STRATASCAN

Geophysical Survey Report

Forest Hill Golf Course, Botcheston
Leicestershire

for

University of Leicester
Archaeological Services

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1 SUMMARY OF RESULTS

Three subsequent areas were targeted from the magnetic susceptibility results to be surveyed using detailed gradiometry. The results have shown a number of faint linear anomalies that can be mainly attributed to agricultural activity. Little to no anomalies can be confidently associated with archaeological activity.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by The University of Leicester Archaeological Services (ULAS) to undertake a geophysical survey of an area outlined for the extension of Forest Hill Golf Course.

2.2 Site location

The site is located north of the present golf course and the village of Botcheston approximately eight miles west of Leicester, Leicestershire at OS ref. SK 484 052.

2.3 Description of site

The survey area consists of 13ha of magnetic susceptibility. The survey area was located in recently cut rough grass fields with gentle sloping topography. The underlying geology is Triassic Mudstone (British Geological Survey Sheet South, Forth Edition Solid, 2001). The overlying soils are known as Wimple 3 soils which are stagnogleyic argillic brown earths. These consist of Reddish coarse and fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging (Soil Survey of England and Wales, Sheet 3 Midland and Western England).

2.4 Site history and archaeological potential

No specific information was made available to Stratascan.

2.5 Survey objectives

The objective of the survey was to locate any features of possible archaeological significance in order that they may be trenched prior to development.

2.6 Survey methods

The reconnaissance technique of magnetic susceptibility was employed over the whole of the survey area. From this two areas of enhancement were targeted with detailed gradiometer survey together with an area of low enhancement to test ‘blank’ areas. More information regarding these techniques is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over four days from the 8/08/05 to the 11/08/05 when the weather was variable.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2. All magnetic susceptibility and detailed magnetometry grids were located and referenced using a Leica System 500 Global Positioning System (GPS).

3.3 Description of techniques and equipment configurations

3.3.1 Magnetic Susceptibility

Alteration of iron minerals in topsoil through biological activity and burning can enhance the magnetic susceptibility (MS) of that soil. Measuring the MS of a soil can therefore give a measure of past human activity and can be used to target the more intensive and higher resolution techniques of Gradiometry and Resistivity. Measurements of MS were carried out using a field coil which provides a rapid scan and has the benefit of allowing "insitu" readings to be taken.

The equipment used on this contract was an MS2 Magnetic Susceptibility meter manufactured by Bartington Instruments Ltd. A field coil known as an MS2D was used to take field readings. This assessed the top 200mm or so of topsoil. To overcome the problem of ground contact all readings were taken 4 or 5 times and an average taken. All obvious localised "spikes" were ignored.

3.3.2 Gradiometer

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each sensor has a

1m separation between the sensing elements increasing the sensitivity to small changes in the Earths magnetic field.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 Sampling interval

Magnetic susceptibility
The magnetic susceptibility survey was carried out on a 20 m grid with readings being taken at the node points.

Gradiometer
Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

3.4.2 Depth of scan and resolution

Magnetic Susceptibility
The MS2D coil assesses the average MS of the soil within a hemisphere of radius 200mm. This equates to a volume of some $0.016m^3$ and maximum depth of 200mm. As readings are only at 20m centres this results in a very coarse resolution but adequate to pick up trends in MS variations.

Gradiometer
The FM256 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. The collection of data at 0.5m centres provides an appropriate methodology balancing cost and time with resolution.

3.4.3 Data capture

Magnetic susceptibility
The readings are logged manually on site, and then transferred to the office where they are entered into a computer and grey scale plots are produced.

Gradiometer
The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each job, data is transferred to the office for processing and presentation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Magnetic susceptibility
No processing of the data has been undertaken.

Gradiometer
Processing is performed using specialist software known as *Geoplot 3*. This can emphasise various aspects contained within the data but which are often not easily seen

in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found on agricultural land. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all processed gradiometer data used in this report:

Zero mean grid	*Threshold = 0.25 std. dev.*
Zero mean traverse	*Last mean square fit = off*
Despike	*X radius = 1 Y radius = 1*
	Threshold = 3 std. dev.
	Spike replacement = mean

3.5.2 Presentation of results and interpretation

Magnetic susceptibility
The presentation of the data for this site involves a grey scale plot of the field measurements overlain onto a site plan (see Figure 3).

Gradiometer
The presentation of the data for each site involves a print-out of the raw data both as grey scale (Figure 4) and trace plots (Figure 5 and 6), together with a grey scale plot of the processed data (Figure 7). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 8).

4 RESULTS

4.1 Magnetic susceptibility

The magnetic susceptibility survey has identified an area of high susceptibility within the northeast field situated in the survey area. A further area of high response has been identified within the north eastern corner of the south west field.

The three subsequent detailed gradiometry surveys have targeted the areas of high magnetic susceptibility in the north and west fields (Areas 1 and 3) (excluding high readings caused by the nearby woodland and locally disturbed ground in the north of the western field). An area of moderate and low readings has been targeted in the south field as a control measure (Area 2).

4.2 Detailed gradiometry

The detailed gradiometery survey has produced a number of faint linear anomalies that are possibly attributed to agricultural activity. Few anomalies can be identified as features of archaeological origin.

The anomalies identified and abstracted have been categorised into the following:

- Positive anomaly with associated negative response – ferrous object
- Linear anomaly with positive and negative returns – probable agricultural marks
- Positive linear anomaly – agricultural marks
- Negative linear anomaly – possible agricultural mark
- Positive linear anomaly – cut feature of possible modern origin
- Faint positive response – probable agricultural marks
- Areas of magnetic debris – probable modern origin

Positive anomalies with negative responses
Situated across all three survey areas with a higher concentration with Areas 1 and 3 are numbers of discrete positive anomalies with negative returns. These anomalies are likely to be caused by near surface ferrous objects of possible modern origin.

Linear anomaly with positive and negative returns
A large number of parallel positive linear anomalies with negative returns have been identified with survey Area 3 with an approximate north to south orientation. These linear anomalies are probably caused by field drainage and are associated with agricultural activity.

Positive linear anomalies – agricultural marks
Situated across Area 2 are a number of positive linear anomalies with similar northeast to southwest linear orientation. Two further positive linear anomalies have also been identified with Area 3. These anomalies are possibly cut features caused by agricultural activity.

Negative linear anomalies – possible agricultural marks
Situated in Area 2 are a number of negative linear anomalies with similar orientations to the positive agricultural marks. These anomalies may represent linear anomalies associated with agricultural activity.

Positive linear anomalies- cut features of possible modern origin
A small number of positive linear anomalies have been identified in the south of survey Area 3. These anomalies are possibly indicating cut features. Due to their small and disjointed appearance these anomalies may be of modern origin.

Faint positive response
A large area of faint positive response has been identified within Area 2. It is orientated approximately perpendicular to the linear agricultural marks identified. This anomaly is possibly associated with ploughing and agricultural activity but may also be of archaeological origin.

Areas of magnetic debris
Small areas of magnetic debris have been identified within the eastern parts of Areas 1 and 3. These anomalies are possibly associated with modern activity.

5 CONCLUSION

The detailed gradiometery survey has produced a number of faint linear anomalies that can be mainly attributed to agricultural activity. Areas 1 and 3 have produced stronger levels of magnetic response (relating to near surface ferrous objects and agricultural marks), which relate to the high magnetic susceptibility results. Little to no anomalies can be confidently associated with archaeological activity.