Land north of Gavray Drive

Bicester

Oxfordshire

Geophysical Survey

Contents

Summary

A geophysical evaluation comprising magnetic scanning followed by selected detailed survey was undertaken at a site east of Bicester covering a total area of 16.25 hectares. The whole of the site was scanned but approximately 45% was not suitable for detailed survey due to the presence of dense, long grass. Consequently detailed magnetometer survey covering 10% of the site (1.6 hectares) was undertaken in the western part of the site. No anomalies indicative of archaeological activity were identified either during the scanning across the whole site or in the selected sample detailed survey blocks. On the basis of the geophysical evaluation the site is considered to have a low archaeological potential.

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1. Introduction and Archaeological Background

1.1 Archaeological Services WYAS was commissioned to carry out a geophysical (fluxgate gradiometer) evaluation of an area of land north of Gavray Drive on the eastern outskirts of Bicester (see Fig. 1), by Sally Randell of CPM Environmental Planning and Design.

1.2 The proposed development area, centred at NGR SP 596 223, comprises 16.25 hectares of agricultural land divided into five separate fields (see Fig. 2) bounded to the south by Gavray Drive, to the east by a field boundary and to the north and west by railway tracks. The three easternmost fields were separated from the remainder of the site by Langford Brook. All five fields were under permanent pasture and were suitable for magnetometer scanning. However the three fields to the east were not suitable for detailed survey due to the presence of dense, high grass. No other problems were encountered during the fieldwork that was carried out between June 21st and 23rd 2004.

1.3 Topographically the site is generally flat. On the Soil Survey of England and Wales map sheet for Eastern England, the soils are recorded as being of the Wickham 2 soil association comprising drift over Jurassic and Cretaceous clay or mudstone. These soils are described as slowly permeable, seasonally waterlogged, fine loamy over clayey soils.

1.4 Recent archaeological work on the edge of Bicester, including on the floodplain of Langford Brook, has revealed that prehistoric and Romano-British occupation in the area is much greater than previously thought and the area more extensively farmed. Information obtained from the Oxfordshire County Council Sites and Monument Record indicates the presence of prehistoric ring ditches and an enclosure in two locations to the north of the site under evaluation. Archaeological investigations at Slade Farm, on the north-western side of Bicester, recovered worked flint dating to the Mesolithic period as well as evidence of Bronze Age and Iron Age occupation. This included a wide linear ditch of Iron Age date possibly relating to a droveway. Several pits and possible palisade gullies appeared to be associated with this feature. An Iron Age ring ditch was identified to the west of the linear feature, probably foundation trenches for the walls of roundhouses. In addition an irregular sub-rectangular feature and a linear gully with two possible post-holes at its base contained Mesolithic microliths.

1.5 More recent archaeological investigations (geophysical survey and trial trenching) at Bicester Fields Farm to the south-west of the site revealed evidence of later prehistoric settlement in the form of a sub rectangular enclosure and associated pits and gullies. A possible circular structure was also revealed on the outer edge of the enclosure ditch. The pottery indicated a Middle to Late Iron Age date. Post-Medieval quarrying had destroyed any archaeology in the south-eastern part of the site. Open area excavation expanded on the results of the evaluation revealing the plan of a substantial rectilinear ditched enclosure of Middle to Late Iron Age date covering one hectare, with a possible causeway formed of a dump of burnt stone. A central building was indicated by a group of stone-packed postholes and curvilinear gullies. There was also evidence of animal and human burial.

1.6 An evaluation to the east of the proposal site in 1996 revealed evidence of a low status Roman settlement of 2nd century date comprising of a number of ditches and gullies, interpreted as a phase of unenclosed settlement, succeeded by an enclosed settlement.

1.7 The archaeological potential of the site was consequently considered to be fairly high despite the presence of Langford Brook that bisects the site.

2. Methodology and Presentation

2.1 The general objectives of the geophysical evaluation were:

- to identify any areas of possible archaeological interest
- to establish the extent and character of any archaeological magnetic anomalies.

2.2 As the area that may be impacted by the proposed development (16.25 hectares) was relatively large it was proposed that magnetic scanning be undertaken (using Geoscan FM36 fluxgate gradiometers) across the whole site in order to achieve the first objective. The second objective was to be achieved by selected detailed survey of areas of potential highlighted by the scanning. It was proposed that detailed survey would be carried out to cover a maximum of 20% of the total site area (3.25 hectares), depending on the results of the scanning. Apparently 'blank' areas as well as those identified as of potential were targeted. No sample detailed block was less than 0.36 hectares, an area equivalent to a block measuring 60m by 60m.

2.3 The survey methodology and report format comply with the recommendations outlined in the English Heritage Guidelines (David 1995) as a minimum standard. All figures reproduced from Ordnance Survey mapping are done so with the permission of the controller of Her Majesty's Stationery Office. © Crown copyright.

2.4 A general site location plan, incorporating the 1:50000 Ordnance Survey mapping, is shown in Figure 1. Figure 2 is a site location plan, showing the processed greyscale gradiometer data, superimposed onto an Ordnance Survey digital base map supplied by the client, at a scale of 1:5000. The processed data is displayed in greyscale format, at a scale of 1:500, in Figures 3, 6, 9, 12, and 15 with the accompanying interpretations shown at the same scale in Figures 4, 7, 10, 13 and 16. Figures 5, 8, 11, 14 and 17 show the unprocessed ('raw') data in XY trace plot format, also at a scale of 1:500.

2.5 Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the archive.

The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

3. Results and Discussion

3.1 Magnetometer Scanning

3.1.1 During scanning it was observed that the magnetic background noise was relatively quiet, fluctuating on average between +/- 0.5 nT. This is probably due to the low magnetic susceptibility of the clay-based soils coupled with the possible presence of alluvium deposited from Langford Brook that bisects the site. Nevertheless it was surmised that any occupational activity within the survey area would be likely to be identified by magnetic scanning and/or detailed survey.

3.1.2 Many ferrous 'spikes' were identified across the site; one area where there was a cluster of these anomalies was subsequently covered by detailed magnetometry and the results are displayed in Block 2. No other areas of archaeological potential were identified so blocks 1, 3, 4 and 5 were located to maximise site coverage over the western part of the site where it was possible to undertake detailed survey.

3.2 Detailed Survey

Block 1

3.2.1 Block 1 was positioned to cover the north-eastern part of the site in an area that was particularly quiet when scanned. Only 'iron spike' anomalies, which are likely to be caused by modern ferrous debris in the topsoil, have been identified in this block thus confirming the negative scanning result.

Block 2

3.2.2 This was the only block that was specifically targeted over an area thought to be of potential archaeological interest. During the scan a cluster of isolated dipolar ('iron spike') responses was identified. A block was therefore positioned to clarify whether this cluster could be associated with any other features of possible archaeological origin.

3.2.3 Plenty of dipolar responses (more so than in any other block) have been confirmed by the detailed survey but the random spacing and lack of any other anomalies suggests that these 'spikes' are due to modern ferrous debris introduced into the topsoil.

Block 3

3.2.4 Block 3 was also positioned at random to sample the north-west part of the site. There are many dipolar 'iron spike' anomalies and a few small areas of magnetic disturbance recorded in the data set, again probably caused by modern activity.

Block 4

3.2.5 This block was positioned to sample the east of the site. Isolated dipolar responses are predominant again in the data set with a presumed modern origin.

Block 5

3.2.6 Block 5 was located at random in the westernmost field where a lack of anomalous responses was noted during scanning. Only 'iron spike' anomalies have been identified.

4. Conclusions

4.1 The detailed survey has confirmed the negative results of the magnetic scanning phase of the survey with no anomalies likely to be indicative of archaeological activity having been identified.

4.2 Although several archaeological sites have been identified in the immediate area no magnetic anomalies have been identified during this survey to indicate that such activity extended into, or occurred within, the current evaluation area.

4.3 It is possible that alluvium from Langford Brook could be masking the magnetic responses from any underlying archaeological features. However, on the basis of the geophysical survey, the archaeological potential of the site is deemed to be fairly low.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains.

Bibliography

David, A., 1995. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines* No. 1. English Heritage

Acknowledgements

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Figures

Appendices

Appendix 1

Magnetic Survey: Technical Information

1. Magnetic Susceptibility and Soil Magnetism

1.1 Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate 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 magnetic ferrous compounds to become concentrated 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 that intrude into the topsoil may give a negative magnetic response relative to the background level.

1.3 The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

2. Types of Magnetic Anomaly

2.1 In the majority of instances anomalies are termed ***'positive'***. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as ***'negative'*** anomalies that, conversely, means that the response is negative relative to the mean magnetic background. Such negative anomalies are often very faint and are commonly caused by modern, non-ferrous, features such as plastic water pipes. Infilled natural features may also appear as negative anomalies on some geological substrates.

2.2 Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

2.3 It should be noted that anomalies that are interpreted as modern in origin may be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

2.4 The types of response mentioned above can be divided into five main categories which are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. An agricultural origin, either ploughing or land drains is a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an X–Y trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

3. Methodology

3.1 Magnetic Susceptibility Survey

3.1.1. There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

3.2 Gradiometer Survey

3.2.1. There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

3.2.2. The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that negative results from magnetic scanning should **always** be checked with at least a sample detailed magnetic survey (see below).

3.2.3. 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. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

3.2.4. The Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used for the detailed gradiometer survey. Readings were taken, on the 0.1nT range, at 0.5m intervals on zig-zag traverses 1m apart within 20m by 20m square grids. The instrument was checked for electronic and mechanical drift at a common point after every three grids and calibrated as necessary. The drift from zero was not logged.

3.3 Data Processing and Presentation

3.3.1. The detailed gradiometer data has been presented in this report in X-Y trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. The data in the greyscale images has been selectively filtered.

3.3.2. An X-Y plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped at 10nT. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. In-house software (XY3) was used to create the X-Y trace plots.

3.3.3. In-house software (Geocon 9) was used to interpolate the data so that 1600 readings were obtained for each 20m by 20m grid. Contors software was used to produce the greyscale images. All greyscale plots are displayed in the range –1nT to 2nT, unless otherwise stated, using a linear incremental scale.

Appendix 2

Survey Location Information

A Trimble Geodimeter 600s total station theodolite was used to set out and tie-in the survey grid in each of the fields. Temporary reference objects (survey marker stakes) were left in each part of the site for geo-referencing and the grids tied-in relative to these markers and to field boundaries. The survey grids were then superimposed onto an Ordnance Survey map base supplied by the client as a best fit to produce the grid locations. Overall there was a good correlation between the local survey and the digital map base and it is estimated that the average 'best fit' error is better than ±1.5m. However, it should be noted that Ordnance Survey co-ordinates for 1:2500 Superplan map data have an error of ±1.9m at 95% confidence. This potential error must be considered if co-ordinates are measured off for relocation purposes from points other than those listed below.

The locations of the temporary reference objects are shown on Figure 2 and the Ordnance Survey grid co-ordinates tabulated below.

Station	Easting	Northing
A	459321.08	222522.92
B	459285.88	222485.77
C	459322.67	222434.27
D	459250.58	222496.60
E	459228.70	222547.94
F	459280.91	222580.86

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party or for the removal of any of the survey reference points.

Appendix 3

Geophysical Archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Word 2000), and graphics files (CorelDraw6 and AutoCAD 2000) files.
- a full copy of the report

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details will also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the relevant Sites and Monument Record Office).