefact frequencies ranged from single artefacts to an extensive open site of 1846 artefacts. The mean frequency of artefact occurrences (including isolated finds) was 125 artefacts, however the extreme variation in size overall meant that this distribution was skewed considerably (Table 6.1). The total of stone artefacts fully recorded was increased to 6269 by the addition of artefacts associated with oven mounds and those examined from local provenanced collections (Klaver 1987).

Stone artefacts recorded in association with oven mound deposits (n=34) were considered as a separate category for analytical purposes. Thirty four, or 18% of mounds had stone artefactual components. That is, stone artefacts were recorded within, or on the surface of the actual mound deposit, or within 5 m of a disturbed mound exposure. The number of artefacts in this group ranged between 1 and 56 per site. Whilst the average number of artefacts was 8, the modal number was 1, and the distribution was also skewed. These figures are considered minimal estimates since, in many cases, the loose surfaces of these deposits or their compacted vegetated surfaces restricted the determination of artefactual content.

6.5 Regional Trends

The quantity of stone artefact bearing exposures or 'lithic sites' was fairly evenly distributed between the landscape categories surveyed. However, when the same regional distribution was considered in terms of artefact numbers and densities, a vastly different impression was obtained. In overall terms, densities throughout the region were low, reaching maximums of just over 250 artefacts per km^2. Even within the densest sites, such as Colombo Creek, where conflation would have exaggerated the density of flaked materials, densities averaged only 1 artefact per $3m^2$.

Table 6.1 Percentages of Raw Materials represented in Open Scatters (excludes artefacts in mounds and collections).

		Raw Material Percentages								
Site Name	n	Quartz	Silcrete	Quartzite	Chert	Chalcedony	Sandstone	Metsed	Conglomerate	Volcanics
Mt Galore 1	116	69	27	3	1					
Mt Galore 2	1	100								
Cobbin Ridge	1			100						
Lake Coolah 3	11	55	9	36						
Buckingbong State Forest 1	1	100								
Buckingbong State Forest 2	1	100								
Buckingbong State Forest 3	2	50		50						
Buckingbong State Forest 4	1	100								
Buckingbong State Forest 5	1		100							
Buckingbong State Forest 6	1	100								
Buckingbong State Forest 7	1	100								
Cornella 1	152	82	1	11			3		2	
Lockhart Urana Rd 1	84	61	26	12					1	
Lockhart Urana Road 2	243	82	9	5			1	1	1	
Lockhart Urana Road 3	206	84	10	4	0.5		0.5	1	0.5	
Lockhart Urana Road 4	12	100								
Urangeline Creek 1	298	93	4	2			1			
Urangeline Creek 2	127	78	19	3						
Urangeline Creek 3	11	91		9						
Goonerah Lagoon	416	31	59	8	1.5	0.5				
Colombo Creek	1846	51	21	25	1		1	0	0.7	0.1
Billenbah Reserve 1	1	100								
Billenbah Reserve 2	1			100						
Billenbah Reserve 4	1		100							
Cuddell Creek	10	40	60							
Widgiewa Road 1	5		80	20						
Lake Urana Quarry Pit 1	9	33		56						11
Bareena 1	1		100							
Euwarderry Lagoon 1	1			100						
Euwarderry Lagoon 2	1						100			
Euwarderry Lagoon 3	42	41	19	31				3	7	
Newell Hwy SR 1	27	22	41	30				7		
NHSR 2	1			100						
NHSR 4	1			100						
NHSR 6	1	100								
NHSR 7	1			100						
NHSR 8	3			100						
NHSR 9	1	100								
NHSR 10	3	67		33						
NHSR 11	6	100								
NHSR 12	2	100								
NHSR 13	1	100								
NHSR 14	1	100								
NHSR 15	1			100						
NHSR 16	1	100								
NHSR 17	1	100								
NHSR 18	1	100								
NHSR 19	1	100								
NHSR 20	1	100								
NHSR 21	1			100						
NHSR 22	1	100								
Jerilderie Urana Rd 1	11	82	9	9						
JUR2a	10	80		10				10		
JUR 2b	5		40	60						
Lake Urana 1	468	71	14	12	2					1
Urana Road 1	8	88		12						
Urana Road 2	30	83	14	3						
Urana Road 3	16	94	6							
Urana Road 4	9	100								
Colombo Road 1	1	100								
Old Urana Road 4	1			100						

Stone discard rates appear to be much greater in the east of the study region. Within the study region 90% of flaked stone material occurs to the east of the Yanco Creek. Of this total, 41% occur in Sloping Plains lands and 49% occur in Eastern Alluvial Valley Plains lands. Within the Eastern Sloping Plains landscape 57 artefacts per km^2 of survey area were recorded. Within the Eastern Alluvial Valley Plains 38 artefacts per km^2 of survey area were recorded. In contrast, within the Western Alluvial Valley Plains only 7 artefacts were recorded per km^2 of survey area, and within the Western Plains, only 6 artefacts per km^2 of survey area were recorded. These figures indicate that stone discard rates were much lower in the western part of the region and this correlates with the reduced local availability of stone raw materials identified in Chapter 3.

Clear trends are also evident in the distribution of raw material types (Figure 6.1). There is an apparently greater proportion of quartz materials discarded in the southeastern part of the region, whilst quartzites and silcretes are the dominant lithologies in the northwestern and western parts of the region. These trends are evident within both large and small sites, and are also evident in the assemblages recorded within mounded deposits (Figure 6.2). The trend is gradual but steady from east to west. In the vicinity of Urangeline Creek, between 78% and 90% of artefacts are composed of quartz. At Colombo Creek, in the centre of the survey region, quartz forms 51% of the assemblage. At Cooey Point Lagoon only 21% of artefacts are composed of quartz. One explanation for this trend would be the localised abundance of quartz materials in the southeastern part of the study region.

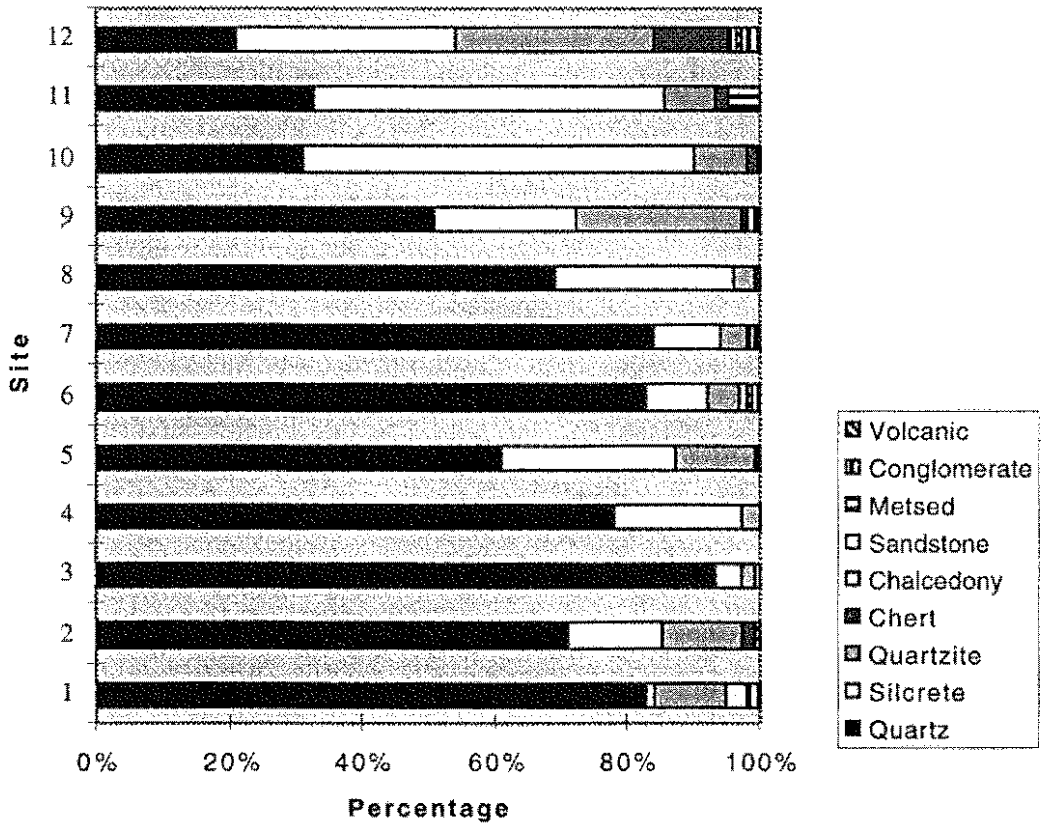
Abundant sources of quartz pebbles are present in Tertiary deposits in the southeast of the survey region, near Urana. Evidence for the human exploitation of these local quartz sources is circumstantial. However, the proposition is strengthened not only by the dominance of quartz in local assemblages, but also by the high observed proportions of pebble cortex present on individual artefacts. Quartz pebble manuports were also present in sites along the Urangeline Creek. If the trend in material composition of the assemblages in the surrounding area and to the west was to be interpreted as a distance-decay phenomenon, then the spread of the materials from the Urana area would appear to be at least in the order of 30 to 40 km.

Quartz, particularly pebble quartz, is considered by Dickson (1977:97) as a relatively low-grade lithic resource due to its inherent fracturing difficulties and its use attributed to the lack of other varieties of suitably siliceous stone . Dickson further comments that the quality of the raw materials will be directly reflected in the artefacts produced. The observed small sizes of available quartz pebbles would certainly impose size limits upon resultant artefacts and debitage. The quality of these raw materials would also exert a strong influence upon the reduction strategies employed. Bipolar reduction would be the

only method able to deal with the degree of flaking inertia of small round materials. This would in turn increase the quantities of debitage produced by these activities since bipolar reduction often results in the shattering of the stone material.

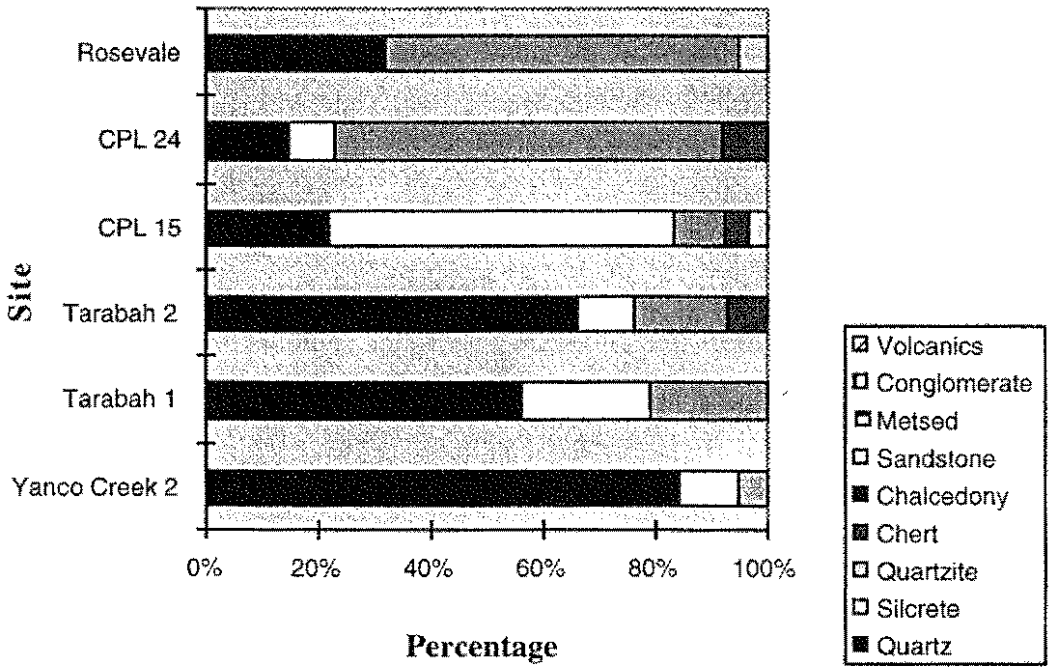
A corollary of these factors would be the prediction that where utilised quartz materials comprised small pebbles, sites where they were reduced may contain quantities of flaking debitage which appear disproportionately large in comparison to sites where more tractable materials and other reduction processes were employed. These trends could lead to a false impression of the intensity of site usage, insofar as the presence of differential numbers of stone artefacts may be used to infer occupation intensity. Artefacts composed of reef quartz, recorded in the vicinity of Lake Urana, do not fit within the previous pattern, since they were not based upon pebble raw materials, and were uncharacteristically large, retaining considerable potential for reuse.

Figure 6.1
Raw Material % in Sites - SE to NW Across the Study Region



Key to Sites
1: Cornella
2: Lake Urana
3: Urangeline Creek 1
4: Urangeline Creek 2
5: Lockhart Urana Road 1
6: Lockhart Urana Road 2
7: Lockhart Urana Road 3
8: Mt Galore
9: Colombo Creek
10: Goonerah Lagoon
11: Bublebundie Creek
12: Cooey Point Lagoon

Figure 6.2 Raw Material Percentages in Mound Sites from SE to NW.



Whilst the western assemblages were dominated by non-quartz materials, much of the debitage displayed pebble cortex. It is possible that the materials were obtained from occurrences of pebble and conglomerate in Devonian sediments observed north of the Murrumbidgee River (White 1986; Gollan 1982). In addition, small (less than 30 mm diameter) pebble manuports were present in some sites e.g. Cooey Point Lagoon 24. The characteristically small lithic industries of the Riverine Plain may thus be a product of small raw materials as much as stone conservation and the maximisation of resources. The 'microblade industries' (Witter 1988) may have evolved partially as a strategy to deal with the small sizes of locally available raw materials.

6.6 Stone Reduction

Reduction charts (after Witter 1990) were constructed for a spatially dispersed sample of the largest sites recorded , see Figure 6.3 for their locations. These illustrate size classes of artefacts represented at sites by plotting artefact thickness against an index of artefact surface area (square root of length times width). Reduction charts may give a rapid indication of any artefact classes which are missing from an assemblage, either as a result of their production/discard elsewhere or their on-site transformation (Witter 1990). The construction of charts enables visual comparison of the entire assemblages as well as enabling the separating out of specific artefact types and raw materials.

In order to cope with the size of the scatters and consequent density of plotted points, separate charts were plotted for each category (Appendix III-1-6). Histograms of debitage length were also constructed in order to demonstrate the intensities of flaking of particular raw materials as well as the trends for flake length between sites (Appendix III-7a-c). For purposes of comparison the debitage was considered in two categories, platformed debitage (Appendix III-7a) and other debitage (Appendix III-7c). Platformed debitage was further sorted on the basis of the presence or absence of cortical surfaces (Appendix III-7b). This aimed to provide some indication of the particular stages of reduction for each raw material at a site. Matching proportional bar charts of raw materials as well as debitage in raw material classes found at sites were also constructed (Appendix III-7a-c). Histograms were constructed for flaked materials exhibiting retouch or usewear (Appendix III-7d).

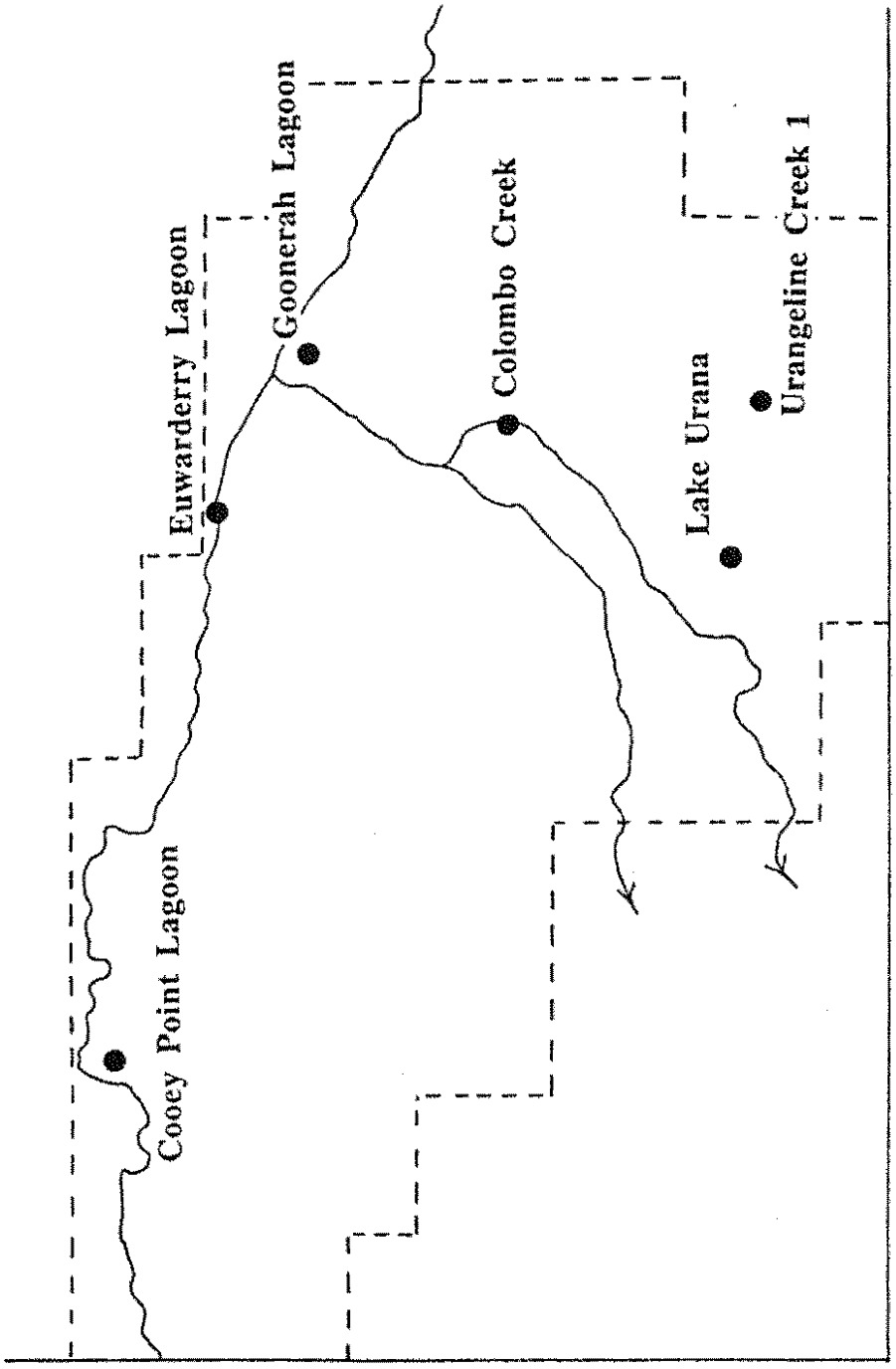
Descriptions and analysis of several sites which typify the range encountered within the region are presented in the following section. The discussion highlights a range of evident formation processes and makes some preliminary interpretations as to the subsistence strategies underlying their formation.

Lake Urana

A total of 468 artefacts was recorded within a site, Lake Urana 1, on the southwestern edge of Lake Urana (see Appendix II for site description). The site covered approximately 400 m^2 and was situated on a gentle elevation forming a ridge between the lake and an extensive backswamp to the south. Artefacts were exposed in a series of shallow scald erosion patches, where overlying red sands had been stripped to reveal a compact red pan. The site area was flat, although there was a fall in level to the south of the site. The site is positioned with vantage over the southern swamp and plains landscape and occupies an ecotone between lacustrine and backswamp wetlands and more arid shrubland plains. Minor sandy ridges with *Callitris* sp are also proximate.

Lake Urana is a relict feature of moister late Pleistocene regional climatic conditions (Page *et al* 1994:38). At its peak it would have presented a regionally significant lacustrine environment. These conditions had declined by approximately 12 000 years ago with the onset of more arid climatic conditions (Page *et al* 1994:43). However, it would have continued to present attractive wetland environs periodically throughout the Holocene period. It is therefore a setting which would be predicted to have attracted considerable Aboriginal attention from at least the late Pleistocene, although the underlying resources available and concomitant subsistence regimes may have altered.

Figure 6.3 Location of Artefact scatters analysed



The stone assemblage was dominated by quartz materials (71%) of which a high proportion retained pebble cortex. Other lithologies present included silcrete (14%), quartzite (12%), chert (2%) and volcanics (1%). Quartz cores were present in a range of reduction stages. The majority of cores were not heavily reduced. Some had reached a blocky cross section whilst still in the medium size category, between 30 and 50 mm maximum dimensions, suggesting a non-intensive use of raw materials. Quartz was also heavily represented in small length classes of debitage (Appendix III-1a-1r).

Cores made of silcrete, chert and quartzite were of medium size and not reduced to the maximum possible. Part of the scatter was quite unusual, in comparison to all other sites recorded in the region, due to the presence of steeply retouched and utilised cores (made on thick flakes or split pebble sections) in a variety of raw materials. 'Producer' cores (Witter 1990) which may have been used to produce such thick flakes were not in evidence, nor was there sufficient debitage to account for their complete reduction had they been present. It is suggested that these materials were already flaked when they were brought onto the site. Apart from these artefacts however, the remainder of the scatter does not seem out of place in comparison to other sites in the region. It is possible that there is a conflation of either functionally or chronologically different assemblages at this site.

Several small 'adzes' made on cortical pebble sections were also present. These entailed removing the top of a small pebble by splitting, presumably with an anvil, and subsequently removing a series of scalar microflakes around 270 degrees of the 'flake' against the cortical surface to produce a small steep-edged implement. The proportions of tiny flaked debitage with cortex suggest that these implements could have been completely manufactured on the site, and further, that more such implements may have been produced and subsequently removed.

Negative flake scars on many of the cores suggested the production of tiny elongated flakes prior to their being later 'recycled' as implements in themselves. Some ended up as distinctively notched and nosed 'scrapers'. Incorporation of length data into histogram format indicates that the majority of retouched and/or used pieces fall within the 15 to 25 mm length classes, with 15 to 20 mm constituting the mode.

The debitage present at Lake Urana was composed of 0.5% blades, 19% flakes, 50.5% flaked pieces and 30% chips. Analysis of platformed debitage (flakes and blades with platforms present) shows the length classes between 10 and 25 mm to have the highest frequencies. The modal length class was the >20≤25 mm category. Broken down into raw materials, this is represented by 62% quartz, 19% silcrete, 9.5% quartzite and 9.5% chert. The reduction chart for all flakes and blades further demonstrates that debitage in

these length classes is proportionately thin. Comparison with the retouched and used artefact categories suggests an under representation of small thin flakes, although several backed thin flakes were recorded. This may be indicative of the production of thin and long flakes for backing and their subsequent use, removal or disposal away from the site.

The dominant category of used implements evident on the site are cores (originating on thick flakes) which have been partially reduced, and which have later episodes of multiple step fractures and formation of distinct nosed and notched working edges. Some demonstrate adjacent nosed and notched features. These cores have parallels with artefacts commonly associated with wood working activities (Gould 1977:164), and were composed of quartzite, silcrete or quartz. The quartz used for their manufacture, however, was reef quartz, of a superior quality to most of the other quartz debitage, which was predominantly small, up to 30mm maximum dimension, and characterised by the presence of pebble cortex.

Other 'implements' present in the assemblage include quartz and quartzite hammerstones, two small grindstones and a grindstone fragment. The grindstones were composed of a reddish quartzite and were flaked around the margins. One grindstone had an oval area of shallow concave usewear on one surface. The other was a typical pear-shaped muller with a ventral ridge. These are commonly used in conjunction with an elongate basal grinding stone and are usually associated with seed grinding (Tindale 1977:347). Slight areas of pitting on some surfaces may have resulted from their use as anvils, although pitting may also result from attempts to rejuvenate grinding surfaces (Smith 1986:9).

One small oven feature was recorded in association with the stone materials, a small pile of oven rakeout composed of calcrete nodules. Clark and Barbetti (1982:147) tentatively suggest that uses of particular materials for heat retainers may have chronological implications. For instance, a hearth with carbonate nodules from Western N.S.W. was dated to 7860±220 BP, whereas those with heat retainers composed of either termite nest or indurated sandy sediment returned dates of between 4000 years BP and modern (Clark and Barbetti 1982:146-147).

The presence of patinated artefacts amidst the scatter is interpreted as confirmation that the site has formed as a result of various episodes of deposition. Whether a period as long as 8000 years is necessarily indicated is uncertain, although, there is evidence of Pleistocene occupation of the wider area. Aboriginal skeletal remains recovered from a nearby quarry pit are thought to date from between 20 000 and 30 000 years ago (Page *et al* 1994:43). The inclusion of 'unusual' larger artefacts with distinctive intensively retouched and used margins, and the carbonate heat retainers may indicate considerable chronological depth for the site components. If so, it may be significant that the artefact raw materials also

appear uncharacteristic in comparison to those of other sites recorded. They are more siliceous, non-local, apart from the possible local source of reef-quartz, and are far less intensively reduced.

Several activities may be tentatively identified as having occurred on the site, although their relative chronological order or degree of contemporaneity is uncertain. It may be interpreted as a locus where stone flaking for the production of flakes destined for backing, possibly for use in composite tools, was carried out. The backing preparation was possibly also an on-site activity. Small adze and semidiscoidal scraper forms were also being produced and might also have been intended for hafting. Preparation of wood for such composite tools might also be suggested by the presence of larger steep-edged nosed and notched implements. Heavily patinated artefacts which are probably associated with the earliest stage of discard within the site included flake cores, flakes and flaked pieces composed of black and white cherts and grey quartzite.

Preparation of wood could be expected in these areas since their local vegetational alliances are likely to have been dominated by *Acacia* spp. Early accounts indicate the importance of *Acacia* especially *Acacia pendula* (boree) for the manufacture of wooden artefacts (Gilmore 1986:146;HP 1896). The presence of additional areas of polished blunting usewear on some acute-edge-angled implements may be resultant of a number of activities including the preparation of twine, vegetable matter, skins or fine woodwork (Tainter 1979:464). The presence of grinding stones as well as steep-edged implements might also be indicative of plant food processing (Tainter 1979:465). The presence of only one identifiably oven-related feature, despite good visibility, would tend to suggest a regionally unusual occupation pattern, or an older one. Surficial fires are likely to have been present and simply not have survived to be incorporated into the archaeological record. Later periods of artefact discard would account for the substantial quantities of other non-patinated artefactual materials.

Urangeline Creek 1

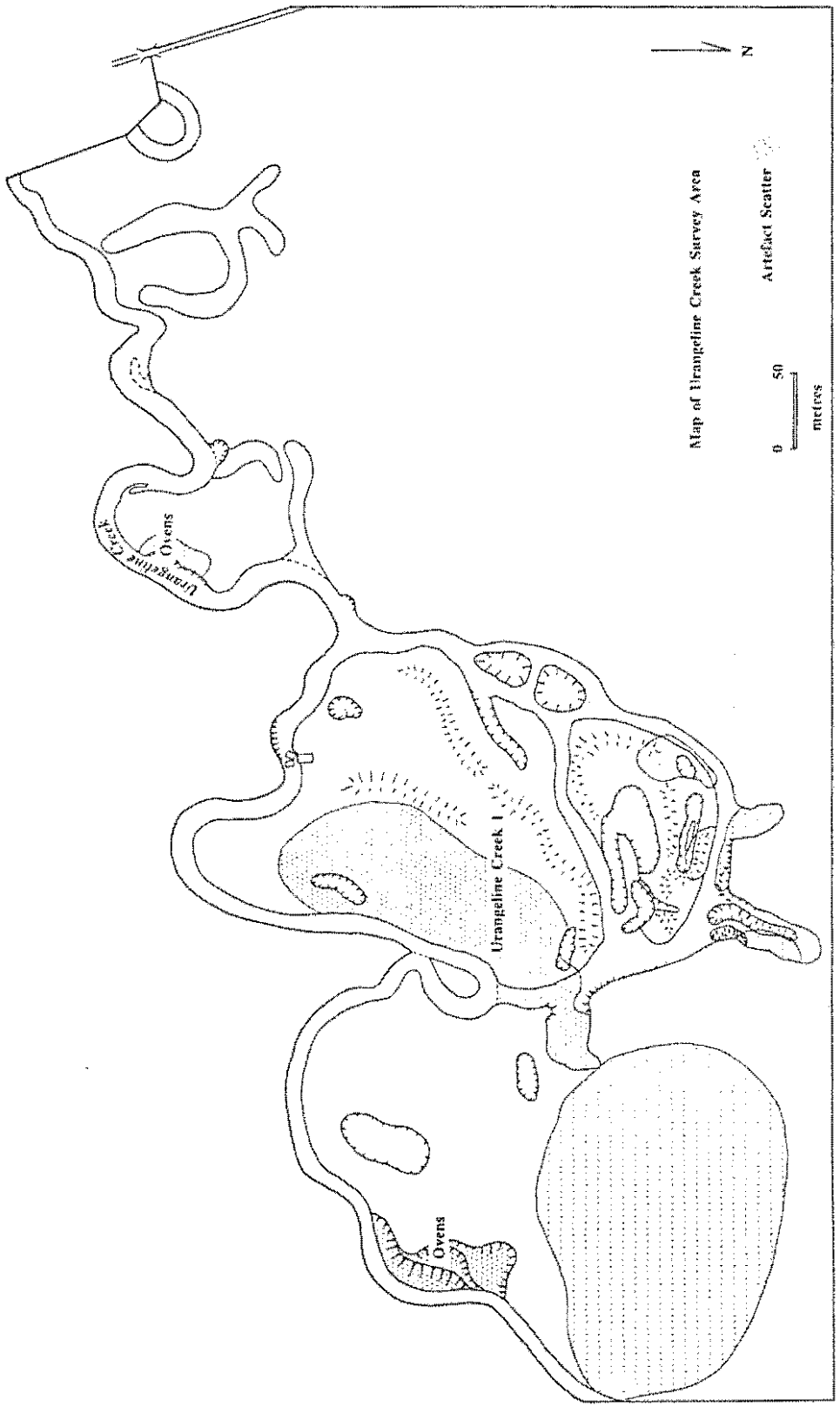
An extensive site containing small ovens and artefacts was recorded on the northern floodplain of the Urangeline Creek, between its confluence with the Washpool and Sandhill Creeks. The site covered an area measuring 950 m east west by 450 m north south. The Urangeline Creek is an intermittent watercourse draining into the eastern side of Lake Urana. It has a catchment area of approximately 1200 km^2 (Page *et al* 1994:39). Wetter late Pleistocene conditions would probably have contributed to a considerably larger stream course than is currently evident, since Page *et al*:(1994:39) note the formation of a substantial delta where the creek enters Lake Urana.

The stream would have contracted amidst its Holocene alluvial sediments during the onset of more arid catchment conditions. Currently, it is recutting a course through alluvial sediments, which appear relatively recent. Its current stream morphology suggests considerable episodes of channel migration, severe erosion and alteration of channel course. There is also evidence of recent deposition of alluvium adjacent to the stream course. These features are consistent with a recent history of more sporadic but intense drainage events. The immediate site environment thus has little potential to reveal very old surficial or *in situ* materials, appearing very much a Holocene product. The surrounding environment would have comprised a sparse *E.largiflorens* woodland vegetated stream corridor juxtaposed with arid shrublands.

Within the survey area three discrete artefact scatters were identified. Site boundaries were defined on the basis of artefact densities and circumscription by current water features (see Figure 6.4). The largest of these was Urangeline Creek 1 with 298 artefacts. Some further analysis was carried out on this site (Appendix III-2a-2r). Quartz was the predominant raw material represented in the assemblage, accounting for 93% of all material recorded. Small quantities of silcrete (4%), quartzite (2%) and sandstone (1%) were also recorded. The assemblage was characterised by the presence of small pebble cores and debitage with pebble cortex. Cortical debitage was predominantly quartz ranging in length from 10 to 30 mm. The modal length class was the >15≤20 mm category.

Quartz cores were small and heavily reduced, many of them bipolar, although small single-platform blade and bifacial flake cores were also present. Bipolar reduction was further suggested by the proportion (60.5%) of chips in the assemblage. The platformed debitage and reduction charts demonstrate a preponderance of small thin flakes in the 10 to 20 mm categories. The modal length was 15 to 20 mm. Only 5 flaked artefacts displayed retouch or usewear, two quartz geometric microliths, a retouched and used quartz adze and two utilised flakes, one of quartz and one of silcrete. Utilised artefacts also occurred within the 10 to 25 mm categories. The finished microliths fell into the 10 to 15 mm category, suggesting their formation on flakes originally of that dimension or slightly longer. Most of the stone reduction thus appears to have been geared to the production of small thin flakes, either for direct use or for manufacturing microliths. It is likely that they have mostly been used and disposed of off-site.

Figure 6.4 Urangeline Creek Sites



Small tabular grindstone fragments were also present, as were small pellets of baked clay, removed from any original oven context. Separate dense occurrences of rakeout from clay pellet ovens occurred to the east and west in the Urangeline Creek 2 and Urangeline Creek 3 sites, respectively. These comprised thick compacted exposures of large grey baked clay lumps averaging 1 m in diameter. They were only evident in recent creekside erosion and, where such exposure had occurred, attained densities of up to 1 per m^2. Four of these features were recorded in Urangeline Creek 2 and in Urangeline Creek 3. They were associated with a dense artefact scatter in the former area.

Evidence at the Urangeline Creek sites suggests intermittent repetitive periods of use. The ovens present are fairly small and are interpreted as indicating relatively short periods of reuse. Time lag between periods of reuse, low intensity of overall reuse, the rapidly changing microtopography, or a combination of the these, may be factors which precluded their relocation for reuse by successive occupation episodes, resulting instead in the manufacture of new cooking pits across the wider area. It is likely that similar oven features existed in discrete areas across the entire site complex. Their former existence is suggested by numerous isolated baked clay clods present in gully washouts and across deflated ground surfaces.

Despite the considerable quantity of stone material in the site area there is little evidence for major occupation. The quantity of flaked stone is attributed to the stage of reduction as well as the presence of bipolar reduction strategies. Considerable reduction of stone materials occurred at an early point in the reduction process, judging by the percentage of cortical material present. As discussed earlier, it is suggested that the quartz raw materials are likely to have come from sources nearby. These sources predominantly consist of small pebble materials which would be most efficiently accessed with bipolar reduction strategies. Such strategies produce prolific debitage. Whilst reduction of some more exotic types of stone is indicated, very little was discarded. Very few used or formal implements were found. The presence of ovens, grindstones, which may indicate some on-site processing, and evidence for manufacture but removal of formal implements, suggests site formation resultant of low intensity repetitive base camp activities. The type of ovens present, indicating minimal reuse, would support this interpretation.

Colombo Creek

The Colombo Creek site is positioned on erosional levee deposits flanking an older but episodically reactivated meander/swamp connected to the Colombo Creek. The Colombo Creek is a tributary/ distributary stream connected by the Yanco Creek to the Murrumbidgee River. It is part of the modern flow regime of the Murrumbidgee river although the current stream course is recutting through a microtopography largely resultant of antecedent channel activity overlying prior stream traces. It is presently

devoid of original woody vegetation, although it is likely that its contact period vegetation was *E.largiflorens* woodland, transitional between the Colombo Creek floodplain and surrounding *A.nummularia* and *A.pendula* plains.

Over the longer term the Colombo Creek could be viewed as the relic of a stream system in relative decline since at least the terminal Pleistocene. The current stream corridor follows the approximate course of a palaeochannel but is vestigial in comparison. As discussed in Chapter 3, palaeochannel activity was waning by the terminal Pleistocene transition to the early Holocene period. Flow conditions in the Colombo Creek appear to have been highly variable during the initial European settlement of the region, occurring after heavy localised rainfall or following major flooding of the Murrumbidgee river. During the latter conditions flow reversal occurs and some drainage is eventually directed into Lake Urana, via a subsidiary creek. At most other times the Colombo apparently consisted of a chain of waterholes (Baylis 1927:255).

Conditions like those encountered in the recent past could be tentatively extrapolated back until about 2000 years before present, on the basis that the Colombo Creek flow regime is dictated largely by catchment conditions which are analogous to those of the Murrumbidgee River. Conditions within the latter, as in the upper Murray River, appear to have been systemically stable for about 2000 years (Ogden 1993).

The site area contained 1846 artefacts and constituted the largest scatter recorded during the field survey. It also presented the most diverse range of raw materials and artefact types, although this diversity is probably partially a function of its size. Evident use of bipolar reduction strategies has contributed to the overall scatter size and impression of intensive site usage. The artefacts occur in spatial association with a high density of small ovens and mounded features (see Appendix III-3a-3y and Figure 5.5).

The majority of artefacts were composed of quartz (51%), followed by quartzite (25%) and silcrete (21%). A wide variety of colour and quality of each raw material type occurred. Some relatively unusual materials, such as large isotropic polyhedral quartz crystals, were also present. Small quantities of chalcedony (1%), sandstone (1%), metasedimentary (0.2%), conglomerate (0.7%) and volcanic stone (0.1%) were also present. Small (<30mm maximum dimension) platformed cortical debitage indicated the reduction of silcrete, quartz, quartzite and metasedimentary materials. However, mapping of the artefact distributions did not provide any indications of *in situ* knapping locations, in the form of concentrations of particular raw materials. The degree of erosion present in the site, however, may have obscured such features. Blade production appeared to have been one reduction strategy present, since 1.5% of platformed debitage

was composed of blades. Six backed microliths were recorded, five constructed from flakes and one from a blade.

A wide variety of raw materials exhibited retouch or usewear. The highest proportion of usewear occurred on flaked material in the 10 to 15 mm category, although use or modification occurred on a wide range of artefact sizes, between 10 and 65 mm in length. Straight, nosed and notched working edges were present on artefacts. The reduction chart for primary flakes and blades indicates the production of mostly small thin to very thin flakes. Larger thick flakes were present but only in small numbers. Quartz primary flakes and blades occupy a very restricted size range, with maximum length of 30 mm. Quartzite and silcrete, in contrast, attain a maximum dimension of 60 mm, although the majority in both cases fall at or under 30 mm. This could indicate the use of smaller quartz raw materials, which would be consistent with the potential local sources, or it could have been a deliberate reduction aim.

Consideration of the reduction chart for all quartz materials indicates that the majority of material has a size index of less than 45 mm. Only 4 cases are larger. The length of quartz manuports (n=72), assuming they are analogous to those reduced, ranges between 12 mm and 64 mm, with 25 mm as the modal length. Only five examples have lengths in excess of 45 mm. The major factor (apart from general technological difficulties with quartz) limiting length of quartz flakes and blades produced on site would thus appear to be available raw materials. Quartzite manuports were also prolific (n=181), however they varied in origin, with 117 displaying pebble cortex and the remainder with quarried cortex. The average length of the quartzite manuports with pebble cortex was 32 mm, although they ranged between 91 and 12 mm, the modal length was 30 mm.

Cores were composed of silcrete, quartzite, quartz and chert. They ranged from small to large and the majority tended to be blocky in cross section, indicating fairly intensive reduction. Bipolar cores were also numerous. Very few had been recycled as implements or appeared to have originated on thick flakes, as was the case with Lake Urana. Although they may have been reduced beyond recognition, and considering the generally intensive use of stone demonstrated, this is considered a possibility.

There is little support for any spatial integrity of the artefactual materials within the site due to the degree of erosion present. It is best considered as a conflation of multiple occupation events, an interpretation reinforced by the presence of patinated and non-patinated artefacts. In addition several artefacts had differential patination on their flaked surfaces indicating individually 'prolonged' flaking histories. For example the platform of a silcrete flake (Artefact no. 635) was composed of an old patinated flaked surface, whilst the remaining surfaces were relatively fresh. Artefact no. 894 consisted of a flake

core with approximately 30% of its surface consisting of an older patinated flaked surface. It appears that individual artefactual materials within the site were reused over a lengthy periods.

More formalised implement types were also present in the assemblage. These included hammerstones, anvils, combination hammerstone/anvils, grindstones, whetstones, grindstone fragments and mortars. According to a local land owner, hatchets had also been collected from the site in the 1960s.

In its entirety, the Colombo Creek assemblage could be taken to represent a substantial period of repetitive occupation. The presence of artefacts with differentially patinated flaked surfaces supports the hypothesis of long term use of the area, and as with Lake Urana, highlights the difficulties involved in the study of such conflated materials. The range of raw materials, diversity of artefact types and quantity of flaked debitage, allowing for the exaggerated impression afforded by bipolar reduction, suggests that it was occupied as a residential camp. This is consistent with the presence of both small ovens and oven mounds in the site.

Euwarderry Lagoon

The Euwarderry Lagoon artefact scatter was positioned on the high northern levee of the Murrumbidgee River. It was only small (n=44 artefacts) however, it was included for further analysis due to its constituting the largest scatter in the northeast riverine environment of the study region (Appendix V-4a-4l). Artefacts from the site were composed of quartz (47%), quartzite (28%), silcrete (16%), volcanic (5%), chert (2%) and conglomerate (2%) materials. Flakes constituted 30.5% of the assemblage but no blades were recorded.

Straight edged and notched usewear and some retouch was present on quartzite and silcrete artefacts. Edge angles were acute. One of the quartz cores was bipolar. No microliths were present. Platformed debitage ranged between 5 and 25 mm in length, the mode being 10 to 15 mm. No debitage was recorded in the 15 to 25 mm length class but this is probably a factor of the small sample size. No other artefact types, such as hammerstones or grindstones, were present. One small feature of baked clay oven-rakeout was associated with the scatter, and numerous deflated clay heat retainers were intermingled with the general scatter.

On the basis of size, low artefact diversity, presence of discarded utilised flakes and the residue from minor usage of a small pit oven the site is suggestive of a short stay duration by one or a few individuals. The activities carried out on site are consistent with the processing and cooking of foodstuffs in the context of a short visit to the locality. There

are no spatially associated components which suggest that the site constituted part of a base camp.

Goonerah Lagoon

A discrete scatter of 416 stone artefacts was recorded to the east of Goonerah Lagoon, an extinct cut-off meander south of the Murrumbidgee River (Appendix III-5a-5w). The artefact scatter was associated with a series of small ovens. These were indicated by piles of baked clay and stone heat retainers.

Silcrete was the dominant raw material (59%), followed by quartz (31%), quartzite (8%), chert (1.5%) and chalcedony (0.5%). Flaked debitage indicated the on-site reduction of quartz, silcrete, quartzite and chert. The quartz and quartzite lithologies were also represented by cortical debitage, indicating the use of small pebbles as a source of raw material. Silcrete was characterised by the presence of quarried cortex, and much of the debitage contained inclusions of poor quality material. Chalcedony flake cores were present but were not represented by debitage.

Backed blades and flakes were present, one made on a quartz flake with a cortical dorsal surface. Three percent of the flaked debitage consisted of blades. Most of the debitage fell within the 10 to 15 and 15 to 20 mm length classes. The mode was 15 to 20 mm. Usewear was present as straight or notched edges on the acute angled sides of small broad flat flakes. No grindstone fragments or other used implements were located.

This site is located approximately 60 km north of the Lake Urana area and is the first of the 'larger' sites to manifest a change to a silcrete dominated assemblage. In technological respects, there is little to distinguish it from the quartz dominated sites. Artefacts are similarly small and reduction strategies are the same.

The microenvironmental position of the site suggests a focus upon the previously extant wetlands of Goonerah Lagoon. Whilst Goonerah lagoon is still part of the Murrumbidgee drainage system, its formation relates to an antecedent stream channel. There is some potential therefore, for time depth for the activities represented at this site. Production of blades and flakes for backing and cutting, and oven-baking, are activities identified at the site. These would be more consistent with 'forager' general camp activities, where the materials discarded relate to the processing of locality-specific resources such as wetland plants or animals, in the context of a mobile residential occupation. The specific site microenvironment would not lead to an expectation of seed processing activities and none were indicated by the artefacts present. The site is thus suggested to be a short-term resource gathering and processing location, and occupation

site, perhaps representative of repetitive periods of similar use. It thus fulfils sufficient criteria to be considered as representing 'forager' base camp type activities.

Cooey Point Lagoon

A large site complex of mounds, ovens, shell middens, scarred trees and artefacts was recorded around Cooey Point Lagoon, a cut-off meander situated on the southern side of the Murrumbidgee River. One site component comprised a localised scatter of 239 flaked stone artefacts (Appendix III-6a-6y). It was situated on recent alluvium which had been superficially scoured by overbank flooding, and was in proximity to an oven mound, CP82. The scatter area measured 110 by 80 m and was defined by the presence of artefacts. Good surface visibility extended around the scatter for a further 50 to 100 m but did not reveal any further artefactual materials.

A detailed examination of the range of artefacts present within the scatter was considered useful for several reasons. It enables a comparison to be made between a scatter spatially associated with, but not necessarily related to mounds, and artefacts recorded within mounds. Such a comparison may give some indication as to whether site complexes of mounds and artefact scatters were formed simultaneously, and simply constitute contemporary occupation components. Alternatively the site usage resulting in mound accumulation may represent a discreet and functionally specialised activity, formed separately to scatters.

A range of artefact types were represented within the scatter including flakes, blades, flaked pieces, cores, chips, manuports, hammerstones and grindstone fragments. Ninety two percent of the flakes were categorised as debitage, comprising primary or decortication flakes. Two flakes were modified, one by retouch and one by backing. Three flakes were exceptionally thick and were probably either resultant of core rejuvenation, or of the core reaching a stage where it split. Either case is seen as indicative of an intensive use of the stone material. All of the secondary or rejuvenation flakes were of the more siliceous raw materials, i.e. quartzite, silcrete or chalcedony.

Materials for which there was evidence of on-site flaking included silcrete, quartzite, chert, conglomerate, chalcedony, milk quartz and glassy quartz. Forty one of the artefacts had pebble cortex, ranging in extent from 2 to 100%. All raw materials with the exception of chalcedony were represented by pieces with pebble cortex present. Slightly more than half the manuports were pebbles, averaging a maximum dimension of 20 mm.

A comparison of the flake to flake-core ratio (7:1) with the blade to blade-core ratio (1:2) seems to indicate the under-representation of blades within the site. This could indicate their use and disposal away from the site. The preponderance of blade cores compared to

flake cores (18 versus 10) certainly suggests a blade dominated industry. Reduction charts constructed for the sites demonstrate the extremely small size of flaked material overall (Appendix III-6).

The cores present were all small and intensively reduced with blocky cross-sections suggestive of bipolar reduction. Whilst chalcedony debitage was present on the site, chalcedony cores were not, indicating either their curation or their complete reduction. Half the debitage was under 15 mm in length and platformed debitage was predominantly composed of silcrete, quartzite and chert. Quartz comprised a very low proportion of platformed debitage, consistent with its bipolar reduction on an anvil.

In its entirety the scatter is particularly suggestive of short term localised manufacture of flakes and blades, possibly for backing. As such it would be consistent with an activity area within a larger overall site. No artefacts exhibited development of *in situ* patination which might suggest multiple episodes of longer term site formation. Artefact densities varied considerably across the site from zero to four artefacts per square metre or a maximum of 21 artefacts per ten square metres. However, given the exposure of the area to flood washing, the spatial arrangement of artefacts within the scatter is unlikely to be significant.

6.7 Mounds with Artefacts

The majority of mounds recorded did not apparently contain stone artefacts, a factor at least partially due to conditions of archaeological visibility. Nevertheless, examination of mounds that did contain stone materials across the region, revealed raw material trends mirroring the broader pattern established by the larger stone artefact scatter sites (Figure 6.2). Analysis was limited by the generally small sample sizes, although consideration of sites with ten or more artefacts indicated a similar diminution of the proportion of quartz raw materials from east to west. East of the Yanco Creek quartz accounts for up to 84% of materials, west of the Yanco Creek the proportion of quartz declines markedly. The presence of such similar assemblages and similar patterns in raw material usage is interpreted as indicative of a cultural relationship. It is suggested that the land use patterns resulting in the production of clay heat retainer ovens with incorporated artefacts and open artefact scatters are part of a broadly contemporary and integrated system.

The artefacts present in mounds were likely to exhibit usewear, retouch, or to be fragments of or complete grindstones, hammerstones (in a broad sense) or hatchets. Microdebitage was also common but only in small quantities. A higher proportion of artefacts associated with oven mounds thus appears likely to comprise discarded implements or to be the result of artefact maintenance, rather than general flaking debitage. However, the latter activity was occasionally identified. For example, Cooey

Point Lagoon 13 contained a small fragment of volcanic material with ground polish which was probably a broken section of a small edge ground hatchet. Of the 25 artefacts recorded in Cooey Point Lagoon 15, two flakes displayed usewear, two were fragments of quartzite mullers and one was a small quartzite sharpening stone or whetstone.

Cooey Point Lagoon 21 contained four artefacts including one quartzite geometric microlith. Cooey Point Lagoon 23 contained a fragment of quartzite muller. Cooey Point Lagoon 25 contained eight artefacts including a retouched flake (discoidal scraper) and a geometric microlith. Cooey Point Lagoon 49 contained five artefacts, one blade with lateral usewear and a muller fragment. Cooey Point Lagoon 80 contained two artefacts of which one was a quartzite muller fragment.

The presence of higher proportions of retouched and used artefacts associated with oven mound sites is supportive of their interpretation as ovens associated with the processing of resources formed in the context of base camp occupation. Had these mounds been formed as secondary accumulations of waste and heat retainers, they would be predicted to have randomly incorporated small debitage adjacent to or in the original oven locations. The lack of associated artefacts in some site complexes where mounds are present is considered to most likely be a product of diminished archaeological visibility. It is significant that mounds only occur ostensibly divorced from scatters in the alluvial plains landscapes. It was predicted in Chapter 5 that smaller site components and subcomponents would be less represented in these landscapes due to the predominantly depositional formation processes. The scatters which have been recorded in these landscapes are situated upon disturbed or eroded groundsurfaces.

Analysis of lithic scatters throughout the region under consideration reveals considerable assemblage diversity in both artefact types and raw materials. Whilst there is a reduction in absolute quantities of lithic materials from east to west across the study region, relatively diverse assemblages are still present in the west. Artefactual evidence appears to suggest that the majority of oven mounds examined did function within the context of, or as components of habitation campsites. In particular a high proportion of function specific artefacts has been recorded with mound deposits.

Quartzite grindstones were recorded on the surface of Toganmain Site 23 and Uardry (Blackgate 7). During the Old Man Creek Survey in 1987, grindstones were also recorded on Topreeds Site 6. If mounds were episodically reused, then a proportion of the artefacts found in association with them might also include such formal processing implements which could be cached for anticipated reuse. Mounds are highly visible locations which would facilitate artefact relocation. However, if mounds were rapidly

formed and then abandoned following use, it would be predicted that useful implements would tend to be removed, in keeping with general patterns of site abandonment .

Mounds that were sufficiently large to constitute useful elevated occupation areas could be predicted to accumulate a broad range of 'everyday' domestic discard. However this would not necessarily be associated with concurrently-used oven pits. It is possible that, as in the Northern Territory (Peterson 1973), a group of oven mounds was concurrently used, with some used for camping and others for cooking.

6.8 Artefacts in Excavated Mounds

Small quantities of flaked stone debitage were recovered throughout the excavation of Cooey Point Lagoon Site 82. In total 42 artefacts and one quartz pebble manuport were present. All were under 20 mm in length. The majority (47%) consisted of non-platformed debitage, mostly tiny chips of less than 5 mm in length, and a flaked piece. Platformed debitage present consisted of small broken and complete flakes (40%) and a blade (2%). Three minuscule quartz cores, including a microblade core, and a minute flaked pebble (7%) and a fragment of quartzite grindstone (2%) were also present. In general the assemblage would be consistent with the reduction of quartz and quartzite materials and/or the maintenance of silcrete, quartzite and chert artefacts.

Quartzite (51%) was the most common raw material followed by quartz (26%), silcrete (21%) and chert (2%). Only quartz was represented by chips, flakes and cores. Tiny beads of resin (0.4 g in total) were also recovered during the excavation. These may have been fortuitously produced by the burning of resinous woody material or may indicate the preparation of hafting materials for composite implements. This would also be consistent with the production of tiny blades.

As noted, previously the artefacts were distributed throughout the excavation from upper to basal levels. However, owing to the obvious mixing and reworking of the deposit during the use of the oven, little significance can be attached to their individual stratigraphic position. The overall range of dates obtained for the site indicate a temporal framework of between 390±70 and 2660±70 BP for the artefactual materials.

Three stone artefacts were recovered from units 7 to 9 of site CP116. These consisted of one quartzite flake, one silcrete flake and one silcrete chip. All were under 15 mm in length and were classed as debitage.

Thirty six flaked artefacts and one manuport were recovered during the excavation of Colombo Creek mound site 31. The artefacts were found in excavated units 8 to 14. Thirty four consisted of quartz, 2 of silcrete and the manuport was a small piece of

conglomerate material. All of the artefacts are classified as microdebitage, all were less then 20 mm in maximum dimension, and the majority were less than 10 mm. Twenty eight of the artefacts were chips, 6 were unmodified flakes, one was a flaked piece and one a core. Some of the quartz was broken *in situ*. The breaks occurred along internal cleavage planes and it is possible that they were induced by overheating. This would of course be consistent with their location within oven debris. However, the possibility of heat treatment of quartz materials may also be raised.

6.9 Conclusion

Many of the hypothesised characteristics of lithic sites in stone-poor regions are fulfilled in the study region. Examination of artefact types reveals numerous general or multipurpose forms. Hatchets and hammerstones double as anvils, and grindstones reveal multiple patterns of usewear. Rejuvenation of grinding surfaces by pecking is common. Adaptive reuse of seed milling grindstones as small amorphous grindstones culminated in the use of worn out and broken small grindstones as heat retainers in ovens.

The presence of exotic stone materials used for hatchets indicate that exchange networks were a mechanism employed to counteract local deficiencies in volcanic stone. The corollary of this is that, should the need for other siliceous stone have existed, it could have been acquired in a similar manner. Others have also drawn attention to the apparently low quantities of stone present within riverine regions of southeastern Australia, leading to questions regarding the desire for, or 'importance' of such stone in such regions (Mulvaney *et al* 1964:492; Pardoe 1995:710). The development of multi-purpose implements may thus have additional advantages, particularly for a population with high residential mobility, in their reduction of the range and quantity of materials requiring transportation. The repetitive nature of Central Murrumbidgee 'forager' site occupation could allow the caching of larger resource specific items, such as wet-milling grindstones.

In the eastern part of the region there was a heavy reliance on locally available raw materials, despite their constituting what has been characterised as relatively undesirable and intractable material i.e. quartz pebbles. The small size of artefacts evident cannot be entirely due to technological intent or the intensive and conservative use of stone, since certain utilised materials are locally abundant. The initial size of these raw materials has been a limiting factor upon artefact size.

Other forms of exotic siliceous stone occur in proportionately lesser quantities in sites in the western part of the region, where local stone sources are not apparent. They consist

of small quartz and quartzitic pebbles, and some siliceous quarried materials. All artefacts are small due, at least, to the limits imposed by the size of raw materials.

There is clear evidence of a reduction in stone discard rates from east to west across the survey region. This is interpreted as a relative decrease in the use and importance of flaked stone artefacts. It is a trend which was probably accompanied by an increased reliance upon alternative technologies and materials. Historical accounts similarly indicate the use of non-lithic technology in food procurement. Plant fibre, wood, bone and shell appear to have largely obviated the need for stone in many spheres of activity. The development of alternatives, such as bone and mussel shell implements, is suggested by the presence of special bone sharpening stones (Klaver 1987:Plates 20a and 20b), and small numbers of mussel shells in various cultural deposits. It is also significant that skeletal remains analysed from the Hay district, in the west of the survey region, reveal patterns of toothwear attributed to the processing of *Typha* and production of fibre. These patterns are manifest as worn tooth surfaces and interproximal grooving, interpreted as the result of drawing fibrous materials through the teeth (Pardoe pers comm 1991). The preparation of fibres for twine used in netting and other material culture would be a likely cause.

There has been criticism of the uncritical use of Australian artefactual typologies, with the consequent inability to characterise assemblages in terms of industrial divisions, and hence reveal modifications induced by environmental change (Holdaway 1995:793). The results of this study suggest that typological change may be inherently difficult to identify in stone poor regions and that stone discard rates have less utility as a basis for assessing the relative intensity of use of sites or landscapes. Nevertheless, evidence of economic change may be embodied in a decreased overall use of stone and development of complex technology geared for mass capture of resources.

The variation in raw materials between sites is consistent with a response to immediate stone resources rather than to temporal or functional differences. Although there are some indications of temporal variation as evidenced between a site at lake Urana and surrounding sites. Hence, minor changes in raw material types may be a poor indicator of relative site chronologies. Whether the quartz pebble supplies in cliffed sediments at Lake Urana would have been available during the wetter Pleistocene time period, with concomitant higher lake levels, is debatable. Nor is there evidence that this specific locality was utilised, apart from the general similarities of its contents with quartz in surrounding sites.

The presence of fresh and patinated flake scars on artefacts in some sites indicates their formation over considerable time frames. This not only indicates the reuse of discarded

materials during later periods of occupation, but also that much of the stone evident represents a concatenation of occupation events. These circumstances confuse the spatial analysis of the artefact distributions. Such formation processes also complicate analyses of site function based on assemblage diversity, since many occupational events have obviously contributed to the scatter. Diachronic and diverse activities could thus account for the assemblage equally as well as synchronic and varied base camp activities.

The presence of certain functionally specific artefact types within sites also suggests the exploitation of particular resources within the survey region. Mullers and grindstone fragments associated elsewhere with the processing of grass seeds occur predominantly throughout all the alluvial plains landscapes. They are outnumbered by amorphous grindstones documented as used for a variety of tasks, including the crushing of roots and tubers, and these also appear to be more widely distributed, occurring within the alluvial valley plains and sloping and arid western plains. Mortars, interpreted as used for the crushing of harder shelled seeds are also distributed widely, although only few were recorded overall.

It is possible that some implements were cached at locations for reuse during successive episodes of site occupation. The analysis of lithic materials from a selection of sites tends to suggest that subsistence practices tended towards 'forager' modes, with the presence of base camps in most environments. There is not substantial inter site diversity, except what might be expected on the basis of assemblage size, and the largest assemblages are demonstrably formed from multiple occupation episodes. The most significant aspect to emerge form the lithic analysis is the potential for whole site complexes associated with artefact scatters to indicate the reoccupation of locations. This degree of base camp reoccupation appears to vary considerably in intensity.

Differential formation processes have certainly influenced the visible patterns of stone discard throughout the region, leading to potentially false impressions of a low incidence of stone artefacts in the alluvial plains landscapes. Indicators of human occupation other than stone artefact scatters, such as middens, oven mounds, ovens and scarred trees are, in these parts of the study region, not necessarily accompanied by significant discard of stone, despite thorough survey and good archaeological visibility. Site complexes in the erosional landscapes, however, are invariably associated with some stone discard. Nevertheless, even in locations where artefacts are abundant, the rates of discard are interpreted as very low, since in these locations there is strong evidence to suggest that the scatters are conflated accumulations of material. It is suggested that the stone deficient nature of the Murrumbidgee riverine plain may have encouraged a creative emphasis upon alternative non-stone technological adaptations for subsistence related pursuits.

Chapter 7
Scarred Trees in the Central Murrumbidgee Riverine Plain

7.1 Introduction

Scarred trees are by definition those trees which have had bark removed by humans (Plate 16). The scar is the approximate negative, considering regrowth, of the piece of bark removed. Bark appeared to be an integral component of Aboriginal material culture in many regions and the individual uses to which it was put are numerous. Bark strips were used for canoes and shelters and many other smaller items of a domestic nature, e.g. containers, pegging boards and toys. Bark was also part of various ceremonial activities. Scars would therefore presumably occur in a range of sizes which varied according to the intended use of the bark piece. The potential for the size attributes of scars as indicators of the function of the utilised piece and hence activities possibly related to that location are explored in this chapter.

In keeping with the general model of occupation outlined in Chapter 1, it would be predicted that areas containing the most scarred trees with domestic functions would coincide with those areas most 'intensively' occupied. A limiting factor, however, would relate to the distribution of suitable tree species, since not all species present in the region would provide usable bark.

The potential value of scarred trees as chronological indicators of landscape use is also investigated, and the limitations of their interpretative value outlined. Scarred trees are generally acknowledged to represent activities within a limited time period which often presents difficulties in their articulation with other types of archaeological evidence of occupation. However their likely range is little explored. In addition, the later period of Aboriginal bark usage overlaps with the initial European use of bark. Whilst the identification of responsible agencies may not always be possible, this discussion investigates whether there are certain criteria which may be applied.

The spatial relationships, between all categories of scarred trees and other habitation or activity sites, are not well understood. Some uses of bark may be more direct than others. For instance, bark stripped for shelters could conceivably be used immediately with little other preparation. Other uses, such as canoe and domestic container manufacture, may involve further time consuming preparation, entailing controlled drying, shaping and perhaps decorating. Some of these further activities would logically involve the use of other implements, including stone.

The selection of trees from which bark was stripped for immediate use may have been more haphazard than the selection of trees for particular characteristics, such as shape and size, relevant to very specific purposes for the bark. The latter trees might have been specifically sought over wider areas. Some scarred trees would therefore be predicted to be related to habitation campsites, since many shelters, and disposable domestic items were composed of bark. However, other scars could result from a one-off event not spatially proximate to longer term activity areas. This analysis therefore, also examines the general spatial distribution of scarred trees within the survey region, particularly in comparison to other occupation evidence, in order to ascertain whether scarred trees are products of haphazard or very focused extractive activities.

7.2 Aboriginal Use of Bark

A limited range of tree species consistently appear in descriptions of Aboriginal bark extraction. Some observers describe scarred trees on the basis of having observed the scarring whereas others are making interpretations of function based upon the size and shape of the scars (see Table 7.1). Mathews (1908:4-6), writing on Aboriginal navigation, noted that *E. camaldulensis* (redgum) was the preferred species for making bark canoes, although *E. macrorhyncha* (stringy bark) and *E. microcarpa* (grey box) were also used. Beveridge (1861:22) noted (along the Lower Murray) that the bark of *E. camaldulensis* was used to make canoes:

> "...they generally select a tree with a bend in it for this purpose, as that saves them a great many hours work in the manufacture of their tiny craft; because if they use the bark of a straight stem they have to give it the necessary curve at each end by use of fire...".

The size range of scars may be useful in suggesting the range of likely functions of utilised bark. Crombie (1927:56) described the use of 'box' tree bark for canoe manufacture, noting that trees with leans or bends were selectively chosen and that a sheet of bark for a canoe would measure in the vicinity of 4.5 m long by 1.2 m wide. A bark canoe on display in the Hay Museum was identified as being made of box bark. It was apparently found near a dry lake bed in the district. It measured 2.20 m in length and varied between 0.70 and 0.80 m in width. It was rounded in shape at the bow with a squarish stern. It is likely that there would have been a range in sizes of bark canoes, depending not only upon anticipated use but also the type of waterbody it was to be employed upon. Beveridge (1883:41) commented that small canoes were far more manageable for fishing and collecting birds and eggs, both activities that would be most likely carried out in still and shallower waters. Large canoes were of more use for moving people and possessions and for navigating faster, deeper waterbodies.

Bark strips or sheets were employed in the construction of dwellings throughout southeastern Australia. Dawson (1981 [1881]:24) said that axes were used to strip bark for dwellings:

> "For the latter purpose the butt end of the handle is made wedge-shaped, to push under the sheets of bark and prize them off the trees.".

Crombie (1927:54) decribed the stripping of bark from a box tree for the construction of a shelter by an Aboriginal man in the Lachlan River area. A tree of suitable size with the 'sap rising' would be chosen and a series of diagonal cuts made across the base of the intended piece. Another series of cuts crossing the first would then be made, this would be repeated at the top of the scar and then the sides cut. This would result in the removal of a piece measuring about 6 by 7 feet (1.8 x 2.1 m). On occasions, multiple pieces would be removed from the same tree.

MacPherson (1885) provides illustrations of various forms of scars on trees, amongst which he notes the bark pieces removed for pegging boards, used in the stretching, drying and scraping animal hides. He provided an illustration of the later effect on the tree by the regrowth which subsequently occurred (1885:fig). He later noted pegging board scars in forested areas of Victoria.

> "The writer scores of times observed a tree of considerable size and age in the Woodbourne Forest, keeping its place while great numbers of apprently healthy young trees were smitten as with some plague and died. A great scar on this tree had laid one side bare, while on the opposite side a rectangular sheet of bark had been taken off by the aborigines for the purpose of making a pegging board in order to stretch out opossum skins." (MacPherson1895:91).

In the Lower Murray district Krefft (1866:362) observed trees with square scars which he also attributed to the removal of squares of bark for drying possum skins. He also mantioned many trees exhibiting old canoe scars of 'great dimensions' commenting that fresh scars were rarely encountered.

Broad shields were used to deflect weapons during fights. They were manufactured from sheets of bark, as well as wood, subsequently undergoing trimming and planing to remove the rougher outer bark (Glance 1949). Specimens included in collections demonstrate the use of the broad shield in the Murrumbidgee Districts (Rowlison *et al* 1981; White 1986).

In Victoria, Dawson observed that dry weather water supplies were stored in a container called a *torrong* (boat) which was made of

> "...a sheet of bark stripped from the bend of a gum tree, about four or five feet long, one foot deep, and one wide, in the shape of a canoe" (1981[1881]:15)

Buckets were also constructed of bark, cemented with wattle gum (1981[1881]:78). He also observed small sheets of bark being used as kneading boards for the preparation of damper (1981[1881]:20). Circular pieces of bark were used as targets in recreational games (Dawson 1981[1881]:85). Sheets of bark were also removed in pursuit of caterpillars (MacPherson 1885:diag). Bark was also reportedly used as fuel in earth ovens (Gammage 1986).

Mathews noted the removal of strips of bark during an initiation ceremony at Waddi, near Darlington Point, on the Murrumbidgee River:

> "Pieces of bark, called munga or dhoorung are stripped from trees somewhere adjacent to the goombo, where they are kept ready for use on the morning of the final ceremony, to be described presently. These strips of bark are about two feet and a half in length, and six inches in width at one end, but tapering smaller at the other in order that they may be gripped in the hand." (1897:127).

He further observed that later on in the proceedings a platform was erected, constructed from logs and sheets of bark. Dawson (1981[1881]:63) noted that children were wrapped in bark sheets for coffins prior to their interment in hollow tree trunks. Beveridge noted the use of a strip of bark at the base of graves in areas along the Murray River (1883:29). In far western New South Wales bark coffins were made from a sheet of bark stripped from the entire circumference of a tree (Konecny 1993:48).

Blandowski (1855:72) observed the scarring and burning of eucalypts by Aborigines living along the Murray upon the death of members of their group.

> "In case the person to whom the tree is thus dedicated dies, the foot of it is stripped of its bark, and it is killed by the application of fire; thus becoming a monument of the deceased".

7.3 Post-Contact Use of Bark

Apart from Aboriginal use of bark resulting in tree scarring, there was a later (post-contact) period of European bark usage, commencing with the extra complication of some of the early 'European' scarring being carried out by Aboriginal people (using both stone and metal implements). John Peter, in response to an 1840 Government circular on the use of Aboriginal labourers on Tubbo station, just south of the central Murrumbidgee river, replied:

> "The principal way in which I have found them useful, is in washing Sheep Stripping bark reaping and shepherding...I have known some of them to strip forty Sheets of Bark in a day..." [in De Serville 1982:34-35].

Crombie (1927) who resided further north in the Lachlan River district, noted that all the station buildings were roofed with bark, cut by Aboriginal labour, for which they were paid 1/6 per sheet .

It is likely that the scars made by Aborigines for European construction would have been for roofing purposes and would have involved the total debarking of the tree trunk. It might also have employed the trees cut down for use in construction, so the number of standing scarred trees would have been fewer. Thus scars from bark removed by Aborigines and produced for European purposes probably occupied a limited typology i.e. for roofing. Furthermore they were probably concentrated in areas near building sites or wood procurement sites.

Europeans would doubtless have stripped bark for their own purposes as well, it was generally noted that squatters dwelt in bark huts (Campbell 1929:101). Early surveyors often noted European 'bark' structures in their traverses along the Murrumbidgee River and southerly creek systems, related to shepherding encampments (Larmer 1847-50; Townsend 1849). Isolated bark stripping occurrences, which may or may not have left standing physical evidence (scarred trees), related to this shepherd activity in the initial settlement of the Riverine Plain must also be accounted for in predicting the nature of the archaeological record.

Burton (1968:plate:68-69) noted that European bark huts were of grey box bark. The bark was stripped in 0.9 by 1.8 m sheets and dried flat for approximately 6 weeks prior to use. A description of early timber buildings along the Hawkesbury River in the 1820s also describes the use of bark sheets for the rooves and some interior structures, such as sleeping bunks, of early European huts (Cox, Freeland and Stacey 1969:44). The sheets measured in the vicinity of 1.8 m long by between 0.6 and 1.2 m wide.

Other scars made by Europeans which may confuse Aboriginal scarred tree definition include early surveyor's blazes, and trees blazed along river channels to indicate mileage for paddle steamers. Along sections of the Murray River such scars were evident on trees every one mile along the river (Burton 1968:55). Scars may also have been made by 'naturalists' seeking fledglings and eggs early during the early settlement of the area. A series of foot-holds would be made up the tree to nest locations.

Methods of land clearance involving ringbarking may also result in scarred trees. Anderson (1976 [1880]:57) described methods of 'ringing' the timber. One involved the cutting of two lines, 0.45 m apart, around the circumference of the tree. The bark from this section was then knocked out with the back of the axe. If not later cleared or burnt in bushfires, these trees could remain with a strip of bark removed from their circumference.

7.4 Recording Criteria and Methodology

With the variety of causal agents and similarity in scar morphology, the field recognition of Aboriginally scarred trees is problematical. Factors that should be considered include the estimated age of the tree, the estimated age of the scar, scar morphology, the evidence for methods of removal and the potential for natural causation.

An estimate of the likely age of a particular tree is necessary to determine whether it is likely to have been of a useful size in the precontact or contact period. The antiquity of surviving sites of such bark usage by Aboriginal people is also restricted by the age, survival rates and preservation potential of the subject trees. In the precontact Australian environment tree survival would have been threatened by bushfire regimes. Opinions vary as to the maximum attainable ages. Some consider that tree ages in the Riverine Plain would not exceed 600 years (Ogden 1978:344), although Gill (1971) presents a radiocarbon date of 950 years for one riverine *E. camaldulensis* sample, based upon the radiocarbon dating of burnt wood. Such dates obtained on burnt wood indicate the age of the wood which was converted to charcoal at the time of the fire (Turner 1984:81). This builds in a necessary assumption that the age of the wood at the time of the fire would be less than the internal error of the radiocarbon date. Beesley (1989:14) sees no reason for *E. largiflorens* and *E. camaldulensis* to be any less long-lived than dated trees from forested areas in eastern Australia which reach ages of up to 1300 years.

The aging of trees, relative to a type specimen, is usually carried out by comparison of annually forming growth rings.

> "In temperate latitudes, many species will add a layer of xylem cells under the cambium each year, which appears as a single ring around the circumference of the trunk when viewed in cross section." (Dunwiddie and La Marche 1980:120).

The number of growth rings can then be used to directly infer the age of the tree. The aging of Australian trees is difficult, since they do not regularly form annual incremental growth rings. They may produce several growth increments (intra-annual bands) or none at all in any one year (Dunwiddie and La Marche 1980:130). It would be possible to determine the number of seasons of growth, but to tie seasons into the vagaries of Australian years, accounting for droughts, when no growth may occur, and particularly good years when growth may occur at several stages, would be impossible without incorporating large error margins.

One clue in the identification of very old trees in some species is the deeply fissured nature of their bark.

> "Because of the expansion in diameter of the trunk of a growing tree arising by growth from the cambium, the outer cylinder of bark is stretched and develops numbers of longitudinal fissures which, if they extended through the phloem to the cambium would allow drying out and open the

way to attack by disease or insects. This is prevented by a second layer of cambium tissue, the cork cambium or phellogen, which lies in the outer edge of the phloem and continually produces cork cells forming the outer bark or 'periderm'. As the periderm is stretched by outward growth of the stem it cracks and a new phellogen is formed deeper in the phloem, the cells outside this layer then dying and forming part of the outer bark." (Russell 1972:459).

According to Russell, as a result of this continual process, the bark on old trees is deeply fissured. This process is not evident in species which shed their bark annually. *E. camaldulensis*, for example, will not have this distinctive bark. However, the longevity of *E. largiflorens* trees may be relatively assessed by looking at bark characteristics among other attributes.

Dead trees provide the additional problem of uncertainty about the period elapsed since death. Beesley (1989:12) estimates that 'durable' trees such as *E. camaldulensis* could remain standing for upwards of 100 years, once dead, before rotting or falling.

Even if the tree is of an appropriate age it is further necessary to consider the age of the scar. Considerable regrowth around the scar margins would indicate its likely antiquity, whereas fresh cuts would be recent. Assessment of the period of time elapsed since a scar has formed proves quite difficult although some indications may be gained from estimation of regrowth around the scar margins. As Beesley (1989:12) notes, however, the speed of regrowth will vary depending upon the age and vigour of the particular tree. A young healthy tree may heal quite rapidly whereas an older already mature, or overmature or sick tree, may form new tissue very slowly.

There is now a sizeable corpus of information concerning the dimensions of scarred trees and their respective scars, mostly obtainable form the VAS and NPWS site registers and various consultancy reports (Beesley 1989; Rhoads 1992). This body of information is useful for comparison with trees recorded during the current survey. The Victorian data indicates that 37.6% of trees scarred were *E. camaldulensis*, 34.4% were *E. largiflorens* and 1.75% were yellow box (Beesley 1989:19). *E. camaldulensis* scars occupied a greater size range compared to *E. largiflorens* and so appeared to have been used for a wider range of purposes (Beesley 1989:20). Most studies have concluded that specific functional interpretations based on scar size and shape are fraught with difficulty. The original dimensions of any piece of bark removed will become increasingly difficult to accurately measure with time due to differential processes of growth and healing. In addition there would be some overlap in size for certain uses. Shelters and canoes, for example, may both have employed large sheets of bark.

Rates of trunk growth (circumferential increases) and the healing activity generally mean that the breadth dimension of scars will be gradually decreased, at a proportionately much

greater rate than the length dimension. For most purposes (particularly for comparison) length is the most reliable indicator and usually the least affected by regrowth. Lateral regrowth is more extensive and, from personal observations, not necessarily symmetrical. Width, while useful as a ratio to length to indicate shape, is the less accurate descriptive unit, unless accurate estimation of the amount of regrowth is able to be made. Beesley (1989:17) has suggested that a radial measurement of scar depth may be useful for estimating scar age. However, the variable growth rates for certain ages of trees would still present a problem.

A large part of previous identification and classification of Aboriginally scarred trees has been on the basis of shape. Regularity and symmetry in shape has often been interpreted as indicative of Aboriginal use with irregular scarring more likely to be attributed to natural causes such as branch scarring (Simmons 1980). Scar shape is a somewhat subjective category. For one thing, the shape currently exhibited by the tree will be a product of the original scar, further modified by regrowth. Depending on the original shape this modification will, in some cases, be of a more severe nature than others.

There are numerous sizes and shapes of scars rendered by Aborigines in the procurement of bark for a multitude of purposes. European usage of bark, as previously discussed, would occupy a far more restricted range of scar morphology. According to Beesley (1989:32):

> "The Aborigines, on the other hand, are not reported as having habitually girdled a tree or of having stripped the bark from the whole of the circumference of the trunk. Their activities are normally limited to the removal of a strip of bark, seldom, apparently, wider than one-half of the circumference of the tree and often much smaller with length appropriate to their immediate needs - with canoes being the longest pieces".

The method of bark removal i.e. whether identifiably with a stone hatchet or steel axe, may also indicate scar origin, although post contact Aboriginal scars would have been made with steel axes as well as stone hatchets. Steel axe marks are distinctly sharper than stone hatchet marks which leave a dented or rough cut mark (Coutts 1977:67) (See also Plate 17). Newland (1899:39) also noted the difference between stone and steel axe cuts:

> "... the marks made by the stone tomahawk are very common still, and easily distinguished from the clean cut of our useful steel tool by their bruised, hacked appearance."

Nevertheless, dead, and some live trees, show pronounced weathering effects, so the distinction is not always an archaeologically clear one.

Many trees are scarred by non human agencies such as bush fires, lightning strike, branch fall, disease, insect attack, animal damage and so on. Fire damage, and branch

falls will often cause scars very similar to those humanly produced. Cockatoos have also been observed to produce substantial bark scars (Beesley 1989; Le Souëf 1901:185).

Fire damage will often produce a scar reaching from ground level upwards in a narrowing split or triangular shape. Usually there will also be evidence of fire damage on the exposed cambial layers. Where the inner trunk is preserved it is generally not difficult to recognise fire scarring, however if the inner section of the trunk has decayed through age, or has been burnt out, it can present more difficulty. The scars remaining after Aboriginal possum 'extraction' are practically identical to hollow fire scars (see MacPherson 1885:diag2). If the cambium was preserved the axe cuts into the trunk would be visible. The identification of fire scars can also employ context. If a tree was fire scarred it would be reasonable to expect neighbouring trees of the same age cohort to also exhibit damage.

Lightning is a common cause of bark damage. As noted by Russell (1972:471):

> "The electric current tends to follow the moist tissues of the inner bark and cambium, and the heat generated may be sufficient to explosively vaporise the sap and blast off strips of bark ... without any sign of scorching. ... Lightning frequently strips pieces of bark off the stem close to branches without the latter being affected." .

Natural separation of the bark from the cambium will also occur with damage to the uppermost growing tissues of the cambium, for instance intense heat from bush fires may cause separation, as might impact, for example from a tree falling against another, or a branch falling and striking the trunk.

Branch scars are produced when a tree loses a limb and the bark attached to it tears in a downward movement. Branch scars are normally identifiable since the knotted area, where the branch originally emerged, should form part of the scar. However, if regrowth has obscured the point of attachment it may be difficult to recognise. Similar damage may occur in flooding environments when trees may be struck by floating debris (Beesley 1989:30).

Insect attack in the cambial layers may also cause patchy death of the cambium, which may or may not result in detachment of the affected bark. It has been suggested (Beesley 1989) that scars exhibiting borer attack mean that the whole scar is resultant of insect damage, since the insect attack can only take place between the bark and the active cambium. This is generally true of bark beetles, athough each genus typically feeds within a different portion of the tree (Bright 1976:12). In addition, particular tree species are host to specific species of beetle, which have differing habits (Duffy 1963). After tunnelling in to the cambium female bark beetles tunnel away from their entrance and lay eggs in galleries, the larvae then feed at right angles to these galleries. Some species feed

entirely within the inner bark and these would be exposed upon removal of the bark (Bright 1976:13). However, apart from their original entrances, the outer bark sheets would be unaffected. Other species of bark beetle feed partially or entirely within the outer bark and these may render bark sheets weak or useless. However, this assumes that bark with borer holes in it was unsuitable for Aboriginal purposes, and this remains to be established. Further, if the borer damage was only evidenced by punched exit-holes, this would not exclude the possibility of insect damage subsequent to the removal of the bark. The attack is usually characterised by 'snaky impressions', although this does vary to some degree with the species of bark beetle responsible. It also assumes that it was the bark that the people were after, when in fact trees were also scarred in pursuit of caterpillars (MacPherson 1885). Evidence of insect attack in exposed scar surfaces thus does not necessarily rule out an Aboriginal origin for the scar.

7.5 Scarred trees in the Central Murrumbidgee Riverine Plain

One hundred and eighty nine scarred trees were recorded during the current survey. Of these, 155 were box trees, (81% were *E. largiflorens* and 1% were *E. microcarpa*) and 34 (18%) were river red gum, *E. camaldulensis*. Most were recorded in woodland along the riverine corridor, although a small number were also located in woodland following the southern prior stream systems. Fewer again were located in isolated stands of woodland amidst low hills and dunes. Most of those located away from the river corridor were found in the west of the survey region, reflecting the lesser amount of tree clearance in this area compared to the more intensively agricultural landuse in the east. Nevertheless, it is considered that loss of these sites has been extensive across the entire region. The greater proportion of *E. largiflorens* versus *E. camaldulensis*, compared to the Victorian data mentioned previously, requires explanation and may be resultant of the early exploitation of *E. camaldulensis* forests. Walker (1941:209) noted that by 1925 most of the Red Gum forest along the Murrumbidgee River was depleted of marketable timber.

Most of the surviving specimens exist along the edges of waterways or within relatively permanent swamps. Whilst at first this seemed a possible indication of functional differences, in reality, it is probably a reflection of legislation to restrict the removal of trees on New South Wales watercourses. This was first enacted in 1946 when it became:

> "... an offence to cut down, ring-bark or destroy any tree, sapling, shrub or scrub within 20 metres of the bank or in the bed of any prescribed river or lake without the permission of the Forestry Commission" (NSW nd).

In 1972 administration of this Law passed to the Catchment Areas Protection Board under the provisions of the Forestry, Soil Conservation and Other Acts (Amendment) Act (*ibid*). Thus river red gums in these positions enjoyed protection from forest operations and general land clearance.

Densities of scarred trees throughout the survey region varied between 0 and 30 per 0.25 km^2. Some survey areas with large numbers of scarred trees, such as Cooey Point Lagoon, Uardy, Toganmain and Gundaline Stock Reserves, also contained substantial other evidence of Aboriginal occupation such as small earth ovens, mounds, shell middens and artefact scatters. However, this was not always the case and some areas with the highest densities revealed little in the way of other occupational evidence. Snake Tree Reserve along the Murrumbidgee River, for example, contained 33 scarred trees but only one small oven. Associations between the trees and other sites also varied considerably. Within some survey areas distinct site groupings suggestive of contemporaneous use occurred, e.g. Cooey Point Lagoon and Uardy Stock Reserve.

Rhoads (1992:202) hypothesised that the age of scarred trees would be a probable maximum of 500 years and suggested that the systematic association of scarred trees with other archaeological materials may offer some clues as to their dating. Excavation of oven mound sites in Cooey Point Lagoon confirmed the potential coexistence of scarred trees and other types of sites, such as oven mounds and shell middens. Oven mounds, Cooey Point Lagoon 116, 82 and 59 and a shell midden site, Cooey Point Lagoon 5, demonstrate most recent dated use up until at least 400 to 320 years before present, well within the hypothesised age range of currently standing scarred trees. Since carbon was not analysed from the uppermost levels of any of these sites due to possible surface contamination, the potential degree of overlap between scarred trees and these sites is even greater.

The spatial association between other oven mound sites and scarred trees may be used to infer similarly recent periods of use for their upper levels. Direct evidence for the use of bark is provided by the excavated piece of carbonised bark at the base of Cooey Point Lagoon 116, used for the basal lining of an oven pit. This provided a radiocarbon age of 970 ± 70 BP [ANU- 8603]. Calibration with the CalibETH program returned a median date of AD 1075 with age ranges calculated from cumulative probability to two sigma (95.44 %) of between AD 919 and AD 1213.

In other parts of the same survey areas little apparent spatial correlation occurs between site types, and scarred trees appear to be in isolation. This is generally interpreted as due to either poor survival rates or low visibility for other occupation evidence. One group of three scarred *E. camaldulensis* trees (Cooey Point Lagoon Sites 132, 133 and 134) is possibly an exception. It consists of three trees of uniform circumference with very small oval and teardrop shaped scars facing one another. No evidence of branch fall between the three or other potential natural cause could be ascertained. It is possible that they relate to the Aboriginal marking of some feature.

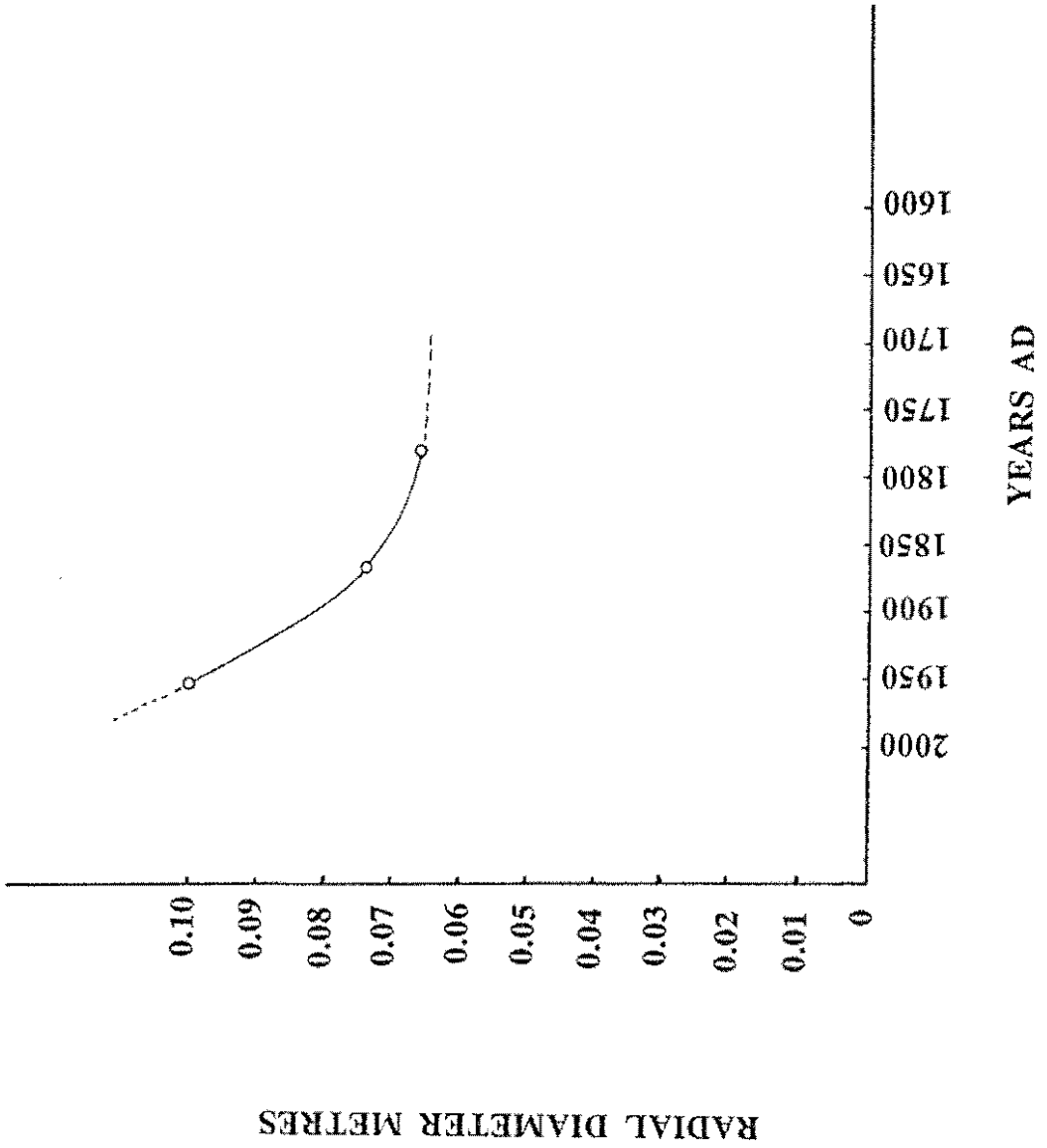
Scars were carefully examined before being recorded as of Aboriginal origin. A large number of scars were observed which were apparently natural or obviously recent and these are not included in any further analysis. Some of the scars recorded were implemented with steel axes, however their general morphology, amount of regrowth and location suggest that they are related to Aboriginal landuse during the early historical period.

In order to obtain some indication of the size of *E. largiflorens* trees of particular ages and their rates of growth, specimens of known age were sought. A small group was located at Overland Corner along the Murray River comprising twelve trees dated from flood events to 1956, 6 trees dated to 1870 and one tree dated to 1780. Whilst this environment is slightly more arid than the Murrumbidgee district, the trees were located along the Murray which has a much more stable flow, so growth conditions are assumed to be sufficiently analogous between the two areas to justify comparison. Measurements of tree girth were taken at chest height. The amount of radial growth per year was then averaged for the multiple samples and the three rates plotted (Figure 7.1). The data suggests an inverse exponential relationship between growth rate and age. This is consistent with Beesley's comment that once Eucalypts have matured, their growth rates decline (1989:12).

Mindful of the fact that this simple analysis is based upon limited data, it is also of interest that growth rates apparently decline at a greater rate after 100 years of age. This would suggest that *E. largiflorens* trees in riverine environments with circumferences of less than 1.5 m are unlikely to be sufficiently old to be related to traditional Aboriginal landuse. It is still possible, however, that smaller circumferences may be sufficiently old, if they are situated in particularly harsh environments, are very crowded, are sick or have died and thus ceased growth altogether.

The 155 box trees accounted for 170 scars. Most exhibited single scars but double and triple scars were also encountered. On average the scars commenced at least 0.5 m above the ground, although some commenced at ground level. The highest scar commenced 1.85 m above the ground. The average scar length was 1.36 m although length generally ranged from 0.32 m to 2.9 m. Average interior width was 0.3 m. Trees were an average of 2.69 m in circumference at chest height, although they ranged between 6.63 m and 1.3 m. The majority of scars occurred on the main trunk (n=127) although location on a major limb in specimens with bilobate trunks was also common. Most of the scarred box trees were live, only 7 were deceased at the time of recording.

Figure 7.1 Extrapolated Growth Rates in Radial Diameter of *E. largiflorens* Trees of Known Ages (Overland Corner, Murray River).



Six of the *E. largiflorens* trees had circumferences of less than 1.5 m suggesting borderline status as Aboriginal sites. However other attributes suggested their acceptibility. Two were long dead at the time of recording (Birdcage Reserve 22 and Cooey Point Lagoon 110), one was on a tree which had partly fallen and suckered (Cooey Point Lagoon 85). The remaining three were associated with other archaeological materials, had axe marks visible or were of typical morphology. Cooey Point Lagoon 70, for example, was a small oval scar removed from the 'elbow' of a curved limb.

The frequency distribution of scarred tree trunk circumferences presents as a normal curve with a slight kurtosis. The distribution appears typical of tree population survival rates, with some younger trees, numerous medium trees and very few very large old trees. Some of the larger/older size classes are missing altogether. Comparison of the entire sample with trees recorded at Cooey Point Lagoon shows conformity between the two distributions and infers that site areas contain samples which are typical of the distribution overall.

Of course this only establishes the likelihood that most of the trees would have been available for use at contact or precontact times. Scarring could have taken place at quite a late period in the trees' lives. In order to eliminate old trees with young scars some estimation of regrowth was made. During recording radial measurements of scar depth, or regrowth thickness were made. This should provide an indication of the likely diameter of the trunk at the time of scarring. The average radial depth was 0.10 m, with a maximum of 0.23 m and a minimum of 0.03 m. The scars with the minimum measurement were reassessed. It was found that they were long dead at the time of recording and hence had stopped growing some time ago.

Thirty seven of the *E. largiflorens* trees scars displayed axe marks. Five of these were unequivocally made with stone axes. These trees had circumferences of between 1.55 and 2.95 m. The implement used for the remainder could not be determined with certainty. Axe cuts generally were manifest in several different 'styles'. Axe cuts at the upper and lower scar terminations consisted of either a series of crossed cuts, similar to those reported by Crombie (1927), or a series of single cuts which were either parallel to the ground or curved to trace an oval scar. Double lines were also common. Axe cuts along the long sides of scars were rarely seen due to the extent of regrowth. Examination of a tree with bark partially removed, Gundaline Reserve 51, demonstrated a long line of single cuts along one side of the scar.

The majority (95%) of scars were elongate in shape and, on average, four times longer than broad. Regrowth would exaggerate this pattern over time. Only two scars were recorded with length approximately equal to breadth. Four displayed irregular regrowth.

Twenty five of the scarred *E. camaldulensis* trees were deceased, one of these had fallen and two were so badly damaged that complete data could not be collected for them. The 34 trees accounted for 36 scars (two of which gave incomplete measurements and have been excluded from analysis). Only one of the *E. camaldulensis* trees had a double scar. The trunk circumference at chest height averaged 3.2 m and ranged between 1.52 and 5.05 m. No comparative data on growth rates of dated *E. camaldulensis* could be obtained. They are also known to be slow growing long-lived trees and it is probable that their growth follows a similar or expanded pattern to that of the *E. largiflorens* trees. The scars commenced on average 0.8 m above ground, some commenced at ground level and the highest scar occurred 1.69 m above ground. Scar length averaged 1.63 m, ranging between 0.41 and 3.38 m. One scar was recorded as round, the remainder were elongate. On average scars were currently 4.5 times longer than broad, although this index ranged from 1.5 times longer to 9 times longer. Thirteen of the scars displayed axe cuts however none could be unequivocally attributed to the use of stone axes. The degree of regrowth around most of the scars is considered to have concealed most cut marks. The depth of regrowth ranged between 0.03 and 0.18 m, averaging 0.09 m. Little can be made of these measurements since the majority of trees are dead and growth could have ceased some time ago.

Several unusual specimens were also encountered during survey. One was an *E. largiflorens* tree with the bark incompletely removed (Gundaline Reserve 51). This tree clearly demonstrated the attempted removal of a long rectangular piece of bark. It was cut at the base, top and along one long side, remaining attached along the other side. The bark had obviously been prised away from the trunk and had partially rejoined underneath the uncut margin resulting in the buckling of the piece. Regrowth on the other sides had begun to encroach under the flap of bark. Regrowth had formed a neat oval at the base and top of the scar although straight lines of axe cuts were clearly visible at the base of the scar.

Another *E. largiflorens* tree (Birdcage Reserve 34) exhibited a series of four small scars in an ascendant line. It was interpreted as a toehold tree, by which Aboriginal people gained access to the upper branches probably in search of fauna. A further *E. largiflorens* tree in Cooey Point Lagoon (CPL 85) displayed an unusual shaped scar with a narrow central section and broad upper and lower pieces. Several trees with hollow trunks and chopped holes and scars were found at Cooey Point Lagoon and Uardry Stock Reserve. It is possible that they resulted from the smoking out and removal of small animals or bees as noted in the ethnographic record elsewhere.

Simmons (1980) recorded a sample of 17 scarred trees, mostly *E. camaldulensis* but including several *E. largiflorens*, during site survey on the floodplain between the Wakool and Murray rivers. Plotting of scar length and width measurements indicated the existence of three common length classes: small, between 0.5 and 0.8 m; medium, 1.2 to 1.9 m; and large 2.7 to 5.0 m. It was suggested that the higher frequencies for these lengths may reflect a functional cause relating to the types of artefacts being produced. The longest class would be resultant of the cutting of bark for canoes, the medium length for shelters and the smallest for containers (Simmons 1980:80).

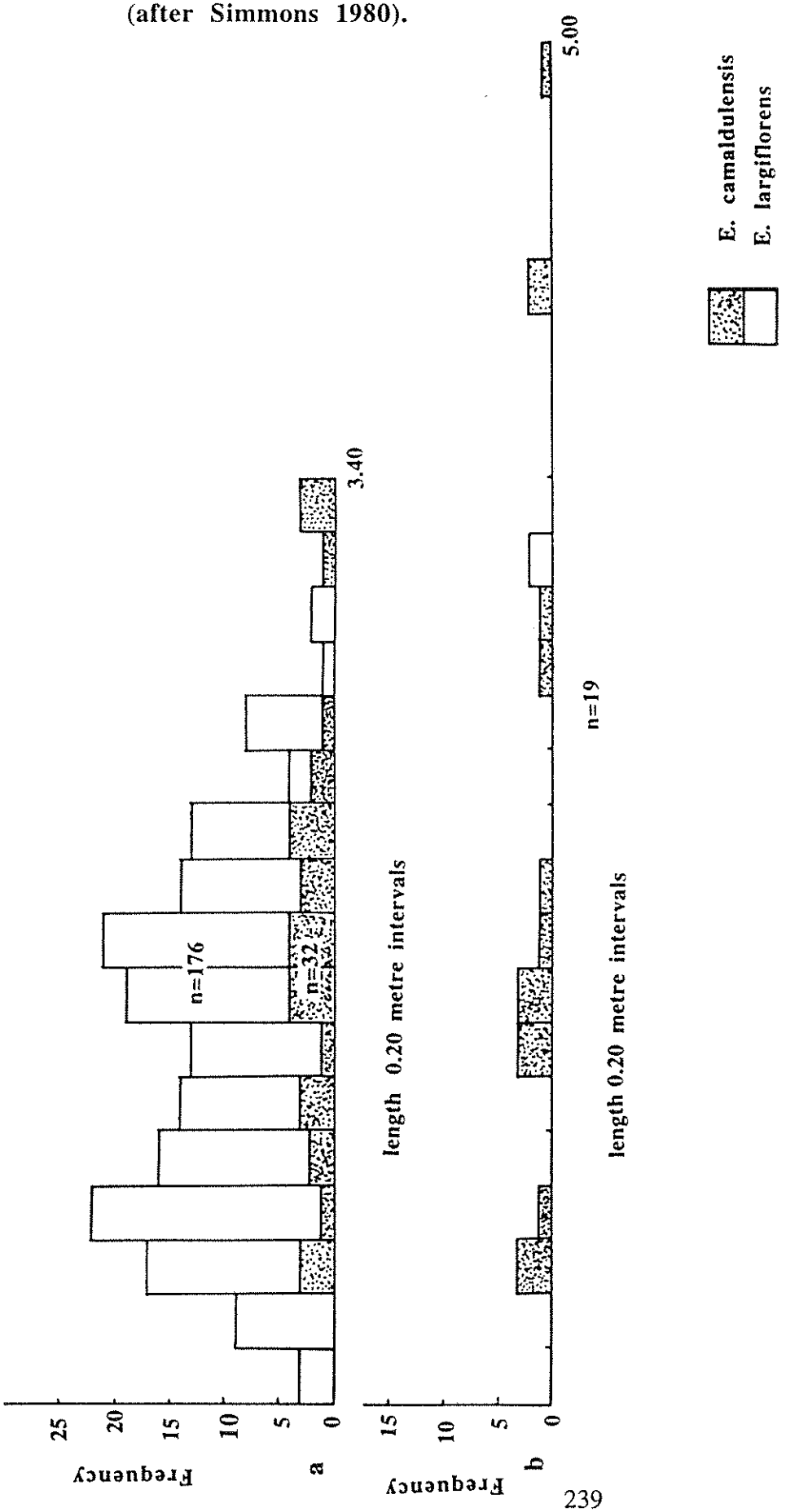
A similar comparison of scar lengths recorded during this fieldwork was undertaken. Due to the larger sample size (208 scars in total), scars on *E. largiflorens* (n=176) and *E. camaldulensis* (n=32) trees were able to be considered separately (Figure 7.2a). Only scars for which complete measurements were able to be taken were included, and scars with highly irregular shapes, such as CPL85 and those apparently relating to toeholds and fauna extraction, were excluded from the analysis.

It is quite likely that the different properties of the respective barks may have influenced the uses to which they were put. Beveridge (1883:40) noted, for example, that *E. camaldulensis* bark was preferred for the construction of canoes. *E. largiflorens* bark was not as durable and was only employed for temporary canoes.

A greater range of scar lengths was represented by the current sample which is consistent with its greater size. However there was still a tendency for a clustering of length classes for the *E. camaldulensis* scars. One cluster appeared to cover the lengths between 0.4 and 1 m, a second appeared between lengths of 1.4 and 2.4 m and a third appeared between 3 and 3.5 m. These are slightly different to the figures obtained by Simmons (Figure 7.2b). Some similarity does appear in the gaps in the scar distributions suggesting that there might only be a real separation between the small to medium classes and the longest class. Within the study area this appears to suggest a threshhold of 3 m (current length) for the longest scars which are probably attributable to the manufacture of canoes. No scars were recorded with dimensions approaching the maximum lengths recorded by Simmons. This is probably a reflection of the preference for larger trees to be initially removed by forest operations. However, it is possible that it reflects differences between the fluvial environments of the Murray and Murrumbidgee Rivers. The Murrumbidgee River is a much lesser body of water in comparison to the Murray River and would be more easily approached with flimsier watercraft. In addition, many of the survey areas encompassed large expanses of swampland and billabongs, with shallow and relatively still waters.

Figure 7.2 a Frequency Distribution of Scar Length for *E. largiflorens* and *E. camaldulensis.*

Figure 7.2 b Frequency Distribution of Scar Length for E. camaldulensis (after Simmons 1980).



The *E. largiflorens* scars did not demonstrate the same clustered distribution, with cases representing each length class throughout the range. However, there was a marked bimodality in the distribution. Comparison of scar length frequencies within some survey areas was made to that of the overall sample. Cooey Point Lagoon demonstrated a weakly bimodal distribution with a higher proportional frequency of scars in the smaller end of the 'small' length range in association with oven mounds. Snake Tree Reserve also demonstrated a bimodal distribution but fewer very small scars were recorded. Sample sizes in most other areas were insufficiently large to draw any statistically valid conclusions.

In total, there were very few scars which approached lengths elsewhere attributed to the manufacture of large canoes. It appears that the length distribution of canoes along the Murrumbidgee may overlap with that of shelters. Examination of the (few visible) patterns of axe cuts on the longer scars does show two probable scar shapes. One, characterised by axe cuts parallel to the ground, is interpreted as more likely to be related to the cutting of bark for shelters or canoes. The other characterised by arcuate axe marks in upper or lower sections is suggested to more likely relate to shaping bark for canoe manufacture. In terms of the distribution of such large pieces, there is no adjacent spatial correlation between them and mounds or other site types. Shelter/canoe sized scars are very likely to occur in association with mounds as well as with small ovens or middens and do also occur in apparent isolation.

Consideration of the range of scar lengths was also made on the basis of comparison with the dimensions mentioned in early accounts (Table 7.1). While a degree of overlap between length classes could exist, a general trend should persist. Such accounts mention two classes of canoe length: large canoes measured in excess of four metres and were used for transporting people and possessions across and along major rivers; a smaller class of canoe was usd for swamp exploitation strategies. Making a generous allowance for regrowth it is reasonable to suggest that scars with current lengths in excess of two metres could have functioned as canoes. The range of shelter lengths recorded in early accounts is generally in the vicinity of 2 metres or slightly less. Allowing for regrowth a shelter class of scar could be estimated to lie between 1.5 and 2 metres of length. The dimensions of pegging boards, for stretching possum skins, and small containers were not specifically mentioned in early accounts, although they were noted to be small, and square or round. It is estimated that their current dimensions would fall within a length class of less than 1 metre (whereas it could be safely assumed that shelter strips would not fall within this class).

Table 7.1 Scar Dimensions in Early Accounts

Location	Species	Aboriginal	European	Use	Dimensions (m)	Note	Reference
Murray River	?	X		Canoe	great dimension	Observing scar	Krefft 1866:362
Murray River	?	X		pegging boards	small square	Observing scar	Krefft 1866:362
Murray River	?	X		Formed by caterpillar extraction	1.2x0.28	Observed activity, grub holes also evident	MacPherson 1885:diag
Murray River	?	X		pegging board for possum skins	rectangular		MacPherson 1885:diag
Murray River	?	X		water container	0.76x?		MacPherson 1885:diag
Murray River	?	X		unspecified	0.39x0.21		MacPherson 1885:diag
Murray River	Eucalypt	X		Marking after death	?	Bark stripped from base of tree upwards, tree killed with fire	Blandowski 1855:72
Lower Murray	E. camaldulensis	X		canoes	large for transportation, smaller for swamp exploitation	trees selected with bend to save effort in shaping	Beveridge 1861:56
SE Australia	E.camaldulensis E.macrorhyncha E. microcarpa	X		canoes	large elongated		Mathews 1908:4-6
Murrumbidgee River	Box	X		canoe	2.2x0.7-0.8	museum specimen	pers obs
Murrumbidgee River	Eucalypt	X		ceremonial	0.75x0.15	observation of activities	Mathews 1897:127
Murrumbidgee River	?	X		broad shields	0.76x0.24	museum collection	Rowlinson et al 1981:87:s42
Lachlan River	Box	X		Shelter	1.8x2.10	observed activities bark cut with XXXX axe marks	Crombie 1927:54
Lachlan River	Box	X		Canoes	4.5x1.2	tree with bend selected to reduce effort in shaping canoe	Crombie 1927:56
Far west NSW	?	X		Coffins	lxcircumference	entire circumference of bark removed from tree	Konecny 1993:48
Western Victoria	?	X		Burial	?	children wrapped in bark for interment	Dawson 1981[1881]:63
Western Victoria	?	X		Kneading boards for damper	small		Dawson 1981[1881]:63
Western Victoria	?	X		targets for practice	small		Dawson 1981[1881]:63
Western Victoria	?	X		water containers	1.35x0.6		Dawson 1981[1881]:63
SE Aust	Stringy Bark		X	huts	1.8x0.6-1.2	European huts	Cox et al 1969:44
Murray	Grey box		X	huts	1.8x0.9	European huts	Burton 1968:68-9

Organisation of the scars into these three classes then approximates a preliminary index of scar diversity which may then be compared with their distribution (Table 7.2). If in accordance with the general model, the greatest level of site component diversity should occur in association with longer term residential sites, then the greatest range of scar sizes (3) might be predicted to occur in these locations. Four survey areas contain trees with scars in all three classes: Birdcage Reserve; Gundaline Reserve, Cooey Point Lagoon; and Uardry Stock Reserve. These are also survey areas which contain extensive other archaeological materials, particularly mounds. If these associations are significant, then the Toganmain Survey area would also be expected to contain the full range of scar sizes, since it also contains substantial other occupation evidence. However several of its scars falling within the shelter size class are at the upper limit of the range, where some functional overlap could occur, so the discrepancy is not considered significant.

Of the other areas only one, Snake Tree Reserve, contains a significant number of scarred trees, yet does not apparently contain other site components. Its specific environmental configuration would not lead to an expectation of mound formation either, since it is elevated. It is possible that this was an area where bark was procured without accompanying occupation, alternatively the trees may have been scarred for other purposes such as markers. Of the nine scars within the largest length category, the longest was made on a River Red Gum, which would typically be attributed to an Aboriginal canoe scar, whilst the remainder were Box trees. A further plausible explanation may lie in early survey records for the locality. Larmer's (1849:not numbered) traverse sketches of the area note considerable localised evidence of European settlement activity relating to the name 'Gardner' precisely within this survey area, in the form of six annotations of small blocked and open squares and the word 'yards'. It may be that the majority of scars on the Box trees in this area were produced by the stripping of bark for the manufacture of European huts and perhaps boundary or fence markers, and that this pattern of tree scarring overlies the previous Aboriginal pattern.

Whilst the current distribution of scarred trees is in part due to their partial removal with land clearance, it is interesting that where the survival of old trees is good, the pattern is for their occurrence to be consistently and very closely associated with other Aboriginal settlement evidence. This is a similar finding to that of Rhoads (1992:215) who concluded that scarred trees had a random distribution pattern but belonged to a similar spatial distribution as campsites.

Table 7.2 Scars in Functional Length Classes within Survey Areas			
Survey Name	**Scar Frequency in Classes**		
	0-1m	**1.5-2.0m**	**2m+**
Four Corners	1	1	-
Gum Creek	1	-	1
Birdcage Reserve	2	1	5
Glencoe Rd	-	-	1
Gundaline Reserve	6	20	12
Cooey Point Lagoon	41	11	6
Uardry Stock Reserve	8	3	2
Nulabor Reserve	1	-	-
Euwarderry Lagoon	-	2	3
Snake Tree Reserve	8	-	9
Billenbah Reserve	1	-	-
Toganmain Reserve	2	6	-
Main Canal Rd	-	1	-

7.6 Discussion

Examination of trees throughout the central Murrumbidgee Riverine corridor and surrounding plains indicates that the majority of scars with other human 'identifiers', such as axe marks, display regularity in shape and may be ordered into broadly functional categories. A small proportion of irregularly shaped scars which are equally attributable to human agency by virtue of axe marks also exist. Interpretation of scars as humanly induced purely by virtue of their shape could thus be tenuous. Once identified however, scarred trees provide an indication of Aboriginal activity patterns within the landscape which are largely reinforced by occupation debris such as middens, mounds, ovens or artefact scatters. When scar sizes are considered on a functional basis, the presence of the greatest size diversity within an area seems consistent with the existence of base camp activities, in this survey this interpretation is supported by the range of accompanying site components. There is some support for suggesting that the selection of trees for obtaining the smaller range of bark sizes was fairly haphazard, whilst selection of trees for the larger size sheets was quite selective towards the choice of River Red Gum trees. Since this species occupies flooded lands the location of these scarred trees is slightly more distant from other occupation evidence, although still proximate. Whilst contemporaneity of all site components could not be assumed, the presence of the scarred trees, occupying a limited timeframe seem to suggest considerable repetition of occupation in particular locations up until recent periods. The absence of associated scarred trees at other site complexes, such as Colombo Creek, may not just reflect land clearance patterns, but might also be indicating relative site chronologies. It may be that microenvironmental change has resulted in the disappearance of a particular site component, which is also significant in indicating a cessation of recent use of that site

area. They thus provide an important adjunct to site survey in these regions. Whilst they can be considered a vulnerable site type, especially to land clearance, in some environments they are obviously more durable and visible than any other associated sites. Whilst scarred trees recorded during this field work suggest size differences in canoes between the Murrumbidgee district and the more major Murray river system, this may also reflect the European removal of much mature timber from the region. In areas where stone materials are discarded at low, approaching negligible rates, such as in these alluvial plains, scarred trees may provide tangible evidence of Aboriginal occupation.

Chapter 8 discusses the configuration of the archaeological evidence subsequently recorded during the field program. It presents a characterisation of the region in terms of the variety of site components present and highlights the difficulties in field recognition of some types. It assesses the degree to which overall site distribution could be seen to reflect purely environmental parameters, as outlined in the model in Chapter 3. It then looks at the distribution of components within sites, site complexes and specific environmental zones, in order to see whether discrimination of 'forager' and 'collector' subsistence strategies is likely. It assesses the available chronological indicators in order to assess which of the visible archaeological evidence might be contemporary and able to be drawn in to developing a regional model of landuse. Site areas which appear to reflect remnant older patterns are also identified.

Chapter 8
The Distribution of Archaeological Evidence

8.1 Introduction

The analysis of site characteristics and distribution across the region is presented through a series of approaches. A regional overview summarises the range of archaeological evidence recorded. The influence of regionally varied post depositional processes upon the visible appearance of this evidence and its subsequent ordering into archaeological sites, is then discussed. It is examined whether any site types are less affected by these processes and may therefore more accurately reflect differential past landuse between the major environmental zones and landform units than other site types. Certain variations in site characteristics between the eastern and western parts of the survey region, which are differentiated by increasing aridity, are then assessed. Variation in site distribution and character between riverine or stream corridor environs and the plains hinterland is also considered. The distribution of sites within landform units, and the association between archaeological sites and particular microenvironmental zones, is examined. The combined distribution patterns of various site component types are then assessed as to their potential to indicate long-term base camp activities, and hence to indicate the settlement and subsistence mode of late Holocene groups.

8.2 Regional Overview

Regional Distribution of Sites

A total of 581 'sites', comprising 787 components, was recorded throughout the survey region (Table 8.1). Based upon the discussion of component attributes (in Chapter 4), 311 (39%) were mounds (Plates 8, 9, 10 and 11), 205 (26%) scarred trees (Plate 15), 146 (18%) small ovens (Plate 7), 54 (7%) artefact scatters (Plate 13), 20 (3%) middens (Plate 12), 5 (1%) hearths and 46 (6%) other types, including isolated artefacts, shelters (Plate 14) and burials. The 54 artefact scatters contained a total of 6259 sub-components (individual artefacts).

On the basis of general material culture the results of the field survey could be taken to indicate cultural consistency throughout the study region. That is with the exception of several lithic sites recorded in the vicinity of Lake Urana. These exhibit the use of relatively unusual raw materials, a relatively high percentage of larger flaked artefacts and a high percentage of individual artefacts with patinated flaked surfaces. Based upon their relationship with potentially older lunette ground surfaces, it is possible that these sites have components which predate the majority of other evidence gathered in this study. Some support is lent to this by the recording of Pleistocene human remains in sand deposits further to the east in the lunette (Page *et al* 1994).

Table 8.1 Sites and Components in all areas

	Eastern Sloping Plains	Eastern Alluvial Valley Plains	Western Alluvial Valley Plains	Western Plains	n
Sample Area	45	80	60	37	222
% Area	20	36	27	17	100
Total Sites	29	137	362	53	581
% Sites	5	24	62	9	100
Total Components	58	212	426	91	787
% Components	7	27	54	12	100
Total Mounds	9	130	140	32	311
% Mounds	3	42	45	10	100
Total Ovens	15	51	55	25	146
% Ovens	10	35	38	17	100
Total Hearths	0	5	0	0	5
% Hearths	0	100	0	0	100
Total Middens	0	0	20	0	20
% Middens	0	0	100	0	100
Total Scarred Trees	0	4	183	18	205
% Scarred Trees	0	2	89	9	100
Total Artefact Scatters	21	12	12	9	54
% Artefact Scatters	39	22	22	17	100
Total Artefacts	2558	3046	457	208	6269
% Artefacts	41	49	7	3	100
Total Other Sites	13	10	16	7	46
% Other Sites	28	22	35	15	100

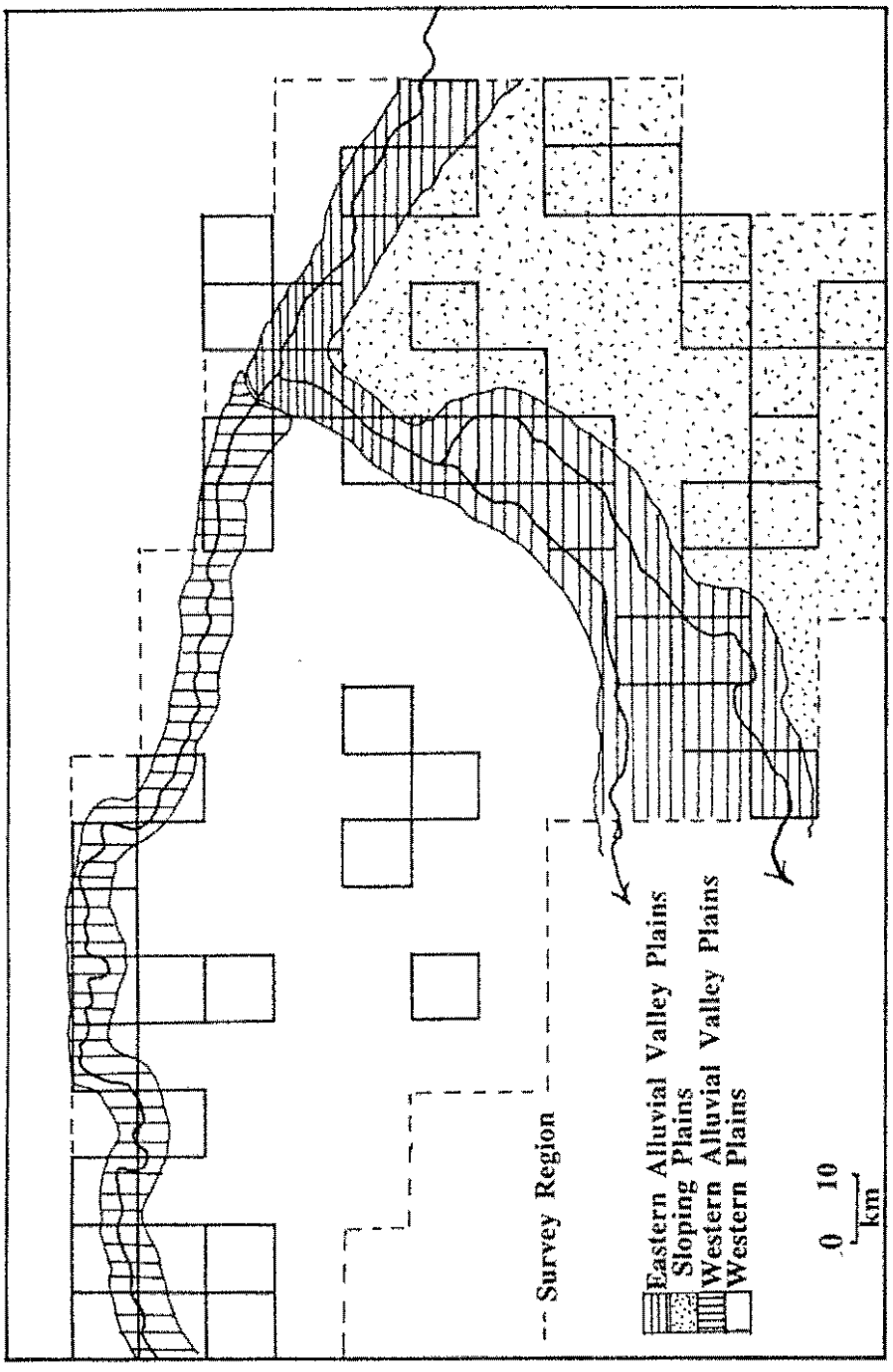
Most component types were found throughout the region in a characteristic series of visible associations. Mounded sites were generally evident as raised roughly circular deposits of blackened ashy soil, with heat retainers and other cultural remains. Dependent upon the season of recording, and their position within the landscape, their surfaces appeared as either circular exposures of loose ashy, dark soil, or lightly grassed compact elevations with embedded heat retainers, or raised occurrences of lush green vegetation overlying moist dark soil with heat retainers. Mound deposits were found in close association with water sources, of variable reliability, such as river and creek channels, billabongs and swamplands. They were located in currently open and wooded situations.

Stone artefacts were often recorded in the vicinity of mound deposits, as were hearths and small ovens. Where these sites occurred in woodland areas, scarred trees were also often present. Stone artefact scatters were frequently associated with other component types such as mounds, small ovens or hearths. Small quantities of stone artefacts were also present within the surface exposures of other component types, such as mounds and freshwater shell middens.

Scarred trees were abundant in *Eucalypt* woodland throughout the region. Whilst they were commonly found in proximity to other site components, in some survey areas they were the only visible archaeological evidence. Some survey areas did not contain any visible archaeological evidence, despite conditions of archaeological visibility and environmental circumstances which equated with other richly endowed areas. There are thus indications of potential variability in site distribution and composition both between and within landform units.

The survey region was grossly categorised into four major landscapes (Figure 8.1) according to climatic aridity and the presence of stream corridor environments. An east-west division reflecting relative aridity and patterns of water availability, with the Yanco Creek as the divide, was made according to general climatic and landscape data (Beattie 1972; Butler *et al* 1973; Lawrence 1937). The presence of specific vegetation categories was not employed in this division since the level of detail required to recreate specific plant resource 'patches' is beyond the scope of this study. However the respective presence of broad vegetation alliances within major landscapes is noted. The potential for site locations to have been influenced by the presence of plant resources is pursued later in this chapter.

Figure 8.1 Four major landscapes



The Sloping Plains comprise the plains east of the Yanco Creek and intermediate between the eastern uplands and western plains. Vegetation alliances originally present within this landscape would have been the *E. microcarpa* woodland, small occurrences of *E. sideroxylon/E. dealbata* woodland and the mixed *Acacia Pendula/ Atriplex nummularia* shrub woodland. Open inundated swamplands present in this landscape would have been dominated by *typha* and *phragmites* spp. Smaller closed swamplands amidst the *Acacia Pendula/ Atriplex nummularia* shrub woodland would have been vegetated with *Eragrostis australasica*.

The Eastern Alluvial Valley Plains comprise the alluvial plains lands surrounding the Murrumbidgee River and its distributary/ tributary streams, to the east of, and including the Yanco Creek and its tributaries. The vegetation alliances originally present in this landscape would have been the *E. camaldulensis* forest alliance, *E. largiflorens* woodland alliance and small areas of *E. melliodora/ callitris* woodland. Swampland understoreys would have also been present in certain areas.

The Western Alluvial Valley Plains comprise plains lands surrounding the Murrumbidgee River west of the Yanco Creek. The vegetation alliances originally dominant in this landscape would have been the *E. camaldulensis* forest alliance, *E. largiflorens* woodland alliance and the *Acacia pendula /Atriplex nummularia* shrub woodland. Swampland understoreys would have also been present in certain areas.

The Western Plains extend west from the Yanco Creek and south from the Murrumbidgee River corridor. The dominant vegetation alliance in this landscape would have been the *Acacia pendula /Atriplex nummularia* shrub woodland. Strips of *E.largiflorens* and *E. melliodora/ callitris* woodland would occur on relict features associated with prior stream courses. Swampy depressions within this landscape would have contained the *Eragrostis australasica/ Muehlenbeckia cunninghamii* alliance.

The total 222 km^2 of sample survey areas for which comprehensive survey coverage was obtained consisted of 45 km^2 (20%) of Sloping Plains lands, 80 km^2 (36%) Eastern Alluvial Valley Plains, 60 km^2 (27%) of Western Alluvial Valley Plains and 37 km^2 (17%) of Western Plains. The features of each of the survey areas were detailed previously in Table 4.1. More detailed features of the survey areas, such as likely past vegetational alliances or particular resources, are described for the individual areas in Appendix II.

Eastern Sloping Plains landscapes contained 29 (5% of total) sites and 58 (7% of total) components. The components were 9 mounds (16%), 15 ovens (26%), 21 artefact scatters (36%) and 13 other components (22%). Sloping Plains contained 3% of all

mounds recorded, 10% of all ovens, 39% of all artefact scatters and 2% of all other types (Table 8.2).

The Eastern Alluvial Valley Plains landscapes contained 137 (24% of total) sites composed of 212 (27% of total) components. These 212 components consisted of 130 mounds (61%), 51 ovens (24%), 12 artefact scatters (6%), 5 hearths (2%) 4 scarred trees (2%) and 10 other types (5%). Eastern Alluvial Valley Plains contained 42% of all mounds recorded, 35% of all ovens, 22% of all artefact scatters, 2% of all scarred trees, 100% of all hearths and 22% of all other types recorded (Table 8.3).

The Western Alluvial Valley Plains landscape contained 362 (62% of total) sites composed of 426 (54% of total) components. These 426 components consisted of 140 mounds (33%), 55 ovens (13%), 12 artefact scatters (3%), 20 middens (4%), 183 scarred trees (43%) and 16 of other types (4%). Western Alluvial Valley Plains contained 45% of all mounds recorded, 38% of all ovens, 22% of all artefact scatters, 89% of all scarred trees, 100% of all middens and 35% of all other types (Table 8.4).

The Western Plains landscape contained 53 (9% of total) sites composed of 91 (12% of total) components. These 91 components consisted of 32 mounds (35%), 25 ovens (27%), 9 artefact scatters (10%), 18 scarred trees (20%) and 7 of other types (8%). Western Plains contained 10% of all mounds recorded, 17% of all ovens, 17% of all artefact scatters, 9% of all scarred trees and 35% of all other types recorded (Table 8.5).

A Chi-square test was carried out on the distribution of total archaeological material within landscape categories, in order to establish whether there were likely to be significant differences in component frequencies (Table 8.6). A hypothetical predicted frequency of occurrence was based upon the relative abundance of each landscape unit examined in the study area. The test rejected the null hypothesis, indicating that archaeological elements were not evenly distributed throughout the region. A disproportionately large number of overall components are situated within the both Eastern and Western Alluvial Valley Plains landscapes. Chi-square tests were also carried out for the most common evidence, mound components and overall artefact numbers (Tables 8.7 and 8.8). In each case the null hypothesis was rejected, suggesting that the number of these components in each landscape category was unlikely to be random.

Table 8.2 Sites in Eastern Sloping Plains

No	Survey Name	km2	Water Source	Minor Landscape	Vegetation	Land Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
1	Mt Galore	6	Ephemeral Creek	Slopes, ridges, valleys	E.Dealbata, E.sideroxylon	Reserve	2	5						2	117		3 shelters	Cfa	600	MJJA
3	Cobbin Ridge	5	Ephemeral Swamp	Slopes, swamp margins	E.microcarpa	Freehold	2	4	2					1	18	1		Cfa	500	MJJA
4	Lake Coolah	[2]	Ephemeral Swamp	Lake margins	E.australasica	Reserve												Cfa	500	JJA
5	Buckingbong SF	4	Nil	Slopes, ridges	E.microcarpa	State Forest	1	2						1	4	1		Cfa	500	JJA
6	Buckingbong SF	4	Nil	Slopes, ridges	E.microcarpa	State Forest		6							6	6		Cfa	500	JJA
7	Comella	3	Ephemeral Swamp	Sandsheet, swamp margins	A.pendula, A.nummularia	Freehold	5	5	4					1	157			Cfa	500	MJJA
8	Lake Uranagong	2	Ephemeral Swamp	Dunes	A.pendula, A.nummularia	Reserve		0										Cfa	500	MJJA
9	Urangeline Creek	2.3	Permanent Creek	levees,floodplain, plains	A.pendula, A.nummularia	Reserve	7	13		6				7	1697			Cfa	500	MJJA
11	Widgiewa	[9]	Ephemeral Swamp	Plains, swamp margins	A.pendula, A.nummularia	Freehold	[10]	[10]	[10]									Cfa	500	JJA
12	Morundah	[20]	Ephemeral Swamp	Plains, swamp margins	A.pendula, A.nummularia	Freehold	[2]	[2]										Cfa	500	JJA
18	Widgiewa Reserve	[0.6]	Nil	Plains	A.pendula, A.nummularia	Reserve	[1]	[2]		[1]				[1]				Cfa	400	JJA
19	Lake Urana	3.75	Ephemeral Swamp	Lake margin, dunes	E.camaldulensis	Reserve	1	2		1				1	9			Cfa	500	JJA
20	Thurrowa	2.5	Permanent Creek	Creek bank, floodplain,levees	E.camaldulensis	Reserve	3	3	3									Cfa	400	JJA
25	Jerilderie-Urana Rd	9	Ephemeral Creek	Creekbank, levees, plains	A.pendula, A.nummularia	Reserve	7	16		8				7	547	1		Cfa	500	JJA
26	Colombo Road	3.75	Permanent Creek	levees,floodplain, plain	E.camaldulensis	Reserve	1	2						1	3	1		Cfa	500	JJA
50	Cullival SF	[1.25]	Nil	Slopes, sandhills	E.microcarpa, Callitris sp	State Forest	0	0										Cfa	500	JJA

Table 8.3 Sites in Eastern Alluvial Valley Plains

No	Survey Name	km2	Water Source	Minor Landscape	Vegetation	Land Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
2	Old Man Creek	45	Permanent Creek	levees, Dunes	E.largiflorens, Callitris sp	Freehold	115	119	112					3	576	4	3 collections	Cfa	500	JJA
10	Goonerah Lagoon	7.5	Ephemeral Swamp	Slopes, plains	E.camaldulensis, Callitris sp	Reserve	1	6		7				1	416			BSfk	400	JJA
13	Colombo Creek	3.8	Permanent Creek	Levees, flood plain	E.camaldulensis	Reserve	2	49	6	37	4			1	1846		1 burial	Cfa	500	JJA
14	Billenbah	1.8	River	Dunes, plains	E.camaldulensis	Reserve	1	4					1		3	3		Cfa	500	JJA
15	Cuddell Creek	1.3	Permanent Creek	Creek bank, slopes	E.camaldulensis	Reserve	1	2			1			1	10			Cfa	400	JJA
16	Tarabah	1.3	Permanent Creek	Floodplain, dunes	E.camaldulensis	Reserve	2	3	2					1	64			Cfa	400	JJA
17	Yanco Creek	5	Permanent Creek	Floodplain, levees	E.camaldulensis	Reserve	7	7	7						68			Cfa	400	JJA
23	Newell Highway	3	Permanent Creek	Floodplain, dunes	E.camaldulensis	Reserve	1	4						4	57			BSfk	400	JJA
27	Old Urana Road	4.3	Permanent Creek	Floodplain, levees	A.pendula, A.nummularia	Reserve	4	13	3	7				1	6	2		Cfa	500	JJA
53	Yanco Weir	2.5	River	Dunes, Floodplain	E.largiflorens, E.camaldulensis	Reserve	3	3					3					Cfa	500	JJA
54	Berembed Weir	4	River	Dunes, floodplain	E.camaldulensis, Callitris sp	Reserve	0											Cfa	500	JJA
55	Kywong Reserve	0.5	Permanent Creek	Floodplain, levee	A.pendula, Atriplex	Reserve	0											Cfa	500	JJA

Table 8.4 Sites in Western Alluvial Valley Plains

No	Survey Name	km2	Water Source	Minor Landscape	Vegetation	Land Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
21	Bareena	8.8	Nil	Floodplain, plains	E.camaldulensis	Reserve	2	3					2		1	1		Cfa	400	JJA
22	Euwarderry Lagoon	14	River	Floodplain, lagoon, levees, dune	E.camaldulensis	Reserve	11	14		1		1	8	1	44	2	Burial?	Cfa	400	JJA
24	Snake Tree Reserve	0.3	River	Floodplain, plains	E.camaldulensis	Reserve	34	34		1			33					Cfa	500	JJA
29	Toganmain	2	River	Levees, floodplain, swamp, plains	A.pendula, A.nummularia,	Reserve	21	24	4	7			10	1	16	2		BSfk	400	JJA
31	Gundaline	6.3	River	Levees, floodplain, swamp, plains	A.pendula A.nummularia,	Reserve	43	55	2	12(10)			37		4	4		BSfk	350	JJA
34	Rudds Point	1.3	River	Floodplain	E.camaldulensis	Reserve	0	1							1	1		BSfk	400	JJ
35	Uardry Stock	3	River	Levees, floodplain, plains	E.camaldulensis	Reserve	23	48	16	3		1	21	7	48			BSfk	350	JJ
36	Cooey Point	6	River	Levees, lagoon, floodplain,plain	E.camaldulensis	Reserve	131	135	55	8 (4)		5	65	1	322	1		BSfk	350	JJ
37	Uardry Station	5	River	Levees, lagoons, floodplain	E.camaldulensis	Freehold	43	44	32	1		8	3		2			BSfk	350	JJ
38	Tom's Point	1.5	River	Levees, floodplain, lagoon	E.camaldulensis	Reserve	3	3	3									BSfk	350	JJ
39	Burrabogie	1.8	River	Levees, plains	E.camaldulensis	Reserve	5	9	3	5 (2)		1						BSfk	350	JJ
40	Nulabor	2.5	River	Levees, floodplain, lagoon	E.camaldulensis	Reserve	6	6	3			1	2		4			BSfk	350	JJ
41	Gre Gre	2.5	River	Levee,prior stream, sandsheet	E.camaldulensis	Reserve	4	5	2	1		1			3	1		BSfk	350	JJ
43	Eli Elwah	1.3	River	Levee, floodplain, meanders	E.camaldulensis	Freehold		0										BSfk	350	JJ
44	Illilkwa	1	River	Plains	E.camaldulensis	Reserve	1	8		7				1	5			BSfk	350	JJ
46	Birriwa	2.5	River	Levee, floodplain, plains	E.camaldulensis	Reserve	7	9		6 (4)		1			3	2		BSfk	350	JJ
49	State Forest	0.6	River	Levees, floodplain	E.camaldulensis	Reserve	28	28	20	3		1	2	1	4	1		BSfk	350	JJ

Table 8.5 Sites in Western Plains

No	Survey Name	km2	Water Source	Minor Landscape	Vegetation	Land Status	Sites	Components	Mounds	Ovens	Hearths	Middens	Scarred Trees	Artefact Scatters	No. Artefacts	Isolated Finds	Other	Koppen Climatic Class	Rainfall (mm)	Effective Rainfall Months
28	Birdcage Reserve	2.7	Ephemeral Creek	Palaeochannel levees, plain	A.pendula, A.nummularia	Reserve	31	40	20	4			10	1	30	5		BSlk	400	JJA
30	Bublebundie	3.75	Ephemeral Creek	Palaeochannel levees, dunes	A.pendula, A.nummularia	Freehold	8	12	4	4			3	1	105			BSlk	350	JJA
32	Goolgumbla	6.25	Ephemeral Creek	Palaeochannel levees, dunes	A.pendula, A.nummularia	Freehold	3	4	1	1				2	21			BSlk	400	JJA
33	Gum Creek Tank	3	Ephemeral Creek	Palaeochannel plains	A.pendula, A.nummularia	Reserve	4	4					4					BSlk	350	JJ
42	Glencoe Road	7.5	Nil	Plains, dune sandsheet	A.pendula, A.nummularia, E.microcarpa	Reserve	1	2					1		1	1		BSlk	350	JJ
45	Cedar Grove	5.6	Nil (Soak?)	Plains	A.pendula, A.nummularia	Freehold	2	8		5				2	6		Soak?	BSlk	350	JJ
47	Rosevale	0.02	Ephemeral Creek	Palaeochannel sandsheet	A.nummularia, E.australasica	Reserve	1	8	7					1	19			BSlk	350	JJ
48	Cobb Highway	3.75	Nil	Plains	A.pendula, A.nummularia	Reserve	2	12		10				2	26			BSlk	350	JJ
51	Kulki Reserve	2.5	Nil	Plains	A.pendula, Atriplex	Reserve	1	1		1								BSlk	400	JJA
52	Argoon Reserve	1.8	Nil	Plains	A.pendula, Atriplex	Reserve	0											BSlk	400	JJA

Table 8.6 Chi Squared Analysis Distribution of All Site Components

Category	Area (km^2) (E)	Components (O)
1. Sloping Plains	45	58
2. E.All.V.Plains	80	212
3. W.All.V.Plains	60	426
4. West.Plains	37	91

	1	2	3	4
Observed Freq.	58	212	426	91
Expected Freq	45	80	60	37

$X^2=\frac{\sum(O-E)^2}{E} = 2577.96$

For three degrees of freedom the null hypothesis that archaeological materials have a frequency proportional to sampled areas is rejected.(Sample =222km^2, O=observed frequency, E=expected frequency)

Table 8.7. Chi Squared Analysis Distribution of Mound Sites.

Category	Area (km^2) (E)	Mounds (O)
1. Sloping Plains	45	9
2. E.All.V.Plains	80	130
3. W.All.V.Plains	60	140
4. West.Plains	37	32

	1	2	3	4
Observed Freq.	9	130	140	32
Expected Freq	45	80	60	37

$X^2=\frac{\sum(O-E)^2}{E} = 196.125$

For three degrees of freedom the null hypothesis that mounds have a frequency proportional to sampled areas is rejected.(Sample =222km^2, O=observed frequency, E=expected frequency)

Table 8.8. Chi Squared Analysis Distribution of Total Artefacts.

Category	Area (km^2) (E)	Total Artefacts (O)
1. Sloping Plains	45	2558
2. E.All.V.Plains	80	3046
3. W.All.V.Plains	60	457
4. West.Plains	37	208

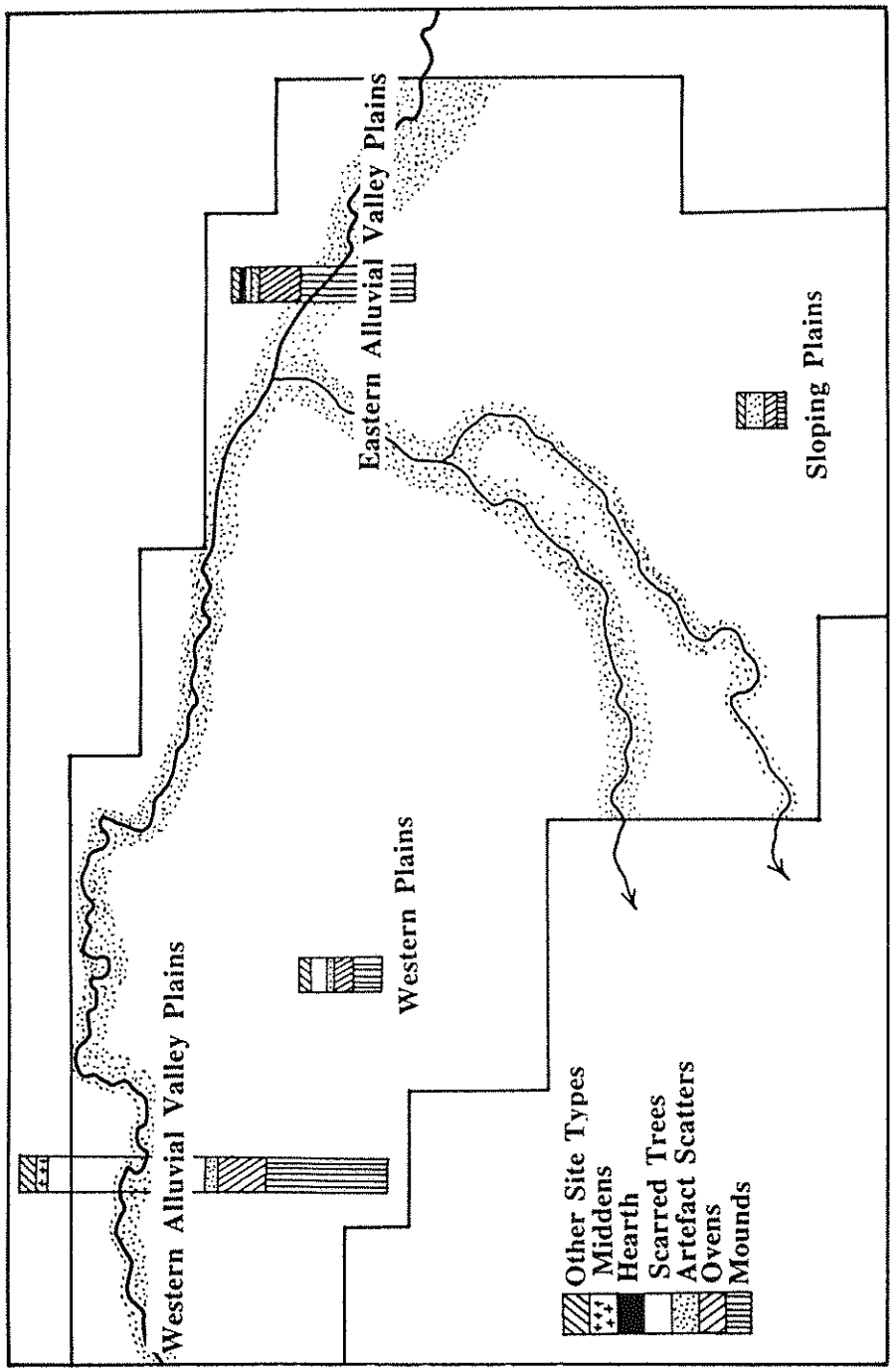
	1	2	3	4
Observed Freq.	2558	3046	457	208
Expected Freq	45	80	60	37

$X^2=\frac{\sum(O-E)^2}{E} = 253718.58$

For three degrees of freedom the null hypothesis that total artefacts have a frequency proportional to sampled areas is rejected.(Sample =222km^2, O=observed frequency, E=expected frequency)

Figure 8.2 depicts the broad pattern of occurrence of archaeological evidence across the survey region, as indicated by the results obtained from survey within sample areas. Mounds, ovens, artefact scatters and 'other' component types are common to all landscape categories. Scarred trees are not present in the sampled areas within the Eastern Sloping Plains, middens are only present in the Western Alluvial Valley Plains, and hearths are only present in the Eastern Alluvial Valley Plains. Prior to reconstructing patterns of Aboriginal land use based upon this evidence, it is necessary to assess the degree to which formation processes, sampling strategies or component characteristics may be contributing to the pattern.

Figure 8.2 Broad pattern of occurrence of archaeological materials across the survey region



In assessing the relative frequencies of particular site types, several points emerge. Hearths are a relatively unobtrusive site type, prone to rapid erosion upon exposure and are easily buried in depositional circumstances. The number of hearths recorded overall is very low (5), and the majority of these were recorded at one site (Colombo Creek). The lack of hearths overall is thus attributed to their poor survival rates and ease of concealment, and the differences in their recovery between areas is not considered significant.

The results of the survey suggest that middens are confined to locations along the current river channels. None were found along creeks adjacent to the banks of lagoons, although mussel populations would have been present in these locations. Mussels were highly likely to have been available in creeks and lagoons, since mussel shell is recorded as part of the matrix of other component types in these locations, particularly mounds. Craibs' (1991) survey along the Murray River revealed a similar pattern, with middens only present along the main river channel. All middens recorded during this survey were located within the Western Alluvial Valley Plains. However, other sources of information document least one shell midden in the Eastern Alluvial Valley Plains along the Murrumbidgee River (Batten nd).

The apparent scarcity of middens in the Eastern Alluvial Valley Plains probably reflects the fact that the surveyed samples of this landscape were mainly associated with creeks rather than the current river channel. Of more significance is the contrasting pattern of midden occurrence along the main river channel and along subsidiary water sources. Their position adjacent to the river channel indicates their formation during non-flood conditions. Furthermore, they were most commonly located on higher sections of river banks, often on inside bends opposite sandy bars and flooded flats. This would suggest that the more intensively exploited mussel beds were located in the deeper water holes formed by the higher velocity scouring of the river bends. It would be more difficult, although not impossible, to procure mussels during winter (May to July) when they aestivate, buried deeply in silty mud (Walker 1981:47). Low water levels during summer would facilitate mussel procurement. In drought conditions these waterholes would contain water for extended periods, even after river flow ceased. It is possible that the middens reflect that more intensive mussel procurement occurred during summer or during pronounced drought periods.

Small ovens, like hearths, are an unobtrusive archaeological feature, although their content of durable baked clay heat retainers aids their discovery. They would be predicted to be more highly visible in erosional or stable, rather than depositional environments. Whilst the sample survey indicates their presence throughout the region, a greater proportion occur within the depositional environments of the Eastern and

Western Alluvial Valley Plains landscapes. This may be significant in terms of Aboriginal land use patterns.

Mounds are relatively large and obvious accumulations of cultural deposit. They could be predicted to be highly visible throughout the region, particularly in the Western Plains. Their tendency to remain visible above alluvial sediments has been noted in other regions (Coutts 1980). They show a similar locational pattern to small ovens insofar as the majority, by far, occur within the Alluvial Valley Plains landscapes. However, they are also present in the Western and Sloping Plains. This pattern is in apparent accord with patterns of Aboriginal land use which were predicted to occur in Chapter 2. Alluvial Valley Plains landscapes surrounding the riverine and creek corridors contain substantial and varied resources attractive to Aboriginal exploitation and it was predicted that this would be reflected in the quantity of material cultural evidence deposited.

Artefact scatters occur throughout the survey region, with the majority (39%) occurring in Sloping Plains lands. They are evenly spread between Eastern and Western Alluvial Valley Plains lands (22% each) but decline in the Western Plains (17%). However, a consideration of the numbers of artefacts represented within these sites indicates major differences across the region. Sloping Plains contain 41% of artefacts, Eastern Alluvial Valley Plains contain 49%, Western Alluvial Valley Plains contain 7%, and the Western Plains contain only 3%. Such a trend of major variation in the use and discard of stone material from east to west across the region could be taken to indicate vastly different subsistence regimes and landuse practices. However, analysis of these patterns in Chapter 6 indicated that these differences were more likely a reflection of the differential local availability of stone resources. Artefact densities are often used to indicate the intensity of usage of a landscape or a site (Hallam 1977:171) but in this region their overall numbers suggest they are poor indicators of occupational intensity. Problems with their interpretation in these ways would particularly increase if they were to be used for inter regional comparative purposes.

Scarred trees are an obtrusive site type which, if present, are likely to be discovered. The low numbers of scarred trees in the eastern areas is probably a reflection of the more extensive tree clearance of these lands following European settlement. Scarred trees have previously been recorded within the Eastern Alluvial Valley Plains landscape (McIntyre 1987; Witter 1982) and low numbers have been recorded in the Eastern Sloping Plains (NPWS Register 1990). As established in Chapter 7, scarred trees are one of the few sites within the region for which some chronological control exists. Most commonly interpreted as 'extractive' sites, often with domestic and economic functions, although some are known to have had ceremonial functions (Mathews 1897), their potential relationship to the location of other components of the archaeological record, such as

indicated by the contemporaneity of mounds, shell middens and scarred trees at Cooey Point Lagoon, provides useful information about Aboriginal activity patterns. Such suites of evidence are interpreted as likely indicators of base camp activities. Although their recognition is hampered by the differential preservation of particular components in different landscapes.

8.3 Assessment of Regional Formation Processes: Factors affecting site component survival and site characteristics

In order to evaluate differences between archaeological data in the eastern and western parts of the study region in terms of resource availability and other parameters, their differentially occurring post depositional processes were considered. There are two main divisions throughout the region based upon predominant landscape processes. Fluvial processes within the eastern and western alluvial valley plains landscapes surrounding the Murrumbidgee River and its tributary/distributary streams characterise this landscape as primarily depositional. In these areas there is great potential for the destruction or concealment of archaeological evidence by burial, water erosion or sheet wash. This has affected small and unobtrusive site components although obtrusive mounded deposits have also been found to be subject to partial burial. Field survey of these landscapes is thus unlikely to be totally representative of small sites or components.

In these environments surficial features are likely to date to a relatively narrow time frame, due to the cumulative addition of flood- and wind-lain sediment to ground surfaces. Analysis of excavated material from Cooey Point Lagoon, and Colombo Creek, indicates that sites initiated between 2500 and 3000 years ago are currently concealed beneath as much as 0.6 m of overburden. Only exceptional conditions of erosion, as in Colombo Creek mound CC31, or continued reuse, as in the case of oven mound Cooey Point 82, reveal these deposits.

The combined effects of seasonal aridity and prevailing winds acting upon the eastern sloping and western plains lands of the riverine hinterland render these primarily erosional landscapes. Deposition rates are slower with localised alternation between deposition and erosion. Arid conditions coupled with wind erosion lead to the removal of surface sediment from some areas, simultaneously causing redeposition of wind borne sediment in others. There is a high regional propensity for scald erosion to occur. Scalds have a long term cyclical nature involving periods of surface deflation and revegetation. In wetter conditions they become shallow water sources which have apparently attracted Aboriginal use, scald prone lands thus have a relation to patterns of archaeological site formation as well as revelation of past activities.

Whilst the current presence of scalds aids the detection of archaeological materials their cycle of formation leads to disturbance of any associated material culture. The erosion leading to clay pan formation reduces archaeological materials, such as lithic artefacts, individual heat retainers and other debris, to a lag deposit where chronologically unrelated materials become conflated into a single feature. As scalds form and vanish, and as successive uses of those landscapes occur, the archaeological record becomes a conflation of chronologically disparate events. Archaeologically 'tough' features which have more capacity to resist erosion, such as pits related to ovens and mounded deposits, appear to retain some spatial integrity, although there is obviously partial loss and deflation of their deposits. The result of post-depositional processes on the archaeological record in scald prone arid plains lands is the presence of sites, such as at Colombo Creek, which are larger, denser and initially appear more complex than in the alluvial plains landscapes.

Only one incidence of a burial was recorded during the field survey, in the Colombo Creek site complex. Historic accounts, however augment data on the interment of human remains in the region. Crown Surveyor Larmer (1848) noted two instances of *'Blacks Graves'* within the survey region in his traverses along the Murrumbidgee River. Larmer's field notes suggested that the graves were grouped and featured above-ground marking, which is reminiscent of the features ascribed to cemeteries elsewhere in southern Australia (Pardoe 1990). Relocation of Larmer's field traverses in the Euwarderry Lagoon area during the current field survey did not find any evidence of Aboriginal burials, but securely confirmed that the original burial locations were in source bordering sand dunes (Appendix II). Such locations are consistent with other historic records mentioning the presence of a likely Aboriginal cemetery in source bordering sandhills near the Murrumbidgee River at Koonadan, uncovered during water control works (anon 1872 in Gammage 1986).

The use of sampling strategies always incurs the risk of missing certain elements of a population (Flannery 1976). This may be compensated for by including consideration of independently acquired data from outside sample areas. The range in variation in known site data was assessed prior to the current survey.

For the purposes of comparison of occupation intensity, between the two main landscape categories, alluvial plains and plains hinterland, mounded sites were generally found to be less affected by post depositional factors in terms of their survival and detection. They have more likelihood of surviving and staying visible in both landscapes. The distribution of mounds across the region is thus considered to provide a foundation for comparative analysis of landuse. This value is reinforced by the functional comparability

of mounded cultural deposits across the region, established by their excavation and is extended by their comparability with small ovens.

8.4 Mounded Cultural Deposits in the Region

On the basis of deposit characteristics and general morphology as set out in Chapter 4, 311 site components were recorded within the broad category of mound. The more detailed information recorded for individual components enabled them to be further classified. The majority were typical rounded platform-shaped oven mound deposits, composed of very dark ashy sediment, large quantities of baked clay heat retainers, sometimes with stone artefacts and mussel shell fragments. Many of these oven mounds also contained quartzite grindstone fragments which had been recycled as heat retainers.

These typical oven mound deposits were present throughout the survey region, although the majority occurred within the alluvial valley plains. Some variation within this type also appeared. Two oven mounds contained only stone heat retainers. They were located at the margins of the Eastern Sloping Plains on ground surfaces where quartzitic cobbles were profuse (Cobbin Ridge Survey). A further variation was suggested by deposits recorded at the Colombo Creek site which appear to be composed of a much higher proportion of baked clay in comparison to ashy deposit. Excavation of Colombo Creek 31 discovered internal features consistent with their being oven mounds, and attributed the apparent differences to lengthy processes of soil pedogenesis.

Incipient oven mounds were also recorded throughout the region. They were barely raised features, characterised by large roughly circular exposures of ashy dark sediment and abundant heat retainers. They generally have a compact surface with discernible concentrations of heat retainers embedded in it. They are interpreted as an agglomeration of rakeout piles from the operation of pit ovens. Most have undergone a considerable mixing of surficial deposits.

Utilised natural mounds were also recorded amidst gilgai soils in two separate locations, within the Western Alluvial Valley Plains lands and the Western Plains lands. These were thin localised deposits of ashy dark soil, baked clay heat retainers and scattered artefacts capping natural grey-soil gilgai puffs. They were located within the Rosevale and Birriwa survey areas.

Evidence obtained through excavation of mound and small oven sites, at Cooey Point Lagoon and Colombo Creek, indicated that they are all primarily the result of activities relating to baking in pit ovens. The extremes in surficial appearance and size, from large soft platform mounds to level compacted deposits with embedded heat retainers, observed in individual deposits throughout the survey region is attributed to variation in intensity of

site reuse, with some influence of post depositional formation processes, rather than an indication of differential primary function.

It is suggested that oven mounds and small ovens are the aggregate and elemental evidence, respectively, of the same activity, which produces essentially the same range of residues. Incipient mounds and agglomerated small ovens fall within the continuum. This is supported by the identical regional distribution of oven mounds and small ovens, although their proportionate numbers vary considerably. One hundred and forty six occurrences of small ovens were recorded. Although the majority occurred as individual piles of baked clay heat retainer, interpreted as rakeout from oven pits, there were also instances where tight groups of up to 4 discrete piles were present. Oven mounds are more than twice as numerous as small ovens in the Eastern and Western Alluvial Valley Plains, whereas they have an approximate ratio of one to one in the Eastern and Western plains lands.

In the Alluvial Valley Plains, most oven mounds appear surrounded by more recent alluvial sediments. During survey the considerable depth of their deposits was in some cases revealed by rabbit burrows. The excavation of mound sites at Cooey Point Lagoon confirmed the burial of their basal levels by at least 0.5 metres of alluvial silts, but suggested that the continued reuse of the oven throughout the period of alluvial deposition maintained their surface visibility. The excavation highlighted the possibility that buried mounds may be concealed in other areas, if their usage ceased in the past. This was certainly the case at Colombo Creek, where the severity of soil erosion revealed otherwise buried archaeological materials. Hence any future search for mound origins may be more usefully directed to older, but otherwise similar, areas where microenvironmental change may have resulted in a cessation of site usage. The buried levees alongside remnant palaeochannels in the Western Plains landscapes would appear to present such opportunities for future research, since these areas may have experienced the first wave of localised aridity following general early Holocene climate change. There is considerable evidence to suggest that Terminal Pleistocene subsistence activities involved pit baking (Clark and Barbetti 1982). If they engaged in similarly repetitive occupation strategies, then oven mounds may exist buried in these areas.

Although the regional survey found oven mounds to occur in apparent spatial proximity to each other, and to other site components, such as scarred trees, stone artefacts, small ovens and surficial midden exposures, only their upper levels could be suggested to be part of related occupation events. Their basal deposits would have to predate most other surficial archaeological evidence, with the possible exception of very old dead scarred trees. The most recent periods of oven mound use, contained in surface deposits are possibly chronologically related to the other surface sites in this landscape, however their

degree of surface disturbance and the difficulties in dating artefactual materials rule out further clarification through site excavation and dating.

In the Western Plains, oven mounds often occurred in erosional contexts, in association with lag deposits of stone artefacts. The Colombo Creek site area is also currently an erosional landscape, although it is classed as Eastern Alluvial Valley Plains due to its constituting a remnant of the Colombo Creek floodplain. Its particular location was characterised by texture contrast soils associated with an old levee deposit. Wind erosion had reduced much of the overall site area to a series of clay plans and residuals, and much of the archaeological evidence was present as a lag deposit. However, oven mound deposits, incipient oven mounds and small ovens were also present as residual rather than conflated evidence.

8.5 Site Distributions within Landscape Units

There are differences in the relative numbers of site components between the eastern and western parts of the study area. Differences are even more pronounced when survey areas within Sloping and Western Plains lands are compared to those from alluvial stream valleys. The broad pattern is that there are more overall site components (per unit of survey sample area) in the western part of the region and, that within both eastern and western areas such occupation evidence is most abundant within the Alluvial Valley Plains landscapes.

The most marked dichotomy in site distribution is between the riverine and hinterland regions. Whilst this could be interpreted as consistent with the initial model, that the richest environments will attract the greatest degree of settlement attention, the pattern of distribution within landscape units suggests that the picture is actually far more complicated. Site densities vary extremely within environmental units, even for oven mounds, a component type whose distribution and recognition is suggested to be less affected by post depositional processes. For example, averaged mound densities recorded in sample areas within the Alluvial Valley Plains vary between zero and twenty per square kilometre.

8.6 Spatial Analysis of Mound Sites

8.6.1 Mound Densities and Distribution

Mound densities throughout southeastern Australia demonstrate some variation according to their surrounding environment. Williams (1988:128) recorded 117 mounded sites in her survey of the Caramut area in the Southwestern Districts of Victoria. They varied in density, averaging 1.5 per km^2 in open country with swamp lands, and rising to 5.7 per km^2 along stream corridors. In the Murray Valley, the highest mound densities were

found to occur along the levees and floodplains of the Murray River and its associated tributary and distributary channels. Berryman and Frankel (1984) recorded mound densities of 38 per km^2 along the Wakool River. Craib's (1991) survey of the Moira-Millewa State Forests suggested overall mound densities of 6 per km^2.

The current survey revealed various oven mound densities throughout different landscapes (Figure 8.3). The highest densities, between 5 and 20 per km^2, occurred along the main channel of the Murrumbidgee River and along prior stream channels interacting with the current river floodplain. Medium densities, between 1 and 5 per km^2 occurred along the river, around swamp lands and along the southern creek systems. Low densities, of less than 1 per km^2 also occurred along the river, along the ephemeral southern prior stream channels and along the southern creek systems. Densities do not appear to be only related to these landscape divisions. The presence or absence of water appeared to be a better discriminant, since areas without proximate extant or potential water sources did not contain mounds. At the same time, several survey units covering creek and riverine floodplain areas that offered good archaeological visibility did not apparently contain oven mounds. This suggests that, whilst there was a general trend for mounds to be located with respect to water, there were also other factors at play.

Within the Western Alluvial Valley Plains the riverine density of oven mounds displays a regular patterning, with areas of particularly high oven mound density occurring approximately 30 to 40 km apart (Figure 8.3). Densities decrease on either side of the concentrated areas and some blank areas have been identified. The aforementioned mound densities are averaged on the basis of total survey coverage. Such figures thus conceal specific microtopographic proclivities which are apparent in the considerable range in site densities within individual survey units. For instance, at Cooey Point Lagoon, oven mounds were located on elevated levees associated with the river channel or billabong, elevated inner floodplain margins, on the margins of minor distributaries and stream banks within the floodplain or within flood prone areas. Most occupied a linear distribution, which tends to complicate estimates of their density.

However, if these elevated areas were considered separately as a bounded study environment, densities would increase markedly, whereas oven mound density would begin to approach zero for other microtopographic situations. Oven mounds do not occur in the undulating hill country of the Eastern Sloping Plains except in lands transitional between sloping and level plains, and even then they only occur in association with elevated swamp margins. Oven mounds do not appear to be present in areas of level open plains distant from water sources. Nor are they present on high sand dunes or in areas of depressed microtopography within floodplains.

The surveyed plan shows that most of the Cooey Point Lagoon sites have a linear distribution (Figure 5.10). Only one definite site cluster occurs in the area. This is at the northeast of the survey area where the lagoon undergoes a transition to flooded red gum flats with old meander scars and irregular flooded depressions. Other apparent clusters of sites are in fact linear groupings following corners at the confluences of the lagoon and its minor tributaries. The linear distributions follow either high levee areas to the south and east of the lagoon, or the floodplain margins at the northeast of the Cooey Point study area.

The relationship of oven mounds to microtopographic positions within the alluvial plains landscapes reveals certain consistencies, but does not appear to completely account for the differences in their distribution. Within these lands 270 oven mounds were recorded after examination of 28 survey areas. Thirteen of these areas contained no oven mounds. Table 8.9 presents the frequency distribution of mounds in various microtopographic positions. It enables a comparison to be made between that distribution and the estimated proportion that each topographic position represents overall of the 28 areas. The lack of large scale or contour mapping for the region precludes a more detailed region wide analysis. The best maps available are at a scale of 1:50 000 and consequently much microtopographic detail is absent. However, the following table enables any major trends to be identified.

Several interesting trends are suggested by these data. If oven mound positioning was random then it would be predicted that they would be equally distributed throughout all microtopographic positions. It would then be expected that the microtopographic position category occupying the greatest area would contain the most oven mounds. This is not the result indicated by the previous table 8.9. In terms of surface area, the largest category represented is the inundated or 'other' areas within the floodplain. However it has a very low frequency of mound occurrence. In contrast the categories comprising areas up to 60 m from a creek or river on elevated levee deposits, on the elevated levee banks of lagoons or billabongs and on the first break of slope at the floodplain margins, contain very high proportions of oven mound sites. These three categories occupy a small proportion of the overall surface area of study areas. These data indicate that oven mounds accumulated on the closest elevated areas offering proximity to sources of standing or flowing water. The choice of elevated areas probably reflects camp site location preferences in floodplains, which are areas of shallow inundation following either minor flood incidence or shallow inundation relating to local rainfall. The range of other microtopographic positions may reflect occupation and use at other drier or wetter periods of the year.

Figure 8.3 Oven Mound Densities throughout landscapes

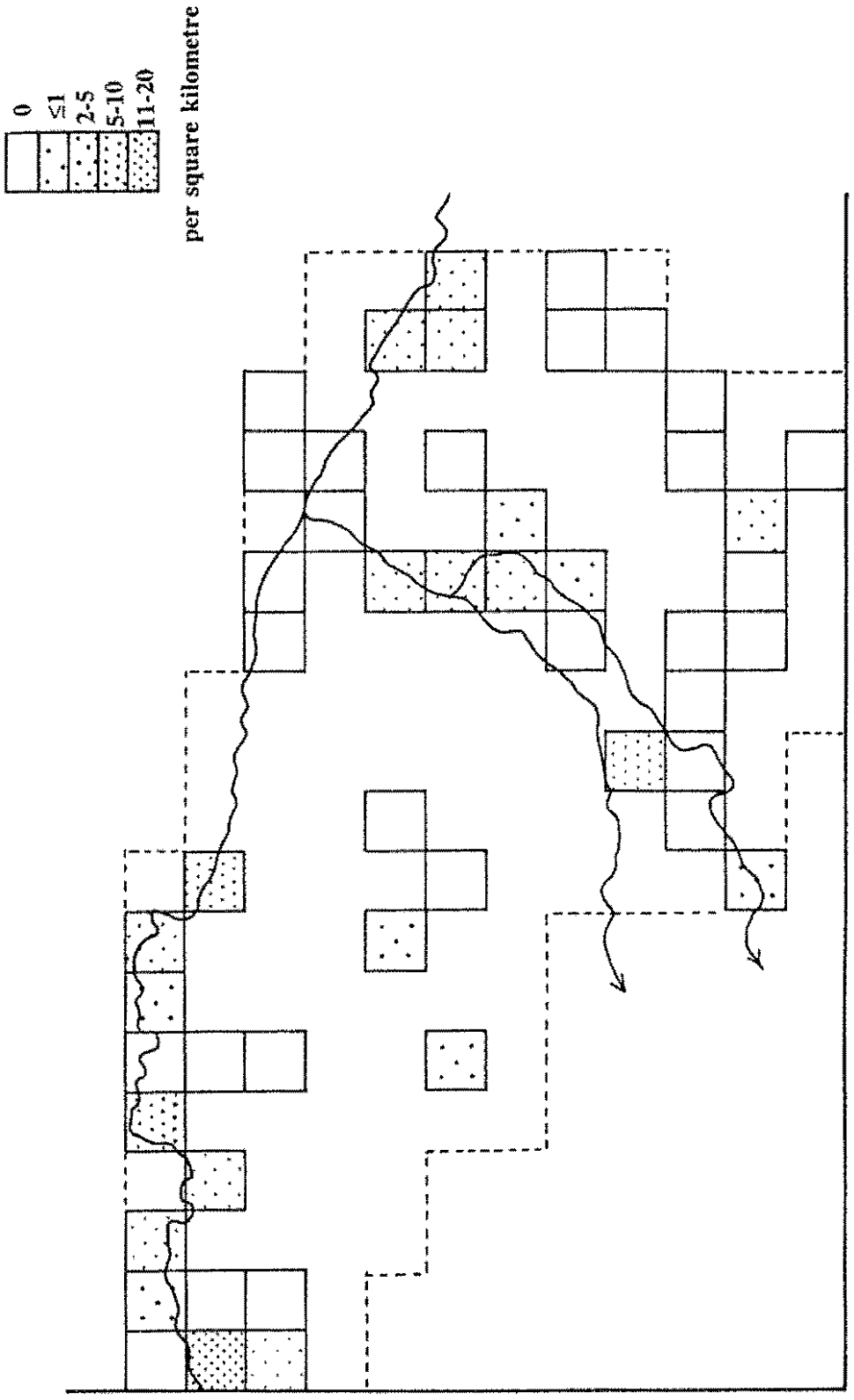


Table 8.9
Microtopographic Position of Mounds within Alluvial Valley Plains Lands

	Microtopographic Position (MP)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Estimated Composition of 28 survey areas	M	L	L	VL	VL	M	H
Estimated % composition of all 28 areas in this MP	15	7	7	3	3	15	50
Number of survey areas containing this MP	28	7	7	21	2	28	28
Number of oven mounds in MP category. (total n=270)	78	58	11	56	18	28	21
Percentage of oven mounds in MP category	29	21	4	21	7	10	8
Linear Distribution	Y	Y	N	Y	Y	N	N
Non linear distribution	N	N	Y	N	Y	Y	Y

KEY: M=medium, VL=very low, L=low, M=medium, H=high; Y=Yes N=No
1. ≤ 60 m from creek or river on elevated levee deposits **2**. Banks of lagoons or billabongs **3**. Banks of minor distributaries **4**. First break of slope lining floodplain **5**. Margins of swamps **6**. Elevated areas in floodplain **7**. Other parts of floodplain

Insofar as oven mounds can be used to infer Aboriginal base camp preferences their dominant positions suggest that Aboriginal camp preferences were strongly influenced by the availability of wetlands or wetland-related resources, and elevated dry positions in proximity to these, as a response to the effects of flooding. These preferences tend to discount the model raised by Lourandos (1980) of Aboriginal perceptions of wetlands as marginal areas. In terms of plant food sources alone, it is relevant that on average aquatic plants produce edible parts during 3.5 seasons of the year, whereas the terrestrial plants produce edible parts in only 2.3 seasons of the year (Horn 1984:48-49). If other resources are considered, such as plant fibre and the animal species permanently or seasonally endemic to wetlands, rather than occasionally attracted to them, their potential economic importance increases greatly.

Social perception of landscapes thus influence not only the groups living within them, but also the interpretations of researchers studying them. For example, Horn (1984:48) noted:

> "... western anthropologists, as products of our own general cultural milieu, are predisposed to view wetlands as dangerous and inhospitable.".

Notable exceptions to the views of wetlands as wastelands were the early models proposed by Sauer (1958) and Coe and Flannery (1967) where seasonally flooded habitats in riverine environments were considered ideal for settlement (Pope and Dahlin 1989:87). The classification of wetlands as marginal lands (Lourandos 1980), whilst convenient for modelling the effects of population pressure, is a serious oversight of their potential importance to prehistoric populations.

Between survey areas there is a considerable difference in the number of mounds recorded, as well as the number of different microtopographic positions which they occupy. Only two of the survey areas have mounds in four or more of the seven microtopographic position categories. The Old Man Creek area has mounds in four positions and Cooey Point Lagoon has mounds in five positions. Of the remainder, one has mounds in two positions and twelve have mounds in only one position. The positions which tended to have oven mounds in the majority of survey areas were within 60 m of creek or river banks on levee deposits, or on levee banks around billabongs. Neither of these positions would be accessible during periods of minor over bank flooding. However, they are positions of relative elevation, and it is possible that they would be attractive once floods started to recede.

The tendency for oven mounds to occur on elevated microtopography was also observed in wider site surveys of the Old Man Creek area (Klaver 1987). In that study 112 mounded features were identified as Aboriginal oven mounds based upon their constituent components. Within the study area, four minor landscape categories were identified: creek levees, inundated floodplain areas, elevated areas within the floodplain and at the margins of elevated sand features and the floodplain. Mounds were found within all four landscape categories. Of the 112, ten were located on creek levees, 18 were located in areas of elevated microtopography (gilgai areas) within the floodplain, 28 were located on elevated groundsurfaces, comprising old levee deposits with some gilgai formations, within the floodplain, and 56 were situated on sandsheets and the sandhill fringes of the floodplain (Klaver 1987:112-113). A Chi Square analysis rejected the chance distribution of sites.

This pattern of oven mound location suggests a strong relation to elevated microtopography near flood-inundated ground surfaces. A more detailed analysis of patterns of flooding within the Old Man Creek environment however suggested that major flooding was not the normal yearly pattern. It would be predicted that the majority of sites would be positioned according to the normal pattern of land accessibility. Reconstruction of the normal cycle of conditions suggested that ground surfaces were commonly influenced by a combination of minor over bank flooding and local rainfall catchment. It was possible that mounded sites had functioned to elevate ground surfaces. However the

necessity to elevate areas is dubious given that equally effective elevation could be obtained on natural ground surfaces nearby. The mounds thus appeared to accumulate as a result of the existence of elevated topography rather than to be the result of efforts to create it. This pattern is at variance with those observed by Lourandos (1980) and Williams (1988) who noted the presence of mounds in low lying swampy areas. Either these mounds were quite different features, or they deserve examination to determine whether they too are founded upon already elevated ground surfaces.

The use of elevated positions, if surrounding soils were damp, would be an advantage for the successful operation of pit ovens. The firing of baked clay in a damp oven pit would result in the conversion of most of the heat energy to steam, rather than stored heat. Consequently the effectiveness of heat retainers would be reduced.

At the Old Man Creek and Cooey Point Lagoon locations a proportion of the sites would be inaccessible during the normal yearly pattern of minor flooding but other oven mound positions would remain accessible. In most other mound locations, for particular example Birdcage Reserve, all mound locations would be temporarily inaccessible each year. During the major flood events such as those of 1931, 1956 and 1974 riverine occupation sites would be virtually all inaccessible. However these events are far from the norm, judging by their approximate twenty year interval.

A possible explanation for the survey areas where oven mounds were found in a variety of microtopographic positions is that they are either those most affected by flood events, or are the only survey units which exhibit that range of microtopography. This is not the case. The range of seven different microtopographic positions is found throughout most of the alluvial plains survey areas, with the exception of areas which traverse source bordering dunes. Furthermore, as can be seen in the 1931 flood data (Storrier and Kelly 1978:22 fig.1.4.6), all of the survey units are greatly affected by major flood events.

The oven mound densities and range of oven mound microtopographic locations at Old Man Creek and Cooey Point Lagoon are not wholly accounted for by survey unit topography and hydrology. A slightly different pattern of landuse may have characterised these places, closely tied to the seasonally and episodically variable position and extent of wetlands, and their associated resources, specifically within these survey areas.

Historical information provides some indications of why specific areas contain so much occupation evidence, at least in the case of the Old Man Creek. Annotations on the original survey traverse sketches recorded for the Old Man Creek area show that the flood prone areas were originally vegetated with 'gum' forest, with an understorey of 'reeds', as well as extensive areas of open reed swamp. Sections of the Old Man Creek lacked a

clearly defined channel, appearing instead as a myriad of anastomosing smaller streams (Townsend 1849a). It is suggested that oven mounds, in this locality are least were specifically related to swamp land use patterns. Surveyor Townsend's record of 11 May, 1849, includes his annotation of several observed Aboriginal features (Townsend 1849a not numbered). These were an 'oven' and a 'fish dam'. The oven was marked with a symbol of radiating hachures to represent a mounded feature. The fish dam was indicated to lie across a tributary leading into the creek, however, no details as to its method of construction were noted.

The fact that Townsend readily accorded the term 'oven' rather than 'mound' or 'hut' supports the previous interpretation of these mounds as ovens (Klaver 1987). The fact that he only noted the existence of one such feature could be attributed to poor conditions of visibility in the area at the time. Present conditions, where up to 50 such sites can be viewed from one position, are the artificial, result of extensive tree clearance, drainage of the swamp-land, and impoundment of the Old Man Creek into one channel. Alternatively, his observation may indicate that whilst dozens of such sites may exist in the landscape, only one oven or a small number were contemporaneously in use and hence unvegetated and easily visible. This view is supported by the dates obtained from sequential pits in proximate sites at Cooey Point Lagoon. These indicate that whilst general use of proximate mounds falls within a broad time period, such use is not continuous, hence the use of individual sites is potentially quite variable. It could also be of relevance that the oven Townsend indicated was adjacent to a defined waterhole in a section of the main creek channel.

Townsend's indicated location of the 'fish dam' on a tributary channel of the Old Man Creek is additional to a location indicated by a current land holder as the site of numerous exotic cobbles lying across the main creek channel (A. Gooden pers comm 1990). These are now rarely visible due to the alteration of flow conditions. Evidence of manipulation of stream flow conditions might also be contained in Townsend's (1849a) reference to 'stones across the river' at a location within the Murrumbidgee River, just east of its western confluence with the Old Man Creek.

These data are highly suggestive of the Aboriginal management of the Old Man Creek environment. Aboriginal and use may have been focused upon the exploitation of swamp resources. It is also suggested that by damming the various tributary inlets of the system, water could be maintained at artificially high levels, thus increasing the reliability of the areas resources. Such actions would increase the range and temporal availability of plant food resources such as *typha.*, and would enable both the mass capture and live storage of fish. The periodicity of flooding however, in this environment, still renders the area only seasonally accessible under normal conditions. Furthermore whilst such manipulation of

water flow could extend the viability of resources it would not ward off the effects of the occasionally prolonged dry conditions observed in early climatic records.

The associated material culture gathered in old collections from the area is unusually rich. Notable in terms of frequency are 'hammerstones' (Plate 11) and amorphous grindstones (Klaver 1987). Smith (1985) has discussed the morphology of grinding implements and argues that so-termed 'amorphous' grindstones are in fact not likely to be seed grinding implements. Hammerstones are acknowledged as multi-purpose implements often employed for the crushing of vegetable foods and fibres (McCarthy 1976:55).

The pounding of roots and tubers to assist their processing for food and fibre is well attested to in early historic accounts from proximate regions of the Murray River and Lower Murrumbidgee River (Beveridge 1883). An account contained in Brough Smyth (1878:209) also attributes the round stones found on 'mirrn-yong' heaps (ovens) to the pounding of roots. The term 'mirrn-yong' or 'murrnong' refers to the daisy yam, *Microseris scapigera* (Gott 1982:63). Also of interest is a wooden shovel-type artefact held by the Australian Museum and collected from the district (White 1986). Such artefacts are also known from other regions in South Eastern Australia (Massola 1959). Although little is known of their range of functions, on the Bogan River, in northern New South Wales, the shovel head was used for digging up roots (White 1986:78).

Comparable evidence documenting environmental manipulation and available resources is not available for the Cooey Point Survey area. Early survey records did not include traverses of the southern lagoon, where the majority of sites occur. Also, it occurs within Crown Reserved land and as a result the degree of disturbance of surface archaeological material is far less, hence materials are unlikely to have been revealed and extensive collection is unlikely to have taken place. Nevertheless other early historical accounts indicate a notable Aboriginal presence in the locality during the early 1840s, when first European settlement occurred, in apparent contrast to surrounding localities (Hurst 1968:37). However the density of associated oven mounds, and other occupation evidence, coupled with the configuration of the riverine resources, expansive seasonal swamp present in the cut-off lagoon, and presence of small flood distributaries which would drain back into the lagoon suggest that the potential for establishment of fish traps and dams is great in this locality.

The importance of the excavation and analysis of individual sites in these landscapes is emphasised for interpretation of these patterns of Aboriginal landuse as reflecting a managed landscape. Without the analysis confirming the function of these sites as ovens, and the sequential dating obtained which indicates that their build up has been gradual, there could be extremes in interpretation based upon their visual impression. If the

mounds had been occupation sites, in terms of dwelling mounds, as suggested elsewhere (Williams 1988) and they had been occupied contemporaneously, in 'village-like' circumstances then large numbers of relatively sedentary hunter gatherer 'Collectors' could be visualised within the landscape. However, as they are not primarily dwelling mounds, but ovens, and have not been used continually, nor even contemporaneously, a much less intensive, although still highly organised, 'Forager' use of the landscape is indicated.

In this region therefore mounds do not appear to have formed from dwellings, but primarily as a 'processing/cooking' component of occupation sites. They may have accrued further functions over time as their bulk increases. This pattern of usage has resulted in the slow and discontinuous build up of their site matrix. Adjacent sites do not appear to have been initiated simultaneously, although it is possible that some of their episodes of reuse may have coincided. The spatial grouping of these sites does not reflect social arrangements but functional ones, they are located where oven construction is facilitated by a number of factors. As outlined in Chapter 3, from numerous and diverse accounts, a major factor influencing the siting of pit-oven facilities is the provision of suitable heat retainers. In stone poor alluvial regions old ovens would be the only reliable source of prebaked clay materials and as such would constitute a valuable resource. The existence of an old oven is thus a strong incentive for its reuse, or alternatively heat retainers from its deposit might 'seed' a nearby site should there be specific factors precluding the *in situ* reuse of the older site. Also the elevation of oven sites means they more efficiently utilise heat. The group use of these facilities may also have benefits, including the more efficient use of fuel.

This tendency for functionally similar site components to group together in other regions has been given various interpretations. The intra-site clustering of ovens requisite for the formation mounds in 'sedentary' sites in the western districts of Victoria, was interpreted by Williams (1987:318) as representative of a change in campsite organisation and spatial structure, resultant of increasing occupation duration, as well as the catering for larger groups of people.

Similar spacing and positioning of sites on elevated riverine and creek levees, as in the Murrumbidgee riverine plain, is documented in many riverine environments throughout the world. In the Mississippi River Valley Guccione *et al* (1988:65) note that the broad pattern of human settlement demonstrated a focus upon natural levees which offered dry ground throughout the year. The results of this study indicate that these archaeological patterns could just as easily be a product of microtopography, repetitive patterns of site use resultant of resource seasonality, and the technology of earth ovens. Sedentism and population size are not necessarily required to enter the equation.

8.6.2 Nearest Neighbour Analysis:

These interpretations of mound sites are further reinforced by their formal spatial analysis, undertaken to elucidate whether mound groupings have potential social significance. Nearest Neighbour analyses are expressions of arrangement in point patterns and were first used in ecological studies. The techniques developed were later incorporated into geographical studies (King 1969:89). To incorporate Nearest Neighbour analysis into prehistoric studies it is necessary to carefully define the environmental parameters governing site location. This will determine which type of analysis, spatial or linear will be most appropriate. Typically, Nearest Neighbour analysis is used to describe areal distributions, since the predicted average Nearest Neighbour distance is predicated upon site density (Durand and Pippin 1992:264).

Linear nearest neighbour analysis involves measuring the distances between sites arranged in linear distributions. It is best applied to contemporaneous groups of sites and for statistical validity is probably best not attempted for sample sizes of less than 10. Hence its application to most of the mound sites recorded in the study is limited. Cooey Point Lagoon presents the largest sample and an analysis of the linearly distributed sites there was undertaken. In order to gain some idea as to whether the distribution in other areas is likely to be regular, clustered or random a modified approach was applied. A simpler version of the analysis operates by determining the number of points which form reflexive pairs, that is those that constitute each others nearest neighbour. If two thirds of the points form reflexive pairs, then the spacing may be interpreted as random. If less than two thirds form reflexive pairs, the distribution is said to be clustered, whilst if more than two thirds form reflexive pairs the distribution is said to be regular (Pinder and Witherick 1975).

The contemporaneity of sites is considered a relative concept. For prehistoric sites the type of contemporaneity dealing with instants of time is not available. However contemporaneity in the sense of sites remaining as visible entities in the landscape is a sufficient concept for this analysis, since all that is to be established is whether there is a significant level of probability that the position of one site could have influenced the position of another.

Whilst linear nearest neighbour analysis is a good analytical tool for assessing the basic characteristics of spatial patterning it, unlike areal nearest neighbour analysis, cannot be further developed to give an indication of particular areas which may be overtly influencing point pattern distribution, forming for instance, clusters of sites. Multiple patterns within one data set may therefore be difficult to detect.

8.6.3 Linear Densities of Mounded Sites

The determination of site densities in distributions which are linear is similarly problematic. In order to obtain approximate densities between survey areas, the distances between sites were averaged (Table 8.10). Nearest Neighbour measurements were calculated for the mound sites at Colombo Creek. The number of mounded sites at Colombo Creek was only 6 and is considered barely acceptable for nearest neighbour analysis. However, the average nearest neighbour distance was 118 m and the six sites formed three reflexive pairs. The degree of randomness was 0.7, which indicates an insignificant level of site clustering. (As randomness approaches 1 the distribution becomes random.)

Nearest neighbour distances between the 53 mounded sites at Cooey Point Lagoon averaged 67 m. Twenty eight (53%) of the sites formed 14 reflexive pairs, that is they constituted each other's nearest neighbour, suggesting that the overall site distribution for large mounds at Cooey Point Lagoon is regular, approaching random, rather than clustered. The distributions for mounded sites in both areas thus indicates low tendencies for clustering.

The fuller analysis carried out for Cooey Point Lagoon tended to confirm the randomness of site spacings. The sites forming linear distributions at Cooey Point were separated into 3 groups of 13, 13 and 11 sites, separated by minor water features. Calculation of the random predicted Nearest Neighbour distance according to the formulae proposed by Pinder and Witherick (1975:17-18) and its comparison to the average observed distances produced a Linear Nearest Neighbour Statistic (LRn) of 1.10, 1.17 and 0.94 respectively. When LRn exceeds 1.0 the implication is that the distribution is tending towards regularity, whilst a value of 2.0 implies perfect regularity. Values proportionately less than 1.0 may indicate increasing degrees of clustering but their significance would require further analysis. The linear site distributions at Cooey Point Lagoon are thus best described as approaching random.

Nearest Neighbour analysis of oven mound sites along the Old Man Creek revealed an average distance of 75 m between sites (Klaver 1987). Twenty two (46%) of a sample of 48 sites formed reflexive pairs, again suggesting a regular approaching random distribution. Sites occurred in both linear and grouped distributions, and whilst some site clusters were identified, they were attributed to circumscribed areas of higher ground within flood prone areas (*ibid*). This effectively precluded further analysis of their distribution since it raised the possibility that such elevated areas could be considered to constitute the boundaries of the distributions. This would reduce the samples to ineffective numbers.

It is interesting to note that Williams (1987:314) carried out a similar analysis of mound distributions. She defined 'clusters' as 3 or more mounds each ≤ 200 m from their nearest neighbour. She observed a range of site occurrence, including isolated mounds, pairs and clusters, and noted that their distribution was not random:

> "Larger clusters (greater than six mounds) are restricted to those areas of high ground with good vantage, which are bounded by creeks on two sides, and often by a swamp on the third" (Williams 1987:314 [emphasis mine]).

The position of a boundary around elements used in spatial analyses critically influences the outcome of such studies (Hodder and Orton 1976:44). The influence of such a boundary may be mediated by eliminating from the analysis those points which are closer to the boundary than to their nearest neighbours (*ibid*), whether this was carried out in the preceding analysis is uncertain. In any case, the obvious circumscription of habitable ground surfaces renders the social interpretation of such spatial analysis fragile, since it is possible that the observed 'clustered' site distributions may be predominantly due to environmental rather than social factors.

Nearest Neighbour analysis of twenty mounded sites in Birdcage Reserve indicates an average distance of 69.5 metres between sites. Fourteen (70%) of these formed reflexive pairs, again suggesting a regular-to-random tendency. The average nearest neighbour distance between 33 mounded sites in the Uardry and Uardry Stock Reserve survey areas was 99 m. Eighteen (55%) of the sites formed reflexive pairs. In this case there is some suggestion of a clustered site distribution, although, again this was considered to be the effect of minor topographic features in the landscape, and similar problems to those encountered at the Old Man Creek, and discussed above, are raised.

The overwhelming tendency for the formation of reflexive pairs in the mounded site distributions and concomitant suggestion of random or regular distribution is interesting. It suggests that whilst specific topographic features are sought for the type of occupation producing mounded sites, once these features are located, the placement of sites within them operates on random principles, at least in the long term. This is not the type of distribution to be expected were they all contemporaneous socially 'related' occupation sites.

Table 8.10.
Average 1st Nearest Neighbour Distances between Mound Sites

Area	n	Distance mean NN	Reference
Old Man Creek	48	75	Klaver 1987
Widgiewa	10	390	current study
Colombo Creek	6	118	current study
Birdcage Reserve	20	69.5	current study
Toganmain	4	86	current study
Cooey Point Lag	53	67	current study
Uardry	32	99	current study
Kerri East	21	56	Littleton 1993
Ovens/Holding	28	70	Williams 1988:130
Coomete Cluster	13	40	Williams 1988:130
South	7	75	Williams 1988:130
Corroboree	6	25	Williams 1988:130
Tea Tree	13	80	Williams 1988:130

There are data, obtained from ethnographic studies throughout the world, which whilst being treated with necessary caution, suggest certain patterns in the layout of settlement structures dependent upon the duration of settlement and numbers of people simultaneously resident (Kent 1991; Gargett and Hayden 1991:26; Fletcher 1977:5). A common tendency is for the distances between structures to become smaller and more regular with increasing degrees of sedentism. Clustered distributions are also common in sedentary settlements. However these are not clusters simply produced by the boundedness of environmental circumstances. Patterns observed by Jochim (1991)are probably more analogous to the distribution of oven mounds. Jochim (1991:313) noted apparently clustered site patterns produced by the aggregated, or cumulative, pattern of several years of occupation by groups known to actually leave dispersed yearly settlement residues.

8.6.4 The interpretation of Clustered Distributions

Social explanations such as sedentism are often advanced for clustered distributions of sites or components. For example, clusters of mounded sites in the Western Districts of

Victoria were interpreted as contemporaneously occupied 'villages' (Williams 1984, 1988). Such interpretations require verification on more than simply spatial grounds however (Clarke 1994:12; Edwards 1989:9). Previous research (Klaver 1987) in the Central Murrumbidgee Riverine Plain interpreted both linear distributions and clusters of mounded sites. The clusters were interpreted as being focussed upon the localised distribution of elevated topography within floodplain areas, likewise linear distributions followed elevated lands at the floodplain margins. It is possible that the clustered areas identified within the Old Man Creek survey area would have continued to accumulate, culminating in the type of extremely large mounded sites identified along the Murray River (*cf.* Craib 1991), had this pattern of Aboriginal landuse not been halted with European settlement.

Other reasons for dispersed or regular patterns include the existence of social preferences for the placement of contemporary households at regulated spaces, or the avoidance of previously occupied campsites. Studies of site reoccupation by the Kalahari Bushmen (Sampson 1984) indicate, for example, that whilst people regularly returned to the same location, such as a waterhole, they rarely reoccupied the same campsite. This was attributed to the deterioration of the vicinity in terms of infestation of hearth areas and huts by parasites, such as ticks, and declining camp hygiene. However, reoccupation would eventually occur after a period of several years.

The Gwi Bushmen were similarly observed to return to the same locality but to avoid old campsites for periods of up to 3 years (Sampson 1984). Areas favoured for camping thus appeared littered with abandoned campsites at distances of a several hundred metres apart (Sampson 1984:18). Camp 'clusters' rather than individual sites thus constituted the basic pattern of Bushman settlement, however the components of such sites were not contemporaneous. In addition, during the intervening periods between reutilisation of base camps, such areas may become foci of resource extraction occupied by fewer people for specific processing activities or scavenging of abandoned material culture (Binford 1982; Sampson 1984).

A caution raised by exponents of various types of point-pattern spatial analysis is that the points reflect the attributes, such as individual dwellings, under examination (Stark and Young 1981:285). The use of oven mounds in point pattern distributions is doubly problematic, due to the depositional nature of the study region. Mounds and their surroundings are experiencing slow burial, and occupation surfaces that might have originally surrounded them are thus no longer visible, even had they survived. Spatially varied surrounding settlement may in fact have used the same mounds.

There are thus qualifications on interpreting the spacings between elements such as oven mounds. Oven mound clusters may, in fact, be the only visible evidence of otherwise abutting or overlapping sequential occupations which also incorporate other activity areas. Whilst closely spaced mounds have been more commonly interpreted archaeologically as contemporaneously occupied, a consideration of cultural norms may in fact indicate that synchronous occupations involved far wider spacings. Dispersed patterns could develop either from social mechanisms through the placement of contemporary households at regulated spaces (Jochim 1991), or the avoidance of recognisable previous campsites. Dispersed patterns could also be taken to indicate an even spread of the resources which encourage occupation. Variability in occupation spacing may also occur however, if there are substantial seasonal variations in subsistence resources and associated group size.

Spatial analysis also reinforces the interpretation of mounds as forming from agglomerations of small ovens. Analysis inclusive of all small oven sites and mounded deposits at Colombo Creek reduces the average nearest neighbour distance to 19 m and indicates an overall degree of randomness of 0.34 which may be taken to indicate considerable clustering in oven distribution. This clustering is visually quite apparent. A cluster contour-interval of half the mean nearest neighbour distance indicates the formation of tight clusters of up to 4 small ovens. Mounded sites and up to 4 small ovens also form clusters within two contour intervals. This pattern suggests that the formation of larger mounded deposits has occurred through a combination of agglomeration and reuse of small ovens, culminating in the blurring of the original usage.

One interpretation of the Colombo Creek site may in that it depicts a fuller contextual pattern of 'mound producing' occupation, which is normally buried or poorly preserved. In this light, the site distributions at Cooey Point Lagoon, and other survey areas, may be considered summary and biased in their representation of larger and perhaps more recent mounded features. Inter-mound areas at Cooey Point Lagoon are thus predicted to have contained substantially more buried small ovens and associated occupation debris than is currently revealed. That such evidence exists, albeit in very poor condition, is confirmed by the recording of such sites in recently and severely flood scoured areas, such as CP Site 98a-e.

The variability in features, particularly stone artefacts, distributed across sites is often assumed to be meaningful in terms of behaviour and activities (Schiffer 1976). Consequently extensive sites are often spatially analysed in ways to detect 'activity sets' indicated by particular patterns in artefact types or raw materials. As noted by Simek (1989:59) however, the analysis and interpretation of such sets of related features within a site is only warranted when there is a good indication that such 'sets' will exist or be preserved in the site. In many cases post-depositional processes will auger against their

preservation or there will be insufficiently definite correlations between artefact function and form (Gould 1977). In such cases there is thus little evidence that the structure of sites is necessarily a direct reflection of past activities. Whilst this is undoubtedly the case for artefactual evidence, there are some indications that other features, such as ovens, may lend themselves to such analysis. For one thing they are relatively firmly anchored in space.

The spatial distribution of flaked stone artefacts at Cooey Point Lagoon was mapped. There were no expectations of patterning due to the degree of flood washing in the vicinity. No apparent patterns were detected. Likewise, artefact positions were plotted within the Colombo Creek site area. However, as recording progressed it became apparent that the scatter was, as expected, a deflated accumulation of materials. This was particularly emphasised by the recording of artefacts which exhibited several stages of flaking activity, evident in differential patination of flaked surfaces. The spatial analysis of several other larger scatters which may have offered densities suitable for analysis was similarly precluded by post depositional formation processes.

Discussion

It is argued that the patterns of site component distribution at Colombo Creek and Cooey Point are essentially the same, and are a product of the same pattern of occupation, despite the likelihood that there a considerable time difference between the period relating to the bulk of their respective formation. This is reinforced by the overlap in the most recent date for Colombo Creek and the oldest date obtained for Cooey Point Lagoon. The difference in the appearance of the surface archaeology is essentially due to differential geomorphic processes in the two site environments. The Colombo Creek environment has ranged between depositional and erosional and the Cooey Point Lagoon environment has been predominantly depositional, with only minor areas of erosion.

Although there is evidence for conflation and aggregation of site elements within these, and other sites throughout the region, it is argued that the inclusion of diverse domestic residues as suggested by component analyses in Chapters 6 and 7, indicates their having functioned as base camps. The degree of erosion at Colombo Creek presents elements of intra site patterning which are obscured in uneroded localities. Whereas the comparative youth of the more recent stage of occupation at Cooey Point Lagoon indicates the inclusion of other site elements such as scarred trees, which are absent at Colombo Creek.

Major divisions in campsite character have been proposed to depend upon whether people practise what Binford has termed residential or logistical mobility (Chatters 1987:340). Residential mobility entails the relocation of people in proximity to resources and produces sites combining resource acquisition and base camp activities. Preparation,

consumption and processing activities reflecting use of available local resources are thus postulated to all take place at the one location. Logistical mobility, on the other hand, entails the transport of resources to the people, with the formation of distinct sites including base camps and task oriented field camps (*ibid*). Logistical base camps are characterised by the consumption of resources from diverse habitats, and preparations for varied activities, whereas evidence of resource processing is more likely to take place at field camps.

In considering site component patterns in other parts of the survey region essentially similar combinations occur. This pattern tends to suggest a more 'forager' style or residentially mobile settlement pattern, with base camps present throughout the landscape, rather than a typical 'collector' or logistically mobile, strategy, as characterised by the formation of functionally different base camps and resource extraction or processing locations. In its entirety Cooey Point Lagoon demonstrates a systematic occupation of the riverine landscape. The local extraction of resources as well as occupation is evident in the range of site components present.

Chapter 9
Towards an Occupation Model for the Central Murrumbidgee Riverine Plain.

9.1 Mound Formation Processes

The site excavations and spatial analysis of mounds demonstrate that their primary function in the Central Murrumbidgee Riverine Plain was as ovens, formed in the context of repetitive occupation of general encampments. The results of the excavations have refined the typology of mounded deposits, and highlighted the effect of post depositional processes upon mound deposit characteristics. At some stages in their histories they may have also functioned as elevated camping areas, although that use was mainly incidental to their substantial formation. Mounds formed as a result of collapsed dwellings constitute an additional type of mound, so far, restricted to the Western Districts of Victoria.

9.2 Mound Formation Rates and Population levels

The dating of the sites has served to emphasise that groups of mounds do not indicate sedentary or contemporary settlement. Dates obtained from sequential pit bases within the mounds suggests their intermittent formation, and the flood prone nature of their surroundings also indicates that their use, and surrounding occupation, could only have been seasonal. A method with which to quantify formation rates of individual mound deposits is needed to further understand any relation they may have to processes such as increasing sedentism and increasing rates of site inception and formation, or to population levels. One approach is to use sample survey data to estimate the quantity of archaeological material in a locality and to present general occupational scenarios which could have produced such a result within a time frame. The Cooey Point Lagoon Site area and surrounding survey units present regionally high mound densities, and are considered from this perspective, to indicate orders of magnitude for occupation intensity, inferred from rates of oven usage, and population size.

There are no records of overall population sizes for this section of the Murrumbidgee River. However, aggregated and dispersed group sizes are mentioned in early regional accounts, and comparison is possible with group sizes in areas with similar environmental circumstances such as the Darling River (Allen 1974). How well the data indicate precontact conditions is variable. A group of 50 to 60 individuals was noted in alluvial valley plains lands south east of the Yanco Creek in 1852 (Bayley 1959:27). A group of 40 to 50 people was noted to be resident on Buckingbong Station, along the Murrumbidgee River in 1872 (Freeman 1982:19). A larger group of

200 people aggregated for a week on Jenkins' station in 1844 (Wall 1845), however it was composed of people drawn from a very wide area, including the Lachlan river. In Winter, 1886, small groups, comprising men with several women (the children had been removed to Warangesda mission) were occupying hinterland areas south of the river (Gallop 1886-7:239).

Allen (1974: 313) presented evidence to suggest that groups of approximately 45 people aggregated along the Darling River in summer, following the spring 'freshes' in river flow. For the remainder of the year, smaller family groups of approximately 13 people were dispersed more widely throughout the riverine hinterland. The environmental conditions and seasonal variations in the configuration of resource zones of the Darling River and Central Murrumbidgee areas are broadly similar. However, the Darling region is more arid overall.

Aboriginal subsistence practices in the Darling region were heavily reliant upon cereal staples, whereas along the Murrumbidgee River this research found that the dominant staple foods were likely to have been subterranean plant parts, and that cereals played a lesser role. Grass seeds generally provide less food energy per unit of work than roots and tubers (Jones and Meehan 1989:125; Smith 1989:313). The nutritional qualities of the subsistence base along the Murrumbidgee River may therefore have permitted a slightly greater population density. In consideration of these factors, the historic data relating to group sizes, and the evidence presented by Allen (1974), an estimate of aggregated groups comprising 40 to 60 individuals and smaller units of up to 15 individuals, is considered reasonable for the Murrumbidgee Riverine Plain.

A total of 103 mounded sites was recorded from the area covering Cooey Point Lagoon, on the south side of the river, and Uardry Station and Uardry Stock Reserve on its immediate north side. Their average diameter is 11.5 metres and the average depth of all deposits can only be estimated. Considering the range of site elevations currently evident, and the depth of excavated deposits, 0.7 metres would appear to be a fair average. Coutts (*et al* 1979:79; *cf.*Webb 1996:49) used the formula for a segment of a sphere in estimating the volume of mound sites along the Murray River. This is $0.5236H(H^2 + 3\ R^2)$, where H equals the height of the segment and R equals the radius of the base (Molesworth 1882:656). This gives an average volume of 36 cubic metres per site. For 103 mounds, this gives a total estimated volume of 3708 cubic metres of deposit.

According to early ethnohistoric accounts, each reuse of an oven required additional baked clay, due to the loss by fragmentation after firing. Beveridge (1883:38)

estimated that a 'barrowload' of fresh material was required for each use, which Coutts *et al* (1979:79) converted to a volume of 0.056 cubic metres. It is possible to extrapolate from these estimates that the total volume of mound deposit present in this 14 km^2 survey locality would be the result of 66,214 individual oven firings, or somewhat fewer insofar as some deposit relates to charcoal and ash.

The range of dates obtained from mounds excavated in this area indicates that most deposits are likely to have accumulated over a period of approximately 600 to 1000 years. The latter figure is reasonable if mound usage had continued up until the 1840s, a possibility suggested by historic accounts for the locality (Hurst 1968:37). The earliest date obtained from CP82 is not included in this estimate for other sites, since its unusual basal stratigraphy indicates that it was not continuously used from that time.

A period of 600 years of use of the locality would indicate that there were some 110 oven firings per year, and a period of 1000 years would indicate some 66 firings per year. If groups aggregated along the Murrumbidgee River during summer, and the previous estimates of group size are acceptable, then estimates can be made of possible oven usage. If one oven firing per day was needed for each smaller unit, or 'family' group, the presence of four such groups could contribute four firings per day, excluding communal use. The total volume of annual firing previously calculated would allow between 28 and 17 days of occupation per year by such an aggregation, for the 600 and 1000 year periods respectively. Further permutations of this example are shown in Table 9.1. Use of particular mounds is predicted to have varied from year to year, or over longer intervals, depending upon various factors. Relative positions of inundated ground surfaces, related to the previous spring flooding, may also have influenced individual site selection and reselection. There are also likely to have been other norms regarding site reuse, related to depletion of fuel and resources, and other cultural factors.

Table 9.1 Oven firings and potential formation periods.

Years	**firings per year**	**Number of Days of Continuous Use** 1 oven	2 ovens	3 ovens	4 ovens	5 ovens
400	165	165	83.5	55	41	33
600	110	110	55	37	27.5	22
800	83	83	41.5	28	21	17
1000	66	66	33	22	17	13

The data are consistent with a settlement pattern involving short-term seasonal sedentism, similar to that noted by Allen (1974), and inferred in studies from other regions such as the Murray River (Coutts *et al* 1979). From the perspective of ethnography the occupation would be categorised as falling between nomadic and semi-sedentary (Kent 1991:37). As Allen (1996:138) observed, cultural remains at sites with demonstrably long histories, like Cooey Point Lagoon, are 'time-averaged composites' which are more likely to reveal persistent and long term trends in activities. Seasonal sedentism for periods of up to a month could be seen as the underlying trend for Aboriginal settlement strategies in this location.

Significant variations may have occurred within the general pattern. For instance, drought periods may have led to more permanent riverine aggregation. Alternatively, particular conditions elsewhere in the plains hinterland may have attracted settlement focus from time to time. Furthermore, it may even be that one group continued to occupy a favoured locality for extended periods whilst other groups dispersed. The shorter term influx of larger groups, in the context of gatherings, meetings or ceremony, could also be accommodated.

Whilst the previous analysis is subject to many qualifications, it provides a gross estimate of the type of occupation which could have resulted in the visible archaeological evidence. Even if the reduction of site materials by various post depositional processes was generously accounted for by doubling the estimated figures, the site patterns would still not suggest their production by very large and sedentary populations.

This reconstruction also accords with the spatial patterning of mounds, with respect to one another, and to microtopographic conditions. That is to say, mound groups were not clustered living platforms located away from flood-prone land, as would be expected of permanent villages or settlements. The variety of positions mounds occupied within minor landscape categories was probably the result of yearly sequences of occupation. Historic observations in the Old Man Creek locality also suggest the contemporary use of only a small proportion of available oven mounds (Townsend 1849a). The identified stratigraphic patterns and dates obtained from proximate sites at Cooey Point Lagoon demonstrate that formation of adjacent mounds did not commence simultaneously. The likelihood that these sites relate to villages is thus much reduced.

The evidence for repetitive long-term reoccupation of site areas supports the idea that regional population densities had been moderate. A long history of densely distributed, large or sedentary populations would be expected to put substantial pressure on

resources such as firewood and foods. It is possible to interpret the predation on rapidly renewable plant and animal species as a measure to compensate for this, although there is no necessary causal connection. The use of pit ovens could be seen as a conservative approach to the use of fuel and foods, through the potential for communal use of such facilities, increased access to nutrition from certain foods, and conservation of heat energy through enclosure of heat retainers in extended cooking. Nevertheless, 'efficiency dividends' could be applied according to widely variable cultural priorities.

The above analysis highlights the dangers of interpreting densely distributed large mounded deposits with their numerous associated site components, and the less visible archaeology of the surrounding hinterland landscapes, according to an assumption of contemporaneity. An impressionistic but incorrect interpretation would be that occupation along the river was permanent and occupation of the hinterland was negligible.

Similar issues are discussed by Dewar and McBride (1992:248-9) in their analysis of remnant settlement patterns in floodplain regions of southern New England, USA. They found that a striking characteristic of an early cultural phase of riverine settlement was the formation of very large sites within the floodplain. These sites were highly focused upon the better drained, but highly circumscribed and narrow, low 'knolls' running parallel to the river banks (ibid:244). This pattern was succeeded by settlement which formed far more dispersed residues and was focused upon riverine terraces beyond the floodplain. Whilst the concentration of evidence in the former situation was attributed to the scarcity of knolls and the latter to the abundance of higher terraces, the question as to which pattern demonstrated the greatest degree of focus upon the riverine resources was posed.

Contrary to expectations, based upon the highly visible and proximate sites on the floodplain knolls, the more distant and diffuse terrace pattern was interpreted as the settlement strategy resulting from the most intensive exploitation of riverine resources. These conclusions were reached on the basis that the occupation reliant upon the river for year round subsistence was required to locate in a position from which it could continually gain access to riverine resources. These would have been inaccessible to the floodplain sites for extended periods during flooding. This analysis has application to the patterns of riverine occupation recorded along the central Murrumbidgee River. Whilst mound producing occupation is highly visible and substantial, it reflects the cumulative formation processes of long term repetitive subsistence activities rather than sedentism.

9.3 The Annual Pattern in Late Holocene Landuse

Aboriginal populations in the Central Murrumbidgee Riverine Plain practised a relatively mobile settlement strategy which involved cyclical movement between the riverine corridor and locations within the riverine plains hinterland. It involved a focus upon riverine resources during Spring and Summer and a split focus upon the river and hinterland in Autumn and Winter.

The importance of wetlands as a focus of occupation is not demonstrated by lithic residues, but by the presence of earth ovens, which utilise baked clay pellets for heat retainers. These ovens have come to represent a landscape facility, attractive in themselves for reuse and perhaps ultimately for recycling as elevated camping positions. The size of an oven mound is directly related to the intensity and duration of its use. There are no indications that they have been artificially built up as mounded platforms, even in inundated areas. Indirectly, they are also indicators of the intensity with which those landscapes have been occupied, although there are no indications that these populations were large or sedentary. Excavations have shown that the continual use, either episodic or regular, of particular ovens spans hundreds of years. Patterns of recycling, and reuse of older sites, span thousands of years.

There is evidence that populations aggregated at particular locations within the Murrumbidgee Floodplain. These locations were characterised by abundant resources. It is possible that the same locations may have been social boundaries, although the data are inconclusive. There are limited historic observations which suggest that wetland areas were subjected to Aboriginal management, in the form of fish traps, dams and burning regimes.

There was, however, seasonal variation in camp position and group size. Semi-sedentary occupations would have been reestablished following the recession of floods, possibly as early as late Spring and generally by Summer, although the approximate timing and duration would have been affected by variable river flow conditions. At these times, subsistence would have been based upon the collection of *Typha*, both for its provision of starchy carbohydrate and its tough fibre. Other aquatic plants, as well as small mammals, particularly possums, reptiles and birds, would also have been consumed. These foodstuffs were prepared within earth ovens. Due to the repetition of this part of the annual pattern, over very long time frames, many ovens had become mounds. Mass capture techniques, involving specialised netting technology, would have been employed. After river levels started to fall, dams and weirs would have retained fish for extended periods in a form of natural storage.

This riverine settlement phase is characterised archaeologically by the presence of both numerous and high densities of oven mounds, scarred trees, and lithic scatters. Mounded sites at the most preferred places were located in a wide range of microtopographic positions. The occupation lasted for the duration of the post flood period and a sequence of occupation positions may be present as individual camps relocated in phase with falling water levels.

The seeds of perennial grasses ripen in late summer, and would occur prolifically in dense stands along the alluvial flats. These would be exploited at this time, as the aggregated groups split into smaller units, forming dispersed base camps along the riverine corridor, and extending south into the plains. These groups would remain in position whilst particular resource patches lasted, and would produce a less concentrated pattern of smaller sites with similar elements to those of the larger sites. Oven mounds would be refired and old mounds reutilised for their provision of heat retainers and well drained, easily dug deposits. As river conditions dried further, waterholes would form and permit the capture of fish.

Autumn/Winter

Late Autumn and Winter experience the maximum amount of rainfall. The onset of these conditions would enable smaller groups to move out onto the southern plains. At this time a large proportion of the population probably dispersed to these locations. Foci of settlement activity became the microenvironments surrounding swamps and ephemeral stream courses. These positions would also have been occupied previously, with each visit accruing a layer of sediment to oven mound sites. Birdlife was noted to be present in the southern swamplands at this time of the year. The underground parts of bulbs and corms would be at their best at this time, and widely distributed rich patches would be targeted. Perennial grassland resource patches and associated fauna were more readily exploited in these environments due to their rapid response to rainfall (Doebley 1984:62).

It is likely that a proportion of people continued to reside along the river, relocated to positions further along the riverine corridor. Their subsistence focus would also have been upon patches of bulbs, corms and tubers, as well as small mammals. The comparatively low productivity of the riverine corridor at this time may have led to frequent moves of base camps as small plant and animal resource patches became depleted. For the remainder of the year settlements were thus small and dispersed. The same archaeological residues were left in both environments, although they become far more concentrated along the river corridor, due to its more circumscribed and

repetitively used nature. These settlement activities are characterised by the low density occurrences of oven mounds, or formation of small clusters of oven mounds, with associated lithic materials and scarred trees, within the riverine corridor. Mounded sites formed at these times would be in the limited range of microtopographic positions avoiding the moist ground surfaces resultant of the winter rainfall regime.

Flooding/Drought

Flooding may occur later or earlier in some years than others, or not at all. In the latter case, a modified pattern involving dispersal along the river corridor, and focused upon deeper waterholes would be anticipated during summer. Alternatively major flooding may occur. Modern major flood incidences in the region are approximately one in eight years. This might result in the activation, and extended duration, of major swamplands in the hinterlands. Exploitation of plains lands might then extend for longer periods of time as they experience flushes of production.

Drought periods may have resulted in the exploitation of less desirable resources, and an initially dispersed and very short term pattern of occupation throughout the landscape. This would have been followed by a longer term focus upon remnant water sources in the river corridor. If drought conditions persisted it is predicted that mortality would rise, and that ultimately groups would disperse to the territories of other groups, where more favourable conditions prevailed.

9.4 Foragers, Collectors and Sedentism

The subsistence strategy indicated by this research is one based upon the exploitation of naturally and artificially concentrated resource patches with occupation nodes in ecotonal positions. A relatively high degree of residential mobility was practised, focused upon a particular range of site locations.

The character, distribution and chronology of evidence suggests that a modified version of the 'forager' model of subsistence and settlement strategy was practised by Aboriginal groups occupying the Central Murrumbidgee Riverine Plain in the late Holocene. The model posits that foragers have relatively high residential mobility. Their choice of settlement location is influenced most strongly by the environmental configuration of the resources that they are exploiting. Their subsistence strategies do not exhibit markedly different patterns of annual movement across the landscape between seasons. Archaeological sites formed by forager settlement patterns typically include short term residential camps and may additionally include sites formed by one-off extractive activities.

Whilst the overall pattern of subsistence and settlement suggested fits best with the forager model, important aspects have parallels with collector strategies. These are evidenced by site infrastructure, including fish traps, ovens and oven mounds. The technological 'toolkit' of these populations also included labour intensive articles, such as nets and brush dams, more characteristic of collectors. The use of earth oven technology facilitates a range of other technology, including that of fibre production. It is likely that fibre products, such as string and nets, were a major contribution of this region to southeastern Australian exchange networks. Unfortunately, their use is poorly reflected in material remains.

There are several archaeological residues which, in diverse or combined occurrence, are interpreted as indicative of base camp activities. These are ovens or oven mounds, lithic scatters, scarred trees, exhibiting scars within a particular size range, and shell middens, as well as the fixed site infrastructure of fish traps and dams. The low quantities of lithic materials documented throughout this region are explicable in an economy which has little requirement for stone. Shell middens and scarred trees cannot be widely expected because they are dependent upon the occurrence of suitable tree species and shell beds. There are no such limits on the potential distribution of ovens, oven mounds and lithic scatters. Some scarred trees may also have been isolated extractive sites. Isolated small ovens and lithic scatters may also represent one-off extractive or travelling activities, such as field consumption or preparation of captured or collected foods, and procurement of specialised stone, wood or other resources.

The occurrence of more concentrated archaeological evidence in the riverine environments of the region is interpreted as the result of lengthier periods of residence permitted by particularly rich resource patches and microtopographic configurations which lend themselves to environmental manipulation, by the use of dams, weirs and burning regimes. These particular areas were the focus of seasonal aggregation of the local population. In this sense, they can also be viewed as important in promoting intra-group social relations.

Their special use, in providing sufficient resources to permit the hosting of groups from other areas, is also a possibility (*cf.*Lourandos 1980). It is interesting that recorded inter-group visits for ceremonial purposes were conducted within reserved or conserved parts of the group's territory, where general occupation had not occurred for some time (Mathews 1897). The ability to maintain such 'fallow' subsistence patches for ceremonial gatherings is consistent with the modest population levels suggested in the present model.

Chapter 10
Late Holocene Occupation of the Central Murrumbidgee Riverine Plain

10.1 Regional Comparisons

The results of this research have general implications for nearby regions of southeastern Australia. Lourandos (1983) and Lourandos and Ross (1994) argued, for the Western Districts of Victoria, and southeastern Australia generally, that evidence for increasing population levels and economic growth did not logically correlate with the pattern of Holocene climatic events:

> "If a connection is to be made between climatic change and the Holocene archaeological sequence, we would have to view cultural changes as responding to environmental stress without any deterministic connotations." (Lourandos 1983:87).

> "The general chronological archaeological trend observed is also the direct opposite of the Holocene environmental trend for the region ... where rainfall (and presumably bioproduction) was highest during the early Holocene, with more stressful conditions in the late Holocene ... These environmental data would argue **against** models which view human responses as closely determined by climate,..." (Lourandos and Ross 1994:59).

Data from the Central Murrumbidgee Riverine Plain raise the possibility that the pattern of change through time in settlement and subsistence they identify, may not be the product of socially induced economic growth, and ensuing population increase, so much as the product of environmentally induced spatial reorganisation of settlement patterns. Such concentrations of population, even without large overall population increases, may nevertheless have had consequences for social and economic organisation.

Lourandos accords wetlands in the Western Districts of Victoria with marginal economic status due to their difficulty of access and interprets their occupation to a form of environmental maximisation brought about by increased population densities, in turn resultant of social dynamics. The reverse could apply. These are areas of predicted economic focus in the Murrumbidgee Riverine Plain, due to their overall resource richness. They are also the areas which would remain comparatively viable during drier climatic periods. The evidence of environmental manipulation in these areas is argued to reflect the skills and technologies applied to maximise use of fewer rich resource areas within a wider environment which had undergone substantial stress.

The evidence from excavation of sites in the Central Murrumbidgee Region does not support a cumulative increase in site formation and intensity of usage over the late Holocene period in this region. The relatively non-intensive rates of mounded site accumulation likewise reduce the likelihood of high regional population densities.

Interpretations of the settlement intensity in the Western Districts may have been exaggerated by the presence of both physically substantial structures which form durable mounded archaeological residues as well as dedicated oven mounds. It has been argued that mounded cultural deposits in the Western Districts do not all have equivalence in their analytical status as 'settlement units'.

The sites excavated have been found directly comparable to those excavated in the Murray River region. The previous mound typologies suggested by researchers there have been examined and refined. All result from the variable expression of the use of earth oven technology. Mounds are a transformed expression of a technology present in southeastern Australian since the Pleistocene, that of pit ovens.

Whilst there are similarities in overall settlement pattern, and site characteristics, the late Holocene occupation of the Murray River is considered to differ to that of the Murrumbidgee region, mostly on the basis of scale. The Murray is a much more substantial river and is more entrenched within a broader floodplain. Its hinterland, particularly on the lower Murray, comprises highly arid mallee environments. Throughout the Holocene there would have consistently been a very disproportionate ratio of resources between floodplain and hinterland areas, and occupation is likely to have focused within the riverine corridors. Antecedent stream systems proximate to the Murray region were larger and more tightly confined than those of the Murrumbidgee Riverine plain. Whilst initial Holocene populations in the Murray regions could have been larger, the spatial distribution of stream corridors has not altered on as great a scale as in the Murrumbidgee floodplain. Mound producing occupation could thus have been focused over a longer period upon stream corridors whose position has not altered so drastically.

The range of site types found during the Murrumbidgee survey, and their specific patterning in the landscape, demonstrates a broad cultural continuity with the Murray River region. The greater quantity and reliability of water resources and higher site densities support inferences about relatively larger populations in the latter region. The types of sites present in the Murrumbidgee Riverine Plain, and their patterning, reflect a long time depth of seasonal focus upon rich reliable resource areas associated with water. In wetter Pleistocene periods, when water related resources were presumably not so circumscribed, there was less repetitive use of particular locales. Increasing Holocene aridity accompanied the trend towards focused occupation. During wetter fluctuations in the Holocene populations may once again have spread over larger areas, and the formation rate of oven mounds may have slowed.

Murrumbidgee Riverine Plain occupation patterns also contrast with those of the more arid western riverine regions, such as the Darling River Valley. There are no palaeochannel systems related to the Darling River and it has fewer billabongs than the Murrumbidgee (Fox 1991:447). An earlier arid period, between 15,000 and 12,000 years ago has been identified there (Smith 1989:314). Thus, its resources have been limited for a much longer period and could not support population levels like those in other regions of southeastern Australia. Allen (1974) concluded that the Darling region population was constrained by the aridity and unpredictability of the environment, although highly patterned and repetitive reuse of environments was characteristic.

Why this repetitive use did not result in the formation of oven mounds, as occurred along the Murrumbidgee River and elsewhere, is a matter of some interest. The subsistence focus upon grass seeds, evident in the Darling region, may have reduced the prevalence of pit baking. There may have been less incentive to reuse ovens as a source of heat retainers due to the local availability of stone and termite mounds. The absence of highly depositional environments may also be a factor.

The occasional occurrence of very large piles of deflated heat retainers in some of these more arid regions, extending westwards from the Darling River towards the Willandra Lakes (pers obs), deserves further attention. It is possible that these, in fact, represent extensive episodes of repeated site use, although they have not accrued substantial mounded matrix material in addition to heat retainers. Their morphology may reflect the different post depositional formation processes operating in these areas. Much more arid conditions, coupled with greater levels of wind erosion could an explanation. However, the potential for oven mounds to be present in this region, where repetitive use of richer localised microenvironments occurs should not be discounted.

10.2 Holocene Settlement Reorganisation in the Central Murrumbidgee Riverine Plain

The Central Murrumbidgee Riverine Plain is a cultural landscape. Oven mounds represent the benefits accruing from past investment in that landscape and reflect particular subsistence aspects of the indigenous economy. Mounds were reused after lengthy periods of abandonment, such as that exceeding a millennium, at one of the Cooey Point Lagoon sites.

A pattern of subsistence and seasonal movement between riverine and hinterland areas can be confidently applied to the region for the last 2500 to 3000 years, based on the earliest levels of two of the mound sites excavated during this research. The underlying pattern may have a greater time depth. The pattern of site usage demonstrated at Colombo Creek is interpreted as the product of localised environmental change,

particularly creek decline. This is predicted to have occurred in other microenvironments throughout the region, possibly extending back to the early Holocene, when regional climatic conditions commenced an arid phase.

It has been suggested that the abundance of mounds throughout southeastern Australian landscapes is resultant of their increasing rates of formation. However, excavations demonstrate that, whilst oven mounds continued to form through intermittent reuse in some landscapes, there were also areas where they were falling out of use. In the particular instance of Colombo Creek, it is argued that the pattern of site formation is a direct response to local environmental change in the nature of stream channel migration, against a background trend of increased aridity, from about 2000 years before present. The degree to which regional climatic regimes contributed to the frequency of such events awaits further geomorphological and palaeoclimatic research.

Occupation evidence in the study region has been dated to the last 3000 years. This confined dating is probably a product of geomorphological processes which are prevalent in riverine regions. Climatic research indicates the stability of river channels for at least the last 2000 years, and mounds relating to this phase of riverine activity are still evident in the landscape. The existence of a prior phase of mound producing occupation is evidenced by the underlying truncated deposit of CP82 (2660 BP). Deposits of this age within the modern river corridor have been subject to reworking and siltation following movement of river channels.

Wetter periods in the late Holocene would have led to increases in stream flow and concomitant channel migration. The reliability of southern distributary creek systems and other wetland systems would also have been high. In wet periods, occupation of these environments could be widely dispersed, using widespread natural water storages, and rates of site reoccupation would have been low. As conditions dried again, and they underwent cyclic transformations to still-water wetlands, occupation around the southern systems would have become increasingly concentrated. Ultimately these systems would have become unreliable and reoccupation would have decreased dramatically.

The wet period dispersal of populations resulted in a dispersal of archaeological residues. Some reoccupation of environments may still have occurred, but at low long-term rates. When regional climatic conditions deteriorated, rich resource zones would diminish in number and increased reoccupation of those which remain would result in a more concentrated build up of archaeological residues. This build up was contiguous with the previous occupation pattern in cases where environmental zones remained rich. In other locations, the degree of site reuse diminished or discontinued following the disappearance of local resources such as wetlands. The Colombo Creek site

demonstrates these processes, and is suggested to be a microcosm of a wider pattern of events occurring during the Holocene.

10.3 Implications for Modelled Mid-to-Late Holocene Change

The argument for mid-to-late Holocene change in population, settlement pattern and economy gleans support from the statistics of site dates throughout southeastern Australia. Mounds are just one component of the suite of site 'type-indicators' arising in the late Holocene period. However these statistics have potential shortcomings. One caution is that much of the surface site survey, relating to current wetland environments, may be related to recent geomorphological events. It is wholly unsurprising that oven mounds should appear to have a late Holocene emergence in these surficial situations.

Mound formation can be related to a fundamental variety of archaeological formation process, that of repetitive site use. Likewise it is suggested that the chronology of mound appearance may also be resultant of geomorphic formation processes. The intensity of its expression is contingent upon small scale environmental conditions but is generally in keeping with a well observed human necessity, that for water, and an economy geared to exploit its associated suite of plant and animal resources.

Nevertheless, it is argued that a change in occupation pattern occurred from Pleistocene to Holocene times in the Central Murrumbidgee Riverine Plain, resulting in the redistribution of settlement evidence from a diffuse to a concentrated pattern. While this change occurred, it was not necessarily accompanied by dramatic changes in the population level. Indeed there is no *a priori* reason to suggest that the late Pleistocene population level was substantially lower, and it could even have declined with the redistribution of resources following the onset of Holocene aridity. Important challenges for the discourse on Holocene cultural change remain in the characterisation of its Pleistocene foundation.

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Late Holocene Occupation of the Central Murrumbidgee Riverine Plain

Volume 2

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Jan Maria Klaver

A thesis submitted for the degree of Doctor of Philosophy in the Department of Archaeology and Anthropology of the Australian National University

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Plate 12. Thin lens of freshwater shell midden exposed in recent bank cutting of the Murrumbidgee River, Site Cooey Point 5. (Scale in 5 cm increments). 6

Plate 13. Extensive open artefact scatter at Goonerah Lagoon. Background woodland marks the most recent location of the remnant palaeochannel. 7

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Plate 25. Mound Colombo Creek 31 after excavation. The cultural deposit is sandwiched between an upper calcareous layer and overburden. A pit underlying the base of the mound deposit cuts through the upper calcareous layer. The lower white calcareous layer is at the left hand excavation base. (Scale is in 20 cm increments) 13

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Plate 27. Excavation of Colombo Creek 32 showing underlying carunculated calcareous pan. 14

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Plate 29. Small oven Colombo Creek 36 after excavation. 15

Plate 30. Soil test pit excavated in erosion residual near Colombo Creek 31. Note upper calcareous layer in excavation base, top right hand corner, which matches the layer into which the pit underlying CC31 was placed. 15

Plate 31. Mound Cooey Point 116 prior to excavation. The extent of recent alluvial deposition has made the site obscure. (Scale is in 20 cm increments) 16

Plate 32. Oven pit at base of Cooey Point Lagoon 116, Trench D4, excavated unit 12. Scale extends across the underlying sheet of carbonised bark. Lighter feature is a smaller overlying piece of carbonised bark. Edge of pit is above upper edge of scale. (Scale is in 1 and 5 cm increments) 16

Plate 33. Cooey Point Lagoon 116 Trench D4, Section 3-4 . Oven pit at base of dipped feature. 17

Plate 34. Feature of baked clay oven rakeout beside small pit in Cooey Point Lagoon 116 Trench D4, excavated unit 5. Note uniformly mixed deposit and fragmentary mussel shell. 17

Plate 35. Cooey Point Lagoon 82 prior to excavation amidst *E. largiflorens* woodland. Note that sites are not prominent in alluvial depositional areas. Facing southeast. 18

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Plate 37. Cooey Point Lagoon 82, Trench 4A, Profile 1-2. Excavation completed and extended into subsoil. The large heat retainer in the centre right has been recycled from an underlying deposit, which is marked by orange and lighter grey sediment. The large heat retainer also marks the edge of a pit cut into the earlier deposit. This later pit activity is clearly marked by darker sediment, at right side of section. 19

Plate 38. Cooey Point Lagoon 82, Trench 6D, Section 1-2 north. Baked clay rakeout feature within excavated unit 7 Rakeout overlies grey clay. Note otherwise uniformly mixed ashy deposit. 19

Plate 39. Cooey Point Lagoon 5 freshwater shell midden prior to excavation Note low water level of Murrumbidgee River at rear. Facing west. 20

Plate 40. Cooey Point Lagoon 5, at top of excavation level 3. Mussel shell (*Velesunio* sp) emerging from beneath recent topsoil. Facing north. 20

Appendix II - Survey Area Descriptions

1. Mount Galore
2. Old Man Creek
3. Cobbin Ridge
4. Lake Coolah
5-6. Buckingbong State Forest
7. Cornella
8. Lake Uranagong
9. Lockhart to Urana Survey Areas
10. Goonerah Lagoon
11. Widgiewa
12. Morundah
13. Colombo Creek
14. Billenbah Reserve
15. Narrandera to Morundah Road - Cuddell Creek
16. Tarabah Stock Reserve
17. Yanco Creek
18. Widgiewa Reserve
19. Lake Urana
20. Thurrowa Road Reserve
21. Main Canal Road near 'Bareena'
22. Eurwarderry Lagoon
23. Newell Highway Stock Reserve
24. Snake Tree Reserve
25. Jerilderie Urana Road
26. Colombo Road
27. Old Urana Road/Newell Highway
28. Birdcage Reserve.
29. Toganmain Reserve
30. Cooinbil Station
31. Gundaline Stock Reserve
32. Goolgumbla
33. Gum Creek Tank
34. Rudd's Point Reserve
35. Uardry Stock Reserve
36. Cooey Point Lagoon
37. Uardry Station
38. Toms Point Stock Reserve
39. Burrabogie
40. Nulabor Stock Reserve
41. Gre Gre Stock Reserve
42. Glencoe Road
43. Eli Elwah
44. Illiliwa/Murrumbidgee River Road
45. Cedar Grove
46. Birriwa
47. Rosevale Reserve
48. Cobb Highway - Jerilderie Road Intersection
49. Barman State Forest Stock Reserve
50. Cullival State Forest.
51. Kulki Reserve.
52. Argoon Reserve.
53. Yanco Weir
54. Berembed Weir.
55. Kywong Reserve

Appendix III-1 Lithic Reduction Charts

III-1-a Lake Urana All Artefacts
III-I-b Lake Urana All Cores
III-1-c Lake Urana Quartz Cores
III-1-d Lake Urana Silcrete Cores
III-1-e Lake Urana Quartzite Cores
III-1-f Lake Urana Chert Cores
III-1-g Lake Urana Flakes and Blades
III-1-h Lake Urana Flaked Pieces and Chips
III-1-i Lake Urana All Quartz
III-1-j Lake Urana All Silcrete
III-1-k Lake Urana All Quartzite
III-1-l Lake Urana All Chert
III-1-m Lake Urana All IIIolcanic
III-1-n Lake Urana All Pebble Cortex
III-1-o Lake Urana All Quarry Cortex
III-1-p Lake Urana Patinated Artefacts
III-1-q Lake Urana Retouch
III-1-r Lake Urana Usewear

III-2-a Urangeline Creek All Artefacts
III-2-b Urangeline Creek All Cores
III-2-c Urangeline Creek Quarz Cores
III-2-d Urrangeline Creek Silcrete Cores
III-2-e Urangeline Creek Quartzite Cores
III-2-f Urangeline Creek Flakes and Blades
III-2-g Urangeline Creek Flakes and Blades quartz
III-2-h Urangeline Creek Flakes and Blades silcrete
III-2-i Urangeline Creek Microliths
III-2-j Urangeline Creek Manuports
III-2-k Urangeline Creek Quartz
III-2-l Urangeline Creek Silcrete
III-2-m Urangeline Creek Quartzite
III-2-n Urangeline Creek Sandstone
III-2-o Urangeline Creek Cortex
III-2-p Urangeline Creek Quarry Cortex
III-2-q Urangeline Creek Retouch
III-2-r Urangeline Creek Usewear
III-3-a Colombo Creek All Artefacts
III-3-b Colombo Creek All Cores
III-3-c Colombo Creek Quartz Cores
III-3-d Colombo Creek Silcrete Cores
III-3-e Colombo Creek Quartzite Cores
III-3-f Colombo Creek Chert Cores
III-3-g Colombo Creek Bipolar Cores
III-3-h Colombo Creek Flake and Blades
III-3-i Colombo Creek Flake and Blades quartz
III-3-j Colombo Creek Flakes and Blades Silcrete
III-3-k Colombo Creek Flakes and Blades Quartzite
III-3-l Colombo Creek Flakes and Blades Chert
III-3-m Colombo Creek Microliths
III-3-n Colombo Creek Manuports
III-3-o Colombo Creek All Quartz
III-3-p Colombo Creek All Silcrete
III-3-q Colombo Creek All Quartzite
III-3-r Colombo Creek All Chert
III-3-s Colombo Creek Sandstone
III-3-t Colombo Creek Metasedimentary
III-3-u Colombo Creek Conglomerate

III-3-v Colombo Creek Pebble Cortex
III-3-w Colombo Creek Quarry Cortex
III-3-x Colombo Creek All Retouch
III-3-y Colombo Creek Usewear

III-4-a Euwarderrry Lagoon All Artefacts
III-4-b Euwarderrry Lagoon All Cores
III-4-c Euwarderrry Lagoon All flakes
III-4-d Euwarderrry Lagoon Manuports
III-4-e Euwarderrry Lagoon Quartz
III-4-f Euwarderrry Lagoon Silcrete
III-4-g Euwarderrry Lagoon Quartzite
III-4-h Euwarderrry Lagoon Chert
III-4-i Euwarderrry Lagoon IIIolcanic
III-4-j Euwarderrry Lagoon Pebble Cortex
III-4-k Euwarderrry Lagoon Retouch
III-4-l Euwarderrry Lagoon Usewear

III-5-a Goonerah Lagoon All Artefacts
III-5-b Goonerah Lagoon All Cores
III-5-c Goonerah Lagoon Quartz Cores
III-5-d Goonerah Lagoon Silcrete Cores
III-5-e Goonerah Lagoon Quartzite Cores
III-5-f Goonerah Lagoon Chert Cores
III-5-g Goonerah Lagoon Chalcedony Cores
III-5-h Goonerah Lagoon Flakes and Blades
III-5-i Goonerah Lagoon Flakes and Blades quartz
III-5-j Goonerah Lagoon Flakes and Blades silcrete
III-5-k Goonerah Lagoon Flake and Blades Quartzite
III-5-l Goonerah Lagoon Microliths
III-5-m Goonerah Lagoon Manuports
III-5-n Goonerah Lagoon All Quartz
III-5-o Goonerah Lagoon All Silcrete
III-5-p Goonerah Lagoon All Quartzite
III-5-q Goonerah Lagoon All Chert
III-5-r Goonerah Lagoon All Chalcedony
III-5-s Goonerah Lagoon Pebble Cortex
III-5-t Goonerah Lagoon Quarry Cortex
III-5-u Goonerah Lagoon Patinated Artefacts
III-5-v Goonerah Lagoon Retouch
III-5-w Goonerah Lagoon Usewear

III-6-a Cooey Point Lagoon All Artefacts
III-6-b Cooey Point Lagoon All Quartz
III-6-c Cooey Point Lagoon All Silcrete
III-6-d Cooey Point Lagoon All Quartzite
III-6-e Cooey Point Lagoon All Chert
III-6-f Cooey Point Lagoon All Sandstone
III-6-g Cooey Point Lagoon All Cores
III-6-h Cooey Point Lagoon Quartz Cores
III-6-i Cooey Point Lagoon Silcrete Cores
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III-6-l Cooey Point Lagoon Bipolar Cores
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III-6-y Cooey Point Lagoon Usewear

Appendix III-7
III-7-a Flake and Blade Debitage Histograms
III-7-a Flake and Blade Debitage Bar Diagrams
III-7-b Flake and Blade Debitage with Cortex Histograms and Bar Diagrams
III-7-b Flake and Blade Debitage with Cortex Histograms and Bar Diagrams
III-7-c Length Classes of All Other Debitage Histograms and Bar Diagrams
III-7-d Flakes Material with Retouch or Usewear Histograms and Bar Diagrams
III-7-d Flakes Material with Retouch or Usewear Histograms and Bar Diagrams

APPENDIX I
Plates

Plate 1. The Murrumbidgee River and dominant *E. camaldulensis* vegetation. (Note recent natural levee on far side of stream channel.)

Plate 2. Lagoon wetland attached to the current stream channel of Colombo Creek, showing open water and *Typha* sp swamp. The *E. largiflorens* woodland in the far background follows the creek course.

Plate 3. Billabong Creek in the south of the survey region, Old Urana Road survey area, near Jerilderie. (Note levee areas remaining above the inundation following average spring flooding). *E. largiflorens* and *E. camaldulensis* woodland lines the creek course.

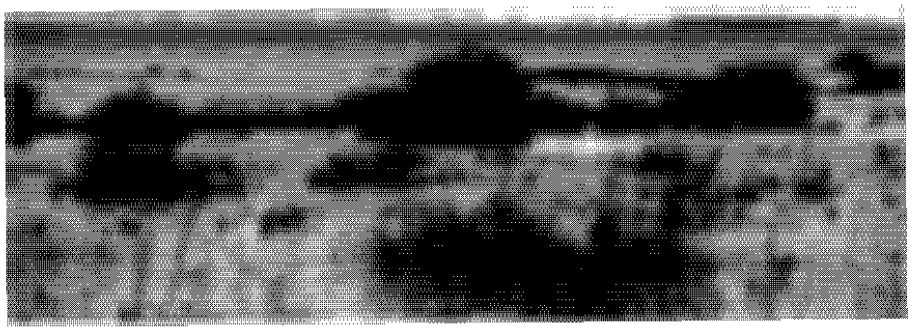


Plate 4. Inundated eastern sloping plains after flooding from local catchment, in south of study region near Lockhart and Urana. (Note small rises above flood levels, and higher sloping lands in background).

Plate 5. Native Pine (*Callitris* sp) woodland on sandhills near Lake Urana.

Plate 6. Eastern Sloping Plains. Landscape shows the extent of European clearance.

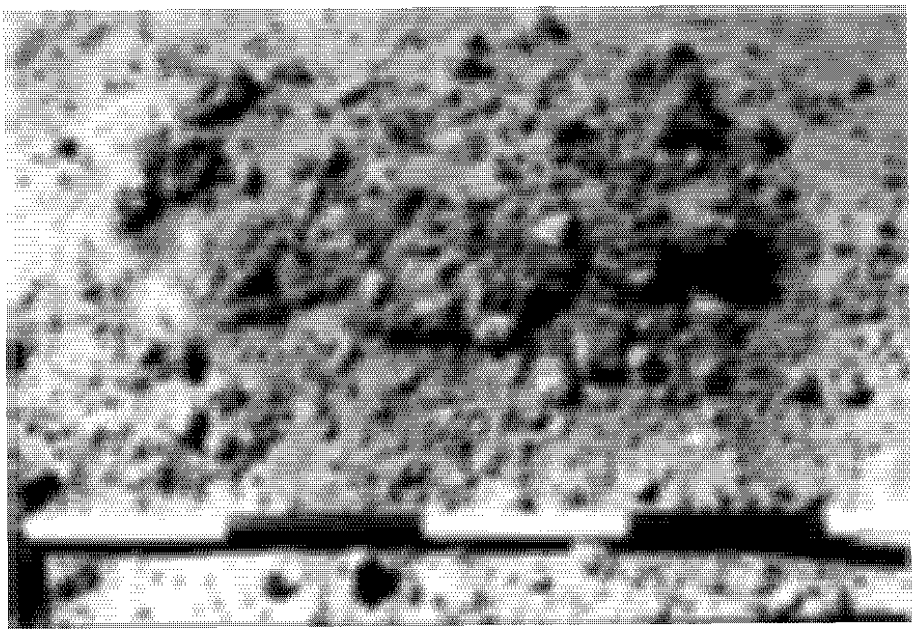


Plate 7. Individual oven indicated by circular concentration of baked clay heat retainer amidst general scatter of rakeout at Colombo Creek.

Plate 8. Mound deposit situated upon flooded margin of Billabong Creek. Mounds in such depositional environments typically support a luxuriant vegetative growth after wet conditions. (View is to south).

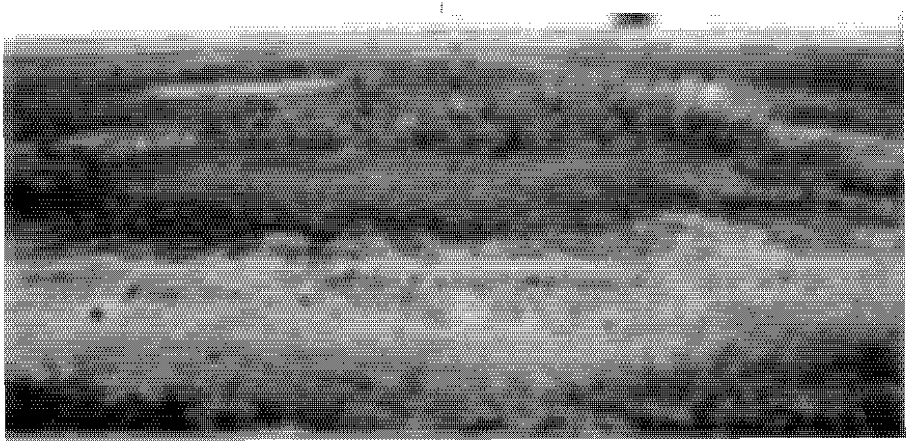


Plate 9. Deflating mound deposit at Colombo Creek. Minor landscape change has made this a relatively dry microenvironment. View is to north east across sloping plains which would have previously supported *Acacia pendula* and *Atriplex nummularia* shrub woodland.

Plate 10. Mound on break of slope leading down to Cooey Point Lagoon. The surface exposure is resultant of ant activity. A further mound deposit also positioned on the lagoon margin is visible just right of centre in the middle distance. Tree line at rear is *E.largiflorens* following the edge of the lagoon and a small tributary. View is to south.

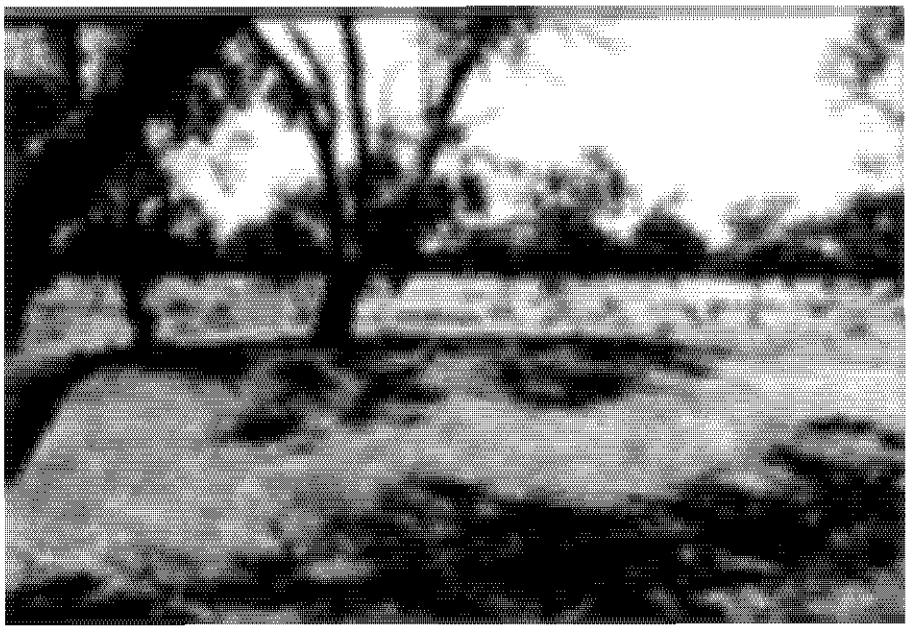
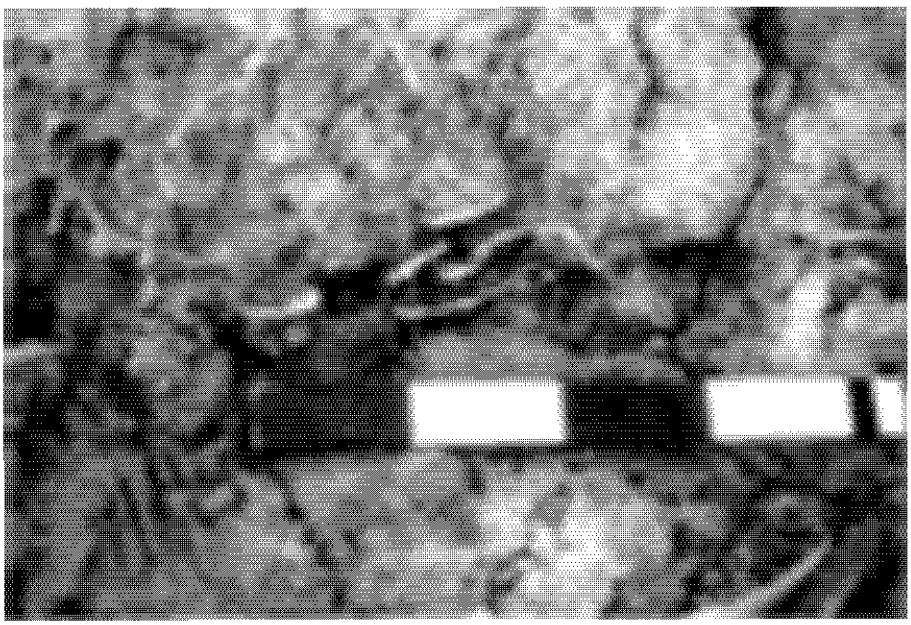


Plate 11. Mound amidst *E. largiflorens* dominated woodland in Birdcage Reserve. Ranging pole is on mound centre. Rabbit activity has extensively disturbed the deposit. The understorey would previously have comprised *Atriplex* sp shrubland.



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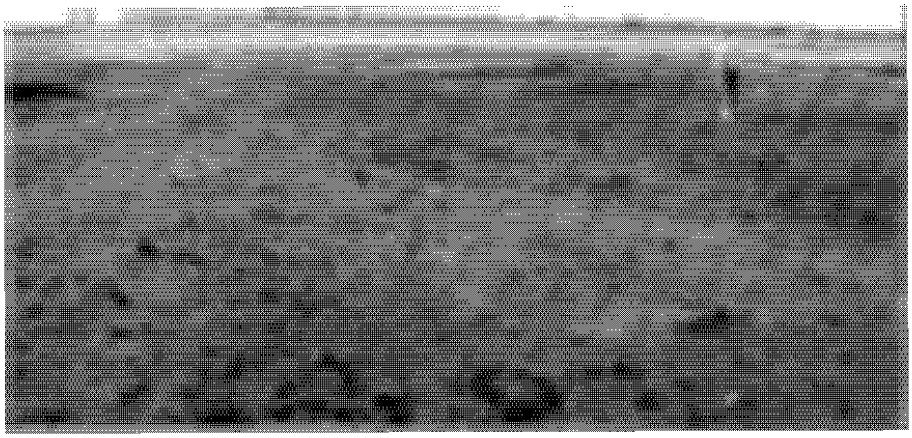

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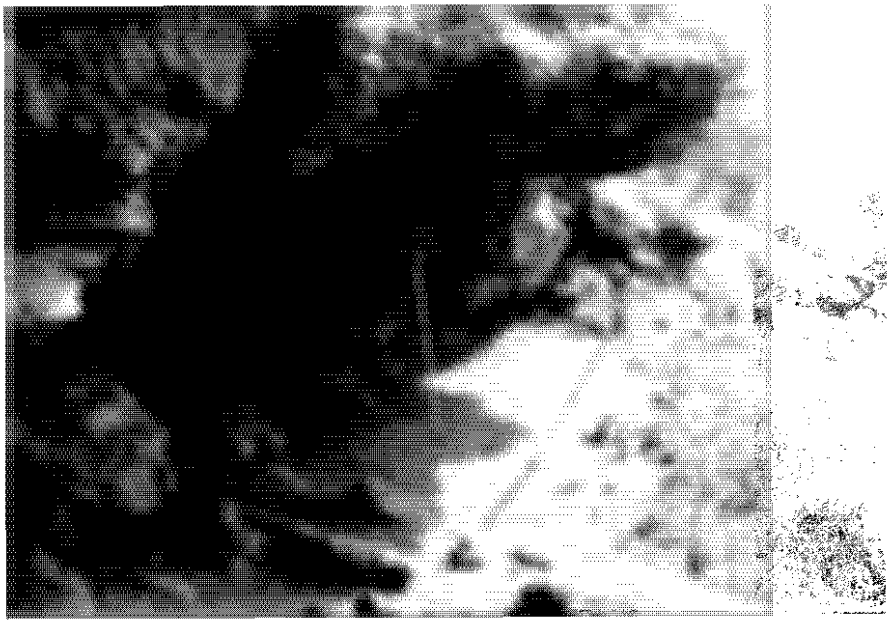

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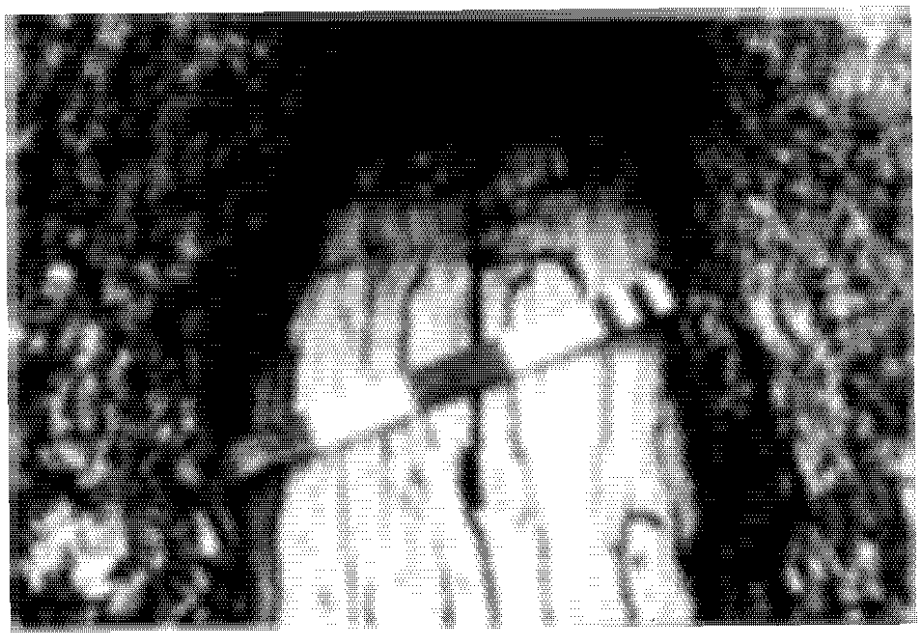

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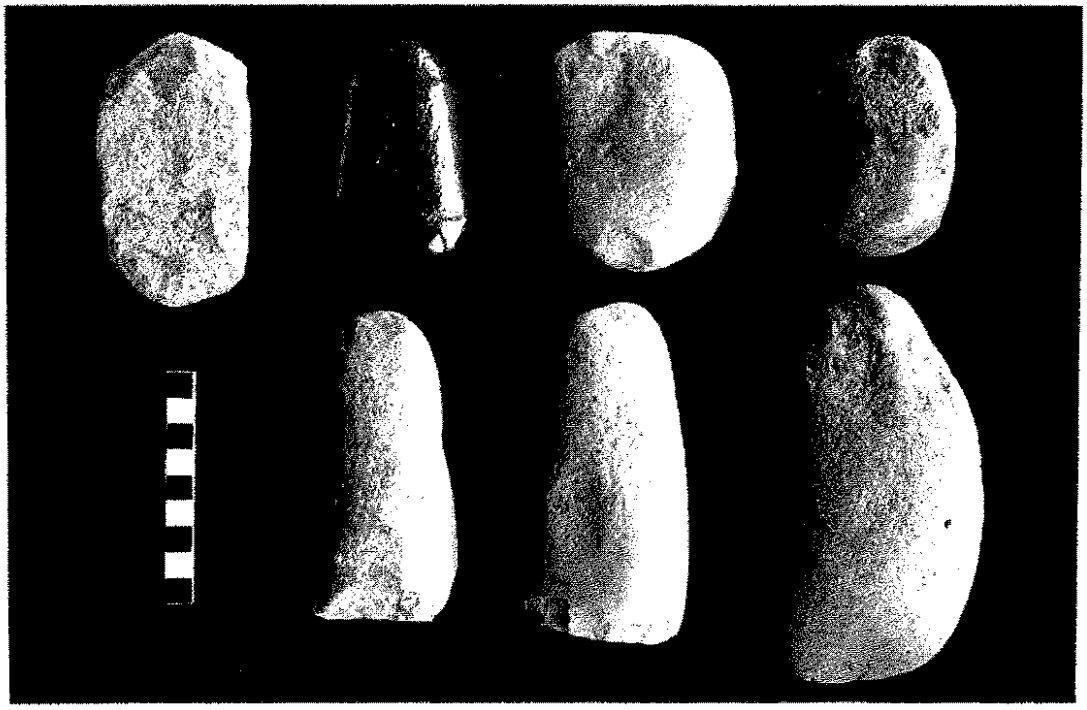

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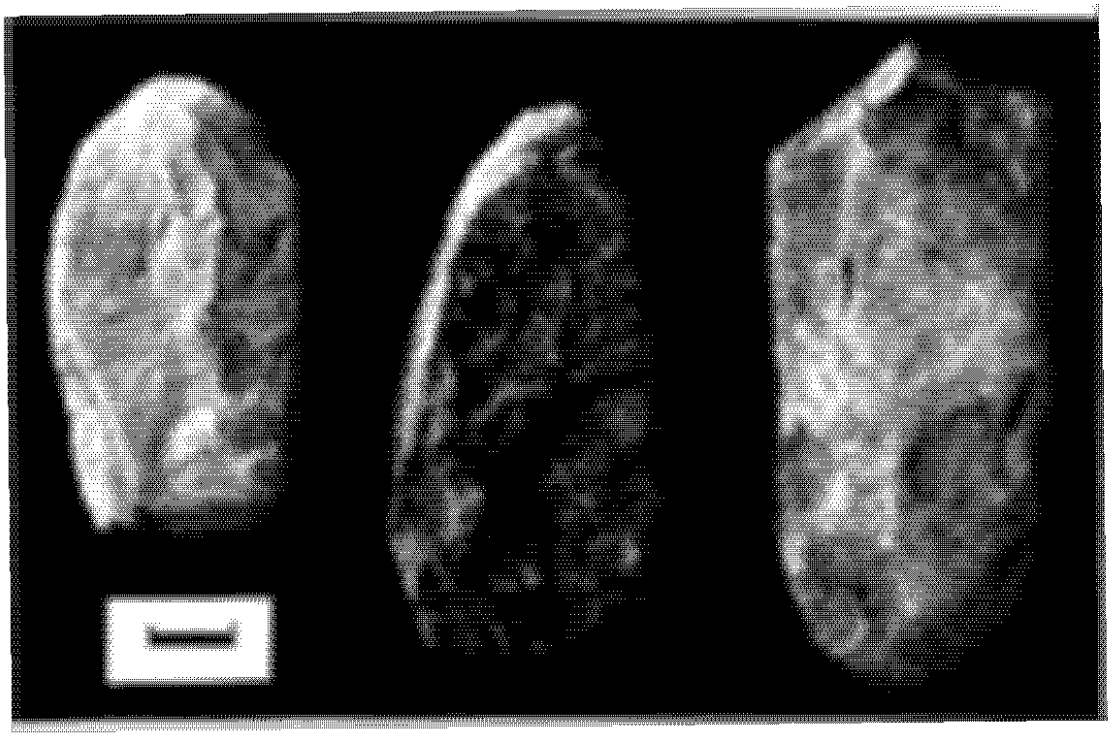

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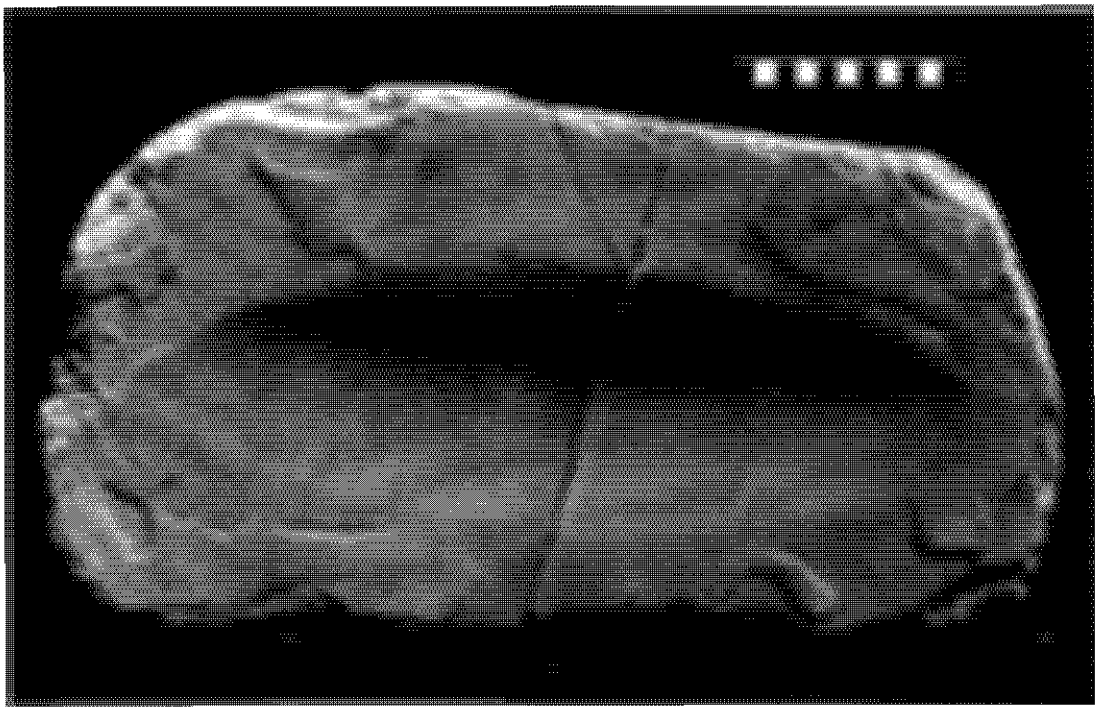

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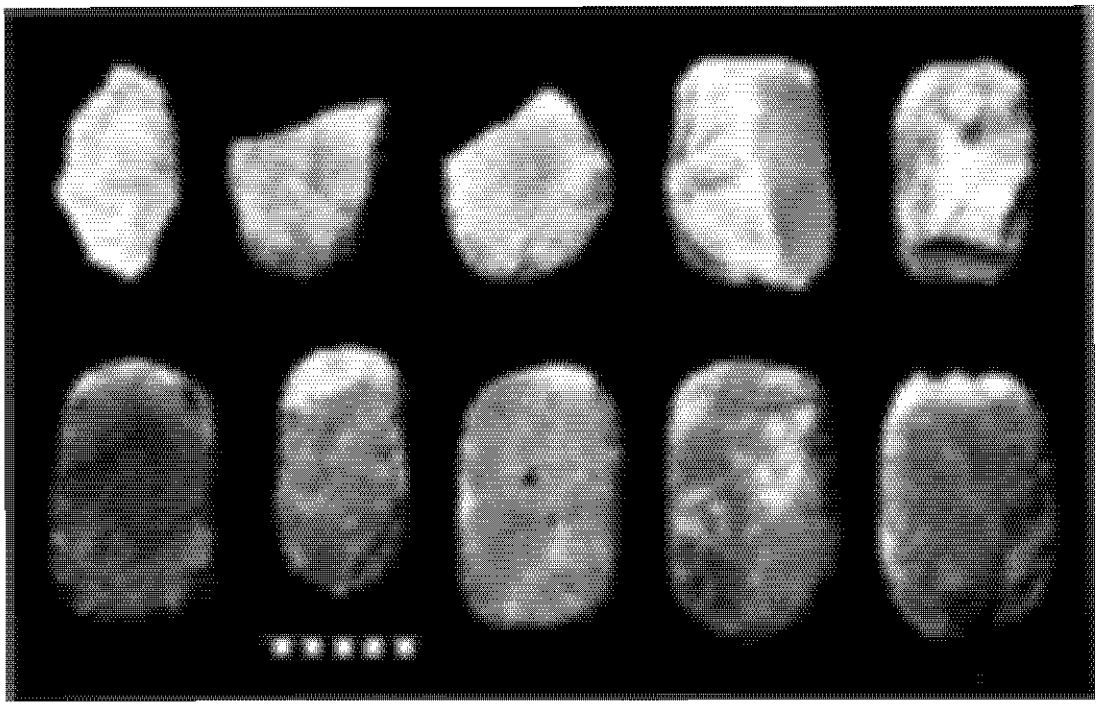

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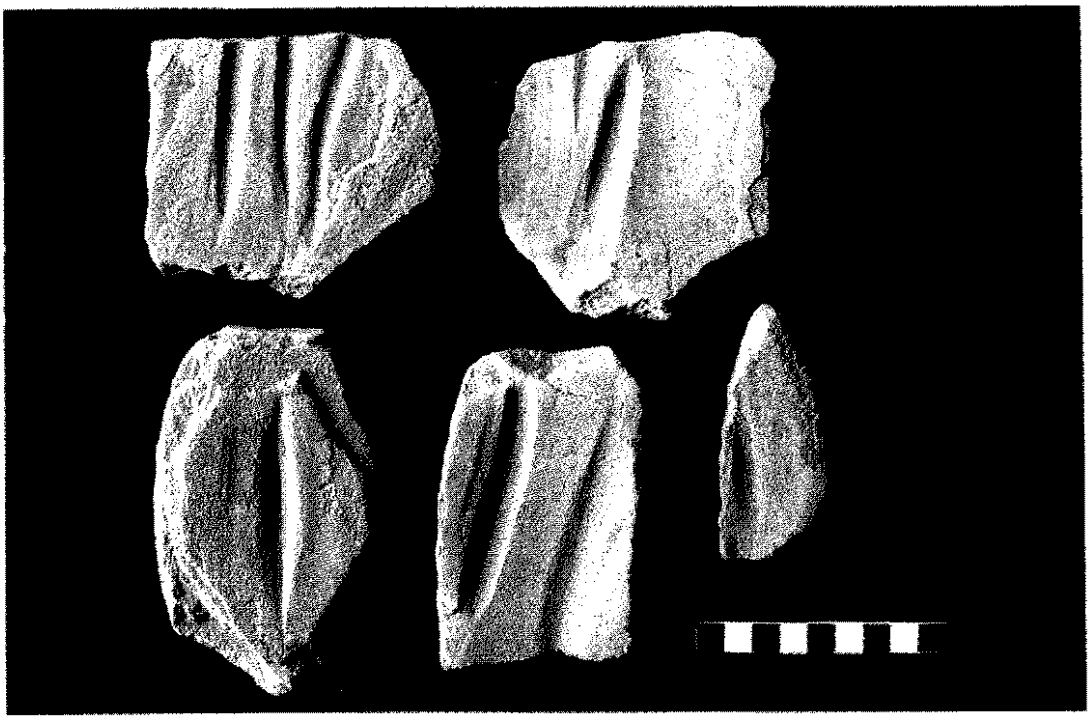

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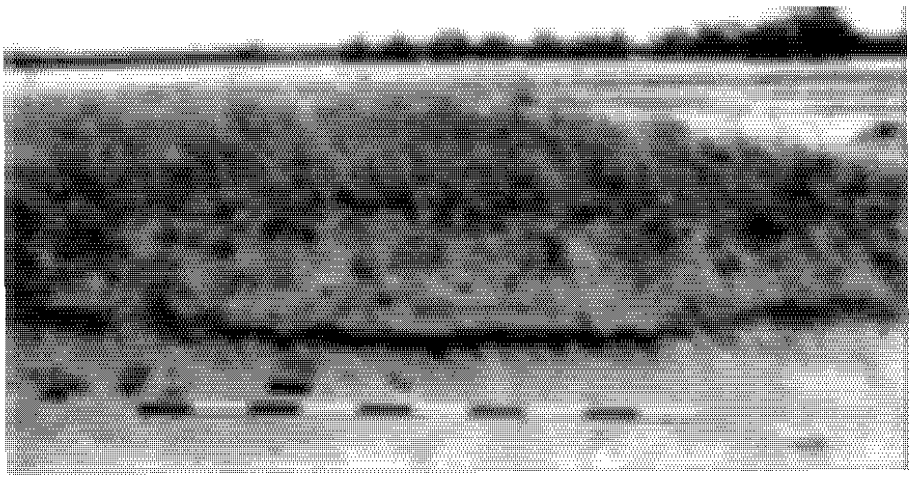

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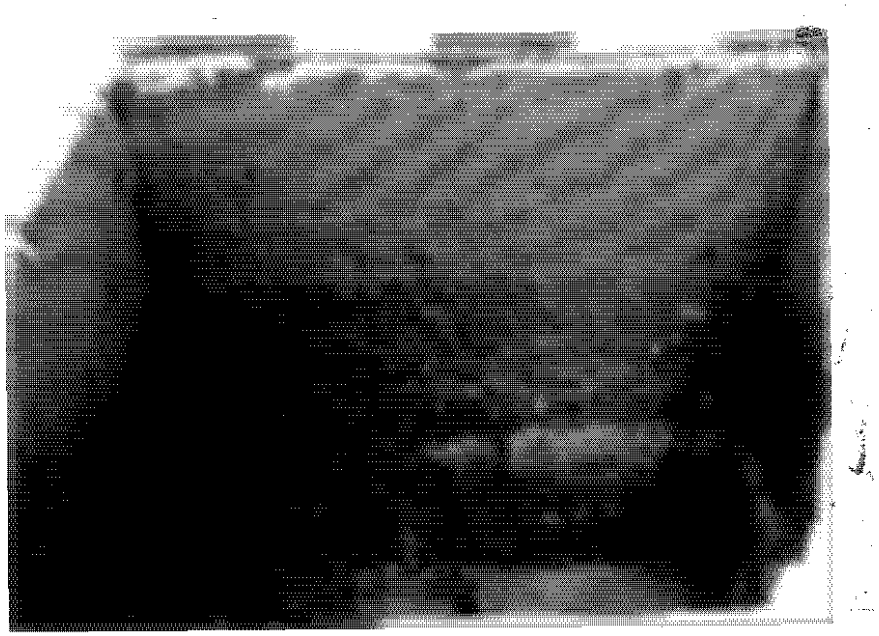

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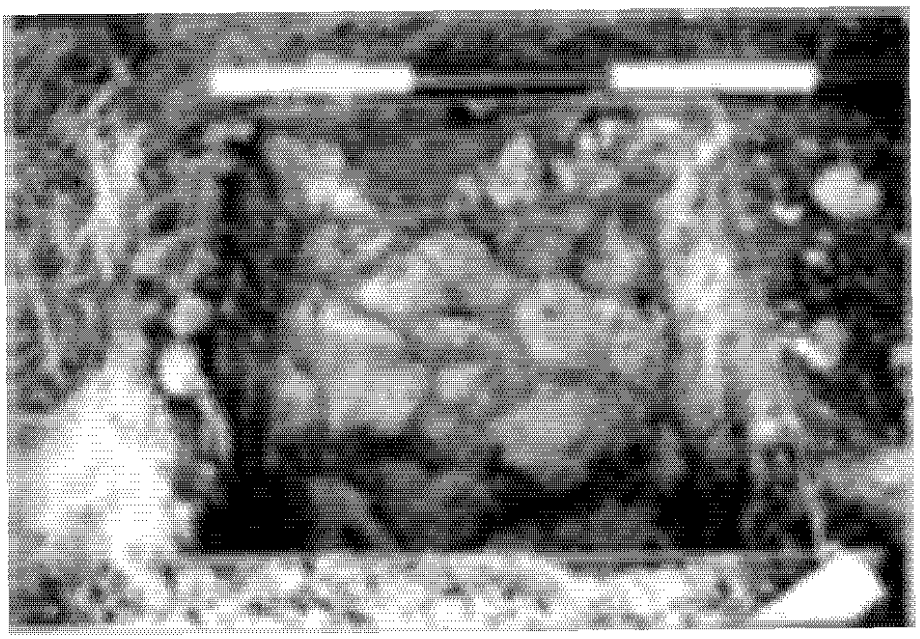

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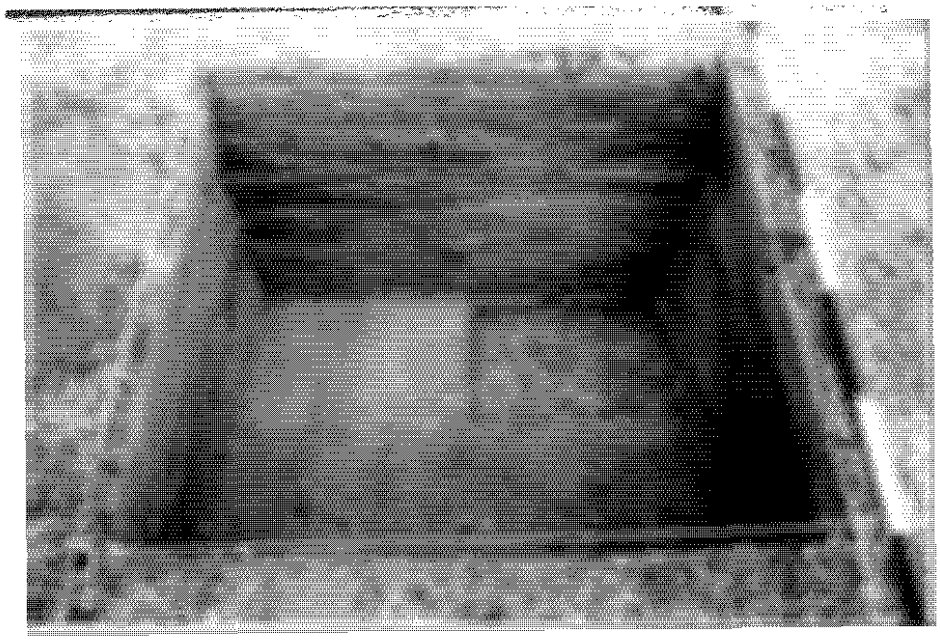

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Plate 31. Mound Cooey Point 116 prior to excavation. The extent of recent alluvial deposition has made the site obscure. (Scale is in 20 cm increments)

Plate 32. Oven pit at base of Cooey Point Lagoon 116, Trench D4, excavated unit 12. Scale extends across the underlying sheet of carbonised bark. Lighter feature is a smaller overlying piece of carbonised bark. Edge of pit is above upper edge of scale. (Scale is in 1 and 5 cm increments)

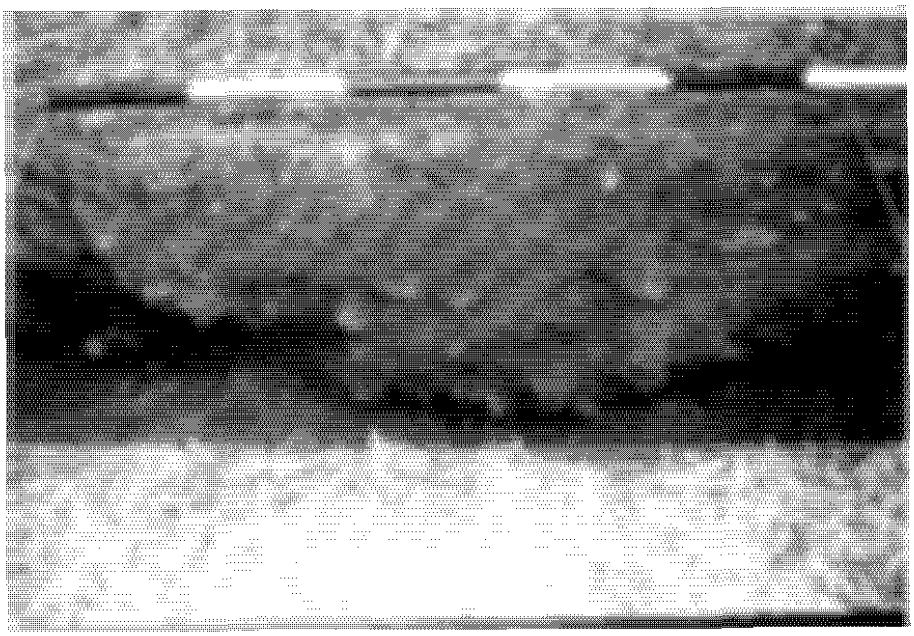


Plate 33. Cooey Point Lagoon 116 Trench D4, Section 3-4 . Oven pit at base of dipped feature.

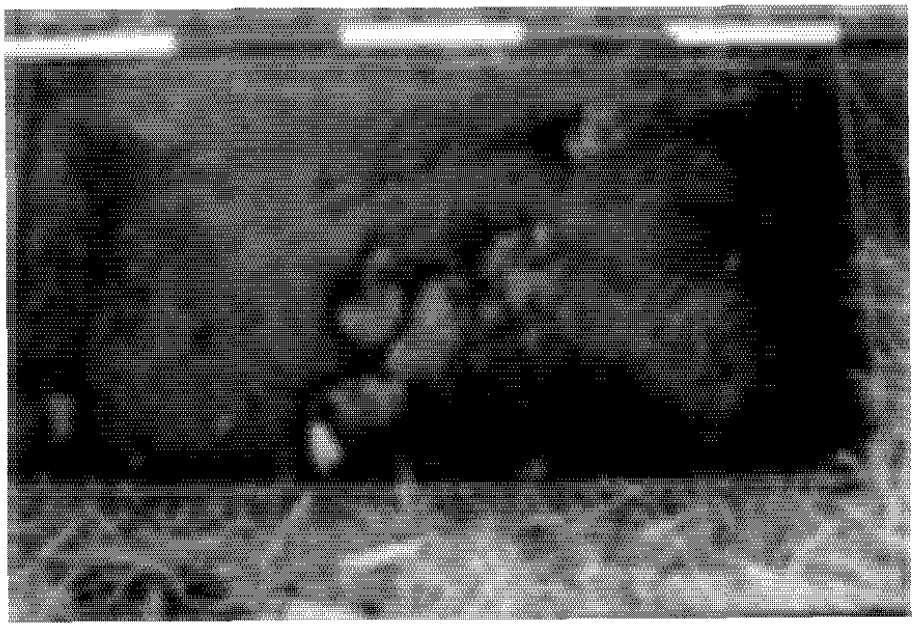


Plate 34. Feature of baked clay oven rakeout beside small pit in Cooey Point Lagoon 116 Trench D4, excavated unit 5. (Note uniformly mixed deposit and fragmentary mussel shell).

Plate 35. Cooey Point Lagoon 82 prior to excavation amidst *E.largiflorens* woodland. (Note that sites are not prominent in alluvial depositional areas). Facing southeast.

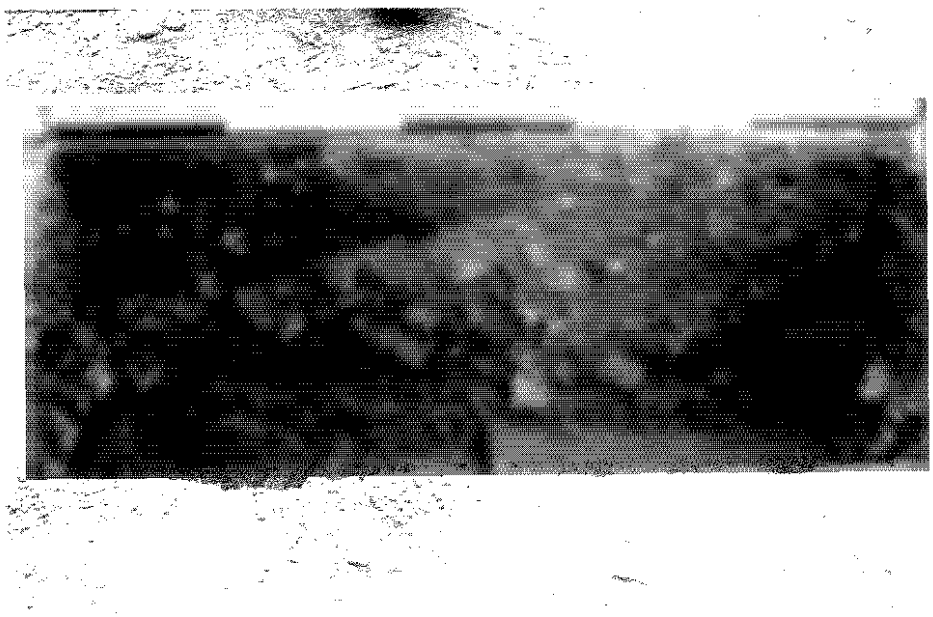


Plate 36. Excavated section in Cooey Point Lagoon 82, Trench 3BB Profile 1-2. Note superposition of dark soils in sequential pits, one at upper left and one at lower right. (Scale is in 20 cm increments)

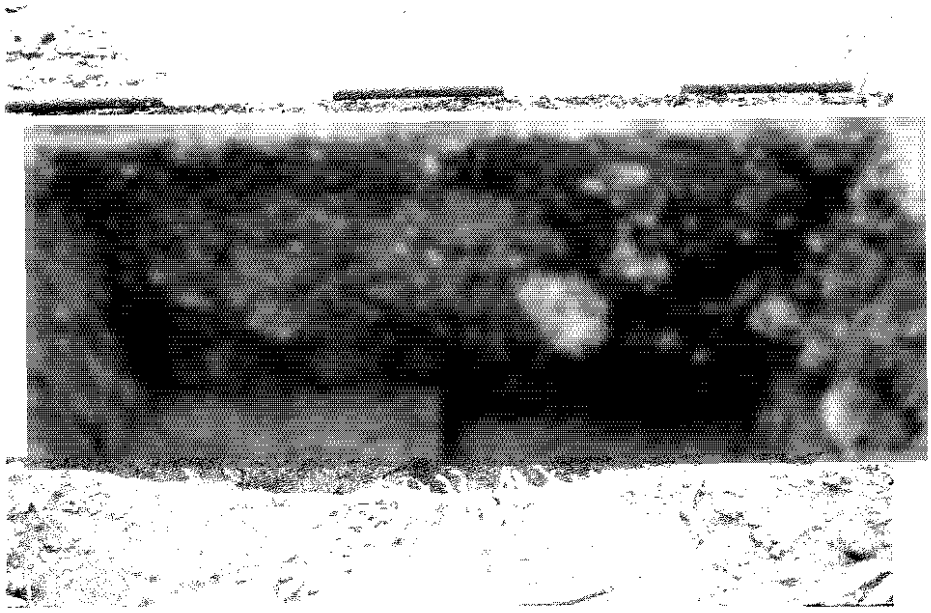


Plate 37. Cooey Point Lagoon 82, Trench 4A, Profile 1-2. Excavation completed and extended into subsoil. The large heat retainer in the centre right has been recycled from an underlying deposit, which is marked by orange and lighter grey sediment. The large heat retainer also marks the edge of a pit cut into the earlier deposit. This later pit activity is clearly marked by darker sediment, at right side of section.

Plate 38. Cooey Point Lagoon 82, Trench 6D, Section 1-2 north. Baked clay rakeout feature within excavated unit 7. Rakeout overlies grey clay. (Note otherwise uniformly mixed ashy deposit).

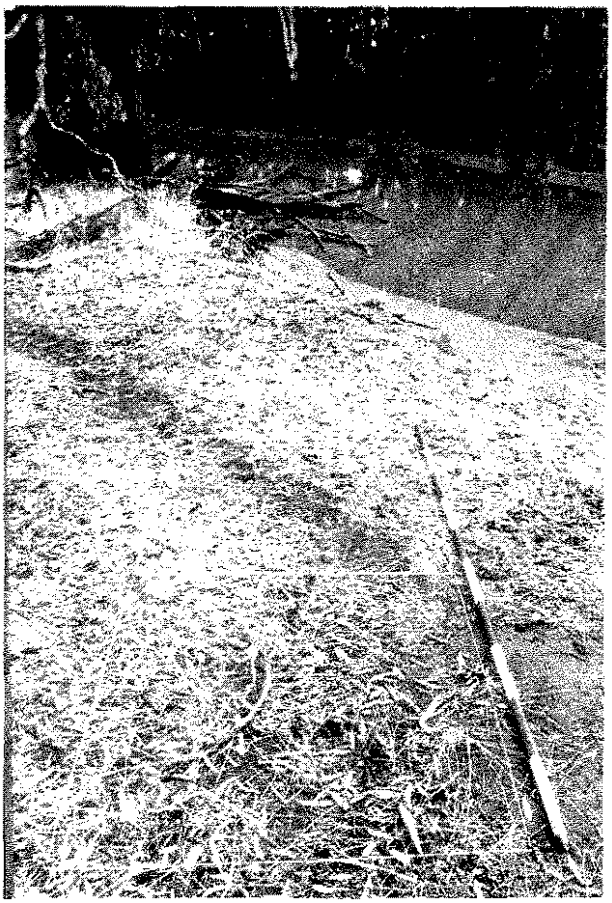


Plate 39. Cooey Point Lagoon 5 freshwater shell midden prior to excavation. (Note low water level of Murrumbidgee River at rear). Facing west.

Plate 40. Cooey Point Lagoon 5, at top of excavation level 3. Mussel shell (*Velesunio* sp) emerging from beneath recent topsoil. Facing north.

APPENDIX II
Descriptions of Sample Survey Areas

1. Mount Galore

Area

An area of approximately 6 km^2 was surveyed on Mount Galore.

Description

Mount Galore is a small bilobate hill rising approximately 340 m above the surrounding sloping plains to a maximum height of 379 m asl. It is composed of folded Devonian metasediments whose components include rudaceous clastic sedimentary materials (conglomerate of pebbles in sandstone matrix) and micaceous schists. Episodic collapse, from cryoclastic weathering as well as tree root action, of overhanging sections of the outcrop has been extreme on the northern and northeastern margins and persistent cavernous weathering has produced potentially habitable shelters, particularly on the upper slopes.

Climate

The area falls within the 600 mm rainfall isohyet and the climate is characterised as warm with uniform rainfall and hot summers, according to the Köppen system. Rainfall generally exceeds evaporation for 4 months between May and August (Davidson 1934).

Water Availability

There are no sources of permanent water on the hill, although several ephemeral creeks drain to the east. One drainage line forms a relatively permanent seepage east of the area (C.Heckendorf pers comm).

Vegetation

Mount Galore is currently vegetated with the *Eucalyptus dealbata* and *Eucalyptus sideroxylon* alliances. They are associated with a dense understorey of native shrubs, some of which are now regionally uncommon. Some areas in the lower slopes have been replanted by the Lockhart Shire Council and do not represent the original vegetation pattern.

Ground surfaces

Soils are thin and composed of weathered sediments. Siltation has occurred at the bases of small creeks. Lower ground surfaces were aggrading due to predominantly water-based erosion of upper slopes. Apart from eroding areas on tracks and clearings the remaining ground surfaces were stable.

Survey Method

Survey was conducted on foot and focused upon areas of high ground exposure. Visibility overall was low, due to dense undergrowth and, on the upper slopes, outcrops of tabular quartzitic stone. Graded access tracks, creek sides, walking trails and a recreation area provided good ground visibility.

Features Recorded

Two artefact scatters and a rock shelter containing an isolated quartz artefact were recorded, two further rock shelters with potential for habitation were also found.

Mount Galore 1

A scatter of 116 artefacts located on the lower slopes near an ephemeral drainage line. Nine artefacts were modified by retouch or usewear. Three flakes were backed to form geometric microliths. Two showed evidence of usewear and a further 2 were retouched to form a more abrupt working edge. A utilised straight edge on a flaked piece was also indicated by the presence of scalar micro-flakes removed perpendicular to the edge (visible with a 10X hand lens). A quartzite cobble showed percussion pitting from use as a hammerstone. Nine artefacts were cores. Seventy six artefacts were classified as debitage consisting of chips, unmodified flakes and blades and flaked pieces. A further 22 consisted of non-local stone and were recorded as manuports. Eighty one artefacts were composed of quartz (70%), 31 were silcrete (27%), 3 were quartzite (2 %) and 1 was chert (1%). The emphasis upon quartz as a raw material is consistent with the southern grouping of sites located throughout the regional survey.

Mount Galore 2
This comprised a small cavernous weathered overhang on the northern face of Mount Galore. A single flaked quartz artefact was located in loose surface sediments.
Mount Galore 3
This comprised a small cavernous weathered overhang on the northern face of Mount Galore. No cultural remains were evident within surface deposits. This site was later excavated.
Mount Galore 4 - Potential Shelter
This comprised small cavernous weathered overhang on the northern face of Mount Galore.

Further information about sites in the vicinity was obtained from local land holders and R. Williams, Sites Officer for the Wiradjuri Regional Land Council. A water soakage to the east of the hill was apparently associated with open campsites containing large oval seed grindstones (C.Heckendorf pers comm). A disturbed artefact scatter was also located on a perimeter access track constructed around the base of the mountain on the western side. This was not relocated in the current survey.

Further Investigations
In order to locate a stratified sequence of archaeological materials a shelter on the north face of the mountain was selected for excavation. Despite the location of a quartz artefact in the surface deposit of a small shelter (MG2), a larger shelter lower down the mountain slope was selected (MG3). This aimed to maximise the chances of locating older sediments.

In October 1991 a small test excavation was carried out in one of the two larger shelters on the north face of Mt Galore. There was considerable evidence of roof fall to the centre and eastern sides of the shelter so the excavation was placed on the western margin and to the rear of the shelter where the roof showed a less irregular surface. Half a square metre was excavated using a combination of twelve natural and arbitrary levels. A total depth of 0.30 m was reached before hitting substantial roof fall after which the excavation was ceased.

Overall the site contained little evidence of past use by Aboriginal people. Three flakes of glassy quartz were found. They came from the loose surface material of the shelter (Unit 1), a similar situation to the quartz flake found in the smaller shelter immediately west. Although there was substantial carbon retrieved from the excavation it is probable that it related to a recent campfire, part of which was contained in Units 1 and 2 of the excavation. Chicken bones were associated with this feature indicating that it was recent. Goat dung was located in Units 1 through 3 so the upper units were all interpreted as of recent and mixed origin. Consequently none of the carbon was submitted for dating. It is still possible that earlier occupation levels could be located beneath massive roof fall, but testing them would require large scale excavation. The steepness of the slope beneath the dripline rules against survival of any materials down slope.

On present evidence the shelters on Mt Galore could not be interpreted as representing any more than transitory occupation resulting only in the discard of a small quantity of waste flakes, probably resulting from the sharpening or maintenance of stone implements. It is possible that the site was useful for the vantage it offered over the surrounding riverine plain and that it was used to assist in the hunting of game. The presence of locally rare plant species may also have been attractive.

2. Old Man Creek

Area

An area of 45 km^2 was surveyed along the Old Man Creek in 1987 (Klaver 1987). Further survey and recording of several sites and research into the historic background of the area was undertaken for this study.

Description

The landscape is predominantly flat alluvial plains and is flanked by low sand ridges and source bordering dunes.

Climate

The area falls within the 450 mm rainfall isohyet and the climate is characterised as warm with uniform rainfall and hot summers according to the Köppen system. Rainfall generally exceeds evaporation for 3 months between June and August (Davidson 1934).

Water

The Old Man Creek is a southern anabranch of the Murrumbidgee River. It drains the Bullenbung Plain to the south via various tributaries. These undergo flow reversal during river flooding, resulting in the extensive spread of water across the landscape. Prior to European settlement the Old Man Creek would have been a small perched stream, associated with a vast system of wetland fed by smaller anastomosing streams. Early records note that the main creek channel contained numerous deep waterholes separated by sandy bars (Baylis 1912b). These would have remained viable for extended periods.

Previous research (Klaver 1987) concluded that the local environment was heavily influenced by the effect of riverine flooding, which would flush the system episodically. Analysis of the flood incidence of the area was then used to conclude that river flooding (which is seasonal) did not constitute the average conditions for the area (Klaver:1987). Instead wet or dry ground surfaces and the viability of the swamp areas resulted mostly from local influences such as runoff from localised rainfall and ponding of rainwater on ground surfaces. It is estimated that these wetland areas would thus have been able to survive for considerable periods, possibly for several years without floods, so long as local rainfall continued. Conversely they could survive localised dry spells so long as water came in from the upland catchments. The area thus constituted an unusually and particularly reliable resource area.

Vegetation

The dominant vegetation alliances originally present in the area would have been *E. camaldulensis*, *Typha sp*, *E. largiflorens* and *Callitris sp*. Understoreys of 'honeysuckle' scrub and 'forest grass' were recorded in the mid 1800's (Sturt 1963, Townsend 1848).

The vegetational patterns today are for an *E. camaldulensis* and *E. largiflorens* woodland to occur along the stream corridor and floodplain with a *Callitris sp* alliance on the sand ridges. The floodplain areas are under cultivation. Initial settlement meant extensive tree clearance, a process which continues up until present in attempts to keep the country open and regrowth free.

Ground Surfaces

Soils throughout the surveyed areas varied from heavy cracking grey clays, some with gilgai formation, to red brown sandy loams and aeolian sands. The area was dominated by alluvial depositional ground surfaces although many areas were superficially disturbed by agricultural activities.

Survey Methods

Field work carried out in 1987 resulted in the recording of 112 oven mounds on five properties along the Old Man Creek. Most of these were in poor states of preservation due to agricultural use of the land, although some had survived reasonably intact. Large collections of stone artefacts had also been made from the properties in the past. Most of these have been recorded (Klaver 1987).

This preliminary survey information was supplemented by further site recording, detailed EDM and theodolite survey of several sites and collection of historic data from archives regarding the early appearance of the landscape.

Historic Research

In April, 1849 government surveyor Thomas Townsend was commissioned to continue with Crown Survey of the Murrumbidgee River frontages west from Wagga Wagga to the confluence of the Old Man Creek, and then along the course of the Old Man Creek itself. The river was in flood when Townsend departed Wagga Wagga on the 16th of April. By the 19th of May Townsend had reached the confluence of the Old Man Creek. In his notes (Townsend 1849 Survey Notebook No.648) he recorded gum plains, open gum, box and oak woodland, some scrubby areas and noted that the creek itself lost a main channel, spreading across its floodplain in a series of reed-filled anastomosing streams, eventually forming a series of undefined streams passing through reeds and gum forest.

Alteration to the Murrumbidgee stream flow has extensively changed stream flow conditions within the creek. Presently it follows just one course, now deeply incised within the floodplain. The reed swamps now no longer exist although patterns of shallow surface inundation and heavy grey soils tracing areas where they would have flourished can still be discerned. Swampy areas are today drained and artificial levees have been constructed. However the area is still prone to flood inundation.

The presence of Aboriginal sites was first indicated by Townsend in his notation of an "oven" followed by his notation of a 'fish dam' (Townsend 1849 Survey Notebook No.648). He also noted 'lines of stones' set up across the Murrumbidgee river just east of the Old Man Creek (ibid). Local accounts also indicate the presence of non-local stones, presumably from Aboriginal dams across the Old Man Creek (Gooden pers comm).

Site Descriptions

The 112 mounds recorded in 1987 ranged in diameter from 10 to over 60 m. Many were in relatively poor condition due to the impact of agricultural land use practices. One group of four mounds surrounding a deep depression were mapped in detail. This depression was located 600 m from the creek. It probably resulted from the continual removal of clay for the manufacture of heat retainers, and may then have served as a small reservoir of water useful for the operation of the adjacent steam ovens.

Mounds in this locality exhibit linear and clustered layouts. Spatial analysis of a major occurrence of clustered mounds concluded that they were selectively occupying areas of existing elevation within the floodplain (Klaver 1987). Linear occurrences tracked the edges of major swamp areas and the creek levees. The general patterns of site distribution in the Old Man Creek area suggested that occupation could have occurred throughout the year. Mounds were located in four microtopographic situations: creek and levee areas; floodplain areas; elevated areas within the floodplain; and on sandsheets and dunes at the margins of the floodplain (Klaver 1987:108). Use of the creek, levee and floodplain areas was proposed during non-flood periods. Use of elevated areas (above major flood level) within the floodplain and sandsheet and dune areas fringing the floodplain was proposed for wetter periods.

Artefactual evidence from the Old Man Creek area was unusually comprehensive owing to the actions of past collectors. Coupled with materials recorded during field survey it became apparent that broad spectrum exploitation of the surrounding environment was indicated. The collection and processing of grass seeds was suggested by the presence of large grindstones with elongate grooves and numerous mullers. Such grindstones are typical of wet milling processes (Smith 1986:8-9).

The presence of oven mounds along the creek course documented through archaeological survey suggests that it may have been one of these that Townsend recorded. The fact that

he readily accorded the term 'oven' rather than 'mound' or 'hut' adds further support to their previous interpretation as such (Klaver 1987). The fact that he only noted the existence of one such feature might be attributed to conditions of visibility in the area at the time. Conditions today, where the layout of up to 50 such sites can be viewed from one position, are artificial, resulting from extensive tree and vegetation clearance and the impoundment of the flow of the Old Man Creek into one clearly defined channel.

Alternatively, his observation may lend support to the idea that whilst dozens of such sites may exist in the landscape, they are not necessarily contemporaneous, and at any one given time, only one oven or a couple out of several dozen might be in use and hence be unvegetated and easily visible.

3. Cobbin Ridge

Area

An area of 5 km^2 was surveyed on the Cobbin Ridge property.

Description

The Cobbin Ridge survey area was the southernmost section of land included in the research project. It was composed of undulating to hilly lands with quartzitic ridges interspersed with plains. The survey area consisted of slopes abutting a small swamp on a poorly defined drainage line to the northwest.

Climate

The area is within the 450 mm rainfall isohyet. The climate is characterised by dry summers and is generally warm. Rainfall exceeds evaporation for four months of the year, from May to August.

Water Availability

Water sources are ephemeral in the survey locality, draining to an intermittent swamp to the west.

Vegetation

E. microcarpa is the dominant vegetation alliance on the hilly lands and the plains would have been vegetated in shrubland, with a mixed *A. Pendula /A. nummularia* alliance.

Ground surfaces

Soils were predominantly well drained loams although low-lying areas were composed of heavier red and grey clays. Ground surfaces were relatively stable, apart from the impact of ploughing. This landuse, coupled with initial clearing would have resulted in deposition of aggraded sediment at the bases of slopes and hence there is considered to be potential for further buried archaeological materials in proximity to the swampy area.

Survey Method

The survey area was entirely traversed by two people and investigation was focused upon disturbed areas offering good visibility such as access tracks and ploughed fields.

Site Descriptions

Two ovens and a low density scatter of 17 stone artefacts were located on a gently sloping area leading up and away from a swampy area prone to inundation. The ovens were circular features of ashy sandy loam and concentrations of burnt quartzitic stone, they had been ploughed and their original dimensions are uncertain. A background scatter of non-artefactual red-brown quartzitic stone was present throughout the survey area. This was apparently the source of the heat retainer material. No artefacts or mussel shell were evident within their deposits. An isolated find of a large red quartzite 'horsehoof' or 'producer' (cf. Witter 1990) core was also recorded in woodland further east.

This site demonstrates the use of stone heat retainers in areas where stone is locally available. Consequently, mounded formations relating to oven operation and discard are not as pronounced. The site appears to be focused upon the ephemeral swamp located to

the west. Although there was only a low density of associated artefactual materials and the ovens were small, it is likely that they functioned as in situ cooking facilities in the context of a base camp.

4 Lake Coolah

Area

An area of approximately 2 km^2 was covered on foot around the eastern and western margins of Lake Coolah.

Description

Lake Coolah is an ephemeral water body situated within sloping plains. The lake is abutted by low hills capped with rocky outcrops and covers an area of approximately 16 km^2.

Climate

The area has a 450 mm annual rainfall. The climate is warm and characterised by dry summers. Rainfall is effective, ie. exceeds evaporation, for three months of the year between June and August.

Water Availability

Lake Coolah is the overflow depression for Mejum Swamp (also referred to as Lake Midgeon in early literature), the former drainage terminal for the Mirrool Creek prior to flow diversion. Old records indicate the episodic nature of water availability considering that levels in Lake Midgeon would have to be high before overflowing in to Lake Coolah. According to D.G. Whiteman, a past manager of Midgeon Station, in 1951 Lake Midgeon was dry, in 1952 it was partly filled, in 1953 it was dry for the latter half of the year, in 1954 it was dry throughout, in 1955 it was half full, in 1956 it overflowed for 6 weeks into Lake Coolah and there had been no run-off since then (until 1958) into Lake Coolah, despite Mejum being three quarters full. He added:

The only creek feeding Midgeon now is the Frying Pan Creek, in your times around here the Mirrool Creek or as on the early maps Murrill Creek used to run into here, but there was a check bank put across it at the Willows 15 miles above here & now this water finds its way to the Lachlan, so I have been told (1958:np).

Vegetation

The vegetational alliances present are those of *Eucalyptus albens* and *Eucalyptus microcarpa*. The *Callitris glauca* alliance is found on low hills and sand ridges throughout the area. The bed of Lake Coolah is predominantly vegetated by *Eragrostis australasica.*

Ground Surfaces

Soils within the lakebed are composed of heavy grey clays, with some areas of gilgai microrelief. The eastern margin of the lake is composed of aeolian sands overlying compact red earth. Wind erosion has stripped this sand to reveal extensive scalded areas. The southwestern margin of the lake is stony with an aggraded fine white silt substrate. Water erosion has resulted in the small scale scalding. Ground visibility was high in these scalded areas and generally poor within the lakebed.

Survey Method

Survey was carried out on foot by two people and concentrated upon areas offering good ground visibility.

Features Recorded

Survey carried out along the eastern and western margins of Lake Coolah revealed numerous small earth ovens, indicated by discrete and eroded piles of heat retainer rakeout. Clay, termite nest and stone heat retainers were employed (Klaver 1987). The fragility of the baked clay heat retainers which were still evident as discrete rakeout events suggests limited reuse of the ovens. The 1987 survey also located one soft mounded

deposit consisting of dark ashy sand, charcoal and stone heat retainers. Rabbits had extensively disturbed the site.
Use of the area is interpreted as seasonal and focused upon the exploitation of birds known to densely populate the *Eragrostis sp* swamps during breeding seasons. Breeding generally occurs in late winter in response to wet periods. In the historic and probably late prehistoric past these wetlands may have been seasonal rather than permanent, since the Mirrool Creek itself only flowed in the wet season.

5-6. Buckingbong State Forest

Area

Two 4 km^2 sections of the Buckingbong State Forest were selected for field survey.

Description

Buckingbong State Forest is in localised hilly country, attaining heights of about 180 m AHD, within sloping plains south of the Murrumbidgee River. Both survey areas were within the southern section of the forest and encompassed areas of flats, slopes, and ridges.

Climate

The area has a 450 mm annual rainfall, effective between the months of June and August. The climate is warm with dry summers.

Water

There are no permanent water sources within southern sections of the forest, apart from localised drainage after rainfall. Such moisture is however, rapidly dispersed.

Vegetation

The current vegetation is composed of managed *Callitris* sp forest. There is an understorey of native shrubs and grasses and *Brachychiton populneus* trees also occur sporadically on upper hillslopes.

Ground surfaces

Soils were red brown earths, stony on upper hillslopes. Ground surfaces were predominantly stable or grassed. Eroded areas existed along tracks and fence lines and around dams. Some of the minor ephemeral drainage lines displayed gullying.

Survey Method

Due to poor visibility in managed plantation areas only tracks and clearings could be comprehensively surveyed. All such land within the two sample areas was covered on foot by two people.

Features Recorded

A total of eight sites was recorded, one scatter of three stone artefacts, including a hammerstone, and seven isolated finds. The sites were spread throughout the surveyed areas and suggested limited use of the area by Aboriginal people, which was not altogether surprising given the lack of water in the vicinity.

7. Cornella

Area

An area of approximately 3 km^2 of the 'Cornella' property with frontage towards the eastern side of Lake Uranagong was surveyed for archaeological materials.

Description

This survey area is situated within the eastern sloping plains landscape. The area consisted of lake margins, plains and the upper stretches of the ephemeral Sandhills Creek.

Climate
The climate of the area is warm with dry summers. Annual rainfall is in the vicinity of 450 mm and is effective for four months, between June and August.

Water Availability
Lake Uranagong is a small ephemeral lake dependent upon local rainfall. It is filled by numerous poorly defined drainage lines flowing from the south and west. The Sandhill Creek drains northerly into Urangeline Creek. Drainage of the area is variable depending upon soil types. Areas of red loamy sand offer reasonable drainage whilst lower lying areas of heavy grey clays remain inundated for considerable periods.

Vegetation
Originally the area would have been vegetated with a mixed *A. Pendula /A. nummularia* shrubland. Currently the area is cleared for agricultural pursuits. These areas were thickly vegetated until the 1920's when post war soldier settlement resulted in virtually absolute tree clearance (J. McFarlane pers comm).

Ground Surfaces
Soils varied between heavy grey clays and sandy loams. Ground surfaces were predominantly depositional. However the area was ploughed at the time of survey, resulting in good although disturbed visibility.

Survey Method
Major site locations were indicated by the landowner and further areas offering good archaeological visibility, such as access tracks and ploughed ground, were targeted for survey. Survey was carried out on foot by two people.

Features Recorded
Four mounds, interpreted as resultant of the operation of earth ovens, and an extensive but disturbed (ploughed) scatter of 157 stone artefacts were recorded. All the mounds were located adjacent to tongues or ribbon like features of grey soil, indicating drainage lines and inundated areas feeding into either the Sandhills creek or an unnamed swampy depression to the southwest. The mounds were not recorded in close association with the recorded artefact scatter. It was located approximately 600 m to the northeast, however scattered artefacts were observed near the mounds and formed a very low density background scatter across the remaining ploughed paddocks. Due to their lack of context they were not recorded. The mounds were all reasonably large, ranging between 22 and 15 m in diameter, but were not very high having been cultivated. They all consisted of loose ashy sand and baked clay heat retainers. Fragments of freshwater mussel shell were also present.

The available archaeological evidence is interpreted as indicative of relatively substantial occupation. This is inferred on the basis of combined occurrences of mound deposits and a spatially segregated artefact scatter, which may indicate the location of a base camp. Unfortunately the present degree of damage to the sites rendered further interpretation difficult.

Cornella 1
C1 comprised an extensive disturbed scatter of 157 stone artefacts.

Cornella 2
C2 comprised a ploughed oven mound measuring 17.8 x 13.2 m. The deposit was levelled and consisted of loose ashy sand with baked clay heat retainers.

Cornella 3
C3 comprised a ploughed oven mound measuring 22.2 x 13.4 m. The deposit was levelled and consisted of loose ashy sand with baked clay heat retainers.

Cornella 4
C4 comprised a ploughed oven mound measuring 9.3 x 14 m. The deposit was levelled and consisted of loose ashy sand with baked clay heat retainers.

Cornella 5
C5 comprised a ploughed oven mound measuring 15x11 m. The deposit was levelled and consisted of loose ashy sand with baked clay heat retainers.

8. Lake Uranagong

Area
A Travelling Stock Reserve of about 2 km^2 was surveyed on the northern margin of Lake Uranagong.

Description
Lake Uranagong is a small ephemeral lake within sloping plains lands, southeast of Lake Urana. Low sandy ridges occur to the north of the lake.

Climate
The climate of the area is warm with dry summers. Annual rainfall is in the vicinity of 450 mm and is effective for four months, between June and August.

Vegetation
The original vegetation alliances of the area would have been the *A. Pendula /A. nummularia* alliance. The area was thickly vegetated at the time of survey with the exception of ploughed firebreaks.

Ground Surfaces
Soils were composed of aeolian red sands. Ground surfaces were stable apart from minor ploughed areas.

Survey Method
The area was traversed on foot by two people.

Sites Located
No archaeological materials were located. This is probably resultant of the reduced archaeological visibility within the survey area.

9. Lockhart to Urana Survey Areas

Area
Two sections of roadside reserve of approximately 0.5 and 1.8 km^2 between the Urangeline Creek and the Lockhart to Urana Road were surveyed for the presence of archaeological materials.

Description
The area is within sloping plains topography. Minor landscape units examined included creek banks, levee and floodplain areas.

Climate
The climate of the area is warm with dry summers. Annual rainfall is 450 mm, effective between the months of May, June, July and August.

Water Availability
The Urangeline Creek is a small creek draining extensive country to the south. It ultimately flows into Lake Urana. The creek course is rapidly migrating and numerous dry meander channels exist, which would activate during flooding. Flooding in these areas can take on major proportions and ground surfaces are predominantly depositional, except in areas of flood scouring.

Vegetation
The general pattern of vegetation is for a sparse scattering of *E. largiflorens* woodland, thickening along stream channels, and an understorey of heavily grazed grasses, and *B.tricuspis* (roly poly). Low lying areas with gilgai soil formations retain water and support sedge communities. Plain areas to the north have remnant *A.pendula* woodland. Original vegetation alliances in plains areas would have been shrubland, dominated by *A. Pendula* and *A. nummularia* , with a *E. largiflorens* woodland along stream corridors.

Ground Surfaces
Soils consisted of red and grey earths, with some localised gilgai formations. Ground surfaces varied between erosional and depositional. Areas of creek bank erosion and water scouring are evident along the creek frontage. Depositional silty soils are found further north on the floodplain. At the time of survey the location was well grassed with numerous patches of scalded red earth.

Survey Method
The area was systematically traversed with foot survey by two people. Pace and compass plans were drawn of landscape features and site locations. Artefact positions were plotted with off-set line surveys.

Features Recorded
Seven open scatters of stone artefacts were recorded, Lockhart Urana Road 1 (n=800+), Lockhart Urana Road 2 (n=243), Lockhart Urana Road 3 (n=206), Lockhart Urana Road 4 (n=12), Urangeline Creek 1 (n=298), Urangeline Creek 2 (n=127) and Urangeline Creek 3 (n=11). Sites were mostly confined to raised levees and flood terraces between the creek meanders and to the higher floodplain north of the creek.

Artefacts appeared mostly confined to red soils and some were embedded quite deeply into this depositional surface. Eroding surfaces, such as small scalds and sheep tracks, contained artefacts loose upon their surfaces. A firebreak, which had been ploughed under and adjacent to the transmission line running along the roadside, also revealed artefacts in the plough furrows.

10. Goonerah Lagoon
Area
Survey in the Goonerah Lagoon area covered approximately 7.5 km^2.

Description
West of the confluence of the Murrumbidgee River and Yanco Creek lies a low range of hills, flanked by consolidated red sand. An extinct southern meander of the river, Goonerah lagoon, now fills sporadically and has formed a wetland area surrounded by flat alluvial plains country. It is abutted to the east by the aforementioned sandy ridges and low hills.

Climate
The climate is semi arid with cool mean annual temperatures. Annual rainfall averages 400 mm. Rainfall exceeds evaporation for three months, between June and August.

Water Availability
Goonerah Lagoon is activated by major floods in the Murrumbidgee River, and also receives minor inflow from localised drainage.

Vegetation
The hilly areas are vegetated with a *Callitris* sp woodland. The flat plains country is vegetated with hummocky grasses, changing to water-tolerant species near the lagoon. Originally the plains areas would have supported an *Atriplex sp* dominated shrubland.

Ground Surfaces
Ground surfaces adjacent to the lagoon are stable or depositional. In addition these areas receive sandy aggraded sediment from the hilly areas. The interface between the plains and slopes is actively eroding, revealing a pisolitic gravelly pan.

Survey Method
The area was traversed on foot by two people. Sites were recorded with a theodolite and electronic distance measurer (EDM).

Features Recorded
Archaeological materials were prolific along the eroding edges of the sandsheet/hills interface. Extensive areas of red clay scalds contained numerous small ovens where quartzitic stone, outcropping on the nearby hills, had been used for heat retainers. Quantities of flaked stone artefacts were also present. A background lag deposit of pisolitic iron rich gravel littered the ground surface.

Seven small ovens were recorded across the site. They were evident as small (<2 m^2) areas of charcoal stained earth and associated piles of heat retainers. A majority of stone heat retainers were employed, although some composed of baked mud were also present. These mud heat retainers were very fragile, but remained in intact rakeout piles, suggesting their minimal reuse.

The artefactual materials were recorded as a continuous, extensive low-density scatter of 416 artefacts. Densities varied across the site.

11. Widgiewa
Area
An area of 9 km^2 of Widgiewa was examined.

Description
The Widgiewa property is situated on internally draining sloping plains country east of the Colombo Creek.

Climate
The climate is warm with dry summers. Rainfall is in the vicinity of 450 mm per annum. Rainfall exceeds evaporation for three months, usually between June and August.

Water Availability
Whilst areas west of the Colombo Creek drain into the creek, areas to the east consist of internally draining plains which form extensive swampy depressions. These may contain water for periods of several months, contingent upon local rainfall conditions.

Vegetation
The swampy areas are vegetated with *Eragrostis australasica*, and provide excellent feeding habitat for waterbirds (Robertson et al 1992:9). *E. australasica* tends to take over from other inundated species when conditions of permanent inundation reduce to episodic and increasingly ephemeral events (ibid). In the event of prehistoric wetter periods it is possible that these swampy areas would have been much more extensive and vegetated with other inundated species such as *Muehlenbeckia cunninghamii* (lignum) and *E. largiflorens*. The surrounding plains would have been vegetated with an *A. pendula* and *A. nummularia* shrubland. Isolated sandy ridges throughout the area would have been vegetated with a *Callitris* sp woodland.

Ground Surfaces
Ground surfaces were stable and most areas had never been cultivated. Soils in the vicinity of the sites were compact red earths. Soils within the swampy depressions were grey to black clays. Ground surface visibility was minimal for all but obtrusive site types.

Survey Method
Survey was targeted to an area of plains and canegrass swamp, indicated by the land owner to contain evidence of Aboriginal occupation.

Features Recorded
Ten undisturbed mounds were located in the vicinity of a large (4 km^2) area of *Eragrostis australasica* swampland. The sites occupied slightly elevated red soils. The property owner had also observed abundant evidence of stone artefact scatters, and a small quantity of grinding stones, mullers and axes had been retrieved from the property over the years. The mounds on Widgiewa are in unparalleled good condition having only ever been grazed, and not cropped or ploughed.

Widgiewa 1
Undisturbed mound measuring 11 m in diameter. Height at Apex approximately 0.3 m.
Widgiewa 2
Undisturbed mound measuring 15 m in diameter. Height at Apex approximately 0.5 m.
Widgiewa 3
Undisturbed mound measuring 9 m in diameter. Height at Apex approximately 0.5 m.
Widgiewa 4
Undisturbed mound measuring 14 m in diameter. Height at Apex approximately 0.5 m.
Widgiewa 5
Undisturbed mound measuring 15 m in diameter. Height at Apex approximately 0.5 m.
Widgiewa 6
Undisturbed mound measuring 20 m in diameter. Height at Apex approximately 0.5 m.
Widgiewa 7
Undisturbed mound measuring 9 m in diameter. Height at Apex approximately 0.3 m.
Widgiewa 8
Undisturbed mound measuring 16 m in diameter. Height at Apex approximately 0.3 m.
Widgiewa 9
Undisturbed mound measuring c.14 m in diameter. Height at Apex approximately 0.3 m.
Widgiewa 10
Undisturbed mound measuring c.14 m in diameter. Height at Apex approximately 0.3 m.

12. Morundah
Area
A 20 km^2 section of the Morundah property was also subject to a preliminary survey for the presence of archaeological materials.

Description
The Morundah area is set on internally draining sloping plains east of the Colombo Creek. This survey formed a continuum, in landscape and site type terms, with Widgiewa to the east and was also in proximity to the Colombo Creek survey area. Again the environment was one of poorly draining areas forming perennial *Eragrostis australasica* swampland.

Climate
The climate is warm with dry summers. Rainfall is in the vicinity of 450 mm per annum. Rainfall exceeds evaporation for three months, usually between June and August.

Water Availability
Water is available in ephemeral swampy depressions. These are filled by local rainfall and may contain water for periods of several months, dependent upon local rainfall.

Vegetation
The swampy areas are vegetated with *Eragrostis australasica*. The surrounding plains would have been vegetated with *A. Pendula* and *A. nummularia* alliances. Isolated sandy ridges throughout the area would have been vegetated with *Callitris sp.*

Ground Surfaces
Ground surfaces were predominantly stable, although the area had been under cultivation. Fox burrows were also numerous in the area.

Survey Method
Survey in the area was targeted to areas offering good visibility and concentrated upon the swampy depressions.

Features Recorded
Numerous large oven mounds were located here on the swamp margins. The sites were extensively disturbed however, due to rabbit and fox burrows. The land had also been subjected to years of cultivation. Local residents could recall the retrieval of skeletal and artefactual material from similar mounds some 60 years previously.

13. Colombo Creek
Area
An area of 3.75 km^2 was surveyed for archaeological materials along the northern frontage of the Colombo Creek. Within this, a complex of sites covering an area of 0.16 km^2 was recorded in detail.

Description
Currently the Colombo Creek landscape is one of low treeless plains and alluvial valley plains cut by a meandering creek course and associated sandy levees.

Climate
The climate is warm with dry summers. Annual precipitation is approximately 450 mm. Rainfall exceeds evaporation for three months between June and August.

Water Availability
The Colombo Creek is a tributary of the Yanco Creek which is in turn a distributary of the Murrumbidgee River. The Yanco, Colombo and Billabong Creeks all rely on high levels in the Murrumbidgee River for consistent flow conditions. Early accounts note that a river level of 3.6 m (12 feet) at Narrandera was required before a proper flow could be achieved (Jerilderie Herald 1913).

Vegetation
The current vegetation pattern is for grassed plains and *E. largiflorens* woodland along stream corridors. Descriptions of the landscape in the mid 1800's are brief, but indicate a relatively tough environment. Pine and scrub were noted on barren sand ridges, vast open plains were apparently covered with 'salsolacious' plants (Townsend 1851). The original dominant vegetation alliances would have been *A. Pendula* and *A. nummularia* .

Ground Surfaces
Where the old palaeochannel levee and aeolian deposits of texture-contrast soils have coincided with road reserves considerable erosion has occurred, resulting in the opening of extensive tracts of scalded land (claypans), interspersed with narrow uneroded ridges. These scalds comprise exposures of the clay subsoil and are relatively impermeable to water penetration (Houghton and Charman 1986).

The unusual levels of site visibility and the degree of site preservation stem from a combination of factors, including its situation on a road reserve, its coincidence with a major travelling stock route, its lack of large vegetation and its constituent soil type. Most of the site complex would have been originally deposited onto the texture contrast soils partially overlain by aeolian sand, adjacent to the wetlands associated with Colombo Creek. These sand deposits generally overlie compacted clay pans at the top of the B-horizon and are readily eroded by wind, water and trampling.

Survey Method
The initial survey was carried out on foot by two people. A 0.8 x 0.2 km complex of 49 sites was fully recorded with a theodolite and EDM. Three of the sites were subsequently excavated.

The Colombo Creek site complex offered an opportunity to investigate mounds within a revealed context of smaller ovens and lithic scatters. It also demonstrated that much of the so-called inter-site activity patterning associated with mounds lies buried beneath present ground surfaces.

Features Recorded
Two sites were recorded, composed in total of 37 small earth ovens, 6 large mounds, 1 burial, 4 probable hearths and an extensive lithic scatter.

Small Earth Ovens:
Colombo Creek 1
A 2 x 3 m mounded accumulation of baked clay rakeout from the operation of a small oven. It was located in an open context in an eroded clay pan. No artefacts were located in the site deposit.
Colombo Creek 2
A small 3 x 1.5 m accumulation of baked clay rakeout resulting from the operation of a small earth oven. The surface of the site was capped with uneroded compact sand. No artefacts were located in association with the site.
Colombo Creek 4
A small earth oven measuring approximately 6.5 x 7 m. The site was evident as an edge of heat retainers eroding from the margins of a compacted sand residual. No artefacts were evidently associated with the site.
Colombo Creek 5
A 2 x 2 m shallow accumulation of baked clay heat retainer rakeout resulting from the operation of a small earth oven.
Colombo Creek 6
An 8 x 1 m accumulation of baked clay heat retainer rakeout resulting from the operation of an earth oven. It was located in an open context partially as a lag deposit on an eroded clay pan surface.
Colombo Creek 7
A small 0.6 x 0.6 m pile of baked clay oven rakeout. It was located in an open context on an eroded clay pan surface.
Colombo Creek 9
A 2 x 1.8 m concentration of baked clay heat retainers resulting from the operation of an earth oven.
Colombo Creek 10
A 1 x 1 m pile of baked clay heat retainers resulting from the operation of a small earth oven.
Colombo Creek 11
An partially exposed concentration of baked clay heat retainers visible at the edge of a residual of uneroded compact sand. The dimensions of 1 x 1 m are approximate.
Colombo Creek 12
A 2 x 2 m pile of baked clay heat retainers.
Colombo Creek 13
A 0.4 x 0.4 m pile of baked clay heat retainers.
Colombo Creek 14
A linear 3 m exposure of baked clay heat retainers and dark sediment eroding from the edge of a sand residual.
Colombo Creek 15
A 1.2 x 1.2 m pile of baked clay heat retainers.
Colombo Creek 16
A 1.2 x 1.2 m concentration of baked clay heat retainers.
Colombo Creek 17
A 1.6 x 1.6 m concentration of baked clay heat retainers.

Colombo Creek 19
A 0.4 x 0.4 m pile of baked clay heat retainers.
Colombo Creek 20
A 1.5 x 1.5 m concentration of baked clay heat retainers.
Colombo Creek 21
A 1 x 1 m concentration of baked clay heat retainers.
Colombo Creek 22
A 2 x 2 m concentration of baked clay rakeout.
Colombo Creek 23
A 2 x 2.5 m spread of baked clay heat retainers.
Colombo Creek 24
A 1.5 x 1.5 m spread of baked clay heat retainer material.
Colombo Creek 28
A 1.5 x 1.5 m concentration of baked clay heat retainers.
Colombo Creek 30
A 1 x 1 m exposure of baked clay heat retainers.
Colombo Creek 32
A 1.5 x 1.5 m concentration of baked clay heat retainers. This site was later excavated.
Colombo Creek 33
A location of baked clay heat retainers of uncertain dimensions covered by a sand residual.
Colombo Creek 34
A location of baked clay heat retainers of uncertain dimensions covered by a sand residual.
Colombo Creek 35
A location of baked clay heat retainers of uncertain dimensions covered by a sand residual.
Colombo Creek 36
A 2 x 2 m concentration of baked clay heat retainers. This site was later excavated.
Colombo Creek 37
A 1.5 x 2 m concentration of baked clay heat retainers.
Colombo Creek 38
A 0.5 x 0.5 m concentration of baked clay heat retainers.
Colombo Creek 39
A 3 x 3 m deflated exposure of baked clay heat retainers.
Colombo Creek 40
A 1 x 1.2 m exposure of baked clay heat retainers.
Colombo Creek 41
A 2 x 2 m exposure of baked clay heat retainers.
Colombo Creek 43
A 1.3 x 1.3 m exposure of baked clay heat retainers.
Colombo Creek 44
A 3.5 x 3.5 m deflated exposure of baked clay heat retainers.
Colombo Creek 46
A 3.5 x 3.5 m deflated exposure of baked clay heat retainers.
Colombo Creek 47
A 1.5 x 1.6 m exposure of baked clay heat retainers with an associated exposed pit.

Mounds/Agglomerated Ovens:
Colombo Creek 8
A 15 x 10 m oven mound consisting of masses of baked clay heat retainer and dark ashy sandy sediment. The surface of the site was capped with an uneroded layer of compacted sand.
Colombo Creek 18
A 6 x 8 m oven mound consisting of compacted baked clay heat retainers and dark sandy sediment. The surface of the site was capped by uneroded compacted sand.
Colombo Creek 27
A compact deposit of heat retainers measuring 6 x (4+) m.

Colombo Creek 31
A 12 x 8 m mounded deposit of heat retainers and dark soil concealed beneath a sand residual. This site was later excavated.
Colombo Creek 42
A 9 x 5 m exposure of baked clay heat retainers.
Colombo Creek 45
A 12 x 12 m mound of baked clay heat retainers and dark sediment.

Hearths:
Colombo Creek 3
A 1 x 1 m area of dark burnt earth presumably resulting from the use of a campfire. It was located in association with CC2 and CC3. No artefacts were located in association with the site.
Colombo Creek 25
A 0.8 x 0.8 m patch of burnt and charcoal stained earth without any associated heat retainers.
Colombo Creek 26
A 0.8 x 0.8 m patch of burnt and charcoal stained earth presumably from a small surface fire.
Colombo Creek 29
A 2 x 2 m charcoal stain presumably resulting from a surface campfire.

Lithics:
An extensive low density artefact scatter (n=1846) was recorded in association with the oven mounds in this area. A detailed recording of the scatter was made and individual artefacts were plotted with the theodolite and EDM.
The assemblage was slightly quartz dominated. Fifty one percent of the artefacts were manufactured from various types of quartz, whereas 46% of artefacts were made from quartzites and silcretes. Small quantities of sandstone, metasedimentary, conglomerate and volcanic materials made up the remainder.

Burial:
The skeletal remains present on the site consisted of the in situ but fragmentary lower limb bones of an adult. The burial appears to have originally been in a flexed position. The bone was heavily mineralised and stained with manganese.

14. Billenbah Reserve
Area
Billenbah Stock reserve covers approximately 1.8 km^2 and is located on the southern side of the Murrumbidgee River.

Description
The reserve is set within alluvial valley plains but encompasses some minor topographic variety, including floodplain and undulating sand sheets.

Climate
The climate is warm with dry summers. Annual rainfall is approximately 450 mm. Effective rainfall occurs within the months of June, July and August

Water Availability
The reserve has frontage to the Murrumbidgee River providing access to a relatively reliable water supply. Old meander channels also cross the area and these would activate during flood periods.

Vegetation
The reserve is composed of a series of differing vegetational units and soils. Adjacent to the river lies a thin belt of flooded flats vegetated with the *E. camaldulensis* alliance. These are flanked to the south by a series of low, gently undulating sandsheets vegetated with *Callitris* sp and *E. melliodora*. Further south lies a low plain of red loam, crossed by extinct flood channels, with grazed grasses and *E. largiflorens* woodland. Originally

the same vegetation alliances would have been present, however timber cover would have been thicker and understoreys would have included small shrubs and native grasses.

Ground Surfaces
Ground surfaces are predominantly stable or depositional, with the exception of access tracks and scoured areas of river bank. Archaeological visibility was thus limited, with potential for buried materials.

Survey Method
The reserve area was thoroughly field-walked by two people.

Features Recorded
One scarred tree and three isolated stone artefacts were recorded. All of the artefacts were recorded on a graded and well used sandy track which traced the perimeter of the reserve.

Billenbah East 1
BE1 consisted of an isolated find of a single milk quartz flaked piece, measuring 21 x 13 x 8 mm. The site was located approximately 100 m from the current channel of the Murrumbidgee River, exposed in a graded access track.

Billenbah East 2
BE2 was a live *E. largiflorens* tree with a small oval scar on the trunk. The tree trunk circumference measured 2.84 m. The scar faced 290 degrees magnetic and commenced at a point 0.65 m above ground. The scar measured 0.74 m in length and was a maximum of 0.21 m in width, excluding regrowth. A small axe cut occurred at the base of the scar.

Billenbah East 3
BE3 was an isolated find of a waterworn quartzite cobble manuport, measuring 130 x 88 x 59 mm. The artefact was located on the floodplain of the Murrumbidgee River, approximately 1150 m from the stream channel. It was located in a grassed flat area.

Billenbah East 4
BE4 consisted of an isolated find of a single stone artefact, an orange silcrete flake, with a distal snap and step fracturing on the dorsal proximal surface. It measured 15 x 17 x 7 mm. The artefact was located on the Murrumbidgee River floodplain, approximately 1050 m from the river channel. It was located in disturbed ground adjacent to a graded access track.

15. Narrandera to Morundah Road - Cuddell Creek
Area
A 1.25 km^2 area of roadside reserve with frontage to the Cuddell Creek, south of Goonerah Lagoon along the Narrandera to Morundah Road was surveyed for the presence of archaeological materials.

Description
The survey area is within the eastern alluvial valley plains landscape. Cuddell Creek is a small and relatively ephemeral tributary of the Yanco Creek. The survey area included flat land adjacent to and within the alluvial floodplain of the creek as well as a small quartzitic ridge to the east.

Climate
The climate is semi arid with cool mean annual temperatures. The area is within the 400 mm rainfall isohyet. Rainfall exceeds evaporation for three months, from June to August.

Water Availability
The Cuddell Creek is a minor water source, however water would be available nearby in the Yanco Creek. Apart from local runoff these creek systems are heavily reliant upon flow conditions within the Murrumbidgee River. Once filled, however, water may be retained within deep water holes.

Vegetation
The quartzitic ridge was vegetated with *Casuarina sp* and *E. melliodora* trees. *E. camaldulensis* and *E. largiflorens* lined the creek bank. The understorey consisted of low grasses, *Marsilia drummondii* (nardoo), sedges and *Solanum esuriale.*

Ground Surfaces
Ground surfaces were eroding and aggrading.

Survey Method
The reserve extended to both sides of the road and the entire area was thoroughly walked by two people.

Features Recorded
A small scatter of 5 stone artefacts and a hearth feature of 'concreted' grey clay was located, as well as a further scatter of five stone artefacts on the eastern roadside. These are interpreted as one site which has been bisected by the road. The site was exposed in a scalded erosion patch measuring 9000 m^2 (300x30 m).

16. Tarabah Stock Reserve
Area
The Tarabah Stock Reserve has frontage to the eastern side of the Yanco Creek, and measures about 1.25 km^2.

Description
The area is situated within alluvial valley plains. A variety of minor relief is evident in the form of low lying river flats and floodplain areas flanked by low sandy rises.

Climate
The climate is semi arid with cool mean annual temperatures. The area is within the 400 mm rainfall isohyet. Rainfall exceeds evaporation for three months, from June to August.

Water Availability
Water would be available within the Yanco Creek, which is heavily reliant upon flow conditions within the Murrumbidgee River. During dry periods some water is retained within deep holes in the creek bed.

Vegetation
The vegetation alliances present include *Callitris* sp on the sand ridges and *E. camaldulensis* along the stream channel. The major alteration from original conditions has been wrought by stock grazing which has removed the shrub and grass understoreys.

Ground Surfaces
Ground surfaces were eroding and aggrading.

Survey Method
The reserve was thoroughly surveyed by two people on foot Archaeological visibility varied across the area. Ground visibility was high in floodplain areas and on tracks extending around the perimeter of the area. The higher sandy ridges were covered in a dense undergrowth dominated by *Echium vulgare.* This was up to 1.2 m high in patches and visibility reduced to zero.

Features Recorded
Two mound sites were located, both associated with artefact scatters. The sites were exposed by vehicular tracks. It is likely that further archaeological materials are located within the reserve concealed by the low degree of ground visibility.

Tarabah 1
Tarabah 1 was a mound exposed in a track skirting the floodplain. It measured 16 m in diameter. It was situated on the first break of slope above the creek floodplain. The actual stream course is 50 m from the mound. A very low density scatter covering 1500 m^2, of 35 stone artefacts was associated with the mound. Four artefacts were embedded within the surface of the mound deposit.

Tarabah 2
Tarabah 2 was located approximately 1.4 km southwest of Tarabah 1. It consisted of an oven mound, again exposed in the track. Its full extent was unable to be determined due to surrounding dense vegetational cover. Twenty nine artefacts were located along a 1.2 km section of track extending either side of the mound.

17 Yanco Creek
Area
A Travelling Stock Reserve of approximately 5 km^2 running between Yanco Creek and the Newell Highway south of Morundah was surveyed for archaeological sites.

Description
The survey area lies within alluvial valley plains, and consisted of floodplain and creek levee topography.

Climate
The climate is semi arid with cool mean temperatures. Rainfall is effective for three months of the year, generally between June and August. Annual rainfall is in the vicinity of 400 mm.

Water Availability
The Yanco Creek is a major distributary of the Murrumbidgee River and stretches in a southwesterly direction across the survey region. Flow conditions in the Yanco Creek are reliant upon conditions in the Murrumbidgee River, although local runoff is also collected. Deep water holes were originally present along the creek course. Several minor tributaries and anabranching flood channels of the creek cross the reserve.

Vegetation
E. camaldulensis trees line the major stream channels, whilst a *E. largiflorens* woodland occupies patchy areas of higher ground. Floodplain areas would probably have been vegetated with a low shrubland of *Atriplex* sp.

Ground Surfaces
Soils were composed of silts and clays, with some sandy areas along levees. Ground surfaces were predominantly stable, although vegetation was minimal along the levee areas, and visibility was generally high.

Survey Method
The reserve was comprehensively field walked by two people.

Features Recorded
Seven oven mounds were located within the survey area, four were located on sandy levee deposits adjacent to the main channel of the Yanco Creek and three were located on elevated sandy levee banks associated with a minor eastern tributary. Three of the mounds located adjacent to the Yanco Creek had artefact scatters in association.

Throughout the Yanco Creek survey area a distinct locational pattern for mounds was observed - all occupied elevated ground, the natural flood levees, adjacent to stream channels. The stone assemblage was strongly dominated by quartz as a raw material. Little other economic remains could be discerned apart from mussel shell fragments, and whilst they would obviously constitute a food resource, the presence of shell in such deposits could equally be attributable to the use of shell for implements.

Yanco Creek 1
YCM1 was located 12 m from the current water levels in Yanco Creek, and occupied an elevated position, between the creek and a track skirting the creek margin, with a slope away on two sides, both towards and away from the creek. The mound measured 8 x 9 m, although its margins were very well vegetated and it may have been slightly larger. The deposit was compact and greyish in colour, with heat retainers and freshwater mussel shell visible on its surface. It had 5 artefacts within 50 m of its deposit. Historic artefacts relating to the use of the reserve as a Travelling Stock Reserve also littered the locality.

Yanco Creek 2
YCM2 was located adjacent to the Yanco Creek approximately 190 m further south (along the track) and had a section of access track crossing its northern edge. It measured 19.5 x 13.5 m and had an elevation of approximately 0.3 m above the surrounding ground surface. Concentrations of fired heat retainers were evident within the mound surface. Fifty flaked stone artefacts were exposed within its loose surface, plus innumerable tiny flakes and chips of quartz. A further 6 artefacts were exposed in the adjacent track.

Yanco Creek 3
YCM3 was located a further 15-20 m along the track, and was adjacent to the Yanco Creek. The edge of its deposit was 20 m from the high water level. It measured 16.5 x 17 m. Its surface was apparently undisturbed, and was obscured with vegetation and leaf litter. Four artefacts were exposed on its surface, a quartz core and three quartz flakes.

Yanco Creek 4
YCM4 comprised a large undisturbed mound 340 m northeast of the Yamma Road bridge over the Yanco Creek. It measured 16 x 11 m and had a height of 0.45 m above the surrounding ground surface. It had an undulating surface, with profuse fired clay heat retainers. No artefacts or mussel shell were evident on its surface.

Yanco Creek 5
YCM5 was located beside a dry flood channel running east of the Yanco Creek. It was approximately 10 m from the stream bank. It comprised a large very ashy dark grey deposit, and had been extensively colonised by rabbits, there were upwards of 30 rabbit burrows entering its surface. It measured 18 x 17 m and had an elevation of approximately 0.8 m above the current ground surface. A crystalline quartz flaked piece and a quartz chip were located about 20 m southeast of the mound. A triangular tabular section of a quartzite grinding stone was located within 40 m of the mound. It had usewear on one flat surface and rejuvenation pitting in the centre.

Yanco Creek 6
YCM6 was also located adjacent to a minor tributary channel of the Yanco Creek. It lies approximately 340 m from Yanco Creek itself. It measured 12 x 14 m and had an elevation of 0.2 m above the current ground surface. No mussel shell or artefacts were visible in the locality.

Yanco Creek 7
YCM7 consisted of a large ashy mound deposit riddled with rabbit burrows. Large grey and yellowish heat retainers studded its devegetated surface. It measured 15 x 15 m and had an elevation of 0.3 m. The mound was situated beside a minor flood channel and was about 8 m from the waters edge. In appearance it was identical to YCM5.

18. Widgiewa Reserve

Area
An area of 0.6 km^2 was surveyed along the Widgiewa Road.

Description
This area was situated within open sloping plains country situated some distance from the Colombo Creek.

Climate
The climate is warm with dry summers. Annual rainfall is in the vicinity of 400-450 mm. Rainfall exceeds evaporation for three months, between July and August.

Water Availability
No water is available in the immediate survey vicinity, although during periods of rain, water may collect in shallow clay pans in the area.

Vegetation
The area would originally have been vegetated with *A. Pendula* and *Atriplex nummularia* alliances. These have been removed by grazing and the area currently supports low grasses.

Ground surfaces
Soils consisted of red earths and were actively eroding. Archaeological visibility was good.

Survey Method
The roadside was walked by two people.

Features Recorded
A low density artefact scatter (maximum 2 artefacts per m^2) and a deflated pile of baked clay heat retainers beside a small oven were recorded. The extent of the site was determined by differential erosion and there is a high likelihood that it continues under uneroded surrounding soils. It is also likely that construction of the sealed road adjacent to the site has already destroyed a proportion of the site.

A range of flaked stone materials were present, including; flaked quartz pebbles, retouched silcrete flakes, silcrete cores and numerous tiny quartz flakes and chips. The oven was quite deflated, consisting of a small concentration of well consolidated grey clay heat retainers amidst a spread-out scatter of baked clay.

19. Lake Urana
Area
An area of 3.75 km^2 on the eastern side of Lake Urana was surveyed.

Description
Lake Urana is a large kidney shaped lakebed situated within sloping plains country. It has a well formed sandy lunette on its eastern side. The western side of the lake has cliffed quite markedly, exposing tertiary pebble beds and gravel deposits. It is likely that these beds would have been exposed to some degree in the past and they may have constituted a valuable resource in this otherwise stone poor region.

Climate
The climate is warm with dry summers. Rainfall averages 450 mm per annum, and is effective for the months of July through to August.

Water Availability
The lake is filled by several small creeks and generally contains some surface water in late winter and early spring. However it has only filled to capacity four times since 1848 (Page et al 1994:38). At present it provides good migratory bird habitat with extensive areas of inundated woodland and marsh understorey.

Vegetation
The lunette is vegetated with *Callitris* pine forest and an understorey of native shrubs. The lakebed is vegetated with *E. camaldulensis* woodland, *Eragrostis* and *Muehlenbeckia* sp.

Ground Surfaces
Soils of the surveyed area consisted of red sands. Ground surfaces were generally stable, with the exception of tracks and several quarried pits.

Survey Method
Areas offering good visibility were sought within the survey area and then intensively searched for archaeological materials. A series of borrow pits for road construction materials and their surrounds, including a section of State Forest offered good visibility.

Features Recorded
One of the quarry pits revealed the presence of a buried site visible in the north-eastern pit profile. It extended for 20 m along the quarry face and as a lag deposit down the cutting bank. Nine stone artefacts and part of an eroded oven were recorded. Baked clay pellets were employed as heat retainers. It is likely that the extraction of sediment from the pit had already resulted in removal of most of the site. No further archaeological materials were located. With the exception of the access tracks and gravel pits however, the remaining ground surfaces were stable. Thus the lack of archaeological materials is likely to be a factor of reduced general visibility.

20. Thurrowa Road Reserve
Area
Thurrowa Road Reserve covered an area of 2.5 km^2.

Description
Thurrowa Road Reserve forms an environmental continuum with the Yanco Creek Stock Reserve previously discussed. The landscape is composed of alluvial valley plains. The reserve lies on the eastern floodplain of the Yanco Creek and was predominantly composed of low lying areas prone to inundation interspersed with minor tributary channels and sandy levee areas.

Climate
The climate is semi arid with cool mean temperatures. Rainfall reaches 450 mm per annum, and is effective for three months, from July to August.

Water Availability
Water would be available in the creek and in the old meander channels during periods of flooding. Flows within the Yanco Creek, as previously mentioned, are dependent upon high water levels within the Murrumbidgee River as well as upon local catchment.

Vegetation
The vegetation comprised a *E. Camaldulensis* woodland alliance with a *E. largiflorens* woodland on better drained areas.

Ground Surfaces
Considerable grading and bulldozing of young flood regeneration timber had occurred in patches throughout the reserve and considerable quantities of timber were being removed for firewood. Ground surfaces were otherwise stable or depositional, although an access track skirting the levee of Yanco Creek and the creek bank itself were actively eroding.

Survey Method
Survey was carried out by two people on foot and the entire reserve was comprehensively walked. Most of the reserve was thickly covered in pasture grasses and visibility for small archaeological features such as individual artefacts was poor.

Features Recorded
Three mounds were recorded. They were large and isolated from one another. All occupied levee deposits. All comprised ashy soil and baked clay heat retainers and were interpreted as resulting from the operation of earth ovens.

Thurrowa Road Reserve 1
Mound 1 was situated on a levee of the creek, 7 m from the waters edge. It was located 1.5 m above the current water level. The mound measured 12 x 16 m. It had a slightly depressed centre and was flanked on its northern side by low pits. These were possibly clay borrow pits, for the production of heat retainers. It had a very black silty deposit with heat retainers visible.

Thurrowa Road Reserve 2
Mound 2 was situated beside a small cut-off billabong of the Yanco Creek. It measured 10 x 10 m and had an elevation of approximately 0.5 m. It was located 12 m from the billabong edge. Its surface was well vegetated, however orange and black heat retainers were visible across its surface.

Thurrowa Road Reserve 3
Mound 3 was situated 40 m from the Yanco Creek and approximately 150 m from Mound 2. It measured 12 x 10 m and also had a depressed centre. It was surrounded by a horseshoe shaped swampy-marsh area. Its deposit was very black with tiny gritty fragments of baked clay heat retainer.

21. Main Canal Road near 'Bareena'

The roadside reserve along Main Canal Road was surveyed for a distance of 12 km, from its junction with the Sturt highway to Billenbah Stock Reserve. The area covered was approximately 8.75 km^2.

Description

This area is situated within alluvial plains lands at the margins of the southern floodplain of the Murrumbidgee River. The reserve was composed of land transitional between the floodplain and sand ridges to the east.

Climate

The climate of the area is classified as semi arid with cool mean temperatures. Rainfall exceeds evaporation for the months of June, July and August, and does not exceed 400 mm per annum.

Water Availability

The closest available water is from the Murrumbidgee River.

Vegetation

Two main vegetation alliances are found in the area, *E. camaldulensis* , on the floodplain and *E. microcarpa /Callitris* sp on the sand ridges.

Ground surfaces

Soils were composed of alluvial clays and areas of red sand. Ground surfaces were predominantly stable.

Survey Method

The area was walked by two people.

Features Recorded

Two scarred trees and one isolated stone artefact were recorded. Ground visibility was poor however and there was potential for further stone materials to lie concealed in the survey area. Both scars were on *E. microcarpa* trees and were elongate and narrow.

Main Canal Road 1
MCR1 comprised a live *E. microcarpa* tree with an elongate oval scar on its trunk. The tree trunk circumference measured 3.28 m. The scar faced 258 degrees magnetic and commenced 0.3 m above ground. The scar measured 1.79 m in length and had a maximum width of 0.28 m, excluding regrowth. No axe marks were visible on the scarred surface. The tree was located at a vegetational boundary between *E. largiflorens* woodland and *Callitris* sp forest.
An isolated stone artefact was recorded in association with the tree. It comprised a proximal silcrete flake section with usewear.

Main Canal Road 2
MCR2 comprised a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.3 m. The scar faced 259 degrees magnetic and commenced 0.3 m above ground. The scar measured 1.28 m in length and had a maximum width, excluding regrowth, of 0.15 m. No axe marks were visible on the scarred surface.

22 Euwarderry Lagoon

Area

A 14 km^2 area of Travelling Stock and Crown Reserve and State Forest was surveyed in the vicinity of Euwarderry Lagoon north of the Murrumbidgee River, just west of Leeton.

Description
The survey area lay within alluvial valley plains topography. Minor topographic variations occurred including; low lying river flats, sandy levees, floodplain areas and a lagoon. To the north the area was flanked by irrigated rice fields.

Climate
The climate of the area is classified as semi arid with cool mean temperatures. Annual rainfall is 400 mm and it exceeds evaporation for the months of June, July and August.

Water Availability
Water is available in the Murrumbidgee River and its associated complex of lagoons and inundated flats.

Vegetation
The area was vegetated with *E. camaldulensis, E. largiflorens* and *Callitris* sp. Major alterations to the vegetation structure have occurred with the displacement of native shrubs and grasses in the alliance understoreys. Tree clearance was also evident in the forested areas. Thick lines of *E. largiflorens* woodland could be discerned in the distance to the north following palaeochannel course.

Ground Surfaces
Soils consisted of alluvial silts and clays with some sandy areas on levees and low source bordering dunes. Ground surfaces were predominantly depositional, and currently stable. Exceptions occurred along the current river bank, where erosion is active, and in one area of sand dune where quarrying has taken place. Animal tracks and trails through the area also provided some visibility.

Survey Method
The area was comprehensively walked by two people. The survey of this area was undertaken with a further aim in mind, which was to attempt a field correlation of a surveyor's report of the early 1800's which had mentioned Aboriginal burials in a sand feature along the river. On the traverse sketches for his 1848 survey of a section of the Murrumbidgee River Larmer made note of "Blacks Graves" marked with an asterisk just west of a creek named Oak Creek flowing into the river from the north (Larmer 1849 Field Notebook no.641). The pattern of river bends and inward flowing creeks suggests quite strongly that this area corresponds with a present section of the M.I.A. State Forest around Euwarderry Lagoon.

An attempt was made to retrace Larmer's steps during field survey and view the area where the graves were marked. The entire northern river bank was examined from the westernmost end of Euwarderry lagoon to an area known as Possum Patch. On a straight river section approaching Whitton beach a low sand hill exists. It would appear to be the feature recorded by Larmer. It is presently being sectioned by the river channel, and has been mined for sand. A single stone artefact was located in the base of the excavated pit, a cream silcrete core measuring 21 x 18 x 12 mm.

The ability of Larmer to recognise such a feature in the landscape clearly suggests that they were at least initially marked with above ground features. The use of plural in his description is also interesting, as he may be referring to what would now be known as a cemetery. It fulfils several of the criteria listed by Pardoe (1988:173-8) for that entity i.e. boundedness of the geographic feature, multiple interment and grave marking.

Features Recorded
A discussion was held with a local landowner who related that oven mounds were numerous in the vicinity 30 to 40 years ago, but had been virtually annihilated by the levelling of land for irrigation agriculture. They were apparently not associated with the river but rather with the *E. largiflorens* woodland, grey soils and palaeochannels several hundred metres to the north of the river corridor. These channels have since been canalised for drainage of the irrigation scheme.

Survey of the reserve corroborated the verbal account, in that little evidence of oven mounds or small ovens was encountered. Only one small oven was recorded, associated with an extensive, low-density scatter of 42 stone artefacts. Numerous disturbed baked clay heat retainers were also distributed across the site area of some 5000 m^2. Eight scarred trees were recorded and a freshwater shell midden was located along the bank of the Murrumbidgee River. Two isolated artefacts were also recorded.

Euwarderry Lagoon 1
EL1 consisted of an isolated find of a red quartzite core, measuring 114 x 93 x 42 mm. It was located north of the river and lagoon system, approximately 20 m from the lagoon edge, in a ploughed field. The artefact exhibited grooved damage from a disc plough.
Euwarderry Lagoon 2
EL2 consisted of an isolated find of a sandstone flaked piece, measuring 21 x 17 x 9 mm, in association with fragments of freshwater mussel shell, one small baked clay heat retainer, and a fragment of old green glass, measuring 16 x 12 x 5 mm. The artefact was exposed in the borrow pit beside a raised bank constructed for field irrigation, and its original context was thus quite disturbed.
Euwarderry Lagoon 3
EL3 was a live *E. largiflorens* tree with an elongate oval scar, with a slightly irregular basal shape on its trunk. The tree trunk circumference measured 2.4 m. The scar faced 107 degrees magnetic and commenced at a point 0.10 m above ground. The scar measured 1.95 m in length and was a maximum of 0.66 m wide, excluding regrowth. Regrowth was estimated at 0.07 m approximately. Two lines of blunt axe marks were located 0.30 m above the base of the scar and a single sharp (more recent) axe mark was located 0.60 m above the base of the scar. An interrupted line of blunt axe marks was also located 0.50 m below the upper termination of the scar.
Euwarderry Lagoon 5
EL5 was a live *E. largiflorens* box tree with an oval scar on its trunk. The tree trunk circumference measured 2.38 m. The scar faced 16 degrees magnetic and commenced at a point 0.10 m above ground. Scar length measured 1.31 m and maximum width measured 0.36 m, excluding regrowth, which was estimated at 0.04 m. Two sharp axe cuts were located at the upper termination of the scar.
Euwarderry Lagoon 6
EL6 comprised a live *E. camaldulensis* tree with an elongate scar on its trunk. The tree was on a slant of approximately 45-50 degrees and the scar was removed from the underside. The tree trunk circumference measured 4.05 m. The scar faced 358 degrees magnetic and commenced at a point 0.25 m above ground. Scar length measured 3.3 m and the maximum breadth was 0.35 m, excluding regrowth. A small hollow in the tree, unrelated to the scar event, was located above the scar.
Euwarderry Lagoon 7
EL7 was a dead *E. camaldulensis* tree with an long, almost occluded, scar on its trunk. It was located in standing water on the interior of Euwarderry lagoon and could not be accessed for measurement.
Euwarderry Lagoon 8
EL8 was a live *E. camaldulensis* tree with an oval scar on its trunk. The tree trunk circumference measured 4.2 m. The scar faced 53 degrees magnetic and commenced at the base of the tree. Scar length was 2.46 m and the maximum width measured 0.54 m, excluding regrowth. The tree was located approximately 10 m from the bank of the Murrumbidgee River.
Euwarderry Lagoon 9
EL9 was a live *E. camaldulensis* tree with an elongate oval scar on its trunk. The tree trunk circumference measured 3.47 m. The scar faced 261 degrees magnetic and commenced at a point 0.10 m above ground. The scar measured 3.1 m in length and was a maximum of 0.36 m wide, excluding regrowth. A small sucker branch had sprouted from the base of the scar. The tree was situated approximately 25 m from the bank of the Murrumbidgee River.
Euwarderry Lagoon 10
EL10 was a fresh water shell midden. The midden occurred along the present bank of the Murrumbidgee River as a buried lens in the bank cutting. The shell lens appeared to be a minimum of 0.03 m thick. It was buried by approximately 0.12 m of soil. It extended

along the river bank for a distance of 50 m. Traces of shell were also discernible in scuffed topsoil extending approximately 5 m away from the bank. Minimum site area was estimated at 250 m^2. The shell deposit was dark in colour with soft fragmentary mussel shell in a powdery matrix. No heat retainers were observed in shell fallout at the base of the cutting.

Euwarderry Lagoon 11

EL11 was a dead *E. camaldulensis* tree with a broad oval scar on the trunk. The tree trunk circumference measured 3.36 m, and the upper section of trunk above the scar had rotted and fallen away. The scar faced 121 degrees magnetic and commenced 0.15 m above ground. Scar length measured 1.67 m and maximum width measured 0.86 m, excluding regrowth. A single line of three axe cuts was located across the base of the scar.

Euwarderry Lagoon 13

EL13 was a live *E. camaldulensis* tree with an elongate oval scar on one forked trunk. Tree trunk circumference measured 3.56 m. The scar faced 160 degrees magnetic and commenced 0.4 m above ground. The scar was 2.38 m long and had a maximum width, excluding regrowth of 0.66 m. Two series of axe cuts crossed the upper and lower terminations of the scar. A section of recent damage resulted in the removal of some of the bark from the lower section of the scar, extending into the fork of the tree trunk.

Euwarderry Lagoon 14

EL14 was an open artefact scatter exposed on an access track leading into the Euwarderry lagoon area. Forty four flaked stone artefacts were scattered over an area of 5500 m^2. Site extent was determined by ground visibility and exposure. Artefacts were composed of varieties of quartz, quartzite, silcrete and chert. A single small oven (EL15) was recorded in association with the scatter. The site was located between 10 and 300 m from the lagoon.

Euwarderry Lagoon 15

EL15 comprised an accumulation of heat retainer rakeout from a small oven. It was situated on wind eroded red soils approximately 50 m from Euwarderry Lagoon. The rakeout measured 0.5 x 0.7 m. The site was recorded in association with an open artefact scatter, EL14.

23. Newell Highway Stock Reserve

Area

A 3 km^2 reserve with frontage to the eastern side of Yanco Creek was surveyed for the presence of archaeological materials.

Description

The survey area was situated within alluvial valley plains. At this point the Yanco creek follows a relatively confined stream course, and the survey area was mostly composed of low source bordering dunes flanking the stream channel, along with some low inundated flats inside the stream meanders. The creek flows within a confined floodplain of approximately 650 m width.

Climate

The area has a semi arid climate. It is characterised by cool mean annual temperatures and seasonally effective rainfall. Annual precipitation does not exceed 400 mm.

Water Availability

Water would be available within the Yanco Creek. As mentioned earlier, the Yanco Creek relies upon high levels in the Murrumbidgee River to maintain a consistent flow. Whilst it also collects localised run-off, this is fairly unreliable, water would however retract to deeper water holes within the stream course during dry periods, before drying altogether.

Vegetation

The reserve was vegetated with *Acacia* sp, *E. camaldulensis* and *Callitris* pine. Originally it would also have had an understorey of shrubs and grasses.

Ground Surfaces
Soils varied between alluvial clays in the lower areas to thick aeolian sands in the dune areas. Ground surfaces were mostly stable, although blow out erosion occurred in the southern areas of the dunes. This appeared to be the result of overgrazing. A graded access track ran between the dunes and floodplain.

Survey Method
The survey area was comprehensively walked by two people.

Features Recorded
Several occurrences of flaked stone artefacts were located throughout the reserve, mostly confined to the lower sections of dune/floodplain ecotone. Some artefacts, however, were located in sand dune erosion blow outs to the east of the reserve. The materials were recorded as a series of four concentrations (n= 27, n=3, n= 3 and n=6) and 18 isolated finds. A nodule of red ochre was located in one of the scatters. It is considered likely that the artefacts represent a continuous scatter of generally low density, and that the non-appearance of any artefacts in some sections is a factor of ground visibility, and the loose sandy substrate.

No evidence of mounds was encountered in the survey, despite particular attention being paid to their discovery. It could be stated with confidence that the absence of mounds is a real pattern. All low lying areas were inspected as were all rabbit burrows and erosion patches for evidence of their characteristic ashy soil and heat retainers. It is possible that smaller individual ovens may be present but are concealed by grass cover and uneroded sediment.

24. Snake Tree Reserve
Area
Snake Tree Reserve is a small parcel of Crown Reserve of about 0.25 km^2, on the north bank of the Murrumbidgee River. It was surveyed virtually as a continuation of the survey of Euwarderry Lagoon.

Description
Snake Tree Reserve is located within alluvial valley plains topography. It consists of high ground directly abutting the main river channel.

Climate
The climate of the area is classified as semi arid with cool mean temperatures. Annual rainfall is 400 mm, and it exceeds evaporation for the months of June, July and August.

Water Availability
Water is available in the Murrumbidgee River.

Vegetation
The area was vegetated with *E. camaldulensis* and *E. largiflorens* alliances. Major alterations to the vegetation structure have occurred due to grazing and forestry. The native shrubs and grasses in the alliance understoreys are removed and many mature trees have been cleared.

Ground Surfaces
Soils consisted of alluvial silts and clays with some sandy areas on levees. Ground surfaces were predominantly depositional, and currently stable. Exceptions occurred along the current river bank, where erosion is active, and in one area where an access track entered the area.

Survey Method
The reserve was comprehensively field walked by two people.

Features Recorded
Thirty four sites were recorded consisting of 33 scarred trees and one small oven. The reconstruction of patterns of initial European settlement in the locality raised the possibility that some, or most, of these scarred trees have resulted from European landuse.

Snake Tree Reserve 1
STR1 was a dead *E. camaldulensis* tree with a rounded scar on its trunk. The tree trunk circumference measured 3.56 m. The scar faced 110 degrees magnetic and commenced at a point 0.65 m above ground. Scar length measured 0.8 m and maximum width measured 0.53 m excluding regrowth.
Snake Tree Reserve 2
STR2 was a half dead *E. camaldulensis* tree with an elongate scar on its trunk. The tree trunk circumference measured 2.92 m. The scar faced 130 degrees magnetic and commenced at a point 0.4 m above ground. The scar measured 1.4 m in length and had a maximum width of 0.5 m, excluding regrowth.
Snake Tree Reserve 3
STR3 was a live *E. camaldulensis* tree with an elongate oval scar on its trunk. The tree trunk circumference measured 4.05 m. The scar faced 56 degrees magnetic and commenced at a point 0.57 m above ground. The scar measured 3.38 m in length and was a maximum of 0.84 m in width, excluding regrowth. A multiple line of relatively sharp axe cuts crossed the scar 0.2. m above the base.
Snake Tree Reserve 4
STR4 was a live *E. largiflorens* tree with an elongate scar on the trunk. Tree trunk circumference measured 4.0 m. The scar faced 163 degrees magnetic and commenced at a point 0.7 m above the ground. The scar measured 2.04 m in length and was a maximum of 0.44 m wide, excluding regrowth. Multiple lines of axe marks crossed the upper and lower ends of the scar.
Snake Tree Reserve 5
STR5 was a live *E. largiflorens* tree with a scar on one forked section of trunk. The tree trunk circumference measured 4.0 m. The scar faced 295 degrees magnetic and commenced at a point 0.65 m above ground. The scar measured 0.92 m in length and was a maximum of 0.2 m wide, excluding regrowth. Axe cuts, almost obscured by regrowth were located crossing the basal termination of the scar.
Snake Tree Reserve 6
STR6 was a live *E. largiflorens* tree with an irregular scar on its trunk. The tree trunk circumference measured 1.62 m. The scar faced 335 degrees magnetic and commenced 0.25m above ground. Scar length measured 2.1 m and maximum width was 0.82 m excluding regrowth. Multiple series of straight axe cuts crossed the scar at the base and the centre and a line of crossed axe cuts crossed the top.
Snake Tree Reserve 7
STR7 was a live *E. largiflorens* tree with an elongate scar on the trunk. The tree trunk circumference measured 1.64 m. The scar faced 15 degrees magnetic and commenced 0.55 m above ground. The scar measured 1.1 m in length and had a maximum width of 0.16 m. Axe cuts were located 0.12 m below the upper termination of the scar and 0.14 m above the lower termination.
Snake Tree Reserve 8
STR8 was a live *E. largiflorens* tree with an oval scar on one forked section of trunk. The basal trunk circumference measured 2.4 m whilst the circumference of the scarred limb measured 1.74 m. The scar faced 212 degrees magnetic and commenced 0.73 m above ground. A series of axe cuts crossed the scar 0.10 m above the base, and a single shallow axe cut was located in the centre of the scar. A small suckering branch was growing just below the scar.
Snake Tree Reserve 9
STR9 was a live *E. largiflorens* tree with an elongate scar on the trunk. The tree trunk circumference measured 1.73 m. The scar faced 63 degrees magnetic and commenced at a point 0.10 m above ground. The scar measured 2.74 m in length and was a maximum of 0.52 m wide, excluding regrowth. A multiple line of axe cuts was located 0.75 m above the basal termination.

Snake Tree Reserve 10
STR10 was a live *E. largiflorens* tree with an irregular scar on a major limb of a bilobate trunk. Basal trunk circumference measured 3.5 m whilst the circumference of the scarred limb measured 2.04 m. The scar faced 129 degrees magnetic and commenced approximately 0.68 m above ground. This was determined by the location of the basal axe marks, since the lower termination of the scar was damaged by fire. A further line of crossed axe cuts was located 1.26 m above the lower series.

Snake Tree Reserve 11
STR11 was an eroding pile of heat retainer rakeout from a small oven, measuring 1 x 0.5 m. The site was exposed on a track and was situated approximately 350 m from the main river channel.

Snake Tree Reserve 12
STR12 was a live *E. largiflorens* tree with a small oval scar on the trunk. The tree trunk circumference measured 2.71 m. The scar faced 320 degrees magnetic and commenced at a point 0.6 m above ground. The scar measured 0.51 m in length and was a maximum of 0.16 m wide, excluding regrowth. Lines of axe cuts were located across the upper and lower terminations.

Snake Tree Reserve 13
STR13 was a live *E. largiflorens* tree with an elongate scar on the trunk. Trunk circumference measured 2.17 m. The scar faced 154 degrees magnetic and commenced 0.3 m above ground. The scar measured 1.53 m in length and was a maximum width of 0.47 m, excluding regrowth. No axe marks were visible on the scarred surface.

Snake Tree Reserve 14
STR14 was a live *E. largiflorens* tree with an elongate scar on the trunk. Trunk circumference measured 2.94 m. The scar faced 150 degrees magnetic and commenced at a point 0.45 m above the ground. The scar measured 2.29 m in length and was a maximum of 0.67 m wide, excluding regrowth. A series of blunt axe cuts were located 0.47 m above the basal termination.

Snake Tree Reserve 15
STR15 was a live *E. largiflorens* tree with an elongate scar on the trunk. Trunk circumference measured 2.29 m. The scar faced 305 degrees magnetic and commenced at a point 0.05 m above ground. The scar measured 2.58 m in length and was a maximum width of 0.72 m, excluding regrowth. Lines of axe cuts were located 0.20 m above the base and 0.39 m down from the top of the scar.

Snake Tree Reserve 16
STR16 was a live *E. largiflorens* tree with an oval scar on the trunk. The tree trunk circumference measured 1.67 m. The scar faced 25 degrees magnetic and commenced 0.43 m above ground. The scar length measured 0.93 m and it was a maximum of 0.20 m wide, excluding regrowth. Two lines of sharpish axe marks were located, one 0.18 m above the base of the scar, the other 0.03 m down from the top.

Snake Tree Reserve 17
STR17 was a live *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 2.6 m. The scar faced 40 degrees magnetic and commenced 0.2 m above ground. The scar measured 1.95 m in length and had a maximum width of 0.63 m, excluding regrowth. Multiple lines of axe cuts were located 0.04 m below the top of the scar.

Snake Tree Reserve 18
STR18 was a live *E. largiflorens* tree with an elongate scar on the trunk. Trunk circumference measured 1.69 m. The scar faced 237 degrees magnetic and commenced at ground level. The scar measured 1.02 m in length and had a maximum width of 0.23 m, excluding regrowth. No axe marks were visible on the scar surface.

Snake Tree Reserve 19
STR19 was a live *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 1.86 m. The scar faced 35 degrees magnetic and commenced at a point 0.55 m above ground. The scar length measured 0.85 m and it had a maximum width of 0.4 m. The basal section of the scar was in poor condition and had started to fall outwards. No axe marks could be located on the visible scar surface.

Snake Tree Reserve 20
STR20 was a live *E. largiflorens* tree with a broad elongate scar on one section of bilobate trunk. The tree trunk circumference measured 2.01 m. The scar faced 27

degrees magnetic and commenced at a point 0.25 m above ground. The scar measured 1.6 m in length and had a maximum width of 0.64 m excluding regrowth. No axe marks were visible.

Snake Tree Reserve 21

STR21 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.59 m. The scar faced 183 degrees magnetic and commenced at a point 0.7 m above ground. The scar measured 1.71 m in length and was a maximum of 0.51 m in width, excluding regrowth. Two straight lines of axe cuts were located 0.36 m above the base of the scar.

Snake Tree Reserve 22

STR22 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. Trunk circumference measured 2.06 m. The scar faced 42 degrees magnetic and commenced at a point 0.3 m above ground. The scar was 1.42 m long and a maximum of 0.31 m wide. No axe marks were apparent.

Snake Tree Reserve 23

STR23 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 3.05 m. The scar faced 92 degrees magnetic and commenced at ground level, although a series of axe cuts may more accurately reflect the base of the scar at 0.4 m above ground. The scar measured 1.86 m in length, from the axe cuts to the top, and was a maximum of 0.56 m wide.

Snake Tree Reserve 24

STR24 was a live *E. largiflorens* tree with a broad elongate scar on the trunk. The tree trunk circumference measured 2.39 m. The scar faced 57 degrees magnetic and commenced at a point 0.3 m above ground. The scar measured 1.2 m in length and was a maximum of 0.31 m wide. Multiple lines of axe cuts crossed the base of the scar.

Snake Tree Reserve 25

STR25 was a live *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 1.53 m. The scar faced 103 degrees magnetic and commenced at a point 0.42 m above ground. Scar length measured 1.94 m, and maximum breadth was 0.57 m, excluding regrowth. Three axe cuts occurred across the midsection of the scar.

Snake Tree Reserve 26

STR26 was a live *E. largiflorens* tree with a small oval scar on the trunk. The trunk circumference measured 3.44 m. The scar faced 183 degrees magnetic and commenced at a point 0.77 m above ground. Scar length measured 0.84 m and maximum width was 0.31 m, excluding regrowth. Two lines of axe cuts were located across the top and base of the scar.

Snake Tree Reserve 27

STR27 was a live *E. largiflorens* tree with an elongate scar on the trunk. Tree trunk circumference measured 2.46 m. The scar faced 175 degrees magnetic and commenced 0.05m above ground. Maximum scar length was 1.67 m and maximum width measured 0.56 m, excluding regrowth. Multiple lines of axe cuts crossed the scar 0.3 m below the upper termination.

Snake Tree Reserve 28

STR28 was a live *E. largiflorens* tree with an elongate broad scar on the trunk. Trunk circumference measured 2.79 m. The scar faced 304 degrees magnetic and commenced at a point 0.4 m above ground. The scar measured 1.25 m in length and was a maximum of 0.49 m wide. Multiple lines of axe cuts crossed the scar at the basal and upper terminations.

Snake Tree Reserve 29

STR29 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 1.92 m. The scar faced 200 degrees magnetic and commenced at ground level. Maximum scar length measured 2.2 m and maximum width measured 0.56 m, excluding regrowth. Multiple straight lines of axe cuts crossed the base of the scar. Two lines of crossed axe cuts traversed the upper section of the scar. Bark at the top section of the scar was incompletely removed above the crossed axe cuts, although the oval outline of the scar was traced with a further series of cuts.

Snake Tree Reserve 30

STR30 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. Tree trunk circumference measured 2.05 m. The scar faced 92 degrees magnetic and commenced at a point 0.55 m above ground. Maximum scar length measured 1.15 m and maximum

width was 0.41 m, excluding regrowth. A double row of axe cuts crossed the base of the scar.

Snake Tree Reserve 31

STR31 was a live *E. largiflorens* tree with an elongate leaf shaped scar on the trunk. Trunk circumference measured 1.9 m. The scar faced 102 degrees magnetic and commenced at a point 0.12 m above ground. The scar measured 1.29 m in length and was a maximum of 0.2 m wide, excluding regrowth. No axe marks were visible.

Snake Tree Reserve 32

STR32 was a live *E. largiflorens* tree with an elongate scar on one forked section of bilobate trunk. The scarred trunk circumference measured 1.32 m. The scar faced 92 degrees magnetic and was located 0.53 m above ground. The scar measured 1.12 m in length and was a maximum of 0.31 m in width, excluding regrowth. Multiple lines of axe cuts crossed the upper and lower sections of the scar.

Snake Tree Reserve 33

STR33 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. Tree trunk circumference measured 1.57 m. The scar faced 305 degrees magnetic and commenced at a point 0.38 m above ground. The scar measured 0.9 m in length and was a maximum of 0.19 m wide, excluding regrowth. Three single axe cuts were located in the lower central section of the scar.

Snake Tree Reserve 34

STR34 was a live *E. largiflorens* tree with an elongate scar removed from one forked section of bilobate trunk. It is likely that the secondary trunk growth was triggered by the scar event. The basal trunk circumference measured 2.1 m and the circumference of the scarred limb measured 1.48 m. The scar commenced 0.10 m above ground. The scar measured 2.11 m in length and was a maximum of 0.51 m wide, excluding regrowth. A line of crossed axe marks were located 0.09 m below the upper termination and a line of straight cuts crossed 0.05 m above the base of the scar.

25. Jerilderie Urana Road

A long strip of roadside and stock reserve along the Jerilderie/Urana road, from its intersection with the Newell highway to Urana, was inspected for the presence of archaeological materials. In total it covered an approximate area of 9 km^2.

Description

The area fell within sloping plains lands. Minor topographic variation occurred throughout the area and included: floodplain areas of the Billabong Creek, discontinuous creek levees and plains north of the creek, and old sand lunette ridges and swampy land associated with Lake Urana.

Climate

The area has a warm climate with dry summers. Annual rainfall is in the vicinity of 450 mm, and is effective for the months of June, July and August.

Water Availability

Water would be available in the Billabong Creek and from time to time in numerous small tributaries. During flood periods water would spread out over the plains for distances of up to several kilometres.

Vegetation

The original vegetation alliances present would have been an *E. largiflorens* woodland along the immediate creek margins and an *A. Pendula* and *Atriplex* sp shrubland on the plains. Currently a sparse *E. largiflorens* woodland exists along the creek and the plains are open and grassed. Native and some introduced species of herbs are present in the understoreys including: *Geraniaceae*, *Helichrysum* sp, *Swainsona galegifolia* and *Arctotheca calendula*. Remnant specimens and small clusters of *A. Pendula* and some *Atriplex* sp are also present. *Callitris* sp woodland is present along elevated sand ridge areas around Lake Urana. An ephemeral back swamp area also exists to the southwest of Lake Urana which would support inundated species.

Groundsurfaces
Soils varied throughout the area but were predominantly cracking red earths, with lighter coloured sandy loams on levee areas. Ground surfaces were generally bare of vegetation and extensive scald erosion was prevalent. Scalded areas often displayed pisolitic gravels. Visibility varied greatly between areas, reducing with patches of grass and herb cover, but was generally high. Some areas where soil was removed for road works were also examined.

Survey Method
The area was comprehensively walked by two people. A large site recorded adjacent to Lake Urana was later recorded with the theodolite and EDM.

Features Recorded
Jerilderie Urana Road 1.
Five flaked stone artefacts were recorded within a scalded layer in an area of 78 m^2.
Jerilderie Urana Road 2
Located 14 km east of Jerilderie an open scatter of 6 flaked stone artefacts was exposed in a series of revegetating and eroding scalded patches of red earth . An extensively retouched quartz pebble flake similar to that recorded in the Cobb Highway scatter was recorded here. Its dorsal surface comprised pebble cortex which had been struck back in a series of elongate thinning flakes. The distal edge was extensively step fractured.
Jerilderie Urana Road 3 a-e and f
Approximately 45 m south of the road and 150 m west of the Colombo Creek, a group of 5 piles of oven rakeout from small ovens was located in a 210 m^2 scalded patch. A scatter of 8 flaked stone artefacts was recorded in association with the oven material and a further scatter of 5 artefacts was located in a further scald approximately 50 m south.
Lake Urana 1
At 31.5 km east of Jerilderie land adjacent to the western flanks of Lake Urana and an associated series of sand ridge and lunette formations was examined. Extensive, deep sandy scalds extended north and south of the road. The original vegetation had been cleared although remnant *Callitris* sp were observed on sand areas. An extensive scatter of 468 flaked stone artefacts was recorded here. The area was unusual in the quantity and style of artefactual materials present. Artefact and feature locations were plotted with a theodolite and EDM. It appeared quite different in character to sites recorded in the surrounding region. The implements were predominantly large, many with 'steep-edge scraper' type forms, 'nosed scrapers' and polyhedral cores. Large pebble cores were also present. A range of raw materials were present, including, quartz, quartzite, volcanics, chert and silcrete. Quartz lithologies dominated the proportions of raw materials accounting for 71 % of the stone present, quartzites, silcrete and chert comprised 12, 14 and 2 % respectively and volcanics and granite comprised 1 %. Cores and flaked pieces comprised the majority of artefacts. Three small grindstones and two hammerstones were also recorded. An accumulation of calcrete nodules was also located which appeared to have been used as heat retainers. The use of carbonate nodules has also been reported by Clark and Barbetti in Western New South Wales (1982:145). No stone or clay oven stones or other oven features were located.
Urana Road 1
At 47.5 km east of Jerilderie a small scatter of 8 flaked stone artefacts was recorded alongside the road in a series of sandy scalds. The site covered an area of 800 m^2 (100 x 8 m) and the area averaged 40 % visibility. One hundred percent visibility was offered within the scalded patches.
Urana Road 2
About 300 m further east, in the same landscape category, a further 28 stone artefacts in association with a small oven were recorded. Two of the artefacts were embedded in the baked clay rakeout from a small oven which measured 0.55 x 0.40 m. The heat retainers were dark grey and poorly consolidated. Spread around the main concentration was a scatter comprising mostly tiny fragments of broken down material covering some 10 m^2. The site was recorded with a tape and compass.
Urana Road 4
About 2 km further east of LUR3 an isolated find of a quartzite blade core was located within a small scalded patch.

Urana Road 5
A further 0.9 km east of LUR4 two stone artefacts, a quartz flake and a split quartzite pebble, were located within a scalded patch.
Urana Road 3
A scatter of 16 stone artefacts and a small oven were located 100 m east of LUR5 in two large scalded patches. Again the oven materials were highly deflated and composed of poorly consolidated baked clay. The total site area covered 400 x 20 m with an average visibility rating of 80 %, rising to 100 % within the scalds themselves.

26. Colombo Road

Area
An area of 3.75 km^2 was surveyed along the Colombo Road, including a small Travelling Stock Reserve with frontage to the Colombo Creek.

Description
The area falls within an alluvial valley plains landscape amidst sloping plains. The area consisted of flat plains with slightly raised sandy levees adjacent to the creek.

Climate
The climate is semi arid with cool mean annual temperatures. Annual rainfall reaches 400 mm, and is effective between the months of June and July.

Water Availability
Water would have been available within the Colombo Creek.

Vegetation
Extensive stands of *Typha* sp and mature *E. largiflorens* trees lined the creek margins. The plains were open and grassed. Previous vegetation patterns would have been similar except that the plains would have been covered in an *Atriplex* sp shrubland.

Ground Surfaces
Soils were predominantly red earths and sandy loams on the margins of the Colombo Creek. Ground surfaces varied between stable and depositional. Visibility was generally low with the exception of several small bands of scald erosion.

Survey Method
From the intersection of the Colombo and Jerilderie to Urana Roads, the roadside was walked continually for a distance of 3.4 km northwards. Scalded patches were profuse, however no artefacts were located. At 3.5 km north of the intersection an isolated quartz flake was located in a series of very extensive scalded patches, reaching an underlying red pisolitic soil. Between 3.5 and 5.7 km north of the intersection no archaeological materials were located, despite fair ground visibility. The landscape changed slightly 5.7 km north of the intersection, coming within the western floodplain of the Colombo Creek. Two flaked pieces of quartz were located in a small erosion patch. No further materials were located in the vicinity. However ground surfaces were stable in this location and the absence of sites may be a factor of poor visibility. If the absence of sites was a reality it may be a factor of changed flow conditions of the Colombo Creek. Previously the main stream channel would have flowed more sporadically, only since water regulation has the creek flowed continuously at high levels, causing it to overspill into its western floodplain. The roadside reserve was continuously checked for a further 9.3 km until it reached the Newell Highway. No further archaeological materials were located.

Features Recorded
Colombo Road 1
An isolated quartz flake located in a series of very extensive scalded patches on open plains country.
Colombo Road 2
Two flaked pieces of quartz located in a small erosion patch within the western floodplain of the Colombo Creek.

27. Old Urana Road/Newell Highway

Area

An area of approximately 4.30 km^2 focussing upon a stock reserve with Billabong Creek frontage and following a section of the Old Urana Road, immediately west of Jerilderie was surveyed on foot for archaeological materials.

Description

The reserve consisted of floodplain and levee areas associated with the Colombo Creek. It ran along both sides of the creek and access to the southern side was via a narrow cattle bridge.

Climate

The climate is semi arid with cool mean annual temperatures. Annual rainfall reaches 400 mm, and is effective between the months of June and July.

Water Availability

Water would have been available within the Colombo Creek.

Vegetation

E. camaldulensis and *E. microcarpa* followed the stream channels and flood depressions, which were also full with water. The floodplain was grassed.

Ground Surfaces

Ground surfaces on the north side were predominantly flat red clay. Ground visibility was variable, generally low in areas which were lower lying and which had been recently wet, covered in a thick carpet of capeweed and buttongrass. Several flood scoured patches revealed an underlying layer of pisolites and indurated sand in blocky formation. Water levels in the Billabong Creek were high at the time of survey, and low lying creek margins were still boggy underfoot and pugged with cattle hoof prints. Drifts of recently flood deposited silt and scum were lying alongside some stream banks. Ground surfaces were mostly depositional.

Survey Method

The reserve was comprehensively examined by two people on foot. One of the sites was recorded by theodolite and EDM.

Features Recorded

Three oven mounds, two isolated finds and one scatter of stone artefacts with small ovens in association were recorded within the reserve. The oven mounds comprised raised deposits of black ashy soil and appeared to have been inundated by the recent flooding. Survey east along the Old Urana Road failed to reveal further sites. The area had recently been flooded and was only just draining away.

Old Urana Road 1

OUR1 was an oven mound located on the northern side of the creek adjacent to the stock crossing bridge. It was surrounded by the creek and a cut-off meander, effectively occupying a small island. The margins of the mound were waterlogged. Small crumbly fragments of heat retainer and mussel shell were visible in the dark deposit. The mound measured 12 x 8 m and had an elevation of approximately 0.50 m above the surrounding ground surface. It is uncertain how much existing ground elevation had contributed to its height.

Old Urana Road 2

OUR2 was an oven mound located on the southern side of the creek, about 250 m south-east from the stock bridge. It was situated 13 m from waterlogged mudflats, and 30 m from the present waters edge, approximately 150 m south of Mound 1. It consisted of a mounded deposit of calcined heat retainers and compact dark soil. A large depression existed in its centre, possibly a result of caved-in rabbit burrows, although there were no signs of active burrows. No mussel shell was visible in the deposit. The mound measured 5 x 4.5 m and had an elevation of approximately 0.60 m.

Old Urana Road 3
OUR3 was a low deflated oven mound deposit, measuring 5 x 5 m, with an elevation of approximately 0.40 m. It was situated 2 m from the mudflats and 4 m from the present waters edge. It had a grey clayey deposit, with heat retainer material studding its surface. It was located approximately 80 m east of Mound 2.

Old Urana Road 4 - 5
The isolated finds consisted of OUR4, a quartzite flake measuring 14 x 24 x 5 mm, and OUR5, a tiny edge ground flake of a black volcanic material. It measured 26 x 20 x 6 mm and was ground on two opposing surfaces to form a small oval chisel-like implement. Both isolated finds were located in small scalded patches at the northern edge of the reserve.

Old Urana Road 6
OUR 6 consisted of an artefact scatter and small oven complex. It was recorded with the EDM and theodolite. It was located at the south eastern margin of the reserve adjacent to private land. From east to west, it comprised a series of parallel ridged scalds, in which 4 stone artefacts and 7 small ovens (OUR6 a-g) were distributed over an area of 1800 m^2. This area flanked a low lying swampy area to the west, which was probably an old back swamp of the Billabong Creek.

28. Birdcage Reserve.

This survey involved coverage of a 2.70 km^2 area of Travelling Stock Reserve on the southern margins of the Murrumbidgee River floodplain, to the north and south of the Sturt Highway.

Description

The survey area lies within western alluvial valley plains associated with the Murrumbidgee River. Ninety percent of the survey area was composed of a flat southern grey soil and sand sheet plain with palaeochannel drainage depressions. The remaining 10% comprised river corridor, levee deposits and red soils.

Climate

The climate is semi arid with cool mean annual temperatures. Annual rainfall ranges between 400 and 450 mm and is effective for three months between June and August.

Water Availability

Water is available within the Murrumbidgee River. In addition remnant palaeochannels rapidly reactivate, forming swampy depressions during wet periods and would still conduct water through the floodplain in periods of major riverine flood. For several months following flood periods water would remain in localised depressions along the palaeochannels.

Vegetation

Vegetation was a combination of woodland and shrubland formation. Except for the immediate environs of the river where *E. camaldulensis* was the dominant vegetation, most of Birdcage Reserve was vegetated with a *E. largiflorens* woodland with an understorey of *Atriplex nummularia* and long grasses. The *E. largiflorens* woodland followed the palaeochannels.

Ground Surfaces

The levee areas along the river were composed of red sandy soils. Further south amidst the remnant palaeochannel activity abrupt changes in soils occurred. Land in between the channels was composed of flat grey cracking clay, prone to bogginess, and with a high proportion of gilgai puff and hollow formation. Stretches of the old courses were flanked by old levees and sandsheets. Ground surfaces varied between depositional along the river and within the grey soil areas, eroding along the stream levees, and aggrading where sands were being wind transported along the levee formations. Minor ground disturbances were also present in the form of rabbit burrows.

Survey Method
Foot survey effectively covered the entire reserve, however ground visibility was felt to be a limiting factor for the discovery of unobtrusive materials such as lithic scatters. Site locations were plotted with pace and compass traverses.

Features Recorded
Forty occurrences of archaeological materials were recorded, comprising twenty oven mounds, four small ovens, one artefact scatter, ten scarred trees and five isolated finds. Site locations were strongly linked to the presence of stream channels and box woodland, however, the artefact scatter was more closely associated with the Murrumbidgee River. The scarred trees were all *E. largiflorens*, all but one living. The scars were mostly elongate, all but one exceeding one metre in length. One tree had an elongate scar removed from two margins. A further tree had a series of four small rounded scars removed in an ascendant line. They were probably removed as toe holds.

Birdcage Reserve 1
This was a single oven mound measuring 11 x 11 m, with an approximate elevation of 0.5 m. The mound cross section approximated a platform, irregular in places due to a severe infestation with rabbits, over 50 burrows were noted throughout the deposit. The deposit was not vegetated and consisted of a light brown earthy soil studded with large 0.13 - 0.14 m diameter calcined grey heat retainers. The heat retainers had small gravels incorporated in an otherwise uniform fine gritty matrix. No artefacts or bone remains were exposed at the time of survey. The site was situated at the margins of a remnant palaeochannel and had a small water-logged depression adjacent to it. The closest associated mound was BC23 located approximately 90 m west.

Birdcage Reserve 2
This was an eroded 14 x 15 x 0.7 m compacted oven mound deposit of a dark ashy sand matrix. The site was tunnelled into by rabbits, although the warren was abandoned at the time of survey. The site is situated at the margins of the stream channel. Numerous young *E. largiflorens* seedlings were on approximately the same position relative to the channel, suggesting that the site still occupied a flood margin position. The deposit contained heat retainers as well as fragments of freshwater mussel shell. The heat retainers reached a maximum of 0.06 m in diameter.

Birdcage Reserve 3
This consisted of a residual oven mound deposit measuring 22 x 10 m with negligible elevation. The deposit presented as a compacted sandy clay surface with numerous heat retainers embedded in the surface. BC3 was situated on the margins of the stream channel vegetation at the far west of the reserve. It occurred in association with oven mounds BC4, 5, 6 and 7, and a small oven BC8.

Birdcage Reserve 4
This was a 17 x 11 x 0.5 m platform shaped oven mound deposit with a compacted ashy/sandy matrix. One rabbit burrow was evident in the centre of the deposit, revealing the continuation of dark ashy deposit to a depth of at least 0.4 m. No contents other than heat retainers were observed. Heat retainers were grey in colour and of irregular rounded shape. The site was located amongst an open woodland of mature and immature *E. largiflorens* at the margins of the stream channel. Sites BC3, 5, 6, 7,and 8 were in close proximity.

Birdcage Reserve 5
This site was a slightly smaller 7 x 7 x 0.5 m platform shaped oven mound deposit. The deposit was densely packed with fired heat retainers and there was relatively less ash/soil matrix than usual. Heat retainers were reddish and grey in colour, of a rounded shape. They reached a maximum of 0.16 m in diameter. No other contents of the deposit were observed. BC5 was situated amongst box woodland at the margins of the stream channel in proximity to sites BC3, 4, 6, 7 and 8.

Birdcage Reserve 6
BC 6 was a live *E. largiflorens* tree which had an elongated oval scar removed from one margin. The trunk circumference of the tree measured 1.64 m. The scar was 2.2 m long and had a maximum width, excluding regrowth of 0.33 m. It faced 202 degrees magnetic. The base of the scar was 0.39 m above the ground surface. A thin sucker

growth had sprouted from the base of the scar. BC6 was situated amongst a light woodland in proximity to sites BC3, 4, 5, 7 and 8.

Birdcage Reserve 7

BC7 was an 11 x 7 x 0.4 m platform shaped oven mound deposit of compacted ashy sand and heat retainers. The surface of the site was lightly covered in a thin layer of reddish aeolian sand. Heat retainers were orange to grey in colour and attained a maximum diameter of 0.05 m. The site was situated at the margins of the stream channel amongst a light woodland. Sites BC3, 4, 5, 6 and 8 were also located in the vicinity.

Birdcage Reserve 8

BC8 was a small oven (rather than a mound) consisting of a small 3 x 3 m spread of baked clay heat retainers. No ashy matrix was present. Heat retainers ranged between grey and pale orange in colour and reached a maximum diameter of 0.06 m. The site was partially covered over with a thin layer of reddish aeolian sand. BC8 was located amongst woodland at the margins of the stream channel. Sites BC 3, 4, 5, 6 and 7 were situated nearby.

Birdcage Reserve 9

This was a deflated 12 x 7 x 0.4 m oven mound deposit of dark ashy earth and heat retainers. The deposit was colonised by ants. The site was located on the margins of the stream channel system amongst box woodland. No other sites were located within close proximity.

Birdcage Reserve 10

This site was a 10 x 7 m oven mound deposit of dark ashy soil and heat retainers. The deposit was level with the surrounding soil. Ants had colonised the deposit. No contents other then heat retainers could be discerned. Heat retainers were grey and reached a maximum diameter of 0.08 m. The site was situated amongst woodland at the margins of the stream channel system.

Birdcage Reserve 11

This site was a 14 x 14 x 0.3 metre platform shaped mound of dark grey ashy deposit and heat retainers. The deposit had been colonised by ants. Heat retainers were grey in colour and those visible attained a maximum diameter of 0.06 m. The site was situated adjacent to a small depression which would hold water in wetter times.

Birdcage Reserve 12

This site was a deflated oven mound deposit measuring 12 x 12 m. Its surface was colonised by ants. Grey heat retainers, maximum diameter 0.10 m, were scattered across the surface of the deposit. The site was situated amidst *E. largiflorens* woodland at the margins of remnant palaeochannel formation. The surrounding soils were cracking grey clays and small gilgai depressions would have ponded water in the vicinity during wet periods.

Birdcage Reserve 13

This was a small 5 x 5 m deflated oven mound deposit. The deposit was composed of very dark black/brown ashy sand and heat retainers. No other contents were observed. Heat retainers were well fired and reached a maximum diameter of 0.05 m. The site was located within *E. largiflorens* woodland in proximity to stream depressions associated with palaeochannel activity.

Birdcage Reserve 14

This was a 14 x 14 x 0.5 m platform shaped oven mound deposit. A young *E. largiflorens* tree was growing in the centre of the mound. Superficial rabbit activity was also evident. The deposit was well vegetated with a dried off grass cover. The deposit consisted of dark ashy sandy sediment and clay heat retainers. Heat retainers were grey and those visible attained a maximum diameter of 0.06 m. A possible borrow pit/ depression was located adjacent to the site. The site was located amidst *E. largiflorens* woodland in proximity to the old stream channel system. Localised water sources would also have existed in areas of hummocky gilgai clays in nearby areas.

Birdcage Reserve 15

This site was a 19 x 19 x 0.8 m platform shaped oven mound deposit. The site was in extremely poor condition having been totally colonised by rabbits. The deposit was composed of dark ashy sand and was relatively compacted. It contained numerous heat retainers and some fragments of freshwater mussel shell. A small chip of silcrete (8 x 8 x 0.5 mm) was located 15 m from the site. The site was located amidst sparse *E. largiflorens* woodland. A low lying swampy area lay immediately west of the site. A

small depression, possibly a borrow pit, lay adjacent to the eastern side of the site. The site appeared as a very distinctive 'bald' elevated deposit in an otherwise flat landscape.

Birdcage Reserve 16

This site comprised a live *E. largiflorens* tree with two elongate scars. The trunk circumference of the tree was 2.03 m.

Scar (a) faced 115 degrees magnetic and commenced at point 0.23 m above the ground. The scar was 2.45 m in length and a maximum of 0.46 m wide, excluding regrowth. It was elongated with oval ends. The upper section terminated in a small bark tear. A single axe cut was located at the top of the scar and a linear series of three cuts were located at the base of the scar.

Scar (b) faced 302 degrees magnetic and commenced at a point 0.83 m above the ground. The scar was 2.02 m in length and a maximum of 0.44 m in width, excluding regrowth. It was a regular elongate oval in shape with bulging regrowth around the margins. No axe marks were discernible on the scar surface. A small sucker growth was located at the base of the scar.

Birdcage Reserve 17

BC17 was a 14 x 13 x 0.5 m platform shaped oven mound deposit. The deposit was extensively disturbed by rabbit activity. The matrix consisted of a dark ashy sand with numerous, mostly embedded, heat retainers. Those visible attained a maximum diameter of 0.09 m. The site was located amidst *E. largiflorens* woodland at the margin of remnant palaeochannel. A small ponded depression, possibly a borrow pit, was located on the southern margin of the site. The site was located 30 m from BC18.

Birdcage Reserve 18

This site was a 9 x 9 x 0.4 m heaped deposit of oven mound. The site was extensively colonised by rabbits. The matrix consisted of a dark ashy compacted earth studded with heat retainers. Heat retainers were grey and up to 0.06 m in diameter. The site was located amidst *E. largiflorens* woodland on the margin of the remnant palaeochannel. BC17 was situated approximately 30 m away, on the opposite channel margin.

Birdcage Reserve 19

This site was an 18 x 18 x 0.9 m platform shaped oven mound deposit. It was extensively colonised by rabbits. The deposit consisted of dark ashy loamy soil and was relatively compacted. Large grey heat retainers, maximum diameter 0.10 m, were profuse throughout the deposit surface. The site was located amidst *E. largiflorens* woodland, approximately 200 m from an extensive *Atriplex* sp plain. A small kidney shaped depression was located south of the site. Site BC 18 was located approximately 118 m away.

Birdcage Reserve 20

This was a small deflated satellite oven located 9 m from BC19. It measured 4 x 4 m and was level in profile. It consisted of compacted dark soil and profuse medium sized grey heat retainers.

Birdcage Reserve 21

This was an isolated stone artefact, a quartzite pebble hammerstone measuring 68 x 51 x 35 mm.

Birdcage Reserve 22

This was a scarred dead *E. largiflorens* tree. The trunk circumference was 1.3 m. The scar faced 46 degrees magnetic and commenced at a point 0.41 m above ground. The scar measured 1.24 m in length and 0.44 m at its widest point, excluding regrowth. It was elongated in shape with roughly squarish ends. A narrow crack extended from the upper section. A single linear series of axe cuts was located across the upper section of the scar. The lower surfaces of the scar had suffered recent fire damage, apparent as two blackened and charred patches.

Birdcage Reserve 23

This was a 7 x 8 x 0.7 m oven mound deposit of very dark ashy brown sediment and heat retainers. The deposit was extensively disturbed by rabbit activity. Heat retainers were large, measuring a maximum of 0.14 m in diameter, and grey with a sandy texture. A small depression, possibly a borrow pit, was located adjacent to the site. The site was located within *E. largiflorens* woodland on the margins of the old stream system.

Birdcage Reserve 24

This was a live *E. largiflorens* tree which had a single scar. The trunk circumference of the tree at chest height measured 2.19 m, the basal circumference measured 2.93 m and

included three suckering regrowth branches probably triggered by the scar damage. The scar faced 10 degrees magnetic and commenced at a point 0.25 m above ground. It measured 2.9 m in length and an estimated further 0.2 m was missing from the upper section due to fire damage. The scar was a maximum of 0.9 m wide, excluding regrowth. It was an elongate oval in shape with regular sides. A linear series of axe cuts ran around the base of the scar.

Birdcage Reserve 25

This site was a live *E. largiflorens* tree with an elongate scar removed from one major limb fork. The basal circumference of the tree was 2.67 m whilst the scarred limb measured 1.85 m in circumference. The scar faced 232 degrees magnetic and began at a point 0.33 m above the ground. The scar was 2.6 m in length, 0.67 m wide at the centre and 0.47 m wide at both upper and basal points. Two lines of axe cuts ran across the base of the scar and a single line of cuts ran across upper section the scar. The upper section terminated in a small irregular tear above the axe cuts. A central vertical split had occurred down the scarred surface.

Birdcage Reserve 26

This was a 7 x 8 x 0.8 m heaped deposit of oven mound. The deposit was heavily disturbed by rabbit activity, and had a small *E. largiflorens* tree growing in one edge. The deposit was dark and ashy in texture with heat retainers. The heat retainers were pale orange and grey and attained a maximum diameter of 0.12 m. BC26 occurred in a dispersed group with BC27 and BC28.

Birdcage Reserve 27

BC27 was a 15 x 15 x 0.9 m oven mound deposit. The deposit was thoroughly damaged by rabbits with numerous active burrows and evidence of many old cave-ins. Two young *E. largiflorens* trees were also growing in the deposit. The deposit matrix was sandy and ashy in texture. Sections revealed in collapsed burrows revealed a uniform mixed deposit of ash, soil and crumbled and whole heat retainers. Heat retainers were predominantly grey and reached 0.10 m in diameter. Fragmentary freshwater mussel shell was also observed in the deposit. BC27 occurred in loose association with BC26 and BC28.

Birdcage Reserve 28

This was a 15 x 15 x 0.2 m oven mound deposit. The surface of the deposit was quite compacted and was wind and water eroded. It was also bisected by the boundary fence of the reserve. The deposit was sandy in texture and dark and ashy in colour. Heat retainers were orange, brown and grey and reached a maximum diameter of 0.12 m. The site was located amidst box woodland on the margin of the remnant palaeochannel system, the surrounding microrelief was undulating and prone to waterlogging. BC28 occurred in loose association with BC26 and BC27.

Birdcage Reserve 29

This was a live *E. largiflorens* tree with a single scar removed. The tree trunk circumference measured 1.96 m. The scar faced 127 degrees magnetic and commenced at a point 0.77 m above the ground. The scar was 0.79 m long and 0.23 m wide, excluding regrowth. It was elongated with squarish terminations. Sharp axe cuts ran across both upper and lower terminations. The upper section of the tree had suffered fire damage and sucker regrowth was forming.

Birdcage Reserve 30

BC30 consisted of a split quartzite pebble measuring 90 x 50 x 10 mm and a tabular piece of unmodified quartzite measuring 55 x 15 x 11 mm. The artefacts were located in a small area of aggraded sandy soil, amidst *E. largiflorens* woodland.

Birdcage Reserve 31

BC31 was an isolated find of a red quartzite flake, with pebble cortex, measuring 20 x 12 x 8 mm.

Birdcage Reserve 32

This was a live *E. largiflorens* tree with a single elongated scar removed. The scar faced 17 degrees magnetic and commenced at a point 0.45 m above ground. The scar was 1.3 m long including a small bark tear at the upper termination. It was a maximum of 0.55 m in width. It was an elongate oval in shape with a small irregularity due to a tear at the upper termination. A single line of axe cuts ran across the basal and upper sections of the scar.

Birdcage Reserve 33
This was a live *E. largiflorens* tree with one scar removed. The tree trunk circumference measured 1.65 m. The scar faced 306 degrees magnetic and commenced 0.34 m above ground. It was elongate and club shaped with bulging upper regrowth. It measured 0.68 m in length and had a maximum width of 0.33 m excluding regrowth. No axe cuts were visible on the scarred surface.

Birdcage Reserve 34
This was a live *E. largiflorens* tree with an ascendant series of 4 small rounded scars removed from one margin. The tree trunk circumference measured 1.6 m. The scars faced southwest. Scar (a) commenced 0.8 m above ground and measured 0.1 x 0.1 m. Scar (b) commenced 1.25 m above ground and measured 0.2 x 0.1m. Scar (c) commenced 1.6 m above ground and measured 0.1 x 0.1 m. Scar (d) commenced 2.0 m above ground and measured 0.25 x 0.25 m. All measurements exclude estimation of regrowth. The scars most probably functioned as a series of footholds used to ascend the tree. Scar (d) would have given access to a major branch fork just above it.

Birdcage Reserve 35
This was a live scarred *E. largiflorens* tree. The trunk circumference of the tree measured 4.04 m. The scar faced 160 degrees magnetic and commenced at a point 1.24 m above ground. The scar was a regular elongate oval in shape. It measured 1.65 m in length and was a maximum of 0.44 m in width, excluding regrowth. No axe marks were present on the scarred surface.

Birdcage Reserve 36
This site was a small oven measuring 0.4 x 0.3 m consisting of a circular concentration of baked clay heat retainer rakeout. It was located in proximity to the Murrumbidgee River.

Birdcage Reserve 37
This was an open scatter of 24 flaked stone artefacts scattered along an access track skirting the Murrumbidgee River. Maximum artefact density was 2 per m^2. The raw materials were varied including silcrete, quartz, glassy quartz, chert and quartzite.

Birdcage Reserve 38
This was a small concentration of baked clay heat retainer relating to the operation of a small oven. It measured 0.5 x 0.6 m, and was situated upon the higher levee areas near the present river channel.

Birdcage Reserve 39
This was an isolated find consisting of a quartzite flake with pebble cortex (20x15x5 mm). It was located 60 m east of BCR 38.

Birdcage Reserve 40
This was an isolated find, consisting of a red quartzite chip (10x7x4 mm). It was situated 45 m east of BCR 39.

BC37,38, 39 and 40 are considered to form part of the same site.

29. Toganmain Reserve

Area
A $2km^2$ section of the Toganmain Travelling Stock Reserve was surveyed during summer.

Description
Toganmain Stock Reserve is an elongate section of land running southward of the Murrumbidgee River. It is within the western alluvial valley plains landscape. As well as the frontage to the Murrumbidgee River, it includes part of Cumbungi Lagoon which comprises a central swamp and lagoon area. Entry to the reserve is from the Sturt Highway which forms its southern boundary.

Climate
The climate is semi arid with cool mean annual temperatures. Annual rainfall is approximately 400 mm and is effective for three months between June and August.

Water Availability
Water is available within the Murrumbidgee River and within the associated Cumbungi Lagoon.

Vegetation
The survey area supported a combination of several vegetation alliances.
E. camaldulensis woodland occurred along the river channel and in the lagoon. An extensive *Typha* sp swamp occurred within the wetland areas, and occasional *Eragrostis australasica* stands occurred on low lying areas of grey soil. *E. largiflorens* woodland areas fringed the floodplains and elsewhere vegetation consisted of grassed open plains. This is probably roughly representative of the original vegetation structure, except that the southernmost plains would have been vegetated with an *Atriplex* sp dominated shrubland. Plains along the river may also have supported native annual grasses.

Ground Surfaces
The southernmost quarter of the reserve consisted of elevated red soils. Apart from a track, which was not well worn, and a holding yard for travelling stock, archaeological visibility for small features such as artefact scatters was poor. A higher tongue of levee deposits consisting of consolidated red earth lay between the lagoon and the river proper. In this area the access track had differentially eroded to a maximum of 0.15 m depth. Between the levee and both water sources the soil was greyer and obviously prone to inundation. The river side was flood-scoured and the lagoon side covered in lush weedy water plant growth. Waterbirds, predominantly ducks, were numerous throughout the lagoon and interior areas.

Survey method
All accessible areas within the reserve were systematically walked by two people. Flooding from the previous spring had maintained water within Cumbungi Lagoon and formed extensive swampy areas which meant that the central/eastern part of the reserve could not be field-walked. A single scarred tree was recorded here (Toganmain 17). Survey then continued over the top northern section of the reserve.

Four oven mounds were recorded within scattered *E. largiflorens* woodland, all occupying the first break of slope above the mud flats/floodplain of the lagoon. One scarred tree was recorded in association with these four, as was one smaller oven. Artefacts were also recorded in-situ in the surface deposits of two oven mounds (site nos. 19 and 23).

Features Recorded
A total of 24 sites were recorded within the reserve, including 4 oven mounds, 7 small ovens, 10 scarred trees, 1 artefact scatter and 2 isolated stone artefacts. Sites were most prolific across the elevated river levee areas. Scattered heat retainers were located along the western boundary fence. Artefacts and ovens were also found in association on the eastern side of the sandsheet area. Artefacts were found within the eroded areas of the access track where it crossed the levee. The raw materials present were quartzite and silcrete. Several of the larger pieces, including a further isolated find (Toganmain 12) exhibited steep fractured usewear.

The spatial distribution of sites again echoes the general trends found elsewhere along the river, with oven mounds at the southern floodplain margins - often in association with scarred trees. Again smaller ovens and artefact scatters are distributed on higher ground usually on compacted red sandy substrates.

Toganmain Reserve 1
Toganmain 1 consisted of a small eroding concentration of baked clay heat retainers, marking the location of an earth oven. It measured 0.3 x 0.2 m. A black quartzite flake measuring 26 x 20 x 8 mm was located 5 m from the heat retainers.

Toganmain Reserve 2
Toganmain 2 was a 0.25 x 0.25 m concentration of baked clay heat retainers, indicating the nearby operation of a small earth oven. The site had been colonised by an ants nest, and was located amidst thick grass cover in an area of dense *Acacia pendula* woodland.

Toganmain Reserve 3
TR3 was a live *E. largiflorens* tree with an irregular elongate scar on one side. Tree trunk circumference was 3.55 m. The scar faced 5 degrees magnetic and commenced 0.25 m above the ground. The scar measured 1.65 m in length and had a maximum width of

0.35 m. Regrowth bulged in across the upper left hand side of the scar, causing an irregular shape to a width of 0.22 m. Two blunt axe cuts were located across the base of the scar.

Toganmain Reserve 4

TR4 was a live *E. largiflorens* tree with an elongate scar on one face. The scar was positioned on the major trunk of the tree above a bulging, callused, thickened section of the trunk. The trunk circumference through the thickened section was 4.25 m, whereas the circumference through the scarred section was 1.92 m. The scar faced 122 degrees magnetic and commenced at a point 0.95 m above ground. The scar measured 1.64 m in length and was 0.31 m wide excluding regrowth. Six axe cuts were angled across the upper section of the scar.

Toganmain Reserve 5

TR5 comprised a live *E. largiflorens* tree with a single scar on one bilobate trunk. The basal trunk circumference measured 2.74 m, and the circumference of the scarred trunk was 2.31 m. The scar faced 195 degrees magnetic and commenced at a point 0.58 m above ground. The scar was elongate with a rounded upper termination and a squared lower termination. The scar measured 1.01 m in length and was a maximum of 0.30 m wide, excluding regrowth.

Toganmain 6

Toganmain 6 was a 0.5 x 0.2 m concentration of baked clay heat retainers, marking the operation of an earth oven. It was exposed by the access track. The site was located amidst generally scalded ground surfaces surrounded by *Bursaria spinosa* and *B.tricuspis* vegetation.

Toganmain Reserve 7

TR7 was a live *E. largiflorens* tree with a small scar on a forked limb. Trunk circumference of the tree was 4.0 m, whilst limb circumference measured 1.93 m. The scar faced 185 degrees magnetic and commenced at a point 1.85 m above ground. The scar was oval in shape and measured 0.53 m in length. Maximum width measured 0.2 m excluding regrowth. No axe marks were visible on the scarred surface.

Toganmain Reserve 8

TR8 was a live *E. largiflorens* tree with an elongate scar on the interior surface of a bilobate trunk. The basal trunk circumference measured 3.75 m, whilst the scarred trunk circumference measured 2.83 m. The scar faced 155 degrees magnetic and commenced at a point 0.6 m above ground. It measured 1.42 m in length and was a maximum of 0.31 m wide, excluding regrowth. Two angled axe cuts were located at the upper scar termination. A narrow split also extended from the upper termination. The entire scar was vertically cracked and split as well.

Toganmain Reserve 9

TR9 was a live box tree with a scar on one margin. The tree trunk circumference measured 3.62 m. The scar faced 125 degrees magnetic and commenced at a point 1.83 m above ground. The scar was elongated and oval in shape, measuring 1.53 m in length. The scar was a maximum of 0.43 m wide excluding regrowth. A series of horizontal and vertical cracks ran across the scar face, and some parasitic plant growth had generated in the base of the scar.

Toganmain Reserve 10

Toganmain Reserve 10 was an open scatter of 6 flaked stone artefacts. They included;

1. A heavily patinated silcrete flake with usewear, (20x20x4 mm)
2. a multiplatform quartzite core, (30x25x18 mm)
3. coarse grey quartzite flake, retouched along one margin, (47x36x14 mm)
4. quartzite flake, (8x8x1 mm)
5. quartzite flaked piece, (28x17x12 mm)
6. vein quartz flaked piece with pebble cortex.(20x10x5 mm)

Two fragments of freshwater mussel shell and some degraded baked clay pellets were associated with the artefacts. The site was situated within eroding ground on an access track. Erosion was approximately 0.15 m deep.

Toganmain Reserve 11

Toganmain 11 consisted of a fragment of a quartzite muller. It measured 25x25x7 mm, and had use polish on both margins. It was recorded in association with a small exposure of baked clay heat retainer, eroding from the side of the access track. The erosion was 0.12 m deep.

Toganmain Reserve 12
Toganmain 12 was an isolated white quartzite flake with extensive usewear on a distal margin. It measured 50x40x13 mm. The used margin had an acute working edge.
Toganmain Reserve 13
Toganmain 13 was a location of disturbed heat retainer material situated beside the access track. Two flaked stone artefacts were recorded in association.
1. Quartzite flake 20x11x6 mm
2. Grey chert chip 10x6x1 mm
Toganmain Reserve 14
TR14 was a live *E. largiflorens* tree with a single scar on its trunk. The tree trunk circumference measured 2.15 m. The scar faced 135 degrees magnetic and commenced at a point 0.2 m above the ground. The scar measured 1.42 m in length and had a maximum width of 0.35 m, excluding regrowth. The scar was elongate and oval in shape.
Toganmain Reserve 15
Toganmain 15 consisted of two eroding 3 m^2 concentrations of large grey baked clay heat retainers, located 8 m apart. A quartz chip (< 5mm) was located within one of the heat retainer concentrations. The sites were situated on a compact sandy levee area which had been recently flood scoured.
Toganmain Reserve 16
TR16 was a live *E. largiflorens* tree of irregular form with two elongate scars on opposing sides of one trunk. Basal trunk circumference of the tree measured 3.58 m, whilst the circumference of the scarred trunk/limb measured 2.69 m. Scar (a) was an acute elongate oval in shape, faced 17 degrees magnetic and commenced at a point 0.6 m above ground. It measured 1.94 m in length and was a maximum of 0.33 m wide, excluding regrowth. Scar (b) was an elongate oval in shape and faced 239 degrees magnetic. It commenced at a point 0.63 m above ground. It measured 1.87 m in length and was a maximum of 0.16 m wide, excluding regrowth. No axe cuts were visible on either scar.
Toganmain Reserve 17
TR17 was a live *E. largiflorens* tree with a single scar removed from one section of bilobate trunk. The tree trunk circumference measured 4.95 m whilst the scarred trunk measured 2.78 m in circumference. The scar faced 25 degrees magnetic and commenced at a point 0.68 m above ground. The scar was an elongate oval in shape. It measured 1.68 m in length and was a maximum of 0.38 m wide, excluding regrowth. No axe cuts were visible on the scarred surface.
Toganmain Reserve 18
Toganmain 18 was an oven mound. It measured 6 x 10 m and was approximately 0.15 m high. It consisted of a compact deposit of dark ashy soil and heat retainers. Part of the site had been colonised by an ants nest.
Toganmain Reserve 19
Toganmain 19 was a small oven measuring 2 x 2 m. A small fragment of quartzite grindstone (12x10x5mm) was recorded in association with it.
Toganmain Reserve 20
Toganmain 20 was an oven mound. It measured 12 x 12 m and was approximately 0.3 m in height. It had a small depression in the centre. Fragments of freshwater mussel shell were evident on the surface of the site. Part of the site had been colonised by ants.
Toganmain Reserve 21
Toganmain 21 was an oven mound. It measured 5 x 5 m and was approximately 0.4 m in height. It was situated on the first break of slope above, and 40 m from, the inundated river flats amidst *E. largiflorens* woodland.
Toganmain Reserve 22
TR 22 was a live *E. largiflorens* tree with two scars removed from two sections of trilobate trunk. The main trunk circumference of the tree measured 3.75 m whilst the circumference through scar (a) measured 1.75 m and through scar (b) measured 2.77 m. Scar (a) faced 102 degrees magnetic and commenced at a point 0.44 m above ground. It was an elongated oval in shape and measured 1.42 m in length, and was a maximum of 0.36 m in width, excluding regrowth. Scar (b) faced 17 degrees magnetic and commenced at a point 0.69 m above ground. It was oval in shape and measured 0.53 m

in length. It was a maximum of 0.14 m in width, excluding regrowth. Scar (b) had a linear series of axe marks at its base.

Toganmain 23

Toganmain 23 was an oven mound. It measured 14 x 14 m and was approximately 0.8 m in height. It had a mature *E. largiflorens* tree growing in its centre, which may have exaggerated the height measurement. The site was situated at the base of the levee fringing the floodplain and was surrounded by cracking grey soil. The mound deposit appeared very ashy and grey in colour. Four stone artefacts were situated upon the surface of the site.

1. Quartz flaked piece (18x15x5 mm)
2. Quartzite grindstone (100x65x20 mm)
3. Sandstone grindstone fragment (26x16x6 mm)
4. Sandstone grindstone fragment (20x14x6 mm)

30. Cooinbil Station

Area

An 8 km length of the Bublebundie Creek, covering approximately 3.75 km^2 was surveyed on Cooinbil Station.

Description

The survey area was situated within western plains crossed by palaeochannels about 35 km south of the Murrumbidgee River. The survey commenced 250 m west of the Cooinbil/Clifford Downs boundary fence and continued westwards. The environment is essentially flat and dry.

Climate

The climate is semi arid with cool mean annual temperatures. Annual precipitation is approximately 350 mm, and this is effective for three months from June to August.

Water Availability

No permanent water exists within the survey area. The Bublebundie Creek traces a palaeochannel drainage pattern and today, rarely if ever, flows. It does pond localised rainfall and conducts water via seepage in widespread wet periods.

Vegetation

E. largiflorens woodland is prolific along the old stream course and successive bands of flood regenerated seedlings line the margins of the creek. Sand ridges blown up from the old stream levee deposits also support *Callitris* pine stands. Vegetation of the surrounding plains would have been predominantly *Atriplex* spp and *Acacia* spp. Other small trees such as *Heterodendrum oleifolium* occur in clumps.

Ground Surfaces

The creek has a winding discontinuous bed consisting of series of wind blown sand deposits, clay pans and expanses of cracking grey earth. Ground surfaces are a combination of erosional and aggrading.

Survey Method

A combination of vehicle and foot transects were employed.

Features Recorded

A variety of archaeological materials were recorded around the creek, including small ovens, artefact scatters, four mounds and scarred trees. Most archaeological materials were exposed in scald-eroded patches at the margins and in some cases in clay pan areas amidst the stream channel. One scatter of stone artefacts (n=104) was recorded in a clay pan amidst *E. largiflorens* woodland. It displayed a wide range of raw material types, mostly with pebble cortex. The flaked stone artefacts were marked by their small size.

The four mounds occurred in a group, and all consisted of blackened, ashy sand, spotted with weakly-cemented heat retainers of a whitish calcined appearance. The mounds were positioned on small spurs of slightly higher ground which jutted into the stream channel.

Several smaller ovens, visible as circular cemented patches of fired clay heat retainers were also recorded. They occurred in association with the mounds, but were located further back from the stream channel on scalded ground. No mussel shell or other food remains were visible. A small sandstone grinding stone was found adjacent to one of the mounds but no further stone materials were evident despite good ground visibility.

31. Gundaline Stock Reserve

Area

Gundaline Travelling Stock Reserve covers an area of 6.25 km^2.

Description

Gundaline Stock Reserve is situated within the western alluvial valley plains landscape. The reserve was crossed east-west by Packadilli Lagoon and terminated upon the banks of the Murrumbidgee River. Minor topographic features encompassed in the survey included river flats, levee deposits, lagoon and plains.

Climate

The climate is semi arid with cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm, and is effective for three months from June to August.

Water Availability

Water is available within the Murrumbidgee River and the associated Packadilli Lagoon wetland areas.

Vegetation

The reserve was generally well vegetated with a thin cover of well grazed grass. *Acacia pendula* and *Geijera parviflora* trees formed clumps across the sandy plain to the south of the river. A *typha* swamp covered the eastern side of these flats. *E. camaldulensis* occurred in the river flat and within the lagoon areas. *E. largiflorens* woodland lined the river and lagoon margins. Past vegetational patterns would have been similar, although the plains country would probably have also supported an *Atriplex* sp shrubland.

Ground Surfaces

A well used track ran down the approximate centre of the reserve and along the floodplain margin south of Packadilli Lagoon. This area consisted of red soil prone to scalding. A large dam excavated to the highway end of the reserve had cut through predominantly sandy soil to a depth of about 6 m. Elsewhere ground surfaces were stable or depositional.

Survey Method

All accessible parts of Gundaline Stock Reserve was inspected on foot. The deeper sections of the wetland areas could not be accessed.

Features Recorded

Oven mounds and scarred trees were recorded along the southern break of slope leading down to Packadilli Lagoon. Between this break of slope and the lagoon lay flats prone to flooding vegetated by dense mature *E. camaldulensis*. Numerous scarred trees, both *E. largiflorens* and *E. camaldulensis*, were recorded from within the flats and within the swamp. The scarred *E. camaldulensis* trees were all dead. Once across Packadilli Lagoon the ground rose again, with *E. largiflorens* woodland vegetation. Scarred *E. largiflorens* trees were numerous, concentrated in an area of high ground inside a now extinct meander. One had the bark half cut off but still growing on one margin. Remnant small ovens visible as deflated piles of baked clay heat retainers were also recorded in the vicinity. The margins of the river were flat and flood prone, with infilled meander scars and billabongs. *Marsilia drummondii* formed a thick carpet underfoot. The river banks were quite steeply undercut and eroding. A possible mussel shell midden, or the last traces of one, was recorded within the eroding bank. A cluster of small piles of baked clay heat retainer rakeout were recorded close to the now dry eastern middle section of Packadilli Lagoon

Altogether a total of 49 sites were recorded as well as 4 isolated finds. There were 2 oven mound sites, 10 small oven locations and 37 scarred trees. The pattern of site distribution evidenced here is typical of the wider area, with scarred trees distributed throughout the wooded areas, oven mounds on the boundaries of current flood patterns and smaller ovens haphazardly occurring but largely confined to red clay levee soils, and freshwater middens along the current river bank. Throughout the area artefacts are few, and mostly associated with smaller ovens and to a lesser extent with oven mounds. This may however be a factor of the erosion patterns, since smaller ovens are more commonly found in areas where scalding is actively removing the topsoil, and these are also places where artefacts are most visible.

Gundaline Stock Reserve 1

GSR1 comprised an isolated find of a single stone artefact.

1. Metamorphosed sedimentary pebble flaked piece (38x25x20 mm). Approximately 15% of the pebble cortex of the material remained on the artefact. The artefact had an acute utilised edge.

Gundaline Stock Reserve 2

GSR2 was an isolated stone artefact.

1. Milk quartz chip measuring (14x8x5 mm).

Gundaline Stock Reserve 3

GSR3 was an isolated stone artefact.

1. Glassy quartz chip (13x12x2 mm).

Gundaline Stock Reserve 4

GSR4 was an isolated stone artefact.

1. Glassy quartz chip (14x9x4 mm).

Gundaline Stock Reserve 5

GSR5 was a deflated deposit of baked clay heat retainer rakeout from the operation of a small oven. It measured 0.50 x 0.40 m. The site was exposed in an eroded scald reaching a depth of approximately 0.4 m below the current surrounding ground surface. Approximately 10 heat retainers were exposed in a circular concentration, freshly eroding from a newly exposed ground surface.

Gundaline Stock Reserve 6

GSR6 was a dead *E. camaldulensis* tree with an elongate oval scar on the trunk. The tree was in very poor condition with its upper section collapsed and broken away, and lying on the ground adjacent to the standing stump. The tree trunk circumference measured 3.15 m. The scar faced 312 degrees magnetic and commenced 0.57 m above the ground. The scar measured 2.4 m in length and was a maximum of 0.46 m wide, excluding regrowth. No axe cuts were visible on the exposed scarred surface.

Gundaline Stock Reserve 7

GSR7 was a dead *E. camaldulensis* tree with an elongate scar on its trunk. The upper section of the tree had completely rotted and fallen away. The trunk circumference measured 4.01 m. The scar faced 256 degrees magnetic and commenced at a point 1.32 m above ground. The scar measured 1.66 m in length and had a maximum width of 0.45 m, excluding regrowth. No axe cuts were visible.

Gundaline Stock Reserve 8

GSR8 was a dead *E. camaldulensis* tree with an elongate scar on its trunk. The tree trunk circumference measured 2.89 m. The scar faced 11 degrees magnetic and commenced at a point 0.93 m above ground. The scar measured 2.16 m in length and was a maximum width of 0.33 m. No axe marks were visible.

Gundaline Stock Reserve 9

GSR9 was a platform shaped deposit of oven mound material measuring 10 x 10 m with an elevation of approximately 0.5 m. The site was quite compacted and heavily vegetated. Baked clay heat retainers were embedded within the deposit. The site was located 60 m from the break of slope leading down to Packadilli Lagoon.

Gundaline Stock Reserve 10

GSR10 was a deflated level exposure of oven mound material measuring 9 x 9 m. The deposit consisted of a loose dark soil with numerous whole and fragmentary baked clay heat retainers. The heat retainers were up to 0.12 m in diameter and had a clay/sand composition. Ants had colonised a central area of the deposit.

Gundaline Stock Reserve 11
GSR11 was a live *E. largiflorens* tree with two oval scars removed from its bilobate trunk. The tree trunk circumference measured 4.48 m. Scar (a) faced 222 degrees magnetic and commenced 0.35 m above ground. It measured 0.64 m in length and was 0.23 m wide. No axe marks were visible on its surface. Scar (b) faced 253 degrees magnetic and commenced 0.5 m above ground. It measured 0.63 m in length and was 0.2 m wide. Axe cuts ran across the base of the scar.

Gundaline Stock Reserve 12
GSR12 was a live *E. largiflorens* tree with an oval scar removed from a forked limb. Tree trunk circumference measured 1.55 m. The scar faced 62 degrees magnetic and commenced at a point 0.95 m above ground. The scar measured 0.5 m in length and was 0.17 m wide. No axe marks were visible on the scarred surface.

Gundaline Stock Reserve 13
GSR13 was a dead *E. largiflorens* tree with a broad scar on its trunk. Tree trunk circumference measured 1.93 m. The scar faced 127 degrees magnetic and commenced at a point 1.04 m above ground. The scar measured 0.79 m in length and was 0.36 m wide. No axe marks were visible.

Gundaline Stock Reserve 14
GSR14 was a live *E. largiflorens* tree with a broad scar on the trunk. Tree trunk circumference measured 1.87 m. The scar faced 132 degrees magnetic and commenced at a point 0.3 m above ground. The scar measured 1.62 m in length and was 0.48 m wide. Blunt axe cuts were located at the top of the scar.

Gundaline Stock Reserve 15
GSR15 was a live *E. largiflorens* tree with a long broad scar on the trunk. Trunk circumference measured 2.55 m. The scar faced 85 degrees magnetic and commenced at a point 0.28 m above ground. The scar measured 1.8 m in length and was 0.55 m wide. Axe marks were located at the upper, lower and central parts of the scar.

Gundaline Stock Reserve 16
GSR16 was a dead *E. camaldulensis* tree with an elongate scar removed from its trunk. Trunk circumference measured 3.42 m. The scar faced 61 degrees magnetic and commenced 1.08 m above ground. The scar measured 1.67 m in length and was 0.26 m wide. The extent of regrowth had caused the entire tree trunk to bulge for the length of the scar. No axe marks were visible.

Gundaline Stock Reserve 17
GSR17 was a live *E. largiflorens* tree with a small oval scar on the trunk. The trunk circumference measured 3.82 m. The scar faced 172 degrees magnetic and commenced 0.54 m above ground. The scar measured 0.48 m in length and was 0.24 m wide. No axe marks were visible on the scar surface.

Gundaline Stock Reserve 18
GSR18 was a live *E. largiflorens* tree with three elongate scars on its trunk. The trunk circumference measured 2.88 m. Scar (a) faced 293 degrees magnetic and commenced 0.15 m above ground level. The scar measured 1.47 m in length and was 0.36 m wide. No axe marks were visible on the scar surface. Scar (b) faced 162 degrees magnetic and commenced 0.05 m above ground level. It measured 1.65 m in length and was 0.35 m wide. No axe marks were visible on the scar surface. Scar (c) faced 234 degrees magnetic and commenced 0.15 m above ground level. It measured 2.69 m in length and in addition a small bark tear extended upwards for a further 0.2 m. It was 0.42 m wide. No axe marks were visible on the scarred surface.

Gundaline Stock Reserve 19
GSR19 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 3.71 m. The scar faced 19 degrees magnetic and commenced 0.45 m above ground. The scar measured 1.68 m in length and was 0.24 m wide. No axe marks were visible on the scar surface.

Gundaline Stock Reserve 20
GSR20 was a live *E. largiflorens* tree with an elongate teardrop shaped scar on the trunk. The tree trunk circumference measured 2.64 m. The scar faced 183 degrees magnetic and commenced 0.33 m above ground. The scar measured 1.31 m in length and was 0.29 m wide. No axe cuts were visible.

Gundaline Stock Reserve 21
GSR21 was a live *E. largiflorens* tree with an elongate scar on the trunk. Tree trunk circumference measured 3.95 m. The scar faced 118 degrees magnetic and commenced 0.21 m above ground. The scar measured 1.77 m in length and was 0.26 m wide. No axe marks were visible on the scar surface.
Gundaline Stock Reserve 22
GSR22 was a live *E. largiflorens* tree with a long broad scar removed from a section of bilobate trunk. Trunk circumference measured 4.4 m. The scar faced 23 degrees magnetic and commenced at a point 0.2 m above ground. The scar measured 2.23 m in length and was 0.63 m wide. The extent of regrowth had resulted in the trunk bulging for the length of the scar. No axe marks were visible.
Gundaline Stock Reserve 23
GSR23 was a live *E. largiflorens* tree with an elongate scar on the trunk. Tree trunk circumference measured 1.9 m. The scar faced 256 degrees magnetic and commenced 0.12 m above ground. It measured 2.42 m in length and was 0.5 m wide. Two curved lines of axe cuts crossed the upper and lower sections of the scar. The extent of regrowth had caused the trunk to bulge for the length of the scar.
Gundaline Stock Reserve 24
GSR24 was a live *E. largiflorens* tree with a small oval scar on one forked limb. The basal trunk circumference measured 2.67 m whilst the circumference of the scarred limb measured 1.33 m. The scar faced 268 degrees magnetic and commenced 0.67 m above ground. The scar measured 0.38 m in length and was 0.15 m wide. No axe cuts were visible on the scarred surface.
Gundaline Stock Reserve 25
GSR25 was a live *E. largiflorens* tree with an elongate scar on the major fork of a bilobate trunk. The trunk circumference measured 2.24 m whilst the circumference of the scarred limb measured 1.49 m. The scar faced 114 degrees magnetic and commenced 0.58 m above ground. The scar measured 1.71 m in length and was 0.24 m wide. No axe cuts were visible on the scarred surface.
Gundaline Stock Reserve 26
GSR26 was a live *E. largiflorens* tree with an elongate teardrop shaped scar on the trunk. The trunk circumference measured 2.44 m. The scar faced 136 degrees magnetic and commenced 0.4 m above ground. The scar measured 2.6 m in length and was 0.55 m wide. No axe cuts were visible on the scarred surface.
Gundaline Stock Reserve 27
GSR27 was a live *E. largiflorens* tree with an elongate teardrop shaped scar on the trunk. The tree trunk circumference measured 3.94 m. The scar faced 228 degrees magnetic and commenced 0.1 m above ground. The scar measured 2.04 m in length and was a maximum of 0.23 m in width. No axe cuts were visible.
Gundaline Stock Reserve 28
GSR28 was a live *E. largiflorens* tree with an elongate scar on the main section of a bilobate trunk. The trunk circumference measured 2.7 m. The scar faced 283 degrees magnetic and commenced 0.82 m above ground. The scar measured 2.46 m in length and was a maximum of 0.4 m wide. No axe cuts were visible on the scarred surface.
Gundaline Stock Reserve 29
GSR29 was a live *E. largiflorens* tree with scars on each section of a bilobate trunk. The basal trunk circumference measured 6.18 m, whilst the circumference through scar (a) measured 3.19 m and through scar (b) 3.23 m. Scar (a) faced 303 degrees magnetic and commenced 0.48 m above ground. It was an elongate oval in shape. It measured 1.46 m in length and was 0.31 m wide. Scar (b) faced 178 degrees magnetic and commenced 0.88 m above ground. It was oval in shape. It measured 0.83 m in length and was 0.21 m wide. No axe cuts were visible on either scar.
Gundaline Stock Reserve 30
GSR30 was a live *E. largiflorens* tree with a long broad scar on the trunk. The trunk circumference measured 3.72 m. The scar faced 324 degrees magnetic and commenced 0.62 m above ground. The scar measured 1.58 m in length and was 0.42 m wide. Axe cuts were located at the base of the scar.
Gundaline Stock Reserve 31
GSR31 was a live *E. largiflorens* tree with an elongate scar on the trunk. Trunk circumference measured 2.64 m. The scar faced 134 degrees magnetic and commenced at

a point 0.35 m above ground. The scar measured 1.95 m in length and was a maximum of 0.35 m wide, excluding regrowth. Curved lines of axe cuts traced the upper and lower terminations of the scar.

Gundaline Stock Reserve 32

GSR32 was a live *E. largiflorens* tree with a broad scar on the trunk. Trunk circumference measured 1.55 m. The centre of the scar faced 71 degrees magnetic. The scar commenced 0.10 m above ground. It measured 1.54 m in length and was a maximum of 0.9 m wide. The centre of the scar was crossed by two lines of blunt axe cuts.

Gundaline Stock Reserve 33

GSR33 was a dead *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 2.05 m. The scar faced 242 degrees magnetic and commenced 0.73 m above ground. The scar measured 2.01 m in length and was 0.25 m wide. No axe cuts were visible on the scar surface.

Gundaline Stock Reserve 34

GSR34 was a live *E. largiflorens* tree with a scar on one section of a bilobate trunk. Total trunk circumference measured 6.0 m, whilst the circumference through the scar measured 2.85 m. The scar faced 285 degrees magnetic and started 0.45 m above ground. The scar measured 1.54 m in length and was 0.21 m wide. No axe cuts were visible on the scar surface.

Gundaline Stock Reserve 35

GSR35 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 3.41 m. The scar faced 211 degrees magnetic and commenced 0.4 m above ground. The scar measured 1.76 m in length and was 0.36 m wide. No axe cuts were visible on the scar surface.

Gundaline Stock Reserve 36

GSR36 was a dead *E. largiflorens* tree with elongate oval scars on two sides of its trunk. Trunk circumference measured 3.62 m. Scar (a) faced 4 degrees magnetic and commenced 0.1 m above ground. It measured 2.12 m in length and was 0.51 m wide. Scar (b) faced 182 degrees magnetic and commenced 0.25 m above ground. It measured 1.96 m in length and was 0.53 m wide. Both scars had multiple lines of axe cuts across their upper and lower terminations.

Gundaline Stock Reserve 37

GSR37 was a live *E. largiflorens* tree with the bark nearly completely stripped in a broad sheet. The tree trunk circumference measured 2.79 m. The centre of the scar faced 99 degrees magnetic and the scar commenced at ground level. Two lines of axe cuts marked the upper and lower sections of the scar. Between these the scar measured 2.01 m in length. It was 1.94 m wide.

Gundaline Stock Reserve 38

GSR38 consisted of a group of three piles of heat retainer/oven rakeout from the operation of at least one small earth oven. The piles measured 0.35 x 0.35, 0.30 x 0.20 and 0.75 x 0.65 m. They were recorded within an overall area of 4 x 4 m. The rakeout was exposed on a deflating ground surface.

Gundaline Stock Reserve 39

GSR39 was a pile of baked clay rakeout from the operation of a small earth oven. It measured 1 x 1 m. The baked clay heat retainers were of a coarse texture, coloured light orange, black and grey. They were up to 0.07 m in diameter and were actively eroding from the subsoil.

Gundaline Stock Reserve 40

GSR40 was a live *E. camaldulensis* tree with an elongate scar on the trunk. The trunk circumference measured 4 m. The scar faced 299 degrees magnetic and commenced 1.41 m above ground. The scar measured 1.46 m in length and was 0.23 m wide. A later branch scar had removed bark from around the scar. No axe cuts were visible on the scarred surface.

Gundaline Stock Reserve 41

GSR41 was a dead, slightly burnt, *E. camaldulensis* tree with an elongate scar on the trunk. The trunk circumference measured 3.68 m. The scar faced 186 degrees magnetic and commenced 1.23 m above ground. The scar measured 1.91 m in length and was 0.25 m wide. No axe cuts were visible on the scar surface. Current high water marks ringed the base of the tree to a height of 1 m above ground.

Gundaline Stock Reserve 42
GSR42 was a live *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 3.35 m. The scar faced 290 degrees magnetic and commenced 0.58 m above ground. The scar was 1.85 m long and 0.45 m wide. Multiple lines of axe cuts crossed the base of the scar. A single line of axe cuts crossed the upper section of the scar, which was cut squarely across with a flap of bark protruding.

Gundaline Stock Reserve 43
GSR43 consisted of a pile of baked clay heat retainers rakeout from the operation of a small earth oven. The pile measured 2 x 1 m. Heat retainers reached 0.08 m in diameter. The oven occurred in association with 6 others.

Gundaline Stock Reserve 44
GSR44 was a deflated pile of baked clay heat retainer rakeout from the operation of a small earth oven. The pile measured 2 x 2 m. Heat retainers reached 0.08 m in diameter. The oven occurred in association with 6 others.

Gundaline Stock Reserve 45
GSR45 was a deflated scatter of baked clay heat retainer rakeout from the operation of a small earth oven. The scatter measured 5 x 1 m. Heat retainers reached 0.04 m in diameter. The oven occurred in association with 6 others.

Gundaline Stock Reserve 46
GSR46 was a small pile of baked clay heat retainer rakeout from the operation of a small earth oven. The pile measured 0.15 x 0.15 m. Heat retainers reached 0.05 m in diameter. The oven occurred in association with 6 others.

Gundaline Stock Reserve 47
GSR47 was a pile of baked clay heat retainer rakeout from the operation of a small earth oven. The pile measured 0.8 x 0.8 m. Heat retainers reached 0.02 m in diameter. The rakeout appeared to be eroding from the base of a small shelf of red topsoil. The oven occurred in association with 6 others.

Gundaline Stock Reserve 48
GSR48 was a deflated scatter of baked clay heat retainer rakeout from the operation of a small earth oven. The scatter measured 0.2 x 0.2 m. Heat retainers reached 0.08 m in diameter. The oven occurred in association with 6 others.

Gundaline Stock Reserve 49
GSR49 was a pile of baked clay heat retainer rakeout from the operation of a small earth oven. The pile measured 2 x 2 m. It was surrounded by a light deflated scatter of loose heat retainers covering an area of approximately 30 m^2. In situ heat retainers reached 0.04 m in diameter, whilst those displaced in the surrounding scatter reached 0.12 m. The oven occurred in association with 6 others.

Gundaline Stock Reserve 50
GSR50 was a live *E. largiflorens* tree with an elongate teardrop shaped scar on its trunk. The tree trunk circumference measured 3.04 m. The scar faced 64 degrees magnetic and commenced 0.3 m above ground. The scar measured 1.95 m in length and was 0.27 m wide. No axe cuts were visible on the scar surface.

Gundaline Stock Reserve 51
GSR51 was a live *E. largiflorens* tree with a long scar on its trunk. The scar was unusual in that the sheet of bark had only been partially cut out, one vertical margin remained attached. The tree trunk circumference measured 2.53 m. The scar faced 155 degrees magnetic and commenced 0.25 m above ground. The scar measured 1.95 m in length. Regrowth reduced the width of scarred trunk, only partially visible, to 0.24 m, although the sheet of bark measured 0.5 m in width. Axe cuts were visible at the base of the scar and along the edges of the bark sheet. The sheet of bark was 0.04 m thick. Whilst the upper and lower sections of the scar were rounded in outline the sheet of bark was clearly rectangular in shape.

Gundaline Stock Reserve 52
GSR52 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The trunk circumference measured 2.4 m. The scar faced 167 degrees magnetic and commenced 0.52 m above ground. The scar measured 1.77 m in length and was 0.23 m wide. No axe cuts were visible on the scar surface.

Gundaline Stock Reserve 53
GSR53 was a live *E. largiflorens* tree with an elongate scar on the trunk. The trunk circumference measured 2.09 m. The scar faced 68 degrees magnetic and commenced

0.43 m above ground. The scar measured 2.45 m in length and was 0.52 m wide. Multiple lines of axe cuts crossed the upper, central and lower sections of the scar.

32. Goolgumbla

Area

A survey of about 6.25 km^2 was carried out on a section of the Goolgumbla property approximately 45 km south of the Murrumbidgee River.

Description

The survey concentrated along a palaeochannel known as the Coleambally Creek. The landscape comprised flat western plains. The stream bed had been canalised by the Water Resources Commission as an outfall effluent of the Coleambally Irrigation Area. The canalisation has extensively modified the creek bed and immediate margins with the construction of canal banks and a service track alongside, and on top of, one of the banks.

Climate

The climate is semi arid with cool mean annual temperatures. Rainfall reaches 350 mm per annum, and is effective for two months of the year, between June and July.

Water Availability

There are no permanent water sources in the vicinity. The palaeochannels do conduct water through the landscape in wet periods however, and localised soaks and wetlands seasonally establish for periods of up to several months.

Vegetation

The remnant palaeochannel is flanked by thick *E. largiflorens* woodland, and most of the plains were covered in low grasses. Swampy depressions are vegetated with *Eragrostis australasica* and dunes and levees associated with the stream channel are vegetated with *Callitris* sp. The past vegetation structure would have been similar, although wooded areas would have been more extensive and the plains would also have supported a woodland community dominated by *Acacia* sp.

Ground Surfaces

Soils generally consisted of red earths. Levees were composed of compact red sandy soils and small areas of cracking grey clays occurred in areas prone to inundation, particularly along the centre of the stream channel. No extensive scalded areas were located on Goolgumbla, although several minor patches had started to erode on levee and dune areas.

Survey Method

The area selected for survey was comprehensively walked by two people.

Features Recorded

Two small eroded locations on an area of sandsheet and low dune of about 350 m length which stretched along the western side of the creek yielded evidence of Aboriginal occupation in the form of artefact scatters, a small oven and a mound. The depth of erosion was approximately 0.40 m.

Goolgumbla 1

The first location contained a low oven mound measuring 10 x 12 m composed of ashy sand and scattered baked clay heat retainers. The surface of the mound was concreted and its elevation was probably 0.10 to 0.15 m above the surrounding ground surface. One rabbit burrow had entered the centre of the mound and a profile in the hole indicated that the mound had only a shallow deposit (c.0.2 m) and consisted of an homogeneous mixture of sediment and heat retainers. No artefacts or mussel shell were present in the deposit.

Goolgumbla 2

A small oven was located nearby situated on a projecting tongue of the sandsheet, within *E. largiflorens* woodland. Only one edge of the oven was visible in the erosion, but its

diameter was estimated to be approximately 1 m. Sixteen flaked stone artefacts were recorded in scalded patches in close proximity to the ovens.

Goolgumbla 3

Approximately 100 m further south a second scatter of 5 stone artefacts was recorded on an elevated section of the sandsheet. Intersite areas were not eroded and it is likely that the site extends over a much broader area. The proximity of small ovens and low mounds of essentially oven rakeout amidst scattered artefacts suggests that the sites may form a related complex. The larger mounds are suggestive of focused cooking and discard areas.

The sites were located on low sandy rises probably blown up from old stream levee deposits. Whilst located in proximity to the stream course (c.80 m) there are further possible reasons for their location. The particular area occupied an ecotone between *Eragrostis australasica* swamp and *Callitris* sp vegetated sand dunes, as well as the creek. Good drainage and slight elevation probably determined the exact site positions since there was ample evidence for poor drainage in the surrounding ground, with deep cattle hoof prints left by preceding wet periods. Areas such as this would become prime food sources during wet periods, waterfowl are particularly attracted to the *Eragrostis australasica* areas and will colonise them at breeding times. As well, the cover afforded by the woodland, proximity to seasonal water and open plains would provide optimal habitat for other wildlife.

33. Gum Creek Tank

Area

The survey area consisted of an area of just over 3 km^2 centred around Gum Creek, a palaeochannel south of the Murrumbidgee river.

Description

The landscape consisted of open western plains crossed by palaeochannels.

Climate

The climate is semi arid with cool mean annual temperatures. Annual precipitation reaches 350 mm, and rainfall exceeds evaporation for two months of the year, during June and July.

Water Availability

There are no permanent water sources within the locality, the closest being the Murrumbidgee River, 25 km north. During wet periods Gum Creek would fill from localised drainage and water may be retained for months, in soaks and swamps.

Vegetation

A mixed *E. camaldulensis* and *E. largiflorens* alliance vegetated the stream channel area. The surrounding plains were vegetated in tussocky grasses and shrubs. The plains areas would originally have been vegetated with an *Acacia pendula* woodland.

Ground Surfaces

Soils in the vicinity were heavy cracking grey earths and some sandy loams. Ground surfaces were stable. Ground visibility was very high due to a recent bush fire.

Survey Method

The reserve was comprehensively walked by two people.

Features Recorded

Four sites were located, all scarred trees. Three of the trees were live *E. largiflorens* and the other was a dead *E. camaldulensis*. All of the scars were elongate. Two measured in excess of 2 m in length and were possibly used for the construction of either light canoes or shelters. No further archaeological materials were located, despite the good ground visibility.

Gum Creek Tank 1
GCT1 was a live *E. largiflorens* tree with a single elongate scar removed from one side. Tree trunk circumference was 2.78 m. The scar faced 303 degrees magnetic and commenced at ground level. The scar measured slightly more then 2 m in length, the upper termination was missing due to later damage to the tree. The maximum width of the scar, excluding regrowth, was 0.6 m. Two single lines of axe cuts were located 0.47 and 1.97 m above the base of the scar.

Gum Creek Tank 2
GCT2 was a live *E. largiflorens* tree with an elongate scar on one forked trunk/limb. Basal trunk circumference of the tree was 2.51 m and the limb circumference was 3.92 m. The scar faced 171 degrees magnetic and commenced 0.86 m above ground. The scar measured 1.45 m in length and was a maximum of 0.45 m in width, excluding regrowth. No axe marks were visible on the scarred surface.

Gum Creek Tank 3
GCT3 was a dead *E. camaldulensis* tree with a small elongate oval scar on one side. Trunk circumference was 1.91 m. The scar faced 22 degrees magnetic and commenced 0.66 m above ground. The scar measured 0.52 m in length and had a maximum width of 0.16 m, excluding regrowth. No axe cuts were visible on the scarred surface.

Gum Creek Tank 4
GCT4 was a live *E. largiflorens* tree with an elongate scar on one side. The tree trunk circumference measured 2.52 m. The scar faced 185 degrees magnetic and commenced at a point 0.65 m above the ground. The scar measured 2.38 m in length and had a maximum width of 0.77 m, excluding regrowth. A series of blunt axe cuts were located across the upper and lower extremities of the scar.

34. Rudd's Point Reserve

Area
Rudd's Point Reserve is a Travelling Stock Reserve covering 1.25 km^2 adjacent to the southern bank of the Murrumbidgee River.

Description
The landscape consists of western alluvial valley plains. The reserve occupied high ground immediately beside the river channel.

Climate
The climate is semi arid and experiences cool mean average temperature. Rainfall reaches 400 mm per annum. Rainfall exceeds evaporation for only two months of the year, between June and July.

Water Availability
Water would have been available within the Murrumbidgee River.

Vegetation
Area along the margins of the river are vegetated with an *E. camaldulensis* alliance. Elsewhere the reserve was vegetated with low grasses, sparse *E. largiflorens* woodland in the southwestern corner, and a planted windbreak of exotic eucalypts. Previous vegetation patterns would have been similar except that the plains area would have supported native grassland and some shrubs.

Ground Surfaces
Soils consisted of red sandy loams. The soil along the higher southern bank was extremely silty, implying considerable over bank deposition. Elsewhere, considerable surface disturbance was evident. An access track had been graded through the area and firebreaks were ploughed around the perimeter. The ground beneath the planted eucalypts was deeply ripped. Various artefacts, campfires, and road works, relating to the historic use of the landscape also occur within the area.

Survey Method
The reserve was comprehensively walked by two people.

Features Recorded
No definite sites were located during the on-foot survey of the reserve. Several loose heat retainer-like lumps of burnt clay were noted, dispersed across the area, but their source was indeterminate. One artefact was located amidst ploughed ground underneath the grove of planted eucalypts. This comprised a quarter section of a small quartzite grinding-stone. It was ground on both margins and displayed flaking around the margins. No other occupation materials were evident in the vicinity, and considering its plough zone location its original location could not be ascertained.

Overall, the reserve displayed a distinct lack of evidence of Aboriginal occupation. This could be due to the burial of materials by floodlain silt, or it could be a reflection of the lesser resources of the high sides of river banks, as opposed to the lower billabong, wetland environs.

35. Uardry Stock Reserve
Area
Uardry Travelling Stock Reserve covers approximately 3 km^2 in area, and is located on the north bank of the Murrumbidgee River.

Description
The area was situated within western alluvial valley plains. The reserve consisted of about 50% floodplain, billabongs and old meanders of the river, and 50% dry plain. The northern floodplain of the river is narrowly confined by a relatively steep bank. The transition to flat dry plains is thus particularly abrupt in this area.

Climate
The climate is semi arid with cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm, effective rainfall, where levels exceed evaporation, is experienced for two months during June and July.

Water Availability
Water would have been available within the Murrumbidgee River, and an associated complex of lagoons.

Vegetation
Sections of the reserve adjacent to the river are covered with a thick *E. camaldulensis* forest and fringing *E. largiflorens* woodland. The northern sections of the reserve consist of open grassland now dominated by *Danthonia caespitosa*. Originally these grassland areas would have supported *Acacia pendula* and *Atriplex nummularia* with *Atriplex vesicaria* but they have been removed by grazing (Porteners 1993).

Ground Surfaces
Soils consisted of heavy grey earths within areas prone to inundation. The remainder comprised compact red clays. These were affected by wind and water erosion and numerous deflated and scalded areas were apparent. The occurrence of lithic materials and small ovens was confined to these areas of eroding surfaces.

Survey Method
The reserve was comprehensively traversed by two people.

Features Recorded
The area was effectively traversed on foot and a total of 48 sites were recorded. These were recorded as a series of 23 occurrences of archaeological material, since some sites occurred in tight groups. Site type composition was as follows; 21 scarred trees, 16 oven mounds, 3 small ovens, 7 artefact scatters and 1 freshwater shell midden.

36. Cooey Point Lagoon
Area
The Cooey Point Lagoon Travelling Stock Reserve covered approximately 6 km^2 and is situated on the south side of the Murrumbidgee River between Carrathool and Hay.

Description
The area lies within western alluvial valley plains. It specifically consists of a section of the Murrumbidgee River channel and an associated cut-off meander or lagoon. An island of higher ground remains between the present river channel and the lagoon. The presence of *E. largiflorens* trees upon this island indicates that it is not usually submerged during flood times, since this species cannot tolerate inundated conditions. Their presence also suggests that the isolation of the meander, forming an island, has occurred relatively recently since they tend only to generate along flood plain margins. Their current distribution probably indicates the past outer floodplain limits of the original river channel, which now forms the lagoon.

Climate
The area experiences a semi arid climate, characterised by cool mean annual temperatures. The annual rainfall is approximately 35 mm, and is typically effective between the months of June and July.

Water Availability
Water would have been available from either the river channel or the associated lagoon.

Vegetation
Presently *E. largiflorens* trees line the outer flood limits of the area and *E. camaldulensis* trees populate the low-lying, often inundated, sections between the lagoon and the river channel. This pattern has probably persisted from past conditions. An *Acacia pendula* woodland would have previously been present on the plains.

Ground Surfaces
Soils consisted of sandy loams along levee areas, red clays in the floodplain and cracking grey clays in low lying areas. Low sand ridges were located in the far north west of the reserve. Ground surfaces were generally stable, although some surface disturbance was present where access tracks and flood scouring occurred.

Survey Method
The area was surveyed totally on foot. The entire area was later recorded with a theodolite and EDM. Four sites were later excavated.

Features Recorded
One hundred and thirty one sites were recorded throughout the reserve. Fifty five mound sites were located. Nine of these consisted of very large, elevated, platform deposits of rich soft black sediment with baked clay heat retainers. Rabbit activity had disturbed most of these sites revealing the upper levels, at least, to be composed of an homogeneous matrix. The remainder, whilst obviously composed of mound materials, were less elevated and consisted of very compacted sediment. Some appeared as agglomerations of smaller oven activity. Patches of baked clay heat retainer could be discerned on the surfaces of some of these sites. Ant nests were also a common feature of these deposits. It may be a combination of post depositional processes that have caused the visual differences between the sites. Rabbits would have artificially elevated sites, whereas others may be continually being buried beneath alluvial silts. Vehicular traffic through the area may also act to compact some sites.

Four separate locations of small oven activity were also recorded. Three consisting of single piles of baked clay heat retainers and another consisting of a group of 5 piles of baked clay rakeout.

Sixty five scarred trees, five freshwater shell middens and two artefact scatters (one isolated find) were also recorded. Seventeen of the oven or mound sites had artefact scatters in association, either within their deposit or within 5 m of their margins. In one area an artefact scatter (CPL136 n=239) extended between several of the mounds. Following the field survey, the entire area was mapped with a theodolite and EDM. Sites

were plotted and incorporated onto a plan also noting features of micro-topographic scale such as flood channels and depressions.

A series of excavations was undertaken in this area, to investigate the structure and function of the mounds, and to establish the relationship between the various site types and obtain chronologies for the span of occupation.

Mounds

Cooey Point Lagoon 7

CPL7 was an artificially mounded (bulldozed) deposit of black ashy earth. It had apparently been bulldozed in order to eradicate rabbits. Its current spread measured some 30 x 25 m including the bulldozed section and its original long axis appeared to run along 262 degrees magnetic, judging by soil colour changes revealed in a bulldozed section of access track. No mussel shell or artefacts were evident in the site area. Heat retainers were numerous, attaining a maximum diameter of 0.12 m, some baked nodules of termite nest were also evident.

Cooey Point Lagoon 17

CPL17 was a large disturbed mounded deposit located on the bank of a small dry tributary of Cooey Point Lagoon. The site measured 24 x 21 m and had an elevation of approximately 0.8 m. It was extensively damaged by rabbit activity. The deposit contained ashy soil, baked clay heat retainers and fragmentary mussel shell.

Cooey Point Lagoon 18

CPL18 was a large platform shaped deposit of oven mound material measuring 23 x 22 m. The site had an elevation of approximately 0.5 m. The deposit consisted of dark ashy soil interspersed with whole and fragmentary baked clay heat retainers. Fragmentary mussel shell was also present through the deposit. The site was in poor condition due to an extensive network of open and collapsed rabbit burrows tunnelling through it.

Cooey Point Lagoon 28

CPL28 was an oval mounded deposit of ashy soil and heat retainers measuring 27 x 24 m with an elevation of 0.35 m. The site was in very poor condition due to having been extensively colonised by rabbits. As well, several young *E. largiflorens* trees were growing in the deposit. No shell or artefactual materials were evident.

Cooey Point Lagoon 29

CPL29 was an approximately circular mounded deposit of very black ashy sediment and baked clay heat retainers measuring 17 x 18 m with an elevation of approximately 0.4 m. The site was extensively disturbed by rabbits. Fragments of freshwater mussel shell were numerous throughout the loose surface deposit. No artefacts were evident.

Cooey Point Lagoon 44

CPL44 was visible as an undulating deposit of soft dark soil and heat retainers. It was crossed by the access track around the lagoon. Apart from the disturbance created by the track crossing the site it was very thickly vegetated and little of its surface could be seen. Some mussel shell fragments were visible in the exposed section. The site was approximately circular and measured 6 by 6 m.

Cooey Point Lagoon 60

CPL60 was an oven mound measuring 18 x 10 m with an approximate elevation of 0.5 m. The site was evident as a high dark mounded deposit with numerous rabbit burrows disturbing the surface. Heat retainers were large and grey, measuring a maximum of 0.09 m in diameter. Charcoal and mussel shell fragments were evident in redeposited rabbit scratchings. No artefacts were visible.

Cooey Point Lagoon 76

CPL76 was a 17 x 9 m exposure of oven mound of undulating elevation. The deposit was compact and well vegetated. Rabbit activity had caused extensive slumping of the deposit surface. The deposit consisted of dark ashy soil with small and fragmentary heat retainers. Mussel shell was also present. The site was located 15 m from the high water level of Cooey Point Lagoon.

Cooey Point Lagoon 6

CPL6 was evident as a small mound of compacted earth and heat retainer material. Its surface was completely vegetated in thick dried grasses and no mussel shell nor artefacts could be discerned. Visible heat retainers were small, measuring 0.02 m in diameter. The site was circular in plan, measuring 5 x 5 m.

Cooey Point Lagoon 8
CPL8 was situated on flat land beside the access track skirting Cooey Point Lagoon. It consisted of a well consolidated deposit of grey earth with circular concentrations of heat retainers of a maximum diameter of 0.12 m visible upon its surface. No mussel shell or stone artefacts were situated in the deposit. A piece of quartzite pebble was located nearby the site on the track. The site was circular in plan and measured 16 m along a bearing of 265 degrees by 11 m perpendicular. The site appeared to be in good condition apart from minor surface erosion.

Cooey Point Lagoon 9
CPL9 was situated on the break of slope leading down into Cooey Point Lagoon. It was visible as a low grassed mound and offered little surface visibility. No mussel shell or artefactual materials were evident. Concentrations of rounded orange brown heat retainers of up to 0.06 m in diameter were embedded in its surface. The mound deposit extended east-west along the lagoon bank for 10 m and 20 m down slope. The deposit was compact and appeared undisturbed by rabbits.

Cooey Point Lagoon 12
CPL12 was situated on the access track skirting Cooey Point Lagoon. The site was visible as a large flattened platform shaped deposit of crumbled baked clay and heat retainers (maximum diameter 0.05 m) and dark grey-black soil. Its surface was extremely compact. A small fragment of animal longbone was visible upon the surface of the site, however no mussel shell nor stone artefacts were evident. An ants nest was located at the western end of the deposit, however otherwise the site appeared to be in good condition. The site measured 16 by 10 m along a long axis of 123 degrees magnetic.

Cooey Point Lagoon 21
CPL21 was a large slightly mounded deposit of oven materials disturbed by construction of an access track around Cooey Point Lagoon. The deposit measured 18 x 10 m, the larger measurement distorted somewhat by the spread of materials along the track. The remaining elevation was approximately 0.2 m. The deposit contained dark ashy soil, baked clay heat retainers (0.06 m maximum diameter), fragments of mussel shell and four flaked stone artefacts.

1. Flaked pebble segment (20x15x14 mm)
2. Quartzite flaked piece (18x13x5 mm)
3. Quartzite flaked piece (17x11x3 mm)
4. Quartzite geometric microlith (13x7x3 mm).

Cooey Point Lagoon 22
CPL22 was an 11 x 11 m mound of approximately 0.15 m elevation. The deposit consisted of compacted ashy soil and heat retainers. The centre of the deposit had been colonised by ants. No shell or artefacts were visible in the surface of the deposit.

Cooey Point Lagoon 23
CPL23 was an 8 x 9 m mound of approximately 0.12 m elevation. The deposit consisted of compacted dark ashy soil and baked clay heat retainers. No shell or artefacts were visible in the surface of the deposit, although a piece of quartzite muller was recorded nearby, exposed in the surface of a track. The site was in poor condition, having been colonised by rabbits. The site was located adjacent to periodically inundated river flats south of Cooey Point Lagoon.

Cooey Point Lagoon 27
CPL27 was an undisturbed mound measuring 12 x 9 m aligned along the bank of Cooey Point Lagoon. The deposit was compact and the surface well vegetated. Baked clay heat retainers could be seen in the surface, however mussel shell or artefacts were not evident. The extent of surface vegetation and its position of the bank of the lagoon made measurement of site elevation difficult, however it is estimated to be at least 0.3 m high.

Cooey Point Lagoon 33
CPL33 was an large mound measuring 31 x 27 m. It had an elevation of approximately 0.3 m. The deposit was compacted and contained dark ashy soil and baked clay heat retainers. No artefacts or mussel shell were evident. Ants had colonised a section of the deposit.

Cooey Point Lagoon 59

CPL59 consisted of a small mound measuring 11 x 6 m and attaining an approximate height of 0.25 m. The site was compacted and well vegetated, situated on the break of slope leading down to Cooey Point Lagoon. No artefacts or mussel shell were evident on the surface of the site. Visible heat retainers were small, approximately 0.02 m in diameter.

Cooey Point Lagoon 80

CPL80 was a 14 x 14 m exposure of mounded deposit located 50 m from the lagoon edge. The site had slight elevation and was heavily grassed. The deposit consisted of compacted dark ashy soil and baked clay heat retainers as well as mussel shell. The site contained two artefacts.

1. Quartzite muller fragment
2. Chert flaked piece.

Cooey Point Lagoon 82

CPL 82 was a compact platform shaped mound amidst a wider exposure of baked clay and cultural sediment situated 40 m northeast of Cooey Point Lagoon. The mounded area measured 20 x 20 m and had an elevation of approximately 0.3 m. The deposit consisted of dark ashy sediment, baked clay heat retainers and mussel shell. Loose surface heat retainers reached a maximum diameter of 0.13 m. There were six stone artefacts recorded in close association with Cooey Point Lagoon 82.

1. Milk quartz flaked piece
2. Quartzite flaked piece
3. Chert flaked piece
4. Silcrete flake with usewear
5. Quartzite chip
6. Fragment of sandstone grinding stone.

At the eastern end of the deposit considerable rabbit activity had disturbed a low area of heat retainer and dark soil. Ants had also colonised the area resulting in considerable subsurface disturbance. Large loose heat retainers were recorded scattered over the site reaching a maximum diameter of 0.12 m. A test excavation was carried out on areas within this site area.

Cooey Point Lagoon 88

CPL88 was a 15 x 15 m platform shaped mound deposit. The site was in good condition with a lightly vegetated surface. The deposit was compact and dark in colour and contained large quantities of embedded heat retainers, reaching a maximum diameter of 0.10 m.. Ants had colonised a 1 x 1 m area of the site. Mussel shell was present in the surface however no artefacts were evident. The site was located 10 m from a small ponded depression north of Cooey Point Lagoon.

Cooey Point Lagoon 89

CPL89 was a 9 x 9 m mound deposit with an elevation of approximately 0.2 m. The deposit was very compact with dark ashy sediment. Heat retainers were embedded in the surface of the site in circular concentrations. Fragments of fresh water mussel shell were also present. The site was located 10 m from a small ponded depression north of Cooey Point Lagoon. One chip of milk quartz was recorded within its loose surface deposit.

Cooey Point Lagoon 94

CPL94 was an 11 x 11 m mound with an elevation of approximately 0.5 m. The site appeared undisturbed and consisted of compact dark ashy sediment baked clay heat retainers, mussel shell and flaked stone artefacts. Heat retainers were of a gravelly texture and reached a maximum diameter of 0.10 m. The site occupied a position between a flood channel and ponded depression and would have formed a small island during wet periods. A small depression was located on the southern margin of the site measuring 4 m in diameter and reaching 0.2 m in depth. Two artefacts were recorded in association with this site.

1. Retouched quartzite flake
2. Milky quartz chip

Cooey Point Lagoon 104

CPL104 was an 8 x 7 m mound deposit with an elevation of approximately 0.3 m. The site had been colonised by ants. No mussel shell or artefacts were evident in the site surface.

Cooey Point Lagoon 107

CPL107 was an 8 x 8 m oven mound deposit of approximately 0.10 m elevation. The site appeared as a low compact vegetated mound. The deposit surface was covered in loose and embedded heat retainers reaching a maximum diameter of 0.09 m. No mussel shell or artefacts were evident in the surface materials.

Cooey Point Lagoon 116

CPL116 was a 14 x 12 m platform shaped oven mound deposit with an elevation of approximately 0.3 m. The surface of the site was compacted and lightly vegetated. Baked clay heat retainer material was evident in patches through grass cover. Loose heat retainers measured a maximum of 0.14 m in diameter. No mussel shell or artefacts were superficially evident. The site was located on the island formed between Cooey Point Lagoon and the present river channel. This site was later excavated.

Cooey Point Lagoon 123

CPL123 was an 8 x 8 m oven mound deposit. The site appeared as a compact cemented mound occupying the break of slope leading to inundated flats adjacent to Cooey Point Lagoon. The site consisted of dark ashy soil, baked clay heat retainers and mussel shell. No artefacts were recorded in the vicinity.

Soft Deflated Mounds

Cooey Point Lagoon 15

CPL15 was visible as a large very deflated deposit of baked clay heat retainers and dark grey ashy soil extensively disturbed by rabbits. The site was approximately circular and measured 17 x 17m. It had no remaining elevation above the surrounding ground surface. Apart from surface deflation, however, it was in reasonable condition.

The baked clay heat retainers had a maximum diameter of 0.10 m and occurred in circular concentrations across the site. Nacreous fragments of mussel shell and a fragment of burnt bone were visible in the surface of the deposit. A total of twenty five artefacts were recorded from the loose surface deposit. Of these 9 were flakes, 2 of which displayed usewear. Five were flaked pieces, 4 were flake cores, 1 of which was bipolar. Four were chips, 2 were small fragments of mullers and 1 was a small sharpening stone or whetstone. A variety of raw materials were represented: silcrete was the most numerous (n=14), followed by various types of quartz (n=5), sandstone (n=3), quartzite (n=2) and chert (n=1). The chert and three of the silcrete artefacts retained pebble cortex

Cooey Point Lagoon 35

CPL35 was a 10 x 11 m level circular deposit of deflated mound materials exposed on an access track. The deposit consisted of dark ashy soil and baked clay heat retainers. No mussel shell or artefacts were visible.

Cooey Point Lagoon 105

CPL105 was a 10 x 10 m level deflated mound deposit. The site was extensively colonised by ants and *E. largiflorens* trees had generated at its margins. The deposit consisted of dark ashy earth and fragmentary baked clay heat retainers. No mussel shell or artefacts were evident.

Compact Deflated Mounds

Cooey Point Lagoon 10-11

CPL10-11 was originally recorded as two separate exposures of mound material however re-examination of the site during dry times revealed the continuation of deposit between the two concentrations. The site is situated on the access track skirting the lagoon and this location has resulted in its artificial spread of 35 m along the track, its maximum width being 8 m. The site is situated in a 'corner' between Cooey Point Lagoon and a small tributary. The site has been heavily disturbed by the construction of the access track and has no remaining elevation. Mussel shell is visible in its surface and approximately circular concentrations of grey heat retainers, with orange interiors, are also evident.

Cooey Point Lagoon 13

CPL13 was a deflated deposit of baked clay heat retainers and dark ashy soil. The site was level with the surrounding ground surface and was roughly circular, measuring 9 x 9 m. Heat retainers attained a maximum of 0.08 m in diameter. The deposit was compacted and fragments of mussel shell were visible upon its surface. An ant colony was situated on one margin of the site and the access track running around the lagoon crossed the site in the same location. The surface of the site had been disturbed by vehicles. Four stone artefacts were evident upon the surface of the site.

1. Fragment of volcanic material which exhibited ground polish. It appeared to be a (sharpening?) flake struck from an edge-ground hatchet.
2. Quartzite muller fragment
3. Quartzite muller fragment
4. Quartz flake

Cooey Point Lagoon 19

CPL19 was a deflated oven mound deposit located on the bank of Cooey Point Lagoon. It was evident as a flat expanse of compact dark soil and heat retainers. The site measured 11 x 8 m and was level with the surrounding ground surface. Baked clay heat retainers attaining a maximum dimension of 0.05 m were prolific across the deposit surface. Fragments of freshwater mussel shell and 3 flaked stone artefacts were present in the deposit.

1. Vein quartz chip with 10 % pebble cortex (18x13x5 mm)
2. Black sedimentary flaked piece (25x14x3 mm)
3. Black chert core (22x18x13 mm).

Cooey Point Lagoon 20

CPL20 was a small 3 x 3 m exposure of mound material exposed in the access track skirting Cooey Point Lagoon. The site was levelled. The deposit contained dark ashy soil, baked clay heat retainers reaching 0.07 m in diameter. Three flaked stone artefacts were recorded on the deposit.

1. Crystal quartz flake (13x12x3 mm)
2. Quartzite flake
3. Milk quartz chip (5x5x5 mm).

Cooey Point Lagoon 24

CPL24 was a deflated mound deposit measuring 14 x 14 m located adjacent to periodically inundated river flats south of Cooey Point Lagoon. It was level with the surrounding ground surface. The deposit consisted of dark compact sediment with concentrations of heat retainers evident upon the surface. Maximum heat retainer diameter was 0.06 m. Fragments of burnt animal bone were also evident in the loose surface material. Ants had colonised a section of the site. The site contained 13 stone artefacts including 1 manuport.

1. Red silcrete flake (13x12x4 mm)
2. Red quartzite chip (12x12x5 mm)
3. Black quartzite manuport (35x18x18 mm)
4. Red quartzite flaked piece with usewear along one margin with an edge angle of 40 degrees (25x17x10 mm)
5. Red quartzite bipolar core (17x15x5 mm)
6. Black quartzite flaked piece (18x15x3 mm)
7. Red quartzite chip (12x11x3 mm),
8. Brown quartzite chip (<5mm)
9. Red quartzite flake with a ridged (prepared) platform (16x18x7 mm)
10. Black chert blade core (20x15x5 mm)
11. Yellow crystalline quartz flake (8x17x1.5 mm)
12. Grey quartzite blade core fragment (12x9x4 mm)
13. unmodified pebble (30x12x12 mm).

Cooey Point Lagoon 25

CPL25 was a level deflated exposure of mound material measuring 26 x 21 m. The deposit consisted of compacted dark ashy sediment and baked clay heat retainers. Fragments of freshwater mussel shell were visible on the site's surface. Ants had also colonised a section of the site. Eight stone artefacts were recorded on the surface of the site.

1. Retouched flake (discoidal scraper)
2. Geometric microlith,

3-5. Chips

6-7. Flaked pieces

8. Split pebble.

Four of the artefacts were composed of quartzite, 3 were silcrete, and 1 was chert.

Cooey Point Lagoon 26

CPL26 was a level deflated exposure of mound material measuring 12 x 11 m. It had a depth of at least 0.2 m, revealed in animal scratches. The deposit consisted of dark ashy

soil and baked clay heat retainers. No mussel shell was visible. Ants had colonised a section of the deposit. Two flaked stone artefacts were recorded on the surface.
1. Split sugary quartz pebble
2. Grey volcanic flaked piece.

Cooey Point Lagoon 30

CPL30 was an oval level compact deposit of mound materials measuring 18 x 15 m. The surface of the site was extremely deflated and heat retainers and mussel shell fragments were visible across the surface. Ants had colonised a section of the deposit. One stone artefact was recorded.
1. Black quartzite chip.

Cooey Point Lagoon 31

CPL31 was a circular deflated deposit of oven mound materials measuring 18 x 15 m. The deposit consisted of compacted dark soil and baked clay heat retainers. No mussel shell or artefacts were visible. Ants had colonised a section of the site.

Cooey Point Lagoon 32

CPL32 was a deflated deposit of compact dark ashy soil and baked clay heat retainers measuring 9 x 7 m. The site had no remaining elevation. No artefacts or mussel shell were evident.

Cooey Point Lagoon 34

CPL34 consisted of a small deflated exposure of oven mound materials measuring 5 x 5 m. The deposit was compact and consisted of dark ashy soil and baked clay heat retainers. The centre of the site was colonised by ants resulting in slight elevation. No mussel shell or artefacts were evident.

Cooey Point Lagoon 36

CPL36 was a deflated deposit of mound materials measuring 8 x 8 m. The site had no remaining elevation and consisted of compacted dark ashy soil and baked clay heat retainers. No artefacts or mussel shell were evident.

Cooey Point Lagoon 39

CPL39 was a very deflated deposit of mound materials measuring 11 x 8 m. Ants had colonised one side of the deposit. No artefacts or mussel shell were evident.

Cooey Point Lagoon 42

CPL42 was a 7 x 7 m exposure of mound material containing dark ashy soil and baked clay heat retainers. The deposit was compacted and ants had colonised one side. No mussel shell or artefacts were evident.

Cooey Point Lagoon 49

CPL49 was situated in a deflated sandy area immediately east of Cooey Point Lagoon. A stand of *E. largiflorens* seedlings generated along an old flood line lie immediately east of the site. The mound is visible as an area of compacted dark sandy soil. Fragments of mussel shell and three small fragments of bone were visible on the surface of the deposit. Circular concentrations of large heat retainers (0.07 m in diameter) were also evident on the surface of the site. The site extended across the break of slope leading into the lagoon and was distinctly mounded at the upper slope. Lower down, the surface of the deposit was deflated, again revealing the concentrations of heat retainers. The site was an elongated oval in shape and measured 23 x 8 m. Five stone artefacts were recorded on the site's surface. Two flakes, 1 blade, 1 chip and 1 muller fragment. Two of the artefacts were quartzite, 2 were sandstone and 1 was chert. The blade displayed usewear along one lateral margin.

Cooey Point Lagoon 64

CPL64 consisted of a 10 x 10 m exposure of tiny fragments of baked clay heat retainer and compacted black stained earth. The deposit was completely deflated and has been colonised by ants. Some loose heat retainers were scattered in the area and they reached a maximum diameter of 0.08 m. No mussel shell nor artefacts were visible. An abrupt soil colour change (to red cracking earth) surrounded the site.

Cooey Point Lagoon 93

CPL93 was a 20 x 20 m level mound deposit. The surface of the site was extremely deflated, appearing as a very compact dark area with water and wind washed loose baked clay heat retainers. The surrounding area had been recently flood scoured and piles of flood deposited debris were banked up against trees. Six stone artefacts were recorded in association with Cooey Point Lagoon 93.
1. Milk quartz flaked piece

2. Metasedimentary flaked piece
3. Quartzite flaked piece, with usewear
4. Quartzite flake
5. Quartzite hammerstone fragment
6. Quartzite hammerstone fragment

Cooey Point Lagoon 103

CPL103 was an 8 x 8 m exposure of mound materials. The site was in poor condition being very deflated and had also been colonised by ants. The deposit consisted of dark earth and heat retainers. No mussel shell or artefacts were evident.

Cooey Point Lagoon 109

CPL109 was located within the river flood plain, to the north of Cooey Point Lagoon, and consisted of a concreted exposure of heat retainers in a vestigial area of darkened soil. A fragment of animal bone and loose heat retainers with a maximum diameter of 0.12 m, were scattered over its surface. The site was in poor condition and measured 6 x 6 m. Two stone artefacts were recorded in association.

1. Metasedimentary flaked piece with usewear
2. Silcrete pebble/hammerstone fragment.

Cooey Point Lagoon 124

CPL124 consisted of a 13 x 10 m compacted area of heat retainers and dark soil which had been extensively colonised by ants. Areas of concentrated heat retainer material were visible across the site's surface. Superficially the site was in good condition, however the action of ants would have caused considerable subterranean disturbance.

Cooey Point Lagoon 125

CPL125 was a 7 x 7 m deposit of mound materials. The site had no remaining elevation and was in poor condition. It appeared as a low grey sandy deposit with loose and embedded heat retainers. No mussel shell or artefacts were evident.

Cooey Point Lagoon 131

CPL131 was a 3 x 3 m exposure of mound material consisting of baked clay heat retainers and dark ashy soil. The site was in very poor condition.

Disturbed Mounds

Cooey Point Lagoon 14

CPL14 was an extensively disturbed deposit of mound materials. Its estimated original extent is approximately 10 x 10 m. The site contained freshwater mussel shell, heat retainers and dark ashy sediment. It had been disturbed by earthworks.

Cooey Point Lagoon 106

CPL106 was a destroyed mound of indeterminate original dimensions.

Cooey Point Lagoon 130

CPL130 was a mound of uncertain dimensions revealed in recent bulldozed earth on the access track around the lagoon. Heat retainers and mussel shell were present in the churned deposit.

Small Ovens

Cooey Point Lagoon 1

CPL1 was an exposure of baked clay heat retainers measuring 0.80 x 0.50 m, resulting from the operation of a small earth oven. At the time of recording it was in the process of slumping into a gully draining into the Murrumbidgee River.

Cooey Point Lagoon 63

CPL63 consisted of a surface exposure of deflated compacted ash stained earth and tiny fragments of baked clay heat retainer. No dimensions were able to be taken due to the poor condition of the site.

Cooey Point Lagoon 98

CPL98 was a linear group of 5 small earth ovens situated beside a swampy area north of Cooey Point Lagoon. The sites consisted of rounded piles of baked clay oven rakeout exposed in recently flood scoured sediments. They measured 1.2 x 1.2, 0.4 x 0.3, 2 x 2, 1.2 x 1.2 and 2.5 x 2.5 m respectively. No artefacts or mussel shell were recorded in the vicinity.

Cooey Point Lagoon 129

CPL129 was a small pile of reddish baked clay oven rakeout measuring 0.55 x 0.5 m.

Middens

The shell middens in this area were all located along the main river channel on the edge of an area of higher ground that has become an island with the cutting off of the meander.

Cooey Point Lagoon 2

CPL2 was a freshwater shell midden. It consisted of a lens of midden material approximately 0.35 m below the current ground surface. It was revealed by the active cutting action of the Murrumbidgee River. The shell lens was approximately 0.05 m thick, possibly thicker, as some down slope bank slump may have been partially covering the deposit. Some loose midden material had slumped completely down slope to the current low water level, resulting in a sparse surface scatter of shell material. The shell lens was visible in the bank cutting for 5 m, and appeared likely to extend further since for a further 30 m shell fragments were visible in the root zones of mature eucalypts. The shellfish species were exclusively mussel.

Cooey Point Lagoon 3

CPL3 was a small exposure of freshwater shell midden. It was located 50 m away from CPL2 and was evident as an 8 m spread of slumped shell midden material originating from a shell lens situated approximately 0.4 m below the current ground surface. Again the shellfish represented were exclusively mussel.

Cooey Point Lagoon 4

CPL4 was a surface exposure of freshwater shell midden. It was located in deflating soil surrounding the base of a mature *E. camaldulensis* tree. The shell material was very fragmentary and occurred in association with small baked clay heat retainers. The extent of the surface scatter was 1.2 x 1.5 m, although this was limited by ground visibility, and it is likely that the site is larger.

Cooey Point Lagoon 5

CPL5 was a freshwater shell midden measuring at least 111 x 5 m in extent. The deposit was exposed in section in the active bank cutting of the Murrumbidgee River and appeared as a continuous deposit from the surface to a depth of 0.18 m. Baked clay heat retainers were also visible embedded in the section. The deposit consisted of dark grey ashy sediment densely packed with whole and fragmentary halves of large thick freshwater mussel shells. From the surface the site could be partially distinguished as a noticeable darkening in colour and a change to a more friable soil texture. This site was excavated.

Cooey Point Lagoon 128

CPL128 consisted of a shallow superficial deposit of shell midden material and crumbly heat retainers. It measured 20 x 10 m and was situated on the lagoon bank. A small fragment of grey quartzite muller, 6 mm thick and with use polish on one plane surface, was recorded amidst the midden scatter.

Scarred Trees

Cooey Point Lagoon 16

CPL16 was a live *E. largiflorens* tree with an oval scar on one fork of a bilobate trunk. The trunk circumference measured 2.95 m. The scar faced southwest and commenced 0.4 m above ground. The scar measured 1.0 m in length and was 0.22 m wide. Axe cuts were located at the top and central sections of the scar. The site was located along a small tributary flood out leading into Cooey Point Lagoon.

Cooey Point Lagoon 37

CPL37 was a live *E. largiflorens* tree with a small elongate scar on one limb. The tree trunk circumference measured 2.8 m, whilst the circumference of the scarred limb measured 1.64 m. The scar faced west and commenced 0.7 m above ground. The scar measured 0.74 m in length and was a maximum of 0.25 m wide, excluding regrowth. No axe cuts were visible on the scarred surface.

Cooey Point Lagoon 38

CPL38 was a live *E. largiflorens* tree with three elongate scars removed from its forked trunk. Tree trunk circumference measured 2.56 m. The circumference of the limb through scars (a) and (c) measured 1.42 m and the limb circumference through scar (b) measured 1.78 m. Scar (a) faced north and commenced at a height of 0.58 m above ground. It measured 1.0 m in length and was 0.18 m wide excluding regrowth. Scar (b) faced north and commenced at a height of 0.75 m above ground. It measured 0.7 m in length and was a maximum of 0.2 m wide, excluding regrowth. Scar (c) faced south and

commenced 0.81 m above ground. It measured 0.7 m in length and was a maximum of 0.11 m wide. The shape of the scar was twisted by regrowth. Two groups of axe marks were evident, one at the base and one at the summit of the scar.

Cooey Point Lagoon 40

CPL40 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 1.92 m. The scar faced southeast and commenced at a point 0.4 m above ground. The scar measured 1.03 m in length and was a maximum of 0.34 m wide. Regrowth had caused the trunk to bulge around the scar. Two lines of axe cuts were located across the basal and upper sections of the scar.

Cooey Point Lagoon 41

CPL41 was a live *E. largiflorens* tree with small oval scars removed from two limbs. The tree trunk circumference measured 3.22 m. Scar (a) faced northeast and commenced at a point 1.2 m above ground. It measured 0.63 m in length and was 0.23 m wide. The limb circumference through the scar measured 1.75 m. A single line of axe cuts crossed the centre of the scar. Scar (b) also faced northeast and commenced at a point 1.0 m above ground. It measured 0.6 m in length and was a maximum of 0.21 m wide. The circumference of the limb through the scar measured 1.64 m. Axe cuts were located at the base of the scar.

Cooey Point Lagoon 43

CPL43 was a live *E. largiflorens* tree with an elongate scar on one limb and two axe cut holes in another. The tree trunk circumference measured 2.9 m. The circumference of the scarred limb measured 1.82 m. The scar faced northwest and commenced at a point 0.65 m above ground. It measured 0.84 m in length and was 0.21 m wide. No axe cuts were evident on the scarred surface.

Cooey Point Lagoon 45

CPL45 was a live *E. largiflorens* tree with an elongate leaf shaped scar on one forked limb. The tree trunk circumference measured 5.25 m whilst the circumference of the scarred limb measured 3.02 m. The scar faced 125 degrees magnetic and commenced at a point 0.55 m above ground. The scar measured 3.09 m in length and was a maximum of 0.4 m in width excluding regrowth. No axe cuts were evident on the scarred surface.

Cooey Point Lagoon 46

CPL46 was a live *E. largiflorens* tree with an elongate oval scar on a forked limb. The tree trunk circumference measured 3.35 m whilst the limb circumference measured 1.87 m. The scar faced 203 degrees magnetic and commenced 0.9 m above ground. The scar was 0.71 m in length and was a maximum of 0.11 m wide excluding regrowth. No axe cuts were visible on the scarred surface.

Cooey Point Lagoon 47

CPL47 was a live *E. largiflorens* tree with an elongate scar on a forked trunk. The trunk circumference measured 2.67 m whilst that of the scarred limb measured 2.21 m. The scar faced 142 degrees magnetic and commenced at a point 0.25 m above ground. The scar measured 0.92 m in length and was a maximum of 0.28 m wide, excluding regrowth. No axe cuts were visible on the scarred surface. A horizontal crack extended across the upper section of the scar.

Cooey Point Lagoon 48

CPL48 was a live *E. largiflorens* tree with an oval scar on a forked trunk. The tree trunk circumference measured 2.75 m whilst the scarred fork measured 1.87 m in circumference. The scar faced 104 degrees magnetic and commenced at ground level. The scar measured 1.83 m in length and was a maximum of 0.26 m in width, excluding regrowth. Axe cut marks were evident around the scar edges.

Cooey Point Lagoon 51

CPL51 was a dead *E. largiflorens* tree with an leaf shaped scar on a forked limb. The tree trunk circumference measured 2.21 m whilst that of the scarred limb measured 1.17 m. The scar faced 83 degrees magnetic and commenced at a point 0.7 m above ground. The scar measured 0.72 m in length and was a maximum of 0.27 m wide excluding regrowth. A single axe cut was evident in the centre of the scar. The scarred limb was sawn off above the scar.

Cooey Point Lagoon 52

CPL52 was a live *E. largiflorens* tree with an elongate leaf shaped scar on the trunk. The tree trunk circumference measured 2.36 m. The scar faced 87 degrees magnetic. The scar measured 1.64 m in length and was a maximum of 0.24 m wide, excluding

regrowth. No axe cuts were visible on the scarred surface. A vertical split ran the full length of the scar.

Cooey Point Lagoon 54

CPL54 was a live *E. largiflorens* tree with an open broad scar (a) on the trunk and a leaf shaped scar (b) on an upper limb. The tree trunk circumference measured 6.63 m. The limb circumference through the upper scar measured 2.71 m. Scar (a) faced 170 degrees magnetic and commenced at ground level. It measured 0.79 m in length and was a maximum of 0.31 m wide. Scar (b) faced 42 degrees magnetic and commenced 0.65 m above ground level. It was 1.65 m in length and a maximum of 0.33 m wide, excluding regrowth. Axe cuts were visible on both upper and lower extremities.

Cooey Point Lagoon 55

CPL55 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.95 m. The scar faced 21 degrees magnetic and commenced 0.37 m above ground. The scar measured 1.11 m in length and was a maximum of 0.22 m wide, excluding regrowth. No axe cuts were visible on the scar surface. A natural scar occurred on the trunk beneath the scar and a small closed over scar, also most likely a branch or other natural scar, occurred on a small limb above the scar.

Cooey Point Lagoon 56

CPL56 was a live *E. largiflorens* tree with a rounded scar on its trunk. The tree trunk circumference measured 2.94 m. The scar faced 117 degrees magnetic and commenced 0.70 m above ground. The scar was 0.41 m in length and a maximum of 0.22 m in width, excluding regrowth. Axe cuts were visible on the lower edge of the scar. A later fire scar had encroached across and around the scar extending down to ground level.

Cooey Point Lagoon 57

CPL57 was a live *E. largiflorens* tree with two oval scars on its bilobate trunk. The tree trunk circumference measured 2.95 m. Scar (a) faced 189 degrees magnetic and commenced 0.15 m above ground. It measured 0.89 m in length and was a maximum of 0.25 m in width. A single line of axe cuts was located across the base of the scar. Scar (b) faced 329 degrees magnetic and commenced 0.63 m above ground. It measured 0.46 m in length and was a maximum of 0.12 m wide. No axe cuts were evident on its scarred surface.

Cooey Point Lagoon 58

CPL58 was a live *E. largiflorens* tree with an elongate scar on its trunk. The tree trunk circumference measured 2.47 m. The scar faced 242 degrees magnetic and commenced 0.48 m above ground. The scar measured 1.79 m in length and was a maximum of 0.19 m wide, excluding regrowth. Regrowth had caused one margin of the scar to bulge inwardly. No axe cuts were evident on the scar surface.

Cooey Point Lagoon 61

CPL61 was a live *E. largiflorens* tree with an elongate scar on one section of bilobate trunk. The tree trunk circumference measured 4.6 m whilst the circumference through the scar measured 2.63 m. The scar faced 170 degrees magnetic and commenced 0.15 m above ground. The scar measured 2.26 m in length and was a maximum of 0.25 m in width, excluding regrowth. The extent of regrowth had caused the scar to twist slightly. Axe marks were located at the base of the scar.

Cooey Point Lagoon 62

CPL62 was a live *E. largiflorens* tree with a small broad scar on the trunk. The tree trunk circumference measured 4.08 m. The scar faced 16 degrees magnetic and commenced 0.58 m above ground. The scar measured 0.73 m in length and was a maximum of 0.34 m in width. Axe cuts were located in two lines running across the basal and upper margins of the scar.

Cooey Point Lagoon 65

CPL65 was a live *E. largiflorens* tree with an elongate oval scar on a forked limb. The tree trunk circumference measured 3.0 m, whilst the circumference of the scarred limb measured 1.92 m. The scar faced 135 degrees magnetic and commenced 0.75 m above ground. The scar measured 1.11 m in length and was a maximum of 0.24 m wide. No axe cuts were located on the scar surface. A recent branch scar was located above the scar.

Cooey Point Lagoon 66
CPL66 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.18 m. The scar faced 326 degrees magnetic and commenced 0.35 m above ground level. The scar measured 1.14 m in length and was a maximum of 0.2 m wide, excluding regrowth. No axe cuts were located on the scarred surface.

Cooey Point Lagoon 67
CPL67 was a live *E. largiflorens* tree with a scar on its bilobate trunk. The tree trunk circumference measured 3.02 m. The scar faced 287 degrees magnetic and commenced 0.18 m above ground. The scar measured 0.82 m in length and was 0.28 m wide. Regrowth had caused a slight distortion of the overall shape of the scar. Axe cuts were located in a line running across the base of the scar and were also scattered across the upper section of the scar.

Cooey Point Lagoon 68
CPL68 was a live *E. largiflorens* tree with an oval scar on the trunk. The trunk circumference measured 1.58 m. The scar faced 305 degrees magnetic and commenced 1.14 m above ground. The scar measured 0.57 m in length and was 0.12 m wide. No axe cuts were located on the scarred surface.

Cooey Point Lagoon 69
CPL69 was a live *E. largiflorens* tree with two scars removed from forked limbs. The tree trunk circumference measured 2.67 m. The circumference of the limb through the scar (a) measured 1.25 m and the circumference through scar (b) measured 1.41 m. Scar (a) was oval in shape and faced 123 degrees magnetic, commencing 1.07 m above ground. It measured 0.32 m in length and was 0.12 m wide. Scar (b) was elongated and faced 98 degrees magnetic. It commenced at a point 0.92 m above ground. It measured 0.51 m in length and was 0.08 m wide. Neither of the scars had any visible axe cuts.

Cooey Point Lagoon 70
CPL70 was a live *E. largiflorens* tree with an elongate oval scar on a forked limb. The tree trunk circumference measured 1.35 m whilst the circumference of the limb through the scar measured 1.12 m. The scar faced 56 degrees magnetic and commenced 0.9 m above ground. The scar measured 0.82 m in length and was a maximum of 0.3. m wide excluding regrowth. The tree was located at the base of an old stream channel feeding into Cooey Point Lagoon.

Cooey Point Lagoon 71
CPL71 was a live *E. largiflorens* tree with a small oval scar on its trunk. The tree trunk circumference measured 1.53 m. The scar faced 282 degrees magnetic and commenced at a point 0.77 m above ground. The scar measured 0.37 m in length and was 0.12 m wide. Two axe cuts were visible at the base of the scar.

Cooey Point Lagoon 72
CPL72 was a live *E. largiflorens* tree with a small oval scar on the trunk. The tree trunk circumference measured 1.92 m. The scar faced 179 degrees magnetic and commenced at a point 0.58 m above ground. The scar measured 0.53 m in length and was 0.11 m wide, excluding regrowth. No axe cuts were evident on the scarred surface.

Cooey Point Lagoon 73
CPL73 was a live *E. largiflorens* tree with a broad oval scar on its trunk. The tree trunk circumference measured 1.76 m. The scar faced 276 degrees magnetic and commenced 0.95 m above ground. The scar measured 0.77 m in length and was 0.24 m wide. No axe cuts were visible on the scar surface. The base of the scar was in poor condition and was beginning to bow out from the trunk.

Cooey Point Lagoon 74
CPL74 was a live *E. largiflorens* tree with an oval scar on its trunk. The tree trunk circumference measured 1.72 m. The scar faced 291 degrees magnetic and commenced 0.97 m above ground. The scar measured 0.72 m in length and was 0.24 m wide. No axe cuts were visible on the scar surface. A vertical crack extended the full length of the scar.

Cooey Point Lagoon 75
CPL75 was a live *E. largiflorens* tree with a small elongate scar on the trunk. The tree trunk circumference measured 2.2 m. The scar faced 250 degrees magnetic and commenced 1.02 m above ground. The scar measured 0.36 m in length and was 0.07 m wide. No axe cuts were visible on the scar surface.

Cooey Point Lagoon 77
CPL77 was a live *E. largiflorens* tree with an oval scar on a fork of its trunk. The tree trunk circumference measured 2.74 m. The scar faced 116 degrees magnetic and commenced 1.04 m above ground. The scar measured 0.38 m in length and was 0.15 m wide. No axe cuts were evident on the scar surface.

Cooey Point Lagoon 78
CPL78 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 1.85 m. The scar faced 268 degrees magnetic and commenced 0.67 m above ground. The scar measured 1.38 m in length and was 0.22 m wide. An axe cut was located, cut in to the bark, beside the scar, none were evident on the scar surface.

Cooey Point Lagoon 81
CPL81 was a live *E. largiflorens* tree with a broad oval scar on the trunk. The tree trunk circumference measured 4.7 m. The scar faced 250 degrees magnetic and commenced 0.42 m above ground. The scar measured 0.65 m in length and was 0.26 m wide. No axe cuts were located on the scar surface.

Cooey Point Lagoon 83
CPL83 was a live *E. largiflorens* tree with an elongate square based scar on the trunk. The tree trunk circumference measured 1.62 m. The scar faced 264 degrees and commenced 0.2 m above ground. The scar measured 1.26 m in length and was 0.28 m wide. No axe cuts were evident on the scar surface.

Cooey Point Lagoon 84
CPL84 was a live *E. largiflorens* tree with a horizontal fallen limb, with two old chopped holes. The holes pierced the hollow centre of the trunk and may have been used to gain access to an animal living in the trunk. They measured 0.21 x 0.21 m and 0.32 x 0.32 m respectively.

Cooey Point Lagoon 85
CPL85 was a live *E. largiflorens* tree with an irregular scar on the trunk. The tree trunk circumference measured 1.47 m. The scar faced 123 degrees magnetic and commenced 0.68 m above ground. The maximum length of the scar was 1.84 m and the minimum was 1.46 m. The maximum width was 0.45 m and the minimum was 0.05 m. Bands of axe cuts crossed the upper and lower sections of the scar. Whether the shape of the scar is a function of regrowth or purpose is uncertain.

Cooey Point Lagoon 86
CPL86 was a live but damaged *E. largiflorens* tree with an elongate broad scar on the trunk. The tree trunk circumference measured 1.77 m. The scar faced 251 degrees magnetic and commenced 0.64 m above ground. The scar measured 1.33 m in length and was 0.64 m wide. Axe cuts traced the upper and lower terminations of the scar. Recent damage to the tree had resulted in the falling away of the entire upper section and the ripping of the bark above the scar, so that the upper regrowth/border of the scar was missing.

Cooey Point Lagoon 87
CPL87 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.5 m. The scar faced 274 degrees magnetic and commenced 0.75 m above ground. The scar measured 0.62 m in length and was 0.12 m wide. No axe cuts were evident on the surface of the scar.

Cooey Point Lagoon 90
CPL90 was a live *E. largiflorens* tree with an elongate leaf shaped scar on the trunk. The tree trunk circumference measured 1.97 m. The scar faced 156 degrees magnetic and commenced 0.65 m above ground. The scar measured 1.04 m in length and was 0.19 m wide. No axe cuts were visible on the scar surface.

Cooey Point Lagoon 91
CPL91 was a live *E. largiflorens* tree with an elongate oval scar on the trunk. The tree trunk circumference measured 2.71 m. The scar faced 64 degrees magnetic and commenced at ground level. The scar measured 1.44 m in length and wa 0.19 m wide. No axe cuts were evident on the scar surface. A later fire scar had occurred at the base of the tree, affecting the base of the scar.

Cooey Point Lagoon 92
CPL 92 was a live *E. largiflorens* tree with a broad oval scar on one section of a bilobate trunk. The tree trunk circumference through the scar measured 1.57 m. The scar faced 283 degrees magnetic and commenced 0.69 m above ground. The scar measured 0.97 m in length and was 0.40 m wide. No axe cuts were evident on the scar surface.

Cooey Point Lagoon 95
CPL95 was a dead *E. camaldulensis* with an elongate scar on the trunk. The tree trunk circumference measured 2.77 m. The scar faced 197 degrees magnetic and commenced 1.69 m above ground. The scar measured 1.49 m in length and was 0.29 m wide. Regrowth around the scar was quite rugose. No axe cuts were evident on the scar surface. A flood line on the tree reached 1.16 m above ground.

Cooey Point Lagoon 96
CPL96 was a dead *E. camaldulensis* with two elongate scars on its trunk. The tree trunk circumference measured 3.2 m. Scar (a) was oval in shape. It faced 278 degrees magnetic and commenced 1.2 m above ground. It measured 2.16 m in length and 0.38 m in width. Scar (b) was a square based oval in shape. It faced 257 degrees magnetic and commenced 0.61 m above ground level. It measured 2.10 m in length and was 0.39 m wide. Neither of the scars revealed axe cuts. A flood line on the tree reached 1.12 m above ground level.

Cooey Point Lagoon 97
CPL97 was a dead fallen *E. camaldulensis* with an elongate oval scar on the trunk. The diameter of the trunk measured 0.75 m. The orientation of the scar was not determinable however it was estimated that it commenced 1.23 m above ground level. The scar measured 1.82 m in length and was 0.19 m wide. No axe cuts were evident on the scar surface.

Cooey Point Lagoon 99
CPL99 was a live *E. largiflorens* tree with an elongate scar on the trunk. The tree trunk circumference measured 2.47 m. The scar faced 147 degrees magnetic and commenced at ground level. The scar measured 1.15 m in length and was 0.22 m wide. Regrowth had caused the shape of the scar to skew slightly. No axe cuts were visible on the scar surface.

Cooey Point Lagoon 100
CPL 100 was a live *E. largiflorens* tree with an elongate scar on the central section of a trilobate trunk. The tree trunk circumference measured 4.38 m and the circumference of the scarred limb measured 1.67 m. The scar faced 131 degrees magnetic and commenced 1.45 m above ground. The scar measured 0.61 m in length and was a maximum of 1.12 m wide, excluding regrowth. No axe cuts were visible on the scar surface. Two adjacent trunk sections exhibited branch scars.

Cooey Point Lagoon 101
CPL 101 was a live *E. largiflorens* tree with an elongate scar on one limb of a bilobate trunk. The tree trunk circumference measured 2.35 m and the circumference of the scarred limb measured 1.3 m. The scar faced 124 degrees magnetic and commenced at ground level. The scar measured 1.55 m in length and was a maximum of 0.22 m wide, excluding regrowth. No axe cuts were visible on the scar surface.

Cooey Point Lagoon 108
CPL 108 was a live *E. largiflorens* tree with oval scars on two limbs of a trilobate trunk. The tree trunk circumference measured 4.48 m. Scar (a) occurred on a limb of 2.33 m in circumference. It faced 70 degrees magnetic. The scar measured 1.46 m in length and was a maximum of 0.42 m wide, excluding regrowth. Scar (b) occurred on a limb of 1.18 m in circumference. It faced 7 degrees magnetic. Scar (b) measured 0.33 m in length and was a maximum of 0.09 m in width, excluding regrowth. No axe marks were visible on either scar.

Cooey Point Lagoon 110
CPL 110 was a dead *E. largiflorens* tree with a teardrop shaped scar on the trunk. The tree trunk circumference measured 1.39 m. The scar faced 143 degrees magnetic and commenced 1.39 m above ground. The scar measured 1.13 m in length and was a maximum of 0.35 m wide excluding regrowth. No axe marks were visible on the scar surface.

Cooey Point Lagoon 111
CPL111 was a dead *E. camaldulensis* with a small oval scar on the trunk. The tree trunk circumference measured 2.68 m. The scar faced north and commenced 1.11 m above ground. The scar measured 0.52 m in length and was a maximum of 0.13 m wide, excluding regrowth. Two sharpish axe cuts were located in the upper central surface of the scar.

Cooey Point Lagoon 112
CPL112 was a live *E. largiflorens* tree with an elongate scar on one limb of its bilobate trunk. The tree trunk circumference measured 4.39 m and the circumference of the scarred limb measured 0.77 m. The scar faced 320 degrees magnetic and commenced 1.73 m above ground. The scar measured approximately 2.5 m in length and was a maximum of 0.34 m wide, excluding regrowth. No axe cuts were visible on the scar surface. The tree was located on the immediate edge of the river cutting and a large section of its root system was currently being undermined by water erosion.

Cooey Point Lagoon 113
CPL113 was a live *E. largiflorens* tree with an elongate teardrop shaped scar on its trunk. The tree trunk circumference measured 3.14 m. The scar faced 137 degrees magnetic and commenced 0.34 m above ground. The scar measured 2.09 m in length and was a maximum of 0.26 m in width. No axe cuts were visible on the scarred surface.

Cooey Point Lagoon 114
CPL 114 was a live *E. largiflorens* tree with a elongate pear shaped scar on the main section of a bilobate trunk. The tree trunk circumference measured 4.35 m. The scar faced 127 degrees magnetic and commenced 0.05 m above ground level. The scar measured 1.46 m in length and was a maximum of 0.47 m above ground. No axe cuts were evident on the scarred surface.

Cooey Point Lagoon 115
CPL115 was a live *E. camaldulensis* with an elongate oval scar on its trunk. The tree trunk circumference measured 4.52 m. The scar faced 250 degrees magnetic and commenced 1.43 m above ground. The scar measured 1.51 m in length and was a maximum of 0.4 m in breadth. No axe marks were visible on the scarred surface. Regrowth was pronounced and thin papery bark was being shed at the scar margins.

Cooey Point Lagoon 117
CPL117 was a dead *E. camaldulensis* with an elongate scar on its trunk. The tree trunk circumference measured 5.05 m. The scar faced 328 degrees and commenced 0.65 m above ground. The scar measured 1.84 m in length and was a maximum of 0.61 m wide. No axe cuts were evident on the scar surface. A small split was located in the upper area of regrowth. The tree was situated in close proximity to a freshwater shell midden currently exposed in the river bank cutting.

Cooey Point Lagoon 118
CPL118 was a dead *E. camaldulensis* with an elongate oval scar on the trunk. The tree trunk circumference measured 1.89 m. The scar faced 285 degrees magnetic and commenced 0.4 m above ground. The scar measured 1.8 m in length and was a maximum of 0.75 m in width. No axe cuts were evident on the scarred surface.

Cooey Point Lagoon 119
CPL119 was a live *E. camaldulensis* with an elongate teardrop shaped scar on its trunk. The tree trunk circumference measured 2.88 m. The scar faced 298 degrees magnetic and commenced 1.63 m above ground. The scar measured 0.94 m in length and was a maximum of 0.18 m in width. The base of the scar was rotting and falling out and the top was covered in knobbly regrowth. A split was also forming at the top of the scar. No axe cuts were visible.

Cooey Point Lagoon 120
CPL120 was a live *E. largiflorens* tree with a broad shield shaped scar on its trunk. The trunk circumference measured 2.7 m. The scar faced 154 degrees magnetic and commenced 0.03 m above ground. The scar measured 1.13 m in length and was a maximum of 0.48 m in width. No axe cuts were visible on the scar surface.

Cooey Point Lagoon 121
CPL121 was a dead *E. camaldulensis* tree with a broad oval scar on the trunk. The tree trunk circumference measured 2.68 m. The scar faced 201 degrees magnetic and commenced at ground level. A line of axe cuts delineated the base of the scar. Axe cuts

were also visible at the top of the scar. The scar measured 2.43 m in length and was a maximum of 0.8 m wide.

Cooey Point Lagoon 122

CPL122 was a living *E. largiflorens* tree with an elongate acute scar on one dead section of a bilobate trunk. The scarred trunk circumference measured 2.65 m. The scar faced 2 degrees magnetic and commenced 0.20 m above ground. The scar measured 1.61 m in length and was a maximum of 0.19 m in width. A branch scar was situated on the reverse side. No axe marks were visible on the scarred area.

Cooey Point Lagoon 126

CPL126 was a dead *E. camaldulensis* stump with the basal section of a broad elongate scar. The trunk circumference measured 2.8 m. The scar faced 139 degrees magnetic and commenced 1.0 m above ground. The scar had an incomplete length measurement of 1.04 m and was a maximum of 0.4 m wide. Axe cuts were located on the scarred surface. A later fire scar was situated adjacent to the scar.

Cooey Point Lagoon 127

CPL127 was a dead *E. camaldulensis* with a small oval scar on its trunk. The tree trunk circumference measured 2.07 m. The scar faced 165 degrees magnetic and commenced 0.31 m above ground level. The scar measured 0.59 m in length and was 0.22 m wide. Regrowth was extensive. No axe cuts were evident.

Cooey Point Lagoon 132

CPL132 was a dead *E. camaldulensis* with a small oval scar on the trunk. The trunk circumference measured 2.02 m. The scar faced 189 degrees magnetic. The scar measured 0.41 m in length and was 0.09 m wide. No axe cuts were visible.

Cooey Point Lagoon 133

CPL133 was a dead *E. camaldulensis* with a small oval scar on the trunk. The trunk circumference measured 1.52 m. The scar faced 159 degrees magnetic and commenced 0.64 m above ground. The scar measured 0.41 m in length and was a maximum of 0.13 m wide. No axe cuts were visible.

Cooey Point Lagoon 134

CPL134 was a dead *E. camaldulensis* with a small teardrop shaped scar on the trunk. The trunk circumference measured 2.49 m. The scar faced 25 degrees magnetic and commenced 0.79 m above ground. The scar measured 0.92 m in length and was a maximum of 0.28 m wide. No axe cuts were visible on the scar surface. CPL132, 133 and 134 were in association with each other, the respective scars facing inwards.

Cooey Point Lagoon 135

CPL135 was a dead fallen *E. camaldulensis* with an elongate oval scar on the trunk. The trunk diameter measured 1.10 m. The direction the scar originally faced is uncertain nor could its original height above ground be determined. The scar measured 1.47 m in length and was 0.43 m wide. No axe cuts were visible.

Lithic Site Descriptions

Cooey Point Lagoon 50

This was an isolated find of a coarse metasedimentary flake.

Cooey Point Lagoon 136 (n=239)

Two hundred and thirty nine artefacts were recorded in an open scalded area in the vicinity of oven mounds CPL82 and CPL79. The site area measured 110 x 80 m and it was defined by the presence of artefacts. Good surface visibility extended around the entire area for a further 50 to 100 m. A range of artefact types were represented within the scatter; there were 71 flakes, 8 blades, 53 flaked pieces, 28 cores, 44 chips, 28 manuports, 3 hammerstones and 4 grindstone fragments. Artefact densities varied considerably across the site, from zero to 4 artefacts per m^2 or a maximum of 21 artefacts per 10 m^2. There were several distinctly denser concentrations within the generalised scatter, as well as several blank areas.

Mounds with Artefacts

Nineteen of the mound sites had artefacts either within their surface deposit, or within 5 m of their margins. These were site nos: 13, 15, 19, 20, 21, 23, 24, 25, 26, 30, 49, 80, 82, 89, 93, 94, 109 and 116. Although artefact numbers were generally low, a wide variety of materials and artefact types were present.

37 Uardry Station

Area

Approximately 5 km^2 of river frontage and plains were field walked within Uardry Station, forming a continuation with Uardry Stock Reserve to the east. This area is on the opposite side of the river to the Cooey Point Lagoon Stock Reserve.

Description

The area was situated within western alluvial valley plains. The area consisted of floodplain, billabongs and old meanders of the river, and dry northern plains. The northern floodplain of the river is narrowly confined by a relatively steep bank.

Climate

The climate is semi arid with cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm, effective rainfall, where levels exceed evaporation, is experienced for two months during June and July.

Water Availability

Water would have been available within the Murrumbidgee River, and associated lagoons and old meander scars.

Vegetation

Sections of the property adjacent to the river are covered with a thick *E. camaldulensis* forest and fringing *E. largiflorens* woodland. Some uncultivated areas consist of open grassland now dominated by *Danthonia caespitosa*. Originally these grassland areas would have supported *Acacia pendula* and *Atriplex nummularia* with *Atriplex vesicaria* but they have been removed by grazing (Porteners 1993). Much of the property is being developed for irrigation agriculture.

Ground Surfaces

Soils consisted of heavy grey earths within areas prone to inundation. The remainder comprised compact red clays, and sandy loams Several paddocks were ploughed during the survey. In addition numerous internal access tracks, gateways and dams offered good ground visibility.

Survey Method

The area was comprehensively traversed by two people.

Features Recorded

Forty four site components were recorded. They consisted of 32 mounds, 8 middens, 3 scarred trees and 1 small oven. The mounds recorded within this survey area are of average to small dimensions and are relatively well preserved, with little disturbance by rabbits (n=2) or agricultural practices (n=2). Few sites revealed the presence of stone artefacts, although this could merely be a function of surface visibility and the aforementioned low level of profound disturbance. No distinct scatters of stone artefacts were detected despite the existence of ploughed paddocks, extensive graded tracks and general clearance. Sites that were very disturbed did not reveal the presence of artefacts either. Mound site, Engine Millet 5 contained a fragment of tabular quartzite. Shell midden Blackgate 7 had a coarse quartzitic muller lying upon its surface.

The shell middens were generally quite substantial deposits, and were mostly exposed in bank cuttings of the river channel, although several associated small exposures of surface material were also recorded. As a rule, however, the main deposit of shell varied between 0.12 and 0.30 m beneath the current soil surface. Site Blackgate 6 is an extensive location of midden material, of approximately 160 m in length (spatial extent not determined). The thickness of deposit as revealed in the cutting was a minimum of 0.05 m. Patchy occurrences of slumped midden material occurred along the midden's length and shells lying upon the bank slope were examined. They were mostly large thick shells of between 50 and 60 mm in length. Many of them exhibited parasitic attack.

The three scarred trees consisted of two *E. largiflorens* and one *E. camaldulensis*. The latter was dead with the uppermost section of trunk and scar missing, the remaining scar length was 3.25 m and it is likely that the bark was used for the construction of a canoe or a shelter. One *E. largiflorens* tree had an elongate section of bark removed, resulting in a scar of 1.7 m in length, the other a smaller acute oval scar measuring 0.85 m in length.

Engine Bend 1:

EB1 was an oven mound measuring 12 x 13 m. The deposit was raised to about 0.10 m above the surrounding ground surface. It contained dark ashy sediment and compacted fired clay was evident on the surface. The surface of the site was grassed and no other features such as artefacts could be discerned.

Engine Bend 2

EB2 was an oven mound measuring 16 x 10 m. It consisted of dark ashy soil and compacted fired clay. The site had an estimated elevation of 0.08 m. No mussel shell nor artefacts were visible in the deposit.

Engine Bend 3

EB3 was an 8 x 20 m area of slightly raised grassed ground upon which 4 exposures of compacted heat retainer material were evident. Vegetation and the undulation of the surrounding ground surface made estimation of site dimensions difficult. No mussel shell nor artefacts were visible.

Engine Bend 4

EB4 was a 17 x 21 m mounded deposit of dark charcoal rich earth and heat retainers. The maximum elevation of the deposit was approximately 0.4 m. Some surface undulations were present which may indicate past rabbit activity within the site. No mussel shell nor artefacts were visible, however visibility was poor due to grass cover.

Engine Bend 5

EB5 consisted of a midden deposit of silty ashy sediment, with dense fragmentary mussel shell and fragments of fired clay. The site was situated within the present high bank of the Murrumbidgee River and parts of it were eroding downslope. The bulk of the deposit was still buried beneath the current ground surface.

Engine Bend 6

EB6 was a live *E. largiflorens* tree with an elongate scar on its trunk. The tree trunk circumference measured 2.48 m. The scar faced south and commenced 0.7 m above ground. The scar measured 1.7 m in length and was a maximum of 0.27 m wide. Regrowth was extensive and bulging around the upper section of the scar. A series of axe cuts were located in the lower section of the scar.

Engine Millet 1

EM1 consisted of a series of exposures of fragmented freshwater mussel shell extending for 28 m along the bank of the river. The first exposure was 12 m long and was visible as a lens in bank sections which have slumped, and as a surface scatter of shell on the upper bank surface. At eroding bank edges it was apparent as a thin shell lens buried about 0.05 m beneath the current ground surface. The shell was highly fragmentary with the majority of pieces measuring under 10 mm. Whole half-shells occurred sporadically. A water worn gully 15 m south also displays shell eroding from the bank section buried about 0.12 m beneath the ground surface.

Engine Millet 2

EM2 was an elevated oven mound deposit consisting of blackened ashy earth and baked clay heat retainers measuring 16 x 33 m. The site was disturbed by an access track crossing its eastern margin. There was an elongate depression across the centre of the site of unknown cause, although other minor surface depressions and pits appeared to result from rabbit activity. Some of the collapsed rabbit holes extended to a depth of 0.2 m exposing a uniform dark deposit. EM2 was located approximately 90 m from EM1.

Engine Millet 3

EM3 was a small oven apparent as a 2 x 2 m exposure of baked clay heat retainers. It was revealed in the cutting of an access track. The site was virtually destroyed and had apparently little depth.

Engine Millet 4

EM4 was a small oven mound consisting of a 7 x 8 m mounded deposit of compacted sediment and baked clay heat retainers. The maximum site elevation was estimated to be 0.15 m. The site was thickly grassed and appeared to be well preserved. No mussel shell nor artefacts could be discerned.

Engine Millet 5
EM5 was an exposed mound of compact sediment and heat retainers measuring 11 x 12 m with a maximum elevation of approximately 0.15 m. Ants had colonised a 1.2 x 1 m area on the eastern side of the site causing an exaggeratedly mounded appearance. One fragment of mussel shell was exposed on the site surface. A small tabular piece of coarse quartzite was also lying on the surface. It did not appear to show evidence of modification or usewear. The site was well preserved, apart from the ant activity, and did not appear disturbed by rabbits or landuse practices.

Engine Millet 6
EM6 consisted of a low mounded deposit of compacted earth and baked clay heat retainers measuring 10 x 11 m. The surface of the site was not vegetated and no mussel shell nor artefacts were exposed in the surface. The site is in good condition.

Engine Millet 7
EM7 consisted of an oven mound measuring 16 x 14 m with a maximum estimated elevation of 0.08 m. The site was thickly vegetated at the time of recording and only fragments of baked clay were evident in the deposit surface. The site was in good condition apparently unaffected by rabbits or landuse practices.

Big Butt 1
BB1 consisted of a residual deposit of oven material measuring 14 x 4 m. The site is exposed in an access track, the construction of which probably caused its destruction.

Big Butt 2
BB2 consisted of a residual scatter of oven mound material. The site had been long destroyed due to past rabbit colonisation and subsequent deep ripping for their eradication. The original site dimensions could not be determined. No mussel shell nor artefacts were evident in the vicinity.

Big Butt 3
BB3 was a slightly elevated oven mound measuring 18 x 15 m. The deposit consisted of very compacted soil and baked clay heat retainers. Mussel shell fragments are evident in the surface of the deposit. The site was in good condition and apparently had not been impacted by rabbits. A fence line crossed the site.

Big Butt 4
BB4 was an oven mound evident as an 18 x 10 m expanse of heat retainers and burnt soil situated on a natural flood levee. Its surface was intermittently exposed beneath loose windblown sand. The site had no obvious elevation due to its coverage by the aggraded sands. Fragments of mussel shell were scattered across the surface of the mound exposures.

Blackgate 1
BG1 was a dead *E. camaldulensis* stump with the partial remains of a large elongate scar on its trunk. The circumference of the tree trunk could not be determined due to the fact that the rear section of the trunk was broken away. The scar commenced 0.10 m above ground and the extent section measured 3.25 m and had a maximum width of 1.1 m. The tree was in very poor condition.

Blackgate 2
BG2 was a freshwater shell midden revealed in the current bank of the Murrumbidgee River. The midden material occurred in two main sections each measuring 2 x 3 m, on either side of a broad erosion gully leading directly to the river. The exposures were located 50 m apart. The midden material was evident as a surface scatter of shell fragments in a dark soil matrix as well as in slumped sections of river bank. Small pellets of baked clay were also evident in the deposit. Due to the nature of the bank slump it was not possible to determine the depth below ground surface or thickness of the shell lens.

Blackgate 3
BG3 comprised an oven mound in a good state of preservation. The site was thickly grassed and appeared as a platform of grey ashy soil containing baked clay heat retainers and fragments of mussel shell. The extent of grass cover made the site dimensions difficult to determine, however, minimum dimensions were 8 x 8 m with an elevation of approximately 0.15 m. The deposit had *E. largiflorens* seedlings and saplings growing at its southern margin.

Blackgate 4
BG4 was an oven mound evident as a raised deposit of fist sized baked clay heat retainers embedded in a very compacted dark grey sediment. The site measured 9 x 7 m. No

mussel shell nor artefacts were evident in the surface. Ants had colonised a small section of the site giving it an exaggerated elevation. True elevation was estimated at approximately 0.10 m.

Blackgate 5

BG5 was a freshwater shell midden evident as a surface concentration of mussel shell. The site is located 100 m from BG4. The shell material was concentrated in one particularly dense exposure measuring 9 x 2 m surrounded by a diffuse scatter of nacreous fragments. The deposit appeared to be at least 0.06 m deep

Blackgate 6

BG6 consisted of a 160 m long exposure of shell midden material eroding from the present bank of the Murrumbidgee River. The shell lens occurred 0.12 m below the current ground surface of grey flood-lain silt/clay. Whilst shell material was present for a 160 m length, within this, three distinct concentrations of shell material were evident. These were areas where dense 0.05 m thick bands of shell and dark soil were visible. Slumped midden material was also located on the lower bank slopes, and both whole and fragmentary shells were present. The whole shells were large (50-60 mm in length) and quite thick, with evidence of parasitic attack. This is probably suggestive of collection from a mature shellfish community.

Blackgate 7

BG7 was a freshwater shell midden visible as a surface exposure of mussel shell in a dark ash rich matrix. The visible extent of the site determined by a diffuse scatter of nacreous material measured 6 x 6 m, however within this area a 2 x 3 m concentration of shell material could be discerned. The site was thickly but patchily vegetated with introduced grass species. A quartzite muller was located on the surface of the site. It was lenticular in cross section with flaked margins and had use polish on both plane surfaces.

Blackgate 8

BG8 was a mounded deposit of baked clay heat retainers and grey ashy soil measuring 10 x 8 m, with a maximum elevation of 0.12 m. One side of the site had been colonised by ants which led to an exaggerated elevation in that area. No mussel shell nor artefacts were evident on the surface of the site.

Blackgate 9

BG9 was a low mounded deposit of blackened ashy earth and fired clay heat retainers measuring 17 x 17 m, with an elevation of approximately 0.12 m. Several concreted patches of heat retainers were evident as concentrations within the site. The site was relatively well preserved although an ant colony had colonised a small area. Fragments of egg shell were scattered across the site surface. No artefacts or mussel shell were evident. A small animal burrow was evident in the surface of the deposit measuring 0.15 x 0.10 x 0.08 m deep. The profile in the pit revealed an homogeneous deposit of black ashy soil and small fragments of heat retainer.

Blackgate 10

BG10 was an obviously mounded, 15 x 14 m, deposit of dark ashy soil and baked clay heat retainers with a maximum height of 0.5 m. The site was located on cracking grey soil fringed by *E. largiflorens* woodland. No artefacts or mussel shell were evident in the site surface.

Blackgate 11

BG11 was a small compacted mounded deposit of dark grey ashy soil and baked clay heat retainers, measuring 6 x 7 m. The maximum elevation of the site was approximately 0.12 m. The site was in good condition. No mussel shell or artefacts were visible in the deposit.

Blackgate 12

BG12 consisted of two exposures of shell midden 30 m apart. Given the nature of bank erosion it was considered that the two exposures represented a continuous site, partially concealed by bank slumpage. The shell layer was located 0.30 m below the current ground surface and was at least 0.03 m thick. It was clearly visible as a dark cultural soil with dense fragmentary and whole mussel shell. Whole shells and fragments also occur as a surface scatter downslope reaching the low water level. The maximum shell density was 15 whole shells per m^2. The width of the site was not possible to determine given the lack of visibility and surface disturbance. A small gully through the eastern section of the site indicated that the site extended back from the river for at least 11 m.

Blackgate 13
BG13 was a 25 x 10 m exposure of shell midden material with an in situ pile of oven rakeout revealed in cross section by gully erosion. The oven rakeout measured 0.6 x 0.6 m and was situated on top of further midden deposit consisting of dark ashy soil, mussel shell and fragmentary baked clay. Very large (0.2 x 0.2 m) displaced clods of baked clay were also located down slope. As revealed in the gullied section, the depth of the oven rakeout was approximately 0.4 m, however this could be exaggerated by the bank slump. Whilst some fragments of shell were evident as a surface scatter the full extent of the midden deposit could not be ascertained.

Blackgate 14
BG14 was a live *E. largiflorens* tree with a small acute scar on its trunk. The tree trunk circumference measured 1.8 m. The scar faced south and commenced 0.8 m above ground. The scar measured 0.85 m in length and was 0.34 m wide. Three axe cuts were evident on the scarred surface. These were blunt hacking cuts partially overgrown along one margin.

Blackgate 15
BG15 was a small 4 x 4 m mound composed of baked clay heat retainers and dark ashy soil with a maximum elevation of 0.12 m. No mussel shell or artefacts were evident within the deposit. The surface of the mound was lightly vegetated.

Blackgate 16
BG16 was a small 4 x 4 m mounded deposit of dark ashy soil and baked clay heat retainers with an approximate elevation of 0.12 m. The surface of the site was thickly vegetated.

Blackgate 17
BG17 was a small 4 x 4 m mound composed of dark ashy soil and baked clay heat retainers. It had an approximate elevation of 0.12 m. The surface of the site was thickly vegetated.

Blackgate 18
BG18 was a small 4 x 4 m mounded deposit of dark ashy soil and baked clay heat retainers with an approximate elevation of 0.12 m. The surface of the site was thickly vegetated.

Blackgate 19
BG19 was a small 4 x 4 m mounded deposit of dark ashy soil and baked clay heat retainers with an approximate elevation of 0.12 m. The surface of the site was thickly vegetated.

Blackgate 20
BG16 was a small 4 x 3 m deflated exposure of compacted baked clay heat retainers. Remaining elevation was estimated at 0.08 m. The surrounding ground surfaces were thickly vegetated. No mussel shell nor artefacts were evident in the site surface.

Blackgate 21
BG21 was a circular 12 x 10 m raised deposit of ashy black soil, baked clay heat retainers and fragmentary mussel shell. The maximum site elevation was approximately 0.13 m. Ants had colonised one margin of the site leading to the removal of vegetation from a small area.

Blackgate 22
BG22 was a circular 6 x 6 m mounded deposit of baked clay heat retainers and dark ash rich soil. The deposit was partially colonised by ants. The surface of the site was not vegetated, probably because of the ant activity. The maximum site elevation was approximately 0.10 m. No artefacts nor mussel shell were evident within the deposit.

Blackgate 23
BG23 was a large circular platform shaped deposit of compacted black ashy soil and baked clay heat retainers measuring 17 x 15 m. The site had a maximum elevation of 0.6 m at the apex and approximately 0.5 m at the margins. A mature *E. largiflorens* tree was growing in the centre of the mound. No mussel shell or artefacts were visible in the surface of the deposit.

Blackgate 24
BG24 was an oval 13 x 9 m mounded deposit of dark ashy soil and baked clay heat retainers. The site had been colonised by ants which resulted in its artificial elevation to approximately 0.4 m at the apex. No mussel shell nor artefacts were evident.

Blackgate 25
BG25 consisted of an 8 x 8 m circular mounded deposit of black soil and baked clay heat retainers. The site was located within very dense grass cover. The maximum site elevation was estimated to be 0.14 m. No mussel shell nor artefacts were evident, however surface visibility was extremely poor.
Blackgate 26
BG26 was a 12 x 10 m mounded deposit of black ashy soil and baked clay heat retainers. The site was located beside a small depression, which may also have been cultural. No mussel shell or artefacts were located on the surface of the deposit.
Blackgate 27
BG27 was a 19 x 10 m mounded deposit of baked clay heat retainers and dark soil. The site had a maximum elevation of 0.2 m. The mound was situated on heavy cracking grey soils. No mussel shell nor artefacts were evident on the surface of the deposit.

38. Toms Point Stock Reserve

Area
An area of approximately 1.5 km^2 was surveyed within Toms Point Travelling Stock Reserve.

Description
The survey area is situated within western alluvial valley plains topography. Toms Point Travelling Stock Reserve is a small section of land adjacent to a pronounced point in the river. The land immediately north of the point is quite high and there is an immediate transition to plains lands. The survey covered areas of floodplain, lagoon, high bank and levee areas.

Climate
The area experiences a semi arid climate with an annual rainfall in the vicinity of 350 mm. Rainfall exceeds evaporation for only two months, during June and July.

Water Availability
Water would be available within the Murrumbidgee River.

Vegetation
The river margins are vegetated with an *E. camaldulensis* woodland, and there is currently no *E. largiflorens* woodland bordering the floodplain. The plains are vegetated with a *Danthonia caespitosa* grassland. The reserve is situated on the opposite side of the river to an extensive area of *Typha* sp and reed vegetated lagoons. Lagoon areas within the reserve contained small rushes. Previous vegetational conditions would have been broadly similar, although woodland areas would have been denser and the plains would have been dominated by an *A. Pendula* shrubland, with similar native grasses as an understorey.

Ground Surfaces
Ground surfaces consisted of compact red earths and were stable.

Survey Method
The reserve was comprehensively traversed by two people on foot.

Features Recorded
Three oven mounds were recorded within the reserve in relatively close proximity to one another. They were all located at a midpoint along the slope leading up from the river channel to the northern plain beside a section of lagoon. They had been disturbed by the ploughing of a firebreak along the slope. They were situated upon cracking red earth. No artefacts were recorded in association with the mound deposits.
Toms Point 1
TP 1 was an oven mound measuring 18 x 14 m. It was approximately 0.2 m high and was located 35 m from a lagoon situated within the river floodplain.

Toms Point 2
TP 2 was an oven mound measuring 30 x 16 m. It was level with the surrounding ground surface. It had a compacted surface completely covered with baked clay heat retainers. It was situated 120 m west of TP 1.
Toms Point 3
TP 3 was an oven mound measuring 14 x 14 m. It was situated 40 m west of TP 2.

39 Burrabogie
Area
This survey area covered 1.87 km^2.

Description
Burrabogie Travelling Stock and Crown Reserve is a small reserve alongside the south bank of the Murrumbidgee River. It is situated within western alluvial valley plains topography. Landforms covered by the survey included river channel, river flats, levee deposits and southern plains.

Climate
The area currently experiences a semi arid climate with an annual rainfall in the vicinity of 350 mm. Rainfall is effective for only two months, during June and July. Mean annual temperatures are cool.

Water Availability
Water would be available within the Murrumbidgee River.

Vegetation
The northern sections of the reserve, along the river channel, supported a dense *E. camaldulensis* forest, subject to inundation. Scattered *E. largiflorens* trees lined the flooded areas. The remainder of the reserve consisted of treeless grassy plains. Past vegetation patterns would have added a shrub woodland dominated by *A. Pendula* to the plains.

Ground Surfaces
The northern section of the reserve consisted of grey soil river flats. These terminated upon a distinct levee deposit of consolidated red sand. At the western side of the reserve this levee intersected a southern bend of the river where gully erosion into the levee had occurred. The remainder of the area consisted of red-soil plains.

Survey Method
The reserve was surveyed comprehensively on foot by two people. Archaeological visibility varied considerably, between 0 and 50%, according to grass cover and erosion.

Features Recorded
Five sites were recorded within the reserve, concentrated along the levee floodplain interchange. Three mounds, 2 oven exposures and a shell midden were recorded. One of the exposures of oven material consisted of a tight group of four round piles of oven rakeout. The midden was located at the bank of the river and was extensively surface exposed, having been deeply ploughed during the construction of a fire break.

40. Nulabor Stock Reserve
Area
Nulabor Stock Reserve covers an area of approximately 2.5 km^2.

Description
Nulabor Stock reserve abuts the northern bank of the Murrumbidgee River and extends northwards to the Murrumbidgee River Road. The area is within the western alluvial valley plains landscape. Topographies covered during the survey included: river bank, floodplain margin, levees and northern plains.

Climate
The area has a semi arid climate and an annual rainfall in the vicinity of 350 mm. Rainfall exceeds evaporation for two months, during June and July. Mean annual temperatures are cool.

Water Availability
Water would be available within the Murrumbidgee River.

Vegetation
Most of the southern section of the reserve comprised low-lying thickly-vegetated land, prone to flooding inundation. The northern sections of the reserve, beside the river channel supported a *E. camaldulensis* woodland. Scattered *E. largiflorens* trees lined the floodplain margins. The remainder of the reserve consisted of treeless grassy plains which in the past would have supported a shrub woodland dominated by *A. Pendula* .

Ground Surfaces
Soils consisted of grey clays within flooded areas and red earths on the levees and plains. Ground surfaces were generally stable, although the river bank was currently eroding severely.

Survey Method
The reserve was surveyed on foot by two people.

Features Recorded
No sites were found in the southern section of the reserve. The northern section comprised the floodplain margin and beginning of the northern plain and the high bank of the river. Six sites were located here, three mounds, two with associated artefacts, two scarred trees and a shell midden. The mound sites had been disturbed by the use of an access track skirting the river bank and floodplain and had also been churned over by cattle, during a recent wet period. The scarred trees were both situated at the margins of a straggly woodland fringing the floodplain. One scar was elongate and the other a small oval. In part of the reserve the river flows through a narrow very deep straight-sided channel and two extensive deposits of buried and stratified shell midden were exposed in the bank cutting. The two concentrations were 40 m apart but probably relate to a single continuous deposit.

Nulabor 1
Nulabor 1 was a live *E. largiflorens* tree with an elongate scar on its trunk. The tree trunk circumference measured 1.98 m. The scar faced NE and commenced 0.89 m above ground level. The scar was 1.28 m long and 0.16 m wide, excluding regrowth. No axe cuts were evident.

Nulabor 2
Nulabor 2 was a live *E. largiflorens* tree with a small oval scar on a section of trilobate trunk. Its trunk circumference measured 3.74 m, whilst the girth of the scarred limb was 1.9 m. The scar faced NW and commenced 1.8 m above ground. The scar was 0.49 m long and 0.29 m wide. No axe marks were evident. A branch scar was also present on another section of the tree.

Nulabor 3
Nulabor 3 consisted of a deflated mound of oven materials. Circular concentrations of baked clay heat retainers were evident within the surface of the site. It measured 5 x 5 m and had little height. The site was located beside a shallow flood depression, within *E. largiflorens* woodland. Two artefacts were associated with the site.
1. Fragment of quartzite muller (45x40x9 mm)
2. Volcanic flake with pebble cortex(30x21x7 mm)

Nulabor 4
Nulabor 3 was of an oval deflated exposure of oven materials measuring 9 x 6 m. It was approximately 0.15 m in height. Four circular concentrations of baked clay heat retainers were evident on the surface of the site. The heat retainers were black and red in colour. The site was situated at the first break of slope on the margins of the floodplain, about 200 m from the river, within *E. largiflorens* woodland. Two artefacts were associated with the site.

1. Brown chert flake (16x12x2 mm)
2. Quartzite flaked piece with pebble cortex (20x13x8 mm)

Nulabor 5

Nulabor 5 was an exposed low mound of oven materials measuring 10 x 7 m. It was approximately 0.15 m in height. Fragments of mussel shell were evident in the surface deposits. The site was situated on clay soils at the floodplain margins, about 120 m from the river.

Nulabor 6

Nulabor 6 was an extensive deposit of freshwater shell midden stretching along the river bank for at least 140 m. The shell deposit was between 0.35 and 0.40 m below the current ground surface and averaged 0.40 m in thickness. It was stratified and three distinct units could be determined. Below 0.35 m of overburden lay a 0.05 m thick layer of bedded large whole shell halves which were burnt. Beneath this lay a 0.20 m thick layer of fragmentary shell material mixed with ash, charcoal and burnt earth. Beneath this lay a 0.15 m layer of baked virtually indurated sandy earth. Beneath this lay the grey clay of the river bank.

41. Gre Gre Stock Reserve

Area

Gre Gre Stock Reserve covers an area of 2.5 km^2.

Description

The reserve occupies a narrow frontage along the southern bank of the Murrumbidgee River and is situated within the western alluvial valley plains landscape. Minor variations in topography occurred throughout the reserve, including: inundated river flats, a section of old floodplain crossed by very shallow extinct meanders lined with low sandy levees and dry southern plains of red sandy loam.

Climate

The area has a semi arid climate and an annual rainfall in the vicinity of 350 mm. Rainfall exceeds evaporation for two months, during June and July. Mean annual temperatures are cool.

Water Availability

Water would be available within the Murrumbidgee River and also within the old flood channels during wet periods.

Vegetation

The inundated areas flanking the river channels and the river banks were vegetated with a *E. camaldulensis* woodland. A *E. largiflorens* woodland followed the floodplain margins and continued along the old flood channels. Many of the mature *E. largiflorens* trees within these strips of woodland had been heavily utilised for timber, with many branches chopped away. The plains were vegetated with low grasses. Past vegetation patterns would have been for denser wooded areas and *A. Pendula* woodland on the plains. A *Callitris* sp woodland with shrub understorey may have existed along the old sandy levees.

Ground Surfaces

The areas prone to inundation consisted of grey clay and gilgai soils, whilst levee areas consisted of red sands overlying clay. Plains areas consisted of cracking red earths. Ground surfaces were generally stable throughout the area, although rabbit activity in the sandy areas had resulted in some subsurface disturbance.

Survey Method

The reserve was thoroughly field walked by two people.

Features Recorded

Five sites were recorded within the reserve, consisting of two oven mounds, 28 m apart, a freshwater shell midden, a small oven and an isolated stone artefact. The archaeological

materials were concentrated upon the sandy levee in the northwestern corner of the reserve. The small oven and isolated find of a milk quartz core were located amidst *E. largiflorens* woodland in an area of old stream channels at the western boundary of the reserve. These channels would be active only during flood times,.

Gre Gre 1
Gre Gre 1 was a small exposure of scattered baked clay heat retainers over and area of 10 m^2.
Gre Gre 2
An isolated find of a milky quartz core (30x15x12 mm)
Gre Gre 3
Gre Gre 3 was an oven mound measuring at least 8 x 8 m. It was situated within loose sandy sediment and was considerably disturbed by rabbit activity. Freshwater mussel shell was scattered across the area. A fragment of quartzite pebble (30x14x8 mm) was recorded 20 m east of this site.
Gre Gre 4
Gre Gre 4 was an oven mound measuring 5 x 5 m. It was very deflated and had been considerably disturbed by rabbit activity.
Gre Gre 5
The midden was in a poor state of preservation, having been colonised by rabbits. It measured approximately 25 x 30 m, and this was determined by the spread of fragments of freshwater mussel shell. It was impossible to determine, without probing the deposit, whether this spread was a result of post depositional processes or not. A small quartzite anvil (40x40x30 mm) was located in the midst of the surface spread of shell.

42 Glencoe Road

Area
The road easement of Glencoe Road running south and south-west from the Newell Highway, east of Hay was surveyed on foot for a distance of approximately 16 km, until its junction with the Jerilderie Road. The width of the road easement was variable, ranging between 100 and 400 m. The area covered was approximately 7.5 km^2.

Description
The survey area falls within the western plains landscape. It provided a narrow transect from the richer riverine environment through a drier riverine plain with areas of sand sheet. Only minor topographic variation occurred along the transect . Areas of sand ridge and scalded and channelled plains were examined.

Climate
The area has a semi arid climate with cool mean annual temperatures, and an annual rainfall in the vicinity of 350 mm. Rainfall is effective for two months, during June and July.

Water Availability
The survey traversed only one potential water source, an ephemeral and unnamed drainage line, now canalised. Water would otherwise be available within the Murrumbidgee River, a distance of between 2 and 18 km from the areas surveyed. In some areas water may collect in scalds and depressions following rainfall.

Vegetation
Vegetation patterns were for scattered patches of *E. largiflorens* woodland, and isolated *E. microcarpa* specimens, on areas of elevated sand sheet. The plains were covered with *Danthonia caespitosa* grassland, remnant *Acacia pendula* woodland and patches of *Atriplex* sp.

Ground Surfaces
Soils consisted of either sand sheet or red earths. Ground surfaces throughout the area were mostly stable, with the exception of the immediate road margins, which had been graded, and small areas of localised scald erosion. Visibility across the area was variable due to patchy coverage of grazed grasses.

Survey Method
The area was comprehensively walked by two people.

Features Recorded
Two sites were located, a scarred *E. microcarpa* tree amongst scattered woodland on an elevated sand sheet, and an isolated find of one quartz artefact in a roadside scald. The predominantly stable nature of the surveyed ground surfaces, as referred to previously, would tend to rule against the discovery of extensive surface archaeological materials and it is significant that the only surface materials recorded were located on actively eroding ground surfaces. Even so there were further extensive areas of eroding ground surfaces inspected which did not yield any evidence of occupation.

Glencoe Road 1
CR1 was a live *E. microcarpa* tree with an elongate oval scar on the trunk. Trunk circumference measured 3.85 m. The scar faced 219 degrees magnetic and commenced at ground level. The scar measured 2.17 m in length and was a maximum of 0.5 m wide, excluding regrowth. Axe cuts were located across both upper and lower sections of the scar.

Glencoe Road 2
GR2 comprised an isolated find of a single flaked stone artefact, a milk quartz flaked piece (2 x15x12 mm).

43. Eli Elwah
Area
A 1.25 km^2 area of the property 'Eli Elwah' was included in the survey.

Description
The survey area is situated within the western alluvial valley plains landscape. It consisted of land abutting the southern bank of the Murrumbidgee River and southern plains crossed by old meander scars.

Climate
The area has a semi arid climate with cool mean annual temperatures, and an annual rainfall in the vicinity of 350 mm. Rainfall is effective for two months, during June and July.

Water Availability
Water would be available within the Murrumbidgee River, or within old flood channels during wet or flood periods.

Vegetation
Vegetational communities present were those of *E. camaldulensis* and *E. largiflorens* woodland and *Acacia pendula* with *Danthonia caespitosa* grassland as well as *Atriplex* sp. Scattered specimens of *Bursaria spinosa* also lined the old flood channels.

Ground Surfaces
Groundsurfaces were predominantly red earths and were not actively eroding, with the exception of land immediately adjacent to the river. Numerous access tracks and gate clearings were inspected and they offered good ground visibility. The Station is one of the earliest settled in the district and the present owners relate the pattern of river channel movement in the locality as extreme (Milliken pers comm 1989). When originally occupied the homestead was set a distance back from the river, today it flows less than 20 m away, and is rapidly encroaching.

Features Recorded
No archaeological sites were located, although an interesting pattern of pseudo-sites was located. A series of mounded deposits of burnt and graded *Bursaria spinosa* lined the old flood depressions and could easily have been initially mistaken for oven mounds. Similarly confusing evidence could be found on old tracks through the property where nodules of worn brick material similar to baked clay heat retainers were profuse.

Apparently this related to the early settlement of the property when locally produced 'failed' bricks were used to pave the road surfaces.

The lack of sites is not readily explicable, since the area offers similar resources and landforms to other areas where sites are visible. The property owner did not know of any archaeological materials located on the property, but could identify ovens and artefact scatters within other areas he owned.

Early accounts relating to the area explain the property name Eli Elwah as a reference to 'a place where the echidna crossed the river' (Baylis nd). The name persists (although with different spelling) on the other side of the river with another property termed Illiliwa. An adjacent property to Illiliwa, Wangara is reported, by the Hay Land Council, to have a Bora Ground within it. It is thus possible to speculate that the general area may have had some special uses attached to it.

44. Illiliwa/Murrumbidgee River Road

Area

This survey area consisted of a 1 km^2 road reserve about 5 km north of the Murrumbidgee River.

Description

The area is situated within western plains, north of the Murrumbidgee River. The landscape was flat.

Climate

The area has a semi arid climate with cool mean annual temperatures, and an annual rainfall in the vicinity of 350 mm. Rainfall exceeds evaporation for the months of June and July.

Water Availability

Water would be available within the Murrumbidgee River, or within localised claypan depressions during wet periods.

Vegetation

The area was vegetated with tussocky grasses and *Atriplex* sp. The original vegetation structure would have been mixed shrub and woodland containing *Atriplex* sp and *A. Pendula* .

Ground Surfaces

Soils consisted of compact red earths. Surface scalding had occurred across the area. Other forms of disturbance included low lying areas created by the formation of the road and associated drainage works. These had formed reedy ponds. A telegraph line ran across the site and one of the transmission poles lay within the general site area.

Survey Method

The area was field walked by two people.

Features Recorded

Seven exposures of oven material were located within a series of scalds and residual vegetated areas, five stone artefacts were also recorded in association with the ovens.

IMR 1

A deflated concentration of baked clay rakeout measuring 2 x 1.2 m.

IMR 2

A deflated concentration of baked clay rakeout measuring 0.8 x 0.5 m.

IMR 3

A deflated concentration of baked clay rakeout measuring 0.2 x 0.2 m.

IMR 4

A deflated concentration of baked clay rakeout measuring 1.7 x 0.8 m.

IMR 5

A deflated concentration of baked clay rakeout, partially concealed beneath uneroded soil, measuring 1.6 x ? m.

IMR 6

A location of baked clay rakeout buried beneath uneroded sandy soil. The dimensions could not be ascertained.

IMR 7

A deflated concentration of baked clay rakeout measuring 1.1 x 0.8 m.

Artefacts

1. White quartzite retouched flake (30x17x12 mm)
2. Grey silcrete flake with usewear (25x22x5 mm)
3. Milk quartz chip (<5 mm)
4. Grey quartzite flaked piece (25x20x8 mm)
5. Milky quartz core fragment (30x20x13 mm)

45. Cedar Grove

Area

An area of 5.6 km^2 was surveyed on the property 'Cedar Grove' approximately 15 km south of Hay.

Description

The area is situated within the western plains landscape. The survey area consisted of level plains with some low sand features and extensive scalded areas associated with palaeochannel levees.

Climate

The area experiences a semi arid climatic regime, characterised by cool mean annual temperatures, and an annual rainfall in the vicinity of 350 mm. Rainfall exceeds evaporation for the months of June and July.

Water Availability

No apparently permanent water sources exist in the vicinity, although a local account had indicated the presence of a soak on the property, thought to be associated with evidence of Aboriginal occupation. Groundwater in the area apparently occurs 2 m beneath the surface (Milliken pers comm 1989).

Vegetation

Current vegetation consisted of a remnant *Acacia pendula* woodland and tall annual grasses. Previous patterns would have been for a denser woodland formation with associated stands of *Atriplex* sp.

Ground Surfaces

Soils consisted of compact red earths and some areas of sandier texture along low ridges. Extensive open areas of shallow scalding had occurred throughout the area.

Survey Method

The area was walked by two people.

Features Recorded

A group of five small ovens was recorded, exposed on an access track leading into the property. Four flaked stone artefacts were recorded scattered across an extensive ridged and scalded area immediately east of the ovens. The aforementioned soak was relocated approximately 500 m north of the ovens. It consisted of a low depression amidst sand sheets, now used as a rubbish dump by the property owner. Two flaked stone artefacts were located in association with the area. No other cultural materials were found. Visibility in the vicinity was poor however and it is likely that further materials lay concealed under thick grass cover. A further area on the southern side of the main road was also indicated by the owner to contain substantial evidence of occupation. However at the time of survey it was covered in long thick grass up to 1.0 m tall and ground visibility was zero.

46. Birriwa

Area

Birriwa Stock Reserve covered an area of 2.5 km^2.

Description

The area was situated within western alluvial valley plains north of the Murrumbidgee River. It consisted of a section of river flats, levee and low lying swampland north of the Murrumbidgee River. It is located in the westernmost section of the study region.

Climate

The area has a semi arid climate, and experiences cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm. Rainfall exceeds evaporation for the months of June and July.

Water Availability

Water would be available within the Murrumbidgee River or within depressions following flooding.

Vegetation

The northern section of the survey area was vegetated with a *E. largiflorens* woodland with an understorey of *E. australasica*. Closer to the river a mixed *E. camaldulensis* and *E. largiflorens* woodland occurred.

Ground Surfaces

Soils were predominantly compact red earths. Ground surfaces were mostly stable with the exception of graded access tracks.

Survey Method

The area was walked by two people.

Features Recorded

Seven occurrences of archaeological materials were recorded. Four exposures of oven material consisting of discrete piles of oven rakeout, a freshwater shell midden and two isolated artefacts.

Birriwa 1

Birriwa 1 was a concentration of baked clay heat retainer rakeout relating to the use of a small oven. It measured 1.1 x 1 m and was exposed in the surface of an access track. A small fragment of quartzite grindstone (28x16x8 mm) with polish on one surface was located adjacent to the site. Fragments of mussel shell were scattered across the area. The site was situated on a high natural levee about 60 m from an old cut off meander.

Birriwa 2

Birriwa 2 consisted of a tightly clustered group of three piles of oven rakeout within an area of 9 m^2. The individual rakeout piles measured 0.97 x 0.64, 1.22 x 1.13 and 1.1 x ? m. The site was located within eroding red levee soils on an access track. The depth of erosion was approximately 0.12 m. It was located 40 m North of Birriwa 3.

Birriwa 3

The shell midden was located back from the main river channel upon a silty sand levee at the edge of a now cut-off meander. Its position is rather unusual in comparison to all other middens recorded in this region, since they are normally located on the current river channel. This is probably due to the rapidly changing nature of the river course in the general vicinity. The midden covered an area of 15 by 30 m, and consisted of a loose disturbed deposit with numerous fragments of mussel shell contained within a darker soil matrix than the surrounding soil. Mature *E. camaldulensis* were growing adjacent to the area and a large quantity of leaf litter had become mixed through the surface of the deposit. The shell was all fragmentary and soft and extended as a lag deposit down the levee bank sloping towards the river.

Birriwa 4

Another small oven was located further west along the track, but had been disturbed by firebreak ploughing. It was manifest as a circular outline of baked clay and reddened fired soil measuring 1.2 x 1 m.

Birriwa 5
A further oven was located in the northwestern area of the reserve amongst an area of gilgai microrelief vegetated with *E.largiflorens* woodland and *Eragrostis australasica*.. It was located adjacent to a small ponded gilgai depression and comprised a disturbed 10 m spread of large grey baked clay heat retainers around a central patch of fired earth.
Birriwa 6
Birriwa 6 consisted of an isolated artefact, a flaked quartzite pebble (20x15x10 mm). It was situated on the access track.
Birriwa 7
Birriwa 7 was a quartzite manuport (200x130x73 mm). It was located within disturbed soil near a stock holding yard.

47. Rosevale Reserve

Area
The survey area covered 0.02 km^2 (350 m in length by 30 to 60 m in width) .

Description
Rosevale Reserve was situated on the southern side of the Jerilderie Road approximately 13 km south of the Murrumbidgee River amidst flat western plains country traversed by palaeochannels.

Climate
The area has a semi arid climate, and experiences cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm. Rainfall exceeds evaporation for the months of June and July.

Water Availability
No permanent water sources exist in the vicinity, however low lying areas within the palaeochannels may collect and retain water for months following wet periods.

Vegetation
The surveyed area consisted of a section of ephemeral swamp. The low lying areas were vegetated with *Eragrostis australasica*, whilst the more elevated sand ridges supported a *E. largiflorens* woodland, up to 10 m tall, with an *Atriplex* sp understorey.

Ground Surfaces
The ground surface was undulating, with a fairly well-defined braided stream channel of grey soil and swampy patches. Ground surfaces were predominantly stable with some aggrading sandy areas, although some rabbit activity was present within the sand ridges. Construction of a firebreak had disturbed the southern section of the area.

Survey Method
The area was comprehensively walked by two people. The sites were later mapped with a theodolite and EDM.

Features Recorded
Seven oven mounds were located, occupying small areas of natural elevation. Their heat retainers had a very sandy texture and were soft and crumbly. Mound deposits were readily distinguished by the presence of large quantities of charcoal, ash and heat retainers. Small excavations made by rabbits revealed a minimum of 0.45 m depth to the deposits. A low density artefact scatter was also present across the area. Nineteen artefacts were recorded, including flaked and ground stone implements. Scattered and displaced heat retainers were also recorded across the area, presumably displaced by the movement of stock. Only one artefact was located in the graded firebreak along the southern boundary fence suggesting a fairly tight confinement of the site to the surveyed section.
Artefacts
1. Red quartzite flake (22x16x5 mm)
2. Faun quartzite flake (25x8x8 mm)
3. Quartzite flake, nosed distal usewear (32x11x12 mm)

4. Milky quartz chip (<5 mm)
5. Milky quartz flake (12x13x6 mm)
6. Unsuccessful quartzite pebble core (23x17x17 mm)
7. Ground piece sandstone (50x35x30 mm)
8. Quartzite flake (15x22x4 mm)
9. Quartzite flake midsection, utilised (14x28x6 mm)
10. Milky quartz flake (20x12x2 mm)
11. Quartzite muller fragment (55x38x16 mm)
12. Vein quartz blade (15x7x2 mm)
13. Sugary quartz flaked piece, utilised (35x17x17 mm)
14. Brown quartzite flake (12x15x2 mm)
15. Grey quartzite flake (20x18x5 mm)
16. Grey quartzite flake (8x8x1 mm)
17. Grey quartzite chip (10x10x5 mm)
18. Milky quartz flaked piece (30x12x12 mm)
19. Pink quartzite flake (10x14x2 mm).

48. Cobb Highway - Jerilderie Road Intersection

Area

Areas totalling 3.75 km^2 of roadside reserve on the eastern side of the Cobb Highway were surveyed for the presence of archaeological materials.

Description

The Cobb Highway area formed the western boundary of the entire field survey. The survey area was situated within the western plains landscape and the area consisted of open dry plains, with extensive scalded areas forming microrelief.

Climate

The climate is semi arid with cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm. Rainfall exceeds evaporation for the months of June and July.

Water Availability

There were no permanent water sources in close proximity, the Murrumbidgee River being located some 20 km to the north, and more ephemeral drainage lines such as the Abercrombie Creek some 10 km to the south, so it is possible that the occupation represented was short term, possibly relying on ephemeral water catchment in the open claypans.

Vegetation

The areas was vegetated with an open grassland and shrubland of *Atriplex vesicaria*.. Past vegetation patterns would have been composed of an *A. Pendula* and *Atriplex* sp shrubland.

Ground Surfaces

Soils consisted of red sandy loams capped with thin aeolian red sands. Ground surfaces were extensively scalded. Visibility was generally high within the scalded areas, although occasionally impeded by aggrading sands.

Survey Method

The area was comprehensively walked by two people.

Features Recorded

It was only in the scalded areas that archaeological materials were located. Two concentrations of archaeological materials were located. The first was situated in a series of scalds running parallel to the Jerilderie Road, just east of its intersection with the Cobb highway.

Cobb Highway 1

It contained eight small ovens and an associated low-density scatter of four stone artefacts, spread over an area of 11,500 m^2.

Cobb Highway 2
The second concentration of archaeological materials was located in an extensive, slightly elevated sandy scalded area running parallel to, and accessible from, the Cobb Highway. It was indicated as swampland on the topographic map. However it had no clearly defined drainage pattern or distinct ponded area, and was probably only seasonally or ephemerally wet. The archaeological materials were mostly confined to more elevated sandy areas amongst the general swathe of swampland vegetation. They consisted of an extensive low density scatter of 22 flaked stone artefacts and two small ovens, 13 m apart.

49. Barman State Forest Stock Reserve
Area
This area covered 0.6 km^2.

Description
The Barman State Forest Stock Reserve is situated within the western alluvial valley plains landscape. It has frontage to the Murrumbidgee River. The area consisted of low lying inundated river flats and higher southern levees and plains.

Climate
The climate is semi arid with cool mean annual temperatures. Annual rainfall is in the vicinity of 350 mm, and is effective for two months from June to July.

Water Availability
Water is available within the Murrumbidgee River.

Vegetation
The reserve was generally well vegetated with a thin cover of well grazed grass. *E. camaldulensis* occurred in the river flats. *E. largiflorens* woodland lined the river margins. Past vegetational patterns would have been similar, although the plains country would probably have supported an *Acacia pendula* shrubland.

Ground Surfaces
Ground surfaces were mostly stable or depositional, with exceptions being an access track which ran into the reserve from the south and skirted the river bank, and disturbed ground surfaces within a holding pen for travelling stock. Soils were red brown earths tending to cracking grey clays close to the river.

Survey Method
The Stock Reserve was inspected on foot by two people.

Features Recorded
Twenty eight site components were recorded within the area, comprising, 20 mounds, 3 small oven locations, 1 midden, 2 scarred trees,1 isolated stone artefact and 1 low density artefact scatter.

Barman Stock Reserve 1
BSR1 was an oven mound measuring 5.0 x 4.0 m.

Barman Stock Reserve 2
BSR2 was an oven mound measuring 5.7 x 4.5 m.

Barman Stock Reserve 3
BSR3 was an oven mound measuring 5.5 x 5.0 m.

Barman Stock Reserve 4
BSR4 was an oven mound measuring 6.0 x 3.0 m.

Barman Stock Reserve 5
BSR5 was an oven mound measuring 8.0 x 8.0 m.

Barman Stock Reserve 6
BSR6 was an oven mound measuring 9.0 x 3.5 m.

Barman Stock Reserve 7
BSR7 was an oven mound measuring 8.5 x 8.5 m.

Barman Stock Reserve 8
BSR8 was an oven mound measuring 10.0 x 5.5 m.
Barman Stock Reserve 9
BSR9 was an oven mound measuring 8.3 x 5.7 m.
Barman Stock Reserve 10
BSR10 was an oven mound measuring 7.0 x 4.0 m.
Barman Stock Reserve 11
BSR12 was an oven mound measuring 6.0 x 5.5 m.
Barman Stock Reserve 12
BSR12 was an oven mound measuring 5.0 x 4.0 m.
Barman Stock Reserve 13
BSR13 was an oven mound measuring 7.5 x 7.0 m.
Barman Stock Reserve 14
BSR14 was an oven mound measuring 8.0 x 8.5 m.
Barman Stock Reserve 15
BSR15 was an oven mound measuring 8.0 x 8.5 m.
Barman Stock Reserve 16
BSR16 was an oven mound measuring 9.0 x 7.5 m.
Barman Stock Reserve 17
BSR17 was an oven mound measuring 5.0 x 4.0 m.
Barman Stock Reserve 18
BSR18 was an oven mound measuring 4.5 x 4.5 m.
Barman Stock Reserve 19
BSR19 was an oven mound measuring 6.0 x 5.4 m.
Barman Stock Reserve 20
BSR20 was a destroyed oven mound of indeterminate dimensions.
Barman Stock Reserve 21
BSR21 was a small exposure of freshwater shell midden exposed in the access track leading down towards the river. It was situated within grey clay soils and measured 1.35 x 0.7 m. Depth of the shell lens appeared to be a minimum of 0.08 m.
Barman Stock Reserve 22
BSR22 was a location of loose baked clay heat retainers indicating the operation of a small oven in the vicinity.
Barman Stock Reserve 23
BSR23 was a location of baked clay heat retainers exposed in the surface of the access track. The site was located on high ground 30 m south of the current river channel.
Barman Stock Reserve 24
BSR24 was a live *E. largiflorens* tree with an elongate scar removed from its trunk. The tree trunk circumference measured 2.6 m. The scar commenced 0.66 m above ground and measured 2.36 x 0.53 m. Axe cuts were present at the base of the scar.
Barman Stock Reserve 25
BSR25 was a live *E. largiflorens* tree with an elongate scar removed from its trunk. The trunk circumference measured 5.56 m. The scar measured 1.28 x 0.2 m, and commenced 0.4 m above ground.
Barman Stock Reserve 26
BSR26 was of an isolated stone artefact, consisting of a quartzite muller/anvil. It measured 70 x 75 x 55 mm and was made from a water worn river cobble. It was pecked around the margins, and a flat surface displayed use pitting. One margin displayed polished usewear.
Barman Stock Reserve 27
BSR27 was an occurrence of 3 flaked stone artefacts exposed in loose soil within a stock holding yard.
1. Backed silcrete flake (20x10x5 mm)
2. Quartz chip (12x8x5 mm)
3. Trapezoidal quartz core (15x15x10 mm)

Barman Stock Reserve 28
BSR28 consisted of a concentration of baked clay heat retainer rakeout, exposed in an eroded surface of the access track. It measured 1.2 x 1.1 m. Erosion reached a depth of 0.20 m.

50. Cullival State Forest.

Area
An area of 1.25 km^2 was surveyed within the Cullival State Forest.

Description
The area is situated within the eastern sloping plains landscape. It was specifically composed of elevated aeolian sand ridges.

Climate
The climate is warm with dry summers. Rainfall averages 450 mm per annum, and is effective for the months of July through to August.

Water Availability
There are no permanent water sources in the vicinity.

Vegetation
The lunette is vegetated with *Callitris* sp pine forest and an understorey of native shrubs.

Ground Surfaces
Soils of the surveyed area consisted of red sands. Ground surfaces were generally stable, with the exception of tracks, which displayed eroding and aggrading substrates.

Survey Method
The area was comprehensively walked by two people. Areas offering good visibility were sought within the survey area and then intensively searched for archaeological materials.

Features Recorded
No archaeological sites were located.

51. Kulki Reserve.

Area
A 2.5 km^2 area of Travelling Stock and Crown Reserve north of Kulki State Forest was examined for archaeological materials.

Description
The area is lies within the western plains landscape. It consisted of open plains and palaeochannel traces.

Climate
The climate is semi arid with annual precipitation in the order of 400-450 mm. Effective rainfall falls between June and August.

Water Availability
There are no permanent water sources in the vicinity, although the undulating microtopography following the old stream channel would enable water to accumulate following rain.

Vegetation
The area supports a *E. largiflorens* woodland alliance, and would have had an understorey composed of A. nummularia and grasses. The adjacent Kulki State Forest consists of *Callitris* sp.

Ground Surfaces
The soils consisted of red earths and were prone to scalding. Some areas of grey clay occurred along the old stream traces.

Survey Method
The area was walked by two people. Areas offering good visibility were sought within the survey area and then intensively searched for archaeological materials.

Features Recorded
One small oven was recorded, emerging from the edge of a scald erosion patch. It was only partially visible and was estimated to be approximately 0.5 m in diameter.

52. Argoon Reserve.
Area
The Argoon Travelling Stock and Crown Reserve covered an area of 1.8 km^2.

Description
The area is situated within the western plains landscape. It consisted of level plains.

Climate
The climate is semi arid. Rainfall averages 450 -450 mm per annum, and exceeds evaporation during the months of July through to August.

Water Availability
There are no permanent water sources in the vicinity.

Vegetation
The Reserve is vegetated with *E. largiflorens* woodland and an understorey of grasses. Previously it would have supported an understorey of *Atriplex* sp.

Ground Surfaces
Soils of the surveyed area consisted of red earths. Ground surfaces were generally stable, with the exception of several sheep tracks, which displayed shallowly eroded substrates.

Survey Method
The area was walked by two people.

Features Recorded
No archaeological sites were located.

53. Yanco Weir
Area
An area of 2.5 km^2 was surveyed within reserved land in the vicinity of Yanco Weir.

Description
The area is situated within the eastern alluvial valley plains landscape. It consisted of an area of source bordering dune adjacent to the current river channel. Some low-lying areas between the dune and a creek were also included.

Climate
The climate is warm with dry summers. Rainfall averages 450 - 500 mm per annum, and is effective for the months of July through to August.

Water Availability
Water would have been available in the river and from the Yanco Creek.

Vegetation
The dune areas were vegetated with *Callitris* sp pine forest and an understorey of native shrubs, whilst the river and creek margins supported a *E.camaldulensis* and *E. largiflorens* woodland.

Ground Surfaces
Soils of the surveyed area consisted of red sands and alluvial clay silts. Ground surfaces were generally stable, with the exception of access tracks, clearings and several sand borrow-pits.

Survey Method
The area was comprehensively walked by two people. Areas offering good visibility were sought within the survey area and then intensively searched for archaeological materials.

Features Recorded
Three scarred *E.largiflorens* trees were recorded.

54. Berembed Weir.
Area
An area of 4 km^2 was surveyed north of the Murrumbidgee River in the Berembed Weir vicinity.

Description
The area is situated within the eastern alluvial valley plains landscape. It was specifically composed of elevated aeolian sand ridges, and some areas of river bank.

Climate
The climate is warm with dry summers. Rainfall averages 450 - 500 mm per annum, and is effective for the months of July through to August.

Water Availability
Water would have been available from within the Murrumbidgee River.

Vegetation
The area was largely cleared, but would have been vegetated with *Callitris* sp forest with a shrub understorey on the sand areas and a *E. camaldulensis* woodland along the river margin.

Ground Surfaces
Soils of the surveyed area consisted of red sands. Much of the area had been ploughed and visibility for features such as artefact scatters was generally high.

Survey Method
The area was comprehensively walked by two people.

Features Recorded
No archaeological sites were located.

55. Kywong Reserve
Area
The Kywong Travelling Stock and Crown Reserve covered an area of 0.5 km^2.

Description
The area is situated within the eastern alluvial valley plains landscape. It consisted of an area of frequently flooded flats adjacent a distributary creek of the Murrumbidgee River.

Climate
The climate is warm with dry summers. Rainfall averages 450 - 500 mm per annum, and is effective for the months of July through to August.

Water Availability
Water would have been available in the adjacent creek.

Vegetation
The area supported a *E.camaldulensis* and *E. largiflorens* woodland, with an understorey of low tussocky grasses and *Atriplex* sp.

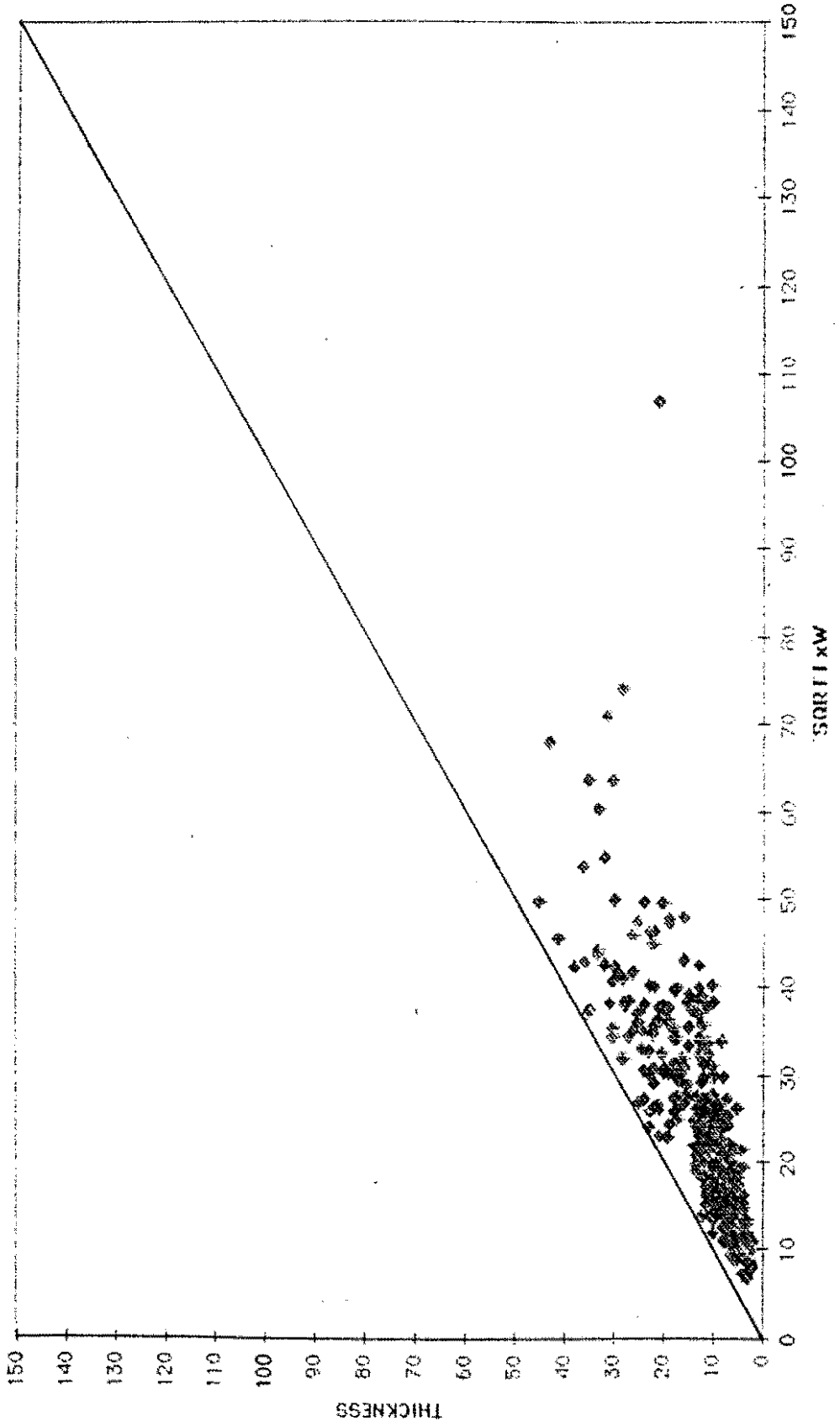
Ground Surfaces
Soils of the surveyed area consisted of red earths and alluvial clay silts. Ground surfaces were generally stable, and thickly vegetated. Ground visibility was very poor.

Survey Method
The area was comprehensively walked by two people.

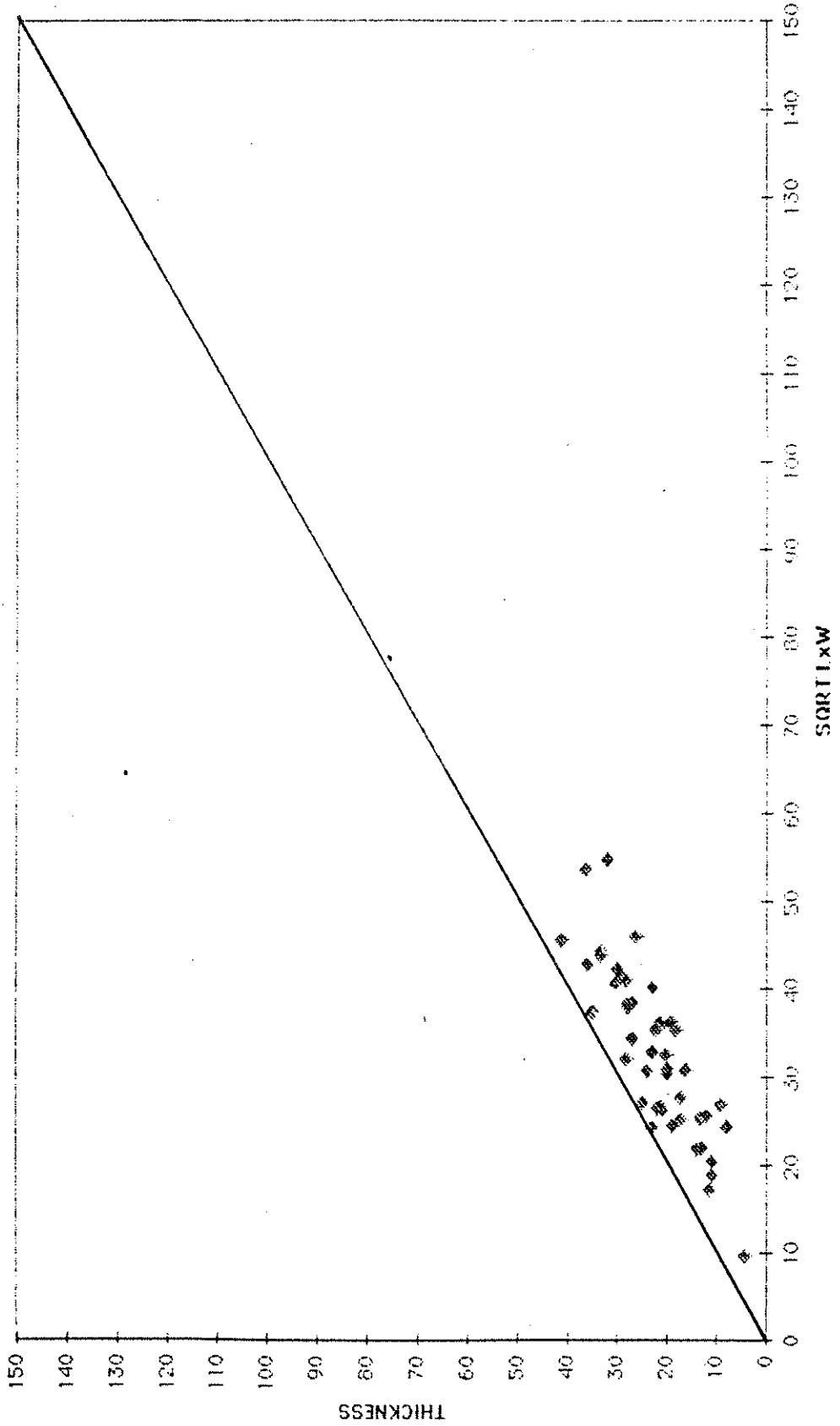
Features Recorded
No sites were located.

APPENDIX III
Lithic Reduction Charts

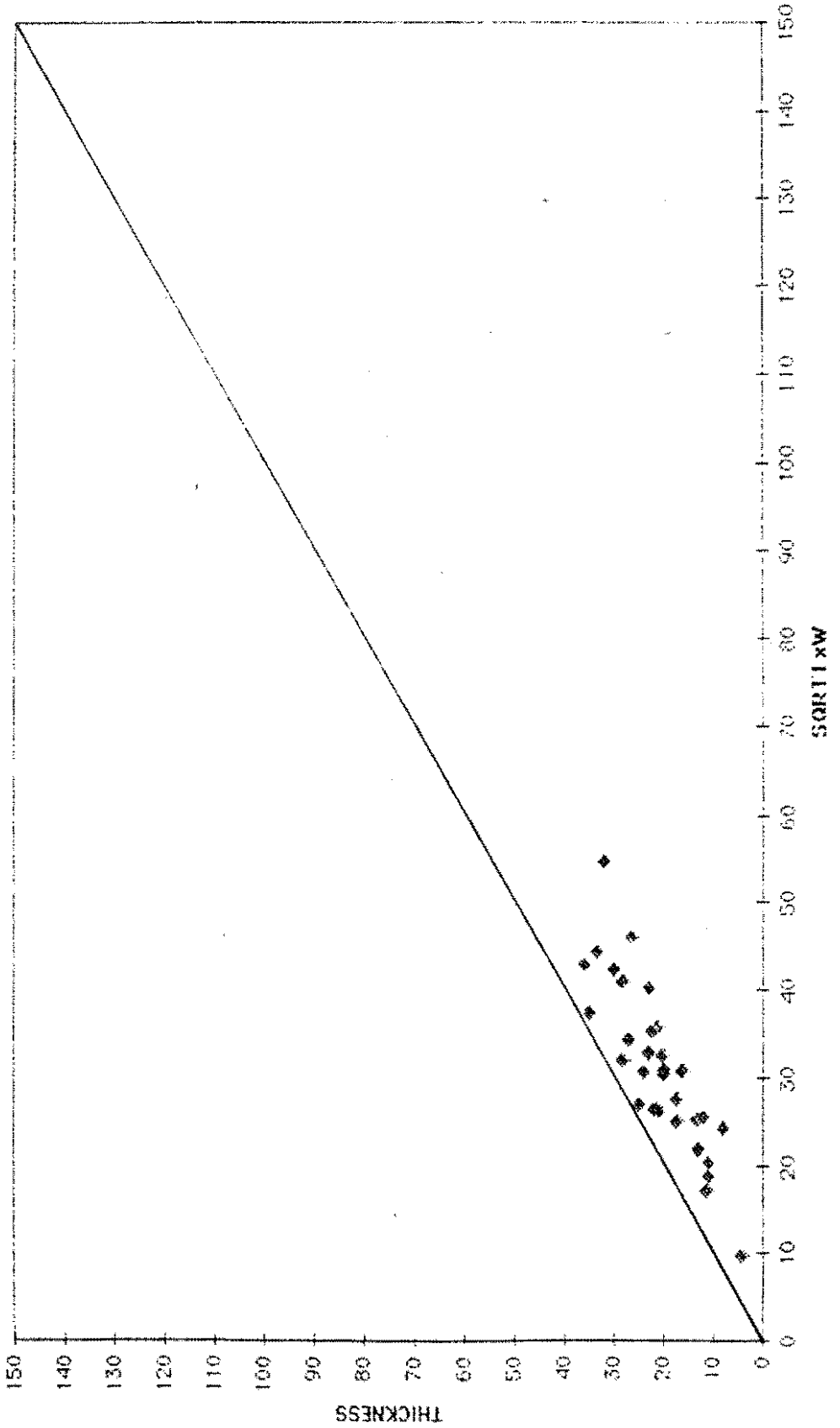
III-1-a Lake Urana All Artefacts



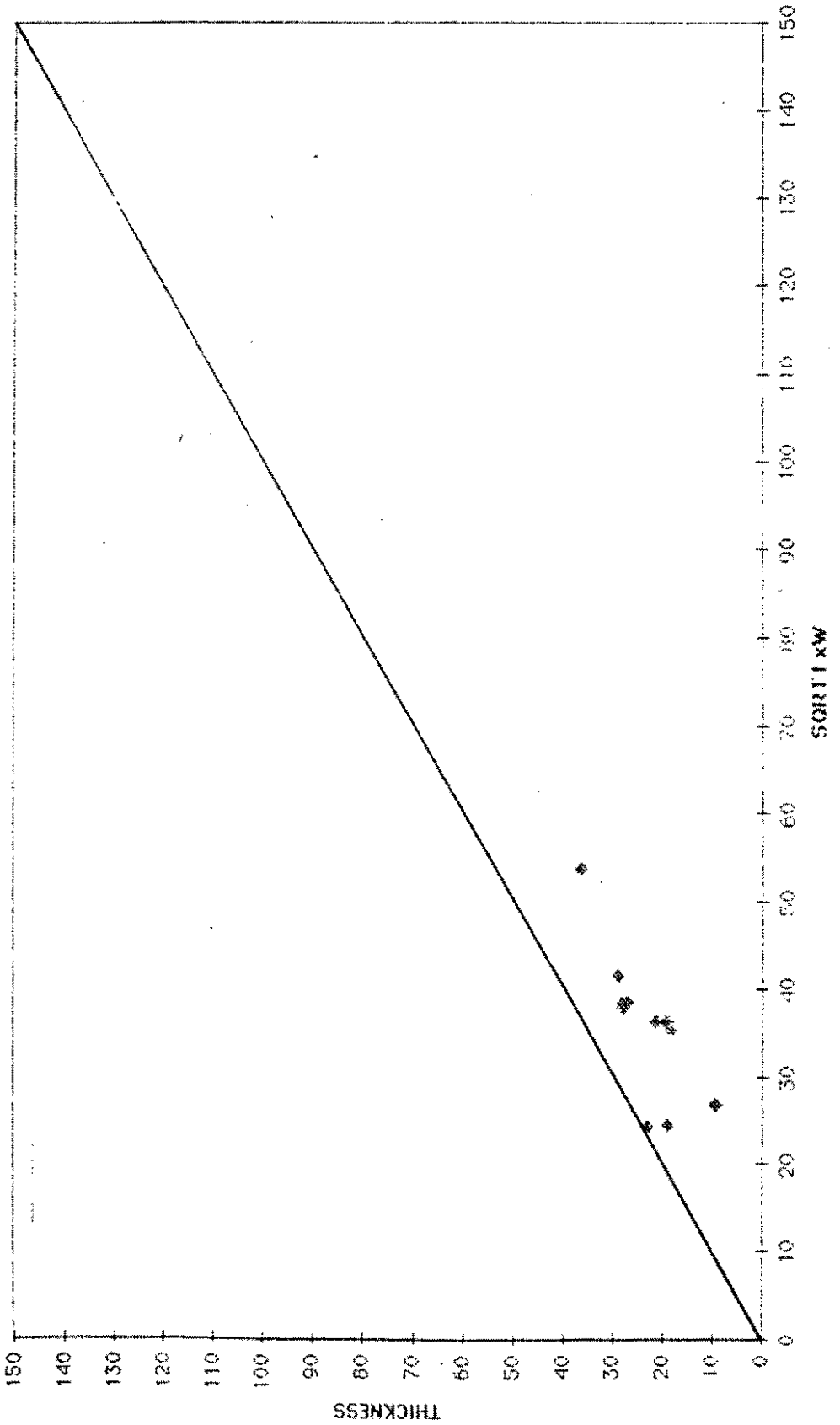
III-1-b Lake Urana All Cores



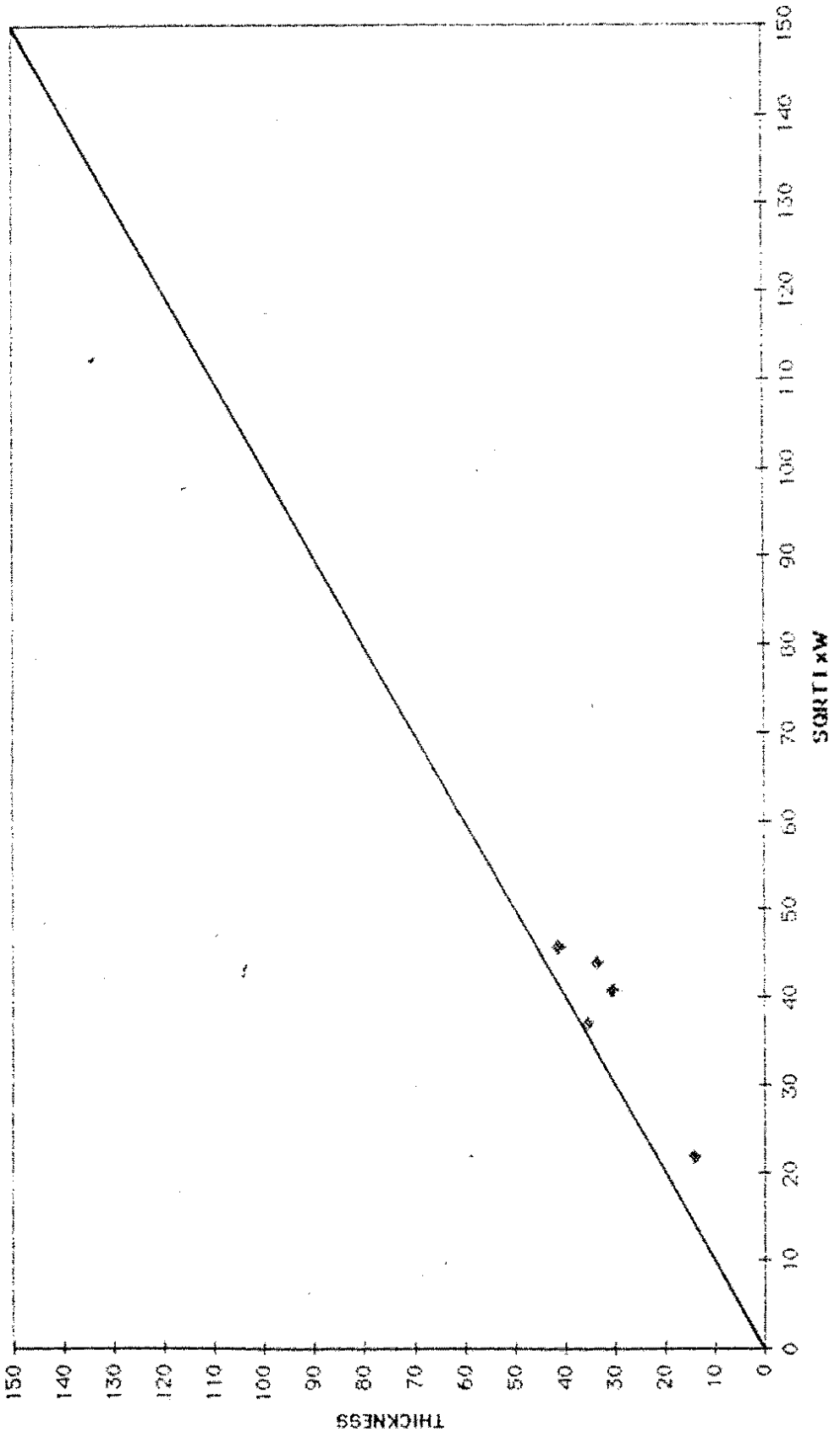
III-1-c Lake Urana Quartz Cores



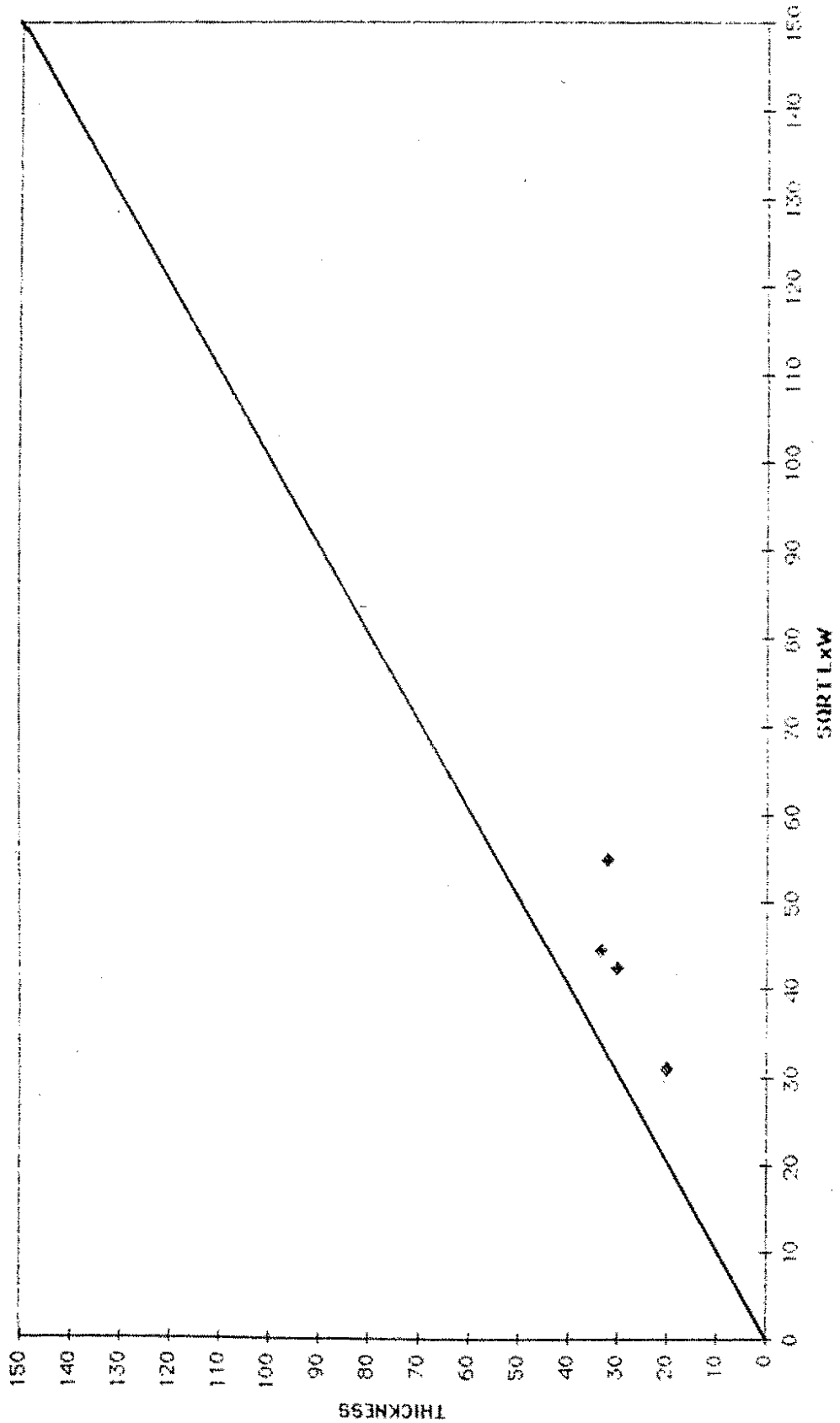
III-1-d Lake Urana Silcrete Cores



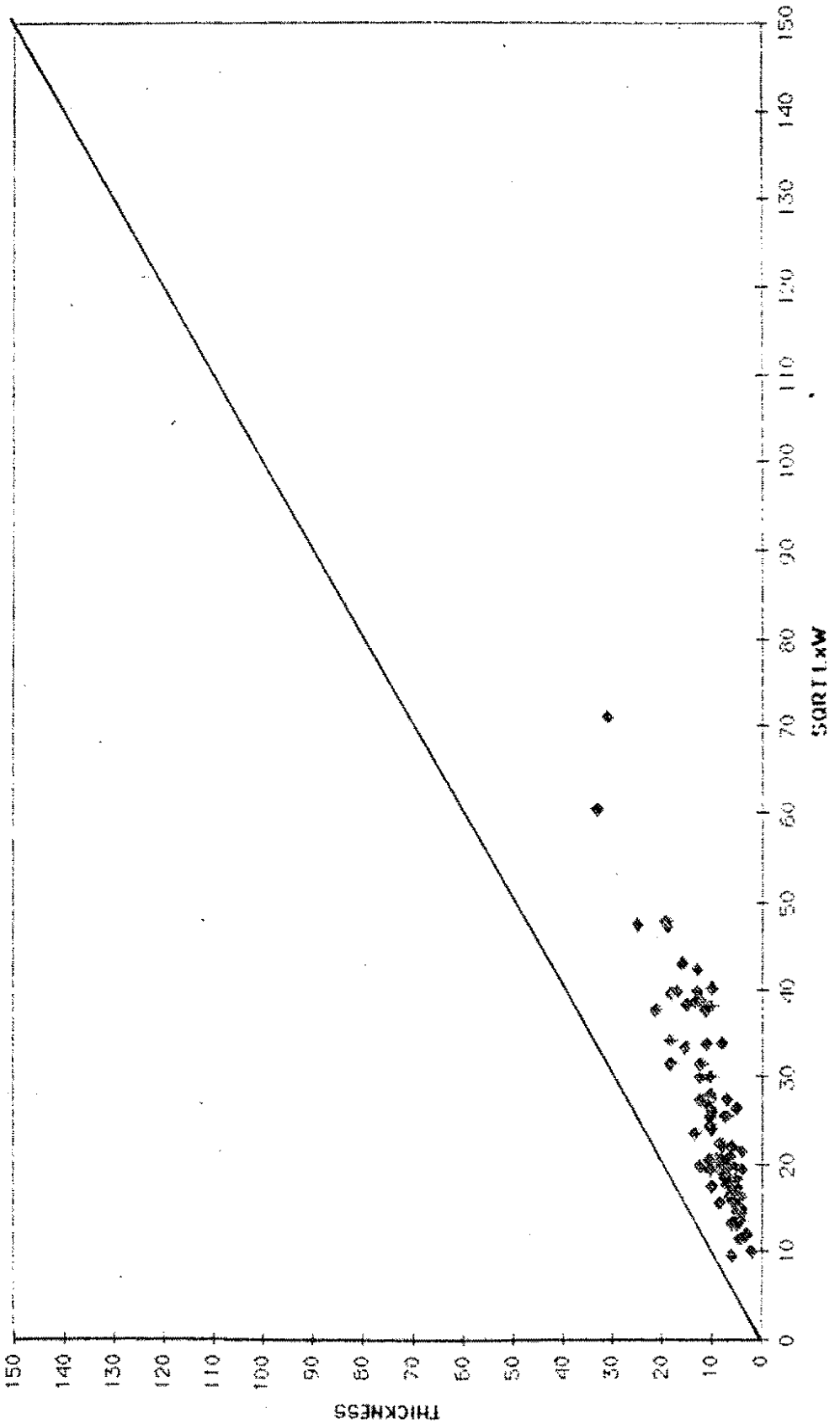
III-1-e Lake Urana Quartzite Cores



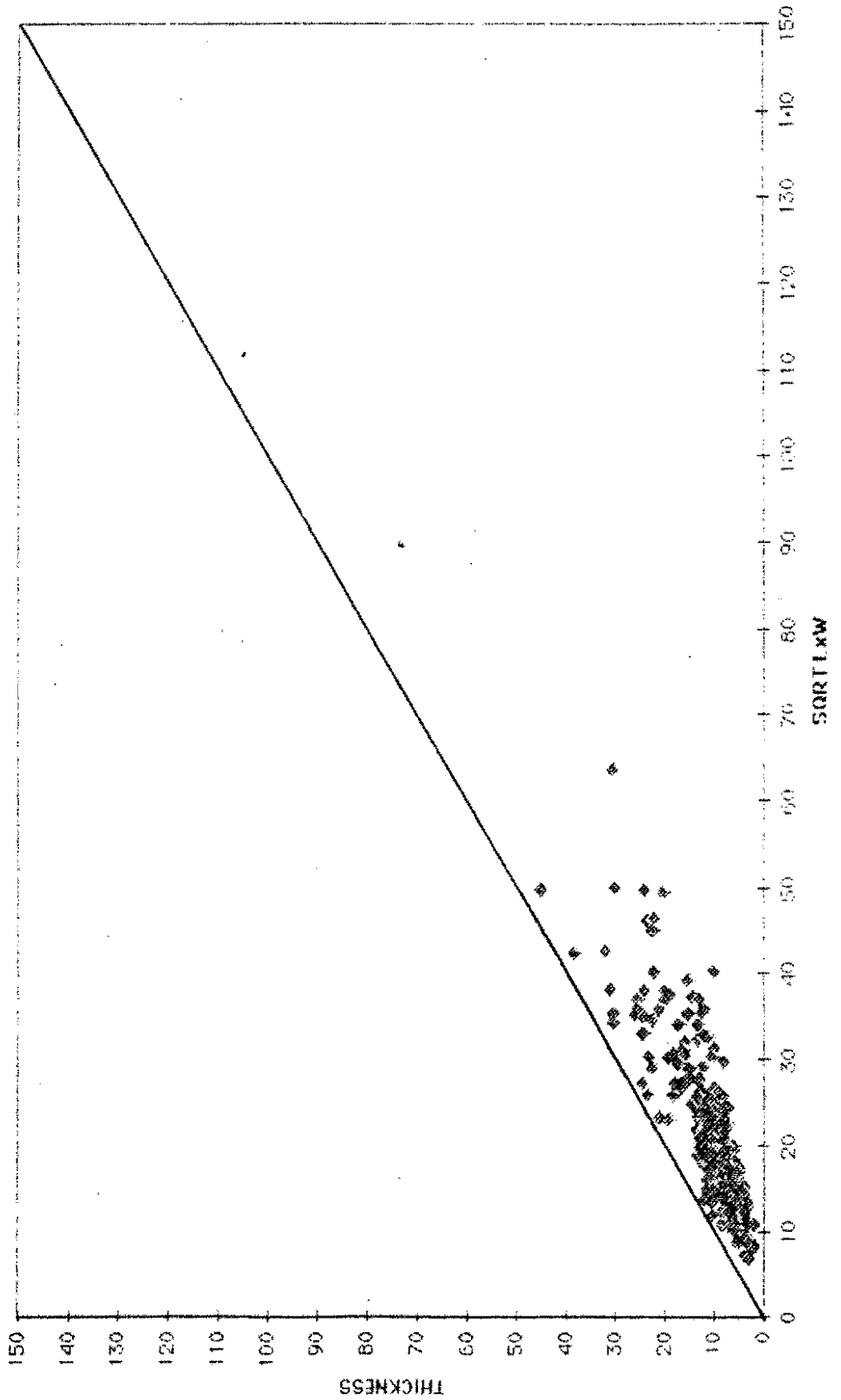
III-1-f Lake Urana Chert Cores



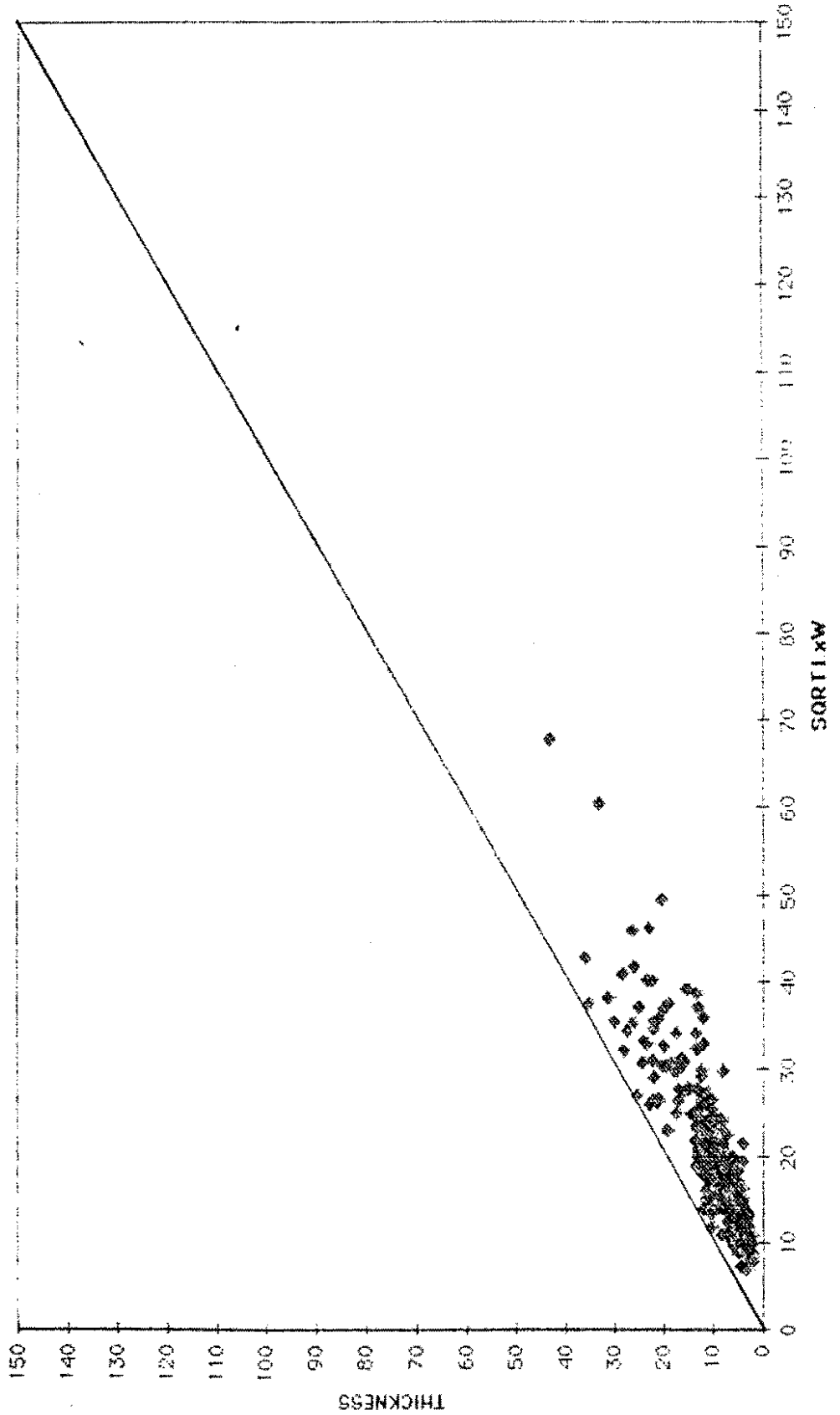
III-1-g Lake Urana Flakes and Blades



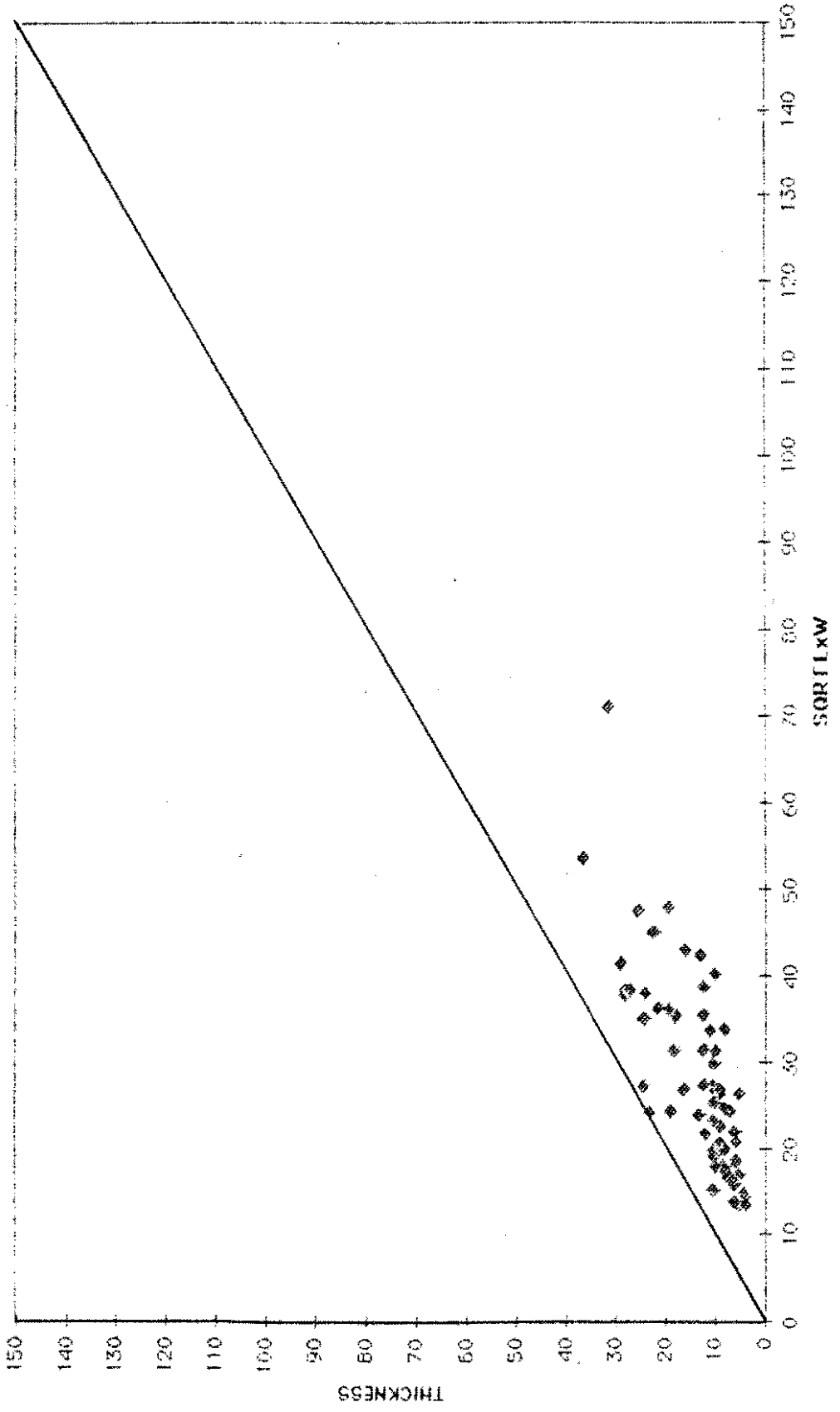
III-1-h Lake Urana Flaked Pieces and Chips



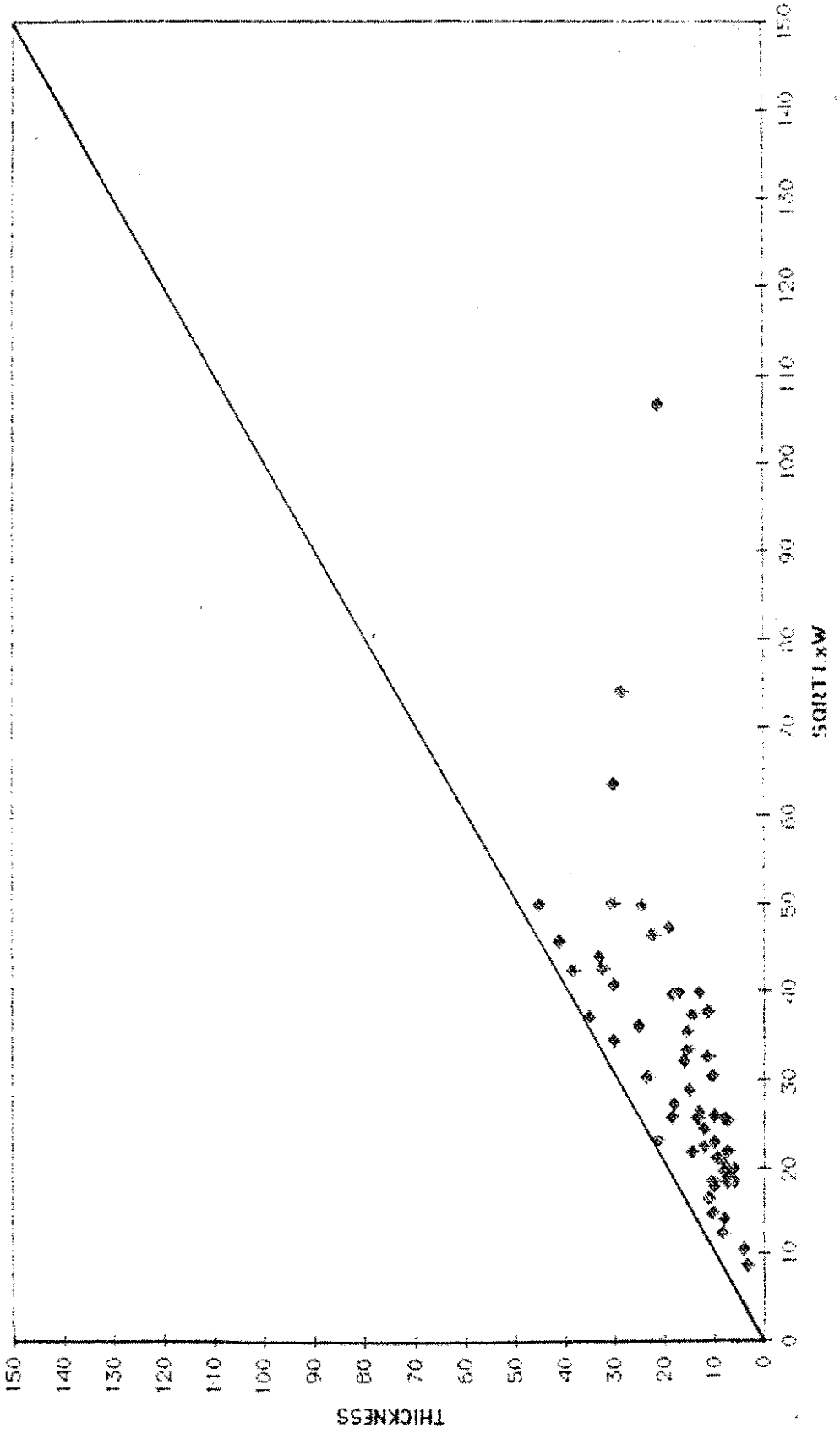
III-1-i Lake Urana All Quartz



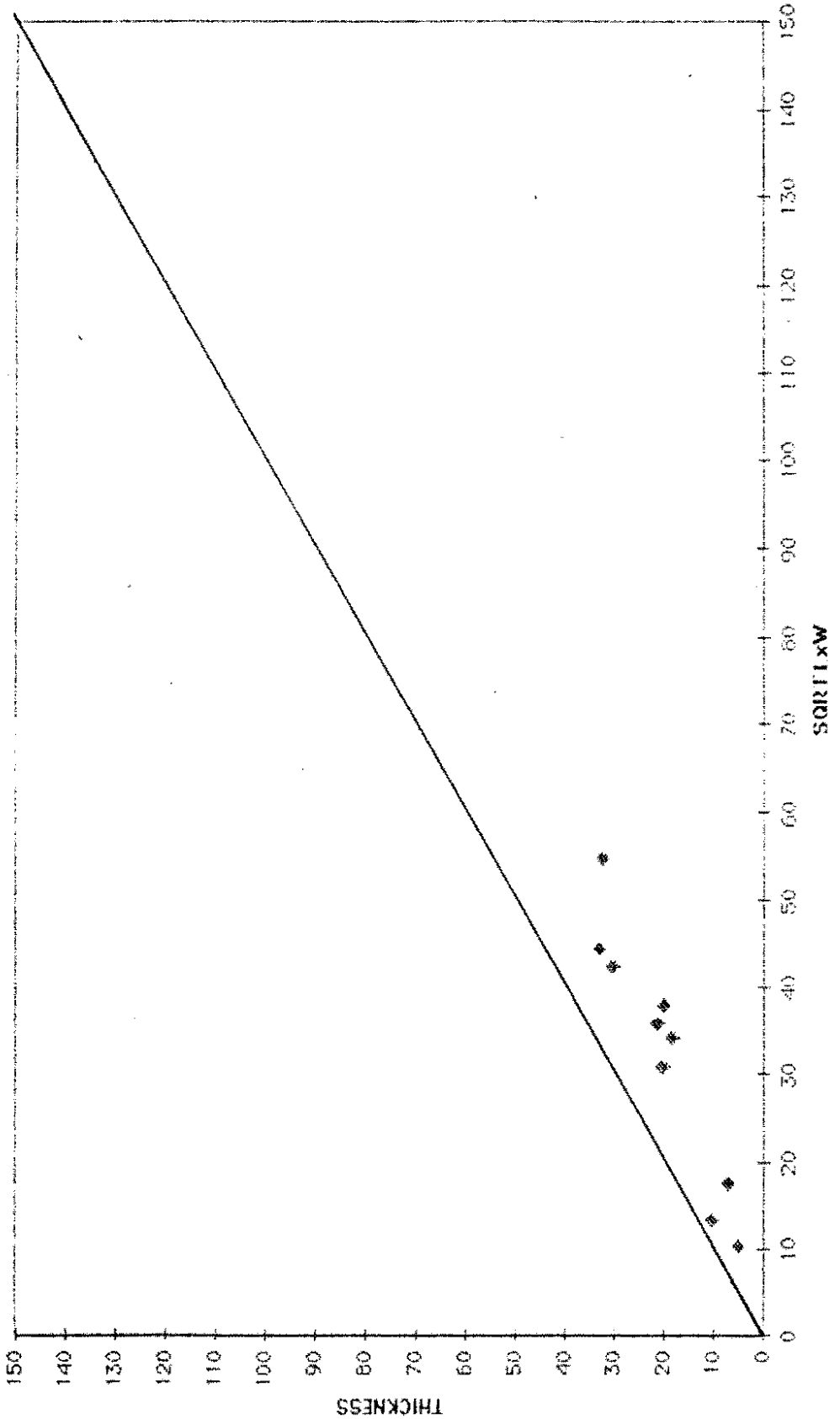
III-1-j Lake Urana All Silcrete



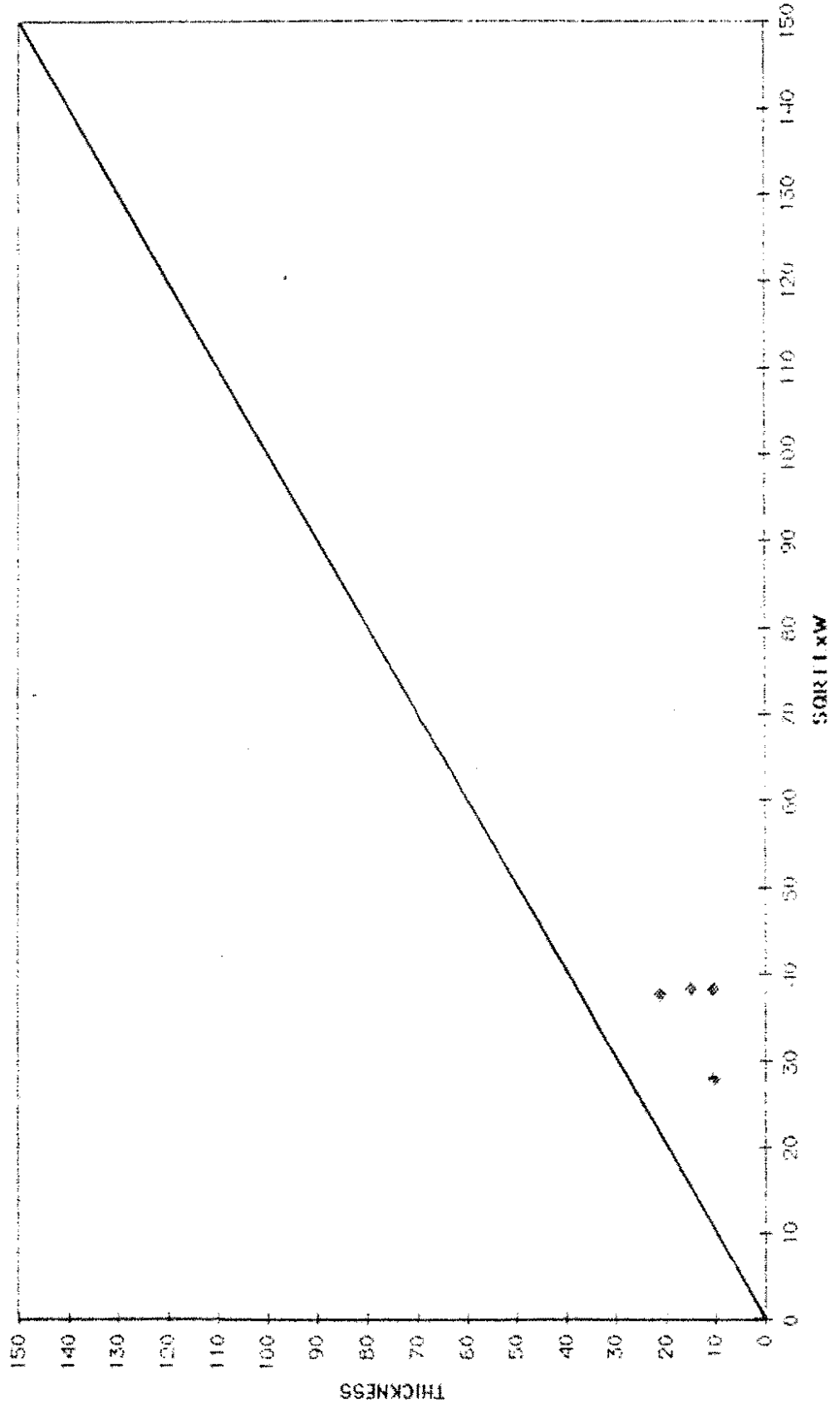
III-1-k Lake Urana All Quartzite



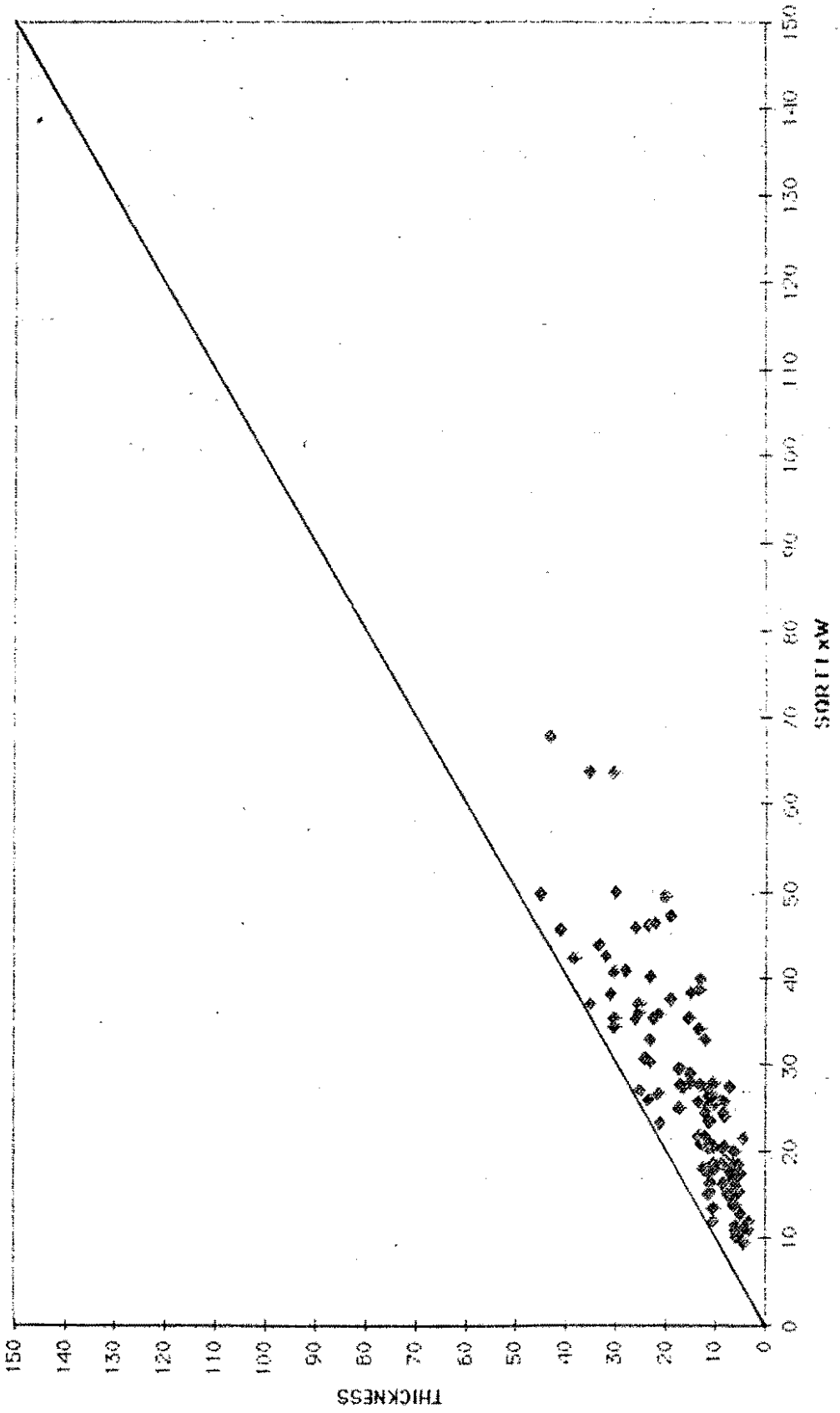
III-1-1 Lake Urana All Chert



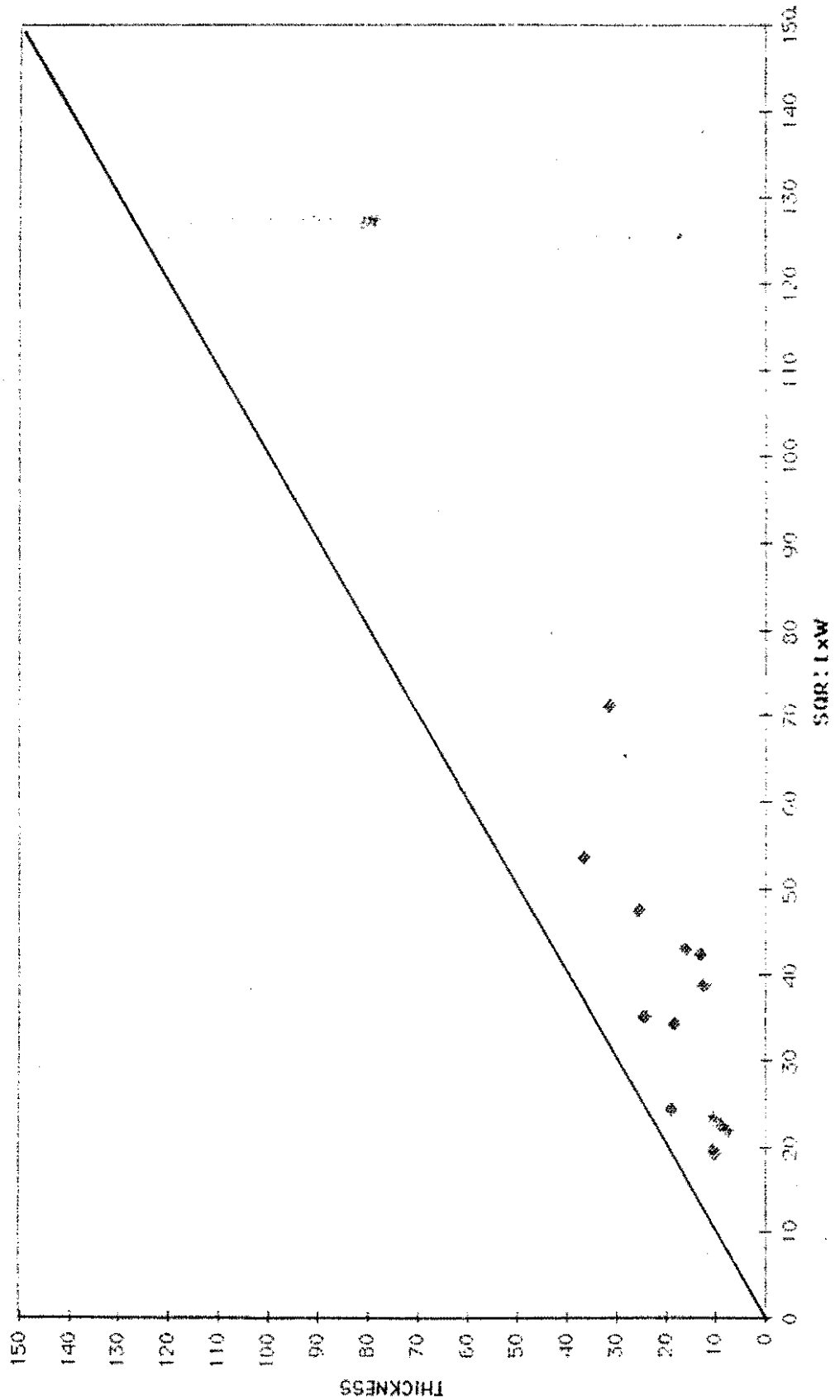
III-1-m Lake Urana All Volcanic



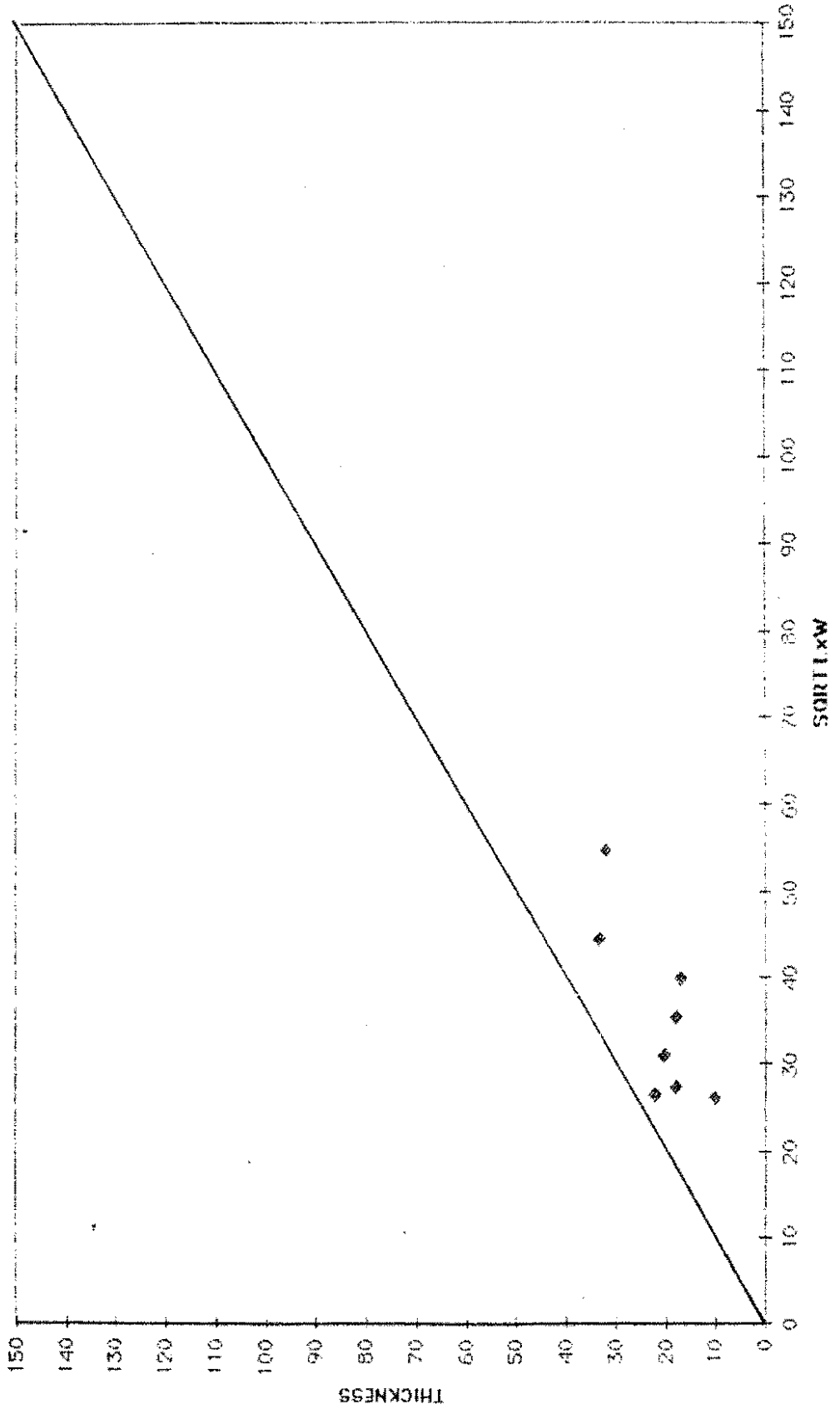
III-1-n Lake Urana All Pebble Cortex



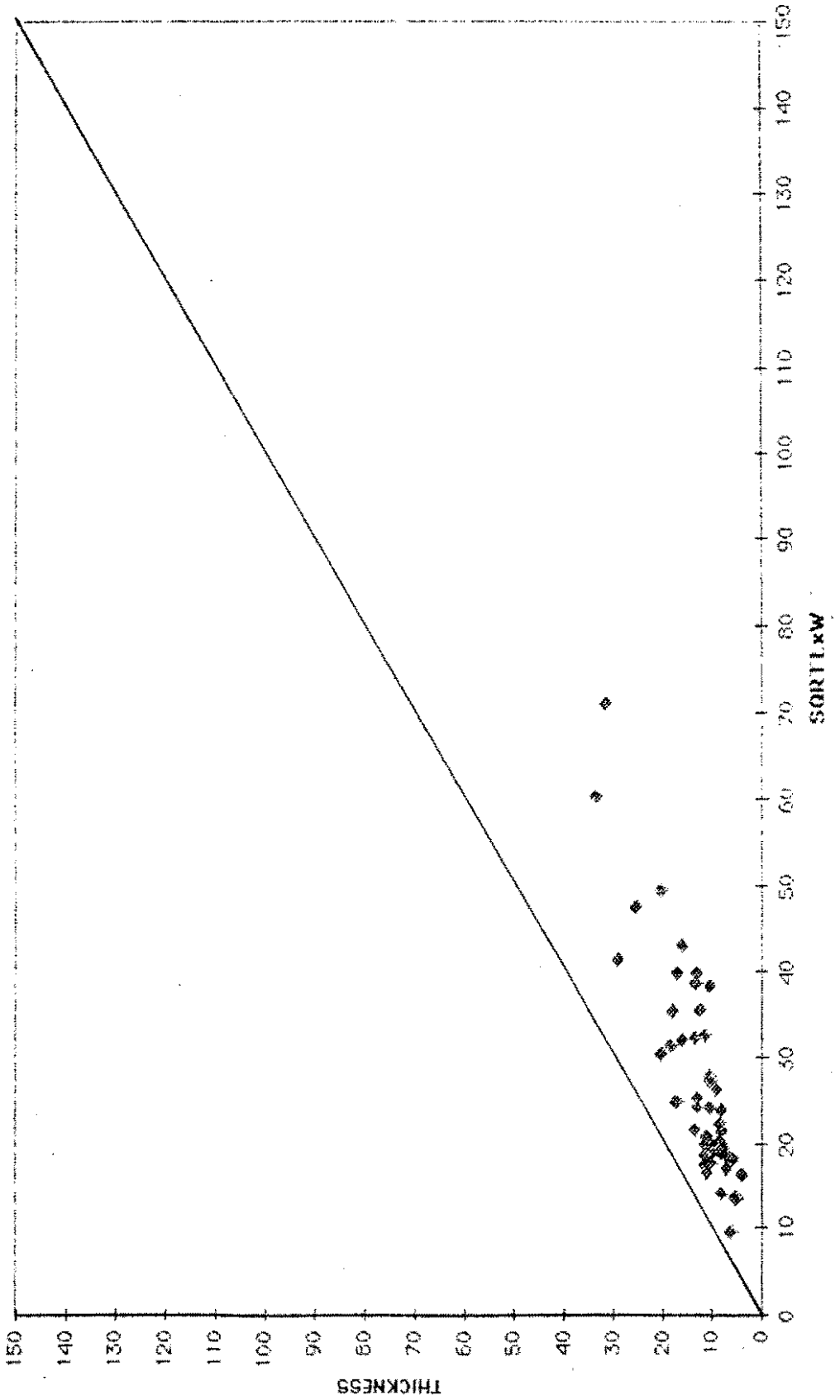
III-1-o Lake Urana All Quarry Cortex



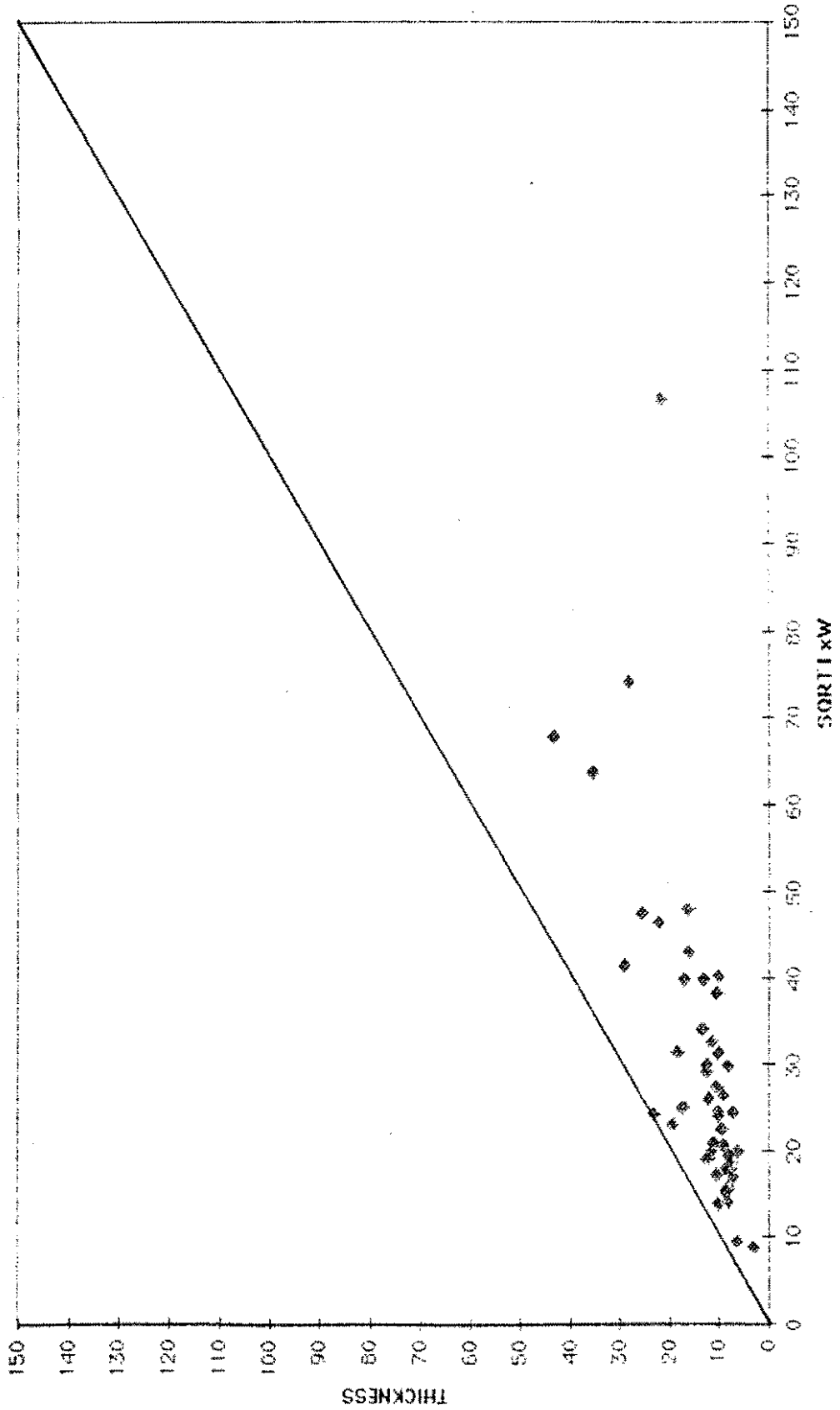
III-1-p Lake Urana Patinated Artefacts



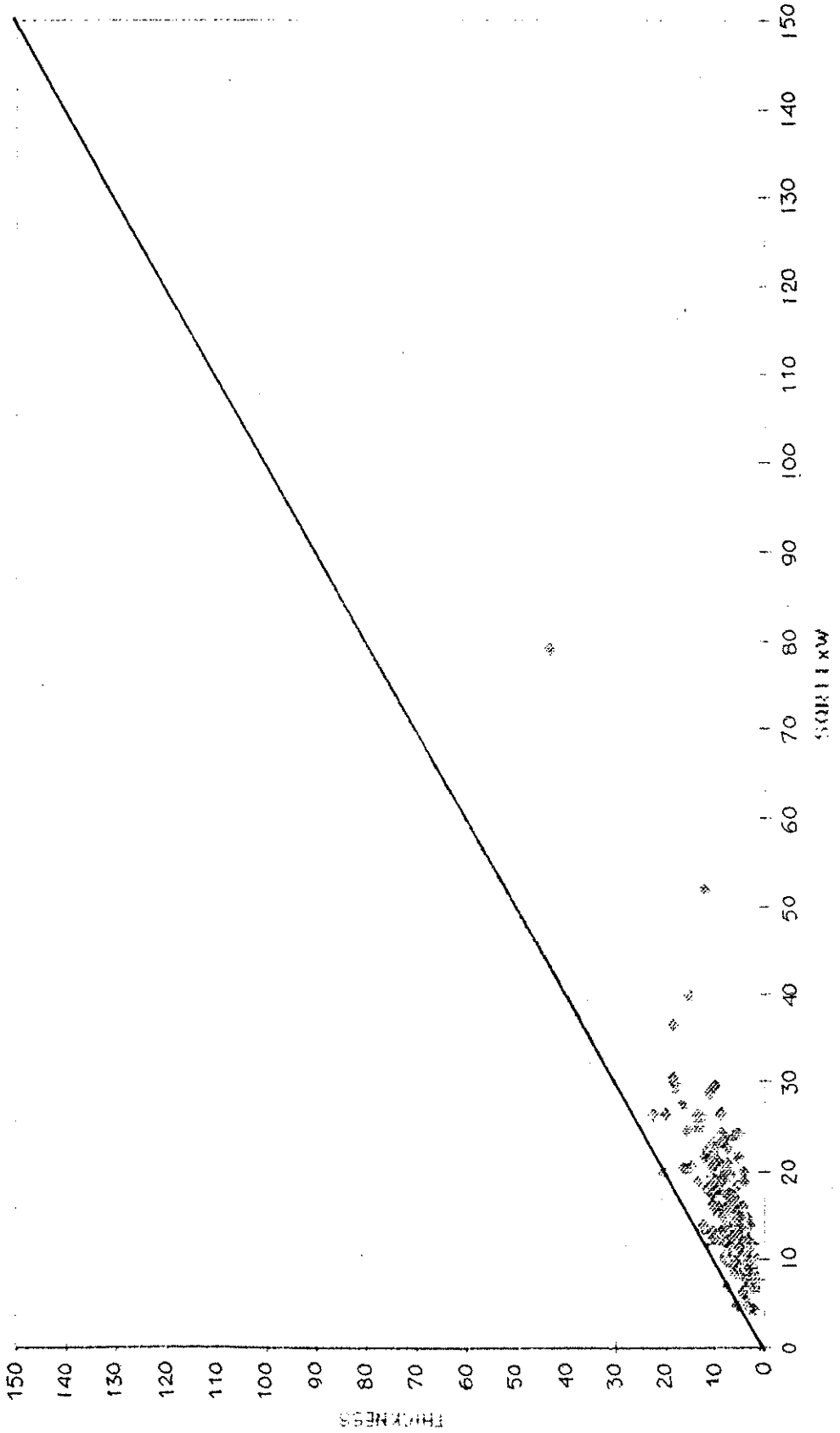
III-1-q Lake Urana Retouch



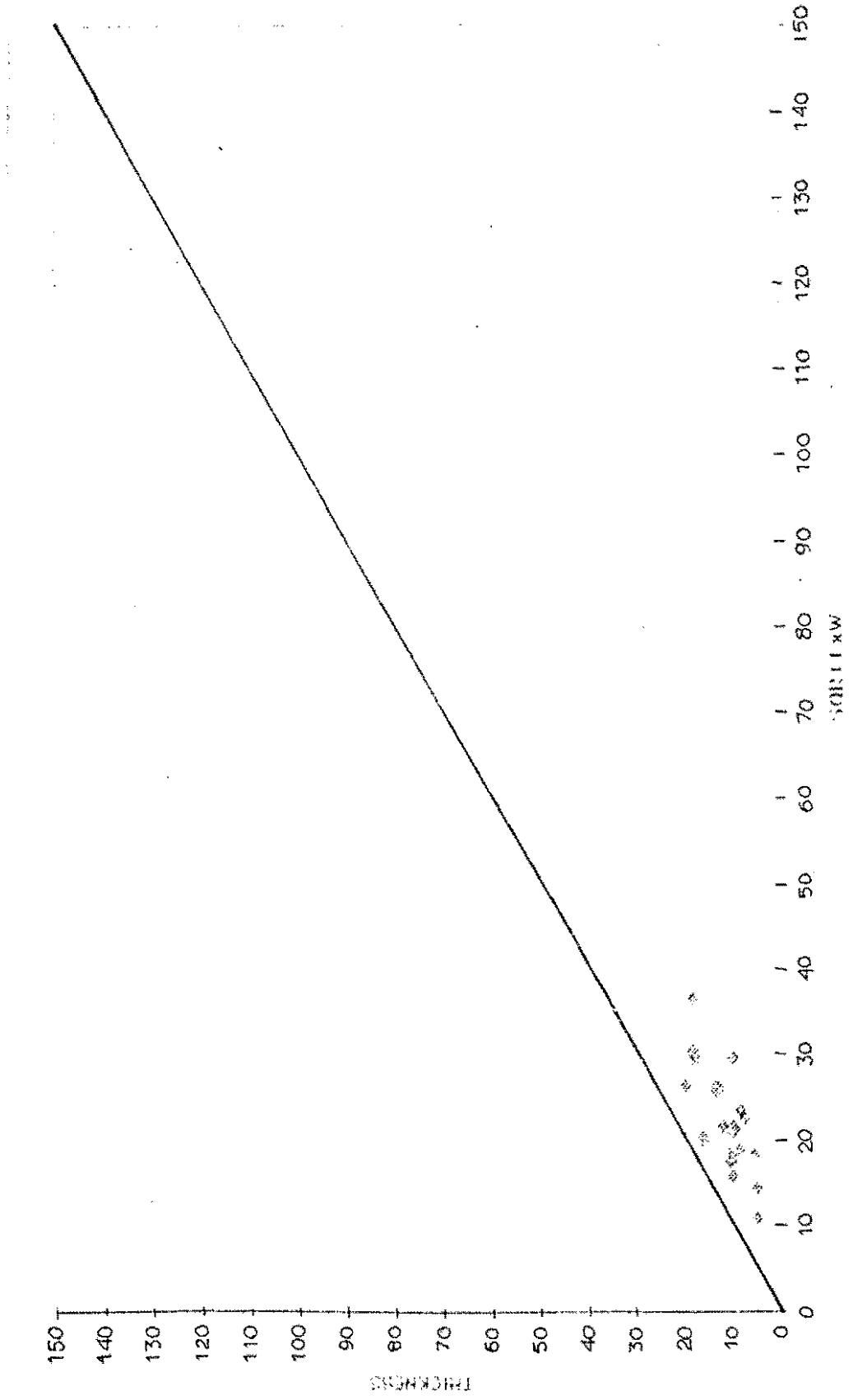
III-1-r Lake Urana Usewear



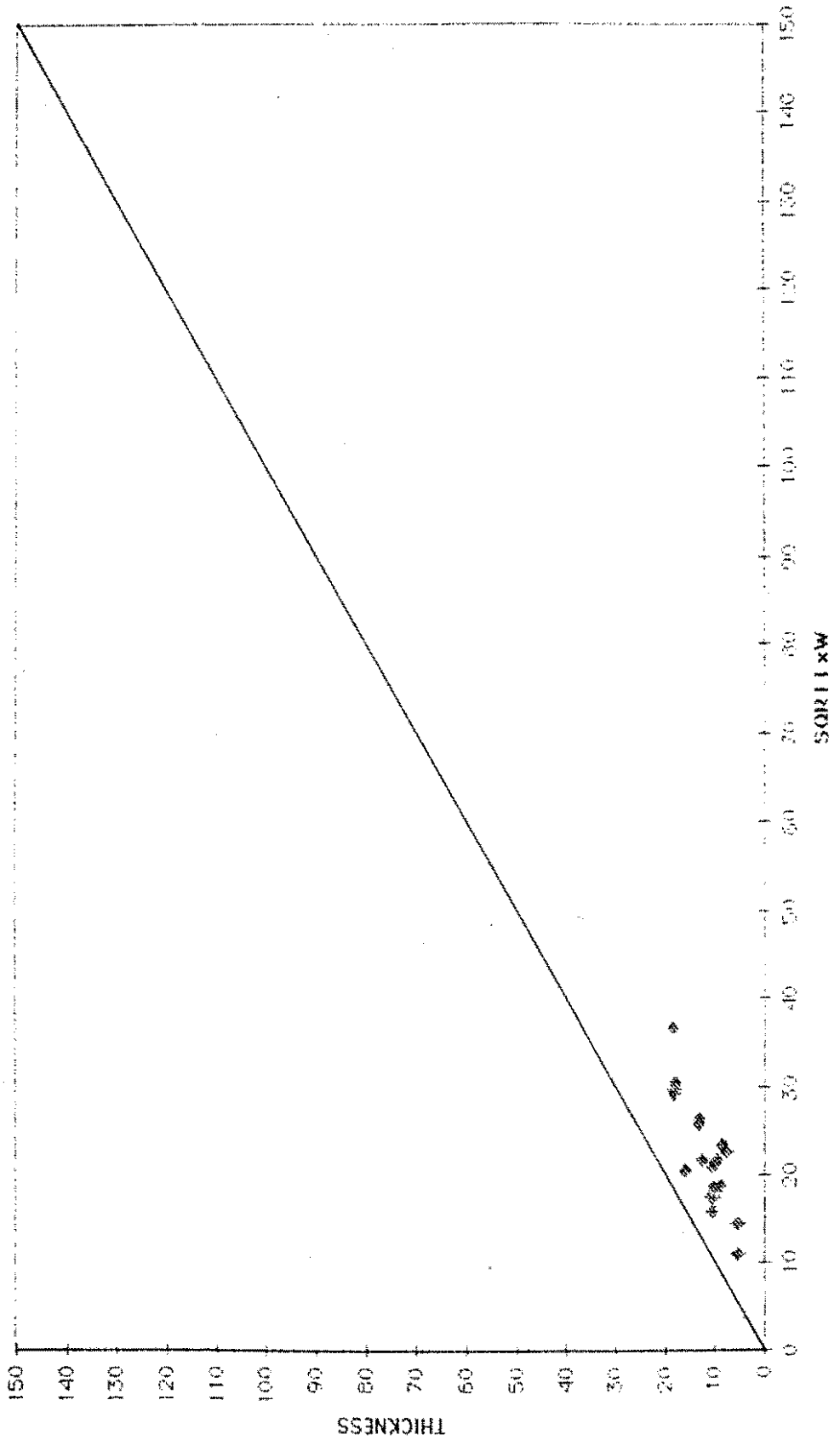
III-2-a Urangeline Creek All Artefacts



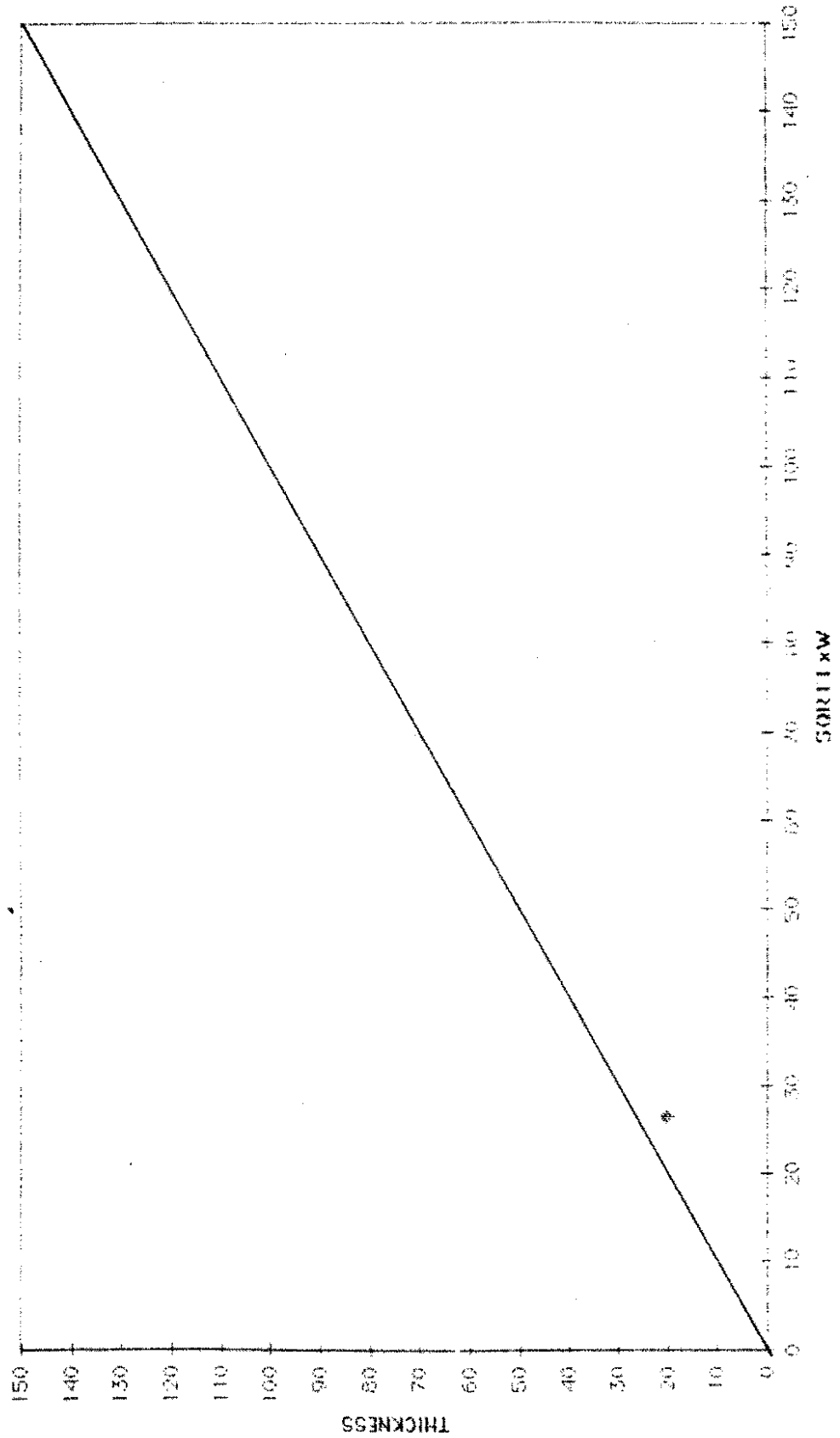
III-2-b Urangeline Creek All Cores



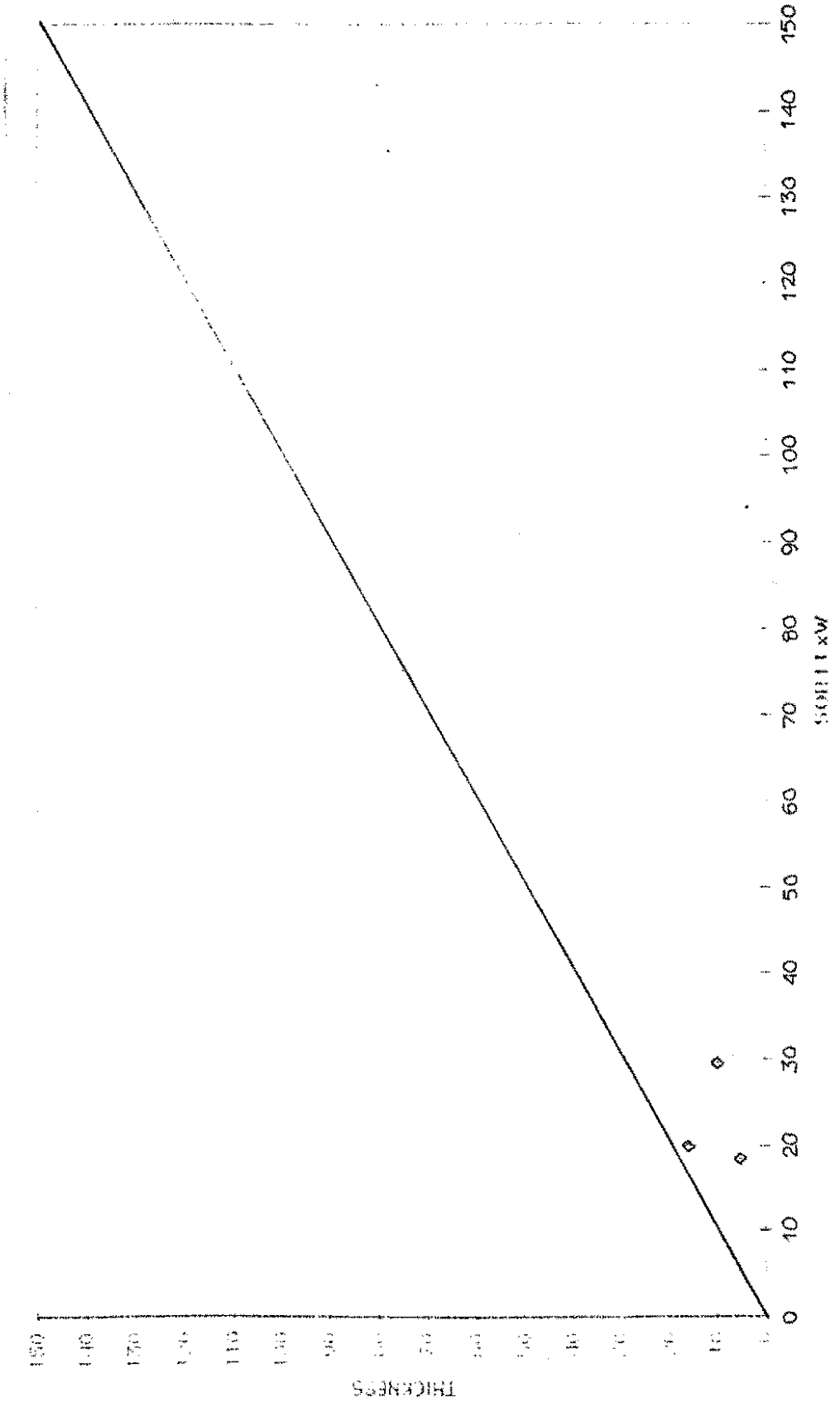
III-2-c Urangeline Creek Quartz Cores



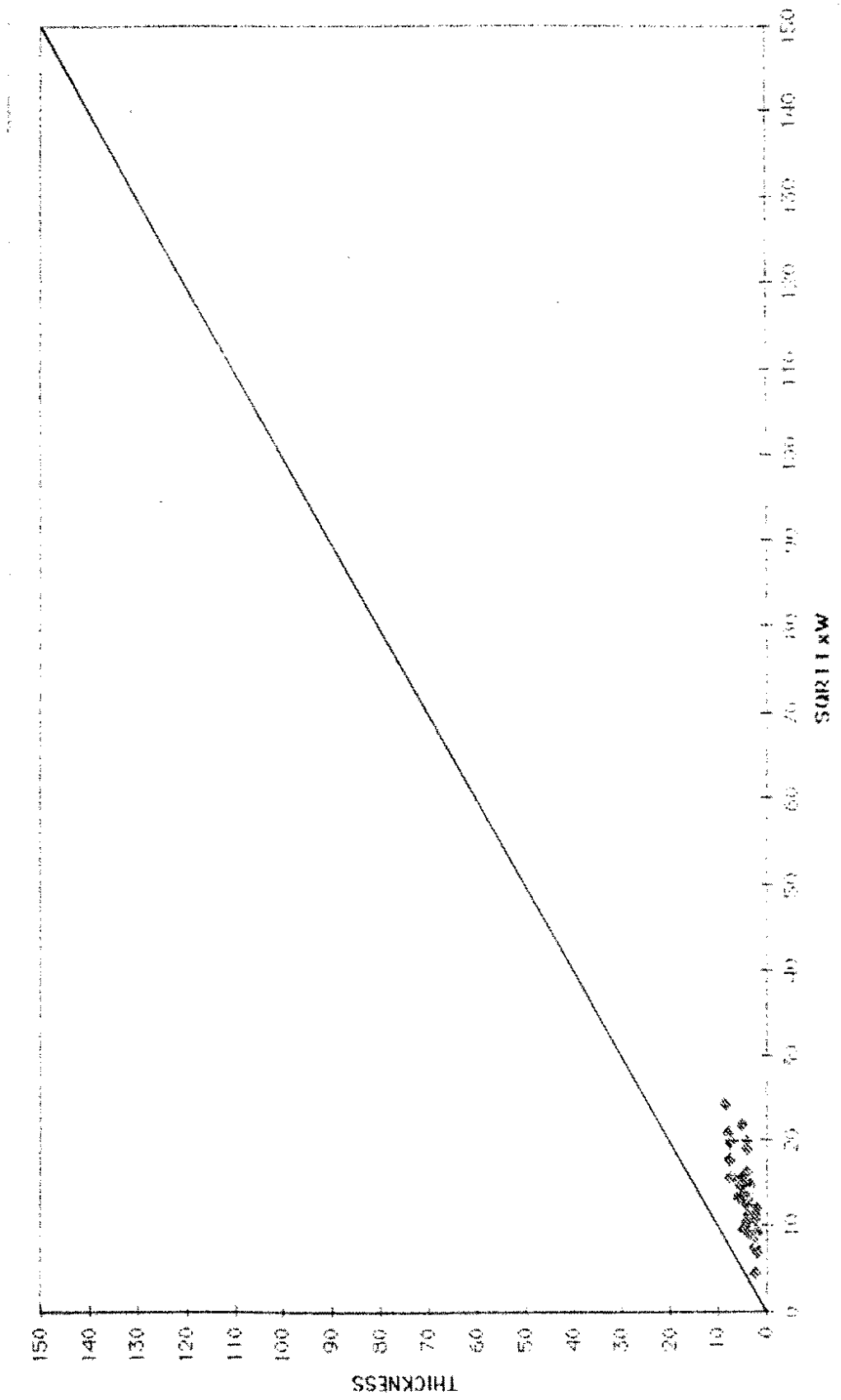
III-2-d Urangeline Creek Silcrete Cores



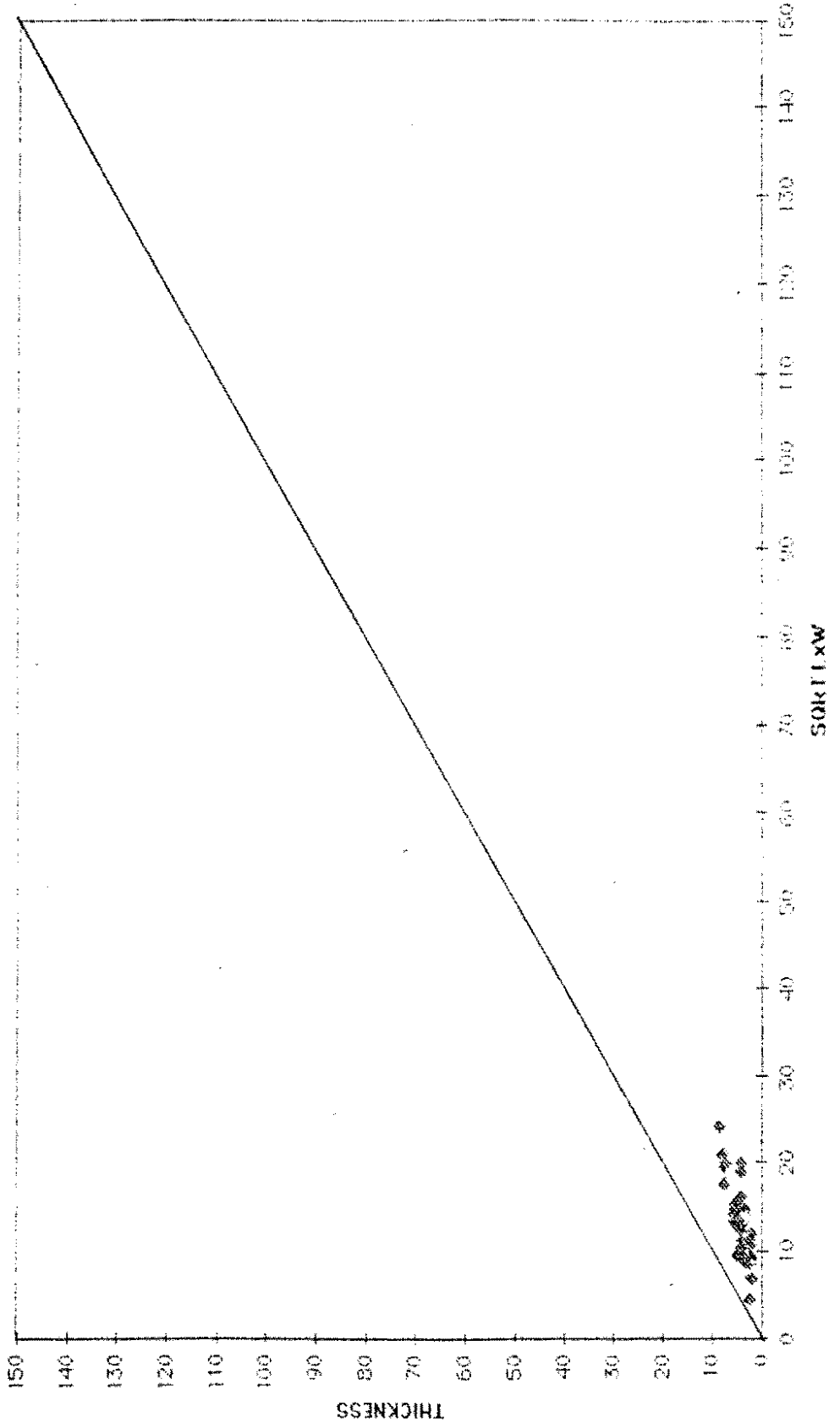
III-2-e Urangeline Creek Quartzite Cores



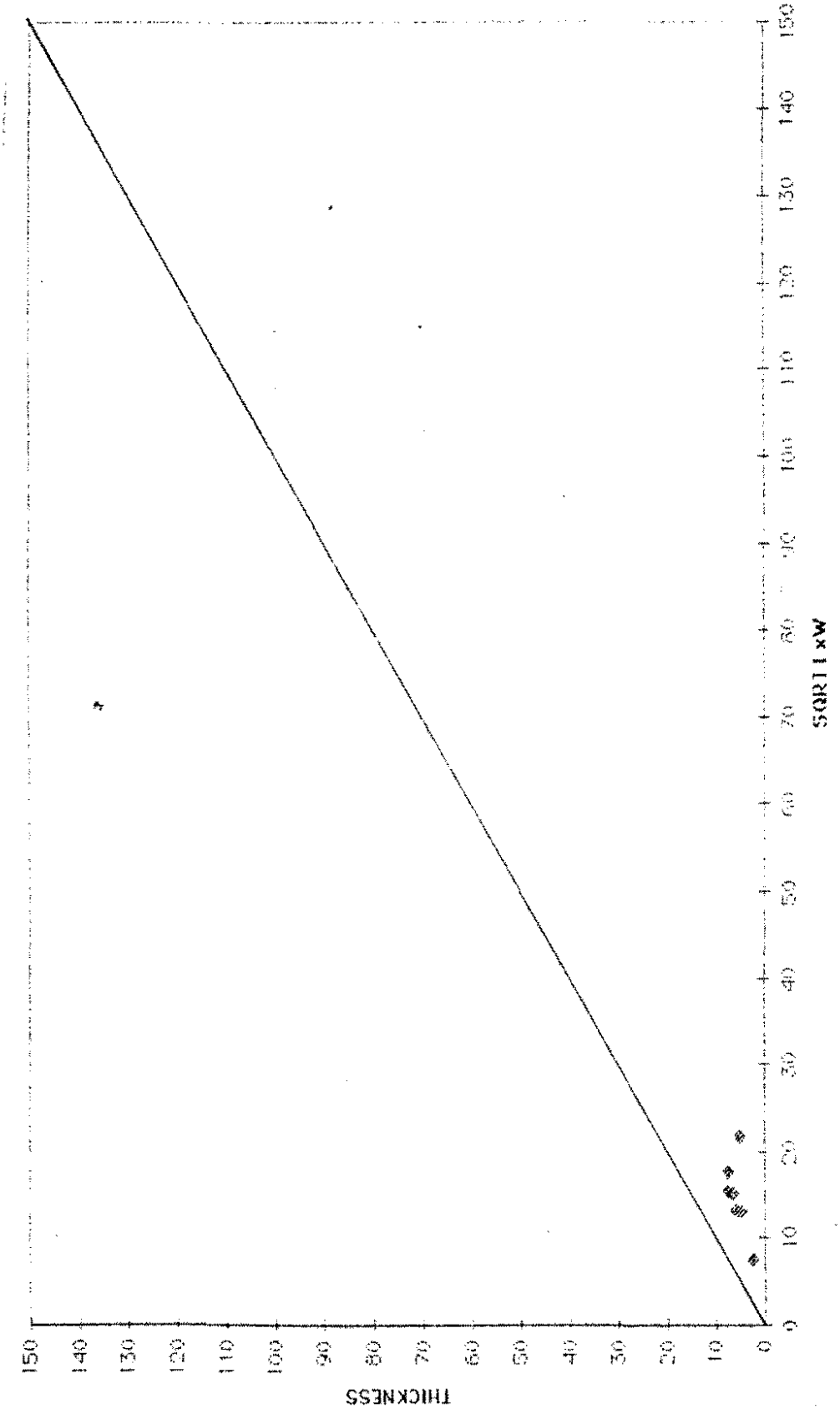
III-2-f Urangeline Creek Flakes and Blades



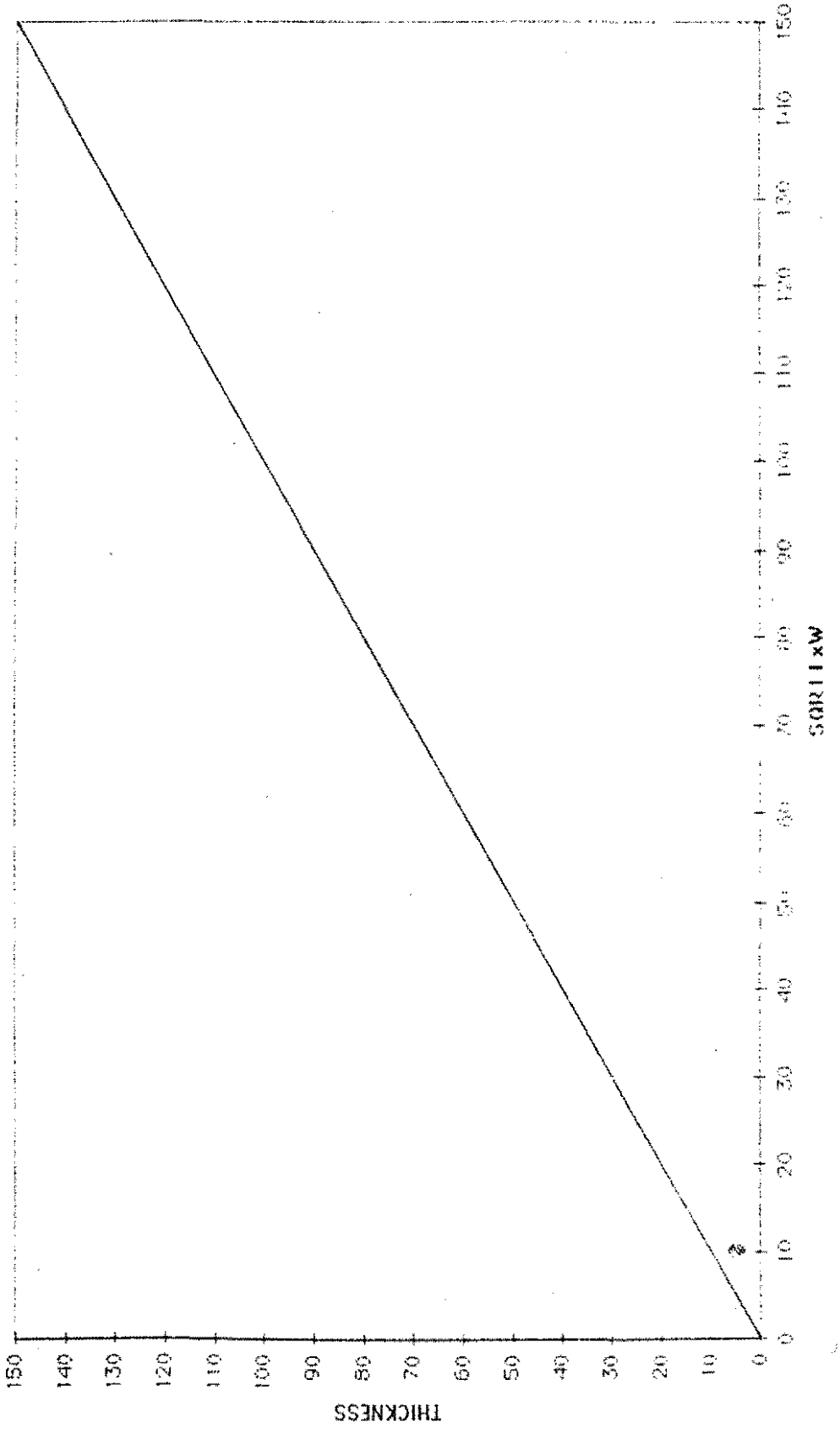
III-2-g Urangeline Creek Flakes and Blades quartz



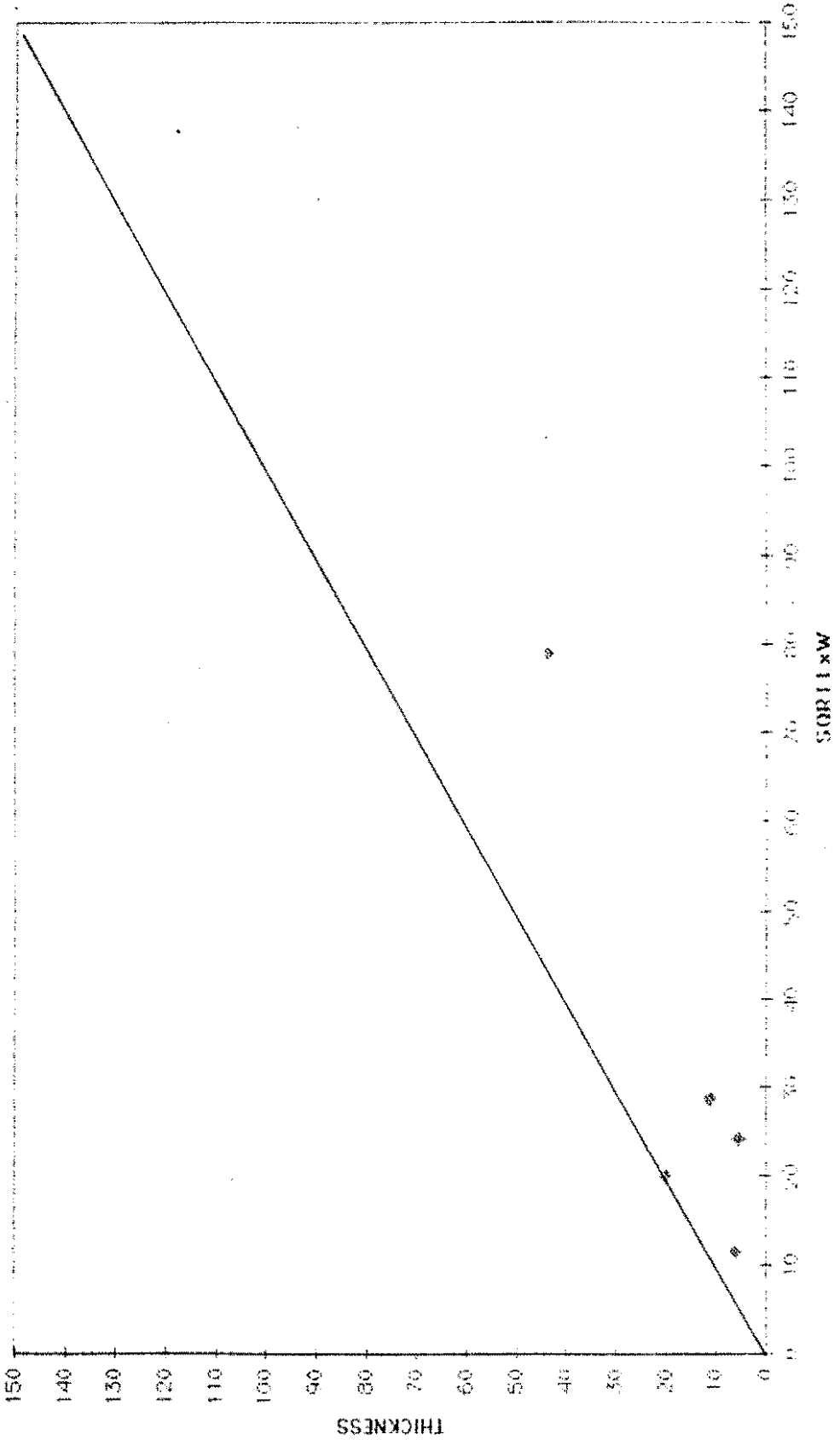
III-2-h Urangeline Creek Flakes and Blades silcrete



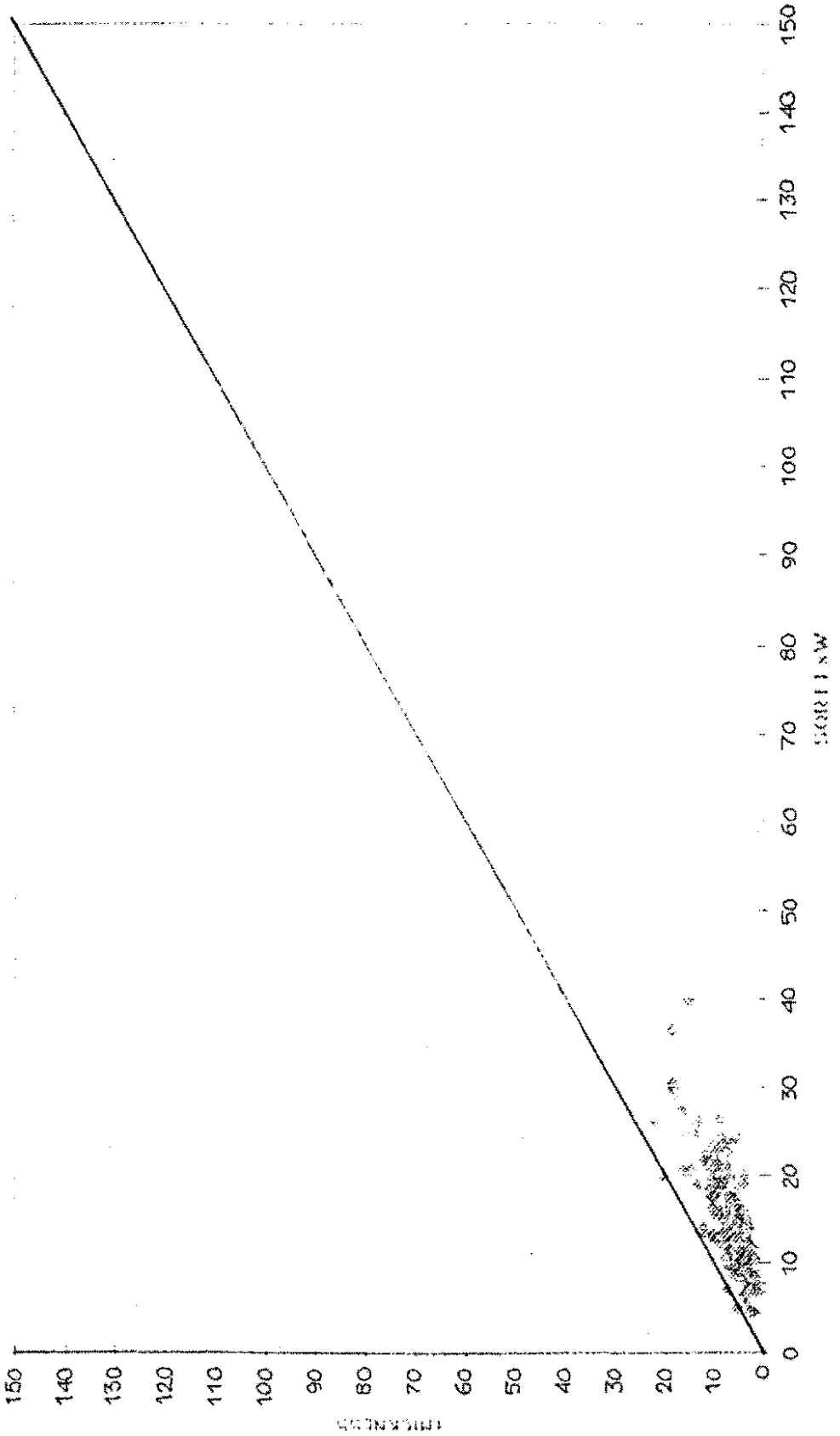
III-2-i Urangeline Creek Microliths



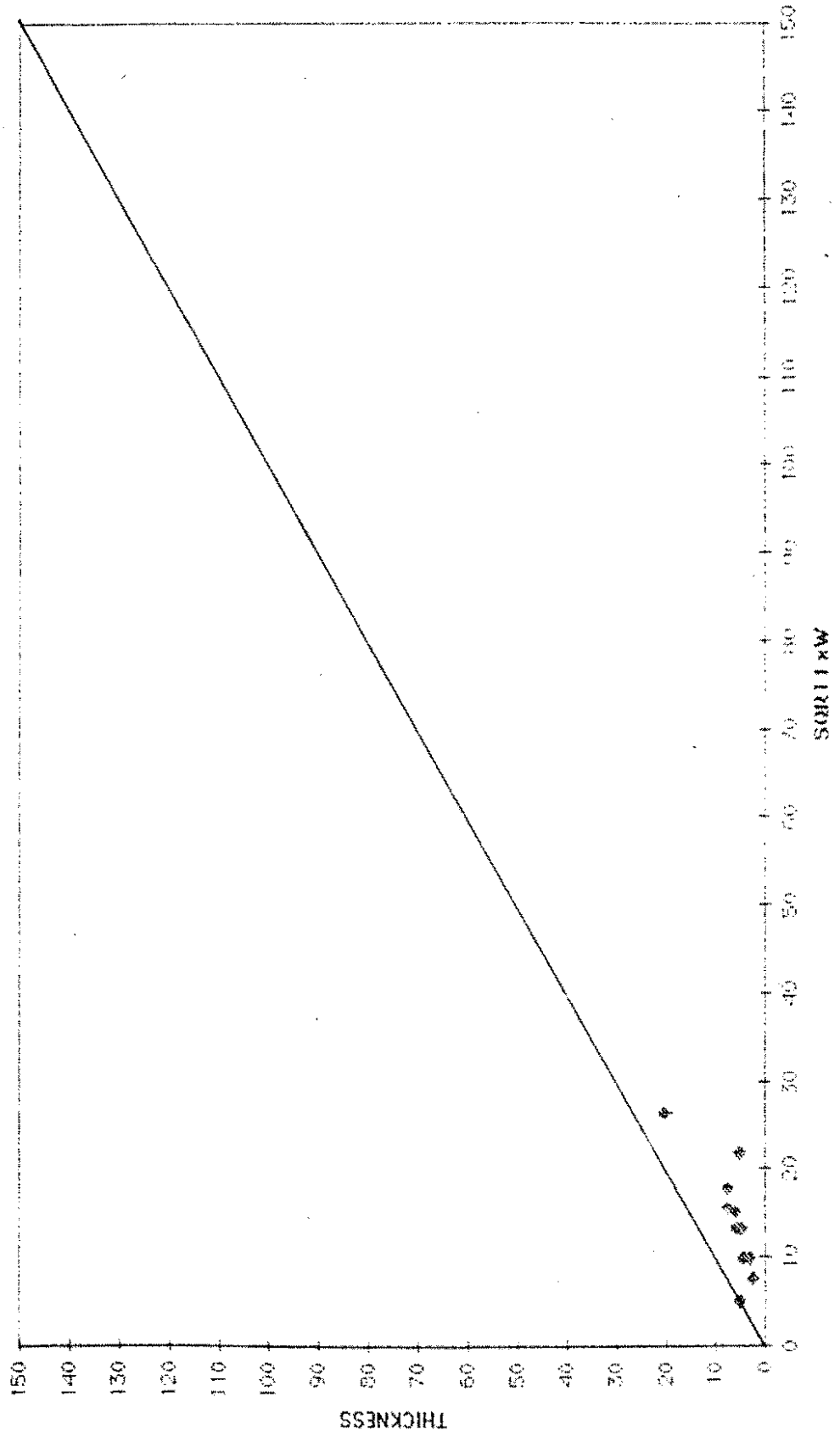
III-2-j Urangeline Creek Manuports



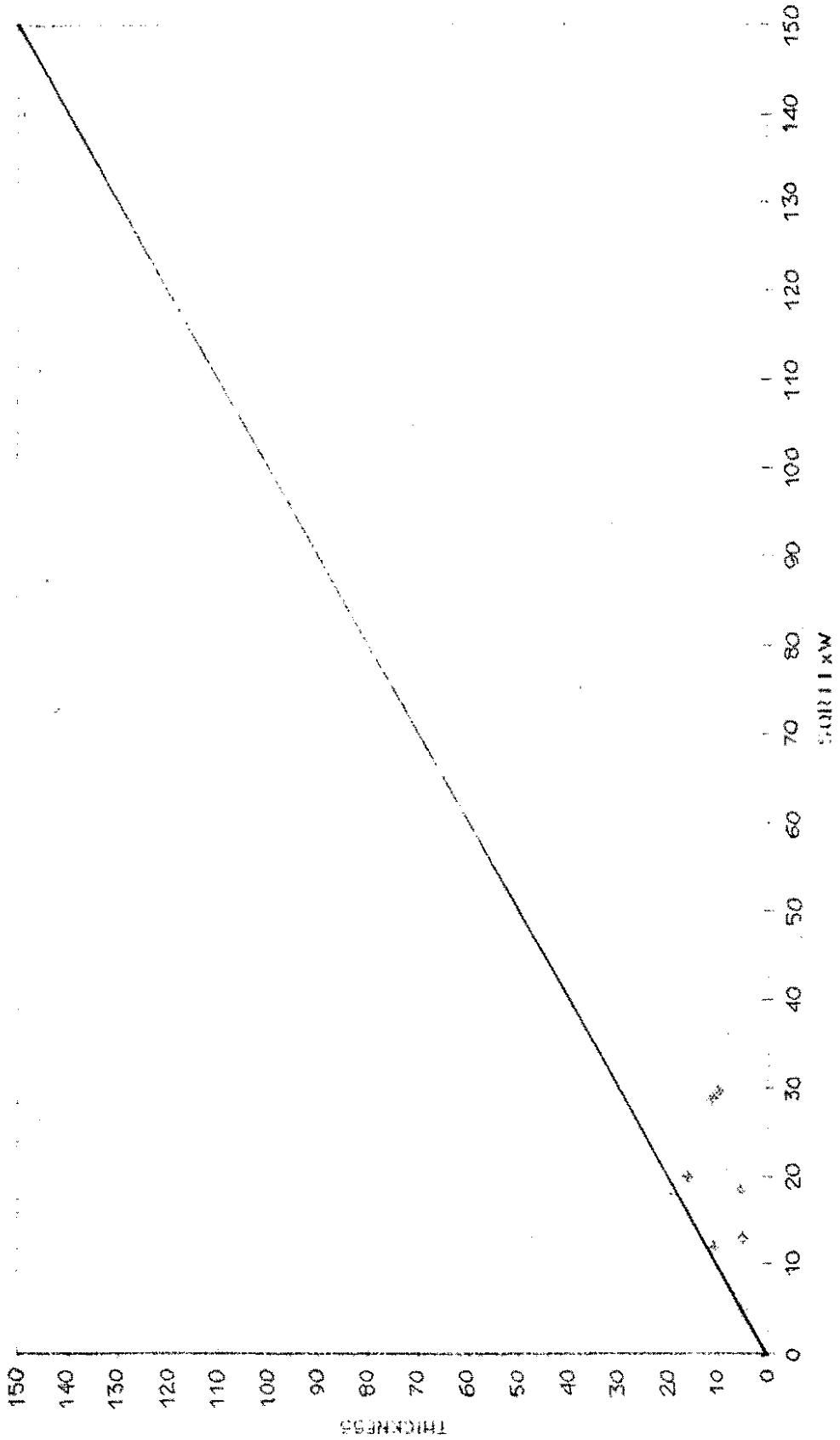
III-2-k Urangeline Creek Quartz



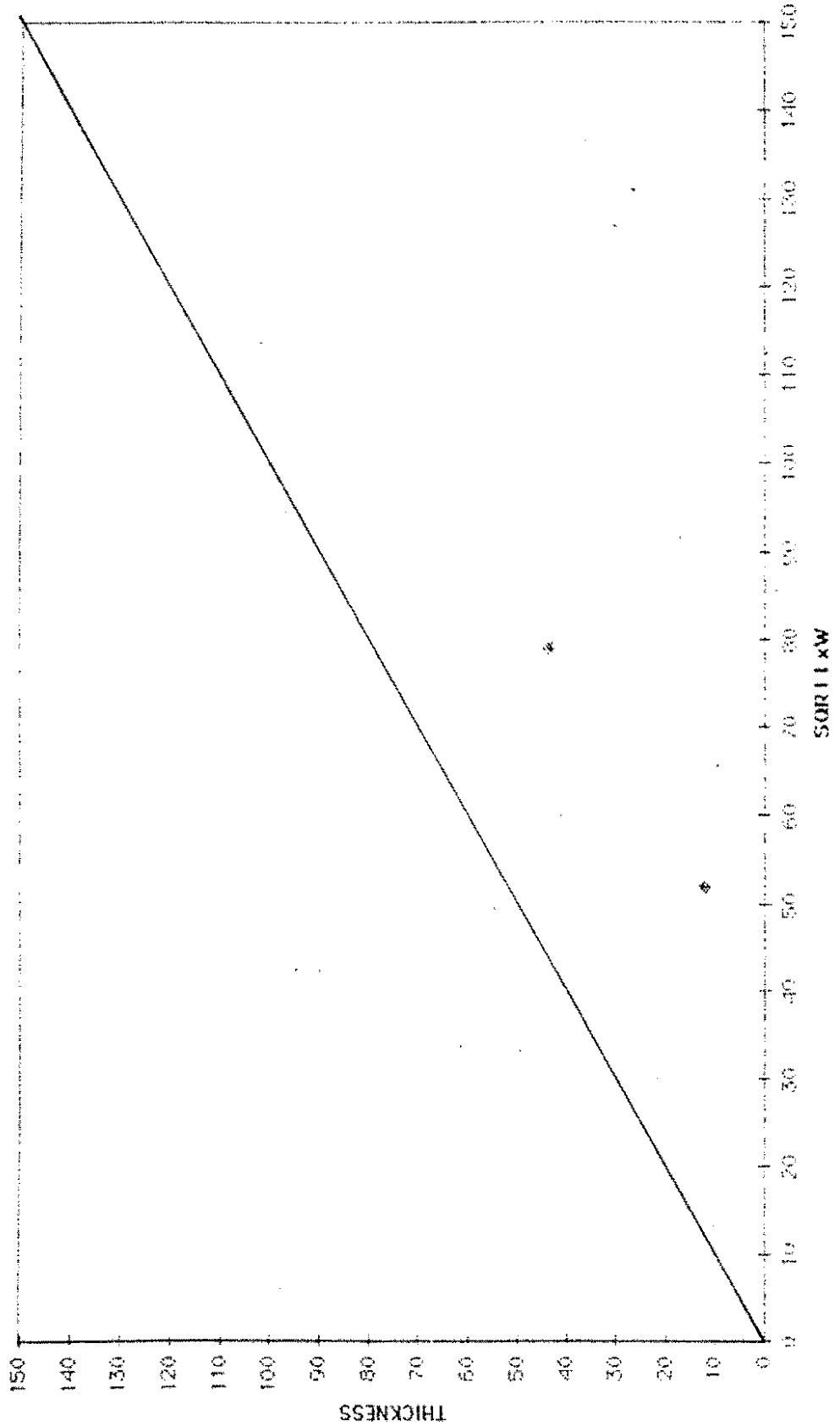
III-2-1 Urangeline Creek Silcrete



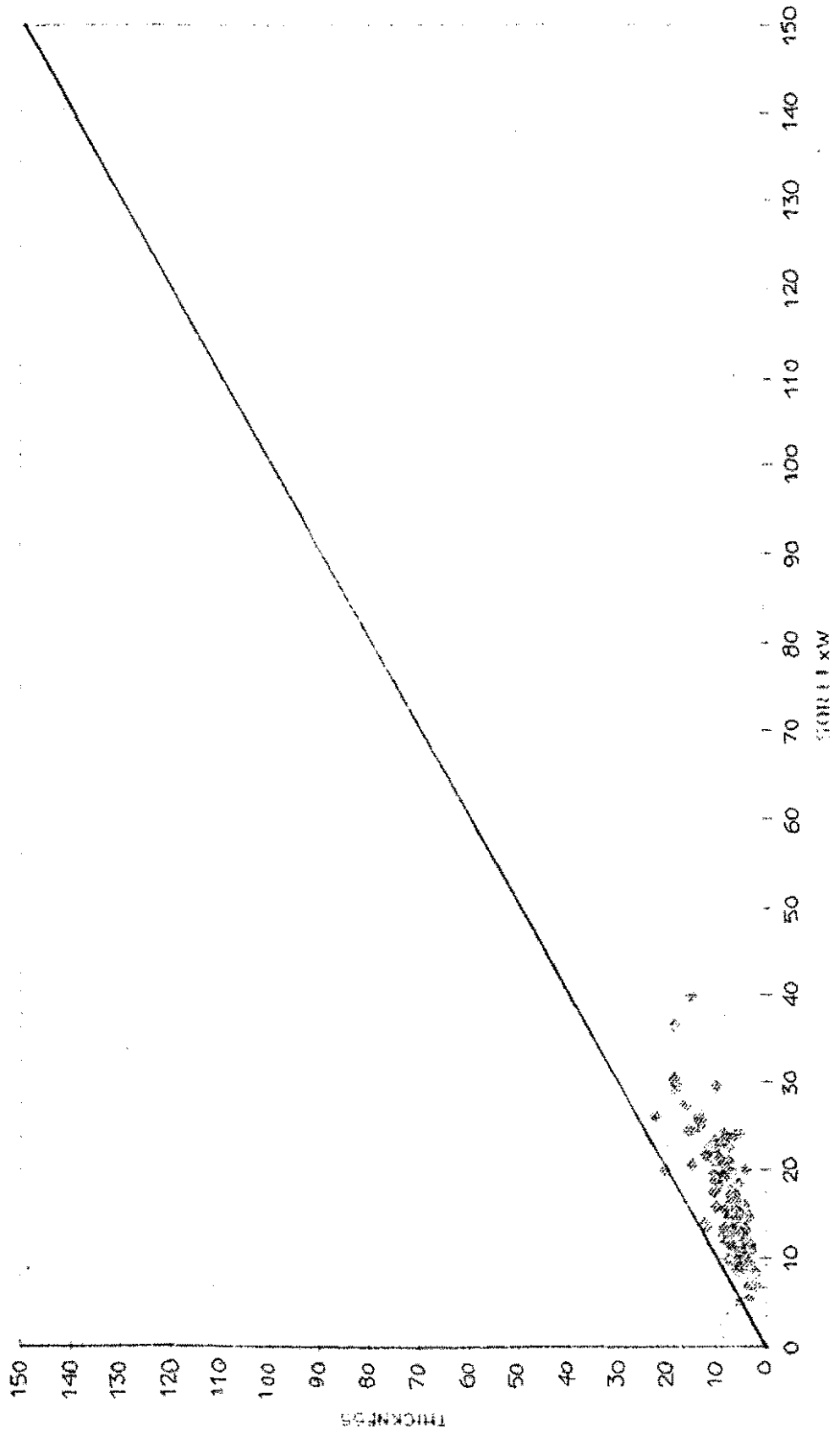
III-2-m Urangeline Creek Quartzite



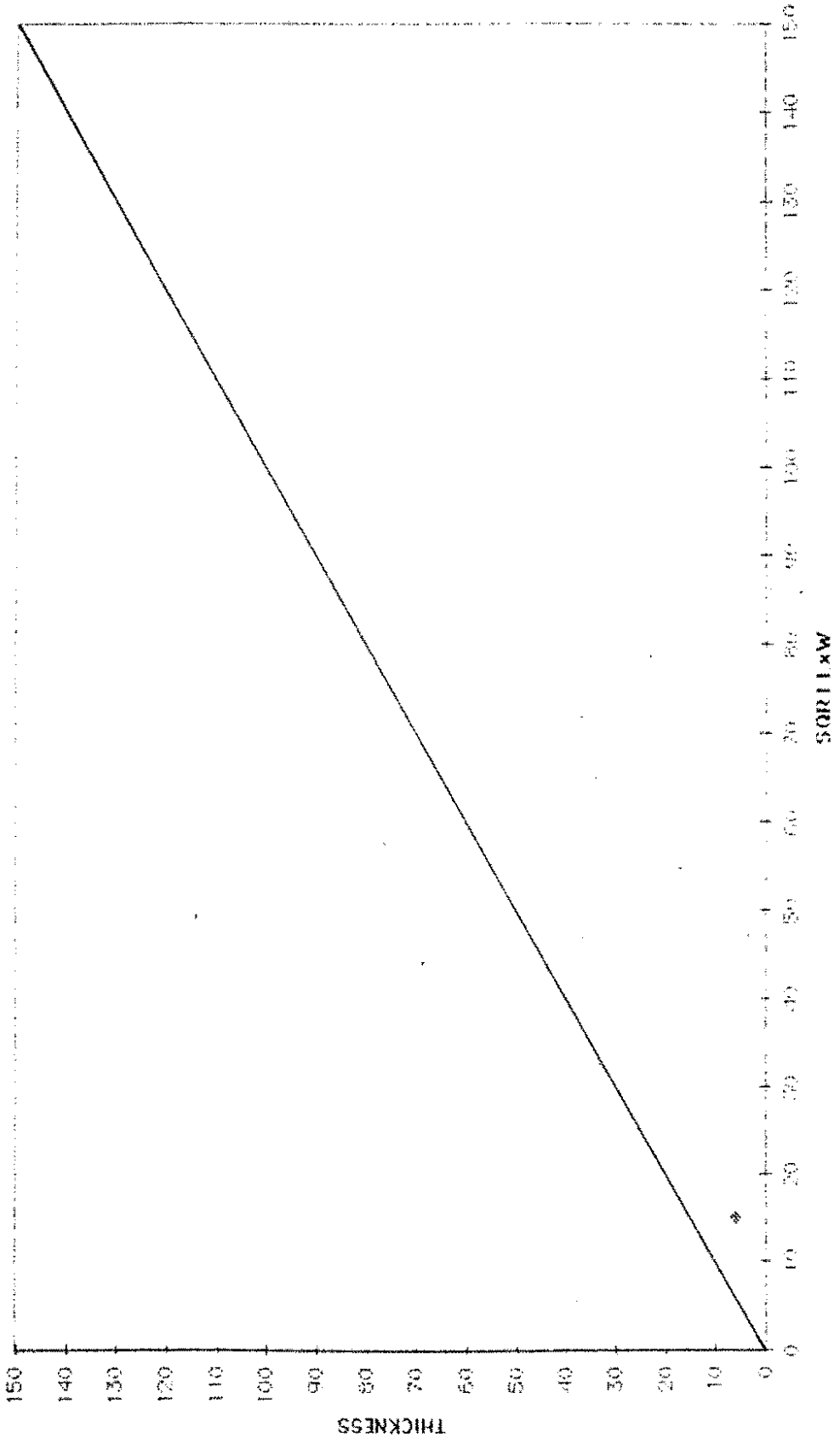
III-2-n Urangeline Creek Sandstone



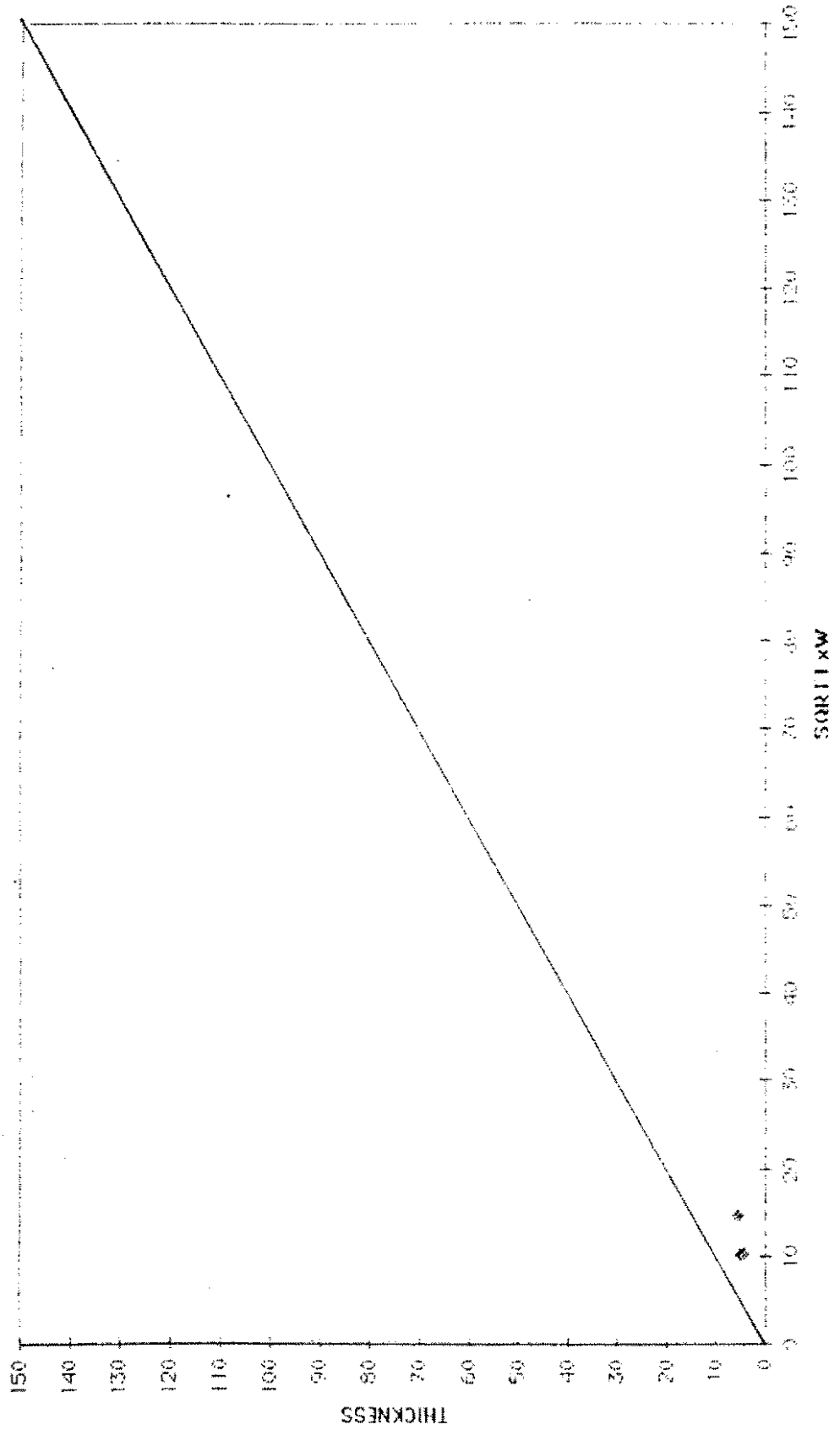
III-2-o Urangeline Creek Cortex



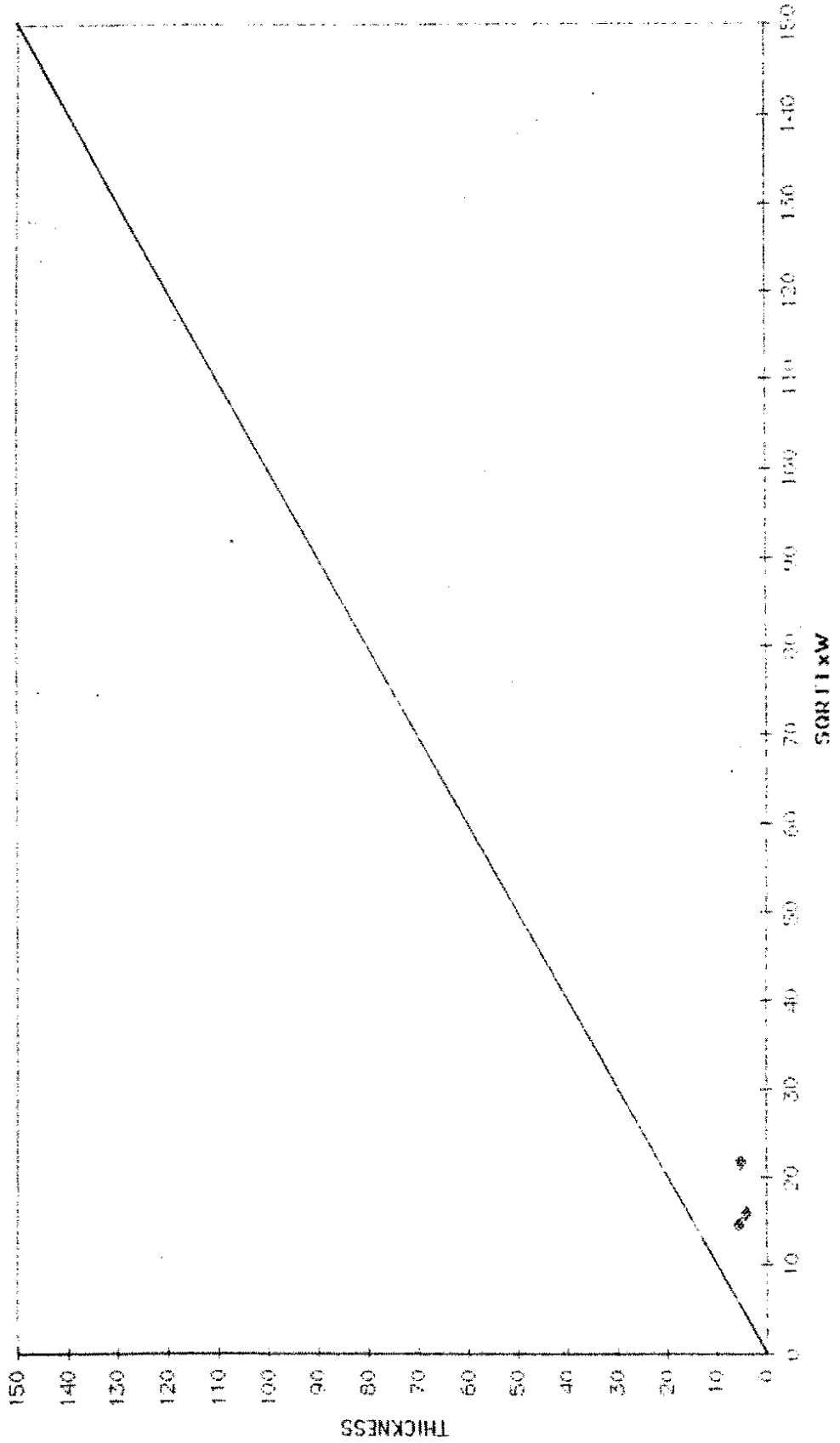
III-2-p Urangeline Creek Quarry Cortex



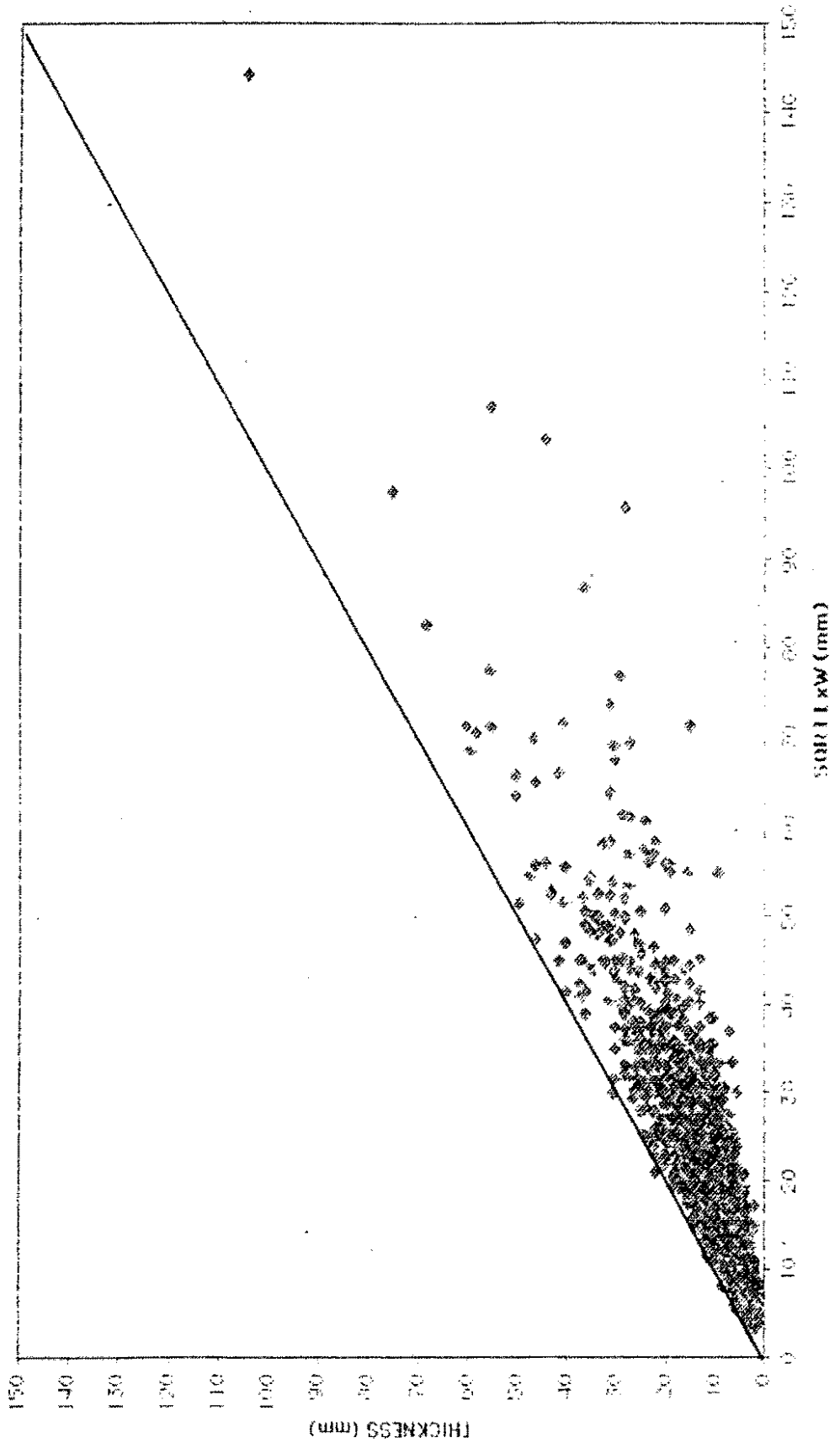
III-2-q Urangeline Creek Retouch



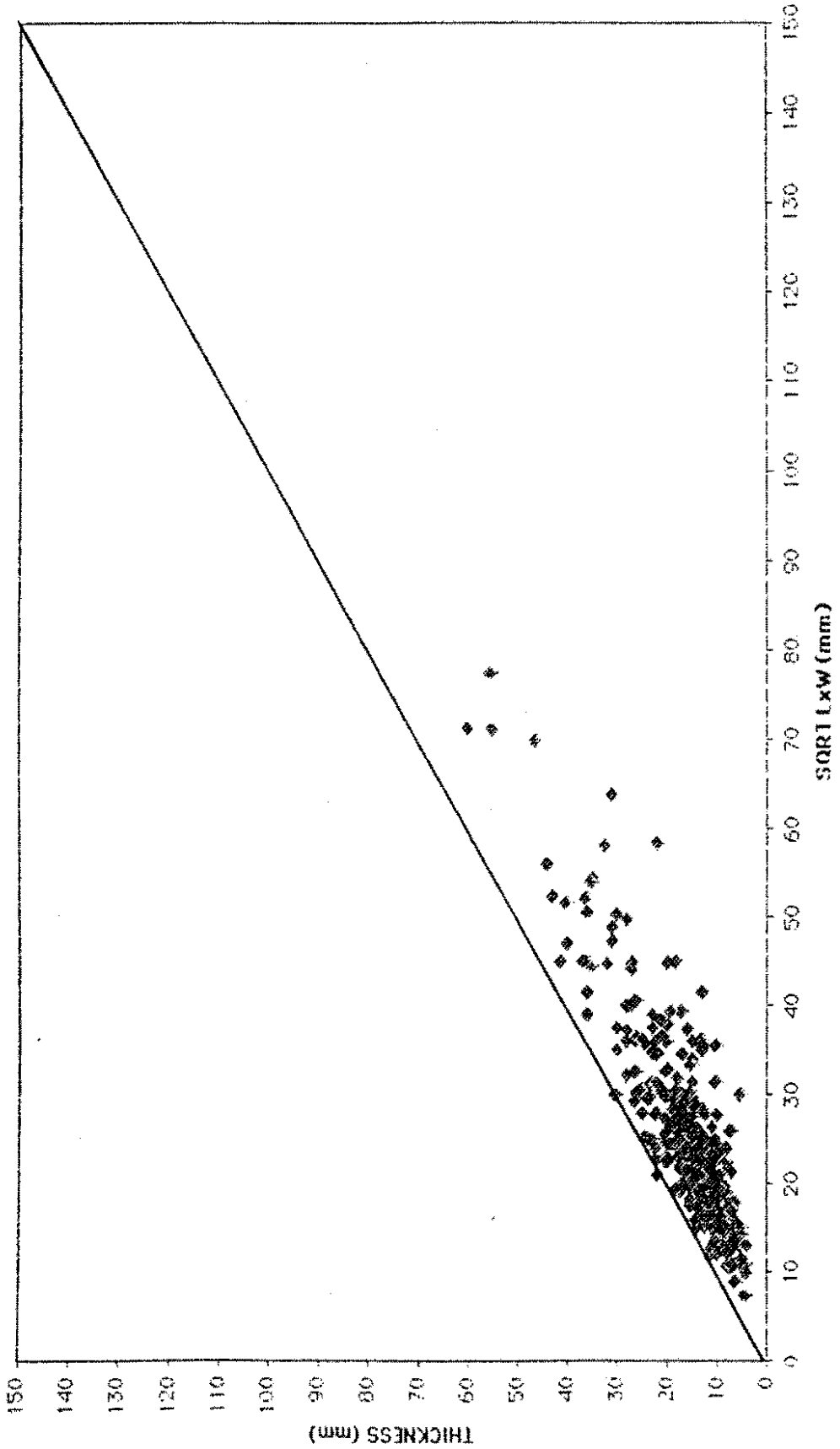
III-2-r Urangeline Creek Usewear



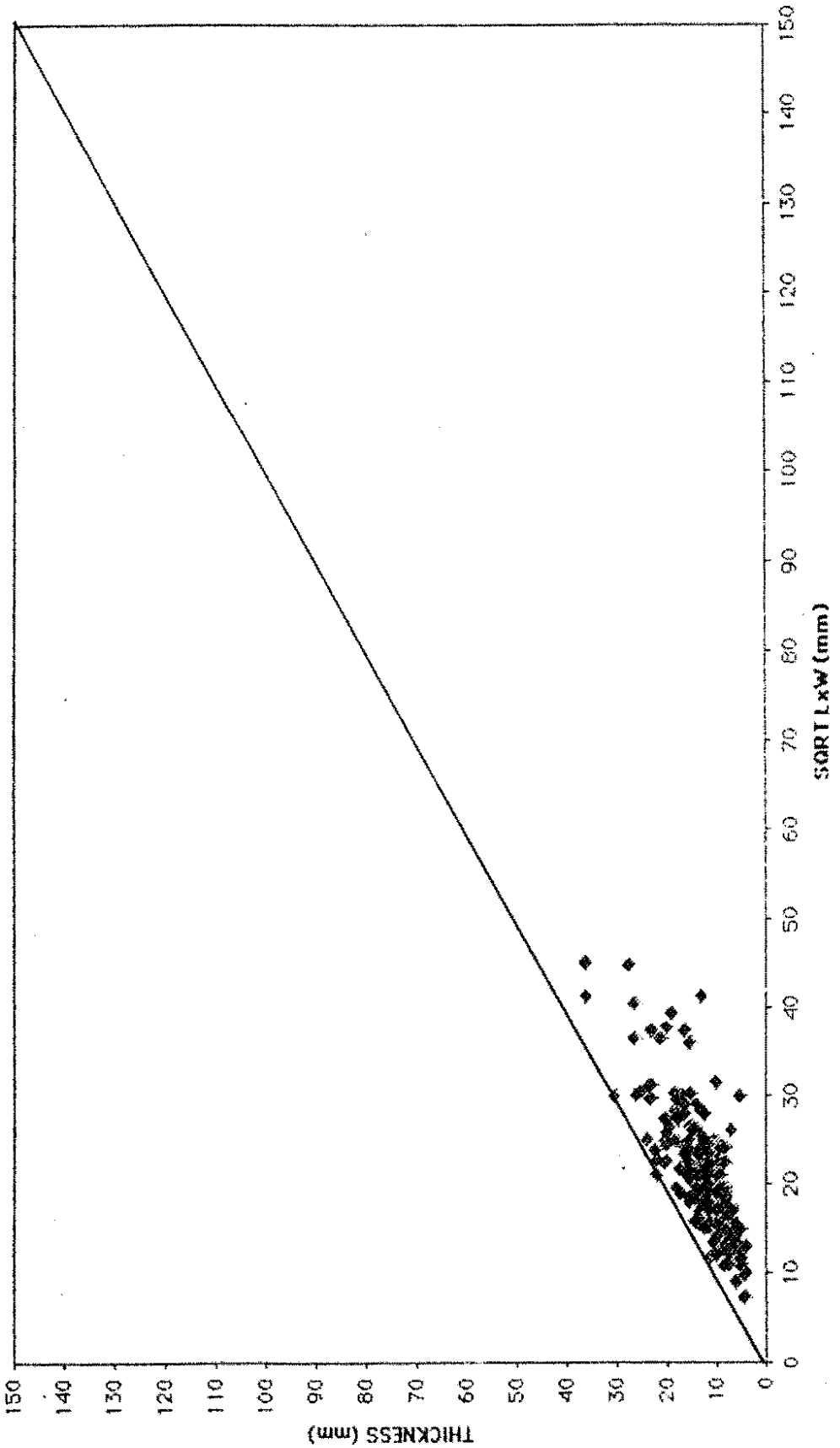
III-3-a Colombo Creek All Artefacts



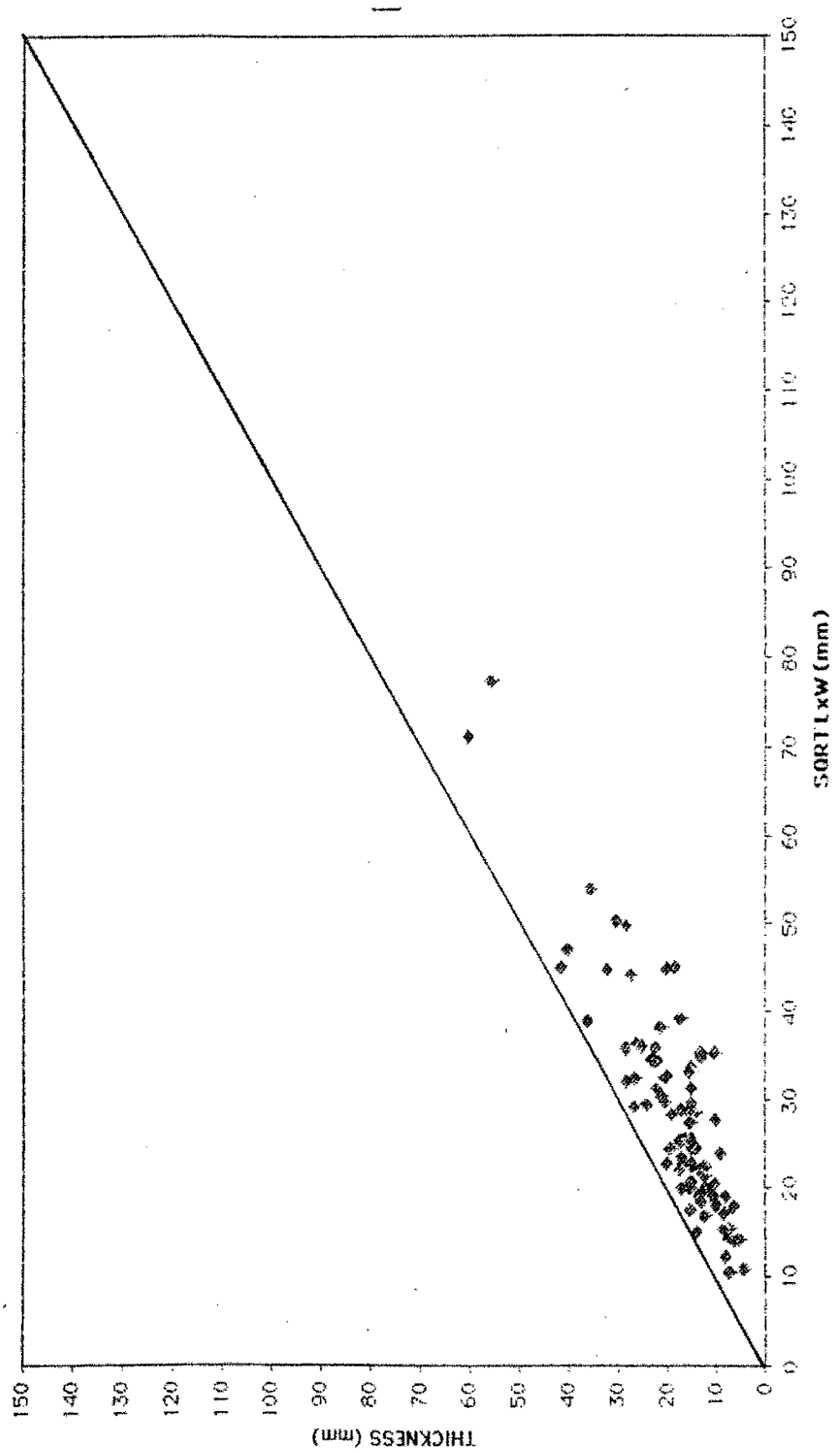
III-3-b Colombo Creek All Cores



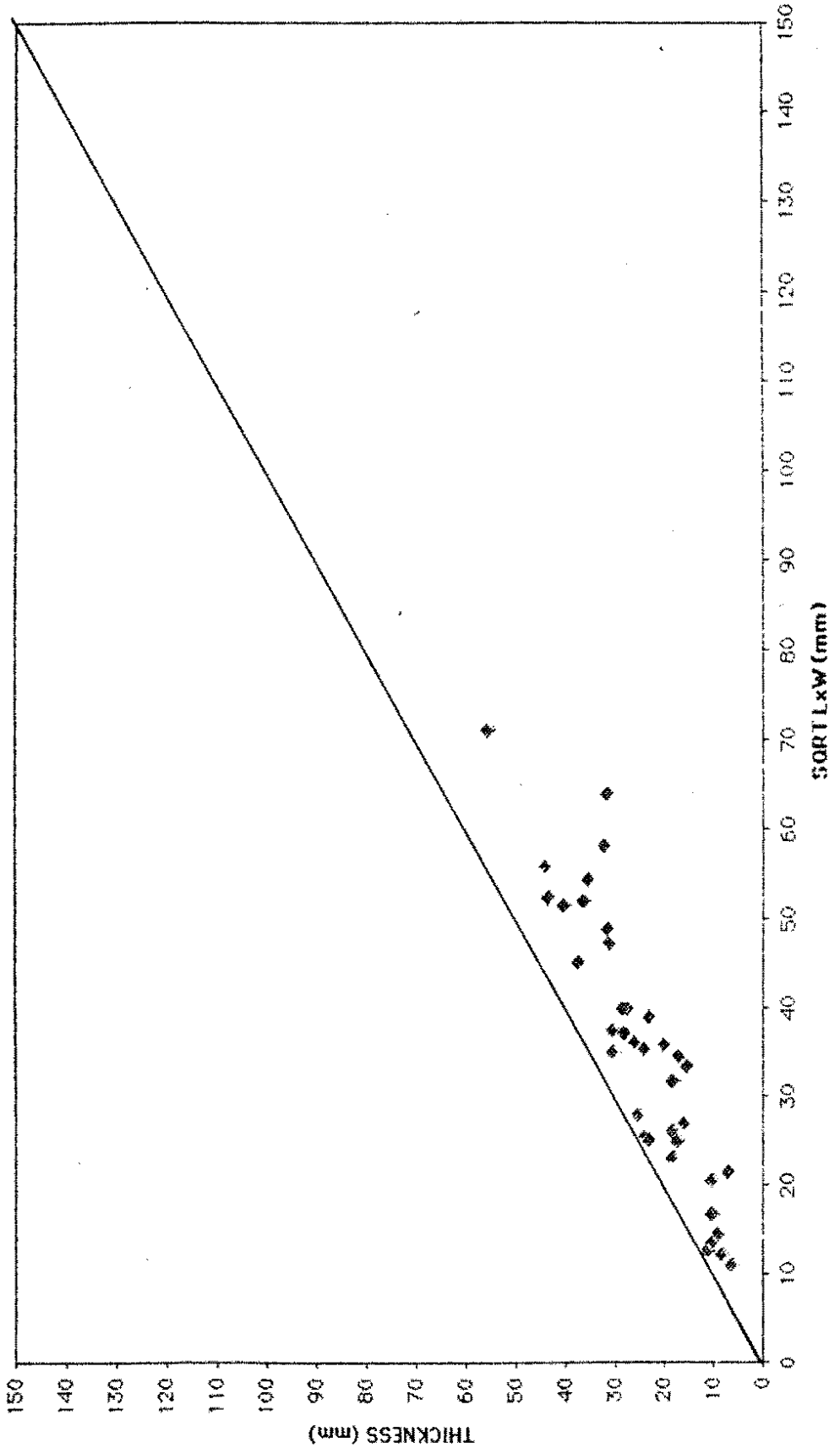
III-3-c Colombo Creek Quartz Cores



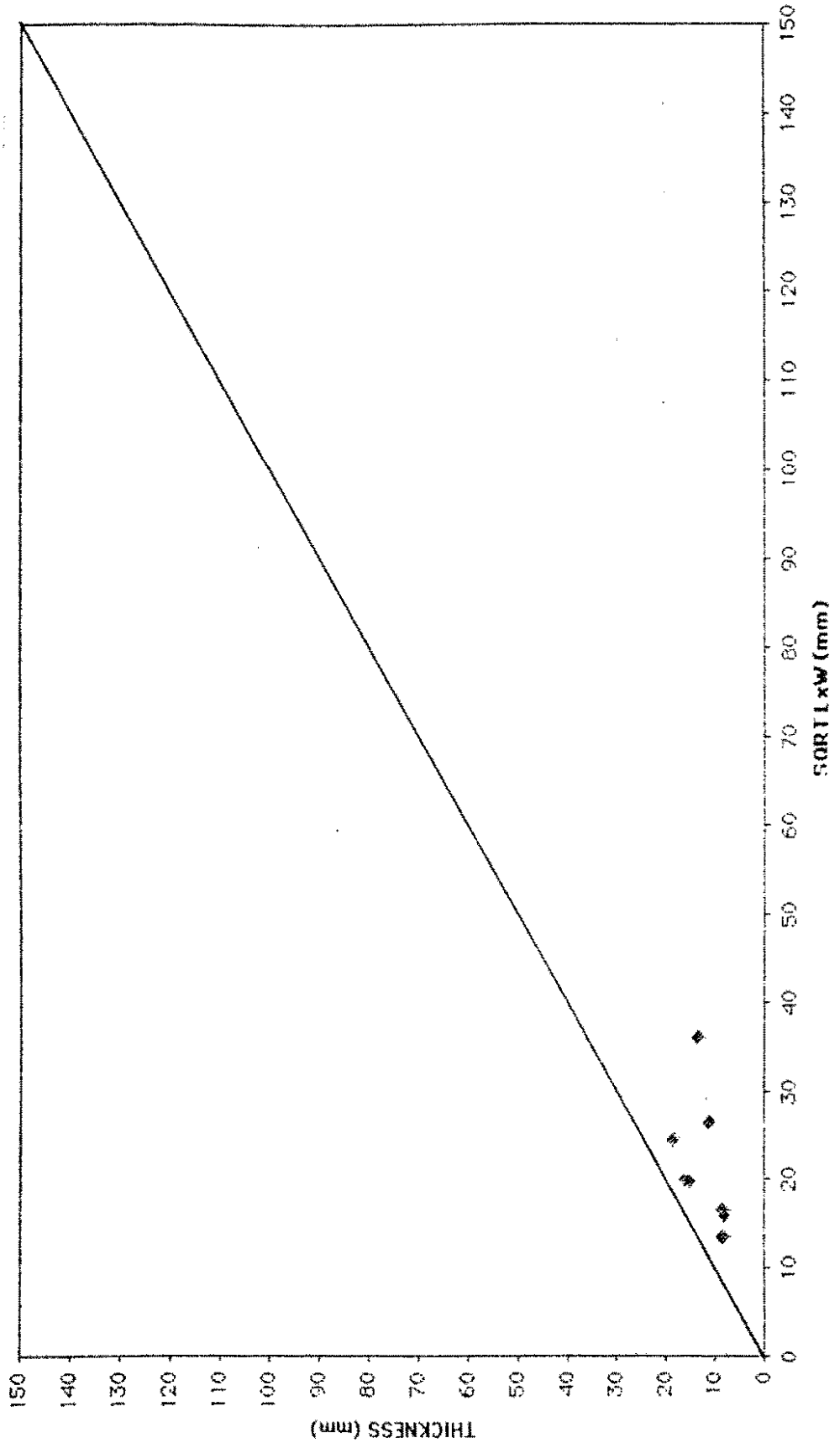
III-3-d Colombo Creek Silcrete Cores



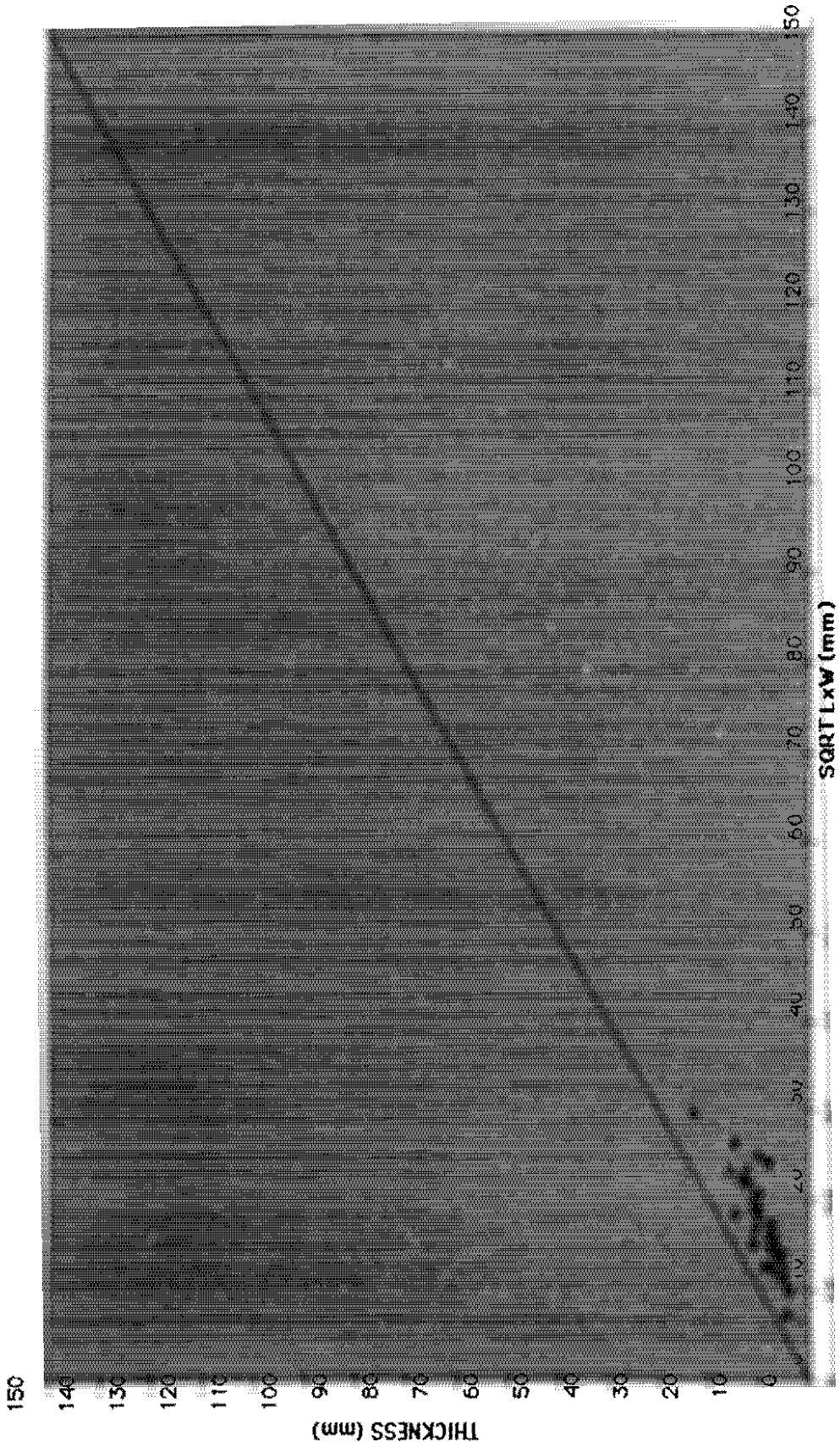
III-3-e Colombo Creek Quartzite Cores



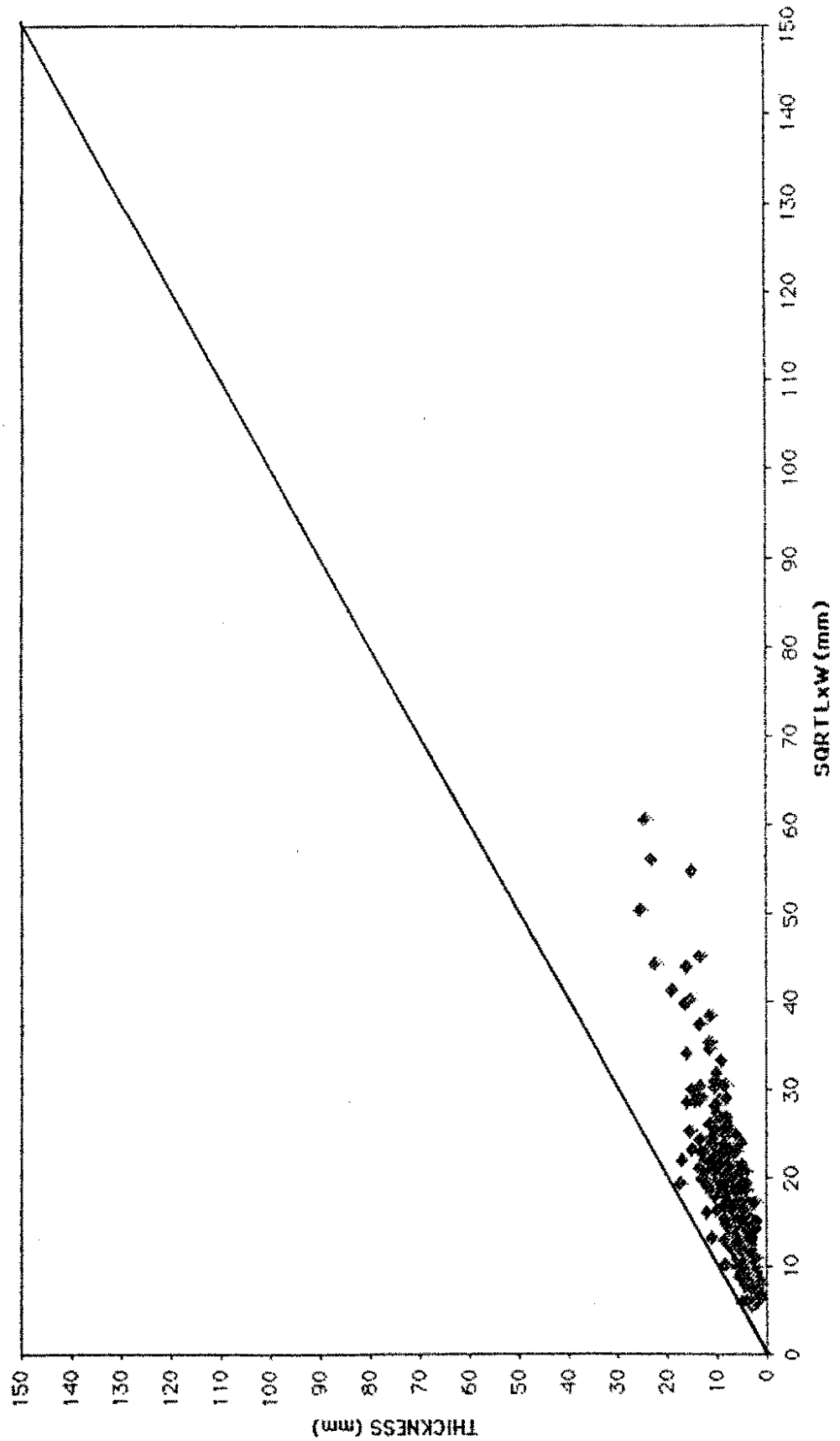
III-3-f Colombo Creek Chert Cores



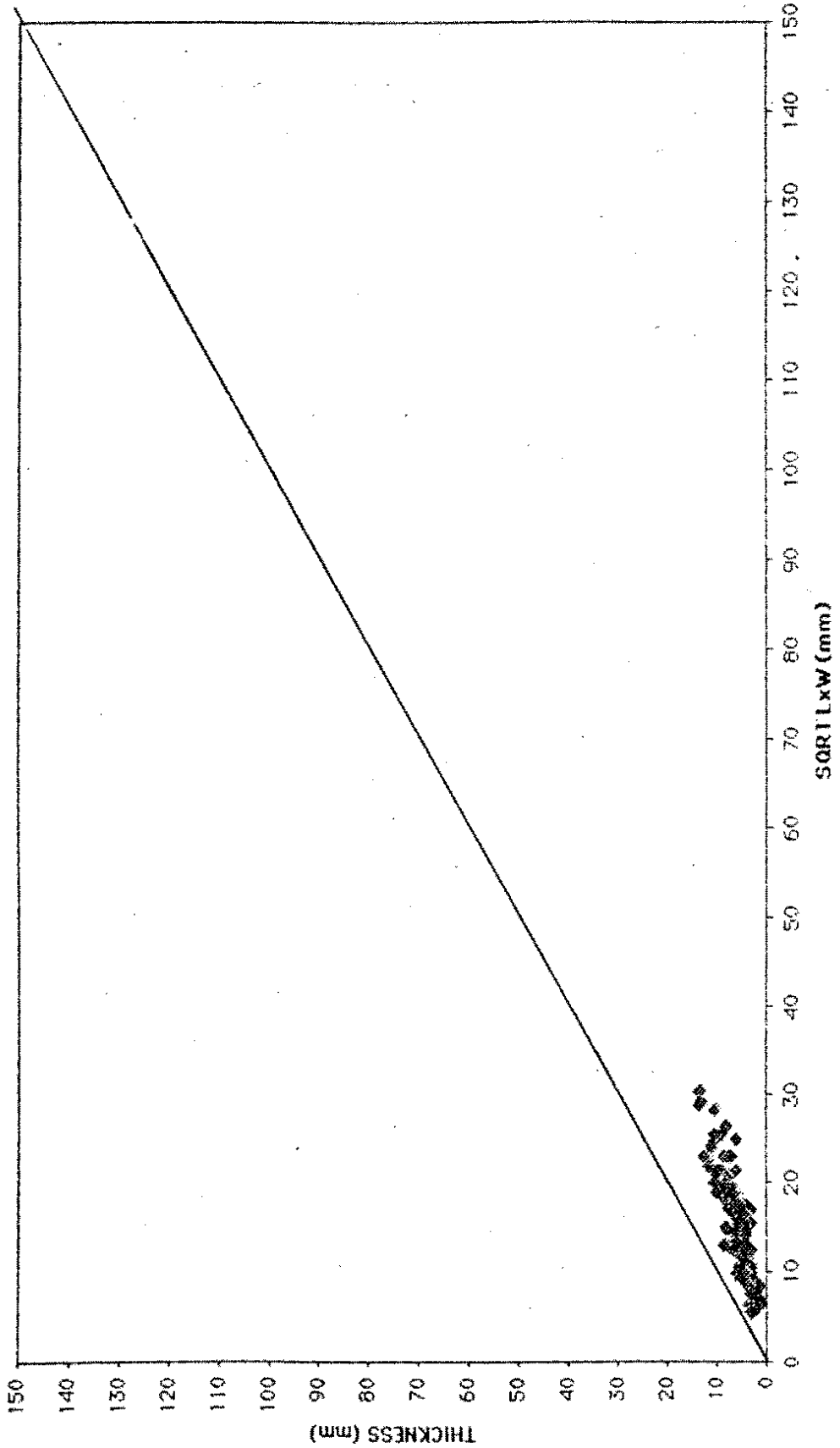
III-3-g Colombo Creek Bipolar Cores



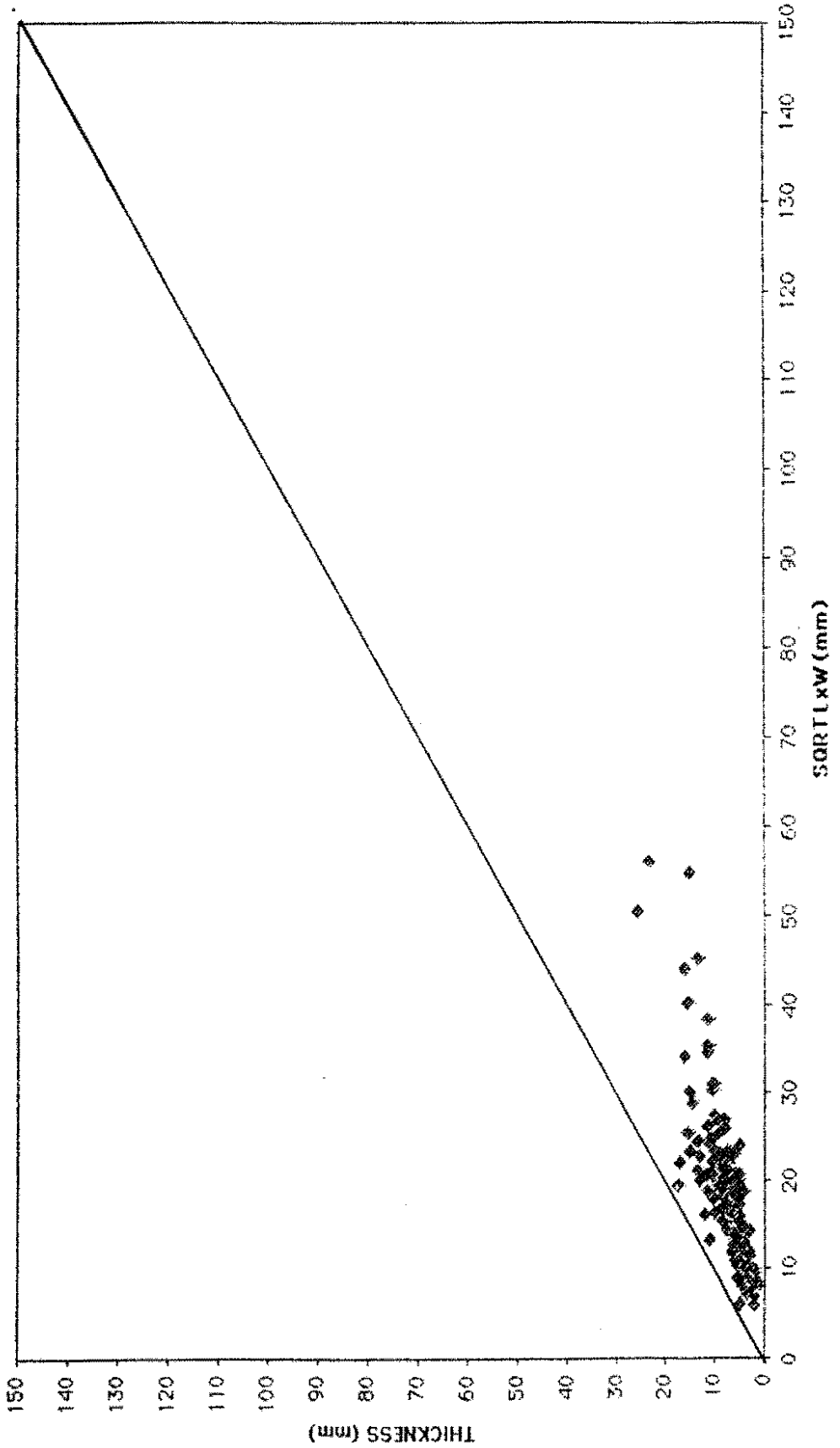
III-3-h Colombo Creek Flake and Blades



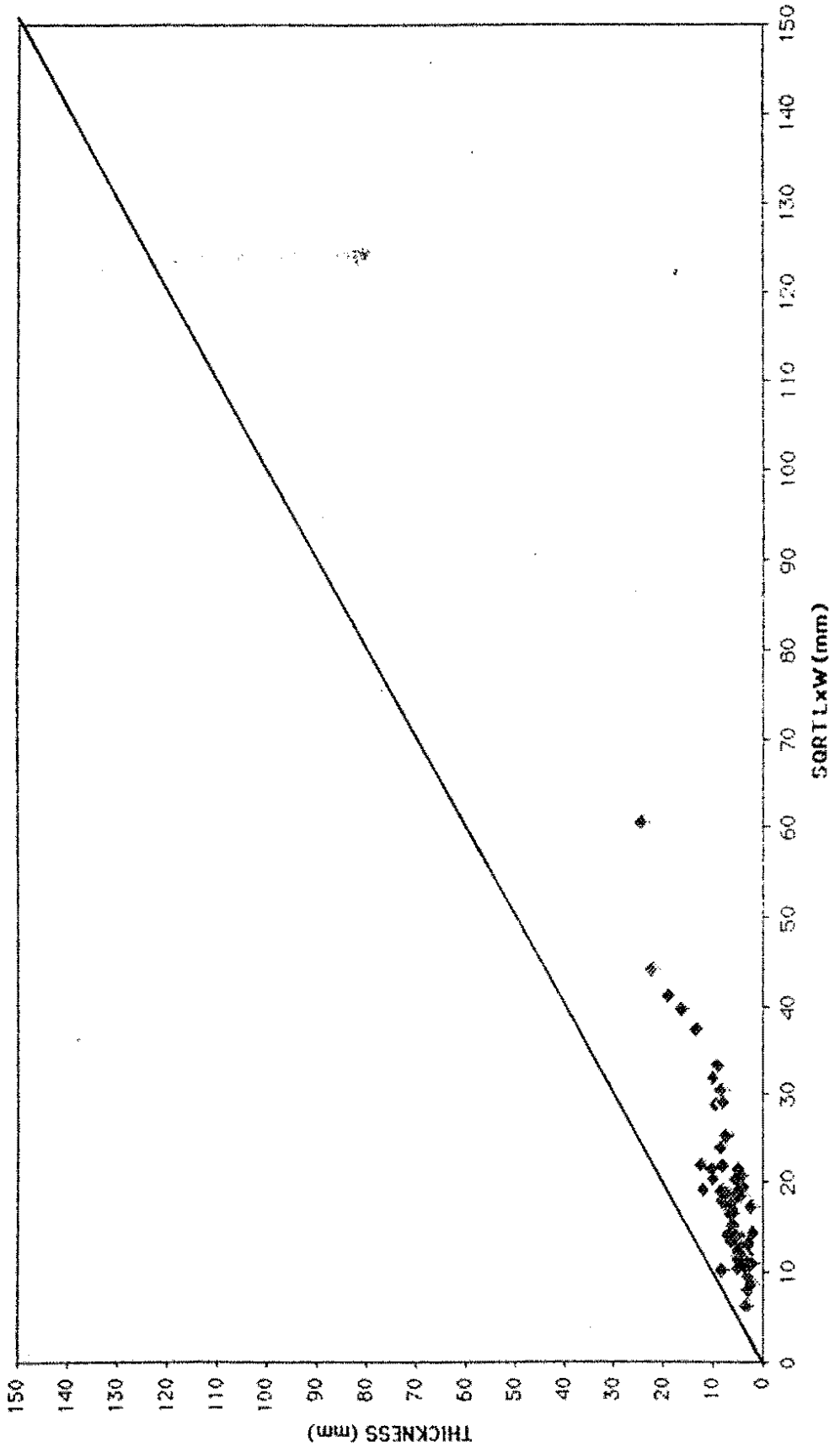
III-3-i Colombo Creek Flakesand Blades quartz



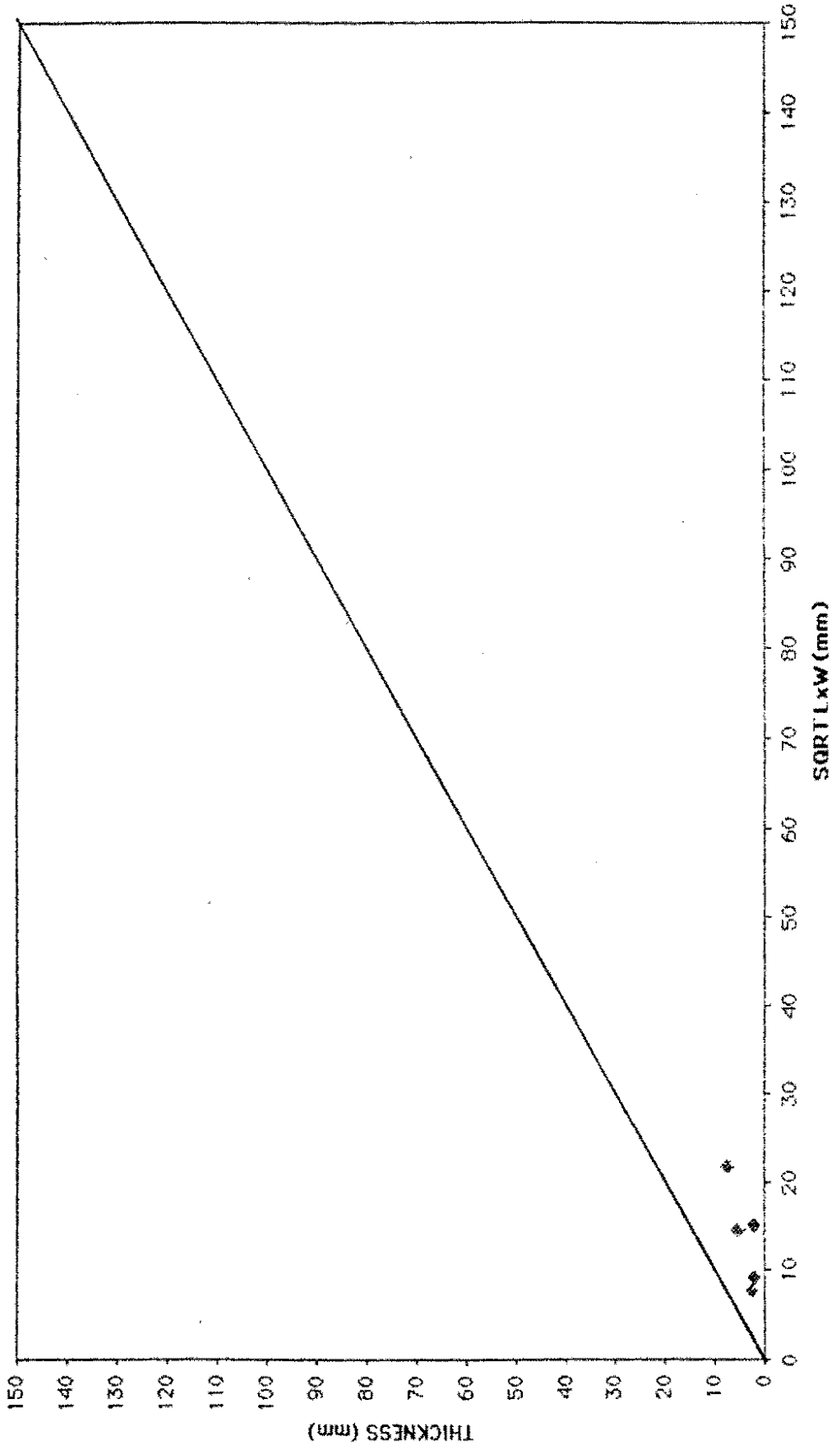
III-3-j Colombo Creek Flakes and Blades Silcrete



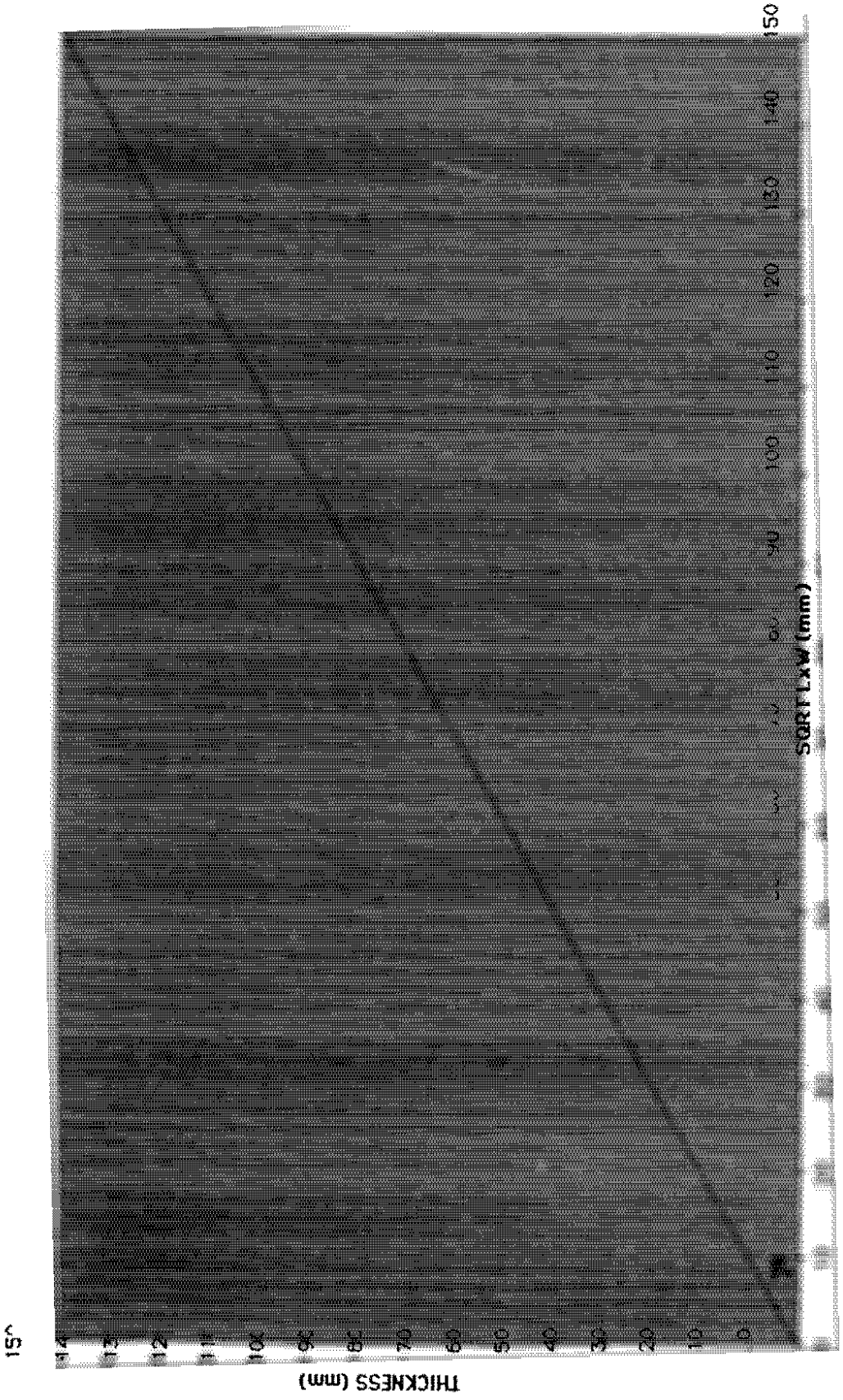
III-3-k Colombo Creek Flakes and Blades Quartzite



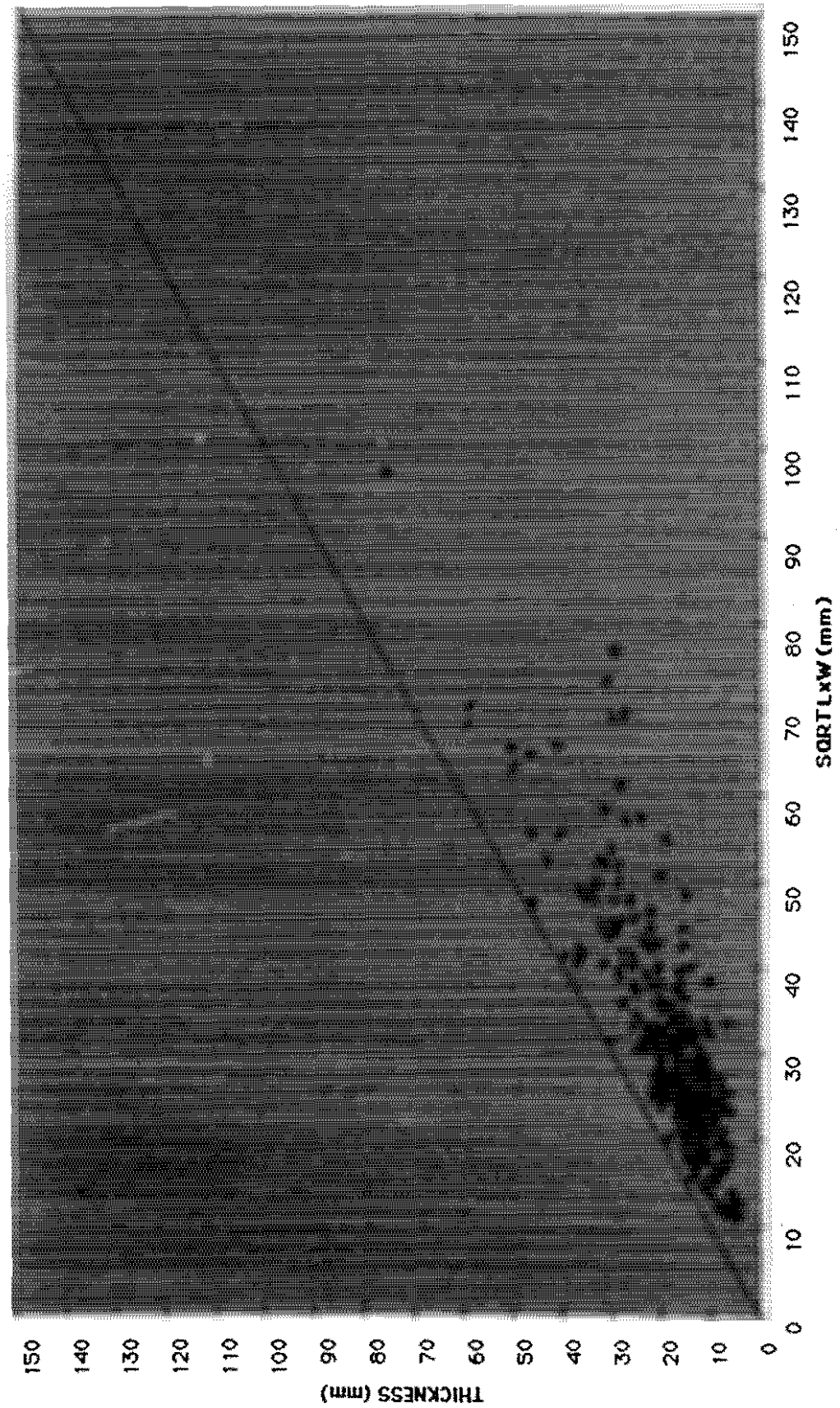
III-3-l Colombo Creek Flakes and Blades Chert



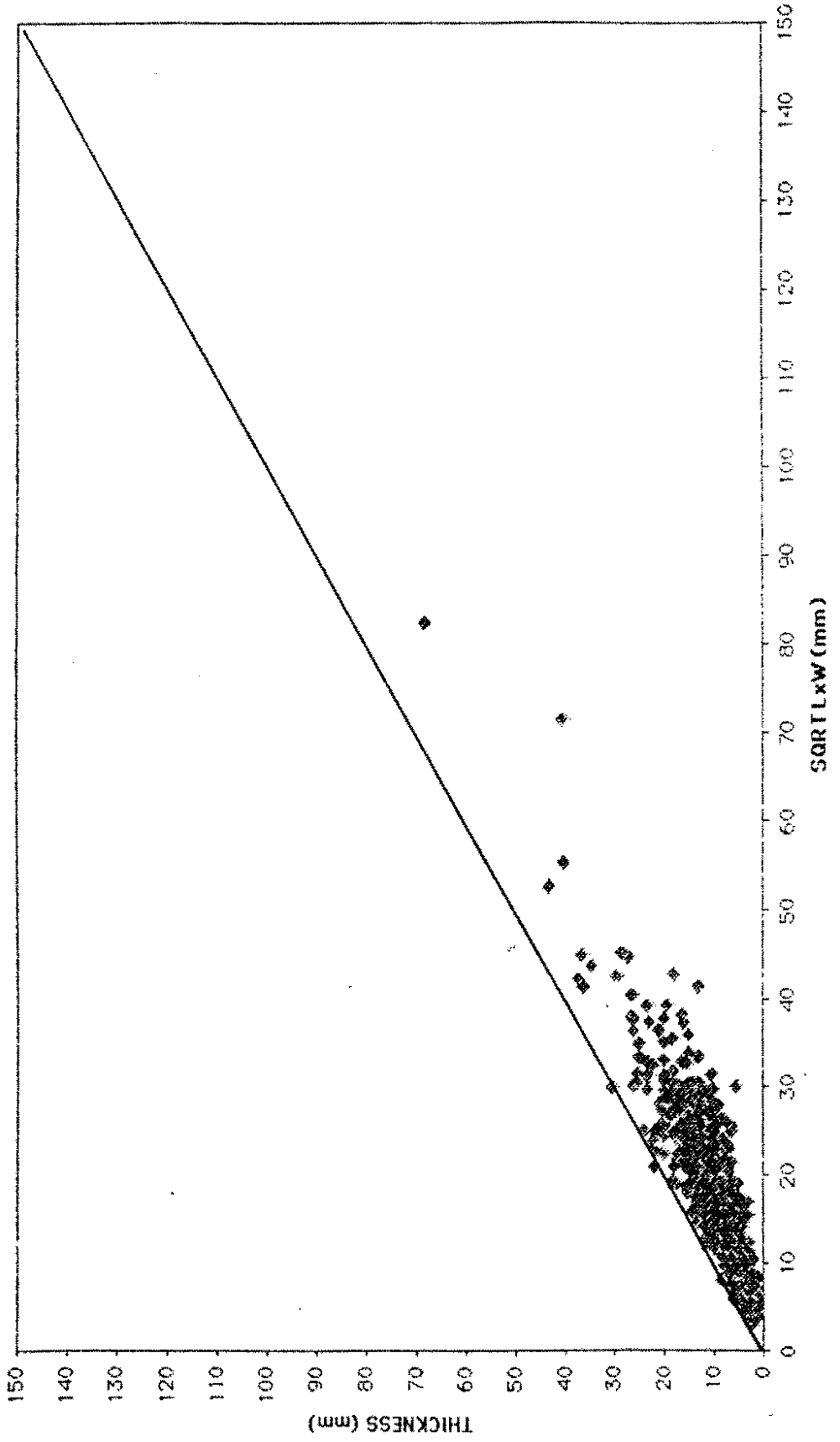
III-3-m Colombo Creek Microliths



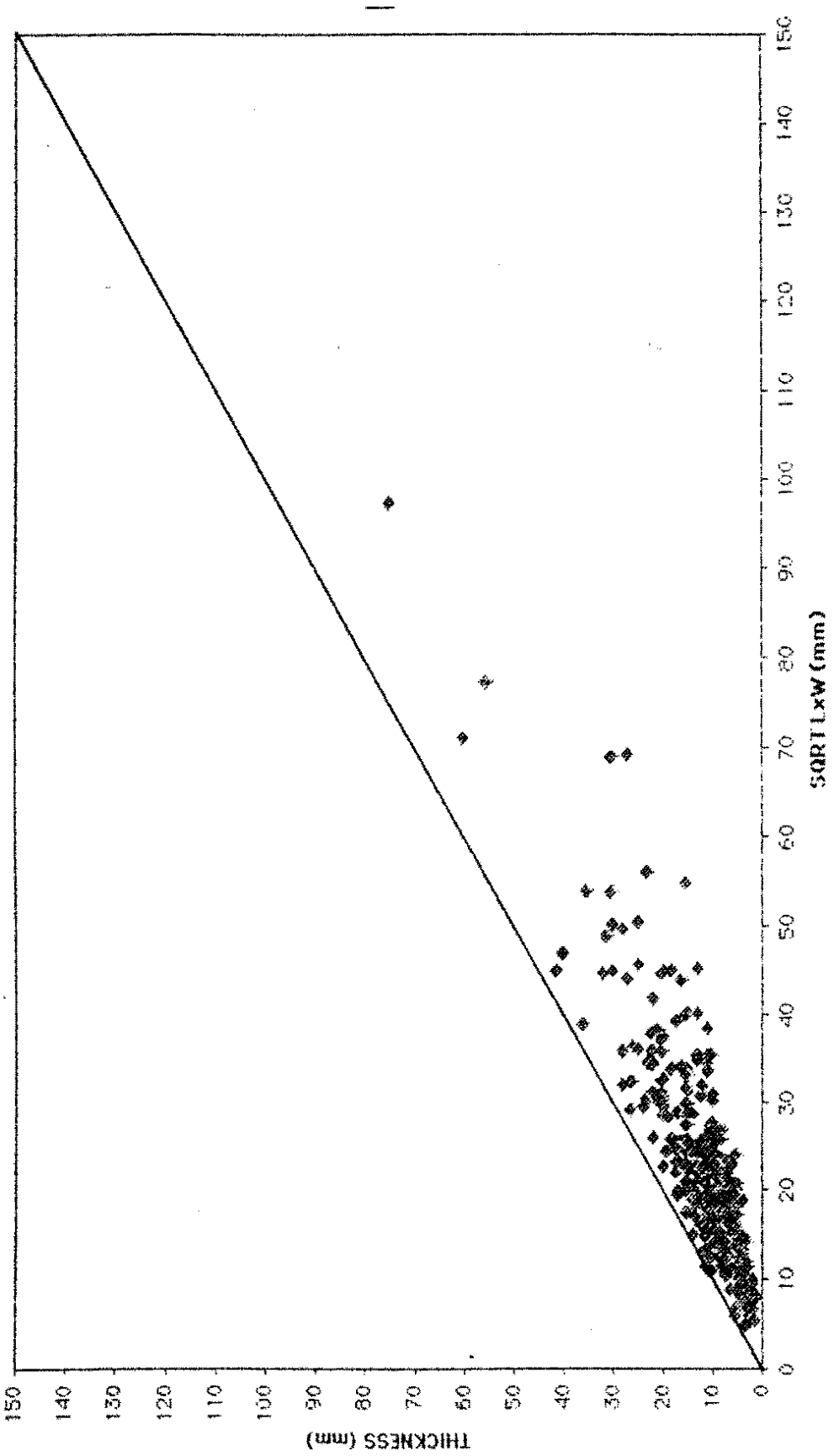
III-3-n Colombo Creek Manuports



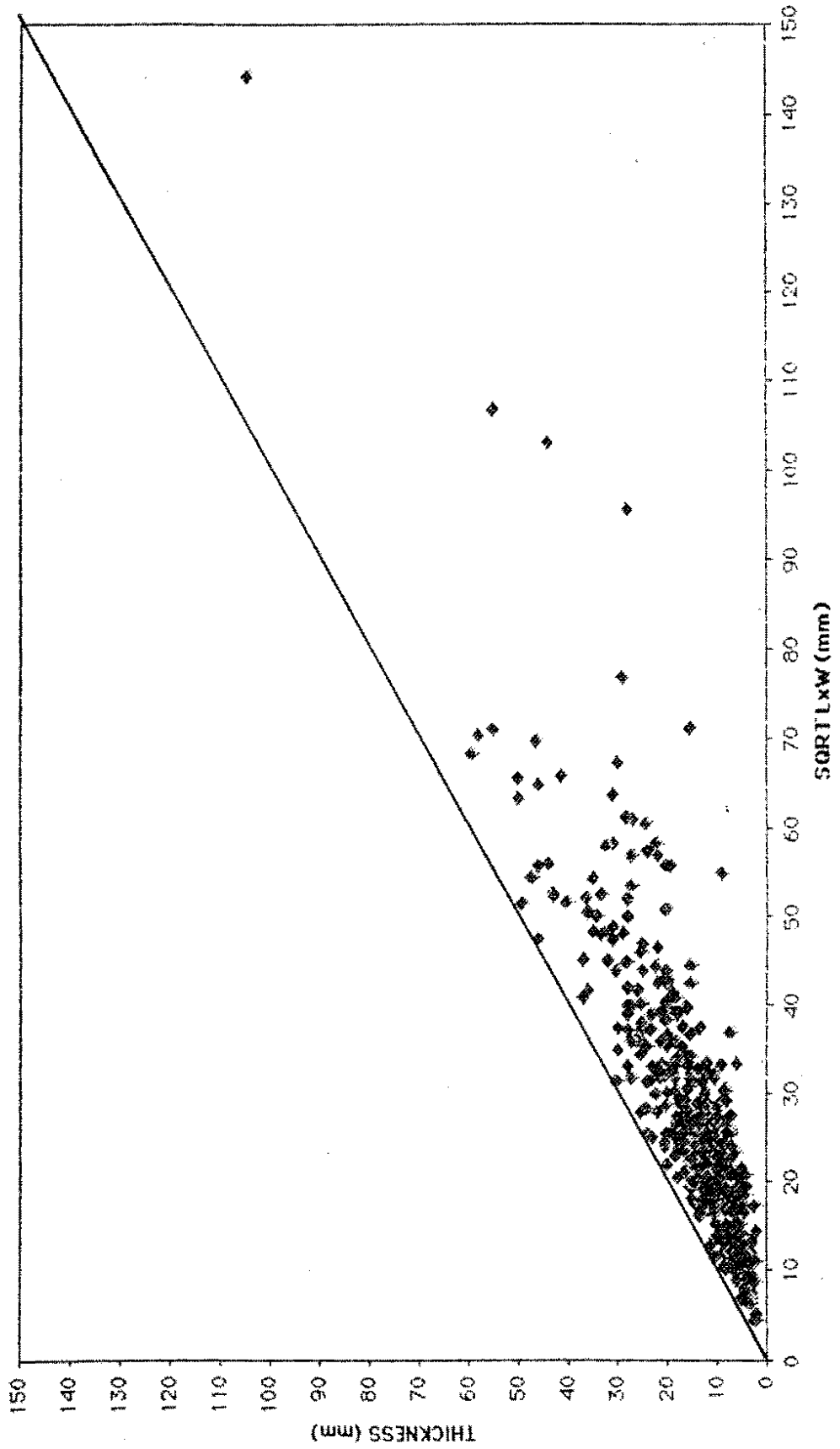
III-3-o Colombo Creek All Quartz



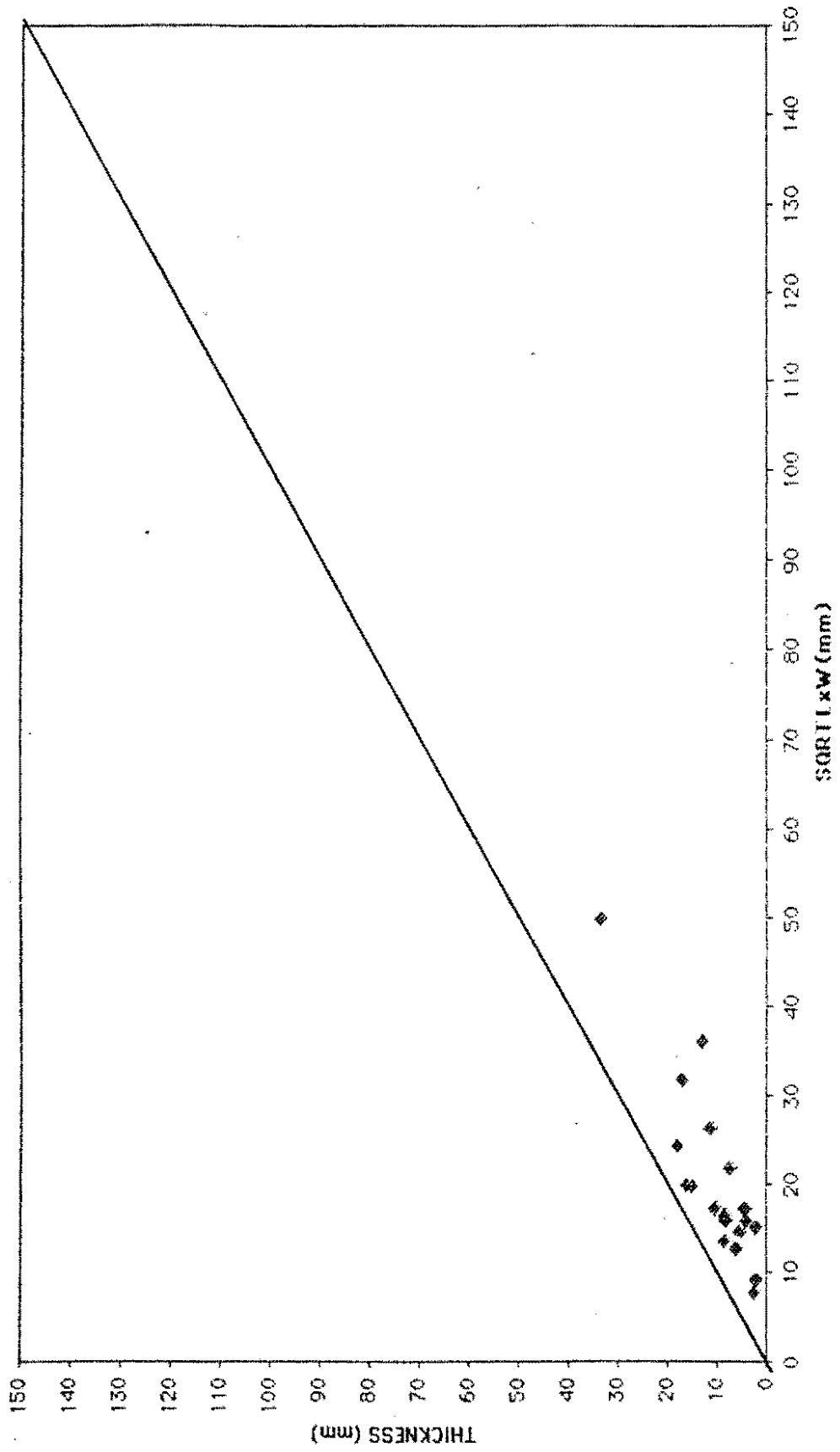
III-3-p Colombo Creek All Silcrete



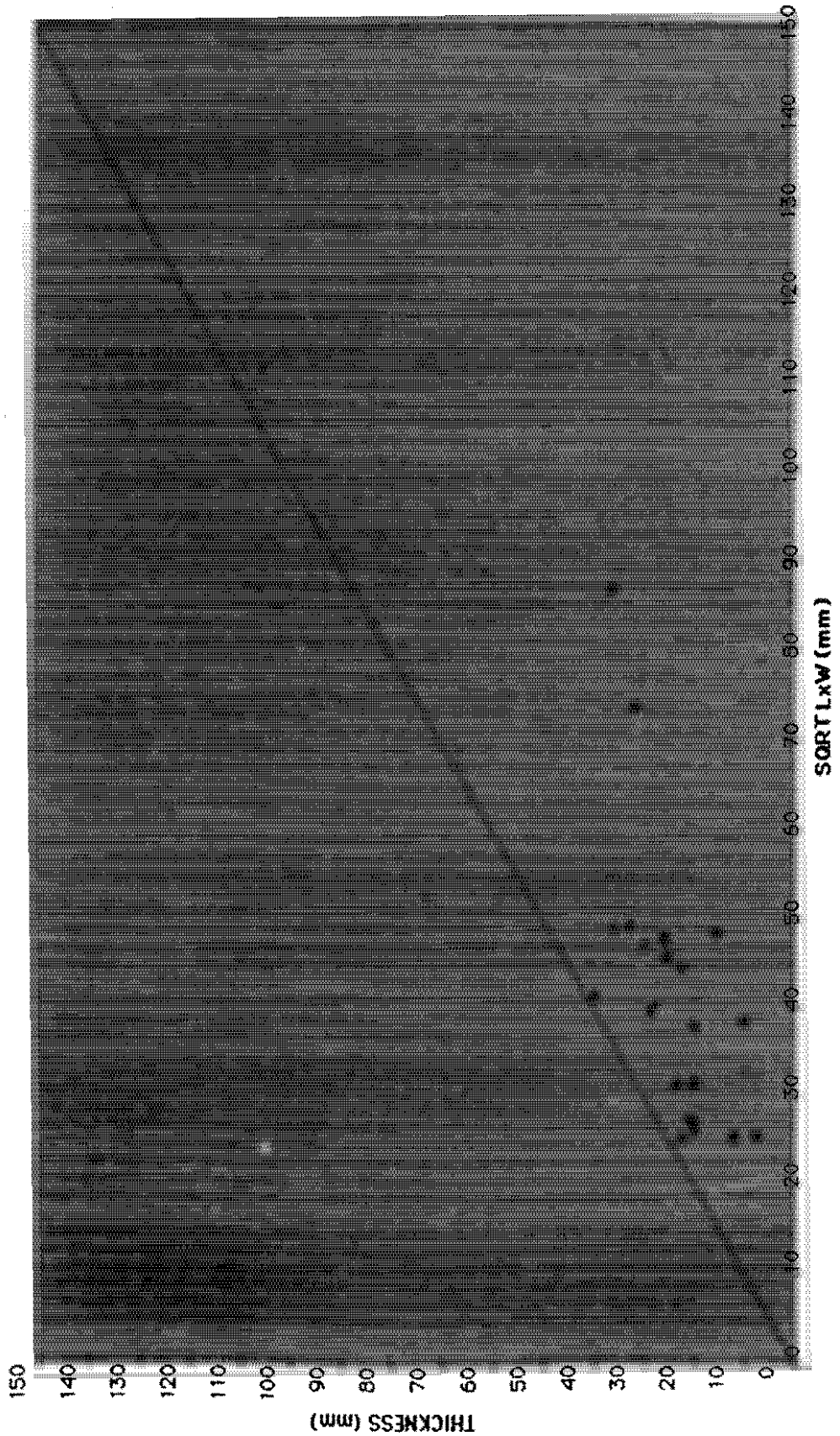
III-3-q Colombo Creek All Quartzite



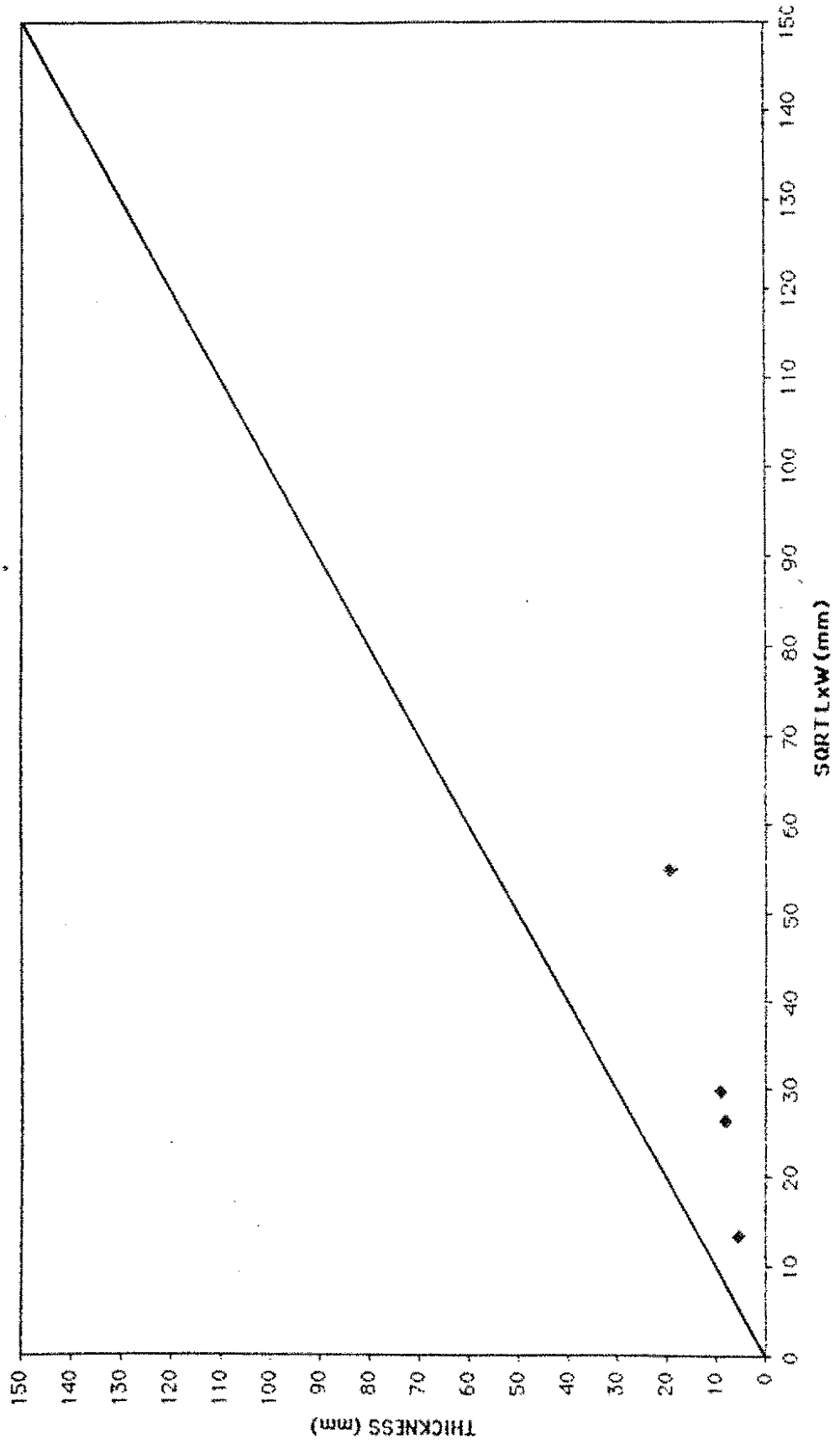
III-3-r Colombo Creek All Chert



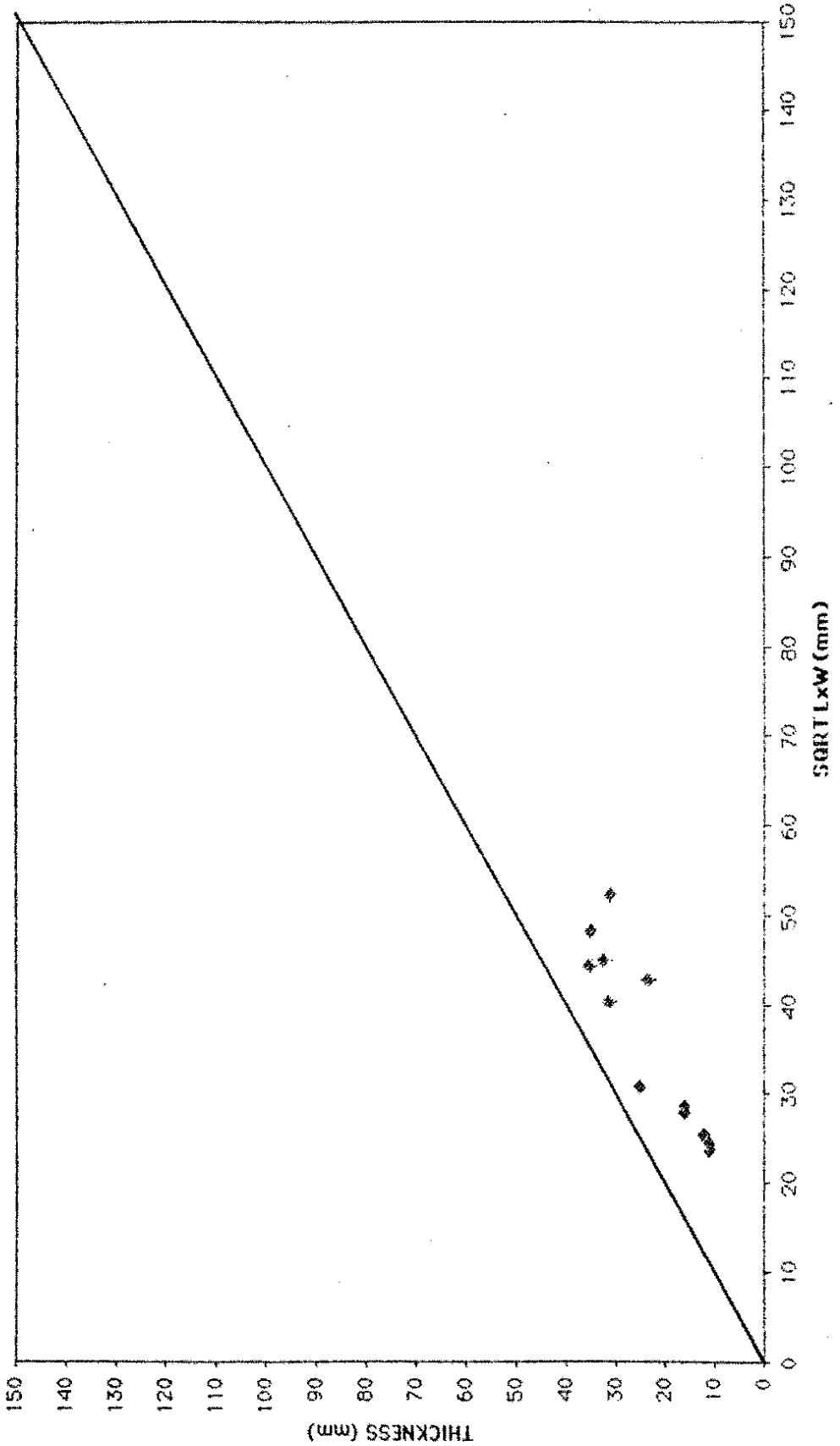
III-3-s Colombo Creek Sandstone



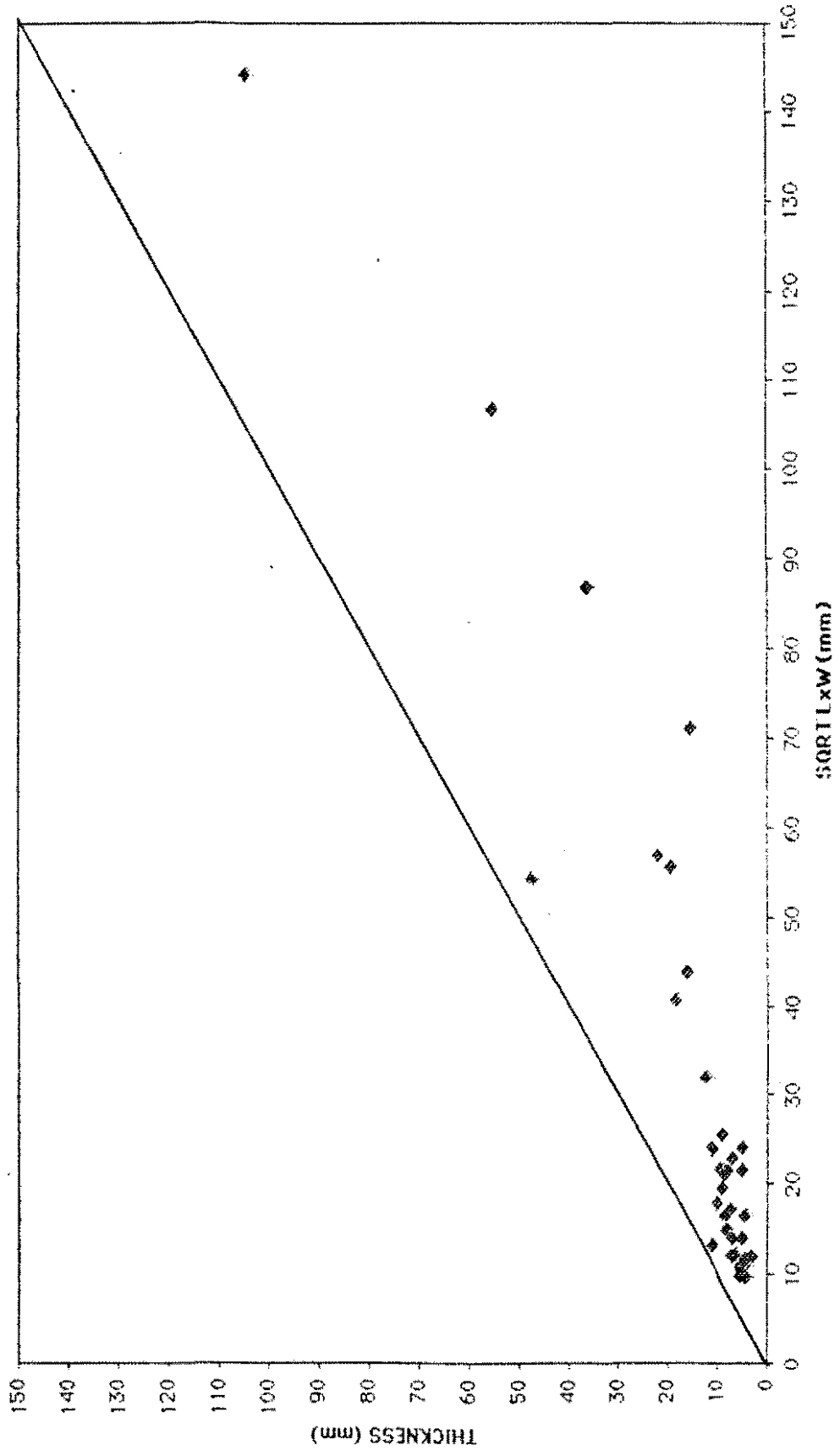
III-3-t Colombo Creek Metasedimentary



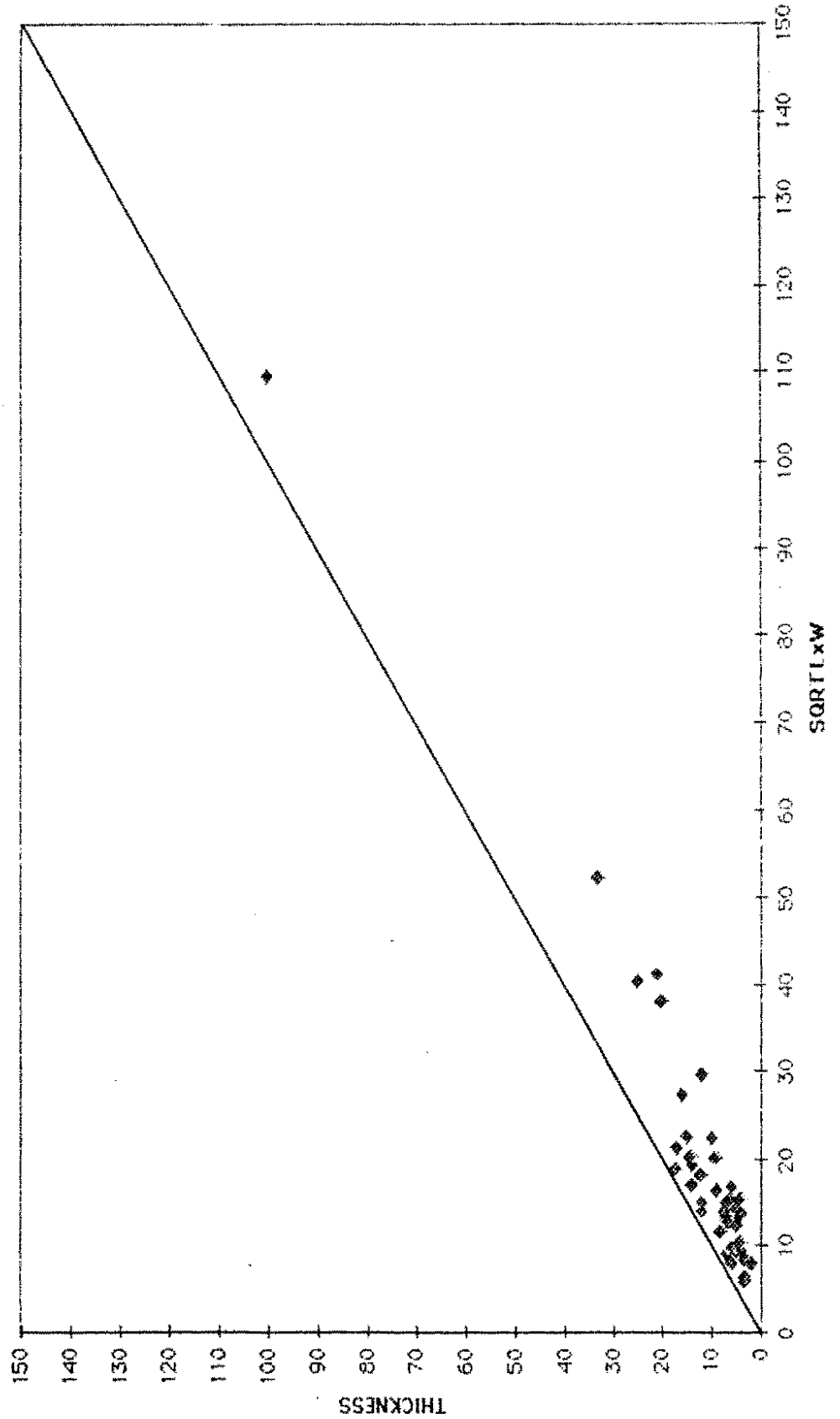
III-3-u Colombo Creek Conglomerate



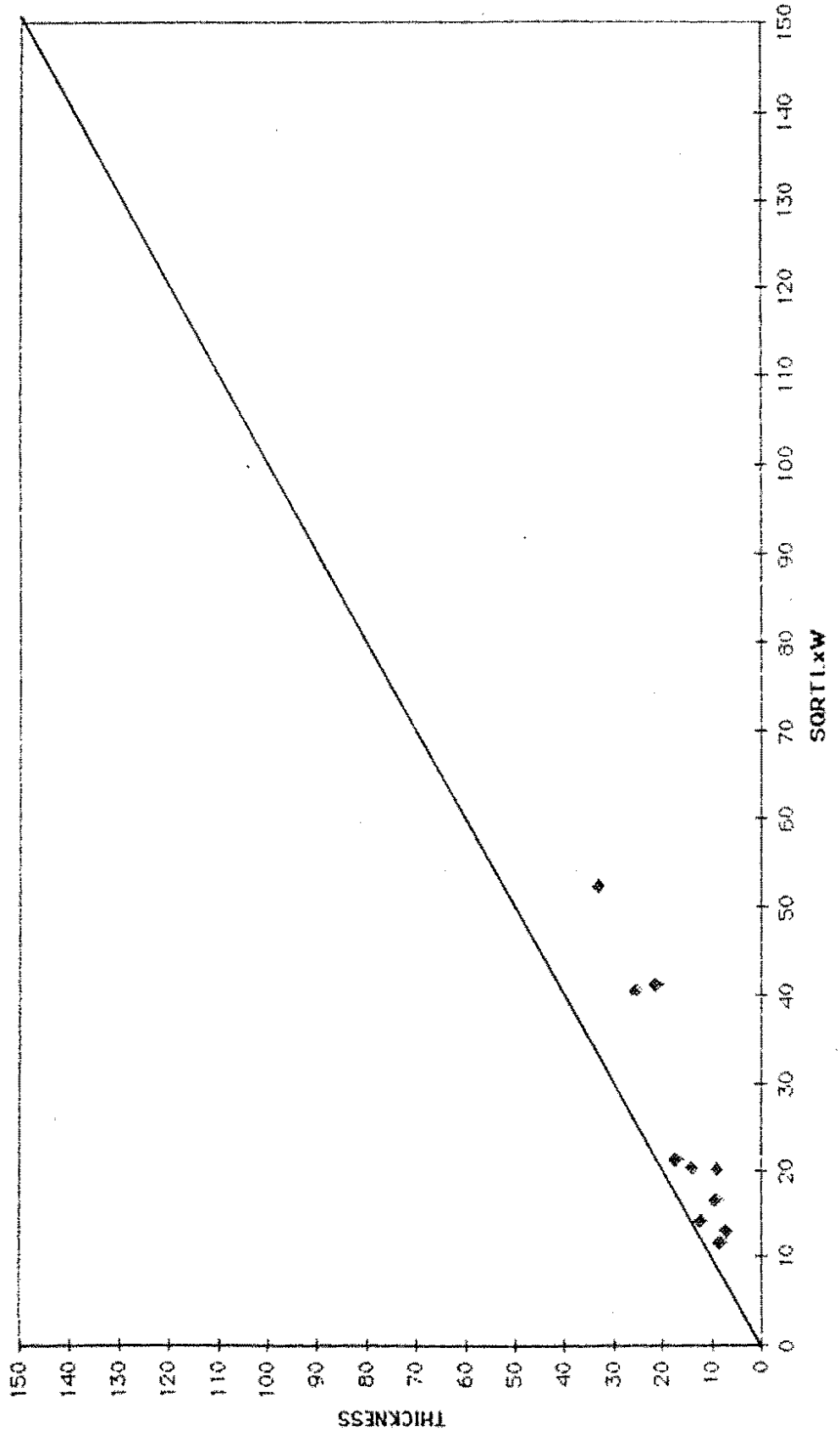
III-3-y Colombo Creek Usewear



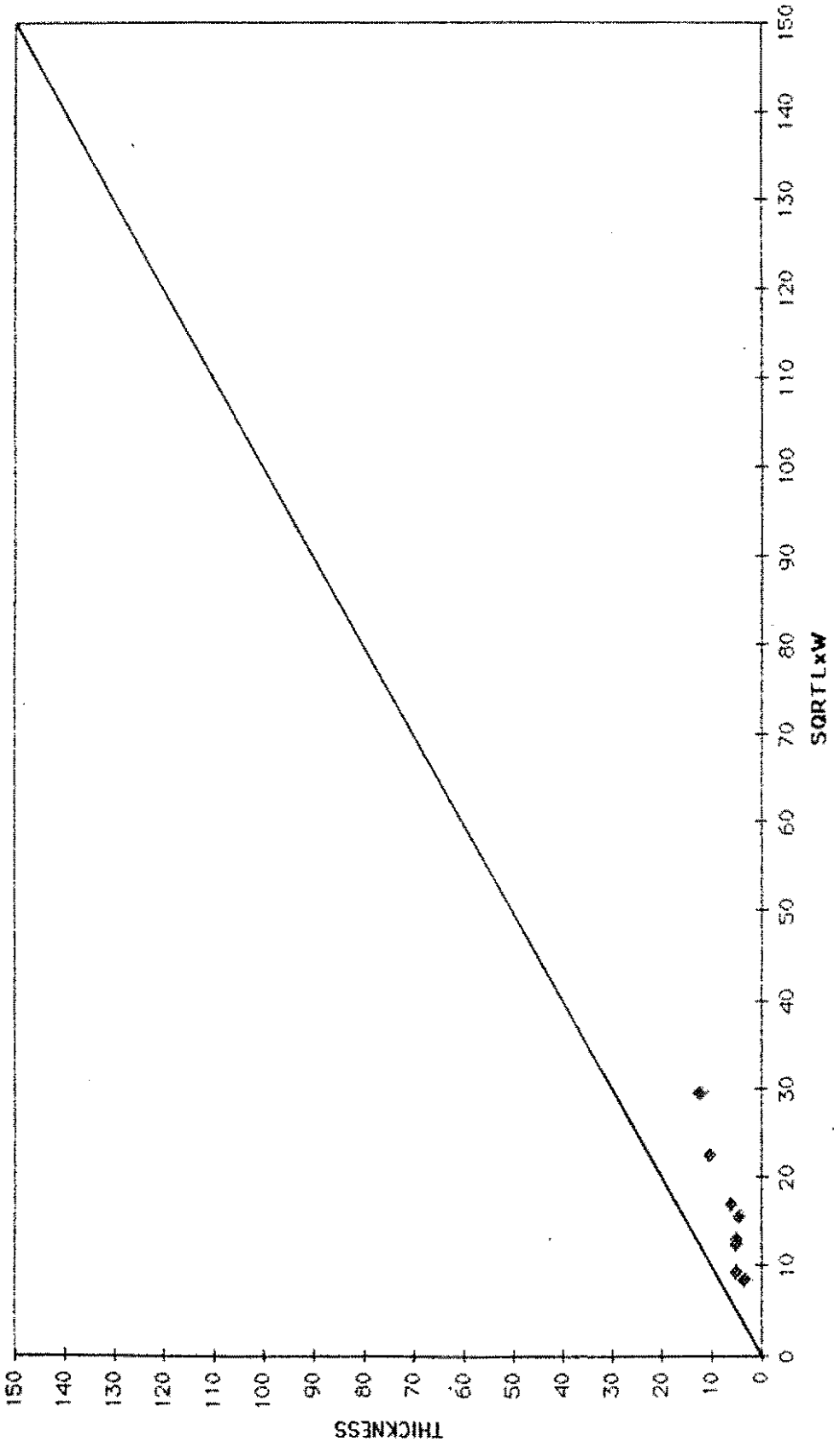
III-4-a Euwarderry Lagoon All Artefacts



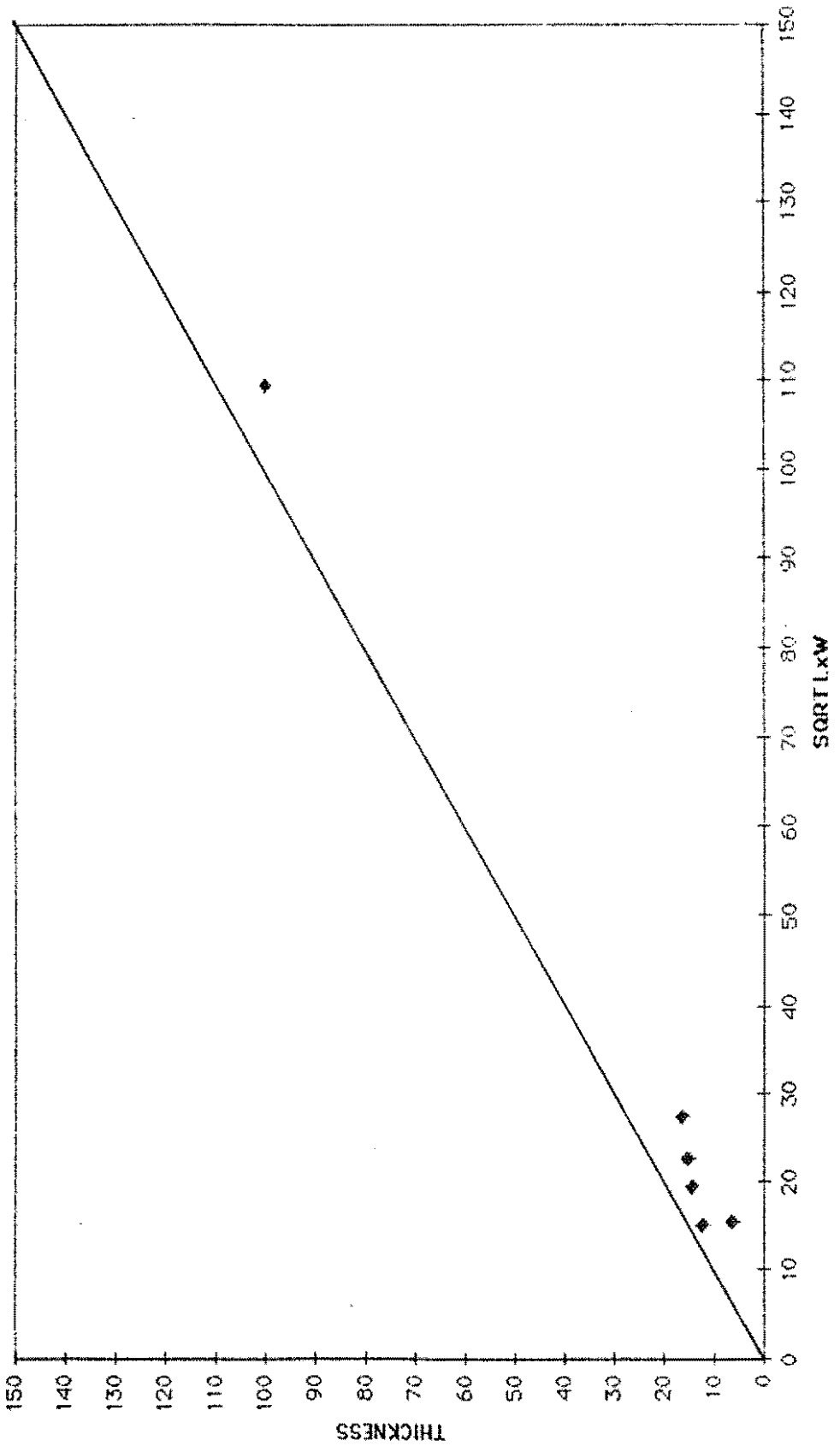
III-4-b Euwarderry Lagoon All Cores



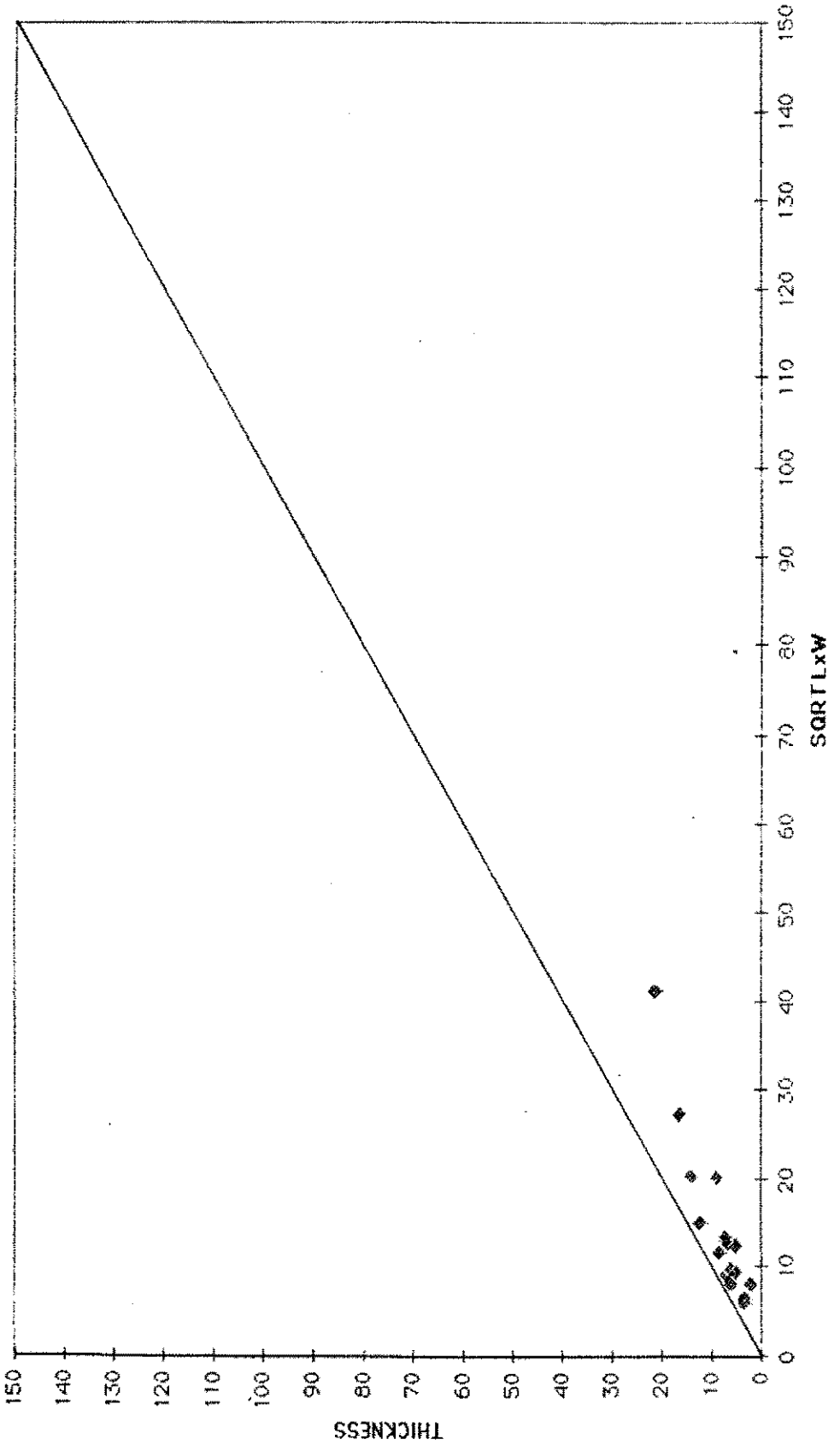
III-4-c Euwarderry Lagoon All flakes



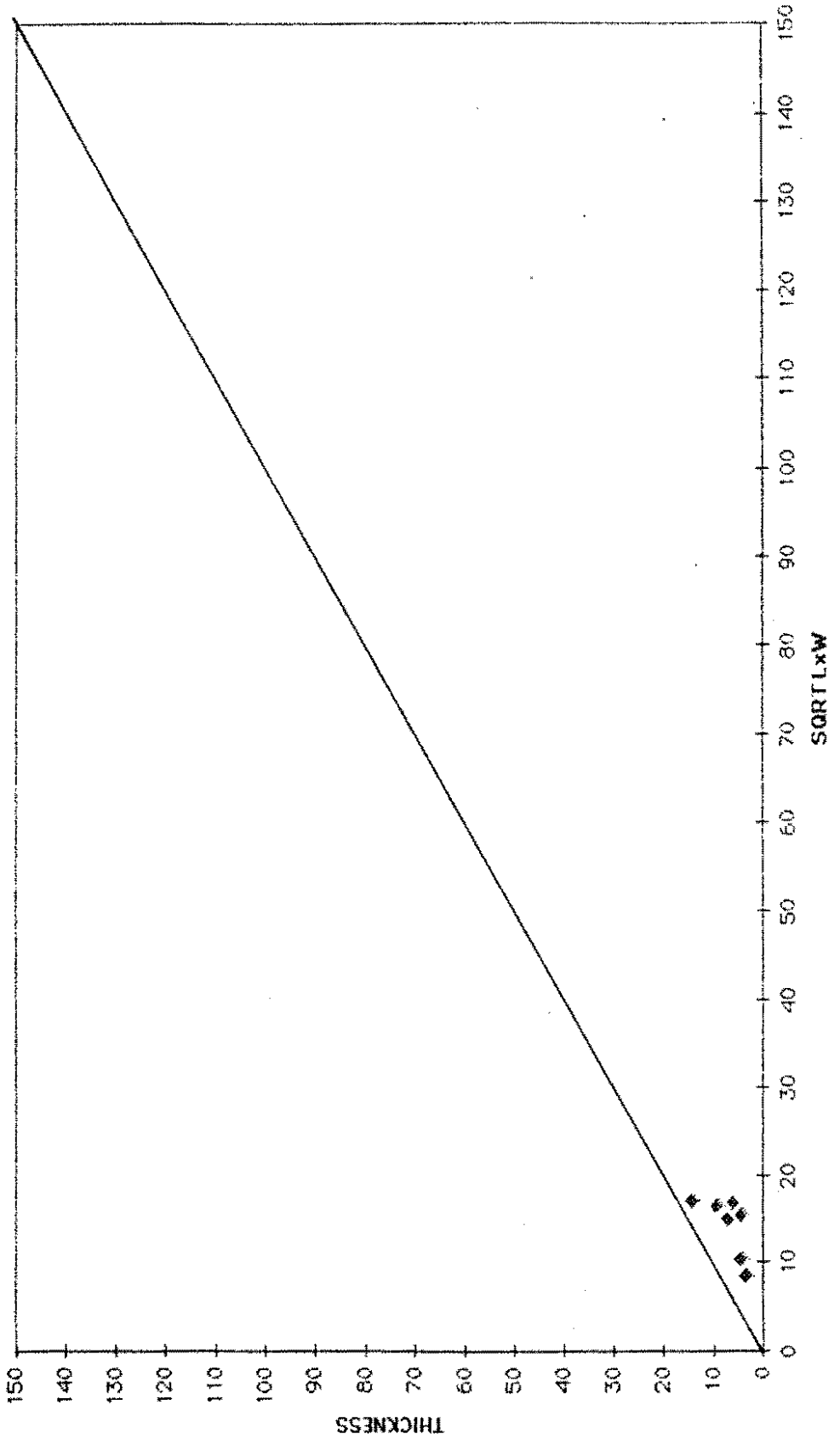
III-4-d Euwarderry Lagoon Manuports



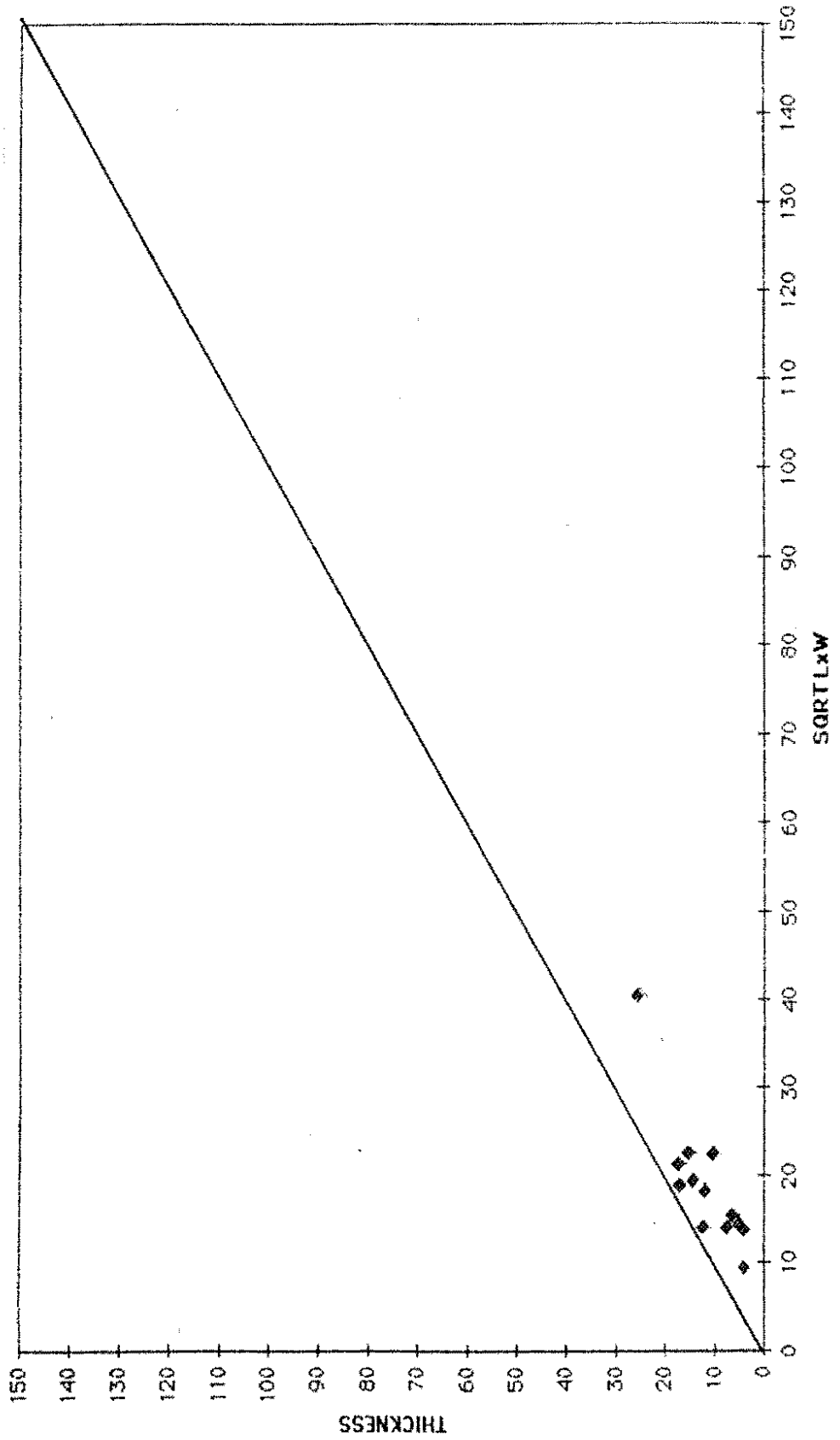
III-4-e Euwarderry Lagoon Quartz



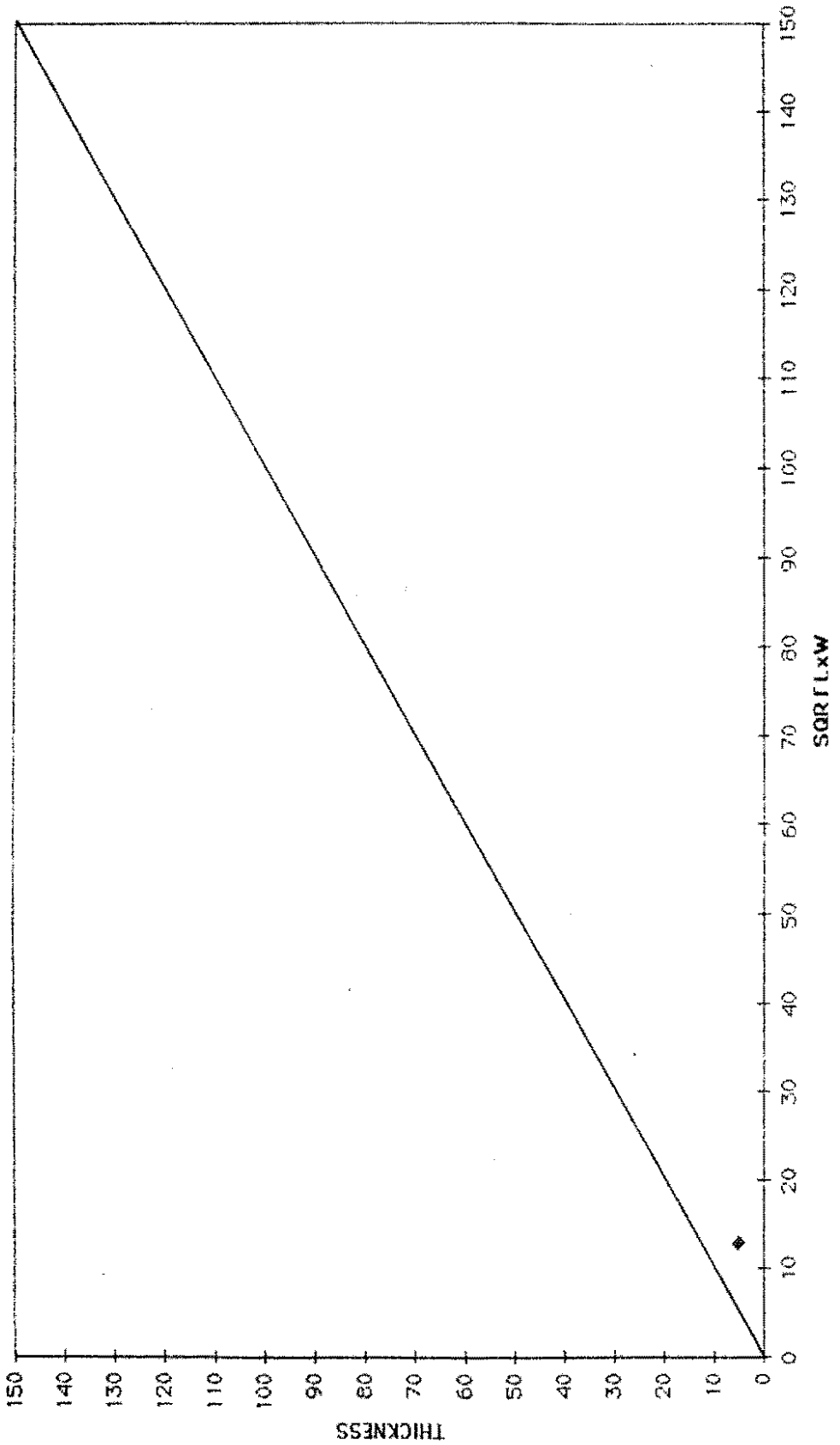
III-4-f Euwarderry Lagoon Silcrete



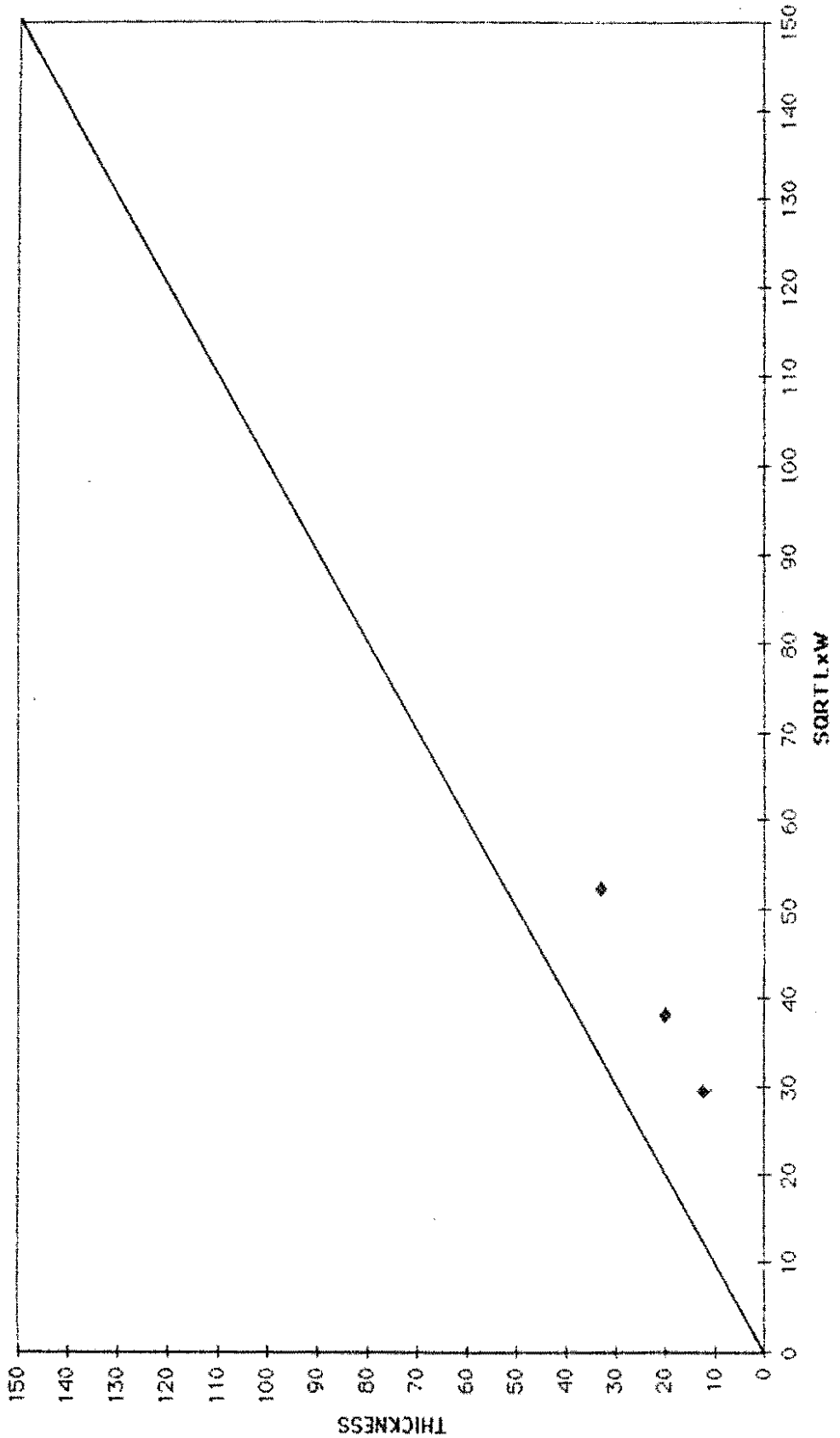
III-4-g Euwarderry Lagoon Quartzite



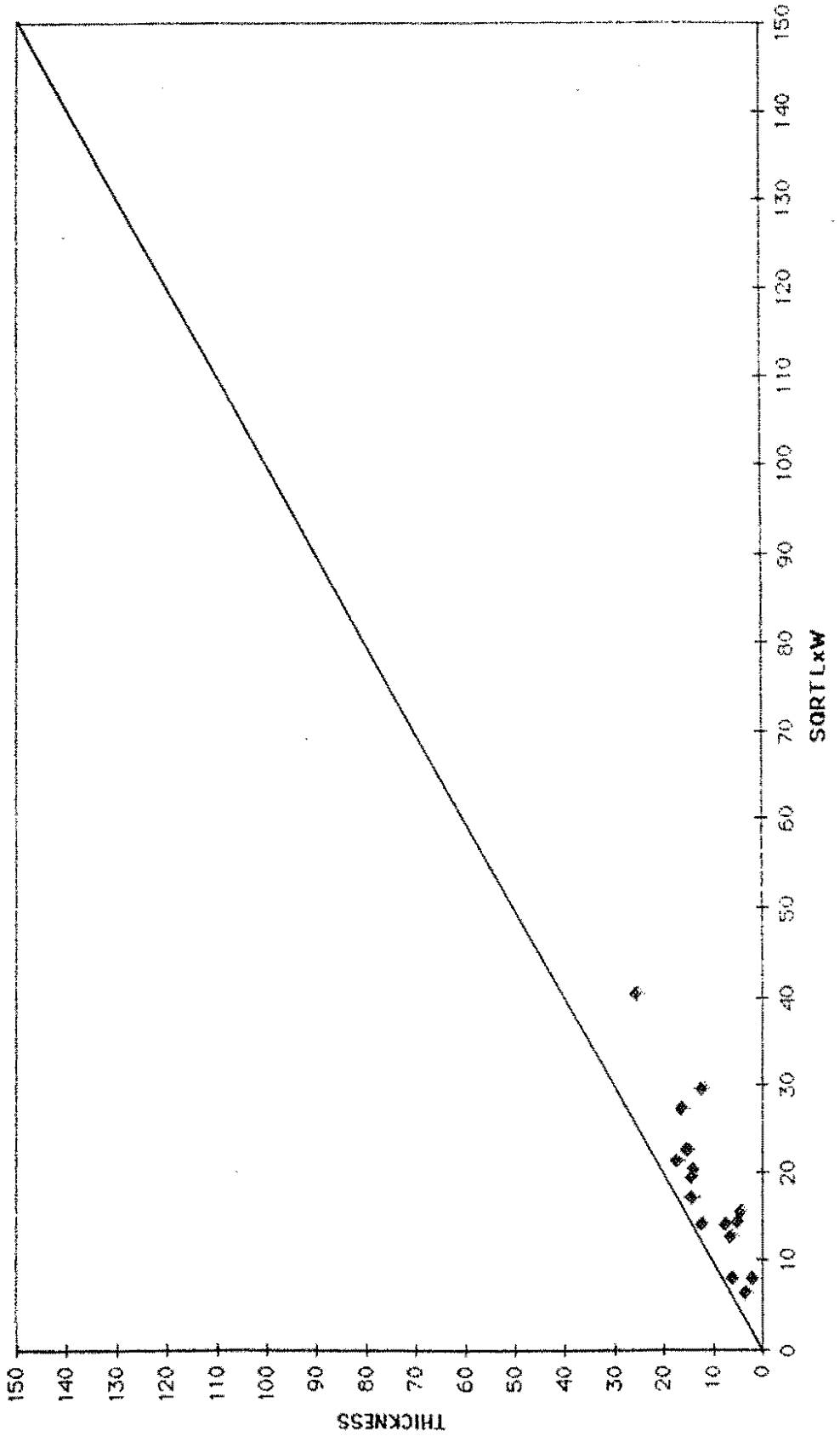
III-4-h Euwarderry Lagoon Chert



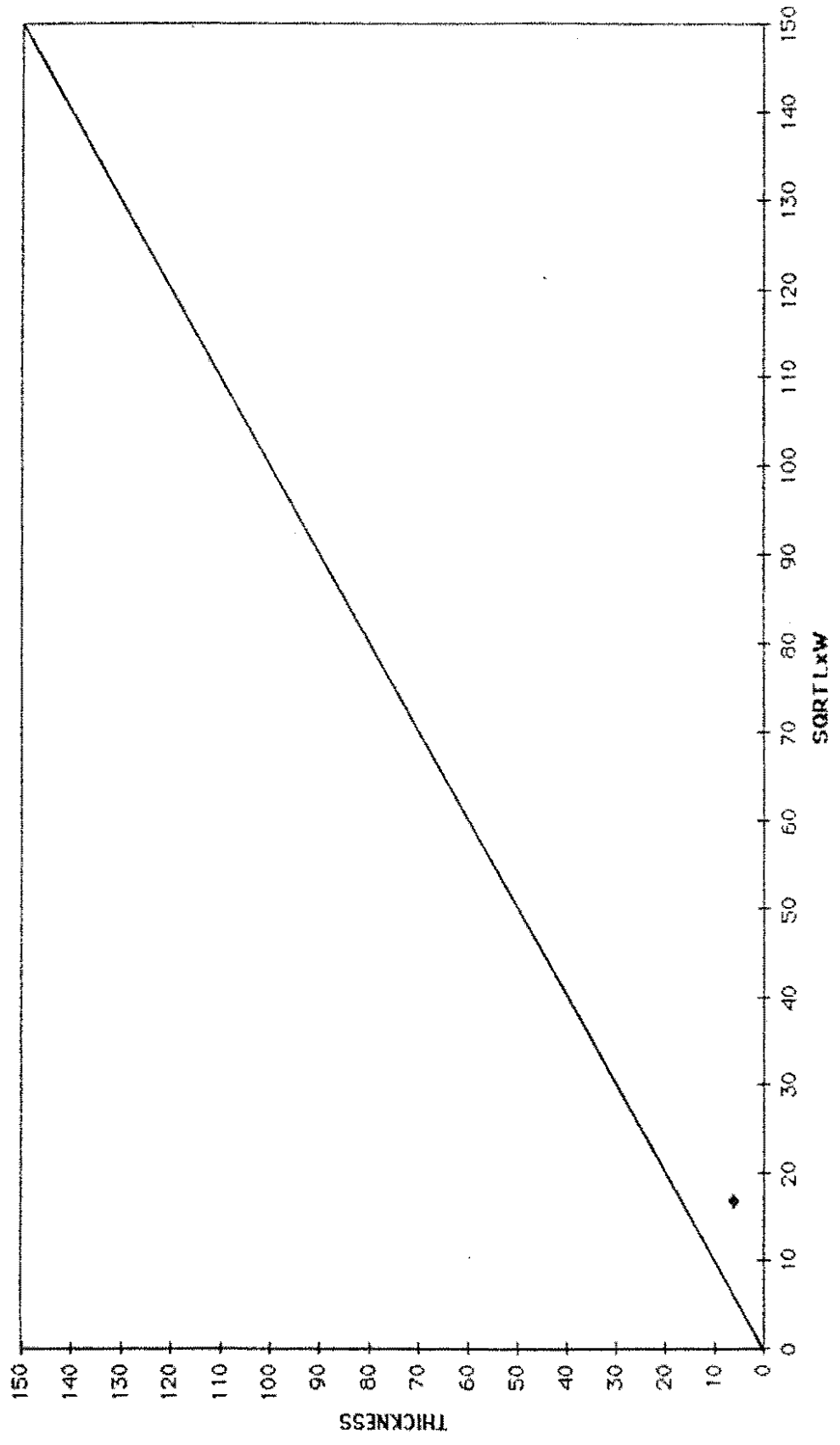
III-4-i Euwarderry Lagoon Volcanic



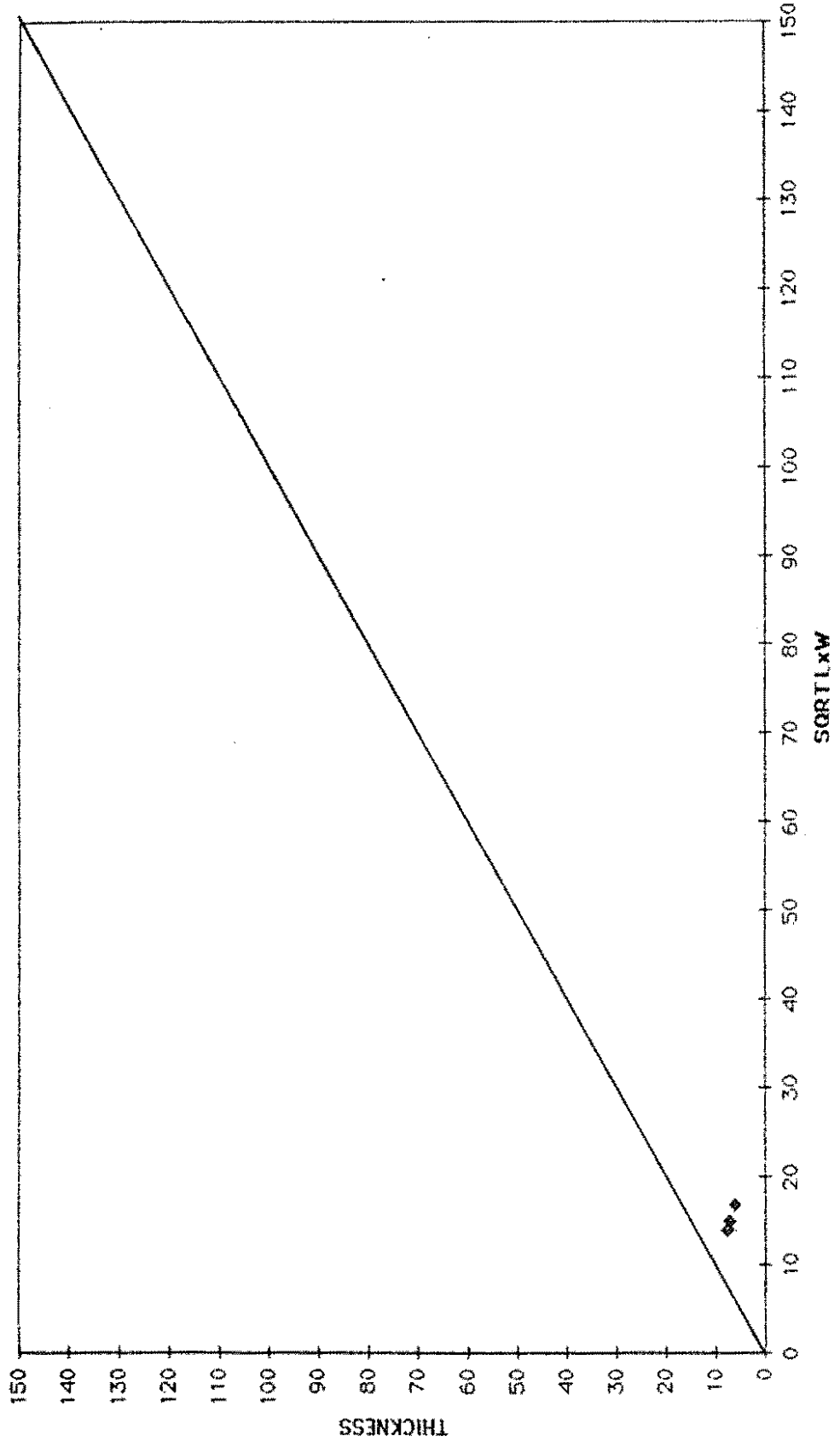
III-4-j Euwarderry Lagoon Pebble Cortex



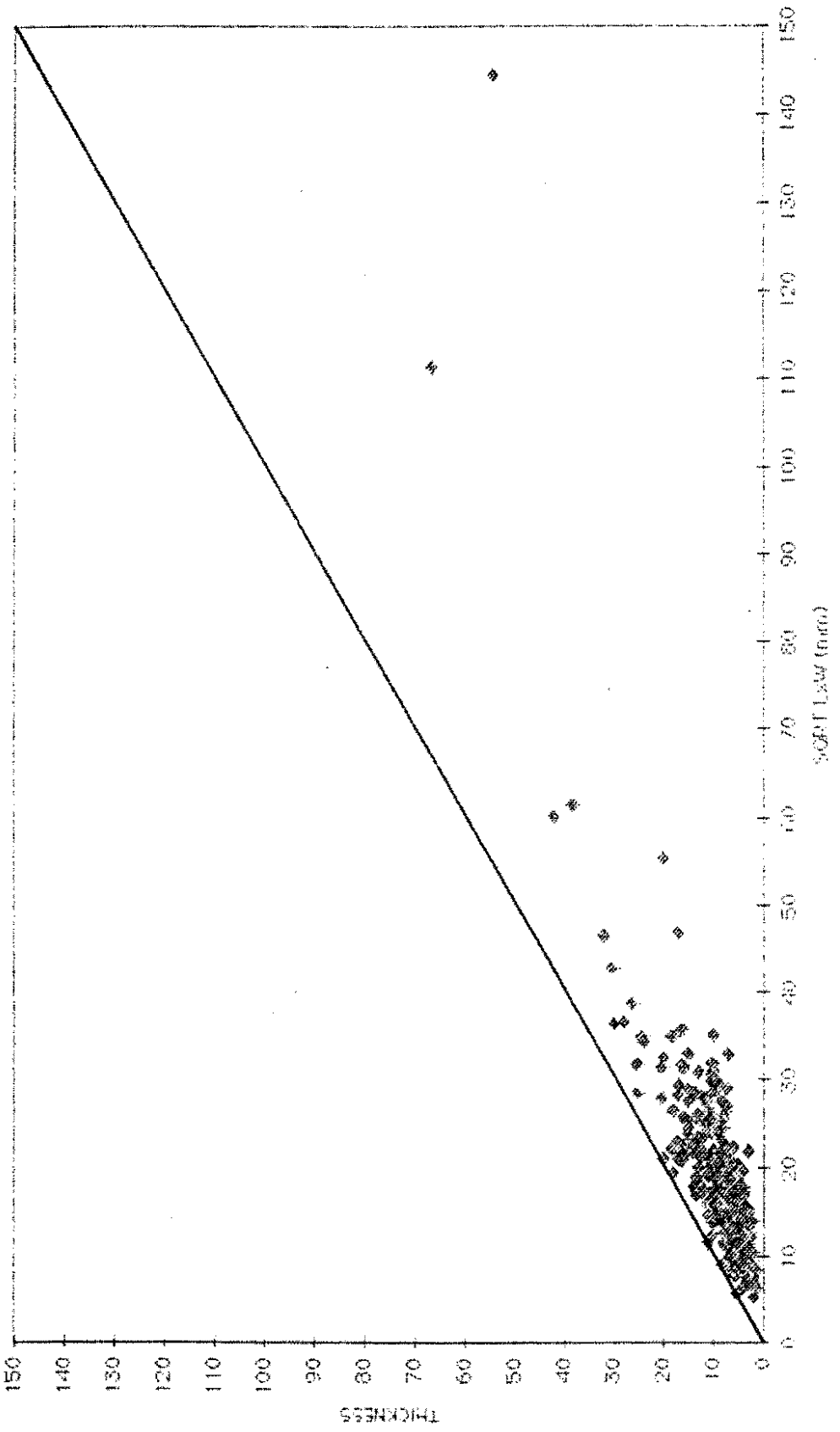
III-4-k Euwarderry Lagoon Retouch



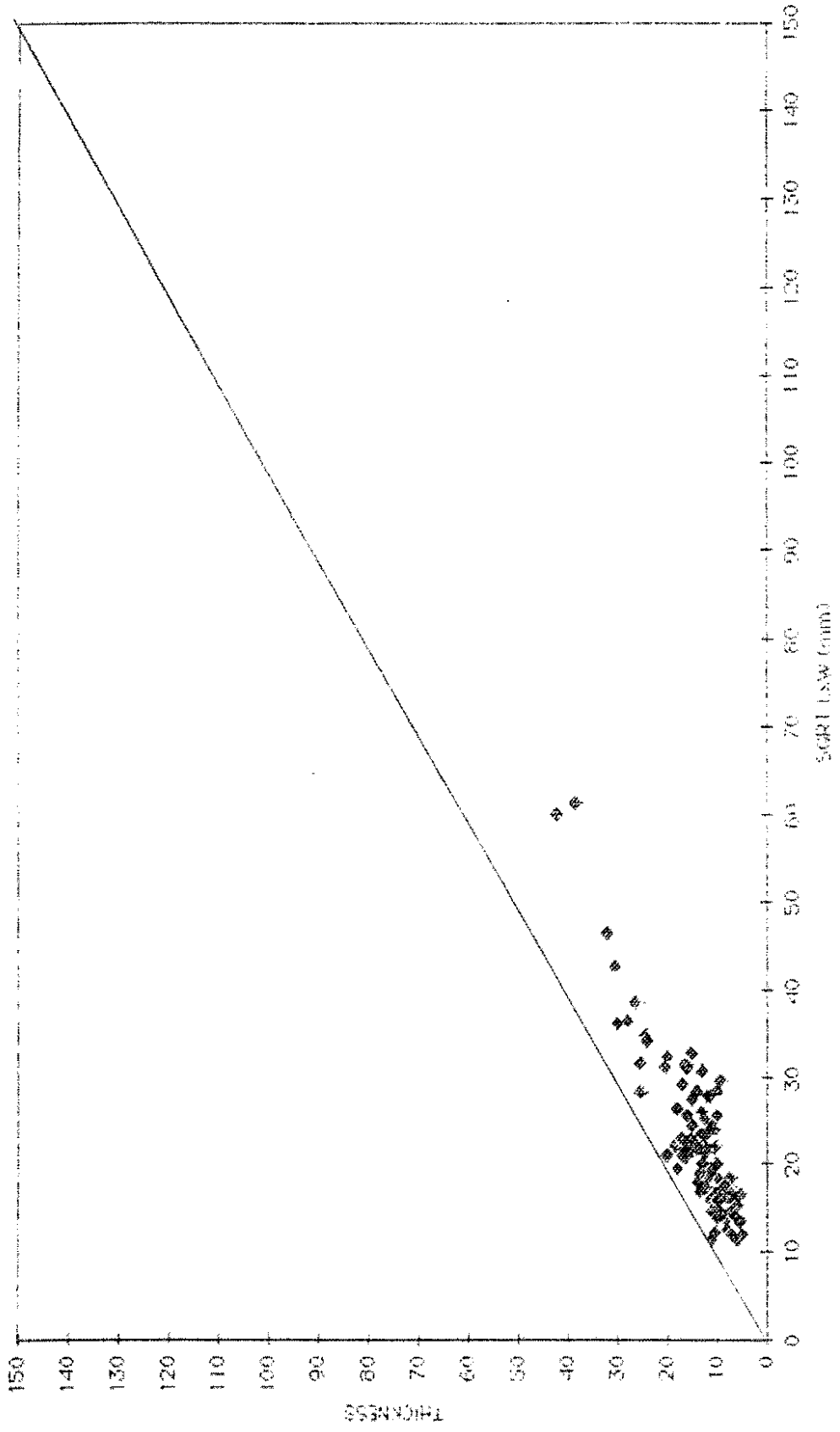
III-4-1 Euwarderry Lagoon Usewear



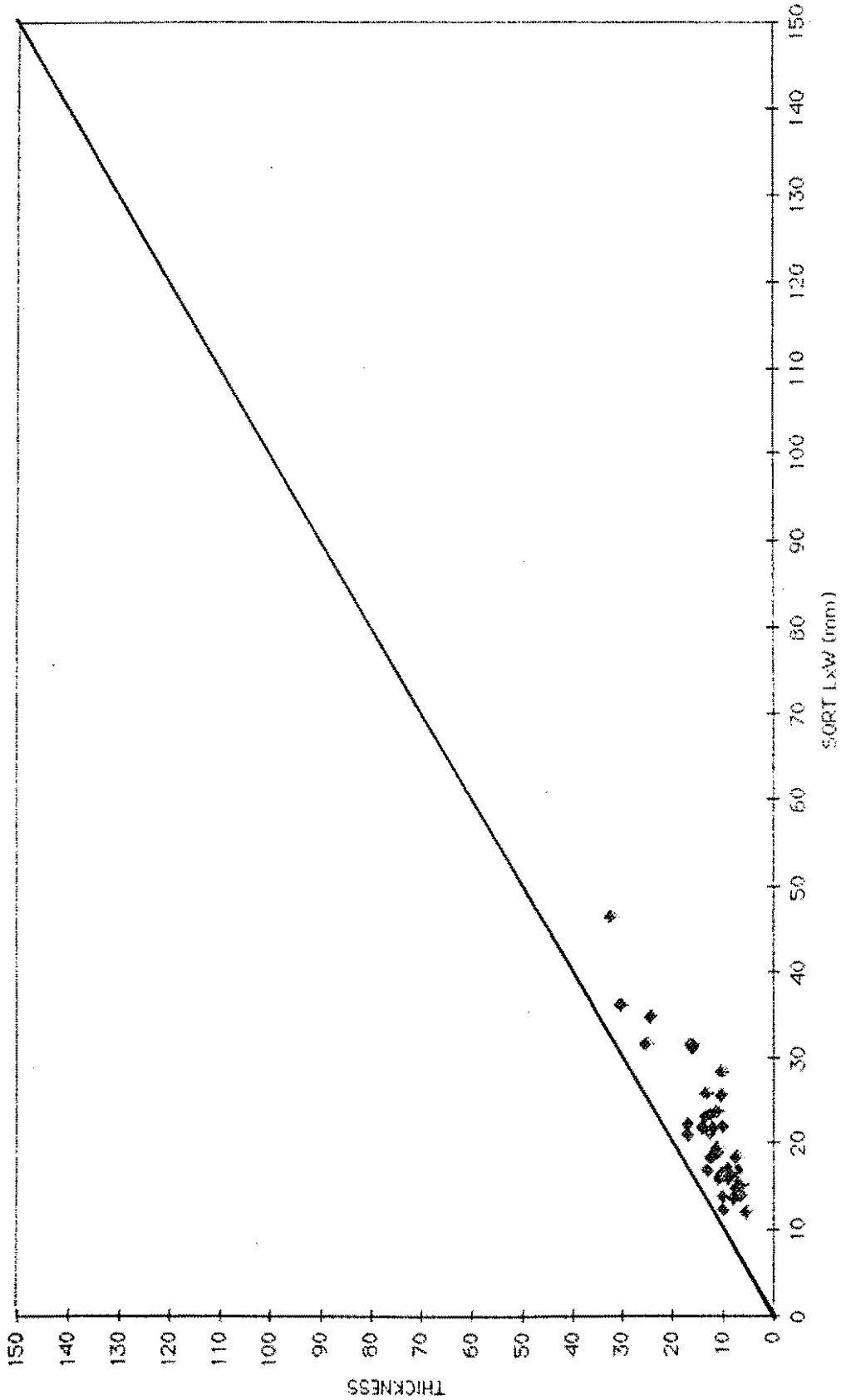
III-5-a Goonerah Lagoon All Artefacts



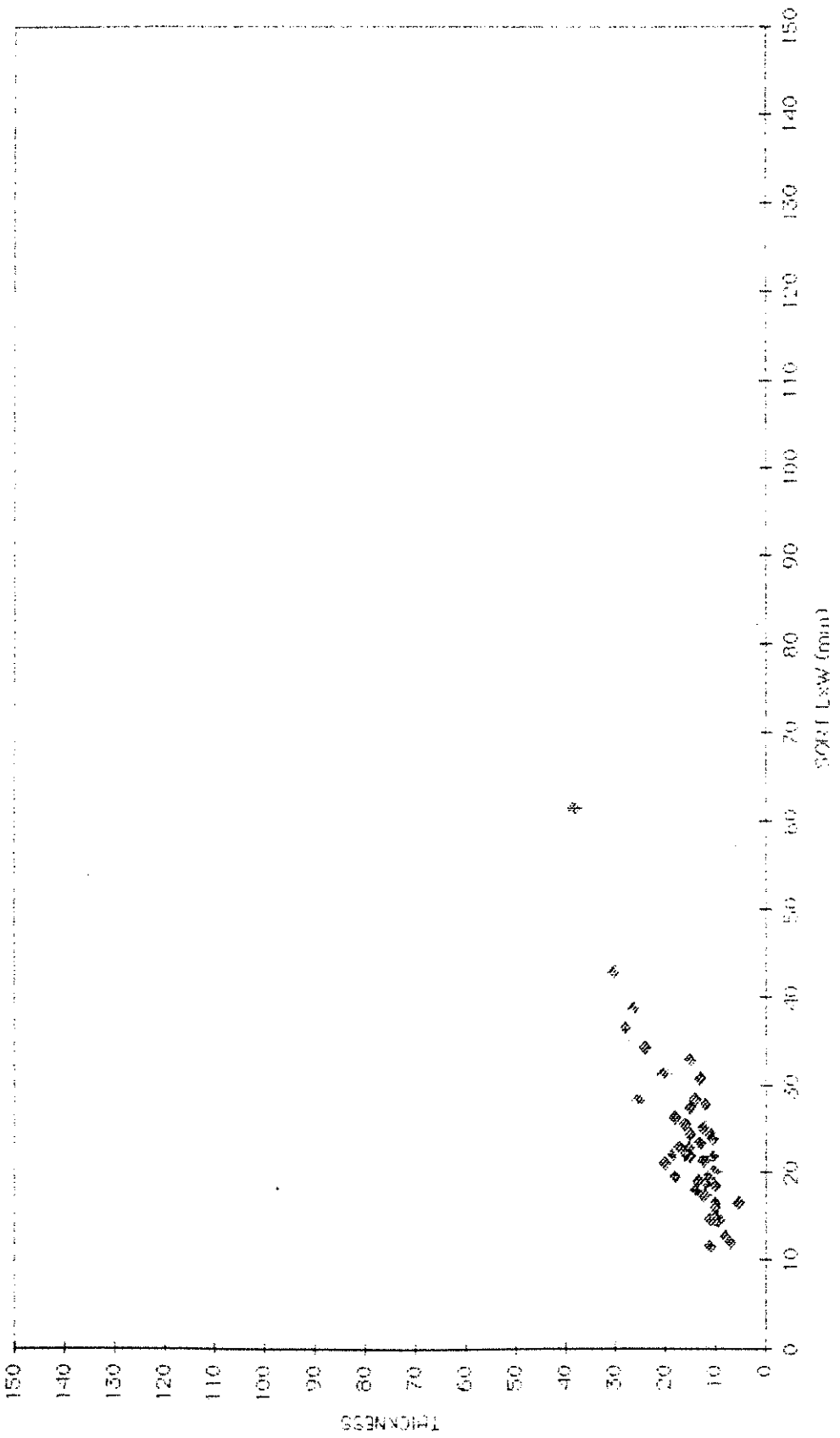
III-5-b Goonerah Lagoon All Cores



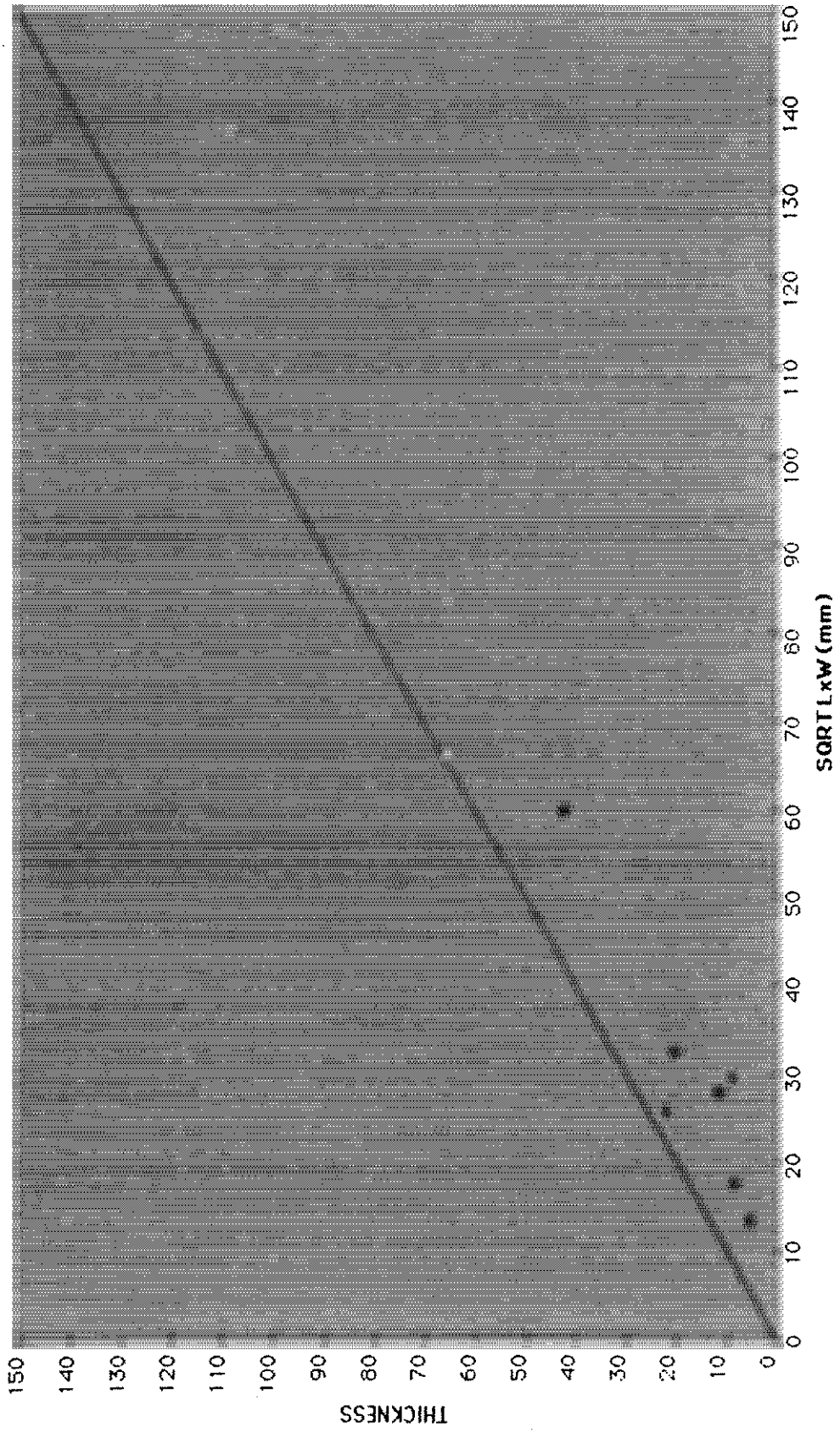
III-5-c Goonerah Lagoon Quartz Cores



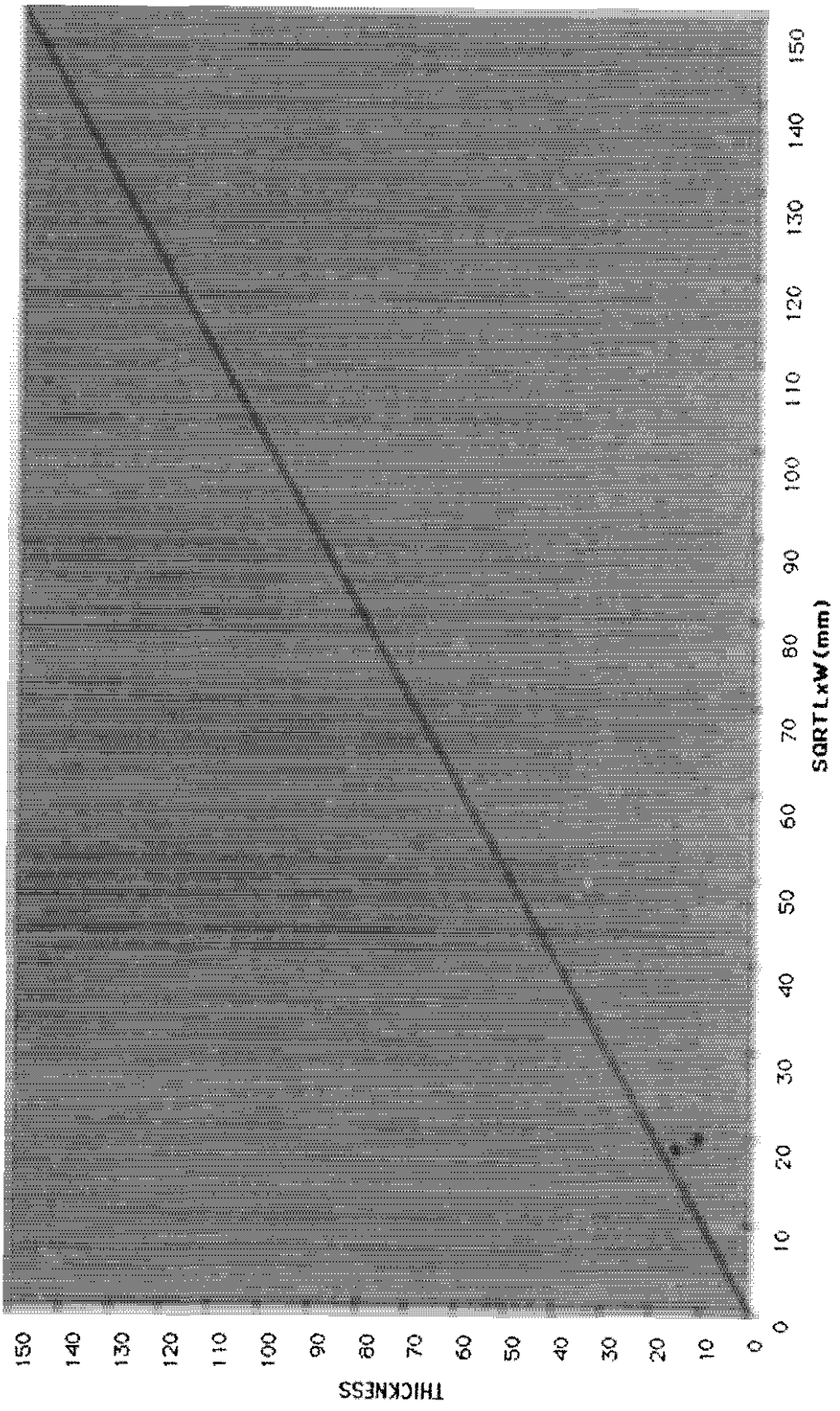
III-5-d Goonerah Lagoon Silcrete Cores



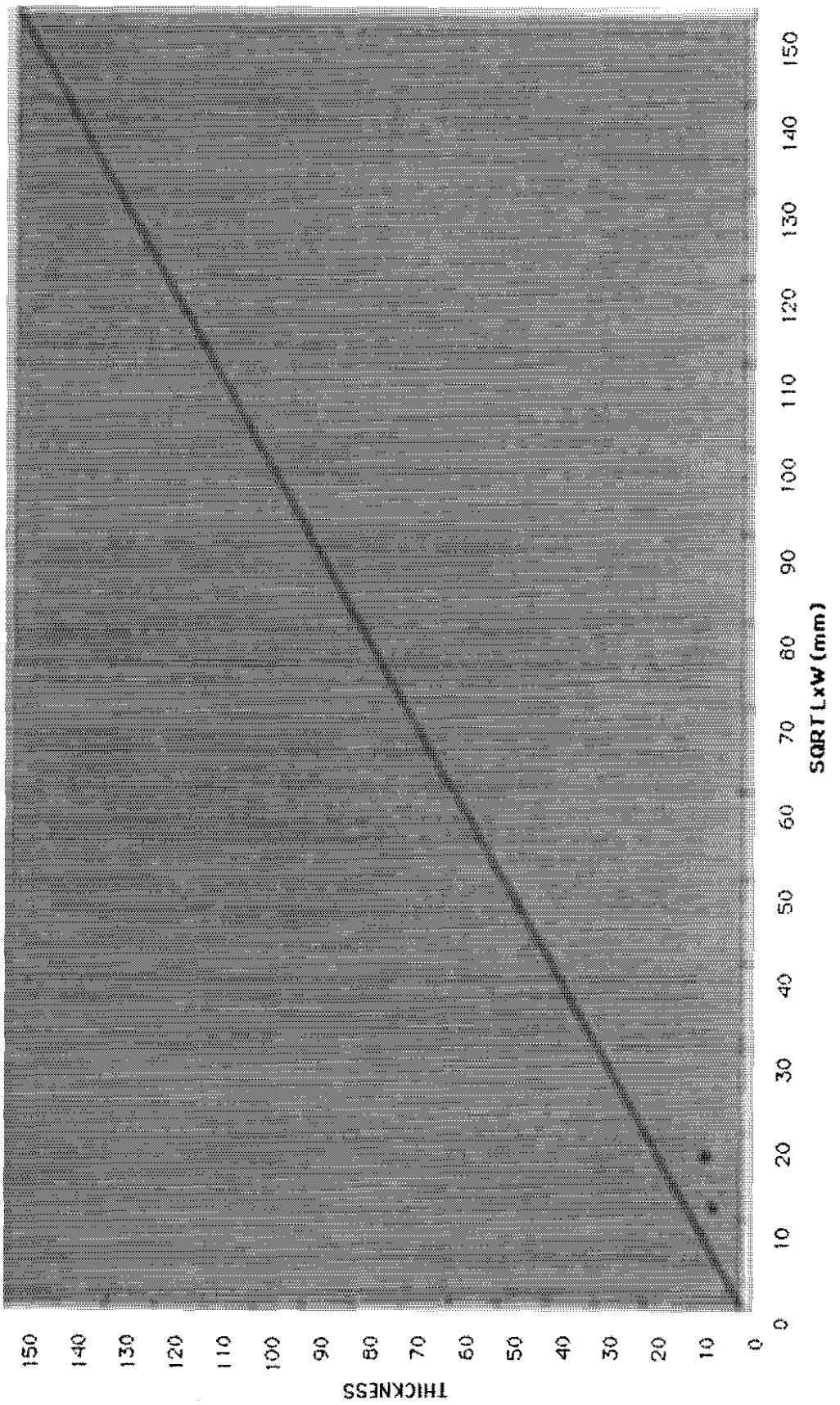
III-5-e Goonerah Lagoon Quartzite Cores



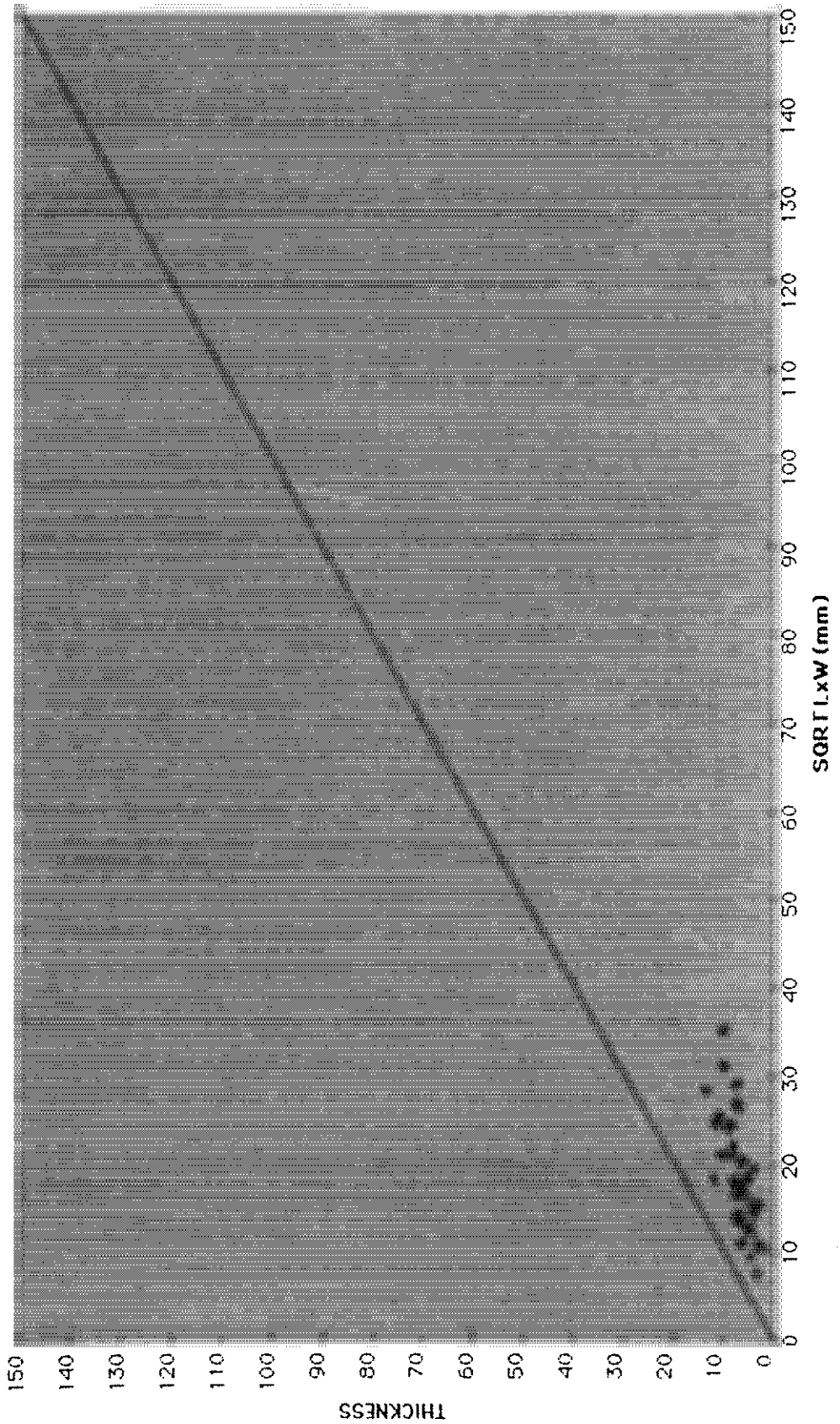
III-5-f Goonerah Lagoon Chert Cores



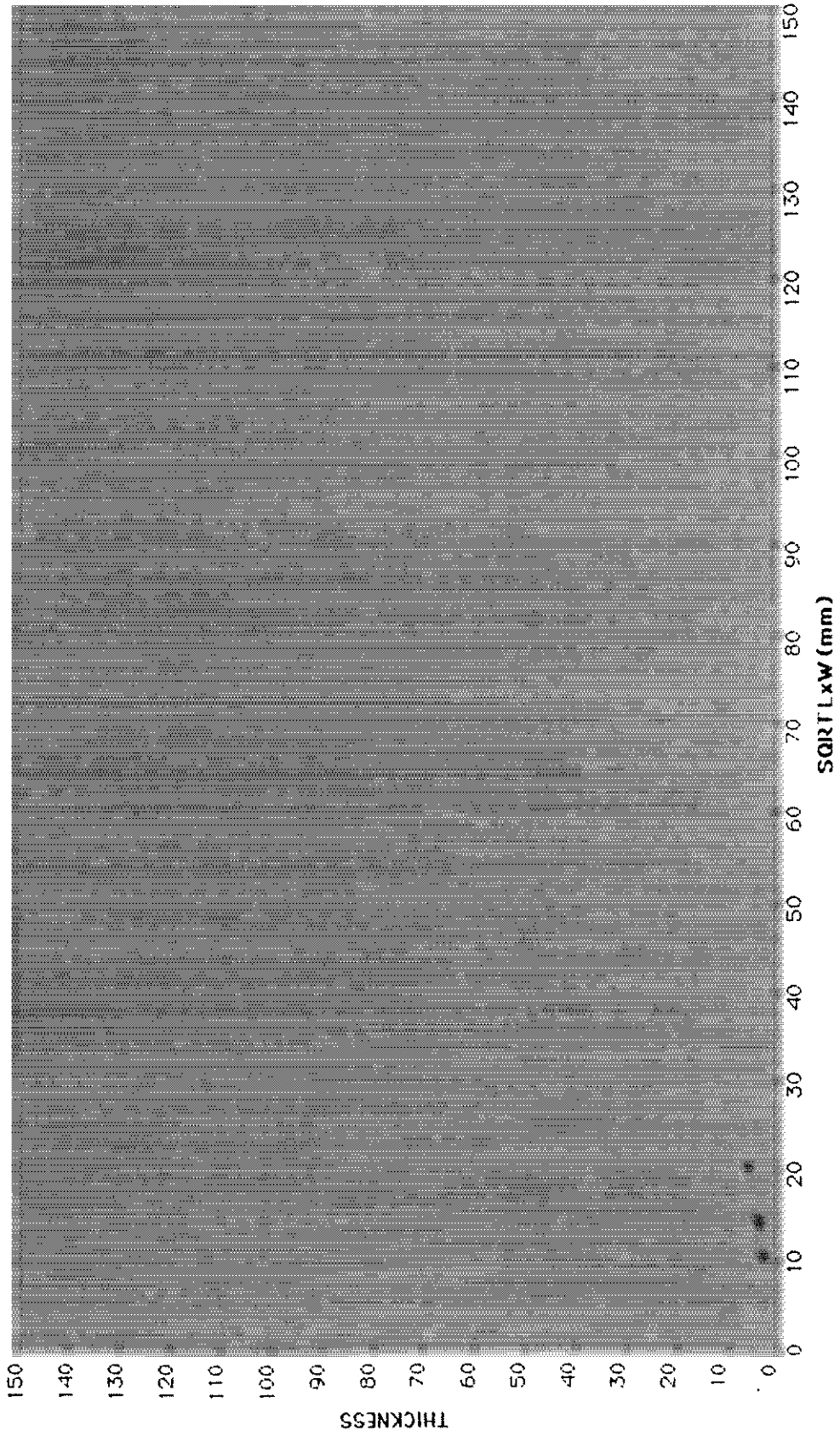
III-5-g Goonerah Lagoon Chalcedony Cores



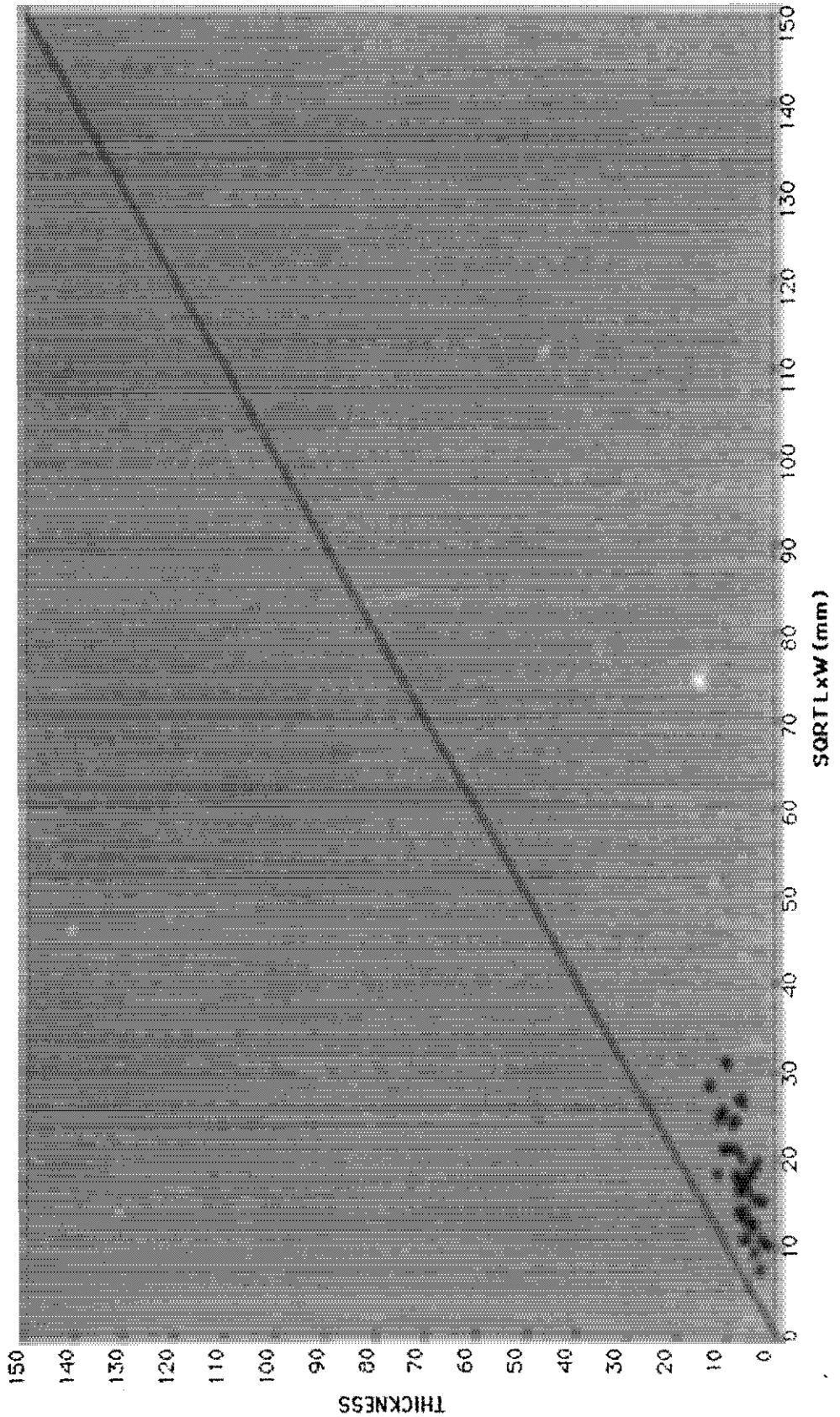
III-5-h Goonerah Lagoon Flakes and Blades



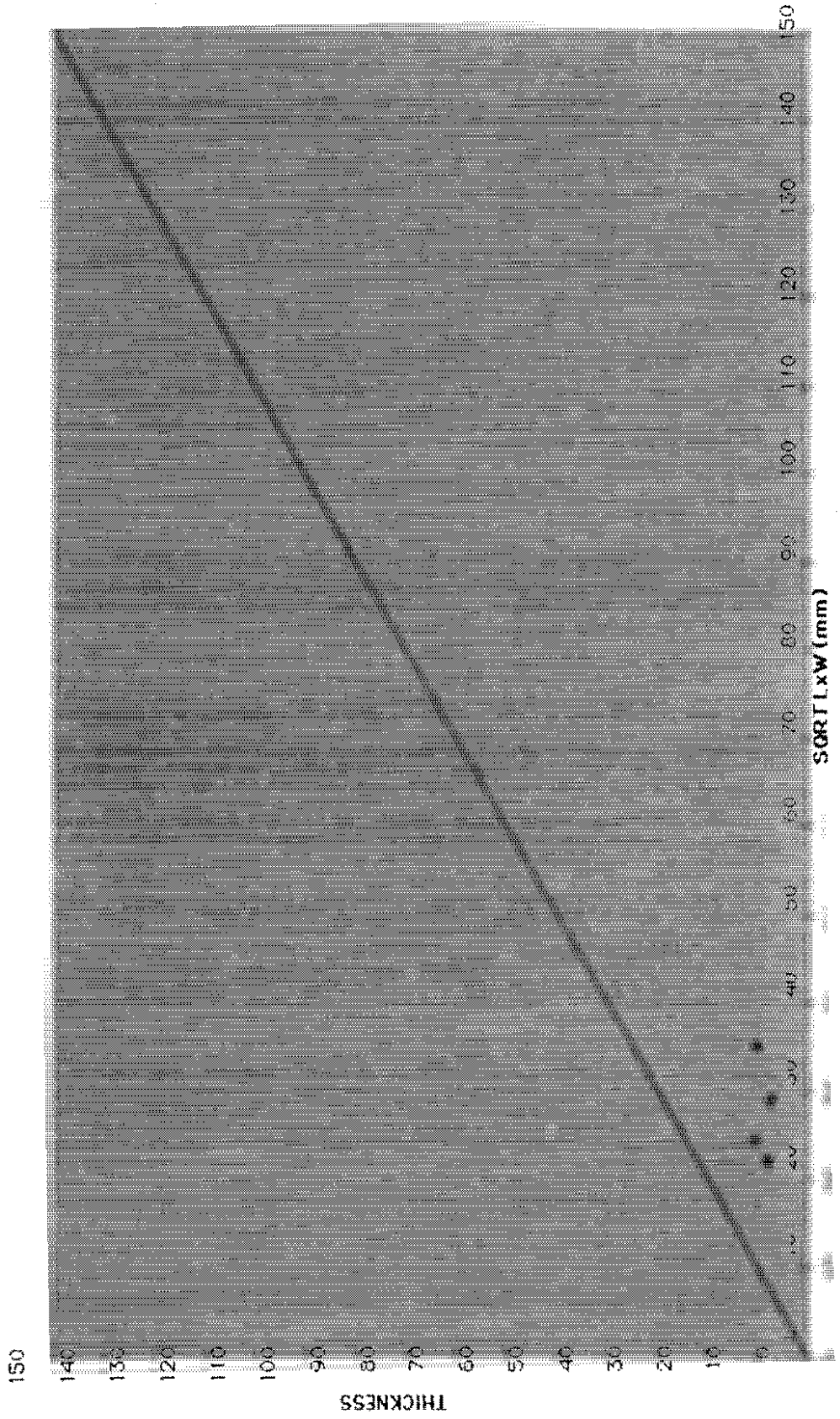
III-5-i Goonerah Lagoon Flakes and Blades quartz



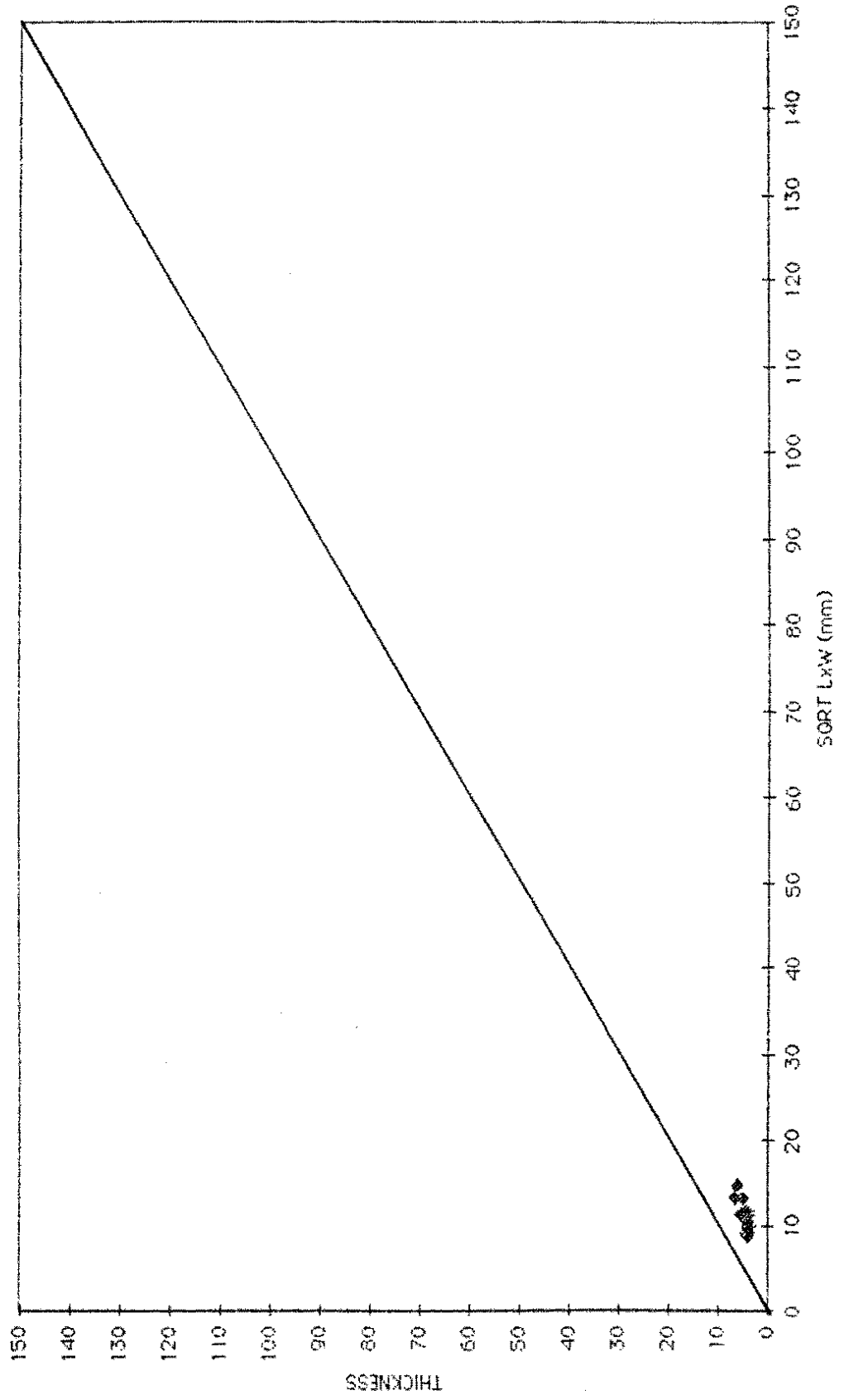
III-5-j Goonerah Lagoon Flakes and Blades silcrete



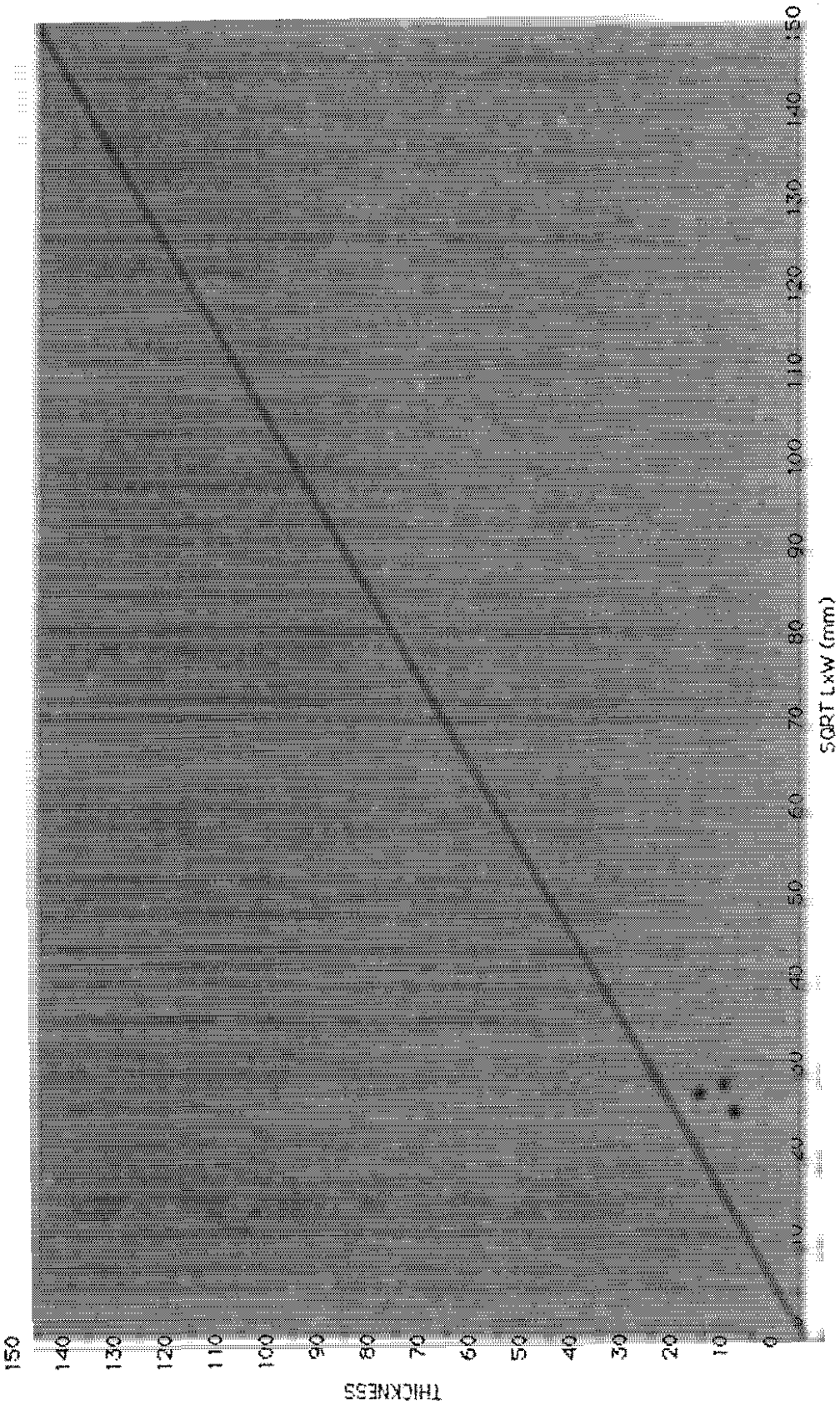
III-5-k Goonerah Lagoon Flake and Blades Quartzite



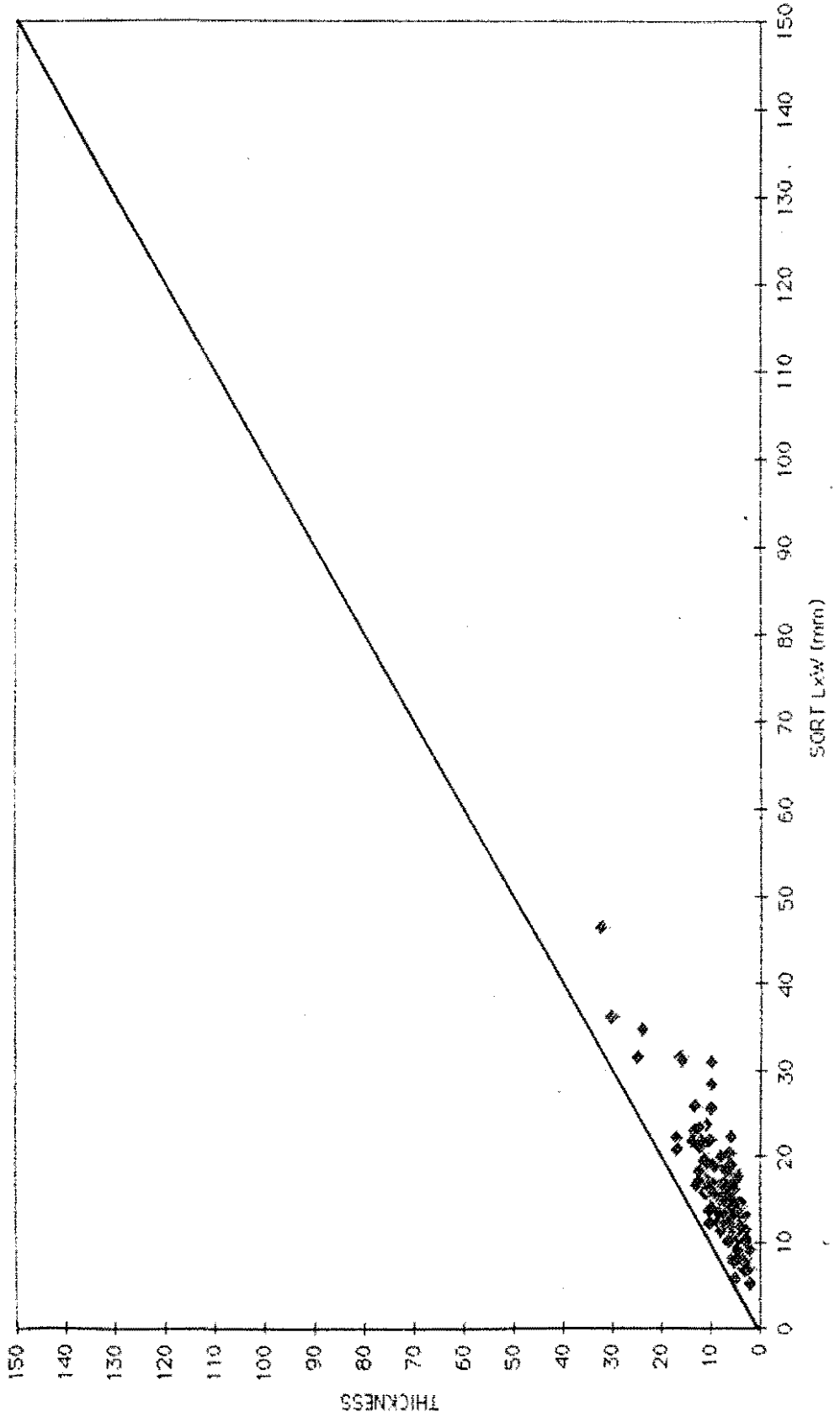
III-5-I Goonerah Lagoon Microliths



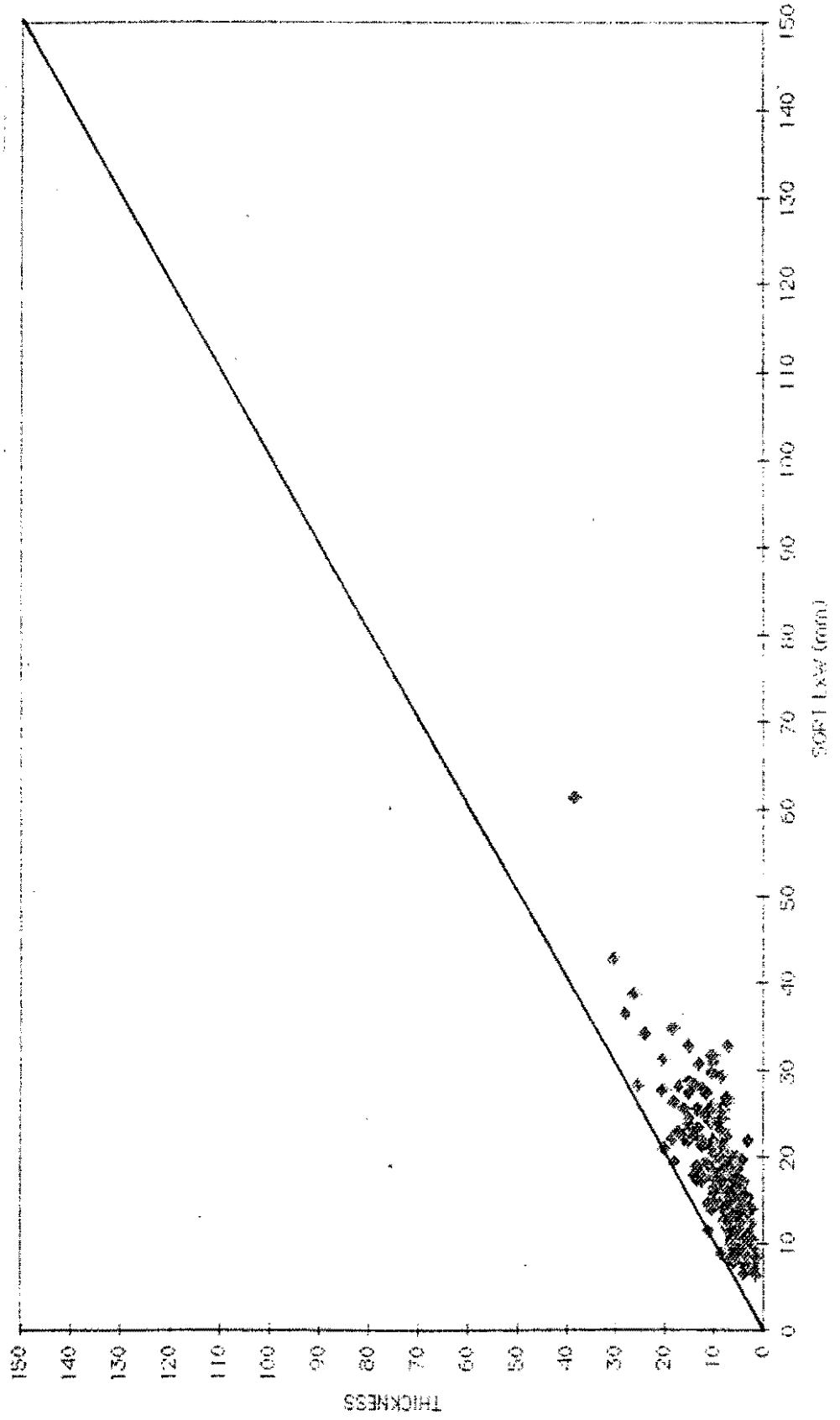
III-5-m Goonerah Lagoon Manuports



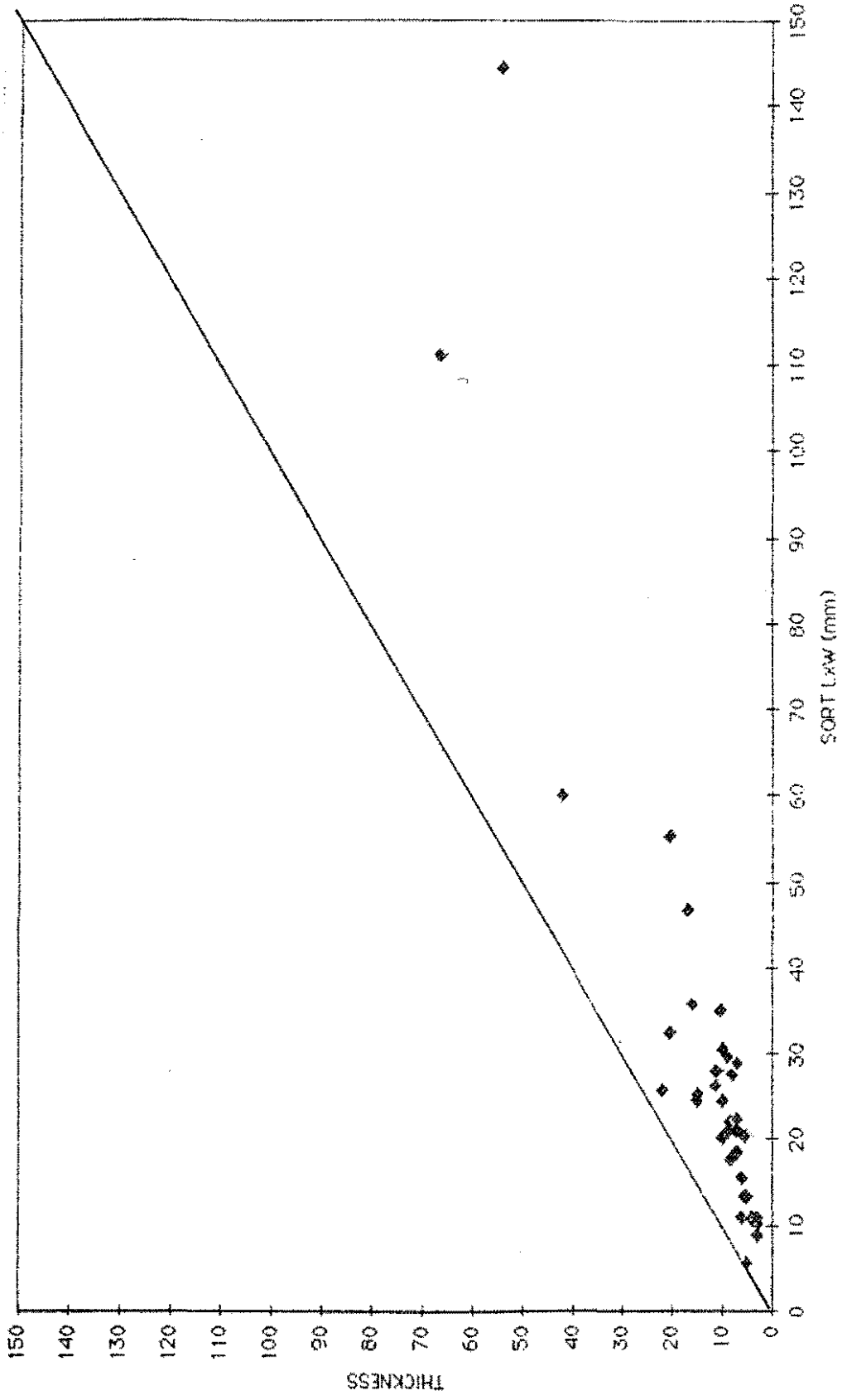
III-5-n Goonerah Lagoon All Quartz



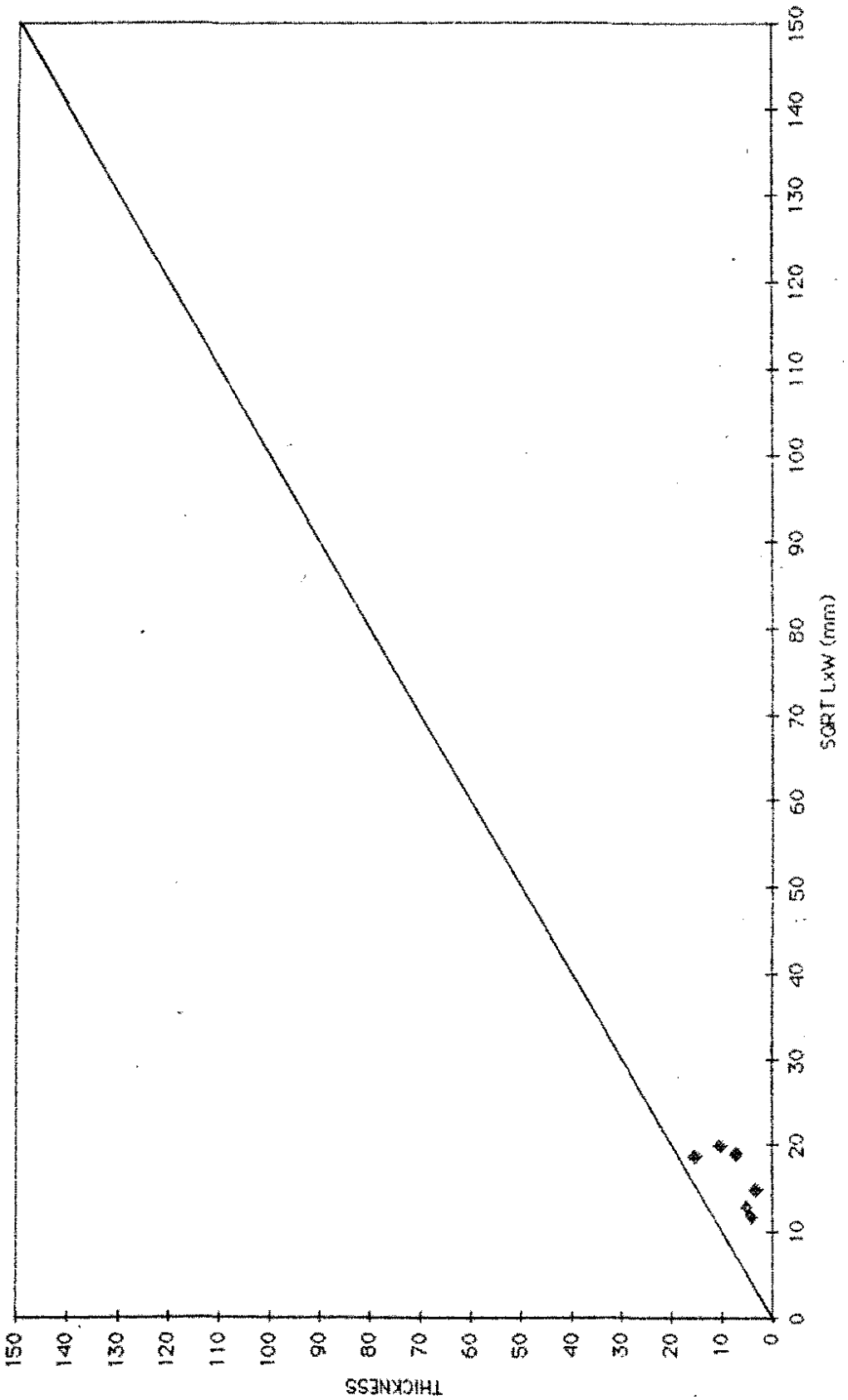
III-5-o Goonerah Lagoon All Silcrete



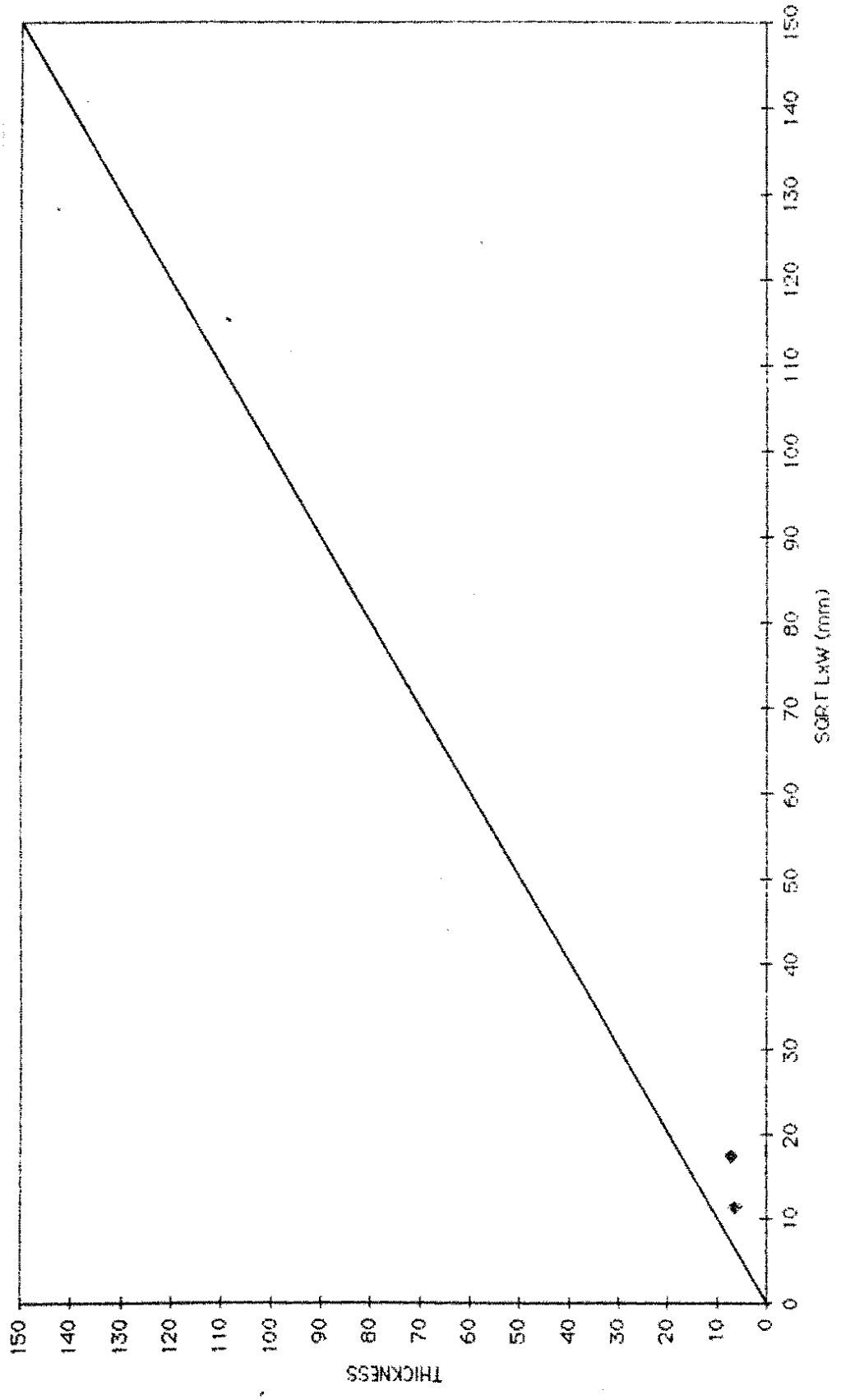
III-5-p Goonerah Lagoon All Quartzite



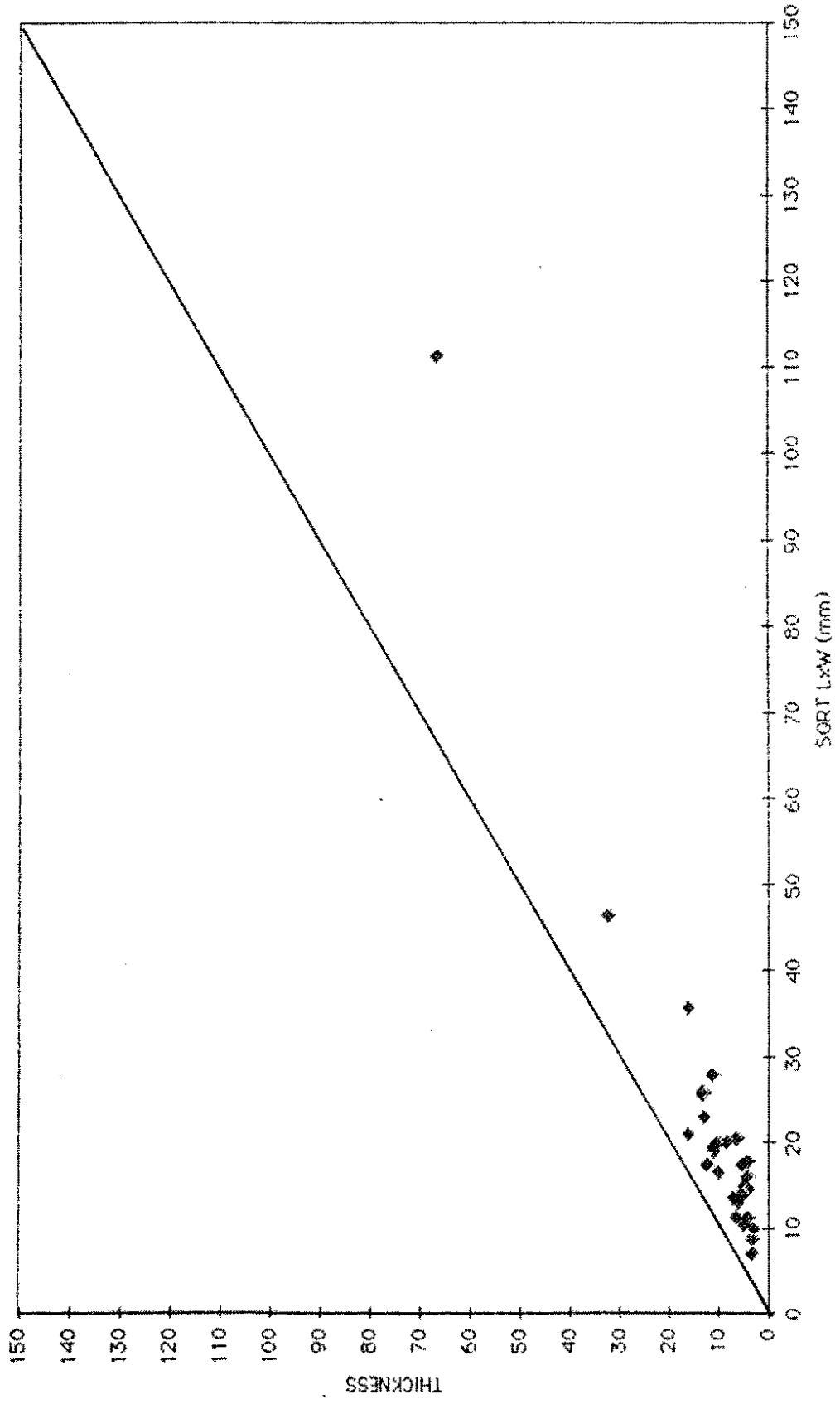
III-5-q Goonerah Lagoon All Chert



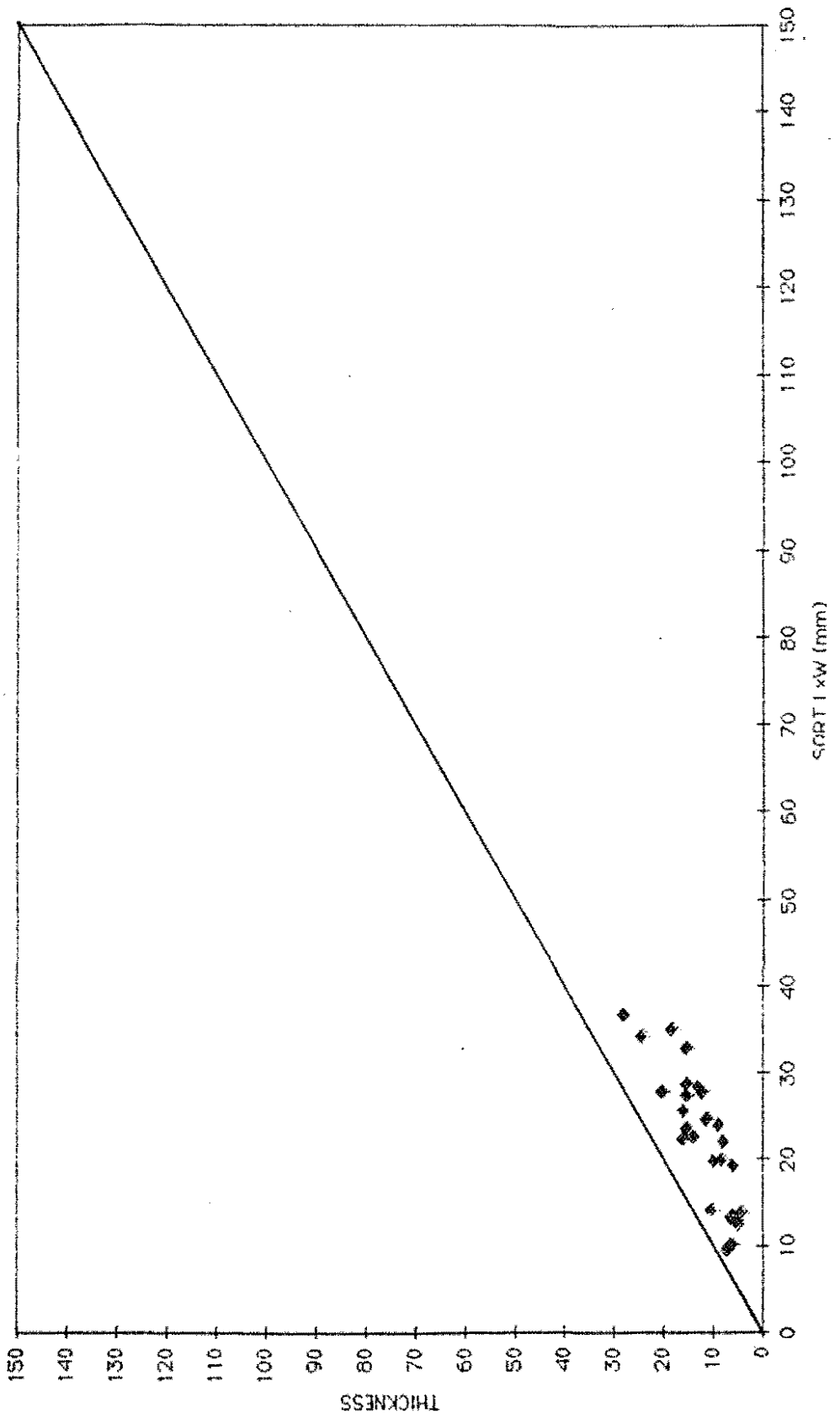
III-5-r Goonerah Lagoon All Chalcedony



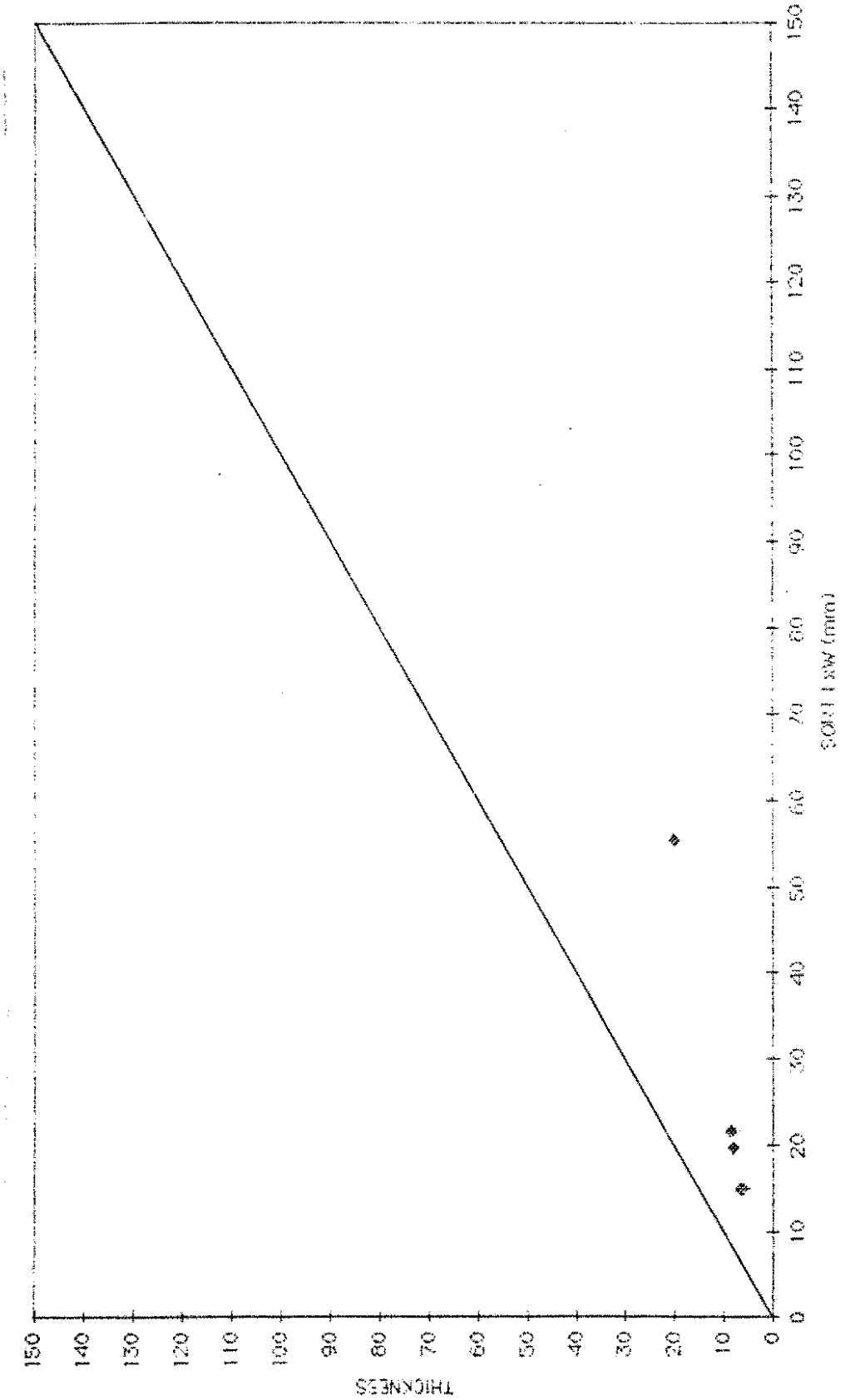
III-5-s Goonerah Lagoon Pebble Cortex



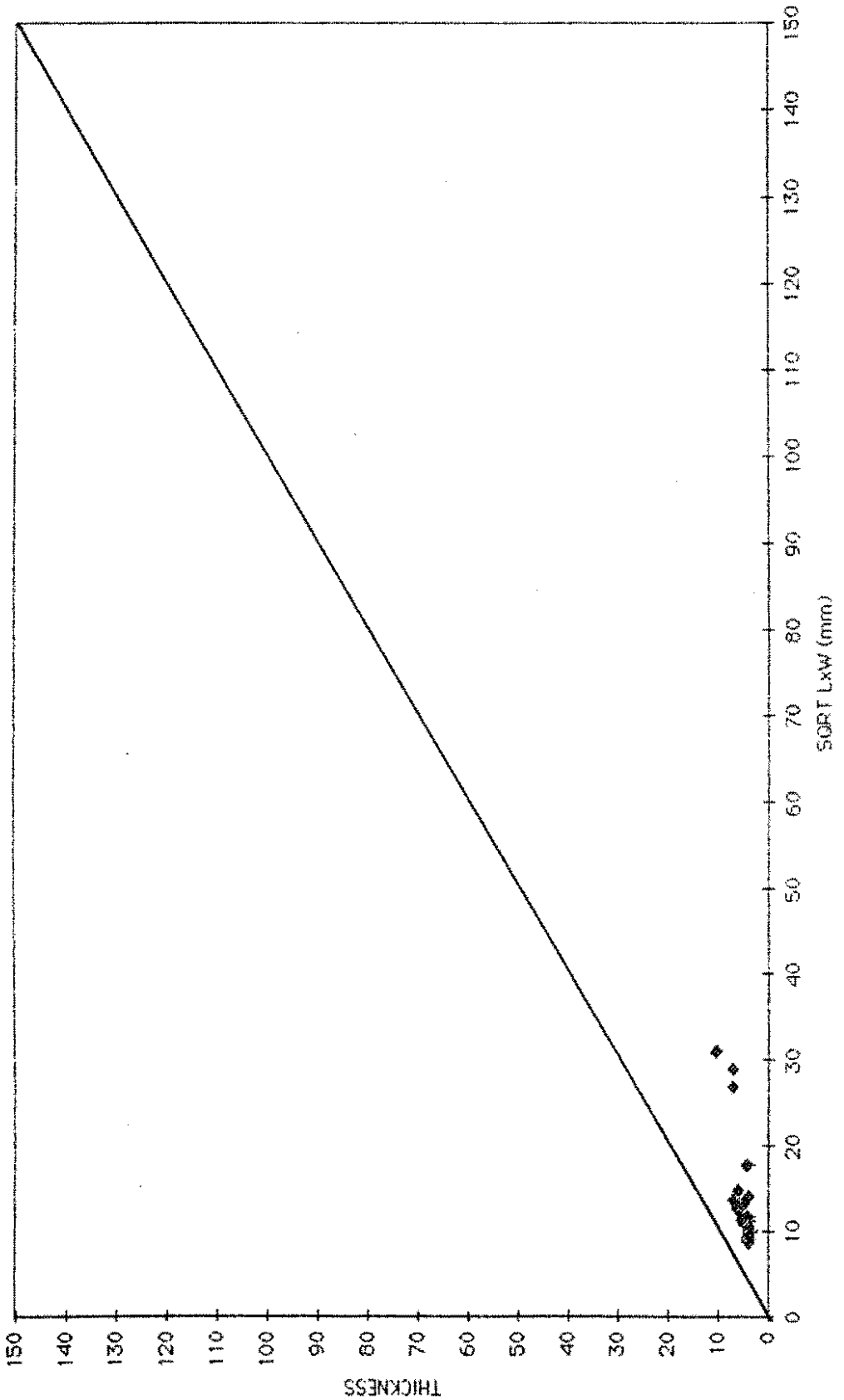
III-5-t Goonerah Lagoon Quarry Cortex



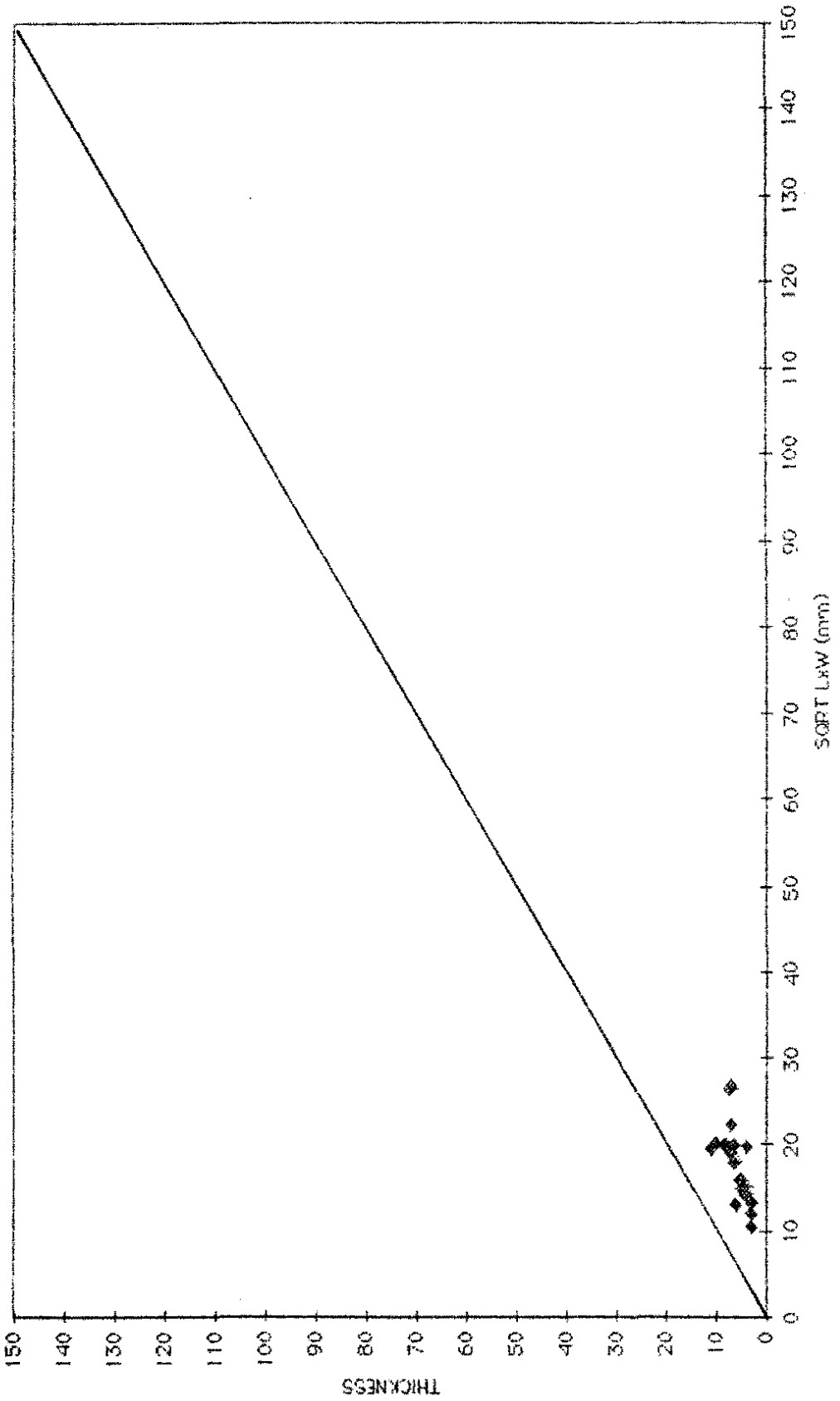
III-5-u Goonerah Lagoon Patinated Artefacts



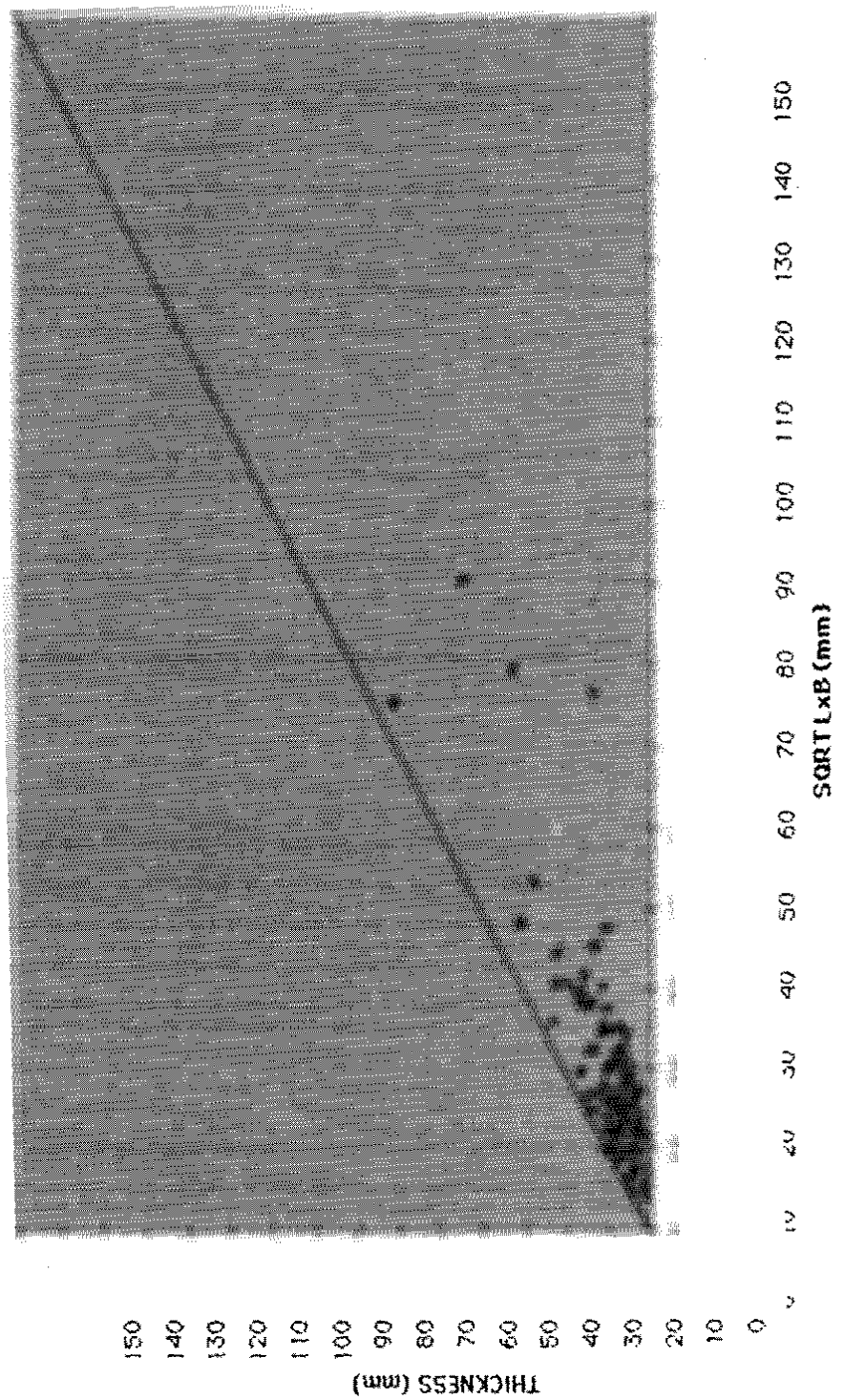
III-5-v Goonerah Lagoon Retouch



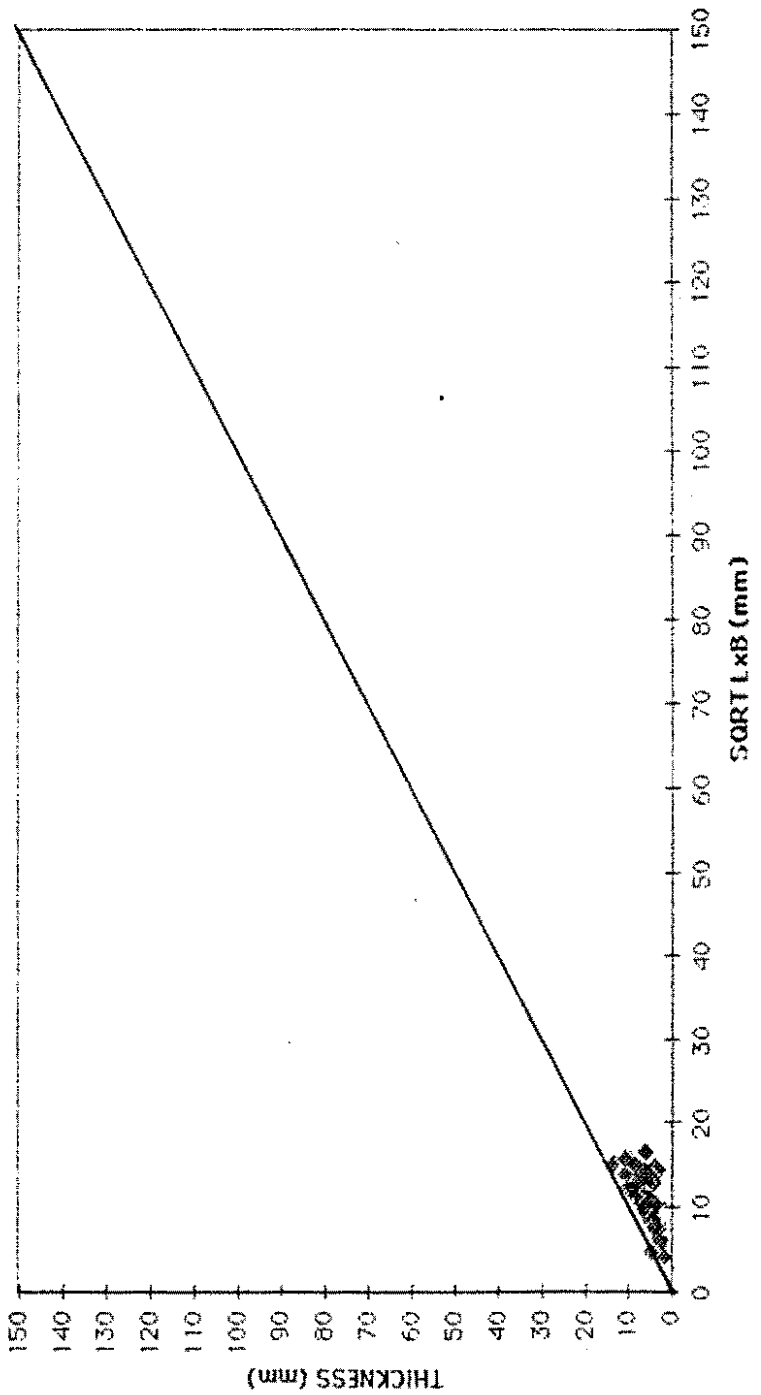
III-5-w Goonerah Lagoon Usewear



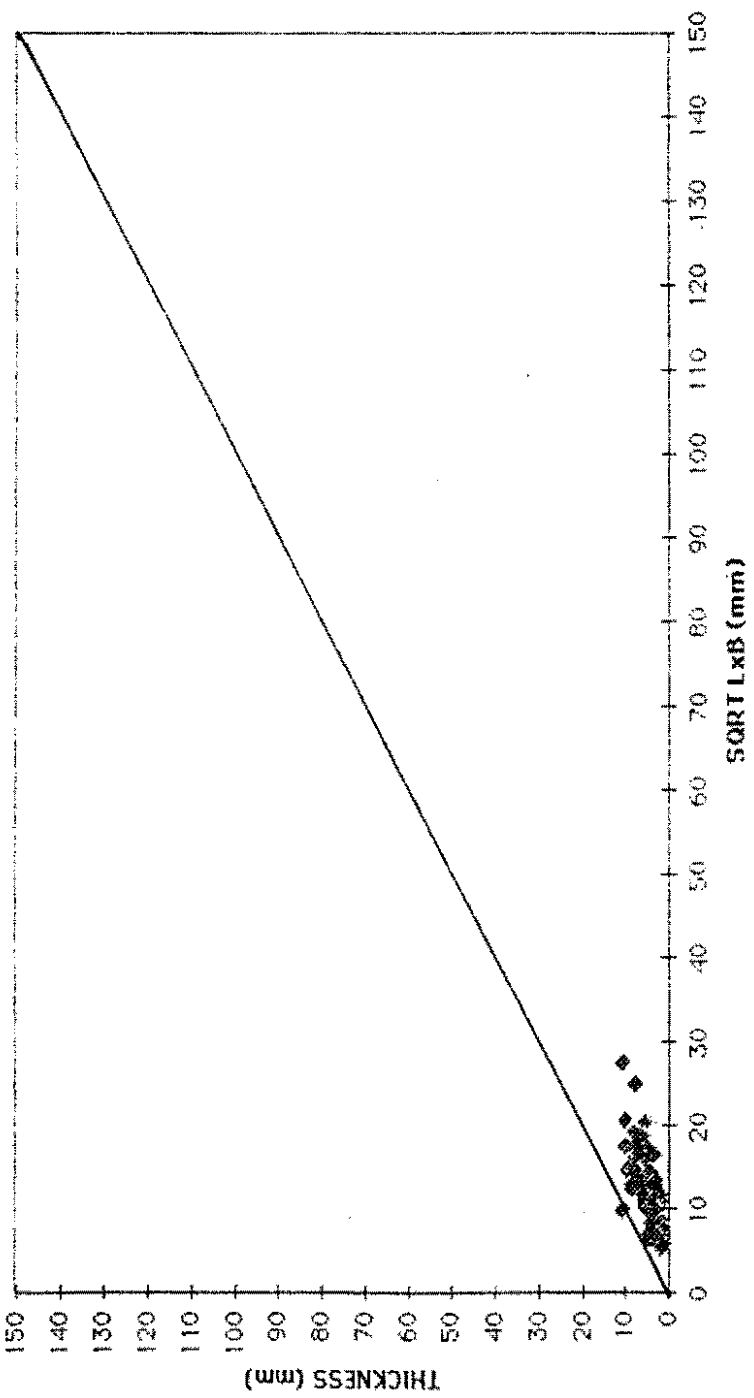
III-6-a Cooey Point Lagoon All Artefacts



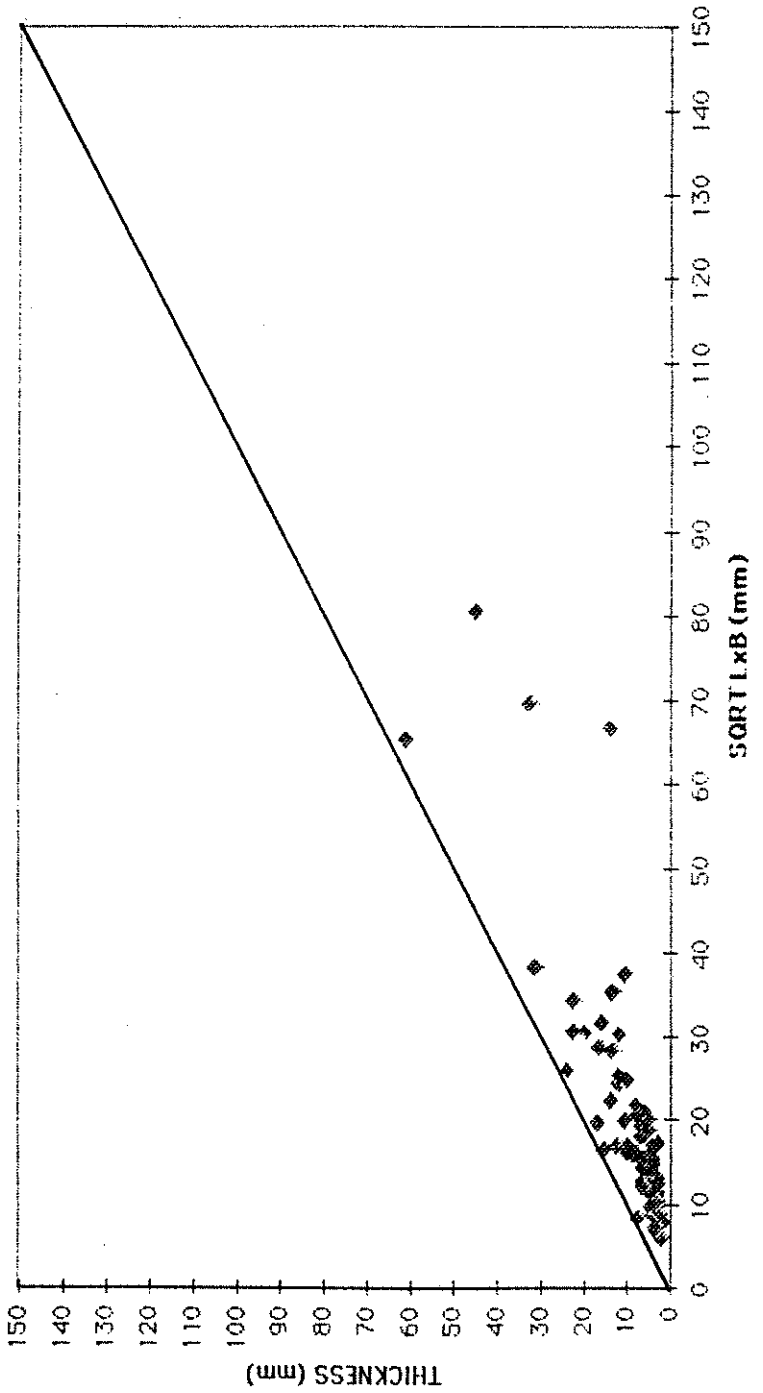
III-6-b Cooey Point Lagoon All Quartz



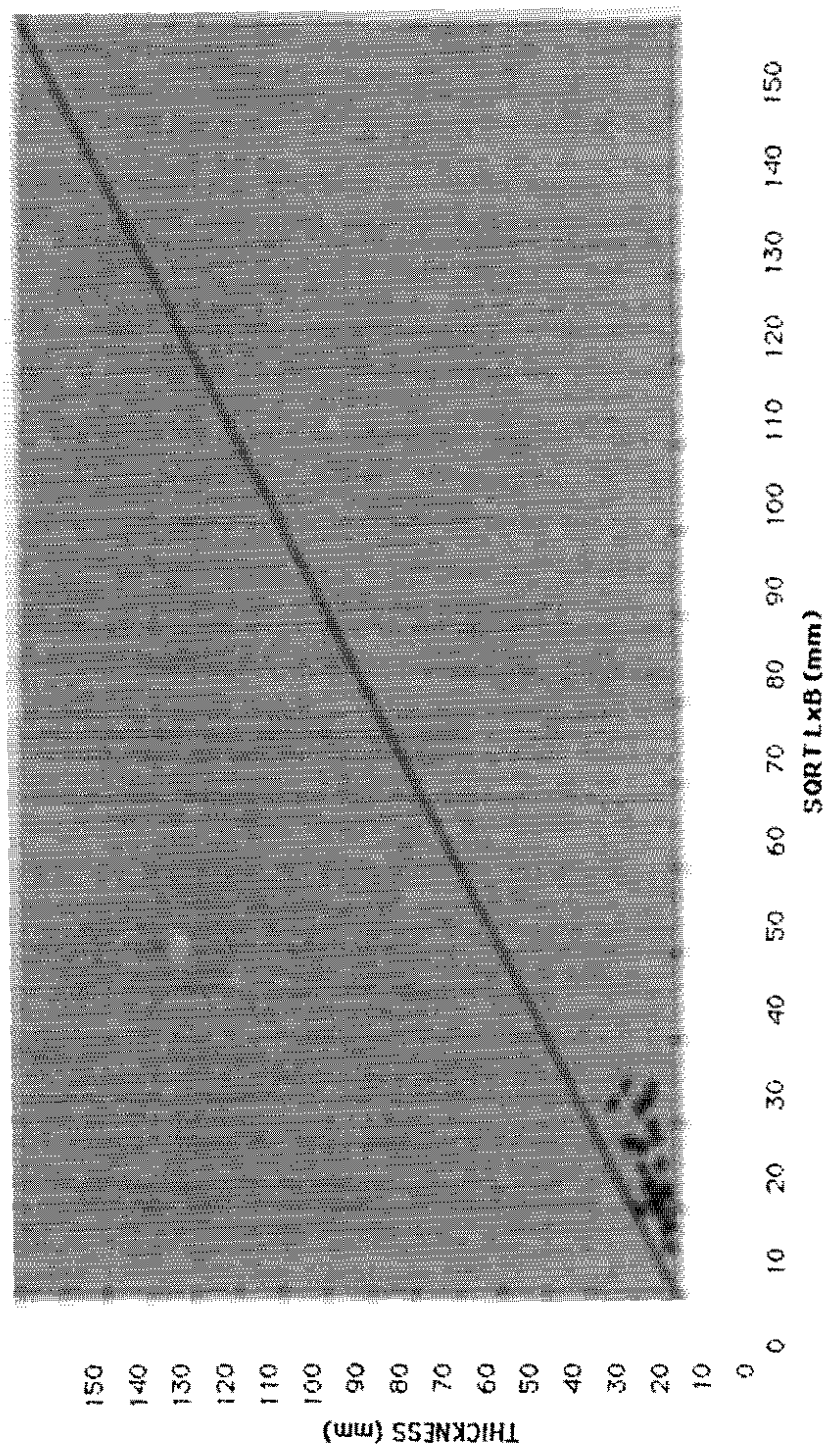
III-6-c Cooey Point Lagoon All Silcrete



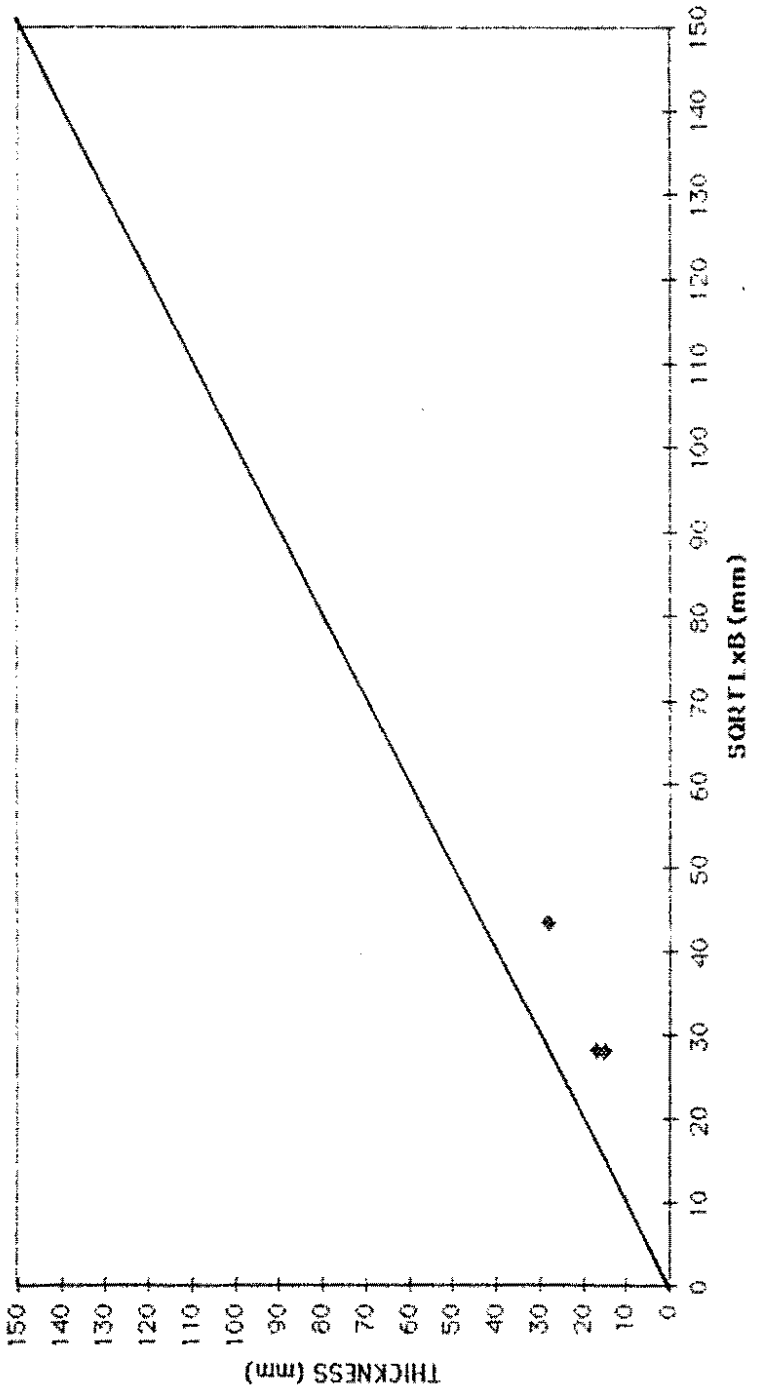
III-6-d Cooey Point Lagoon All Quartzite



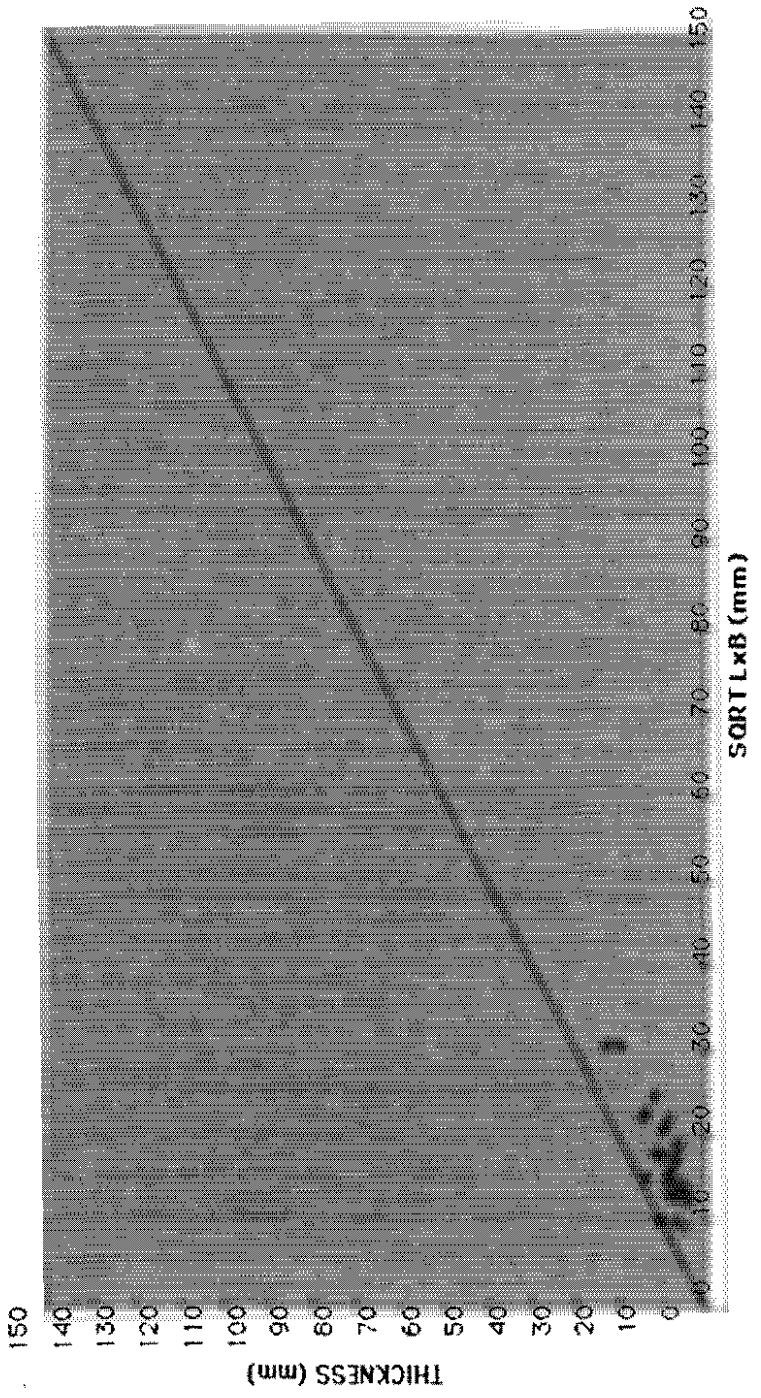
III-6-e Cooey Point Lagoon All Chert



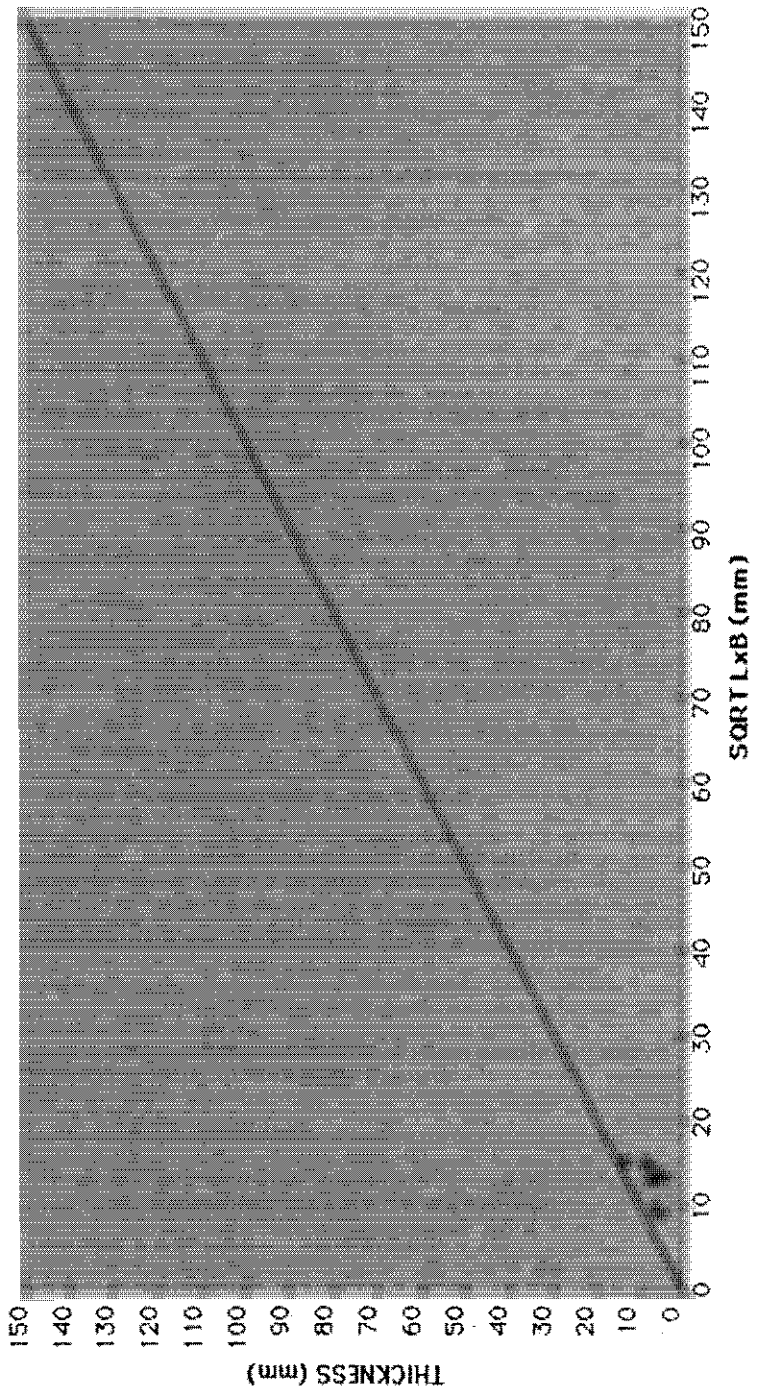
III-6-f Cooey Point Lagoon All Sandstone



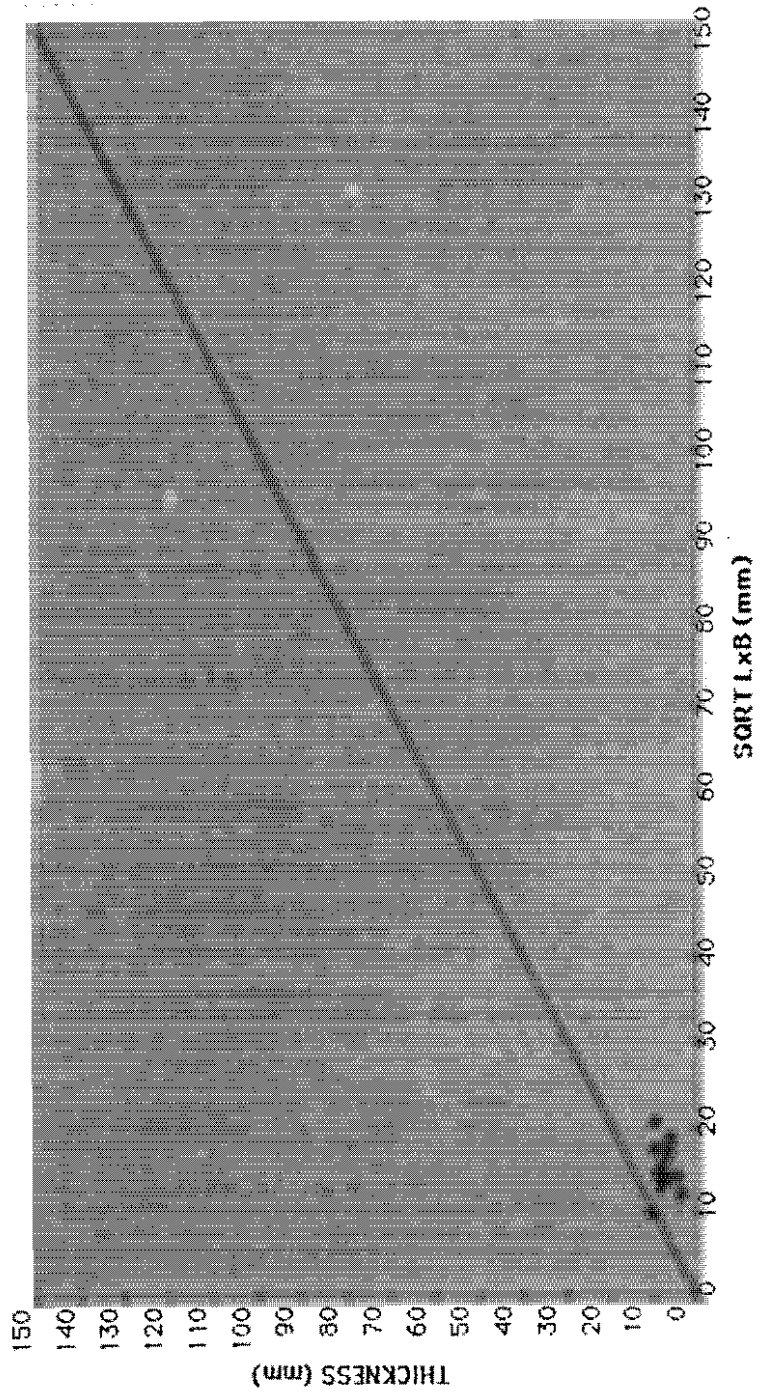
III-6-g Cooey Point Lagoon All Cores



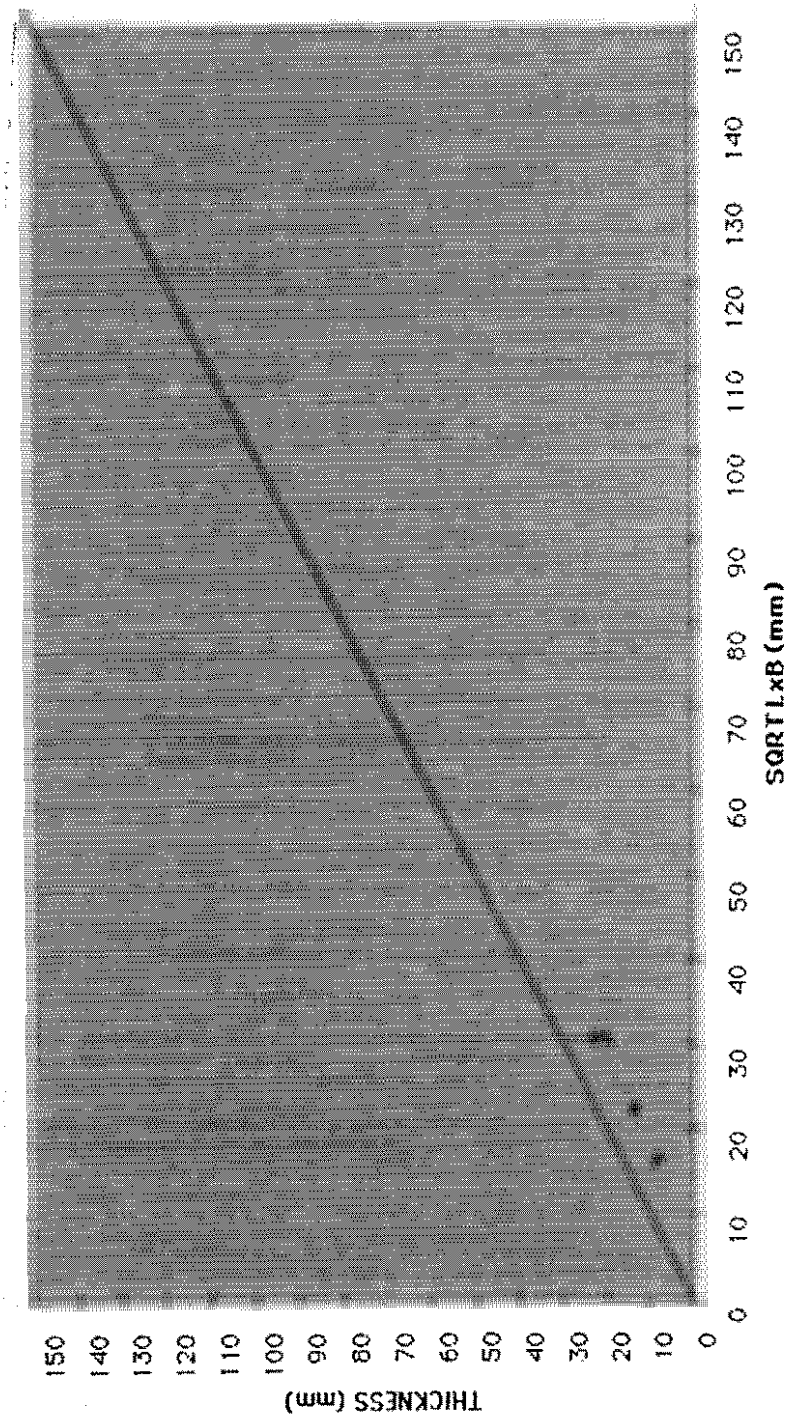
III-6-h Cooey Point Lagoon Quartz Cores



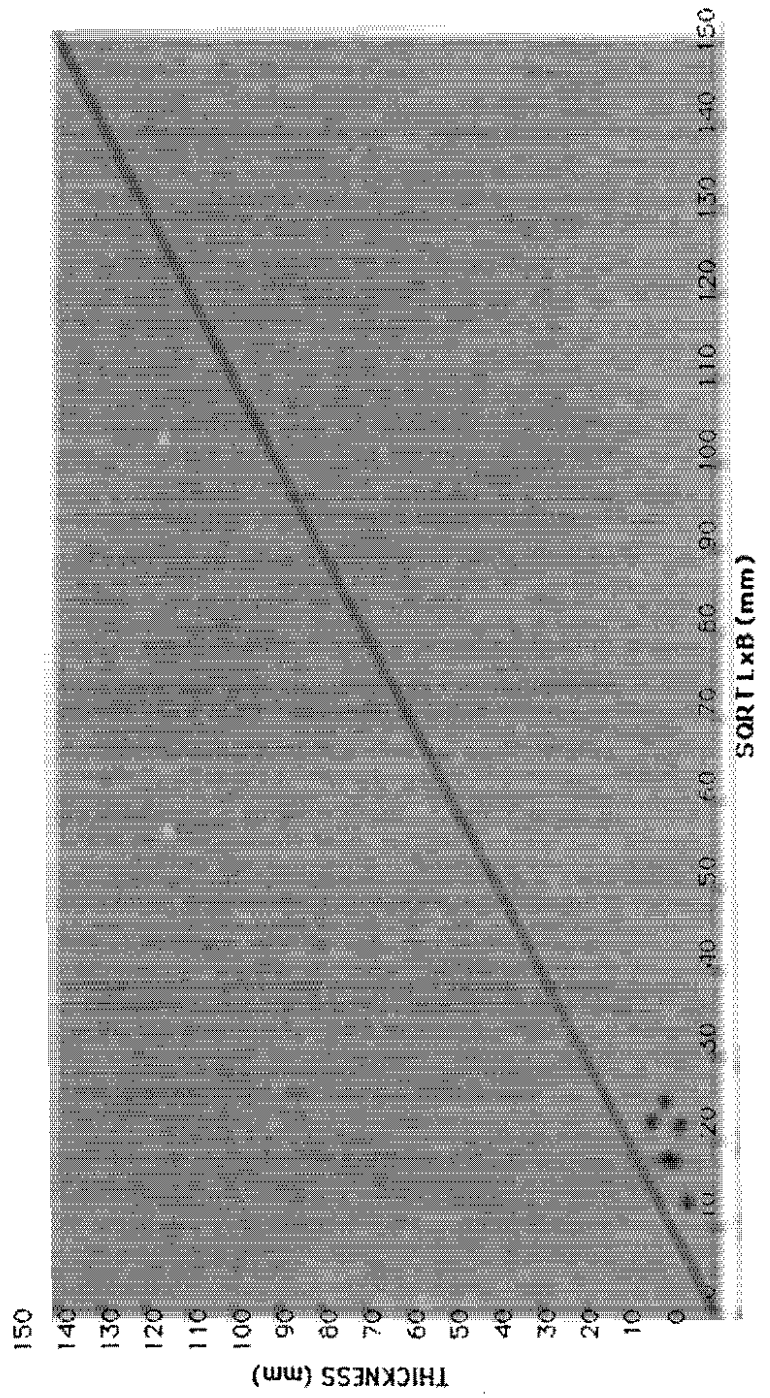
III-6-i Cooey Point Lagoon Silcrete Cores



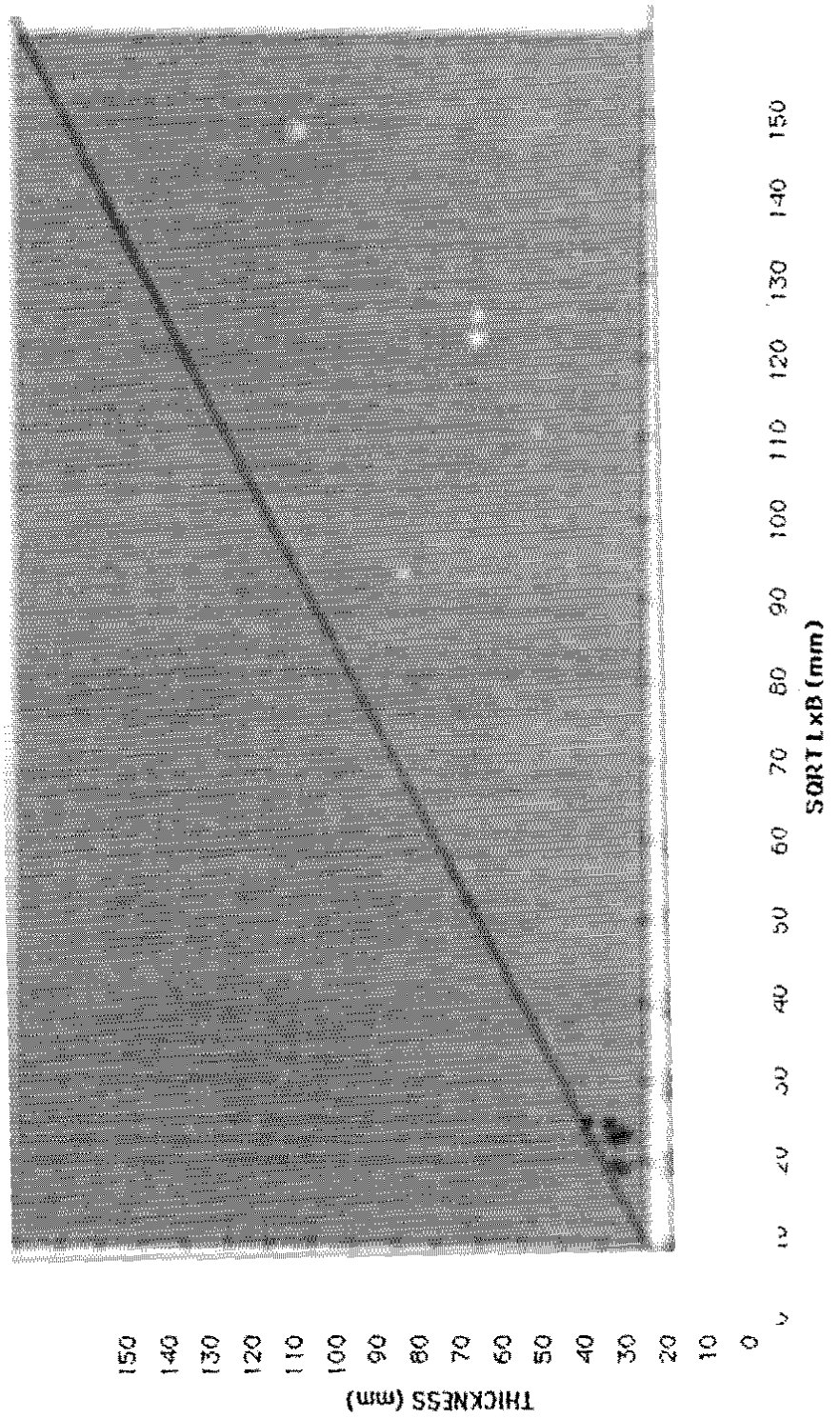
III-6-j Cooey Point Lagoon Quartzite Cores



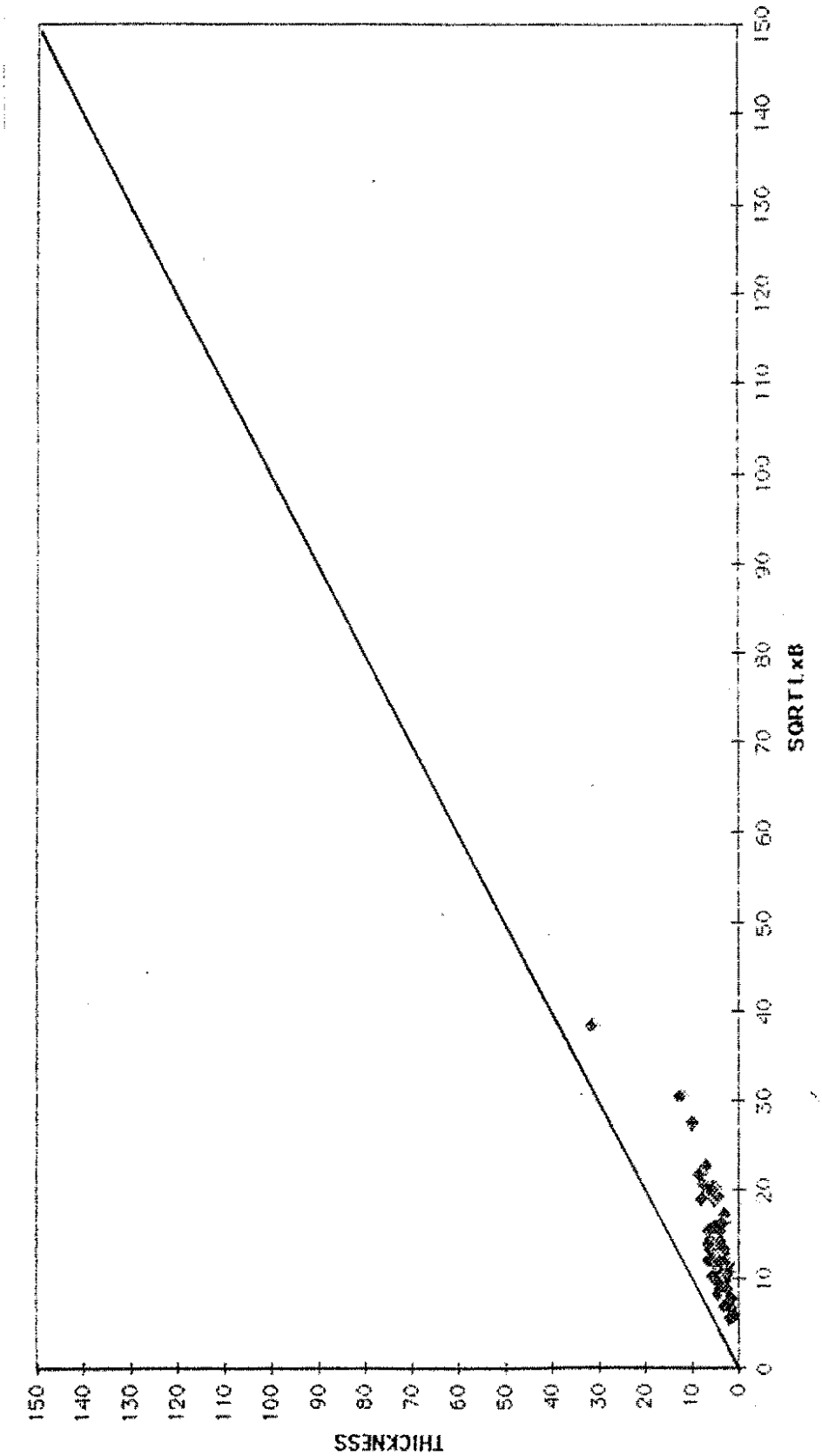
III-6-k Cooey Point Lagoon Chert Cores



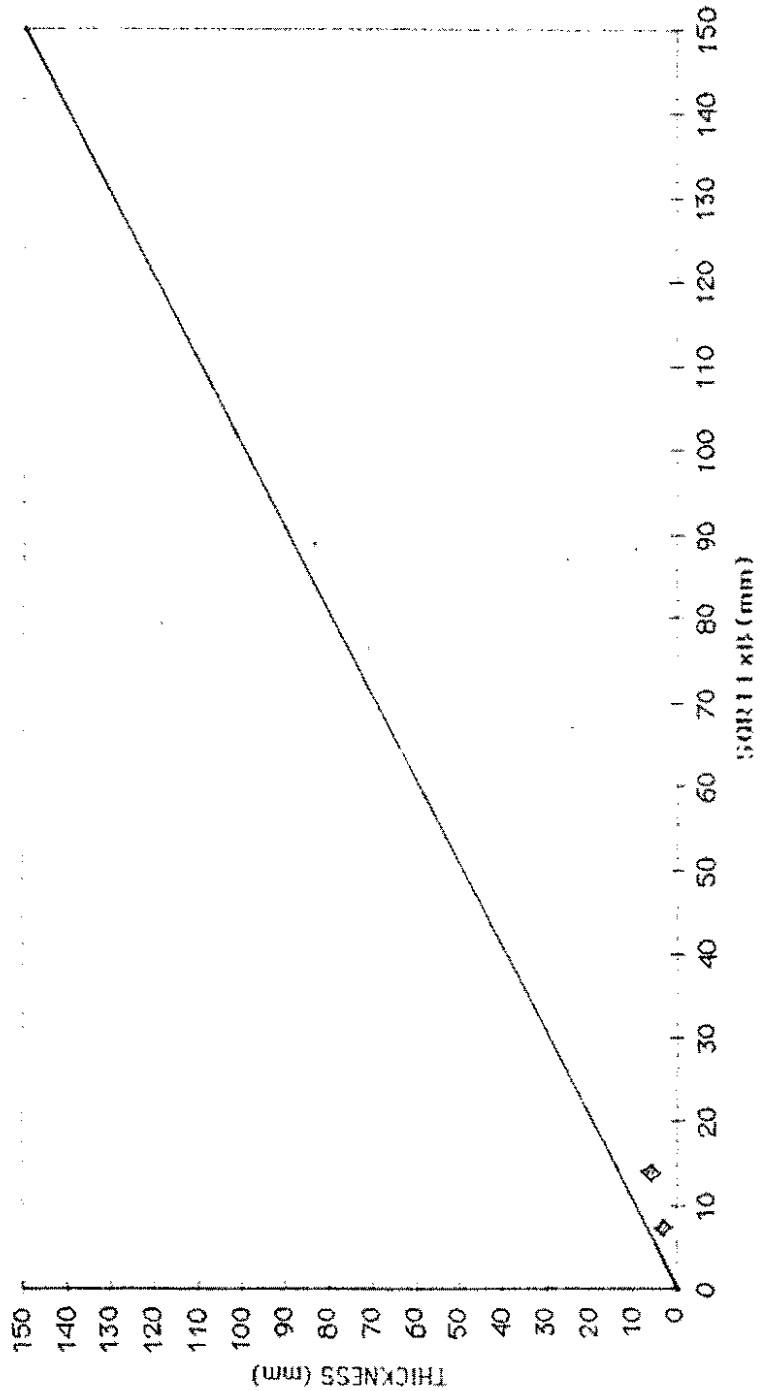
III-6-1 Cooey Point Lagoon Bipolar Cores



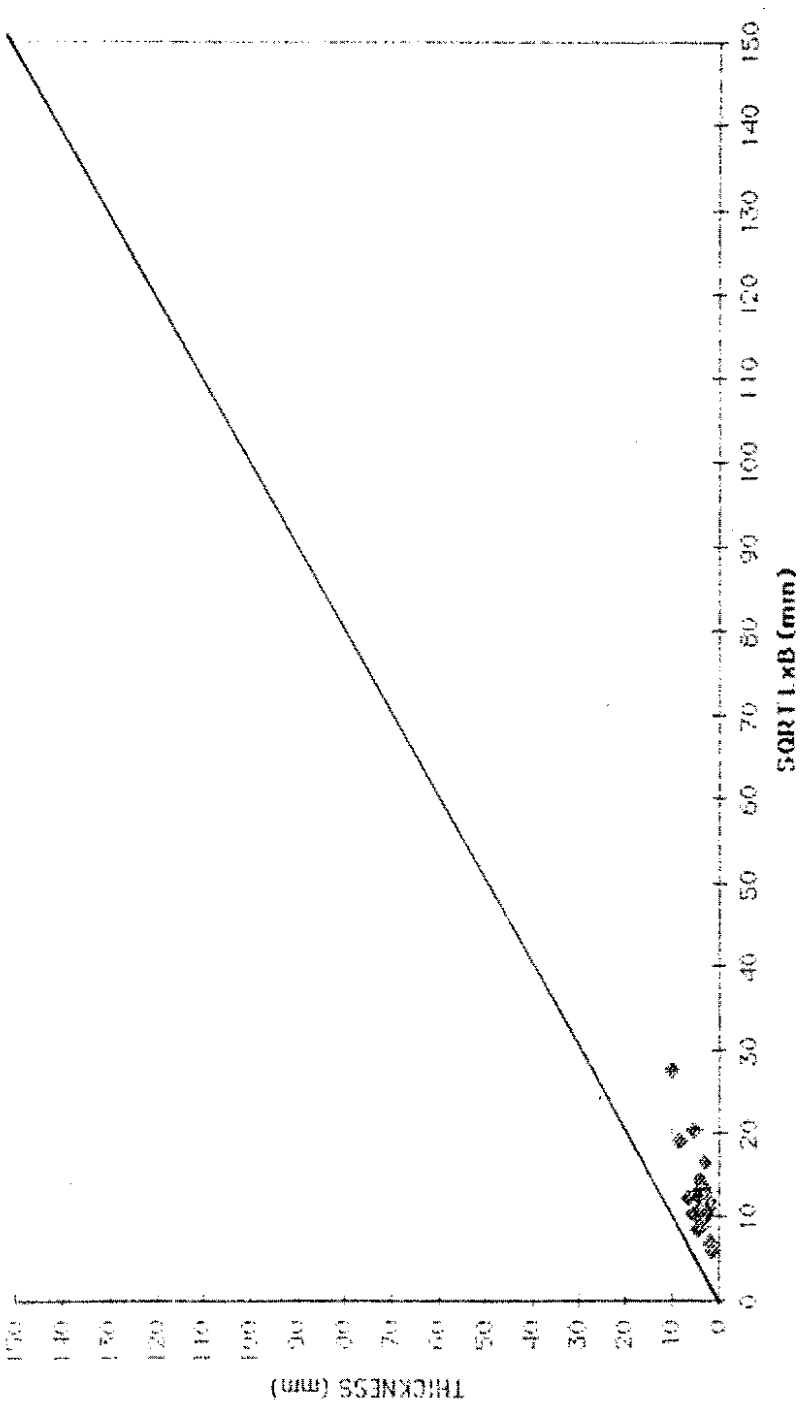
III-6-m Cooey Point Lagoon All Flakes and Blades



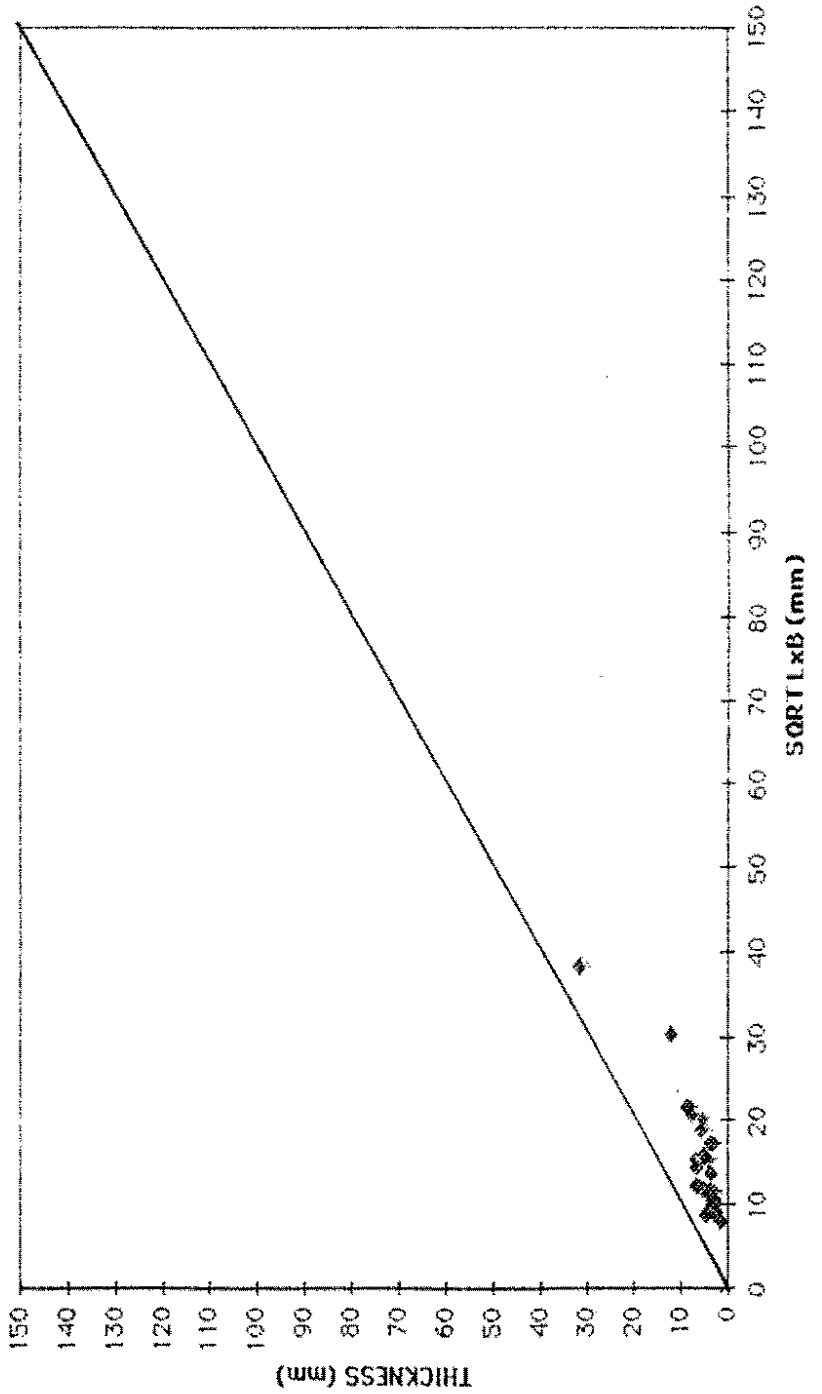
III-6-n Cooey Point Lagoon Flakes and Blades quartz



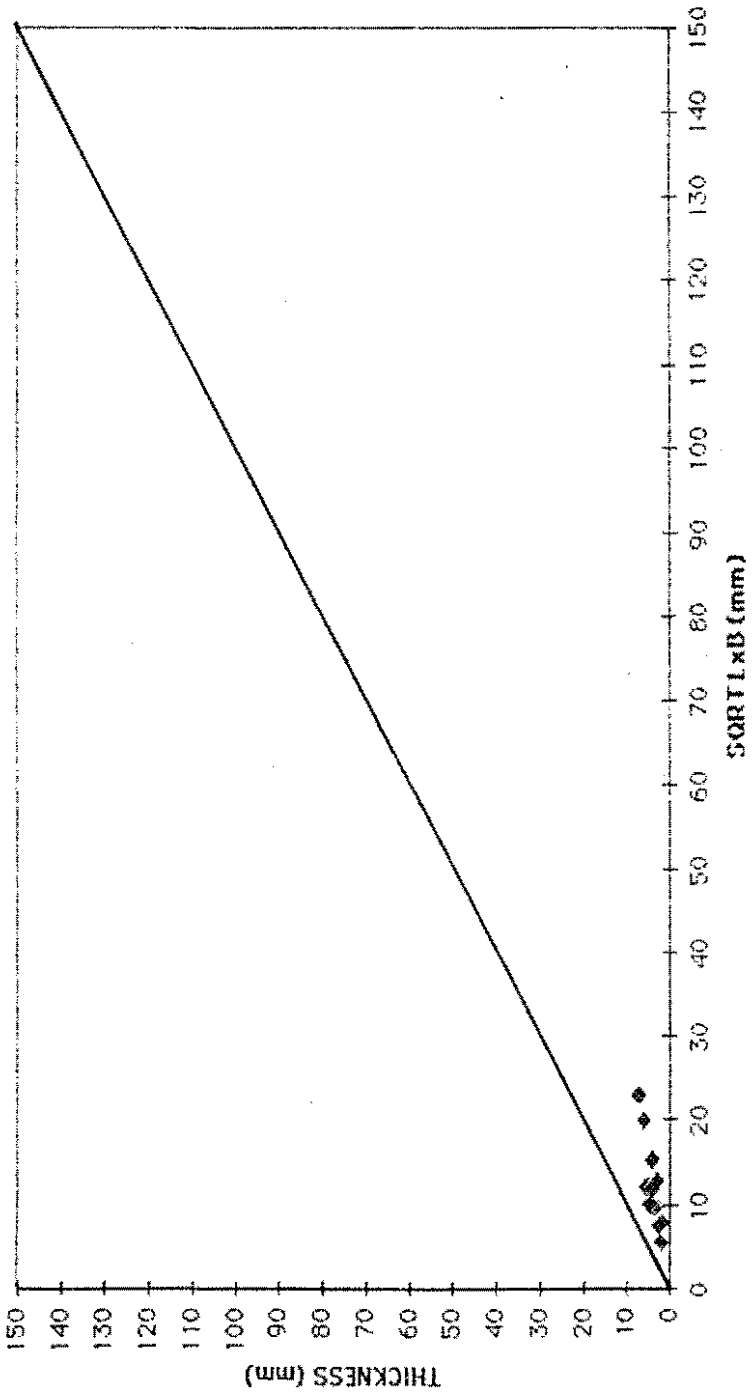
III-6-o Cooey Point Lagoon Flakes and Blades Silcrete



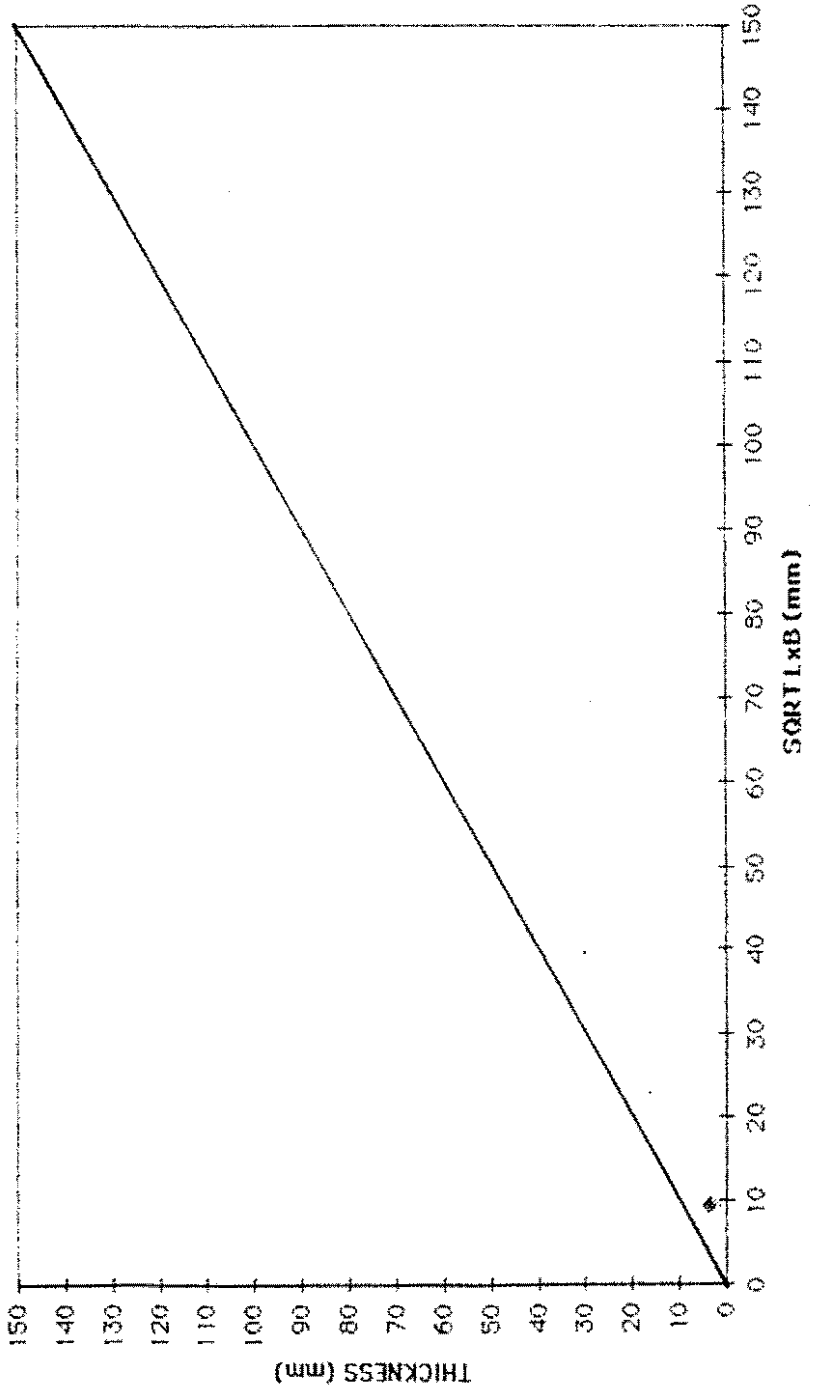
III-6-p Cooey Point Lagoon Flakes and Blades Quartzite



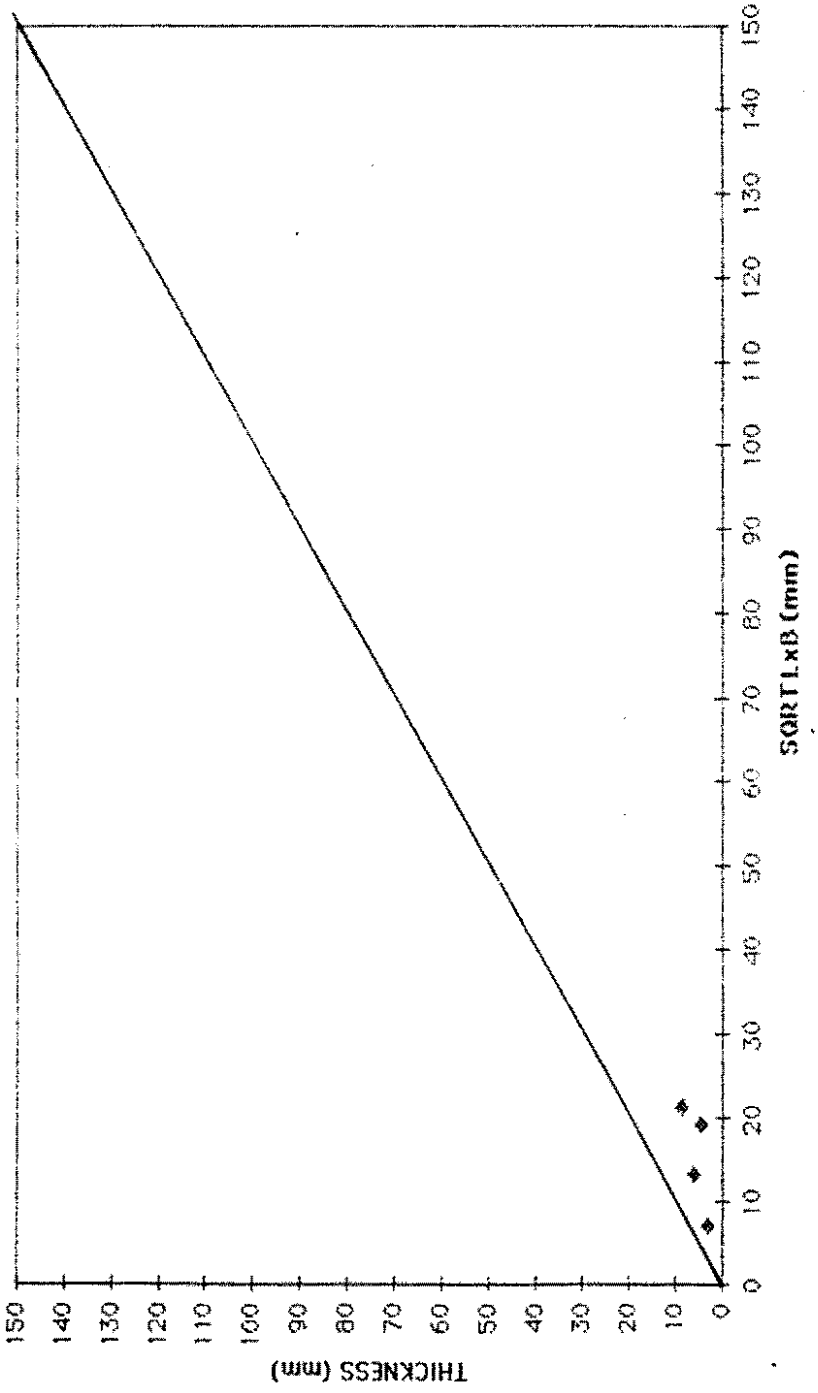
III-6-q Cooey Point Lagoon Flakes and Blades Chert



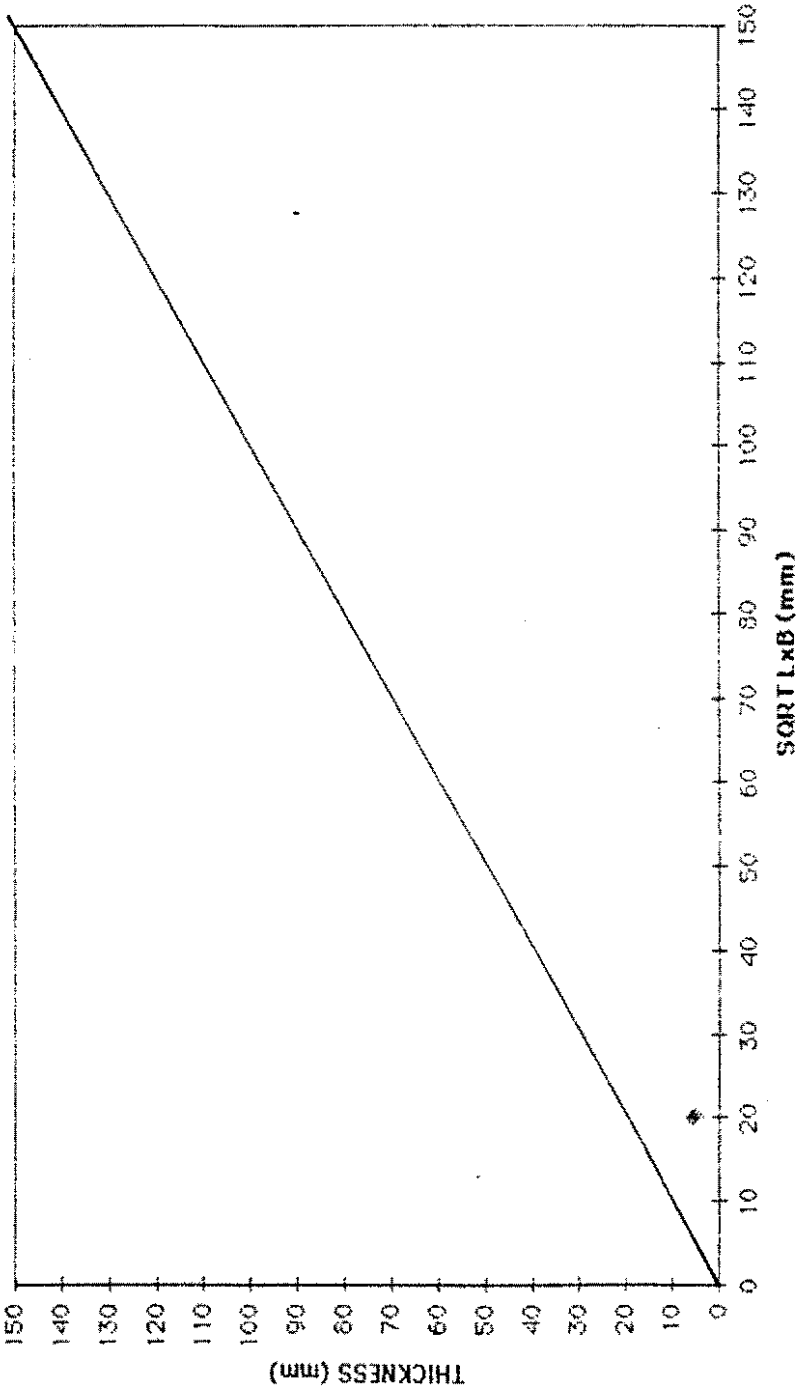
III-6-r Cooey Point Lagoon Flakes and Blades Chalcedony



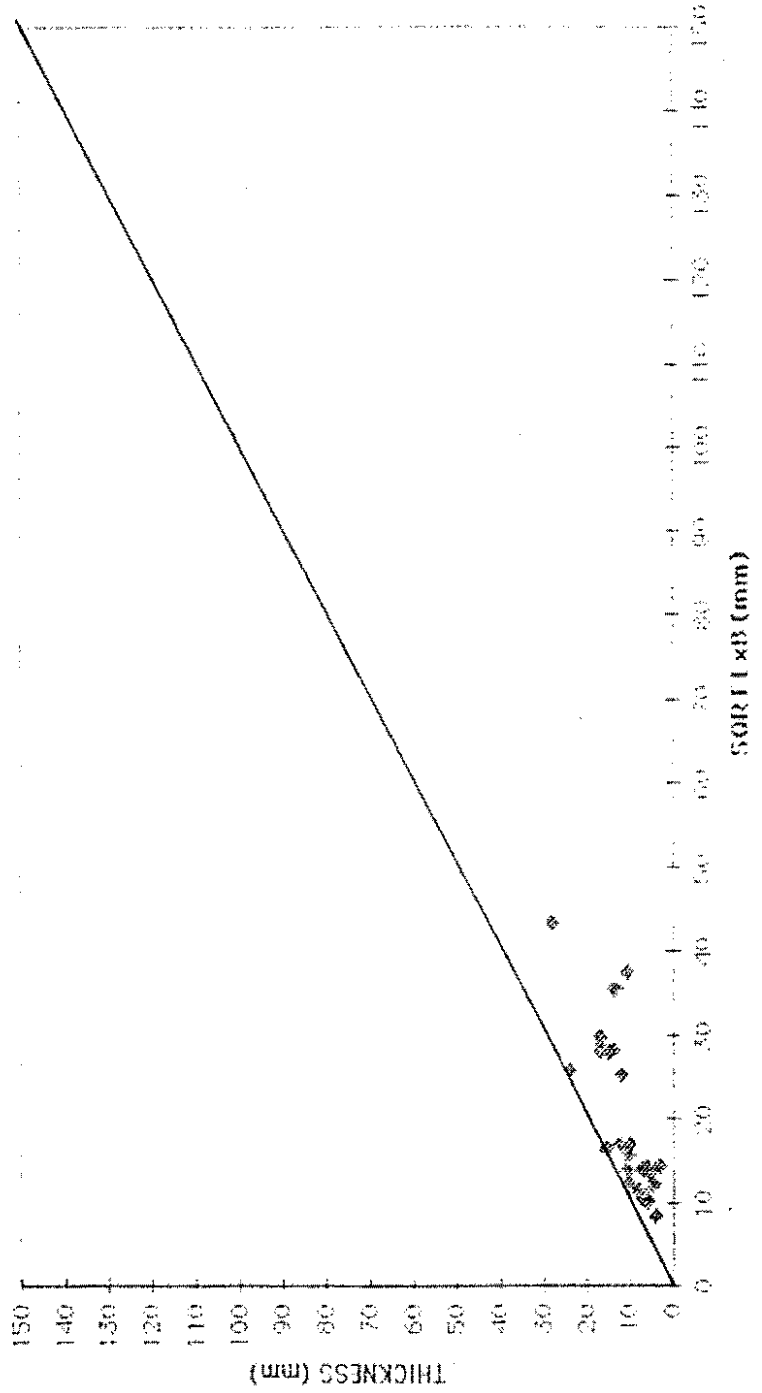
III-6-s Cooey Point Lagoon Flake and Blades Conglomerate



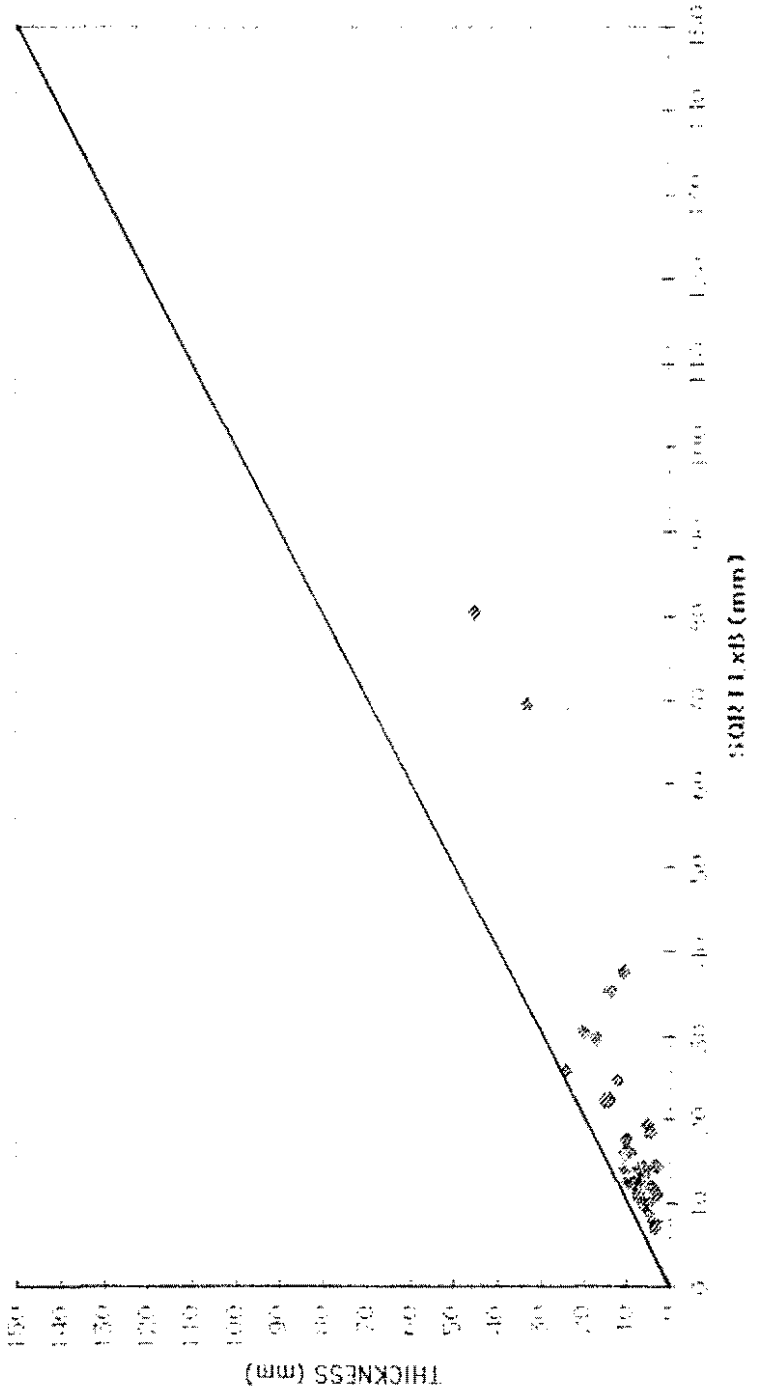
III6-t Cooey Point Lagoon Flakes and Blades Metasedimentary



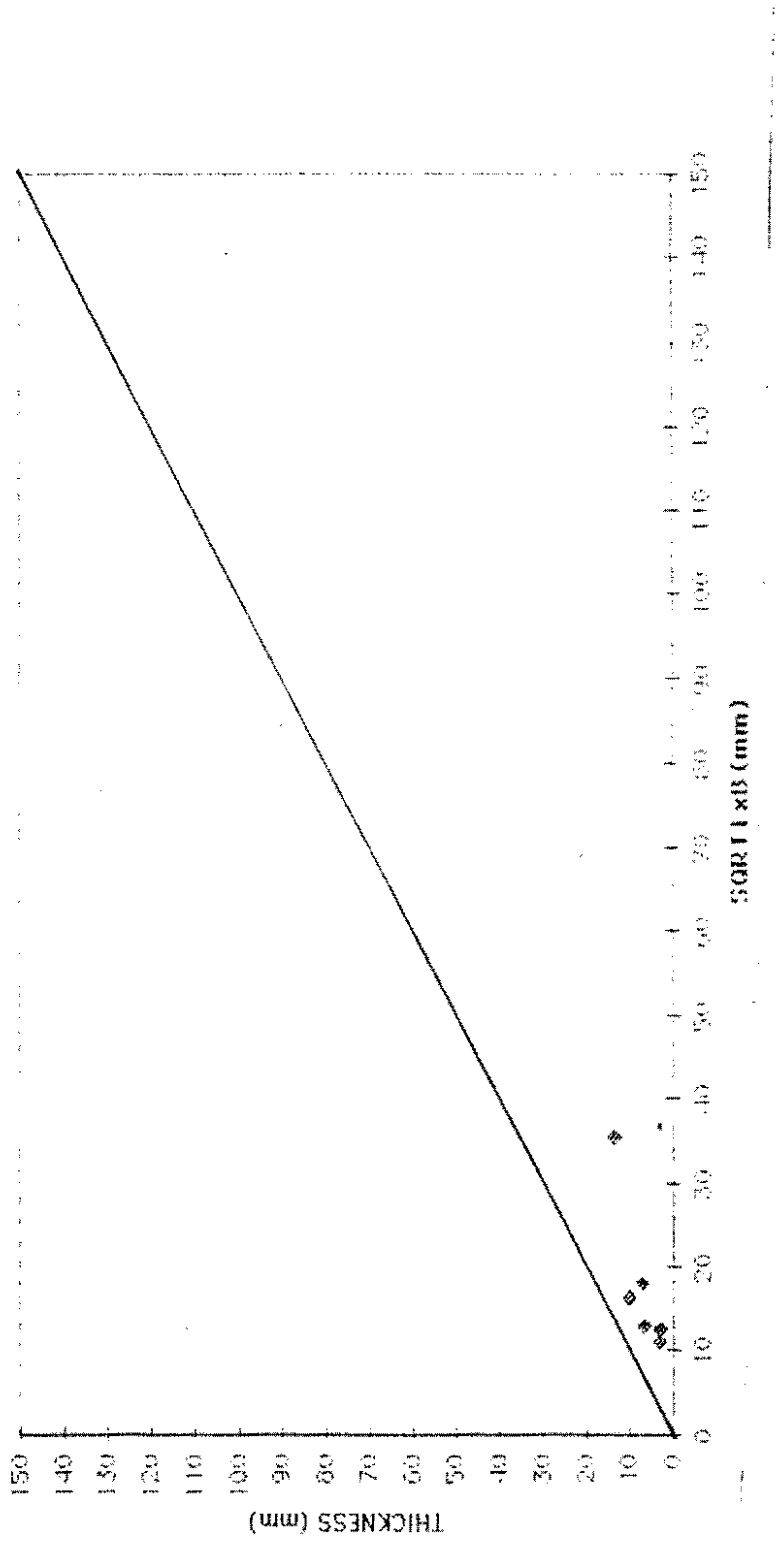
III-6-u Cooey Point Lagoon Manuports



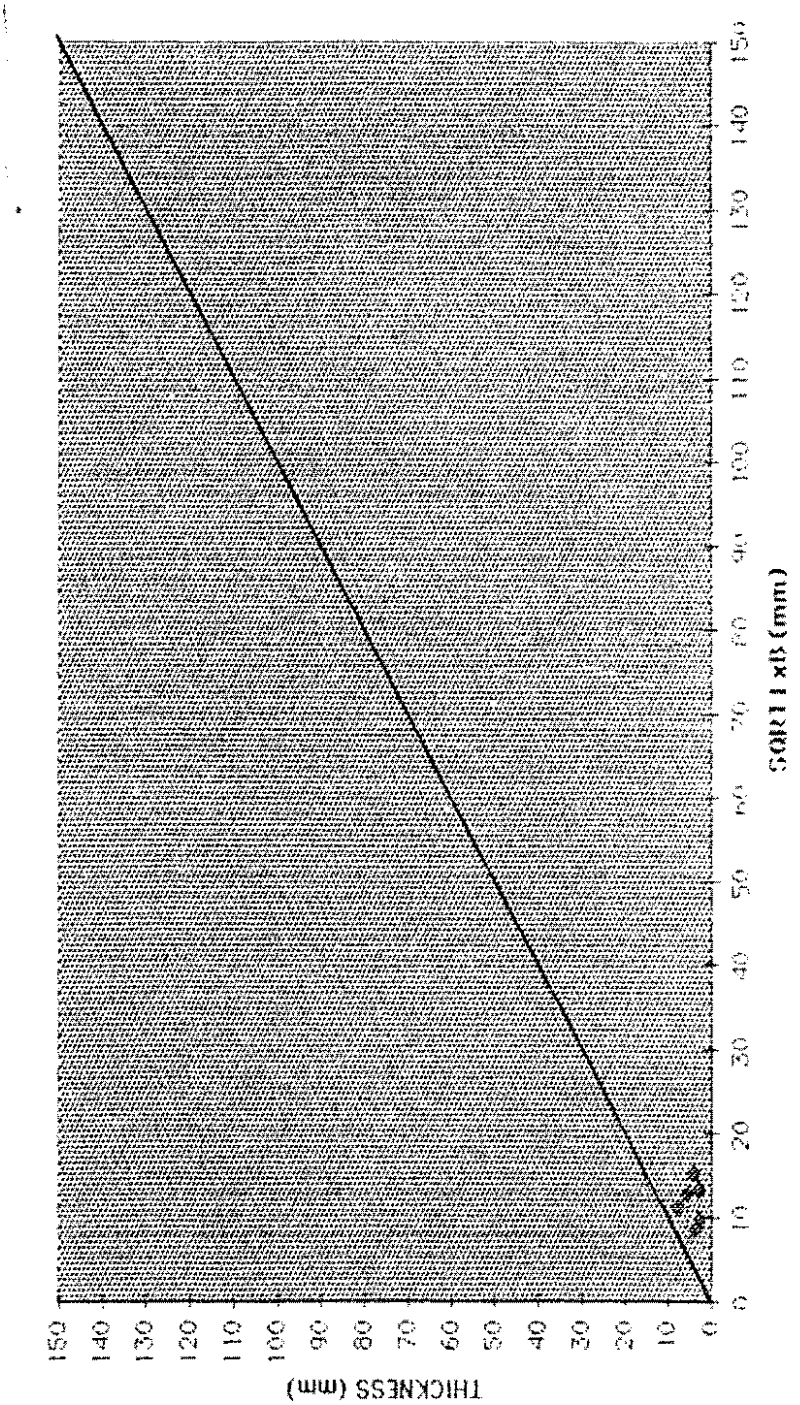
III-6-v Cooey Point Lagoon Pebble Cortex



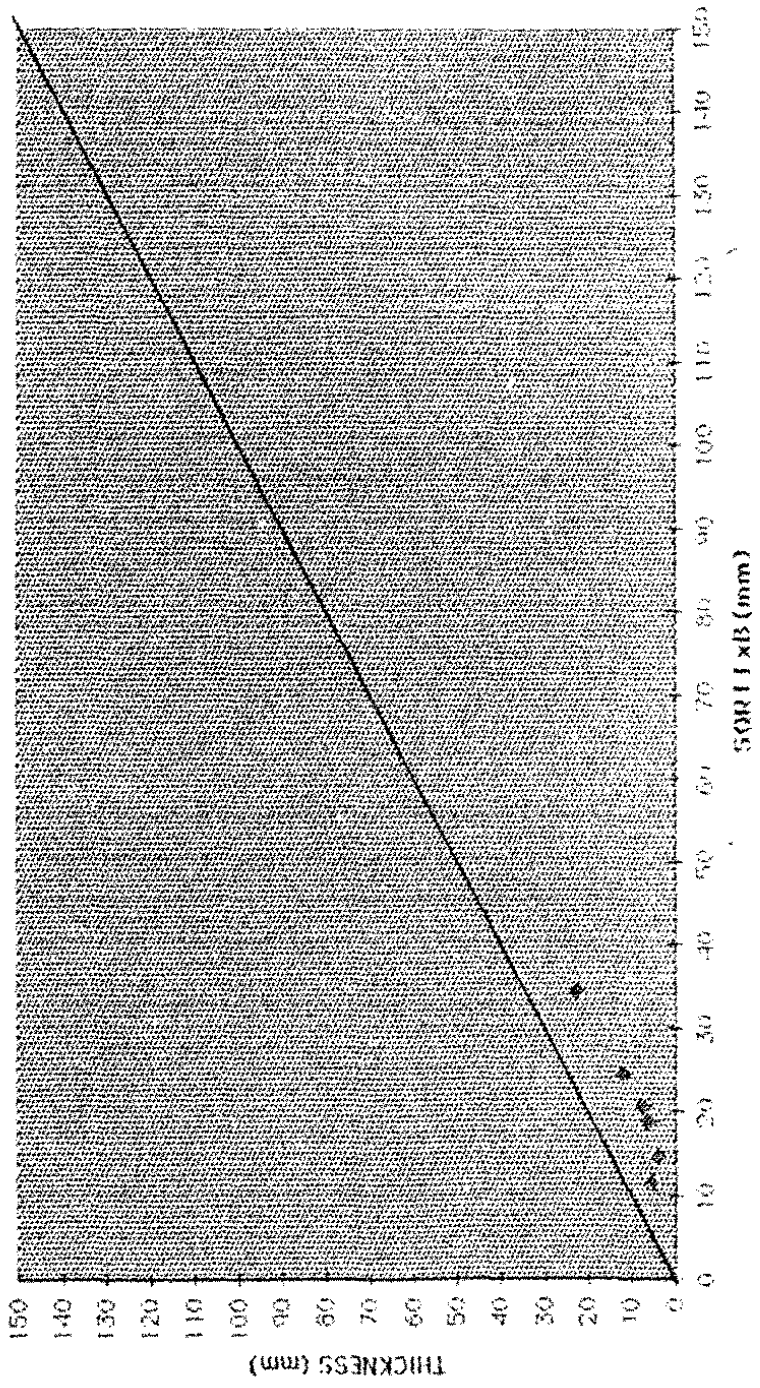
III-6-w Cooey Point Lagoon Patinated Artefacts



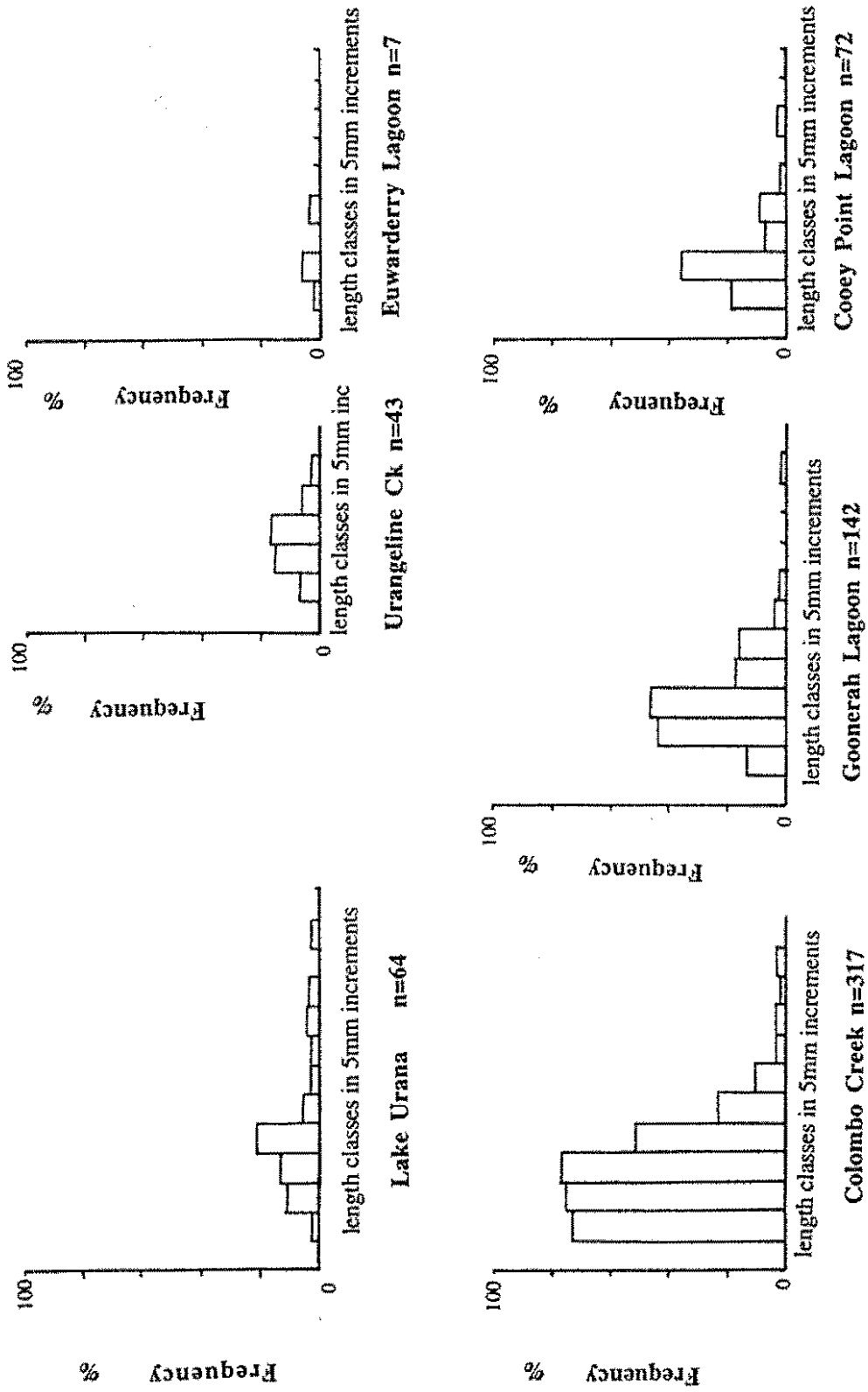
III-6-x Cooey Point Lagoon Retouch



III-6-y Cooey Point Lagoon Usewear

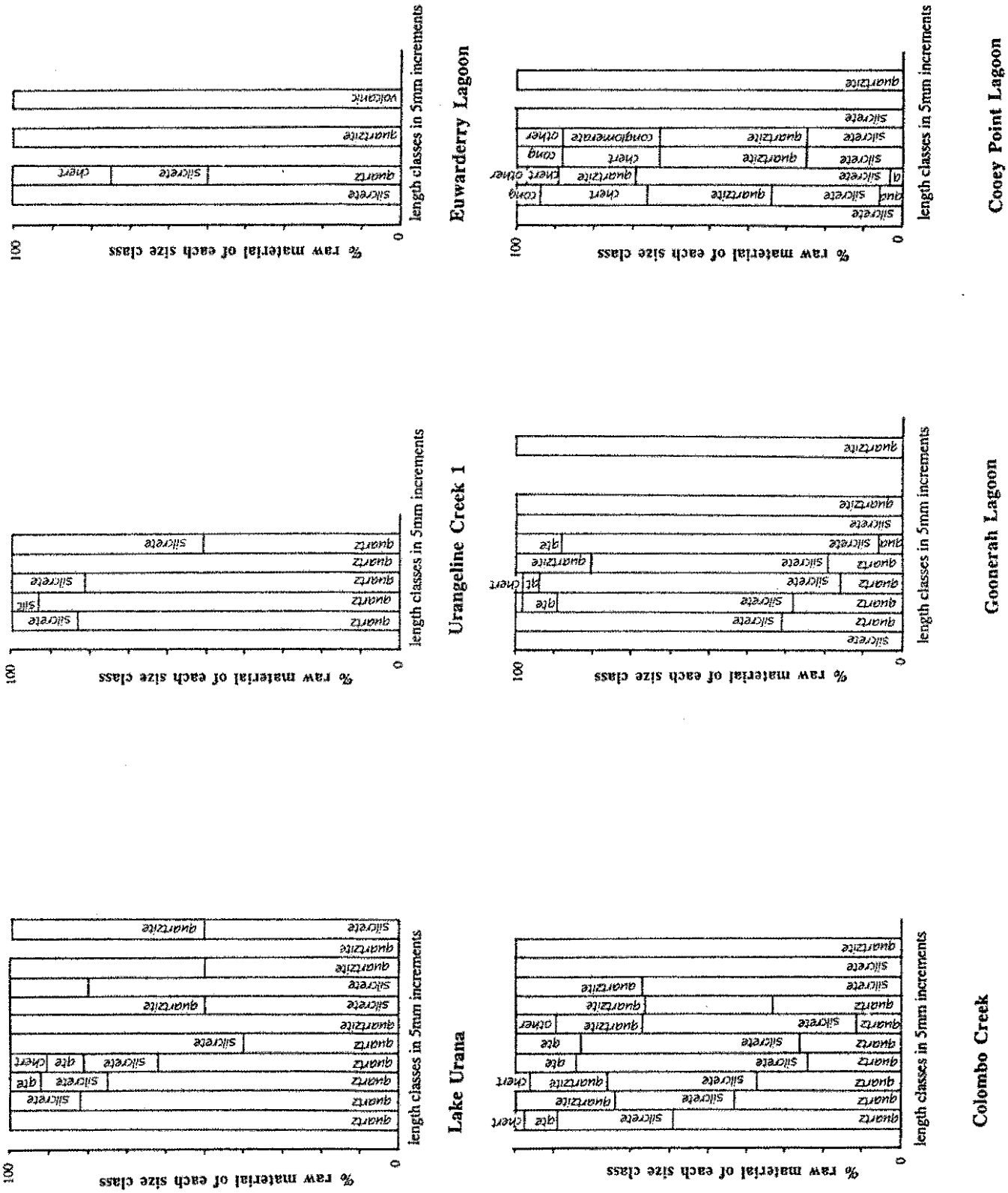


III-7a Flake and Blade Debitage Histograms

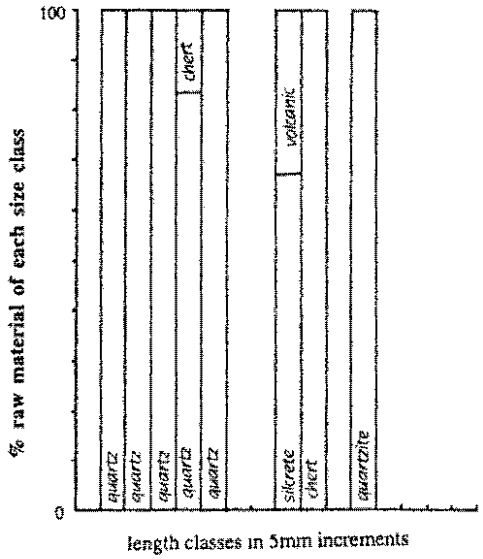


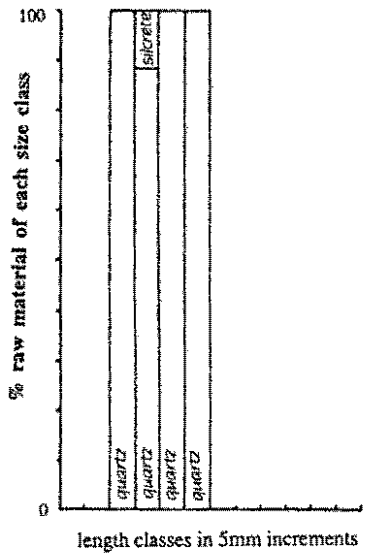
III-7-a Flake and Blade Debitage Bar Diagrams

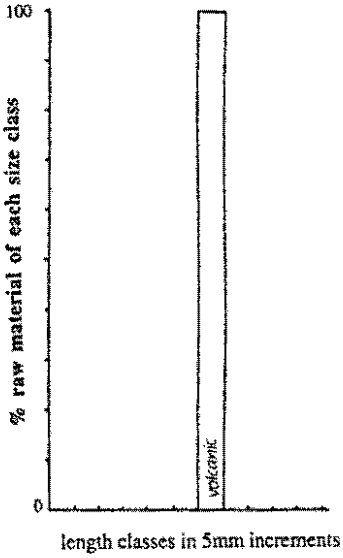
(%raw material composition of each length class)

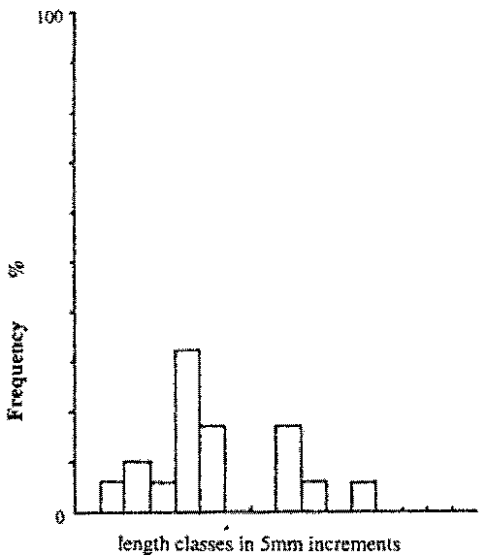


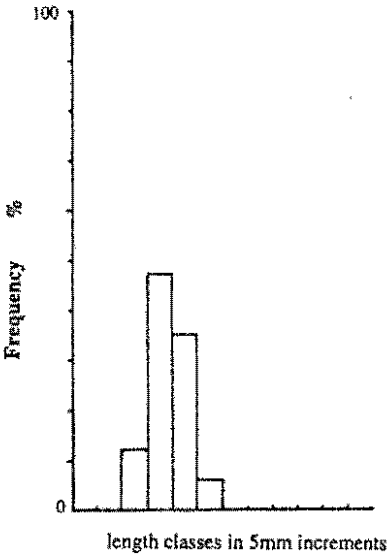
III-7-b Flake and Blade Debitage with Cortex Histograms and Bar Diagrams

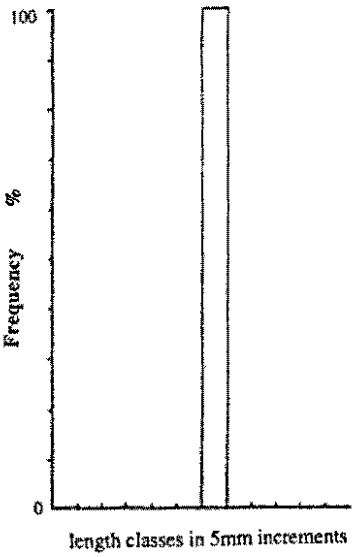






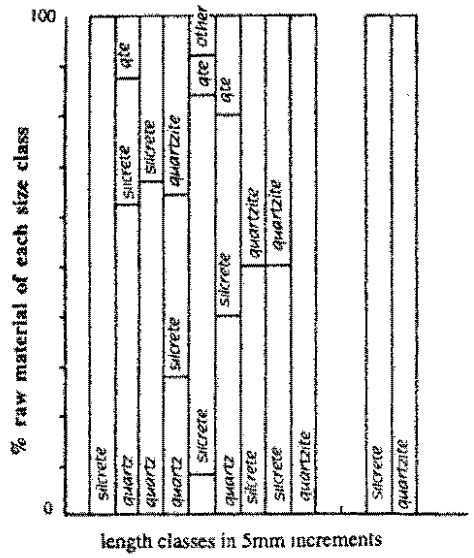


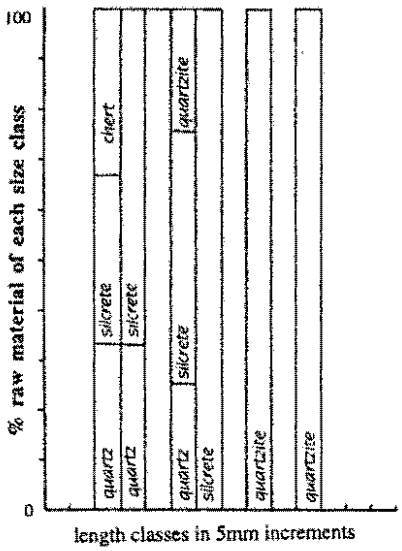


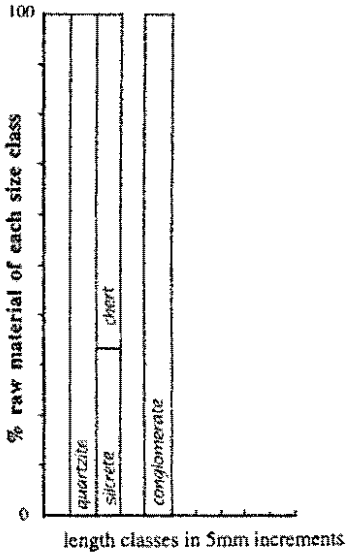


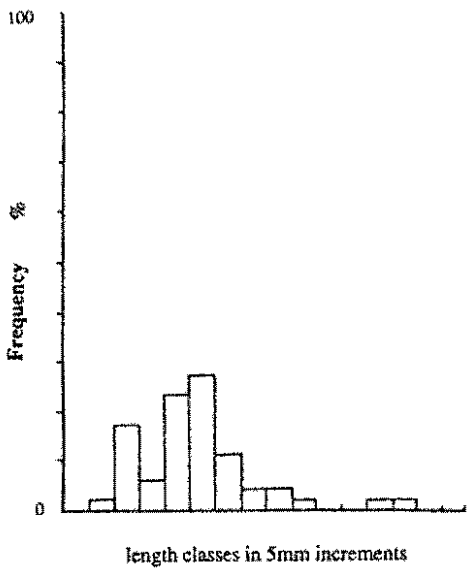
Lake Urana n=17 **Urangeline Creek 1 n=17** **Euwarderry Lagoon n=1**

III-7-b Flake and Blade Debitage with Cortex Histograms and Bar Diagrams

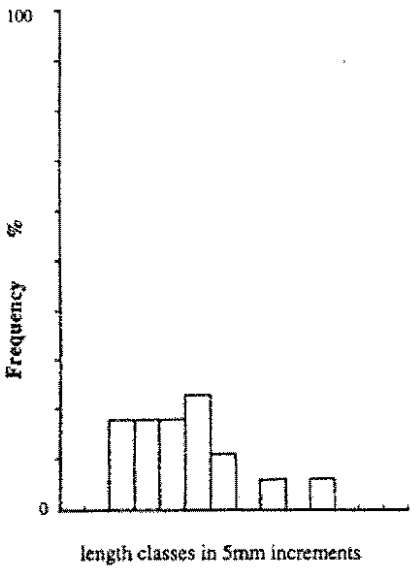




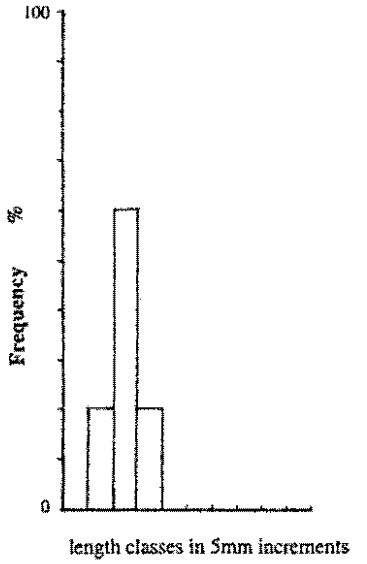




Colombo Creek n=48

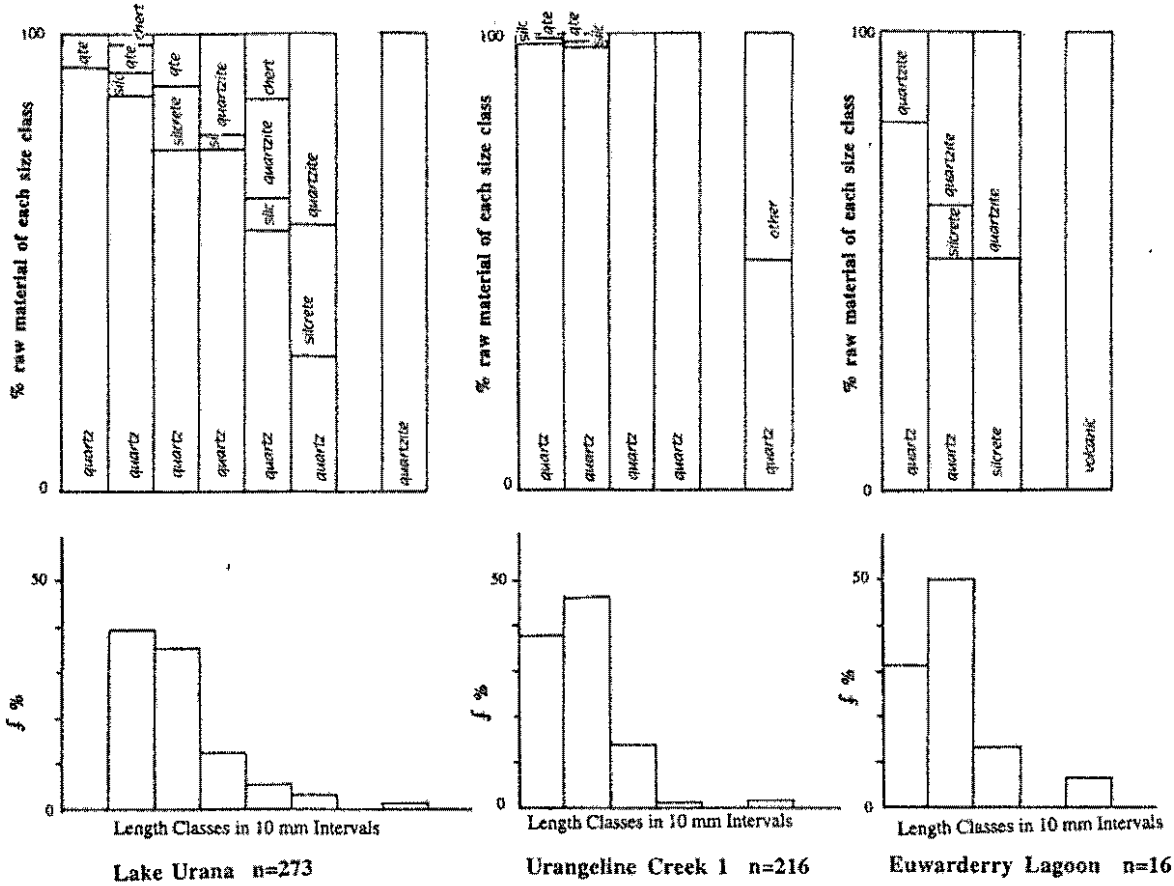


Goonerah Lagoon n=17

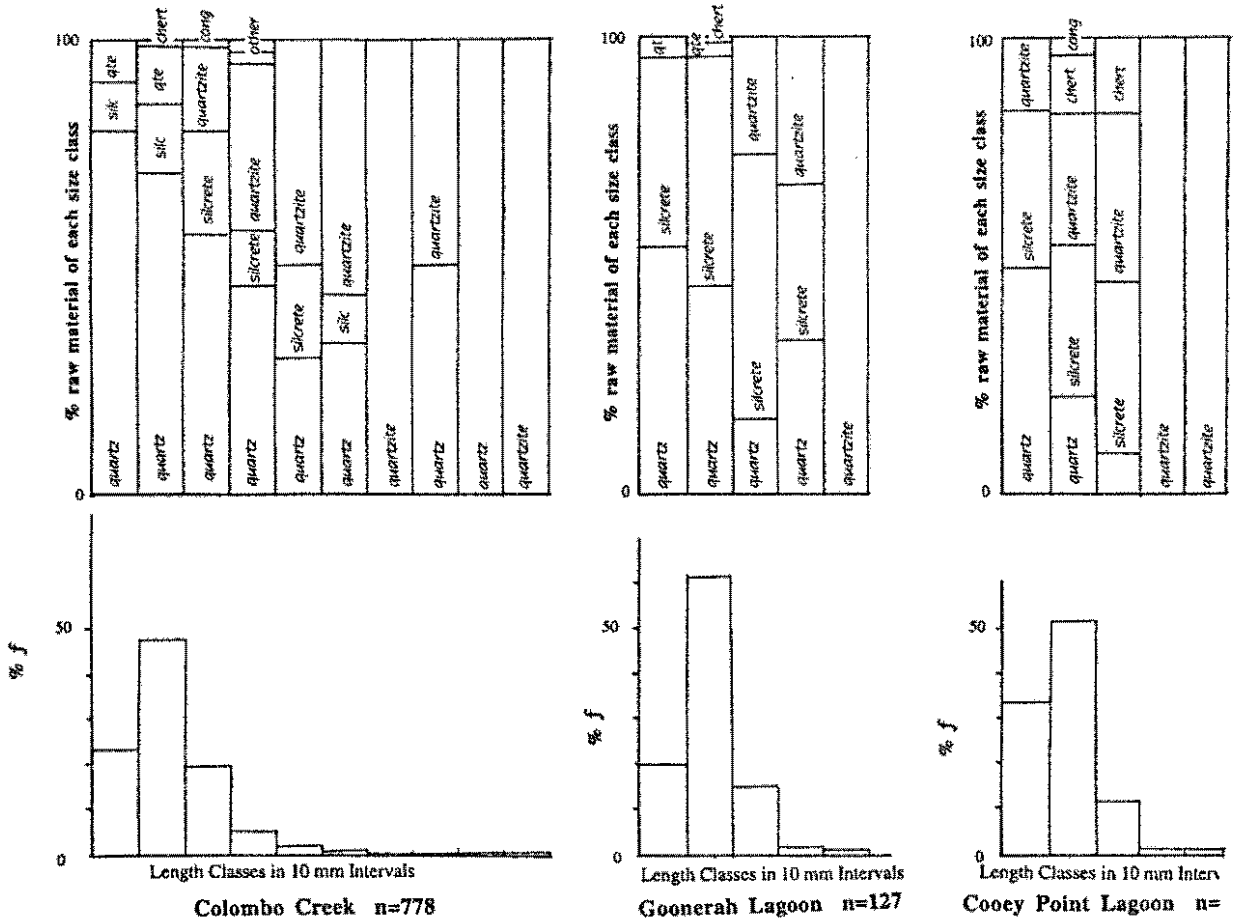


Cooey Point Lagoon n=5

III-7-c Length Classes of All Other Debitage Histograms and Bar Diagrams

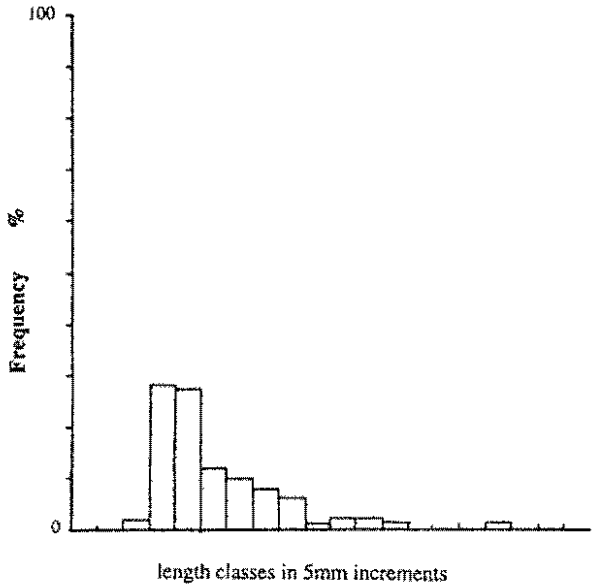


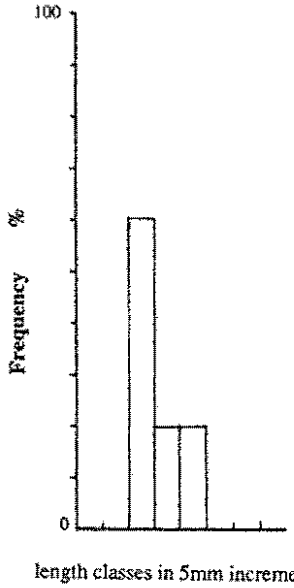
Lake Urana n=273 | Urangeline Creek 1 n=216 | Euwarderry Lagoon n=16

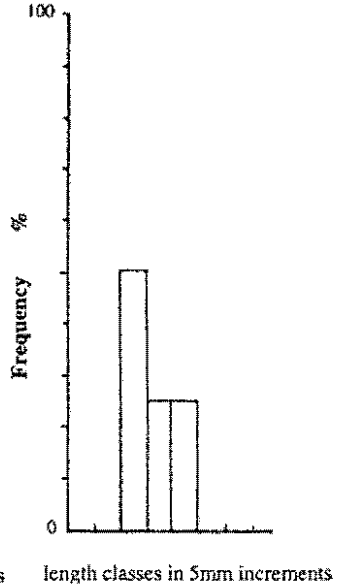


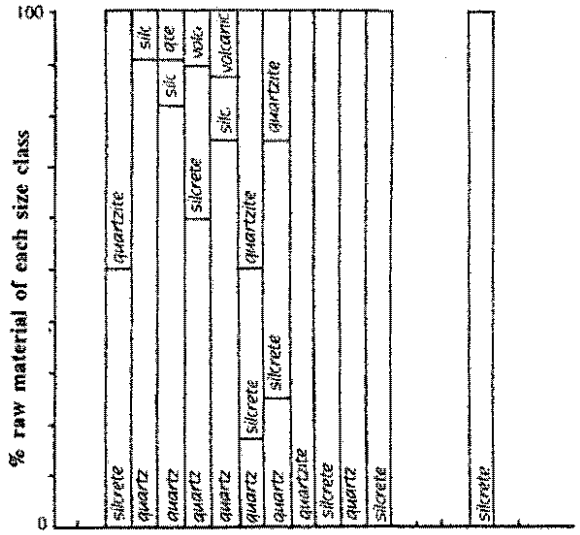
Colombo Creek n=778 | Goonerah Lagoon n=127 | Cooey Point Lagoon n=

III-7 d Flaked Material with Retouch or Usewear Histograms and Bar Diagrams

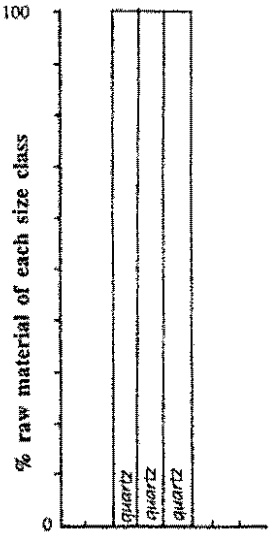




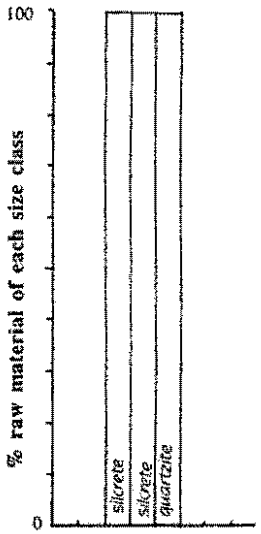




Lake Urana

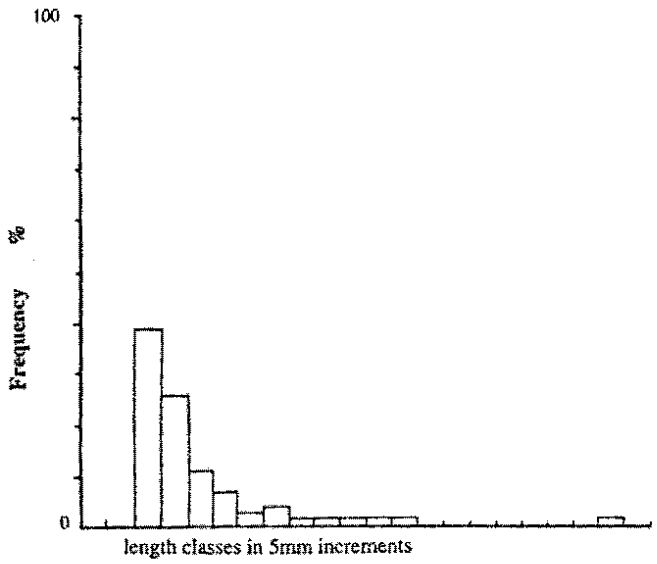


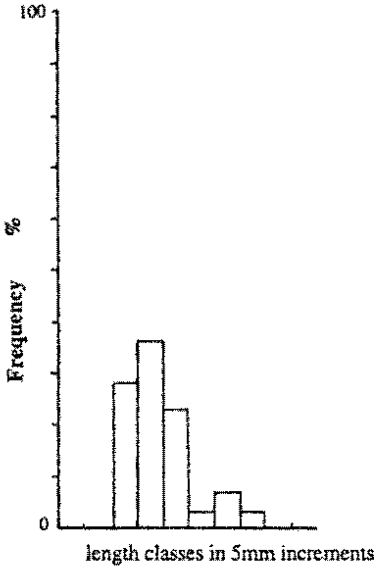
Urangeline Creek 1

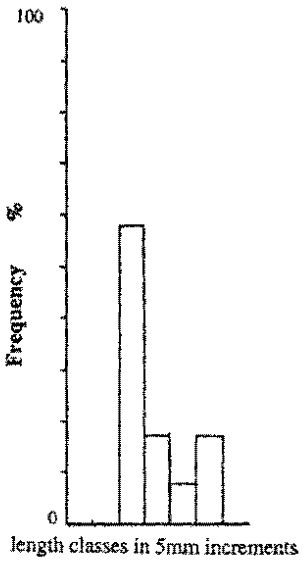


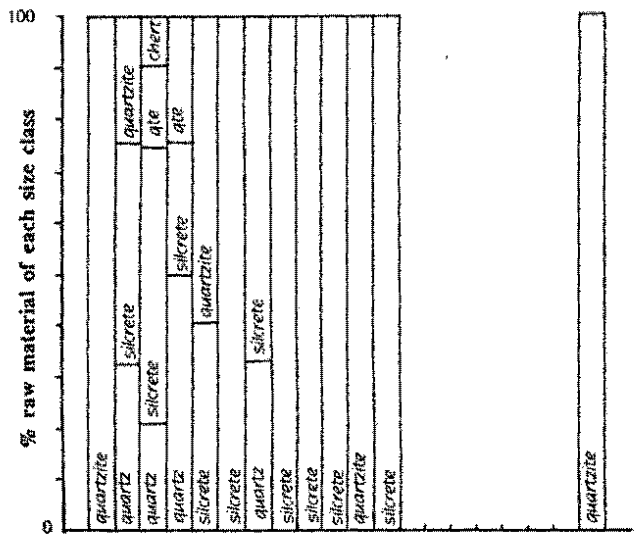
Euwarderry Lagoon

III-7-d Flaked Material with Retouch or Usewear Histograms and Bar Diagrams

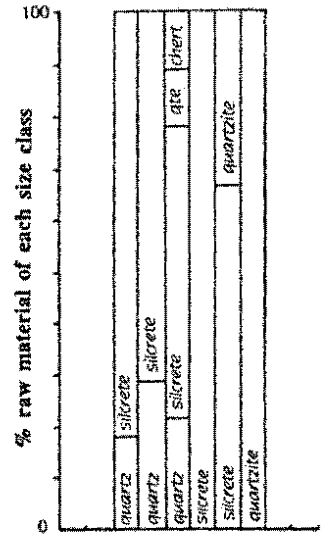




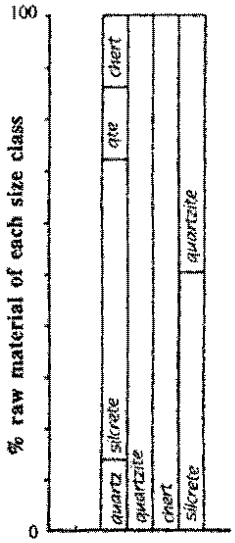




Colombo Creek



Goonerah Lagoon



Cooey Point Lagoon