WYAS Archaeological Services

Twin Oaks Farm

Doveridge

Derbyshire

Geophysical Survey

Report no. 2799
September 2015

Client: GRC Ltd

West Yorkshire Joint Services

Land at Twin Oaks Farm, Doveridge, Derbyshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately eleven hectares of agricultural land at Twin Oaks Farm, Derbyshire was undertaken. The survey area comprised two fields. The northern aspect of the survey area had been under cereal crop whilst the southern field was used as pasture. The results from the geophysical survey have detected numerous anomalies relating to the underlying geology of the site, and ferrous responses from a pylon and disturbance around the western periphery of the southern field. A large area of magnetic enhancement in the northern field corresponds with an area of gravel extraction and subsequent infilling. Based on the geophysical survey results, the archaeological potential of the site is deemed to be low.

WYAS
Archaeological Services

Report Information

Client:	Global Renewables Construction
Address:	1 Lyric Square, Hammersmith, London, W3 7FG
Report Type:	Geophysical Survey
Location:	Doveridge
County:	Derbyshire
Grid Reference:	SK 12855 33200
Period(s) of activity:	Early Modern
Report Number:	2799
Project Number:	6130
Site Code:	TOF15
OASIS ID:	--
HER Event No.:	--
Planning Application No.:	N/A
Museum Accession No.:	N/A
Date of fieldwork:	July and September 2015
Date of report:	September 2015
Project Management:	Christopher Sykes BA MSc
Fieldwork:	Ross Bishop BA
	Becky Goulding MSc (Dip)
	Mark Evans BSc
Report:	Christopher Sykes
Illustrations:	Ross Bishop and Becky Goulding
Photography:	Mark Evans
Research:	N/A

Authorisation for distribution: ----------

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Fiona Davies of Global Renewables Construction (the Client) to undertake a geophysical (magnetometer) survey of approximately 11 hectares on land at Twin Oaks, Doveridge, Derbyshire. The work was undertaken in order to inform a planning application for the proposed development of the site and in accordance with the National Planning Policy Framework (DCLG 2012), in line with current best practice (CIfA 2014; David *et al*. 2008) and to a Project Design (Scales 2015). The survey was carried out between 21st to 23rd July and the 26th and 27th September 2015 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The survey area is located to south-east of the village of Doveridge, Derbyshire. It is bound on its western edge by a farm track, agricultural land to the north, a field boundary to the south and Brocksford Brook to the north. It comprises two agricultural fields all currently under agricultural management. The site is centred SK 413000 332700.

Soils and geology

The underlying bedrock for the site is from the Mercia Mudstone Group, partially overlain by superficial deposits of glaciofluvial terrace deposits and alluvium (BGS 2015). The soil formations are identified in this area as deep permeable coarse loamy soils affected by groundwater (Soil Survey of England and Wales 1983).

2 Archaeological Background

There is evidence from aerial photographs of medieval and post-medieval ridge and furrow in the surrounding areas, yet nothing of archaeological interest is known within the survey area.

3 Aims and Methodology

Magnetometer survey

The aim of the geophysical survey, as described in the Project Design (Scales 2015), is to as far as possible, identify the presence or absence, and extent and layout, of buried archaeological remains across the site, through the interpretation of magnetic anomalies identified following the processing of data gathered during the survey.

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. Features such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the Earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney and Gater 2003). Further information on the types of anomalies is provided in Appendix 1.

On this site Bartington Grad601 magnetic gradiometers were used. These instruments are calibrated to take readings at 0.25m intervals on zig-zag traverses 1m apart within a series of 30m by 30m grids resulting in 3600 readings per 30m grid square. The data are stored in the memory of the instrument before being downloaded to a lap-top computer each day in preparation for data processing and interpretation.

The survey grid was laid out using a Trimble VRS differential Global Positioning System (Trimble TSC3 model) providing an accuracy greater than 0.01m. The locations of the survey grid and anomalies are available as a DXF file. 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.

Data processing

The gradiometer data have been presented in this report in XY trace and greyscale formats. In the former format the data shown are 'raw' with no processing other than grid biasing having been done. 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 have 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 potential archaeological anomalies differentiated from 'iron spikes'. The data in the greyscale images have been interpolated and selectively filtered, using Geoplot 3 (Geoscan Research) software 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.

Presentation

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 shows the extent of the survey area together with the processed data at a scale of 1:2500. Figure 3 shows on overall interpretation of the survey area at a scale of 1:2500. Detailed data plots ('raw' and processed) and interpretative figures are presented at a scale of 1:1000 in Figures 4 to 9 inclusive.

Further information on magnetic survey and characterisation and interpretation of anomaly types are given in Appendix 1. Appendix 2 describes the composition and location of the site archive and Appendix 3 reproduces the OASIS entry.

The survey methodology, report and any recommendations comply with the Project Design (Scales 2015) and guidelines outlined by English Heritage (David *et al.* 2008) and by the

Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

Disclaimers

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.

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.

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

4 Results and Discussion (see Figures 3-9 inclusive)

Ferrous anomalies

Ferrous responses, either as individual 'spike' anomalies or more extensive areas of magnetic disturbance, are typically caused by modern ferrous (magnetic) debris, either on the ground surface or in the plough-soil, or are due to the proximity of magnetic material in field boundaries, buildings or other above ground features. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris or material is common on rural 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.

A large area of ferrous disturbance, within the area surveyed, relates to an electricity pylon located within the field.

An area of high magnetic disturbance **A** has been identified, relating to the infilling of material into an area of former gravel extraction.

Geological anomalies

Throughout the survey area discrete geological anomalies, characterised as localised areas of enhanced magnetic response, have been identified. Whilst any of these anomalies could, in theory, be archaeological in origin, the sheer number precludes an archaeological

interpretation. Therefore, these anomalies are interpreted as geological in origin, probably caused by variation in the composition of the soils from which they derive.

An area of former gravel extraction has been identified. The magnetic enhancement corresponds to geological material being disturbed and brought to the surface. Cartographic information shows that this gravel pit was in use between 1901 and was redundant by the time of the 1978 mapping.

5 Conclusions

The survey has detected geological anomalies which are widespread across the survey area, including an area of former gravel extraction. Magnetic disturbance, caused by interference occurs along the western boundary of the survey area, and a large ferrous response correlates with a pylon within the field. An area of magnetic disturbance, to the north of the area of gravel extraction, and relating to the subsequent infilling of the pit has also been identified. Based upon the survey results, therefore, the archaeological potential of the site is deemed to be low.

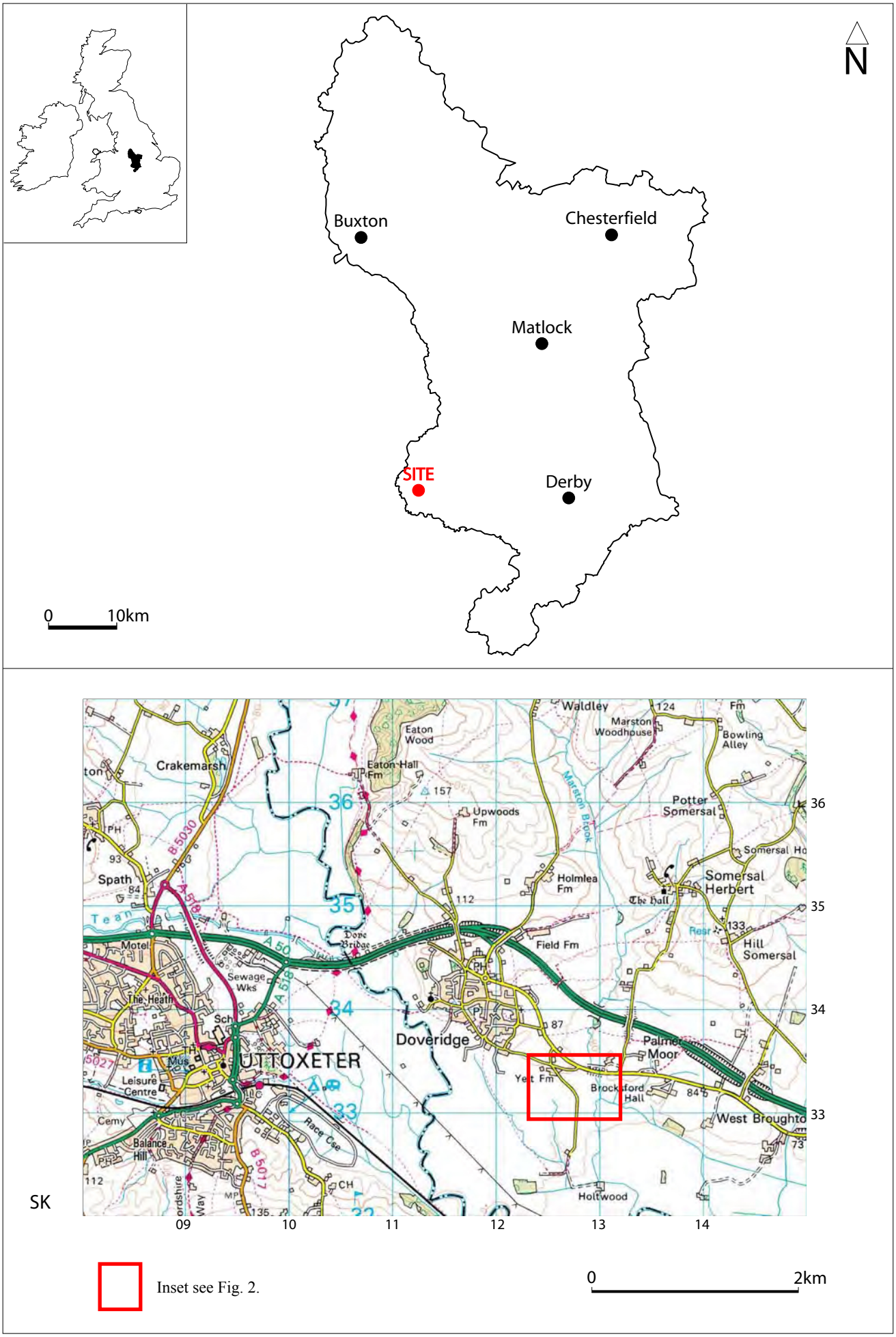

Fig. 1. Site location

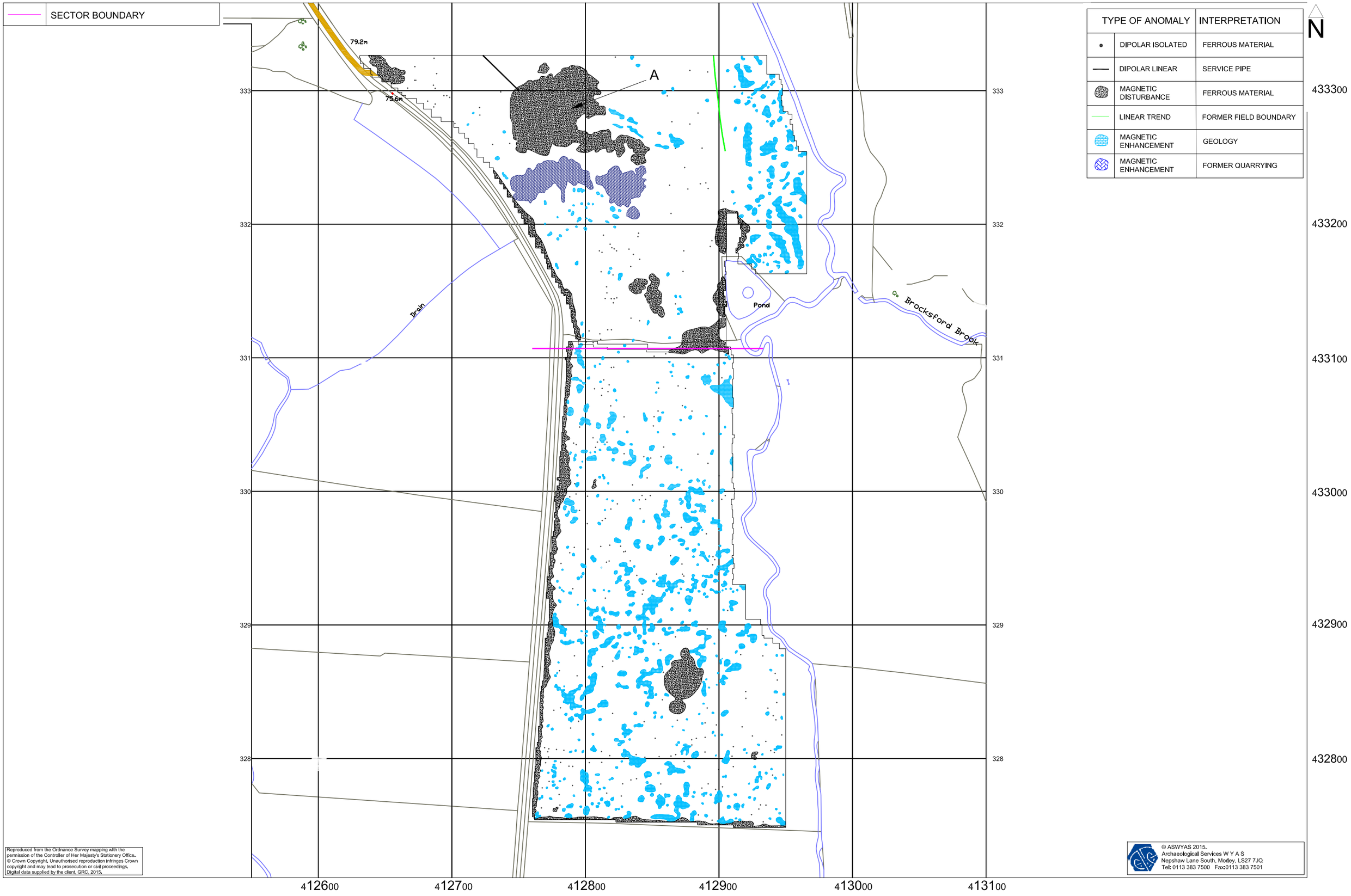

Fig. 3. Survey location showing overall interpretation of magnetometer data (1:2500 @ A3)

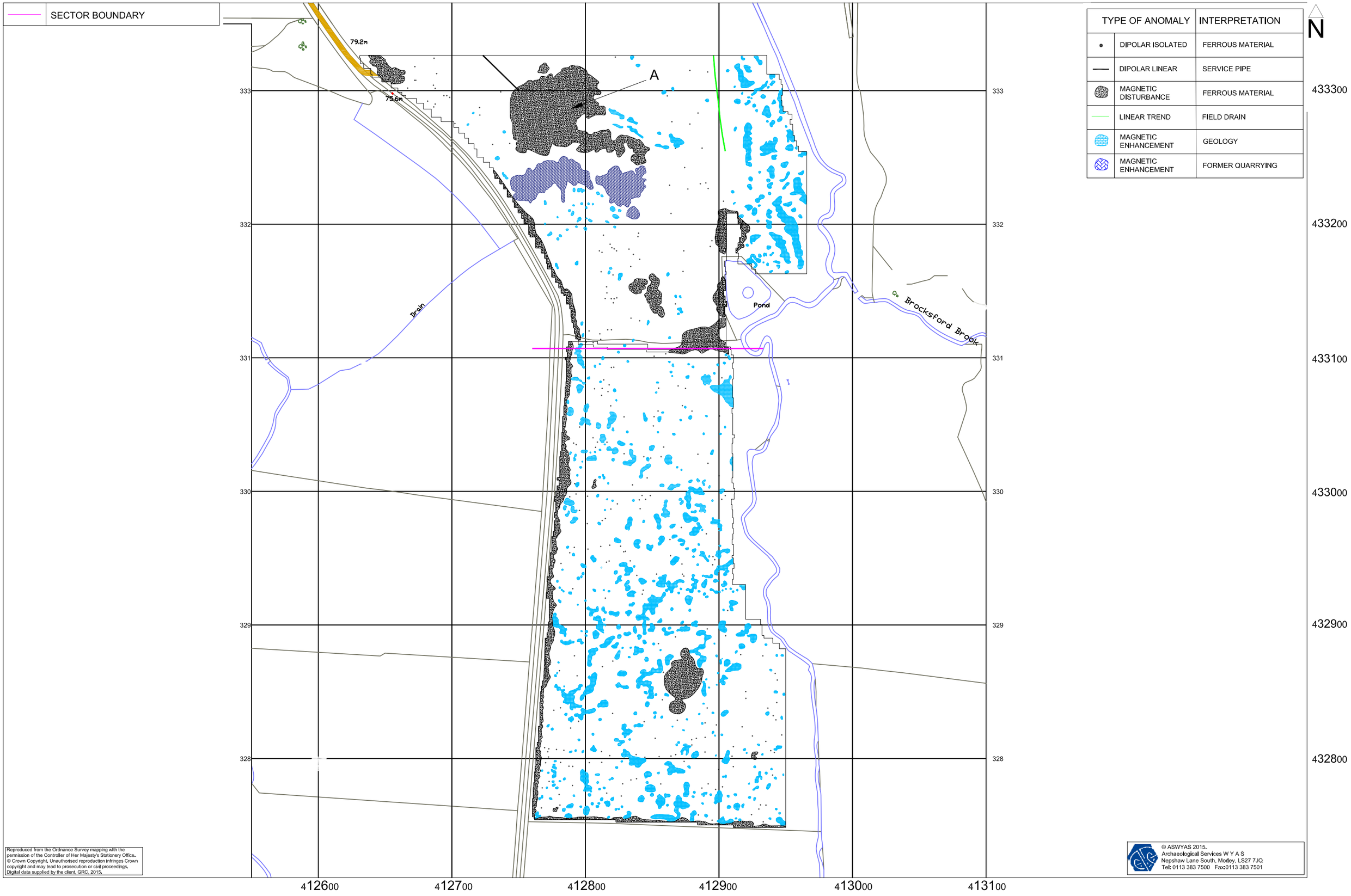

Fig. 3. Survey location showing overall interpretation of magnetometer data (1:2500 @ A3)

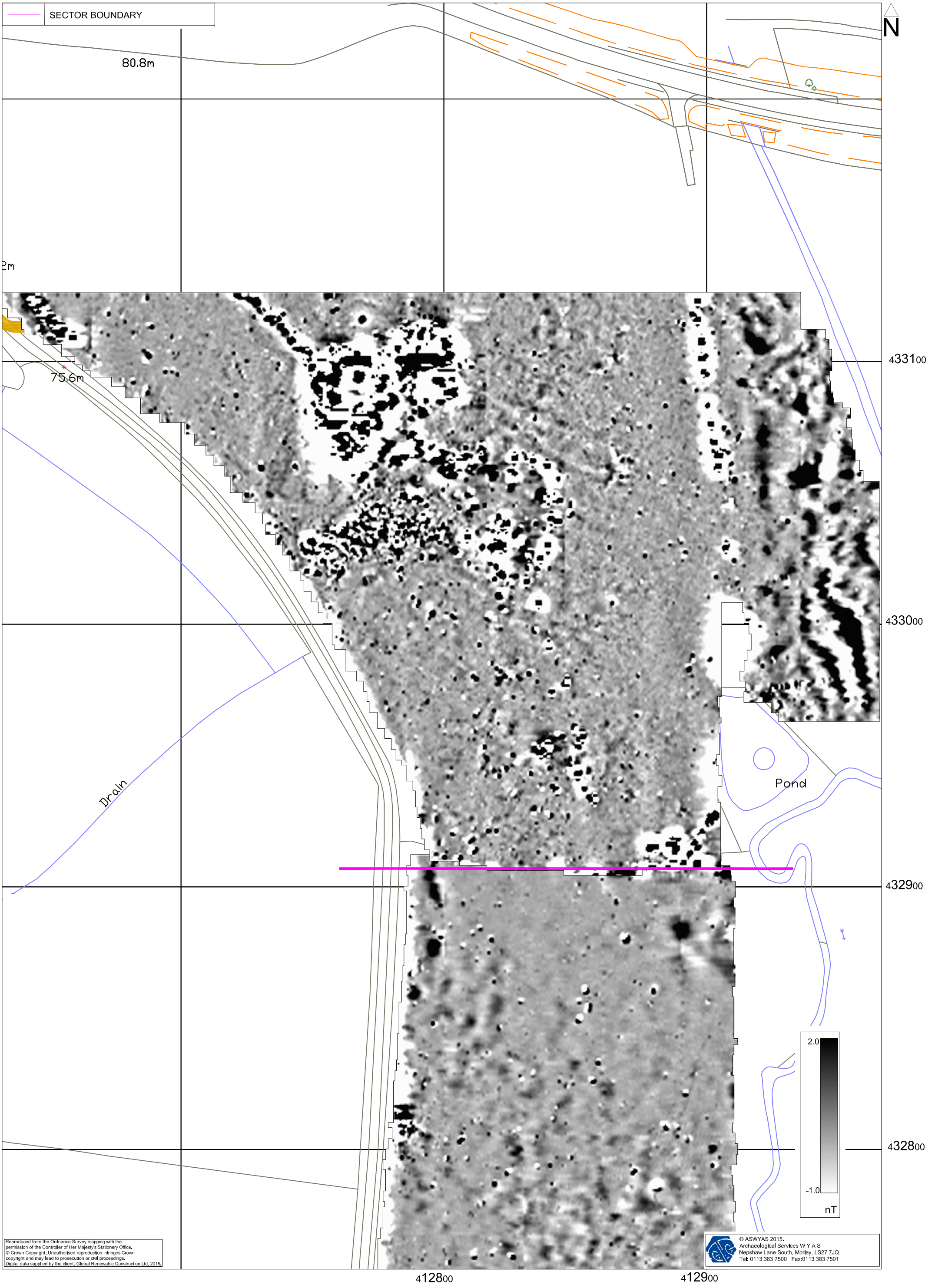

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1250 @ A3)

SECTOR BOUNDARY

15.0 nT/cm

N

80.8m

75.6m

Drain

Pond

4331 00

4330 00

4329 00

4328 00

4128 00

4129 00

0 30m

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Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1250 @ A3)

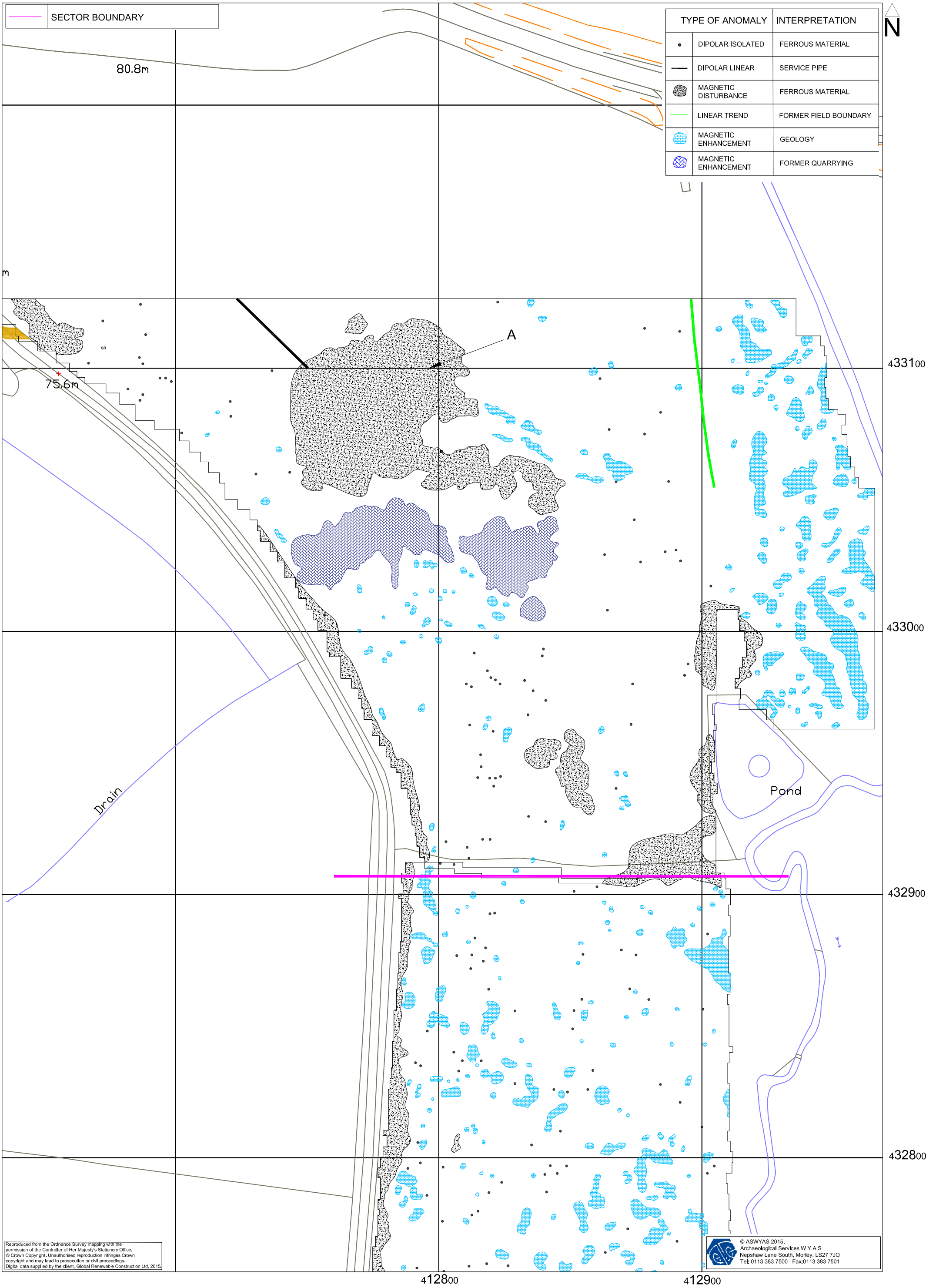

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1250 @ A3)

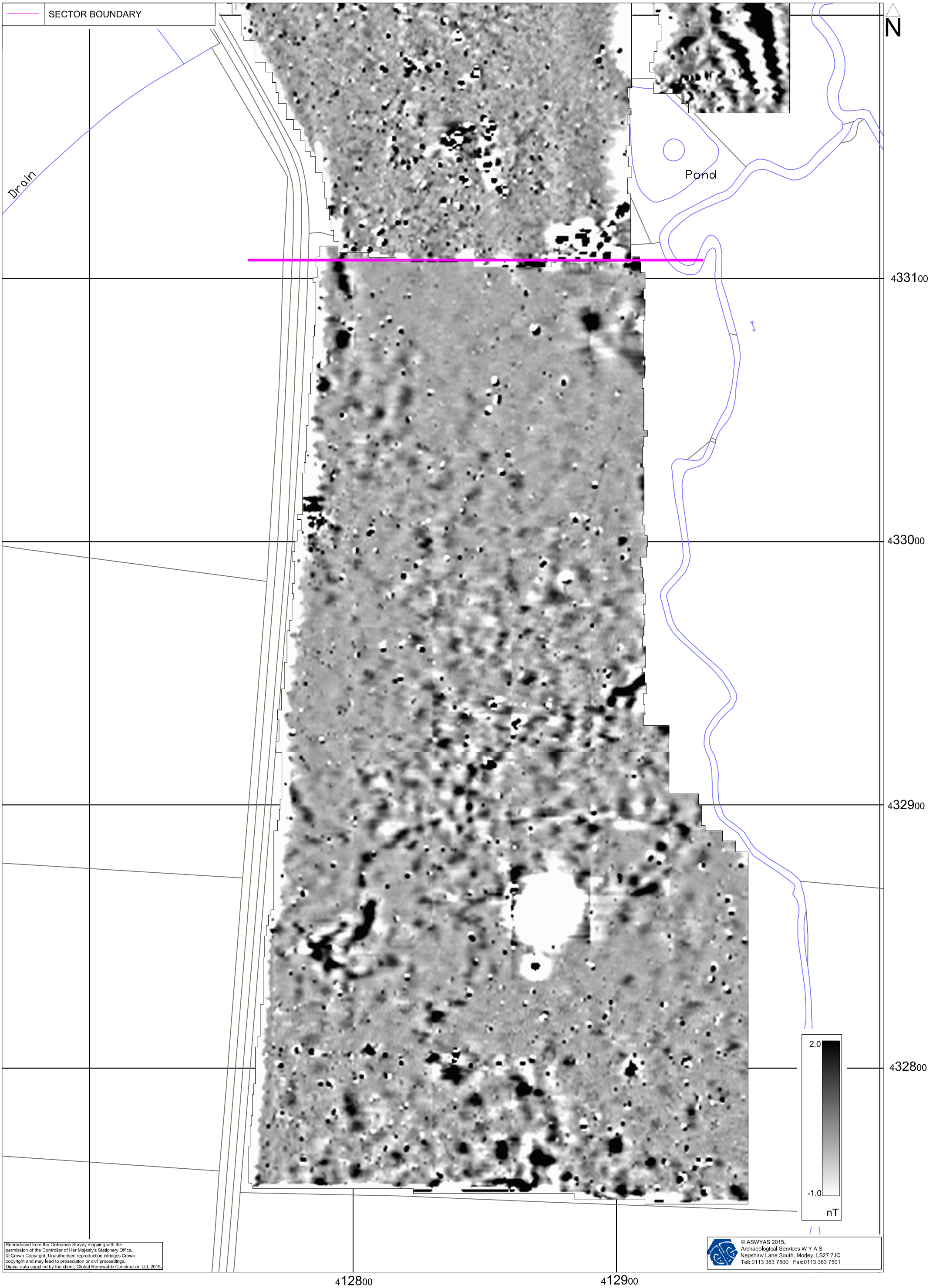

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1250 @ A3)

SECTOR BOUNDARY

15.0 nT/cm

N

Drain

Pond

4331 00

4330 00

4329 00

4328 00

4128 00

4129 00

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0 30m

Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1250 @ A3)

SECTOR BOUNDARY

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	MAGNETIC ENHANCEMENT	GEOLOGY

N

Drain

Pond

4331 00

4330 00

4329 00

4328 00

4128 00

4129 00

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0 30m

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1250 @ A3)

Plate 1. General site overview looking south east

Plate 2. General site overview looking north

Plate 3. General site overview looking south west

Plate 4. General site overview looking south 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. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because 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.

Appendix 2: 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 CS6 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). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the West Yorkshire Historic Environment Record).

Appendix 3: OASIS Form

OASIS DATA COLLECTION FORM: England

List of Projects | Manage Projects | Search Projects | New project | Change your details | HER coverage | Change country | Log out

Printable version

OASIS ID: archaeol11-224831

Project details

Project name	Twin Oaks Farm
Short description of the project	A geophysical (magnetometer) survey, covering approximately eleven hectares of agricultural land at Twin Oaks Farm, Derbyshire was undertaken. The survey area comprised two fields. The northern aspect of the survey area had been under cereal crop whilst the southern field was used as pasture. The results from the geophysical survey have detected numerous anomalies relating to the underlying geology of the site, and ferrous responses from a pylon and disturbance around the western periphery of the southern field. A large area of magnetic enhancement in the northern field corresponds with an area of gravel extraction and subsequent infilling. Based on the geophysical survey results, the archaeological potential of the site is deemed to be low.
Project dates	Start: 21-07-2015 End: 23-07-2015
Previous/future work	No / Not known
Any associated project reference codes	TOF15 - Sitecode
Any associated project reference codes	6130 - Contracting Unit No.
Type of project	Recording project
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	NONE None
Significant Finds	NONE None
Investigation type	"'Geophysical Survey"'
Prompt	National Planning Policy Framework - NPPF
Solid geology (other)	Mercia Mudstone Group
Drift geology (other)	Glaciofluvial Terrace Deposits
Techniques	Magnetometry

Project location

Country	England
Site location	DERBYSHIRE DERBYSHIRE DALES DOVERIDGE Twin Oaks Farm
Study area	11 Hectares
Site coordinates	SK 12855 33200 52.895771550529 -1.808891242264 52 53 44 N 001 48 32 W Point
Height OD / Depth	Min: 90m Max: 95m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Consultant
Project design originator	Archaeological Services WYAS
Project director/manager	C. Sykes
Project supervisor	M. Evans
Type of sponsor/funding body	Archaeological Consultancy
Name of sponsor/funding body	Global Renewables Construction

Project archives

Physical Archive Exists?	No
Digital Archive recipient	N/A
Digital Contents	"none"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Land at Twin Oaks Farm, Doveridge, Derbyshire: Geophysical Survey
Author(s)/Editor(s)	Sykes, C.
Other bibliographic details	Report No. 2799
Date	2015
Issuer or publisher	Archaeological Services WYAS
Place of issue or	Morley

publication	
Description	A4 Bound report
Entered by	Zoe Horn (zhorn@aswyas.com)
Entered on	28 September 2015

OASIS:

Please e-mail Historic England for OASIS help and advice

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