WYAS Archaeological Services

# Old Stone Farm Solar Park

# Blackawton

# Devon

## Geophysical Survey

Report no. 2763
June 2015

**Client:** British Solar Renewables Ltd

Registered CIfA Organisation

West Yorkshire Joint Services

# Old Stone Farm Solar Park
# Blackawton
# Devon

## Geophysical Survey

*Summary*

*A geophysical (magnetometer) survey covering 11.9 hectares was carried out to the east of Blackawton to inform planning proposals for a solar park development at Old Stone Farm, Devon. The majority of the anomalies are indicative of recent agricultural practice, although two anomalies are consistent with landscaping features from the 18th century Old Stone Park. In addition, a series of linear anomalies of uncertain origin have been identified, most of which are on the lower southern portion of the site. These are most likely the result of post-medieval farming activity. Consequently, based on the results of the survey, the potential for the site to contain archaeological remains, other than those that related to post-medieval agricultural activity, is considered to be high in the area of the surviving 18th century landscaping and low in the remainder of the site.*

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## Report Information

| | |
|---|---|
| Client: | British Solar Renewables Ltd |
| Address: | Higher Hill Farm, Butleigh, Glastonbury, Somerset, BA6 8TW |
| Report Type: | Geophysical Survey |
| Location: | Blackawton |
| County: | Devon |
| Grid Reference: | SX 81817 51470 |
| Period(s) of activity: | Modern |
| Report Number: | 2763 |
| Project Number: | 4407 |
| Site Code: | BAD15 |
| OASIS ID: | archaeol11-213410 |
| Planning Application No.: | Pre-application |
| Museum Accession No.: | n/a |
| Date of fieldwork: | May 2015 |
| Date of report: | June 2015 |
| Project Management: | Jane Richardson PhD MCIfA |
| Fieldwork: | Alex Schmidt BSc |
| | Ross Bishop BA |
| Report: | David Wiliams BA MCIfA |
| Illustrations: | David Willaims |
| Photography: | Site Staff |
| Research: | n/a |

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


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# 1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Matthew Morgan of The Environmental Dimension Partnership (EDP) on behalf of their client, British Solar Renewables Ltd., to undertake a geophysical (magnetometer) survey of land 8.5km south of Totnes, near Blackawton, Devon (see Fig. 1). The work was undertaken in order to support planning proposals for a solar park development. 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 (Richardson 2015) approved by the client and by Graham Tait, Archaeological Advisor to South Hams District Council. The survey was carried out between May 11th and May 14th 2015 to provide additional information on the archaeological resource of the site.

### Site location and topography and land use

The proposed development area (PDA) covers 11.9 hectares of agricultural farmland 8.5km to the south of Totnes, 950m to the east of the village of Blackawton, centred at SX 81817 51470. It comprises four roughly rectangular fields and a single triangular shaped field to the north. All the fields were used as pasture, bound to the north and east by roads (see Fig. 2), with farmland to the south and west. The PDA is positioned on the top of a hill, generally south to south-east facing, which is located at c.170m above Ordnance Datum (aOD) in the north east corner, but which slopes down to the south and west to c.150m aOD.

### Soils and geology

The solid geology underlying the site comprises a band of Bovisand Formation sandstone running across the site in a north-east to south-west direction, with areas of mudstone, siltstone, limestone and sandstone to the north-west and south-east of the PDA (British Geological Survey 2015). The soils in the area are classified in the Denbigh 1 association, characterised as well drained fine loamy and fine silty soils over rock (Soil Survey of England and Wales 1983).

# 2 Archaeological and Historical Background

An archaeological and Heritage Assessment (Morgan 2015) confirmed that the site contains a small portion of an earthwork related to the former Old Stone Park, which is located in the far north corner of the PDA. Old Stone Park was located around the now ruined Old Stone House which dates from the 18th and 19th centuries, with perhaps a 17th century predecessor. The earthwork forms a ‘depression’ which may have afforded views towards Old Stone House from a possible prospect mound located to the east of the PDA. Post-medieval quarrying activity has also been identified in the centre of the site through historical map analysis.

## 3 Aims, Methodology and Presentation

The general objective 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 (1:2000) 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 12 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 12 inclusive)

Generally, there is a high level of variation in the magnetic background due to the underlying geology. A clear increase in the magnetic background is present towards the southern end of Field 4 and across Field 5. This variation is likely caused by a change in the recorded underlying geology and does not interfere with the accuracy of the data presented below. Against this background, anomalies classified into several different types and categories, according to their origin, are recorded. These are discussed below and cross-reference to specific examples and locations within the site where appropriate.

**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 linear dipolar anomaly, **A**, running north-west/south-east across the western side of Field 3 before terminating along the northern boundary of field 4, is caused by a buried service pipe.

**Agricultural Anomalies**

Across the survey area vague linear trend anomalies aligned either north-east/south-west or north-west to south-east are parallel with the field boundaries are indicative of recent ploughing. These are caused by post-medieval cultivation of the land – specifically ploughing activity.

**Geological Anomalies**

Throughout the site numerous broad areas of enhanced magnetic response have been identified. On the higher ground to the north and west of the site these anomalies are generally sub-rectangular in shape and of fairly limited extent with a concentration to the northern part of Field 2.

On the lower lying parts of the site to the south the individual anomalies are much more extensive and of a generally higher magnitude with a clear boundary within the southern part of Field 4, which most likely reflects the underlying geological boundary between the band Bovisand Formation sandstone and mixed deposits of mudstone, siltstone, limestone and sandstone located either side.

**Possible Archaeological Anomalies**

The small section of early 18th-century earthwork recorded within the PDA corresponds with two linear trend anomalies (**B**) located in the northern corner of Field 3. These anomalies are tightly focused and localised within the northern corner.

Several linear anomalies, **C** to **G**, are identified, mostly on the sloping south-eastern portion of the site. None of these anomalies correspond with any features on the historic mapping. However, some, such as **C**, **D** and **E**, run in parallel to the existing field boundaries and may, therefore, relate to post-medieval agricultural activity within the fields. A further linear trend (**F**) is located at the southern end of (**E**), and could indicate an enclosed area. Anomalies **D** and **F** consist of two parallel anomalies and could be the remnants of stone revetting that may haver formed a hedge or boundary that has subsequently subsided into the flanking ditches.

Linear anomaly **G** most likely forms a possible enclosure appended onto the extant south-western field boundary within Field 5. Given the agricultural nature of the land, both **E** and **G** could form parts of stock corrals. A second possibility is that these linear anomalies also have a geological origin. Equally an earlier archaeological origin for any of these anomalies cannot be discounted and so these anomalies have been interpreted as of possible archaeological origin.

## 5 Conclusions

No anomalies of obvious or definite archaeological origin have been identified by the geophysical survey, although anomalies consistent with landscaping features associated with the 18th century Old Stone Park have been identified in the northern corner of the site. However, as well as the agricultural and geologically related anomalies, a series of linear anomalies of uncertain origin have been identified, most of which are confined to the south-eastern portion of the site. Whilst an archaeological origin cannot be discounted, it is considered on balance that a non-archaeological origin (i.e. post-medieval agriculture) is more likely. Consequently, based on the results of the survey, the potential for the site to contain archaeological remains, other than those related to post-medieval agricultural activity, is considered to be high in the area of the surviving 18th century landscaping and low in the remainder of the site.


*Fig. 1. Site location*

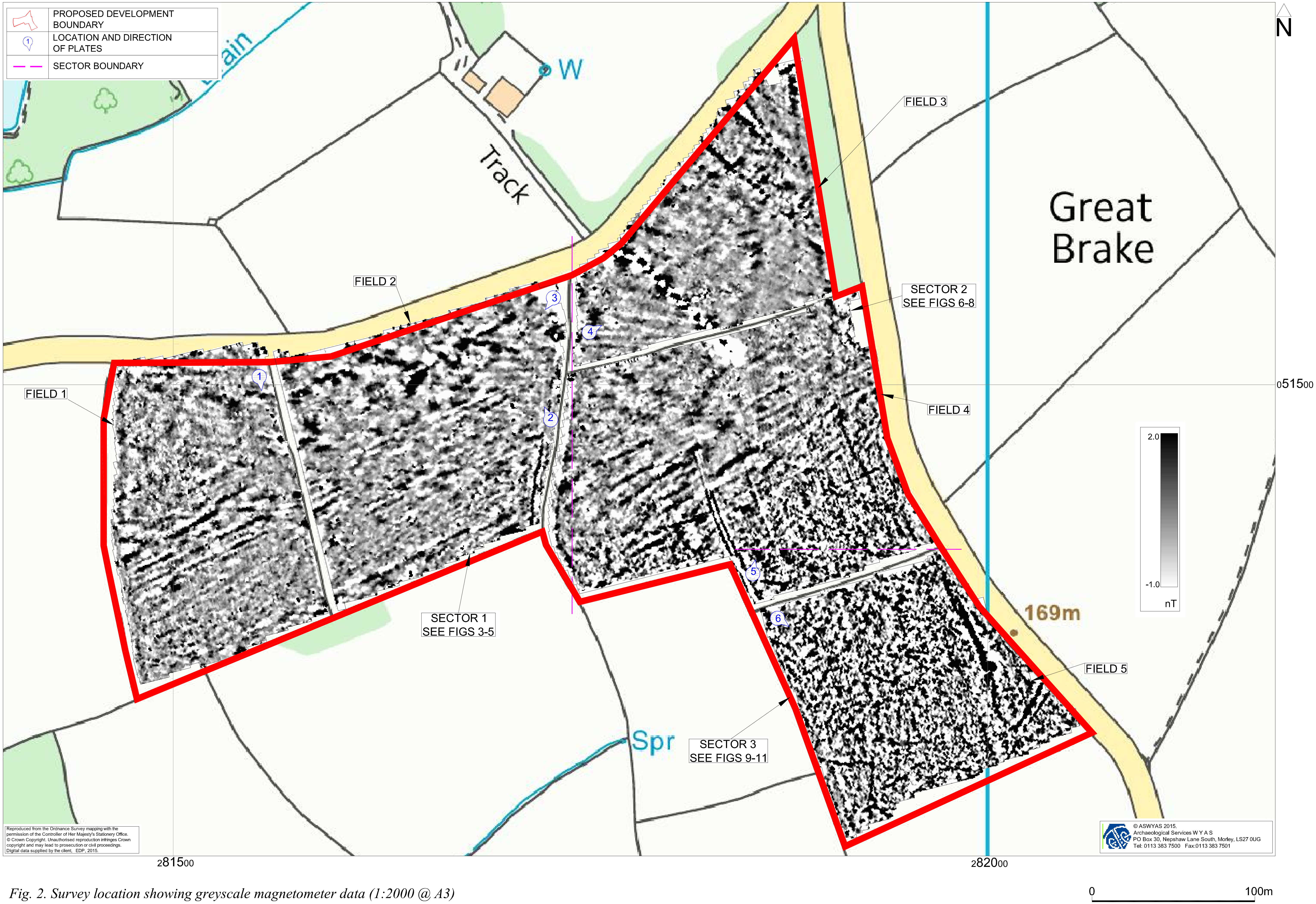


*Fig. 2. Survey location showing greyscale magnetometer data (1:2000 @ A3)*

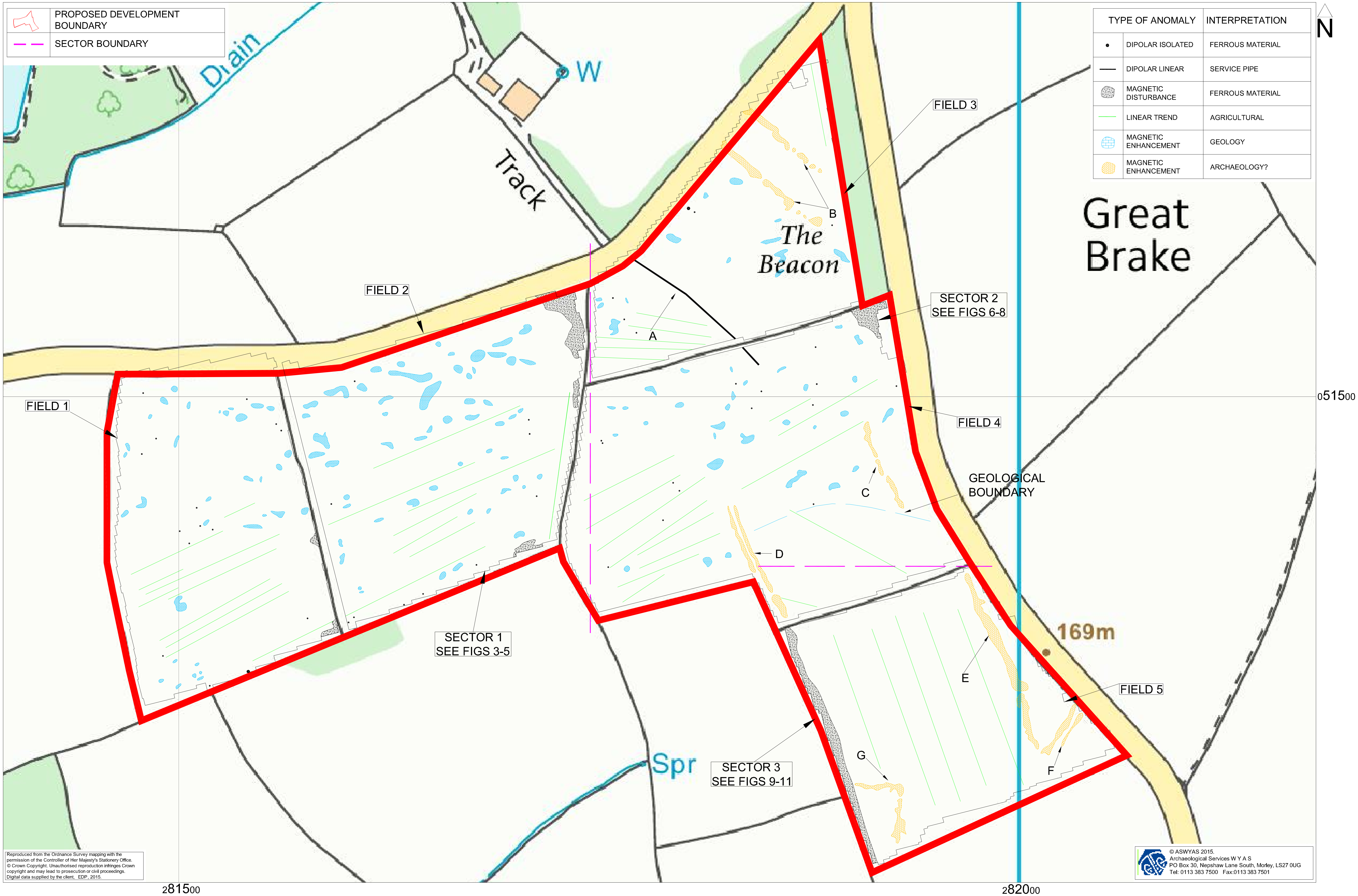


*Fig. 3. Overall interpretation of magnetometer data (1:2000 @ A3)*

0 100m


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

0 30m

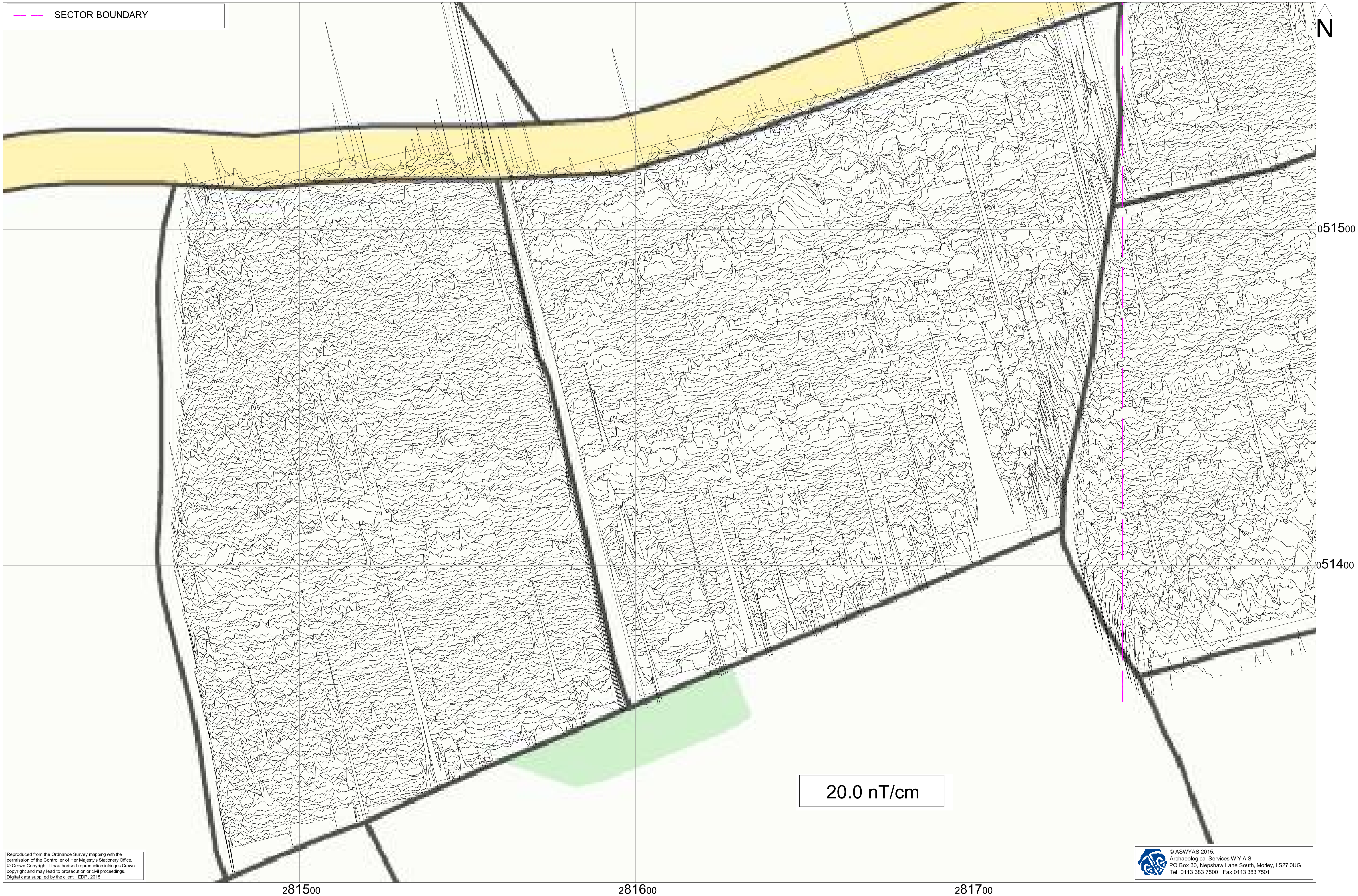


*Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)*

0 30m

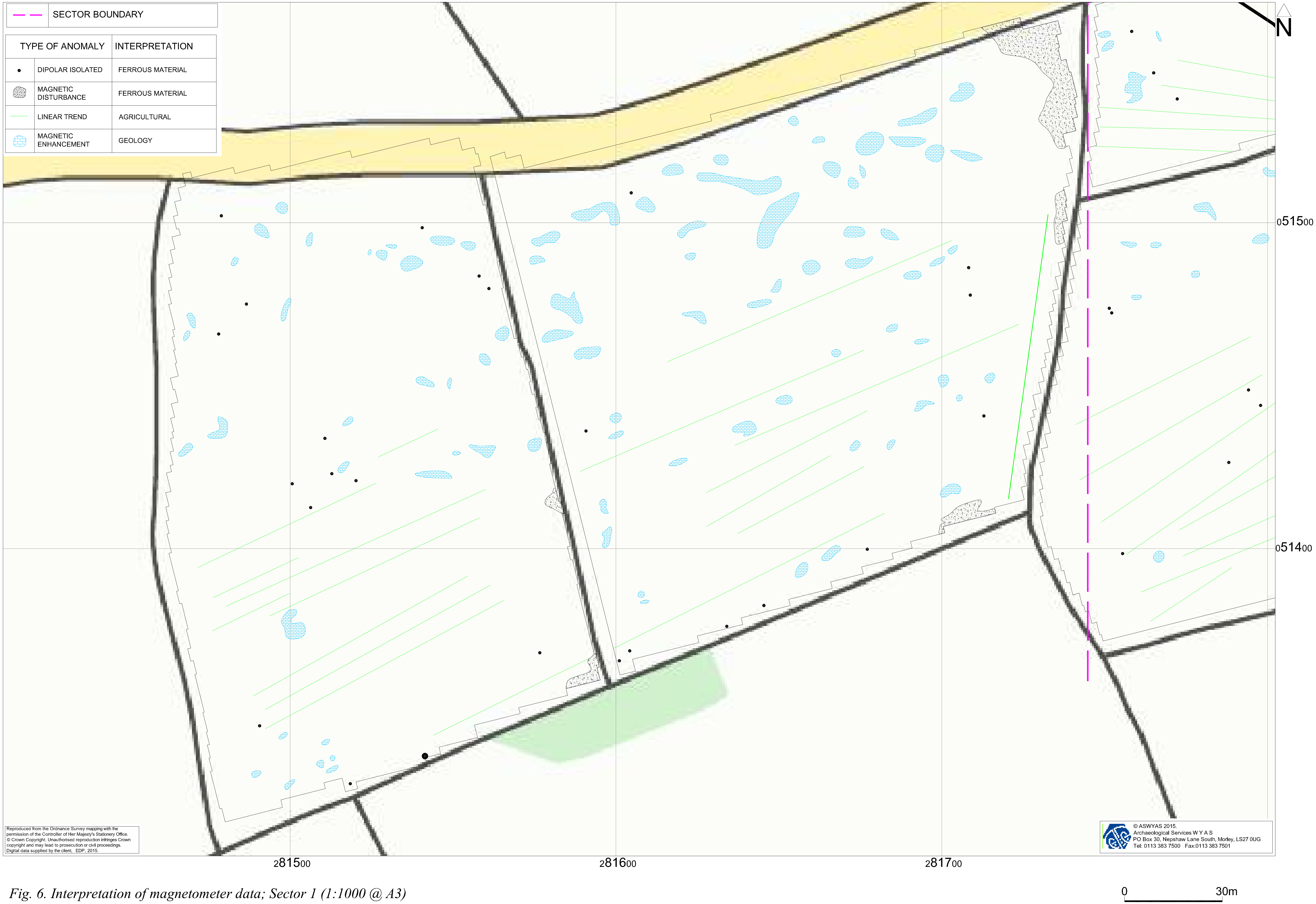


*Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)*


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

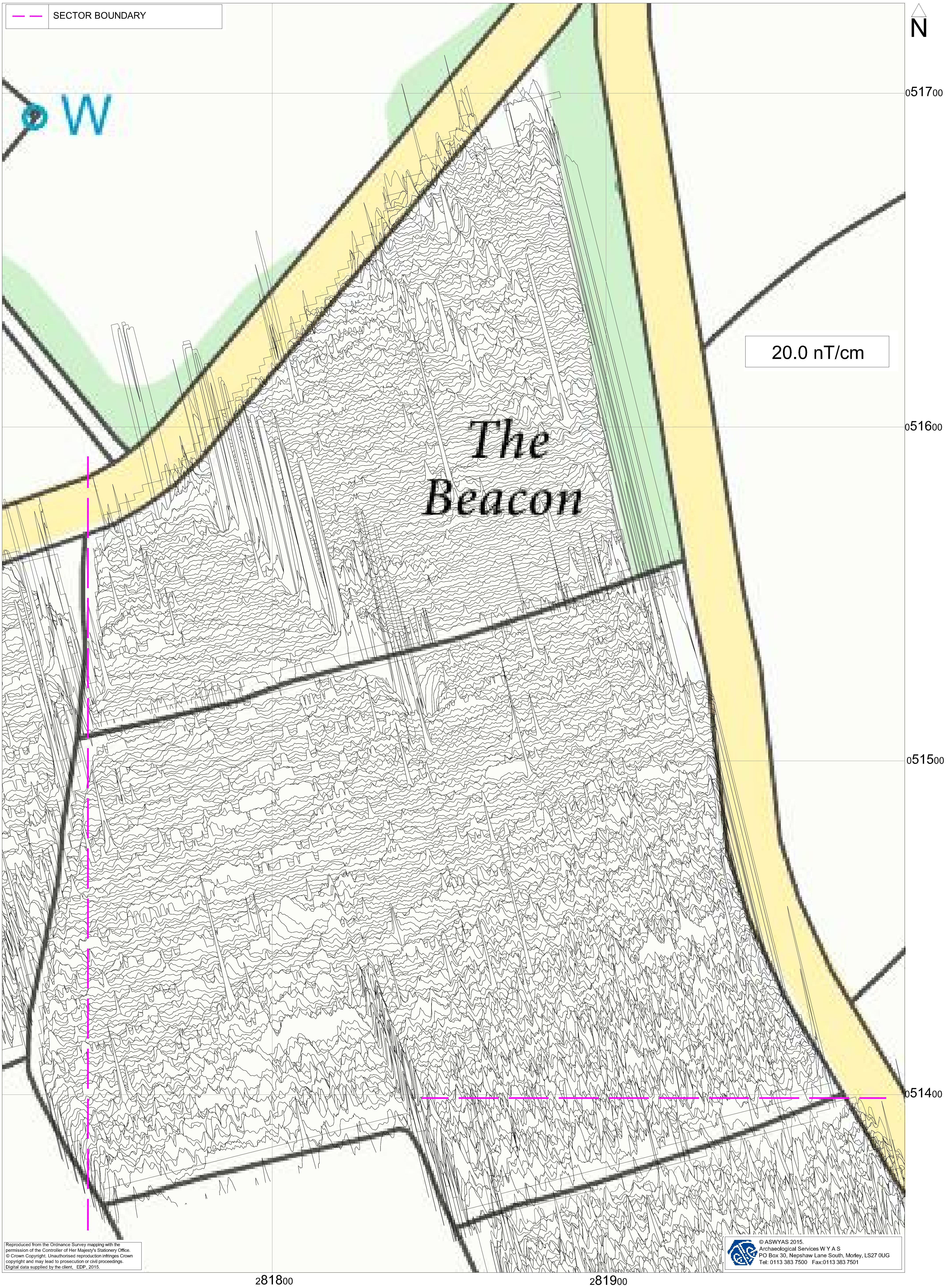




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*Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)*

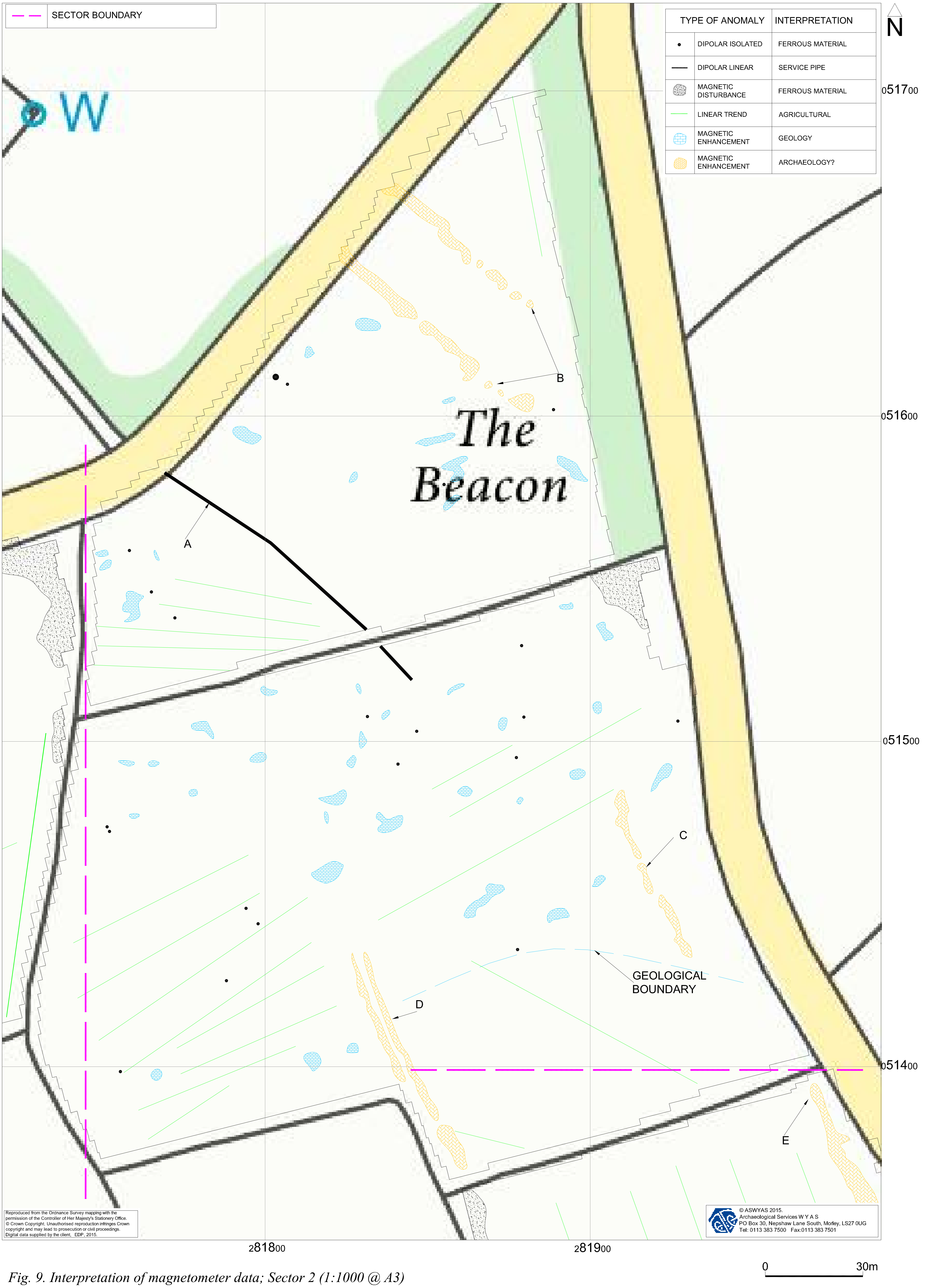


*Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)*

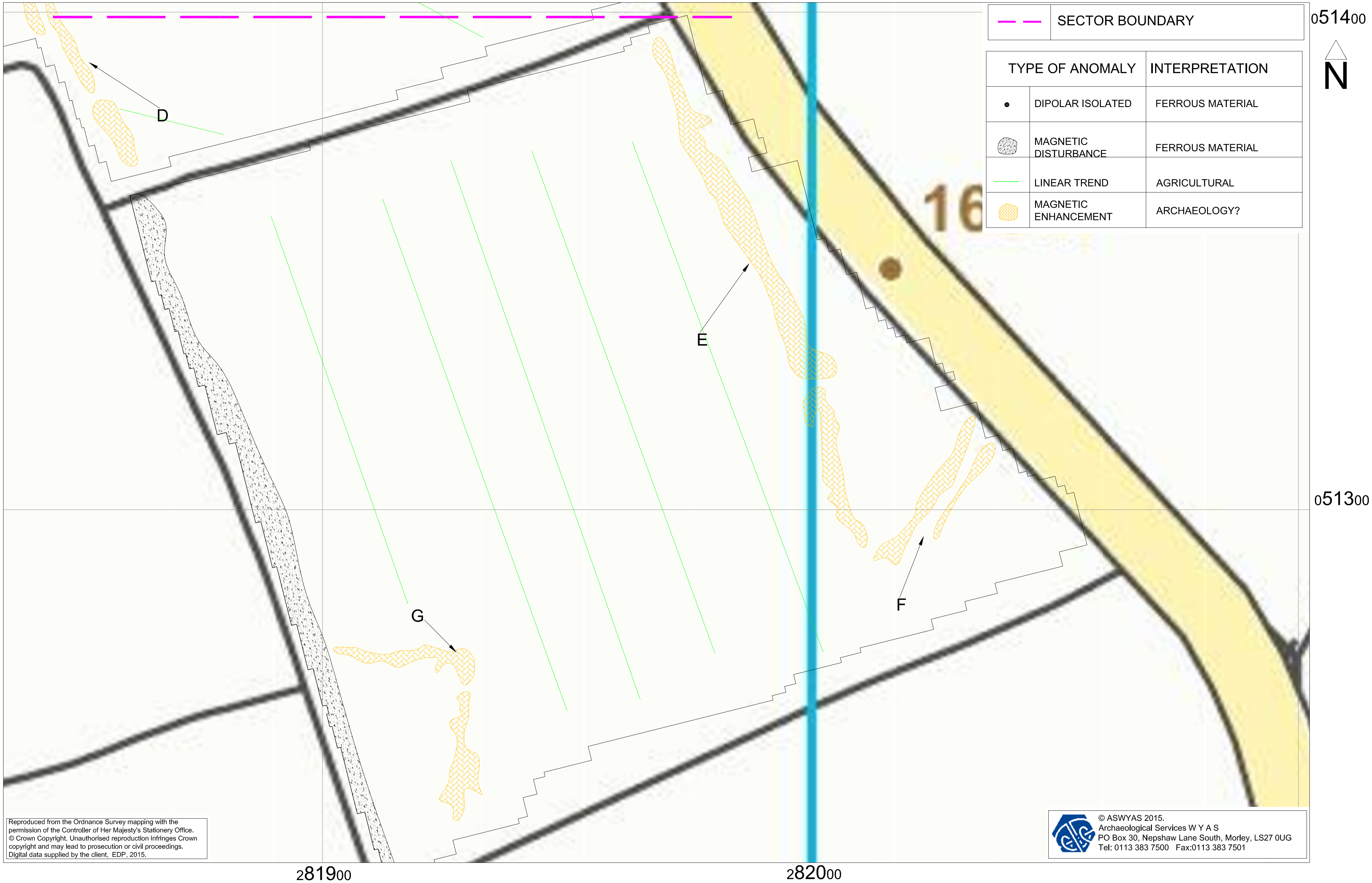


*Fig.12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A4)*

0 30m


*Fig.11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A4)*


*Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A4)*

*Plate 1. General view of Field 1, looking south*

*Plate 2. General view of Field 2, looking north-west*

*Plate 3. General view of Field 2, looking south-west*

*Plate 4. General view of Field 3, looking north-east*

*Plate 5. General view of Field 4, looking north*

*Plate 6. General view of Field 5, looking south-west*

# 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.

## 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 will 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 Devon 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: archaeol11-213410

### Project details

| | |
|---|---|
| Project name | Old Stone Farm Solar Park |
| Short description of the project | A geophysical (magnetometer) survey covering 11.9 hectares was carried out to the east of Blackawton to inform planning proposals for a solar park development at Old Stone Farm, Devon. The majority of the anomalies are indicative of recent agricultural practice, although two anomalies are consistent with landscaping features from the 18th century Old Stone Park. In addition, a series of linear anomalies of uncertain origin have been identified, most of which are on the lower southern portion of the site. These are most likely the result of post-medieval farming activity. Consequently, based on the results of the survey, the potential for the site to contain archaeological remains, other than those that relates to the post-medieval agricultural activity, is considered to be high in the area of the surviving 18th century landscaping and low in the remainder of the site. |
| Project dates | Start: 11-05-2015 End: 14-05-2015 |
| Previous/future work | Not known / Not known |
| Type of project | Field evaluation |
| Site status | None |
| Current Land use | Cultivated Land 4 - Character Undetermined |
| Monument type | VANTAGE POINT Post Medieval |
| Monument type | PLOUGH MARKS Modern |
| Significant Finds | NONE None |
| Methods & techniques | "Geophysical Survey" |
| Development type | Not recorded |
| Prompt | National Planning Policy Framework - NPPF |
| Position in the planning process | Pre-application |
| Solid geology (other) | Bovisand Formation |
| Drift geology | Unknown |
| Drift geology (other) | None |
| Techniques | Magnetometry |

## Project location

| | |
|---|---|
| Country | England |
| Site location | DEVON SOUTH HAMS BLACKAWTON Old Stone Farm Solar Park |
| Postcode | TQ9 7BL |
| Study area | 11.90 Hectares |
| Site coordinates | SX 81817 51470 50.3506448316 -3.66137175692 50 21 02 N 003 39 40 W Point |
| Height OD / Depth | Min: 150.00m Max: 170.00m |

## Project creators

| | |
|---|---|
| Name of Organisation | Archaeological Services WYAS |
| Project brief originator | Environmental Dimension Partnership |
| Project design originator | Archaeological Services WYAS |
| Project director/manager | Richardson, J. |
| Project supervisor | Schmidt, A. |
| Type of sponsor/funding body | Developer |
| Name of sponsor/funding body | British Solar Renewables Ltd |

## Project archives

| | |
|---|---|
| Physical Archive Exists? | No |
| Digital Archive recipient | N/A |
| Digital Contents | "none" |
| Digital Media available | "Geophysics","Images raster / digital photography","Survey","Text" |
| Paper Archive Exists? | No |

## Project bibliography 1

| | |
|---|---|
| Publication type | Grey literature (unpublished document/manuscript) |
| Title | Old Stone Farm Solar Park Blackawton Devon |
| Author(s)/Editor(s) | Williams, D. |
| Other bibliographic details | Report No. 2763 |
| Date | 2015 |

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| Issuer or publisher | Archaeological Services WYAS |
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| Description | Text, 12 figures 6 plates |

| | |
|---|---|
| Entered by | David Williams (dwilliams@aswyas.com) |
| Entered on | 9 June 2015 |

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