GEOPHYSICAL SURVEY REPORT

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Project name:

Welford Road, Husbands Bosworth, Leicestershire

Client:

University of Leicester Archaeological Services

Job ref:

J9688

March 2016

GEOPHYSICAL SURVEY REPORT

Project name: **Welford Road, Husbands Bosworth, Leicestershire** Client: **University of Leicester Archaeological Services**	Job ref: **J9688**
Survey date: **3rd March 2016**	Report date: **23rd March 2016**
Field team: **Robert Knight** BA (Hons) **Rosie Everett** BA (Hons)	Project Manager: **Simon Haddrell** BEng (Hons) AMBCS PCIfA
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V1 23/03/2016	

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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 1ha of grassland. No features of archaeological origin have been identified. A former field boundary and evidence of ridge and furrow cultivation suggest that the site has been used for agricultural purposes since the medieval period. The remaining features include an area of natural magnetic variation, scattered magnetic debris, a land drain, disturbance from nearby fences and a magnetic spike.

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 University of Leicester Archaeological Services.

2.2 Site Details

NGR	SP 641 839
Location	The site is located to the south of Husbands Bosworth, Leicestershire. Welford Road forms the eastern boundary of the site, with a cemetery to the south, open agricultural land to the west and north-west, and a residential area to the north.
	
HER/SMR	Leicestershire
District	Harborough
Parish	Husbands Bosworth
Topography	Mostly flat, slightly undulating ground

Current Land Use	Pasture
Weather Conditions	Sunny, dry, and clear
Soils	Beccles 3 – typical stagnogley soils. These consist of slowly permeable, seasonally waterlogged, fine loamy over clayey soils. (SSEW 1983, Sheet 3 Midland and Western England).
Geology	Dyrham Formation – siltstone and mudstone, interbedded. Superficial deposits of Till, Mid Pleistocene – Diamicton are recorded across the site.
Archaeology	No archaeological investigations have been carried out on the site, however an area immediately to the east has been subject to geophysical survey and trial trenching. The evaluations recorded an Iron Age/Romano-British enclosure and a field system of uncertain date (MLE21686). Given that the field system aligns with agricultural furrows, it is suggested that it is medieval in origin. Post holes were also identified in the trial trenching of the area. Within the wider area of the site of a Bronze Age metalwork hoard (MLE6320) has been discovered along with a prehistoric pit thought to be a buried hearth (MLE15781). The village of Husbands Bosworth itself is recorded as having Anglo-Saxon or early Medieval origins (MLE9467) (Leicestershire County Council, 2016).
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c.1ha

2.3 Aims and objectives

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

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

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

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

3.2 Survey methods

Given the potential for Iron Age, Romano-British, and medieval activity, detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

More information regarding this technique is included in Appendix A.

3.3 Processing

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

1. *Destripe*
2. *Destagger*

3.4 Presentation of results and interpretation

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

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

4 RESULTS

4.1 Probable Archaeology

No features of probable archaeological origin have been identified within the survey area.

4.2 Possible Archaeology

No features of possible archaeological origin have been identified within the survey area.

4.3 Medieval/Post-Medieval Agriculture

An area of medieval ridge and furrow cultivation **[1]** is visible in the centre of the site in the form of widely spaced, parallel linear anomalies. A linear anomaly running on a north-south orientation **[2]** may be related to a former field boundary, but is not present on available OS mapping.

4.4 Other Anomalies

A small area of enhanced magnetic variation in the north **[3]** is likely to be natural in origin while the remaining features are modern in origin, including a weak bipolar linear anomaly **[4]** associated with a land drain and an area of scattered magnetic debris **[5]**. Areas of magnetic disturbance **[6]** are the result of nearby ferrous metal objects, such as fences. A smaller ferrous anomaly or 'magnetic spike' **[7]** indicates a ferrous metal object and is likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Mudstone and siltstone geologies, such as the Dyrham Formation present across the site, can give variable results for gradiometer data, as can superficial deposits of glacial till. The data across the site is fairly uniform in appearance, with only stronger magnetic anomalies being seen. This suggests that the underlying geology and superficial deposits are not fully conducive to magnetic survey and weaker archaeological anomalies may not have been detected.

6 CONCLUSION

The survey at Husbands Bosworth has not identified any features of archaeological origin, despite Iron Age and Romano-British features existing immediately to the east. Evidence of medieval ridge and furrow cultivation and a possible former field boundary indicate that the site has been used for agricultural purposes since the medieval period, likely forming part of the agricultural hinterland of Husbands Bosworth. The remaining features are natural or modern and include an area of scattered magnetic debris, a land drain, disturbance from nearby ferrous objects, and a magnetic spike which is likely to be modern rubbish.

7 REFERENCES

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IfA 2002. The Use of Geophysical Techniques in Archaeological Evaluations, IFA Paper No 6, C. Gaffney, J. Gater and S. Ovenden. Institute for Archaeology, Reading

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 3 Midland and Western England*

8 APPENDIX A - Technical Information: Magnetometer Survey Method

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

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

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

Instrumentation: Bartington *Grad*601-2 / GSB CARTEASY^{N} Cart system
Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m.

The readings are logged consecutively into the data logger which in turn is daily down- loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

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

Interpretation Categories

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

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

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

9 APPENDIX B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected.

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

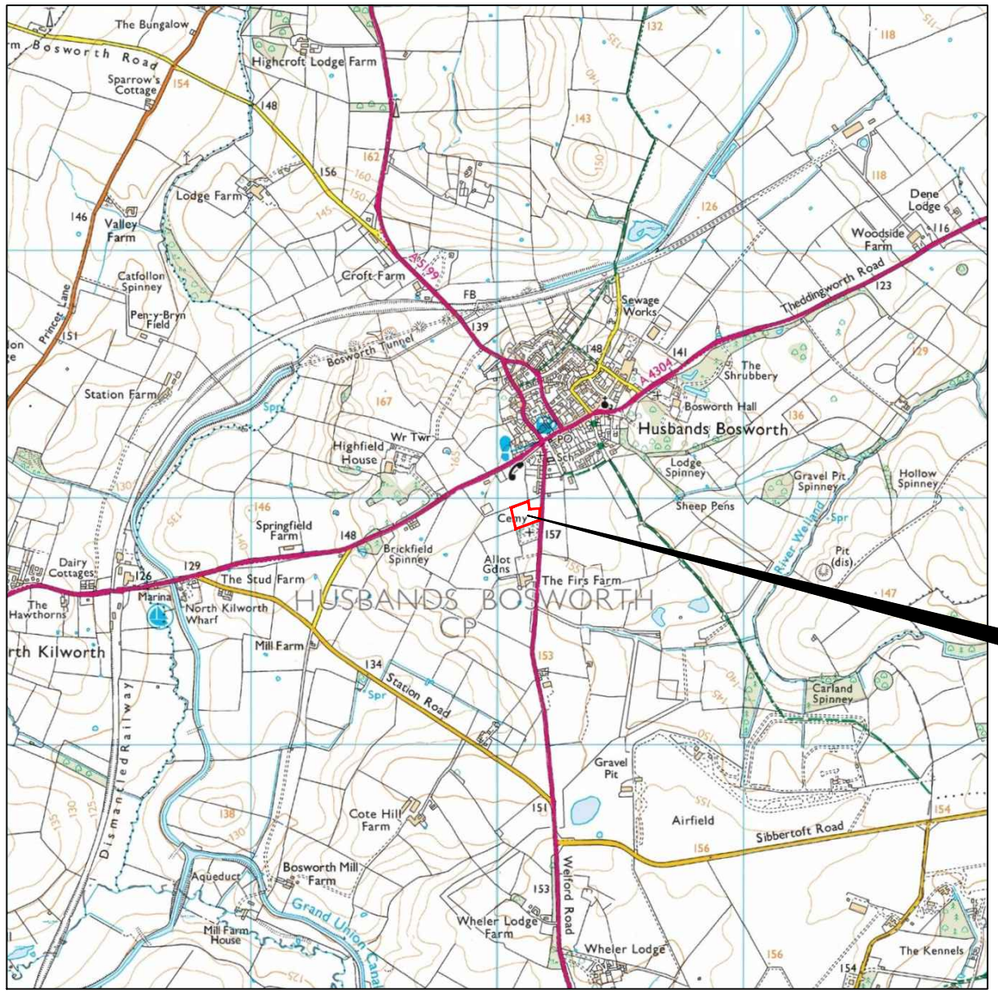
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.



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Amendments

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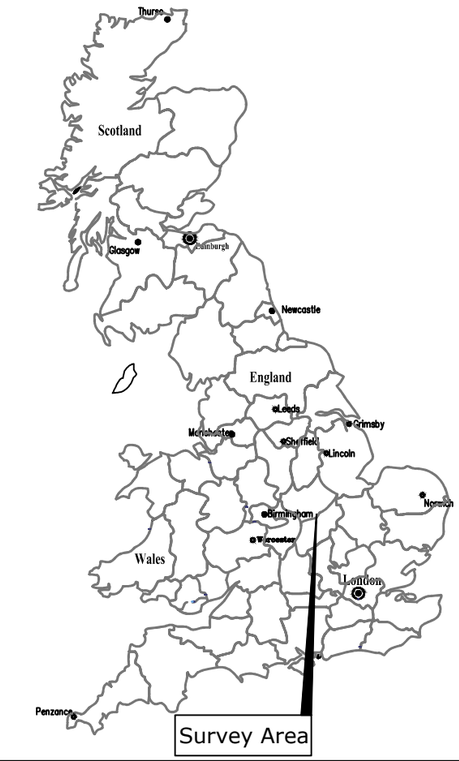

Site centred on NGR SP 641 839

Client
UNIVERSITY OF LEICESTER ARCHAEOLOGICAL SERVICES

Project Title Job No. 9688
GEOPHYSICAL SURVEY - WELFORD ROAD, HUSBANDS BOSWORTH, LEICESTERSHIRE

Subject
LOCATION PLAN OF SURVEY AREA

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Survey date	Drawn by	Figure No.
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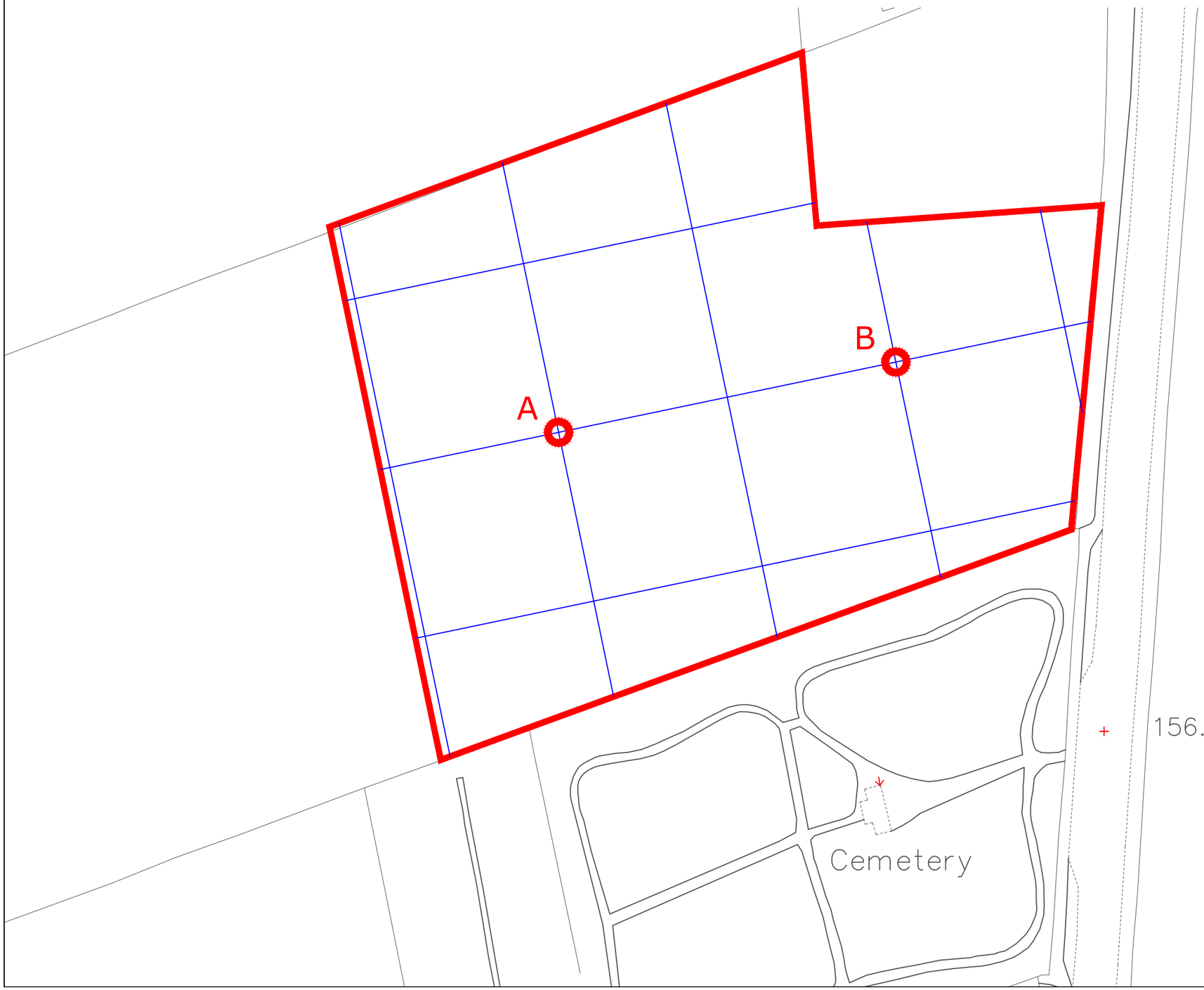

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OS GRID REFERENCES

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Project Title — Job No. 9688
GEOPHYSICAL SURVEY - WELFORD ROAD, HUSBANDS BOSWORTH, LEICESTERSHIRE

Subject
LOCATION OF SURVEY GRIDS AND REFERENCING

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Survey date	Drawn by	Figure No.
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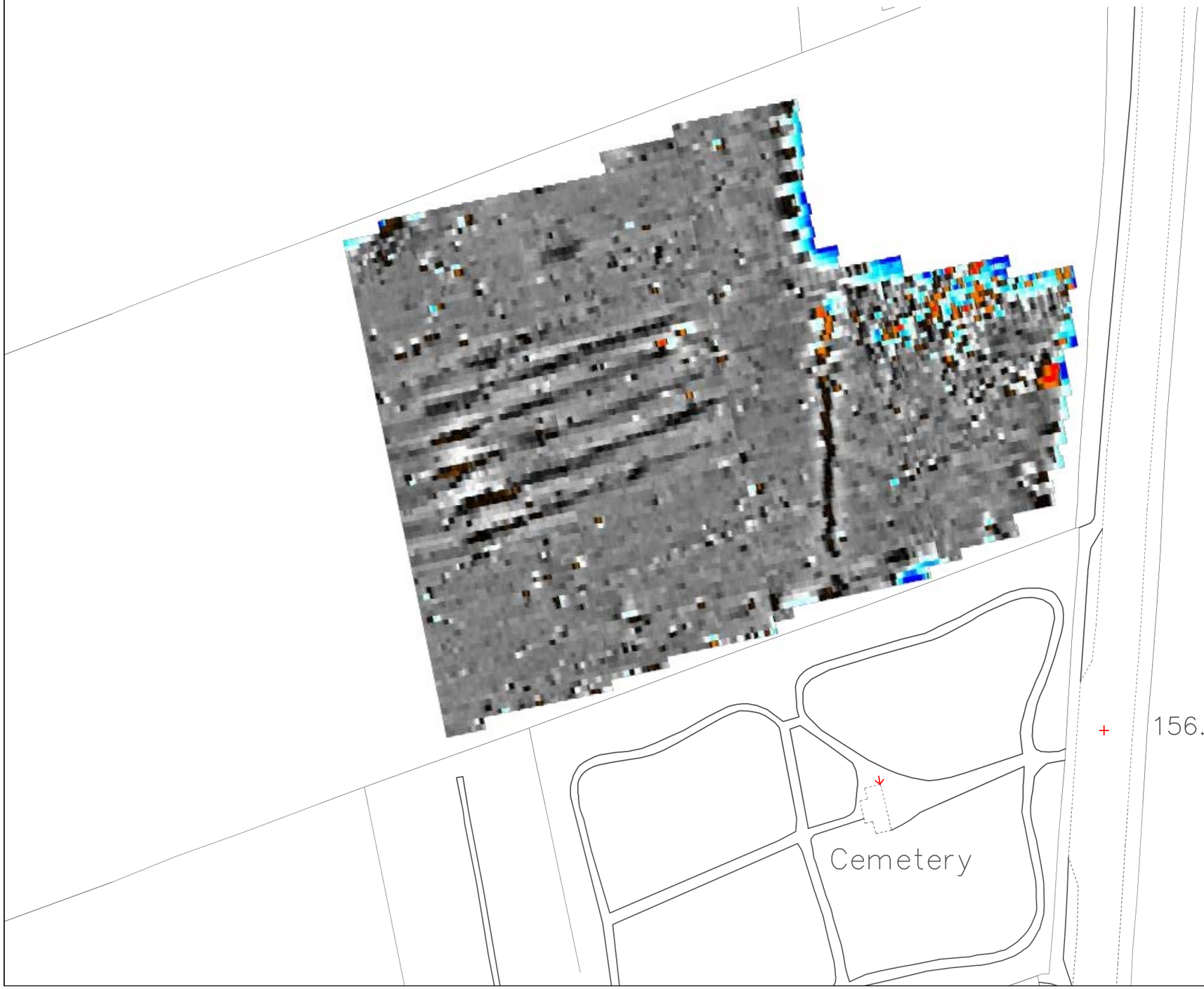

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Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

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Project Title — Job No. 9688
GEOPHYSICAL SURVEY - WELFORD ROAD, HUSBANDS BOSWORTH, LEICESTERSHIRE

Subject
COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES

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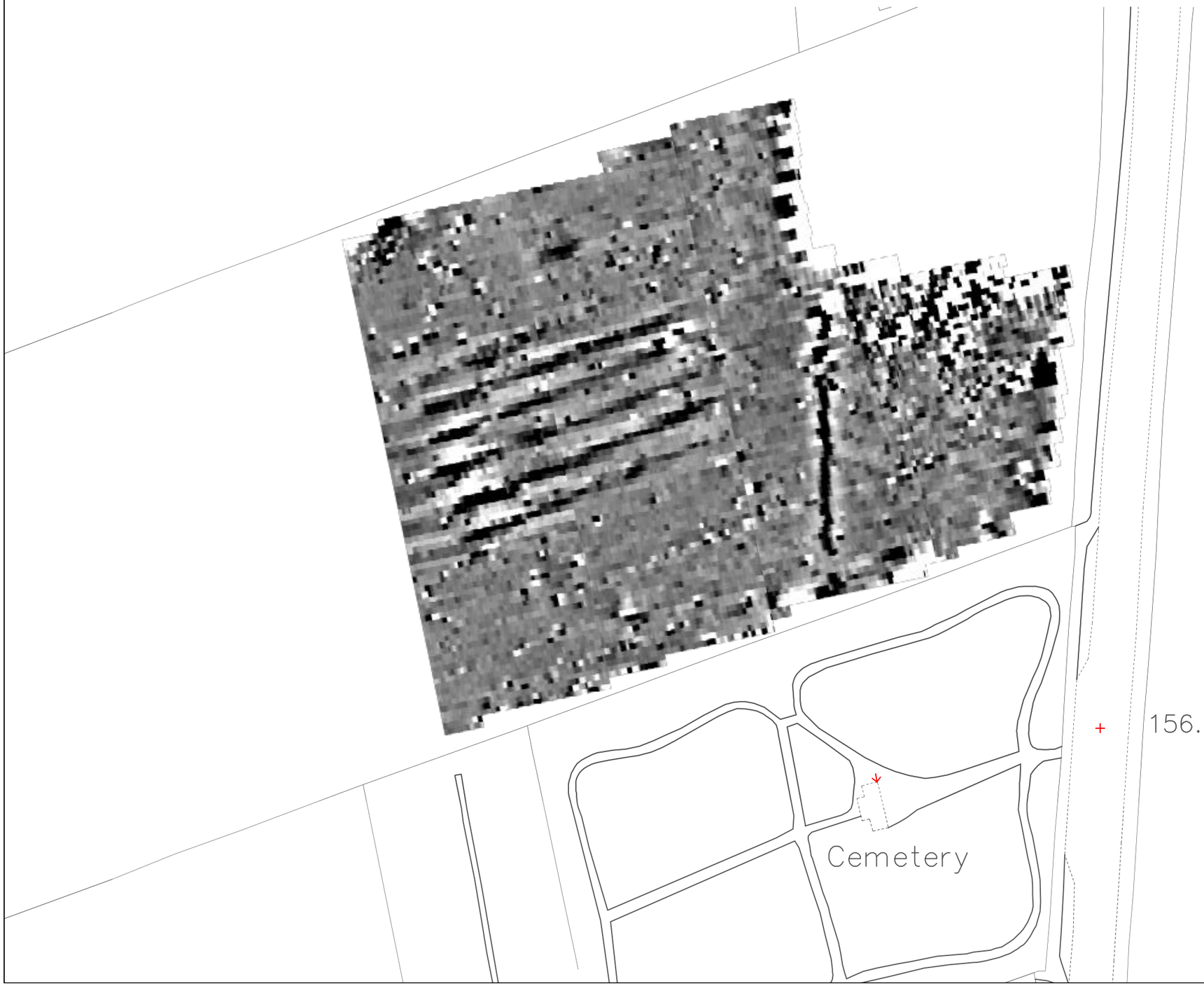

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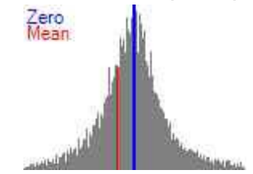

-2nT +2nT

+2nT

-2nT

Client
UNIVERSITY OF LEICESTER ARCHAEOLOGICAL SERVICES

Project Title Job No. 9688
GEOPHYSICAL SURVEY - WELFORD ROAD, HUSBANDS BOSWORTH, LEICESTERSHIRE

Subject
PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA

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MAR 16	RD	04

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Issue No.	Date	Description
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PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin

POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin

MEDIEVAL/POST-MEDIEVAL AGRICULTURE

- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow
- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - probably related to a former field boundary not present on available mapping
- Linear anomaly - related to a former field boundary present on available mapping

OTHER ANOMALIES

- Linear anomaly - probably related to pipe, cable or other modern service
- Linear anomaly - possibly related to land drain
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Strong magnetic debris - possible disturbed or made ground
- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin
- Magnetic spike - probable ferrous object

Client
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GEOPHYSICAL SURVEY - WELFORD ROAD, HUSBANDS BOSWORTH, LEICESTERSHIRE

Subject
ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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