

GEOPHYSICAL SURVEY REPORT

STRATASCAN™



Project name:
Café Field, Standon, Hertfordshire

Client:
CgMs Consulting

Job ref:
J9914

September 2016

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1 SUMMARY OF RESULTS

A detailed magnetic survey was carried out over approximately 11 hectares of land at Café Field, Standon. The results would seem to support the view that a possible enclosure, visible on cropmarks, is in fact due to localised differences in the soils, geology and topography.

Natural magnetic responses dominate the results, particularly in the western half of the field. Those in the east also appear natural but there are several pit-like responses which cannot totally be ruled out as having an anthropogenic origin, hence they have been classified as uncertain.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for residential development. This survey forms part of an archaeological investigation being undertaken by CgMs Consulting on behalf of Sunland Nominees PTY Ltd.

2.2 Site Details

NGR / Postcode	TL 382 226 / SG11 1SA
Location	Café Field lies in a triangle of land between the A10 and the A120 on the western outskirts of Standon, south of Puckeridge, Hertfordshire. Standon Hill (A120) forms the southern boundary, a tributary of the River Rib the western limit, open fields lie to the north and a residential estate to the east.
HER/SMR	Hertfordshire
Planning Authority / Ref	East Hertfordshire District Council
Unitary Authority	East Hertfordshire
Parish	Standon CP
Topography	Gently sloping down from south to north and a more marked slope down from east to west. The south east corner is 96m AOD and the south west corner 86m AOD.
Current Land Use	Arable / stubble
Weather Conditions	Fine / Dry
Soils	The soils are from the Melford Association (571o): deep well drained fine loamy over clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).
Geology	Solid geology: West: Chalk (Lewes Nodular & Seaford Chalk Formations). East: Lambeth Group – clay, silt and sand. Superficial: West: Head deposits – clay, silt and sand; Lowestoft – diamicton. East: Glaciofluvial deposits – sand and gravel. (BGS 2016)

Archaeology	A potential cropmark within the survey area has been interpreted as an enclosure; however, an archaeological origin is uncertain because of the underlying geological deposits (CgMs 2014).
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c. 11 hectares

2.3 Aims and objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in Appendix A.

3.3 Processing

The following schedule shows the basic processing carried out on the data used in this report:

1. *De-stripe*
2. *De-stagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, for example: probable, or possible archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification "possible".

4 RESULTS

The survey at Café Field has identified a variety of magnetic responses in the western half of the field, the majority of which are interpreted as being natural in origin due to localised variations in the soils and geology. In the eastern half of the data the anomalies are different in character and many appear pit-like in origin. There are also several trends though they form no particular patterns. While an archaeological origin cannot be totally ruled out, the responses are more likely to reflect the different geology in this half of the field. The responses have been classified as uncertain, with a preference for natural or agricultural effects being the origin.

4.1 Probable Archaeology

No responses indicative of probable archaeology have been identified.

4.2 Possible Archaeology

No responses indicative of possible archaeology have been identified.

4.3 Medieval/Post-Medieval Agriculture

Ploughing trends in the data are visible following a variety of orientations.

A long linear anomaly plus trend aligned south-south-west / north-north-east, recorded in the data in the western half of the field, coincides with a line clearly visible on Google imagery from 2003. It is possibly a drain or other relatively modern agricultural effect; its precise origin remains uncertain.

4.4 Other Anomalies

The western half of the field is dominated by sinuous curvilinear responses which are characteristic of natural / geological variations. The geology and soil maps (see introduction) show clear changes across the field and the banding is indicative of where the layers come near to the surface on the sloping topography. The observed magnetic responses reflect soil changes visible on Google imagery and, although the cropmark evidence (HER entry MHT10214) has not been seen, the geophysics would seem to support the assertion that the 'recorded enclosure' is indeed due to the local geology / topography.

The magnetic responses in the eastern half are different from those in the west; in the east the topography is generally more level, being more like a plateau. The anomalies are less sinuous and there are numerous pit-like responses. While an archaeological origin cannot be totally ignored, there is no supporting evidence to indicate they are anthropogenic. They do not form specific patterns and clusters of small ferrous responses are more indicative of modern agricultural activity. The 'pit' responses could easily be pockets of magnetic soils / gravels. Given the slightly unusual nature of the responses an uncertain origin has been assigned.

Elsewhere fences and gates are responsible for ferrous responses along the survey edges. Smaller ferrous anomalies, or 'magnetic spikes', indicate small ferrous metal objects and are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Chalk geologies generally provide good responses for magnetic survey. In this instance though, the varying superficial deposits and the sloping topography are having a dominant effect on the recorded magnetic responses.

6 CONCLUSION

The survey at Café Field has not identified any magnetic responses of probable or possible archaeological interest.

Variations in the local soils, geology and sloping ground have affected the results. Natural responses dominate the data in the west, while the recorded responses in the east have been classified as uncertain. Here the anomalies have pit-like characteristics but these are also typical of localised variations in the magnetic gravels. The soil / geology maps and Google imagery suggest that all the observed magnetic anomalies are, on balance, likely to be natural.

7 REFERENCES

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Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad601-2*

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m.

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 site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.

Step Correction (Destagger) When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall*, etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

<i>Archaeology/Probable Archaeology</i>	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
<i>Possible Archaeology</i>	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
<i>Industrial / Burnt-Fired</i>	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal- working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
<i>Former Field Boundary (probable & possible)</i>	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
<i>Ridge & Furrow</i>	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
<i>Agriculture (ploughing)</i>	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
<i>Land Drain</i>	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains will often lead and empty into larger diameter pipes and which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
<i>Natural</i>	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
<i>Magnetic Disturbance</i>	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
<i>Service</i>	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
<i>Ferrous</i>	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
<i>Uncertain Origin</i>	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of <i>Possible Archaeology</i> and <i>Possible Natural</i> or (in the case of linear responses) <i>Possible Archaeology</i> and <i>Possible Agriculture</i> ; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

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. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected.

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

Thermoremanence 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. Thermoremanent 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 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.

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