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Hardham Camp Coldwaltham, West Sussex: Report on Geophysical Surveys, October 1997

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Summary

A geophysical survey was carried out at Hardham Camp, one of a series of Roman Stations situated on Stane Street in West Sussex. The aim of the survey was to provide evidence of the precise form and extent of the monument to support a reassessment of the site by the Monuments Protection Programme for the purpose of reviewing the scheduled area. Despite a generally poor geophysical response, the survey successfully defined the layout of the monument in relation to Stane Street revealing that it is rather more regular and symmetrical in plan than previously thought. The survey also provided new detail of the form of the defensive earthworks and evidence of features in the interior although no clear indications of any substantial masonry buildings were detected. Archaeological activity in the form of ditches, pits and smaller enclosures was also shown to continue beyond the boundaries of the enclosed area to the east and west along the route of Stane Street. The survey thus significantly extends knowledge of a previously poorly understoood Roman site of considerable importance.

Keywords

Geophysics

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Hardham Camp, Coldwaltham, West Sussex

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INTRODUCTION

A geophysical survey was carried out by the former Ancient Monuments Laboratory at Hardham Camp - a Roman site positioned on Stane Street at NGR TQ 031174 in West Sussex. The survey was commissioned by the Monuments Protection Programme (MPP) with the aim of improving understanding of the monument to enable assessment of its importance and to assist with a review of the extent of the current scheduling (SAM WS 125).

The camp at Hardham consists of a roughly square enclosure 1.4 hectares in area defined by earthwork defences of Roman type laid out on a north-west/south-east axis across the route of Stane Street. About a third of the enclosure was destroyed in the 1860s by the construction of the cutting for the now disused Mid-Sussex railway line, which ran through the centre of the site. Quarries for ballast material contemporary with the railway construction (now deep, flooded and tree-filled depressions) on each side of the railway cutting, have further damaged the interior of the enclosure. The remaining undisturbed parts of the site now lie in two pasture fields separated by the former railway cutting (see Figure 1). The enclosure survives best in the north field as a raised platform edged by a steep bank with traces of outer ditches. In the southern field, the defences have been reduced by ploughing and are much harder to trace on the surface. No original entrances or internal structures are now recognisable on the ground.

Despite some limited excavation by S E Winbolt in the north-eastern corner of the enclosure in 1926 (Winbolt 1927) and evidence from finds recorded during the railway construction, the site is still poorly understood. Both the character and the form of the enclosure are unclear. Based on the limited evidence available, the history of the site appears quite complex. Finds of building materials and pottery sherds have suggested a Roman occupation date between AD50-150 (Curwen, 1954), but it is uncertain whether the earthwork defences relate to this or a later part of the Roman period. Late Iron Age/Early Romano-British cremation burials have also been found both within the enclosure and continuing outside it along the course of Stane Street, but their full extent and relationship to the camp is also uncertain. Various suggestions regarding the original function of the enclosure have been made, such as a quasi-military posting station or *mansio* (Curwen, 1954), but the date-range of the artefacts found indicates multi-period occupation, probably involving functional change and both civil and military use. Other interpretations of the site have included its identification as a minor enclosed roadside settlement (Ordnance Survey Map of Roman Britain), a cemetery, a late Roman military camp and a Claudian fortlet overlying an earlier civilian settlement, both lying beneath a later Roman *burgus* (fortified customs post). These latter interpretations are culled from data held by the National Archaeological Record.

The site is situated at 10m OD on riverine sand and gravel deposits which form a low tongue of land rising above the marshy ground between the Rivers Rother and Arun, 2.5km west of

Pulborough. The underlying solid geology is composed of Upper Cretaceous Gault (Gault is a marly clay) (British Geological Survey 1996).

METHOD

A large-scale magnetometer survey and more limited resistivity and magnetic susceptibility surveys were carried out. All three surveys were based on a grid of 30m squares, set out parallel to and on either side of the dismantled railway (see Figure 1). Since the main aims of the project were to establish the boundaries of the known monument and the extent of any existing archaeological remains around it, a magnetometer survey was carried out initially following standard English Heritage procedure (see Appendix A). Because it is a slower technique to operate, resistivity (see Appendix A) was applied more selectively over a 60m by 90m area to investigate a complex series of magnetic anomalies in the south-western corner of the enclosure tentatively interpreted as possible building remains. To complement the magnetometer survey, 100g samples of topsoil were retrieved for magnetic susceptibility measurement at intervals of 30m along a transect crossing through the earthwork enclosure from east to west in the southern of the two fields surveyed (see Figure 1). The samples were taken back to the laboratory, dried and weighed and standardised mass specific low frequency magnetic susceptibility (χ_{LF}) values were then obtained using a Bartington MS1 meter and MS2B bench sensor.

The results of the magnetometer survey are displayed in Figures 3a-b in X-Y traceplot and greyscale form after initial elimination of the effects of instrument drift and reduction of extreme values in the data caused by iron objects. The resistivity results are presented in Figure 4 as graphical traces (4a) and greyscale plots (4b-4e). In addition to the raw data (presented in Figures 4a-c), the results of further data processing are presented in Figures 4d and 4e. This involved firstly the use of a 10m radius Wallis filter to selectively enhance the lower magnitude resistivity variation (4d) followed by the application of a Gaussian low-pass filter of 1m window radius to suppress small scale instrument noise inadvertently emphasised by the Wallis process (Figure 4e). An interpretation of the magnetometer and resistivity data is provided in Figure 5. The magnetic susceptibility data is presented in Figure 6 in the form of a histogram spatially referenced to a plot of the magnetometer data from the southern field. An additional 1:2500 scale interpretation of the magnetometer data is provided on Figure 7 showing the geophysical evidence in relation to the Ordnance Survey plan of the camp.

RESULTS

Alpha-numeric references in bold text correspond to anomalies identified on the interpretation diagrams presented in Figure 5.

Magnetometer Survey

Magnetic anomalies at Hardham are generally weak and poorly defined and the results unfortunately lack overall clarity. Various mathematical enhancement techniques were tried in order to improve the recognition of archaeological detail in the plots, but with limited success.

The earthworks

Despite the generally disappointing response, the magnetometer survey has succeeded in defining the boundaries of the enclosure as a series of intermittent and weakly defined positive and

negative linear magnetic anomalies. Although the outline is indistinct in places, the results are sufficiently clear to indicate that the enclosure is more regular and symmetrical in plan than shown on the 1976 1:2500 Ordnance Survey map (compare Figures 1, 2 and 7). In the magnetometer survey the camp earthworks exhibit the typical plan (square with rounded corners) of a Roman military site or defended settlement[1] and the camp is clearly positioned symmetrically over the course of Stane Street (assuming this is indicated correctly on the OS maps). The geophysical survey evidence also confirms the regular outline of the camp depicted on Winbolt's plan published in 1927.

The magnetometer survey also revealed some detail of the form of the defensive earthworks and evidence of possible structures inside the enclosure. Although the perimeter defences cannot be continuously traced on the survey, their structure can be most clearly seen on the south-west and north-east sides and south-east corner of the enclosure [**A - C**] where they appear as parallel lines of relatively high positive magnetic gradient (readings of up to 5 nT). These possibly represent a system of up to three ditches (or perhaps two separated by a wide berm) with a total width of approximately 12m. Unfortunately their precise form cannot be easily identified because the results lack clarity due to the weak and intermittent nature of the anomalies. Curiously these anomalies are not apparent around the northern side of the enclosure (where a bank still survives as a well-preserved earthwork), possibly because they are filled with or sealed by alluvial deposits, being closer to the river floodplain.

Although no ditches can be distinguished in the magnetic data on the northern side of the earthwork, a linear negative anomaly **[D]** has been located running WSW-ENE which coincides with the inner scarp of the bank shown on the 1976 OS map. Buried wall material often has a lower magnetic susceptibility than the soil sealing it, and the negative linear anomaly could therefore represent part of a perimeter wall around the camp within the line of the outer ditches. This feature might represent the continuation of a fragment of flint wall foundation found near the north-east corner of the camp during Winbolt's 1926 excavation. An inter-vallum road might be another possibility. It is not so well defined around the rest of the enclosure because the extent of other anomalous activity results in a more confused picture.

In places the positive magnetic anomaly from the inner ditch appears to bounded on the inside by linear zones of anomalous readings, 5-7m wide, clearest at points **E**, **F**, **G** and **H** on the interpretation diagram (Figure 5). It is tempting to suggest from the rectangular form of these that they represent ranges of buildings laid out around the perimeter of the camp, but it was not possible to confirm the presence of masonry structures using resistivity survey (see below). It is equally possible that the strong magnetic anomalies could represent further earth-cut features or perhaps the remains of a turf and/or earth rampart. In the first century, the walls of Roman auxiliary forts tended to be constructed from turf or earth and according to Breeze (1994) such ramparts were generally between 4.5 and 7.6m in thickness, similar to the width of anomalies **E - H**. A turf rampart that formed part of the defences around the Roman town of Cataractonium (Catterick) in North Yorkshire was previously detected in a magnetometer survey as a slight positive magnetic anomaly (Cole, forthcoming). This is one case where trial excavation will

[1] The plan of the ditches revealed by the magnetometer survey is similar in layout to defended settlements on the line of Watling Street in Staffordshire at *Letocetum* (Wall) and *Pennocrucium* (Water Eaton) according to plans published in Welfare and Swan (1995).

probably be required to determine the precise nature of the features.

A further possible explanation for anomalies around the inner perimeter of the camp is that they could represent fired oven structures which were commonly built into the ramparts at Roman forts and camps. This trend was previously noted in a magnetometer survey of the 1st-century Roman vexillation fort at Lake Farm near Wimborne Minster in Dorset. At this site, a line of erratic strong positive anomalies that ran behind the defences were thought to be related to the kilns, hearths and furnaces required by the Roman army to be sited around the periphery of the fort to minimise nuisance and danger of fire (Clark 1990).

The interior of the enclosure

i) Southern part

The most obvious feature here is a sinuous negative linear anomaly [**I**] about 2.5 m wide (visible in grid squares 24-26, 30-31 and 38), cutting across the enclosure from the southern corner to the middle of the north-eastern side. Because the alignment of this anomaly is not straight and it cuts unconformably across the Roman defences, it is probably not of Roman origin. It may represent a later roadway making use of the higher ground (which forms a natural route-way for communications) on which the camp is situated. The linear feature may be heading towards a gap in the old defences in the middle of the north-east side of the camp where Stane Street is presumed to run, although this cannot be confirmed because of the break in the survey caused by the later railway. The negative magnetic response suggests the presence of a metalled or paved road surface constructed from material with a lower magnetic susceptibility than the soil in which it is buried. Winbolt's 1927 plan shows a "disused track to Hardham Mill" in a similar position to anomaly **I**; however, whilst on a similar heading, this corresponds more closely with the resistivity anomaly [**R5**] discussed below. A further possibility is that anomaly **I** represents the line of a former field boundary.

To the north of the negative linear [**I**] there is an appreciable increase in magnetic activity inside the enclosure, while there is a comparative decrease in activity to the south. These trends are accompanied by corresponding changes in topsoil magnetic susceptibility (see Figure 6). Although this could be a reflection of more recent activity related to the construction and use of the railway line, the zone of generalised magnetic disturbance that occurs north of [**I**] is probably related to archaeological activity along the course of Stane Street. Unfortunately the image is not sufficiently coherent to discern distinct structural patterning in the data such as the outlines of former buildings. This is perhaps not surprising as buildings were generally constructed from timber during the early period of Roman occupation and would therefore leave only slight traces in the soil detectable by magnetometer or resistivity survey. One group of positive magnetic anomalies at [**J**] in the form of a semi-oval with an easterly extension may represent the bedding trenches of a former large timber structure, the foundation trenches of a robbed stone building, a burnt or fired structure, or other ditches or gullies of unknown purpose. (The National Archaeological Record contains a reference to an alleged ploughed-out barrow at Hardham Roman Station). Low resistance readings recorded over the same area also suggest the presence of a circular or oval ditch or gully. The exact nature of this interesting feature will need to be resolved by more intrusive methods. Immediately west of the oval feature is an isolated intense positive magnetic anomaly [**K**], with a magnitude of about 85 nT, characteristic of thermally magnetised features associated with industrial activity such as hearths, kilns or furnaces. Several similar anomalies occur at various points around the perimeter of the enclosure at [**L**, **M** and **N**].

This could indicate that the kiln material found by Winbolt near the north-east corner of the camp is part of a wider trend where industrial activity was located around the periphery of the enclosure away from buildings to prevent fire risk. As mentioned previously, zonation of such features is already known at other Roman forts.

The area of generalised magnetic disturbance is sub-divided in the eastern half of the camp by a couple of linear positive anomalies at [**O**] and [**P**] running south-east to north-west at right angles to Stane Street. These may represent ditches or gullies marking internal boundaries. The line of the eastern of the two linear anomalies [**P**] may possibly continue outside the enclosure to the south as a linear positive anomaly at [**Q**]. It is possible that this represents the course of a contemporary roadway running into the camp from the south-east forming a T-junction with Stane Street somewhere within the area destroyed by the construction of the railway cutting. The response to the ditches around the southern side of the enclosure is interrupted where the line of this possible roadway passes through them adding further weight to this interpretation.

A scatter of moderately strong discrete positive anomalies east of linear anomaly [**O**] may represent large infilled pits, buried hearths or ovens and two parallel strongly positive linear anomalies running east-west at [**R**] close to the modern field boundary may also be of archaeological significance.

ii) Northern part

The response within the northern part of the enclosure shows the same heightened magnetic disturbance and confused pattern of anomalous activity as the area immediately south of the former railway cutting. Amongst the general disturbance some individual anomalies can be recognised, including several discrete positive pit-type anomalies [**S**] and a weak curvilinear negative anomaly [**T**] that could represent a cobbled or metalled pathway or perhaps remains of a buried wall (the width of the anomaly makes this less likely). A narrower negative linear anomaly [**U**] cutting across the angle formed by the north-east corner of the camp coincides with the position of a long excavation trench cut across the interior of the camp by Winbolt in 1926 from which most of what is known about the site is based. This limited intervention uncovered several burials and a large tip of broken pottery vessels and this could account for the noisy but not very revealing magnetic response in the area. Just inside the north-eastern corner of the enclosure is another sharp strongly positive discrete anomaly [**L**], with a maximum strength of +50 nT, similar to those located near the other corners of the camp. This anomaly could potentially represent a pottery kiln, the presence of which is suggested by the recovery of large numbers of pottery wasters found in the vicinity by Winbolt.

Activity beyond the enclosure

As might be expected archaeological activity continues beyond the confines of the earthwork enclosure to the east and west along the course of Stane Street. Numerous large pit-type features are present and several linear ditches with adjoining sub-rectangular ditched enclosures [**V** and **W**]. It is possible that the pit-type anomalies represent more of the Belgic shaft burials that have previously been unearthed in the vicinity. The extra-mural activity probably extends beyond the limits of the survey, which is therefore not extensive enough to reveal the overall pattern.

Resistivity Survey

The resistivity survey included the western part of the interior of the southern portion of the enclosure and the south-west corner and western sections of the boundary earthworks. This area contains the interesting linear distribution of positive magnetic anomalies previously described (**H** on Figure 5) running alongside the inner edge of the western section of the defences. It was initially thought that this narrow strip of anomalies might represent the position of a long rectangular building such as a barrack block or *mansio*. It was in order to explore this possibly that the resistivity survey was positioned in the south-west area of the site.

The resistivity survey has resolved up to two outer ditches [**R1** and **R2**] as wide curving low resistance anomalies east of the south-west corner of the enclosure. North of the corner these anomalies disappear but instead become clearly visible in the magnetometer data. This suggests there must be some change in the fill characteristics of the ditches. The narrow rectilinear magnetically disturbed strip at **H** immediately adjacent to the eastern defences appears in the resistivity as a zone of uniformly low resistance [**R3**]. This is indicative of a water-retentive feature and on this basis the presence here of masonry building remains seems unlikely.

A high resistance area [**R4**] is apparent bounding the course of Stane Street immediately north of the oval anomaly at **J** defined by the magnetometer (also vaguely resolved as a weak low resistance anomaly). The high resistance may relate to the course of Stane Street or perhaps a building located adjacent to it, but could also relate to later activity associated with the railway cutting or the rabbit disturbance observed in this area at the time of the survey. Roman brick and tile has previously been noted in the sides of the railway cutting and therefore the presence of a high resistance masonry structure at **R4** would be reasonable.

A low resistance linear anomaly [**R5**] cuts across the western boundary of the enclosure just north of the point where the defences begin to turn east. This is on a similar alignment to the negative linear anomaly [**I**] mapped by the magnetometer in this area, but when the two surveys are overlain it is clear that it represents a separate feature. The resistivity anomaly is most likely the course of the disused track to Hardham Mill depicted on Winbolt's 1927 plan.

Magnetic susceptibility (MS) measurements

The MS of the lone sample outside the boundary of the enclosure to the north (see Figure 6) was particularly low in relation to the rest of the samples suggesting a fall-off in archaeological activity in this direction. The greatest rise in the MS values (from 46.5 to 82.0 $m^3/Kg^{-1} \times 10^{-8}$) occurs in the vicinity of the oval feature [**J**] and the possible fired feature [**K**] adjacent to it. The MS continues to increase as the sample transect converges on the course of Stane Street suggesting, together with the magnetometer survey, that archaeological activity was most concentrated in the zone bordering the road corridor.

CONCLUSIONS

The survey has added important new information on the extent and plan of Hardham Camp, achieving one of the main aims of the project. The resulting revised plan of the site is in general agreement with Winbolt's earlier plan published in 1927, but the depiction of the site on modern OS maps (based on surface observation after the site had been partially levelled by ploughing), is now shown to be misleading (see Figure 7). The current scheduling significantly underestimates

the size of the enclosure and presently fails to include the majority of the defences of the camp except for those on the north side where they are more easily recognisable on the surface.

The survey has also provided information on the form of the defensive earthworks surrounding the site. These appear to consist of two or more concentric ditches and exhibit the typical plan (square/rectangle with rounded corners) of a Roman military site or defended settlement. Wider more intermittent anomalies on the inside of the ditches are difficult to interpret but may represent the remains of a turf or earth-built rampart.

It was hoped that it would be possible to gain a better understanding of the internal character of the site from the geophysical evidence. Unfortunately because survey was not possible in the central area, due to the former railway cutting, it was only possible to recover fragmentary detail of the internal layout of the camp. With such a large break in the survey coverage, it is difficult to interpret the resulting partial and truncated pattern of anomalies in the camp interior with any confidence.

Internal activity is not even throughout the enclosure and appears to cluster along the course of Stane Street. This pattern seems to continue outside the enclosure suggesting that the earthworks of Hardham Camp may have been superimposed on an earlier settlement pattern related to Stane Street as suggested by Davies (1995). The level of magnetic variation in the northern two-thirds of the enclosure suggests that former activity inside it was widespread, but it is difficult to discern any distinct structures in these anomalous regions. It is possible that the confused response could reflect former ground disturbance from ploughing, localised gravel quarrying or activity associated with the railway. If archaeological features have been badly disturbed and fired-clay building-materials such as brick and roof tile have been dispersed through the soil, this could account for the confused magnetic response recorded over much of the site.

The results indicate that some archaeological activity - including ditches (some defining sub-rectangular enclosures) and scattered pit-type features - spreads beyond the perimeter of the camp and the confines of the survey. Because only a limited margin around the enclosure was surveyed it is difficult to read any overall pattern into this extra-mural activity or interpret its precise archaeological significance. Further survey will be required to define the full extent of the complex, particularly to the south, where archaeological anomalies are still present at the southern limit of the survey. Anomalous activity appears to fall off towards the northern limit of the survey, but this may be an effect of the low lying poorly drained floodplain of the Rother which may act as a barrier to obtaining further useful results in this direction.

Surveyed by : Emma Bray
Andy Payne

October 1997

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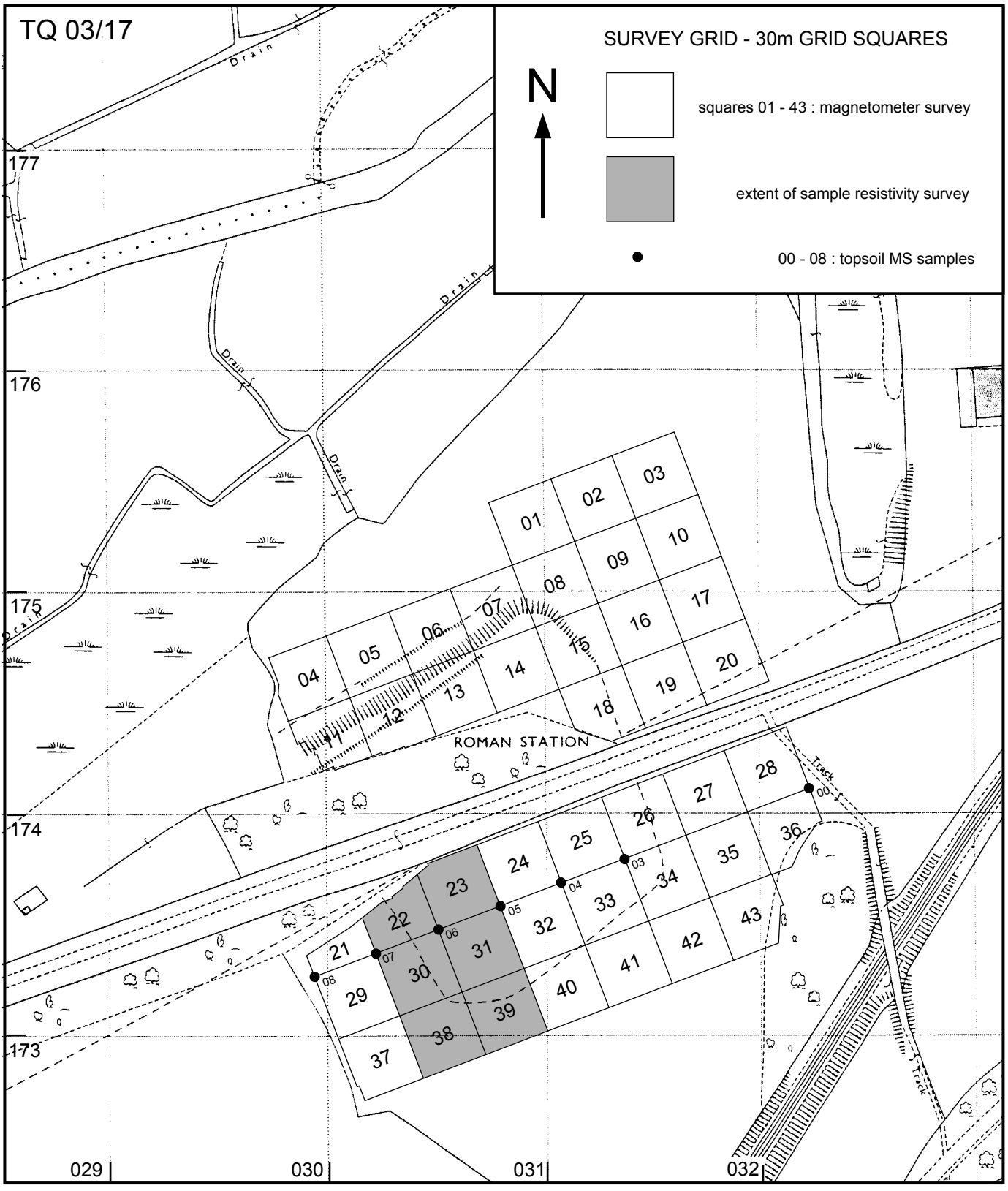
Figure 1: HARDHAM CAMP, COLDWALTHAM, W. SUSSEX

Location of Geophysical Surveys, October 1997

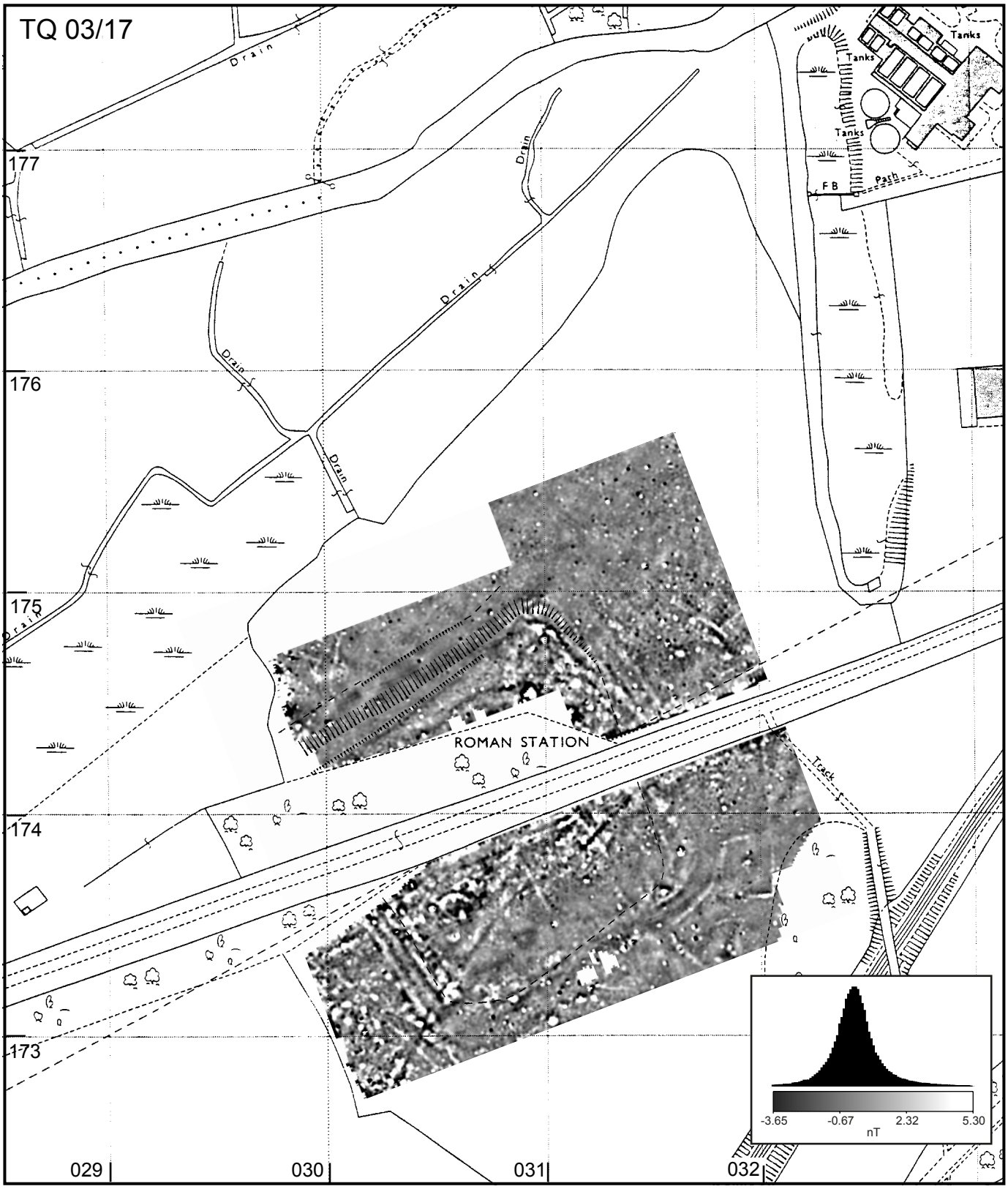


Scale

0 50 100 150m

Figure 2: HARDHAM CAMP, COLDWALTHAM, W. SUSSEX

Location of Fluxgate Magnetometer Survey, October 1997



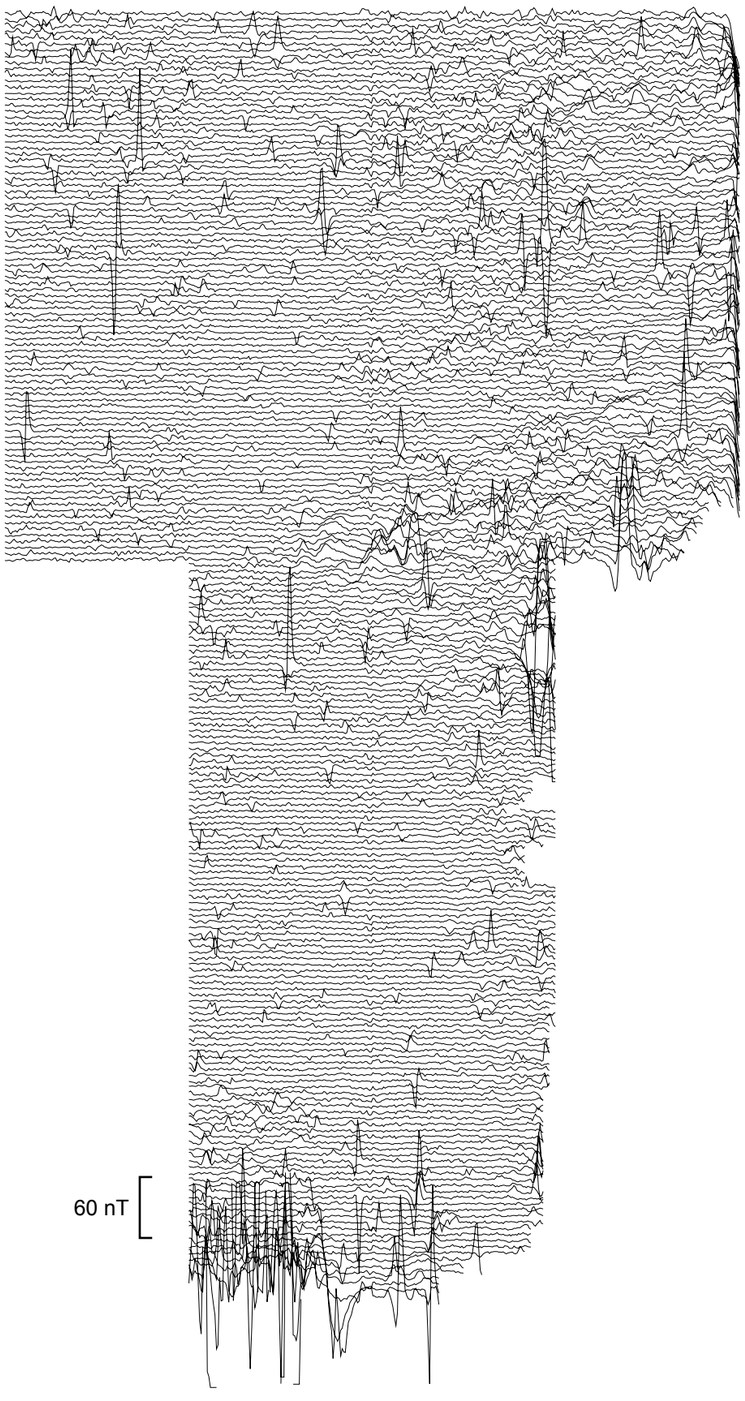
Scale

0 50 100 150m

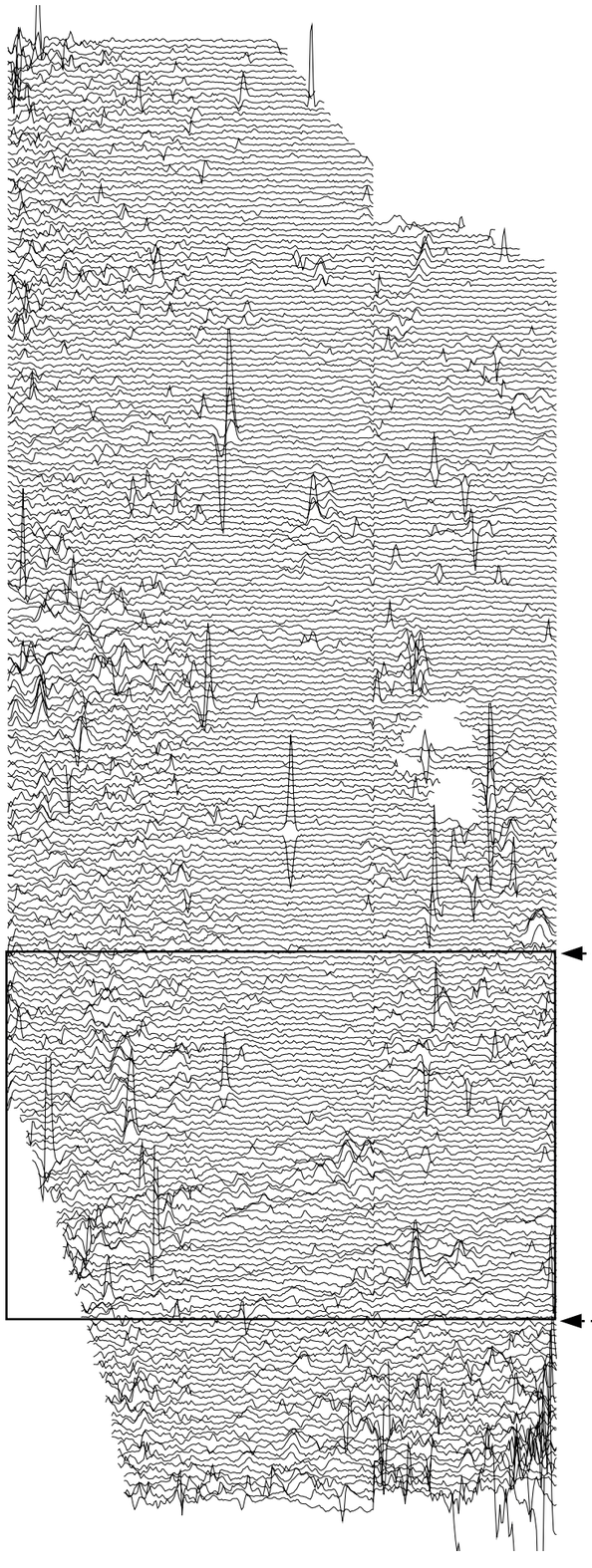
FIGURE 3(A)

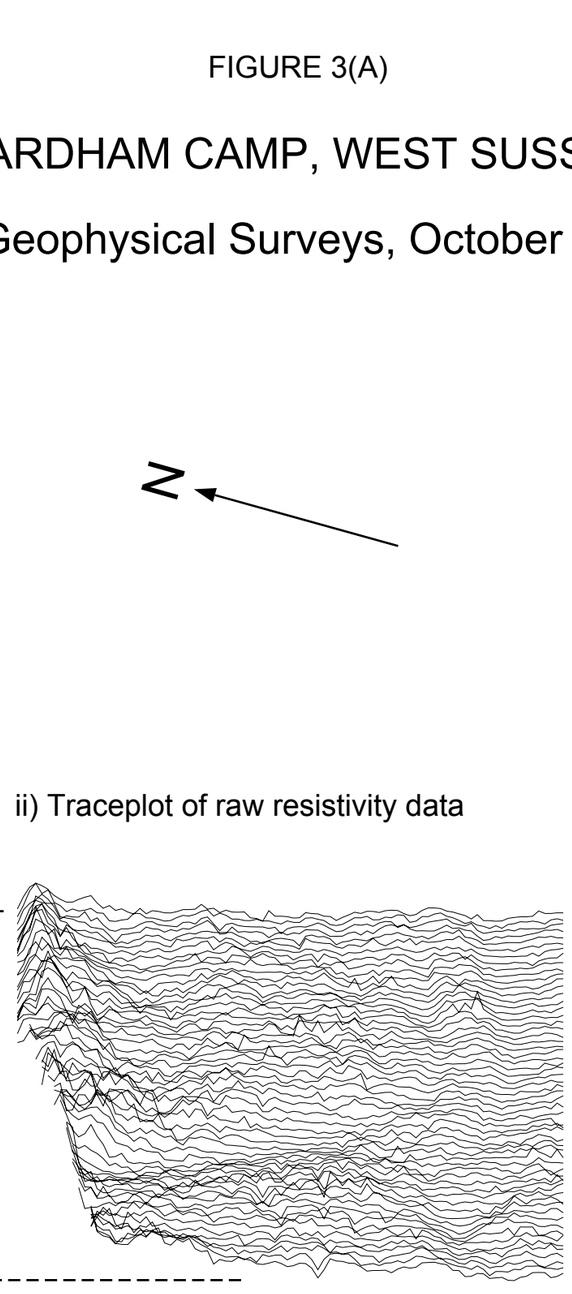
HARDHAM CAMP, WEST SUSSEX

Geophysical Surveys, October 1997



i) Traceplot of raw magnetometer data





ii) Traceplot of raw resistivity data

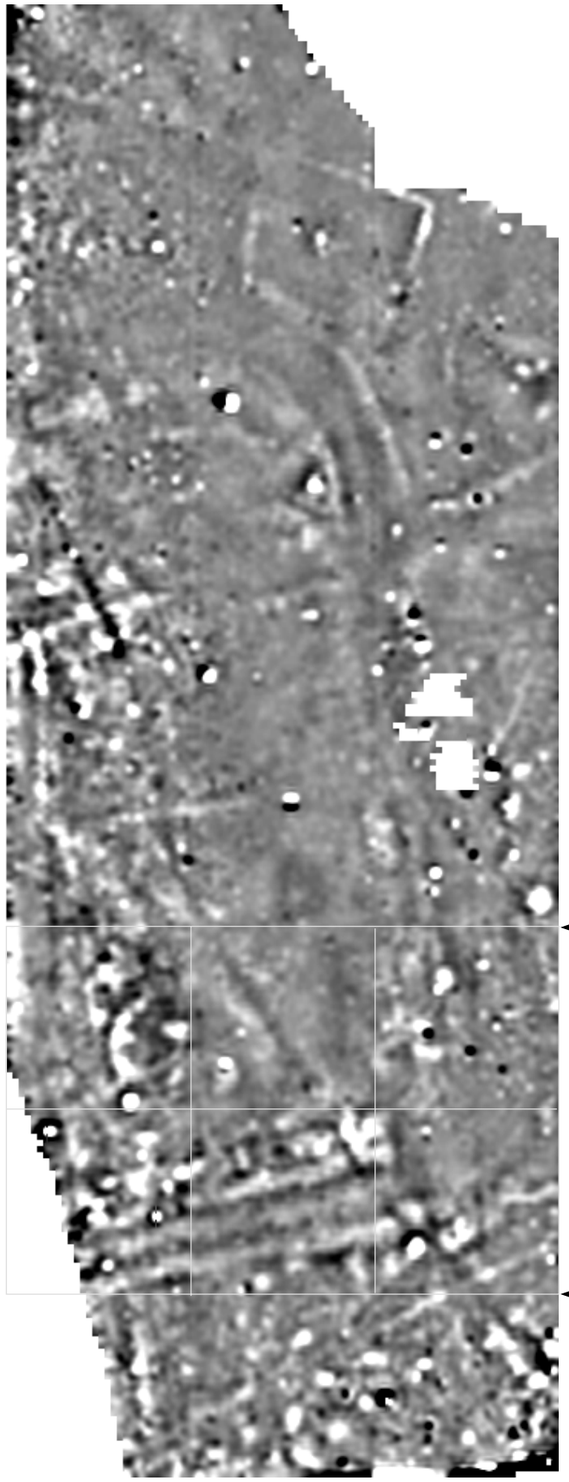
N

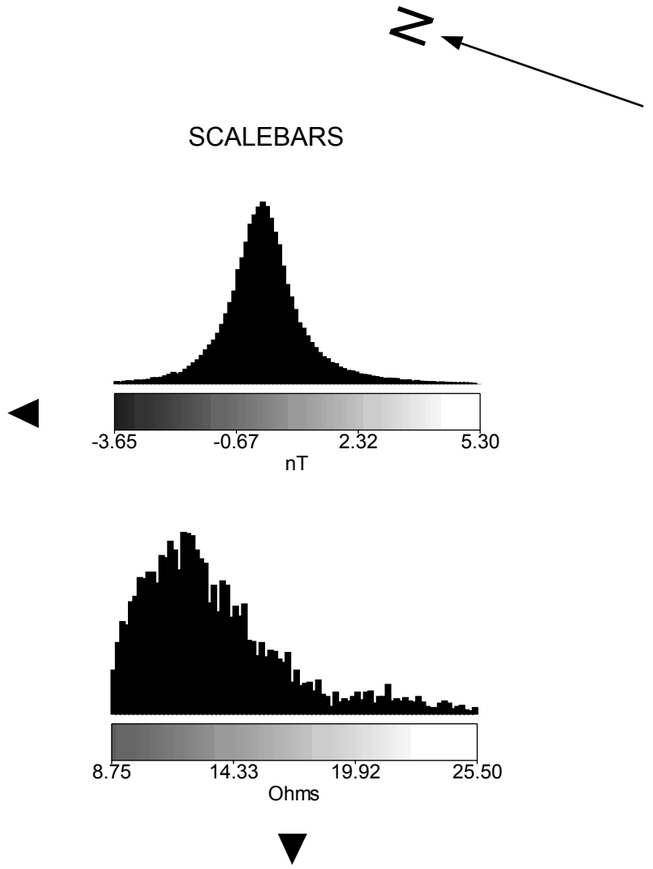
0 90m

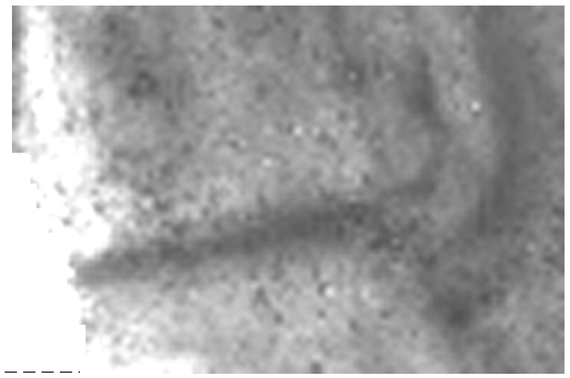
Scale

FIGURE 3(B)

HARDHAM CAMP, WEST SUSSEX Geophysical Surveys, October 1997





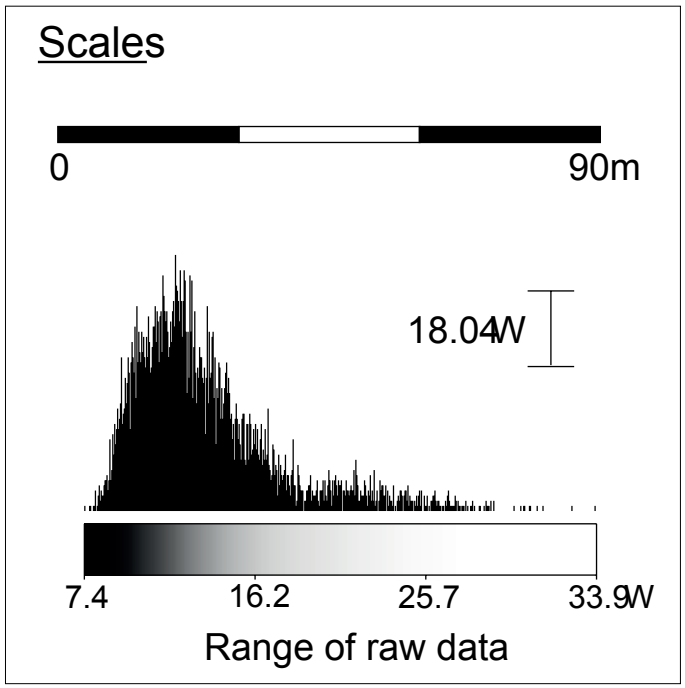


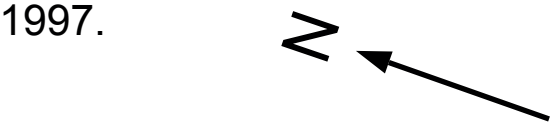
a) Greyscale plot of processed magnetometer data with position of resistivity survey indicated

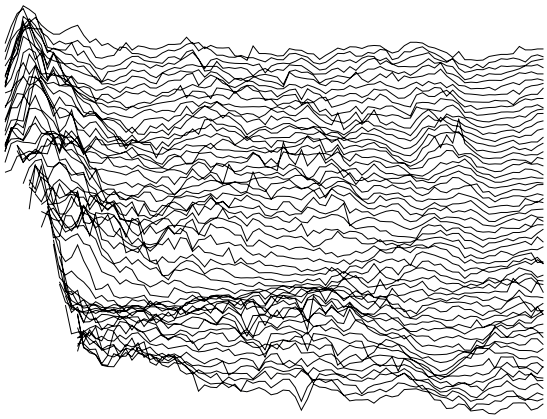
b) Greyscale plot of raw resistivity data

0 — 90m
Scale

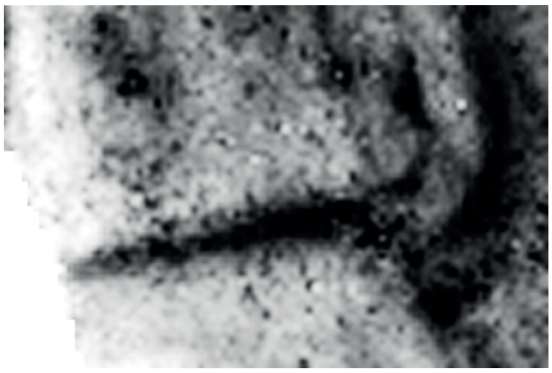
Figure 4 : HARDHAM CAMP, WEST SUSSEX
Resistivity Survey, October 1997.



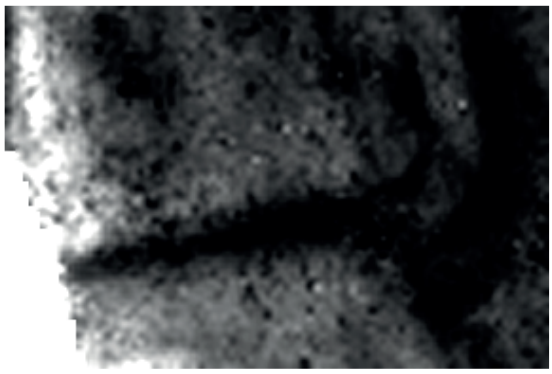




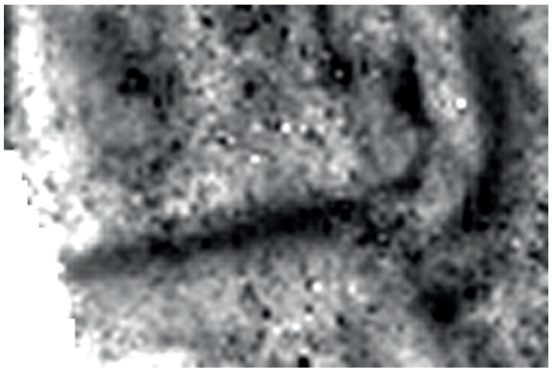
a) Trace plot of raw data



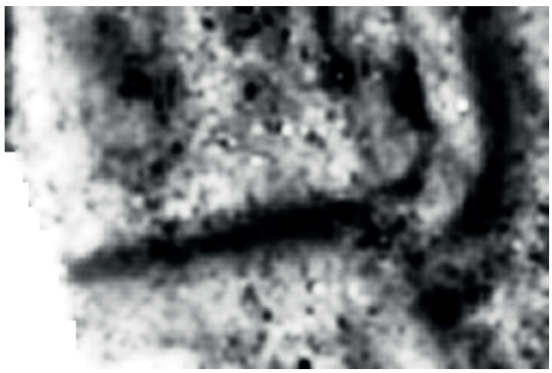
b) Histogram equalised greyscale plot of raw data



c) Linear greyscale plot of raw data



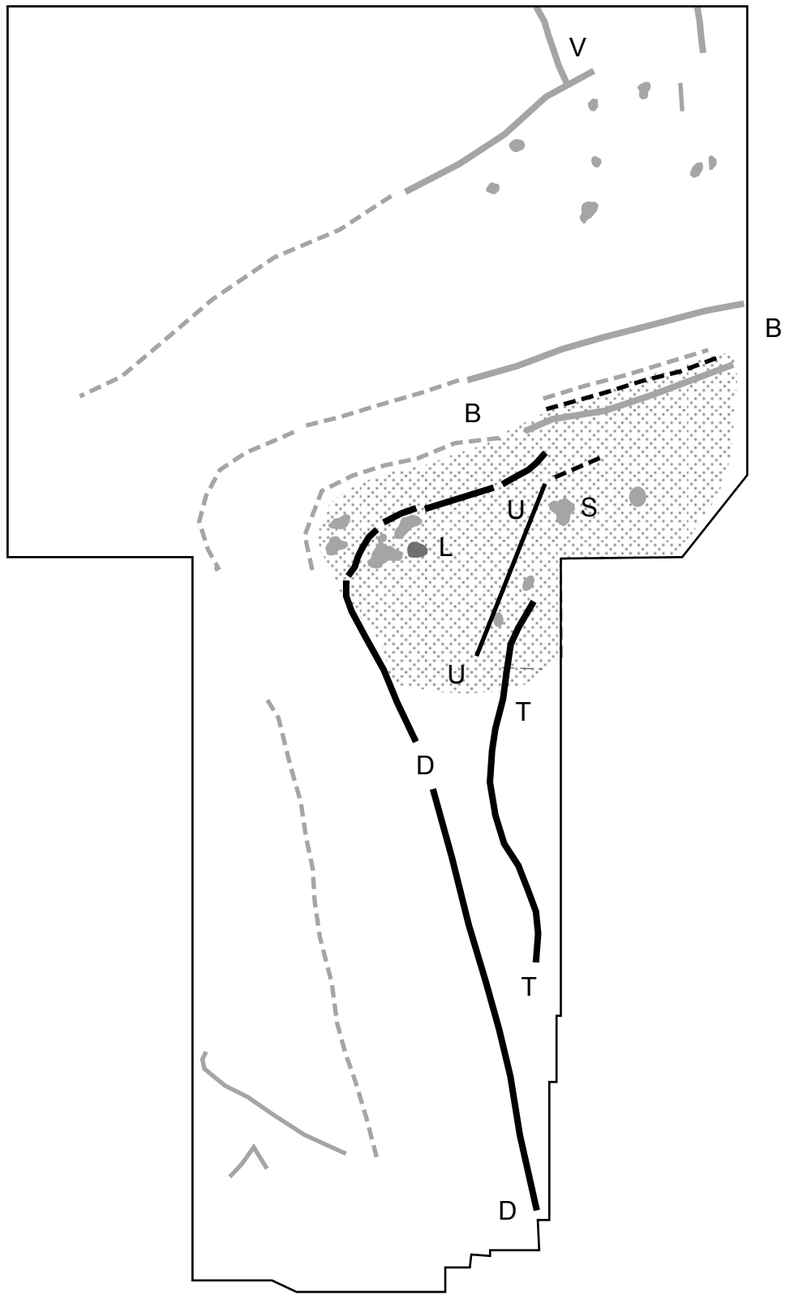
d) Linear greyscale plot of Wallis filtered data

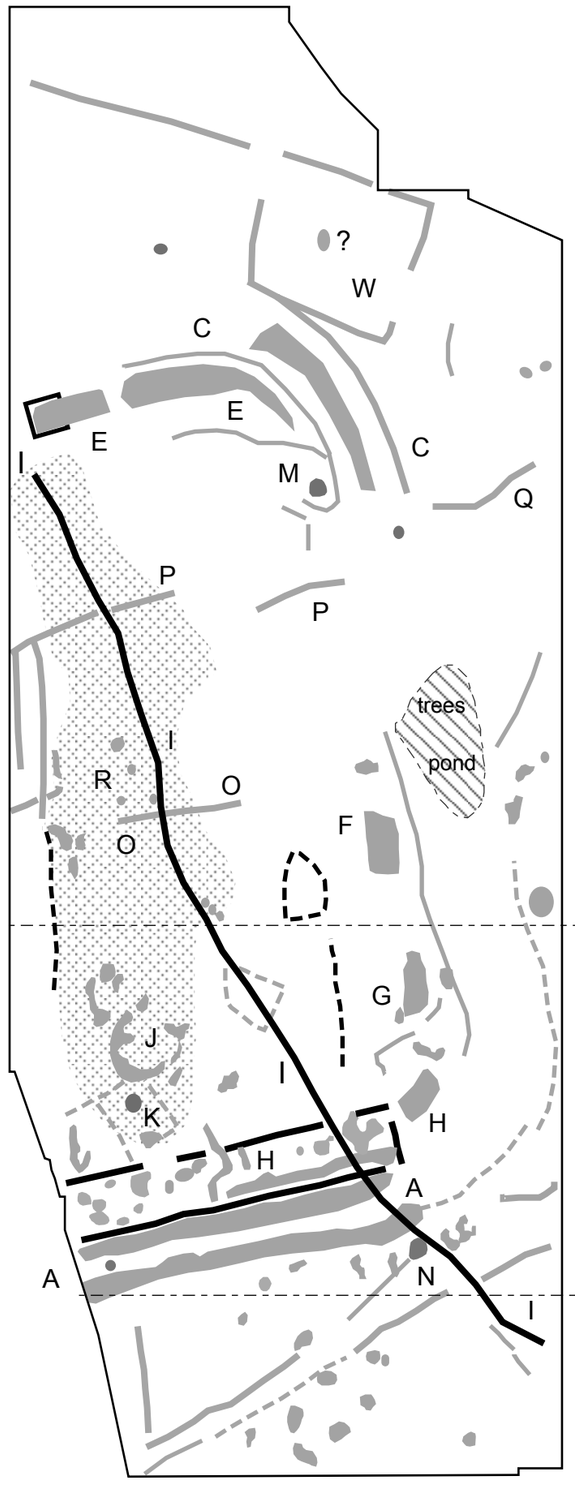


e) Greyscale plot of Gaussian filtered data

FIGURE 5

HARDHAM CAMP, WEST SUSSEX Interpretation of Geophysical Surveys



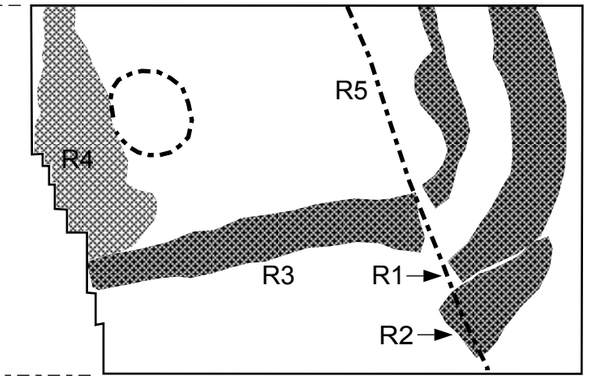


a) Interpretation of magnetometer data

- intense positive magnetic anomaly
- positive magnetic archaeological anomaly
- negative magnetic archaeological anomaly
- area of heightened magnetic disturbance
- suspected archaeological anomaly ?

b) Interpretation of resistivity data

- low resistance linear/curvi-linear anomalies
- area of high resistance
- weaker low resistance anomalies



N

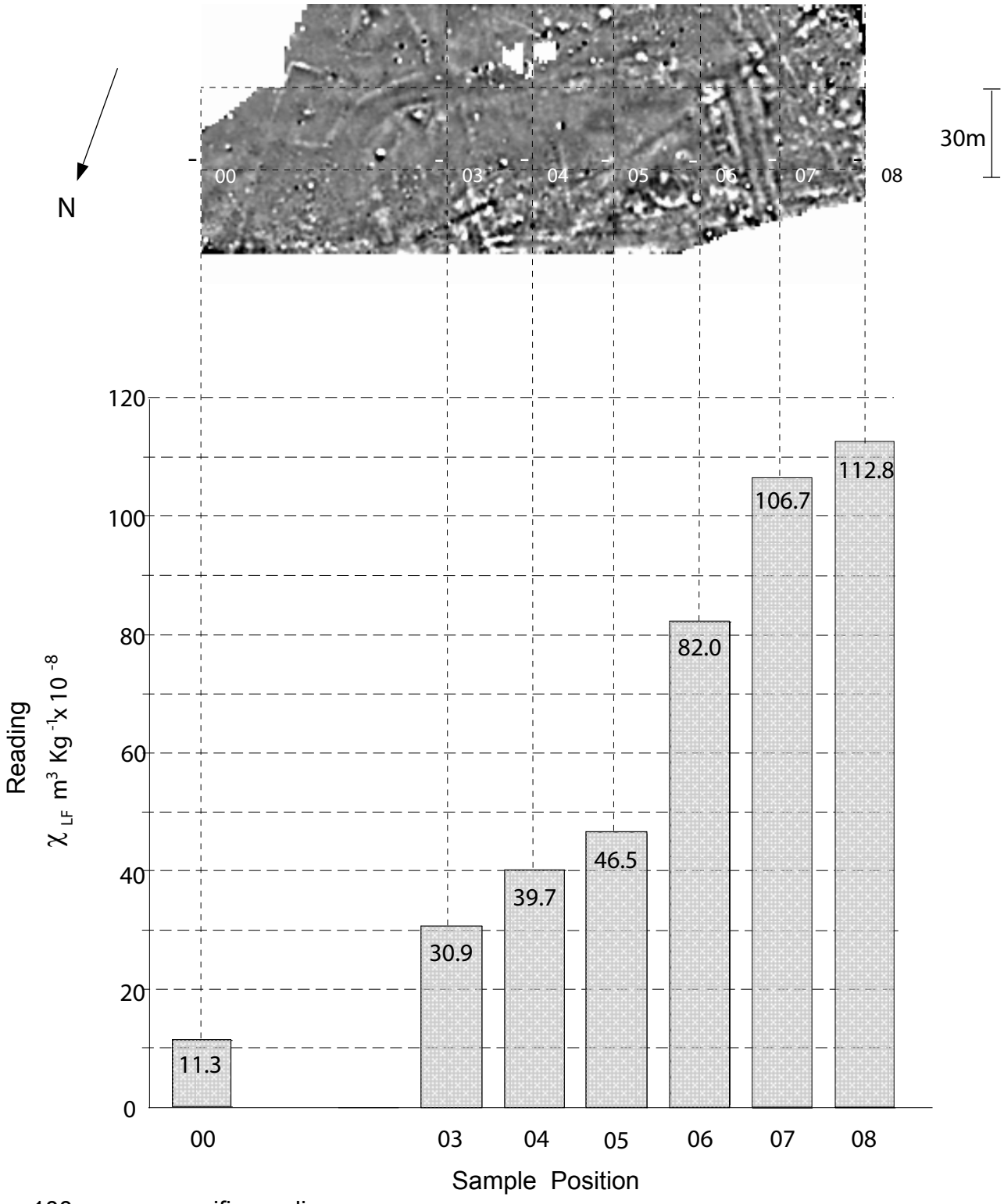
0 — 90m

Scale

Figure 6: HARDHAM CAMP, WEST SUSSEX

Magnetic Susceptibility Data

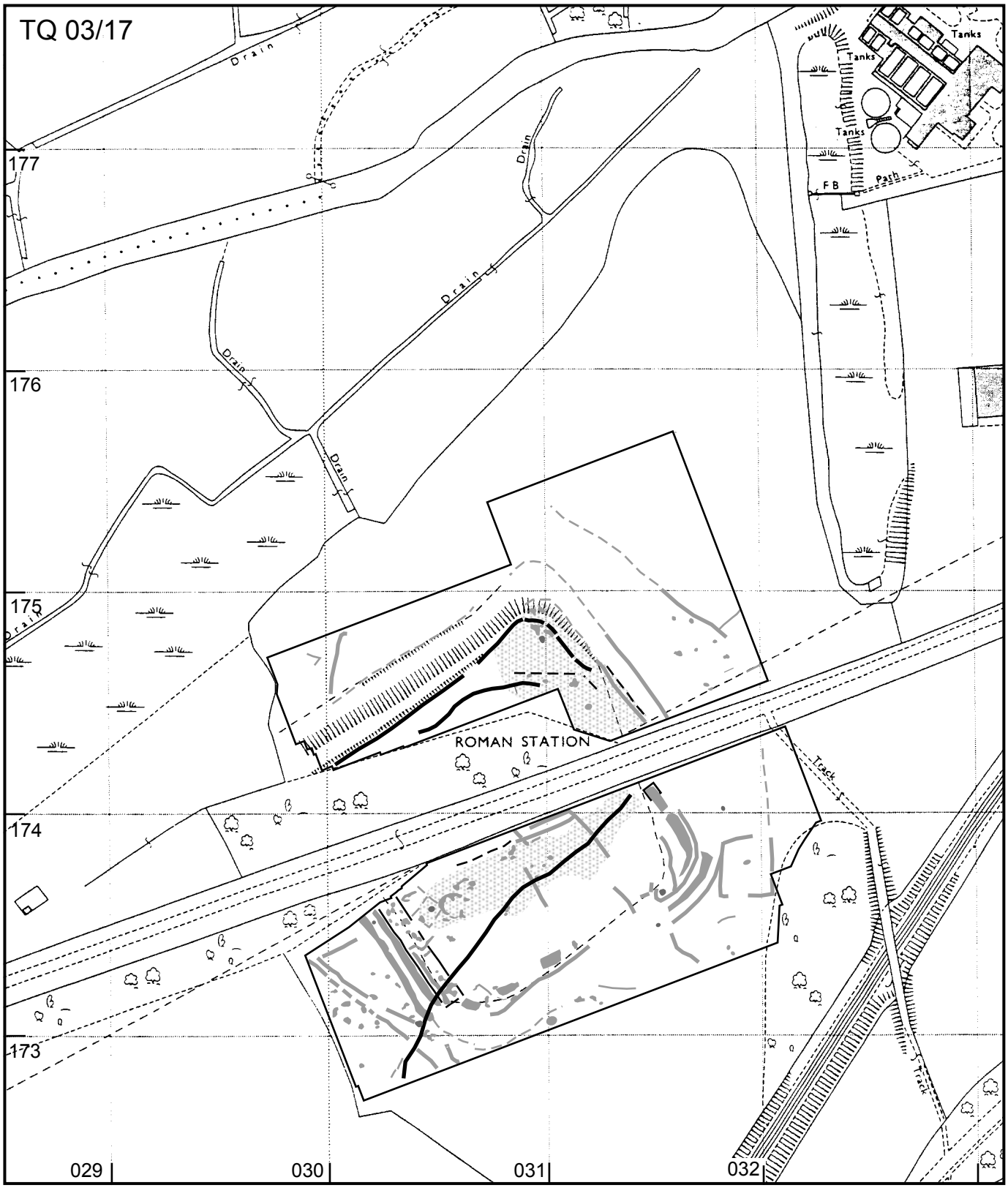
Chart showing field sample position and laboratory-measured mass susceptibility values



100g mass specific readings
Sample interval = 30m

Figure 7: HARDHAM CAMP, COLDWALTHAM, W. SUSSEX

Interpretation of Fluxgate Magnetometer Survey, October 1997



positive magnetic anomalies

negative magnetic anomalies

zone of magnetic disturbance

Scale

0 50 100 150m