ARCHAEOLOGICAL SERVICES WYAS

Ashby Solar Farm
Packington
Leicestershire

Geophysical Survey

Report no. 2722

February 2015

Client: Cotswold Archaeology

REGISTERED CIfA ORGANISATION

Ashby Solar Farm
Packington
Leicestershire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering 12.5 hectares was carried out on agricultural land near Packington in advance of the submission of a planning application for a proposed solar farm. No anomalies of archaeological potential have been identified by the survey. The only anomalies not attributable to variation in the soils are due to modern activity such as drains, pipes and modern dumping and a 19th century former boundary. On the basis of the survey, the archaeological potential of the site is considered to be very low.

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Report Information

Client:	Cotswold Archaeology
Address:	Building 11, Kemble Enterprise Park, Cirencester, Gloucestershire, GL7 6BQ
Report Type:	Geophysical Survey
Location:	Packington
County:	Leicestershire
Grid Reference:	SK 348 140
Period(s) of activity:	Modern
Report Number:	2722
Project Number:	4368
Site Code:	ADZ15
OASIS ID:	archaeol11- 204839
Planning Application No.:	
Museum Accession No.:	n/a
Date of fieldwork:	February 2015
Date of report:	February 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	Ross Bishop BA
	Mark Evans BSc
	Lewis Colau BA MA
Report:	Alistair Webb BA MCIfA
Illustrations:	Sam Harrison
Photography:	Mark Evans
Research:	n/a

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

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Julia Sulikowska of Cotswold Archaeology (The Client), to undertake a geophysical (magnetometer) survey of land 1km south-west of Packington, near Ashby-de-la-Zouch, Leicestershire (see Fig. 1). The work was undertaken in order to inform a planning application for the proposed development of the site for a solar farm. The work was undertaken in accordance with policy contained within the National Planning Policy Framework (NPPF - DCLG 2012), in line with current best practice (CIfA 2014; David *et al.* 2008) and to a Project Design (Harrison 2014) approved by the Client. The survey was carried out between February 11th and February 13th 2015 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The proposed development area (PDA) covers approximately 12.5 hectares of agricultural farmland 1km to the south-west of Packington, centred at SK 348 140. It comprises a single sub-rectangular field, currently under arable cultivation, bound by Measham Road to the west and south (see Fig. 2) with farmland to the north-east and Packington Sewage Treatment Works to the east. The PDA is located within a gently undulating landscape on a generally east facing hillside that rises from approximately 115m above Ordnance Datum (aOD) to the east to approximately 125m aOD along the western site boundary.

Soils and geology

The underlying bedrock geology comprises sandstone, siltstone and mudstone of the Tarpoley Siltstone Formation. In the centre of the site the bedrock geology is overlain by till (diamicton). There are no superficial deposits to the north and south of the site (British Geological Survey 2015).

The soils are classified in the Flint association being characterised as reddish fine loams over clayey soils with slowly permeable subsoils (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Heritage Desk-Based Assessment (Cotswold Archaeology 2014) concluded that there '*are no overriding heritage constraints which are likely to prohibit development*'. The report did however acknowledge that the location of the site close to the projected line of two Roman roads (the Via Devana leading from the Roman town in Leicester towards Burton-upon-Trent and a postulated road linking Sawley and Tamworth) raises the possibility of roadside activity. However, analysis of aerial photographs did not identify any cropmarks likely to be indicative of such activity. From the medieval period the site is likely to have been part of the agricultural landscape within known settlements. Two boundaries recorded on the first edition Ordnance Survey (OS) map of 1882 have been removed.

A single heritage asset within the site has been identified, this being the potential below ground remains of a former tree avenue, removed in the 20th century, associated with Willesley Hall and park. Likely remains (tree boles) are considered not to comprise heritage assets as defined in the NPPF.

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remains identified within the PDA and to help inform further strategies, should they be required.

Specifically, the 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 1.0m 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. A large scale (1:4000) survey location plan, showing the processed data, is provided as Figure 2 with an overall interpretation of the data at the same scale included as Figure 3. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 4 to 9 inclusive, at a scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the OASIS form is in Appendix 4.

The survey methodology, report and any recommendations comply with 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).

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 (see Figures 4 to 9 inclusive)

Generally, the survey has identified little variation in the magnetic background response and no obvious change between the central part of the site, where there are superficial deposits of till, and the northern and southern parts where there are no superficial deposits. Several anomalies have been identified by the survey which are discussed below and cross-referenced to specific examples depicted on the interpretative figures, where appropriate.

Ferrous 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 rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution on this site, other than as described below, to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

There is a cluster of ferrous responses, **A**, in the south-western corner of the site where Measham Road turns to the east. This point is the closest either of the Roman roads passes to the site but in the absence of any other evidence it is considered unlikely that these anomalies are of archaeological significance and are more likely to be due to modern dumping in the corner of the field.

Several other high magnitude 'spike' responses, **B**, are also noted. These anomalies do not correspond with any surface feature although two of these anomalies do lie very close to former boundaries (see below).

A single linear dipolar anomaly, **C**, aligned south-west/north-east, that terminates on one of the former boundaries (see below) is caused by a sub-surface pipe or drain.

Agricultural Anomalies

Two boundaries recorded on the first edition OS map (see Fig. 2) fall within the survey area. One of these former boundaries manifests as a very weak linear anomaly, **D**.

Two avenues of trees, forming part of the landscape feature in Willesley Hall Park, also crossed the site (see Fig. 2). One discrete anomaly, **E**, on the line of the avenue may be caused by a soil-filled tree bole.

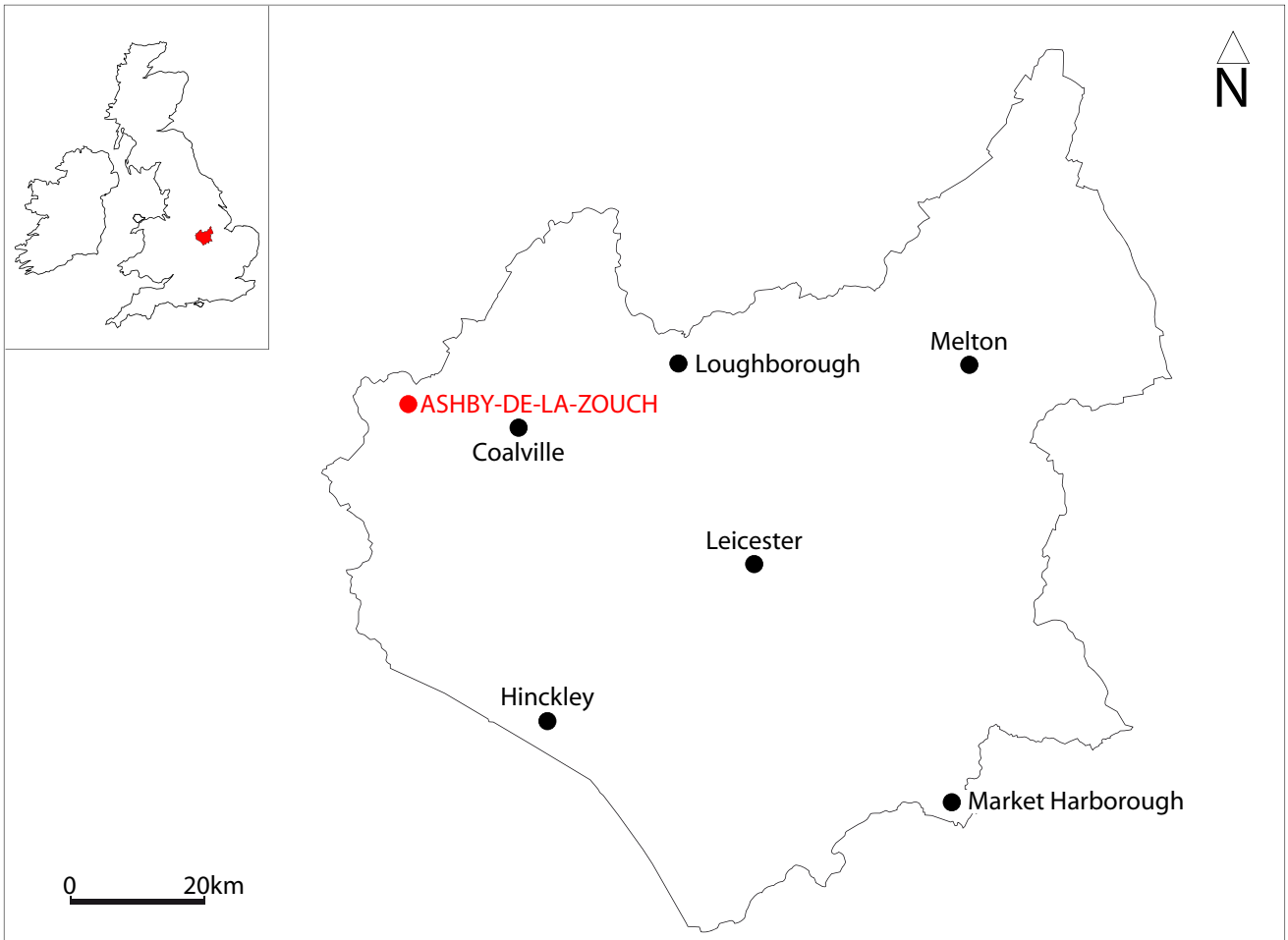
At the northern edge of the survey area vague linear trends in the data aligned parallel with the existing field boundary are recorded. These anomalies reflect modern ploughing. Two probable field drains at right angles to the ploughing trends are also noted.

Geological Anomalies

Throughout the site small anomalies of slightly enhanced magnetic response are identified. These are interpreted as geological in origin being caused by minor changes in the composition of the soils. There does not appear to be any correlation between the distribution of these anomalies and the band of till superficial deposits which covers the higher, central part of the site.

5 Conclusions

No anomalies of archaeological potential have been identified by the geophysical survey. The survey has identified a drain that probably terminated at a former field boundary (undetected) whilst a second former boundary is identified as a very weak trend in the data. Ploughing trends and a couple of field drains are also identified. On the basis of the survey, the archaeological potential of the site is considered to be very low.



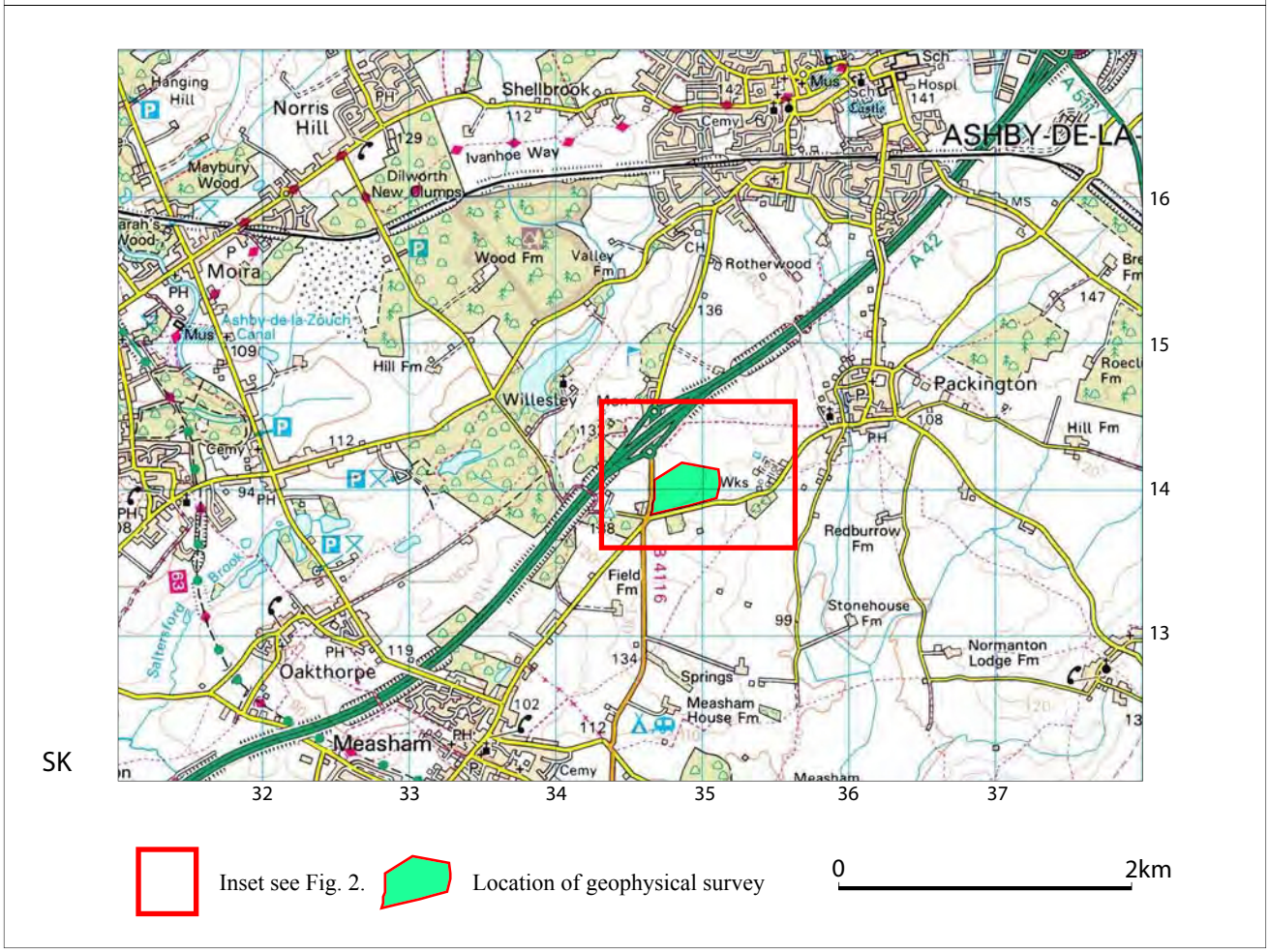


Fig. 1. Site location

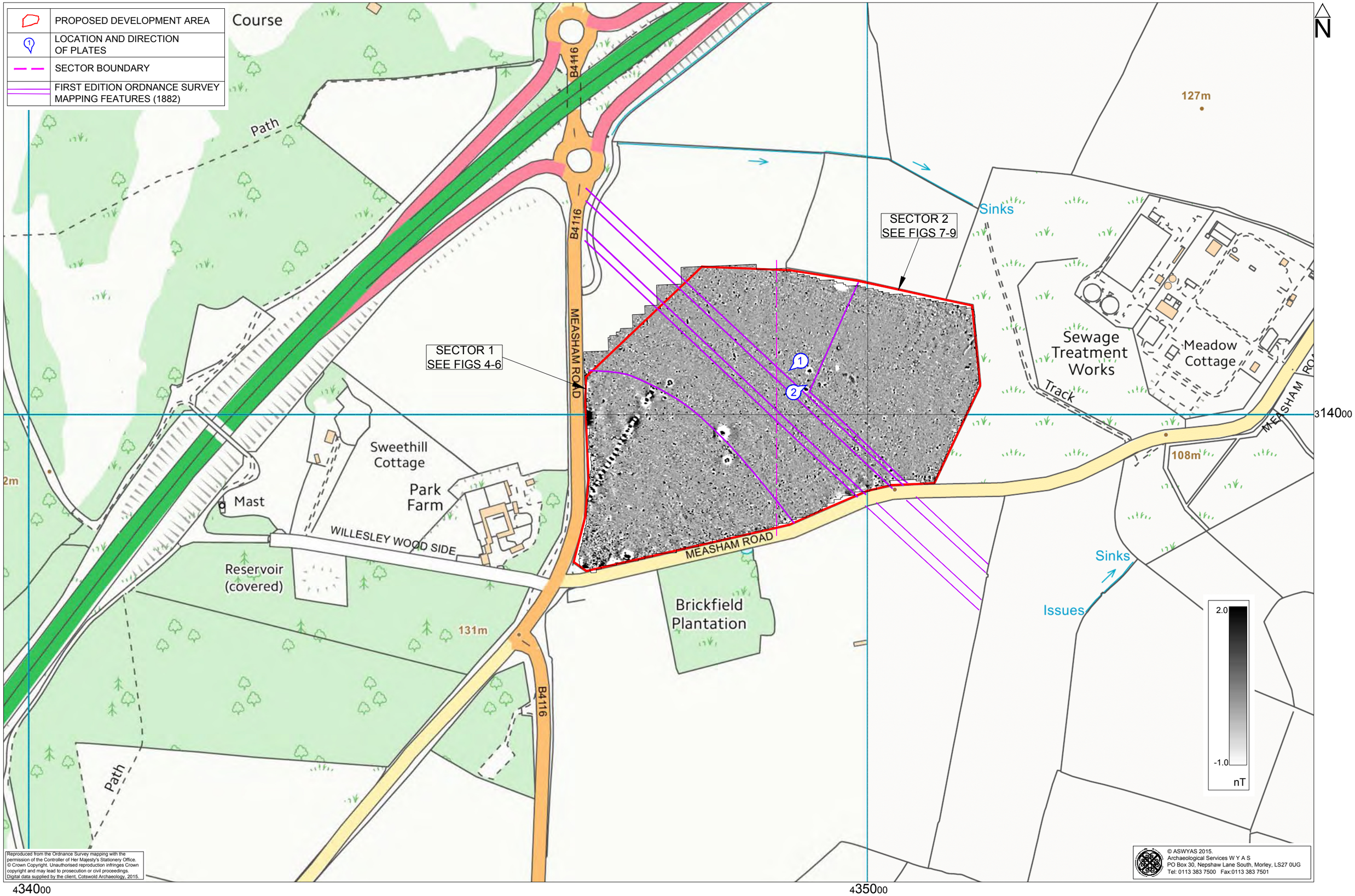


Fig. 2. Survey location showing greyscale magnetometer data (1:4000 @ A3)

	PROPOSED DEVELOPMENT AREA
	SECTOR BOUNDARY
	FIRST EDITION ORDNANCE SURVEY MAPPING FEATURES (1882)

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
—	DIPOLAR LINEAR	SERVICE PIPE
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	LINEAR TREND	FIELD DRAIN
	LINEAR TREND	AGRICULTURAL
	MAGNETIC ENHANCEMENT	GEOLOGY

N

Course
Path
B4116
MEASHAM ROAD
SECTOR 1
SEE FIGS 4-6
SECTOR 2
SEE FIGS 7-9
Sinks
Sewage Treatment Works
Meadow Cottage
Track
Sweethill Cottage
Park Farm
Mast
WILLESLEY WOOD SIDE
Reservoir (covered)
131m
113m
108m
Brickfield Plantation
Issues
A
B
C
D
E
Path
3140$_{00}$
4340$_{00}$
4350$_{00}$
0
200m

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Fig. 3. Overall interpretation of magnetometer data (1:4000 @ A3)

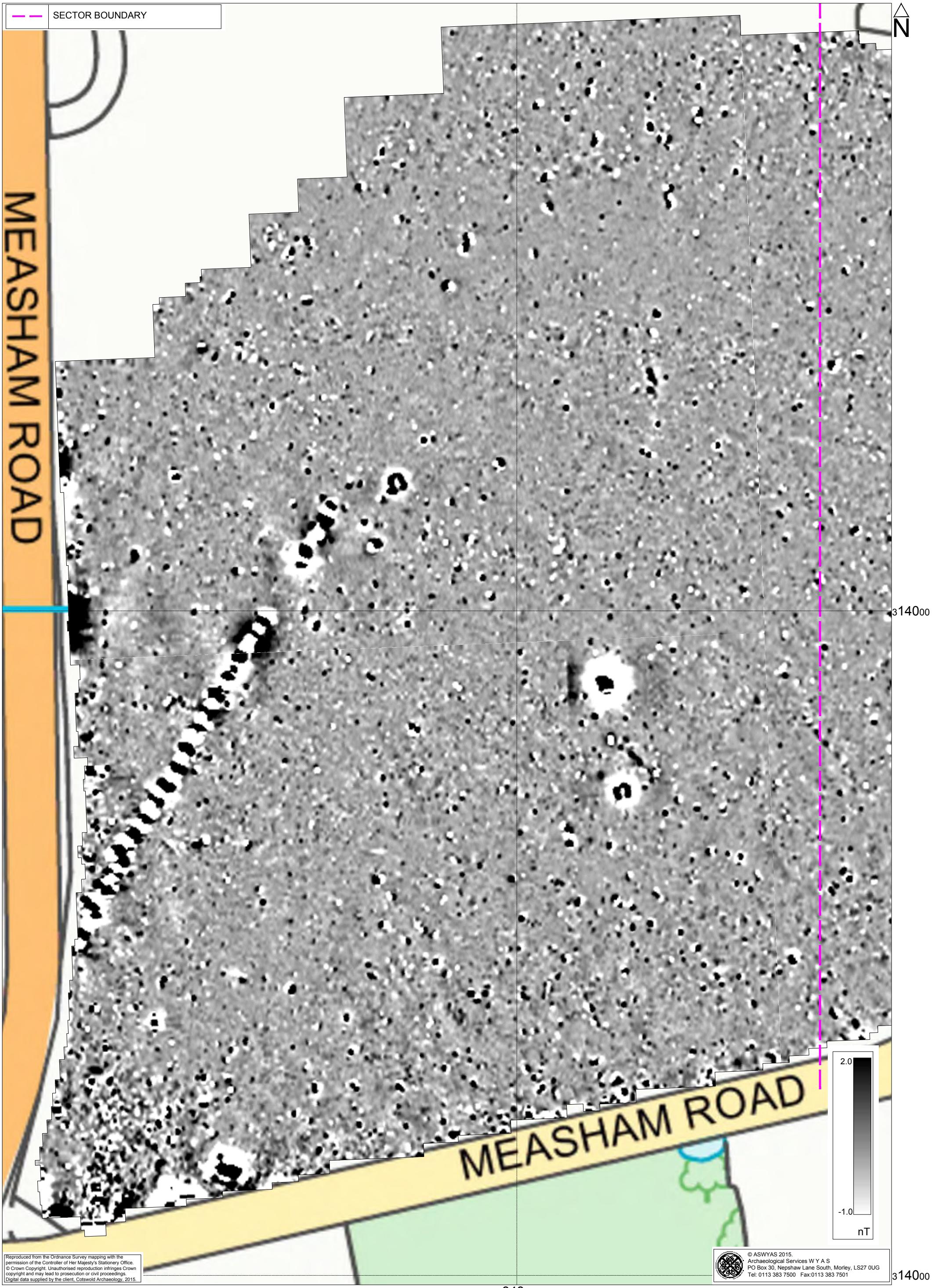

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

SECTOR BOUNDARY

N

MEASHAM ROAD

3140 00

MEASHAM ROAD

20.0 nT/cm

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Tel: 0113 383 7500 Fax:0113 383 7501

3140 00

4348 00

Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

0 30m

— —	SECTOR BOUNDARY

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
—	DIPOLAR LINEAR	SERVICE PIPE
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
—	LINEAR TREND	AGRICULTURAL
	MAGNETIC ENHANCEMENT	GEOLOGY

N

MEASHAM ROAD

B

C

C

B

B

MEASHAM ROAD

3140 00

3140 00

4348 00

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 30m

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

SECTOR BOUNDARY

N

3142 00

3140 00

4350 00

2.0

-1.0

nT

Archaeological Services W Y A S
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Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

0 30m

SECTOR BOUNDARY

N

3142 00

3140 00

4350 00

20.0 nT/cm

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

0 30m

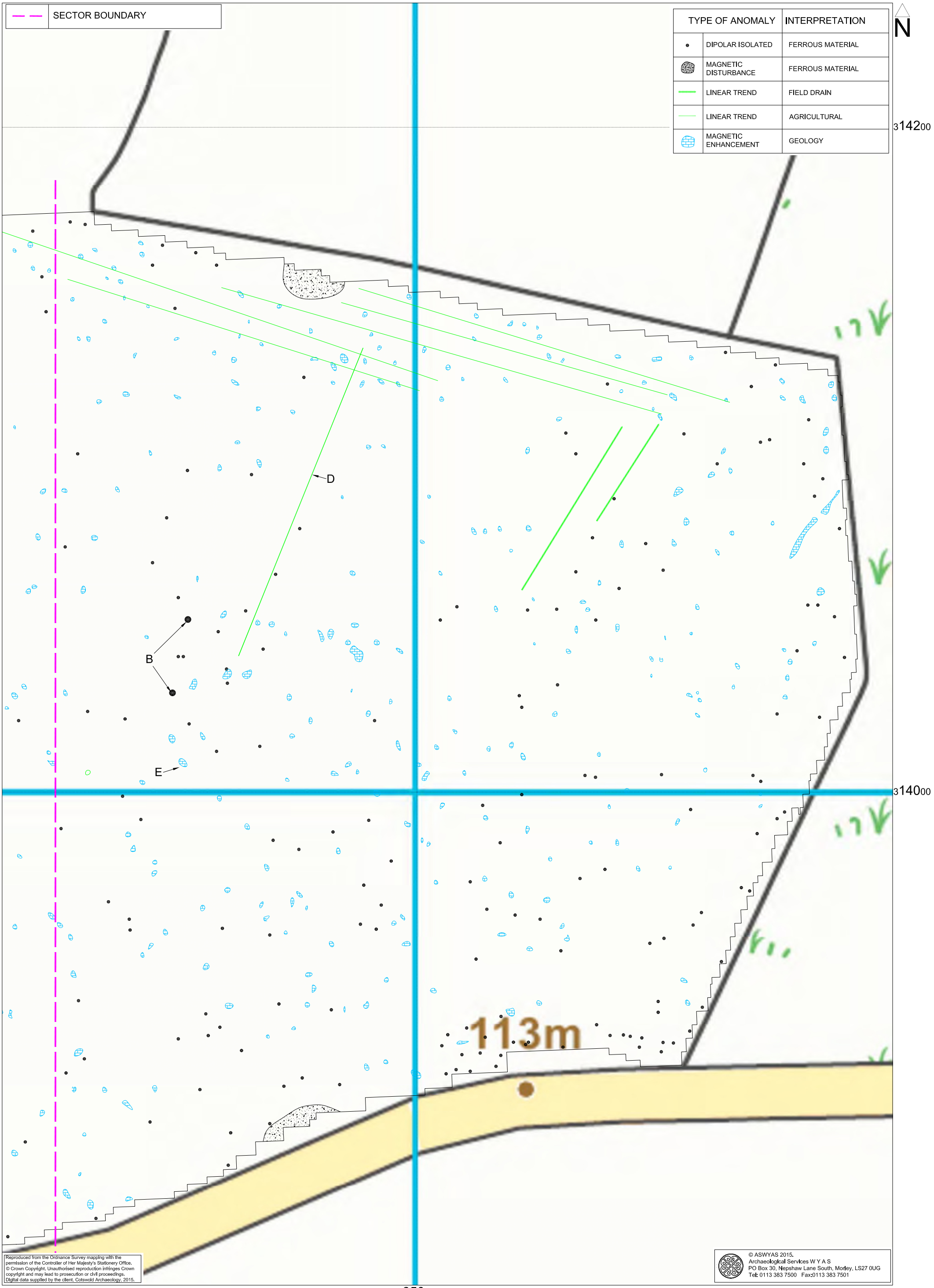

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

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

Plate 2. General view of survey area, looking north-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.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped 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 0.5m 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.

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.

Appendix 2: Survey location information

The site grid was laid out using a Trimble dual frequency Global Positioning System (GPS) with two Rovers (Trimble 5800 models) working in real-time kinetic mode. The accuracy of such equipment was better than 0.02m. 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 for relocation purposes.

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). 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 Leicestershire Historic Environment Record).

Appendix 4: 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: archaeol11-204839

Project details

Project name	Ashby Solar Farm
Short description of the project	A geophysical (magnetometer) survey covering 12.5 hectares was carried out on agricultural land near Packington in advance of the submission of a planning application for a proposed solar farm. No anomalies of archaeological potential have been identified by the survey. The only anomalies not attributable to variation in the soils are due to modern activity such as drains, pipes and modern dumping and a 19th century former boundary. On the basis of the survey, the archaeological potential of the site is considered to be very low.
Project dates	Start: 11-02-2015 End: 14-02-2015
Previous/future work	Not known / Not known
Any associated project reference codes	ADZ15 - Sitecode
Any associated project reference codes	4368 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Solar farm
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Tarpoley Siltstone Formation

Drift geology (other)	till
Techniques	Magnetometry

Project location

Country	England
Site location	LEICESTERSHIRE NORTH WEST LEICESTERSHIRE PACKINGTON Ashby Solar Farm
Study area	12.50 Hectares
Site coordinates	SK 348 140 52.7221879357 -1.48470094234 52 43 19 N 001 29 04 W Point

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Cotswold Archaeology
Project design originator	Archaeological Services WYAS
Project director/manager	Harrison, S.
Project supervisor	Evans, M.
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	N/A
Digital Contents	"other"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Ashby Solar Farm, Packington
Author(s)/Editor(s)	Webb, A.
Other bibliographic details	Report No. 2722
Date	2015
Issuer or publisher	ASWYAS
Place of issue or publication	Morley
Description	A$ blue comb bound report

Project bibliography 2

Publication type	Grey literature (unpublished document/manuscript)
Title	Ashby Solar Farm, Packington
Author(s)/Editor(s)	Webb, A.
Other bibliographic details	Report No. 2722
Date	2015
Issuer or publisher	ASWYAS
Place of issue or publication	Morley
Description	A4 blue comb bound report
Entered by	Sam Harrison (sharrison@aswyas.com)
Entered on	27 February 2015

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