STRATASCAN

Geophysical Survey Report

Aston Clinton, Buckinghamshire

for

Buckinghamshire County Council

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1. SUMMARY OF RESULTS

A reconnaissance magnetic susceptibility survey was carried out over 35ha. Detailed magnetic and resistance surveys were then targeted on areas based on these results.

While the west of the site provides little evidence of archaeological activity the eastern side contains anomalies which may be of an archaeological origin. These include cut features, bank features, and discrete anomalies possibly representing pits/depressions.

There is no evidence of a Roman building.

2. INTRODUCTION

2.1. Background synopsis

Stratascan were commissioned by Buckinghamshire County Council to undertake a geophysical survey of an area outlined for development.

2.2. Site location

The site is located at Aston Clinton, Aylesbury, Buckinghamshire at OS ref. SP847 135.

2.3. Description of site

The survey area is 35ha of flat pasture land. The western area of the site contains numerous earthworks including a scheduled moat, while the eastern end is cluttered with modern debris. The underlying geology is Upper Greensand and Gault from the Lower Cretaceous, this consists of sand and mudstones (British Geological Survey South Sheet, Third Edition Solid, 1979). The overlying soils are of the Grove association. These are defined as moderately permeable fine loamy calcareous soils over chalky gravel affected by groundwater; some fine loamy over clayey soils with slowly permeable subsoil and slight seasonal waterlogging; some slowly permeable seasonally waterlogged clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).

2.4. Site history and archaeological potential

The following bulleted list identifies the type of archaeological remains known to be/possibly present on the site:

- Scheduled medieval moat
- Earthwork remains of medieval fields and trackways
- Medieval/post medieval settlement
- Possible Roman villa
- Akeman Roman road giving potential for Roman settlement
- General potential for late prehistoric/Roman/Saxon occupation

2.5. 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. This includes specifically to confirm the presence/absence of a Roman villa whose position has been suggested by information reported to Buckinghamshire Sites and Monuments Record.

2.6. Survey methods

The reconnaissance technique of magnetic susceptibility was employed over the whole of the survey area. Based on these results and site knowledge seven areas were selected to carry out a detailed magnetic survey over. A further two areas were chosen to carry out a resistance survey over. More information regarding these techniques is included in the Methodology section below.

3. METHODOLOGY

3.1. Date of fieldwork

The fieldwork was carried out over 6 days from 20th April 2005 to 27th April 2005 when the weather was mixed.

3.2. Grid locations

The location of the survey grids is based on the Ordnance Survey National Grid, see Figure 4 & 20. The referencing and alignment of grids was achieved using a Leica GPS System 500.

3.3. Description of techniques and equipment configurations

3.3.1 *Magnetic Susceptibility*

Alteration of iron minerals in topsoil through biological activity and burning can enhance the magnetic susceptibility (MS) of that soil. Measuring the MS of a soil can therefore give a measure of past human activity and can be used to target the more intensive and higher resolution techniques of Magnetometry and Resistivity. Measurements of MS were carried out using a field coil which provides a rapid scan and has the benefit of allowing "insitu" readings to be taken.

The equipment used on this contract was an MS2 Magnetic Susceptibility meter manufactured by Bartington Instruments Ltd. A field coil known as an MS2D was used to take field readings. This assessed the top 200mm or so of topsoil. To overcome the problem of ground contact all readings were taken 4 or 5 times and an average taken. All obvious localised "spikes" were ignored.

3.3.2 *Magnetometer*

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (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 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.

3.3.3 *Resistance survey*

This method relies on the relative inability of soils (and objects within the soil) to conduct an electrical current which is passed through them. As resistance is linked to moisture content, and therefore porosity, hard dense features such as rock will give a relatively high resistivity response, while features such as a ditch which retains moisture give a relatively low response.

The resistance meter used was an RM15 manufactured by Geoscan Research incorporating a mobile Twin Probe Array. The Twin Probes are separated by 0.5m and the associated remote probes were positioned approximately 15m outside the grid. The instrument uses an automatic data logger which permits the data to be recorded as the survey progresses for later downloading to a computer for processing and presentation.

3.4. Sampling interval, depth of scan, resolution and data capture

3.4.1 *Sampling interval*

Magnetic susceptibility
The magnetic susceptibility survey was carried out on a 20m grid with readings being taken at the node points.

Magnetometer
Readings were taken at 0.25m centres along traverses 1m apart in a zig-zag pattern. This equates to 3600 sampling points in a full 30m x 30m grid.

Resistance survey
Readings were taken at 1.0m centres along traverses 1.0m apart. This equates to 900 sampling points in a full 30m x 30 grid. All traverses were surveyed in a "zigzag" mode.

3.4.2 *Depth of scan and resolution*

Magnetic Susceptibility
The MS2D coil assesses the average MS of the soil within a hemisphere of radius 200mm. This equates to a volume of some $0.016m^3$ and maximum depth of 200mm. As readings are only at 20m centres this results in a very coarse resolution but adequate to pick up trends in MS variations.

Magnetometer
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.

Resistance
The 0.5m probe spacing of a twin probe array has a typical depth of penetration of 0.5m to 1.0m The collection of data at 1m centres with a 0.5m probe spacing provides an appropriate methodology balancing cost and time with resolution.

3.4.3 *Data capture*

Magnetic susceptibility
The readings are logged manually on site, and then transferred to the office where they are entered into a computer and grey scale plots are produced.

Magnetometer
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.

Resistance
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*

Magnetic susceptibility
No processing of the data has been undertaken.

Magnetometer
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 magnetometer data used in this report:

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

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.

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

Resistance
The processing was carried out using specialist software known as *Geoplot 3* and involved the 'despiking' of high contact resistance readings and edge matching of adjacent grids. This removes any exceptionally high readings that may be caused by ground contact problems and balances any discrepancy in average readings between adjacent grids.
The following schedule shows the processing carried out on the processed resistance plots.

Despike *X radius = 1*
Y radius = 1
Spike replacement
Edge match

3.5.2 *Presentation of results and interpretation*

Magnetic susceptibility
The presentation of the data for this site involves a colour scale plot of the field measurements overlain onto a site plan (see Figure 2).

Magnetometer
The presentation of the data for each site involves a print-out of the raw data both as grey scale (e.g. Figure 5) and trace plots (e.g. Figure 6 and 7), together with a grey scale plot of the processed data (e.g. Figure 8). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (e.g. Figure 9).

Resistance
The presentation of the data for the site involves a print-out of the raw data as a grey scale plot (e.g. Figure 21), together with a grey scale plot of the processed data (e.g. Figure 22). Anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing (e.g. Figure 23).

4. RESULTS

4.1. Magnetic susceptibility

The reconnaissance magnetic susceptibility survey was carried out over the entire 35ha site. It has shown the majority of that area to have a relatively low level response, below 10 $x10^{-8}$ SI units. Despite this several hot spots are observed. Most of these very high amplitude responses (red in colour) are related to modern ferrous debris observed on the ground surface. However some hot spots are not associated with observed surface features. It must be borne in mind that while these areas appear to have an origin other than modern some are located along fence lines which may indicate they are still related to modern dumped material.

4.2. Detailed magnetic survey

Area A

Area A is located on a moderately enhanced area of magnetic susceptibility adjacent to the SAM in the north. It contains an area of magnetic debris which may explain the raised magnetic susceptibility readings. It is not apparent what may have caused the magnetic debris, but it is suggestive of ground disturbance.

Area B

This has been located on two areas of moderately enhanced magnetic susceptibility values. The resulting plots show these enhanced regions can be explained by the presence of strongly magnetic linear anomalies likely to be caused by modern utility pipes. Also observed is a weaker linear magnetic debris response which may be associated with a system of clay field drains.

Several discrete dipolar anomalies are present between the two parallel services. These are probably due to dumped modern debris, which has been observed on the surface in Area B.

In the south of this area are two weak magnitude area anomalies. Their cause is unclear, but an archaeological origin can not be ruled out.

Area C

Targeted on a region of moderately raised magnetic susceptibility levels this area has defined a strong linear anomaly which probably represents a continuation of the pipe line observed in Area B. This anomaly appears to cut through a series of parallel linear anomalies which are likely to relate to ploughing activity, probably medieval ridge and furrow.

Area D

This area has been targeted on the possible location of a Roman villa suggested by information reported to Buckinghamshire Sites and Monuments Record. The resulting plot shows no evidence of the presence of a villa, or any other structural remains in this area.

Parallel linear anomalies are observed which provide more evidence of mediaeval ridge and furrow ploughing activity. Cutting perpendicular to these is a linear anomaly which is probably related to field drainage.

Two strong areas of magnetic disturbance are defined in the north of the area which are caused by modern telegraph poles.

Straddling the hedge line in the east is a strong area of magnetic debris. This coincides with a gap in the hedge and may indicate an area of cattle related compacted ground which may also contain modern ferrous debris.

Area E

This area has revealed a large number of anomalies indicating a complex zone of activity.

While the hot spot in the magnetic susceptibility corresponds with a strong magnetic disturbance of probable modern origin numerous other anomalies have been identified which correspond with no enhancement in the magnetic susceptibility survey. Positive and negative rectilinear anomalies have been identified which appear in places to form complete enclosures. It is possible these relate to ditch and bank features of archaeological origin. Also present are positive area anomalies and positive discrete anomalies which may be caused by depressions/pits of archaeological origin.

This area is a good example demonstrating that magnetic susceptibility at this sample interval is only a reconnaissance technique that can miss weak anomalies, and should not be relied up on as a stand alone method.

Area F

The east of Area F contains a series of parallel linear anomalies probably associated with agricultural activity. The strong response in the centre of the southern edge of the area is caused by a telegraph pole. In the north is a weak area of magnetic disturbance with an unknown origin. There are also two curvilinear positive anomalies which may represent cut features of an archaeological origin.

The western side of the area shows a positive linear anomaly with an associated negative response aligned north west – south east. It is possible this is associated with a ditch and bank feature of archaeological origin. The western side of this anomaly displays a strong area of magnetic disturbance in the south and several positive anomalies and negative anomalies further north. The magnetic disturbance probably has a modern origin while the remaining anomalies may have an archaeological origin.

Area G

This area defines a strong linear anomaly likely to represent a modern service pipe.

4.3. Detailed resistance survey

Area D

Area D has been located to cover the position of the possible Roman villa. As with the magnetic data the resistance data has provided no evidence to suggest the presence of a villa or any other structural remains.

There is an underlying high resistance response which seems likely to be a result of natural variations in pedology/geology. Cutting through this response are parallel linear anomalies probably caused by ridge and furrow ploughing.

Area E

This area has been targeted on the results of the detailed magnetic survey of the corresponding area which includes several eathworks. The magnetic survey showed a complex area of rectilinear anomalies which may represent features of an archaeological origin.

The resistance survey has not revealed as much detail as the magnetic survey. Two high resistance, parallel linear anomalies have been defined in the centre of the area. These do not seem to correlate with any anomalies identified in the magnetic data. It is unclear exactly what their origin may be, it is possible they are caused by buried stone. There are several small areas of moderately high resistance response and high resistance response. Again it is not apparent what this may be, but buried stone of an archaeological origin is possible.

5. CONCLUSION

The magnetic susceptibility identified several areas to carry out more detailed magnetic surveys and resistance surveys.

The east of the site has revealed little evidence of archaeological features. Only ridge and furrow ploughing and undated field drains represent non-modern features. It is possible the strong magnetic responses from modern services located in Areas B, C & G may be obscuring weaker archaeological anomalies, although if any archaeological features do exist the trenching associated with the services may have wholly or partially destroyed them. The west of the site provides more convincing evidence of archaeological activity. Areas E and F define complex zones of anomalies possibly relating to cut features and bank features of archaeological origin. Area E may also include buried stone remains.

There is no evidence to support the presence of a Roman building in Area D.

REFERENCES

British Geological Survey, 1979. *Geological Survey Ten Mile Map, South Sheet, Third Edition (Solid)*. British Geological Society.

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