GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:

Land Off Kingsclere Road, Overton, Hampshire

Client:

CgMs Consulting Ltd

January 2015

Job ref:
J7768

Report author:
Rebecca Davies BSc (Hons)

Project name:

Land Off Kingsclere Road, Overton, Hampshire

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Techniques:

Detailed magnetic survey – Gradiometry

Project manager:

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Survey date:

5th - 8th January 2015

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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 16.6 hectares of arable farmland. A former settlement and enclosure have been identified, along with numerous former pits, which supports evidence in the desk-based assessment of the site. Former field boundaries provide evidence of past agricultural activity. A number of linear anomalies and possible pits may be of archaeological or natural origin. A large area of magnetic variation is a result of superficial deposits of clay, silt, sand and gravel. The remaining features are modern in origin and include a service, disturbance from ferrous objects and magnetic spikes.

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 Ltd.

2.2 Site location

The site is located to the north of Overton, Hampshire at OS ref. SU 509 504. A railway line bounds the site to the north with an area of woodland to the west, a village centre to the south and a residential area to the east.

2.3 Description of site

The survey area is approximately 17.4 hectares of arable farmland. An area of approximately 0.9 hectares of woodland on the western edge of the site could not be surveyed. The area has an undulating topography with the eastern and western areas elevated above the low-lying central area of the site.

2.4 Geology and soils

The underlying geology is chalk of the Seaford Chalk Formation (British Geological Survey website). There are superficial deposits of Head – Clay, Silt, Sand and Gravel running north-south in the low-lying area of the site (British Geological Survey website).

The overlying soils are known as Andover 1 across the north and west of the site, which are typical brown redzinas and Charity 2 across a small area in the south and east which are typical argillic brown earths. The Andover 1 soils consist of shallow, well drained calcareous silty soils over chalk on slopes and crests while Charity 2 soils consist of well drained flinty fine silty soils in valley bottoms or calcareous fine silty soils over chalk or chalk rubble on valley sides (Soil Survey of England and Wales, Sheet 6 South East England).

2.5 Site history and archaeological potential

Extract from “Land off Kingsclere Road, Overton, Hampshire – Archaeological Desk-Based Assessment” (CgMs Consulting Ltd, 2014):

"There are no designated archaeological heritage assets identified within the study site itself or its immediate proximity. The registered park and garden of Laverstoke Park identified to the south-west is a nationally important heritage asset.

The study site is identified to contain a series of non-designated cropmark features that on the basis of their form, and from investigations conducted adjacent, appear likely to represent the remains of a probable settlement enclosure and associated activity that could date from the prehistoric and/or Roman period. The presence of these, and any associated remains, are on the basis of current evidence considered likely to be of no more than regional significance.

Beyond these assets, the assessment has identified a low potential for the presence of any significant unknown buried archaeological remains on the study site. The study site is likely to have remained an area of agricultural land from the medieval period, if not earlier. The presence of any evidence relating to agricultural practices is considered to be of no more than local significance."

*2.6 **Survey objectives***

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

*2.7 **Survey methods***

This report and all fieldwork have been conducted in accordance with both the English Heritage guidelines outlined in the document: *Geophysical Survey in Archaeological Field Evaluation, 2008* and with the Institute for Archaeologists document *Standard and Guidance for Archaeological Geophysical Survey.*

Due to the high potential for prehistoric and/or Roman remains, and the good response of chalk geology for gradiometer survey, detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in Appendix A.

*2.8 **Processing, presentation and interpretation of results***

2.8.1 Processing

Processing is performed using specialist software. 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. 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 minimally processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)
2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

Presentation of results and interpretation

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

3 RESULTS

The detailed magnetic gradiometer survey conducted at Overton has identified a number of anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin.

The difference between *probable* and *possible* archaeological origin is a confidence rating. Features identified within the dataset that form recognisable archaeological patterns or seem to be related to a deliberate historical act have been interpreted as being of a probable archaeological origin.

Features of possible archaeological origin tend to be more amorphous anomalies which may have similar magnetic attributes in terms of strength or polarity but are difficult to classify as being archaeological or natural.

The following list of numbered anomalies refers to numerical labels on the interpretation plots.

3.1 ***Probable Archaeology***

1-2 A number of positive linear and curvilinear anomalies in the northeast and south west of the site. Anomaly 1 is likely to be related to a former enclosed settlement, with Anomaly 2 related to a former enclosure.

3-4 A number of small, discrete positive anomalies in the northeast and southwest of the site. These are indicative of former cut features of archaeological origin such as backfilled pits. Anomaly 3 is related to the settlement activity of Anomaly 1. Anomaly 4 is related to the former enclosure of Anomaly 2.

5 Positive anomalies in the northeast of the site. These are related to the former enclosed settlement evidenced by Anomalies 1 and 3.

6 A linear anomaly in the east of the site that is related to a former field boundary present on available historic mapping from 1872 to 1961.

3.2 ***Possible Archaeology***

7 Positive linear anomalies in the southeast of the site. These are likely to be related to former field boundaries but are not present on available historic mapping.

8 A number of positive linear anomalies across the site. These are indicative of former cut features of possible archaeological or natural origin.

9 A number of small, discrete positive anomalies across the site. These are indicative of former cut features such as backfilled pits and may be of archaeological or natural origin.

10 A positive anomaly in the east of the site. This is indicative of a former cut feature of possible archaeological or natural origin.

11 Negative linear anomalies running down the centre of the site that are indicative of former banks or earthworks. These may be archaeological in origin, or relate to the underlying drift geology of the site.

3.3 ***Other Anomalies***

12 A strong bipolar linear anomaly in the southeast of the site. This is related to a modern service such as a pipe or cable.

13 A large area of amorphous magnetic variation running roughly north-south in the centre of the site. This is related to the underlying superficial deposits of clay, silt, sand and gravel.

14 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies, but on this site have not affected a significant proportion of the area.

15 A number of magnetic ‘spikes’ (strong focussed values with associated antipolar response) indicate ferrous metal objects. These are likely to be modern rubbish.

4 CONCLUSION

The survey at Overton has identified a number of anomalies of probable and possible archaeological origin. Evidence of a former enclosed settlement in the northeast and a further enclosure in the southwest support information provided in the archaeological desk-based assessment of the site of there being a high potential for remains of settlement activity of prehistoric or Roman date. Former field boundaries provide evidence of past agricultural activity, again supporting the desk-based assessment. A number of linear features and possible former pits may be of archaeological origin, however their exact origin cannot be determined with any degree of confidence. The remaining features are natural or modern in origin and include a large area of natural variation caused by underlying superficial deposits of clay, silt, sand and gravel, a service such as a pipe or cable, magnetic disturbance from nearby ferrous metal objects such as fences and magnetic spikes that are likely to be modern rubbish.

5 REFERENCES

British Geological Survey South Sheet, 1977. *Geological Survey Ten Mile Map, South Sheet First Edition (Quaternary).* Institute of Geological Sciences.

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

British Geological Survey, n.d., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer.

CgMs Consulting Ltd, 2014. *Land off Kingsclere Road, Overton, Hampshire – Archaeological Desk-Based Assessment*

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation.*

Institute For Archaeologists. *Standard and Guidance for Archaeological Geophysical Survey.* http://www.archaeologists.net/sites/default/files/nodefiles/Geophysics2010.pdf

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 6 South East England*.

APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT

Grid locations

The location of the survey grids has been plotted 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 or a Leica Smart Rover RTK GPS.

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. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

Survey equipment and gradiometer configuration

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 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 gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

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.

Depth of scan and resolution

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

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

APPENDIX B – 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 *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.

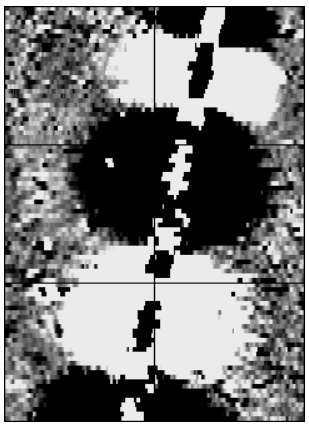
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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.

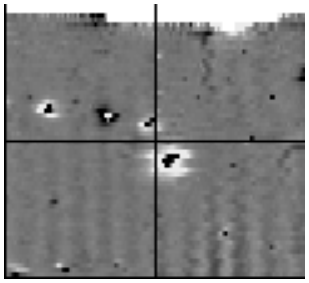
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES

Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

Dipolar

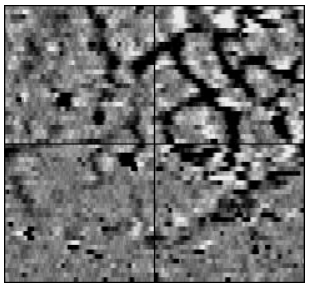


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

Positive anomaly with associated negative response

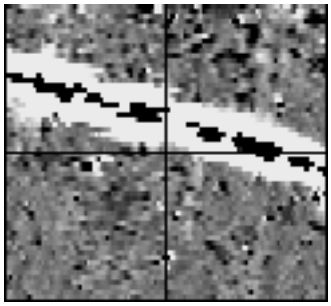
See bipolar and dipolar.

Positive linear



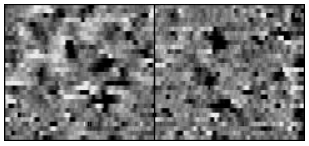
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

Positive linear anomaly with associated negative response



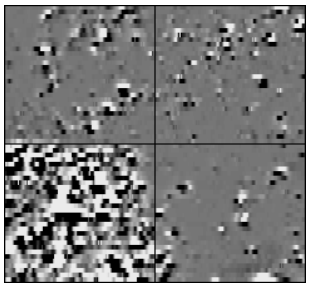
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

Positive point/area



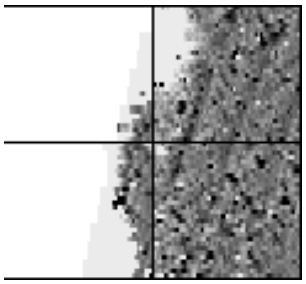
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

Magnetic debris



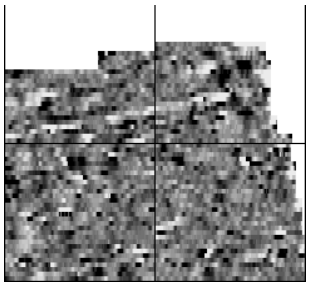
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly (+/-250nT) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

Negative linear

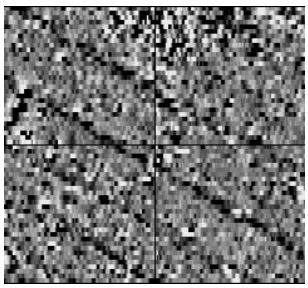


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing, clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

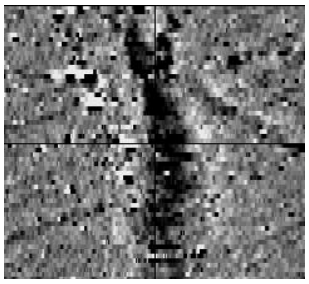
Strength of response

The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a $10m^2$ area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.

Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.

APPENDIX D – EMAIL CORRESPONDENCE IN REGARD TO SURVEY METHODOLOGY

That's great. Its just sometimes they can be a bit thoughtless, but it is not always clear whether they thoughtless in how they did the task or thoughtless in how they presented the results. Cheers, David

David Hopkins
County Archaeologist
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Elizabeth II Court West, The Castle, Winchester SO23 8UD

Email david.hopkins@hants.gov.uk
01962 832339

From: Steven Weaver [mailto:steven.weaver@cgms.co.uk]
Sent: 11 December 2014 11:27
To: Hopkins, David (ENV)
Subject: RE: Land off Kingsclere Road, Overton, Hampshire - WSI for geophysical survey

Dear David,

Many thanks for getting back to me on this matter and for highlighting your concerns. I shall pass these on to our geophysicists so that they can suitably address to ensure that we produce and provide a robust report.

Kind regards,

Steven

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Senior Associate Director
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From: Hopkins, David (ENV) [mailto:david.hopkins@hants.gov.uk]
Sent: 11 December 2014 10:18
To: Steven Weaver
Subject: RE: Land off Kingsclere Road, Overton, Hampshire - WSI for geophysical survey

Dear Steven, thank you, that was kind. However I don't tend to comment on Geophysics WSIs, it is a very specialist area of competence and I don't feel I would be able to contribute to the discussion in any meaningful way. However I do have a couple of concerns regarding geophysical survey. The first is that we (you and I) are somewhat in the hands of the geophysics 'experts' to ensure that they choose and implement the most appropriate techniques in the particular circumstances. The second is that it should be explicit in their report what confidence they place on the results (in light of the techniques applied, the conditions, the geology etc). I am afraid that I have read some geophysics reports of late that have been quite naive in the way that they represent the results. It may seem unhelpful of me to comment at the end but not at the beginning, but it is the quality of the reporting that reveals to me

the quality of the techniques used not any inherent technical knowledge I have of the techniques as set out in a WSI.

I am very pleased that your client has commissioned the survey and I very much look forward to seeing the results in due course.

sincerely

David Hopkins
(County Archaeologist)

Economy, Transport and Environment Department
Elizabeth II Court West, The Castle, Winchester SO23 8UD

Email david.hopkins@hants.gov.uk
01962 832339

From: Steven Weaver [mailto:steven.weaver@cgms.co.uk]
Sent: 11 December 2014 09:31
To: Hopkins, David (ENV)
Subject: Land off Kingsclere Road, Overton, Hampshire - WSI for geophysical survey

Dear David,

As part of on-going assessment works to inform proposals at the above, we have been instructed to implement a geophysical survey across the site area. As with the previous monitoring exercise maintained during geotechnical works I am uncertain whether you should wish to comment on the above, but I attach copy of the WSI for the works for your comment/approval so that we ensure that you are happy with the methodology and scope that is being adopted. Stratascan have been appointed to undertake the works which we are currently looking to commence as of the 5th January.

I look forward to hearing from you shortly regarding the attached and discussing the survey results in due course.

Kind regards,

Steven

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