ARCHAEOLOGICAL
SERVICES
WYAS

# A64 Brambling Fields Improvements
# near Malton
# North Yorkshire

*Geophysical Survey*

*May 2011*

*Report No. 2208*

CLIENT
WSP Environment and Energy

# A64 Brambling Fields Improvements near Malton North Yorkshire

## Geophysical Survey

*Summary*

*A geophysical (magnetometer) survey covering approximately 4.5 hectares was carried out around the junction of the A64 with the B1248 Scarborough Road, to the east of Malton, prior to a series of improvements to the Brambling Fields intersection. The survey has identified anomalies across all parts of the site although none have been interpreted as of probable archaeological origin. The majority of the anomalies are considered to have no archaeological potential being due to natural variation in the superficial sand and gravel deposits and upper soil horizons or to relatively recent activity related to agricultural practice or to the construction of the road junction in the mid 1970s. Several linear anomalies have been identified any of which could have archaeological potential. However, the narrow width of the survey areas makes a confident interpretation difficult and it is considered equally likely that these anomalies could also have a recent origin. Overall the survey results indicate a low to moderate archaeological potential confirming the conclusions of an earlier desk-based assessment.*

ARCHAEOLOGICAL
SERVICES
WYAS

## Report Information

| | |
|---|---|
| Client: | WSP Environment and Energy |
| Address: | Mountbatten House, Basing View, Basingstoke, Hampshire, RG21 4HJ |
| Report Type: | Geophysical survey |
| Location: | Brambling Fields, near Malton |
| County: | North Yorkshire |
| Grid Reference: | SE 818 726 |
| Period(s) of activity represented: | |
| Report Number: | 2208 |
| Project Number: | 3735 |
| Site Code: | BRF11 |
| Planning Application No.: | Pre-application |
| Museum Accession No.: | n/a |
| Date of fieldwork: | April 2011 |
| Date of report: | May 2011 |
| Project Management: | Alistair Webb BA MIfA |
| Fieldwork: | Alex Harrison BSc |
| | Sam Harrison BSc MSc AIfA |
| | Marina Rose BSc |
| Report: | Alistair Webb |
| Illustrations: | Sam Harrison |
| Photography: | Sam Harrison |
| Research: | n/a |

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

ISOQAR QUALITY ASSURED ISO 9001
Cert. No. 125



PO Box 30, Nepshaw Lane South, Morley, Leeds
LS27 0UG
Telephone: 0113 383 7500.
Email: admin@aswyas.com

REGISTERED IfA ORGANISATION

# Contents

## List of Figures



## List of Plates

# 1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Ian Barnes of WSP Environment and Energy on behalf of their clients the Highways Agency, North Yorkshire County Council and Ryedale District Council to undertake a geophysical (gradiometer) survey on land around the A64 Brambling Fields junction near Malton prior to the proposed commencement of a series of improvements to the junction layout. The provisional survey areas covered a total of approximately 6 hectares although parts were unsuitable for survey (see below). A total area of 4.5 hectares was surveyed on April 13th 2011.

**Site location, land-use and topography**

The site is located in an area known as The Marrs approximately 2km north-east of Malton, centred at SE 818 726 (see Fig. 1) around the intersection of the B1248 Scarborough Road with the main A64 York/Scarborough trunk road. The survey comprised four separate linear areas (see Fig. 2 - Areas 1, 2, 3 and 4) around the periphery of the current junction and embankments all of which were under agricultural production at the time of survey. The areas within the junction were wooded and had been heavily landscaped and were therefore unsuitable for survey and were not included within the proposed survey areas. Area 1 was planted with carrots covered by a thick layer of straw (see Plate 1) and was unsuitable for survey. Area 2 and Area 3 were planted with oil seed rape whilst Area 4 was under a maturing arable cereal crop. The site was flat at about 20m above Ordnance Datum.

**Geology and soils**

The superficial geology comprises sands and gravels of uncertain origin overlying Kimmeridge Clay. The soils are classified in the Landbeach soil association being described as permeable, calcareous coarse loams.

# 2 Archaeological and Historical Background

Research undertaken by the Client for a desk-based assessment (Barnes 2011) of the site identified that whilst there is evidence for Roman activity in the wider area there are no known archaeological remains within the boundary of the proposed development area (PDA). However, the assessment concluded that there was the potential to encounter archaeological remains of Roman, Medieval or post-medieval date and that therefore '*there may be a need for additional archaeological fieldwork prior to construction activity being commenced*'.

## 3 Aims, Methodology and Presentation

The principal objectives of the survey were:

- to characterise as far as possible the nature of any anomalies identified and thereby,
- to determine the location and extent of any archaeological features within the defined survey areas,
- to prepare a report summarising the results of the survey.

In order to achieve these aims detailed (recorded) magnetometer survey was undertaken over those areas which may be impacted by groundworks for the junction improvements.

**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 mapping is shown in Figure 1. Figure 2 shows the location of the site and the processed data at a scale of 1:4000 whilst Figure 3 shows the same data and map base overlain by the first edition mapping. 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 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 (see Figs 4 – 15 inclusive)

The results are discussed by area.

**Area 1 (see Plate 1)**

This area was unsuitable for survey due to the presence of a carrot crop.

**Area 2 (see Figs 4, 5 and 6; Plate 1)**

Numerous parallel, weak, linear trend anomalies, aligned broadly east/west parallel with the current field boundary, are identified. These trend anomalies reflect the direction of the most recent ploughing regime.

In the eastern half of the area four very vague linear trends can be seen in the data, one of which marks a boundary between an area of very low magnetic background (to the west) from an area of more variable magnetic background. All these trend anomalies are interpreted as having a geological origin being due to natural variations in the composition of the superficial deposits and upper soil horizons.

Two large ‘iron spike’ anomalies are due to the iron caps on two boreholes/groundwater monitoring wells. Other magnetic disturbance around the periphery of the area is due to modern ferrous material probably resulting from the construction of the junction and are of no archaeological significance.

No anomalies of archaeological potential have been identified in this area. However, it should be noted that three former field boundaries shown on the first edition mapping (see Fig. 3) do not show as magnetic anomalies.

**Area 3 (see Figs 7 – 12 inclusive; Plate 3)**

Three linear anomalies and several discrete or short linear anomalies have been identified in Sector 1. To the east of the sector a linear anomaly, **A**, aligned south-south-west/north-north-east and parallel with the northern edge of the survey block, can be seen. On a slightly different alignment at the western edge of Sector 1 is a second, shorter, linear anomaly, **B**. Another short linear anomaly, **C**, can be seen approximately 25m west of **B**. Any of these anomalies could be caused by an infilled archaeological ditch feature but might equally be due to a modern feature or to agricultural activity. However, none of these anomalies correlates with any boundaries shown on the first edition mapping perhaps slightly increasing the likelihood of an archaeological origin.

Several discrete anomalies (areas of magnetic enhancement) which might also have an archaeological origin are also noted particularly to the east of Sector 1. However, it is perhaps more likely that they are due to either modern ground disturbance or to localised variations in the superficial deposits or soil horizons. Nevertheless an archaeological cause cannot be dismissed.

No anomalies other than an 'iron spikes', which are caused by ferrous debris in the plough soil, and an area of disturbance caused by a steel gate into the field can be seen in Sector 2. This area was only 20m wide making interpretation very difficult.

**Area 4 (see Figs 13 – 18 inclusive; Plate 4)**

The data from this area is dominated by an area of very strong magnetic responses either side of the boundary between Sector 1 and Sector 2. Again the cause of these anomalies is not certain but is considered probable that the strength of the anomalies is such that a modern cause, possibly material discarded following the construction/groundworks associated with the junction, is a more likely than a band of magnetic gravels in the superficial deposits. On the interpretation figure the distinction between anomalies due to the presence of probable modern ferrous material and those possibly due to geological variation is made solely on the basis of the strength of the magnetic response. It should be noted that this may be spurious distinction but that these anomalies are not considered to be of any archaeological significance.

Elsewhere vague linear trends similar to those identified in Area 2 are again present. These are also ascribed a natural origin being due to minor variations in the composition of the soils which were noted as being particularly sandy in this area relative to the other parts of the site.

No anomalies of archaeological potential have been identified in this area.

## 5 Discussion and Conclusions

The geophysical survey has identified numerous anomalies across all parts of the site although none have been interpreted as of probable archaeological origin. The majority of the anomalies are considered to have no archaeological potential being due to natural variation in the superficial sand and gravel deposits or to relatively recent activity related to agricultural practice or to the construction of the road junction in the 1970s or more probably to a combination of both causes.

Several linear anomalies have been identified any of which could have archaeological potential. However, the narrow width of much of the survey areas makes a confident interpretation difficult and it is considered equally likely that these anomalies could also have a recent origin.

Interestingly none of the field boundaries shown on the first edition Ordnance Survey mapping (since removed) is visible as a magnetic anomaly in the data set. This raises the possibility that the magnetic susceptibility of the prevailing sandy soils is very low which may in turn lessen the likelihood of identifying archaeological features, if present.

However, based on the results of the geophysical survey, the archaeological potential of the site is considered to be low to moderate confirming the initial assessment of the potential derived from the historic environment desk-based assessment.

***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.***

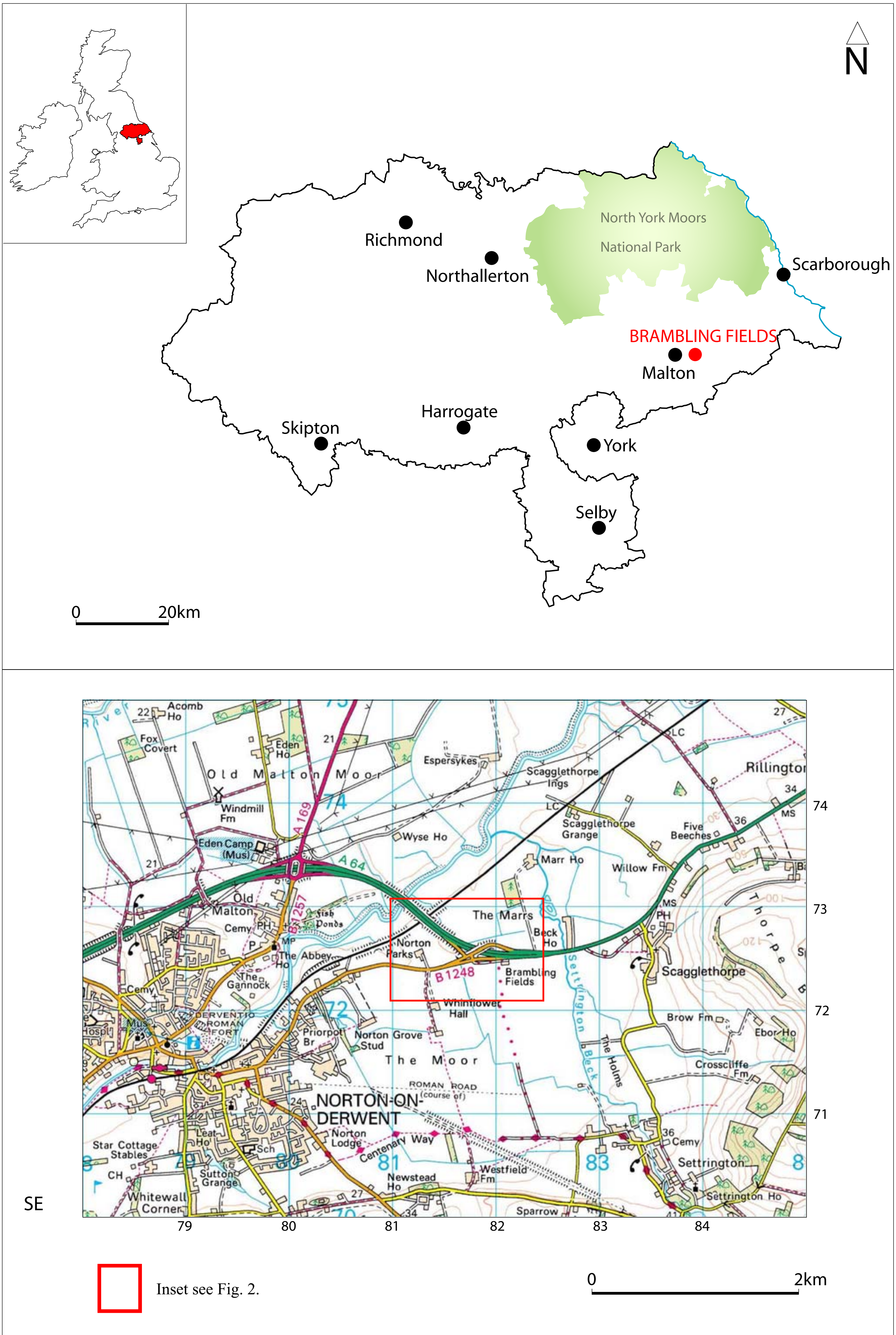


*Fig. 1. Site location*

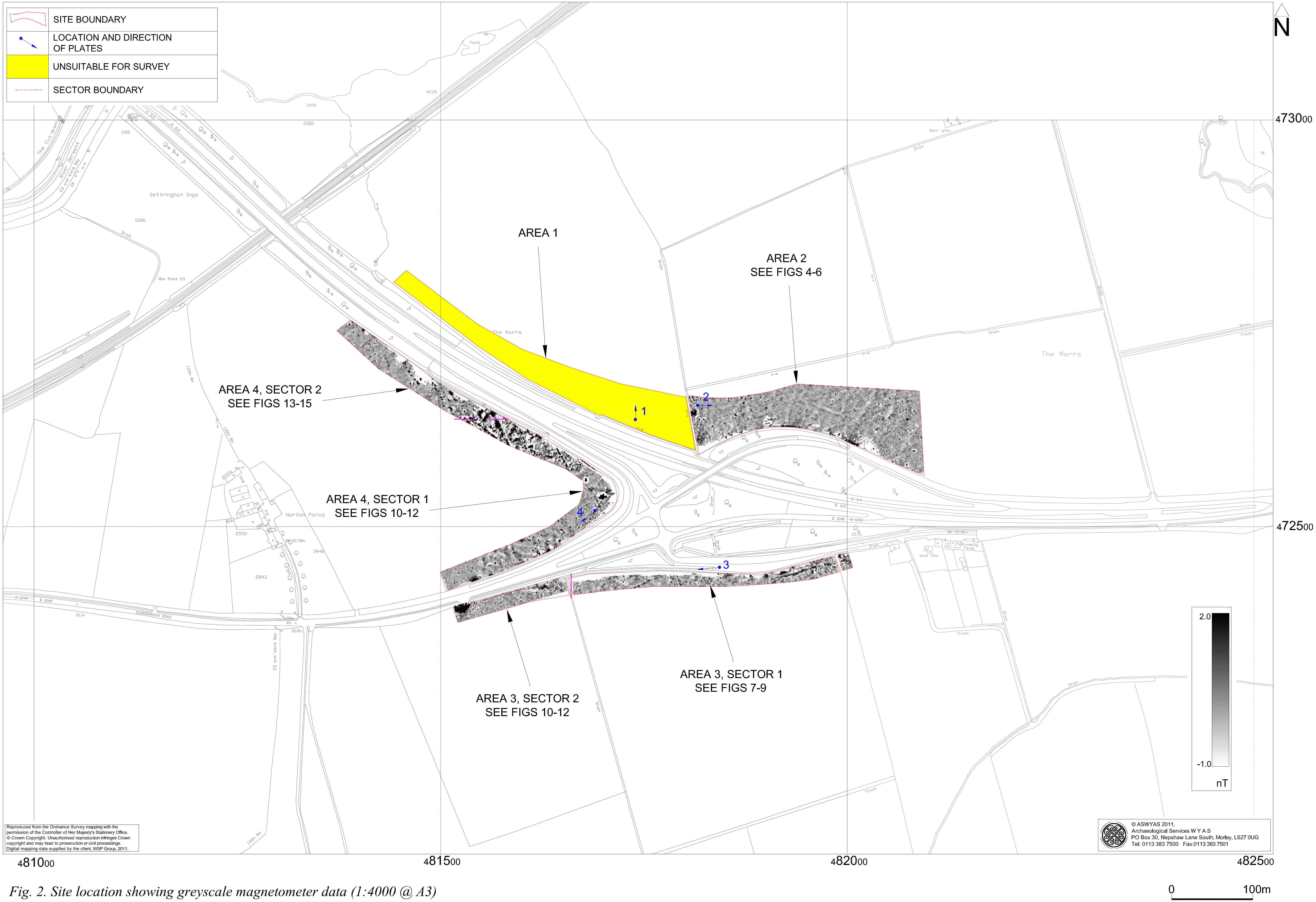


*Fig. 2. Site location showing greyscale magnetometer data (1:4000 @ A3)*


*Fig. 3. Site location showing greyscale magnetometer data and first edition Ordnance Survey mapping of 1854 (1:4000 @ A3)*

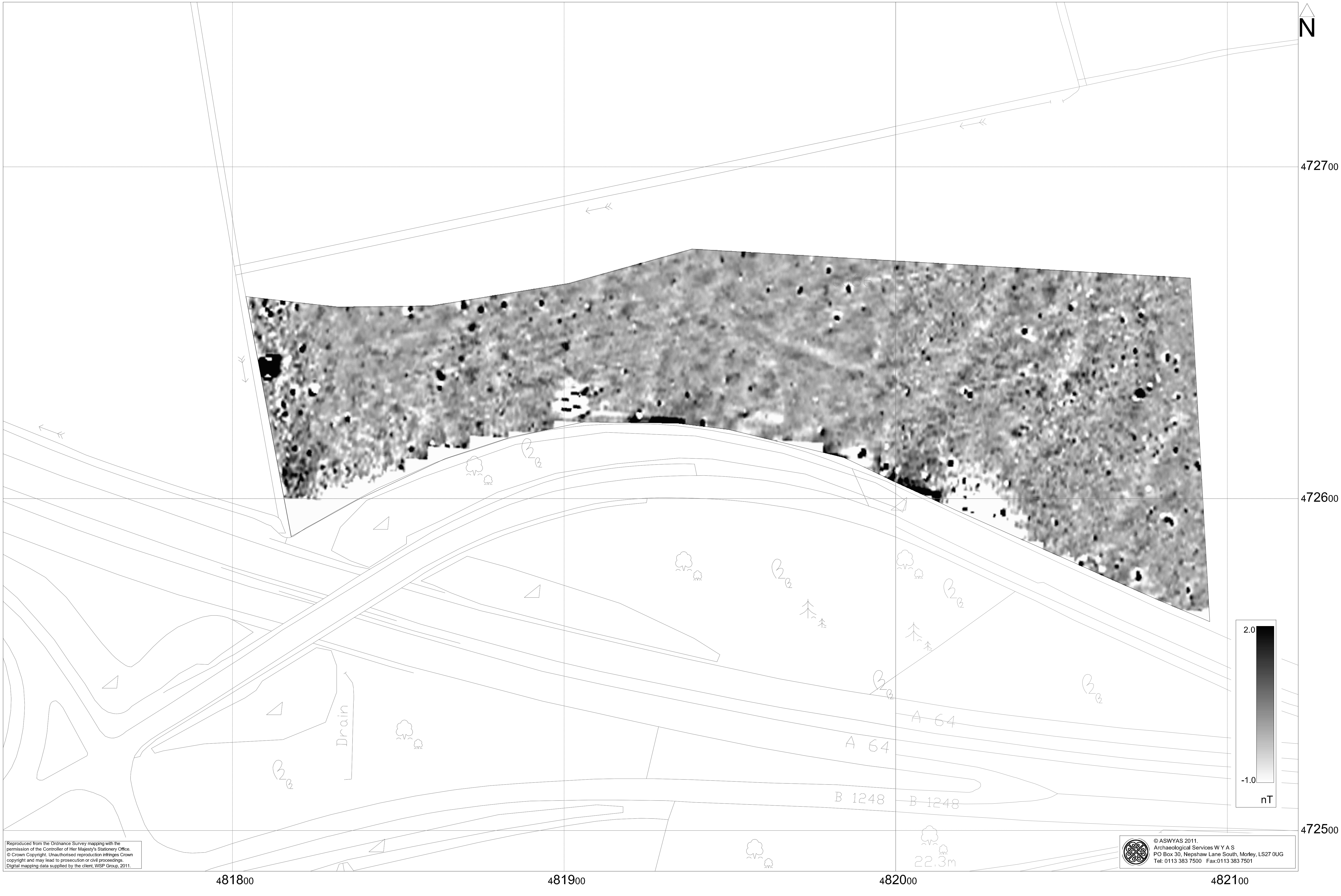


*Fig. 4. Processed greyscale magnetometer data; Area 2 (1:1000 @ A3)*

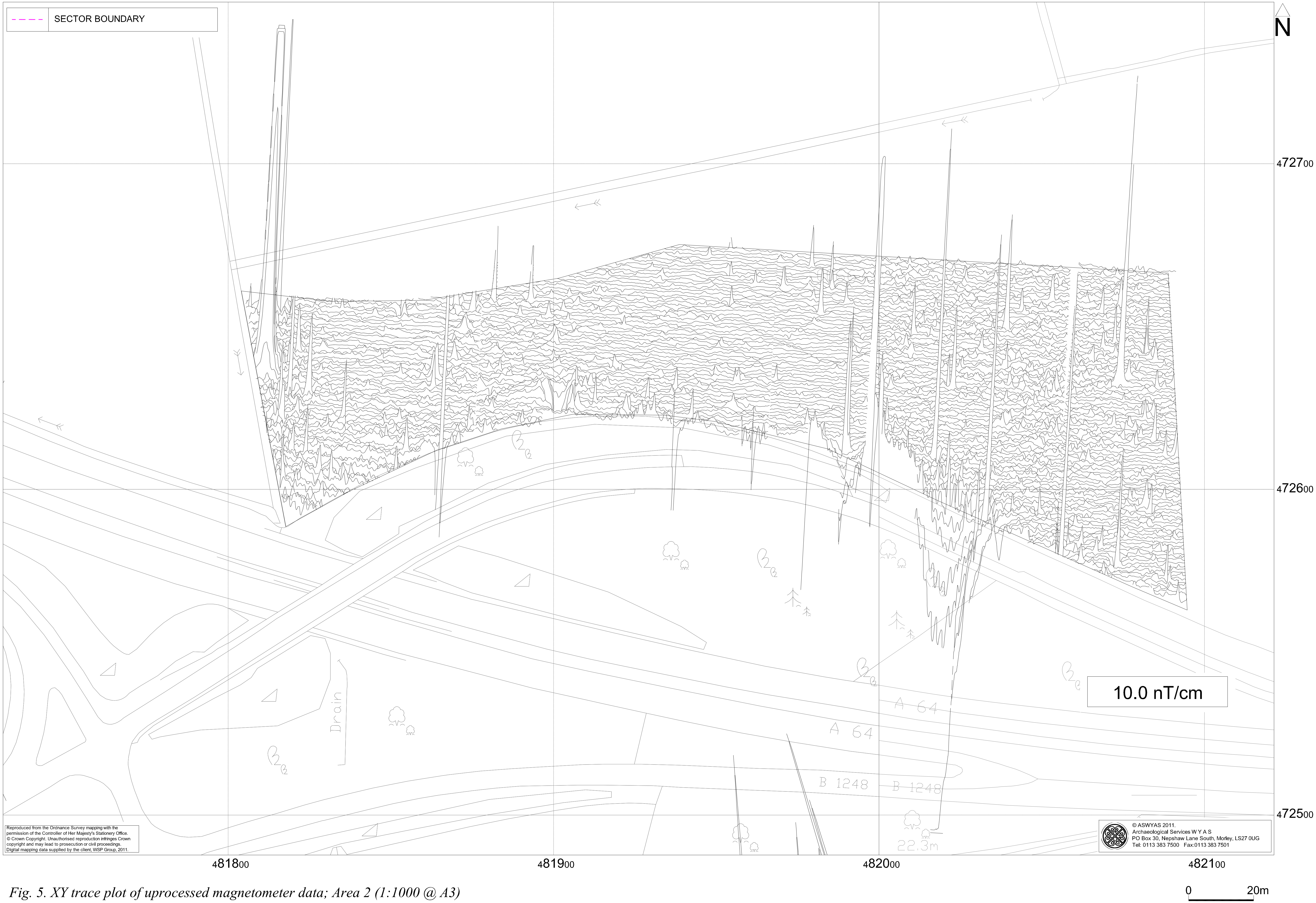


*Fig. 5. XY trace plot of uprocessed magnetometer data; Area 2 (1:1000 @ A3)*

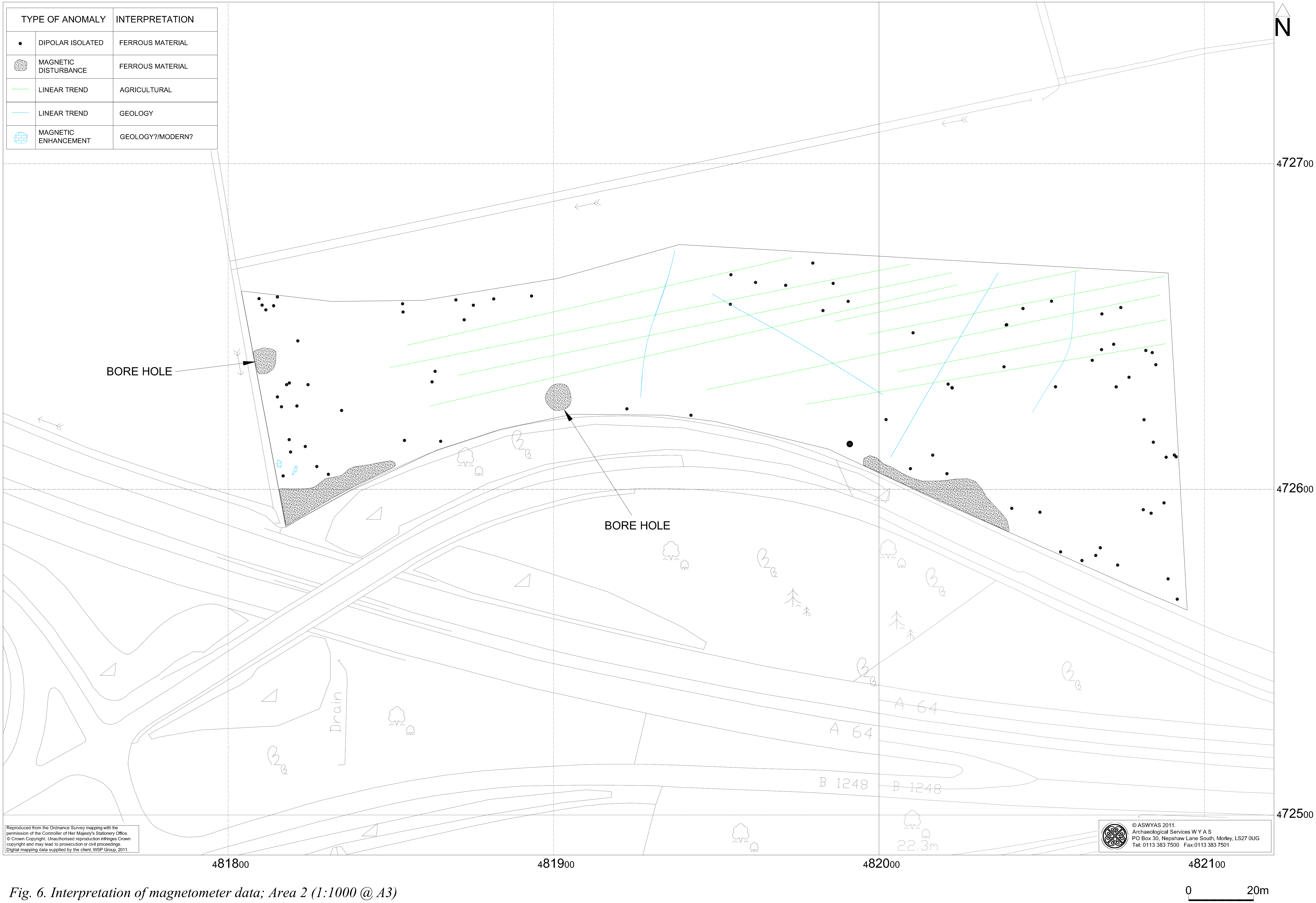


*Fig. 6. Interpretation of magnetometer data; Area 2 (1:1000 @ A3)*


*Fig. 7. Processed greyscale magnetometer data; Area 3, Sector 1 (1:1000 @ A3)*

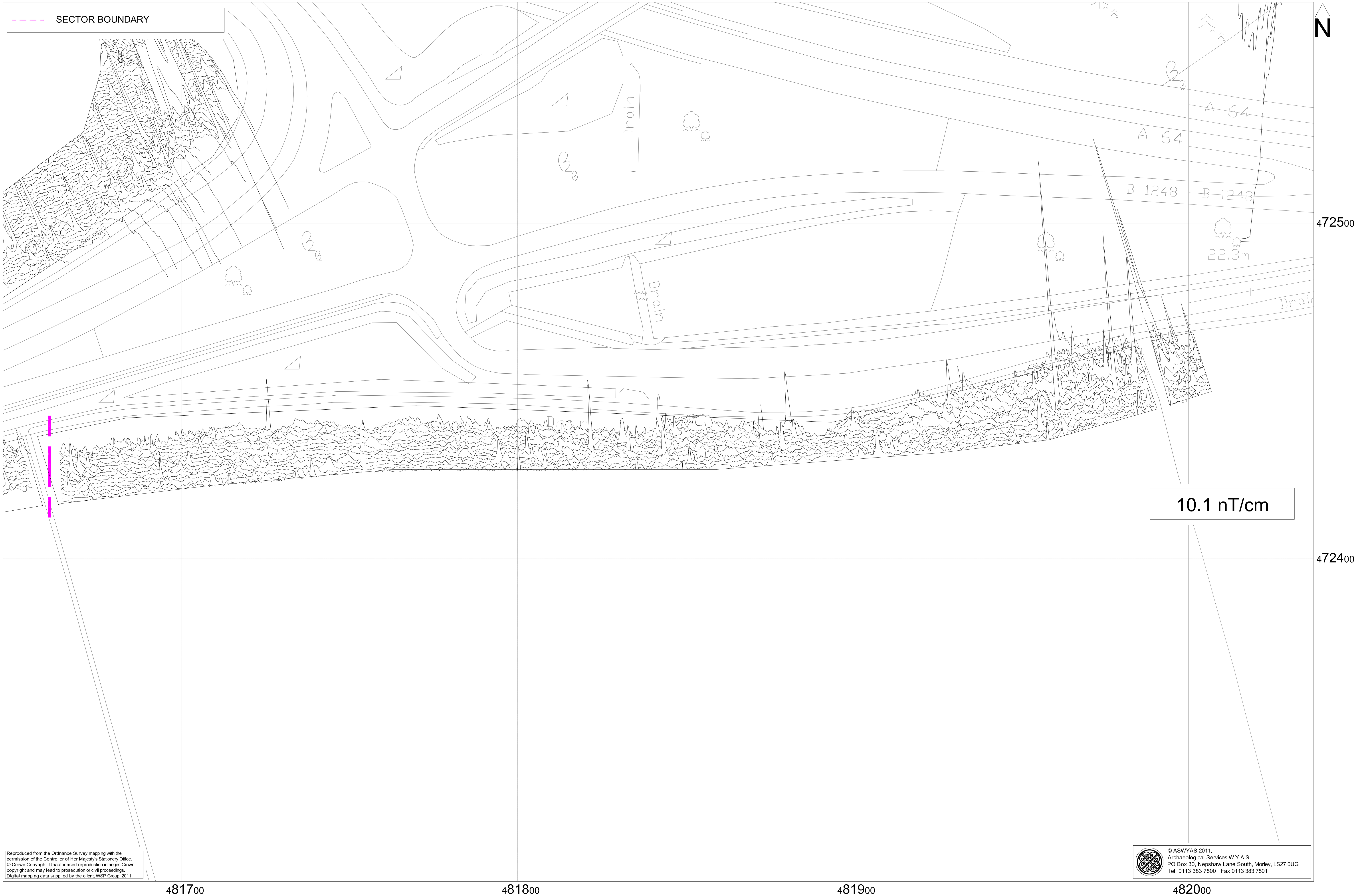




*Fig. 8. XY trace plot of unprocessed magnetometer data; Area 3, Sector 1 (1:1000 @ A3)*

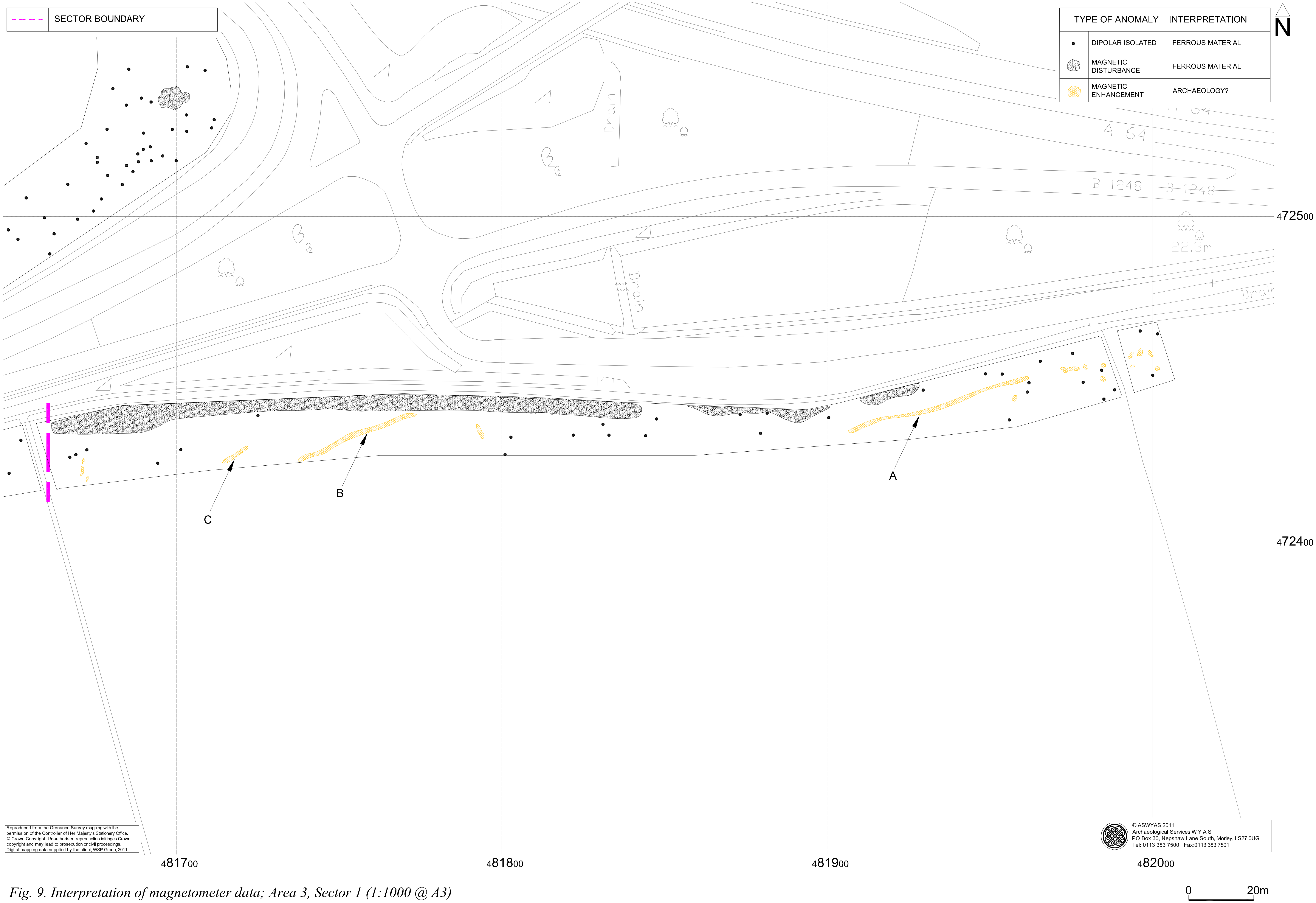


*Fig. 9. Interpretation of magnetometer data; Area 3, Sector 1 (1:1000 @ A3)*

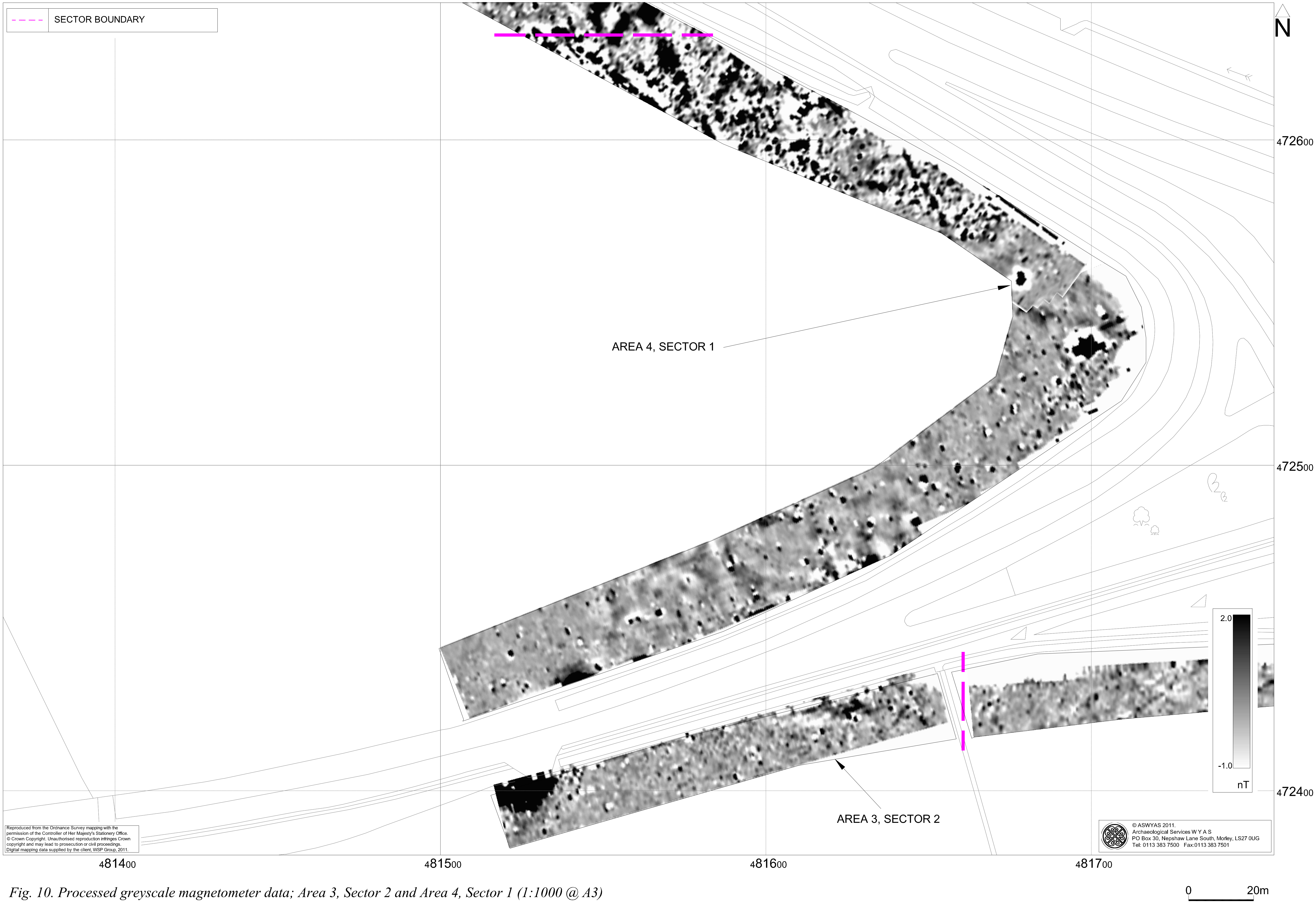


*Fig. 10. Processed greyscale magnetometer data; Area 3, Sector 2 and Area 4, Sector 1 (1:1000 @ A3)*





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

*Fig. 11. XY trace plot of unprocessed magnetometer data; Area 3, Sector 2 and Area 4, Sector 1 (1:1000 @ A3)*

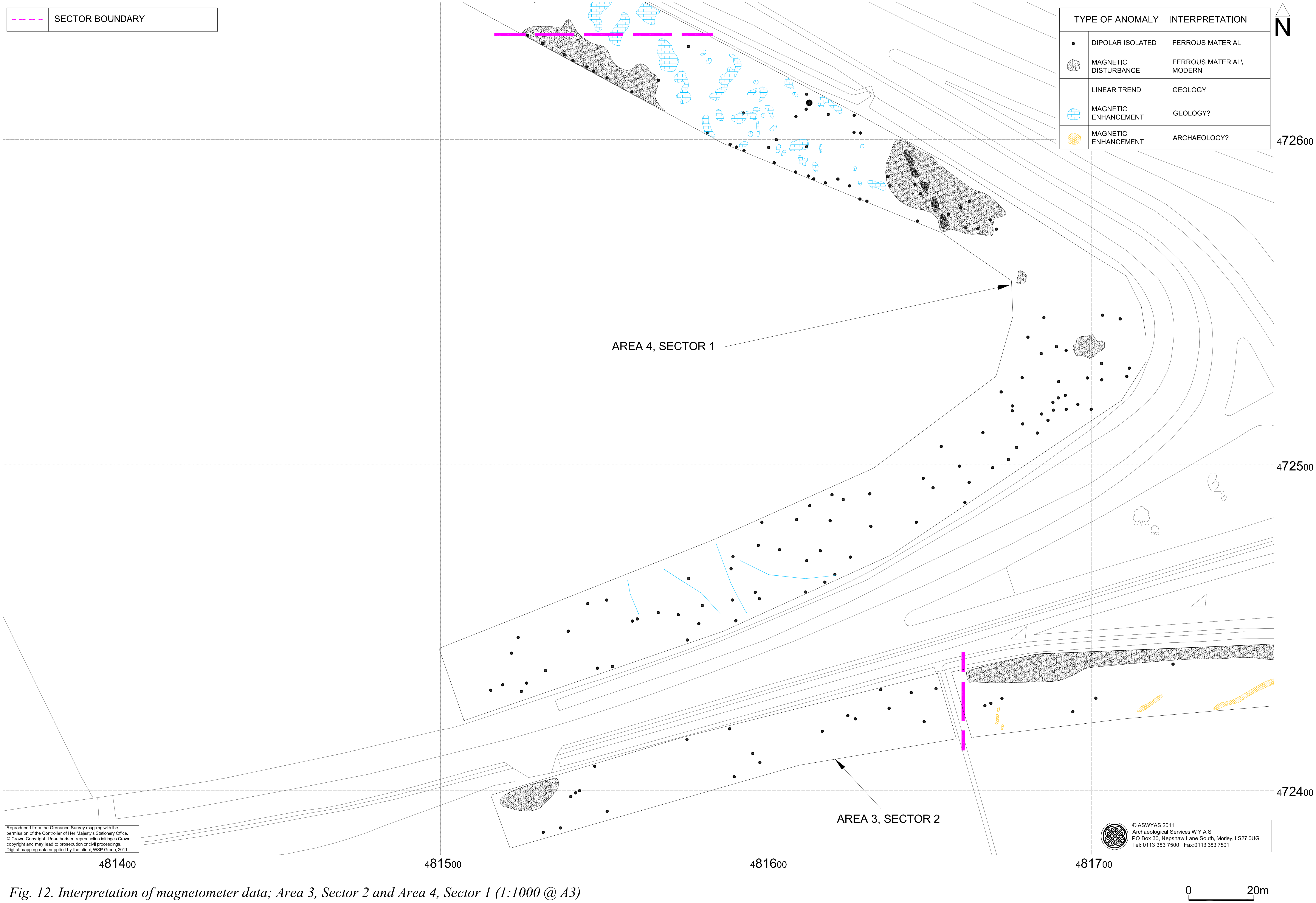


*Fig. 12. Interpretation of magnetometer data; Area 3, Sector 2 and Area 4, Sector 1 (1:1000 @ A3)*

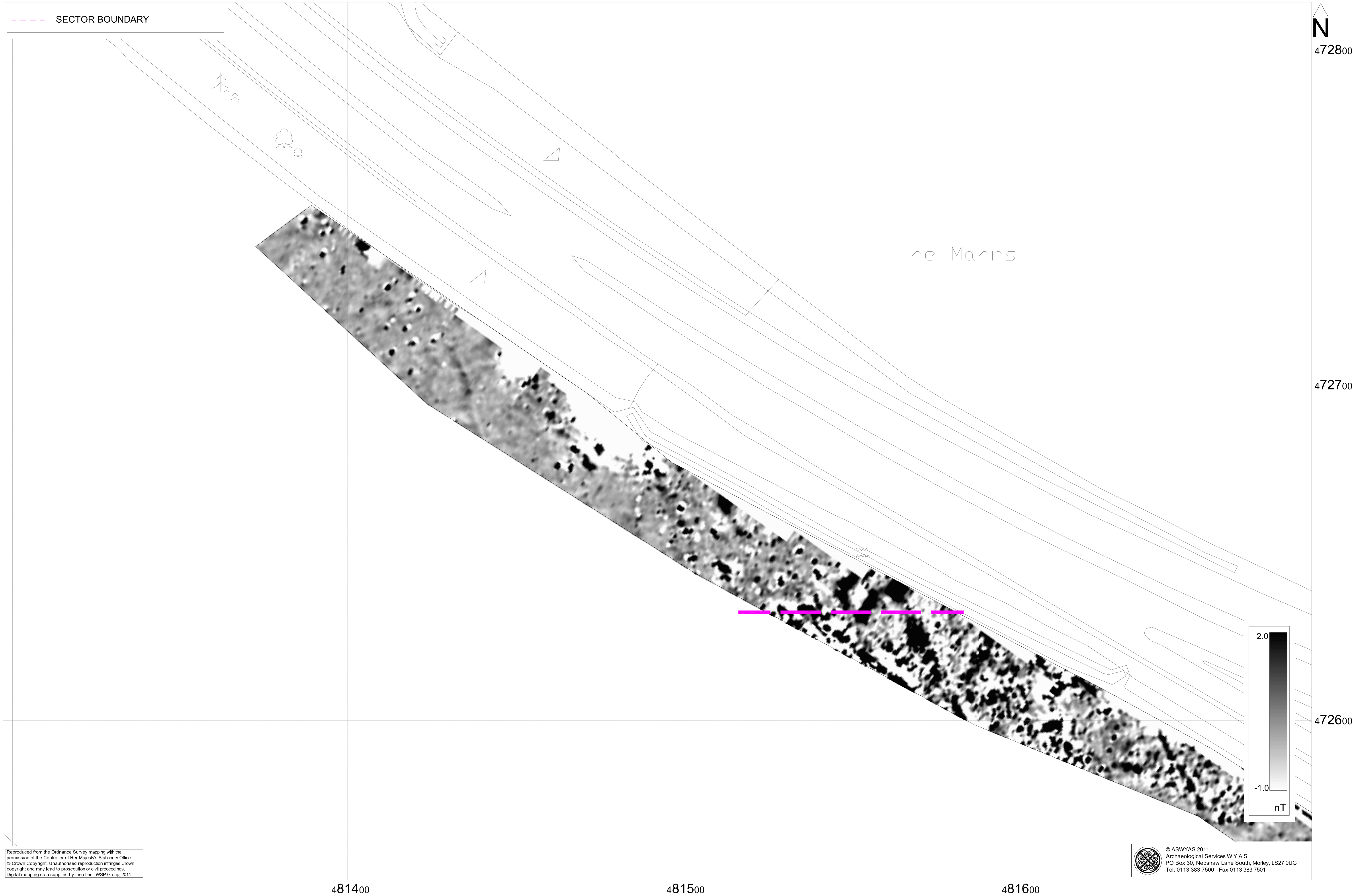


*Fig. 13. Processed greyscale magnetometer data; Area 4, Sector 2 (1:1000 @ A3)*

0 20m

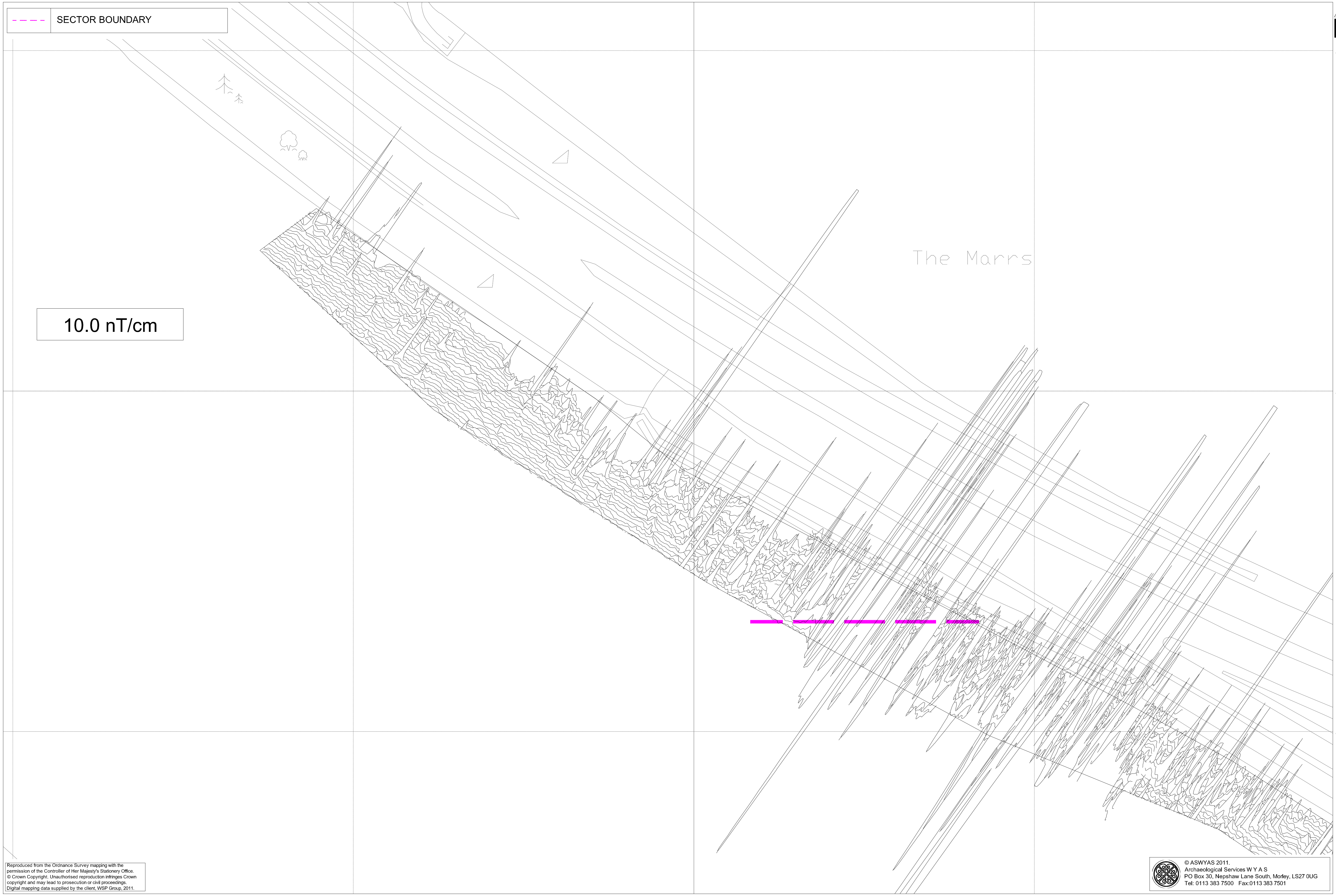


*Fig. 14. XY trace plot of unprocessed magnetometer data; Area 4, Sector 2 (1:1000 @ A3)*

0 20m

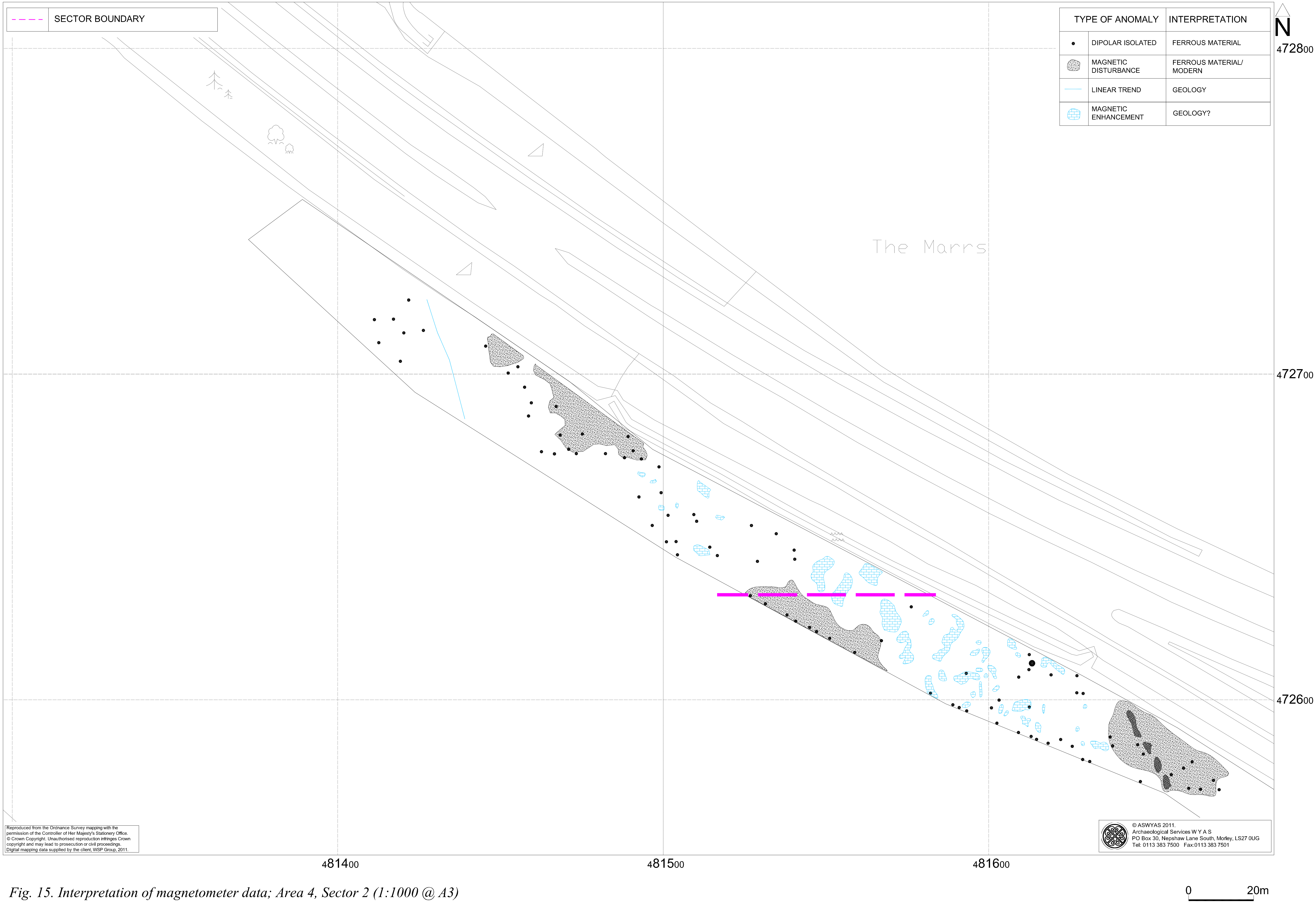


*Fig. 15. Interpretation of magnetometer data; Area 4, Sector 2 (1:1000 @ A3)*


*Plate 1. General view of Area 1 showing carrot crop overlain by straw, looking north*


*Plate 2. General view of Area 2, looking east*


*Plate 3. General view of Area 3, looking west*


*Plate 4. General view of Area 4, 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. 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 North Yorkshire Historic Environment Record).

## Bibliography


Barnes, I., 2011. *Historic Environment Desk Based Assessment of the A64 Brambling Fields Improvements, North Yorkshire*. Unpublished WSP Client Report

David, A., N. Linford, P. Linford and L. Martin, 2008. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

Gaffney, C., Gater, J. and Ovenden, S. 2002. *The Use of Geophysical Techniques in Archaeological Evaluations*. IFA Technical Paper No. 6