STRATASCAN

Geophysical Survey Report

A3 Hindhead, Surrey

for

Wessex Archaeology

March 2007

J2279

Hannah Heard BSc (Hons)

REGISTERED • IFA • ORGANISATION

Document Title:	**Geophysical Survey Report** **A3 Hindhead, Surrey**
Client:	**Wessex Archaeology**
Stratascan Job No:	**J2279**
Techniques:	**Detailed magnetic survey (gradiometry)**
National Grid Ref:	**SU 858 331, SU 875 343, SU 902 372, SU 905 384, SU 906 391**

Field Team:	Richard Elliot BA (Hons), Mark Styles, Justine Biddle BSc (Hons), Lynda O'Sullivan BSc (Hons), Richard Fleming
Project Manager:	Simon Stowe BSc (Hons)
Report written by:	Hannah Heard BSc (Hons)
CAD illustration by:	Hannah Heard BSc (Hons)
Checked by:	Simon Stowe BSc (Hons)

Stratascan Ltd.

Vineyard House
Upper Hook Road
Upton upon Severn
WR8 0SA

Tel: 01684 592266
Fax: 01684 594142
Email: ppb@stratascan.co.uk

www.stratascan.co.uk

LIST OF FIGURES

1 SUMMARY OF RESULTS

A detailed gradiometry survey was carried out along seven separate survey areas either side of the A3 in Hindhead, Surrey. Evidence for possible archaeological activity has been identified throughout the survey areas in the form of linear and discrete cut features. A number of positive linear anomalies may represent cut features or ground disturbance of archaeological origin. The majority of these anomalies are faint and disjointed and constitute weak evidence of archaeological activity. Discrete positive and area responses have also been identified, indicating additional cut features, although a number of these anomalies may be pedolgical in origin.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Wessex Archaeology to undertake a geophysical survey of an area outlined for the widening of the A3 highway. This survey forms part of an archaeological investigation undertaken by Wessex Archaeology.

2.2 Site location

The survey areas are located along the A3, centred at Hindhead, approximately 8 miles south of Aldershot, Surrey at OS references of SU 858 331, SU 875 343, SU 902 372, SU 905 384, SU 906 391.

2.3 Description of site

The survey area is approximately 20ha of agricultural land situated either side of the A3. The survey consists of seven separate survey areas, M21, M3, M12, M16S, M15, M17 and M16N. An area to the north of M16S could not be surveyed, as this was located within woodland.

2.4 Geology and soils

The underlying geology is Lower Greensand (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils across the majority of the survey areas are known as Shirrell Heath 1 soils which are humo-ferric podzols. These consist of well drained very acid sandy soils (Soil Survey of England and Wales, Sheet 6 South East England). The soils covering the northern survey areas (M16N and M17) are known as Frilford soils which are argillic brown sands. These consist of deep well drained sandy and course loamy soils (Soil Survey of England and Wales, Sheet 6 South East England).

2.5 Site history and archaeological potential

A series of Medieval and Post-medieval plough marks and possible holloways have been identified within area M3. Post-medieval spot finds and possible activity are identified throughout the other survey areas.

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 19 days from 1st - 16th January and 12th - 20th February 2007. Weather conditions during the survey were variable, but mainly dry.

3.2 Grid locations

The location of the survey grids has been plotted in Figures 2, 8, 14, 20 and 26 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 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 and 1600 sample points in a full 20m x 20m 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. The data is collected at a reading resolution of 0.1nT.

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 values were removed from the data set in an attempt to reveal additional anomalies.

3.5.2 <u>Presentation of results and interpretation</u>

The presentation of the data for each site involves a print-out of the raw data both as greyscale (Figures 3, 9, 15, 21, 27) and trace plots (Figures 4, 5, 10, 11, 16, 17, 22, 23, 28, 29), together with a greyscale plot of the processed data (Figures 6, 12, 18, 24, 30). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figures 7, 13, 19, 25, 31).

4 RESULTS

Possible evidence for archaeological activity has been identified in areas M3, M12, M15, M16N and M17. Any anomalies of possible archaeological activity situated in M21 have been obscured by the dominating presence of strong magnetic disturbance. The following results have examined each survey area in turn.

Area M21
The survey area was restricted to a thin strip of land situated either side of the road due to woodland and areas of overgrown vegetation. A single track road ran northeast to southwest across the south of the survey area. The data is largely dominated by areas of strong magnetic disturbance likely to be associated with modern ground disturbance and ferrous debris. These large area responses have obscured any faint anomalies of possible archaeological origin. However, a strong positive linear anomaly can be seen in the north of the survey. This anomaly may represent a possible cut feature of archaeological origin. A number of discrete positive anomalies with associated negative returns can be seen mainly in the south of the survey area. These anomalies may represent near surface ferrous objects.

M3
Area M3 A is dominated by agricultural marks, with at least two phases of agricultural activity being observed. Plough marks have also been identified within area M3 B. A

series of disjointed positive linear anomalies can be seen across the southern and western parts of M3 A and B. These anomalies may represent cut features of archaeological origin; however no 'structural' plan can be seen, possibly suggesting a general area of archaeological activity. A series of positive area anomalies have been identified along the southern and eastern survey limits of M3 B. These area anomalies may represent possible cut features of archaeological activity, although a pedological origin can not be ruled out.

A negative linear anomaly can be seen in the south of M3 B. This linear anomaly may represent an area of compacted ground, possibly of agricultural origin. A large number of discrete positive responses have been identified throughout M3 B and across the south of M3 A. These anomalies may indicate discrete cut features of possible archaeological origin. However due to their high numbers, a proportion of these anomalies may be caused by pedological processes.

Strong positive responses with associated negative returns can be seen throughout the survey area. These anomalies may represent near surface ferrous objects. Concentrated areas of these responses may indicate areas of ground disturbance. Areas of magnetic disturbance seen in both M3 A and M3 B may indicate areas of ferrous debris. An area of magnetic response seen across area M3 B is associated with a metal fence running through the survey area. Several areas of magnetic disturbance are situated around the perimeter of the survey areas. These anomalies are associated with the nearby field boundaries.

M12

Weak evidence for archaeological features is also seen in area M12. A series of positive linear anomalies identified across the survey area may represent a number of cut features of possible archaeological origin. However a number of these anomalies may be of agricultural origin, or caused by areas of disturbed ground. Six positive area responses can be seen across the centre of the survey area. These anomalies may represent possible cut features or anomalies of pedological origin. Agricultural marks can be seen across the survey area, running parallel with the central field boundary. A faint bipolar linear anomaly has been identified along the south of the survey area. This linear may represent a field drain or possible service.

Areas of magnetic disturbance can be seen around the perimeter of the survey area. These anomalies are associated with nearby field boundaries. Discrete dipolar anomalies seen throughout the survey area represent near surface ferrous objects. A band of magnetic disturbance identified to the west of the central field boundary may represent an area of ground disturbance and possible ferrous debris associated with agricultural activity. Areas of strong magnetic response situated within the survey area may represent areas of ferrous debris.

M15

Area M15 show similar findings to that of Area M3. A series of parallel linear anomalies can be seen across the survey area that relate to agricultural activity. A number of disjointed positive linear anomalies have been identified mainly across the north of the survey area. These linear anomalies may represent cut features of possible archaeological origin, however they may also indicate areas of general ground disturbance. A positive area anomaly situated in the centre of M15 A may represent a further cut feature, but may also be pedological in origin. Four discrete positive anomalies situated in the south of M15 B may represent weak evidence of cut features, such as pits of possible archaeological origin.

Areas of magnetic disturbance around the perimeter of the survey area are associated with the nearby field boundaries. The discrete dipolar responses may represent near surface ferrous objects. The linear area of strong magnetic debris situated across the centre of M15 A may represent a previous field boundary or service.

M16S

M16S shows little evidence for archaeological activity. A number of discrete positive anomalies in the extreme north and centre of the survey area may provide weak evidence for possible pits of archaeological origin. Agricultural marks have been identified running parallel with the road.

Magnetic disturbance associated with the field boundary can be seen along the western edge of the survey area. Two areas of magnetic disturbance can be seen in the centre of the survey area, indicating areas of possible ferrous debris. Discrete positive responses with associated negative returns have been identified throughout the length of the survey area, indicating possible near surface ferrous objects.

M16N

Area M16N is dominated by agricultural marks running parallel with the road. Three faint positive linear anomalies identified in the centre of the survey area may provide weak evidence for cut features of archaeological origin. A number of dipolar anomalies can be seen mainly in the north of the survey, indicating near surface ferrous objects. Areas of magnetic disturbance associated with the nearby field boundaries can be seen along the eastern and southern edges of the survey.

M17

Evidence for possible archaeological activity have been identified throughout area M17, with a higher concentration situated within M17 C. A series of disjointed positive linear anomalies have been identified throughout areas A-C. These anomalies may represent cut features or areas of ground disturbance of archaeological origin. Areas of positive response seen within areas B and C may indicate further cut features or ground disturbance, but may also be of pedological origin. Discrete positive anomalies have been identified throughout the survey area, with a higher concentration across the centre of M17 C. These anomalies may represent discrete cut features of archaeological origin, although they may also be caused by pedological variations.

Areas of magnetic disturbance associated with nearby field boundaries can be seen throughout the survey area along with near surface ferrous objects responses.

5 CONCLUSION

Evidence for archaeological activity has been identified within Areas M3, M12, M15, M16N and M17. Disjointed linear anomalies may represent cut features or areas of ground disturbance of archaeological origin. However no coherent ‘structured’ plan can be seen. A large number of discrete positive responses have been identified, with a high concentration in area M3. These anomalies may represent discrete cut features, such as pits, but may also represent peological anomalies. The same can be said of the areas of positive response mainly seen in areas M3, M12, M15 and M17. These anomalies may represent cut features, areas of more recent ground disturbance or anomalies of pedological origin. Area M21 is dominated by strong magnetic debris. These area anomalies have obscured the identification of anomalies of possible archaeological origin. Further investigation is needed to identify the nature and extents of these anomalies.

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.

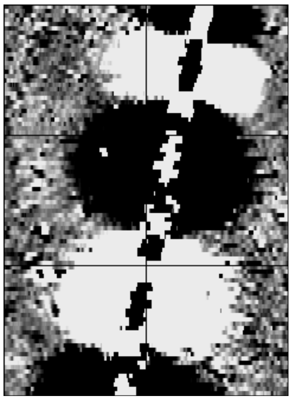
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement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

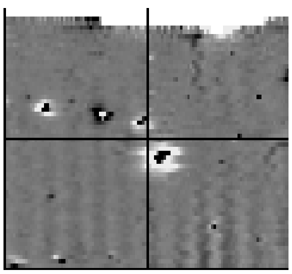
APPENDIX B – Glossary of magnetic anomalies

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

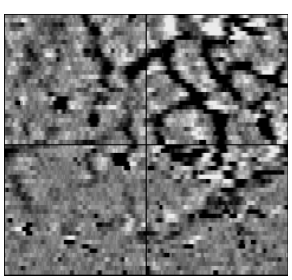


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very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

Positive anomaly with associated negative response

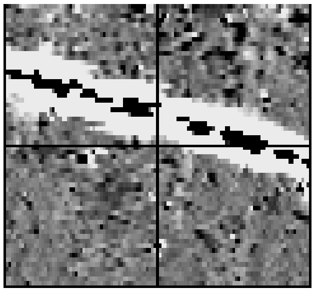
See bipolar and dipolar.

Positive linear



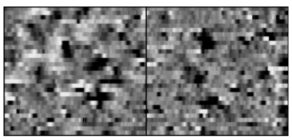
A linear response which is entirely positive in polarity. These are usually related to infilled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity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

Positive linear anomaly with associated negative response



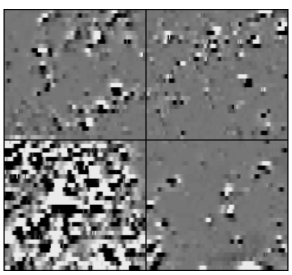
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field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

Positive point/area



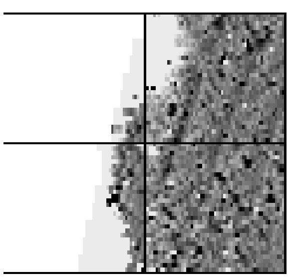
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by infilled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally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

Magnetic debris



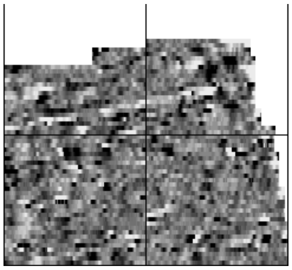
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly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

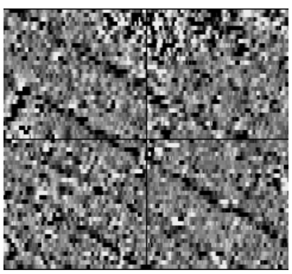


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

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).

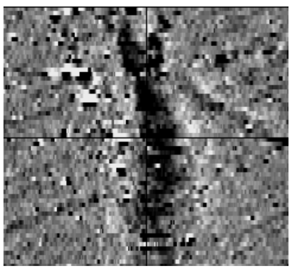
Strength of response

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. Trace plots are used to show the amplitude of response.

Thermoremnant 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 insitu (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.