STRATASCAN

# Geophysical Survey Report

## Royal Naval Stores Depot,
## Topsham
## Devon

for

**John Moore Heritage Services**

February 2006

J2089

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REGISTERED IFA ORGANISATION

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| Stratascan Job No: | **J2089** |
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| National Grid Ref: | **SX 956 906** |

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## LIST OF FIGURES

# 1 SUMMARY OF RESULTS

A detailed gradiometer survey was carried out in an area outlined for development southeast of Exeter. A rectilinear enclosure of possible archaeological origin has been identified in the south of the northern field. A number of positive linear anomalies have been identified mainly in the centre and western parts of the survey area. A possible circular cut feature has been identified in the east of the survey area that may be of archaeological origin. Areas of magnetic disturbance of modern origin situated in the south and east of the survey area may obscure subtle features of possible archaeological origin.

# 2 INTRODUCTION

## 2.1 Background synopsis

Stratascan were commissioned by John Moore Heritage Services to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation undertaken by John Moore Heritage Services.

## 2.2 Site location

The site is located southeast of Exeter, situated south of the A379 at OS ref. SX 956 906.

## 2.3 Description of site

The survey area is approximately 16.5ha of agricultural land. Obstructions in the survey included overgrown vegetation situated in the south of the survey area, a modern housing development north of Old Rydon Lane and present farm buildings.

**Plate 1**: Looking southeast across the south of the survey area showing areas of overgrown vegetation

2.4 Geology and soils

The underlying geology is Permian basal breccias, sandstones and mudstones (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are known as Bridgnorth soils which are typical brown sands. These consist of Permio-Triassic reddish sandstone (Soil Survey of England and Wales, Sheet 5 South West England).

2.5 Site history and archaeological potential

No specific details were available to Stratascan. However a rectilinear enclosure has been identified from aerial photographs in the north of the survey area.

2.6 Survey objectives

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

2.7 Survey methods

Detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below.

## 3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 12 days from the 21st to the 25th and the 29th to the 30th of November 2005 and from the 6th to the 8th and 15th to the 16th of February. Weather conditions during the survey were variable and occasionally wet.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 together with the referencing information. Grids were set out using a Leica DGPS system 500. OS grid references have been supplied at each reference corner of the grid.

3.3 Survey equipment

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

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

The Grad601-2 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 0.25m centres provides an appropriate methodology balancing cost and time with resolution.

### 3.4.3 Data capture

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

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:

1. *Despike* (useful for display and allows further processing functions to be carried out more effectively by removing extreme data values)

   *Geoplot parameters:*
   X radius = 1, y radius = 1, threshold = 3 std. dev.
   Spike replacement = mean

2. *Zero mean grid* (sets the background mean of each grid to zero and is useful for removing grid edge discontinuities)

*Geoplot parameters:*
Threshold = 0.25 std. dev.

3. *Zero mean traverse* (sets the background mean of each traverse within a grid to zero and is useful for removing striping effects)

*Geoplot parameters:*
Least mean square fit = off

In addition the following processing has been carried out to further enhance the data: Extreme high and low values caused by modern features have been removed in an effort to enhance faint anomalies.

3.5.2 Presentation of results and interpretation

The presentation of the data for each site involves a print-out of the raw data both as greyscale (Figures 3-5 and 16) and trace plots (Figures 6-11), together with a greyscale plot of the processed data (Figures 12-14 and 17). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figures 15 and 18).

## 4 RESULTS

Agricultural marks can be seen throughout the majority of the survey area, identified by a series of parallel linear anomalies. A number of services have been identified running across the southern and eastern fields. Large areas of magnetic disturbances are associated with these services that may mask subtle archaeological anomalies lying in close proximity. Large areas of magnetic debris have been identified in the east of the survey area; these anomalies are likely to be caused by modern debris, nearby boundaries and roads.

A number of discrete positive anomalies have been identified across the north of the survey area. These anomalies may indicate possible pits of archaeological origin. A number of positive anomalies with associated negative returns can be seen throughout the survey area. These anomalies are likely to represent near surface ferrous objects.

Situated in the south of the northern field is a positive rectilinear feature (a). This anomaly may represent a cut feature of archaeological origin. Situated towards the west of the northern field are two areas containing faint positive linear anomalies (b and c). These anomalies may represent weak evidence for archaeological activity. Positive linear anomalies e, d and f may indicate cut features of archaeological origin. However, due to their similar orientation to the agricultural marks these anomalies may represent previous field boundaries or be agricultural in origin.

Situated in the centre of the southern field is a negative linear anomaly with associated positive linear anomalies (h). This feature possibly represents a previous field boundary, consisting of a bank with ditches either side. Further positive linear

anomalies can be identified within the southern field (i and g). These anomalies may represent cut features of archaeological origin.

A positive circular anomaly (j) has been identified in the east of the survey area. This anomaly may represent a cut feature of archaeological origin. Identified to the west of this anomaly is an area of magnetic disturbance of unknown origin (k). It is possible that this anomaly is associated with modern activity.

A weak negative linear anomaly has been identified in the east of the survey area (l). This anomaly may indicate a possible bank of archaeological origin.

## 5 CONCLUSION

A rectilinear enclosure of possible archaeological origin has been identified in the south of the northern field. This rectilinear enclosure has also been identified in aerial photography and is thought to be Romano-British in origin. Further evidence for archaeological activity can be identified in a number of positive linear anomalies situated mainly in the centre and western parts of the survey area. However a number of these anomalies may be agricultural in origin due to their orientation. A possible circular cut feature has been identified in the east of the survey area that may be archaeological in origin. Areas of magnetic disturbance of modern origin situated in the south and east of the survey area may obscure subtle features of possible archaeological origin.

# **APPENDIX A –** Basic principles of magnetic survey

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremnant* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremnance is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremnant archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically either 0.5 or 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.