SS5
The Neolithic and early Bronze Age archaeology of the Raunds area investigated by geophysical survey

Andrew Payne

SS5.1 Introduction

Extensive tracts of the Raunds area were the subject of geophysical surveys conducted throughout the 1980s and 1990s by a variety of organisations for various reasons and for a number of separate projects, all falling within the overall auspices of the Raunds Area Project or Raunds Parish Project. The majority of the excavation carried out in the area by the Central Excavation, Northamptonshire Archaeology and Oxfordshire Archaeological Units was threat-led in advance of gravel extraction and road construction in the Nene Valley corridor from Irthlingborough in the south-west of the area to Thrapston in the north-east. A number of Roman villas, monument complexes and multi-period archaeological sites were affected by this development and were therefore the subject of archaeological excavation in advance of their complete or partial destruction.

From the mid 1980s onward initial application of geophysical techniques in the Raunds area concentrated on the large-scale excavations carried out at the Stanwick Iron Age and Roman settlement in advance of gravel quarrying under the direction of David Neal of the then Central Excavation Unit of English Heritage (Neal 1989b). Magnetometer survey was employed with considerable success here by the Ancient Monuments Laboratory (AML) to undertake an extensive examination of the wider landscape surrounding the settlement that this project famously addressed. The magnetic response in the area was found to be exceptionally clear, largely due to the influence of the naturally iron-rich Jurassic geology of the area. Subsequently, during the 1990s, the focus of geophysical activity shifted to investigation of the West Cotton area and its rich evidence of Neolithic and early Bronze Age prehistoric ceremonial and funerary activity.

Additional geophysical surveys carried out by the AML on a variety of other sites in the Raunds area (including several enclosure complexes on the higher Boulder Clay-capped ground to the east of the Nene valley) will be reported on elsewhere. These sites are of suspected Iron Age to Roman date and belong more appropriately in separate publications on the later prehistoric and Roman archaeology of the Raunds area and the Raunds Area Survey volume (Parry forthcoming).

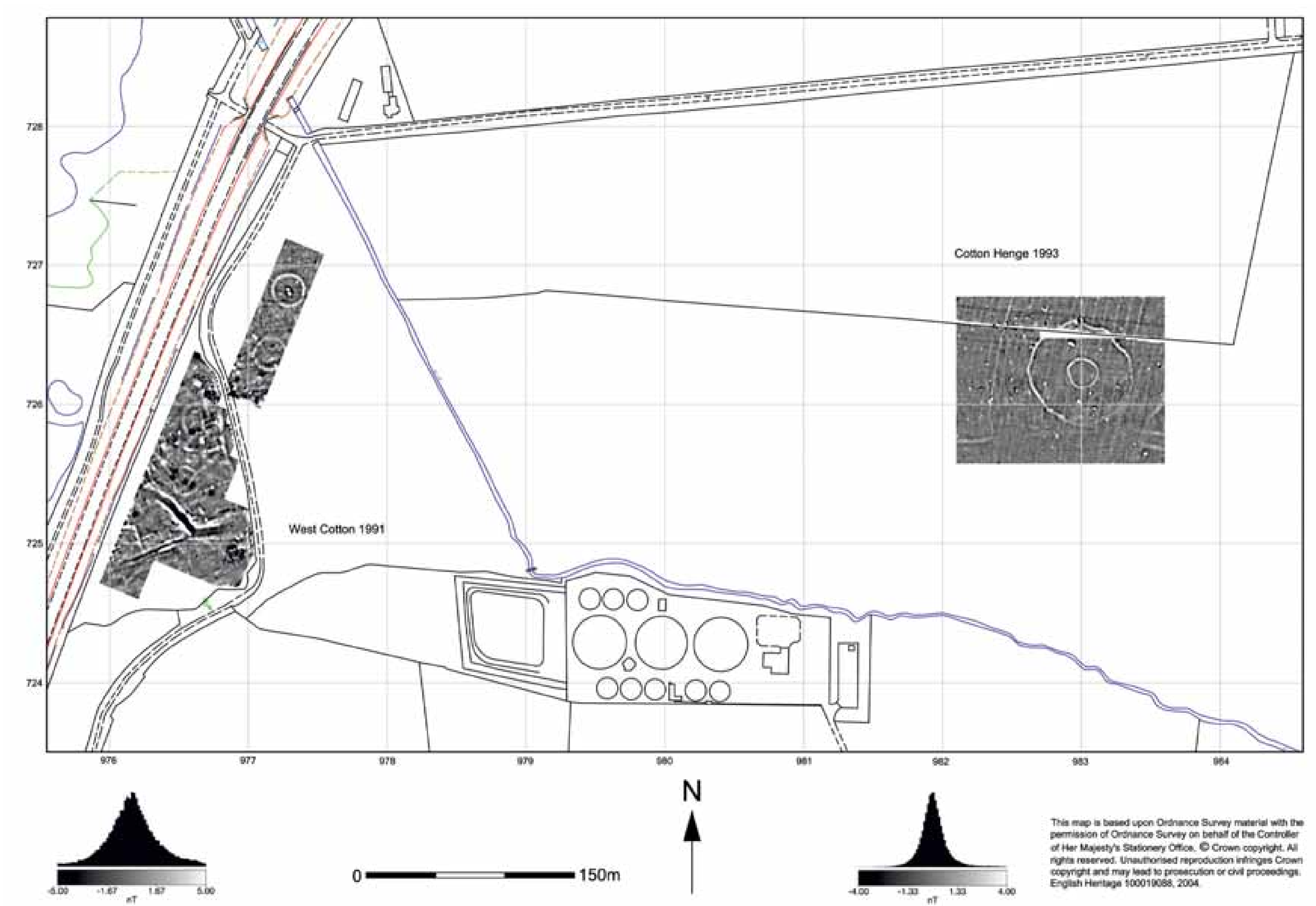
The surveys reported on here are those that were carried out by the AML in the 1990s on sites which contain major Neolithic and early Bronze Age archaeology or monuments. Some of the sites have been complicated by later activity – such as the remains of the deserted Saxon and medieval settlement at West Cotton – but have nevertheless been included on the basis that they include significant earlier prehistoric phases. On the basis of these criteria a total of six individual geophysical surveys can be discussed encompassing the following range of sites in the order in which they were surveyed.

SS5.1.1 The sites surveyed

West Cotton

The survey at West Cotton (NGR SP 976 725; Fig SS5.1) was carried out in 1991 at the request of Northamptonshire Archaeology to investigate that part of the site remaining *in situ* following the rescue excavations in advance of the construction of the new A605 Stanwick/Raunds bypass in 1985 (Windell *et al* 1990). The excavation revealed an extensive ritual focus of ceremonial and funerary monuments, dating to the Neolithic and early Bronze Age periods (SS1.1, SS1.3, SS1.5, SS1.8, SS1.9, SS1.17, SS1.21, SS1.22). The site was subsequently occupied by several phases of early medieval settlement (in the

Figure SS5.1 Location of the West Cotton and Cotton 'Henge' magnetometer surveys.



form of late Saxon and Norman manorial complexes). The final phase of activity on the site consists of the remains of a deserted medieval village still surviving in part as well-preserved earthworks in the remaining undisturbed pasture east of the new road corridor. The intention of the geophysical survey at West Cotton was to gain a more complete picture of the extent of a regionally important complex of prehistoric monuments previously uncovered by excavation beneath the later activity on the site. Because of the multi-period nature of the archaeology at West Cotton, a complex geophysical response was to be expected, but it was none the less hoped that the surveys would be able to shed further light on the distribution of the earlier prehistoric activity in the area.

The Cotton 'Henge'

The survey of the monument known as the Cotton 'Henge' (NGR SP 983726, Northants SMR 1725/1/1; Fig SS5.1) was undertaken in advance of and to guide the targeting of sample excavations at this cropmark site carried out by Jon Humble of the Central Archaeology Service in 1993 (SS1.10).

Round barrows and ring ditches

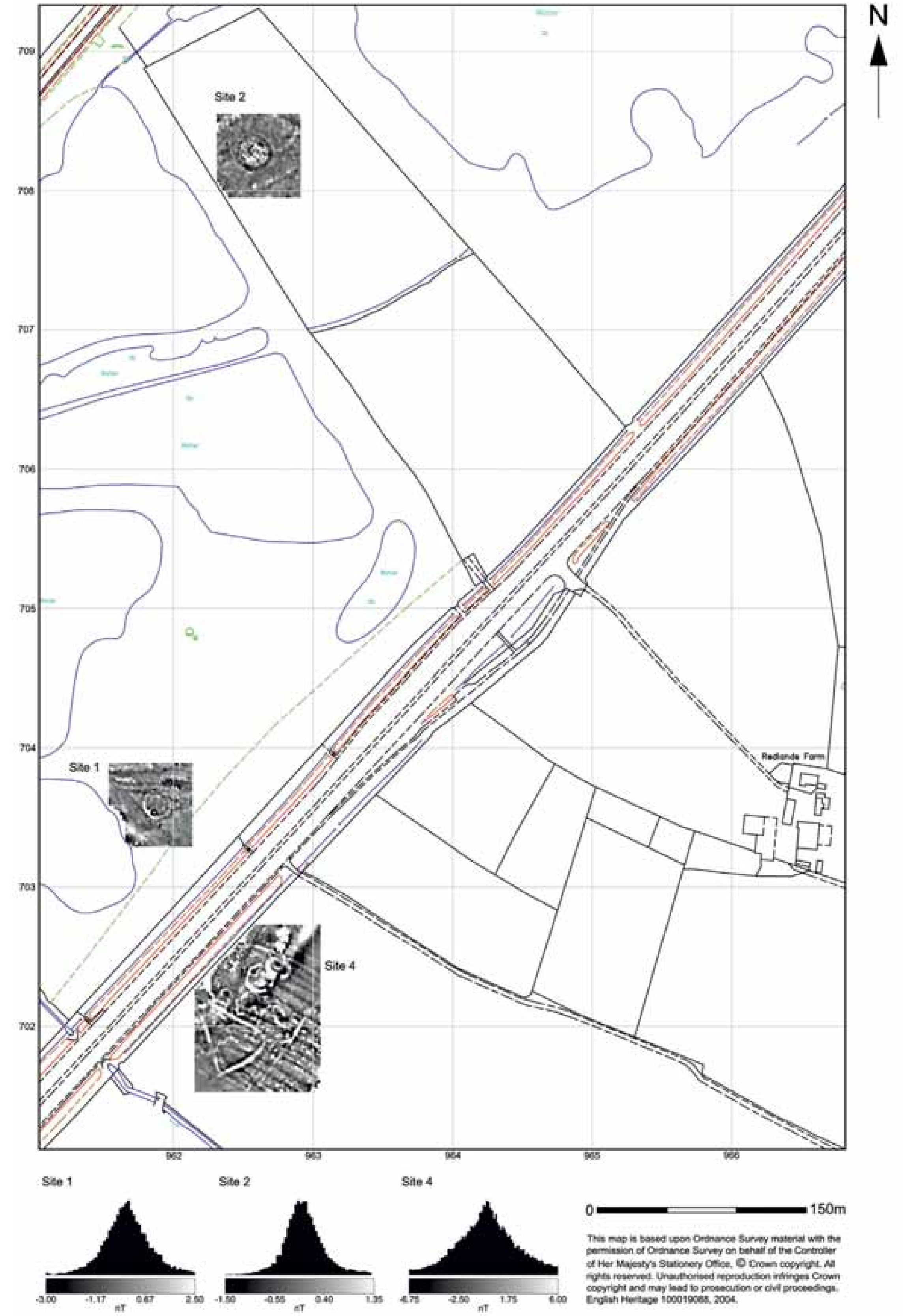
In addition to the above surveys, a number of smaller surveys were carried out over relatively isolated individual barrow sites dispersed along the fringes of the floodplain of the river Nene south-west of the village of Stanwick (Figs SS5.2, SS5.3). The purpose was to provide supplementary information on the likely extent, form and survival of these previously un-investigated burial monuments in order to fill gaps in the understanding of the wider distribution of monuments in the earlier prehistoric landscape of the Raunds area. A total of four possible barrow sites were investigated, some plough-flattened, others only partially upstanding and some where the mound was and still is in a relatively good state of preservation. Some of the sites were initially identified from aerial photo-graphs as crop or soilmarks lacking any surface relief and could only be classified as suspected ring ditch or barrow sites without further investigation. The barrow surveys were carried out in 1995, again at the request of Jon Humble, and have previously been reported on in the Ancient Monuments Laboratory Reports Series (Cole 1995; Payne 1995). The barrows selected for geophysical survey were all that remained of a larger distribution of barrows lying on and adjacent to the floodplain of the Nene near Irthlingborough, substantially destroyed in the 1980s as a result of exploitation of the local river gravel deposits by the mineral aggregate industry. Excavation in advance of the destruction of the Irthlingborough barrows was carried out by Claire Halpin in the mid 1980s for the Central Excavation Unit of English Heritage (Halpin 1989; SS1.12, SS1.14, SS1.15).

SS5.2 Methods

Where possible both resistivity and magnetometer survey were employed, as the two methods when used in combination can provide complementary information on the structure of barrows (see, for example, Cole 1997; Payne 2000). Magnetometry is particularly suited to mapping external quarry ditches which are often no longer clearly visible on the surface as a result of silting. Resistivity, on the other hand, will often provide useful information on the internal structure of barrows. Time did not permit the use of resistivity survey at two of the individual barrow sites investigated and at the Cotton 'Henge'. In the case of Cotton 'Henge', the magnetometer survey was supplemented by a detailed investigation of the magnetic susceptibility variation within the topsoil covering the site, the underlying natural subsoil and the fills of the archaeological features cut in to it (see later section).

Magnetometer survey is usually the preferred geophysical technique for the initial location or general planning of archaeological sites (English Heritage 2008). Rapid ground coverage (at a rate of around 1.5 ha per day) and the ability, under suitable conditions, to detect a wide range of archaeological features are the principal advantages of the method over slower techniques such as resistivity and ground radar that are generally employed more selectively. Magnetometry involves the measurement of local variation in magnetic flux density at close intervals (1m or less) across the ground surface. The technique responds to local modification of the geomagnetic field by magnetic iron oxides in archaeological features, either due to the thermoremanent effect in fired structures (Aitken 1974) or magnetic susceptibility (MS) contrasts between the silting of features and the subsoil into which they are cut (Tite and Mullins 1971). The generally higher magnetism of the topsoil is enhanced by activities associated with human occupation, especially burning (Le Borgne 1960) and when this becomes incorporated in the fills of ditches, detectable magnetic anomalies

Figure SS5.2
Location of the geophysical surveys of RAP Barrows: Sites 1, 2 and 4.



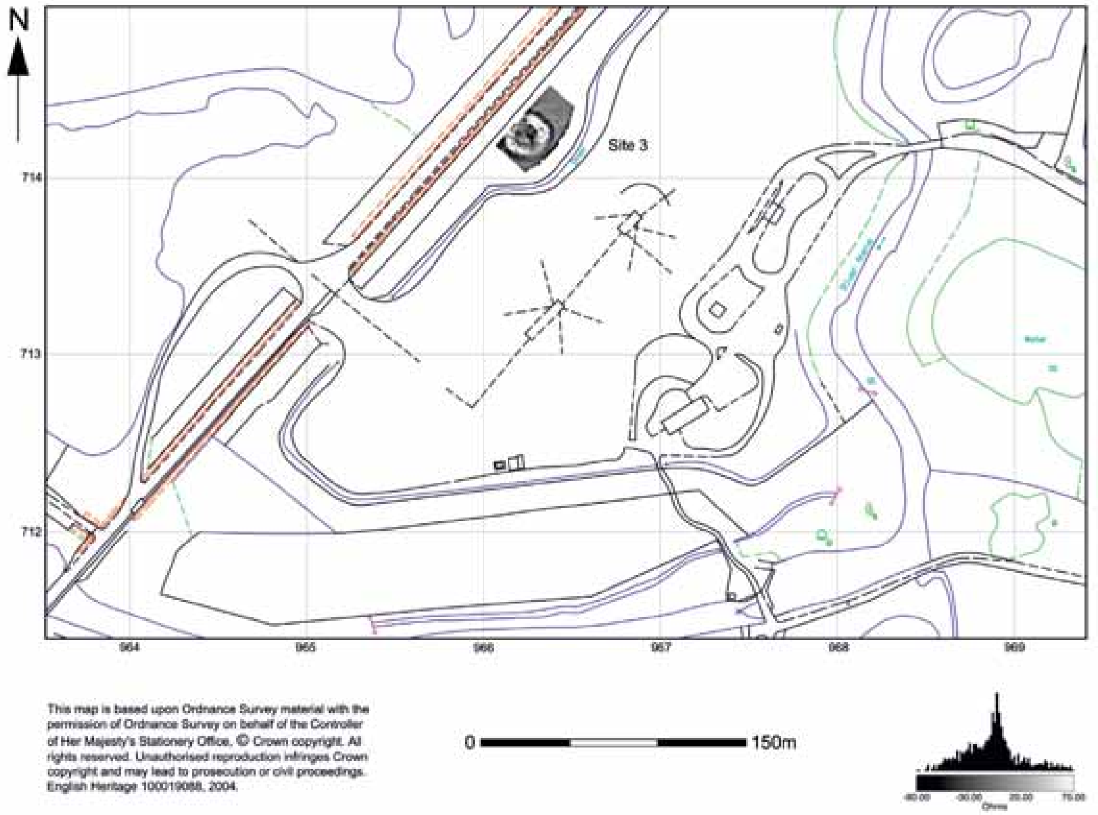


Figure SS5.3 Location of the geophysical survey of RAP Barrows: Site 3 (Barrow 2).

occur. A magnetic susceptibility contrast can also exist between buried masonry features (particularly those constructed from various types of limestone) and the soil enveloping them, often resulting in the detection of walls as low magnetic gradient (or negative) anomalies. Where the buried masonry has been strongly heated, increasing the magnetism of the stone, the magnetic signature from walls can reverse to a high magnetic gradient (positive anomalies). Magnetometers are therefore capable of detecting a wide range of buried archaeological features, including silted-up ditches and pits, walls constructed from materials with contrasting magnetism to the surrounding soil, fired clay structures and deposits of burnt material.

An alternative method of measuring the magnetic properties of soils is magnetic susceptibility (MS). In simple terms this is defined as the degree to which materials become temporarily magnetised in the presence of an applied external magnetic field. Magnetometers measure magnetic susceptibility variation in the soil indirectly by the effect this has on the prevailing magnetic field. Direct magnetic susceptibility measurement involves applying a magnetic field to a volume of soil in the ground on a site by means of a field coil or alternatively a sample of soil inserted into a coil in the laboratory. In contrast to magnetometer measurement, direct magnetic susceptibility measurement is used to detect zones of generalised magnetic enhancement of the topsoil (caused by greater concentrations of magnetic minerals such as magnetite) linked to a past human presence on a site. It is mostly used for the broad definition of areas of former occupation or industrial activity as a precursor to magnetometer survey or subsequently at a more detailed level to support the interpretation of a magnetometer survey. Provided a sufficiently close sampling interval is used, MS survey can also be informative in the case of severely plough-truncated sites where evidence of former activity has only survived as traces of occupation material in the topsoil (Clark 1996, ch 4). Because the MS of the topsoil influences the ability of the magnetometer to detect earth-filled features, the magnetic susceptibility may provide an insight into the variation of magnetic response and general magnitude of response over a site particularly where the drift geology is variable. One disadvantage of MS is that it is substantially influenced by natural factors, notably soil parent material (which affects the overall iron content of the soil and the quantities of magnetic minerals present).

Thus areas of enhancement may arise from human activity (eg burning) or natural factors and therefore caution has to be exercised in interpreting MS surveys.

Resistivity survey is mainly used in archaeology as a technique for detecting buried masonry and stony layers or surfaces but can also detect moisture contrasts in buried ditches and other former ground disturbance such as previous archaeological excavation. The method is considerably slower than magnetometry due to the requirement to insert probes into the ground at each reading point. The principle of the technique depends on the ability of soils and buried archaeological deposits to conduct an electrical current (introduced into the ground via electrodes) to a greater or lesser degree according to the relative moisture content of the material present. The presence of relatively impermeable and therefore dryer and less conductive masonry compared to a surrounding more water retentive soil will cause a detectable increase in the resistance of the subsurface to the passage of an electric current. Resistivity was employed in the Raunds area as a supplementary technique to complement the information provided by magnetometer survey. It proved particularly useful for providing information on the internal structure of some of the barrow mounds and for indicating the ground plan and extent of the medieval buildings partially obscuring the unexcavated barrows at West Cotton.

The magnetometer surveys were conducted using Geoscan FM36 fluxgate gradiometers programmed to measure the vertical magnetic field gradient at 0.1 nanotesla (nT) resolution. The readings were collected on a 30m grid at intervals of 0.25m on 30 m-long traverses spaced 1.0m apart. Resistivity was measured using a Geoscan RM15 meter and Twin Electrode configuration with a 0.5m mobile probe separation. Readings were recorded on a 30m grid at 1.0m intervals. The methodology adopted for the magnetic susceptibility analysis of Cotton Henge is described fully in the results section below.

SS5.3 Results

SS5.3.1. West Cotton

West Cotton is located at NGR SP 976725 at a height of 34m OD on a slightly raised gravel peninsula at the eastern edge of the floodplain of the River Nene (Fig SS5.1). The site had been recognised for some time as a deserted medieval hamlet based on the presence of a series of readily interpretable earthworks (Windell *et al* 1990, 6). Prior to excavation, however, the presence of an underlying complex of Neolithic and Bronze Age monuments had not been suspected (Figs SS5.5a–b). The earthworks indicated that the medieval hamlet had comprised a series of building plots, set around an open space or 'green', which was approached along a sinuous trackway branching from Cotton Lane (the former road from Higham Ferrers to Thrapston). Two further building plots or tenements stood beside the lane itself. At the south and west the hamlet was flanked by an embankment and relict stream channel. The 1798 enclosure maps show that this was the course of the Cotton Brook – a tributary of the Nene rising near Raunds village – which was later diverted to the north via an artificial water course.

Medieval features

Many of the medieval features described above, including the building plots, the trackway and the embankment left *in situ* after the road construction, are clearly visible as anomalies in the resistivity and magnetometer surveys of West Cotton carried out in 1991 (Fig SS5.4). The medieval building plots backing onto Cotton Lane are visible as rectilinear arrangements of high resistance represented by lighter shades in the greyscale plots and as positive linear magnetic anomalies and areas of increased magnetic disturbance (M1–2 and R1–2 on Figs SS5.6–7). A further probable building is present at R3. The trackway is defined in the magnetic data as parallel linear high magnetic gradient anomalies (M3) representing side-ditches and as high resistance alignments (R4), indicative of flanking walls (known to be present from excavation). The embankment on the south is represented by a linear high resistance anomaly (R5), and the eastern edge of the 1985–6 excavation is visible as a low resistance area (R7) near the western boundary of the survey.

Neolithic and early Bronze Age features

Note. The terminology applied below to the previously excavated elements of the prehistoric monument complex at West Cotton is that used in the rest of this publication. 'New' barrows located by geophysical survey are identified by numerical references prefixed by 'R' in the case of resistivity anomalies and 'M' in the case of magnetic anomalies.

In addition to anomalies that clearly relate to the layout of the deserted medieval settlement and earlier patterns of late Saxon land allotment, a series of other low-resistance and high magnetic gradient anomalies of circular form (R8–9 and M4–7) can be identified in the geophysical surveys (Figs SS5.6–7). These are likely to represent further previously unidentified buried ring ditches. One of them (R8, M4) clearly seems to be overlain and partially obscured by the more northerly of the two medieval building plots defined by the resistivity survey (R1), reinforcing the probability that they represent features with an earlier origin than the later Saxon and medieval occupation. The weakness of the response to these features would also be compatible with an earlier origin and thus greater burial depth beneath later deposits. At least two of these circular features (R8, R9/10 and M4–5, also known as ring ditches 1 and 2) can be identified within the area of the later medieval settlement. They range in diameter from 20m to 24m and lie near or adjacent to the excavated Ditched Enclosure and Barrow 6 in the centre of the complex. With the addition of the geophysical survey evidence, it is now clear that Barrow 6 is part of a more extensive grouping of at least five ring ditches composed of R8, R9/10, M4, M5 and two more ring ditches known from aerial photography in the next field to the north (ring ditches 3 and 4 or SMR 1338/0/1 and 1338/0/2), now also mapped by magnetometer survey; see below). High resistance (R10) in the centre of anomaly R9 may indicate the presence of a surviving mound within the circular ditch and potential for good preservation of any funerary deposits. There is a suggestion in the magnetic data that the ditch of barrow M5/R9 may have been recut or reinstated on a slightly different alignment, making it similar to the inner ditch of Barrow 6 immediately to the west with which M5/R9 also shares a similar diameter.

During the investigation of the main site at West Cotton two further ring ditches (M6

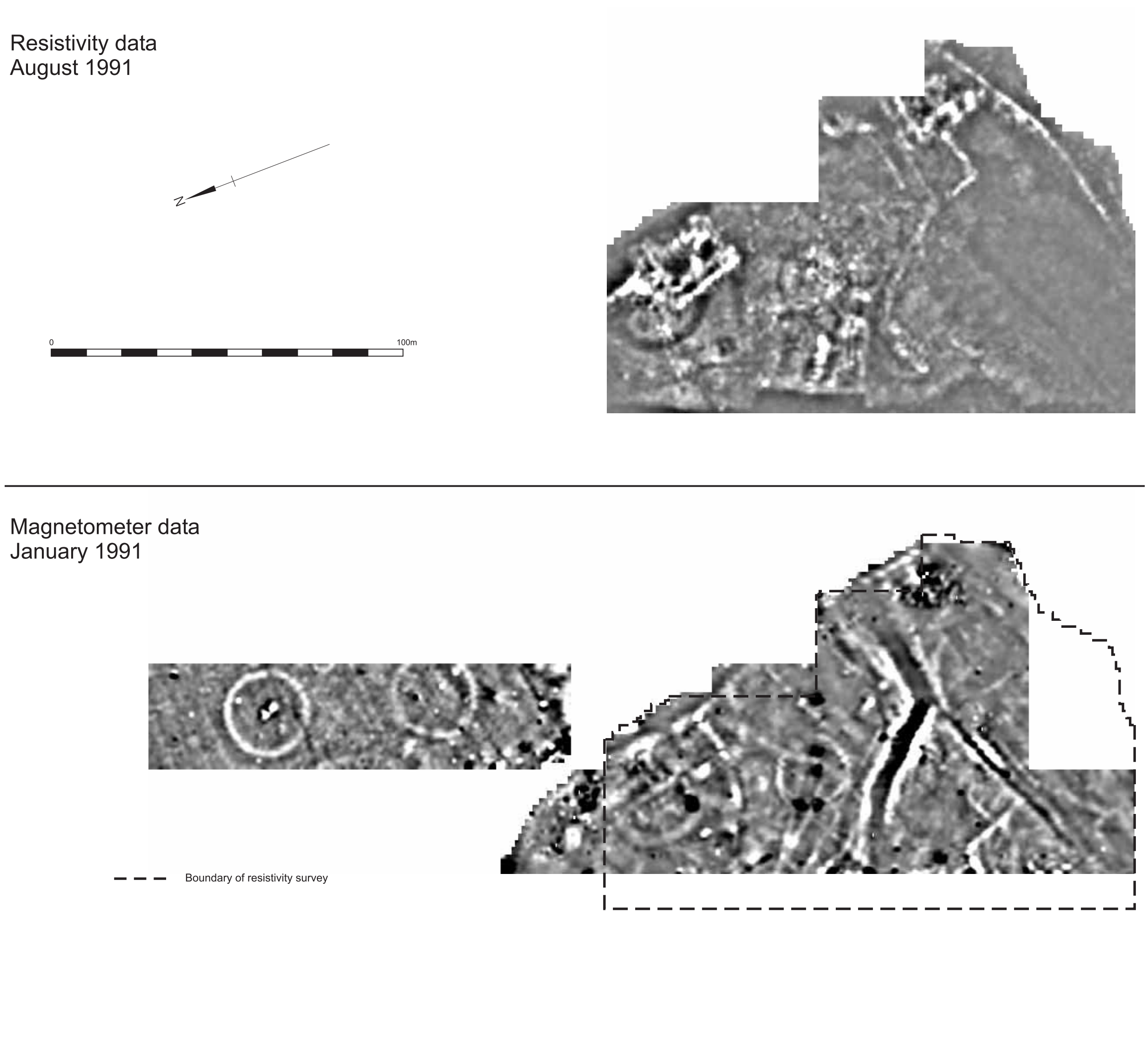


Figure SS5.4
Plots of the magnetometer and resistivity data from West Cotton.

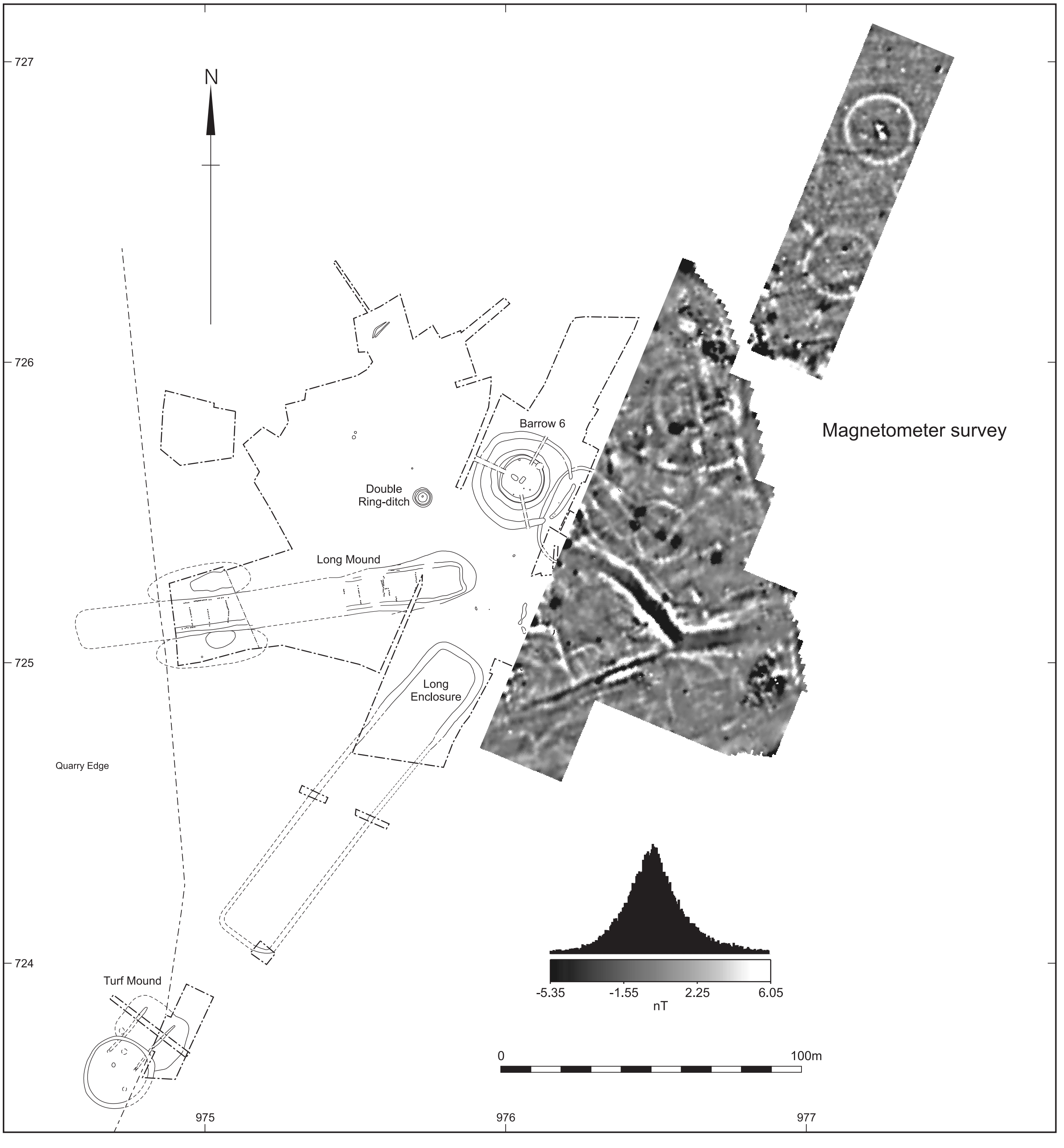


Figure SS5.5A Relationship of the magnetometer survey results from West Cotton to previously excavated features.

and M7, ring ditches 3 and 4, SMR 1338/0/1 and /2), presumably forming a northern extension of the West Cotton monument complex and previously known from aerial photography, were located on the ground by magnetometry in the arable field immediately to the north. The more northerly of the two ring ditches (M7, ring ditch 4, SMR 1338/0/2) falls roughly on a northward projection of a line drawn between the Turf Mound, the long enclosure and the ditched enclosure uncovered by the excavations. This ring ditch contains two internal features represented by localised positive magnetic anomalies near the centre. It is not clear if these represent modern intrusions into the ground in search of burials or undisturbed funerary deposits associated with the barrow.

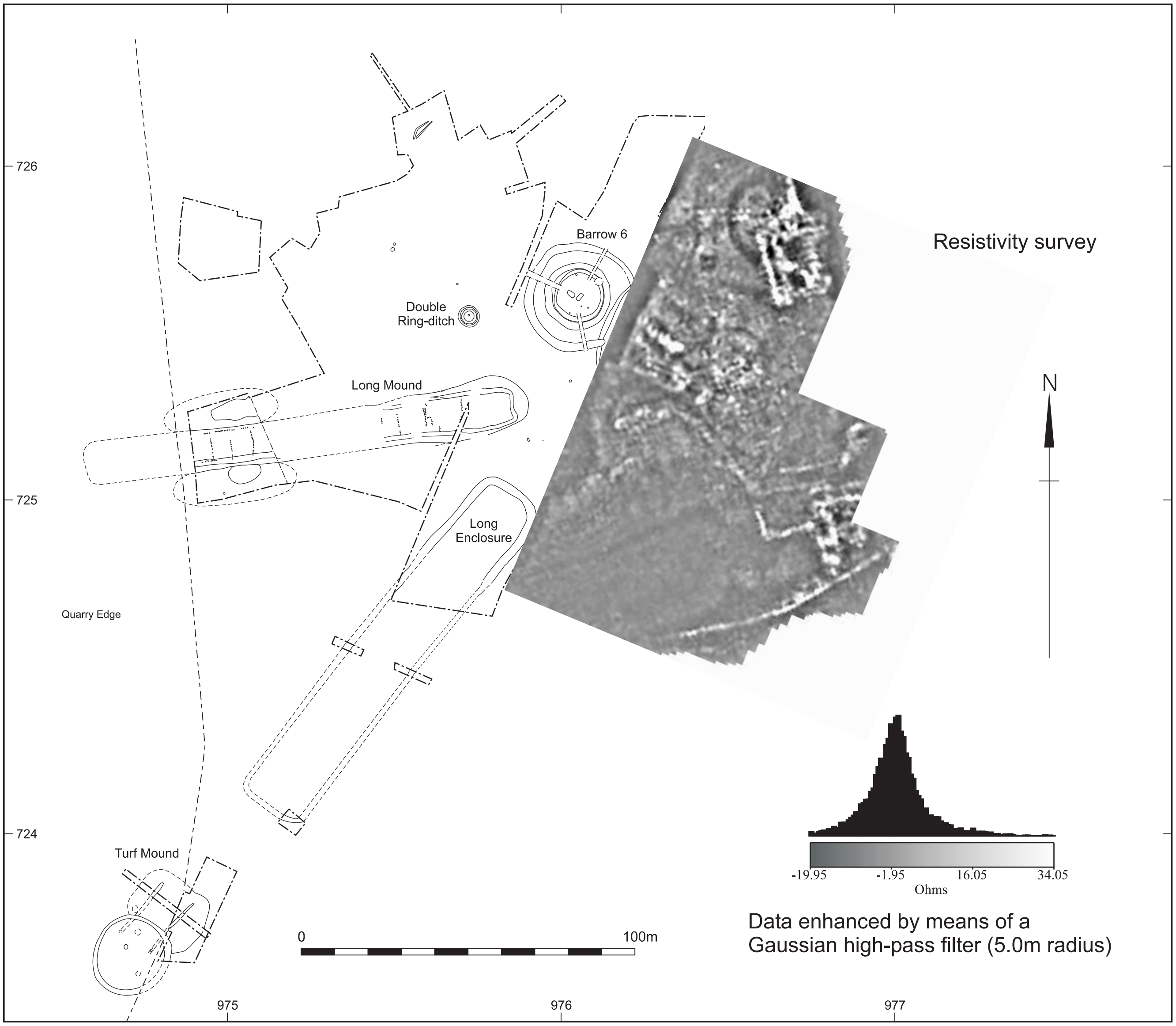
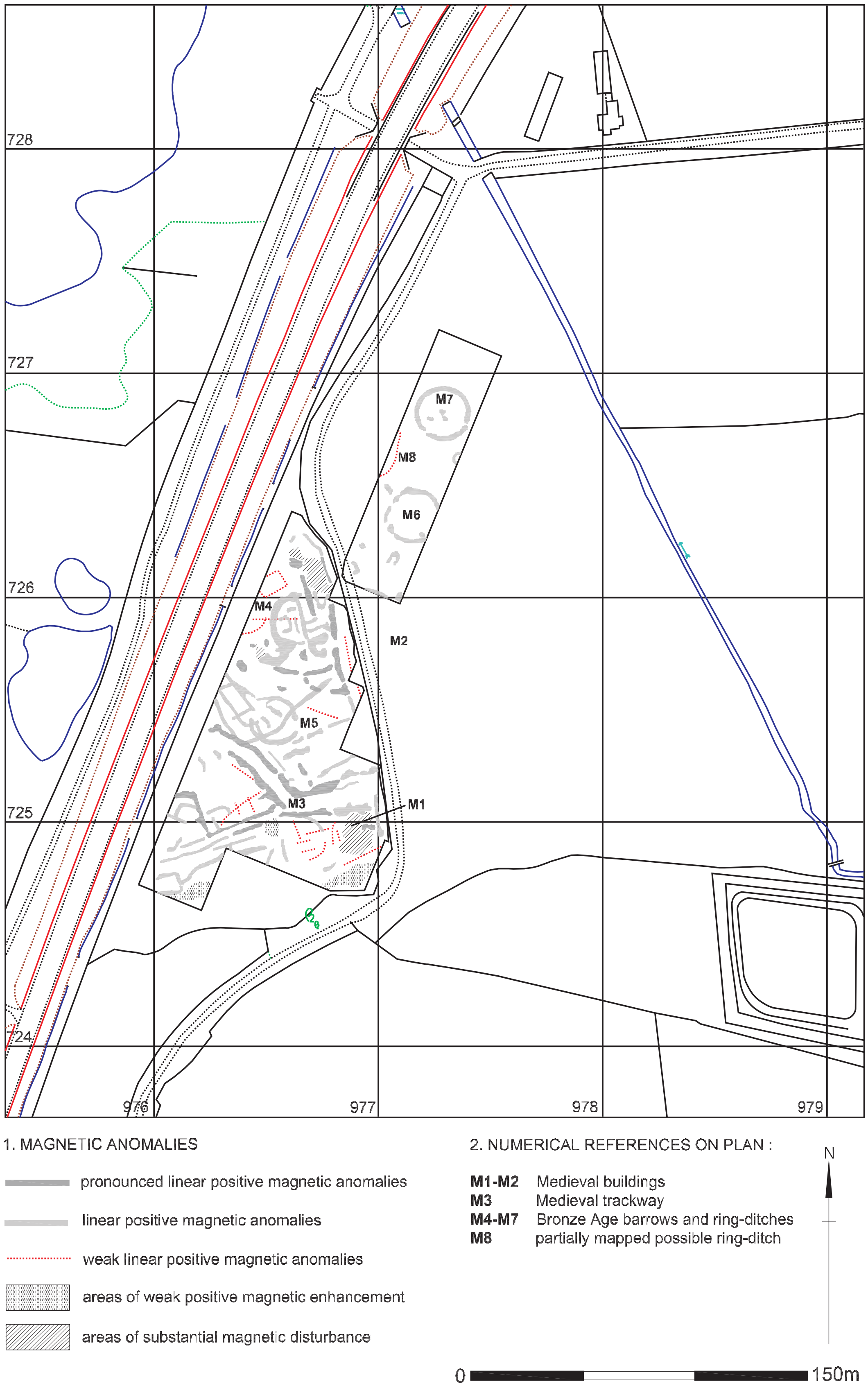


Figure SS5.5B Relationship of the resistivity survey results from West Cotton to previously excavated features.

It is interesting to note that the two internal features revealed near the centre of the north ring ditch compare well with the multiple pits and graves discovered within the excavated Barrow 6. In addition to the primary burial within Barrow 6 (a central grave pit containing the skeletal remains of a male, a long-necked beaker and flint and jet items) there were also later insertions. Similar multi-phase usage may also have occurred in the case of the north ring ditch. An additional enclosure, possibly similar to that excavated to the south (the Ditched Enclosure) or a larger ring ditch, may be present immediately west of the two ring ditches located by the magnetometer in the arable field north of Cotton Lane. This additional feature is not easily recognisable at first sight being incompletely defined by a gently arcing or curvilinear weakly positive magnetic anomaly (M8) very close to the western edge of the survey area. Confirmation of the presence of a further feature here will require a westerly extension of the existing survey coverage. For now this feature will be termed the curvilinear ditch. Parallel linear anomalies aligned approximately east-west in this area are probably a response to medieval ridge and furrow or more recent cultivation trends. It is possible that the barrow ditches may have been truncated by this cultivation in some places where the magnetic response to the ditch is interrupted by the parallel linear anomalies.

In summary, a total of four ring ditches were located by the magnetometer and

Figure SS5.6 Interpretation of the magnetometer data from West Cotton.



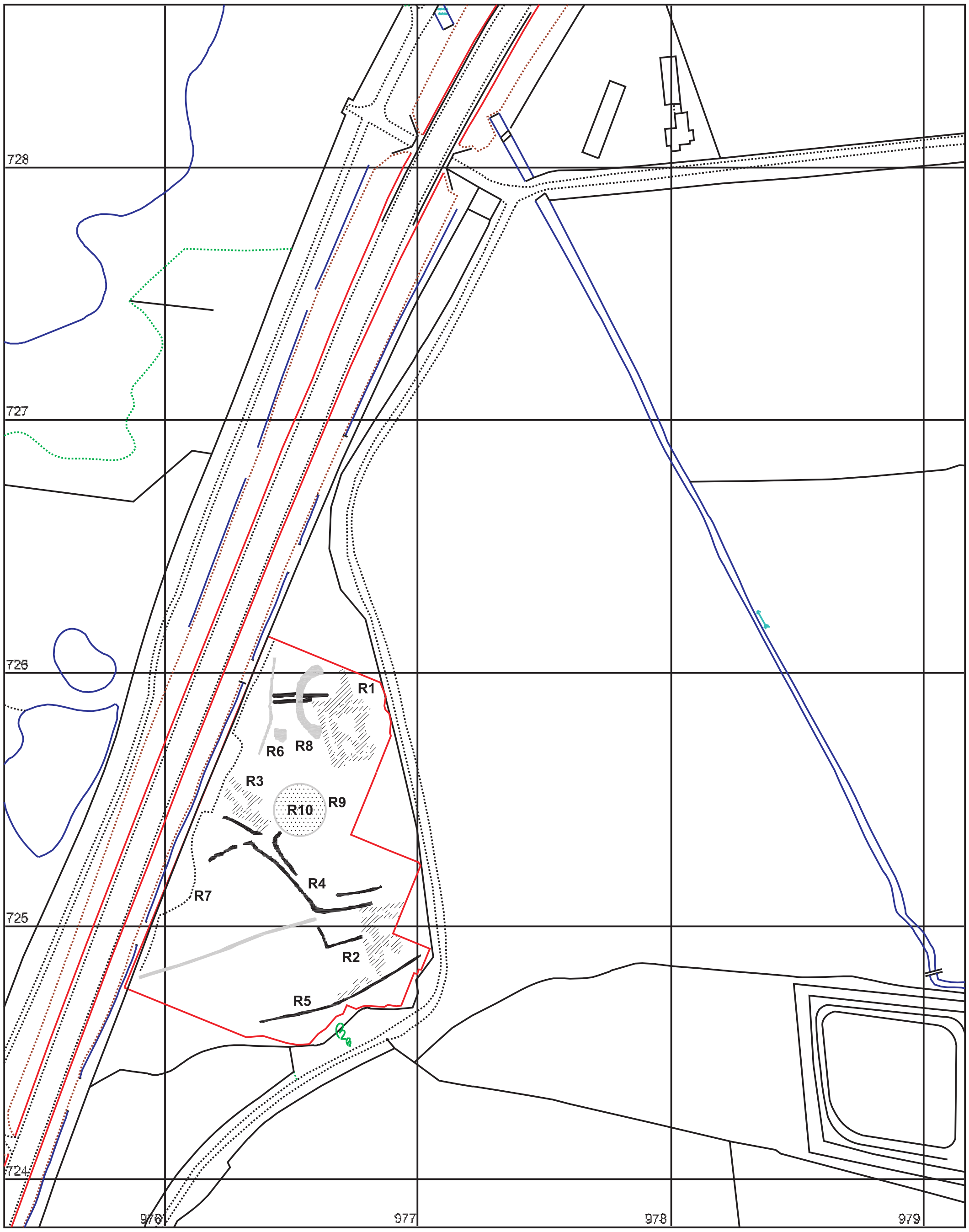


Figure SS5.7 Interpretation of the resistivity data from West Cotton.

1. ANOMALIES OF MEDIEVAL ORIGIN

Linear low resistance anomalies - ditches

Linear high resistance anomalies - wall/s/embankments

High resistance areas - masonry structures

2. ANOMALIES OF PREHISTORIC ORIGIN

Low resistance barrow ditches

High resistance barrow structure

3. ANOMALIES OF MODERN ORIGIN

Limit of previous excavation (visible as area of low resistance)

4. NUMERICAL REFERENCES ON PLAN

R1-R3 wall-footings and rubble fill of Medieval tenements
R4 Medieval drove-way
R5 Medieval embankment
R6 Medieval fish-pond
R7 limit of excavation
R8, R9-10 Bronze Age barrows

N

0 150m

resistivity surveys at West Cotton. Two, the pair within the survey area to the east of Cotton Lane (M6–7), had previously been identified from aerial photographs. Within the main survey area, two previously unknown ring ditches were located – R8, R9/10, M4 and M5 – underlying medieval settlement remains. Ring ditch R9/10, M5 coincides with the location of a raised area identified by the earthwork survey. This would seem to represent a single-ditched round barrow with a partially intact mound which may well be gravel-capped. The ditch forming the southern arc of the barrow may have been redefined on at least one occasion. Ring ditch R8, M4 is assumed to be a circular or subcircular ring ditch, but the eastern half is concealed by a medieval tenement. The ditch of this barrow is substantially broader than the ditch defining the smaller barrow to the south and it is therefore possible that it may represent the outer ditch of a double ring ditched feature similar in form to Barrow 6.

The identification of a further two ring ditches and the confirmation of another two, previously seen on aerial photographs, with the potential addition of an adjacent partially resolved new ring ditch or enclosure adds significantly to our understanding of the probable extent of the West Cotton monument complex. There now seems to be considerably more to the complex than could have initially been appreciated from excavation. The area lying further to the south and closely east of the Turf Mound produced no evidence for further ring ditches. This suggests that there is a cluster of probable round barrows at the northern end of the West Cotton complex but no comparable cluster at the southern end of the complex in the fields immediately east of the new A605 Raunds by-pass. The geophysical survey has, therefore, provided crucial evidence for defining the probable extent and also the probable monument character and distribution within this complex.

Other magnetic anomalies at West Cotton that may potentially be of significance include rectilinear and discontinuous ovoid arrangements of positive magnetic anomalies, although, given the potential for confusion caused by the multi-period occupation of the site and the resulting complex pattern of magnetic anomalies, these anomalies should not automatically be regarded as representing further extensions of the prehistoric monument complex.

SS5.3.2. The Cotton ‘Henge’

Background

The cropmark known as the Cotton ‘Henge’ (NGR SP 983 726; Fig SS5.1, Northants SMR Site Number 1725/1/0) comprises two concentric but widely separated ditches. The outer ditch is slightly elliptical with a major north-west to south-east axis of 75m and a minor axis of 70 m; the inner ditch is *c* 21m in diameter. During 1993 the monument was evaluated using a combination of metric survey, geophysical survey and excavation jointly by the then Central Archaeology Service and Ancient Monuments Laboratory of English Heritage (now combined in the Research Department of English Heritage). Previously the site had been targeted by surface collection (fieldwalking) and magnetometer surveys conducted by Northamptonshire Archaeology as part of the Raunds Area Survey. The most extensive surface flint scatter encountered anywhere in the Raunds area was recorded at this location (Humble 1994; Humble 2006).

The Cotton ‘Henge’ appears to form part of the complex of Neolithic and early Bronze Age burial and ceremonial monuments otherwise located on the terrace and floodplain of the river Nene at West Cotton, Stanwick and Irthlingborough. When projected *c* 600m eastwards, the axis of the Long Mound at West Cotton passes through Cotton Henge (Windell *et al* 1990), suggesting adirect relationship with the West Cotton complex.

Sited on the Northampton Sand with Ironstone deposits which outcrop along the sides of the Nene Valley, the monument lies at 50m OD on gently sloping ground forming the northern side of a small tributary valley of the Nene containing the Cotton Brook (Fig SS5.1). The site is presently contained in two large open fields under arable cultivation and is ploughed every year. A boundary hedge divides the majority of the site from a smaller portion in the field to the north. Ploughing and downhill soil movement have resulted in varying thicknesses of soil cover over the archaeological features and varying degrees of truncation of the archaeological features themselves. Excavation demonstrated a close relationship between the topography, the depth of the modern ploughsoil and the severity of the truncation of the archaeological features. On the higher contour areas, the overburden is as little as 0.20m, ranging to over 1m downslope on the southern side of the outer ditch.

The geophysical surveys

Objectives and methodology

The geophysical survey was carried out in advance of and to support a programme of limited excavation carried out by Jon Humble designed to

i) Assess the condition of the archaeological features defining the monument

ii) Establish more precisely the form and date of the monument

iii) Examine a previously neglected component of the Raunds Neolithic and Bronze Age landscape

The 1993 AML magnetometer survey was more extensive and of a higher resolution both in terms of reading interval and instrument sensitivity than a previous magnetometer survey carried out by the Northamptonshire Archaeology Unit in 1990. The survey methodology employed by the AML was designed to increase the possibility of detecting archaeological features additional to the ditches within and around the monument. Readings were recorded at 0.1 nanotesla (nT) sensitivity at intervals of 0.25m along traverses 1m apart, following standard AML procedure.

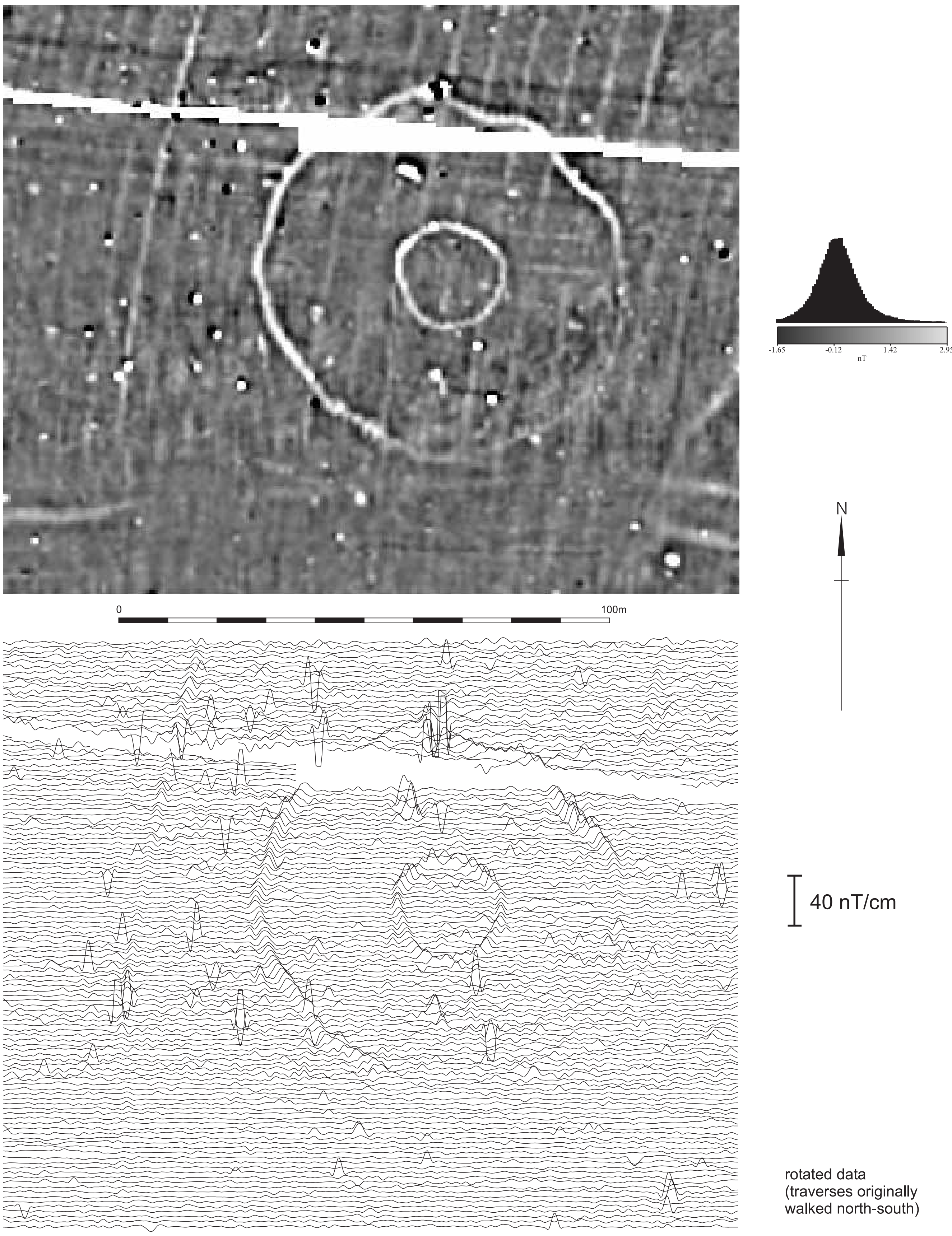
Because of the plough-damaged state of the monument, the magnetometer survey was supplemented by magnetic susceptibility measurements (employing a range of alternative sampling and measurement methodologies) to test for traces of possible associated activities such as fires or hearths that might only have survived in the topsoil. A comparable study at the Coneybury Henge near Stonehenge, Wiltshire had previously produced useful results (Clark 1983; Clark 1996; David and Payne 1997). The secondary purpose of the MS surveys was to contribute to an examination of the possibility that the ditches of Cotton Henge had once encircled a now eroded mounded structure that may have left residual traces in the topsoil detectable in the MS record.

Volumetric susceptibility measurements were firstly taken at 2m intervals across all of the monument (including the ditches) south of the field boundary using a Bartington MS2-D field sensor. This apparatus measures the magnetic susceptibility of a hemispherical volume of soil to a depth of approximately 0.15m beneath the sensor coil which is placed in close contact with the ground surface. The resulting readings were plotted as a series of grey-tone cells (with higher values represented by the paler tones) presented in Fig SS5.10. Samples of topsoil were also collected from within the monument at 5m intervals for subsequent more controlled and standardised MS measurement in the laboratory using a Bartington MS2-B apparatus. The laboratory method of MS measurement allows the removal of water and coarse stony material from the samples to give a purer measurement of the MS and the determination of the MS by weight thus providing a more directly comparable measurement between different samples. This enabled the subsequent direct comparison of the topsoil measurements with laboratory MS measurements of samples obtained at a later stage from excavated features. The results of the laboratory measurements for the topsoil are displayed schematically as circular symbols in Figure SS5.11 and the results from the laboratory measured samples of topsoil, natural subsoil and feature fills are summarised in Table SS5.1.

Table SS5.1. Cotton 'Henge' (CAS 483)
Summary of MS results from topsoil and excavated samples

Bartington MS2-B (bench) sensor, mass specific (100g) readings

Sample source	*Susceptibility χ_{LF} x 10^{-8} m^3/kg*
Topsoil (144 samples, see Fig SS5.10)	103–74 mean = 125.9 std. dev = 9.3
TRENCH 1 (W side of monument)	
Subsoil (natural)	107.54
Inner ditch — upper fill	213.92
Inner ditch — upper fill	446.06
Inner ditch — middle fill	215.43
Inner ditch — lower fill	146.29
Inner ditch — lower fill	194.55
Outer ditch — upper fill	167.27
Outer ditch — upper fill	163.33
Outer ditch — middle fill	171.03
Outer ditch — lower fill	145.22
Fill of treehole	260.54
TRENCH 4 (S side of monument)	
Subsoil (natural)	102.36
Outer ditch — upper fill	70.73
Outer ditch — upper fill	63.45
Outer ditch — middle fill	114.97
Outer ditch — middle fill	69.18
Outer ditch — lower fill	31.77
Fill of treehole (4011)	154.39
Fill of treehole (4017)	36.60
Fill of furlong boundary	42.02


-1.65
-0.12
1.42
2.95
nT
N
0
100m
40 nT/cm
rotated data
(traverses originally
walked north-south)

Results

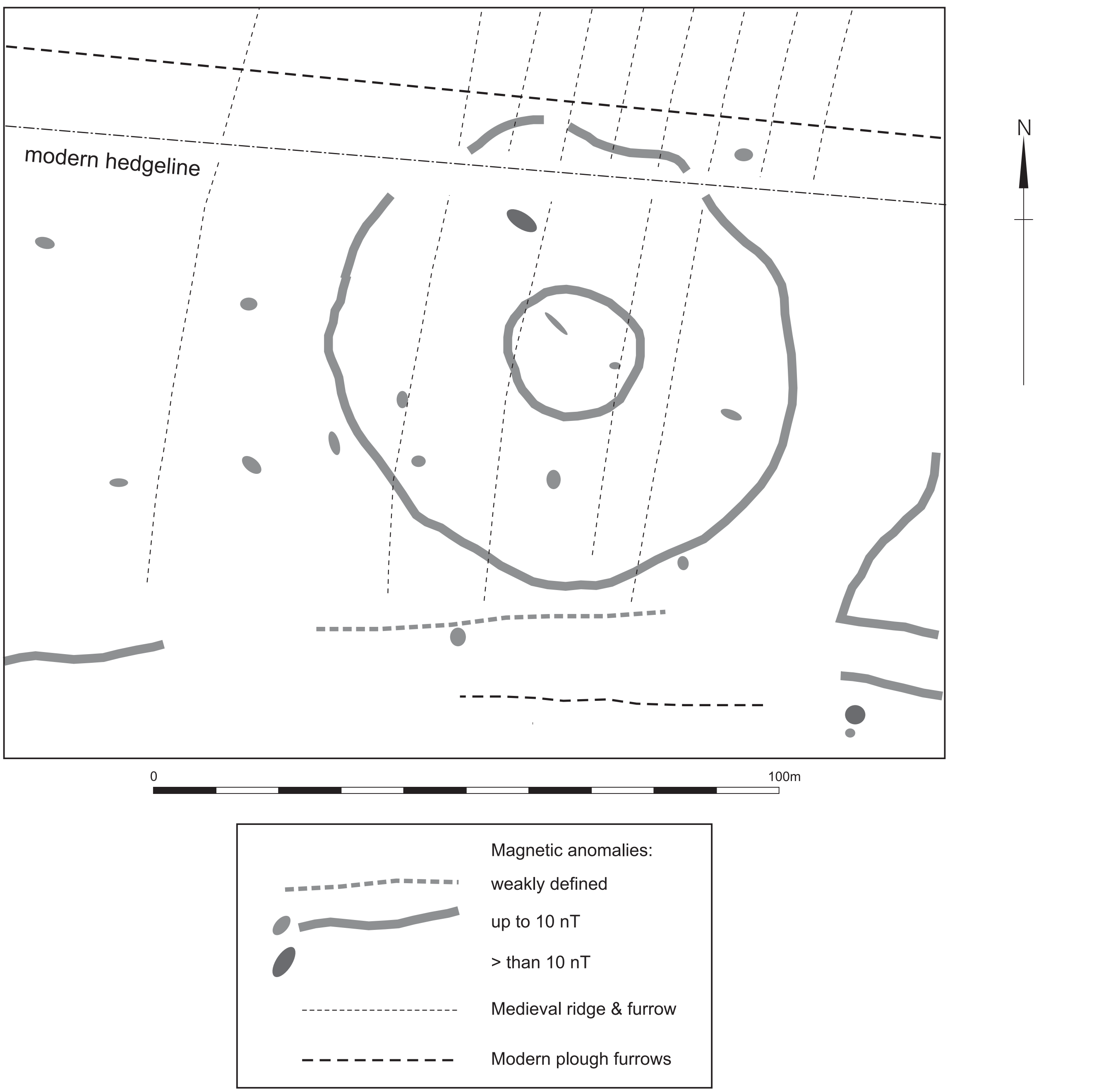
Magnetometry

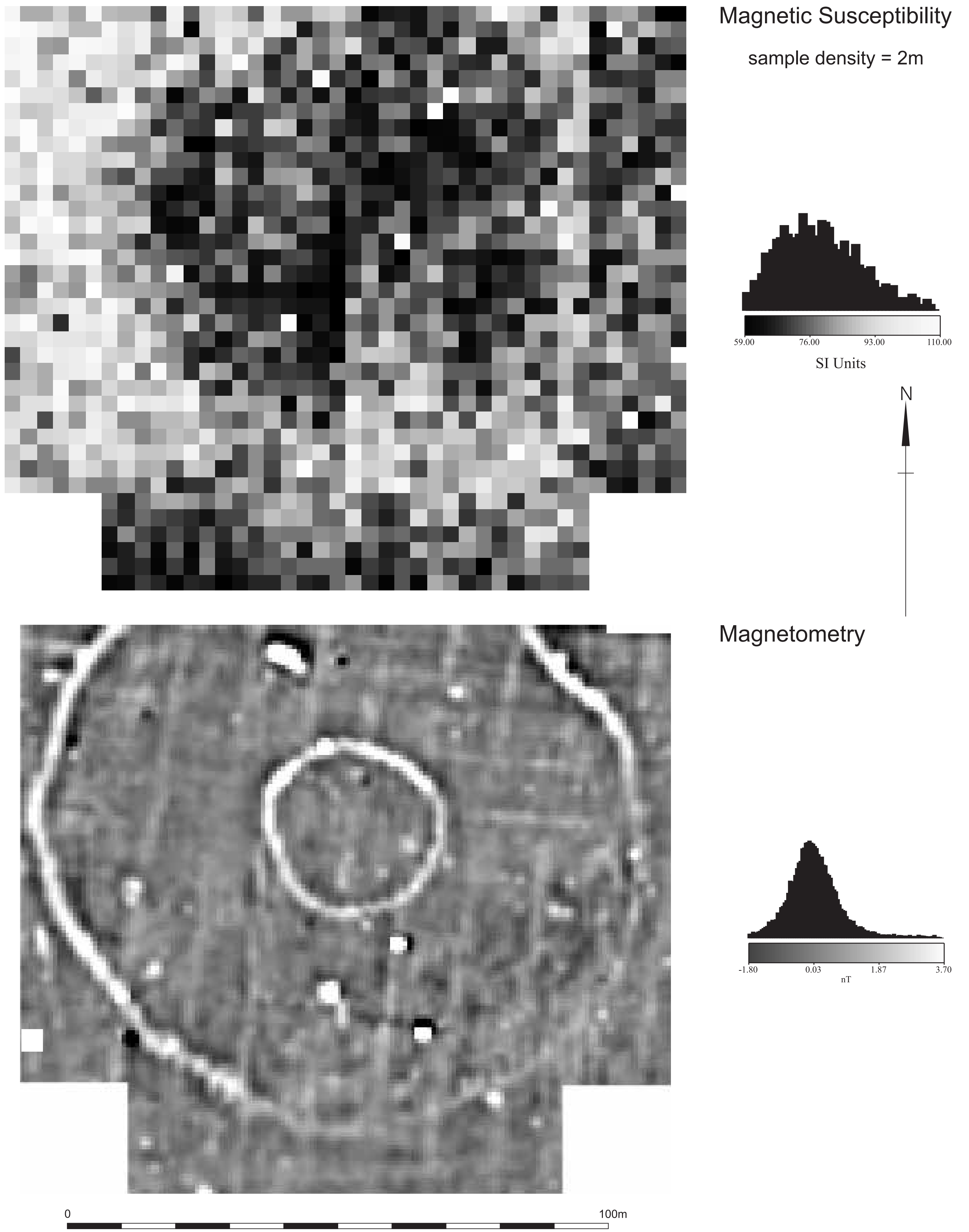
The magnetometer results are fairly self-evident. The most obvious anomalies (Figs SS5.8–9) derive from the two buried concentric ditches previously known from cropmarks – both of which are imperfect circles. In general the signal strength from these ditches is in the range of 8–10 nT (nanotesla – the unit of magnetic flux density), but over the south-eastern arc of the outer ditch circuit a distinct reduction in the magnitude of the anomaly can be observed. The response to the outer ditch is generally stronger on the west and north and weaker to the south and east possibly as a result of greater soil depth sealing the archaeological features.

Less obvious is the apparent absence of an entrance, which leaves the classification of the monument as a true henge open to considerable doubt. The results of the earlier magnetometer survey undertaken by the NAU in 1990 initially appeared to show a

Figure SS5.8 (opposite) Plots of the magnetometer data from the Cotton 'Henge'.

Figure SS5.9 Interpretation of the magnetometer data from the Cotton 'Henge'.





Magnetic Susceptibility
sample density = 2m
59.00
76.00
93.00
110.00
SI Units
N
Magnetometry
-1.80
0.03
1.87
3.70
nT
0
100m

break in the northern arc of the outer ditch, which was interpreted as a possible entrance in the centre of the northern side of the monument. This anomalous feature was subsequently shown by the second magnetometer survey to be due to the presence of a near-surface iron object close to the field boundary producing a strong negative magnetic signal that had obscured the response to the underlying ditch in this area. The presence of a continuous ditch at this point was subsequently confirmed by excavation (Trench 3).

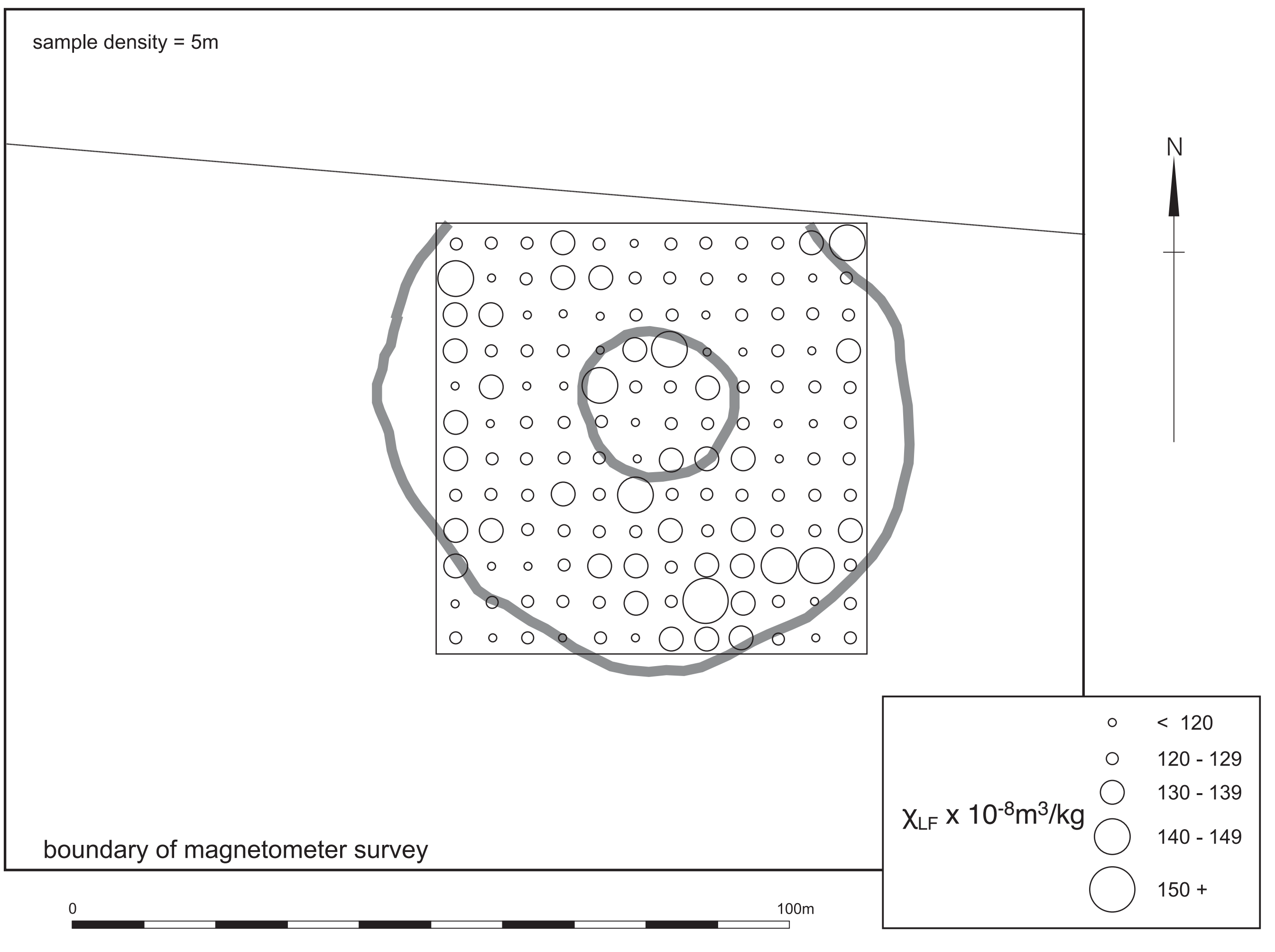
In addition to the ditches, several localised anomalies suggestive of pits were identified by the magnetometer survey within and around the monument. When some of these discrete anomalies were examined during the evaluation excavation (Humble 1994), they were found without exception to result from past tree-root disturbance rather than to be man-made features connected with the monument. Also detected were a series of medieval plough furrows that cross the site from north to south. The medieval ploughing appears to terminate down-slope of the monument, near the southern edge of the survey at what is interpreted as a furlong boundary. Despite being buried beneath a deep covering of ploughwash up to 1m thick, this feature was still faintly resolved by the magnetometer. An Iron Age four-post structure discovered in Trench 2 to the west of the monument was not clearly resolved in the magnetometer survey due to the stronger response to the overlying later ridge and furrow.

MS Survey

The field survey (Fig SS5.10). There is a contrast between the MS of the topsoil inside the enclosure, where the readings are generally low, and the area bounding the monument, where the readings are considerably higher. These results support the probability that the site was not occupied in any sense, as suggested by the apparent lack of an entrance. They might also point to the

Figure SS5.10 (opposite) The magnetic susceptibility survey of the Cotton 'Henge' in relation to the corresponding magnetometer data.

Figure SS5.11 Symbol plot of the magnetic susceptibility results from the laboratory measured samples in relation to the outline of the 'Henge'.



former presence of a central mound (assuming a mound constructed of subsoil quarried from the ditches), but, without more extensive susceptibility data from the wider surrounding landscape, this interpretation of the data can only be speculative. The problem could be addressed by extending the survey to test to what extent the high readings around the ditch are a localised effect. It seems most probable that the high readings forming an arc around the perimeter of the monument are a result of plough or biological action bringing soil from the outer ditch filling to the surface which then becomes spread across a wider area.

Laboratory MS measurements on soil samples (Fig SS5.11). The results of the laboratory measurements on the 144 topsoil samples and 22 excavated samples are summarised in Table SS5.1.

Despite the laboratory-measured data being based on a more restricted sample than the field survey in terms of area and sample density, the two sets of data are consistent. MS values within the concentric ditches are very uniform (most lie within half a standard deviation of the mean), but show an increase towards the edge of the survey replicating the field survey results. Interestingly this increase is highest and most obvious towards the south-east of the area sampled, in the same area where the magnetometer response to the ditch is reduced. The localised increase in the MS of the topsoil in this area could have contributed to the more erratic magnetometer response over this section of the outer ditch causing the ditch anomaly to become less well defined than in other parts of the survey. Other factors observed during excavation including thicker ploughsoil cover over the ditch and a greater proportion of sand to ironstone in the subsoil in this area have also probably contributed to the observed variances in both the topsoil MS data and magnetometer data in the south east sector of the site. The samples obtained from the fill of the outer ditch on the south east side of the monument (examined by excavation Trench 4 – see Table SS5.1) also have much lower MS values than the fills of the outer and inner ditches on the west side of the monument in Trench 1. They also have much less contrast with the surrounding subsoil and are lower than the overlying topsoil. The opposite is true in the case of the ditches in Trench 1. These results clearly account for the variations in the response to the outer ditch observed in the magnetometer survey, but it is uncertain if these changes reflect archaeological or geological influences. The south-east side of the monument lies close to a geological boundary between Northampton Sand with Ironstone and Upper Lias clay.

Discussion

With the exception of a single Iron Age four-post structure uncovered in Trench 2, the geophysical survey provided a reliable indication of the range of archaeological features subsequently encountered during the excavation. Excavation demonstrated that few archaeological deposits appear to survive other than the outer and inner ditches, and that within the trenches all the discrete features detected by the magnetometer survey proved to be treethrow holes. Few finds were recovered and there was an absence of material suitable for environmental analysis and radiometric dating.

Despite the detailed geophysical surveys and subsequent targeted excavation, the nature of the site remains enigmatic. The close correlation between the geophysical survey and the results of excavation appears to confirm that, unlike 'classic' henges with one or more entrance ways, the outer ditch circuit is unbroken. With this absence of an obvious entranceway and the relatively slight nature of the ditches, the site does not conform to the typical notion of a henge. The combination of the lack of entrances, paucity of finds and low magnetic susceptibility associated with the interior of the monument all suggest that Cotton 'Henge' was not an occupation site or even a focus of regular human activity. The evidence strongly suggests that the enclosed space demarcated by the ditch defining the Cotton 'Henge' was not designed to be entered, suggesting that it had more in common with funerary monuments. Excavation was unable to determine the sequence of construction of the two concentric ditches, but the characteristics of the flint artefacts found within the ditch fills are compatible with a Neolithic date. The monument may represent a distinctive regional variant of large Neolithic ceremonial circles with similar sites known in the region from cropmarks. The ditches were apparently purposefully backfilled, suggesting a deliberate act of decommissioning the monument.

The magnetic susceptibility studies undertaken at the site so far could usefully be extended by increasing the survey area around the site. Resistivity survey could also usefully be employed in the future to aid the reconstruction of the original form of the monument (rendered difficult by its now plough flattened state) by testing for the presence of a residual mound structure and banks and resolving the question of entrances.

SS5.3.3. RAP Barrows

Background

Four suspected isolated barrow sites in the Raunds area were investigated by the Ancient Monuments Laboratory by means of geophysical techniques in 1995. The sites are all situated on the river terraces on the south-west edge of the floodplain of the Nene between the village of Stanwick and the town of Higham Ferrers (Figs SS5.2, SS5.3). Three of the barrows lie to the west of the A605 within areas of active gravel extraction, while a fourth less certain barrow site is located slightly further away from the river on the northern edge of Higham Ferrers to the east of the A605 near Glebe Farm. Collectively the four sites were termed the RAP barrows and the relevant site codes and other references that identify each barrow individually are as follows :

Site 1 (SMR 1344/1/4). suspected barrow at NGR SP 9618 7036, initially observed in the form of a cropmark on aerial photographs and located on the first river gravel terrace.

Site 2 (SMR 1766/0/1, Scheduled Ancient Monument 13676). An upstanding earthwork known locally as 'flat-top barrow' Located on the floodplain of the Nene at NGR SP 9626 7083 resting on and possibly partially overlain by alluvial deposits. In the scheduled ancient monument listings the site is titled 'Raunds bowl barrow' and erroneously located at SP 9630 7079 (20m south and 30m east of its true position as demonstrated by the geophysical survey). The most likely source of this error is the use of a grid reference that is insufficiently detailed to register the true position of the ring ditch on a large scale map.

Site 3 (Barrow 2, SMR 1765/0/2, Scheduled Ancient Monument 13667). This is the last remaining barrow in the Irthlingborough island group of round barrows formerly distributed in a loose cluster across the alluvial floodplain of the River Nene prior to destruction by gravel extraction (Harding and Healy 2007, fig 1.4). The three other barrows in the group were totally excavated by Claire Halpin between 1986 and 1987 in order to preserve them by record in advance of their destruction. The extant Barrow 2 is located at NGR SP 9659 7139, sandwiched between a drainage channel and a disused railway embankment used by quarry vehicles in an area occupied at the time of the fieldwork by ARC's gravel sorting plant. In the English Heritage scheduled monument listings, the site is titled 'Irthingborough bowl barrow' even though it is nearer to Raunds than the so-called Raunds bowl barrow at Site 2.

Site 4 (SMR 1344/1/1). This site located at NGR SP 9627 7025 near Glebe Farm was initially interpreted as a possible ring ditch based on aerial photographic evidence. The cropmark evidence suggested the presence of a small ring ditch, approximately 15m in diameter containing a central pit. The site lies on the boundary between the first fluvial gravel terrace and deposits of Upper Lias clay (geological Survey of Great Britain (England and Wales) 1974). The overlying soils consist of clayey and fine loamy soils of the Moreton association (Soil Survey of England and Wales 1983).

The aim of the surveys was to confirm the presence of barrows at each location and to attempt to shed additional light on the form and structure of each barrow (including determining presence or absence/number of quarry ditches, revealing evidence of internal structure and any external features).

Results

Site 1

The magnetometer survey over this cropmark (Fig SS5.12) clearly located a circular ring ditch approximately 20m in diameter. The ditch anomaly is absent on the northern side of the monument, suggesting that it is perhaps interrupted at this point or that it has been removed by later activity. Other causewayed ring ditches are already known in the Irthlingborough area – Barrow 4 of the Irthlingborough island group was found to have a causewayed ditch during excavation (SS1.15) and a Neolithic causewayed ring ditch was excavated in trench B118 on the nearby terrace (Halpin 1989; SS1.6). Although a causewayed ring ditch would not be out of place in the area, other factors could be responsible for the curtailment of the Site 1 ring ditch on the north. The northern third of the survey area shows a greater level of magnetic disturbance, and it is possible that this larger-scale magnetic variation could have resulted in the loss of definition of the ring ditch anomaly on the north side of the circumference. Earth movement involving the dumping and levelling of topsoil related to the nearby gravel extraction has reportedly taken place in the vicinity of

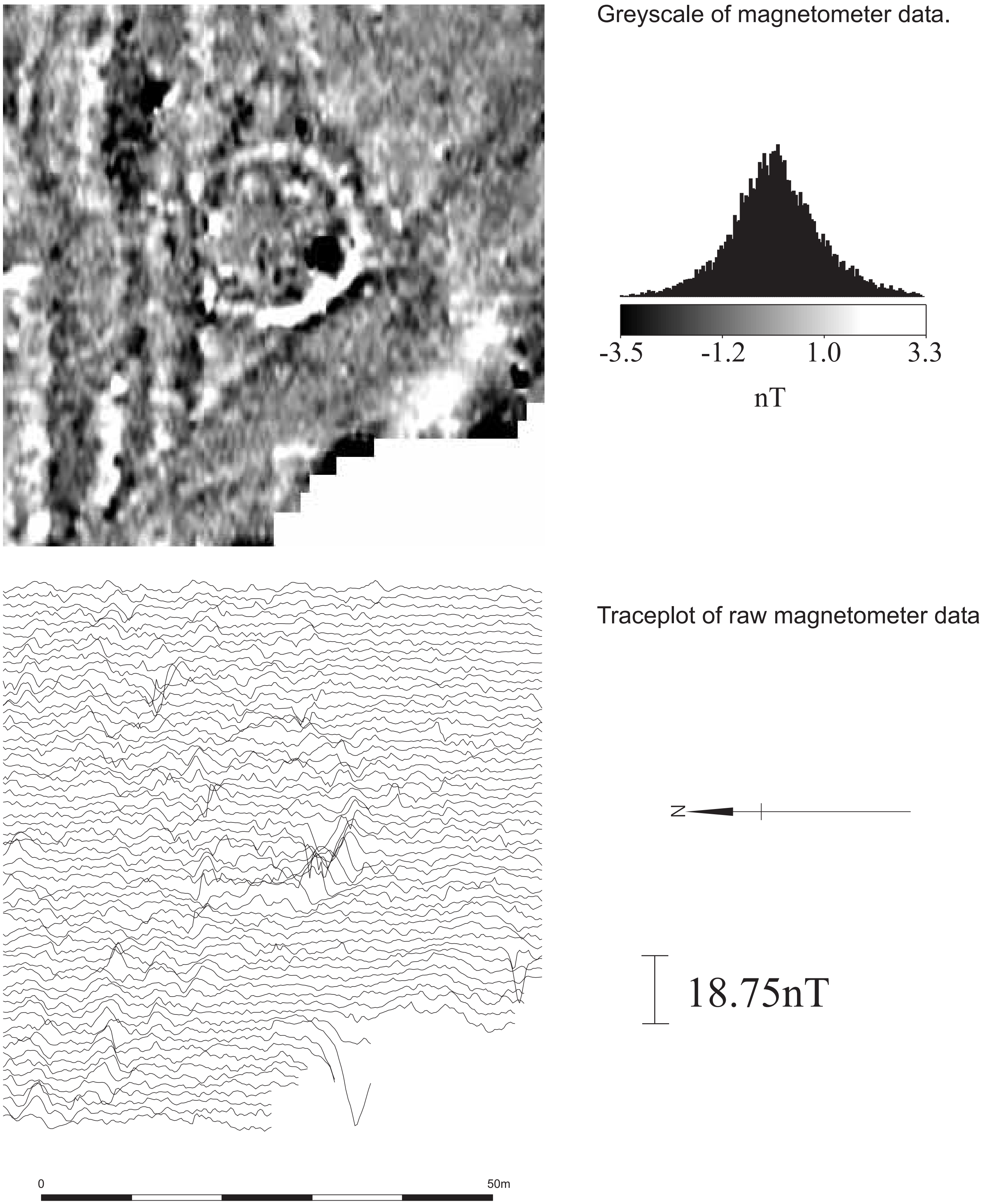


Figure SS5.12 Plots of the magnetometer data from RAP Barrows: Site 1.

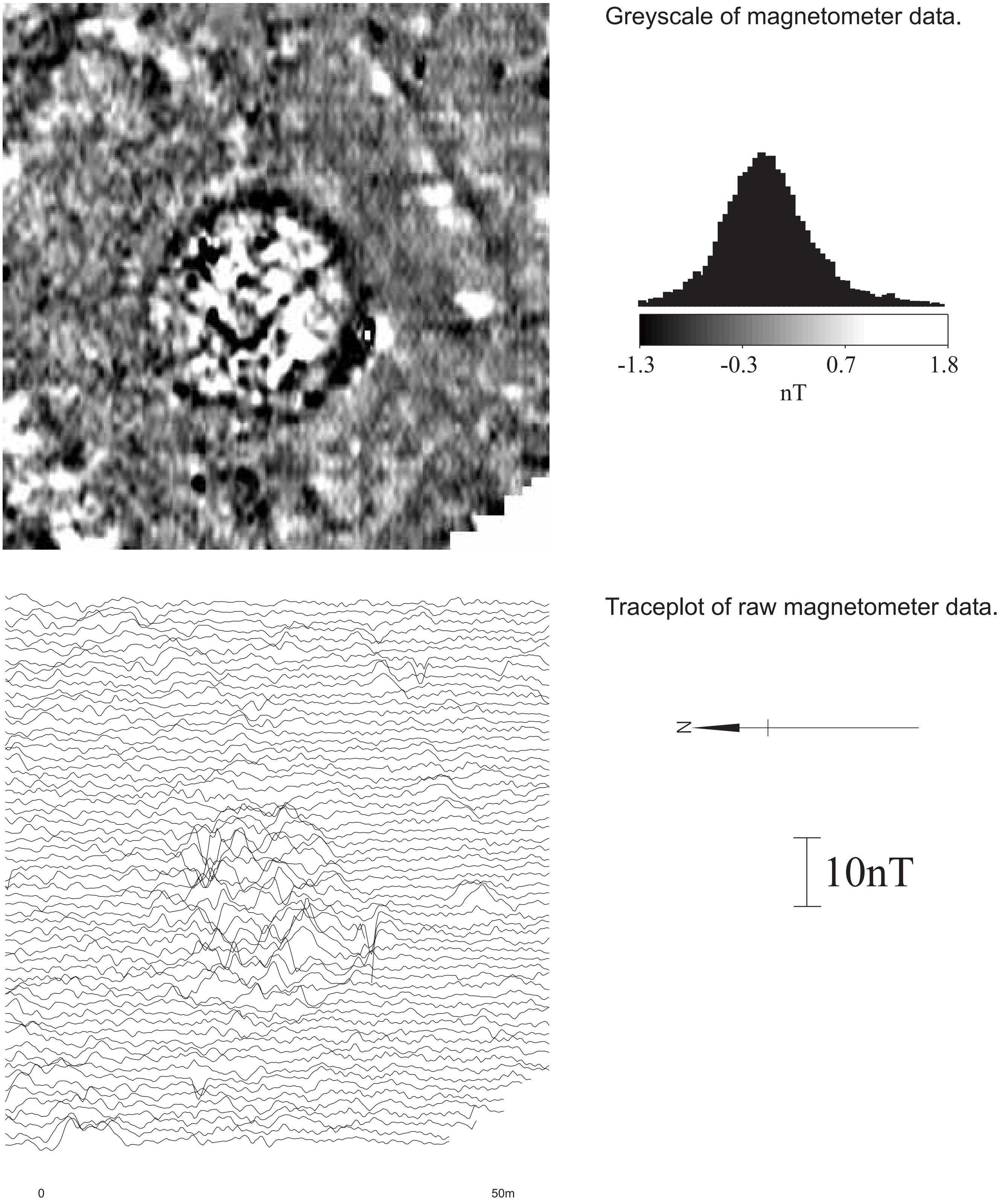


Figure SS5.13 Plots of the magnetometer data from RAP Barrows: Site 2.

Site 1. As a result the northern circuit of the ring ditch may perhaps be more deeply buried and less susceptible to detection by the magnetometer. Alternatively the ditch may have been accidentally bulldozed during the levelling process. The latter would certainly help explain the east-west parallelism evident in the data to the north and additionally, the linear negative anomaly running north-west to south-east which clips the ring ditch to the south-west. Another possibility is that the larger-scale magnetic disturbance in the northern part of the survey is of riverine, geomorphological origin and alluvial deposits may be obscuring the response to the ditch on the north.

It is worth noting that the magnetometer has responded most strongly to the ring ditch in its south-western arc. This is suggestive of the use of fire in this area – perhaps associated with some funerary activity. Once again, however, the variation in magnetic response may be due to differing depth of burial. No obvious internal features appear to have been detected, the strong dipole response to the south most probably being due to modern, extraneous iron.

Site 2

The magnetometer survey of Site 2 (Fig SS5.13) has clearly located a circular feature 28m in diameter, but the response is very unusual for a barrow. An area of strong positive magnetic enhancement is encircled by a negative magnetic (low magnetic gradient) anomaly with a suggestion of a weaker outer positive ring.

The ring of negative magnetic readings may indicate a wall, bank or revetment around the mound made from stonier material (such as gravel or the local limestone) with a significantly lower magnetic susceptibility than the surrounding soil. A similar negative anomaly could also occur in the case of a ditch containing a large amount of stone of lower susceptibility than the soil it was cut into (presumably as a result of deliberate deposition) or a ditch naturally infilled with deposits of river alluvium. Gravel deposits heaped up around the periphery of the mound were a feature of several of the excavated barrows. A similar feature could possibly account for the negative magnetic response around Site 2.

The activity detected within the negative ring surrounding Site 2 is unusually intense and is certainly not a typical response to the interior of a burial mound. The response is indicative of the presence of magnetic deposits or burning within or on the mound, perhaps linked to occupation or funerary activity. At the centre of the area of magnetic enhancement, an L-shaped negative anomaly can be discerned which may represent an infilled excavation trench.

Cremation deposits were uncovered in the upper levels of several excavated barrows, and it is possible that the positive magnetic response to the mound at Site 2 may also represent pyre activity. A second possible explanation for the raised magnetic response over Site 2 would be the presence of occupation or deposited material, in which case the mound could contain similar deposits to Barrow 1, which contained the fragmentary remains of about 200 cattle skulls suggestive of ceremonial feasting and sacrifice (Halpin 1989; SS1.12; SS4.6.1). The possibility should be borne in mind that Site 2 is not a barrow at all but a feature such as a burnt mound. Given the presence nearby of the Redlands Farm Roman villa, Site 2 could also have undergone alteration in later periods that could have influenced the magnetic signature. Barrow 5 showed evidence of elaboration and reuse in the Roman period (SS1.16). There is a suggestion of an outer enclosure around the site 2 mound, but if present this feature has been only partially defined by the survey.

Site 3 (Barrow 2)

Despite the barrow being located within the heart of the gravel processing plant, surprisingly clear results were obtained (Fig SS5.14). An outer ring ditch approximately 25m in diameter has been detected almost in its entirety. The magnetic response to the ditch is not uniform around its circuit and is at its strongest to the west. The magnetic response is rather confused, but there is a suggestion of a second internal ring. Two discrete anomalies have been detected near the centre of the barrow, one of which correlates well with a low resistance anomaly detected by the resistivity survey. The site also responded well to resistivity survey, with the outer ditch being detected clearly as a low resistance anomaly. Within the ring ditch is a broad circular band of high resistance, approximately 8m wide, which surrounds a central area of generally lower resistance bounded by a possible inner ring ditch with a diameter of approximately 11m. This could be interpreted as a mound containing a less resistive core constructed from a different material to the outer mound covering or an outer bank surrounding an inner hollow

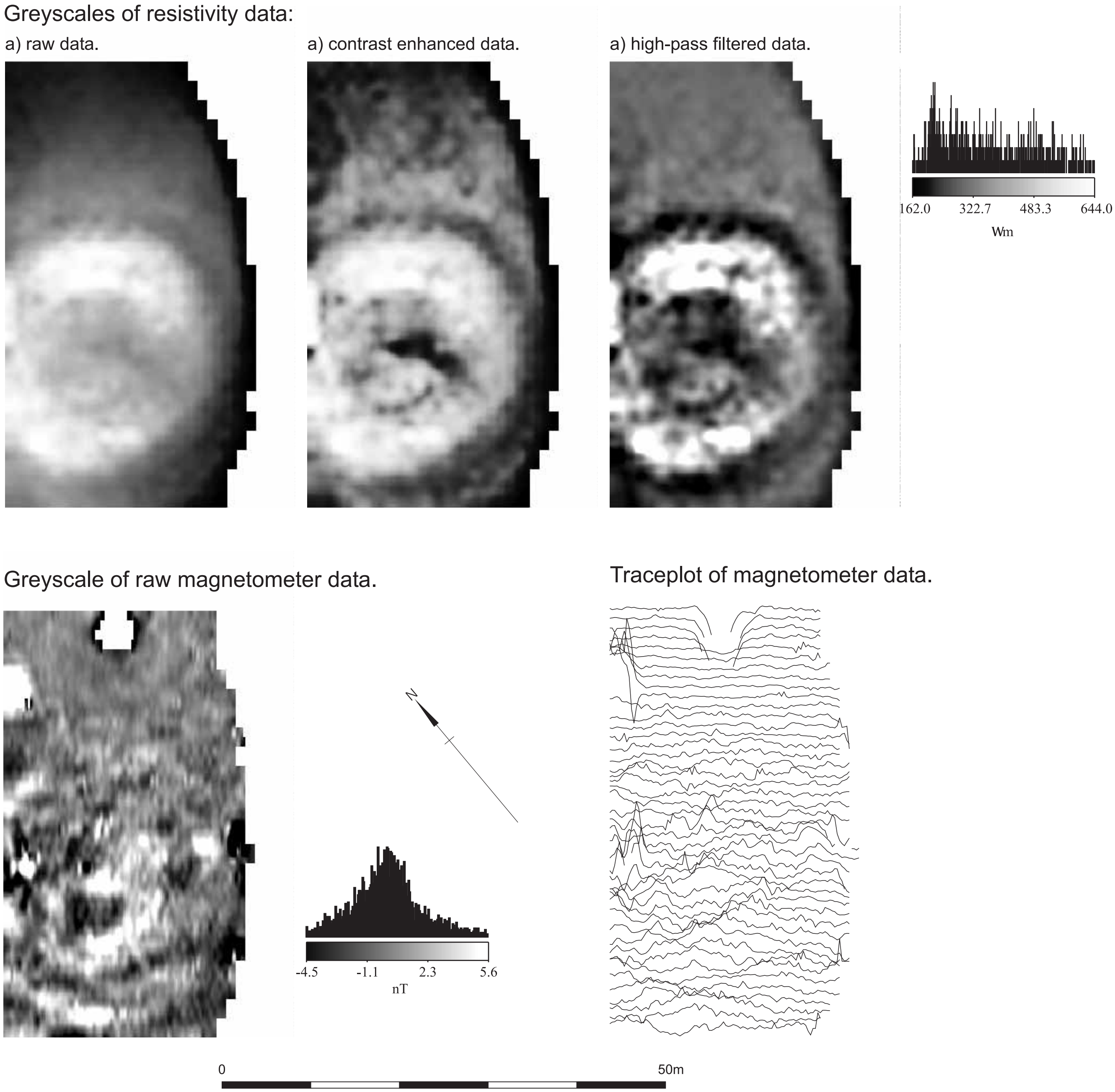


Figure SS5.14
Plots of the magnetometer and resistivity data from RAP Barrows: Site 3 (Barrow 2).

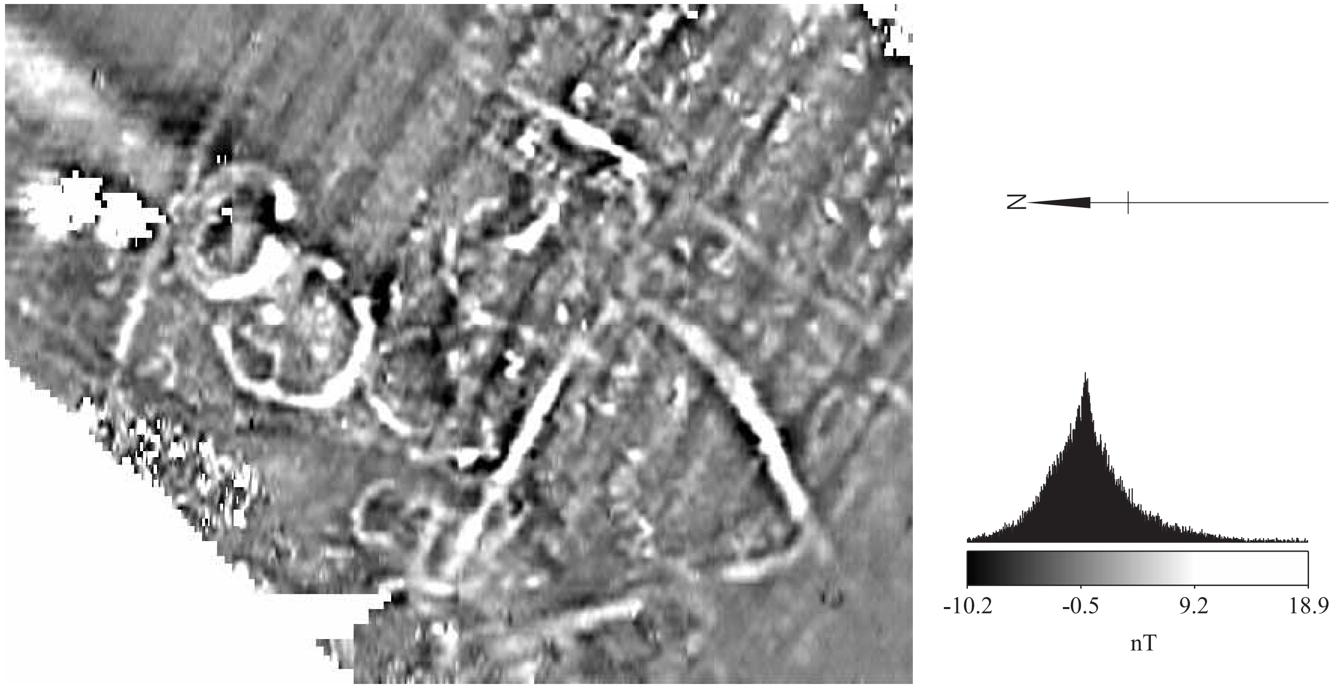
although the latter does not conform to any recognised barrow morphology. At the very centre of the barrow there is an irregularly-shaped low resistance anomaly, also resolved by the magnetometer, which may be the response to an original pit or a more recent attempt to explore the contents of the barrow. Overall it does seem likely that some excavation over the centre of this barrow has taken place. The presence of a possible internal ring ditch here is suggestive of a multi-phased or enlarged barrow similar to Barrows 1, 3, 5, 6 and 9. The outer, more resistive, ring mirrors the banks of gravel found around the periphery of several of the excavated barrows.

Site 4

Contrary to expectations, the magnetometer results indicate the presence of an archaeological site of much greater complexity and extent than the single ring ditch anticipated from the aerial photography.

Up to six ring ditches, one more oval in form and ranging from 15 to 20m in diameter, have been detected in addition to a ditched

Greyscale of magnetometer data.



Traceplot of raw magnetometer data.

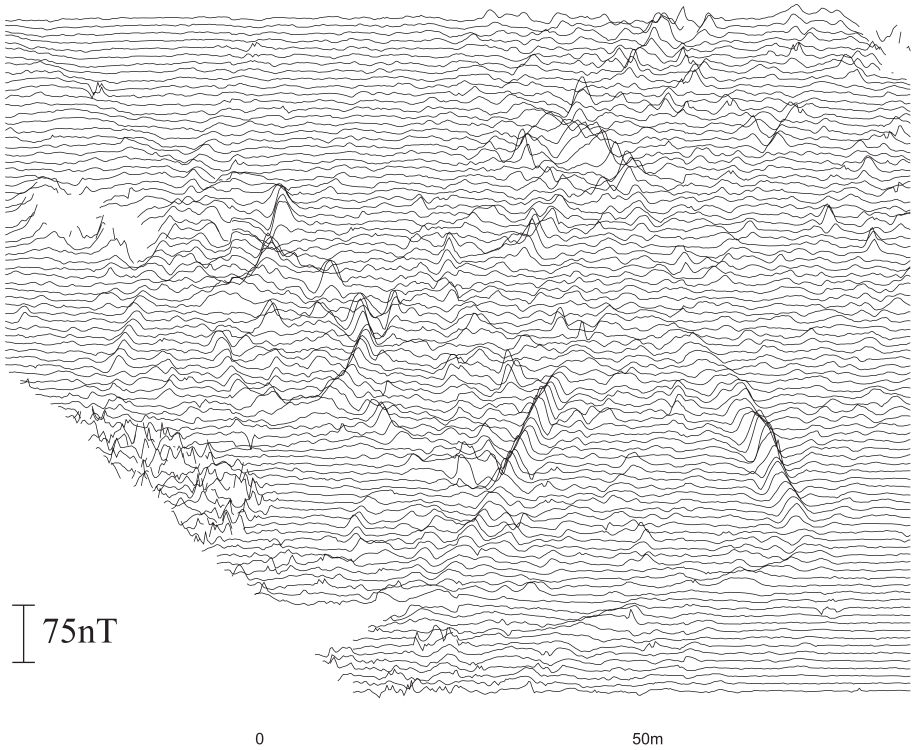


Figure SS5.15 Plots of the magnetometer data from RAP Barrows: Site 4.

triangular enclosure (Fig SS5.15). The majority of the annular features occur in the area north of the enclosure with the most northerly oval ditched feature coinciding most closely with the recorded position of the cropmark. The ditch of the oval feature (A on Fig SS5.16) is clearly interrupted on the south side and intersects with a second well-defined causewayed ring ditch (B) which contains internal features (possibly pits or hearths) and has particularly accentuated ditch terminals flanking the south-east facing break in the ditch. The response to the ditches of A and B is particularly strong near the terminals suggesting the inclusion of greater quantities of magnetically enhanced material in the ditch fills in these areas possibly indicating some form of symbolic or structured deposition. Two further, but more partial and less well-defined ring ditches (possibly segmented) were detected in close proximity to one another at C and D and other partial rings are tentatively identified at E and F. Feature F is bisected by the linear ditch of the triangular enclosure (G) and therefore the two features are unlikely to be contemporary.

A series of linear anomalies (H, I and J) to the north and east of the ring ditches (A to F) may also be significant but are suspiciously rectilinear with the direction of the ploughed-out ridge and furrow that has been detected trending NW–SE. If features H and I represent ditches, it is possible that they may define two sides of a second rectilinear enclosure adjoining feature G and surrounding the main focus of the circular features. A similar arrangement of features has been mapped previously by magnetometer survey at Keyston Road in the north-east of the Raunds Project area (Payne 1991).

Discrete anomalies south-east of I may represent a continuation in this direction of related archaeological activity.

The response to ridge and furrow appears to be enhanced over the annular and enclosure features suggesting localised accumulation of magnetically enhanced topsoil, more diagnostic of a settlement function than a funerary one. Topsoil magnetic susceptibility (Xlf) values are relatively high in the area (range: $60–119 \times 10^{-8}$ m^3/Kg, mean: 89) and are comparable with MS values ($63–112 \times 10^{-8}$ m^3/Kg, mean value 89) recorded in 1989 over a Roman villa settlement on similar substrates.

If the site represents some form of settlement, as seems most likely from the magnetic susceptibility, the internal features might represent domestic pits or hearths. However, if the annular and oval features do represent ploughed-out barrows or mortuary-style enclosures, the internal features could represent burial deposits. The intersection of features A and B is remarkably similar to the combination at West Cotton of Barrow 6 and the Ditched Enclosure and of the original Turf Mound and the ditched mound built onto it. The overlapping anomalies indicate successive phases of activity on the site, but without dating evidence the site is difficult to interpret. The collection of features detected by the magnetometer could represent a combination of funerary and or ceremonial activity and settlement with a broad date span but in all probability prehistoric. With the absence of dating evidence it is impossible to say if the site represents a Neolithic or Bronze Age or later complex of prehistoric features. It is tempting to suggest an occupation site on the basis of the magnetic susceptibility readings (which are in a comparable range to measurements recorded at Stanwick Iron Age and Roman settlement). The site morphology shows similarities to both the funerary complex at West Cotton and the later Iron Age settlement at Keyston Road (Payne 1991).

The presence of the main causewayed ring ditch and oval ditched features was confirmed by resistivity survey but no additional information on the site was obtained by this method.

Discussion

The geophysical surveys succeeded in locating archaeological features at all four suspected barrow sites. The magnetometer survey at Site 1 confirmed the presence of a single-ditched barrow which may have been disturbed to a limited extent by the quarrying activity which it lies in close proximity to. The magnetometer survey at Site 3 was similarly successful, although a response of greater clarity was achieved by the resistivity survey which confirmed the presence of an outer ditch and clearly indicated a physical difference in the make up of the barrow structure (and some possible structural detail) at the centre of the mound. The results of the magnetometer survey at Site 2 are rather enigmatic. As such they are difficult to interpret with any confidence but suggest the barrow has an untypical internal structure or contains unusually distinctive deposits. At Site 4 the geophysical survey demonstrated the presence of a much more complex site than the single ring ditch anticipated from the AP evidence. The previous

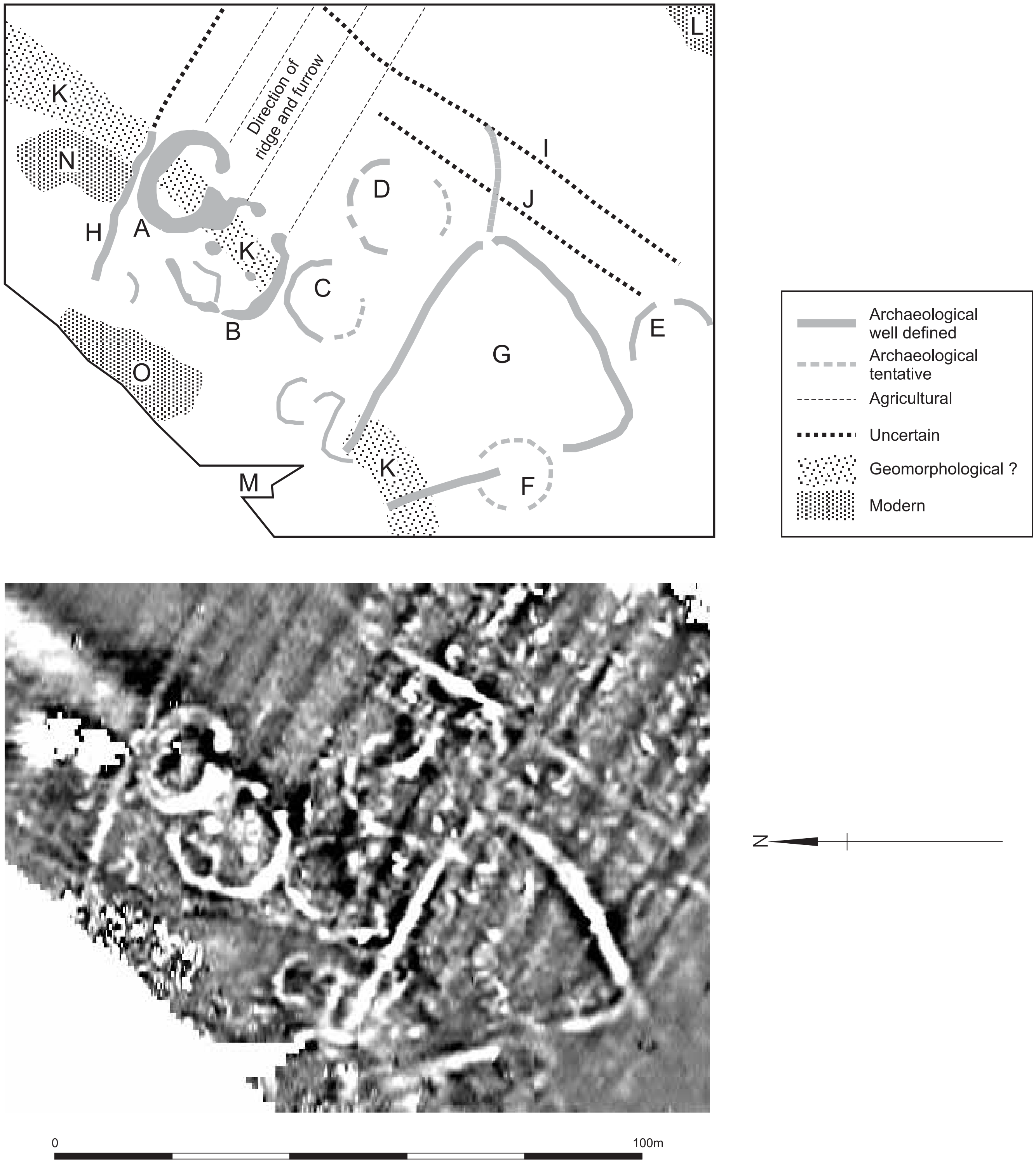


Figure SS5.16 Interpretation of the magnetometer data from RAP Barrows: Site 4.

classification of this feature as a possible barrow requires reassessment in the light of the geophysical evidence. The ring ditch can now be interpreted as a single element in a complex of several similar features, of apparently several phases, set within and amongst ditched enclosures. The date and function of the site is open to interpretation but the layout of Site 4 has similarities to both small single entrance hengiform or causewayed ring ditch enclosures of early prehistoric origin and also cropmark enclosures of probable late prehistoric date identified on the higher Boulder Clay-capped plateau to the east of Raunds.

SS5.4 Some overall conclusions

The application of geophysical survey techniques to the investigation of the prehistoric monuments in the Raunds area has proved highly productive. Clear geophysical results were obtained from all the sites investigated providing important information on the sites left untouched by excavation or gravel extraction. The geophysical investigations not only succeeded in locating new evidence of barrows in many parts of the Raunds area, they also revealed considerable detail of the internal structure of several of the barrows suggesting phased development in some cases. The surveys helped fill out and broaden the picture of the barrow distribution obtained from excavation and in turn the interpretation of the geophysical results was considerably enhanced by the availability of the excavation evidence from neighbouring sites.

To date the majority of geophysical survey in the Raunds area has been monument-focussed, targeted on particular sites initially known from either earthwork or cropmark evidence. The discovery of a hitherto unknown complex of ring ditches at Glebe Farm (Site 4), previously only hinted at by the presence of a single cropmark, raises the possibly that large-scale archaeological prospection of the wider Raunds district – particularly the gravel terraces and higher ground flanking the Nene floodplain – could be very productive in revealing new evidence of the prehistoric landscape. This is especially important given the predominantly arable landscape of the Northamptonshire region that has developed since the medieval period, within which few upstanding archaeological monuments are visible (Chapman 1999). Much of the archaeological evidence that does exist in these areas remains vulnerable to agricultural erosion or is obscured by later ridge and furrow where pasture exists. Geophysical prospection of such areas would help to redress the balance of archaeological research in the county which to date has been largely reactive in advance of destructive activities such as quarrying and road building.

SS6
Absolute Chronology

Alex Bayliss, Frances Healy, Christopher Bronk Ramsey, F Gerald McCormac, Gordon T Cook and Jan Harding

SS6.1 Introduction

A total of ninety-eight radiocarbon dates was obtained on samples from prehistoric contexts within the Raunds Area Project between 1989 and 1998.

Most of the samples were submitted in the course of fieldwork and the early stages of post-excavation analysis. Material was selected primarily to date individual contexts and to provide a basic chronology for the monuments. The overall objectives were not articulated explicitly and there was no formal sampling strategy designed to achieve overarching aims.

In 1995 a series of samples was submitted from the excavations at Redlands Farm as part of post-excavation analysis undertaken by the Oxford Archaeological Unit. Samples from the Long Barrow were selected using a mathematical simulation which integrated the potential radiocarbon results with the stratigraphic sequence through the monument. The comparative success of this strategic approach in providing precise chronology encouraged a reassessment of the existing results and the available samples from the other monuments. This led to the selection of further samples in 1997–8. These were submitted to refine the chronology of specific sites, from which samples had already been dated. Replicate single-entity samples of short-lived material were submitted from contexts where bulked samples or long-lived material had already been dated. An attempt was also made to integrate the limited amount of relative dating information provided by stratigraphy with the existing radiocarbon results. This modelling highlighted a small number of additional samples which would materially contribute to the project aims.

Dating the monuments on the valley floor was extremely difficult. This is because bone preservation was generally poor, illustrated by the fact that four further bone and antler samples, in addition to those listed in Table SS6.1, were processed but failed to produce sufficient organic material for analysis. The severely restricted range of material which could be dated successfully necessitated a reliance on charred plant remains, the taphonomy of which is often less secure than that of other sample types because of their mobility and potential inhomogeneity (Ashmore 1999; Bayliss 1999).

SS6.2 Radiocarbon analysis and quality assurance

Sixty-three samples were dated by the Oxford Radiocarbon Accelerator Unit between 1989 and 1998. Plant remains were processed according to methods outlined by Hedges *et al* (1989). The pretreatment method used for bone was a collagen extraction (Hedges and Law 1989; Hedges *et al* 1989) followed by purification by ion exchange (Hedges and van Klinken 1992). For OxA-7950 collagen extraction was followed by gelatinazation and separation by filtration (Bronk Ramsey *et al* 2000). All samples processed before 1998 (and OxA-7958) were measured using the carbon dioxide ion source and methods outlined by Hedges *et al* (1989). Samples processed in 1998 were measured using the graphite source and methods outlined by Bronk Ramsey and Hedges (1997).

Seventeen samples were dated by the Radiocarbon Dating Laboratory of the Queen's University, Belfast, between 1989 and 1991. These were processed according to methods outlined by Mook and Waterbolk (1985) and Longin (1971) and measured using liquid scintillation counting as described by Pearson (1984) and Noakes *et al* (1965).

Five samples were dated by the Scottish Universities' Research and Reactor Centre in 1993. Samples were processed and measured using methods outlined by Stenhouse and Baxter (1983).

Seven samples were dated by the NERC Radiocarbon Laboratory in 1988, as part of a larger series relating to palaeoenvironmental investigations in the Nene valley by A G Brown and M K Keough. The samples were processed according to methods outlined by

Mook and Waterbolk (1985), and measured as described by Harkness and Wilson (1972).

Three peat samples were measured at AERE Harwell in 1990. They were pretreated as described by Mook and Waterbolk (1985) and combusted to carbon dioxide and synthesised to benzene using methods similar to those initially described by Tamers (1965) and a vanadium-based catalyst (Otlet 1977). Radiocarbon content was measured using liquid scintillation counting as described by Otlet (1979).

Two samples were dated by the British Museum in 1993, using methods described by Ambers and Bowman (1998).

During the period when these measurements were made all the laboratories concerned maintained continual programmes of quality control, in addition to participation in international inter-comparisons (Scott *et al* 1990; Rozanski *et al* 1992; Scott *et al* 1998). These tests indicate no laboratory offsets and demonstrate the validity of the precision quoted.

In addition, six pairs of replicate determinations were made on samples at the Oxford Radiocarbon Accelerator Unit in 1998. All of these are statistically consistent (Table SS6.1; Ward and Wilson 1978). A pair of measurements on replicate humic acid and humin fractions of sample RS04 (SRR-3607a–b) is also consistent.

A further measurement (GrA-22378) was obtained in 2003, and is hence not included in the chronological model, which was completed in 2000. This is an AMS measurement made on the structural carbonate fraction of cremated bone by the Institute of Archaeology, University of Groningen, according to the methods outlined by Lanting *et al* (2001) and van der Plicht *et al* (2000).

SS6.3. Results

The results are given in Table SS6.1, and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986). They are conventional radiocarbon ages (Stuiver and Polach 1977).

SS6.4. Calibration

The simple calibrations of these results, which relate the radiocarbon measurements directly to the calendrical time scale, are given in Table SS6.1, in black in Figures SS6.3 and SS6.13 and in outline in Figures SS6.4–12 and SS6.14. All have been calculated using the dataset published by Stuiver *et al* (1998) and the computer program OxCal version 3.5 (Bronk Ramsey 1995; 1998; 2000). The calibrated date ranges cited in the text are those for 95% confidence. They are quoted in the form recommended by Mook (1986), with end points rounded outwards to ten years. The *estimated date ranges* quoted in italics are derived from the mathematical modelling of the archaeological chronology and are posterior density estimates. Laboratory numbers are quoted in italics where they refer to posterior density estimates, and in normal type where they refer to samples or to simple calibrated date ranges. The ranges in normal type have been calculated according to the maximum intercept method of Stuiver and Reimer (1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993). Weighted means have been taken from replicate measurements before calibration (Ward and Wilson 1978).

SS6.5. Analysis

The information available from the radiocarbon dates and the archaeological stratigraphy has been combined to provide estimates of the chronology of the individual monuments and of the landscape as a whole, which are represented graphically in Figures SS6.2 and SS6.4–11. It should be emphasised that these estimates are often based on restricted evidence. This results from the limited choice of samples suitable for radiocarbon dating and from the stratigraphic isolation of almost all the monuments which means that few dates can be constrained by others from earlier and later contexts.

A Bayesian approach has been adopted for the interpretation of the data (Buck *et al* 1996). The technique used is a form of Markov Chain Monte Carlo sampling and has been applied using the program OxCal version 3.5 (http://www.rlaha. ox.ac.uk/orau; Bronk Ramsey 1995; 1998; 2001), which uses a mixture of the Metropolis-Hastings algorithm and the more specific Gibbs sampler (Gilks *et al* 1996; Gelfand and Smith 1990). Details of the algorithms employed by this program are available from the on-line manual, and fully worked examples are given in the series of papers by Buck *et al* (1991; 1992), Buck, Litton *et al* (1994), and Buck, Christen *et al* (1994). The algorithms used in the models described below can be derived either from the structure

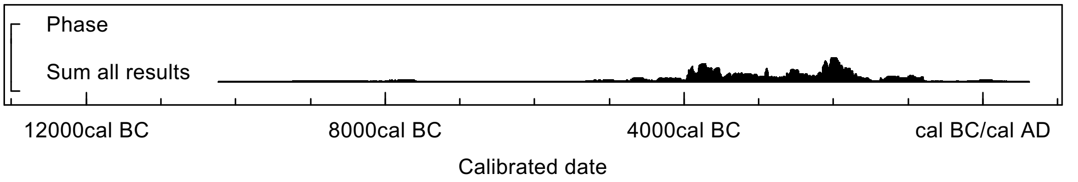


Figure SS6.1
Sum of the probability distributions of the simple calibrated radiocarbon dates from the Raunds Area Project (pre-Iron Age). A weighted mean has been taken of replicate measurements before calibration (see Table SS6.1). This distribution provides an estimate of the chronological distribution of the events dated by radiocarbon measurements.

shown in Figures SS6.2 and SS6.4–11, or from the chronological query language files which are contained in the project archive.

It has been demonstrated that, when radiocarbon dates are constrained by relative dating information, there is a danger that the posterior density distributions may be spread evenly across plateaux in the calibration curve, irrespective of the actual age of the material dated (Steier and Rom 2000). This is because the statistical weight of a group of measurements naturally favours longer overall spans. This effect can be eliminated by imposing a uniform prior distribution on the spread of the dates while assuming that, within this distribution, the dates are independent and a random sample of a relatively constant level of human activity. This is the technique that has been employed in this analysis. See Bronk Ramsey (2000) for details of the implementation.

In this case the prior distribution is derived from the sum of the probability distributions of all the dated events (Fig SS6.1). There are very few dated events before *c* 4000 cal BC or after *c* 1500 cal BC. Within this period, dated events are not distributed uniformly, but peak in the earlier fourth millennium and in the centuries around 2000 cal BC. Despite this, the dated events which fall into this period have been modelled as if they were distributed uniformly (Fig SS6.2). This does not in fact introduce any appreciable distortion, because the period is sufficiently long and the number of dated events sufficiently small that the model is robust against different assumptions about the distribution of dated events. For example, the model shown in Figures SS6.2 and SS6.4–11, where the Long Mound is part of a uniformly distributed phase of activity running from 4000 to 1500 cal BC, estimates that it was built in *3940–3780 cal BC* (*95% probability*; *Long Mound*; Fig SS6.4). If this monument is placed instead within a uniformly distributed phase of events dated between 5000 and 2500 cal BC then this estimate is *3940–3780 cal BC* (*95% probability*; distribution not shown), showing that the results are robust and rely more on data than assumptions.

SS6.6 Interpretation

SS6.6.1. Palaeochannels and valley bottom deposits

Peat and wood samples were used to date valley bottom and palaeochannel deposits and the pollen samples and sequences from them (Campbell and Robinson 2007; Brown

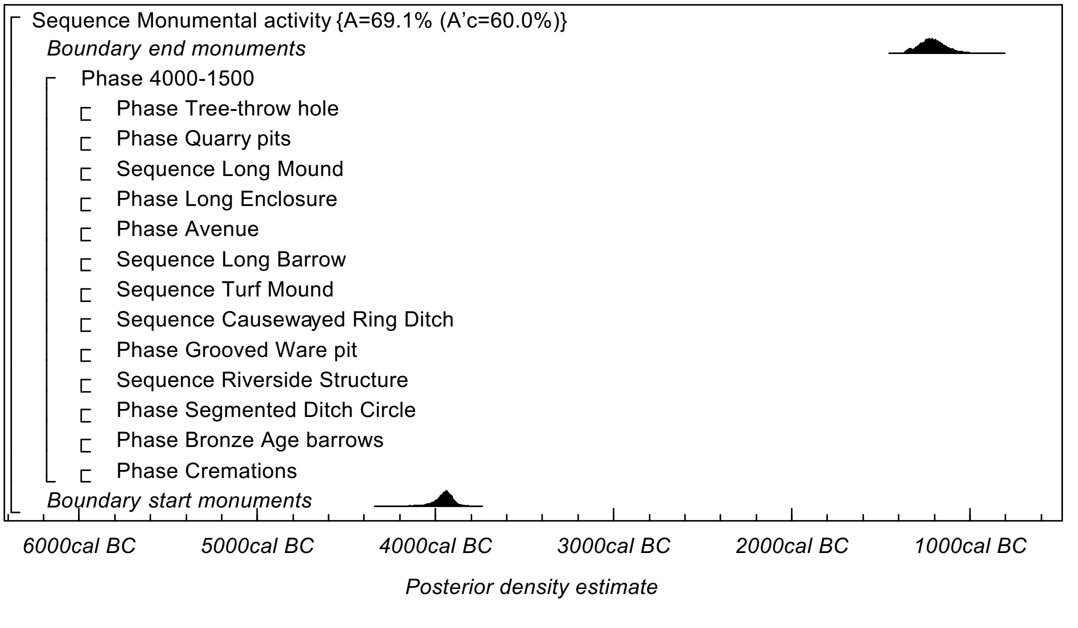


Figure SS6.2
Overall structure for the chronological model of activity dated to between c 4000 cal BC and c 1500 cal BC from the Raunds Area Project. The component sections of this model are shown in detail in Figures SS6.4–11. The large square brackets down the left hand side of these figures, along with the OxCal keywords, define the overall model exactly.

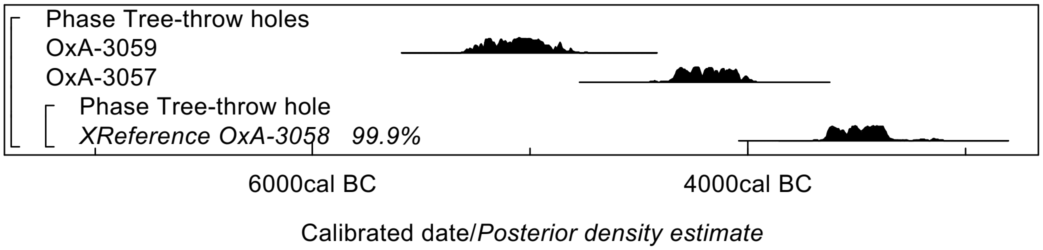


Figure SS6.3 Probability distributions of dates from treethrow holes in trench B140. Each distribution represents the relative probability that an event occurred at a particular time. The distributions for OxA-3057 *and* OxA-3059 *are the result of simple radiocarbon calibration (Stuiver and Reimer 1993). The distribution for OxA-3058 is a posterior density estimate derived from the model defined in Figure SS6.2. The format for this distribution is identical to that of Figure SS6.4*

The distributions represented are: OxA-3059 *short-life charcoal from upper fill of treethrow hole F62126,* OxA-3057 *short-life charcoal from bottom fill of treethrow hole F62123,* OxA-3058 Corylus/Alnus *sp charcoal from top fill of treethrow hole F62113*

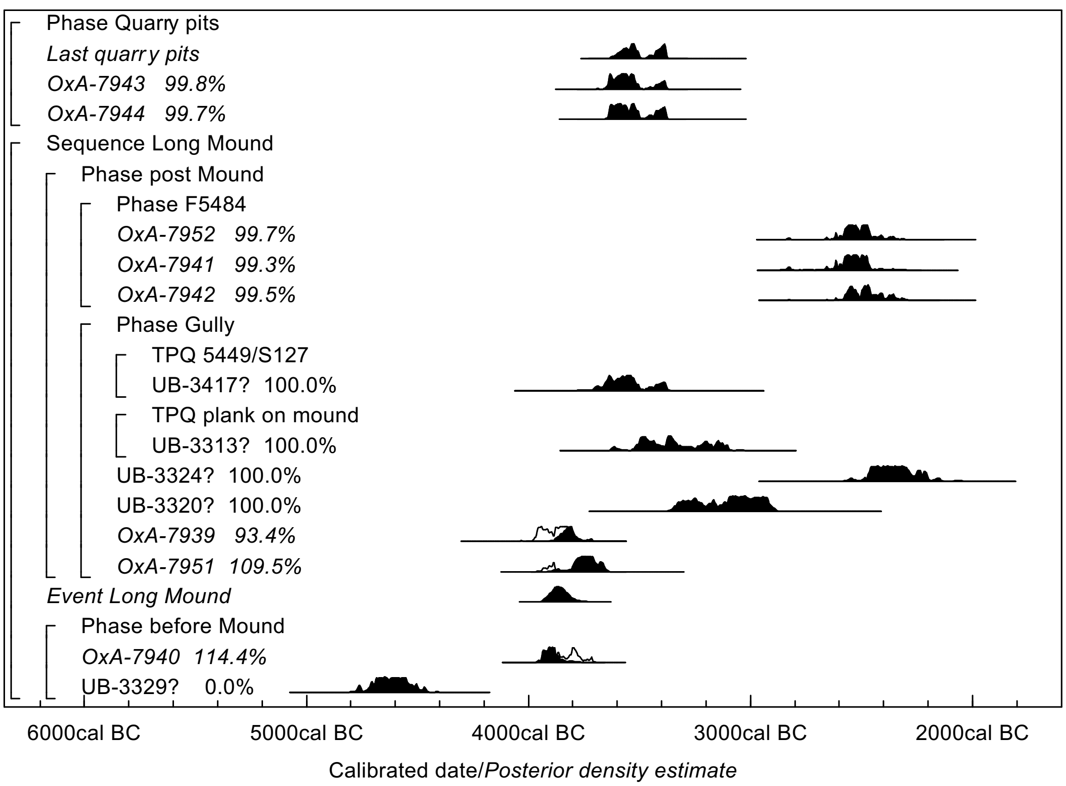


Figure SS6.4 Probability distributions of dates from the Long Mound and related features. Each distribution represents the relative probability that an event occurred at a particular time. For each radiocarbon date, two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and a solid one based on the chronological model used; the 'event' associated with, for example, OxA-7939, is the growth of the wood that was carbonised and dated. The other distributions correspond to aspects of the model. For example, the distribution 'Long Mound' is the estimated date for the construction of the monument, which must have been built at a point between the latest of the features sealed by the mound and before the earliest stakes that were driven into it. Measurements followed by a question mark have been excluded from the model for reasons explained in the text, and are simple calibrated dates (Stuiver and Reimer 1993).

The distributions represented are: UB-3329 charred Quercus *sp trunk fragments from F5488; OxA-7940* Quercus *sp sapwood charcoal from east end of mound; OxA-7951 and -7939* Quercus *sp sapwood charcoal from stakes set in gully cut into top of mound; UB-3320 and -3324* Corylus/Alnus *sp charcoal from stakes set in gully cut into top of mound; UB-3313 Quercus sp charcoal from 'plank' on east end of mound; UB-3417* Quercus *sp charcoal from west end of gully; OxA-7941, -7942, and -7952* Quercus *sp sapwood from wood burnt* in situ *on top of pit F5484; OxA-7944 and -7943 tuber and charred hazelnut shell from primary layer in F5263 in base of northern 'quarry pit'.*

and Keough 1992c, fig 18.3; Brown 2006). Channel incision in the late Devensian and early Flandrian (Harding and Healy 2007, panel 2.1) is indicated by SRR-3604 (11,850–11,100 cal BC; 95% confidence) and SRR-3605 (8790–8470 cal BC; 95% confidence) for the lowest and uppermost surviving organic fills in a palaeochannel section; by SRR-3610 (13,570–12,180 cal BC; 95% confidence); by SRR-3607a–b (11,200–10,700 cal BC; 95% confidence) from another palaeochannel section; and by HAR-9243 (9220–8260 cal BC; 95% confidence) for the basal fills of a palaeochannel in Trench B141. HAR-9243 also dates a single sample which contained waterlogged plant and insect remains (Robinson and Campbell SS4.3.2; Robinson SS4.3.3) and pollen (Brown and Keough 1992c, 188). The roots of an alder growing on the floodplain gravels are dated by SRR-3606 (4230–3800 cal BC; 95% confidence). In the channel which flowed past the West Cotton monuments, HAR-9241 provides a date of 3370–2470 cal BC (95% confidence) for sediments containing pollen, macroscopic plant remains and insect remains indicative of an environment which included a substantial amount of woodland (Robinson and Campbell SS4.3.2; Robinson SS4.3.3; Brown and Keough 1992c, 187–9). Further upstream, the base of a pollen sequence dominated by grasses with some scrub, in sediments which accumulated as the channel narrowed, is dated by HAR-9242 (170 cal BC–cal AD 240; 95% confidence).

SS6.6.2. Treethrow holes

Dates were obtained on samples from three out of some thirty-five treethrow holes excavated in trench B140. OxA-3059 from the upper fill of F62126 (5300–4800 cal BC; 95% confidence) and OxA-3057 from the bottom fill of F62123 (4360–3980 cal BC; 95% confidence) reflect the burning-out of dead trees at different times during the later Mesolithic (Fig SS6.3). In F62123 the location of the sample in the bottom fill of the treethrow hole makes it unlikely to have been redeposited. This conclusion is reinforced by association with a small blade-based flint industry, some pieces of which refitted, making them unlikely to have been much displaced. The soil of the hollow contained less translocated iron and clay than soils of later periods in the area and is likely to have formed in woodland (Macphail, SS4.8.2).

OxA-3058, from the burnt upper clay fill of F62113 (*3660–3330 cal BC at 95% probability*) suggests that trees were still being burnt out in the fourth millennium (Fig SS6.3). The soils here were more heavily burnt than in F62123 and had features characteristic of disturbance (Macphail, SS4.8.2). In trench B271, to the south-west, archaeomagnetic dating was attempted on unevenly magnetised burnt clay from a further treethrow hole (F60528). This suggested a Bronze Age date (Linford 1989). The long time-span for comparable activity in the immediate area means that undated man-made features in B140, often containing ash, charcoal or both, and undated treethrow holes there cannot be related to any particular episode.

SS6.6.3. The Long Mound

The dating of the Long Mound is unsatisfactory.

The mound

A *terminus post quem* for the construction of at least the western part of the mound is provided by UB-3329. The measurement was made on a bulk sample of charred oak trunk fragments from the upper fill of a pit (F5488) cut into the old land surface and sealed by the mound, and provides a date within the mid-fifth millennium cal BC (Table SS6.1). Another pit, close to this one (F5484) and also thought to be sealed by the mound, was capped by four large pieces of carbonised wood which seemed to have been burnt *in situ* in the top of it, in an area riddled with rabbit burrows. Three single fragments of oak sapwood yielded measurements (OxA-7941, -7942, -7952) which are statistically consistent ($T'=0.5$, $T'(5\%)=6.0$, $\nu=2$). The *in situ* burning suggests that the samples were contemporary with their context, yet they date to the mid-third millennium cal BC (Table SS6.1).

A *terminus post quem* for the building of the east end of the mound, which was of different construction and perhaps of different date from the west and centre, is provided by *OxA-7940*, an early fourth millennium date on a single fragment of oak sapwood from the body of the mound. Where sherds from any part of the mound can be identified they are of plain Neolithic Bowl or are indeterminate crumbs.

A plank on the surface of the east end of the mound also provided a measurement which calibrates to the fourth millennium (UB-3313).

UB-3329 and OxA-7940 seem to provide reliable *termini post quos* for the initial

Table SS6.1. Radiocarbon age determinations

Site	*Sample reference*	*Phase*	*Context*	*Description*	*Laboratory number*	*$\delta^{13}C$ (‰)*	*Radiocarbon age (BP)*	*Weighted mean (BP)*	*Calibrated date range (95% confidence)*
'Upstream site' Irthlingborough island, SP 965 720	RS01			Organic silt on bed of palaeochannel	SRR-3604	-28.6	11,395±55		11,850–11,100 cal BC
'Upstream site' Irthlingborough island				Uppermost preserved organic fills of channel base of which is dated by SRR-3604	SRR-3605	-28.5	9375±40		8790–8470 cal BC
'Upstream site' Irthlingborough island	RS03			Rootwood of *Betula* sp or *Alnus glutinosa* growing into top of gravels, overlain by finer alluvium	SRR-3606	-28.9	5195±65		4230–3800 cal BC
'Downstream site', SP 972 725	RS04			Well humified peat from top of eroded palaeochannel fill in cross-bedded gravel near base of floodplain sequence. 'Humic' carbon	SRR-3607a	-29.3	10,870±55	10920±39 (T'=1.7, T'(5%)=3.8, ν=1)	11,200–10,700 cal BC
'Downstream site'	RS04			As SRR-3607a. 'Humin' carbon	SRR-3607b	-29.7	10,970±55		
'Downstream site'	RS07			Organic-rich sediment at base of eroded palaeochannel infill located within basal gravel units	SRR-3610	-29.7	12,420±60		13570–12180 cal BC
'Downstream site'	RS05			Rootwood, posibly *Alnus glutinosa*, in disturbed upper layers of basal gravel unit	SRR-3808	-28.6	3840±50		2470–2140 cal BC
Palaeochannel E, Irthlingborough island	AML 881264			Trench B141, peat from basal fills of channel	HAR-9243	-31.6	9370±170		9220–8260 cal BC
Palaeochannel C, West Cotton	AML 881262			Peat containing wood and other plant macrofossils (NGR SP 975 728)	HAR-9241	-31.6	4300±150		3370–2470 cal BC
Palaeochannel D, trench B139	AML 881263			Trench B139, peat from bed of West Cotton channel	HAR-9242	-29.9	1970±80		170 cal BC –cal AD 240
Treeholes	291-33044		62114	*Corylus*/*Alnus* sp charcoal (Gill Campbell) from top fill of treehole F62113 in trench B140	OxA-3058	-25.7	4700±80		3650–3340 cal BC
Treeholes	291-33037		62127	Charcoal of short-lived species, ie not oak etc (Gill Campbell) from upper fill of treehole F62126 in trench B140	OxA-3059	-26.6	6130±80		5300–4800 cal BC
Treeholes	291-33047		62140	Charcoal of short-lived species (Gill Campbell) from bottom fill of treehole F62123 in trench B140	OxA-3057	-26.6	5370±80		4360–3980 cal BC
Long Mound	WC85-S139	1	5460	*Quercus* sp charcoal from trunk fragments (Gill Campbell) within pit F5488 beneath W end of Long Mound	UB-3329	-24.8±0.2	5767±58		4780–4460 cal BC
Long Mound	S27/2061	3.2	2061	Charcoal from mound. *Quercus* sp sapwood (Rowena Gale)	OxA-7940	-24.7	5035±30		3950–3710 cal BC
Long Mound	WC85-S28	3.3	2062	*Quercus* sp charcoal (Gill Campbell) from 'plank' on surface of mound at east end	UB-3313	-26.1±0.2	4602±72		3630–3090 cal BC
Long Mound	WC85-S127	4.2	5449	*Quercus* sp charcoal fragments from west end of gully cut into top of mound. (Gill Campbell)	UB-3417	-24.60±0.2	4795±71		3710–3370 cal BC
Long Mound	S25/990	4.3	990	*Quercus* sp sapwood charcoal (Rowena Gale) from charred stake in gully F938 cut into top of mound	OxA-7939	-24.9	5090±45		3980–3770 cal BC
Long Mound	S26/990	4.3	990	Charred *Quercus* sp sapwood (Rowena Gale) from stake in gully F938 cut into top of mound	OxA-7951	-24.4	4970±50		3940–3640 cal BC
Long Mound	WC85-S20	4.3	990	*Corylus*/*Alnus* sp charcoal from stake within east end of gully F938 cut into top of mound. 20 years growth, rootlet penetration (Gill Campbell/ Mark Robinson).	UB-3324	-26.1±0.2	3883±58		2560–2140 cal BC
Long Mound	WC85-S24	4.3	990	*Corylus*/*Alnus* sp charcoal, 10-20 years growth (Gill Campbell) from stake in east end of gully F938 cut into top of mound	UB-3320	-27.2±0.2	4417±75		3360–2880 cal BC
Long Mound	WC85-850/ 5261	4.4.iN	5261	Tuber from 'quarry pit' F5263 alongside monument. *Arrhenatherum elatius* ssp *bulbosum* (Gill Campbell)	OxA-7944	-26.1	4750±45		3650–3370 cal BC

Table SS6.1. Continued.

Site	*Sample reference*	*Phase*	*Context*	*Description*	*Laboratory number*	*δ¹³C (‰)*	*Radiocarbon age (BP)*	*Weighted mean BP*	*Calibrated date range (95% confidence)*
Long Mound	WC85-874/ 5261	4.4.iN	5261	Charred hazelnut shell fragment from 'quarry pit' F5263 alongside monument. *Corylus* sp nut shell fragments (Gill Campbell)	OxA-7943	-23.9	4770±45		3650–3370 cal BC
Long Mound	S133/5456	5	5456	*Quercus* sp sapwood charcoal (Rowena Gale) from group of charred wood fragments apparently burnt *in situ* in top of F5484 in disturbed area beneath W end of mound	OxA-7942	-24.2	3970±45		2620–2340 cal BC
Long Mound	S136/5456	5	5456	*Quercus* sp sapwood charcoal (Rowena Gale) from group of charred wood fragments apparently burnt *in situ* in top of F5484 in disturbed area beneath W end of mound	OxA-7941	-23.7	4015±45		2830–2460 cal BC
Long Mound	S134/5457	5	5457	*Quercus* sp sapwood charcoal (Rowena Gale) from group of charred wood fragments apparently burnt in situ in top of F5484 in disturbed area beneath W end of mound	OxA-7952	-24.8	3995±50		2660–2350 cal BC
Avenue	291-99156		87502	Charred hazel nut shell (Gill Campbell) from F87501 of Avenue	OxA-7868	-24.4	4970±45		3940–3650 cal BC
Avenue	291-99158		87507	Charred tubers (Gill Campbell) from F87506 of the southern Avenue	OxA-7867	-27.2	5325±50		4330–3990 cal BC
Avenue	291-99251		87569	*Quercus* sp charcoal (Gill Campbell), recorded in field as single piece, *c* 100 mm x 60 mm, from F87566 of southern Avenue.	GU-5319	-24.6	4990±110		4040–3530 cal BC
Avenue	291-99228		87648	*Quercus* sp (Gill Campbell), recorded in field as single piece *c* 70 mm x 60 mm, from F87647 of southern avenue	GU-5318	-23.7	5090±60		4040–3710 cal BC
Segmented ditch circle	291-91806	3	87580	Red deer antler (Simon Davis) from bottom fill of pit F87581 of segmented ditch-circle	GU-5317	-22.9	3560±70		2140–1690 cal BC
Segmented ditch circle	291-91805	3	87640	Red deer antler (Simon Davis) from interface of primary and overlying fills in pit F87641 of segmented ditch-circle	GU-5316	-22.6	3570±70		2140–1690 cal BC
Segmented ditch circle	291-99196	4	87556	Tuber from main fill of pit F87555. *Arrhenatherum elatius* spp *bulbosum* (Gill Campbell)	OxA-7907	-24.6	5750±45		4770–4460 cal BC
Segmented ditch circle	291-99191	4	87560	Tuber from main fill of pit F87559. *Arrhenatherum elatius* spp *bulbosum* (Gill Campbell)	OxA-7958	-27.8	5455±70		4460–4050 cal BC
Segmented ditch circle	291-99206	4	87595	*Corylus* sp nut shell fragment (Gill Campbell), one of two from cremation pit F87594	OxA-7906	-23.1	8715±60		8160–7590 cal BC
Long barrow	233	1	233	Weathered human long bone from cist fill 233(1) (Angela Boyle)	OxA-5632	-20.2	4825±65	4823±50 T'=0.0, T'(5%)=3.8, ν =1)	3710–3510 cal BC
Long barrow	233	1	233	Weathered human long bone from cist fill 233(1) (Angela Boyle)	OxA-5633	-20.5	4820±80		
Long barrow	ST 239	1	239	*?Cervus elaphus* humerus (Simon Davis) from pit fill 239(1)	OxA-5551	-21.6	2655±55		910–760 cal BC
Long barrow	ST128	2.2.i	226	Waterlogged seeds from top of organic ditch fill 226 in barrow quarry ditch 226. 12 species identified, submerged aquatics excluded (Mark Robinson)	OxA-3001	-26 assumed	4810±80		3760–3370 cal BC
Long barrow	ST131	2.2.i	229	Waterlogged seeds at base of organic ditch fill. 13 species identified, submerged aquatics excluded (Mark Robinson)	OxA-3002	-26 assumed	4560±140		3650–2890 cal BC
Long barrow	250, 32	2.2.i	226	*Quercus* sp woodchip from dump of wood working debris within context 226, near bottom of southern barrow ditch, F303; toolmarks match worn edge of flint axe from same ditch. *Quercus* sp sapwood (Mark Robinson)	OxA-6406	-27.4	4960±45		3910–3640 cal BC
Riverside Structure	WC 7109 CAS		7109	*Castor fiber* femur in deposits postdating Riverside Structure (U Albarella)	OxA-4740	-21.8	2900±60		1300–910 cal BC

Table SS6.1. Continued.

Site	*Sample reference*	*Phase*	*Context*	*Description*	*Laboratory number*	*δ¹³C (‰)*	*Radiocarbon age (BP)*	*Weighted mean BP*	*Calibrated date range (95% confidence)*
Long barrow	250, 35	2.2.i	226	*Quercus* sp woodchip from dump of wood working debris within context 226, near bottom of southern barrow ditch; toolmarks match worn edge of flint axe from same ditch. *Quercus* sp sapwood (Mark Robinson)	OxA-6405	-26.5	5005±50		3960–3660 cal BC
Long barrow	ST140	2.2.i	226	Outer rings of *Quercus* sp plank (Mark Robinson) from within context 226, near bottom of southern barrow ditch, F303. Residue identified as sapwood by Rowena Gale	OxA-3003	-26 assumed	4790±90		3760–3360 cal BC
Long barrow	168, 276	2.2.ii	168	*Alnus glutinosa* root cluster (Mark Robinson) growing into fills of southern barrow ditch F303	OxA-6403	-27	3610±80		2200–1740 cal BC
Long barrow	185, 284	2.2.ii	168	*Alnus glutinosa* root cluster (Mark Robinson) growing into fills of southern barrow ditch F303	OxA-6404	-28.4	3685±65		2290–1880 cal BC
Long barrow	Skel 130	3.2	130	Adult ?male human femur, tibia, fibula + pelvis (Angela Boyle) from burial	OxA-5549	-20.9	3665±45		2200–1890 cal BC
Long barrow	Skel 131	3.2	131	Collagen from adult female human femur and tibia (Angela Boyle) from burial with Beaker	BM-2833	-21.4	3450±45		1890–1630 cal BC
Long barrow	Skel 131	3.2	131	Disarticulated subadult humeral diaphysis (Angela Boyle) from same grave as articulated skeleton dated by BM-2833	OxA-5550	-21.8	3730±45		2290–1980 cal BC
Long barrow	ST 126	3.3	208	*Quercus* sp charcoal (Mark Robinson) associated with cremation outside NE end of barrow	OxA-2989	-27.2	3320±80		1860–1420 cal BC
Turf Mound	WC85-S98	3.2	6302	*Quercus* sp charcoal fragments (Gill Campbell) from gully F6303 cut into top of N end of mound, close to stake dated by UB-3314 and possibly derived from it	UB-3317	24.8±0.2	4873±56		3770–3530 cal BC
Turf Mound	WC85-S99	3.2	6302	Charred *Quercus* sp stake c 80 mm diameter (Gill Campbell) from gully F6303 cut into top of N end of mound.	UB-3314	-24.1±0.2	4937±56		3910–3640 cal BC
Turf Mound	S97/6302	3.2	6302	Charred *Corylus* sp root (Gill Campbell) from gully F6303 cut into the top of N end of mound.	OxA-7945	-23.9	5035±35*		3950–3700 cal BC
Turf Mound	S100/6361	3.2	6361	Charred *Corylus* sp root (Gill Campbell) from gully F6366 cut into top of N end of mound.	OxA-7865	-24.3	4975±35*		3910–3660 cal BC
Turf Mound	S90/6053	4.2	6053	*Corylus* sp charcoal (Gill Campbell) from 'plank' in pit F6047 under S end of mound	OxA-8017	-25.8	3920±30*	3895±21 (T'=1.4, T'(5%)=3.8, ν =1)	2470–2290 cal BC
Turf Mound	S90/6053	4.2	6053	*Corylus* sp charcoal (Gill Campbell) from 'plank' in pit F6047 under S end of mound	OxA-7947	25.7	3870±30*		
Long Enclosure	WC85-S32		2102	Proximal cattle tibia (Simon Davis) from primary fill of ditch, *c* 0.15m above base	UB-3308	-28.4±0.2	4278±156		3360–2460 cal BC
Long Enclosure	WC85-S56		2102	Red deer antler rake within primary fill of ditch, *c* 0.10m above base. Shed and worked antler (Simon Davis).	UB-3312	-23.5±0.2	4411±77		3360–2880 cal BC
Causewayed Ring-ditch	291-33421		38317	*Alnus*/*Corylus* sp charcoal (Gill Campbell) from primary silt of N terminal	OxA-3055	-23.4	4480±70		3370–2910 cal BC
Causewayed ring-ditch	291-55374		38387	*Corylus* sp charcoal (Gill Campbell) from primary silt	OxA-7904	-23.8	4505±45		3370–3020 cal BC
Causewayed Ring-ditch	291-55372		38100	Red deer antler tine (Simon Davis), part of fragmentary antler implement lying beside antler pick in recut in S terminal of ditch	OxA-3121	-23	4450±90		3490–2880 cal BC
Minor features	291-33382		31821	Hazelnut shells (Gill Campbell) from fill of pit F31820, which contained Grooved Ware	OxA-3056	-24.3	4210±70		2920–2580 cal BC

Table SS6.1. Continued.

Site	*Sample reference*	*Phase*	*Context*	*Description*	*Laboratory number*	*δ^{13}C (‰)*	*Radiocarbon age (BP)*	*Weighted mean BP*	*Calibrated date range (95% confidence)*
Riverside Structure	WC85-U7135		7135	*Corylus/Alnus* sp wood within gravel beneath brushwood. (Gill Campbell).	UB-3419	-29.0±0.2	4268±32		2920–2870 cal BC
Riverside Structure	WC85-S163		7141	*Fraxinus* sp wood from regularly-laid poles at base of brushwood layer between W ends of main alder trunks. Outer rings available *c* 10 years (Gill Campbell)	UB-3321	-27.7±0.2	4062±54		2830–2340 cal BC
Riverside Structure	WC85-S146		6765/7118	Wood from main trunk of Riverside structure. *Corylus/Alnus* sp, ? >50 years (Gill Campbell)	UB-3319	-29.2±0.2	3990±54		2560–2140 cal BC
Riverside Structure	WC 7109 CAS		7109	*Castor fiber* femur in deposits postdating Riverside Structure (U Albarella)	OxA-4740	-21.8	2900±60		1300–910 cal BC
Barrow 1	291-6410	2.1	30476	Human bone from adult male (Janet Henderson) from primary Beaker burial in grave F30426	UB-3148	-21.0±0.2	3681±47		2200–1920 cal BC
Barrow 1	291-11439	2.1	30467	*Quercus* sp sapwood (Rowena Gale) from chamber or coffin enclosing primary Beaker burial in grave F30426	OxA-7902	-25.1	3775±45		2400–2030 cal BC
Barrow 1	291-35126	2.1	30481	Boar's tusk (Andrew Foxon), one of grave goods accompanying primary Beaker burial in grave F30426	OxA-4067	-22.4	4100±80		2890–2460 cal BC
Barrow 1	291-34873R	2.2	30417	R aurochs second molar, ?upper (Simon Davis) from bone cairn overlying Beaker burial, forming part of same find as sample for OxA-2086, with other teeth and a horncore all from domestic cattle	OxA-2085	-21.0 assumed	4040±80		2880–2340 cal BC
Barrow 1	291-34873L	2.2	30417	L aurochs second molar, ?upper (Simon Davis) from bone cairn overlying Beaker burial, forming part of same find as sample for OxA-2087, with other teeth and a horncore all from domestic cattle	OxA-2086	-21.0 assumed	3810±80		2470–1980 cal BC
Barrow 1	291-34628R	2.2	30417	Upper R cattle molar (Simon Davis) from badly preserved skull in bone cairn overlying Beaker burial	OxA-2084	-21	3610±110		2290–1680 cal BC
Barrow 1	291-35082R	2.2	30417	Upper R cattle molar (Simon Davis) from badly preserved skull in bone cairn overlying Beaker burial	OxA-2087	-21.0 assumed	3810±80		2470–1980 cal BC
Barrow 1	291-6409	3.3	30470	Human bone of adult male (Janet Henderson) from secondary inhumation F30449	UB-3147	-22.1±0.2	3504±38		1940–1690 cal BC
Barrow 1	291-6400	3.3	30018	Cremated bone from deposit combining ?male of 20–40 yr and child of c 13–14 yr (Simon Mays), accompanied by early Bronze Age urn, dagger with horn hilt, antler pommel, bone pin	GrA-22378[1]		3520±40		1950–1730 cal BC
Barrow 1	291-11076	8.3	30031	Charred *Arrhenatherum* sp tubers (Gill Campbell) from cremation F30030 cut into silted middle ditch	OxA-3089	-26 assumed	2950±50		1370–1000 cal BC
Barrow 1	291-11256	8.3	30309	Indet. tuber fragments (Gill Campbell) from lower fill of cremation pit F30307, outside outer ditch	OxA-7948	-25.4	3005±35		1390–1120 cal BC
Barrow 3	291-33027	1	39107	*Quercus* sp charcoal (Gill Campbell) from fill of posthole F39107 cut into fill of pit F39102	OxA-3051	-22.9	3590±70		2140–1740 cal BC
Barrow 3	291-33008	5.1	30738	*Rhamnus catharticus* charcoal (Gill Campbell) from spread in fill of second ditch	OxA-7903	-25.1	3650±45		2140–1880 cal BC
Barrow 3	291-33008	5.1	30738	*Prunus* sp charcoal (Gill Campbell) from spread in fill of second ditch	OxA-7949	-24.5	3610±40		2130–1820 cal BC
Barrow 4	291-33478		60315	Oak charcoal (Gill Campbell) from 'plank' within barrow mound	OxA-3053	-25.1	3530±70		2110–1680 cal BC
Barrow 4	291-33467		60312	Charred tubers (Gill Campbell) from cremation in barrow mound	OxA-3052	-22.5	3450±70		1940–1530 cal BC

Table SS6.1. Continued.

Site	*Sample reference*	*Phase*	*Context*	*Description*	*Laboratory number*	*δ¹³C (‰)*	*Radiocarbon age (BP)*	*Weighted mean BP*	*Calibrated date range (95% confidence)*
Barrow 5	291-33308		47085	Highly burnt twigs (Gill Campbell) associated with cremation in F47087 between inner and outer ditches.	OxA-3054	-24.6	4460±70		3370–2910 cal BC
Barrow 5	291-55243		47181	Tibia, large artiodactyl (Simon Davis) from pit F47168 cutting barrow mound.	OxA-7950	-21.3	3625±40	3633±37 (T'=0.3, T'(5%)=3.8, ν =1)	2140–1880 cal BC
Barrow 5	291-55243		47181	Tibia, large artiodactyl (Simon Davis) from pit F47168 cutting barrow mound.	OxA-3120	-22.9	3680±100		
Barrow 6	WC85-U3390	1.1	3390	Disarticulated human bone from 2 adults (1 male, 1?male) (Simon Mays) in pit F3390 beneath Beaker burial	UB-3310	-21.1±0.2	4500±33		3360–3030 cal BC
Barrow 6	WC85-F3259	1.2	3259	Human bone from adult male (Simon Mays) in central Beaker burial beneath barrow mound	UB-3311	-22.3±0.2	3608±41		2130–1820 cal BC
Barrow 6	WC85-S47	7	3206	Charcoal fragments, oak mainly, no twiggy material (Gill Campbell) from cremation F3206 inserted into silted outer ditch	UB-3315	-27.0±0.2	3347±54		1750–1510 cal BC
Barrow 6	S53 (3224)	7	3224	Pomoideae type charcoal (Gill Campbell) from stakehole in cremation pit F3219 cut into silted outer ditch.	OxA-7866	-23.9	3610±40		2130–1820 cal BC
Barrow 9	Skel 747	1.1	750	Human femur, tibia, fibula (R+L) (Angela Boyle) from adult male inhumation in grave F727	OxA-5544	-21.1	3750±55	3688±35 (T'=2.2, T'(5%)=3.8, ν =1)	2200–1950 cal BC
Barrow 9	Skel 747	1.1	750	Human femur, tibia, fibula (R+L) (Angela Boyle) from adult male inhumation in grave F727	OxA-5543	-21.4	3645±45		
Barrow 9	Skel 732	1.4	726	Human femur, tibia, fibula, radius ulna, humerus (R+L) (Angela Boyle) from child inhumation in grave F725	OxA-5547	-21.7	3495±40	3496±35 (T'=0.0, T'(5%)=3.8, ν =1)	1920–1690 cal BC
Barrow 9	Skel 732	1.4	726	Human femur, tibia, fibula, radius, ulna, humerus (R+L) (Angela Boyle) from child inhumation in grave F725	OxA-5548	-21.6	3500±70		
Barrow 9	Skel 737	1.4	730	Human femur, tibia, fibula (R+L) (Angela Boyle) from child inhumation in grave F729	OxA-5546	-21.1	3615±45	3657±30 (T'=1.5, T'(5%)=3.8, ν =1)	2140–1920 cal BC
Barrow 9	Skel 737	1.4	730	Human femur, tibia, fibula (R+L) (Angela Boyle) from child inhumation in grave F729	OxA-5545	-21.4	3690±40		
Barrow 9	Skel 751	1.4	742	Human femora, humeri and tibia (Angela Boyle) bone from child inhumation accompanied by Beaker in grave F741	BM-2866	-21.6	3610±50		2140–1780 cal BC
Field Systems, etc	291-80523		85061	*Fraxinus* sp charcoal (Gill Campbell) from posthole F85059 forming part of fence-line next to hut	GU-5320	-24.6	2990±50		1390–1040 cal BC
Field Systems, etc	291-80522		85107	*Triticum dicoccum* grain (Gill Campbell) from top fill of posthole F85106 of fence associated with Bronze Age hut	OxA-7946	-21.4	2795±40		1050–830 cal BC
Field Systems, etc	291-80522		85107	*Triticum dicoccum* grain (Gill Campbell) from top fill of posthole F85106 of fence associated with Bronze Age hut	OxA-7905	-22.8	2815±40		1110–830 cal BC

[1]GrA-22378 was received after the chronological model was completed, and is not incorporated in it.

* = double-precision run

construction of the mound. The consistency of the results from the top of pit F5484 suggests that these samples relate to a single event, but not one which pre-dates the mound. Later disturbance was noted in the immediate area, and it seems likely that the dated wood was burnt in the base of a mid-third millennium cut, obscured by the rabbit warren which occupied this area (Fig SS1.21). The plank, UB-3313, unfortunately consisted of oak charcoal of unknown maturity and so this measurement cannot be used as a *terminus ante quem* for the construction of the long mound. Since it was a plank, it may also have been reused.

The gully

The gully cut into and surrounding the top of the entire mound contained much burnt material, all of it stratigraphically later than samples in and under the mound. Five radiocarbon measurements have been made on charcoal from this feature: three fall in the earlier part of the fourth millennium cal BC (UB-3417, OxA-7939, -7951), and two wholly or partly in the third (UB-3320, -3324). UB-3417 was a bulked sample of oak charcoal from the west end of the gully, the other four samples were charred stakes inserted into the east end, all of them approximately 80mm in diameter and of short-lived charcoal. The samples for UB-3320 and -3324 were of hazel or alder of up to twenty years growth. That for UB-3324, although broken, seemed to consist of a single piece of wood; that for UB-3320 consisted of many fragments, which were less obviously from a single object. The samples for OxA-7939 and -7951 were single fragments of sapwood from oak stakes.

The five measurements from the gully are not statistically consistent (T'=299.6, T'(5%)=9.5, ν=4). They cover well over a thousand years.

The bulked sample for UB-3417 is particularly likely to be of different age from its context, since it consisted of oak fragments of unknown maturity which did not have any functional coherence and so may not all have been of the same age. It thus differs from the other samples from the gully which all came from charred stakes. However, it is short-lived, apparently *in situ*, stakes which provide the earliest and the latest dates from the gully (Fig SS6.4: OxA-7939, UB-3324). The two measurements on single fragments of oak sapwood are statistically consistent (T'=3.2, T'(5%)=3.8, ν=1), and are rather earlier than all three conventional dates. The conventional dates are widely scattered (T'=103.0, T'(5%)=6.0, ν=2), which may suggest that the samples, which consisted of more than a single fragment of charcoal, contained material of differing ages. Rootlet penetration is ubiquitous in temperate climates, and was particularly noted during the selection of the sample for UB-3324. It may be no coincidence that this sample provided the latest date. The stakes were driven into fills which already contained much charred material, not all of which burnt *in situ*, and which directly underlay Saxon and medieval soils, so that intrusive as well as redeposited charcoal could easily have been present, especially given the level of worm-, mole-, and rabbit-activity in the soft, fine-grained deposits. It is pertinent that charred cereal grains of varieties likely to have derived from overlying Saxon and medieval contexts were found in features under the mound and in the mound itself (Campbell SS4.5.3). In these difficult circumstances, several interpretations are possible, none of them completely satisfactory:

1. The whole stake samples (UB-3320, -3324) may have included some fragments derived from overlying deposits. The AMS results on single sapwood fragments are, on the other hand, reliable measurements on *in situ* stakes in the gully.

In this case, the model shown in Figure SS6.4 estimates the date of construction for the mound to be *cal BC 3940–3780 at 95% probability; Long Mound*. The gully may have been used for a relatively short period of time in the early fourth millennium, with later activity evidenced by the 'quarry pits', artefacts from superficial contexts, and the pit cut through the mound (F5484).

2. All the stake samples came from stakes, which were inserted into the gully and burnt there over more than a millennium.

In this case, the estimated construction date of the mound is unaltered but its use lasted for well over a millennium, until *cal BC 2500–2190 at 94% probability*, the date of the latest stake (*UB-3324*). If, however, this sample was contaminated by the noted rootlet penetration, then the activity may only have lasted until *cal BC 3340–2900 at 95% probability* (*UB-3320*).

3. On the premise that a context dates to the latest material recovered from it, UB-3324 dates the gully. This interpretation demands that the measurements on other apparently *in situ* stakes (OxA-7939, -7951, UB-3320) were made on redeposited fragments of charcoal. Part or all of each sample

may not have come from the stake itself, and may have derived from the surrounding fill of the gully.

In this case, it is possible that the gully was not cut until *cal BC 2500–2190 at 94% probability* (*UB-3324*), and the construction of the mound could have occurred at any point during the fourth or earlier third millennia.

The model shown in Figure SS6.4 adopts the first interpretation because this seems the most plausible. The hypothesis that the conventional samples contained intrusive material also explains why the AMS measurements, which came from different stakeholes, should be statistically consistent while the conventional measurements are not.

The possibility that such stakes may have been reused is remote, and it is difficult to see how poles could have remained usable after more than 500 years. Because of the fragility of charred wood, it is also difficult to see how the stakes could be other than *in situ*.

The 'quarry pits'

The flanking 'quarry pits' were not sealed by the mound, and, on stratigraphic grounds, may have been cut at any time in its history. The available measurements are for a single context from one of the pits in the base of the northern hollow. This was a layer against and primary to the north side of F5263, which contained charcoal, burnt pebbles and a concentration of Ebbsfleet Ware and plain sherds in comparable fabrics. This layer seemed to be a coherent deposit, unlike the more artefact- and charcoal-poor silts filling the rest of the hollow. The short-life samples on which OxA-7943 and -7944 were made make them likely to be close in age to their context. This is supported by the fact that the measurements are statistically consistent ($T'=0.1$, $T'(5\%)=3.8$, $\nu=1$). On the basis of the latest material within this deposit, the date of F5263 is *3620–3490 cal BC at 59% probability* or *3460–3370 cal BC at 37% probability* (*quarry pits*; Fig SS6.4). The overlying fills of the main hollow may, on the evidence of their contained pottery, have continued to accumulate into the early Bronze Age.

The relation of the 'quarry pits' to the mound depends on the dates of the mound and the gully.

SS6.6.4. The Avenue and the Segmented Ditch Circle

Samples were submitted from four separate components of the southern alignment of the Avenue. Two single pieces of charred oak from comparable positions in the burnt upper fills of the continuous south-west section yielded statistically consistent early fourth millennium dates (GU-5318, -5319). A charred hazelnut shell from the north-east end of the alignment provided a third consistent measurement (OxA-7868; $T'=2.6$, $T'(5\%) = 6.0$, $\nu=2$).

Charred tubers from a third feature provided a fifth-millennium date (OxA-7867). Two more tubers, from the main fills of the Segmented Ditch Circle at points where it cut the south-west end of the Avenue, were also dated to the fifth millennium (OxA-7907, -7958).

The character and history of the monument can be interpreted only tentatively, which makes the taphonomy of the samples uncertain. If the dated material represents a unitary monument, then, on the grounds that the latest measurements should be closest to the event, the model provides an estimated date for construction of *3860–3620 cal BC at 92% probability* (*Avenue;* Fig SS6.5). Whether this estimate relates to the construction or demolition of the monument depends on the archaeological interpretation of the taphonomy of the dated material. Also, it assumes that the monument was built and used as a whole, rather than formed of piecemeal accretions.

The three measurements on charred tubers are not statistically consistent ($T'=41.8$, $T'(5\%)=6.0$, $\nu=2$). They do, however, point to activity in the area during the fifth millennium cal BC. There are two

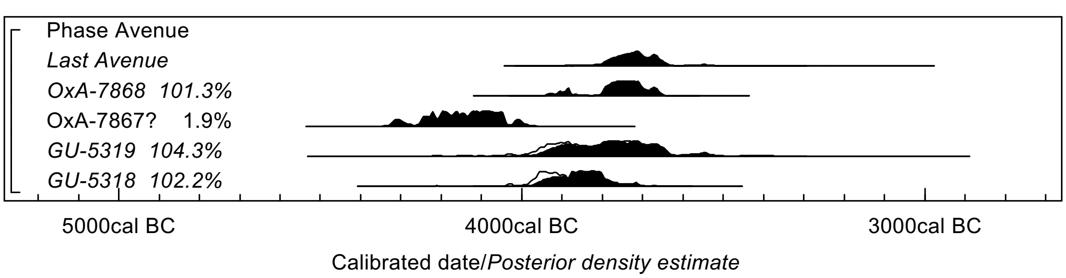


Figure SS6.5 Probability distributions of dates from the Avenue. The format is identical to that of Figure SS6.4.

The distributions represented are: GU-5318 Quercus *sp charcoal from F87647; GU-5319* Quercus *sp charcoal from F87566;* OxA-7867 *charred tubers from F87506; OxA-7868 charred hazelnut shell from F87501.*

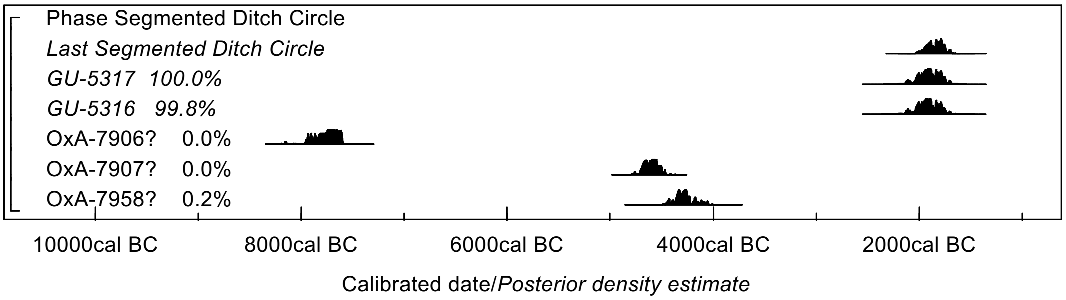


Figure SS6.6 Probability distributions of dates from the Segmented Ditch Circle. The format is identical to that of Figure SS6.4.

The distributions represented are: OxA-7958 *and* -7907 *charred tubers from primary silt;* OxA-7906 *charred* Corylus *sp nutshell fragment from cremation F87594; GU-5316 and -5317 red deer antlers from within and on surface of primary silts in F87581 and F87641.*

possibilities: either this relates to vegetation burning prior to the construction of the monument, or the Avenue itself has a fifth millennium origin and the fourth millennium material relates to its later development or destruction.

The tubers from the Segmented Ditch Circle are undoubtedly redeposited, as the construction of the monument is provided by two statistically consistent measurements on red deer antlers, from the bottom fill of one segment and the surface of the primary fill of another (GU-5316, -5317, T'=0.0, T'(5%)=3.8, ν=1). The estimated date for the construction of the circle is *2020–1680 cal BC at 95% probability* (*Segmented Ditch Circle;* Fig SS6.6). The location of the Segmented Ditch Circle on the end of the Avenue indicates that the earlier monument had remained visible, if only as a depression.

The dated hazelnut shell from a cremation deposit inside the Segmented Ditch Circle is also residual, and points to activity in the area in the eighth millennium cal BC (OxA-7906).

SS6.6.5. The Long Barrow

Fragments probably from a single human long bone, found in a limestone cist at the tail of the barrow, may predate their context, since the bone was disarticulated. Measurements on one of the fragments (OxA-5632, -5633) are statistically consistent (T'=0.0, T'(5%) = 3.8, ν=1). The cist probably predated the mound because it was built on the old land surface, although so little of the mound survived at this point that certainty is impossible. Waterlogged fills immediately above the primary silts of the ditches are bracketed by measurements on seeds from the lowest and topmost layers (OxA-3001, -3002). A plank and woodchips, almost certainly generated during the construction of the wooden revetment of the mound (OxA-3003, -6045, -6046), were preserved in the same layer as the sample for OxA-3001. Axe marks on the dated woodchips precisely fitted the cutting edge of a flint axehead recovered higher up in the ditch fills. The dated woodchip samples were of sapwood, but none retained bark.

The model for the chronology of the Long Barrow is shown in Figure SS6.7. This incorporates the stratigraphic order of the samples and shifts the probability distributions of the dates of the woodchips by an estimate of the number of sapwood rings which were missing from the dated samples. The distribution of the number of sapwood rings used is that of Hillam *et al* (1987) which has been derived empirically from the surviving number of sapwood rings on timbers with bark edge dated by dendrochronology in England. This has the effect of making the calibrated dates slightly younger than they otherwise would be. This model estimates that the construction of the Long Barrow occurred in *3800–3640 cal BC at 95% probability* (*Long Barrow*; Fig SS6.7). It must be remembered, however, that the façade, which preceded the revetment of the mound and is likely to have been an early freestanding feature (Fig SS1.42), remains undated, so that the estimate is a minimum one for the start of construction.

The measurement from OxA-3002 is not in agreement with the stratigraphic position of this sample. As the results from the woodchips, plank and macrofossils from context 226 are so consistent, it seems most likely that OxA-3002 does not provide an accurate date for the context from which it was recovered. The most likely explanation for this is that some or all of the dated seeds were intrusive. A possible mechanism for intrusion is provided by the Beaker age alder roots dated by OxA-6403 and -6404, which grew down into the waterlogged deposits. There is no evidence of laboratory contamination, although this cannot be entirely excluded because the sample was very small, as evidenced by the large error term on the measurement. The index of agreement for bone from the cist (A=12.9%) is rather low. This may be a statistical outlier, or the bone may in fact postdate the mound if

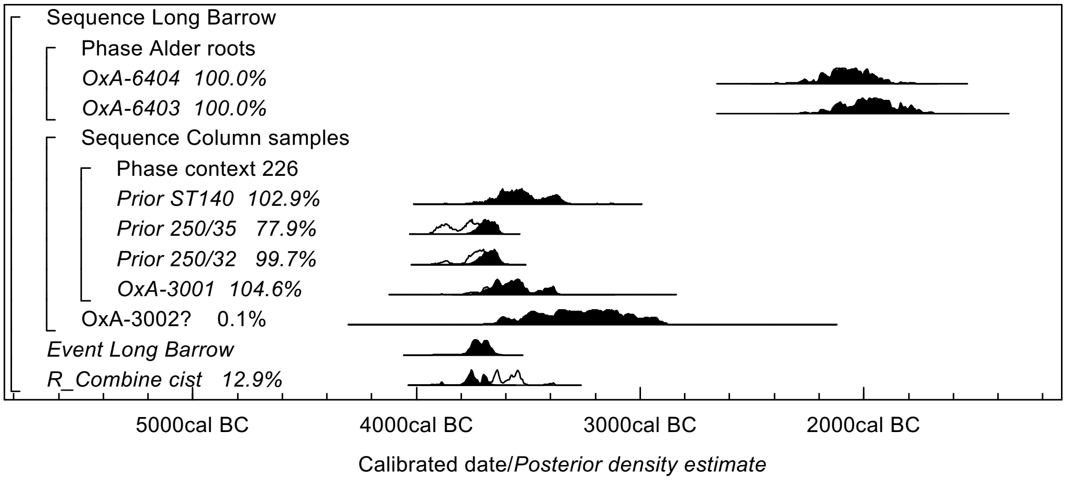


Figure SS6.7 Probability distributions of dates from the Long Barrow. The format is identical to that of Figure SS6.4.

The distributions represented are: cist (OxA-5632 and -5633) weathered human longbone from cist F233; OxA-3002 *waterlogged seeds in layer 229, OxA-3001 waterlogged seeds in layer 226; 250/32 (OxA-6406) and 250/35 (OxA-6405)* Quercus *sp sapwood from woodchips in layer 226; ST140 (OxA-3003) outer rings of* Quercus *sp plank in layer 226, OxA-6403 and -6404* Alnus glutinosa *roots growing into ditch fills.*

the cist remained accessible from the top after the mound was built.

The topmost layer of F239, a pit probably originally sealed by the barrow mound, contained a badly preserved ?deer humerus dated to 910–760 cal BC (95% confidence (OxA-5551). The first millennium BC date of the sample accords with the disturbance to the feature observed during excavation and otherwise evidenced by a Beaker sherd, which is likely to relate to the insertion of contemporary inhumations into the north-east end of the mound.

SS6.6.6. The Turf Mound

The gully which contained the samples for OxA-7865 and -7945 and UB-3314 and -3317 was one of two cut into the northern part of the mound. The sample for OxA-7865 came from a recut of the south part of that gully, the others from the northern part of the gully, which appeared to be part of the recut rather than the original slot. The sample for UB-3314 was the tip of a stake which had burnt *in situ*. The stakehole, like others in the row of which it formed a part, was circular in plan and *c* 80mm in diameter, which suggests that the stake was of fairly young wood and was thus close in age to its insertion. The remaining three charcoal samples were among the burnt material in the fill of the recut. All four measurements are statistically consistent (T'=6.7, T'(5%) =7.8, ν=3). The intervals between the construction of the mound and the cutting of two successive gullies can only be guessed at. If they were negligible, the mound would have been built in *3750–3620 at 77% probability or 3600–3520 cal BC at 18% probability* (*Turf Mound 1*; Fig SS6.8). A stake charred *in situ* can scarcely have been derived from an earlier context, and the consistency of all the dates reinforces the argument that a tightly defined concentration of Beaker pottery in the mound was in fact in a pit undetected at the time of excavation.

The sample for OxA-7947 and -8017 came from a pit (F6047) under the southern part of the mound. It was a single, rectangular piece of carbonised hazel 105mm x 45mm and less than 5mm thick. It seemed to have been the surviving, charred part of a larger wooden object or structural element other-

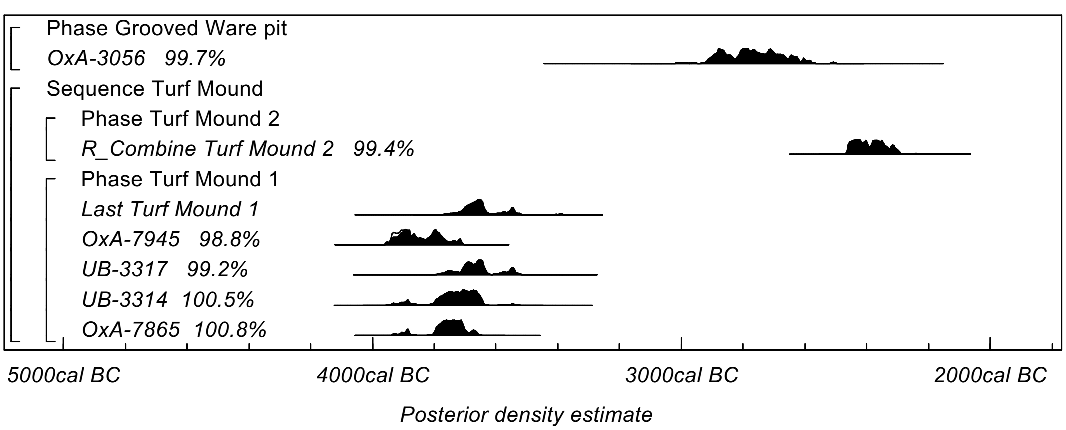


Figure SS6.8 Probability distributions of dates from the Turf Mound and Grooved Ware pit (F31820). The format is identical to that of Figure SS6.4.

The distributions represented are: OxA-7865 charred Corylus *sp root from gully F6366; UB-3314 charred* Quercus *sp stake in gully F6303; UB-3317* Quercus *sp charcoal in gully F6303; OxA-7945 charred* Corylus *sp root from gully F6366; Turf Mound 2 (OxA-7947, -8017)* Corylus *sp charcoal from 'plank' in pit F6047 under S end of mound; OxA-3056 charred hazelnut shells from pit F31820.*

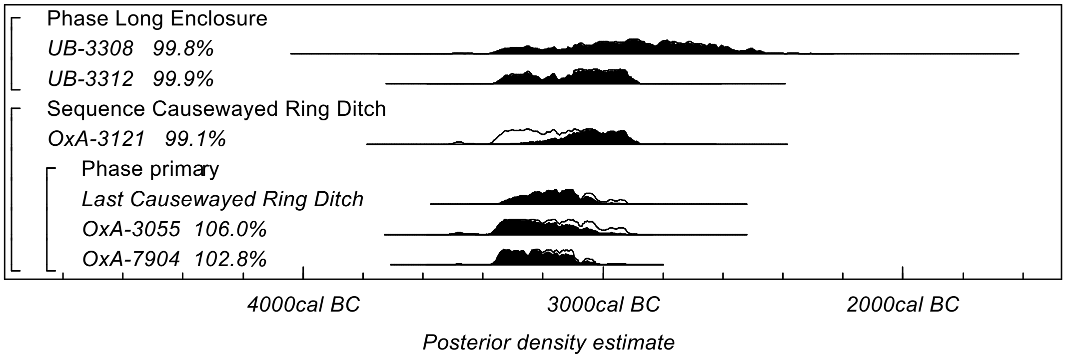


Figure SS6.9 Probability distributions of dates from the Long Enclosure and Causewayed Ring Ditch. The format is identical to that of Figure SS6.4

The distributions represented are: OxA-7904 and -3055 Corylus *sp or* Corylus/Alnus *sp charcoal from the primary silt of the Causewayed Ring Ditch; OxA-3121 red deer antler tine from recut in Causewayed Ring Ditch; UB-3312 red deer antler rake from primary fill of Long Enclosure; UB-3308 cattle tibia fragment from primary fill of Long Enclosure*

wise represented by two linear soil marks (Fig SS1.35). The pit also contained a badly preserved red deer antler and a sherd of Grooved Ware or Beaker. The dates place the pit in *2470–2300 cal BC at 95% probability* (*Turf Mound 2;* Fig SS6.8). Either the pit was cut through the mound, or the southern mound, with its encircling ring ditch, was a substantially later addition to the northern one. The salvage conditions in which the pit was excavated leave both options open, but the recognition of this pit only after the mound had been removed, while others were observed cut into its surface, suggests that it may indeed have preceded the mound.

SS6.6.7. The Long Enclosure

The two measurements (UB-3308, -3312) are statistically consistent (T'=0.6, T'(5%)= 3.8, ν=1). The samples were respectively 0.10m and 0.15m above the base of the ditch in gravel primary silts. It seems probable that the antler was used to build the enclosure, in which case it is likely to be close in age to its construction. Because of the large error term on UB-3308, which was a very small sample, *UB-3312*, made on the antler rake, is preferred as a more robust estimate for the date of construction. This is *3350–2890 cal BC at 95% probability* (Fig SS6.9).

SS6.6.8. The Causewayed Ring Ditch

The hazel charcoal samples for OxA-3055 and -7904 came from just above the base of the ditch. Both were short-lived, single-entity samples and are statistically consistent, as is the antler 'rake' dated by OxA-3121, which lay with an antler pick in the south terminal of the ditch, on the base of a recut which it may plausibly have been used to dig (T'=0.3, T'(5%)=6.0, ν=2). The construction date of the ring ditch is estimated as *3340–3020 cal BC at 95% probability* (*Causewayed Ring Ditch*; Fig SS6.9). Molluscs from three successive samples though the lower fill of the same recut some 15m away indicate a progression from open conditions to woodland as the silts accumulated (Campbell, SS4.5). *OxA-3121* should provide a *terminus post quem* for the start of this process.

SS6.6.9. The Grooved Ware Pit

Hazelnut shell from F31820 was dated to *2930–2570 cal BC at 95% probability* (*OxA-3056*, Fig SS6.8). The short-life sample makes the measurement likely to be close in age to its context, and places the pit in the earlier part of the currency of southern British Grooved Ware (Garwood 1999a).

SS6.6.10. The Riverside Structure

A stratigraphic sequence is formed by UB-3419 from a lens of clay and sand containing tightly packed wood debris within the underlying natural gravels and by UB-3321 and UB-3319 from the structure itself. The estimated date for the construction of the structure is *2870–2800 cal BC at 13% probability* or *2760–2470 cal BC at 82% probability* (*Riverside Structure*; Fig SS6.10).

The existence of a series of OSL dates for the sequence through the channel deposits here (Rees-Jones 1995, 82–85) was discovered too late for inclusion in this chronological model. Those most pertinent to the structure are from the sediment next to it, calculated as 3300–2370 BC (2850±240 BC; IRSL-792c) and from the clay layer overlying it, calculated as 2100–1260 BC (1680±210 BC; IRSL-792d). The remainder of the series covers the Saxon part of the sequence. The large error terms on both the dates quoted mean that their inclusion would not refine the dating of the structure significantly. IRSL-792d supplies an early to middle Bronze Age date for the lightly-grazed grassland reflected by the plant and insect remains from the clay layer (Campbell and Robinson 2007).

A beaver femur from an overlying layer, thought to be Saxon in date, produced a radiocarbon date of 1290–910 cal BC (OxA-4740; 95% confidence).

Two oak pegs, probably driven into the structure in Saxon times to secure bundles of flax retting at the side of the channel, produced radiocarbon dates of cal AD 650–890 (1267±49 BP, UB-3328) and cal AD 650–900 (1264±52 BP, UB-3323; both at 95% confidence; Chapman 2010).

SS6.6.11. Barrow 1

The primary burial is dated by measurements on the skeleton itself (UB-3148), oak sapwood from the surrounding chamber (OxA-7902), a boar's tusk piled with other grave goods at the feet of the skeleton (OxA-4067), two cattle teeth from badly preserved skulls in the surmounting cairn and two loose aurochs teeth, also from the cairn (OxA-2084–7; Fig SS6.11). The two measurements on the primary skeleton and sapwood from the chamber or coffin are statistically consistent (T'=2.1, T'(5%)=3.8, ν=1). The date of the construction of the mound is estimated as *2140–1800 cal BC at 95% probability* (*Barrow_1*; Fig SS6.11).

An inhumation found within the inner ditch during the removal of a baulk was outside the area of the primary limestone and bone cairn and may thus postdate it, although the level from which it was cut is unknown. It is dated to *1920–1730 cal BC at 93% probability* (*UB-3147*; Fig SS6.11).

There is a closely similar date on cremated bone from a double cremation deposit, also within the inner ditch, of 1950–1730 cal BC (95% confidence; GrA-22378). This was received after the chronological model was complete, and is not incorporated in it.

Charred tubers provided short-life samples which should be close in age to the two peripheral cremations from which they came. The cremation in F30030 is dated to *1390–1140 cal BC at 95% probability* (*Barrow 1 F30030* (OxA-3089); that from F30307 to *1390–1160 cal BC at 95% probability* (*Barrow 1 F30307*(OxA-7948); Fig SS6.12). F30030 post-dated the final enlargement of the mound, since it was cut into gravel upcast derived from the cutting of the outer ditch and deposited in the top of the partly silted middle ditch.

Two of the measurements reflect the burial of already old material. The boar tusk dated by OxA-4067 was piled up with the other grave goods at the feet of the skeleton dated by UB-3148, and must have been placed there at the same time, yet it was between *990 and 420 years old at 95% probability* when buried (Difference *Barrow_1* and *OxA-4067*). In the same heap was a broken, re-used, heavily worn stone bracer, in association with the 'wrong' kind of Beaker (Humble *et al* SS3.7.1, AOR 35125).

The cairn must have been piled up after the burial was complete, yet one aurochs tooth, dated by OxA-2085, was between *320–330 years old at 95% probability* (Difference *Barrow_1* and *OxA-2085*). The difference in age between this and the second dated aurochs tooth (OxA-2086) makes them unlikely to have belonged to the same animal, although they were found together. Neither formed part of a longer tooth row, unlike both dated domestic cattle molars, suggesting that they were already loose when deposited.

SS6.6.12. Barrow 3

The stratigraphic position of posthole F39107, dated by OxA-3051, is unclear. The written record appears to state that the hollow into which it was set was cut through the mound. Plans, sections and the excavator's memory do not support this interpretation (SS1.14), and it is probable that it pre-dated the mound, it which case it provides a *terminus post quem* for its construction.

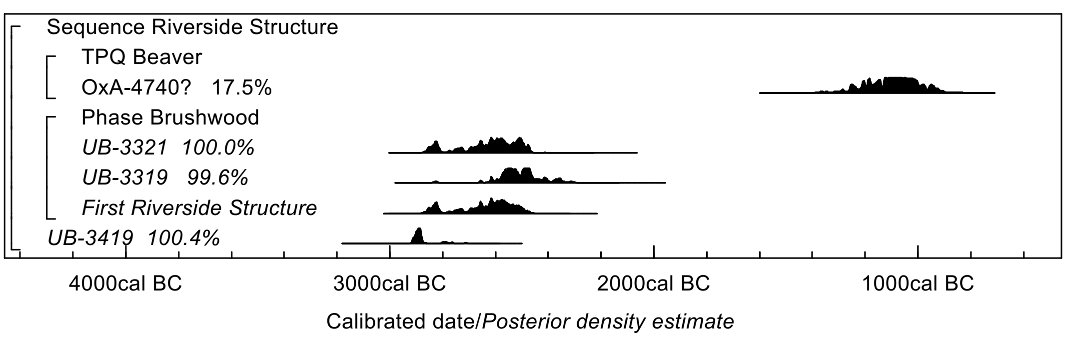


Figure SS6.10 Probability distributions of dates from the Riverside Structure and a disarticulated femur of Castor fiber *recovered from a deposit of Saxon date. The format is identical to that of Figure SS6.4.*

The distributions represented are: UB-3419 Corylus/Alnus *sp wood in gravel beneath Riverside Structure; UB-3321* Fraxinus *sp poles at base of Riverside Structure; UB-3319* Corylus/Alnus *sp wood from main trunk of Riverside Structure;* OxA-4740 Castor fiber *femur.*

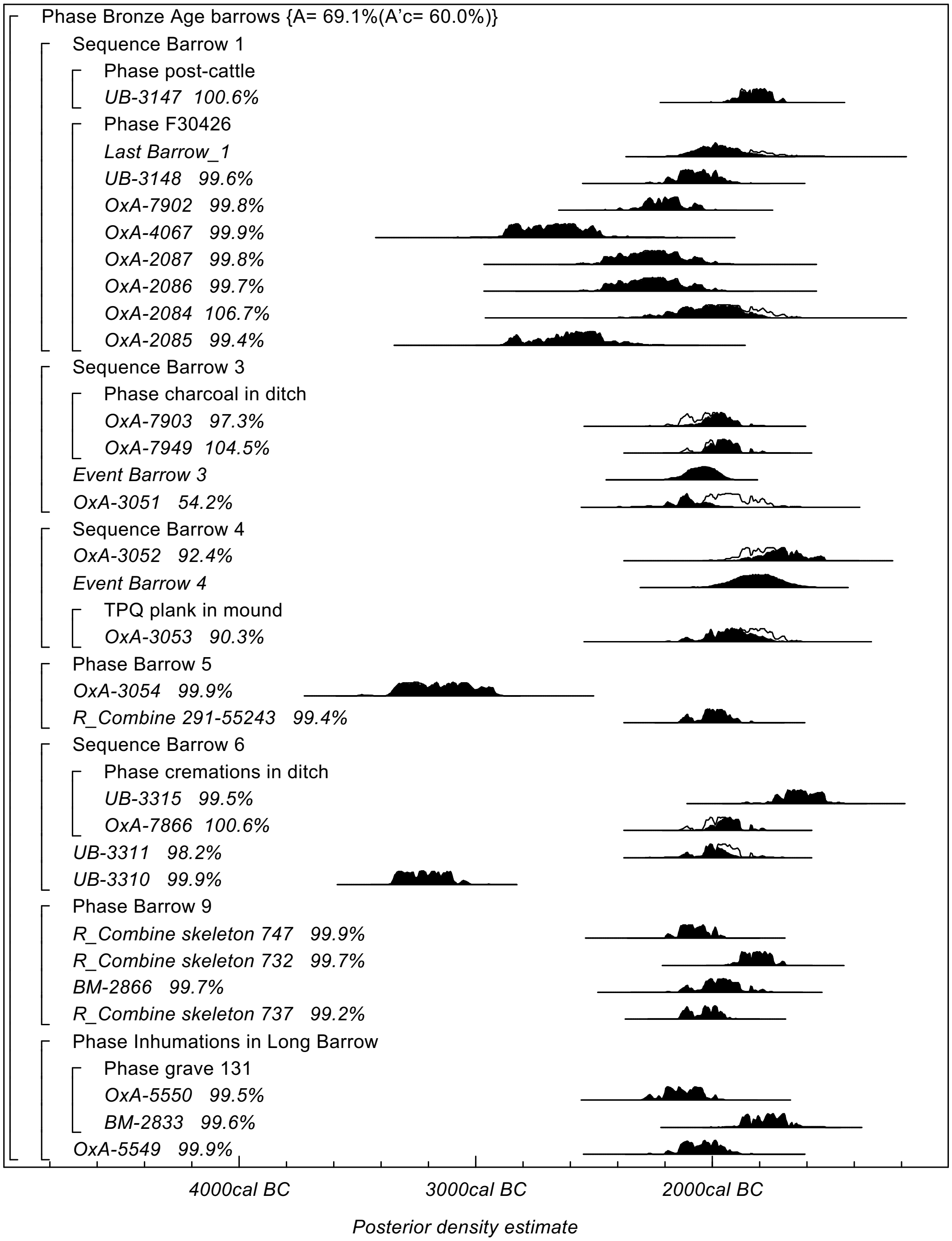


Figure SS6.11

Probability distributions of dates from round barrows and from Beaker or early Bronze Age burials elsewhere. The format is identical to that of Figure SS6.4. The distributions represented are:

***Long Barrow:** OxA-5549 burial in F130; BM-2833 burial in F131; OxA-5550 disarticulated bone in F131*

***Barrow 9:** skeleton 737 (OxA-5543 and -5544) peripheral burial in F729; BM-2866 peripheral burial in F741; skeleton 732 (OxA-5547 and -5548) peripheral burial in F725; skeleton 747 (OxA-5543 and -5542) central burial in F727*

***Barrow 6:** UB-3310 disarticulated double burial in F3390; UB-3311 central burial in F3259; OxA-7866 Pomoideae stake from cremation in F3219; UB-3315 charcoal (mainly* Quercus *sp) from cremation in F3206*

***Barrow 5:** 291–55243 large animal* tibia *from pit F3219; OxA-3054 charcoal from cremation in F47087*

***Barrow 4:** OxA-3053* Quercus *sp plank within mound; OxA-3052 tubers from cremation in F60312*

***Barrow 3:** OxA-3051* Quercus *sp charcoal from posthole F39107; OxA-7903 and -7949* Rhamnus catharticus *and* Prunus *sp charcoal from spread in ditch*

***Barrow 1:** OxA-2085 and -2086 aurochs molars from cairn over primary burial; OxA-2084 and -2087 cattle molars from badly preserved skulls in cairn over primary burial; OxA-4067 boar tusk from heap of grave goods at feet of primary burial; OxA-7902* Quercus *sp sapwood from chamber containing primary burial; UB-3148 primary burial; UB-3147 peripheral burial.*

The oak charcoal fragments dated by OxA-7903 and -7949 were stratified in the same layer in base of the recut ditch and may relate to scrub clearance from the mound at some time after its construction. The measurements are statistically consistent (T'=0.4, T'(5%)=3.8, ν=1) and provide a *terminus ante quem* for the construction. This evidence combined provides an estimate for the construction of the barrow of *2180–1930 cal BC at 95% probability* (*Barrow 3*; Fig SS6.11).

SS6.6.13. Barrow 4

Several oak planks were heaped in a layer in the mound directly overlying the old land surface. Although the outside of the trees could not be identified, the material did not appear to be heartwood. OxA-3053 is therefore a *terminus post quem* for the construction of the mound, although it may not be very far in date from the actual construction, unless of course the plank was reused.

The cremation which contained the sample for OxA-3052 was in the body of the mound, and had probably been cut into it, at what must have been a short time after its construction, although some doubt attaches to this, since the cremation was recognised only after the disturbed top of the mound had been machined away.

If the cremation was indeed cut into the mound, rather than inserted during construction, the mound must have been built between the dates of these two samples, and so, despite the lack of material directly dating this event, the date of construction can be estimated as *2020–1600 cal BC at 95% probability* (*Barrow 4*; Fig SS6.11). If the cremation was inserted during construction, its age provides a second *terminus post quem* for the construction of the mound, the date of which can be estimated as *1880–1520 cal BC at 95% probability* (distribution not shown).

SS6.6.14 Barrow 5

Two dates on a large artiodactyl tibia from a pit cut into the mound (OxA-3120, -7950) are statistically consistent (T'=0.3, T'(5%) =3.8, ν= 1). They may provide a *terminus ante quem* for construction, unless the bone was redeposited, of *2140–2070 cal BC at 15% probability*, or *2050–1880 cal BC at 80% probability* (*291–55243*; Fig SS6.11). The date of the pit might be refined by measurements on short-life samples from among the charred plant remains in its lowest layer. A cremation cut into the old land surface between the inner and outer ditches yielded a date of *3350–2920 cal BC at 95% probability* (*OxA-3054*; Fig SS6.11), made on twig charcoal so highly burnt as to be unidentifiable, suggesting that it may have been reburnt (Campbell SS4.5.4). Either the cremation greatly predated the barrow, as the disarticulated bones under Barrow 6 predated its primary burial, or the sample consisted of older charcoal which had become incorporated into the pyre.

SS6.6.16. Barrow 6

A bone from one of two incomplete disarticulated skeletons in a grave beneath the primary burial of the barrow was dated by *UB-3310* to *3360–3090 cal BC at 95% probability* (Fig SS6.11). Around a thousand years later, the primary burial was made, an event which would have been almost immediately followed by the construction of the first mound and ditch. The articulated skeleton, which was accompanied by a Beaker and elaborate grave goods, is dated to *2140–2080 cal BC at 14% probability* or *2050–1890 cal BC at 82% probability* (*UB-3311*; Fig SS6.11).

Pomoideae charcoal fragments from a stakehole in a cremation pit cut into the silted outer ditch (*OxA-7866*) are later than the construction of the mound, and provide an estimate for the date of the cremation of *2030–1870 cal BC at 89% probability* (Fig SS6.11). The charcoal seems to have formed part of the surrounding cremation and to have fallen into the stakehole together with fragments of cremated bone after the stake had decayed. It is likely to be close in age to the cremation. Material from the second dated cremation from this ditch was mature oak and so provides only a *terminus post quem* of *1750–1490 cal BC at 95% probability* (*UB-3315*; Fig SS6.11).

SS6.6.17. Barrow 9

Articulated skeletons from four graves were dated, with replicate measurements on the central adult male burial, skeleton 747 in F727, and on two of the peripheral child burials, skeletons 732 in F725 and skeleton 737 in F729. All the replicates are statistically consistent (Table SS6.1). The two earliest burials are 747 and 737, with 747 roughly twice as likely to be the earlier, which would accord with its central position and the depth of the grave. Skeleton 751, associated with a rusticated Beaker in F741

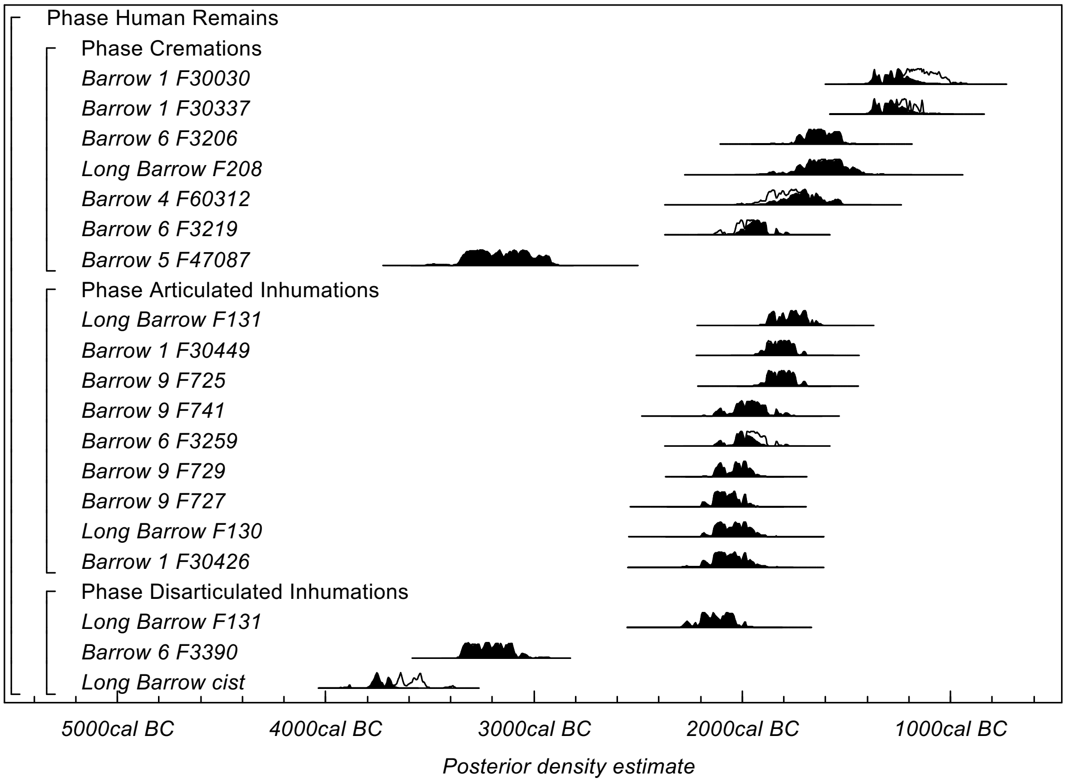


Figure SS6.12

Probability distributions of dates for disarticulated human remains, articulated inhumations and cremations. Each distribution represents the relative probability that an event occurred at some particular time. The distributions correspond to aspects of the model outlined in Figures SS6.2 and SS6.4–SS6.13. The format is identical to that of Figure SS6.4.

The distributions represented are: Long Barrow cist (OxA-5632 and -5633) weathered human longbone from cist F233; Barrow 6 F3390 (UB-3310) disarticulated double burial; Long Barrow F131 (OxA-5550) disarticulated humerus; Barrow 1 F30426 (UB-3148) primary burial with Beaker and other grave goods; Long Barrow F130 (OxA-5549) unaccompanied burial; Barrow 9 F727 (OxA-5543, -5542) central burial, skeleton 747; Barrow 9 F729 (OxA-5543, -5544) peripheral burial, skeleton 737; Barrow 6 F3259 (UB-3311) central burial with Beaker and other grave goods; Barrow 9 F741 (BM-2866) peripheral burial with Beaker; Barrow 9 F725 (OxA-5547, -5548) peripheral burial; Barrow 1 F30449; (UB-3147) peripheral burial; Long Barrow F131 (BM -2833) burial with Beaker and other grave goods; Barrow 5 F47087 (OxA-3054) cremation between inner and outer ditches; Barrow 6 F3219 (OxA-7866) Pomoideae stake from cremation cut into outer ditch; Barrow 4 F60312 (OxA-3052) tubers from cremation cut into mound; Long Barrow F208 (OxA-2989) Quercus *sp charcoal from cremation beyond barrow; Barrow 6 F3206 (UB-3315) charcoal (mainly* Quercus *sp) from cremation cut into outer ditch; Barrow 1 F30337 (OxA-7948) charred tubers from cremation beyond mound; Barrow 1 F30030 (OxA-3089) charred tubers from cremation between middle and outer ditches.*

(*BM-2866*), is *85% probable* to be later than the central burial. The latest dated burial, at *95% probability*, is 732 from grave F725. A neonate burial cut into F741 remains undated. The lack of stratigraphic relation between the dated burials makes it difficult to estimate a construction date. If 747 was indeed primary, its age puts the construction at *2150–1950 cal BC at 90% probability* (*skeleton 747*; Fig SS6.11).

SS6.6.18. Inhumations in the Long Barrow

Dates were obtained for two of a row of three inhumations inserted into the north-east end of the Long Barrow, an unaccompanied possibly male adult (130), and an adult female (131) buried with a Beaker, a shale armlet and a copper alloy 'earring'. Also dated was a disarticulated subadult humeral diaphysis, which was one of several additional human bones in the grave with 131 (Fig SS6.11). The disarticulated fragment was significantly older than the skeleton with which it was buried, and burial 130 was significantly older than burial 131 (T'=11.4, T'(5%)=3.8, ν=1).

SS6.6.19. Cremations

Seven dates were obtained on charred plant material from cremations (Fig SS6.12). Most have been discussed with other dates from the barrows in which they occurred. Two were made on oak charcoal (UB-3315

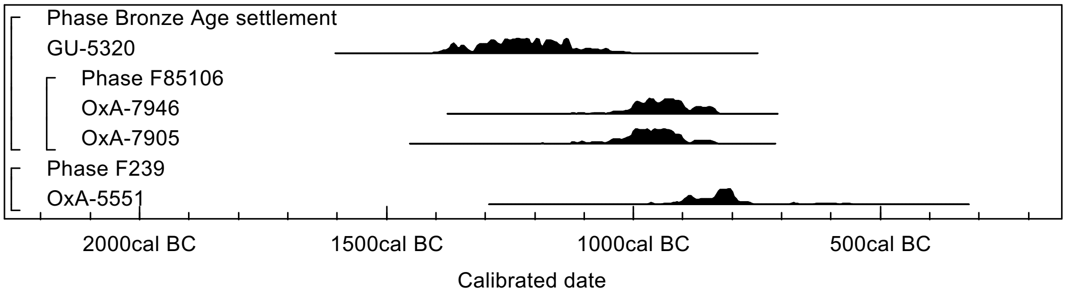


Figure SS6.13 Probability distributions of dates from postholes in fencelines related to building 85151 at Stanwick and F239 on the axis of the Long Barrow. Each distribution represents the relative probability that an event occurred at a particular time. These distributions are the result of simple radiocarbon calibration (Stuiver and Reimer 1993).

*The distributions represented are: OxA-5551 ?*Cervus elaphus *humerus from pit F239 in Long Barrow; OxA-7905 and -7946* Triticum dicoccum *grains from top fill of posthole F85106 in fence near hut; GU-5320* Fraxinus *sp charcoal from posthole F85059 in second fence near hut.*

and OxA-2989), the remainder on short-lived material. These are a minority of the 35 cremations from the area, as dating was focussed on samples relating to barrows. For this reason, the results may not be representative of the total population of cremations.

SS6.6.20. Bronze Age Settlement

Although the ditches of two systems of enclosures and droveways were sampled intensively, no material suitable for dating was obtained. A *terminus ante quem* for the north block is provided by a pit (F38646) containing early Iron Age pottery which cut one of its ditches. A *terminus post quem* for the south block is provided by the fact that one of its ditches cuts the Segmented Ditch Circle, dated to *2020–1680 cal BC at 95% probability* (*Segmented Ditch Circle*; Fig SS6.11). The only related samples came from posthole alignments, probably fences, outside a post-built roundhouse within the south block (Fig SS6.13). The base of an ash wood stake, burnt *in situ* in one posthole, which may be close in age to the construction of the fence, was dated to 1390–1040 cal BC (95% confidence; GU-5320). A substantial deposit of charred grain, predominantly emmer wheat, in the top of a nearby posthole is dated at 95% confidence to 1110–830 cal BC (OxA-7905) and 1050–830 cal BC (OxA-7946) by measurements on two individual grains. The difference in age between the stake and the grain deposit may stem from different dates for the two alignments to which the postholes belonged, or the deposition of the grain after the fence had gone out of use.

SS6.7. Overview

SS6.7.1. Monument Building

Figure SS6.14 summarises the chronology of the construction of the dated monuments. It is readily apparent that the monuments fall into two groups: a series of diverse structures in the earlier fourth millennium and a number of round barrows around 2000 cal BC. There is comparatively little dated monument construction in the intervening period, and the monuments in question called for less input of resources than the earlier ones. The Cotton Henge may, on morphological grounds, have been built in this period, but its date remains unknown.

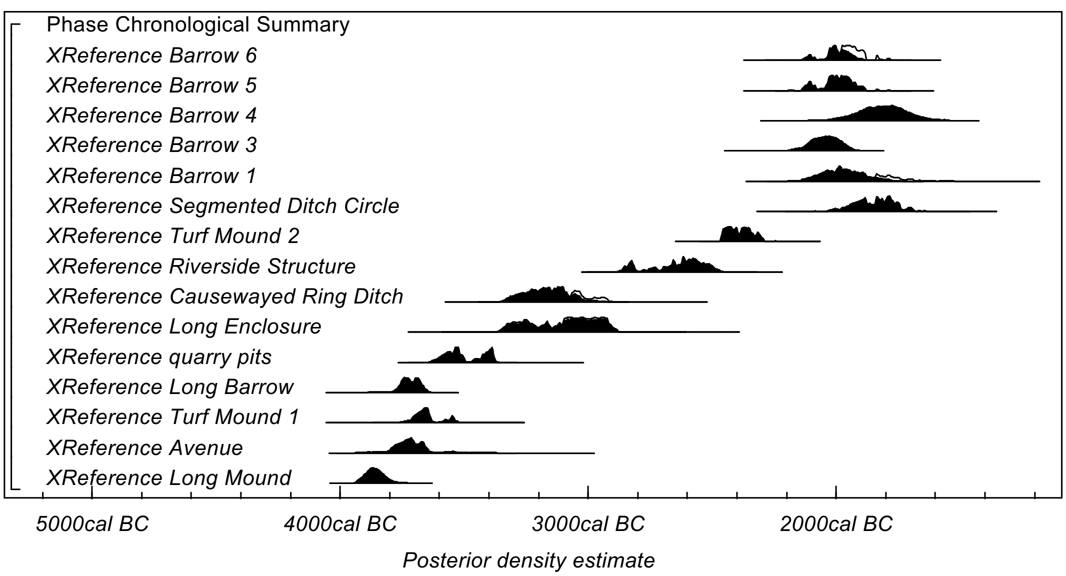


Figure SS6.14 Probability distributions of construction dates of individual monuments, with a terminus post quem *for the south part of the Turf Mound and a* terminus ante quem *for the construction of Barrow 5. Each distribution represents the relative probability that an event occurred at some particular time. The distributions correspond to aspects of the model outlined in Figures SS6.2 and SS6.4–SS6.13. The format is identical to that of Figure S6.4.*

Table SS6.2. Probabilities of the relative chronology of each pair of Neolithic monuments

The cells show the probability that the monument listed at the left of the table is earlier than the monument listed at the head of the table, eg the probability that the Long Mound is earlier than the Avenue is over 95%.

	Avenue	*Turf Mound 1*	*Long Barrow*	Long Enclosure (*UB-3312*)	*Causewayed Ring Ditch*
Long Mound	>95%	100%	>95%%	100%	100%
Avenue		81%	49%	100%	100%
Turf Mound 1			13%	100%	100%
Long Barrow				100%	100%
Long Enclosure (*UB-3312*)				68%	

The Neolithic

The dating of the earliest monuments is difficult, as discussed above. It is based on few measurements, and their interpretation is sometimes problematic. Using the model described above, the probable sequence is summarised in Table SS6.2. It should be noted that this relates to the Long Barrow mound, not to the preceding façade. The most substantial monuments were built in the fourth millennium, with relatively slight investments of effort in the late third millennium (Harding and Healey 2007, Panel 3.6). Treethow holes were burnt out both before (OxA-3057, -3059) and after (*OxA-3058*) the start of monument building.

The early Bronze Age

Articulated early Bronze Age inhumations, primary or secondary, cluster tightly around 2000 cal BC. The first round barrow was built in the last quarter of the third millennium and the last in the first quarter of the second, the primary construction of the barrows spanning approximately 250–500 years. Maintenance, refurbishment and expansion continued for a period of unknown duration, but possibly also confined to the first quarter of the second millennium. It was within this period that two cremations were inserted into the largely-silted third, outer ditch of Barrow 6 (Fig SS6.11: *OxA-7866*); and a charcoal spread accumulated in the ditch of Barrow 3, perhaps representing the burning of scrub off the mound (Fig SS6.11: *OxA-7903*, *-7949*). The dated Bronze Age cremations seem to span a longer period and to start rather later, basically covering the entire second millennium (Fig SS6.12).

Four of the dated articulated skeletons were associated with stylistically 'late' Beaker pottery, *UB-3148* with a vessel of Clarke's Southern style in the primary grave of Barrow 1 (Tomalin SS3.8.4, P85), *UB-3311* with another of comparable affinities in the primary grave in Barrow 6 (Tomalin SS3.8.4, P84), *BM-2866* with a rusticated Beaker in a peripheral grave in Barrow 9 (Barclay SS3.8.3, P19) and *BM-2833* with probably long-necked Beaker in an inhumation inserted into the Long Barrow (Barclay SS3.8.3, P12). *UB-3148* (*2200–1930 cal BC at 95% probability*) is probably the earliest (*61% probable*), and *BM-2833* (*1890–1630 cal BC at 95% probability*) is almost certainly the latest (over *95% probable*). *UB-3311* and *BM-2866* appear to be close in date, although *UB-3311* is likely to be earlier (*64% probable*). Their dates fall in the middle and later part of the currency suggested by Kinnes *et al* (1991; Fig SS6.12). In this particular case, rusticated vessels seem to have been used as grave goods at a later date than more elaborate ones. Less stylistically developed Beakers, of Clarke's Wessex/Middle Rhine group from Barrow 5 (Tomalin SS3.8.4, P83) and from a pit at Redlands Farm (Barclay SS3.8.3, P20) are not dated. The Beaker in Barrow 5 was stratigraphically earlier than a large artiodactyl tibia dated to 2*140–2070 cal BC at 15% probability*, or *2050–1880 cal BC at 80% probability* (*291–55243*; Fig SS6.11). The condition of the sample, which could not be identified to species, and the lack of articulation mean, however, that it could have been redeposited.

The latest dated Bronze Age burials are the cremations at the edge of Barrow 1, deposited in *1390–1140 cal BC and 1400–1160 cal BC at 95% probability* (*Barrow 1 F30030* and *Barrow 1 F30337*; Fig SS6.12), while the earliest settlement feature is a stake in a fenceline dated by GU-5320 (95% confidence; 1390–1040 cal BC). On such slender evidence, it is impossible to be sure whether these two phases of activity overlapped.

SS7
Appendices

D7.1 Introduction

Frances Healy

The information in this Appendices SS7.1–4 was collected during the composition of Chapters 4 and 5 of Harding and Healy (2007), and supports some of the discussion in those chapters. It provides the basis on which some of the conclusions were reached and gives the reader the opportunity to rework or reject the evidence on which they were based.

The Appendices are all Access database tables and are to be found at www.english-heritage.org.uk. Detailed information about their content is to be found in the design view of each. General information is summarised here.

Appendix SS7.1 assembles information about published Beaker and Bronze Age burials in Northamptonshire and neighbouring areas. It covers Northamptonshire and adjoining parts of Lincolnshire, Cambridgeshire, Bedfordshire and Buckinghamshire as well as those areas of Cambridgeshire, Suffolk and Norfolk which border the south and east of the fenland basin. This encompasses dense concentrations of barrows in the valleys of the Welland, Nene, and Great Ouse as they approach the western edge of the fens and on the chalk ridge and adjoining sands which form their southern and eastern edges (Lawson *et al* 1981, fig 1). The burials listed here provide the basis for tables 4.3–7 of Harding and Healy (2007) and the text which discusses them. There is a record for each individual burial.

Appendix SS7.2 assembles information about those Neolithic monuments in the Welland-Nene-Ouse area which feature in Figure 5.10–11 and in table 5.1 of Harding and Healy (2007). The identifications of uninvestigated cropmarks and earthworks are necessarily tentative. The authenticity of two possible long barrows, for example, has been questioned as a result of fieldwork carried out in the 1990s, and they have been excluded here. One is at Rainsborough (Chapman 1997b), the other at Upton (Jackson 1994).

Appendix SS7.3 lists the round barrows and ring ditches plotted in figure 5.12 of Harding and Healy (2007). It has been compiled from the Northamptonshire and Peterborough SMRs, winnowed by a critical evaluation of the records and augmented by information from publications and from the Raunds project. Sites where there is evidence for a date other than a Bronze Age one have been excluded, as are those located only in general terms (for example to a village or a parish) and generalised records of several mounds or ring ditches. This last category almost invariably applies to areas where individual sites have also been identified. Where a single record describes more than one monument, as several of the Peterborough records do, it is repeated for each of those monuments.

For Northamptonshire, the results of the National Mapping Programme (Deegan and Foard 2007; http://ads. ahds.ac.uk/catalogue/projArch/NMP/nnmp_eh_2003/index.cfm) have been taken as the most up-to-date and consistent record of the aerial photographic evidence. Previously recorded cropmarks which are not duplicated in it have been excluded. Other sources, including the main body of the SMR, have been used to supplement this with excavated barrows and ring ditches, upstanding mounds, and sites which have been destroyed.

Appendix SS7.4 provides the coordinates and names of points from which viewsheds have been calculated, including those in Chapter SS2 of this publication and chapter 5 of Harding and Healy (2007). It includes struck flint concentrations identified during the fieldwalking survey and published by Parry (2006).

SS8
The archive

SS8.1 Overall archive structure and location

Claire E Jones and Frances Healy

The site archive

The archive generated during fieldwork forms part of the larger archives of five separate projects: Irthlingborough (primary record number 291i), Stanwick (primary record number 291), the Cotton 'henge' (primary record number 483), West Cotton (primary record number 435) and Redlands Farm (Oxford Archaeology codes STRF 89 and STRF 90). These archives were created following the systems employed by the then Central Unit of English Heritage (Irthlingborough, Stanwick and the Cotton 'henge'), the then Northamptonshire County Council Archaeology Unit (West Cotton) and the then Oxford Archaeological Unit (Redlands Farm), as outlined by Harding and Healy (2007, 12–13). All are still (2010) the subject of analysis in the course of the Raunds Iron Age and Roman Project. The finds and the paper and photographic records are currently held by English Heritage at Fort Cumberland, Fort Cumberland Road, Eastney, Portsmouth PO4 9LD. Their final destination has yet to be determined. The digital site archives for Irthlingborough and Stanwick are also held at Fort Cumberland; those for West Cotton and Redlands Farm remain with Northamptonshire Archaeology and Oxford Archaeology. Elements of all the digital archives are incorporated in the Raunds Prehistoric database available at www.english-heritage.org.uk, as described by Anthony Beck (SS8.2).

The research archive

All of the archive generated during post-excavation analysis for this publication is currently (2004) held at Fort Cumberland. Where feasible it is divided between the component projects. Much of it, however, relates to pre-Iron Age aspects of the Raunds Area Project as a whole, and is thus held as Raunds Prehistoric. As with the site archive, elements of the research archive are incorporated in Raunds Prehistoric database which is to be found at www.english-heritage.org.uk.

SS8.2 The creation of an integrated GIS-ready digital archive

Anthony Beck

Note A glossary of terms and abbreviations is to be found in Table SS8.2.

SS8.2.1 Introduction

Background

The brief was to create an integrated GIS-ready digital archive and its supporting metadata to facilitate digital spatial analysis and publication as well as future research. The data were converted and integrated between 2001 and 2002 and this report was completed during this period This dataset is to be found at www.english-heritage.org.uk. It consists of a single Raunds Prehistoric AutoCAD drawing, an associated G-Sys copy of the AutoCAD data and a suite of integrated MS Access relational databases. For the purposes of analysis, these were integrated with Ordnance Survey (OS) raster map sheets and digital elevation models (DEM), SMR and aerial photographic data derived from the Peterborough Unitary Authority and Northamptonshire County Councils Sites and Monuments Records (SMR), and OS vector map sheets. These greatly facilitated the relation of the Raunds data to the archaeology of the surrounding area, with particular reference to the composition of Chapter 5 of the synthetic volume (Harding and Healy 2007, 264–84). They are not included in the final dataset because the now complete version of the National Mapping Programme for Northamptonshire (Deegan and Foard 2007) is available through ADS (http://ads. ahds.ac.uk/catalogue/projArch/NMP/nnmp_eh_2003/index.cfm) and because the sites and monuments records have developed from their state in 2001 when the work was done. Information drawn on in particular aspects of Chapter 5 is presented in Appendices SS7.1–4 at www.english-heritage.org.uk.

The task necessitated integrating the data from the five separate components of the Raunds Prehistoric project:

Field Walking Survey (FWS) by the then Northamptonshire Archaeological Unit, 1985–92

Irthlingborough and Stanwick excavations (IRS) by the then Central Excavation Unit, 1985–1992. These employed a single local grid and a single series of context and other record numbers, but were separate projects for which separate databases were developed

Redlands Farm (RF) excavations by the then Oxford Archaeological Unit (OAU), 1989–1990

West Cotton (WC) excavations by the then Northamptonshire Archaeological Unit (NAU) Unit, 1985–1989

Cotton Henge (CH) excavations by the then Central Excavation Unit (CEU), 1993

All three units employed versions of single-context recording, although OAU used their Thornhill recording system (Wilkinson 1992) for the Long Barrow and Barrows 7 and 8, excavated in 1989, but not for Barrow 9, excavated in 1990.

In order to analyse the landscape setting of the prehistoric monuments and their relation to each other it was determined to convert the archive to digital format. This conversion process was undertaken from October to December 2001.

Processing overview

The project archive was supplied on five CDs comprising 4071 files, many of which were duplicates. Upon closer examination, the archive consisted of 248 AutoCAD drawings, 462 plans and illustrations in tiff format and twenty-one MS Access databases. It had already been ascertained that all primary data was stored in these file formats. Other files in the archive were predominantly obvious duplicates, derivatives and documents.

A single GIS-ready AutoCAD drawing (RndsPlan.dwg) was created from all the Raunds prehistoric excavation data and co-ordinated to the Ordnance Survey (OS) grid. Where possible each context was 'seeded' by adding a database identifier as a compound key of Site, Context/Feature Number and Thornhill subdivision. Where appropriate individual scans were merged and exported in geotiff format with an associated. tfw locational file extension. Towards the end of the project extra site plans were provided and access was made available to English Heritage's redigitised Stanwick archive. This data was used to complete the spatial dataset.

A single MS Access database (Rnds Raw.mdb) was created, in which all context, environmental and object data were integrated into a single relational model. In order to maintain uniqueness within the relational model the primary key at the context level was a combination of site code (site), context/feature number (context) and Thornhill subdivision (ctxlay) (please note for all projects except RF this value was defaulted to '-'). This compound primary key was propagated as a foreign key to all related tables and as a linking unique identifier to the spatial dataset. Lookup tables (data dictionaries, thesauri) were created for fields where appropriate. Three metadata tables were created to store dataset (to Dublin core specifications (Gillings and Wise 1998)), database and project specific metadata (MetaT, MetaTDB and SiteT respectively).

SS8.2.2 The data model

The data model refers to the relationships between and within different datasets. Common relational GIS data models rely on the identification of a common spatial and a-spatial link, often referred to as a primary key. Due to the fact that all of the data provided to the conversion team were undocumented and of unknown quality, it was impossible to define a robust data model at an early stage. Thus, a flexible data model system that would respond to problems encountered in the dataset was built on the following premises:

- An a-spatial and spatial link would be determined that would work for ALL the datasets.
- It should be possible to analyse the object and environmental components as assemblages.
- All file, folder and field names for the primary datasets would adhere to deposition conventions (see appendix at the end of the document).

• Where appropriate the database would be normalised.
• The spatial archive should be exportable to standard GIS formats (ie a non-proprietary data structure).
• Field values would be standardised and appropriate lookup tables created.

The broad-scale data models described below define the approaches developed during the conversion process. Due to the nature of the archive, it was impossible to create a full audit trail of all the changes performed as most of the data that was undocumented. Integration of this data involved lengthy consultation with Dr Healy at Newcastle University in order to validate our assumptions on the rationale of the original data, for which we are most grateful.

The spatial data model

The vector archive is managed through AutoCAD MAP 2000. MAP adds extensive GIS functionality to AutoCAD. Of particular relevance is its ability to create clean drawing topology from 'spaghetti data'. All data conforms to the layering system outlined in Table SS8.1.

Where any topology layer needs 'seeding' a 'seed' layer was created with the same layer name prefix with the suffix '_seeds' (see archaeology_seeds in Table SS8.1).

All point data, such as artefact locations, was stored in the a-spatial data model in fields named XCOORD, YCOORD and ZCOORD.

Seeding contexts

The GIS requires that each spatial entity is uniquely referenced. In normal scenarios one would use the unique context number. However, there is duplication of context numbers employed by the three archaeological units during their investigations. Hence, a unique primary key was created for each spatial object by combining the context/feature number, the site code and the Thornhill layer. An object table was created within AutoCAD MAP called PlanID. Three fields were added to this object table. Namely: Feature_Nos, Site and CtxLay as a character fields. Data was added to these fields and attached to 'points' within the appropriate polygon.

Data export

AutoCAD MAP can export topologically intact point, line and polygon data in a variety of industry-standard GIS formats (Intergraph (DGN), ESRI (shape, coverage and interchange) and MapInfo (Mif)). Shape file format was used for this project. Polygon topology was created for the archaeological features. This topology was used to create a closed polygon layer with attributed seed data. This closed polygonal layer was exported as an ESRI shape file. The shape file's .dbf extension was imported into MS Access (maintaining the feature order) and a new field (compkey) was created as a combination of site, Feature_Nos and CtxLay. The shape file was then imported into G-Sys. The unintelligent line files (ie containing all the other layers) were exported as a polyline shape file and imported into G-Sys.

The a-spatial data model

Figure SS8.1 details the table relationship model for RndsRaw.mdb. Due to the incomplete nature of the archive, referential integrity has not been invoked. The common foreign

Table SS8.1 Layer names for RndsPlan.dwg

Layer name	*Topology*	*Layer type*	*Comments*
Aerial_ SURVEY	N	Polyline	Aerial Survey data. Of unknown origin
Application_Area	N	Polygon	Extents of application area. Derived from photocopied and scanned map
Archaeology	Y	Polyline	Topologically intact layer containing the archaeological excavation data
Archaeology_Seeds	N	Point	Point seeds with attached object data in table Plan ID
Area_Boundaries	Y	Polyline	Limits of Project Code boundaries
Contours	N	3D Polyline	3D contours. Of unknown origin
Original_FEATURES	N	Polyline	The original digitised archaeological features
PALAEOCHANNEL	Y	Polyline	Topologically intact palaeochannel limits
TERRAIN-TIN	N	Surface	Surface model derived from the contours layer
TRENCHES	N	Polyline	Trench outlines. Also contains OAU Trial trenches which are digitised as a line with a width value
Unknown	N	Various	Unknown data from the original drawings

key in the database is a composite key derived from the fields site, context and ctxlay in table CtxT. To simplify GIS-linking this primary key has been combined in two fields (CompKey and FROMDRAW). CompKey is a simple update query using the fields site, context and ctxlay. FROMDRAW, on the other hand, gives the appropriate drawing link for all features (ie fills have the composite key of their cut). CompKey and FROMDRAW are the linking fields for GIS analyses within G-Sys. The field definitions for all the tables are described in Figure SS8.1.

For data management purposes two extra databases were linked to RndsRaw.mdb to store queries and the Graphical User Interface (GUI) (RndsQury.mdb and RndsForm.mdb respectively). Figure SS8.2 describes this relationship.

Database RndsArch.mdb was created to store all the original tables. It also contains all the tables that are unused in RndsRaw.mdb. Information derived from many of these files has been updated in RndsRaw.

The GIS data model

Figure SS8.2 describes the broad GIS data model. The system is relatively simple due to the fact that the majority of the analysis was undertaken with vector data.

Table SS8.2. Glossary

ADS	Archaeological Data Service (http://ads.ahds.ac.uk/)
AutoCAD	Popular CAD package by AutoDESK (http://www.autodesk.co.uk/)
CAD	Computer-Aided Design
CD	Compact Disc
CEU	Central Excavation Unit (English Heritage)
Composite Key	Primary Key using more than 1 field
DBMS	DataBase Management System
DEM	Digital Elevation Model (A raster representation of height)
DRW	G-Sys vector file format
DWG	AutoCAD vector file format
EH	English Heritage (http://www.english-heritage.org.uk/)
ESRI	Vendors of ArcView and ArcGIS GIS (http://www.esri.com/)
Foreign Key	One or more fields in a table that relate to another table's primary key
FWS	Field Walking Survey
GDMS	Geographic Data Management System
Geotiff	Spatially referenced Tiff file
GIS	Geographical Information Systems
G-Sys	GDMS produced by the Landscape Research Centre (http://www.landscaperesearchcentre.org)
GUI	Graphical User Interface
IRS	Irthlingborough and Stanwick
MDB	MS Access file format
MoLAS	Museum of London Archaeological Services
MS	Microsoft
NAU	Northamptonshire Archaeology Unit (now Northamptonshire Archaeology)
OAU	Oxford Archaeological Unit (now Oxford Archaeology http:// thehumanjourney.net/)
OS	Ordnance Survey (http://www. ordnancesurvey.co.uk/oswebsite/)
PDF	Portable Document Format. File format produced by Adobe
Primary Key	One or more fields whoose values create a unique index in a table
Raster	Cell-based representation
RF	Redlands Farm
Seeds	GIS identifier for a polygon
SHP	Shape file. ESRI format
SMR	Site and Monuments Record
Spaghetti data	Unclean vector data
TFW	Spatial referencing file for a Tiff
TIFF	Tagged Image File Format. Common raster format
Vector	Point and Line based representation
WC	West Cotton

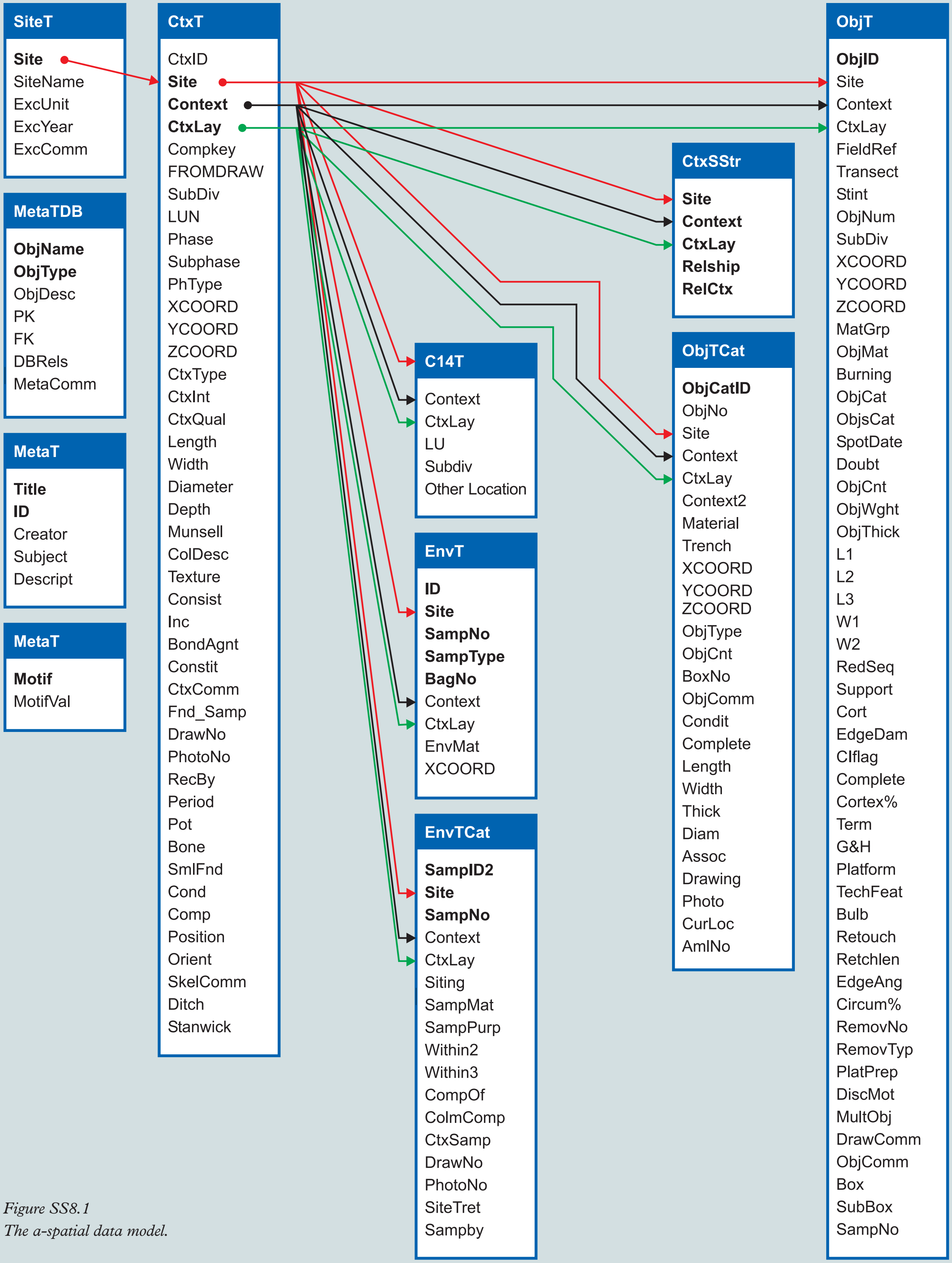


Figure SS8.1
The a-spatial data model.

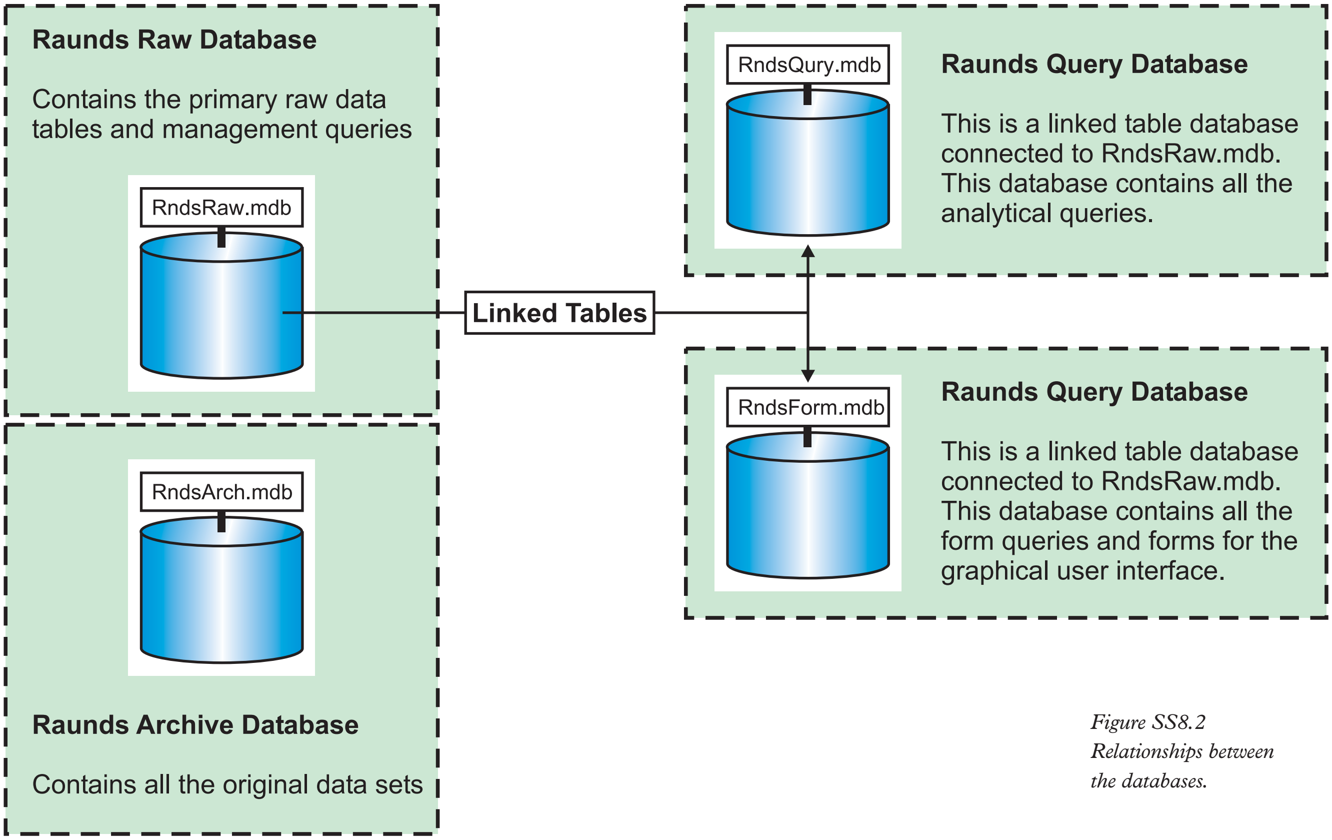
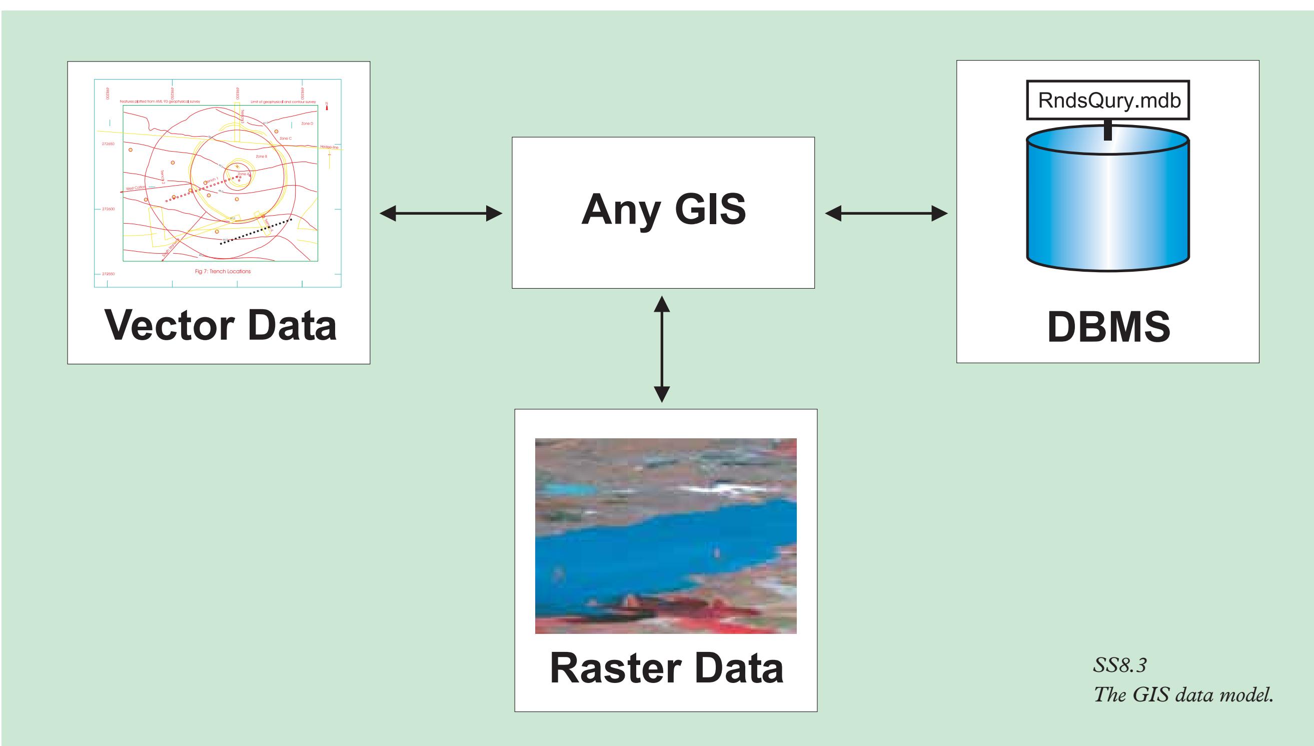


Figure SS8.2
Relationships between the databases.



SS8.3
The GIS data model.

The GIS software links the spatial and attribute data through the compound primary key. This is a text link in the vector dataset embedded within each polygon and linked to either Compkey or FROMDRAW in RndsQury.mdb.

SS8.2.3 Converting the spatial archive

After comparing all the AutoCAD drawing files it was determined that one file contained the most up-to-date data. This file was already in the OS grid projection and was copied and renamed as RndsPlan.dwg. A copy of the original archaeological features was created on the layer original_features. The layers were rationalised (see Table SS8.1).

Polylines on the layer Archaeology were unclosed 'spaghetti' data. Using the cleaning functionality of MAP and manual editing this layer was turned into a topologically intact polyline layer.

For seeding purposes the original scanned plans were georeferenced in AutoCAD Overlay. Once georeferenced each plan was exported as a geotiff with an associated world reference file (.tfw). It should be noted that the vast majority of the supplied plans were located in a local grid system. All West Cotton plans were converted to OS grid by the following move and offset: move from 0,0 to 496070.7, 270740.55, then rotate by 12 degrees clockwise around the point 497174.64, 271660.43. All Irthlingborough and Stanwick plans were converted to OS grid by the following move and offset: move from 0,0 to 495965.818, 270921.705, then rotate by 11.8995 degrees clockwise around the point 496252.734, 271248.937. These rotations were also used to convert the coordinates of objects in local grid to OS grid.

Where appropriate adjacent plans were merged to create one geotiff. This effectively reduced the geotiff archive to 59 files. It was now possible to view the raster plans in conjunction with the vector plan in AutoCAD. Although the CAD plan was meant to represent all of the excavated information, it was noted that a substantial number of excavated contexts had not been digitised (it is likely that the majority of these features were identified as non-prehistoric). Where applicable these features have been digitised crudely. Postholes, for example, have been generalised to circles. This generalisation was due to constraints on time and funding.

After this initial digitising process many features were still either missing or not seeded. More scanned plans and a copy of the recently redigitised Stanwick plan were received. These were used to provide the extra polyline and seeding data. Unfortunately at this stage it was discovered that some of the supplied digitising was inaccurate in comparison to the redigitised Stanwick plan. Where possible the inaccurate data was scaled, rotated and moved to fit in with the current EH AutoCAD drawing.

Four retrospectively identified features in the Turf Mound at West Cotton, which had been named pits A, B, C and D, were given the context numbers 7399–7402 respectively.

The contour and surface modelling data provided with the archive were added to this drawing on layers contours and terrain-tin respectively.

SS8.2.4 Converting the a-spatial archive

The a-spatial archive was very fragmented. After studying the datasets thirty-four MS Access tables were determined as the most up-to-date original tables. Four databases were created (stored in database/archive) called contexts.mdb, enviro.mdb, finds.mdb and metadata.mdb and each table was imported into the appropriate database.

Conversion of Contexts.mdb

A new table was created called CtxT with a primary key of site, context and ctxlay. Field names and types were propagated from analysis of the original constituent data. The field names were redefined to conform to the naming conventions. Detailed descriptors for each field were also added in MS Access.

Some of the fields had compound data values (for example Colour in table irthcontext contained both Munsell and hue, colour, modifier colour descriptions). Where appropriate (for analytical purposes) these fields were standardised. The update and append queries used in the process are all saved within the database. The physical and stratigraphic relationship fields contained embedded one-to-many data (this is probably an inheritance from Delilah). Using bespoke VB code these fields were appended into the table CtxSStr. The phasing information was updated into CtxT as a 1:1 query.

The division between the Irthlingborough and Stanwick databases meant that some pre-Iron Age features were actually part of the predominantly Iron Age and Roman Stanwick archive. The Stanwick archive is stored in a database called RRAD.mdb.

Rather than trying to determine which were the pre-Iron Age datasets, it was determined that the whole context archive and its physical and stratigraphic relationships should be imported into the database. This procedure has the advantage of providing context information for pre-Iron Age finds from later contexts. These queries are stored in the database database\archive\RRAD.mdb. The Stanwick database is still (2003) in the process of development, as the Iron Age and Roman project moves towards publication. Those contexts which are common to it and to this database are indicated in the Stanwick field in CtxT. Those of them which originated in the Irthlingborough project are fuller than those originating in the Stanwick project, for which further information will be found in the Stanwick database.

Conversion of Enviro.mdb

A new table was created called EnvT with a primary key of site, sampno, samptype and bagno. Field names and types were propagated from analysis of the original constituent data. The field names were redefined to conform to the naming conventions. Detailed descriptors for each field were also added in MS Access. Fields that were originally derived from the context table were not imported as, it was assumed, that the context table would contain the most accurate information. The update and append queries used in the process are all saved within the database.

Table Irthsample contains the on-site sample register from Irthlingborough. This table was copied and renamed to EnvTCat. The fields were renamed to conform to the naming convention and the descriptors added. Fields Site and SampNo were used to create the compound primary key.

Both EnvT and EnvTCat are assemblage-level tables (ie they contain all the information about all the ecofacts in one table).

Conversion of finds.mdb

Two new tables were created called ObjT and ObjTCat (both tables have an autonumber primary key as there is no other way to uniquely reference the data) to contain assessment/analysis and the on-site find register respectively. Field names and types were propagated from analysis of the original constituent data. The field names were redefined to conform to the naming conventions. Detailed descriptors for each field were also added in MS Access. Fields that were originally derived from the context table were not imported as, it was assumed, that the context table would contain the most accurate informationF. The update and append queries used in the process are all saved within the database.

Both ObjT and ObjTCat are assemblage-level tables (ie they contain all the information about all the objects in one table).

When all the object data had been imported, the local grid references were converted into OS grid using the algorithms contained in 'SS8.2.3 Converting the spatial archive'.

Integration of the converted data

A new database called RndsRaw.mdb was created. All of the tables created above were imported into this new table. The tables were linked according to the relationships in Figure SS8.1. Two further databases were created, by 'linking' tables from RndsRaw.mdb, to store and maintain the form interface and queries (RndsForm.mdb and RndsQury.mdb respectively in Figure SS8.2). This tripartite structure was used to aid long-term data management. Forms and form-related information are stored in RndsForm.mdb, queries are stored in RndsQury.mdb, and all the raw data and data validation queries are stored in RndsRaw.mdb.

Other information of limited interpretative value (photo registers, drawing registers, environmental processing summaries etc.) is stored with all the other 'original data' in a separate database called RndsArch.mdb.

Many artefacts, ecofacts and contexts did not have co-ordinates. Co-ordinates were supplied by exporting the centroids as comma delimited xcoord, ycoord and CompKey. This data was updated into the context table and then propagated throughout the rest of the tables through its relational links.

Metadata tables

Three metadata tables (Site, MetaT and MetaTDB) were created to store project summary, dataset and database metadata respectively. Table MetaT conforms to Dublin core specifications.

Ancillary tables

The radiocarbon database was supplied from the datelist provided by Alex Bayliss (SS6). This table was imported into the database and named C14T.

Creation of lookup tables

Prior to creating lookup tables each appropriate field was checked and corrected for internal standardisation (eg PH, P-H, post hole, posthole and typo variants all refer to Posthole). In comparison to the provided data dictionaries some values did not make sense (in the final lookup tables they were referenced as' 'Unknown Value. Possibly Typo'). It is possible that these are derived from missing delimiters in Delilah.

Lookup tables (data dictionaries or thesauri) were created for appropriate fields in all tables. These were created by grouping make table queries (these queries are stored in \database\archive\thesauri.mdb). Once created each table had a new field added to hold a non-codified long text entry. Some tables had extra fields added to further group the data (eg ObjLRed's field RedSeq1 classifies a flint flake as primary, secondary or tertiary). It is recommended that this be carried out for as many of the lookup tables as appropriate to enhance future analyses. The lookup tables were linked through to their appropriate fields. These relationships are defined in DBObjMod.pdf.

Some lookup tables contain compound data values (eg ObjLRet contains the multiple retouch values for each retouched flint artefact). This will need normalising at the table level.

SS8.2.5 Data directory structure

Within the parent, Raunds, directory there are two subdirectories:

Database subdirectory

Within the subdirectory Database reside the four primary MS Access databases. The subdirectory Archive contains the archived datasets (contained within Old_DB.zip) that contain the majority of update, integration and thesauri queries run throughout the course of the conversion project. The subdirectory code contains the visual basic code used in the conversion.

Vector subdirectory

Within the subdirectory Vector reside all the vector datasets. This directory is subdivided into CAD, G-Sys, and Shape to store software-related data. All the datasets in G-Sys and Shape have been derived from data contained in the CAD subdirectory.

SS8.2.6 Future recommendations

Data entry

It is recommended that all outstanding datasets are integrated into the archive. In particular, the Oxford Archaeological Unit's Redlands Farm archive (raw, a-spatial and spatial data, rather than synthetic) would make a more complete dataset.

It may also be considered appropriate to fully integrate the Raunds Prehistoric plan with the redigitised Stanwick plan, or at least update this plan from it.

Extra fields should be added to the lookup tables to facilitate more refined grouping.

Data normalisation

Some fields within the database structure have remained unnormalised. This was due to the time and cost constraints of the project. It may be considered appropriate to fully normalise the field that contain multiple information events (For example see the fields L1, L2 and L3 in ObjT).

Data validation

These datasets are essentially unvalidated. It is strongly recommended that some programme of validation be initiated. This should include checking the links between the GIS plan and the database (ie checking that all drawing links correlate with the correct Cut, Group or Layer numbers) and logical consistency checks within the database (ie checking that all cuts can access the correct fills in the table CtxSStr). The results of this validation procedure should be entered into the metadata.

Database articulation

A small form-driven interface was created for the archive. Currently this interface only provides basic functionality and should not be used for such tasks as data entry or data validation. If it is deemed desirable then a more integrated form interface, within which specific queries, forms and pivot tables, can be designed.

Data deposition

With the exception of minor project-related metadata documentation this archive is ready for deposition with an organisation such as the ADS. The project-related metadata is stored in the project database. It is imperative that the metadata component is updated to respond to changes in the project archive. However, the Raunds Prehistoric archive is a part of the complete Raunds archive. It is important to embed this information into the project metadata. This has particular relevance to the spatial archive. English Heritage has completely redigitised the Stanwick spatial dataset from the original site plans. The conversion team were unaware of this work prior to commencement. Thus, the Raunds Prehistoric spatial dataset is based upon the original digital product which is of inferior quality. However, this is an 'intelligent', GIS-ready dataset as opposed to the redigitised EH archive. Thus, both datasets need depositing as they contain different information sets.

SS8.2.7 Caveat

These datasets represent the conversion and integration of the Raunds Prehistoric archive conducted over October to December 2001. This archive has been converted for digital purposes only and has not undergone further validation. Therefore, any problems or inconsistencies inherent in the original archive have also been converted. Furthermore, the conversion team cannot be held responsible for the quality or accuracy of any data added to these datasets after the initial conversion process.

Appendix. Naming conventions

Where possible all files, folders, tables and fields are named with a maximum of eight characters. All metadata pertaining to the files is stored in the MetaT table within RndsRaw.mdb. Table and field metadata are maintained within Access 'descriptors'. Furthermore, more specific metadata for the tables is stored in the MetaTDB table within RndsRaw.mdb.

Tables within the database are named to a strict hierarchy. A maximum of the first four characters are used to display the tables primary relationship (ie Context is referred to as Ctx), the next character refers to the table type (ie T = Main table, S = Sub Table, J = Junction table and L = Lookup Table) the remaining characters are used to provide further information. For example the Lookup Table that contains Material Types for the Object Table is called ObjLMat.

Due to the complexity of the archive, the names of layers within AutoCAD are allowed to be greater than eight characters. Table SS8.1 shows the layer names and types used in RndsPlan.dwg.

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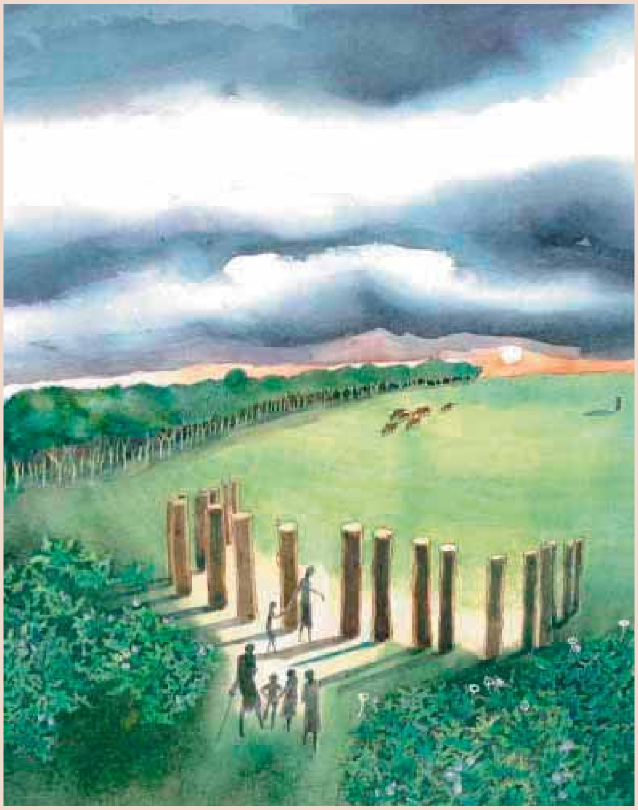
The Raunds Area Project investigated more than 20 Neolithic and Bronze Age monuments in the Nene Valley – West Cotton, Stanwick and Irthlingborough, Northamptonshire.

By *c* 5000 BC the confluence of the River Nene and a tributary had become a regular stopping-place for flint knapping and a range of domestic tasks. Soon after 4000 cal BC the Long Mound, a 135m-long landmark had been built there.

Three other monuments – the Long Barrow, the north part of the Turf Mound and the Avenue – were also built in the first half of the 4th millennium. Plant, insect and pollen evidence, including opium poppy seeds, show that the Long Barrow stood in a lightly grazed clearing in cleared woodland.

By *c* 3000 cal BC a chain of five or six diverse monuments stretched along the river bank (the Long Mound, the Long Enclosure, the Turf Mound, the Causewayed Ring Ditch, the Avenue, perhaps the Southern Enclosure, and the Long Barrow). Domestic settlements were probably in the nearby valley.

During the next 500 years or so the monuments were increasingly neglected and woodland cover increased on and around them. The Riverside Structure, a timber platform at the edge of a channel of the Nene, was the only major new construction. The focus of ceremonial activity may have shifted to a little-understood monument, the Cotton 'Henge', which survives as two concentric ditches on the occupied valley side.



By *c* 2200 cal BC the valley was more heavily grazed and less wooded. Monument building accelerated and included the Segmented Ditch Circle and at least 20 round barrows, almost all containing burials. The most outstanding is of a male inhumation in Barrow 1, accompanied by numerous artefacts, some of them exotic, covered by a limestone cairn and then by a heap of about 200 defleshed cattle skulls. The barrows were progressively enlarged, as cremation gradually became the normal burial rite.

The valley bottom remained uninhabited, while settlement extended along the valley sides and extended onto the surrounding Boulder Clay plateau. Cremation burial continued in and around the mounds until *c* 1000 cal BC, by which time two overlapping systems of paddocks and droveways had been laid out. The terrace began to be settled when these had gone out of use, in the early 1st millennium cal BC.

Front cover (background) Reconstruction of the West Cotton monument complex in the early 2nd millennium Cal BC. (left to right) Long Mound: east-central area with later features and gully (photo Northamptonshire County Council); Red deer antler exposed near the Turf Mound (photo Northamptonshire County Council); Shale armlet from the Long Barrow (photo Michael Dudley); Part of field system and related structures in Trench B99 (photo English Heritage).
Back cover: A reconstruction by Judith Dobie of the primary features of the Long Barrow. The opium poppies shown in the foreground were represented by seeds found in the waterlogged fills of the ditches that flanked the mound.

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