STRATASCAN

Geophysical Survey Report

Former Airfield, Hemswell Cliff
Lincolnshire

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For

Witham Archaeology

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Document Title:	**Geophysical Survey Report** **Former Airfield, Hemswell Cliff, Lincolnshire**
Client:	**Witham Archaeology**
Stratascan Job No:	**2268**
Techniques:	**Detailed magnetic survey (gradiometry)** **Detailed resistance survey**
National Grid Ref:	**SK 950 905**

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LIST OF FIGURES

1 SUMMARY OF RESULTS

Detailed magnetic and resistance surveys were carried out over approximately 7625m^2 of land at a former airfield near Hemswell Cliff, Lincolnshire.

The results show there to be large amounts of ferrous debris across the site which may be masking weaker archaeological targets. Responses which are likely to be anthropogenic cannot be classified as to whether they relate to the former airfield or older archaeology.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Witham Archaeology to undertake a geophysical survey of an area outlined for proposed development for storage silos.

2.2 Site location

The site is located to the north of Hemswell Cliff, Lincolnshire at OS ref. SK 950 905.

2.3 Description of site

The survey area is approximately 7625m^2 and is located adjacent to existing storage silos. The survey area is flat and mostly grass covered with some areas of vegetation, rubble and concrete around the perimeter. The underlying geology is limestone of Inferior Oolite (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are of the Elmton 1 soil association which are brown redzinas (Soil Survey of England and Wales, Sheet 4 Eastern England).

2.4 Site history and archaeological potential

Crop marks have been identified from aerial photographs in adjacent fields to the east of the site of probable prehistoric date. However none are recorded within the survey area itself. The site has been previously used as an RAF airfield from 1916-1967.

There is potential to locate features of prehistoric date in line with adjacent crop marks, however it is likely that ferrous debris form the former airfield may interfere with the results.

2.5 Survey objectives

The objective of the survey was to locate any anomalies that may be of archaeological origin in order they can be assessed prior to development.

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 on a single day, 4th December 2006 when the weather was fine.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 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 in conjunction with an MPX15 multiplexer 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

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.

Resistance
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

Gradiometer
The Grad 601-2 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
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

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.

Resistance
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

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 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

Resistance
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

Gradiometer
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
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 Magnetic survey

The data from the magnetic survey show large amounts of strong dipolar responses spread across the site. It is likely that this is the result of scattered ferrous debris probably resulting from the former airfield located on the site.

A moderately strong bipolar linear response is observed running across the site west to east with values ranging up to +/-50nT. It is likely that this is caused by a modern ferrous service, which may be deeply buried as a shallow pipe would return values significantly greater of +/-1000nT or more.

4.2 Resistance survey

The resistance survey shows a large area of high and moderately high resistance in the west of the site. It is possible that this relates to stone and masonry remains of anthropogenic origin. It is not clear whether this might be modern features associated with the airfield or older archaeological structures. A low resistance linear response is identified which may be caused by a cut feature, similarly it is not apparent whether this is modern or older. Running parallel to the west of this response a moderately high resistance anomaly can be seen. This is likely to be associated with the possible cut feature and may represent some form of bank to the cut feature.

Three weakly high resistance linear anomalies are also identified towards the east of the survey area. These have only a very low contrast and as such are probably caused by ephemeral features such as ploughing marks, however it remains possible (but unlikely) that they are remnants of more significant high resistance features which have suffered from degradation such as stone walls.

5 CONCLUSION

The site appears to contain a large amount of ferrous debris which may be masking weaker archaeological targets from the magnetic survey data. Anomalies identified in the resistance data seem to be anthropogenic in origin but it is not possible to say if these relate to the former airfield or originate from older archaeological periods.

6 REFERENCES

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

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