Archaeological Services WYAS

Land at Crowpits
Near Honiton
Devon

Geophysical Survey

Report no. 2639

August 2014

Client: British Solar Renewables Limited

Registered Organisation IfA

Land at Crowpits
Near Honiton
Devon

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 23 hectares, was carried out south of Honiton to inform planning proposals for a solar park development at Crowpits, Devon. Anomalies indicative of recent agricultural practice, small scale extraction and variation in the depth and composition of the superficial geological deposits have been identified. In addition a series of linear anomalies of uncertain origin have been identified, most of which are on the lower lying eastern half of the site. Whilst a non-archaeological cause is considered more likely an archaeological cause for some or all of these anomalies cannot be discounted. Consequently the archaeological potential of the site, based on the results of the survey, is considered to be low.

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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:	Claypits, Honiton
County:	Devon
Grid Reference:	SY 134 963
Period(s) of activity:	post-medieval?
Report Number:	2639
Project Number:	4272
Site Code:	CRP14
OASIS No:	archaeol11-188876
Planning Application No.:	Pre-application
Museum Accession No.:	n/a
Date of fieldwork:	August 2014
Date of report:	August 2014
Project Management:	David Harrison BA MSc MIfA, Alistair Webb BA MIfA
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	Mark Evans
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Photography:	Site Staff
Research:	n/a

Authorisation for distribution: ---

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Ed Oakley of The Environmental Dimension Partnership (EDP) on behalf of their client, British Solar Renewables Ltd., to undertake a geophysical (magnetometer) survey on land approximately 5km to the south of Honiton and 21km east of Exeter, Devon (see Fig. 1), to support planning proposals for a solar park development. The work was undertaken in accordance with a Project Design (Harrison 2014) supplied to and approved by the client and by Stephen Reed, Archaeological Advisor to East Devon Council, with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice (David *et al.* 2008). The survey was carried out between August 4th and August 8th 2014 in order to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA) covers approximately 25 hectares, including a small area of woodland in the centre of the site (see Fig. 2), and comprises three large fields all of which were under grass at the time of survey. The PDA is centred at SY 134 963 and is bordered to the north, south and west by woodland (Crowpits Covert) beyond which are two minor roads with a track (Muddy Lane) to the west.

The site is situated on a gradual east facing slope on the eastern flank of Chineway Hill, which is situated itself towards the northern end of East Hill, a prominent escarpment. The site slopes gradually downwards from the highest point in the west of the PDA, at approximately 240m above Ordnance Datum (aOD) to 220m aOD in the east.

Soils and geology

The solid geology underlying the site comprises Upper Greensand Formation (sand and sandstone) overlain by superficial deposits of Clay-with-Flints Formation. This superficial deposit is formed from the dissolution, decalcification and cryoturbation of the bedrock data and locally comprises sand and clays with angular shattered blocks of chert. This material may collect in dissolution hollows or on inclined slopes (British Geological Survey 2014). This characteristic may explain many of the recorded anomalies (see below).

2 Archaeological and Historical Background

An Archaeological and Heritage Assessment (Oakley 2014) confirmed that there '*are no previously recorded non-designated heritage assets within the application boundary*' but that there is '*considered to be the potential for previously unrecorded archaeological activity on the site by virtue of the proximity of prehistoric remains in the wider area*'. These remains comprise an extensive barrow cemetery to the east with further barrows also along the escarpment to the west.

3 Aims, Methodology and Presentation

The general 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

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 shows the location of the site and the processed data at a scale of 1:5000, whilst Figure 3 is an overall interpretation of all the anomalies identified during the survey at the same scale. Detailed data plots (‘raw’ and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 4 to 15 inclusive.

Further 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 site archive.

The survey methodology, report and any recommendations comply with the approved Project Design (Harrison 2011), with guidelines outlined by English Heritage (David *et al* 2008) and by the IfA (Gaffney, Gater and Ovenden 2002). 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 Figs 4 to 15 inclusive)

Generally, there is a high level of variation in the magnetic background due to the underlying soils and superficial deposits (see below). Against this background anomalies classified into several different types and categories, according to their origin, are recorded. These are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

Ferrous anomalies

Individual iron 'spike' anomalies are ubiquitous across all of the fields within the survey, as they are on most arable fields. These anomalies are caused by ferrous debris, which is either lying on the surface of the field, or has been incorporated into the plough soil. These anomalies are not considered to be archaeologically significant unless there is any other supporting evidence for an archaeological interpretation, or any obvious clustering that might imply an archaeological origin, being present in the soil usually as a consequence of manuring.

A linear dipolar anomaly, **A**, running north-west/south-east across the north-eastern corner of Field 1 before heading on an easterly bearing along the northern edge of Field 2, is caused by a buried service pipe.

Three adjacent clusters of high magnitude responses, **B**, **C** and **D**, are identified in the centre of Field 2 either along or immediately adjacent to former field boundaries (see below). These anomalies are interpreted as probable backfilled extraction/rubbish pits and are not considered to be archaeologically significant. Two other linear bands of disturbance along the eastern boundary of Field 1 are due to ferrous material forming part of, or adjacent to, the field boundary.

Agricultural Anomalies

Analysis of 19th century estate, tithe and Ordnance Survey maps (Oakley 2014) indicates that four field boundaries have been removed over the last 125 years. Only three of these former boundaries manifest as magnetic anomalies; **E** and **F** which formerly sub-divided what is now Field 2 and **G**, which sub-divided Field 3. The fourth boundary, which sub-divided Field 1, is not recorded in the data.

In Field 1 vague linear trend anomalies aligned north/south, parallel with the eastern field boundary are indicative of recent ploughing.

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 north-western corner of the site. On the lower lying parts of the site to the east and particularly the south-east the individual anomalies are much more extensive and of a generally higher magnitude with a specific cluster defined by dashed line, **H**. All these anomalies are interpreted as being geological in origin being due to variation within and accumulation of superficial deposits on the bedrock.

Possible Archaeological Anomalies

Several linear and curvilinear anomalies, **I** to **S**, are identified, mostly on the sloping lower lying eastern half of the site. None of these anomalies corresponds with any features on the historic mapping. However, some, such as **I**, **J** and **L**, do correspond with cropmarks visible on aerial photographs of the site. These photographs also show a linear cropmark to the north-west of Field 2 that corresponds with a track depicted on the 1891 Ordnance Survey map. Although this former feature does not manifest as a magnetic anomaly one possibility is that these anomalies may be caused by paths or animal tracks. A second possibility is that these linear anomalies also have a geological origin. Equally an archaeological interpretation 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. However, as well as the ubiquitous agricultural and geologically related anomalies a series of linear anomalies of uncertain origin have been identified, most of which are on the lower lying eastern half of the site. Whilst an archaeological origin cannot be discounted, hence the interpretation, it is considered on balance that a non-archaeological origin is more likely although the precise origin is unknown. Consequently the archaeological potential of the site, based on the results of the survey, is considered to be 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.

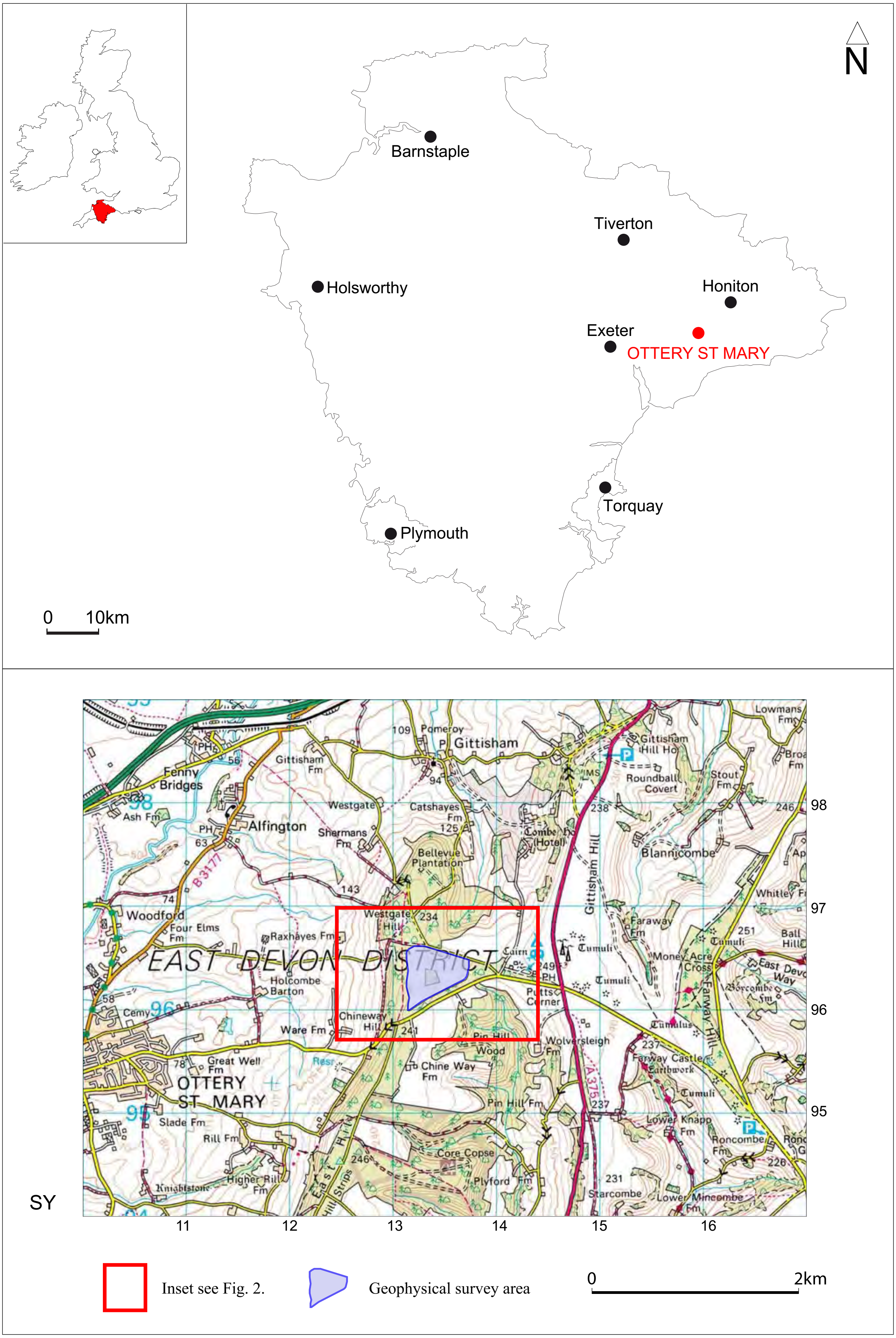

Fig. 1. Site location

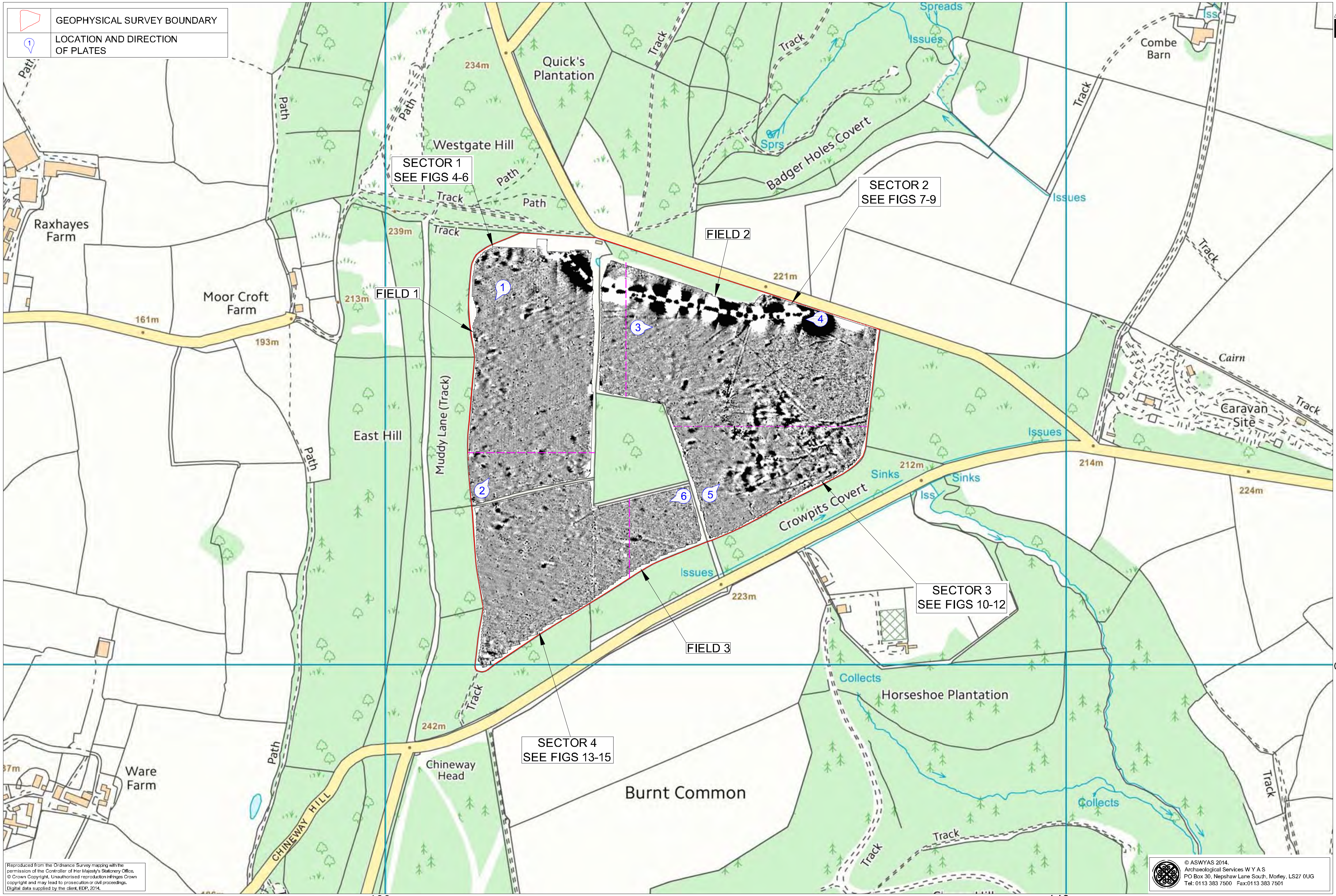

Fig. 2. Survey location showing greyscale magnetometer data and sector boundaries (1:5000 @ A3)

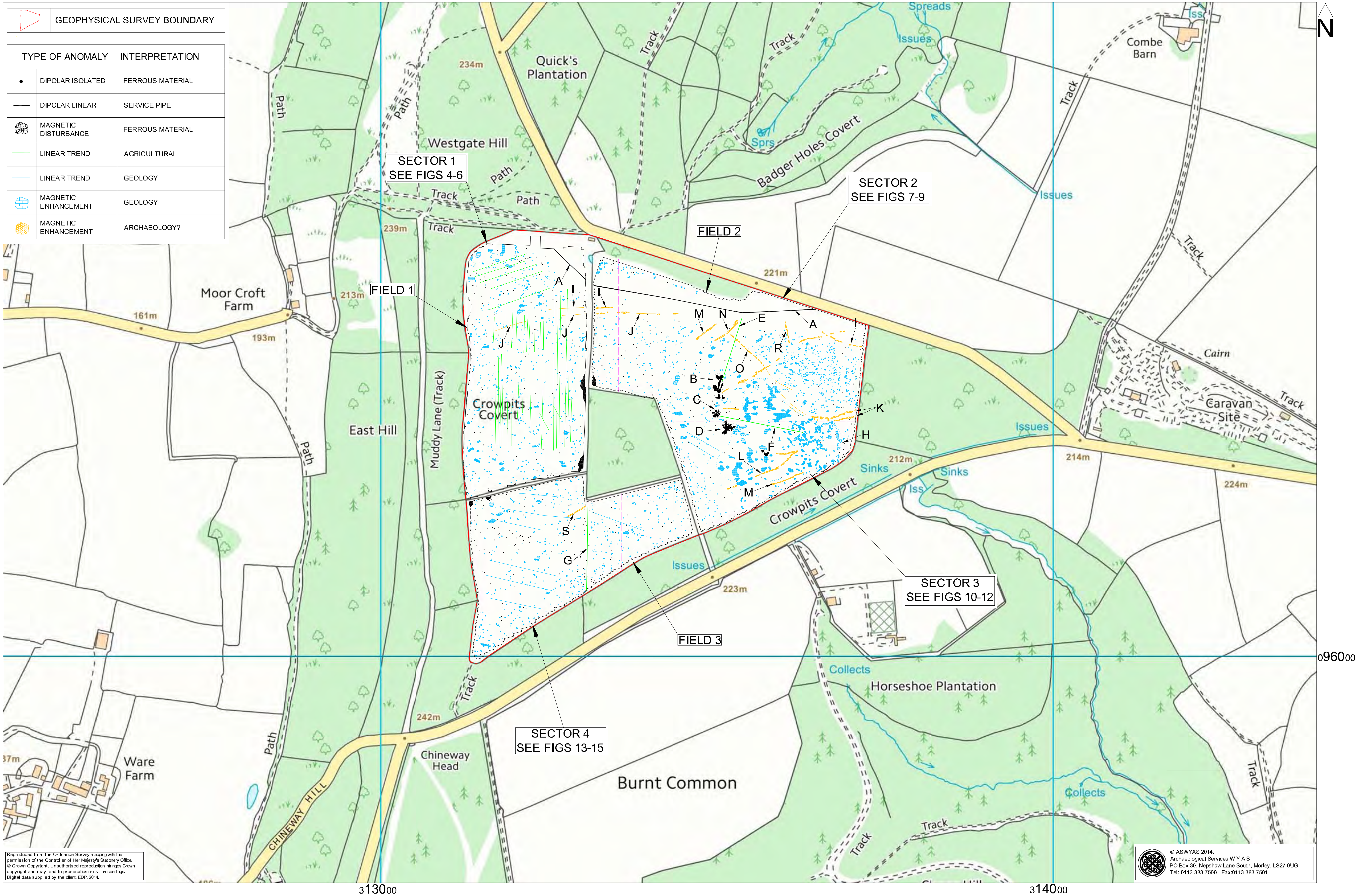

Fig. 3. Overall interpretation of magnetometer data (1:5000 @ A3)

0 100m

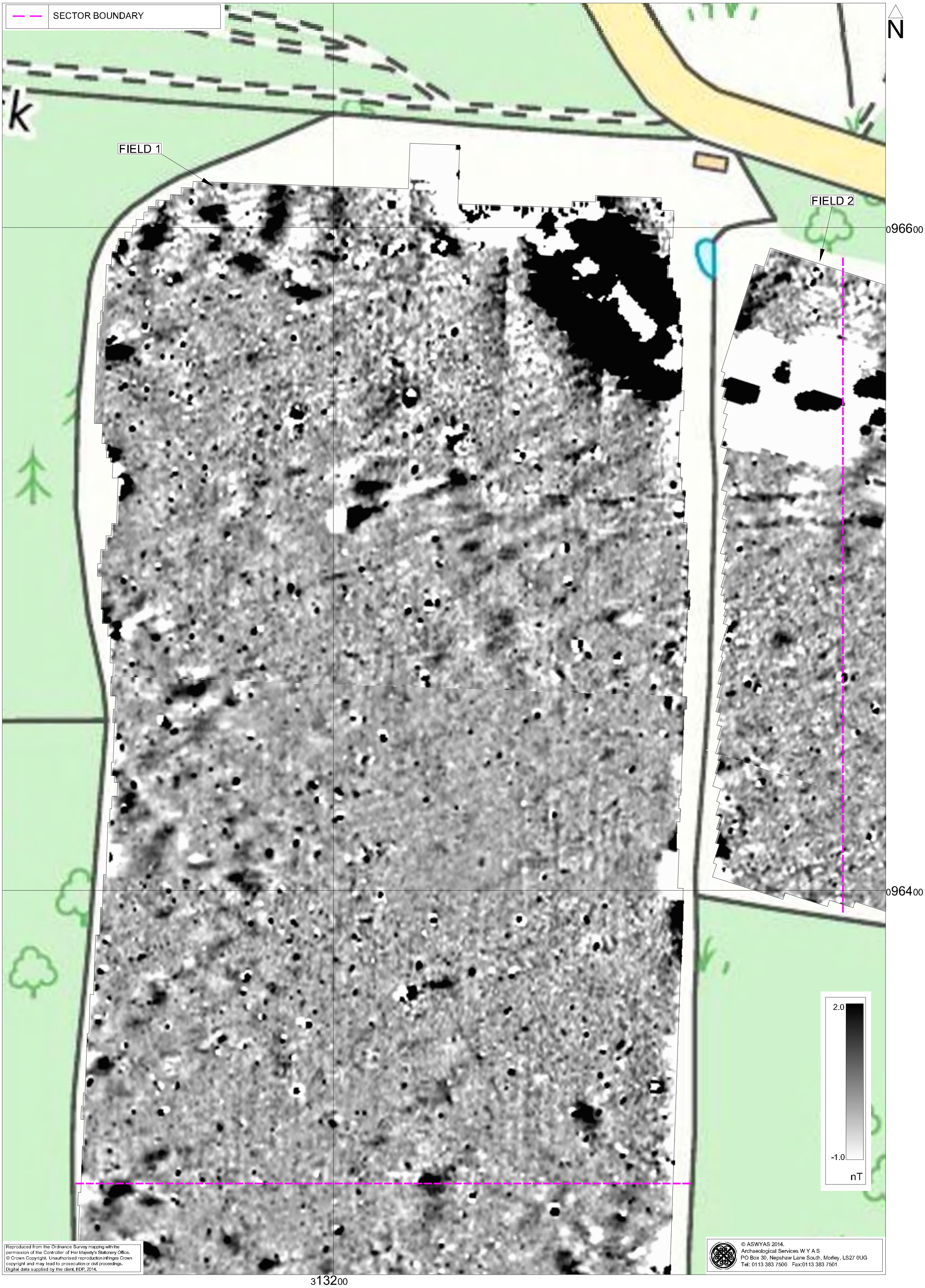

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

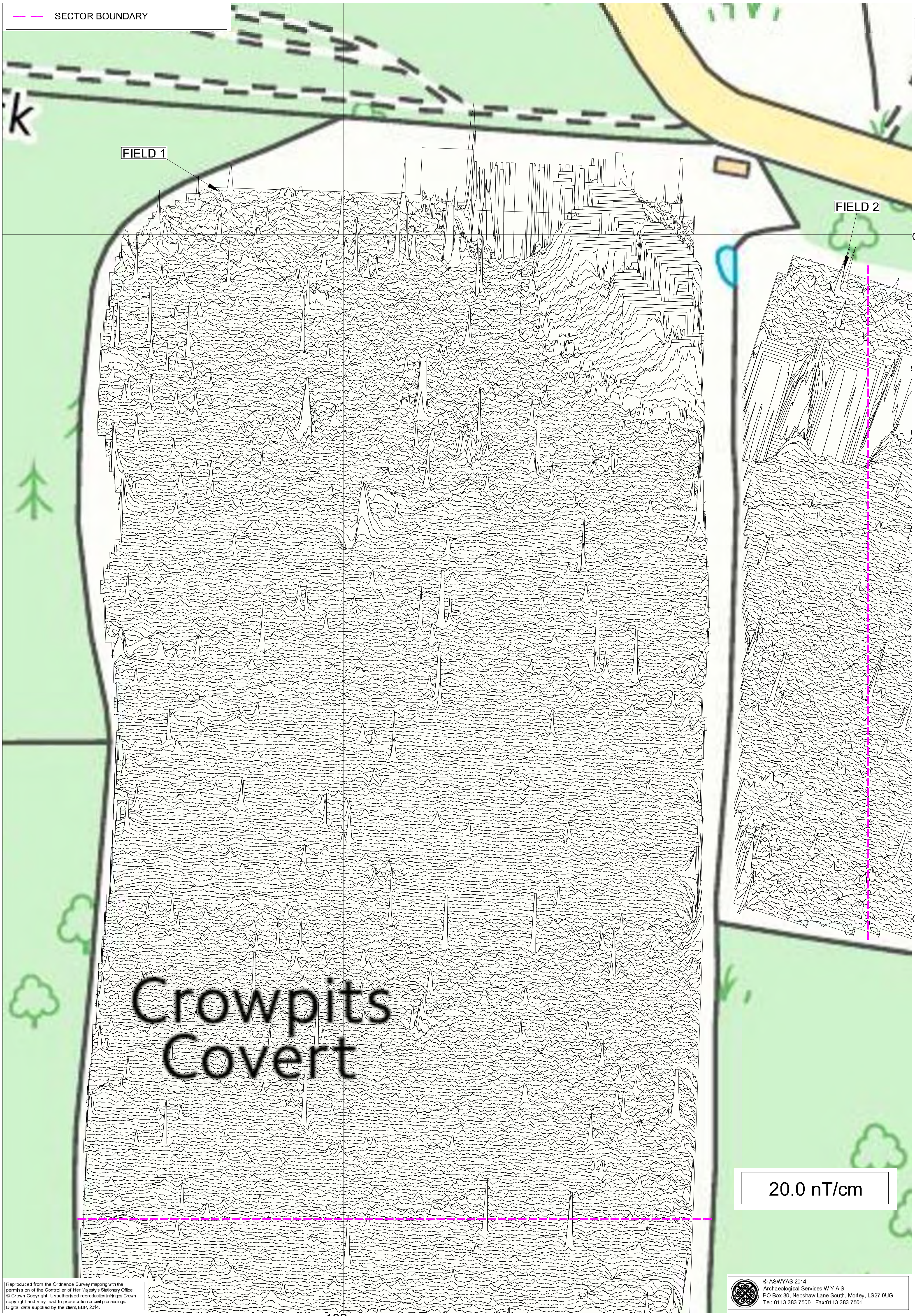

Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

0 25m

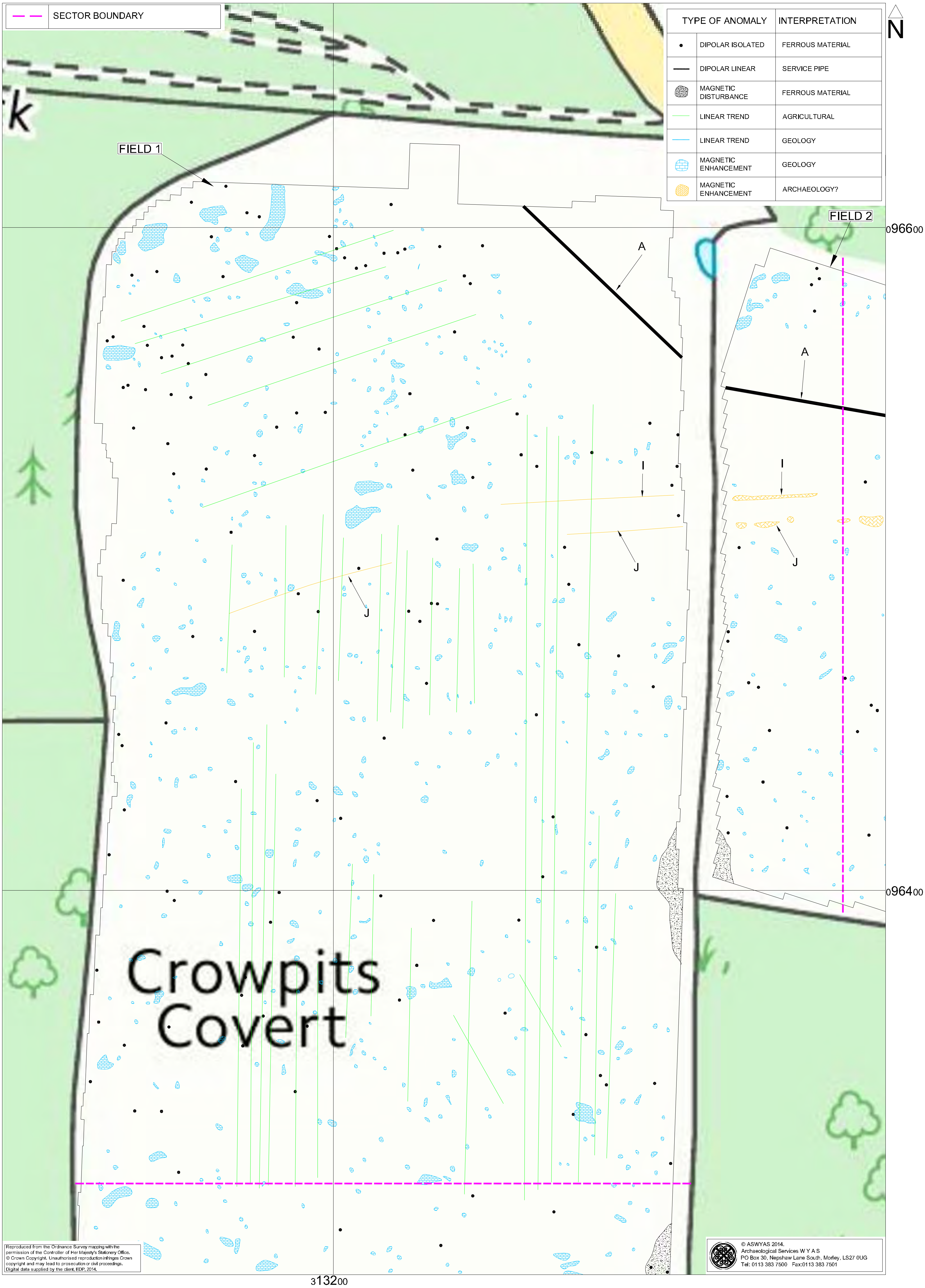

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

0 25m

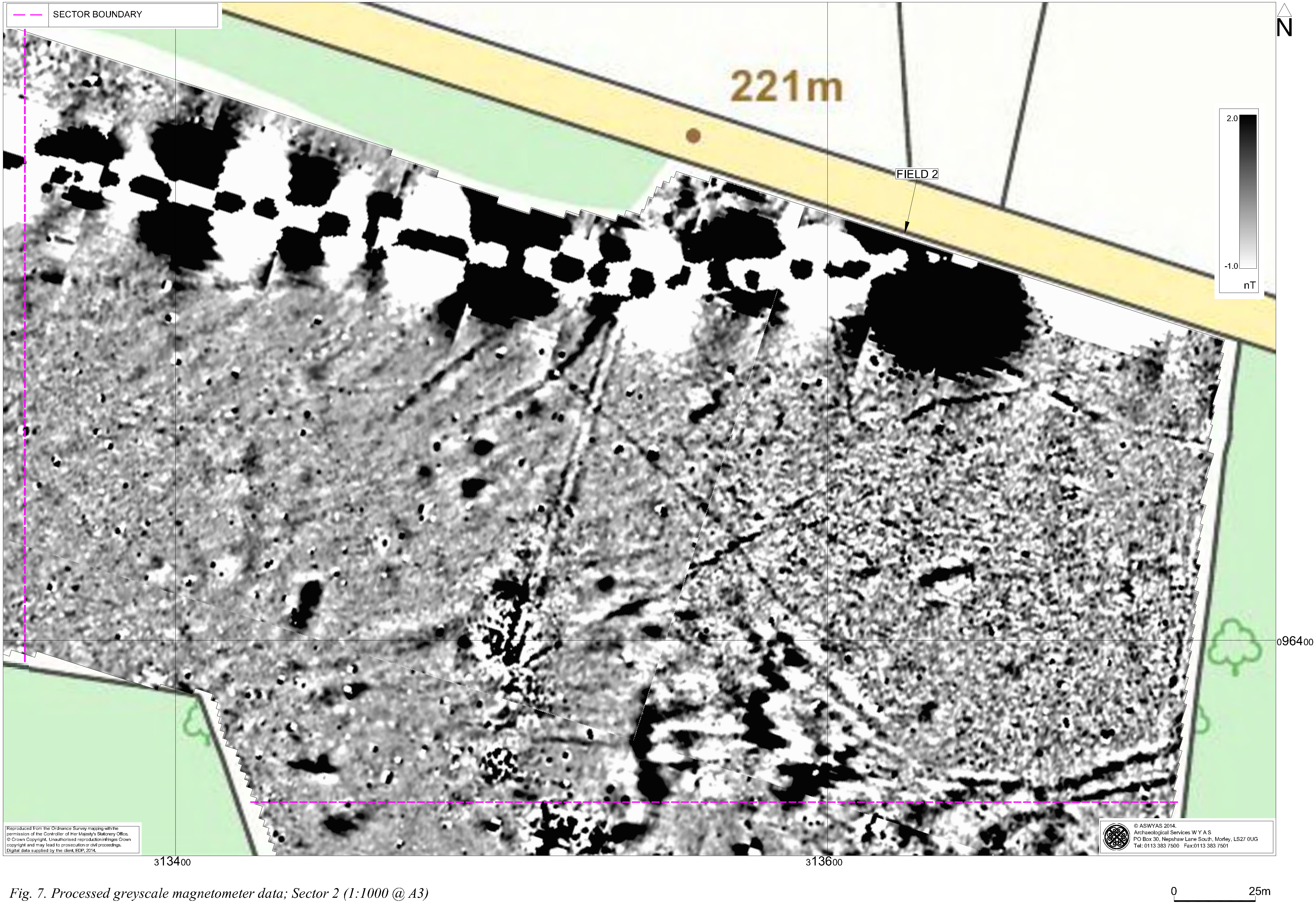

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

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

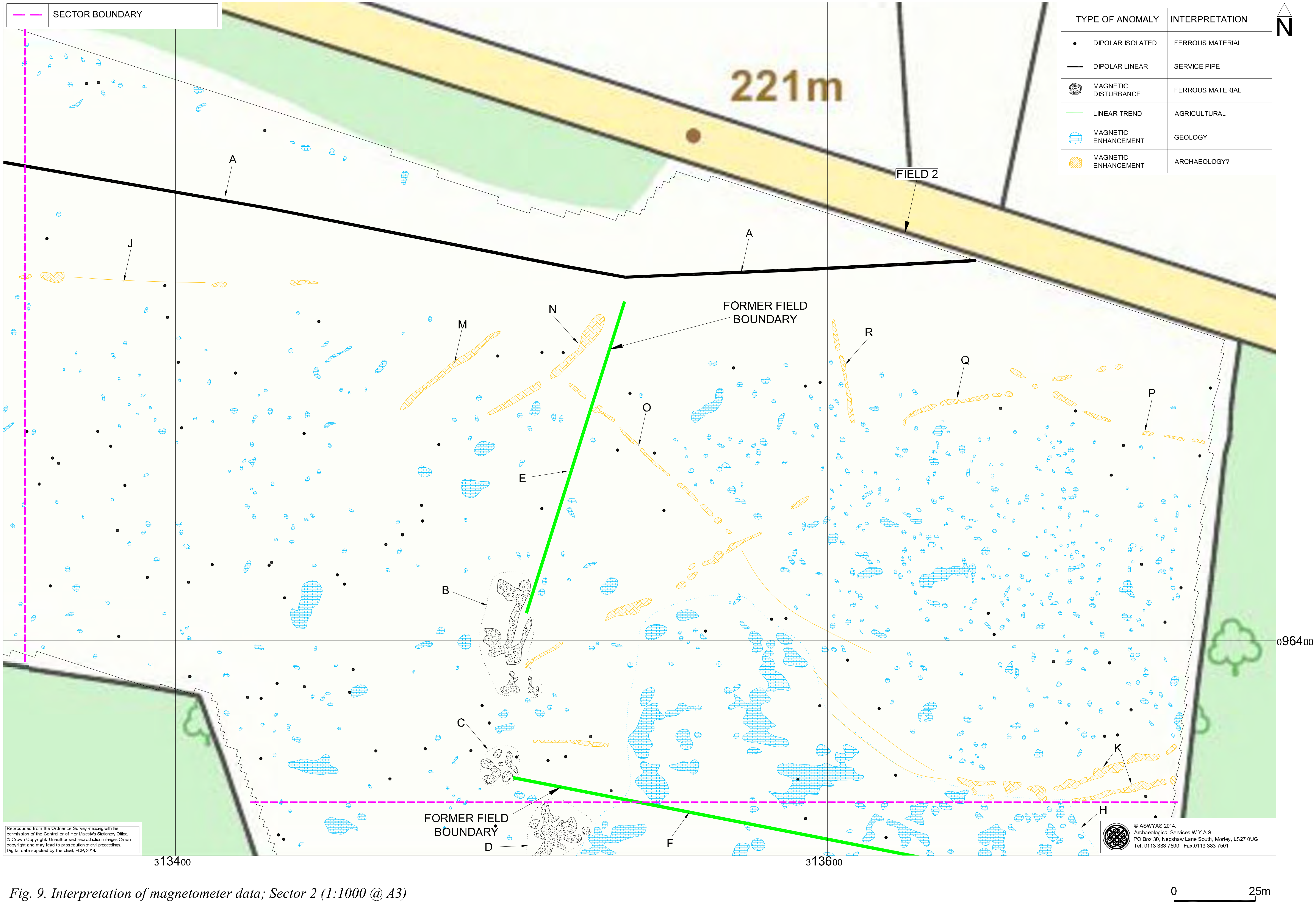

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

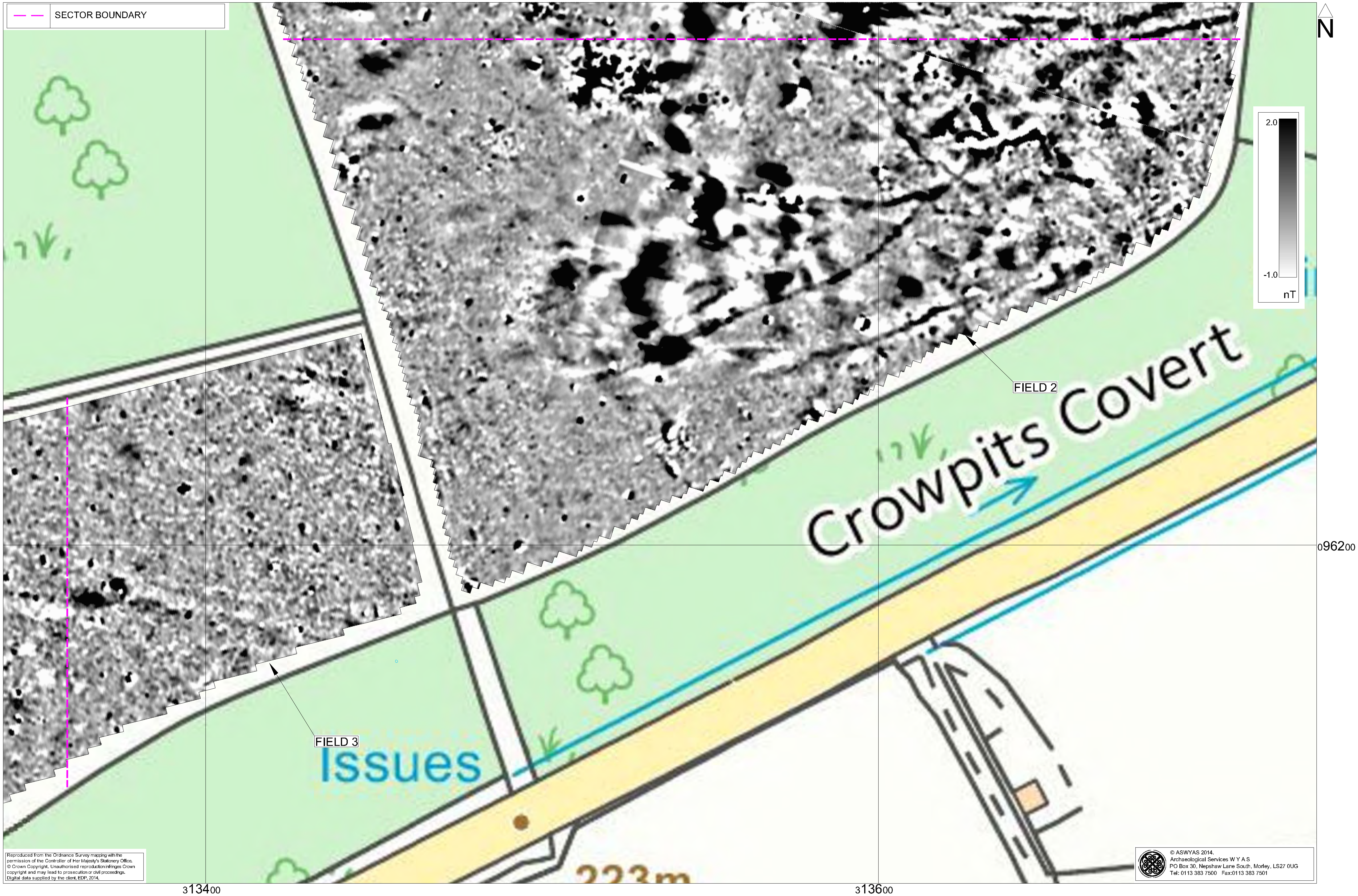

Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

0 25m

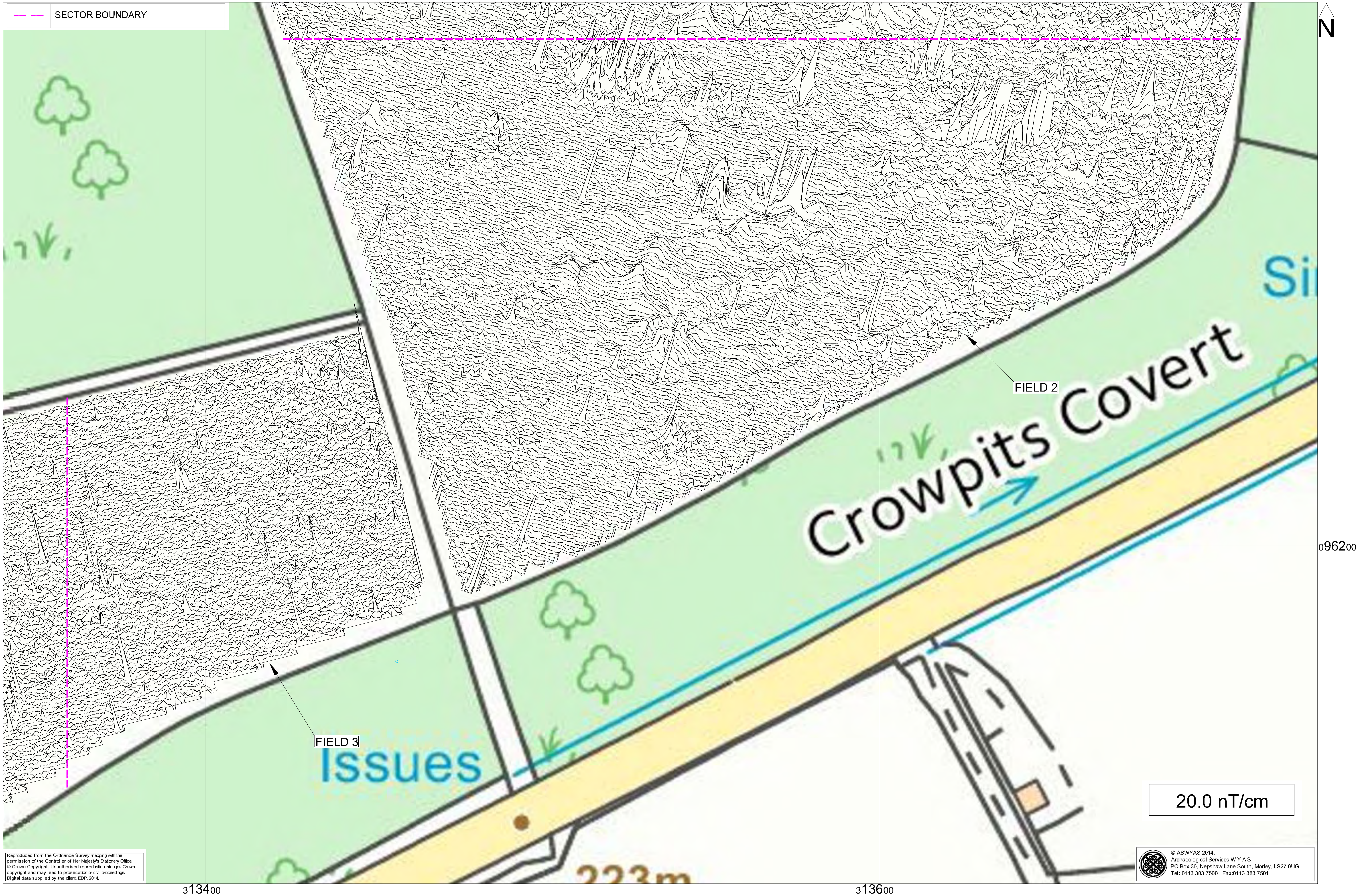

Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

0 25m

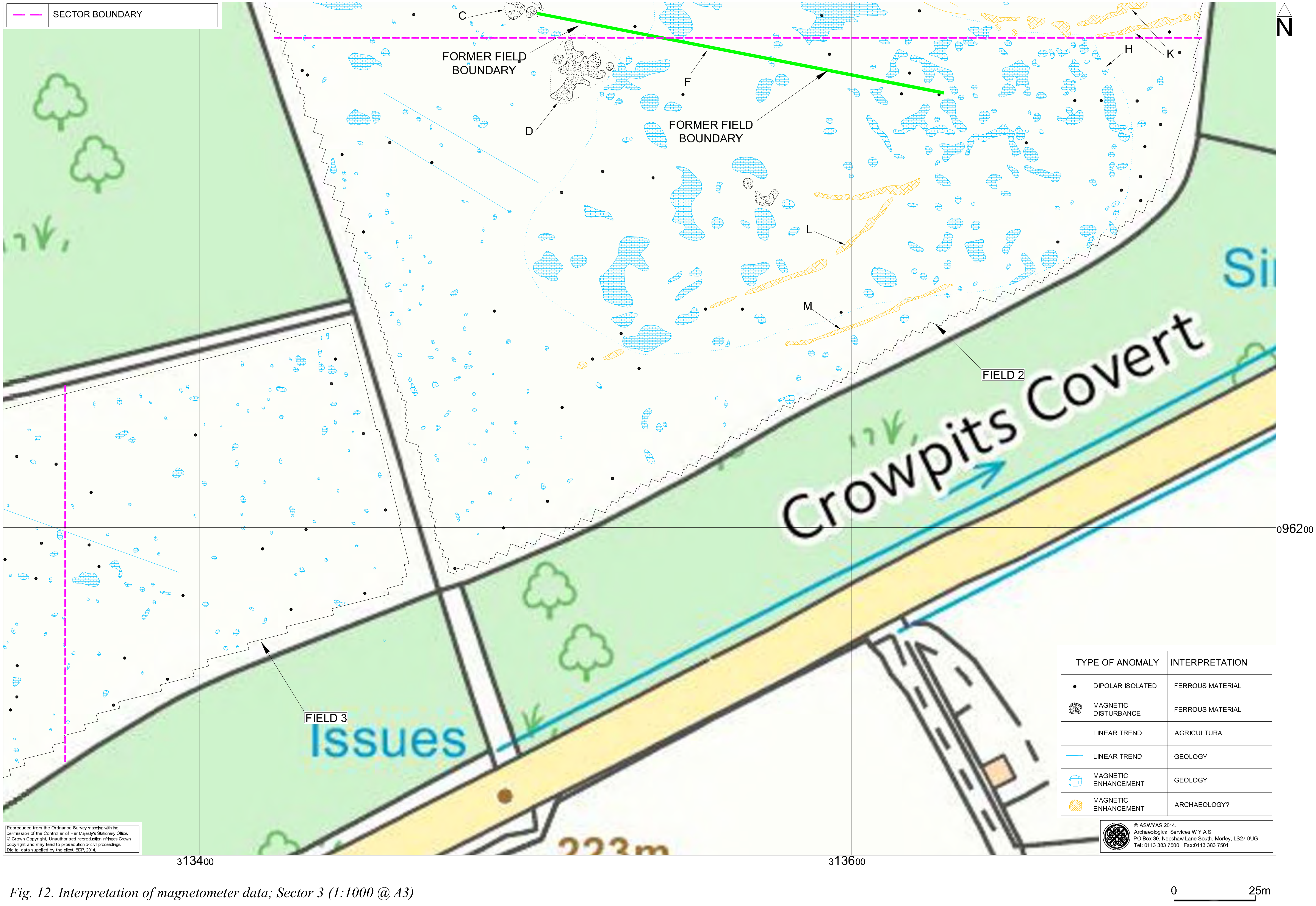

Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

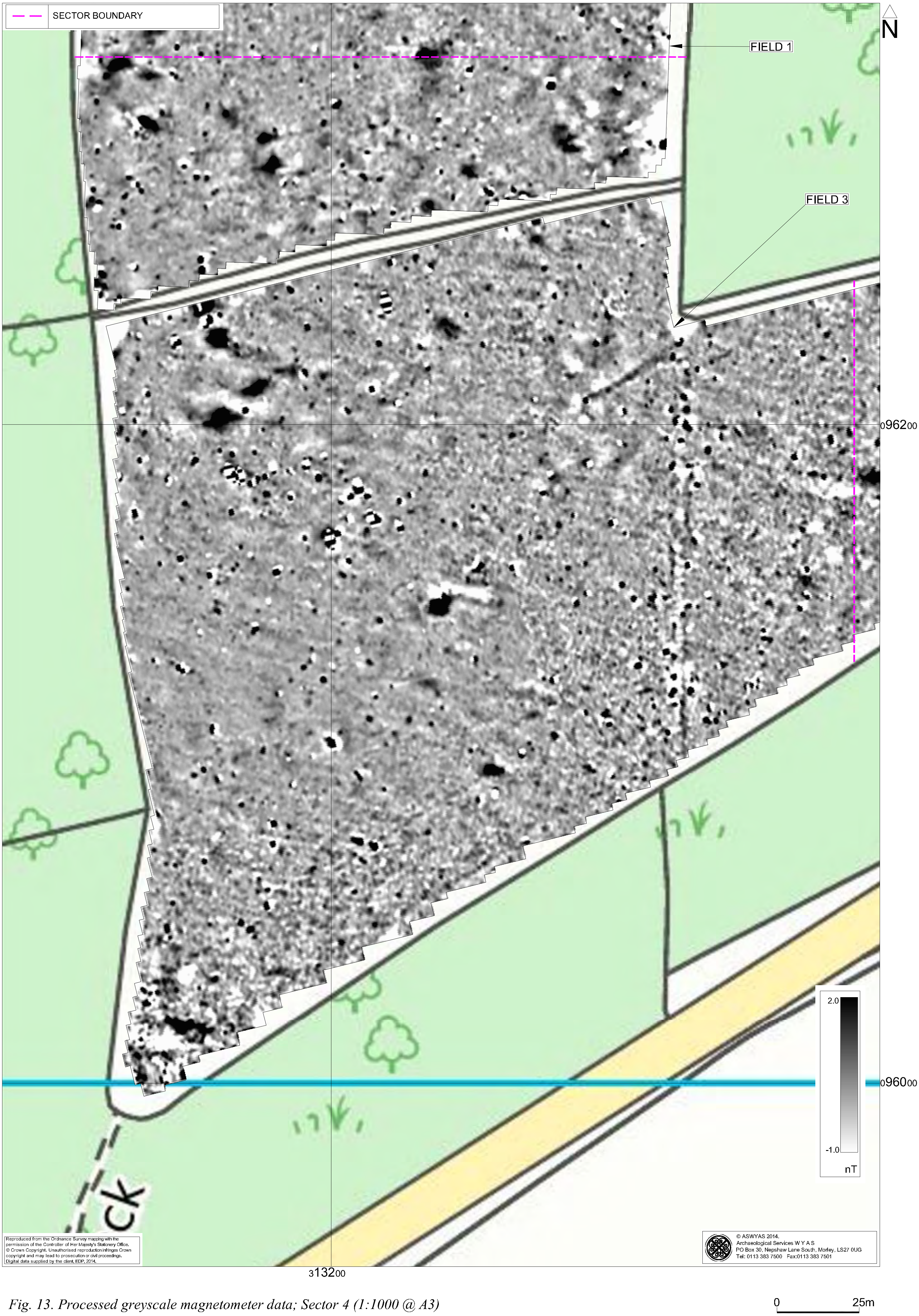

Fig. 13. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A3)

Fig. 14. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

0 25m

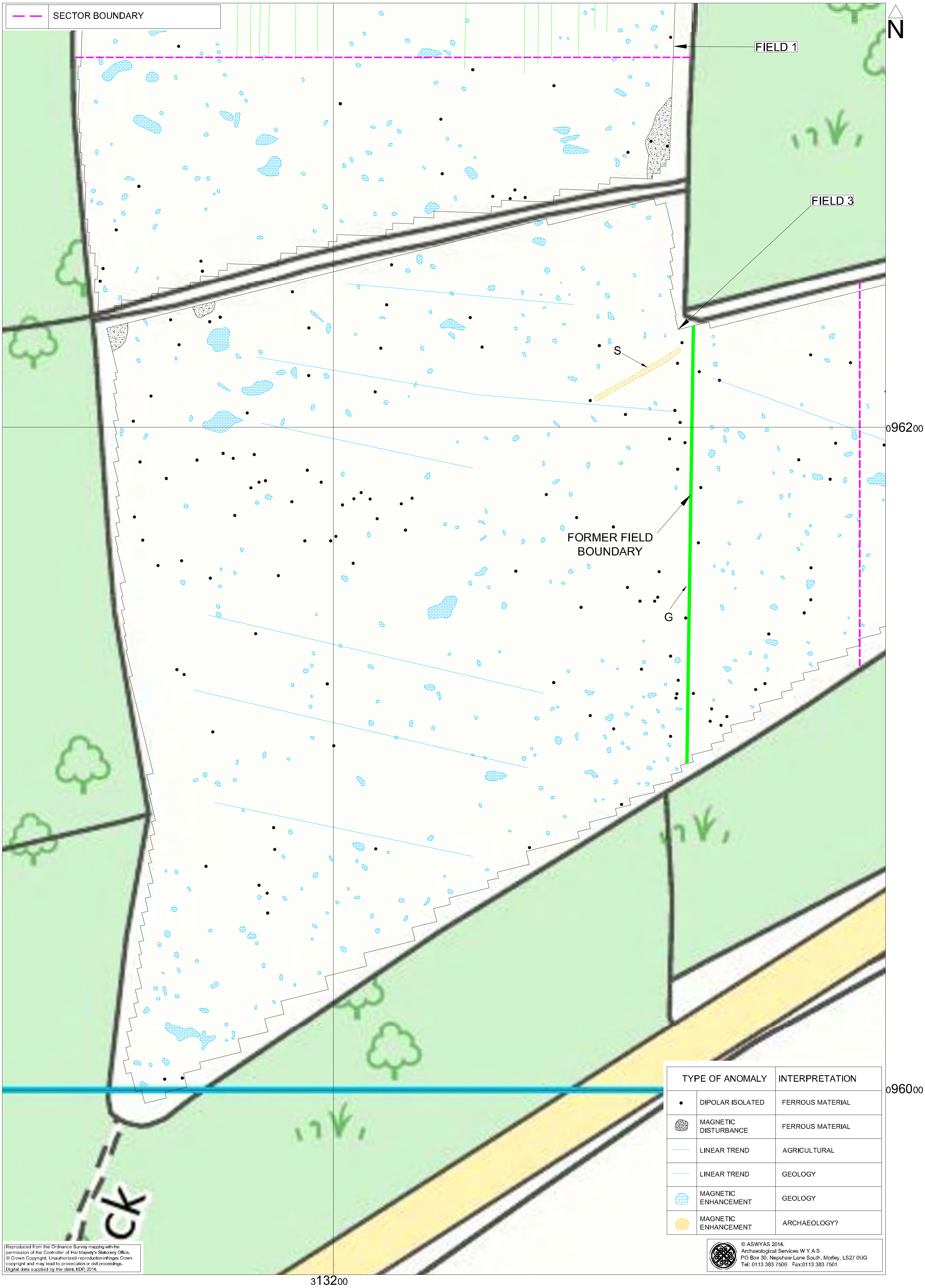

Fig. 15. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

0 25m

Plate 1. General view of Field 1, looking south-west

Plate 2. General view of Field 1, looking north-east

Plate 3. General view of Field 2, looking east

Plate 4. General view of Field 2, looking west

Plate 5. General view of Field 2, looking north-east

Plate 6. General view of Field 3, 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 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

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a 'negative' scanning result should be validated by sample detailed magnetic survey (see below).

The second method is referred to as ***detailed survey*** and 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. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

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 locations of the survey grid and anomalies are available as a DXF file. The internal accuracy of these markers is better than 0.01m. Reference Objects were established at suitable locations around the site boundary. 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.
- 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 Devon Historic Environment Record).

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