Archaeological Services WYAS

Land at Jawbone Lane
Melbourne
Derbyshire

Geophysical Survey

Report no. DRAFT

February 2015

Client: Headland Archaeology

Registered Organisation CIfA

Land at Jawbone Lane
Melbourne
Derbyshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 2.6 hectares was carried out at Melbourne in advance of the proposed development of the site for housing. Anomalies caused by modern activity and recent agricultural practice have been located. A linear band of disturbed readings corresponds with a 19th century field boundary and a pond shown on the 1804 Plan of Melbourne has also been located. These features may be of local historical interest. No anomalies of obvious archaeological potential have been identified. Therefore, based solely on the results of the survey, the archaeological potential of the site is assessed as low.

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Report Information

Client:	Headland Archaeology
Address:	Unit 1, Premier Business Park, Faraday Road, Hereford, HR4 9NZ
Report Type:	Geophysical Survey
Location:	Melbourne
County:	Derbyshire
Grid Reference:	SK 3885 2585
Period(s) of activity:	modern
Report Number:	DRAFT
Project Number:	4376
Site Code:	MED15
OASIS ID:	archaeol11-
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	February 2015
Date of report:	March 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	Ross Bishop BA Alex Schmidt BA
Report:	Alistair Webb BA MCIfA
Illustrations:	Sam Harrison BSc MSc MCIfA
Photography:	
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Mike Kimber of Headland Archaeology (the Client), to undertake a geophysical (magnetometer) survey on a small parcel of land on the northern outskirts of Melbourne, Derbyshire (see Fig. 1), approximately 12km south of Derby, prior to the proposed development of the site for housing. The work was undertaken in accordance with a Project Design (Harrison 2014) agreed with the Client and with Steve Baker of Derbyshire County Council, with guidance within the National Planning Policy Framework (DCLG 2012) and in line with current best practice (David *et al*. 2008). The survey was carried out on February 23rd 2015 in order to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA), centred at SK 3885 2585, is located to the north-east of Melbourne and is bound by Jawbone Lane to the east, houses on Huntingdon Court to the south and west, a cemetery to the north-west and open land to the north. The PDA comprises a single agricultural field, left fallow post-harvest (see Plate 1), and a large area of lawn (see Plate 2) to the rear of Bond Elm, a large residential property. The site covers an area of approximately 2.6 hectares, is flat and situated at approximately 50m above Ordnance Datum (aOD).

Soils and geology

The underlying bedrock comprises alternating bands of mudstone, siltstone and sandstone of the Morridge Formation and Chatsworth Grit. No superficial deposits are recorded.. The soils are classified in the Bardsey association, described as slowly permeable, seasonally waterlogged loams over clays and fine silts (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Cultural Heritage Assessment (Headland Archaeology 2014) summarised that:-

> ‘*the PDA lies within an area with some potential for archaeological remains to be uncovered. This comprises remains associated with medieval or post-medieval agricultural activity, and in particular associated with a pond shown on 19th century maps in the south-eastern part of the PDA. It is also possible, although unlikely, that earlier (prehistoric or Roman) remains could be uncovered, based on the find-spots of such material in the surrounding area. The lack of recent development on the PDA, aside from the construction of the house and barn, means that it is likely that earlier archaeological remains would survive across the majority of the PDA*.’

3 Aims, Methodology and Presentation

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the proposed development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim a magnetometer survey covering all available parts of the PDA was carried out.

The general archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 is a large scale (1:1500) location plan displaying the processed greyscale magnetometer data. Detailed data plots (‘raw’ and processed) and an interpretative figure are presented at a scale of 1:1000 in Figures 3, 4 and 5.

Further technical information on the equipment used, data processing and survey methodologies is given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The survey methodology, report and any recommendations comply with the Project Design (Harrison 2015) and guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2013). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty’s Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in ‘raw’ and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (Figs 3, 4 and 5)

Ferrous/Modern Anomalies

Ferrous anomalies, as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on most sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Bands of magnetic disturbance, present along the south-western edge of the survey area and around the perimeter of Bond Elm, are caused by the proximity of buildings and services and ferrous material in the boundaries. A linear band of disturbance aligned south-west/north-east, **A**, corresponds with a field boundary depicted on the first edition OS map of 1882.

A single large 'spike' anomaly, **B**, is identified in the south-eastern corner of the site. This corresponds with the position of a pond shown on the 1804 Plan of Melbourne and later on the first edition OS map.

Agricultural Anomalies

In the field linear trend anomalies aligned north-west/south-east, parallel with the long axis of the field, reflect the direction of recent agricultural regimes.

5 Conclusions

Two post-medieval agricultural features, a former boundary and pond, have been identified by the survey. These former features may be of local historical interest. No anomalies of archaeological potential have been identified with the only other anomalies recorded being indicative of modern activity and recent ploughing. Therefore, on the basis of the survey, the archaeological potential of the site is considered to be very low.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

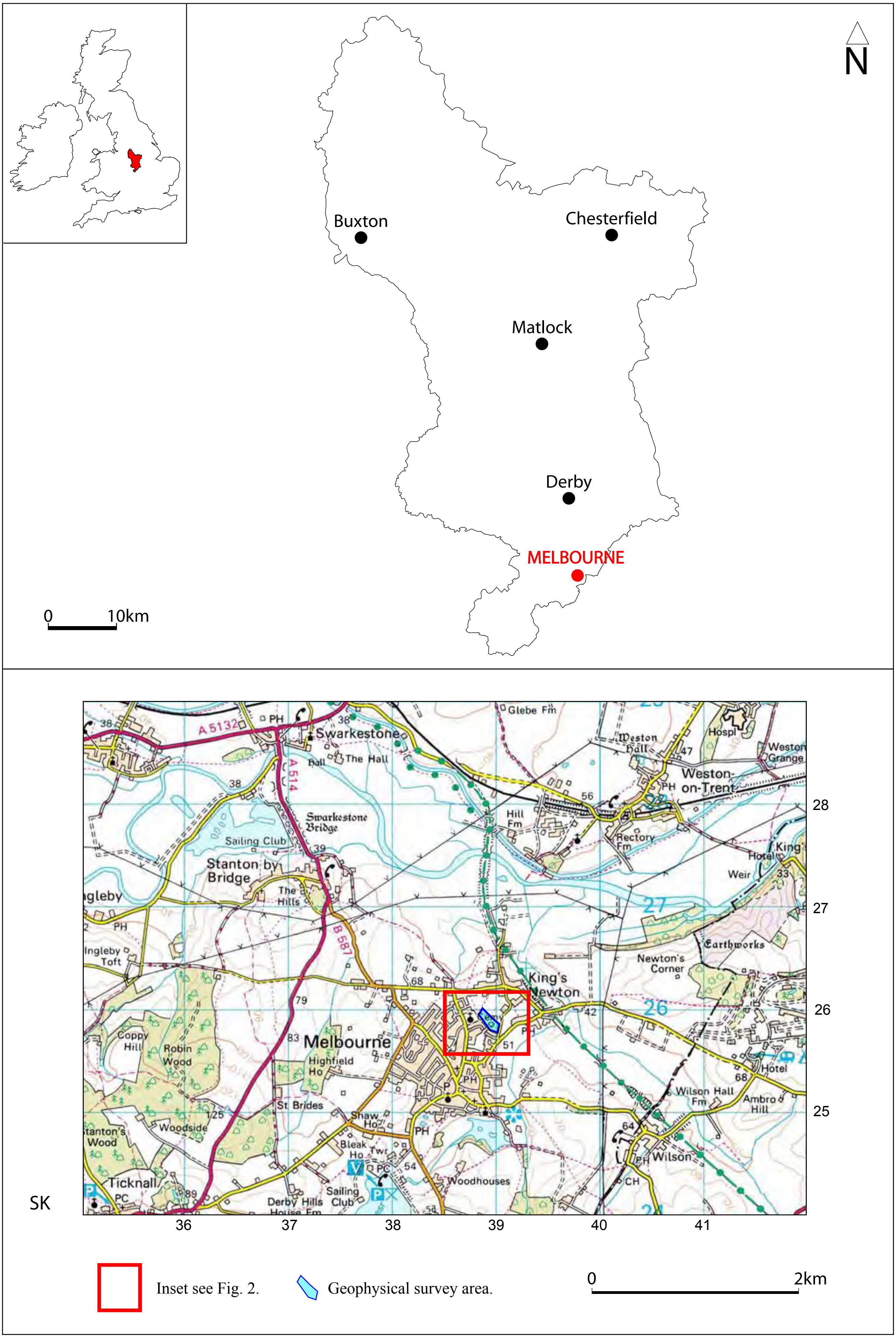

Fig. 1. Site location

Fig. 2. Survey location showing greyscale magnetometer data (1:1500 @ A3)

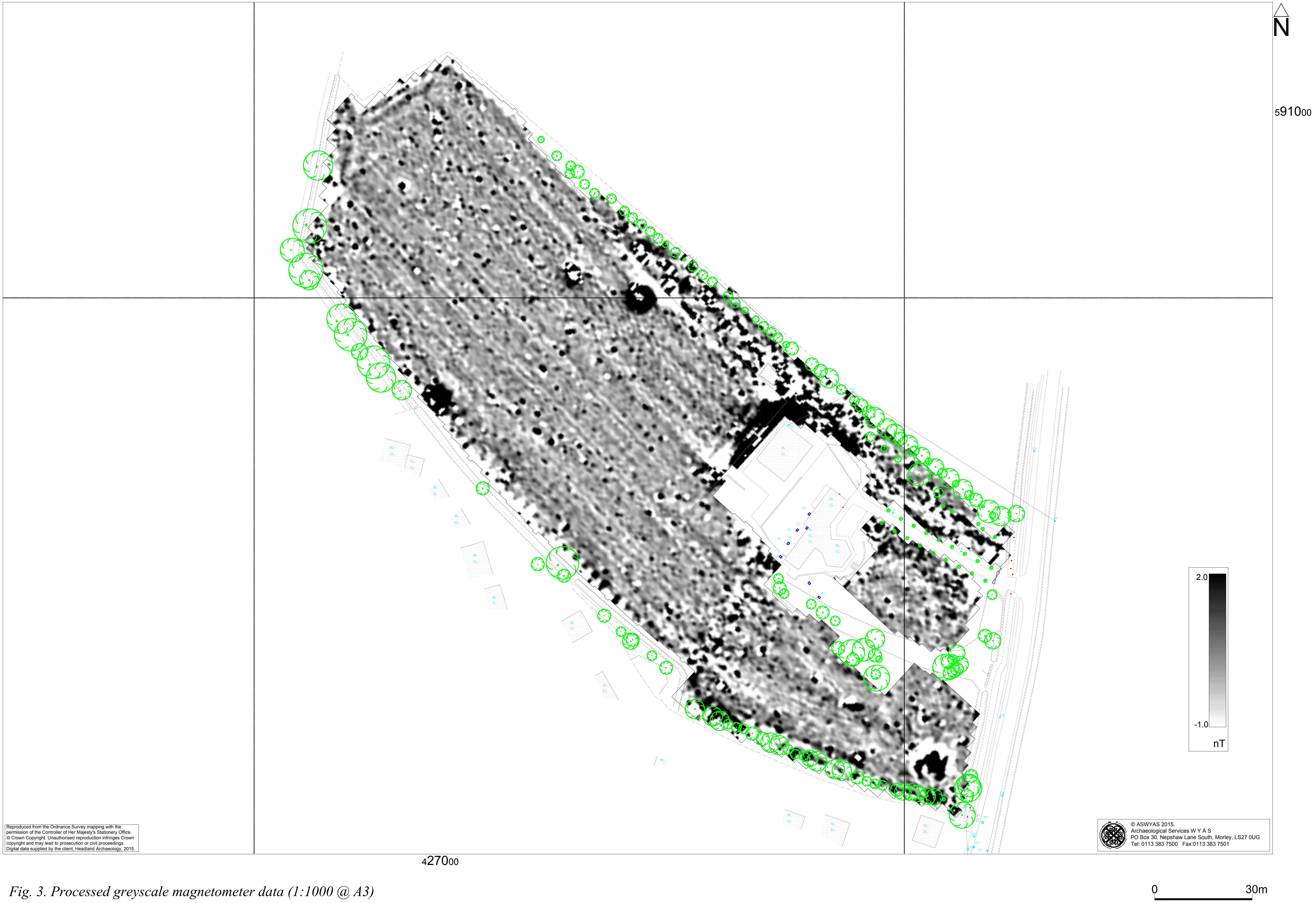

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Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

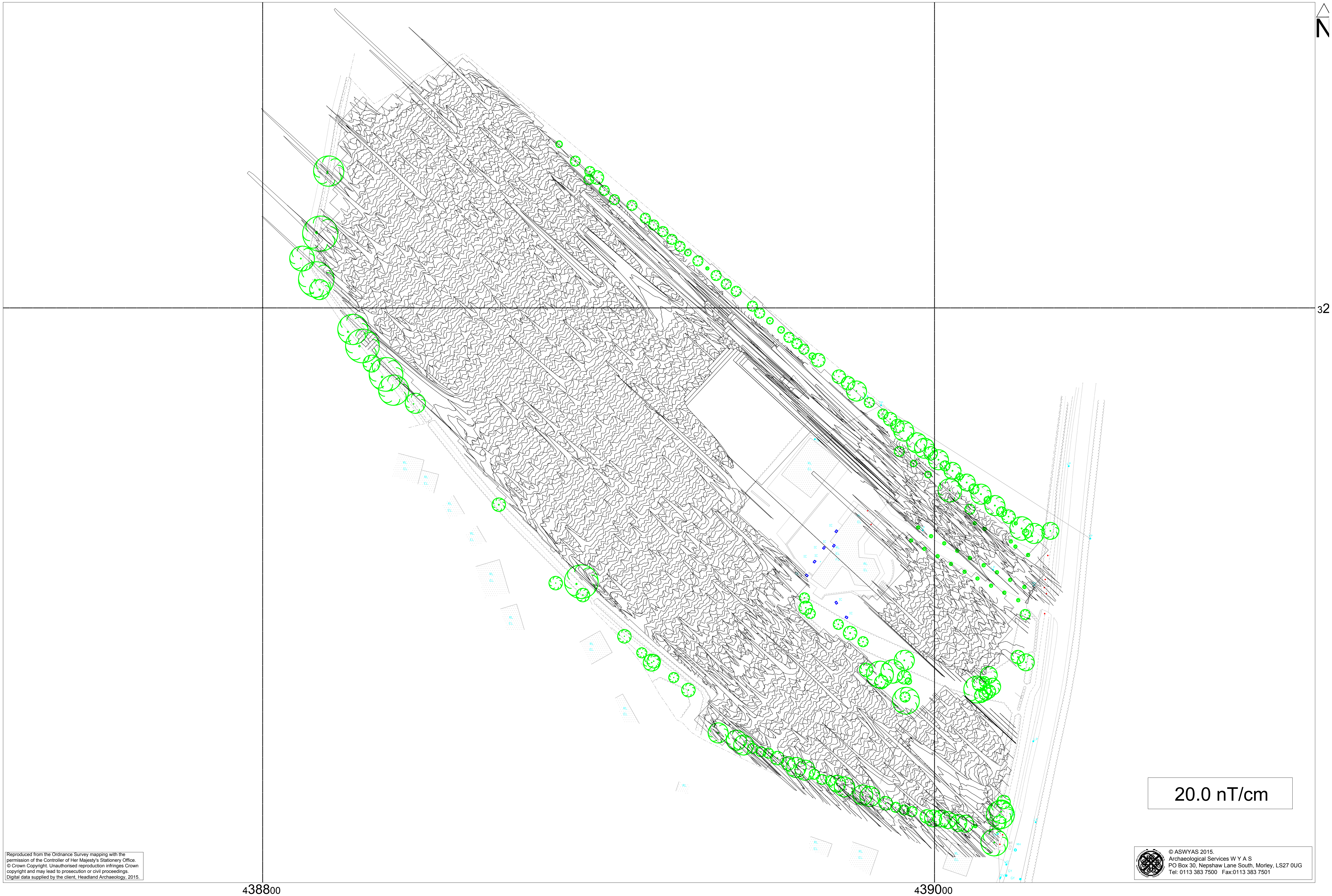

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Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	LINEAR TREND	AGRICULTURAL

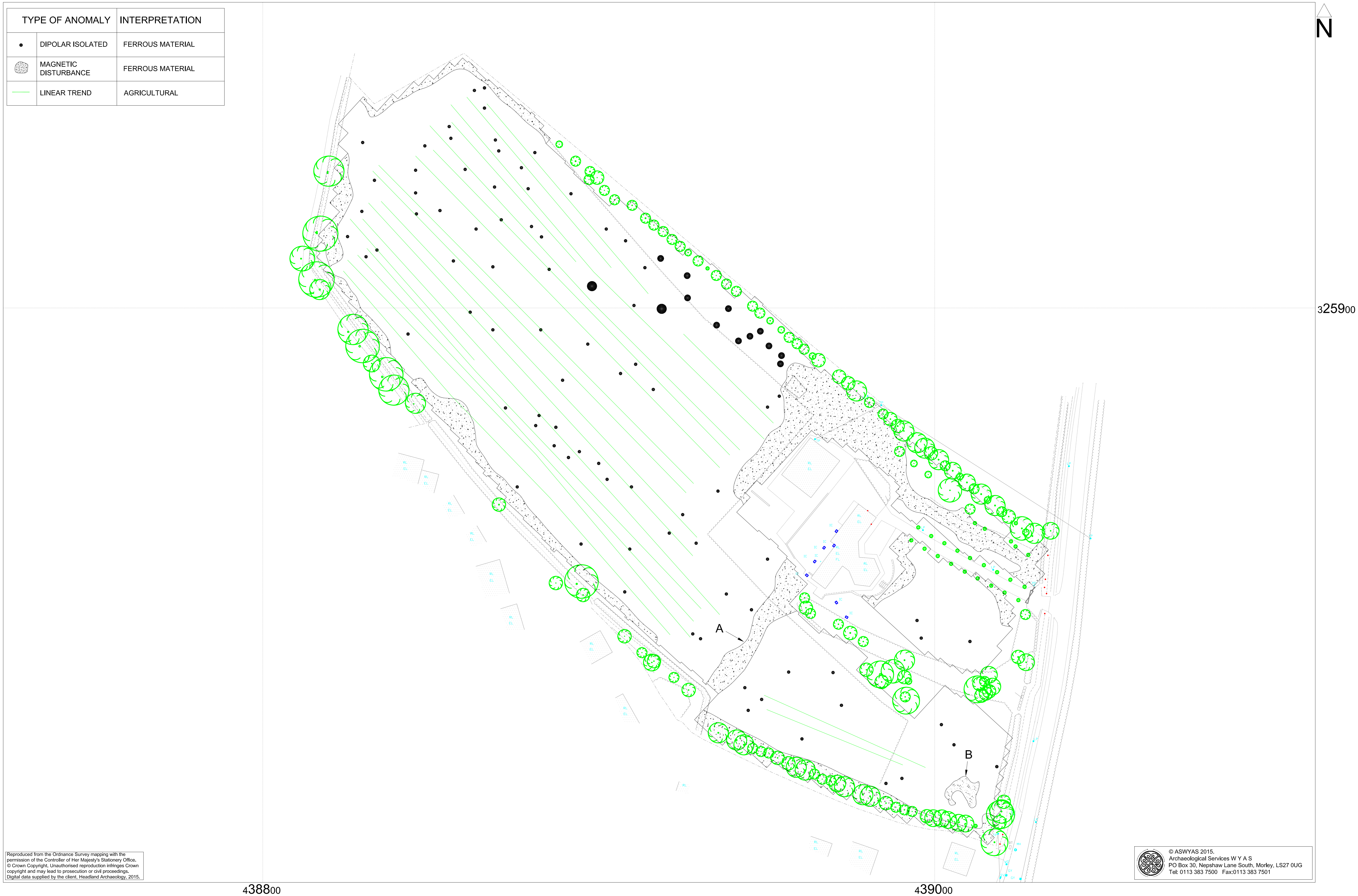

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Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

Plate 1. General view of survey area, looking south-east

Plate 2. General view of garden survey area, looking east

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

Conventional gradiometer survey, using hand-held magnetometers, employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart within grids sometimes 20m by 20m but now more usually 30m by 30m. These readings are stored in the memory of the instrument and are later downloaded to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is ‘raw’ with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a ‘stacked’ plot. A hidden line algorithm has been employed to block out lines behind major ‘spikes’ and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the ‘shape’ of individual anomalies can be discerned and potentially archaeological anomalies differentiated from ‘iron spikes’. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2: Survey location information

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better then 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). The report will be made available for consultation in the Derbyshire Historic Environment Record.

Appendix 4: OASIS Form

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