CHAPTER 5

EXCAVATION OF THE RAVENSWORTH 3 & TCHELERY 1 MOUNDS & GUNDALINE OVENS

5.1 INTRODUCTION

Chapter 4 established the prevalence and significance of heat retainer hearth or oven cooking in the Murray Darling Basin, which includes the Hay Plain. Previous work reviewed in Chapter 2 suggests that many mounds are the result of accumulations of waste material from such heat retainer cooking nucleated in one location. Klaver's excavations of mounds at Cooey Point Lagoon on the Murrumbidgee East (Figure 5.1), show that they were associated with heat retainer cooking (Klaver 1998). The aim of the Ravensworth 3 and Tchelery 1 excavations (Figure 5.1) is to demonstrate that the mounds of the Hay Plain Southwest are (or are not) related to heat retainer cooking, and to provide some chronological data including the rate of build of mound material. The Gundaline ovens, Hay Plain Southeast (Figure 5.1), provide evidence for the structure of individual ovens that are not related to mound construction, an aspect that has been largely ignored on the Hay Plain and the larger Riverine Plain. The excavations also provided data to demonstrate:

- How the mounds were made, what sort of technology may have been involved in the construction.
- The age of the mounds and the rate of build up of the sediment.
- Stratigraphy, structure and features such as pits or hearths.

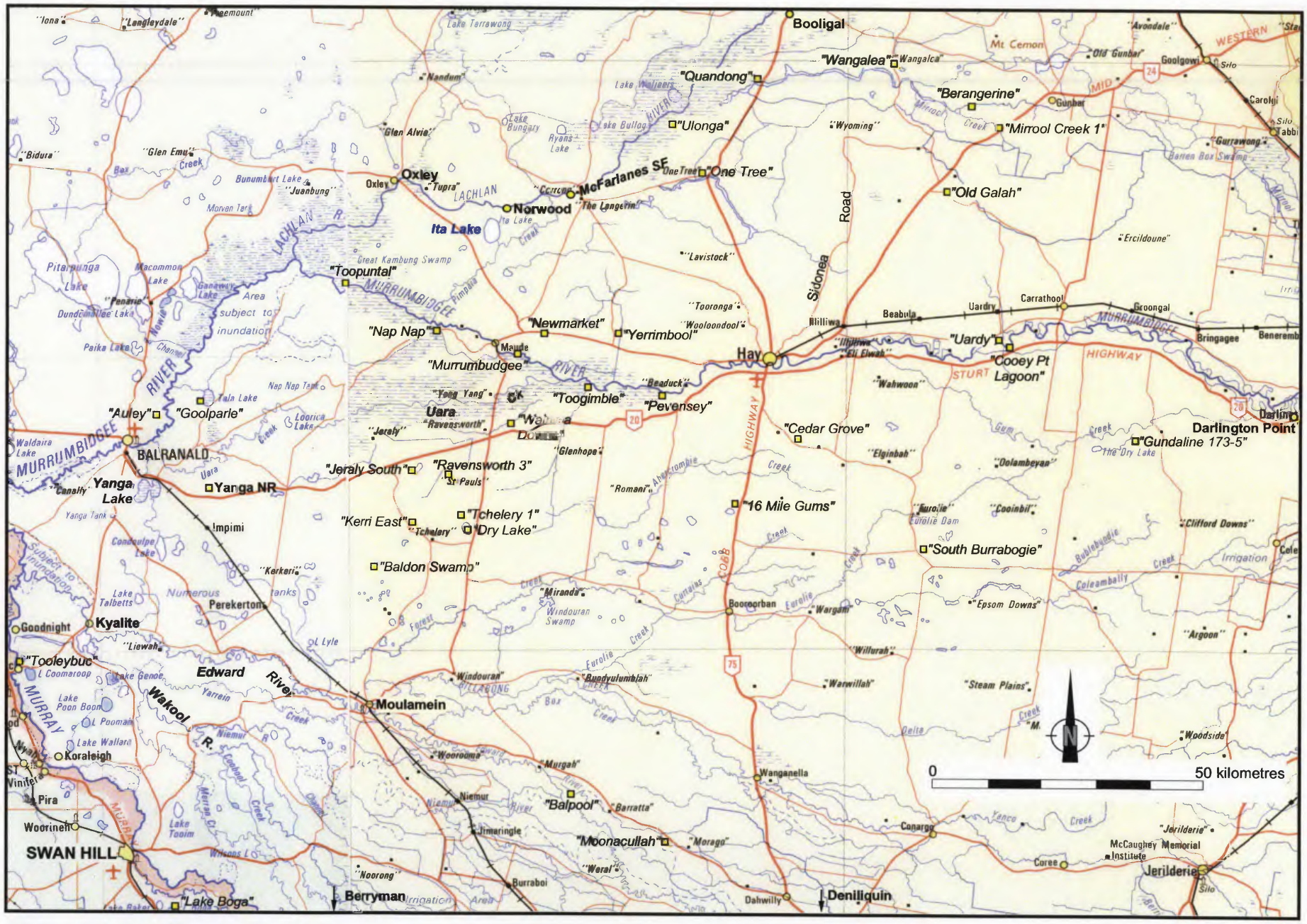


Figure 5.1: Locations on Hay Plain

- The faunal and plant material contents.
- Stone material technology contents.
- The Gundaline oven excavations provide chronological evidence and evidence of oven structure and use.

5.2. THE RAVENSWORTH 3 MOUND

5.2.1 Survey of the Ravensworth Mound

Ravensworth is a cattle feed-lot and intensive irrigation development located on the Hay Plain south of the Murrumbidgee River approximately 60 km west of Hay and 20 km south of the small river village of Maude (Figure 5.1). The Ravensworth 1-5 black earth mounds were originally recorded by NPWS officers Christian Hampson, Harvey Johntson, Randelle Blair and Steve Meredith in November 1997 after they were damaged by the construction of a levee bank (Johnston 1997). These mounds are located on the low lunette of an ephemeral lake which is now used to store irrigation water runoff. I was issued a NPWS Permit to Carry out Excavation (Permit # 1118) in 1998 to record this mound complex and excavate part of the damaged Ravensworth 3 mound (photos 6-13). In 1999 a section of the mound was excavated and a series of cores were also taken from the lake across and over the Ravensworth 3 mound to provide comparative sediments, delineate the height of the mound, and provide dates. The Ravensworth 1-5 mound complex was recorded in detail and mapped to provide context for the excavated mound (Figure 5.2).

Off-mound open area excavation was also initially proposed to determine if any evidence of occupation and/or activities carried out off the mounds remained. However, there was sufficient surface exposure to determine whether off-mound material existed and off-mound excavation was considered beyond the scope of this project and not a priority as previous efforts to the south of the Hay Plain had been unsuccessful. Open area excavation in the vicinity of a mound on the Wakool River found no archaeological evidence (Frankel 1991:80). On the Murray River a front end loader was used to open up large areas around the DP1 mound but no oven pits or cultural material was found, and large scale excavation of mound DP2 and its surroundings failed to find evidence of surrounding features such as ovens or

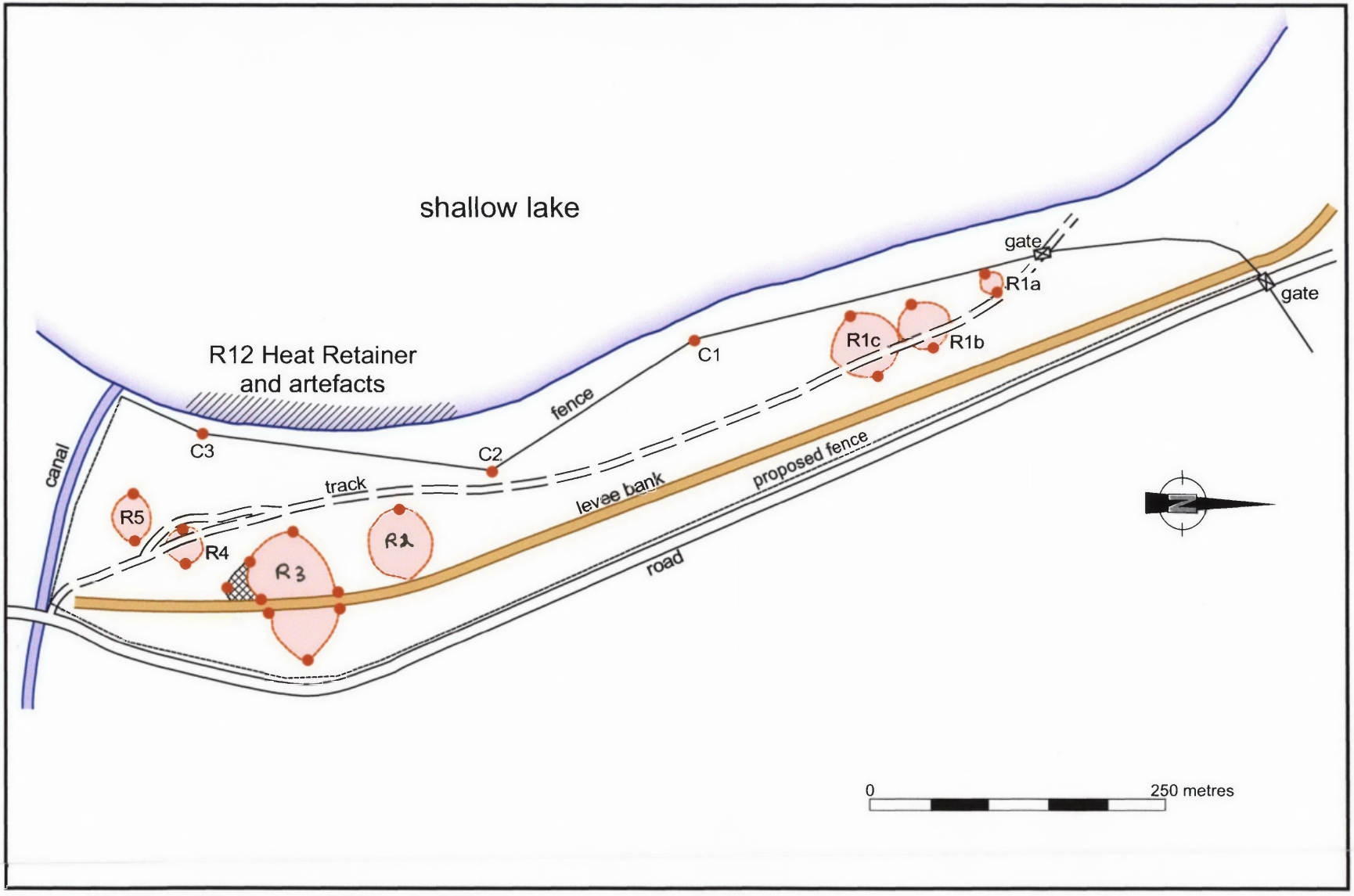


Figure 5.2: Plan of Ravensworth Mounds 1-5

fireplaces (Coutts et al. 1979:85, Coutts 1980:31). Test excavation on an Edwards River mound complex just to the south of the Hay Plain also failed to produce any results (Edmonds & Long 1998).

A period of 7 days field survey work in January 1999 focussed on the Ravensworth 1-5 black earth mounds and other sites around nearby lakes. The field work was undertaken between the 20-27 January by Sarah Martin, Linda Conroy, Catherine Clarke from UNE, and Badger Bates and Steve Meredith from NSW NPWS. This field period aimed to describe and plan the Ravensworth 1-5 complex, take core samples from Ravensworth 3 and adjacent non-mound areas, and make a longitudinal cross section drawing of this mound showing the mound and the surrounding landscape features such as the lake and the very low lunette-like feature that the mound is built on. The survey of the area indicated that Ravensworth 3 is the largest mound in the complex and has been literally cut in half by a bulldozer during construction of a levee bank. The mound is 112 metres east-west by 70 metres north-south and up to 1.49 metres high. The mound material is dark grey/brown on the surface and throughout the deposit. The cores taken from the mound and surface material recorded include heat retainers, stone artefacts, faunal remains including mussel shell, bird bone, small mammal bone and turtle shell. There is also a tongue of beige coloured deposit with rounded heat retainers on the southern side of this mound (hatched area on Figure 5.2). The main section of the mound seems to be built over most of this feature which may therefore represent an older episode of mound building.

A survey of other sites in the area was undertaken during this field period to place the Ravensworth 1-5 complex in context, and also to enable the management of all these sites to be considered at the one time. A report outlining the serious management problems and conservation proposals for the paddock containing the lakes was completed at the request of NPWS and the Hay Local Aboriginal Land Council (Martin 1999b), and this was used to negotiate a Conservation Agreement between the landowner and National Parks and Wildlife Service. This is of relevance because it discusses effects of overstocking, roads, earthworks, infrastructure, cultivation and rabbit 'control' that has resulted in ongoing damage to many mounds and other sites including burials on the Hay Plain. This report also documents some of the surviving original vegetation in this Ravensworth paddock, including a clump of three living

Casuarina trees which are the only evidence of why the paddock was originally named 'Back Oaks'.

5.2.2 Coring of the Ravensworth 3 Mound

The cores enabled an examination of the sediments, delineated the depth of the mound and AMS dates were obtained from charcoal found in the lower part of the Mound (Beck, Conroy & Martin 1999). The cores were brought up in 4 cm diameter clear plastic tubes using an ESP Plus (Environmentalist's Subsoil Probe Plus). This equipment is ideal for coring mounds as it does no damage to the surface of the mound, leaving only a clean narrow hole with a diameter of approximately 3 cm which at Ravensworth was backfilled with a sterile soil of a different colour. The plastic tubes allow an on-site inspection of the stratigraphy and it was possible to immediately check whether the core has reached the clay rich basement layer. The tubes were unable to go more than a centimetre or two into the basement which was so hard it crumpled the plastic tubes if they were hammered into the clay. Each plastic tube is one metre in length and the ESP Plus corer allows for the required number of tube lengths to be brought up from the hole. In the case of Ravensworth 3 the higher sections of mound required two tube lengths for each core sample, as the deposit was 1.49 metre high.

The cores were taken from the mound and areas either side of the mound. Figure 5.3 shows the profile of the area sampled and a section of the mound with the height estimated from the core samples. A centreline was surveyed in using a dumpy level and a series of points along it were levelled to provide a profile. Selected points along the centre line were then cored; sampling the lake edge (C6), the flat area between the lake and the mound (C3&C4), the edges, sides and highest point of the mound, and one from the east of the mound (C14). A total of 10 cores were taken along the centreline plus an extra two cores off the centreline (Cores 15 and 16). The resulting longitudinal section of the mound is shown in Figure 5.4. and Figure 5.5 summarizes the core sections plotted against the ground surface height (but best compared with Figure 5.4).

Figure 5.3 Ravensworth Mound Core Section with Relative Surface Elevation in Bold Numbers

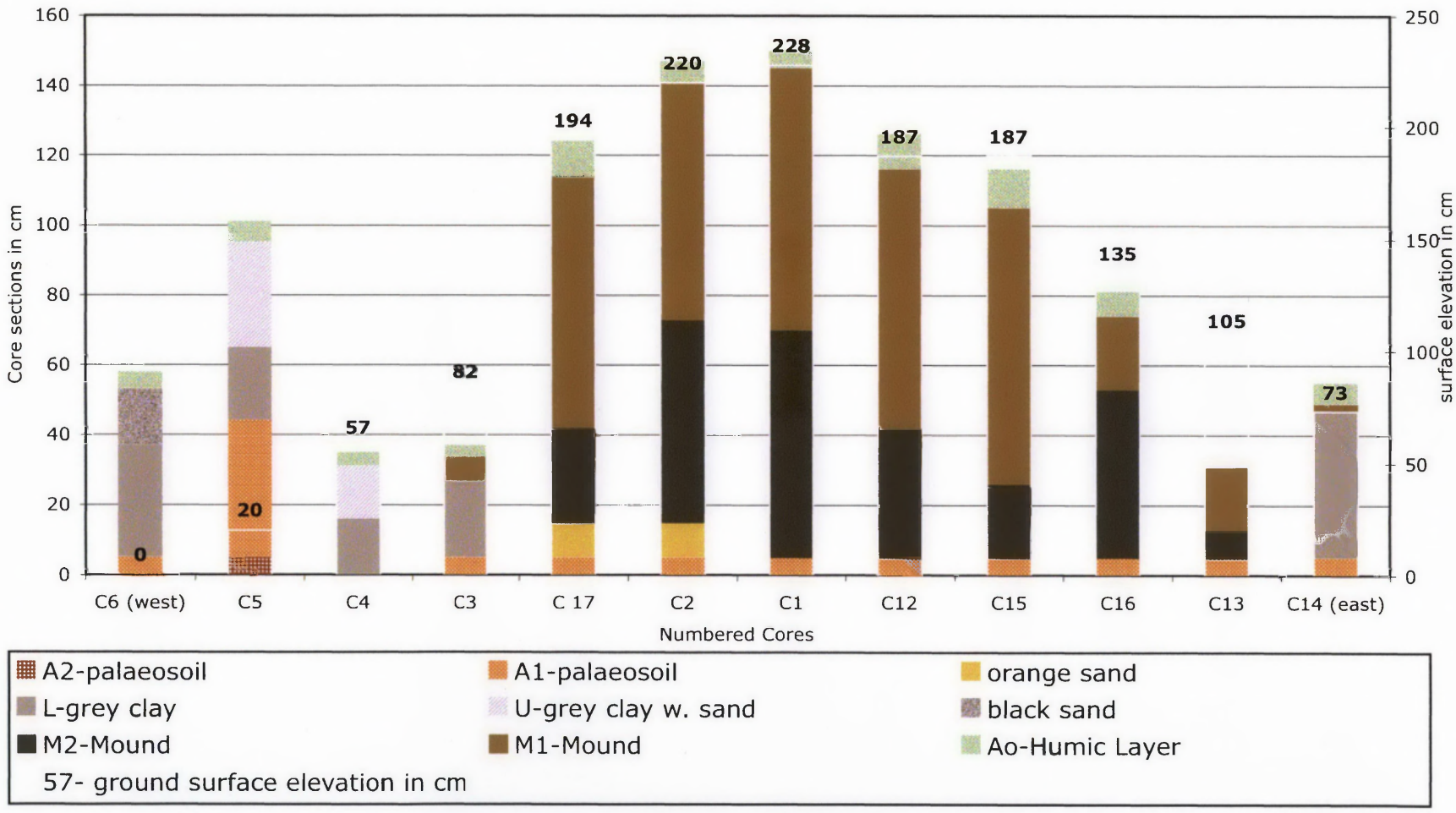


Figure 5.4 Ravensworth 3 Longitudinal Section (10 x vertical exaggeration)

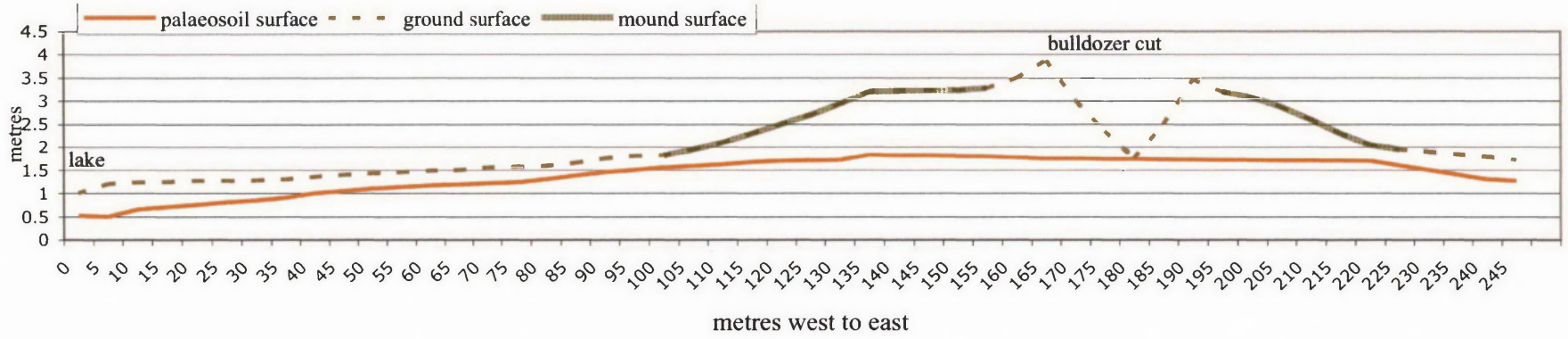
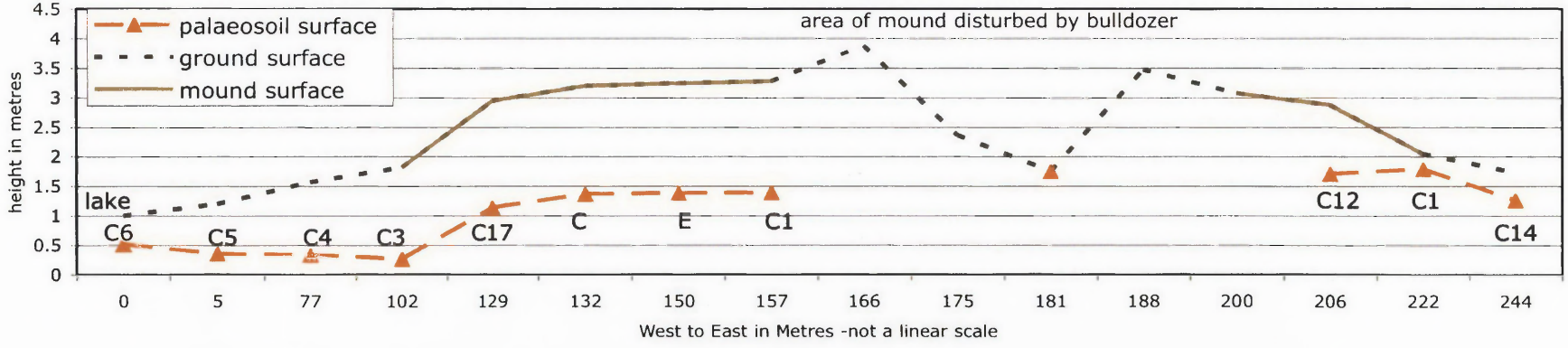


Figure 5.5 Ravensworth 3 Longitudinal Section from Survey and Core Data (telescoped - not a linear scale)



The cores were described and measured in the field and show a clear west to east transition from:

i. sandy lake bank sediment overlying mottled orangey clay rich loam,

ii. grey clay rich loam,

iii. mound sediment over yellow-orange clay rich lunette soil

iv. grey cracking clays over mottled orangey clayey material to the east of the lunette.

The bank of the lake (C6) is formed of coarse dark sands overlying grey clays and then a beige clay rich material mottled with patches of black and pink. The area between the lake and the mound consists of a mixture of grey clays and silts with coarse sand, and grey clays and silts with less sand, once again overlying beige clay rich material mottled with blotches of pink and black (C5). Core C4 crumpled when it hit a grey clay/silt material with large carbonate nodules. The western edge of the mound (C3) has a thin layer of mound material spread over grey clay/silt, underlain by the same mottled beige material. The central part of the mound is similar (C17, C2, C1 & C12), with gradually increasing and then decreasing amounts of mound material overlying the same beige clay rich material mottled with pink an black. The upper layer M1 is a slightly lighter grey than the lower M2 layer, and has evidence of baked clay heat retainers. The darker grey M2 layer is characterised by heat retainers, charcoal and gypsum crystals. An unusual feature is the 5cm thick layer of pinkish-orange silty sand between the mound and the mottled beige basement on the western side of the mound (C17 & C2), the remnants of a localised wind blown deposit, originally an attractive camping location. C15 and C16 are offset from the centreline, but do not show any unexpected characteristics. C13 has no humic layer because of recent machinery disturbance, and the lower mound layer shown as M2 in Figure 5.5 is different to the other mound sections. The upper layer M1 is dark grey with burnt clay and other cultural materials, but M2 is a fine powdery medium grey with minor traces of burnt clay and charcoal, suggesting that it may be a mixture of mound material and grey clay such as seen in C14. The same mottled beige clay rich material forms the basement. C14 consists of grey clay overlying the mottled beige with noticeable carbonate nodules, and there is a 3cm layer of fine dark grey material

between the grey clay and the humic layer which may be the very edge of the mound material, or mound material that has been spread out by stock.

The maximum height of the mound obtained in Core 1 was approximately 149 centimetres above a zone of mixed mound and basement material. The basement consists of a mottled beige/pink/orange clay loam and above this is 6cm of brown mixture of brownish grey material with nodules of beige clay rich basement. The measurements taken from the cores allowed an estimation of the height of the mound and the slight rise in the underlying clay rich soil. The contour survey and coring program showed the centre of the mound was built on an extra 20 cm height of the yellow clayey basement. The highest point of the mound is 228cm above the bank of the lake, and the basement under the highest point of the mound is approximately 78cm above the bank, which indicates that the mound was built on a slightly elevated lunette-like feature on the windward or eastern side of the lake. Figure 5.4 shows that the mound is balanced on top of the highest part of the lunette like feature, and that there is a gentle slope in both the ground surface and the underlying palaeosoil towards the lake.

In summary, the mound is formed on the highest point of the lunette, and the highest part of the mound is built directly on the palaeosoil of the lunette, or in the area of C17 and C2, on the layer of wind blown pink/orange sand. The western edge of the mound spreads out over the grey clay for a short distance, while the eastern edge appears to have a significant spread over the grey soil and there is a zone of mixed grey soil and mound material beneath the unmixed mound material. The two major layers M1 and M2 are present in most of the cores except for C3 and C13 on the very edges of the mound. This suggests that the mound has not been spread out too far by post contact damage, if this was the case the top layer would be spread much more widely than the bottom layer. The entire area from the lake to the east of the mound seems to be underlain by the mottled beige palaeosoil, over which coarse lake beach sediment and fine grey clay and silt have been deposited. The palaeosoil indicates that the lunette feature is very old, although the pink/orange sand layer may represent a more recent phase of lunette building. It is possible that the lunette formed on a large feature such as a source bordering dune belonging to the ancestral Abercrombie Creek system (part of the Gum Creek system), and the existing lake has embedded itself adjacent to the dune, which has been reworked to some degree to

look like a lunette.

5.3 EXCAVATION OF THE RAVENSWORTH 3 MOUND

5.3.1 Excavation Location and Trench Size

The location of the trench on the mound (E on Figure 5.5& photos 7 & 8) was chosen for the following reasons:

i. A high part of the mound to give a maximum exposure of the mound from top to bottom.

ii. A relatively level area that appeared to be less disturbed by rabbits.

iii. Parallel to the long axis of the mound and from the centre of the mound out towards the ephemeral lake which may have been the focus of activity.

iv. Angled so that the 2 metres long south wall was in sunlight for much of the day, to record and photograph the stratigraphy.

v. Near Core 1 so the results of the core analysis and dating could be used to interpret the excavation.

A 1 x 2 metre trench was determined to be adequate to examine:

i. The structure of the mound, i.e. how the mound was built up (layers, ovens, oven rake out, material tipped out of baskets etc.).

ii. Stratigraphy.

iii. Features (ovens, fireplaces, hut platforms, hut remains, workshops).

iv. Chronology of the mound.

v. Mound contents.

5.3.2 Excavation Procedure

The excavation was carried out over a two week period from April 12-26th 1999 by the writer, Badger Bates and Steve Meredith from National Parks and Wildlife, Ian Woods from the Hay Local Aboriginal Land Council, Vanessa Edmonds, Bilyara Bates, and

a group of students from UNE including Tim Hill, Denise and Ed Bennett, Sue Welch, and Emmett Burns. Eddy Legge from Ravensworth filled the trench at completion of the excavation with the bucket of a large excavator.

The trench was laid out in two adjacent 1 x 1 metre squares, parallel to the long axis of the mound. The corners of the trench were surveyed in. The squares were labelled A and B and were excavated and bagged separately. The excavation of the Squares A and B proceeded in 5 cm spits taken out by trowel, brush and dust pan, and then placed in buckets to be lifted out of the trench and weighed. Spits were used unless distinct cultural layers were encountered. In this case spits were followed until the uneven junction of the mound and basement was encountered and extra part spits were taken out of the lower areas.

Material was sieved using a large wooden two person sieve with 11mm sieve on top to catch rare large bone fragments, rare whole shell, and the majority of baked clay heat retainers. A 2mm sieve was fixed beneath the large sieve to catch the smaller fraction of the archaeological material (whole and fragmented bone, teeth, shell, stone artefacts, bone points, large pieces of charcoal, and smaller heat retainers). Each spit of each square was excavated and sieved separately, bagged in large and small sieve fractions and labelled. Preliminary sorting took place in the field whenever there were sufficient excavators to allow this. This field sorting aimed at separating the following: bone, shell, stone, large pieces of charcoal for possible species identification and dating, and baked clay casts with impressions. Material that was not sorted was bagged, labelled and sorted after the excavation.

Important finds such as large pieces of charcoal, easily identified and fragile faunal remains (eg jaws) or retouched tools, were removed as soon as found (in the pit, in the sieve or during sorting) and bagged or boxed separately. Features were measured in, drawn and photographed and samples taken. All charcoal rich features had charcoal samples taken for dating. Bulk samples of approximately 2kg were taken every 2.5 cm (two per spit) to allow for sediment analysis. Sections were drawn as the excavation proceeded and completed at the end of the excavation.

5.4 RESULTS OF THE RAVENSWORTH 3 EXCAVATION

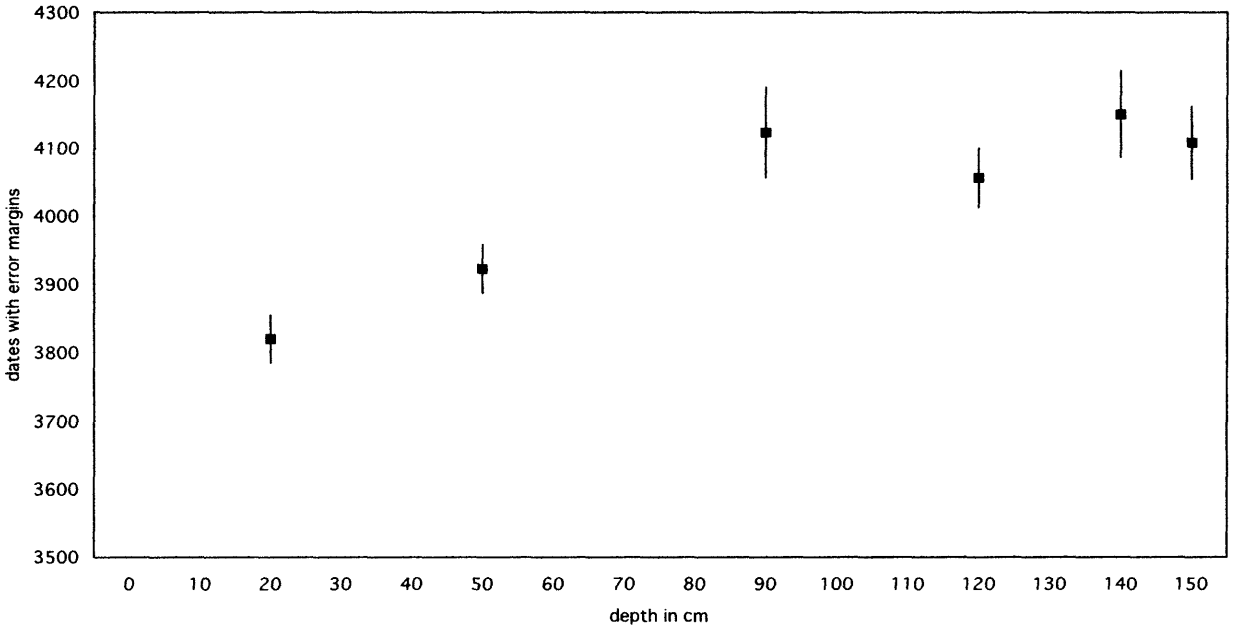
5.4.1. Chronology

Charcoal samples from the lower excavation layers of Square A provided a series of four Radiocarbon dates from Spits 17, 24, 27 and 29 which overlap and range from 4,151 ± 65 BP to 4,057 ± 45 BP (Table 5.1 & Figure 5.6). These compare closely to the charcoal AMS dates obtained earlier from the Core 2 charcoal sample which range from 4,100 ± 70 BP to 3,860 ± 60 BP. Core 2 is located on the same axis as the excavation trench, but 25 metres to the west, so the depths of the two areas cannot be directly compared and the Core 2 area of mound has less depth than the excavation location. However, the lower Core 2 date and the A:29 date both come from close to the junction of mound sediments and underlying sediments. Although the excavation charcoal dates all overlap, the middle Core 2 date is 2-300 years older than the other Core 2 dates. The overall lack of differentiation of dates indicates that the mound is not a finely stratified site, which is evidence for the way mounds are built. The upper spits of the excavation had little or no charcoal. Samples of calcined faunal bone supplied bone apatite AMS dates from Spit 3 and Feature A in Spits 10 and 11 which are slightly younger than the dates from the lower spits. The dates from Square A indicate that the Ravensworth 3 mound built up over the relatively narrow time frame of approximately 300 years, or 50cm per 100 years. The relatively small margins of error for the dates from Square A suggest that the mound was constructed in a time frame somewhere between a maximum period of 370 years and a minimum period of 198 years. The slight date inversions from Square A may be accounted for by the magnitude of error of the dates. The dates also indicate that the lower half of the mound was built up over a very short time, as the lower 4 dates are very similar. In fact the lower half or even the lower two thirds may have been built up almost simultaneously. In such an open, arid and windy environment this is a remarkably fast build up of material.

Table 5.1 Dates from Ravensworth 3 Excavation Square A and Core 2, and Age by Depth Box Plot

Sample	Waikato Number	Depth	Uncalibrated	Calibrated	Type of Date
R3 A:3	Wk-17504	10 –15 cm	3820 + 36 BP	4250 - 3980	Bone AMS
R3 A10-11	Wk -17490	45-55 cm	3923 + 37 BP	4420 - 4150	Bone AMS
R3 A:17	Wk -17503	80 –85 cm	4124 ± 68 BP	4830 - 4410	Charcoal
R3 A:24	Wk -17502	115 – 120 cm	4057 ± 45 BP	4790 – 4410	Charcoal
R3 A:27	Wk -17501	130 – 135 cm	4151 ± 65 BP	4830 – 4450	Charcoal
R3 A:29	Wk -17489	140 – 145 cm	4109 ± 55 BP	4820 - 4430	Charcoal
R3 Core 2	***Wk -7500***	***96 –98 cm***	***3860 ± 60 BP***	***4422 – 4090***	***Charcoal AMS***
R3 Core 2	***Wk -7501***	***112 – 114 cm***	***4100 ± 70 BP***	***4832 – 4418***	***Charcoal AMS***
R3 Core 2	***Wk -7502***	***128 – 130 cm***	***3890 ± 60 BP***	***4518 - 4092***	***Charcoal AMS***

(R3 A dates calibrated to 95.4% probability by Waikato Dating Laboratory. Core 2 dates calibrated to 2 sigma range)



5.4.2. Depth of Deposit and Stratigraphy

The excavation revealed that the mound has a maximum height of between 143cm to 160 cm (the variation indicates a very uneven clay base resulting from tunnels and pits dug into the clay). A total of 29 spits were removed (a depth of 145 cm) and up to another 2 spits in the low areas or pits and burrows in the mound base. A further 30 cm of the clay lunette beneath the mound was removed from a corner of Square A. The first 20 cm of this was compact and relatively hard, the last 10 cm was extremely hard. The excavation revealed that the mound has eight stratigraphic layers visible in the trench sections (Table 5.2, Figures 5.6 & 5.7, Photos 10 & 13).

Table 5.2 Ravensworth 3 Stratigraphic Layers drawn from Excavation

LAYER	SPITS	DEPTH	COLOUR	COMMENTS
1	1	0-5 cm	brown-grey	humic layer, roots, insects, few heat retainers, little bone or stone, cow manure
2	2	5-10 cm	brown-grey	concentrated small heat retainers
3	3-4	10-20 cm	orange-beige	harder layer, apparently clay rich, small heat retainers
4	5-6	20-28 cm	grey-brown	large disturbed areas, rabbit warrens?, larger heat retainers
5	6-9	28-48 cm	dark grey	large heat retainers, uneven top, possible pits
6	10-12	48-64 cm	paler grey	ash rich and ashy lenses, heat retainers
7	13-19	64-100 cm	brownish grey	gritty texture from broken down heat retainers, heat retainers, large ashy lens in Square A
8	20-29	100-149 cm	brownish grey	slightly darker than 7, smoother texture, heat retainers, nodules of beige basement material mixed in
9	30-	149-178 cm	beige with orange, black, white mottling	basement, hard, compact, clay rich, with gypsum and small white (carbonate?) nodules, no heat retainers, some minor mixture of mound material uneven surface with burrows and shallow pits
10		178-? cm	beige with orange, black, white mottling	basement, extremely hard, compact, clay rich, with gypsum and carbonate nodules, no heat retainers and no admixture of mound material, artefacts or faunal material

The stratigraphy is poorly defined and partly a result of post-depositional processes. Spits were used throughout the excavation as the stratigraphic layers were difficult to distinguish even in the finished wall sections. The top half of the mound has very little charcoal and is paler in colour than the lower half, reflecting leaching processes. Rabbit warrens had disturbed the top half of the mound, with rabbit skeletons found as deep as Spit 16 (80 cm deep). The bottom half of the mound was also disturbed by animals; tunnels and coprolites being common. Tunnels also occurred on the clay

Figure 5.6 Ravensworth 3 East Wall Excavation Section

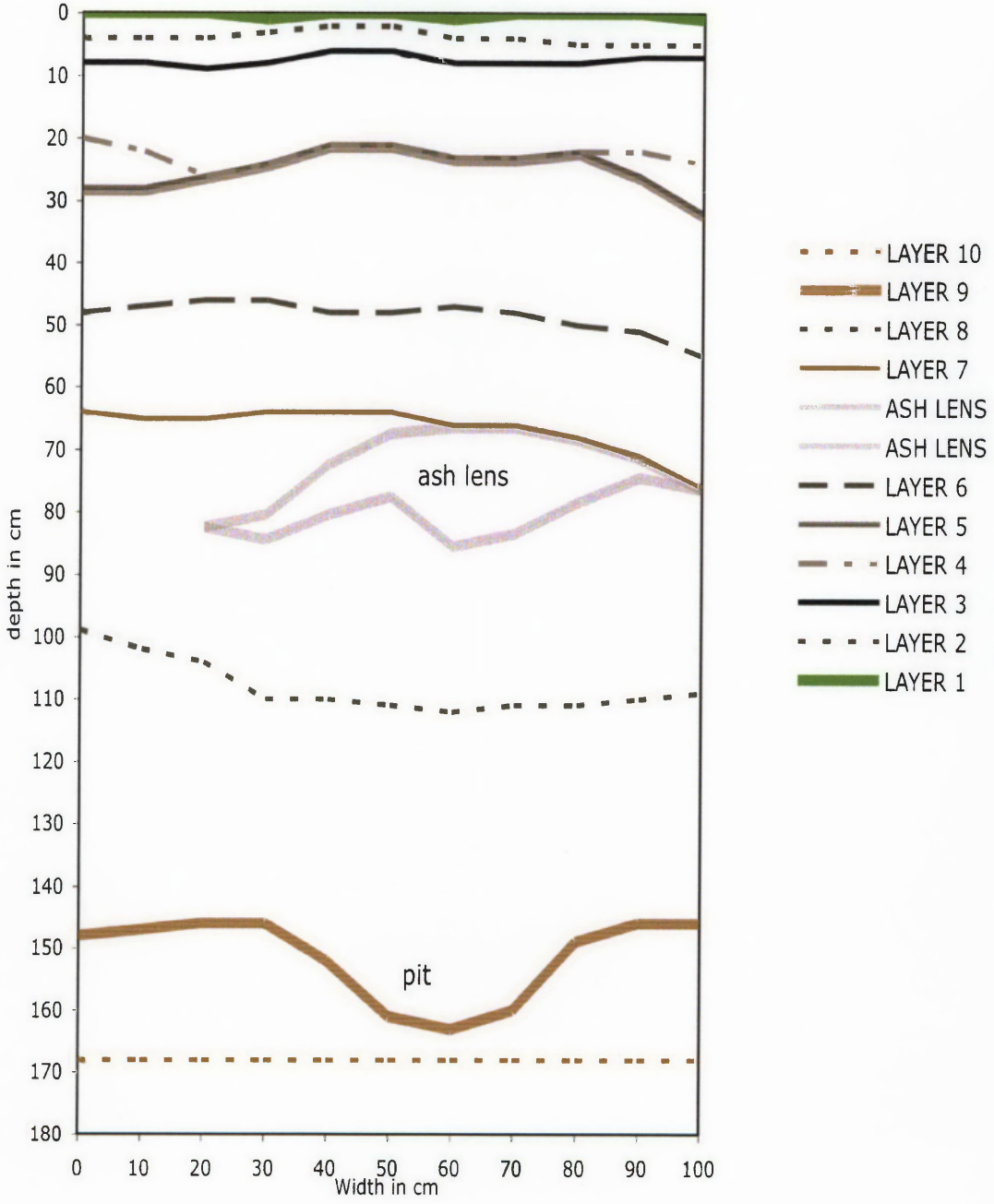
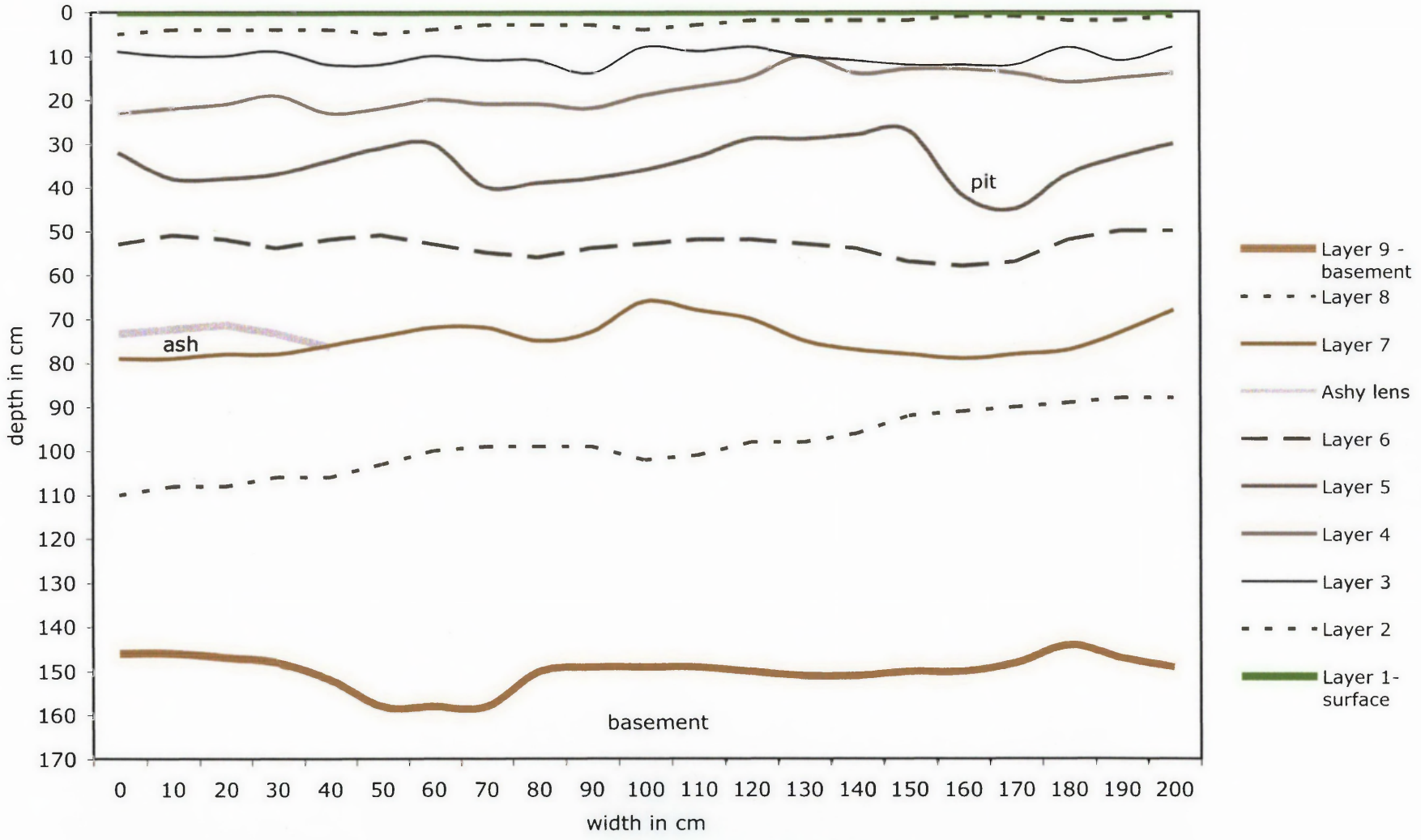


Figure 5.7 Ravensworth 3 : South Wall Excavation Section



floor of the mound base. The underlying basement or lunette revealed two layers in excavation, taking the total of stratigraphic layers to 10. Not all layers were continuous, particularly in the top layers where layer 3 appears to phase out and disappear in places. This may be the result of rabbit burrows that were seen as disturbed areas with rabbit bone beneath layer 3. Underlying the changes in colour and charcoal content there is a consistent layering, which reflects a change in sediment texture and content as well as colour. The sediment layers are discussed in detail in Chapter 6.

5.4.3 Oven and Hearth Features

The excavation revealed two hearth features, including an area with a circular concentration of baked clay heat retainers (FA) in Spit A:10 and spit A:11, and a compact ash and charcoal feature (FB) in Spit B:20 (photo11). In addition to this several pit features and an ashy lens in layer 7 are seen in sections (Figures 5.6, 5.7). The uneven distribution of heat retainers may also reflect disturbed hearth features such as ovens.

5.4.4. Mound Material

The mound material consisted of heat retainer fragments and a fine sand-silty material with varying amounts of ash, charcoal, heat retainers, and baked clay casts, in addition to the bone, shell and stone (photos 10-13). No burial material was found during the excavation. The sediment, particularly from the lower layers was waxy in texture, possibly indicating fats and waxes from cooking of food. The results of the sediment and heat retainer analysis are described in Chapter 6.

5.4.5 Faunal Remains

The faunal remains indicate a wide range of aquatic and non-aquatic fauna was being exploited. The bone from the excavation is extremely fragmented, thus making analysis very difficult. The occasional whole bones are nearly all solid pieces such as calcaneum or metatarsals. The bone has been sorted into basic types wherever possible to give an idea of the range of foods eaten or species living on/in the mound. Table 5 lists a presence/absence indication of major types of fauna for the spits throughout the mound, showing there is very little change in the types of faunal remains throughout the mound, except for the lack of mussel shell in the top and

bottom layers of the mound. Faunal remains indicate that the species represented in the mound were obtained from the nearby lakes and swamps, with consistent additions from the plains. Lake/swamp types of fauna include yabby, mussel, fish, and turtle, and bird remains are the size of ducks or rarely larger species, possibly swans. The rare emu egg shell and kangaroo remains indicate food was also obtained from the plains, and it is probable that other species such as the rats, bandicoots and bilbies may have lived on/in the mound. The difficulty in identifying the bone makes it likely that there are other species present that have not been identified, including the 'small mammal' category.

In all spits the bird bone accounts for the majority of material. This consists of fragmented pieces of long bone shaft which can be identified by its smooth, thin, cylindrical walls, but also includes some end bones and diagnostic phalanges or 'claws'. Most of the bird bone falls into the size categories of ducks and waterhens, with some larger pieces possibly belonging to swans (or geese?). Eggshell is poorly preserved but fragments indicate that relatively large eggs such as those of swans were being eaten.

The aquatic fauna includes fish species, indicating a link with river systems during seasonal flooding from the rivers. The fish remains are interesting as they are predominantly very small vertebrae, with some larger mostly fragmented vertebrae, and fragments of spines. Otoliths are very rare. The smallest vertebrae are in the range of 1-2mm diameter, and often needed identification with a hand lens, and although difficult to see (and probably many missed in sorting) these are the most common. This indicates that tiny fish were caught with fine sieve like nets during the initial flooding phase. The tiny fish, together with shrimps, may have been simmered in wooden bowls placed on 'the ashes' of ovens/fires (Beveridge 1889:84). Larger fish would have been caught over a longer period of time as the floods stabilised and receded. Some of the baked clay casts had impressions which appear to be of fish, suggesting that larger fish were covered in mud and baked. A half otolith found in Spit 15 is consistent with that of golden perch (*Macquaria ambigua*), and one large broken vertebra may belong to a Murray Cod (*Maccullochella peeli*). Medium to large vertebrae tend to be broken up and difficult to recognise.

Mussel shell is mostly very fragmented, although larger pieces enabled a sure identification as lake mussel (*Velesunio ambiguus*) rather than river mussel (*Alathyria*

jacksoni or *condola*). The thinness of the shell and the rounded corners enabled identification throughout the mound. However, one large piece in Spit 6 appears to belong to river mussel, which may have been carried from the river to use as a tool. Yabby remains are relatively rare considering the location next to large lakes/swamps and the usually good preservation of gastroliths, suggesting that they were not often eaten on the mound or that the remains were disposed of elsewhere. Remains consist of fragments of nipper ends, and gastroliths. Turtle shell appears in almost every spit, but only as very small fragments. It can be identified by the pattern on the outside walls, and the internal structure. Some of the bone fragments may also be turtle, but have not been identified as yet.

Skeletons and teeth of rodents were found throughout the mound from the surface to the bottom layer, jaw fragments and teeth indicate identify many as probably swamp rat (*Hydromys*) (identified by 3 molars, 5 roots in first molar and no indentation of incisor). These bones were different from all the other bones in that they tend to be whole despite their fragility, and are mostly uncooked. This indicates that they lived in burrows in the mound, and some died naturally while others were cooked. Bandicoots from two species (*Isodoon* and *Perameles*) are found as lower mandibles and isolated teeth throughout the mound. These are the only whole to partial mammal jaws in the excavation and some of the bone is not cooked, suggesting that some may have died in the mound. Thus bandicoots may have scavenged on the mound and/or lived in the mound, and were occasionally cooked and eaten. Other faunal evidence collected for identification includes coprolites found in the bottom layers of the mound. At least some of these are similar to those found in Tchelery 1 and have been tentatively identified as belonging to a member of the bilby family (Triggs 1996:104-106). The coprolites were found in the tunnels on the floor of the mound as well as in the bottom layers from Spit 20 to Spit 29, indicating the animals were living in tunnels deep in the mound, as recorded by Krefft in the 1850's (see Chapter 8). Bilby burrow systems are up to 3m long and 1.8m deep compared to rabbit warrens which tend to be only .5 metres deep (Triggs 1996: 221 & 228). Large kangaroo (most likely Grey Kangaroo) can be identified from rare molars or molar fragments, and occasional fragments of heavy long bone including tibia.

Minimum number counts from such fragmented material would be misleading, so the material has been weighed per spit for an estimate of the total amount of bone material present. The weights per spit of bone (Figure 5.8) shows that the amount

of bone varies considerably throughout the excavation, and that there is actually very little bone considering the size of the mound. There is less bone in the upper 3-4 spits, and a series of highs and lows throughout the rest of the mound, with a decline in the lowest spits. The amount of shell follows similar trends, but there is a more definite decline in the upper and lower layers, there is almost no shell or no shell in the upper Spits 1-6 and the lower Spits 25-29. The reduction of bone and shell in the upper Spits coincides with the spits affected by soil formation and mechanical damage from stock, and therefore reflects a change in preservation conditions. This aspect and relevant pH changes are discussed further in Chapter 6.

5.4.6 Bone Colour and Texture

The majority of bone is to some degree carbonised or calcined resulting from the deliberate and/or accidental exposure of the bones to different fire regimes. The fire regime that the bones were subjected to is another form of evidence about the activities carried out on the mounds and the formation of mounds.

David (1990:65) proposed that bones are burnt for the following reasons:

- in the process of food preparation
- in the process of garbage disposal
- used as fuel in fires
- buried or semi-buried bones burnt by accident because of their position underneath campfires
- burnt by bushfires.

He then undertook experiments to examine the effect on bones of bush fire and varying exposure to high temperature campfire. Using his data it is possible to analyse the type of fire that the bones in Ravensworth 3 have been subjected to. David's evidence indicates that bushfire would not produce the degree of carbonisation and calcination seen in the Ravensworth bones. In his controlled campfire experiment bones that were removed from a very hot fire after 25 minutes were predominantly carbonised to varying degrees, with a very minor amount of calcination. The bones that were subjected to prolonged high temperatures (65 minutes at up to 840 degrees C and five hours smouldering) were almost all

calcined (David 1990:68-74). In another experiment Stiner & Kuhn (1995:231) obtained similar results and also determined that bones buried 5 cm in sediment beneath a fire burned to the point of carbonisation, but none of the bone became calcined even though fires were at least 900 degrees C.

The carbonisation and calcination of bone results from changes to the crystal structure of the bone and this can be visually assessed by the colour (Stiner & Kuhn 1995:226). Bones from three Ravensworth spits were sampled (A3, A15 and A24); A15 from middle of the mound and A3 and A24 randomly chosen to represent the upper and lower parts of the mound (Table 5.3). In each spit sample all bone was counted to ascertain the percentage of uncooked bone, carbonised, or calcined bone. Each of the small bone fragments was sorted into: 1) uncooked [cream to orange/tan colour]; 2) carbonised [brown/black colour; 3) calcined [white/pale grey colour]; 4) calcined [blue/green-grey colour]. There is a continuum of colours and textures with some bones showing evidence of partial carbonisation and partial calcination, but most could be assigned to one category. The few that showed both carbonisation and calcination were categorised on the conservative side as calcined. The white calcined bone shows extensive 'crazing' fracture marks on the outer surface, unlike the natural and partially or fully carbonised bone that tends to have a smooth surface. In many cases the outer 'crazed' surface has been removed by further erosion leaving a soft chalky surface.

Table 5.3 : Ravensworth 3 Numbers and Percentages of Natural, Carbonised and Calcined Bone in 3 Spits

Numbers	***Bone Colours***				
spit	natural	brown/black	blue-grey	grey/white	total
A:3	0	52	8	98	158
A:15	32	440	14	232	718
A:21	42	679	7	440	1168
Percentages	***Bone colours***				
spit	natural	brown/black	blue-grey	grey/white	total
A:3	0.0	32.9	5.1	62.0	100.0
A:15	4.5	61.3	1.9	32.3	100.0
A:21	3.6	58.1	0.6	37.7	100.0

The amount of uncooked bone in the three Spits (mostly intrusive rodent bone) is very small (0%, 4.5% and 3.6%). Only a very small percentage of calcined bone (5.1%,

1.9% and 0.6%) showed signs of being burnt 'green' with high fat content or flesh on, resulting in a blue-grey or green-grey colour. Spit A3 has a higher percentage of grey/white calcined bone than carbonised bone (62% to 32.9%). Both Spit A:15 and A21 have more carbonised bone than grey/white calcined bone (61.3% and 58.1% respectively for carbonised and 32.3% and 37.7% respectively for calcined).

The very small percentage of blue or green grey calcined bone indicates that most of the bone was calcined after the flesh and fats were removed. This indicates that the majority of bone was calcined when dry and probably already carbonised, suggesting bone was accidentally incorporated in ovens or very hot hearths, perhaps several times. The majority of calcined bones in Ravensworth 3 are white rather than grey, again indicating that they had been subjected to prolonged very high temperatures. This implies the re-use of areas of mound as ovens or hearths and the continual incorporation of dry bone fragments accidentally into the floor or sides of new ovens or beneath new hearths. The burning of buried bones beneath fires would result in carbonised bones (Stiner & Kuhn 1995) but not calcined bones. Thus a mixture of degrees of burning occurs.

In summary, the number and colour of carbonised and calcined bones equates well with bones burnt as a result of accidental positioning close to or in ovens or fires (David 1990:65), rather then an attempt to burn all freshly cooked bone for garbage disposal. The latter would result in a higher percentage of calcined bone with the distinctive bluish or greenish grey/white colour. It also indicates that bone was not used as a fuel source, if this was the case 'green' bones with fat retained would have been used and would also result in a higher percentage of the bluish or greenish calcined bone. The mixture of carbonised and calcined bone is most likely to reflect a situation where bone is accidentally incorporated into ovens and fires, sometimes once, sometimes several times, and at different degrees of exposure to the fire.

5.4.7 Bone Fragmentation

The Ravensworth 3 bones, in common with bones in mounds in general (Coutts et al. 1979, Simmons 1980, Solomon 1998), are extremely fragmented. Examination of the bones does not show the teeth marks that might be expected if the bones were crunched up by a carnivore, and many of the bones are not the type that would be chewed up by humans, for example fish vertebrae and bird long bones which have

fine needle like structures that are dangerous to eat. It is therefore not immediately obvious what has caused this fragmentation.

Burning of bone at prolonged high temperatures causes extensive fracturing of bone (David 1990:71). David found longitudinal and transverse fragmentation was a common effect of high temperatures but that this process began at relatively low temperatures. He found transverse snapping, longitudinal fracturing, oblique or spiral fracturing and long bone cylinder collapse began with his bushfire experiment and developed with more prolonged exposure to higher temperatures (David 1990:68-73). In the controlled campfire experiment he found bones fractured principally longitudinally and that long bone cylinders collapsed, and transverse snapping also occurred. In the prolonged high temperature experiment fragmentation was extensive (David 1990:71). In a similar experiment Stiner & Khun (1995:229) found that agitation and trampling of bones caused fragmentation according to the degree of burning, the more burnt the bones were, the more trampling caused fragmentation. Similarly, burnt bones that were buried under hearths and then trampled were extensively fragmented, while unburnt bones in the same situation were hardly affected.

In the Ravensworth 3 bone assemblage, the whole bones of uncooked intrusive animals such as rodents, despite their small size and inherent fragility, are a contrast to the fragmented nature of the burnt and calcined bone. The Ravensworth 3 bones display a range of fractures, almost all long bone cylinders have collapsed, and longitudinal, transverse and oblique fractures occur. While there are no bones that display only longitudinal fractures leaving long splinters of bone, some bone fragments are up to 4cm long and appear to be longitudinally fractured bone that has begun the process of transverse fracturing. It is probable that the serial incorporation of bones into new fires continued the fragmentation process (David 1990:71). The digging activities associated with making ovens and other types of fires and trampling by people would continue this process of fragmentation (Stiner & Kuhn 1995:229), particularly of long thin pieces of bone, thus explaining the small pieces of bone that characterise the mound.

5.4.8 Plant Remains

Large pieces of charcoal were collected for dating and also for identification to help solve the problems of which fuel source was being used for the ovens, what food

was being cooked in the ovens, and what may have been used in the ovens to wrap food, keep it clean, and provide moisture for steaming of food. The amount of charcoal varied considerably throughout the excavation. In Square A there is a lack of charcoal pieces in the upper Spits; with none in the upper Spits 1-7; less than 1 gram per spit (1 x 1 metre x 5cm) in Spits 8-15; increasing although variable from Spits 16-29 (ranging from 1 to 8 grams but averaging 3.2 grams) (Appendix 5.2).

Charcoal was initially examined under a dissecting lamp and found to have varying characteristics. At this initial stage some pieces appeared to be round bulb or corm like specimens, seeds, hollow reed stems, rhizomes, and pieces of wood or smaller twigs. A total of 14 specimens with varying characteristics (12 from Ravensworth and 2 from Tchelery), were dissected and prepared for SEM examination, using Hope (1998) and Smith et al. (1998) as a guide. The resulting SEM images (Appendix 3) were sent to Beth Gott for identification. Appendix 5.2 Table 5.1.4 lists the prepared samples and the identifications made by Gott. Five out of the 14 samples are consistent with *Typha* rhizome or stem, another appears to be a rhizome with a young root arising from the surface (similar to Cyperaceae), and one may be large grass like canegrass (*Eragrostis*), or *Phragmites* reed. Two round 'bulb' like structures 10-11 cm in diameter were sampled, and are consistent with *Bolboschoenus* spp. corms. Four samples are wood, one of which appears to be a dicot with annual rings. Thus out the 14 samples, 9 are consistent with wetland monocots including *Typha* and *Bolboschoenus*, four are of wood, and one needs further photos before identification. All of the charcoal samples are from the lower part of the mounds and date to around 4,000 BP.

The bulk samples collected from the excavation provided material for a preliminary pollen analysis. Slides were made from an upper and lower sediment sample, approximately 15cm depth and 140 cm depth respectively. It was largely unknown if pollen would survive in mounds, particularly mounds from such an arid environment, so it was considered important to establish whether this could be another avenue for examining aspects of mound building and the surrounding environmental conditions. Both slide sets (three were made from each sample) contained a range of pollen in relatively low numbers but enough to establish that pollen had survived.

The pollen slides confirmed that the area contained wetlands with *Cyperaceae* and *Typha*, but also grasses and chenopods which may have come from the adjacent

Figure 5.8. Ravensworth 3 Excavation Square A : Weights of Bone, Shell and Stone By Spit

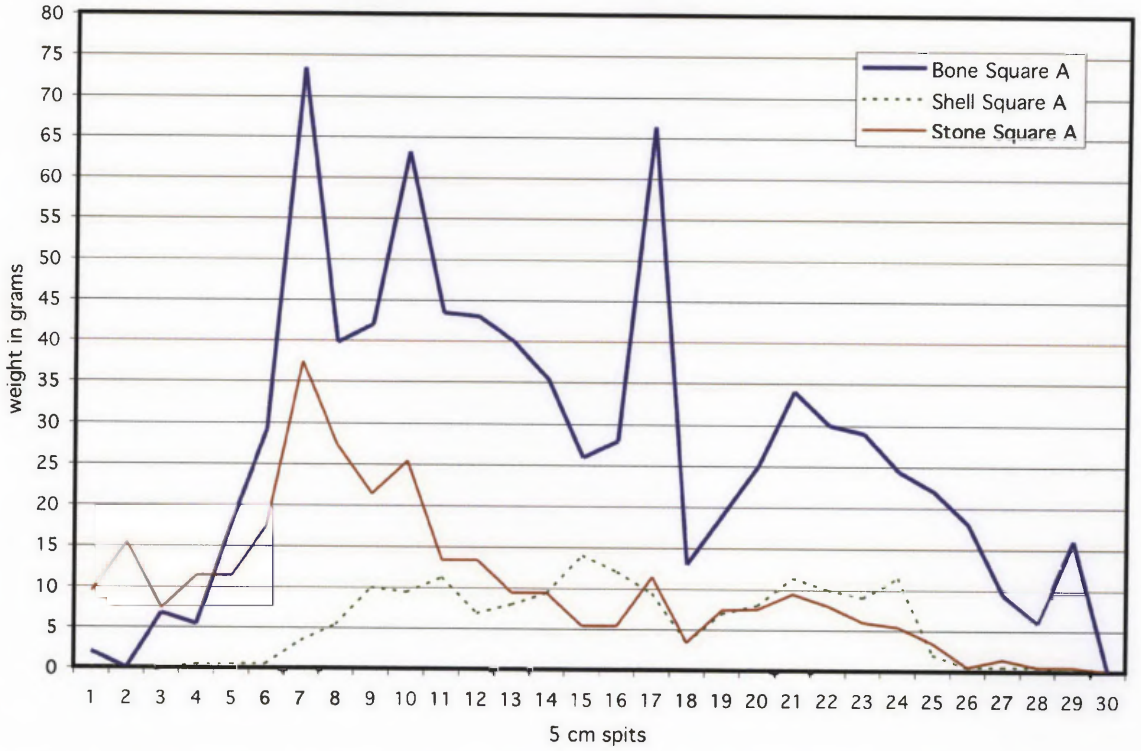
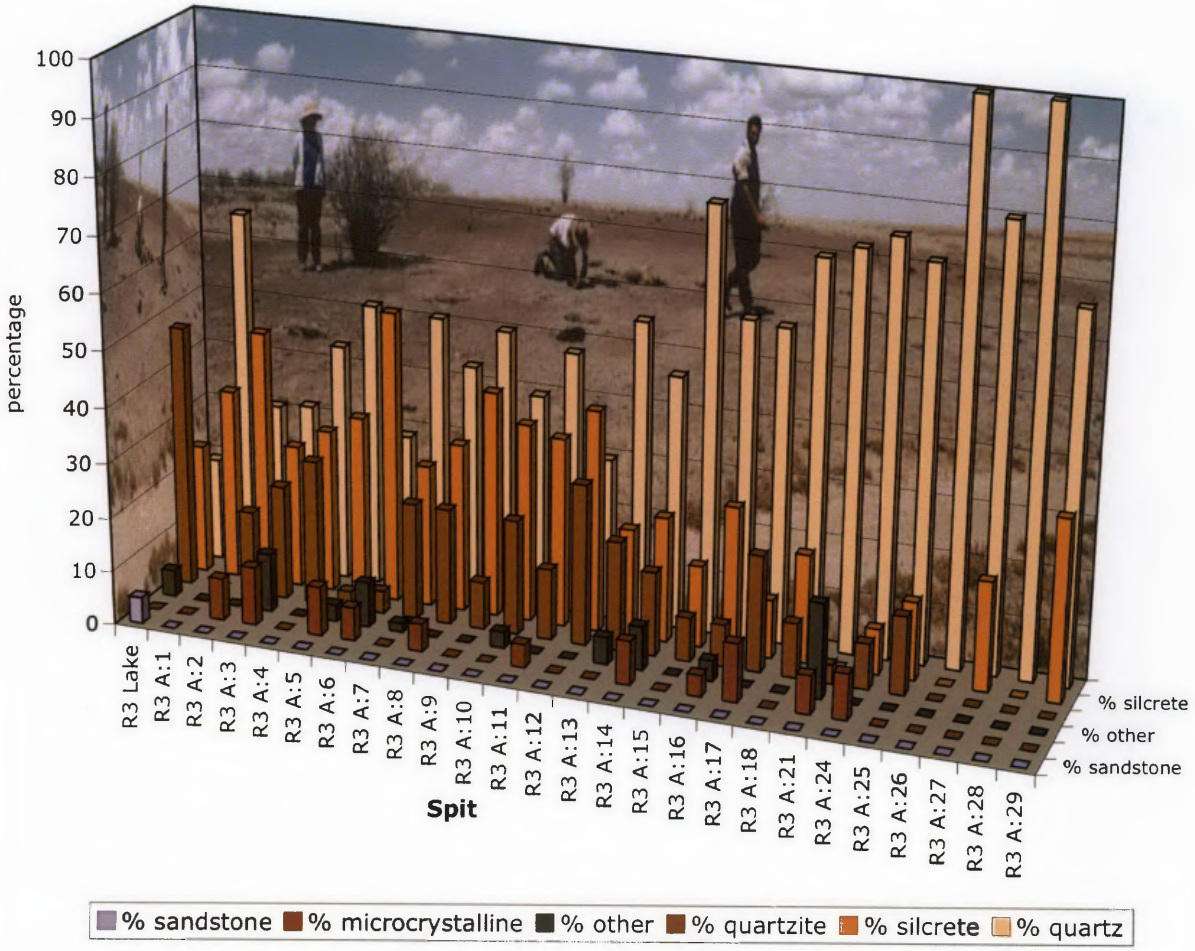


Figure 5.9. Ravensworth 3 Excavation Sample : Percentage of Stone Material Type per Spit



plains, or a wetland that periodically dried out. Tree pollen appears to be scarce, but may include eucalypt pollen. The fact that there is more pollen in the upper sample than the bottom sample, even though dating has confirmed there little age difference, may say more about the way the mound was being built up than the surrounding vegetation or differential preservation of pollen. If mound building had slowed by the time the upper layers were laid down, then more wind blown pollen may have been incorporated per gram of sediment. Conversely, during the time of rapid build up, less wind blown pollen may have been incorporated.

5.4.9 Stone Tool Technology

The distinctive bipolar and semi-bipolar microblade technology found on the mounds and other types of open sites of the Hay Plain (Martin 1996c, 2000a) was found from the surface of the mound to the bottom of the mound. As the size of flaked material (length, width, thickness measurements) remains similar throughout (see below), the weight of stone gives a reasonable measure of the number of artefacts. Figure 5.8 shows that the amount of stone found throughout the mound varies in a similar way to the bone and shell, with a notable decrease in the amount of stone in Spits 26-29. Spits 6-10 have an increase in the amount of stone that is a mirror of one of the major spikes in the amount of bone material. Overall, stone increases markedly from spits 12 - 6. The stone technology from Spits 1-29 was analysed in detail using the same methods outlined in Chapter 7 and following definitions in Holdaway and Stern (2004). A total of 593 artefacts were measured and described (Appendix 3 Charts 2 & 3, and raw data in Appendix 5.4). All artefacts with one dimension over 5mm were measured. A small sample from the scatter of artefacts and heat retainers located on the beach of the Ravensworth 3 Lake is included for comparison (Appendix 2 Chart 1, and Appendix 5.4).

1. Artefact Type and Size

The stone material consists of usually very small flakes and occasional small thin blades, bipolar cores, bipolar split cores, and low numbers of finished small and often broken tools such as geometric backed blades, bondi points, burins, and flake tools with retouch and /or usewear on straight sides and ends (Appendix 5.4 Table 5.4.3). Overall only 10.2 % of artefacts can be described as tools (artefacts with retouch and/or usewear), which is much less than some other sites in the area such as the microblade workshop near Dry Lake where tools compose 33% of the total

artefacts. Appendix 5.4 Table 5.4.1 shows that average artefact length per spit ranges from 14.5mm to 7.5mm, and average whole flake length per spit ranges from 15mm to 7.7 mm. Maximum flake size per spit ranges from 37mm to 8mm. Average flake thickness per spit ranges from 4.2 to 2.1 mm. Overall there is very little variation in sizes of artefacts in the excavation, with just a few slightly larger artefacts in with the mass of very small artefacts.

2. Material Type

Figure 5.9 and Appendix 5.4 Table 5.4.4 show the distribution of stone material type throughout the excavation. Overall quartz is dominant and comprises 56% of the total, silcrete 25% and quartzite 13%. Small amounts of microcrystalline material ('chert', 'jasper' etc) and 'other' (mostly dark hornfels) comprised 5.6%.

3. Flake Type

Flaked non-tool material consists of 52.4% whole flakes, 9.6% proximal flakes, 5.6% distal flakes, 1.9% split cone flakes, and 17.9% flake fragments, in addition to the 2.4% cores and 10.2% tools (Appendix 5.4 Table 5.4.2). Two flakes struck off ground edge axes were noted. No food grinding/pounding implements were found in the excavation, in contrast to the open site on the edge of Ravensworth Lake, which contained pieces of both seed grinders and mortar/pestle type implements.

4. Platform and Termination

Figure 5.10 shows the types of flake platforms by spit. No focal/bifacial platforms were noted, and broad/bifacial types are rare, especially in the lower half of the mound. Focal/unifacial platforms are more common in the top half of the mound, and broad/unifacial is spread throughout. Crushed platforms are spread throughout, but there is a slight tendency for it to be more common in the lower half of the mound. The platforms are clearly related to the small size of the artefacts and the bipolar flaking technique used. Crushed platforms and simple broad/unifacial platforms together form nearly 85% of the platforms in the total sample. There is a slight tendency towards a greater variety of platforms and less crushed platforms in the upper section, indicating more accurate flaking, possibly better quality cores or less reduction.

Figure 5.10 Ravensworth 3 Excavation Sample : Percentage of Platform Types by Spit

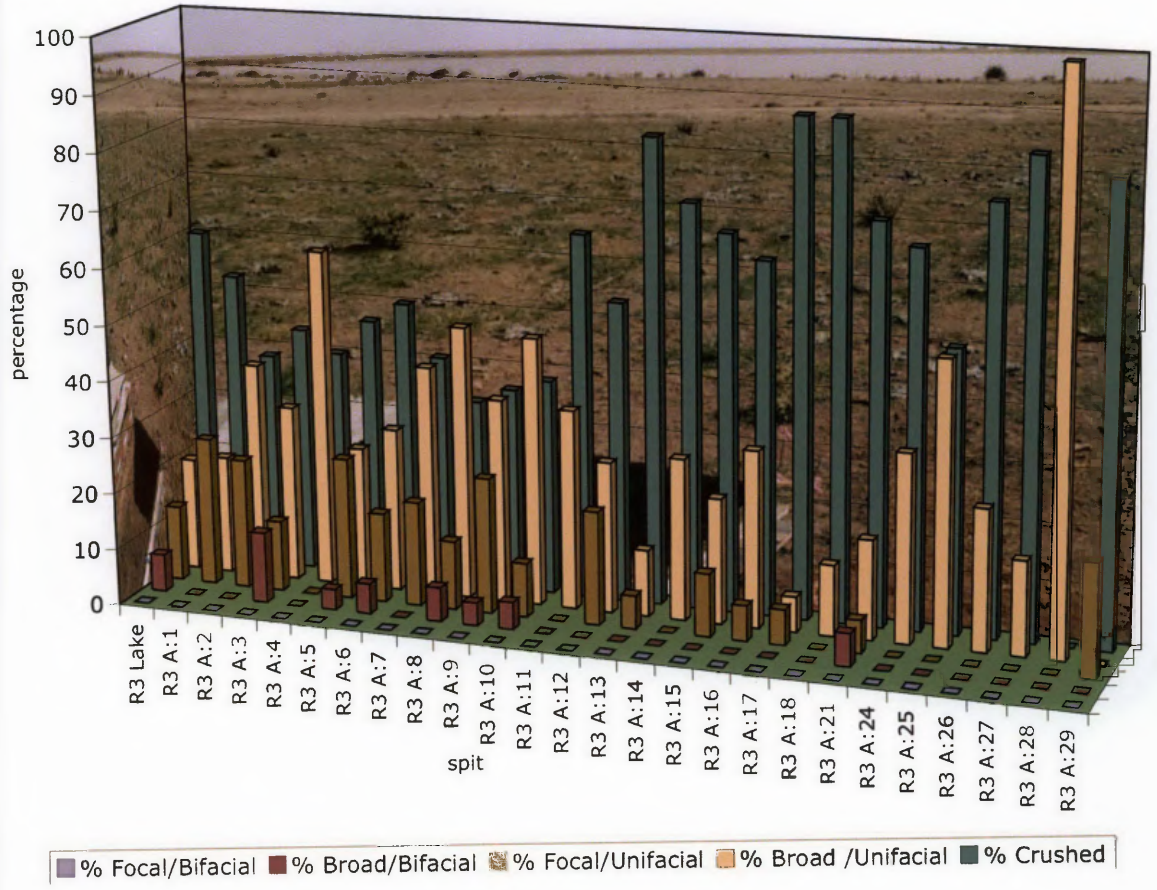


Figure 5.11 Ravensworth 3 Excavation Sample : Percentage Termination Types by Spit

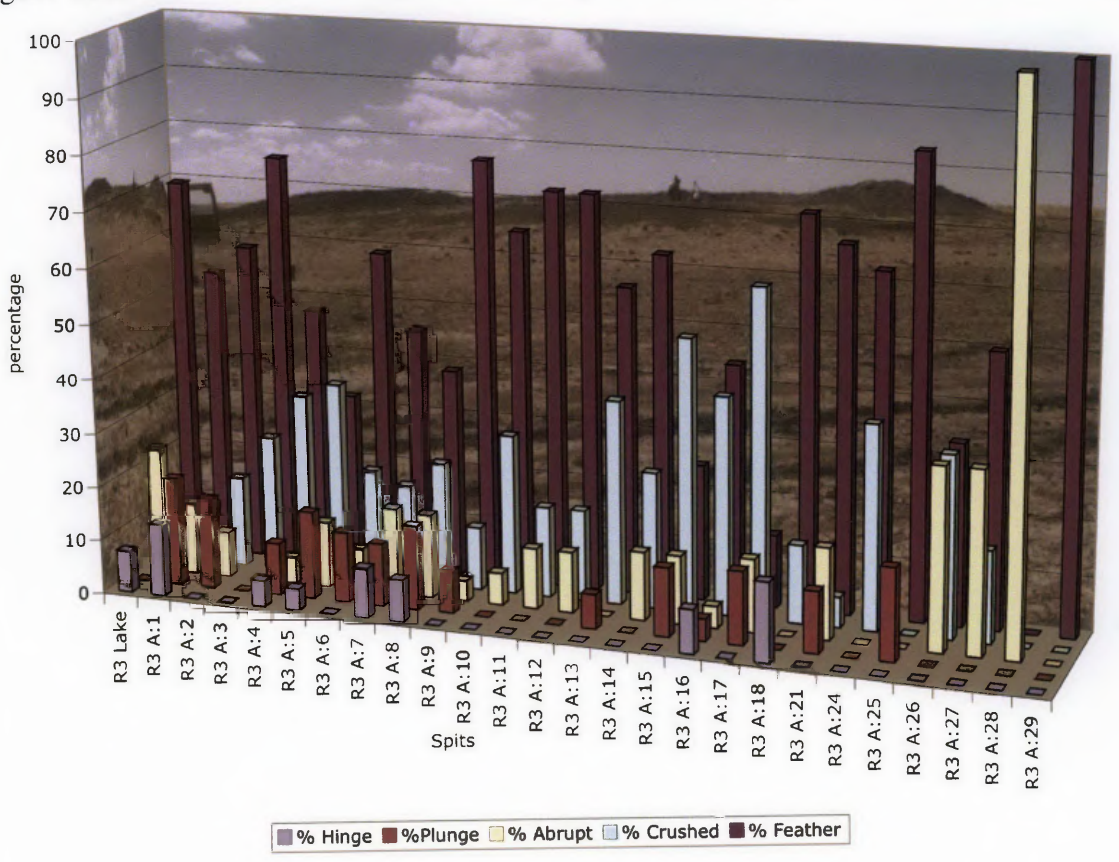


Figure 5.11 shows the types of termination by spit. The four termination types are spread throughout the spits, with some unevenness but no particular trend (the last 2 spits should be combined because of low sample numbers). Nearly 80% of all terminations are either feather or crushed, the substantial number of feather terminations suggesting that semi-bipolar flaking was taking place as well as fully bipolar flaking that often results in crushed terminations.

5. Fracture Type.

The majority of flake fractures are bending fractures rather than conchoidal fractures, resulting from the bipolar and semi-bipolar technique and the small size and often poor quality of the stone material. A snatch sample from the middle of the excavation resulted in a count of 11 conchoidal fractures compared to 191 bending fractures, illustrating the complete dominance of bending fractures. Some of the quartzite and silcrete flakes with bending fracture showed features associated with this type including a crescentic platform with a lip and 'waist', and fissures (as illustrated in Holdaway & Stern 2004:35), but the quartz flakes tended not to show these features except for the fissures.

6. Cortex

Cortex on artefacts indicate that pebbles of quartz and quartzite, and small weathered nodules of silcrete form the dominant stone source. Artefacts with cortex are spread throughout the excavation, some spits have no artefacts with cortex, but in others up to 20% of artefacts have cortex. Flakes may have up 60% cortex, but this is rare. There is only limited evidence for decortifying cores on site, suggesting that much of the actual flaking took place elsewhere. This is also backed up by the fact that cores make up only 2.4% of the artefacts from the excavation, and these are nearly all very small bipolar split cores that had finished their life as cores. The small size of the pebbles and nodules clearly influenced the type of technology used and the resulting artefacts. The Ravensworth artefacts are small because the resource was mostly small, it does not reflect a simple case of distance decay. At this stage it is not known where the source of the raw material is, but it has been imported into the Hay Plain.

7. 'Witter' Reduction Charts

'Witter' reduction charts (Witter 1992) of complete flakes, tools and cores are shown in Appendix 2 Charts 2 & 3 for Spits 1-10 and Spits 11-29. Reduction charts give a

visual record of artefact sizes, flake thickness, reduction stage of cores, and can illustrate the process of core reduction by flake size trend lines. An arbitrary division was made at Spit 10-11 to divide the charts into upper and lower and as there were two many artefacts to fit on one chart and to see if any differences could be noted between the two. The charts are both very similar, and illustrate the mass of very small flakes in the lower left hand corner, together with some flake tools. Some larger flakes and flake tools spread out, particularly the few larger mainly quartzite flakes. Cores tend to cluster slightly above the flakes, they are not blocky in outline as discarded cores tend to be. This is because as they are split, the typical end result of bipolar flaking. There is a tendency for some quartz flakes to be thicker than the other materials, but other quartz flakes are very thin.

8. Stone Artefact Indicators of Activities on the Mound

Definite stone artefact manufacturing activity areas in the mound, such as flaking floors, were not found with the exception of 5 quartz artefacts found in a group in Spit 20B which appeared to be the result of a flaking episode. Most spits contained a range of material that could not be refitted. The overall impression is that activity in the mound was limited to some manufacture of bipolar flakes and some tool maintenance activities. The digging into the mound material to make ovens would disturb any flaking floors, however, if a large amount of this type of activity had been carried out on the mound the excavated material would still reveal relationships between cores and flakes, flakes and flakes, and unfinished artefacts.

Another type of activity area is revealed in spit 8 which had a cluster of 4 proximal ends and one medial flake which all appear to be broken Bondi points from the remaining retouch and triangular cross section. A full Bondi point was found in the adjacent spit 9. The points may have been broken off elsewhere and the remnants discarded on the mound during the maintenance of tools such as spears. Failure during manufacture is likely to produce snapping of the distal tip (Holdaway & Stern 2004:262), rather than snapping close to the platform as in the Spit 8 discards.

Evidence suggests the rare small tools such as geometric backed blades, Bondi points, and thumbnails were brought onto the mound from elsewhere. There were no unfinished small tools in the excavation sample, in contrast to the nearby Ravensworth Lake site that contained an unfinished geometric microlith. The differences between the excavation material and the Ravensworth Lake sample

suggest that different activities were carried out at each site, although a larger sample of the Lake material is necessary for further analysis. Unfortunately the Lake sample is undated, however, the artefacts are much larger (Appendix 5 Table 5.4.1), including the unfinished geometric which is over twice the size of any other geometric recorded in the Ravensworth 3 excavation. The most obvious difference is the number of fragments of grinding and/or pounding implements which form 19% of the Lake sample, and several flakes also had a ground face, indicating they had been flaked from grinding/pounding implements. This suggests that the Ravensworth Lake site was the focus of a different type of food preparation than the mound. At this stage we do not know whether these different food preparation activities are concurrent or not.

5.5 SURVEY OF THE TCHELERY MOUND COMPLEX

The Tchelery 1.1 mound complex consists of 4 large mounds and 4 smaller mounds, and is also associated with a burial cluster/campsite recorded by Judith Littleton. This mound complex is situated on a low rise on an otherwise flat plain of grey cracking clay rich soil. The Tchelery burial cluster is situated on a similar low rise on the plain between Tchelery 1.1 and the ephemeral Dry Lake that also has a major complex of mounds, campsites, microblade workshops and burials. The mound complex was mapped using a colour 1:50,000 air photo that clearly shows the 4 larger mounds, and the 4 smaller mounds were accurately positioned from the vegetation and scald patterns (Figure 5.12). Cultural material on the surface of the mounds was recorded on a presence/absence basis to identify possible functional differences. Appendix Table 5.5.2 presents this data which indicates that the mounds in the complex all contained a similar range of cultural materials, with the exception of the very degraded smaller mounds which lack diversity of cultural material.

The contour survey of the Tchelery 1.1 mound was undertaken as a record of the size of the mound and also so we could estimate how deep the excavation would be. A general contour survey of the mound (Figure 5.13) gives the dimensions and also shows the elliptical and domed shape of the mound. A Datum Point was set up roughly in the centre of the mound (marked by a peg) and a longitudinal section and a cross section perpendicular to the longitudinal section were surveyed (Figures 5.14, & 5.15). The Tchelery 1.1 mound (photos 14 -17) is approximately 130 metres long x 80 metres wide by 1.86 metres high (maximum dimensions). The excavation later revealed that the underlying yellow-orange soil has a rise of approximately 20cm

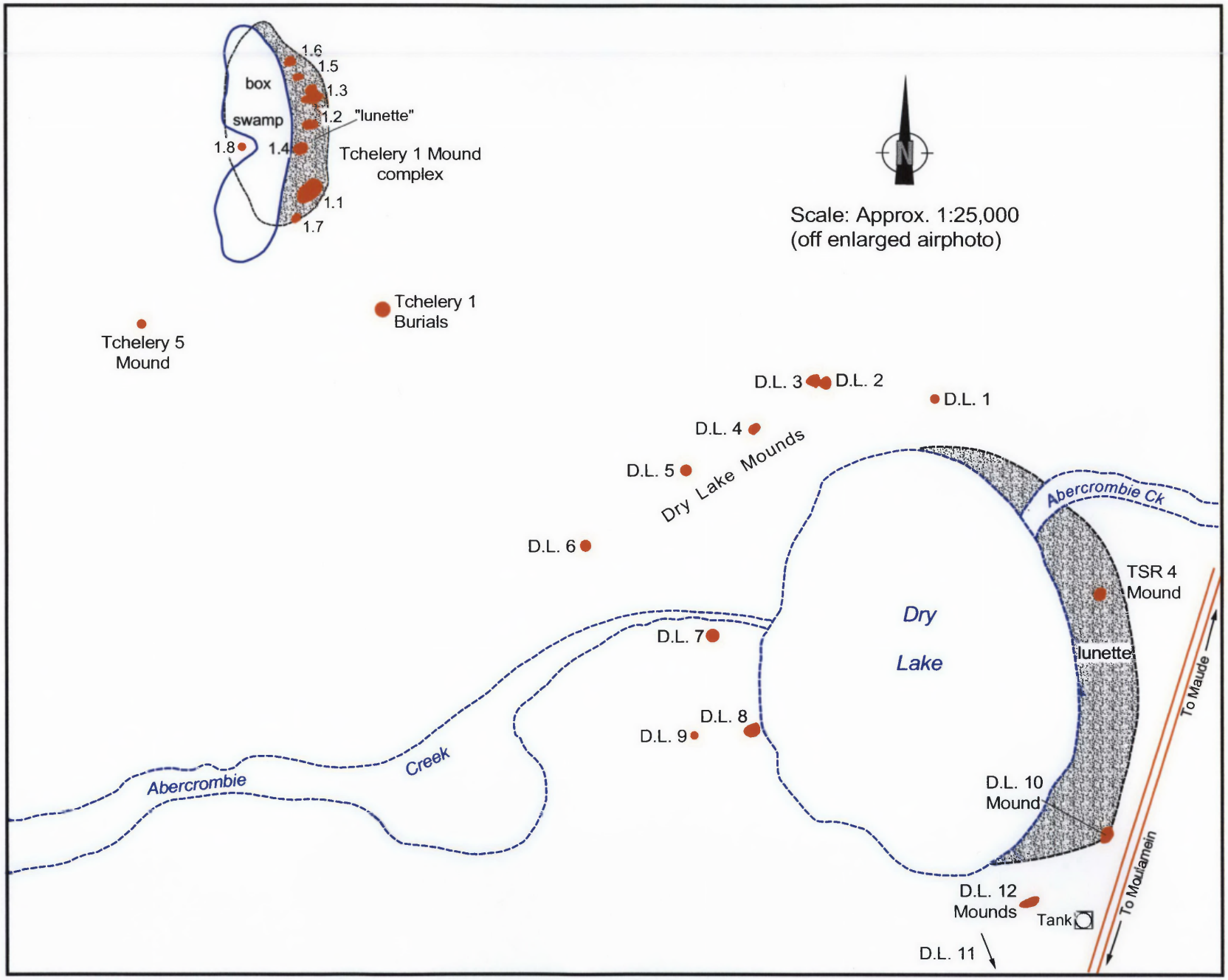


Figure 5.12: Map Showing the Tchelery 1 Mound Complex and Nearby Sites

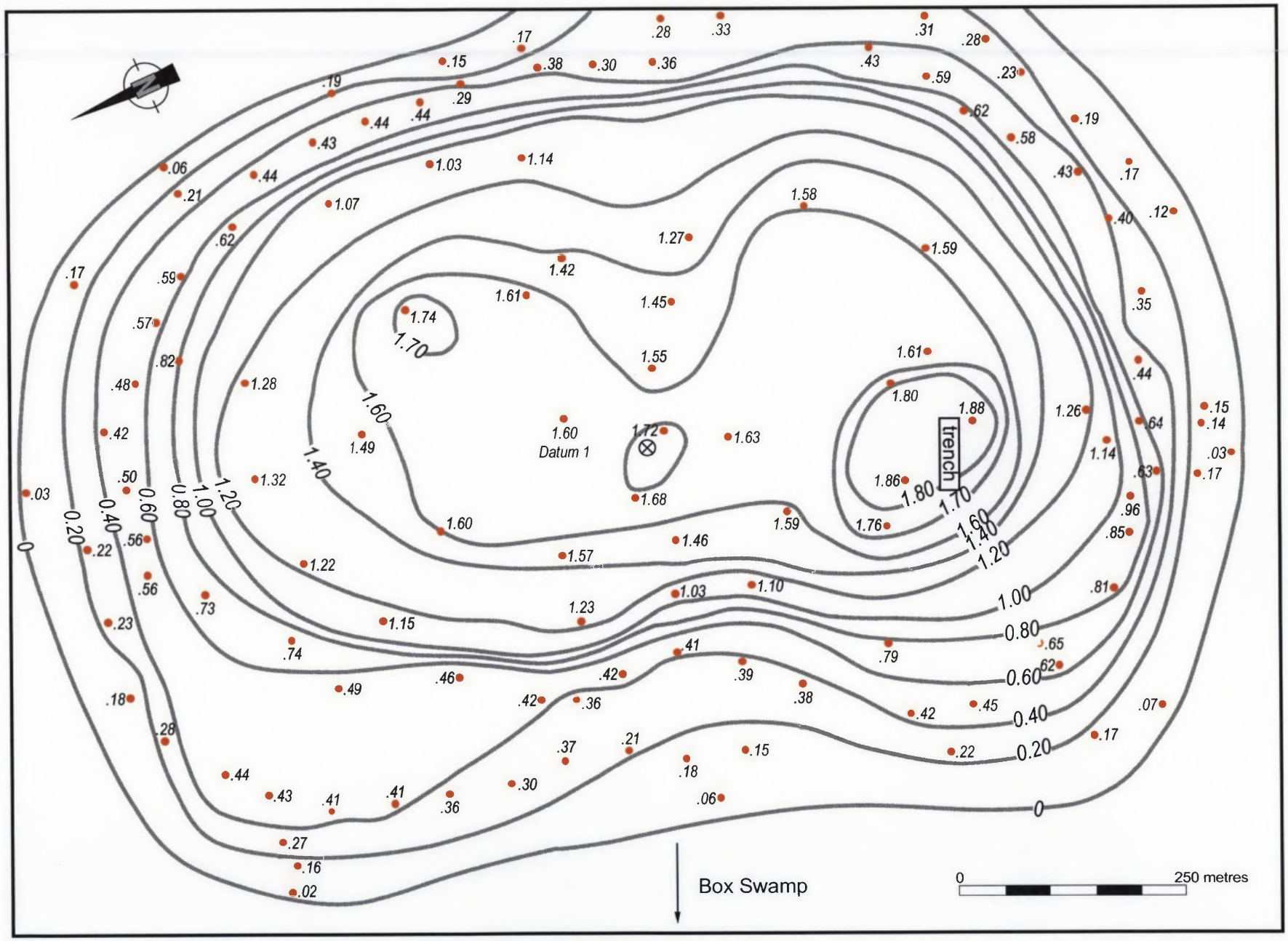


Figure 5.13: Contour Survey of Tchelery 1.1 Mound

Figure 5.14 : Longitudinal Section of Tchelery 1.1 Mound on 17 Degrees North Axis (10 x vertical Exaggeration)

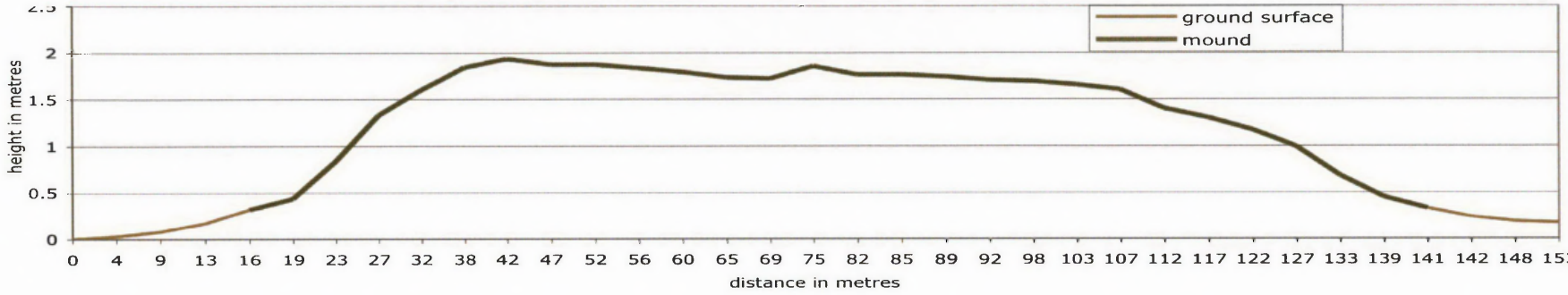


Figure 5.15: Cross Section through Middle of Tchelery 1.1 Mound, on 287 Degrees West Axis (approx. 10 x Vertical Exaggeration)

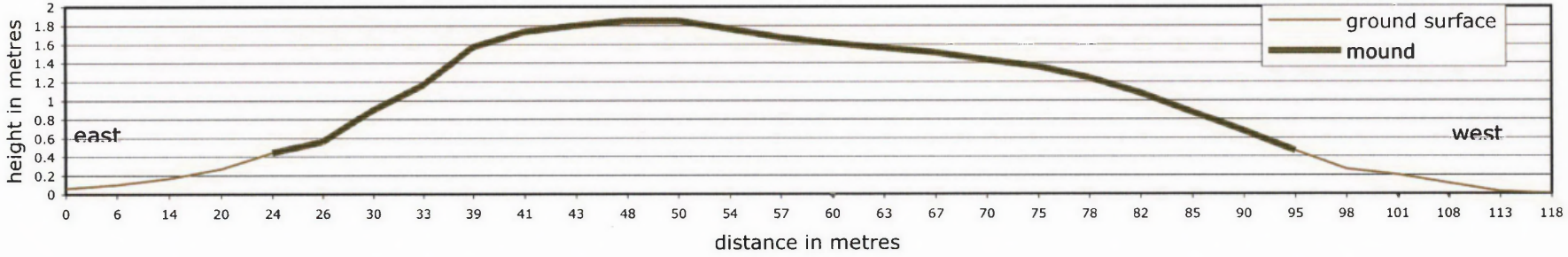
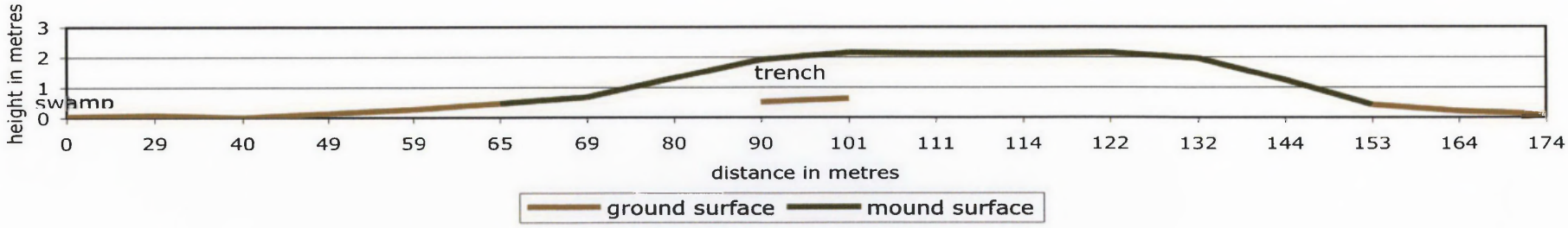


Figure 5.16 Cross Section of Tchelery 1.1 from Swamp across Mound & Excavation Trench (over 10 x Vertical Exaggeration)



that reduced the actual height of the mound to a maximum of about 1.6 metres. The Tchelery 1.2, 1.3 and 1.4 mounds are considerably smaller than Tchelery 1.1 but still larger than most mounds found in other regions. The other 4 mounds in the complex are smaller again and 1.6 and 1.8 have been severely deflated. Appendix Table 5.5.2 summarises the size, description and content of the Tchelery 1 mounds. Local knowledge collected from a range of people, mostly farmers, indicate that the mounds of the Hay Plain have been reduced in height within living memory, and some may have been considerably reduced in height since the beginning of the pastoral period. It is difficult to estimate how much has been blown off the tops of these mounds, or physically removed by the trampling etc of stock. At least some of the material moved around by stock may now be around the edges of the mound which would still be included in the length, width and volume measurements.

5.6 EXCAVATION OF THE TCHELERY 1 MOUND

5.6.1 Excavation Location and Trench Size

The location of the trench on the mound (Figure 5.13) was situated for the following reasons;

i. it is on a high part of the mound to give a maximum depth, approximately 1.6 metres of mound material

ii. a relatively level area that appeared to be less disturbed by rabbits

iii. it was placed perpendicular to the long axis of the mound, i.e. from the centre of the mound out towards the box swamp which may have been the focus of activity.

A relatively large trench (1 x 8 metres) was excavated in order to examine:

i. the structure of the mound, or how the mound was built up (layers, ovens, oven rake out, material tipped out of baskets etc.)

ii. the stratigraphy

iii. visible features (ovens, fireplaces, hut platforms, hut remains, workshops)

iv. the chronology of the mound by obtaining datable material

v. mound contents including faunal material, stone artefacts, charcoal.

5.6.2 Excavation Procedure

i. The trench was laid out in four 1 x 2 metre 'squares', a total of 1 x 8 metres perpendicular to the long axis of the mound. The corners of the trench were surveyed in. The 'squares' were labelled A,B,C and D and were excavated and bagged separately.

ii. The excavation of the Squares A, B, C & D proceeded in 5 cm spits taken out by trowel, brush and dust pan, and then placed in buckets to be lifted out of the trench. This technique was continued throughout because of a lack of clear stratigraphic units.

iii. Material was sieved using a large wooden two person sieve with 11mm sieve on top to catch rare large bone fragments, rare whole shell, and the majority of baked clay heat retainers, with 2mm sieve beneath to catch the smaller fraction of the archaeological material (whole and fragmented bone, teeth, shell, stone artefacts, bone points, large pieces of charcoal, and smaller heat retainers).

iv. Each spit of each square was excavated and sieved separately, sorted into categories, and bagged and labelled. Preliminary sorting took place in the field, or sieved material was taken back to Hay for sorting. The preliminary sorting aimed at separating the following:

- bone + shell
- stone
- large pieces of charcoal for possible species identification and dating
- baked clay casts with impressions
- fragile remains, or material that appeared to have anything unusual such as cut marks was wrapped and put in labelled small plastic boxes
- faunal material that could be easily identified to species, such as teeth, jaws,

etc, was bagged separately and placed in small plastic boxes.

- heat retainers
- features were measured in, drawn and photographed and samples taken. All charcoal rich features had charcoal samples taken for dating
- bulk samples were taken throughout the excavation to allow for future sediment analysis.

5.7 RESULTS OF THE TCHELERY 1 EXCAVATION

5.7.1 Chronology

Eight dates were obtained for the Tchelery mound (Table 5.4). The lack of charcoal in the upper half and the disturbance by rabbits and farmers ripping rabbit warrens made it difficult to date the upper section, however a bone apatite AMS date was obtained from Spit C:2. The A:14 date was obtained from charcoal disseminated in the spit, and the other six dates are from charcoal found in actual hearth or ovens features, and thus date an actual event or activity (Table 5.5). Some of the lower dates have a relatively large magnitude of error owing to the small charcoal samples.

The dates obtained indicate the mound started at around 4,300 BP and it was constructed relatively rapidly over approximately 700-800 years, or 18.7 cm per 100 years. It then apparently ceased to be used as a heat retainer oven cooking location, but may have continued to be used for other purposes. The 'basal' date of 4,340 ± 160 BP comes from a hearth at the junction of the mound material and the underlying sterile material. This could represent an event some time before the beginning of the mound but the second date of 4,010 ±170 BP only 10-15 cm higher up confirms the approximate beginning of this mound.

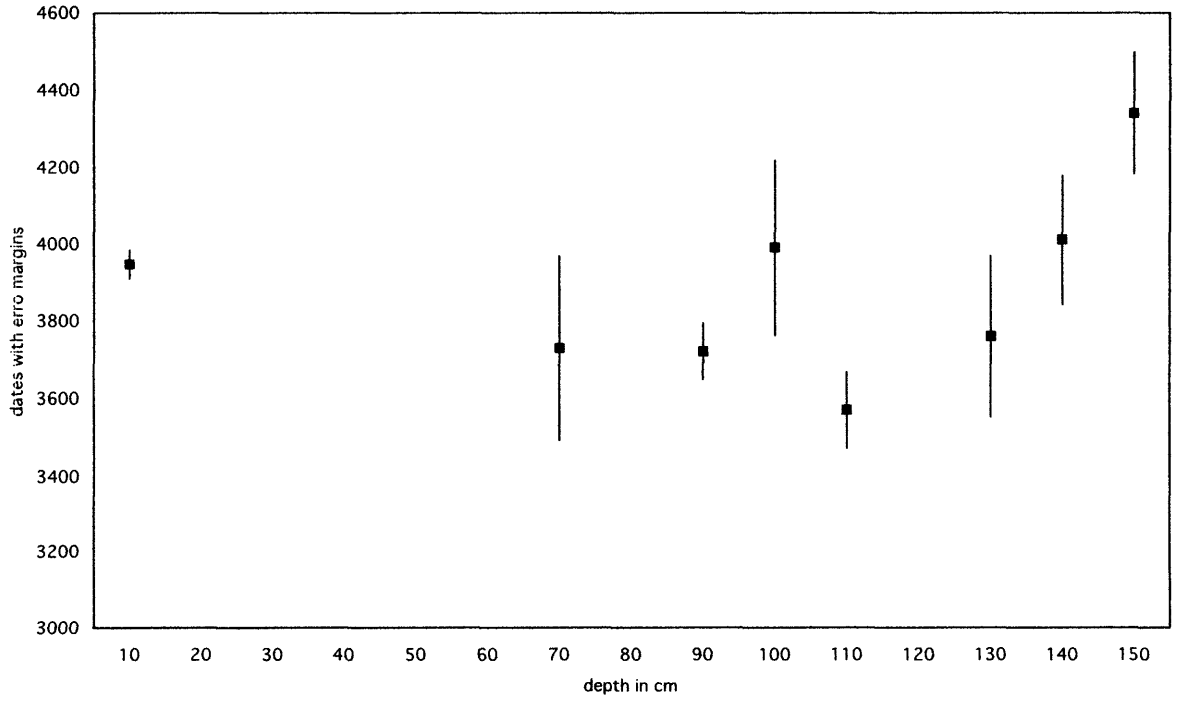
The dates obtained were mostly in stratigraphic order, and the minor discrepancy in the dates can be explained by the following:

- structural mixing during re-use, i.e. younger hearths dug into older material
- overlapping dates with large errors

- the horizontal distance between samples (up to 8 metres between Square A and D), and differential build up of mound in the different area
- post-European disturbance.

Table 5.4 : Tchelery 1 Depth and Type of Dates and Age by Depth Box Plot

Sample (spit no)	Depth	Wk Number	Uncalibrated Date	Type of Date
T 1 C:2	5-10 cm	Wk 17491	3947 ± 39 BP	bone apatite AMS
T1 A:14	65-70 cm	Wk 4095	3730 ± 240 BP	Charcoal
T 1 D:17	80-85 cm	Wk 4096	3721 ±75 BP	Charcoal AMS
T1 C:18-19	85-95 cm	Wk 4097	3990 ± 230 BP	Charcoal
T 1 C:22	105-110 cm	Wk 4098	3570 ± 100 BP	Charcoal
T1 D:26-28	125-135 cm	Wk 4100	3760 ± 210 BP	Charcoal
T 1 D:28	135-140 cm	Wk 4099	4010 ± 170 BP	Charcoal
T1 D:29-30	140-150 cm	Wk 4101	4340 ±160 BP	Charcoal



The four Square D dates are all in order, and together with the Square A indicate the lowest 70 cm of mound was built up over approximately 600 years, or 11.6 cm per 100 years. However, the top two Square C dates are slightly older than expected, although the error margins overlap with other dates. The T1C:2 date from the top of the mound comes from bone disseminated in the spit, and the slight inversion of this

date may result from post-European disturbance such as rabbits. The slight inversion of the T1C:18-19 date may simply result from a combination of its large error margins, the digging of ovens into older material resulting in some of the other younger dates, and differential build up of the mound in different areas.. Taking the large margins of error into account, the mound took approximately a maximum of 1,000 years, or a minimum of 500 years, to be constructed. It is possible that the lowest date relates to a pre-mound occupation, and if this is removed the mound may have been constructed in as little as 277. The Tchelery 1 mound therefore may have taken longer than the Ravensworth 3 mound to build up to approximately the same height, possibly because it is a longer, wider and slightly higher mound. Given the large surface area of the mound, and the arid, open, windy environment, this must still be considered a very rapid build up of material.

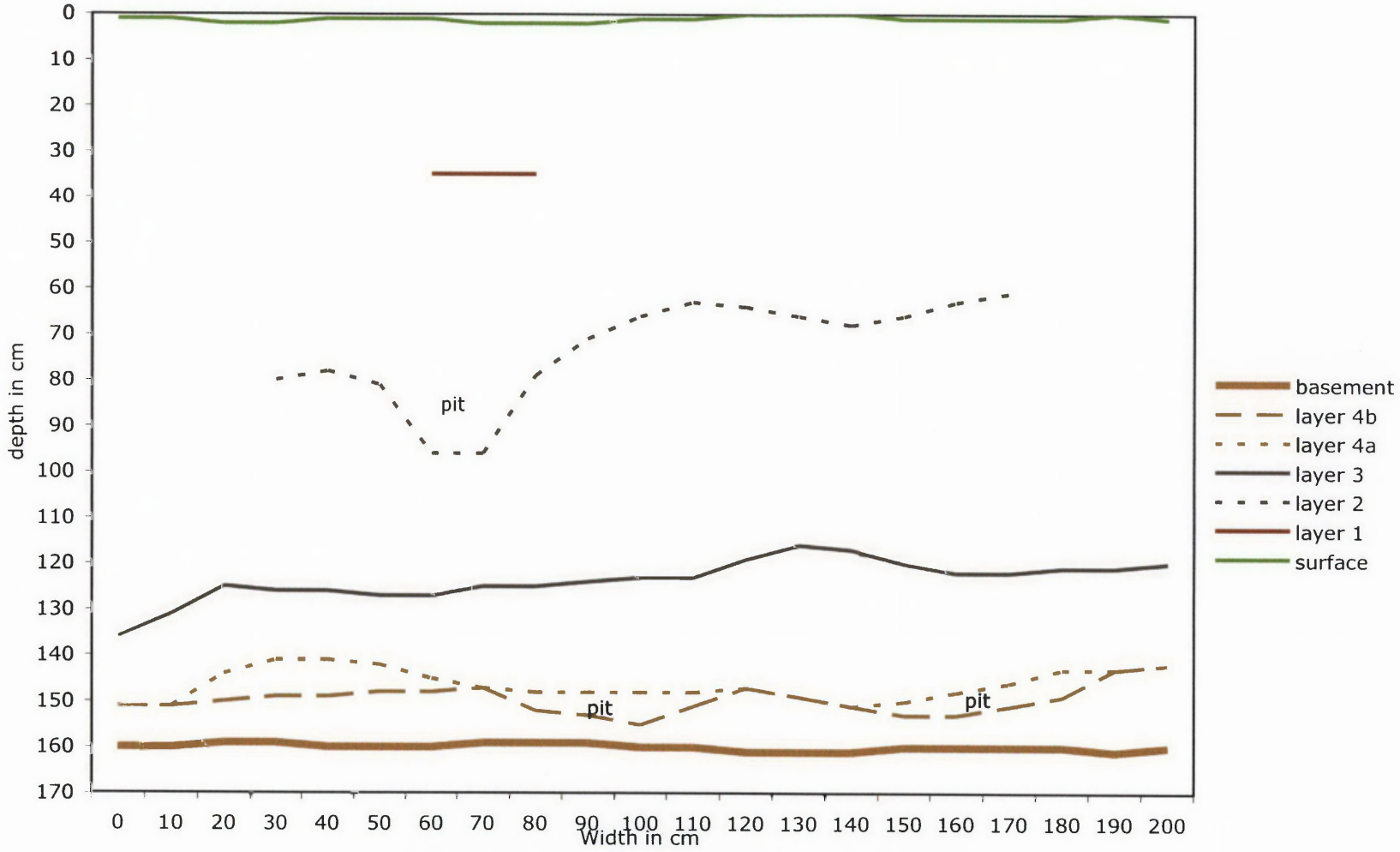
Table 5.5 : Tchelery Excavation Description of Features with Dates

SPIT (5 cm)	Waikato RC DATE	LAYER	DESCRIPTION
C:2	3947 ± 39 BP Wk 17491	I	Bone disseminated in spit, including large pieces of kangaroo leg bone
A:14	3730 ±240 BP Wk 4095	II	charcoal disseminated in spit
D:17	3721 ±75 BP Wk 4096	II/III	Feature F3- black compact material in basin shaped feature
C: 18-19	3990 ±230 BP Wk 4097	III	Feature F5-black waxy material with charcoal, bone and shell
C:22	3570 ±100 BP Wk 4098	III	Feature 7-charcoal rich area with concentrated heat retainers
D: 26-28	3760 ±210 BP Wk 4100	IVa	Feature 10-charcoal rich material beneath circular baked clay lens
D:28	4010 ± 170 BP Wk 4099	IV a	Feature F8-grey/black ashy compact material beneath in-situ heat retainers
D:29-30	4340 ±160 BP Wk 4101	IVb	Feature F11-basin excavated into basement, infilled with charcoal rich black material & mound material

5.7.2 Depth of Deposit & Stratigraphy

The excavation revealed that the underlying yellow-orange soil has a rise of approximately 25 cm which reduced the actual height of the mound to a maximum of about 1.6 metres. The mound was built up on the A2 horizon of a palaeochannel soil, a hard, orange-yellow clay rich sand, and the slight elevation of this landform feature influenced the location of the mound.

Figure 5.17 Tchelery 1.1 Excavation Section West Wall Square D



The excavation also revealed four stratigraphic layers including the upper layer that was heavily disturbed by rabbit warrens (Figure 5.17). The stratigraphy is poorly defined and partly a result of post-depositional processes (photos 18-23). The top layer is best described as 'plough zone' resulting from the ripping of rabbit warrens, the ripper marks clearly visible in the top 30cm. This mound has been heavily leached throughout the top third resulting in paler coloured sediment. The effect of leaching gradually diminishes downwards with the bottom layer consisting of a dark charcoal rich material.

Underlying the changes in colour and charcoal content due to leaching there is a consistent layering, which reflects a change in sediment texture as well as colour. Stratigraphy has also been affected by insect activity, including that of spiders, scorpions, termites and ants. Thin lenses of sand appear to result from sand wind blown during dry periods, a more likely explanation than sand found on the Murray in mound in DP/1 which was interpreted as tempering agent for heat retainers (Coutts 1980:31).

5.7.3 Oven and Hearth Features

The excavation revealed a number of hearth features, including ovens with baked clay heat retainers and ash, (photos 19 & 21) and hearths with charcoal rich layers over baked clay lenses (photo20). There were definite oven pits but in other cases the material corresponded more to partly consolidated heat retainer and ash raked out of an oven. The features found during excavation are summarised in Table 5.6.

Table 5.6 Description and Depths of Tchelery 1.1 Features

Feature	*Spit*	*Depth*	*Description*
F1	C:10 – C:13	50-68 cm	Semi-circular, hardened dark soil plus heat retainers, mussel shell, no charcoal
F2	D:14	65-73 cm	Charcoal rich, oval, 23cm x 44 cm
F3	D:17 -20	85-100 cm	Black greasy compact material with grey heat retainer rich very compact material around outside, circular, charcoal
F4	D:19	96cm	Dark ashy area
F5	C:19-20	94-98cm	40 cm diam, large pieces mussel + burnt bone, black waxy material, grey ash
F6a	C:20	100-105 cm	Circular feature, 50cmdiam, black ashy area w. little heat retainer, burnt bone +shell
F6b	A:23	115-120 cm	Small patch of charcoal stained sediment + cluster of heat retainers, burnt bone and shell
F7	C:22	110-114 cm	Small compact area of charcoal, clustered blackened heat retainers, bone, 50 cm diam
F8	D:26 – D:28	125-140 cm	Cluster of in-situ heat retainers surrounded by grey-black ashy compact material with degraded heat retainers, baked clay base
F9	D:27	130-138 cm	Very compact circular black sediment feature, whitish stain on hard baked material, 38 cm diam
F10	D:26-D:28	125-140 cm	Circular baked clay lens, orange colour, with hard very black layer &charcoal beneath,
F11	D:29 - D:30	145-155 cm	Basin shaped pit in hard basement, infilled with hard charcoal rich black material

5.7.4 Hut Floor

The base of the mound consisted of a clearly defined junction with the A2 horizon of the underlying yellow-orange clayey sands. This sediment was extremely hard (we had to use a crow bar to excavate it) and did not contain any archaeological material. The surface of the junction between the mound and the underlying soil was uneven and shallow, relatively small hearths had been dug in the soil and infilled with a dark charcoal rich material (the oldest date of 4,300 BP came from one of these pits). The junction in Square D displayed a compacted, flat and 'polished' looking floor with one very definite post hole and one possible post hole (Photos 22-23) and a small shallow basin hearth indicating that the area had been used as a hut floor before the build up of mound material began, or during the first stages of mound build up. There was no direct evidence of hut floors higher up within the mound, which is to be expected as they would not be conserved in the softer and dug over sediment of the mound. However, some of the features recorded, such as the more confined hearth features or other activity areas, may reflect placement in or near huts.

5.7.5 Activity Areas

In places fragmented bones from of one species and size of animal were found in a loose cluster, and in similar fashion stones from one flaking episode were found close together. For example in D:2 there was a concentration of larger than average pieces of leg bone from a large animal, probably kangaroo tibia. These areas may represent an activity area, but they may represent areas where material has been 'tidied up' and dumped, for example swept up and dumped on the mound or in a fireplace. These elements may represent an activity that has been carried out nearby, the debris tidied up and dumped on the mound. It is not possible at this stage to say whether material was deliberately moved at all, or the debris was just swept a little way from one part of the mound to another, or if there was more substantial movement, for example the debris may have been put in a basket and carried from the actual activity area over to the mound and dumped on it.

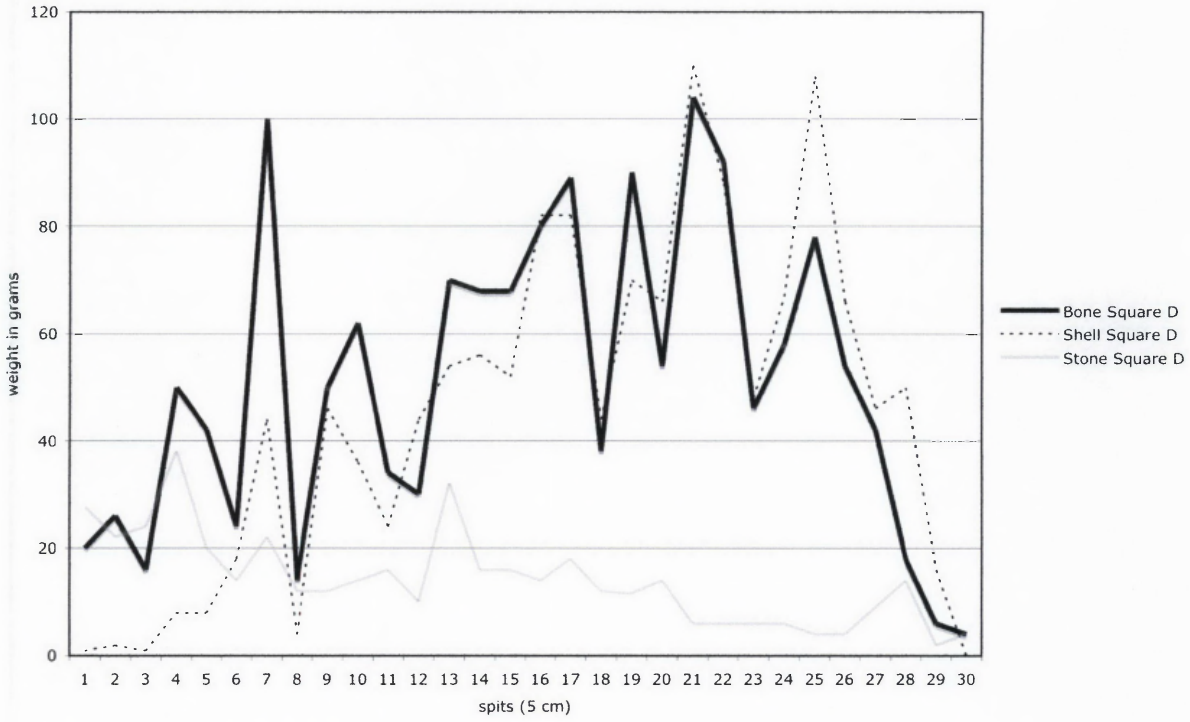
5.7.6 Mound Material

The Tchelery 1.1 mound consists of an alkaline (pH 8-9) fine silty-sandy material with varying amounts of ash, charcoal, fragmented faunal remains (mostly carbonised), stone and bone artefacts including bone points, baked clay heat retainers and baked clay casts. No burial material was found during the excavation. The sediment, particularly from the lower layers, was waxy in texture, indicating fats and waxes from cooking of food. The bulk samples from layers 14 and 28 were both tested for pH and found to fall within pH 8-9.

5.7.7 Stone Tool Technology

The distinctive bipolar microblade technology found on the mounds of the Hay Plain Southwest (Martin 1996c), and in the Ravensworth 3 excavation, was found from the surface of the mound right down to the bottom spit C29, which was dated to between 4,300 BP and 4,010 BP. A sample of artefacts from Square D was analysed and found to be similar to the Ravensworth mound, characterised by very small bipolar flakes, with low numbers of geometric backed blades, notched tools, thumbnails, and retouched flakes (Appendix 5 Table 5.5.5). Figure 5.18 shows that stone artefact weights decline slightly throughout the mound.

Figure 5.18 Tchelery 1.1 Excavation Square D (1 x 2 metres): Weights of Bone, Shell and Stone by Spit



Unlike Ravensworth 3, Tchelery 1.1 contains small fragments of grindstone, some with a sheen or use-polish indicating that grass seed or similar silica rich plant materials were ground on them (Fullagar and Field 1997:302). It is not possible to be absolutely sure if these small fragments indicate that seeds were ground on the mound or if these fragments are the result of recycling of broken grinding equipment, for example to produce flakes, to use as bone point files, wet stones, or skin scrapers.

5.7.8 Faunal Remains

The very fragmented bone indicates a wide range of aquatic and non-aquatic fauna was being exploited, a similar range of species to the Ravensworth 3 excavation. A larger range of dryland animals was identified than at Ravensworth, but this is expected as the Tchelery excavation was 4 times larger in volume (Appendix 5 Table 5.5.4). Aquatic fauna includes mussel, fish (Murray Cod, Golden Perch plus others - identification was constrained by almost complete lack of otoliths), yabby, turtle, as well as small to large water birds. Non-aquatic fauna includes emu (egg shell), large kangaroo, bettong, hare wallaby, both short and long nosed bandicoot, bilby,

wombat, echidna, brush tail possum, rodents, as well as reptiles (goanna, shingle back, snake). However, wombat, echidna, possum, and hare wallaby were identified from a single bone, jaw or tooth, and therefore contribute little to the overall faunal bone composition. The same coprolites found in the Ravensworth excavation are also found in the lower part of the Tchelery excavation. These have been tentatively identified as belonging to a bilby species, and an incomplete partly *in-situ* bilby skeleton was excavated from an infilled tunnel in the lower part of the mound. The aquatic fauna such as Murray Cod indicates a link with river systems during seasonal flooding. Compared to Ravensworth, Tchelery seems to have less fish, more yabby, more mussel shell and more dryland species including emu egg shell, small mammals and kangaroo bone. Figure 18 shows that there is very little mussel shell in the top layers, probably a result of weathering and soil formation processes.

5.7.9 Plant Remains

Plant evidence is supplied by charcoal and impressions of leaves and roots on baked clay heat retainers. What appears to be impressions of *Typha* leaf, or large leaves with parallel ribbing, are particularly common on the Tchelery mound heat retainers. Large pieces of charcoal were collected for identification in the detailed analysis and two samples from Tchelery were submitted to Beth Gott for identification (Appendix 5.2). A round carbohydrate storage organ 11mm in diameter from A:28 was consistent with *Bolboschoenus medianus* or similar species, and a wood sample from C:29 was identified as a dicotyledon (in this context not *Callitris spp.*). Specimens of charcoal viewed under a dissecting lamp are consistent in structure to *Typha* rhizome/stem, tree wood and 'twigs'.

5.8 SURVEY OF THE GUNDALINE 3 OVENS

Gundaline is located on the southern side of the Murrumbidgee River between Darlington Point and Hay. An area named Sam's Paddock near Dow Creek, a tributary of Gum Creek, located to the south of the Murrumbidgee River was surveyed by archaeologist Jim Kelton (1998, 1999. The Sam's Paddock area consists of degraded open grassland with minor *Acacia pendula* (myall or boree) and occasional shallow swamps. The soil is a very hard, heavy, clay rich red brown earth (Soil Conservation Service 1990). Kelton recorded two areas of mainly scattered baked clay heat retainers, and a third area, G-OS -1, consisted of a large artefact scatter and

scattered and *in-situ* heat retainer features on an eastern margin of a swamp, as well as scattered heat retainers covering an extensive area of open grassland. The swamp in the area of the G-OS -1 site is shallow and only ephemerally holds water. It is etched into the plain and has a barely noticeable rise on the eastern margin made of the same red clay rich material found on the surrounding plain, with a very slight accumulation of the same material blown up from the swamp margin. The G-OS-1 open site was recorded in detail, and 3 heat retainer features adjacent to the swamp were excavated prior to irrigation development (Martin 2000a). The artefact scatter and heat retainer features were located on the eastern side of the swamp (photo 26) on a very low rise. The artefacts were exposed on the lower edge of the rise near the swamp margin and also on top of the rise. The analysis of these is discussed in Chapter 7 and data tabled in Appendix 5.6.

5.9 EXCAVATION OF GUNDALINE OVENS 173, 175A AND 175B

The ovens were located on top of the rise and on the plain behind (Figure 5.19). A total of three ovens were excavated at Site G-OS-1, they were chosen because they appeared to be the most intact and offer the best chance of having material for C14 dating. All three ovens were similar and made up of a tight cluster of baked clay heat retainers partially exposed at ground level (photo 25). The dense grass cover made it difficult to see the ovens but on excavation they were clearly *in-situ*, only the tops of the heat retainers were exposed and there was another layer beneath. Excavation of the ovens was extremely difficult and time consuming because of the very hard red clay rich soil. Only one half or quarter of the ovens were excavated so there would be material left for future analysis. After excavation the small hole was back filled so the untouched oven material would not be damaged. The size and basin shape of the features and the rounded nature of the heat retainers indicate that these are ovens with clay heat retainers rather than baked clay from the base of burnt trees (Mitchell 1996).

Oven 173 was half sectioned and excavated to below the heat retainers. It consisted of a cluster of baked clay heat retainers next to a basin shaped feature with some heat retainers and charcoal stained soil, but no charcoal was found for dating. Several large heat retainers were kept for possible future TL dating. This feature is different to the other two ovens, and it appears that the cluster of heat retainers represents heat retainers cleared out of the oven and left beside the oven. The basin shaped

feature with charcoal stained and baked soil and some heat retainers is the actual oven pit.

Ovens 175a and 175b were only 2 metres apart. Oven 175b was quarter sectioned (three quarters were left intact) and oven 175a was incompletely quarter sectioned due to lack of time and the large amount of charcoal. Both these ovens had large pieces of charcoal located beneath the heat retainers and samples were collected from both for dating. Both ovens consisted of basin shaped pits with baked soil bases and filled with ash and charcoal stained soil, pieces of charcoal, and heat retainers forming the top layer. The charcoal samples were carefully taken from below large *in-situ* heat retainers to lessen the chance of contamination.

5.10 RESULTS OF THE GUNDALINE EXCAVATIONS

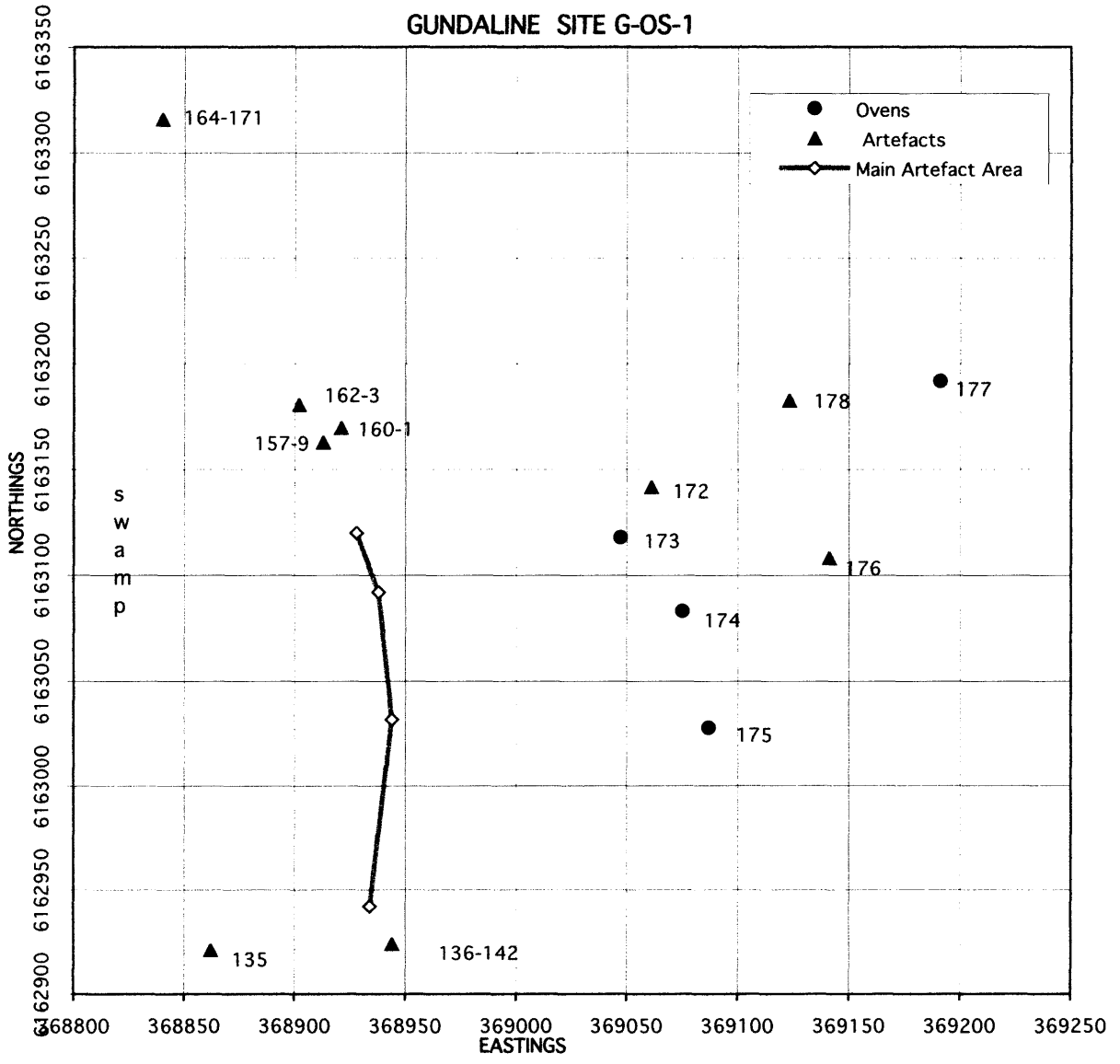
The partial excavation of features 175a and 175b showed that they have a basin shaped structure with ashy, charcoal rich soil (and in the case of 175a and 175b pieces of charcoal) beneath and between a layer of baked clay heat retainers. Oven 175a was dated to 1310 ± 50 BP and oven 175b was dated to 440 ± 70 BP (Table 5.7). Both ovens looked very similar from the surface and in cross section after excavation, and both had significant quantities and large pieces of charcoal. Despite these similarities and the fact that they were only two metres apart, there is an age difference of nearly 900 years. The age difference between the two ovens indicates that the surface of this landform has remained relatively stable over the last 1000 years until recent erosion resulting from pastoral practices removed some of the top soil thus exposing the ovens to further erosion. No charcoal was found in oven 173 and it was not dated. It showed a different life history to the other two ovens, however, as the heat retainers had been raked out of the basin and left beside it (photo 24). In the other two ovens the heat retainers had been left in the basin. The structure and contents indicates that these features are the remains of ground ovens used for baking and/or steaming.

The Sam's Paddock area is consistent with other surveys in the area where the archaeological material is dominated by small heat retainer features or 'ovens' and artefact scatters. The excavations of the three features in Sam's Paddock conclusively shows that they are heat retainer ovens and that the two dated ovens are dated at 1310 ± 50 BP and 440 ± 70 BP respectively.

Table 5.7 : Description of the Gundaline Ovens and Dates

oven number	amount excavated	heat retainer	oven diameter	oven depth	oven shape	charcoal	Radiocarbon Date
173	1/2	baked clay	90 cm	12 cm	basin	stain	n/a
175a	<1/4	baked clay	77 cm	8 +cm	basin	pieces	1310 ± 50 BP Waikato 8750
175b	1/4	baked clay	50 cm	11 cm	basin	pieces	440 ± 70 BP Waikato 8751

Figure 5.19 Gundaline Ovens and Artefact Scatter



5.11 DISCUSSION OF THE EXCAVATION RESULTS

The excavations revealed a range of information about the chronology, structure, contents, and construction of the Ravensworth 3 and Tchelery 1 mounds, and the ovens at Gundaline. There is a close agreement with the dates from the Ravensworth 3 mound and the Tchelery 1 mound, although they are on different swamp systems and 6.5 km apart in a direct line. The two mounds are approximately the same age, starting build up between approximately 4,300 BP and 4,100 BP (uncalibrated), and finishing build up approximately 3,800 BP to 3,500 BP. These mounds were built up very rapidly for an open site in such a semi-arid environment, and are almost twice the age of any other dated mounds in South-Eastern Australia. Both the age and the rapid build up are surprising and suggest specific cultural events were repeated within a short time frame. Both mounds are similar at a broad level, but also show differences such as a higher proportion of non-wetland fauna at Tchelery compared to Ravensworth, and presence of seed grinding material in the Tchelery mound but not the Ravensworth mound. This suggests these two big mounds from this narrow time frame demonstrate a focus on a slightly different range of foods.

The excavations also provide support for the ethnohistorically observed focus on wetland plant foods such as *Typha* and *Bolboschoenus*. The use of these plants is strongly suggested, but not proven, by the macroscopic charcoal that included specimens consistent with *Typha* rhizome and *Bolboschoenus* corms. Baked clay casts have impressions of large ribbed leaves consistent with *Typha*, and the pollen includes *Typha* and *Cyperaceae*, the family that includes *Bolboschoenus* and other food plants. This evidence makes it possible to use the ethnohistorical evidence with more credibility, as there is as much as 4,000 years time gap between the bottom of the mounds and the observations of the contact to recent periods. The consistent but minor amount of wetland animal foods such as freshwater mussel, turtle, fish, yabby and waterbirds, also suggests that wetlands were the focus, but that the major food resources were probably wetland plants that left little evidence. Minor amounts of emu egg shell and macropod bones indicate that some foods were supplied from the non-wetland plains.

The excavations also provide actual evidence of mounds being constructed from the waste from heat retainer ovens, including the heat retainer, fused silica, charcoal, ash,

lenses of ash, and hearth or oven features. The carbonised, calcined and fragmented bone provided evidence of repetitive use of hot ovens in the mounds. The fine grained, thin baked clay casts suggest that different types of heat retainer cooking were used on the mound, including the wrapping of food in mud for baking.

The stone artefacts from the Ravensworth and Tchelery mounds show that the same technology is present throughout the mounds and that it is very similar to many other mound sites in the area, but differs to some non-mound sites in the area. The artefacts suggest that a limited amount of bipolar flaking was carried out on the mound or immediately adjacent to it, and minor tool maintenance. Small flakes were produced and utilised for simple retouched or unretouched flake tools. Low numbers of specialised tools such as geometric backed blades, Bondi points, adzes and thumbnails are also found in the mound, but appear to have been largely produced elsewhere. The type of technology and the poor quality stone material is consistent with use for day to day campsite activities, rather than specialised hunting or ceremonial activities. There is evidence of one episode of replacing Bondi points in a spear in the Ravensworth 3 mound, but this confirms that very little specialised tool making or even maintenance occurred on the mounds. The comparison between the Ravensworth 3 mound artefacts and the artefacts from the edge of the Ravensworth Lake suggest that different activities were carried out at the two sites, including grinding/pounding of plant foods at the lake edge.

The Gundaline ovens are significant as few ovens are dated any where on the Hay or Murray riverine plains, and the structure of the ovens revealed two different types of oven use, one where heat retainers were raked out from the pit ready for re-use, and two ovens which had been used and abandoned. All three ovens consisted of basin shaped pits excavated into the clay rich soil, and the clay rich floors and sides of the ovens were baked hard and had also acted as heat retainers. The dates from Gundaline showed that adjacent ovens had been used nearly 1000 years apart. The Gundaline site is also significant as it is an example of a site where the use of individual heat retainer ovens occurred over a long period of time but did not result in mound building.

The excavations have revealed that heat retainer cooking was a focus of cooking both in mound complexes and in non-mound sites with individual small ovens. The mounds contain evidence of at least two ways of heat retainer cooking, heat retainer

ovens and food wrapped in mud and cooked in ovens. The chronology of the two mounds indicates that they were rapidly built up over 300-600 years by a repetitive activity involving heat retainer cooking. This fits with multiple dates for mounds from other research in the region. At Cooey Point Lagoon on the Murrumbidgee East, Klaver's dates suggest the mound-like section of 82/3 was built up in around 200 years, and another two mounds were built up in around 500 years. Multiple mound dates from the Central Murray to the south of the Hay Plain indicate that mounds are built up over a time period of between 1,200 and 400 years (Appendix 4). A combined average for all these dates indicates that mounds tend to be built up over around 600 years, which does not support Klaver's (1998: 328-330) conclusions that mounds were built by small groups episodically over several thousand years.

The next chapter describes and discusses an analysis of the heat retainer and the sediment and aims to further define the history of the heat retainer and sediment that composes the majority of the mound material.