ARCHAEOLOGICAL SERVICES WYAS

River Humber Replacement Pipeline
Soff Lane Access Track
Goxhill
North Lincolnshire

Geophysical Survey

Report no. 2711

February 2015

Client: Hyder Consulting (UK) Ltd

REGISTERED ORGANISATION CIfA

River Humber Replacement Pipeline
Soff Lane Access Track
Goxhill
North Lincolnshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 2 hectares, was carried out near Goxhill along the proposed route of an access track associated with the construction of a replacement high pressure pipeline beneath the River Humber. The survey has identified anomalies caused by ridge and furrow cultivation and more recent agricultural activity in the form of field drains. No anomalies of obvious archaeological potential have been identified although a single discrete anomaly of uncertain origin has been highlighted. Consequently, on the basis of the survey, the archaeological potential of the site is considered to be low.

ARCHAEOLOGICAL
SERVICES
WYAS

Report Information

Client:	Hyder Consulting (UK) Ltd.
Address:	The Mill, Brimscombe Port, Stroud, Gloucester GL5 2QG
Report Type:	Geophysical Survey
Location:	Goxhill
County:	North Lincolnshire
Grid Reference:	TA 1128 2010
Period(s) of activity:	modern
Report Number:	2711
Project Number:	4348
Site Code:	RHG14
OASIS ID:	archaeol11-203539
Planning Application No.:	
Museum Accession No.:	n/a
Date of fieldwork:	January 2015
Date of report:	January 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	Alex Schmidt BA
	Ross Bishop BA
Report:	Chris Sykes BA MSc
Illustrations:	Chris Sykes
Photography:	Alex Schmidt
Research:	n/a

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

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

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Jenny Wylie of Hyder Consulting (UK) Limited (the Client) on behalf of National Grid, to undertake a geophysical (magnetometer) survey along a 30m wide corridor to the east of Soff Lane, Goxhill (see Fig. 1), approximately 9km east of Barton-Upon-Humber. The work has been undertaken in advance of the proposed construction of an access track that is required as part of the enabling works for the replacement of a high pressure pipeline beneath the River Humber. The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012), in line with current best practice (CIfA 2014; David *et al.* 2008) and to a Project Design (Harrison 2015) approved by the Client. The survey was carried out on January 16th 2015 to provide additional information on the archaeological resource along the access corridor.

Site location, topography and land-use

The survey area, centred at TA 1128 2010, comprised a corridor 30m in width and approximately 0.5km in length which runs on a south-south-west direction from Church Side (see Fig. 2). At the southern end of this corridor the new access track connects with an existing track linking through to Soff Lane and at the northern end with a new junction linking onto Chapelfield Road.

The survey corridor crosses flat, arable land and is situated at 6m above Ordnance Datum (aOD).

Soils and geology

The underlying bedrock comprises chalk of the Burham Chalk Formation overlain by superficial deposits of sand and gravel (British Geological Survey 2015). The soils are classified in the Wick 1 association, characterised as deep, well-draining, sands and coarse loams (Soil Survey of England and Wales 1983).

2 Archaeological Background

Although there are no known archaeological assets within the survey area cropmarks, indicative of a possible Iron Age/ Roman enclosure, have been identified to the north of the site. Immediately south of the intersection of Soff Lane and Church Side are the upstanding earthworks of a former medieval moated site and landscape (see Fig. 1). This information has been collated from the Pastscapes website (www.pastscapes.org.uk).

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 is provided as Figure 2. An overall interpretation is depicted in Figure 3 at a scale of 1:4000. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 3 to 8 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.

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)

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 to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Areas of magnetic disturbance are recorded at either end of the survey corridor. This disturbance is due to the proximity/accumulation of ferrous material in the field boundaries and is not considered to be of any archaeological interest.

Agricultural Anomalies

At the southern end of the corridor several broad, parallel linear trend anomalies aligned north/south are identified. These anomalies are about 5m-6m apart and are indicative of ridge and furrow cultivation. No evidence for this former agricultural practice are recorded in the northern half of the corridor.

A higher magnitude linear anomaly, **A**, which runs oblique to the ploughing anomalies, is on the same alignment as a former boundary (see Fig. 8) and is interpreted as a field drain. Two similar anomalies, **B** and **C**, on the same north-west/south-east alignment are also interpreted as drains as are three parallel anomalies, **D**, **E**, and **F**, running east/west across the corridor at the northern end of Sector 2.

Geological Anomalies

Throughout the survey area a number of discrete anomalies, characterised as localised areas of enhanced magnetic response, have been identified. These anomalies are interpreted as geological in origin, being caused by variation in the composition of the superficial deposits and the soils from which they are derived. These geological anomalies are especially prevalent in Sector 1 (see Fig. 5).

A single more extensive area of enhanced magnetic response, **G**, stands out by virtue of the greater extent and the relative paucity of similar geological anomalies in this part of the site. This anomaly is still interpreted as of likely geological origin but a modern cause cannot be discounted.

5 Conclusions

The magnetometer survey has identified anomalies indicative of ridge and furrow cultivation to the south of the corridor and more recent agricultural practice in the form of field drains. Evidence of variation in the soils and superficial deposits is also recorded. A single anomaly of uncertain origin is identified although a modern or geological origin is considered most likely. Consequently, on the basis of the survey, the archaeological potential of the survey corridor 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.

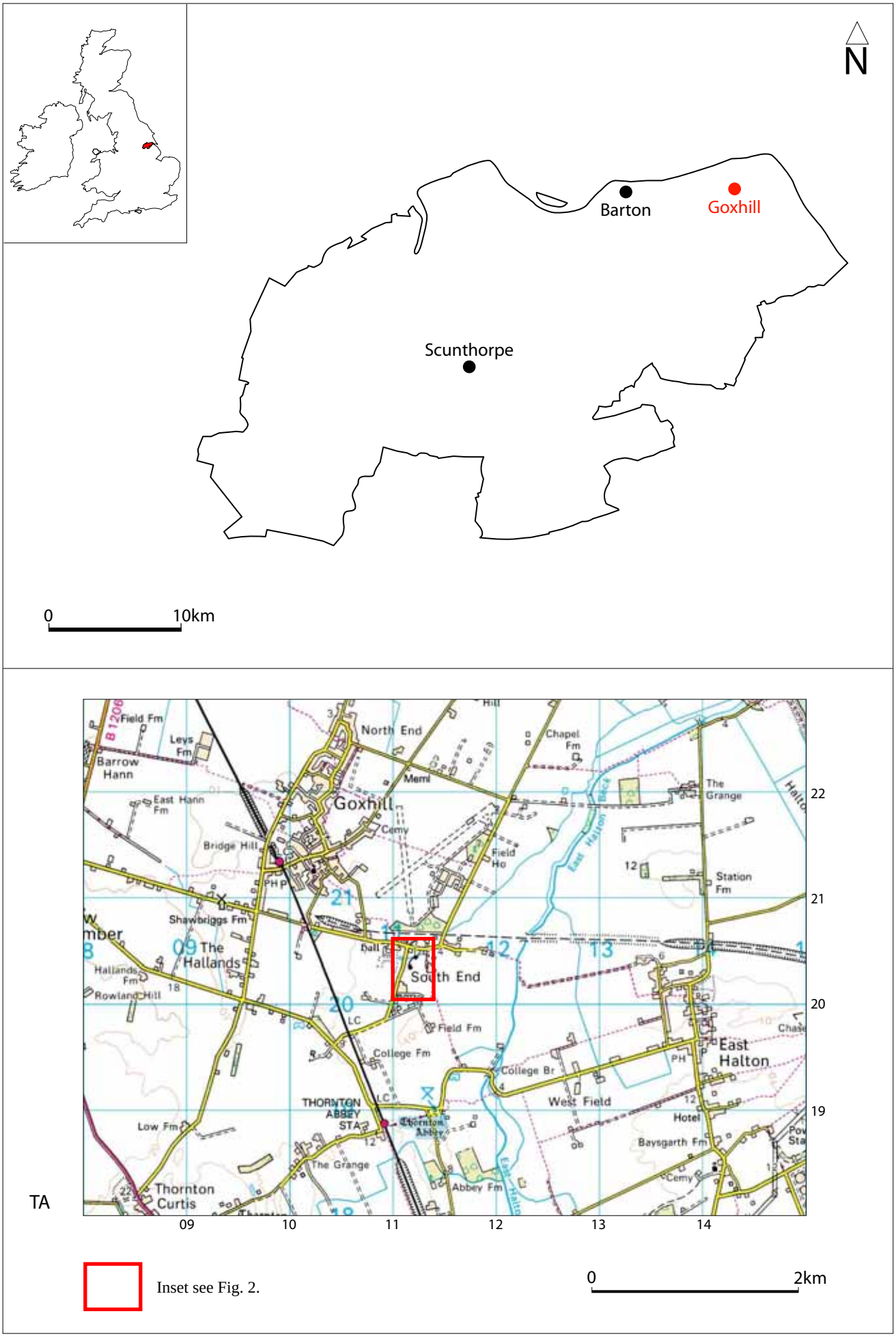

Fig. 1. Site location

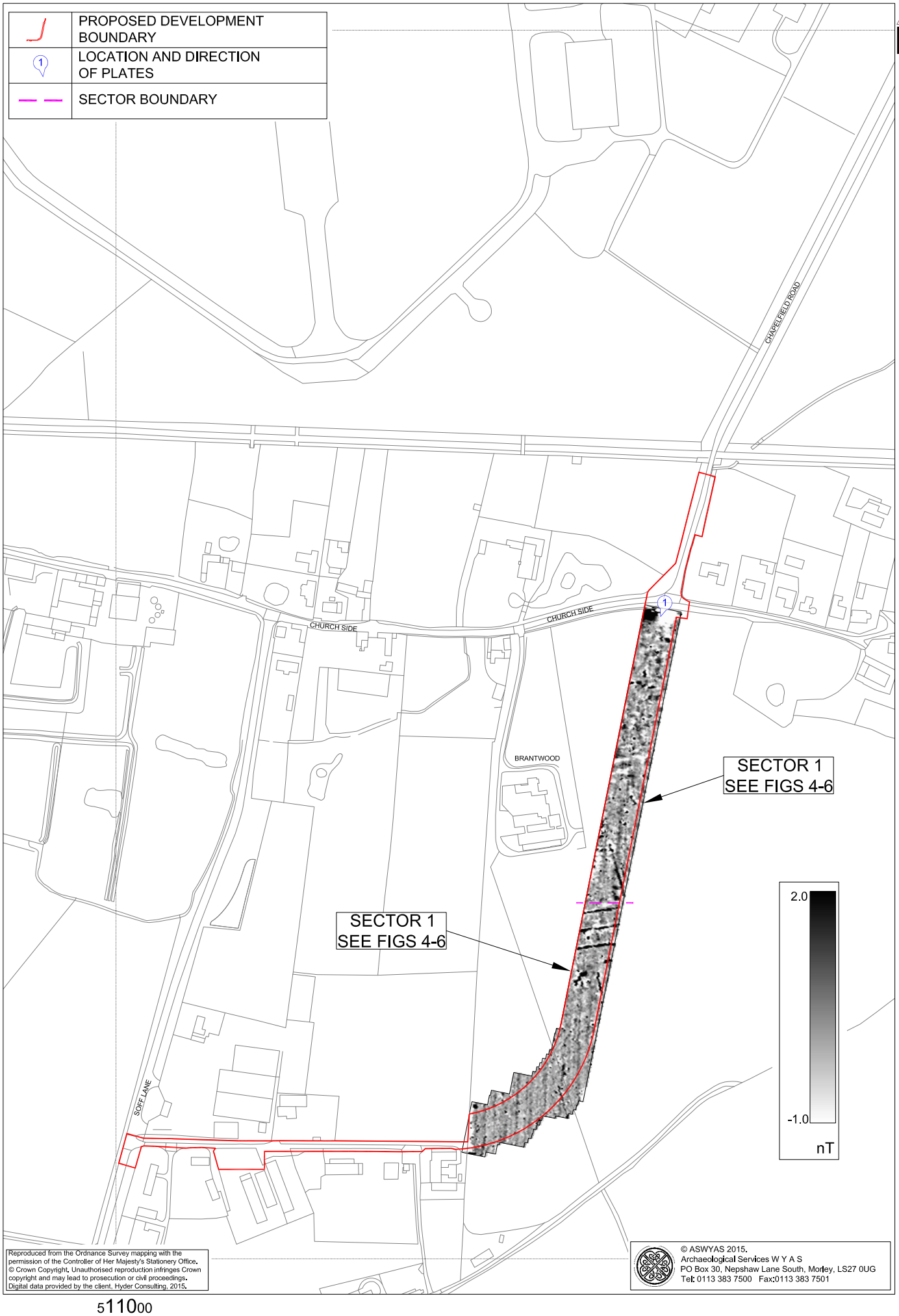

Fig. 2. Survey location showing greyscale magnetometer data (1:4000 @ A4)

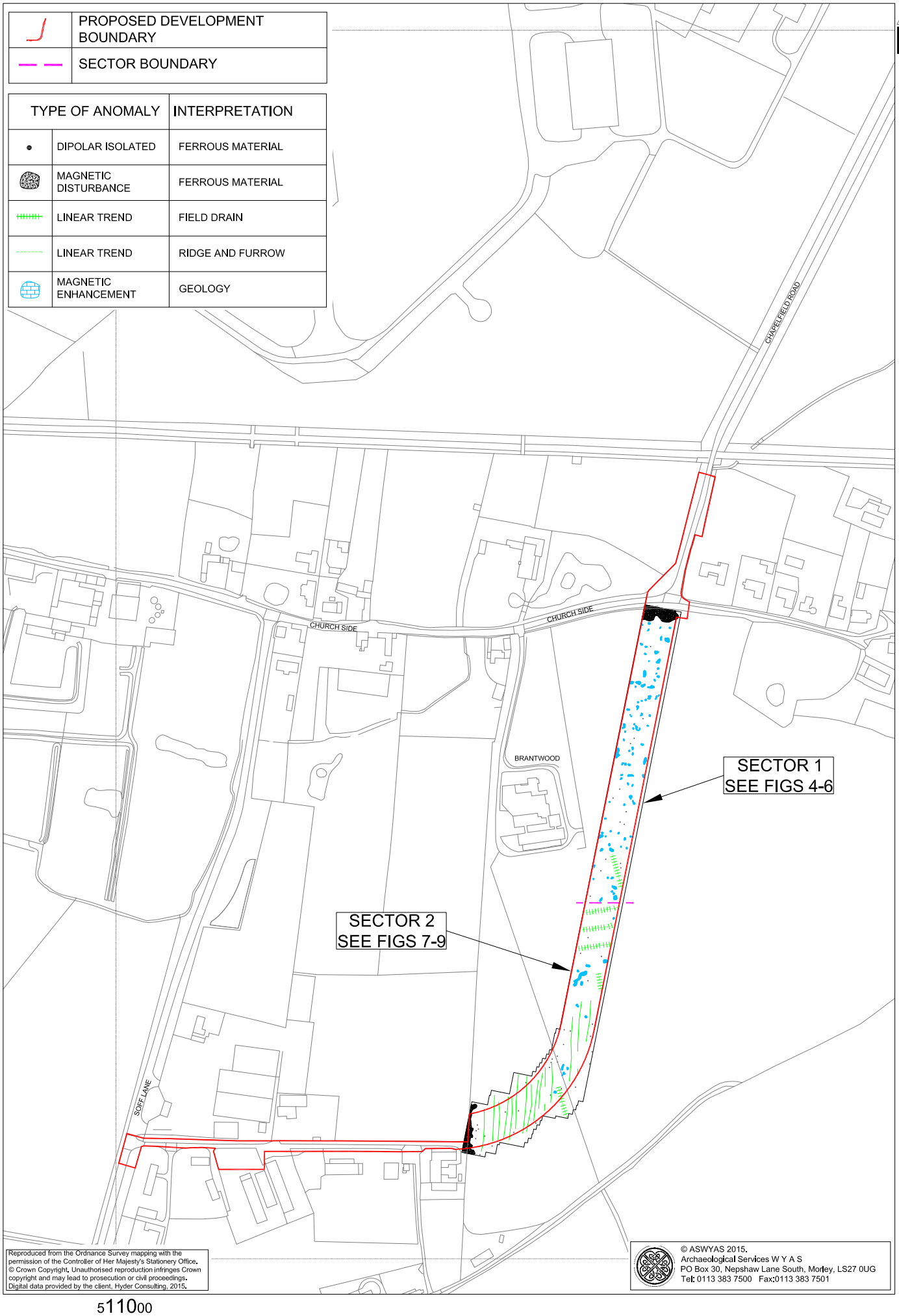

Fig. 3. Overall interpretation of magnetometer data (1:4000 @ A4)

Fig. 4. Processed greyscale magnetometer data: Sector 1 (1:1000 @ A4)

Fig. 5. XY trace plot of minimally processed magnetometer data: Sector 1 (1:1000 @ A4)

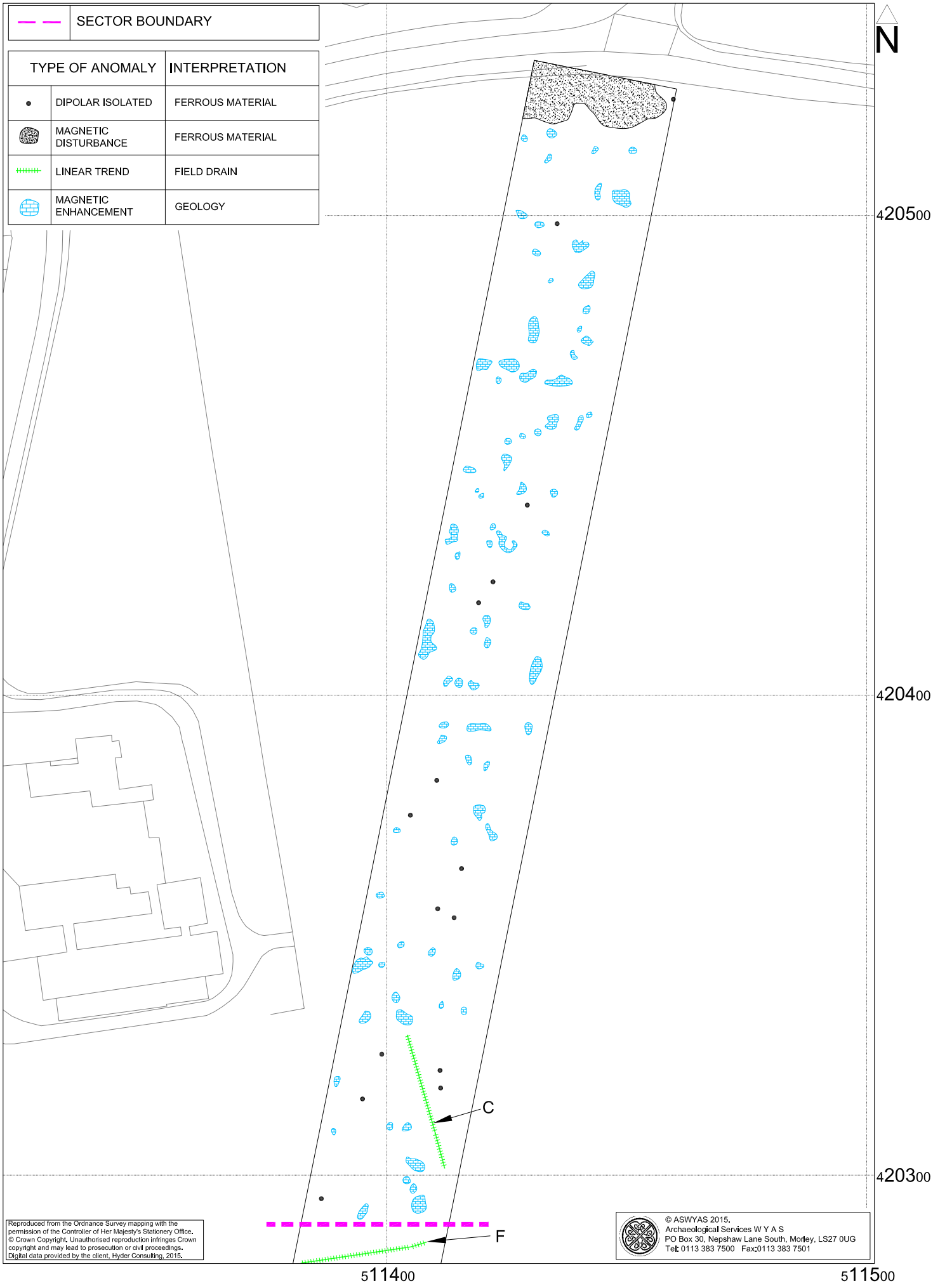

Fig. 6. Interpretation of magnetometer data: Sector 1 (1:1000 @ A4)

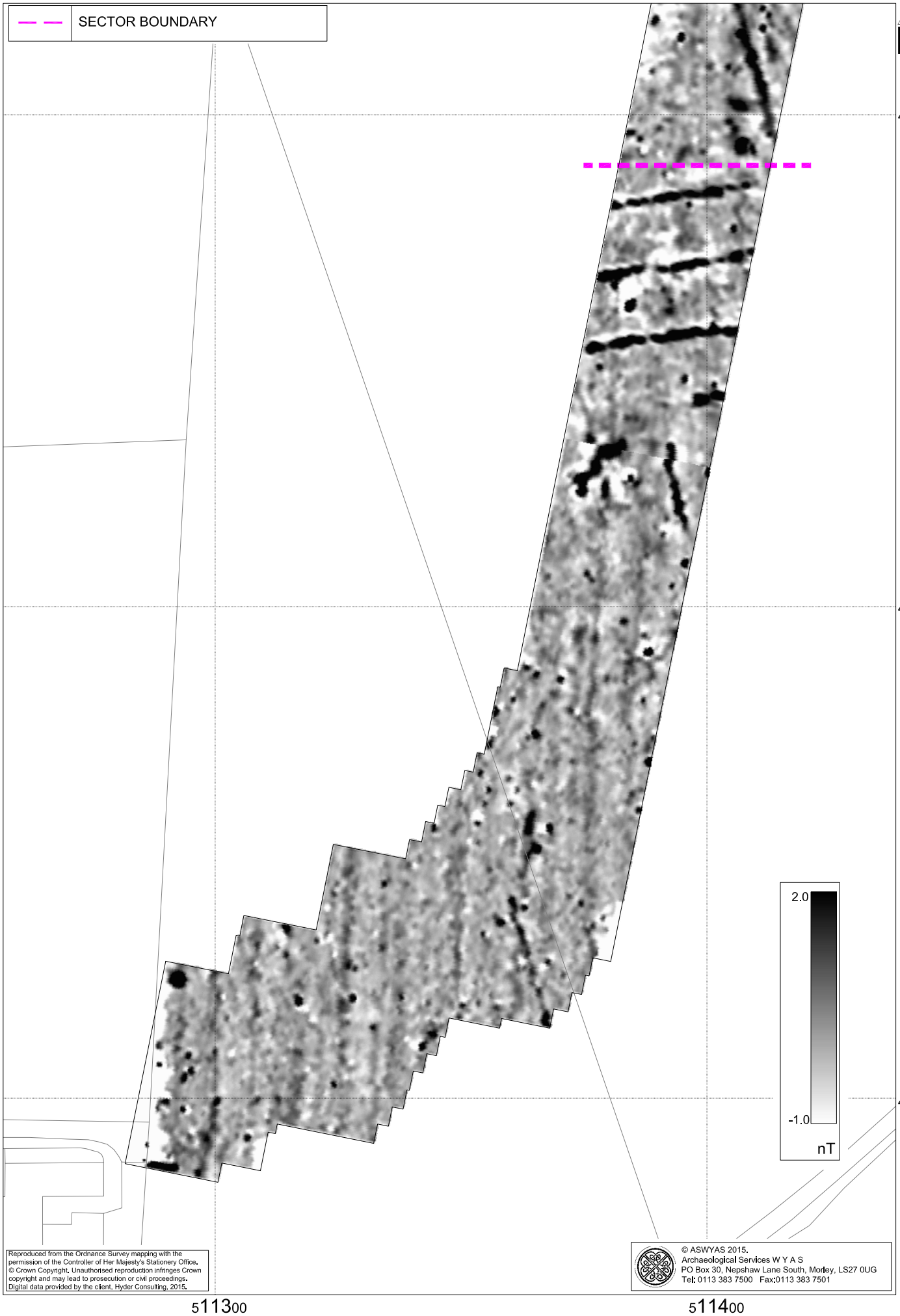

Fig. 7. Processed greyscale magnetometer data: Sector 2 (1:1000 @ A4)

Fig. 8. XY trace plot of minimally processed magnetometer data: Sector 2 (1:1000 @ A4)

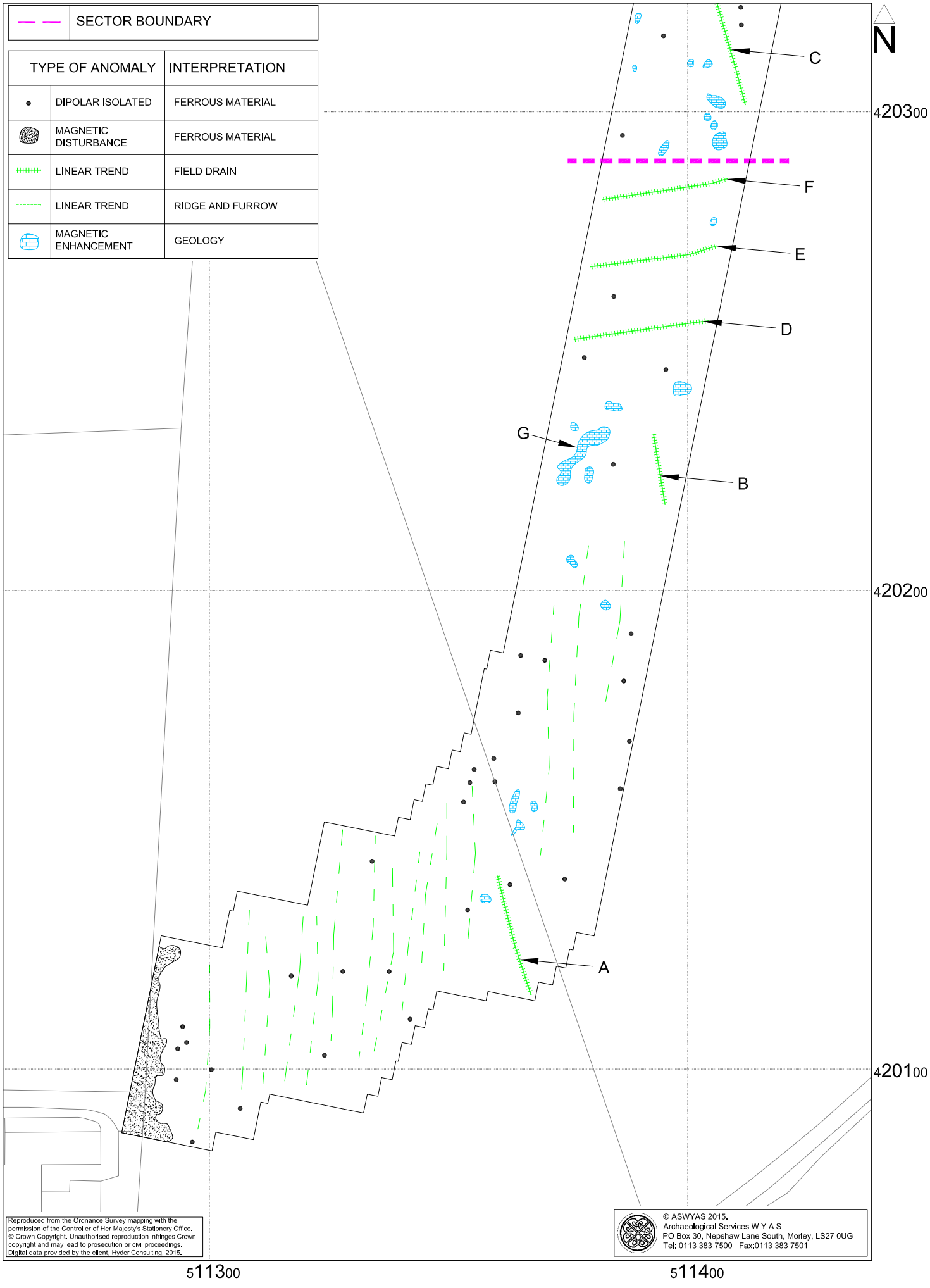

Fig. 9. Interpretation of magnetometer data: Sector 2 (1:1000 @ A4)

Plate 1. General view of survey area, looking south

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: 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

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 North Lincolnshire Historic Environment Record).

Appendix 4: OASIS Form

OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol11-203539

Project details

Project name	River Humber Replacement Pipeline Soff Lane Access Track
Short description of the project	A geophysical (magnetometer) survey, covering approximately 2 hectares, was carried out near Goxhill along the proposed route of an access track associated with the construction of a replacement high pressure pipeline beneath the River Humber. The survey has identified anomalies caused by ridge and furrow cultivation and more recent agricultural activity in the form of field drains. No anomalies of obvious archaeological potential have been identified although a single discrete anomaly of uncertain origin has been highlighted. Consequently, on the basis of the survey, the archaeological potential of the site is considered to be low.
Project dates	Start: 16-01-2015 End: 16-01-2015
Previous/future work	Not known / Not known
Any associated project reference codes	RHG15 - Sitecode
Any associated project reference codes	4348 - 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	Service infrastructure (e.g. sewage works, reservoir, pumping station, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded

Solid geology (other)	Burham Chalk Formation
Drift geology (other)	sand and gravel
Techniques	Magnetometry

Project location

Country	England
Site location	NORTH LINCOLNSHIRE NORTH LINCOLNSHIRE GOXHILL Soff Lane Access Track
Study area	2.00 Hectares
Site coordinates	TA 1128 2010 53.6652811344 -0.315598861747 53 39 55 N 000 18 56 W Point

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Hyder Consulting
Project design originator	Archaeological Services WYAS
Project director/manager	Harrison, S.
Project supervisor	Schmidt, A.
Type of sponsor/funding body	Consultant

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	River Humber Replacement Pipeline Soff Lane Access Track
Author(s)/Editor(s)	Sykes, C.
Other bibliographic details	Report Number 2711
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	11 February 2015

OASIS:

Bibliography

British Geological Survey, 2015. www.bgs.ac.uk/discoveringGeology/geology OfBritain/viewer.html. (Viewed January 22nd 2015)

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

DCLG, 2012. *National Planning Policy Framework*. Department of Communities and Local Government

English Heritage, 2015 www.pastscapes.org.uk (Viewed 22nd January 2015)

Harrison, S., 2015 *River Humber Replacement Pipeline, Soff Lane Access Track, Goxhill, North Lincolnshire* Unpublished ASWYAS Geophysical Survey Project Design

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey.* CIfA

Soil Survey of England and Wales, 1983. *Soil Survey of England and Wales: Soils of Northern England*, Sheet 1