

# **Geophysical Survey Report**

## **Highfield Farm, Littleport**

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**David Elks MSc.**



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Detailed resistance survey**

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**Field Team:** Luke Brown, Richard Fleming, Richard Smalley, Steven Russell

**Project Manager:** Simon Stowe BSc.

**Project Officer:** David Elks MSc.

**Report written by:** David Elks MSc.

**CAD illustration by:** David Elks MSc.

**Checked by:** Simon Stowe BSc.

Stratascan Ltd.

Vineyard House  
Upper Hook Road  
Upton upon Severn  
WR8 0SA

Tel: 01684 592266  
Fax: 01684 594142  
Email: [ppb@stratascan.co.uk](mailto:ppb@stratascan.co.uk)  
[www.stratascan.co.uk](http://www.stratascan.co.uk)

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## **1 SUMMARY OF RESULTS**

A detailed magnetic survey and resistance survey were carried out at Highfield Farm, Littleport.

The results show an area in the north which may relate to cemetery features possibly bounded by a linear feature to the west. Several anomalies which may relate to cut features are also present across the site.

## **2 INTRODUCTION**

### **2.1 Background synopsis**

Stratascan were commissioned by APS to undertake a geophysical survey of an area of land at Highfield Farm, Littleport.

### **2.2 Site location**

The site is located at Highfield Farm, Littleport, Cambridgeshire at OS ref. TL 560 862.

### **2.3 Description of site**

The survey area is 1.8ha of arable land which is being built on. The underlying geology is Kimmeridge clay from the Upper Jurassic Period (British Geological Survey South Sheet, Third Edition Solid, 1979). The overlying soils are of the Ashley soil association. These consist of fine loamy over clayey soils with slowly permeable subsoil and slight seasonal waterlogging with some calcareous and non-calcareous slowly permeable clayey soils (Soil Survey of England and Wales, Sheet 4 Eastern England).

### **2.4 Site history and archaeological potential**

Excavations have taken place which have located ditches and pits across the survey area which fit in with the wider prehistoric landscape. Excavations in the north of the survey area have located shallow Saxon inhumations cut into natural deposits.

### **2.5 Survey objectives**

The objective of the survey was to define the extent of burials and locate any other anomalies that may be of archaeological origin prior to further trenching.

### **2.6 Survey methods**

Detailed magnetometry and resistance 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 9 days, 23 & 24 February 2005 when the weather was snowing (field work postponed due to frozen ground), 28 February - 3 March when the weather was showery and 10 -12 March 2005 when the weather was fine.

#### **3.2 Grid locations**

The location of the survey grids has been plotted in Figures 2 & 8 together with the referencing information. Grids were set out using a Leica 705auto Total Station and referenced to suitable topographic features around the perimeter of the site.

#### **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 increasing the sensitivity to small changes in the Earth's magnetic field.

##### **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 manufactured by Geoscan Research incorporating a mobile Twin Probe Array. The 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.

##### *Resistance survey*

Readings were taken at 0.5m centres along traverses 0.5m apart. This equates to 3600 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.

##### *Resistance survey*

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 0.5m centres with a 0.5m probe spacing provides an appropriate methodology to give a high resolution.

#### 3.4.3 Data capture

##### *Magnetometer*

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

### *Resistance survey*

The readings are logged consecutively into the data logger which in turn is daily downloaded 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:

<i>Despike</i>	<i>X radius = 1      Y radius = 1</i> <i>Threshold = 3 std. dev.</i> <i>Spike replacement = mean</i>
<i>Zero mean traverse</i>	<i>Last mean square fit = on</i> <i>Threshold = +/- 5</i>

#### *Resistance survey*

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 through a high pass filter. This has the effect of removing the larger variations in the data often associated with geological features. The net 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.

<i>Despike</i>	<i>X radius = 1</i> <i>Y radius = 1</i> <i>Spike replacement</i>
<i>Edge matching</i>	



### 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 (Figure 3) and trace plots (Figure 4 and 5), together with a grey scale plot of the processed data (Figure 6). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 7).

#### *Resistance survey*

The presentation of the data for the site involves a print-out of the raw data as a grey scale plot (Figure 9), together with a grey scale plot of the processed data (Figure 10). Anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing (Figure 11).

## 4 RESULTS

### 4.1 Detailed magnetic survey

The detailed magnetic survey has revealed anomalies which can be broadly classified as:

- Weak positive linear anomalies possibly caused by cut features of archaeological origin
- Positive area anomalies of unknown origin
- Negative area anomalies of known origin
- Positive area anomalies with associated negative response of unknown origin
- Low magnitude positive responses that may relate to pits
- Strong discrete anomalies probably caused by modern ferrous debris
- Areas of magnetic disturbance likely to have a modern origin

In the north of the survey area several weak positive linear anomalies have been identified. Generally those in the east have a north to south alignment, while those further west have an east to west orientation. It is likely these are caused by cut features of archaeological origin.

Three areas of negative magnetic anomaly have been located. The northern most and southern most have a high magnitude response implying they are caused by modern metallic objects. The remaining anomaly is weakly negative suggesting it may have an archaeological origin possibly caused by a mound or place of material build up.

The positive area anomaly in the north has generally low values except in its eastern side where it rises to a maximum of around 100nT. This suggests it may be caused by a single metallic object oriented that the associated negative response is hidden.

In the south of the survey area is a positive anomaly with an associated negative halo. It has moderate strength with a maximum of about 15nT. This is the typical style of anomaly that may be caused by a cut feature with a surrounding embankment. This may

be of archaeological origin, though the discrete and isolated nature of the anomaly is ambiguous.

Two weakly positive points have been located which may be caused by pits, while those with an associated negative response are probably caused by ferrous debris.

The strong areas of magnetic disturbance around the edge of the survey area are likely to be related to modern sources.

#### 4.2 Resistance survey

The detailed resistance survey has revealed anomalies which can be generally categorised as:

- Moderate resistance linear anomalies of possible archaeological origin
- Low resistance linear anomalies possibly related to cut features of archaeological origin
- Moderately high resistance area anomalies
- Low resistance area anomalies of possible geological/pedological origin
- Low resistance area anomalies of unknown origin
- Low resistance linear anomalies likely to be associated with former excavation trenches

In the north of the survey area, just south of the excavated region, the resistance data shows a mottled appearance. Within this it is possible to define several curvilinear positive anomalies. This area probably represents a continuation of cemetery features, possibly grave cuts, that extends approximately 15m into the survey area. Its western extent seems to be defined by a moderate resistance linear anomaly. This is not high enough to represent structural remains, although it may relate to compacted ground and material build up. Cutting across this anomaly north east to south west runs a low resistance linear anomaly possibly caused by a cut feature of archaeological origin.

To the east of this is a curvilinear negative resistance anomaly. This may be caused by a cut feature of archaeological origin. It is unlikely to enclose the cemetery as it seems to curve in towards the mottled area.

Two large areas of low resistance, one in the north, one in the south, are both widespread and take no geometric form. This suggests they are likely to have a geological or pedological origin.

A high resistance area anomaly in the east appears to form a right angle in the eastern corner of the survey area. It is unclear what causes this. The geometric form suggests it may be of anthropogenic origin, although its widespread nature and blurred edges imply it may have a natural origin.

Spread across the site numerous moderately high resistance area anomalies are observed. Again it is not certain what causes these. It is interesting to note that those in

the west have a speckled appearance compared to those in the east. This may suggest the western area has a harder, stonier subsoil.

In the south of the survey area is a low resistance linear anomaly which seems to align with the location of a previous excavation trench, which it is probably related to.

## **5 CONCLUSION**

The geophysical survey has described anomalies that may relate to features of archaeological origin and features of natural origin. These include:

- An area in the north which may relate to the continuation of the Saxon cemetery with its western extent appearing to be defined by a linear feature.
- Numerous curvilinear anomalies possibly relating to archaeological cut features located across the site.
- Regions of natural variation in the north and south

## **REFERENCES**

British Geological Survey, 1979. *Geological Survey Ten Mile Map, South Sheet, Third Edition (Solid)*. British Geological Society.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 4 Eastern England*.