STRATASCAN

Geophysical Survey Report

Beam Washlands, Dagenham
Essex

For

Oxford Archaeology

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Hannah Heard BSc (Hons)

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Field Team:	Lee Moorhead MA and Mark Styles
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

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1 SUMMARY OF RESULTS

A detailed gradiometry and resistivity survey was carried out at Beam Washlands, southeast of Dagenham, Essex. The gradiometry survey was of limited success due to the high levels of magnetic debris in and around the survey area. The resistivity survey has located by a series of low resistance linear anomalies that may indicate cut features of archaeological origin. Low and high resistance anomalies situated in the south of the survey area are likely to relate to the continuation of the Post Medieval flood defences identified in the previous archaeological investigations situated west of the survey area. Low resistance linear anomalies orientated northwest to southeast across the survey area may represent cut features of archaeological origin. A number of high and low resistance anomalies may relate to the archaeological features excavated within the Oxford Archaeology trial trenches.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Oxford Archaeology to undertake a geophysical survey of an area outlined for proposed development. This survey forms part of an archaeological investigation being undertaken by Oxford Archaeology.

2.2 Site location

The site is located southeast of Dagenham, south of the former Dagenham Hospital close to the Beam River, Essex at OS ref. TQ 502 835.

2.3 Description of site

The area surveyed totalled 1.4 hectares. The current land use is open grassland with gently sloping topography down towards the Wantz stream in the south of the survey area. The survey area is scattered with areas of metallic debris and a large spoil heap and a heavy plant track way is situated along the northwestern end of the survey area. A metal fence runs across the eastern extent of the survey area.

The underlying geology is London Clay overlain by Lower Thames Valley, Mucking Gravels of the first terrace (British Geological Survey South Sheet, Fourth Edition Solid, 2001, (British Geological Survey South Sheet, First Edition Quarternary, 1977). The overlying soils have not been comprehensively mapped due to the sites urban environment. However the site is situated on the River Beam floodplan and therefore unlikely to contain the alluvial and peat deposits that are observed closer to the Wantz Stream and Beam River.

Plate 1: Looking northwest over survey area showing the large spoil heap situated over the western edge of the survey area

2.4 Site history and archaeological potential

This report forms part of an ongoing archaeological investigation carried out by Oxford Archaeology. Previous archaeological work carried out to the west of the survey area has identified a managed landscape and areas of industrial activity in the form of pottery kilns dating to the Roman period. Although evidence for structural remains is scarce the quantities of artefactual remains suggests the possibility of settlement within the immediate area. The 13 trial trenches excavated within the survey area has revealed few and randomly dispersed archaeological features. Two cremations were discovered within the centre of the survey area, one dating to the Roman period. A series of post holes and ditches have been identified of unknown date. Running along the south of the survey area a Post Medieval ditch has been identified and is likely to represent the continuation of a ditch identified within Area 1, possibly relating to an early flood defence barrier.

2.5 Survey objectives

The objective of the survey was to locate any anomalies that may be of archaeological significance prior to development.

2.6 Survey methods

An initial 30m x 30m grid trial was carried out within the survey area to assess the success of each technique. The resistivity proved to be more successful due to the high levels of magnetic debris disrupting the gradiometry data. The presence of a large spoil heap and a frequently used heavy plant trackway situated along the northwestern edge of the survey area restricted the data collection carried out by the resistivity survey. Therefore, a gradiometer survey was also carried out to cover as much as possible of the initial survey area. 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 8 days from the 5th to the 9th and the 11th to the 13th December 2005 when the weather was dry.

3.2 Grid locations

The location of the survey grids has been plotted on Figure 2 together with the referencing information.

3.3 Description of techniques and equipment configurations

3.3.1 Gradiometer

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 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 sensor has a 1m separation between the sensing elements giving a strong response to deep anomalies.

3.3.2 Resistance Meter

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 resistivity 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.

Though the values being logged are actually resistances in ohms they are directly proportional to resistivity (ohm-metres) as the same probe configuration was used through-out.

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

3.4.1 Sampling interval

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

Resistivity
Readings were taken at 0.5m centres along traverses 0.5m apart. This equates to 3600 sampling points in a full 30m x 30m grid. All traverses were surveyed in a "zigzag" mode.

3.4.2 Depth of scan and resolution

Gradiometer
The Grad 601 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 0.5m centres provides an appropriate methodology balancing cost and time with resolution.

Resistivity
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 0.5m centres with a 0.5m probe spacing provides an appropriate methodology for the collection of high resolution data.

3.4.3 Data capture

Gradiometer and Resistivity
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

Gradiometer

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:

Zero mean grid	*Threshold = 0.25 std. dev.*
Zero mean traverse	*Last mean square fit = off*
Despike	*X radius = 1 Y radius = 1* *Threshold = 3 std. dev.* *Spike replacement = mean*

Resistivity

The processing was carried out using specialist software known as *Geoplot 3* and involved the 'despiking' of high contact resistance readings and the passing of the data though a high pass filter. This has the effect of removing the larger variations in the data often associated with geological features. The nett effect is aimed at enhancing the archaeological or man-made anomalies contained in the data.

The following schedule shows the processing carried out on the processed resistance plots.

Despike	*X radius = 1* *Y radius = 1* *Spike replacement*
High pass filter	*X radius = 5* *Y radius = 5* *Weighting = uniform*

3.5.2 Presentation of results and interpretation

Gradiometer

The presentation of the data for the survey involves a print-out of the raw data both as grey scale (Figure 3) and trace plots (Figure 4 and 5), together with a grey scale plot of the processed data (Figure 6). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 7).

Resistivity
The presentation of the data for the site involves a print-out of the raw data as a grey scale plot (Figure 8), together with a grey scale plot of the processed data (Figure 9). Anomalies have been identified and plotted onto the ‘Abstraction and Interpretation of Anomalies’ drawing (Figure 10).

4 RESULTS

4.1 Gradiometer (Figures 3-7)

The gradiometer survey was of limited success due the high levels of metallic debris situated within and around the survey area, which effectively mask any low amplitude, subtle features. The previous hospital boundary has been identified running across the north of the survey area, whilst the south of the survey area is dominated by magnetic anomalies caused by near surface modern debris. A broad positive linear anomaly has been identified towards the northwestern edge of the survey area. This anomaly is likely to be associated with the heavy plant trackway. A number of trial trench locations have been identified in the form of negative linear anomalies.

4.2 Resistivity (Figures 8-10)

The resistivity data has highlighted interesting features throughout the survey area. The survey has identified a number of low resistance anomalies that may be of archaeological origin.

The anomalies have been classified into the following categories (Figure 10):

- Linear anomaly – previous hospital boundary
- Low resistance linear anomaly – cut feature of possible archaeological origin
- High resistance linear anomaly – possible structural remains of archaeological origin
- Low resistance area anomalies – cut features of possible archaeological origin
- Moderate low resistance anomalies - cut features of possible archaeological origin
- Low resistant linear anomalies – associated with evaluation trenches
- High resistance area anomalies – structural debris of possible archaeological origin
- Discrete high resistance area anomaly – structural remains of possible archaeological origin
- Moderate high resistance anomaly – structural remains of possible archaeological origin
- Low resistance area anomaly – possible archaeological/pedological origin

4.2.1 Linear anomaly – previous hospital boundary

Running across the northern edge of the survey area is a linear anomaly that is associated with the previous hospital boundary. This boundary has also been identified within the gradiometer data.

4.2.2 Low resistance linear anomaly – cut feature of possible archaeological origin

Three low resistance linear anomalies have been identified situated in the south of the survey area (**1-3**). Anomalies **1** and **2** may represent cut features of archaeological origin; however these anomalies have not been identified within trial trench 10. This could suggest that these are deep archaeological features, modern surface responses or are possibly pedological in origin. Anomaly **3** is situated at the break of slope in the south of the survey area may represent a cut feature of archaeological origin relating to the Post Medieval flood defensive features identified to the northwest of the survey area.

4.2.3 High resistance linear anomaly – possible structural remains of archaeological origin

A high resistant linear anomaly has been identified along the eastern edge of the survey area (**4**). This anomaly may represent structural remains of archaeological origin and appears to be cut by a moderate low resistance anomaly (**15**). This suggests that it predates the moderate low resistance features.

4.2.4 Low resistance area anomalies – cut features of possible archaeological origin

A large number of low resistance area anomalies have been identified within the survey area (**9-11**). These may represent cut features of archaeological origin. Anomalies **5-7** have not been identified within trial trenches 10, 11, 14 or 16. If these anomalies are of archaeological origin, they may be situated at greater depths than the limit of excavation, although the natural gravels appear to have been exposed within the trial trenches. These linear anomalies are also in an orientation that appears to be unrelated to any of the linear features identified within the previous Area 1 excavation. This may suggest that these features are of pedological or geological origin.

Anomaly **8** may relate to the wide shallow ditch identified within the northern section of trench 11. Anomaly **9** may represent the continuation of a cut feature identified with in trial trench 15. Anomaly **10** is situated towards the east of the survey area, indicating a possible linear cut feature with a northeast to southwest orientation. This anomaly may relate to a truncated cut feature identified within trial trench 17. Anomaly **11** may also represent a cut feature of archaeological origin. Although no direct relationship can be identified within the trial trenches, this anomaly does appear to run parallel to a post-medieval cut feature identified within trench 14 and so may be associated with to this feature.

4.2.5 Moderate low resistance anomalies - cut features of possible archaeological origin

Several moderate low resistance area anomalies have been identified situated towards the outer edges of the survey area (**12-17** and **30**). These anomalies may relate to cut features of archaeological origin. Anomaly **12** may be of archaeological origin but has not been identified within trial trench 15. Anomalies **13** and **14** may relate to cut features identified within trench 15. Anomalies **15** and **16** may indicate weak evidence for cut features of possible archaeological origin. Anomaly **17** may represent a cut feature situated across anomaly **18** and may relate to the Post Medieval flood defence features. Two parallel linear area anomalies (**30**) have also been identified in the south of the survey area that may represent cut features associated with the flood defence features.

4.2.6 Low resistant linear anomalies – associated with evaluation trenches

Several low resistance linear anomalies have been observed in the data corresponding to the position of the Oxford Archaeology trial trenches.

4.2.7 High resistance area anomaly – structural remains of possible archaeological origin

A large number of high resistance area anomalies have been identified, mainly to the north of the survey area (**18-26**). Anomalies **19-26** may represent area of structural debris of archaeological origin. However, due the presence of modern structural debris and the nearby site of the former hospital, a number of these anomalies may be associated with modern landscaping activity and debris. Anomaly **18** may represent a former bank situated along the south of the survey area, possibly associated with the Post Medieval flood defences.

4.2.8 Discrete high resistance area anomaly – structural remains of possible archaeological origin

Discrete areas of high resistance have also been identified within and around the area of high resistance. These anomalies may indicate discrete structural remains or debris of possible archaeological origin. It is possible that a bank may be associated with the low resistance anomaly **(5)** situated across the centre of the survey area.

4.2.9 Moderate high resistance anomaly – structural remains of possible archaeological origin

A moderate high resistance area anomaly (**27**) has been identified in the north of the survey area which may relate to structural remains of archaeological origin. However this anomaly appears to correspond with a cut feature identified in the eastern end of trial trench 15, suggesting that anomaly **27** is associated with changing soil fill properties.

4.2.10 Low resistance area anomaly – possible archaeological/pedological origin

Two discrete bands of low resistance area anomalies have been identified in the south of the survey (**28** and **29**). These anomalies correspond with an area of sloping topography associated with the Wantz stream. These responses possibly represent a combination of pedological and archaeological features. If any of these features are archaeological in origin they are likely to be associated with the Post Medieval flood defences identified within the previous archaeological investigation undertaken by Oxford Archaeology to the west of the survey area.

5 CONCLUSION

The gradiometry survey was of limited success due to the high levels of magnetic debris in and around the survey area. The resistivity data is dominated by a series of low resistance linear anomalies. These anomalies may indicate cut features of archaeological origin. Anomalies situated in the south of the survey area are likely to relate to the continuation of the Post Medieval flood defences identified in the previous archaeological investigations to the west of the survey area. The resistivity data appears to correspond well with a number of archaeological features identified with the Oxford Archaeology trial trenches, however the low resistance anomalies **5-7** appear not to have been identified within the trial trenches. These anomalies may represent cut features of archaeological origin at depth; however as the natural gravels have been identified within all trial trenches, this is unlikely. These anomalies may represent shallow modern activity or by of geological origin.