Land at Santingley Lane,

Crofton,

Wakefield.

(SE 384 177 site centred)

Additional Gradiometer Survey

Contents

Summary

An additional gradiometer survey totalling 0.72 hectares was carried out at the site of a proposed housing development at Santingley Lane, Crofton. A discontinuous linear anomaly, thought to be a continuation of a ditch forming part of a possible Romano-British enclosure system, two parallel anomalies, indicative of a double ditch trackway, and four positive isolated anomalies, possibly representing pits or areas of burning were detected.

Introduction & Archaeological Background

Archaeological Services (WYAS) was to carry out additional geophysical survey on a proposed housing development site, located to the north of Santingley Lane on the south-eastern edge of Crofton (see Figs 1 & 2).

The site (total area 3.6ha) slopes down from *c.* 80m O.D at the southern end to *c.* 65m O.D at the northern boundary and is situated on Coal Measure sandstone and shales; trial trenching subsequently revealed that the geology varied greatly across the site, often with changes within individual trenches.

The first phase of the archaeological evaluation (Webb 1998) consisted of a gradiometer survey over a 40% sample of the development area which had been specified by the West Yorkshire Sites and Monument Record in advance of the proposed development. The area to be sampled included a field east of the main survey area which, at the time of the original survey, was under mature crop and therefore not available for survey.

Prior to the archaeological evaluation of the site there were no known archaeological remains within the proposed development area, although a cropmark thought to be indicative of a late prehistoric/ Romano-British enclosure had been identified *c.*150m north of the site boundary with a possible associated ditch running south-west towards the application area.

During the sample geophysical survey anomalies were identified, some of which appeared to continue eastwards into the unsurveyed arable field. It was therefore decided, in consultation with the Sites and Monument Record Officer, to evaluate the nature of these anomalies by intrusive investigation before deciding whether to implement the additional geophysical survey. On this basis selective trial trenching targetting the geophysical anomalies took place (Brown 1998 forthcoming). This evaluation identified linear and curvi-linear ditches, as well as a small pit and gullies, that are thought to be archaeological in nature.

After further consultation with the SMR officer, and with the approval of the client, the additional gradiometer survey was implemented in order to establish the extent of the identified archaeological features within the eastern part of the development area. This work was carried out on July 30th 1998 after the crop had been harvested.

Results & Discussion

The gradiometer data of the whole site are presented as a greyscale plot super-imposed on a 1:2500 Ordnance Survey digital map base in Figure 2 and as a 1:1250 greyscale plot with an interpretative overlay in Figures 3 and 4. The additional survey is also presented as dot density and X - Y trace plot formats at a scale of 1:500 in Appendix 5.

The most obvious anomalies are the three strong positive linear/curvi-linear anomalies that are orientated approximately from east to west. The two parallel curvi-linears in the southern part of the additional survey area are indicative of a double-ditch trackway. These anomalies were not detected during the previous survey because it can be seen that they appear to curve into an area that was not included in the original 40% sample. The anomalies, as detected, lie just outside the eastern limit of the development area although they appear to extend westwards into an unsurveyed area of the proposal site.

In the northern part of the additional survey area an east to west discontinuous linear anomaly can be observed. This anomaly appears to be a continuation of an anomaly observed in the previous geophysical survey that was subsequently identified as an archaeological ditch during the trial trenching evaluation (Brown 1998). The geophysical response of the feature in this area appears to be slightly staggered and discontinuous possibly indicating that the feature has been disturbed by later processes such as ploughing or that the observed response is affected by the geology.

To the south of the discontinuous linear there are three positive isolated and one short positive linear response. These anomalies do not have the spiked response typically caused by ferrous material in the topsoil so that they may be caused by areas of burning or pits possibly associated with the adjacent linear ditch anomaly. It should be noted that the eastern-most isolated anomaly and the short linear anomaly are outside the development area.

Conclusions

A positive linear anomaly has been identified that is probably a continuation of the ditch interpreted during the previous geophysical survey and subsequently proven by excavation.

The second ditch identified during the previous geophysical survey that appeared to run into the additional survey area was not detected. It is possible that the anomaly turns to the north and therefore does not cross the additional survey area.

Two parallel anomalies not identified during the previous geophysical survey were also observed, as were four positive isolated responses. The former anomalies are indicative of a double-ditch trackway whilst the latter may represent areas of burning or pits.

The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeology. It is normally only possible to prove the archaeological nature of anomalies through intrusive means such as by trial excavation.

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Bibliography

Webb, A. W., 1998, 'Land at Santingley Lane, Crofton, Wakefield, West Yorkshire, Gradiometer Survey'. WYAS R611.

Appendices

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Appendix 2 Survey location information
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Appendix 1

Gradiometer survey: technical information and methods

1. Technical Information

1.1 Iron makes up about 6% of the Earth's crust and is mostly dispersed through soils, clays and rocks as chemical compounds. These compounds have a weak, measurable magnetic response which is termed its magnetic susceptibility. Human activities can redistribute these compounds and change (enhance) others into more magnetic forms. These anthropogenic processes result in small localised anomalies in the Earth's magnetic field which are detectable by a gradiometer.

1.2 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for the more magnetic compounds to concentrate in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil will tend to give a negative magnetic response relative to the background level.

1.3 The magnetic susceptibility of the soil can also be enhanced significantly by heating. This can lead to the detection of features such as hearths, kilns or burnt areas.

1.4 High, sharp responses are usually due to iron objects in the topsoil. These produce a rapid change from positive to negative readings ("iron spikes").

1.5 The types of response mentioned above can be divided into five main categories which are described below:

Iron Spikes (Dipolar Anomalies)
These responses are referred to as dipolar and are caused by buried or surface iron objects. Little emphasis is usually given to such responses as iron objects of recent origin are common on agricultural sites. Occasionally, however, iron spikes can indicate the presence of smithing activity by detecting hammerscale.

Rapid, strong variations in magnetic response
Also referred to as areas of magnetic disturbance, these can be due to a number of different types of feature. They are often associated with burnt material, such as industrial waste or other strongly magnetised material. It is not always easy to determine their date or origin without supporting information.

Positive, linear anomalies

The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or more recent agricultural features.

Isolated positive responses
These usually exhibit a magnitude of between 2nT and 300nT and, depending on their response, can be due to pits, ovens or kilns. They can also be due to natural features on certain geologies. It can, therefore, be very difficult to establish an anthropogenic origin without an intrusive means of examining the features.

Negative linear anomalies
These are normally very faint and are commonly caused by features such as plastic water pipes which are less magnetic than the surrounding soils and geology. They too can be caused by natural features on some geologies.

2. Methodology

2.1 There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as *scanning* and requires the operator to visually identify anomalous responses whilst covering the site in widely spaced traverses, typically 10-15m apart. The instrument logger is not used and there is therefore no data collection. This method is used as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be surveyed. Scanning can also be used to map out the full extent of features located during a detailed survey.

2.2 The second method is referred to as *detailed survey* and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.5m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

2.3 During this survey a Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used to take readings at 0.5m intervals on zig-zag traverses 1m apart within 20m by 20m square grids. Eight hundred readings were taken in each grid and in-house software (Geocon Version 9) was used to interpolate the “missing” line of data so that 1600 readings in total were obtained for each complete grid.

Appendix 2

Survey location information

A baseline was established on a south-east to north-west alignment, parallel with the field boundary that separates the rough pasture from the improved pasture field. The survey area was laid out so that as many full grids as possible could be surveyed within the development area, adjacent to the archaeological features identified from the previous geophysical survey and trial trenching. As the eastern limit of the development area intersected obliquely with the geophysical survey grids a small area was surveyed beyond the current limits of the development site. This was for ease of survey and to ensure that a reasonable interpretation of any anomalies could be made.

The site grid was tied in relative to the field boundaries and to the temporary marker pegs, SLC3 and SLC4 that had been established during the earlier survey, using a Geotronics Geodimeter 600 series total station theodolite. The additional survey data was then super-imposed on the 1:2500 Ordnance Survey Digital Map SE 3817 (see Figure 2) using the previous reference datum.

It should be noted that the Ordnance Survey co-ordinates for 1:2500 digital maps have an error of +/- 1.08m at a 99% degree of confidence.
If measurements for location purposes are taken from Figure 2 this error should be taken into account.

Appendix 3

Specification for Field Evaluation

Appendix 4

Geophysical Archive

The geophysical archive comprises:-

- an archive disk containing the raw data, survey tie-in information and grid location information, the report text (Word 6), and compressed CorelDraw files of the illustrations

- a full copy of the report

- a paste-up of the 1:500 data plots.

At present these are all held by Archaeological Services (WYAS).

Appendix 5

Gradiometer data plots (1:500)