STRATASCAN

Geophysical Survey Report

Flitwick Manor, Bedfordshire

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Stratascan Job No:	**2235**
Techniques:	**Detailed magnetic survey (gradiometry)** **Detailed resistance survey**
National Grid Ref:	**Brickyard Site TL 029 339** **Kiln Site TL 032 341**

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LIST OF FIGURES

1 SUMMARY OF RESULTS

A geophysical survey was conducted over two areas within the grounds of Flitwick Manor. A detailed magnetic survey and resistance survey was carried out over the area of a 17th century brick yard, and a magnetic survey was carried out over an area where a medieval kiln is suspected to be located.

Results from the brick yard indicate possible structural remains exist at the site along with other cut features. The magnetic survey over the kiln site has identified the possible location of the kiln, and other anomalies of an unclear origin have also been identified which would require further investigation to clarify.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Greensand Trust to undertake a geophysical survey of two separate areas within the grounds of Flitwick Manor. This survey forms part of an archaeological investigation being undertaken by Greensand Trust.

2.2 Site location

The sites are located at Flitwick Manor, Bedfordshire, with the brickyard site at OS ref. TL 029 339 and the kiln site at OS ref. TL 032 341.

2.3 Description of site

The survey area totals approximately 1 hectare for both of the sites. The land use at present at the brickyard site is flat grassland with the kiln site also being flat grassland but with the obstruction of some trees. The underlying geology is upper greensand and gault (British Geological Survey Ten Mile Map South Sheet, Fourth Edition Solid, 2001). The overlying soils are known as Frilford soils which are Mesozoic and Tertiary sands. These consist of deep well drained sandy and coarse loamy soils (Soil Survey of England and Wales, Sheet 4 Eastern England).

2.4 Site history and archaeological potential

Of the two areas that are to be surveyed the chance for archaeological potential is high. At the site of the brickyard, surface irregularities are recorded and the site is documented in the 17th and early 18th century. At the kiln site, medieval pottery wasters found during the construction of a boundary suggest that a kiln could be found nearby (Simco, 2004).

2.5 Survey objectives

The objective of the survey was to locate any anomalies that may be of archaeological origin in order for them to be assessed.

2.6 Survey methods

Detailed magnetometry and resistivity surveys were carried out across the site in order to assess the area with complementary techniques. 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 one day on the 9th October 2006 when the weather was overcast but dry.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 and Figure 11 together with the referencing information.

3.3 Description of techniques and equipment configurations

3.3.1 Magnetometer

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 instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. 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 giving a strong response to deep anomalies.

3.3.2 Resistance Meter

This method relies on the relative inability of soils (and objects within the soil) to conduct an electrical current, which is passed through them. As resistivity is linked to moisture content, and therefore porosity, hard dense features such as rock will give a relatively high resistivity response, while features such as a ditch which retains moisture give a relatively low response.

The resistance meter used was an RM15 incorporating an MPX15 multiplexer manufactured by Geoscan Research using a twin probe array. The mobile twin probes are separated by 0.5m and the associated remote probes were positioned approximately 15m outside the grid. The instrument uses an automatic data logger, which permits the data to be recorded as the survey progresses for later downloading to a computer for processing and presentation.

Though the values being logged are actually resistances in ohms they are directly proportional to resistivity (ohm-metres) as the same probe configuration was used through-out.

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

3.4.1 Sampling interval

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

Resistivity
Readings were taken at 1.0m centres along traverses 1.0m apart. This equates to 900 sampling points in a full 30m x 30m grid. All traverses were surveyed in a "zigzag" mode.

3.4.2 Depth of scan and resolution

Magnetometer
The Grad 601 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.

Resistivity
The 0.5m probe spacing of a twin probe array has a typical depth of penetration of 0.5m to 1.0m The collection of data at 1m centres with a 0.5m probe spacing provides an appropriate methodology balancing cost and time with resolution.

3.4.3 Data capture

Magnetometer
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.

Resistivity
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

Magnetometer
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 magnetometer data used in this report:

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

Resistivity
The processing was carried out using specialist software known as *Geoplot 3* and involved the 'despiking' of high contact resistance readings and the passing of the data though a high pass filter. This has the effect of removing the larger variations in the data often associated with geological features. The nett effect is aimed at enhancing the archaeological or man-made anomalies contained in the data.

The following schedule shows the processing carried out on the processed resistance plots.

Despike	*X radius = 1*
	Y radius = 1
	Spike replacement
High pass filter	*X radius = 10*
	Y radius = 10
	Weighting = Gaussian

3.5.2 Presentation of results and interpretation

Magnetometer
The presentation of the data for the survey involves a print-out of the raw data both as grey scale (Figures 3 and 12) and trace plots (Figures 4, 5, 13 and 14), together with a grey scale plot of the processed data (Figures 6 and 15). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figures 7 and 16).

Resistivity
The presentation of the data for the site involves a print-out of the raw data as a grey scale plot (Figure 8), together with a grey scale plot of the processed data (Figure 9). Anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing (Figure 10).

4 RESULTS

4.1 Brick Yard

The gradiometer data at the brickyard site shows a number of anomalies over the area that may have an archaeological origin. A positive magnetic linear response can be seen cutting across the area in a north to south direction. This may be associated with an infilled cut feature. Other positive responses are also observed including a cluster of point anomalies which may be related to small pit like features.

Three areas of moderate amplitude positive response with an associated negative anomaly can be seen in the western half of the site. These are not strong enough in amplitude to be caused by ferrous debris, but are too strong to be simple earthwork features. It is possible they represent debris relating to the brick yard. Fired material such as bricks will retain a moderate magnetic enhancement which can be detected. Similarly an area of magnetic debris in the south of the site may also relate to material debris or some form of ground disturbance.

The resistance survey shows extensive areas of high resistance response across the area. It is likely that these represent structural remains associated with former buildings. In the north corner of the survey area the high resistance anomaly appears to form a right angle again indicative of a building footing. Areas of moderate resistance may also be associated with structural remains but perhaps represent more fragmentary features in a poorer state of survival. Low resistance areas can often be difficult to interpret and may be caused by cut features or depressions in the ground which allow greater levels of moisture to be retained.

4.2 Kiln

The kiln site is located to the north of the brick yard and adjoins the back gardens of properties along Church Road. Numerous short positive linear responses have been identified along with small area anomalies. The exact cause of these responses is uncertain, but it is likely that they relate to cut features of an archaeological origin. In the east of the site a moderately enhanced bipolar anomaly can be observed which ranges in amplitude from around -20nT to 100nT. This anomaly has a diameter of approximately 10m. The range of readings recorded is typical of a thermoremnant

feature, such as a kiln. It is possible that this represents the position of the kiln which is suspected to be located in this area.

5 CONCLUSION

The survey results have identified responses of likely archaeological origin over both the brick yard and kiln sites. It seems likely that archaeological remains at the brick yard site continue beyond the survey area as responses have been detected up to the very edge of the area. A possible location of the kiln has been identified at the kiln site but other anomalies in this area remain ambiguous and further investigation would be required to clarify their cause.

REFERENCES

British Geological Survey, 2001. *Geological Survey Ten Mile Map, South Sheet, Fourth Edition (Solid)*. British Geological Society.

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