STRATASCAN

# Geophysical Survey Report

## Triangle Site, South Marston, Swindon

for

**RPS Planning, Transport and Environment**

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# 1 SUMMARY OF RESULTS

A detailed magnetic survey conducted over 9ha on land near South Marston, Swindon, located a number of geophysical anomalies across the site. Ferrous objects are represented by strong bipolar anomalies, however all other anomalies are of a very low magnitude generally no stronger than 1.5nT. Despite the low magnitude several linear, curvilinear and possible rectilinear anomalies have been identified that may relate to cut features with an archaeological origin.

# 2 INTRODUCTION

## 2.1 Background synopsis

Stratascan were commissioned by RPS Planning, Transport and Environment, on behalf of Gazeley Properties Ltd, to undertake a geophysical survey of an area outlined for a development consisting of distribution units, parking, roads and a park and ride facility.

## 2.2 Site location

The site is bounded by the A419, Kingsdown Road and Highworth Road and is located northwest of the Honda motor works at South Marston, Swindon at OS grid ref. SU 177 885.

## 2.3 Description of site

The site covers approximately 14.6ha of agricultural land (Figure 1a), however as the western part of the site was still under crop at the time of survey, a total of 9ha was surveyed within the east of the site (see Figure 2).

## 2.4 Geology and soils

The underlying geology is the Upper Jurassic Corallian Beds (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are known as Sherborne soils which are brown rendzinas. These consist of shallow well drained brashy calcareous clayey soils over limestone, associated with slowly permeable calcareous soils (Soil Survey of England and Wales, Sheet 5 South West England).

## 2.5 Site history and archaeological potential

Aerial photographs have revealed cropmarks of sub-rectangular enclosures within the site. The site also contains findspots of prehistoric flints, an Iron Age pottery fragment and several Roman pottery fragments.

### 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. The location of such anomalies will guide RPS Planning, Transport and Environment in their preparation of the site layout and development brief and the subsequent Environmental Statement.

### 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 4 days from the 26th to the 29th of October 2004. Weather conditions during the survey were sunny with showers.

### 3.2 Grid locations

The location of the survey grids for the two areas surveyed has been plotted in Figure 2 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 Survey equipment

The magnetic survey was carried out using dual FM256 Fluxgate Gradiometers, manufactured by Geoscan Research. The gradiometers are suspended on a frame CF6. One gradiometer acts as a master trigger that controls the second slave gradiometer. The instruments each consist of two fluxgates mounted 0.5m vertically apart and 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.

## 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 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 0.25m 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

### 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 (Figure 3) and trace plots (Figure 4 and 5), together with a greyscale 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).

## 4 RESULTS

Although originally 14.6ha was due to be surveyed over a total of seven areas, crop coverage meant that access was not available within the west of the site. The majority of the east of the site was surveyed within two grids covering a total of 9ha.

The detailed magnetic survey located a number of geophysical anomalies within the two survey areas, however the magnitude of these anomalies is very low and has made abstraction of them difficult. The low magnitude of magnetic anomalies may be due to a number of factors including the properties of the soils or the underlying geology, the features may have been back filled with material that is not magnetically enhanced or the features themselves may be very deeply buried or truncated.

Anomalies that have been located can be characterised as positive linear anomalies associated with agricultural activity, positive linear and curvilinear anomalies of a possible archaeological origin with others of an uncertain origin and strong discrete positive anomalies with negative returns (bipolar anomalies) which are responses to ferrous objects within the topsoil. The results of the two separate survey areas will be discussed below and anomalies have been numbered from (1) to (10) in Area 1 for ease of reference.

*Area 1 (centred on SU 177 885) (Figures 2-7)*

Towards the northern corner of the survey area, a positive curvilinear anomaly (1) approximately 36m in diameter can be seen. From the results it is not possible to ascertain if this anomaly extends to form a circular feature, however it is possible that this anomaly is a response to the slightly magnetically enhanced fill of a cut feature and an archaeological origin should be considered.

Close to the western corner of the survey area is a group of positive linear anomalies (2). Although it is difficult to tell if these anomalies are associated with one another it is possible that they may form a sub-rectilinear feature with dimensions of approximately 25m x 72m and an archaeological origin is possible.

Located near the southern corner and extending towards the centre of the survey area is a positive linear anomaly (3). This anomaly extends for approximately 165m and is oriented north-north-west to south-south-east. It is possible that this linear response is associated with a cut feature and an archaeological origin could be considered.

In the centre of the survey area are three positive curvilinear anomalies (4) with an approximate diameter of 10m. Although the low magnitude of these anomalies has made abstraction and interpretation problematic it is possible that these curvilinear responses may form circular cut features with an archaeological origin.

Area 1 contains several other positive linear (5) and curvilinear (6) anomalies within the site. In the south of the survey area is a group of linear anomalies (7) and close to the southern corner is a possible rectilinear anomaly (8). It is not possible to confidently define these anomalies as characteristically archaeological features, however this possibility cannot be ruled out.

A series of linear anomalies (9), oriented east – west, can be seen across the majority of the survey site. These parallel anomalies are likely to have been caused by agricultural activity.

The presence of ferrous objects within the topsoil is indicated by several strong discrete bipolar anomalies with negative returns (10).

*Area 2 (centred on SU 175 882) (Figures 8-12)*

In the southeast of the survey area are two positive linear anomalies that appear to form a fragmented curvilinear anomaly. To the northeast of this is an area of magnetic debris with strong bipolar anomalies associated with it. It is likely that is anomaly is a response to thermoremnant material or may indicate an area of burning.

There are several short linear anomalies within this survey area, however, because of their diffuse nature and low magnitude it is not possible to ascertain their origin. Several strong bipolar anomalies indicate that ferrous objects are present within the site.

## 5 CONCLUSION

Several positive linear, curvilinear and possible rectilinear anomalies have been located within the site. Apart from ferrous “spikes”, geophysical anomalies were generally of a very low magnitude across the site, making confident abstraction and interpretation difficult. Anomalies within Area 1 to the north indicate that cut features with a possible archaeological origin may be present including linear, curvilinear and possible rectilinear responses. Area 2 also contained a possible curvilinear anomaly that may also relate to a cut feature.

# **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.