

OFBS17



UPPER OUTWOODS FARM, BURTON UPON TRENT, STAFFORDSHIRE

GEOPHYSICAL SURVEY

commissioned by Hallam Land Management

November 2017

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PROJECT INFO:

HA Project Code **OFBS17** / NGR **SK 2271 2544** / Parish **Outwoods** / Local Authority **Staffordshire** / OASIS Ref. **headland5-300180**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **Kevin Heaton, Neil Paveley, Olivier Vansassenbrouck, Ross Bishop, Sam Harrison** / Graphics **Beata Wiczorek-Oleksy, Caroline Norrman, David Harrison**

Approved by **David Harrison**



Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com
w www.headlandarchaeology.com



PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 68 hectare site, north-east of Burton upon Trent, to inform planning proposals for a proposed residential development. The survey has successfully evaluated the site identifying anomalies consistent with the post-medieval and modern agricultural landscape including backfilled marl pits, ponds, agricultural buildings/barns, former field boundaries and isolated areas of ridge and furrow cultivation. No anomalies of clear archaeological potential have been identified in any part of the site, and only a vague curving anomaly of uncertain origin has been identified 40m from an undated cropmark enclosure which is recorded on the Staffordshire HER. Therefore, on the basis of the magnetic survey the site is assessed as of low archaeological potential, corroborating the results of the Desk-Based Assessment.

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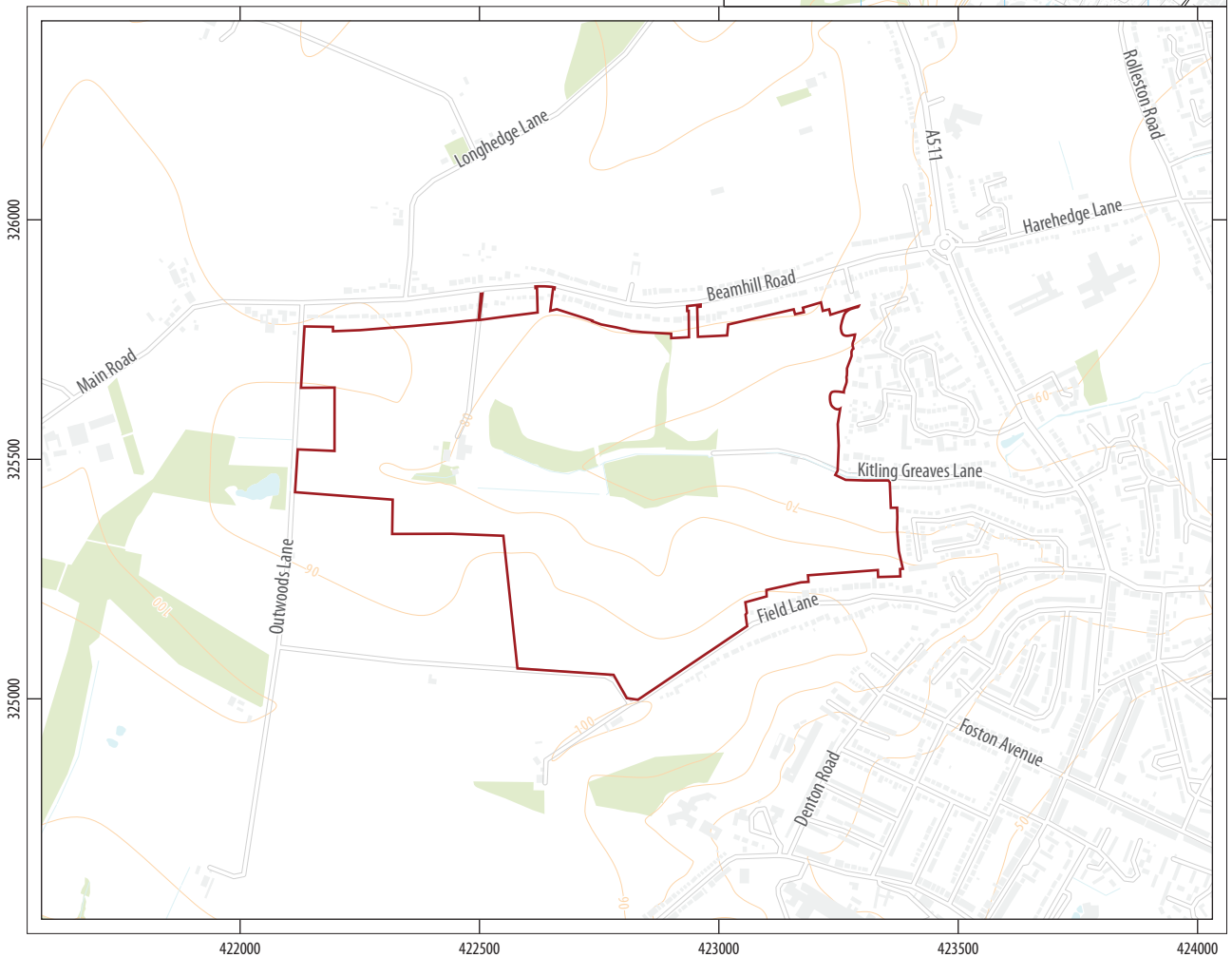
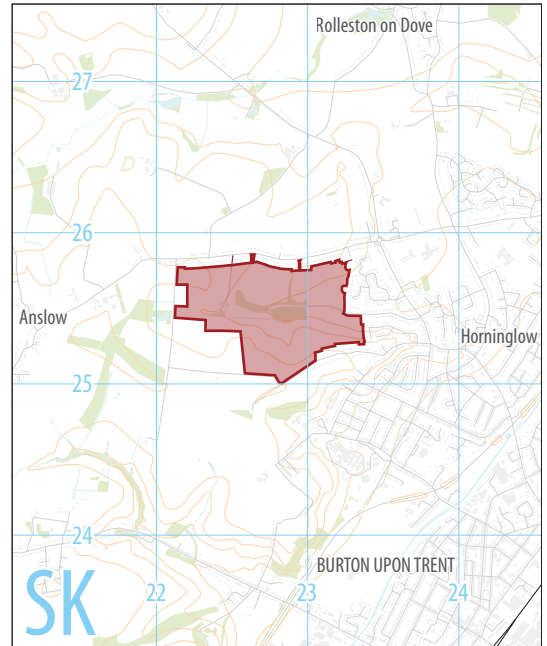
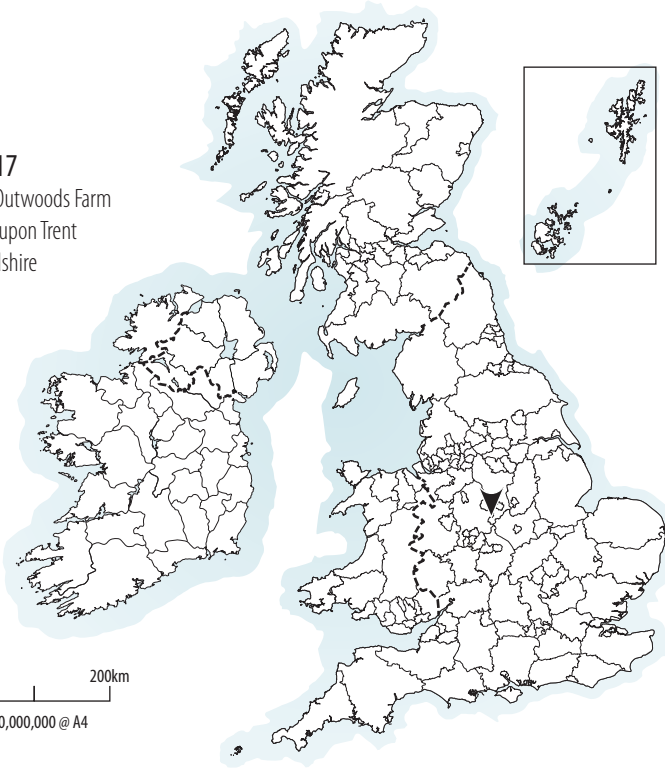
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OFBS17
 Upper Outwoods Farm
 Burton upon Trent
 Staffordshire

0 200km
 1:10,000,000 @ A4



0 300m
 1:15,000 @ A4

proposed development area



Headland Archaeology North
 Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
 t 0113 387 6430
 e north@headlandarchaeology.com
 w www.headlandarchaeology.com

UPPER OUTWOODS FARM, BURTON UPON TRENT, STAFFORDSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Hallam Land Management, to undertake a geophysical (magnetometer) survey on land out Upper Outwoods Farm, on the north-western periphery of Burton upon Trent (Illus 1), where a residential development is being proposed. The survey was carried out in order to inform planning proposals by assessing the heritage potential of the proposed development area (PDA) and therefore the impact of the proposed development on the historic environment.

The work was undertaken in accordance with guidance contained in the National Planning Policy Framework (DCLG 2012). All work was undertaken in line with current best practice (Chartered Institute for Archaeologists 2014, English Heritage 2008).

The survey was carried out between October 5th and October 20th 2017.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The proposed development area (PDA) is located north-west of Burton upon Trent, centred at SK 2271 2544. It comprises 68 hectares of mainly agricultural land which is bound to the north by Beamhill Road, to the west by Outwoods Lane, to the south by Field Lane and by existing residential development to the east and south-east. Upper Outwoods Farm is located in the west of the PDA.

At the time of the survey the site was under a mix of arable farmland (F1; see Illus 2, F4 and F5) and pasture (F2 and F3). F6-F13 were fallow (see Illus 3) and overgrown vegetation restricted survey, particularly at the field edges. F5 had been deeply ploughed and was unsuitable for survey and land to the south of F6/F7 and north-east of F4 were

wooded and could not be surveyed. Of the 68ha PDA, 48ha were available for survey.

The topography varies greatly throughout the PDA but generally falls towards a small stream which runs W-E across the centre of the site at approximately 70m Above Ordnance Datum (AOD). The land rises to 90m AOD at Beamhill Road in the north and to 100m AOD at Field Lane in the south.

1.2 GEOLOGY AND SOILS

The underlying solid geology comprises Mercia mudstone. No superficial deposits are recorded across the majority of the site, although glacial till is recorded at the southern limits of the PDA (NERC 2017).

The soils are mainly classified in the Soilscape 8 association, characterised as slightly acid loams and clays with impeded drainage. In the north-west and south-east of the site the soils are classified in the Soilscape 18 association, characterised as slowly permeable, seasonally wet slightly acid but base-rich loams and clays (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

An Archaeological Desk-Based Assessment (CgMs 2011) concluded that the PDA has a low to nil potential for the presence of unrecorded archaeological remains from the prehistoric to Saxon/Early Medieval Period. However, the presence of an unrecorded cropmark enclosure (Staffordshire Historic Environment Record 05227; see Illus 5) in the south of the site may increase the potential for prehistoric or early



ILLUS 2 Field 1 (east), looking north

Roman activity in the area. A low potential has been identified for the medieval and post-medieval/modern period although the HER records areas of ridge and furrow (20283) to the north of Kitling Greaves Lane.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the PDA. This will therefore enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

The specific archaeological objectives of the geophysical survey were:

- › to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- › to therefore model the presence/absence and extent of any buried archaeological features; and
- › to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with

buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:15,000. Illus 2 and Illus 3 are site condition photographs. Illus 4 is a 1:4,000 scale survey location plan showing the GPS swath data. The Staffordshire



ILLUS 3 Field 10, looking south

HER data is shown in Illus 5 overlying the six inch Ordnance Survey (OS) map (1892–1905), also at 1:4,000. The processed greyscale data and an overall interpretation plot are also presented at 1:4,000 on Illus 6 and Illus 7. Detailed data plots of the fully processed data (greyscale), the minimally processed data (XY traceplot) and an accompanying interpretative plot are presented at a scale of 1:2,500 in Illus 8 to Illus 16 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations 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 illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

With the exception of the ferrous contamination of the topsoil, which is ubiquitous across the PDA, the survey has detected a moderate to low level of background magnetic variation across the site. This has resulted in a fairly homogenous, mono-tone appearance to the dataset. Nevertheless, numerous magnetic anomalies have been identified by the survey, most of which can be confidently interpreted by cross-referencing the data with historical Ordnance Survey maps. All are discussed below and cross-referenced to specific anomalies on the interpretative drawings, where appropriate.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes' in the data, 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 is common on most sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

High magnitude dipolar linear anomalies have been identified within the east of F1 (SP1) and the north of F4 (SP2/SP3). All locate buried pipes. SP3 is likely to have serviced a wind pump which is shown in

the north-east corner of F4 on twentieth century OS maps. Other non-dipolar high magnitude linear anomalies have been identified to the immediate west and south of Upper Outwoods Farm (see Illus 8 – Illus 13). These are thought to be due to culverts leading from/to former ponds which are identified as broad areas of magnetic disturbance (FP1 and FP2).

Immediately west of Upper Outwoods Farm a rectilinear anomaly (FT1) is caused by a modern farm track.

Localised areas of magnetic disturbance (B1 and B2; see Illus 11 to Illus 13), to the east of F4 and the east of F6 correspond with the location of former buildings which are shown on the 1892-1905 six inch OS map (see Illus 5). The disturbance is thought to be caused by demolition material within the upper soil horizons.

Other areas of magnetic disturbance around the field edges is due to ferrous material within or close to the adjacent field boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historic OS mapping indicates that the division and layout of land within the PDA has changed a great deal over the last 134 years with several field boundaries having been removed. Twelve of these former boundaries have been detected by the survey as linear magnetic anomalies (FB1 to FB12).

Series of parallel linear trends are identified across the PDA either parallel with, or perpendicular or at 45 degrees to, the extant and former boundaries. The closely-spaced trends are typical of modern cultivation whereas the more broadly-spaced trends are characteristic of the medieval and post-medieval practice of ridge and furrow cultivation. Ridge and furrow anomalies are recorded across F6, F7 and F12.

Seven infilled marl pits (Q1 – Q7) have been identified within F3 and F4 (see Illus 11 – Illus 13) as broad areas of magnetic disturbance. The anomalies correspond to features which are shown on historic OS maps (Illus 5) and are caused by ferrous material (bricks, tiles, rubble etc) within the backfilled pits.

4.3 GEOLOGICAL ANOMALIES

A plethora of low magnitude discrete anomalies throughout the PDA are caused by localised variations in the depth and composition of the soils.

4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

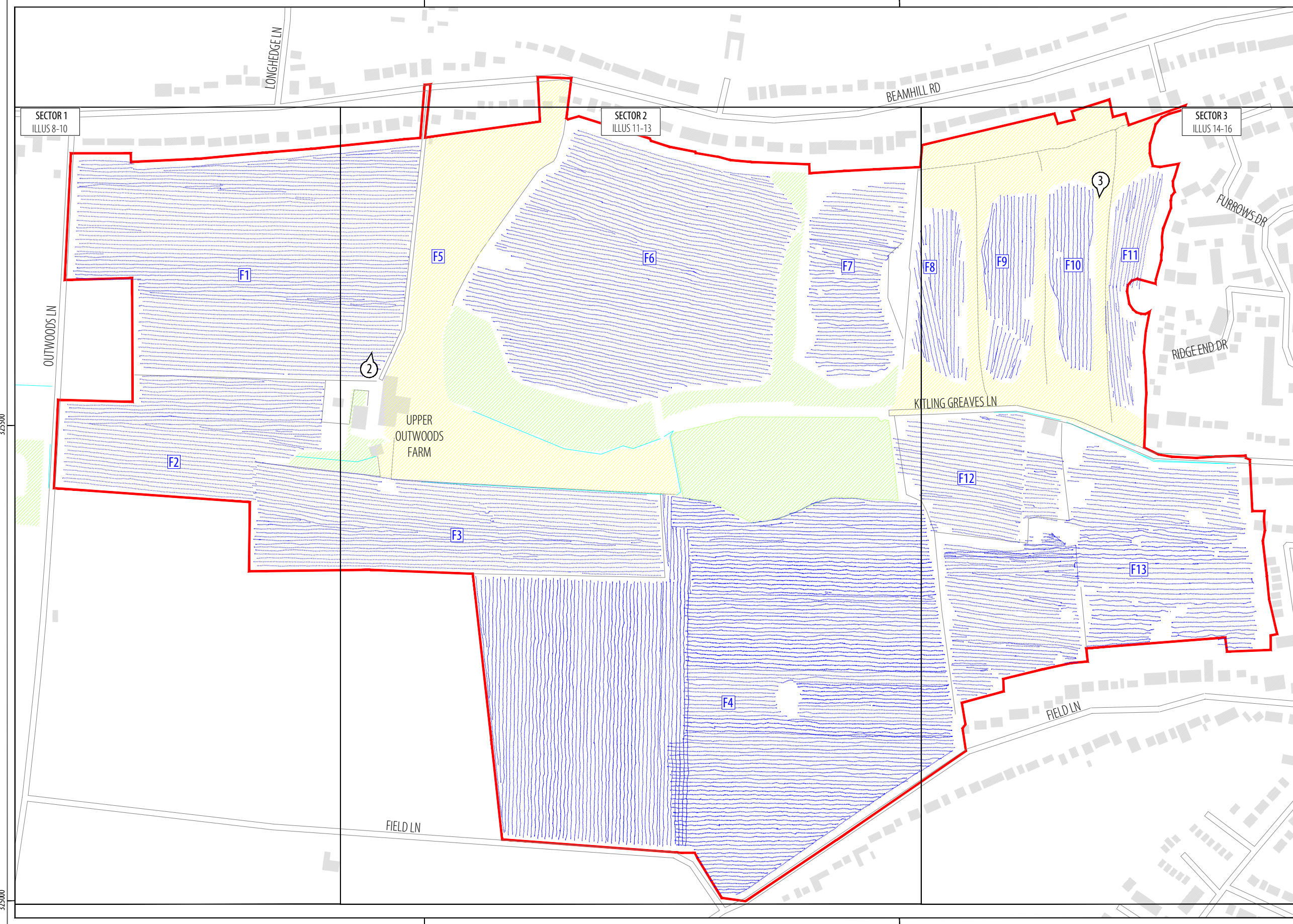
No anomalies of clear archaeological potential have been identified in any part of the site. A vague curving anomaly (D1; see Illus 11 – Illus 13) within the south of F4, and 40m south-east of the cropmark recorded on the HER, is interpreted as of possible archaeological potential, perhaps locating a ditch. However this interpretation is extremely tentative and the anomaly may be caused by localised variations in the soils.

5 CONCLUSION

The survey has successfully evaluated the proposed development site identifying anomalies which are consistent with the post-medieval and modern agricultural landscape including backfilled marl pits, ponds, agricultural buildings/barns, former field boundaries and isolated areas of ridge and furrow cultivation. No anomalies of clear archaeological potential have been identified in any part of the site, and only a vague curving anomaly has been identified 40m south-east of an undated cropmark which is recorded on the Staffordshire HER. It is unclear whether the anomaly corresponds to the cropmark enclosure or to a previously unrecorded feature. On the basis of the magnetic survey the site is assessed as of low archaeological potential corroborating the results of the Desk-Based Assessment.

6 REFERENCES

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- proposed development area
- GPS swaths
- location and direction of ILLUS 2-3
- area unsuitable for survey
- woodland



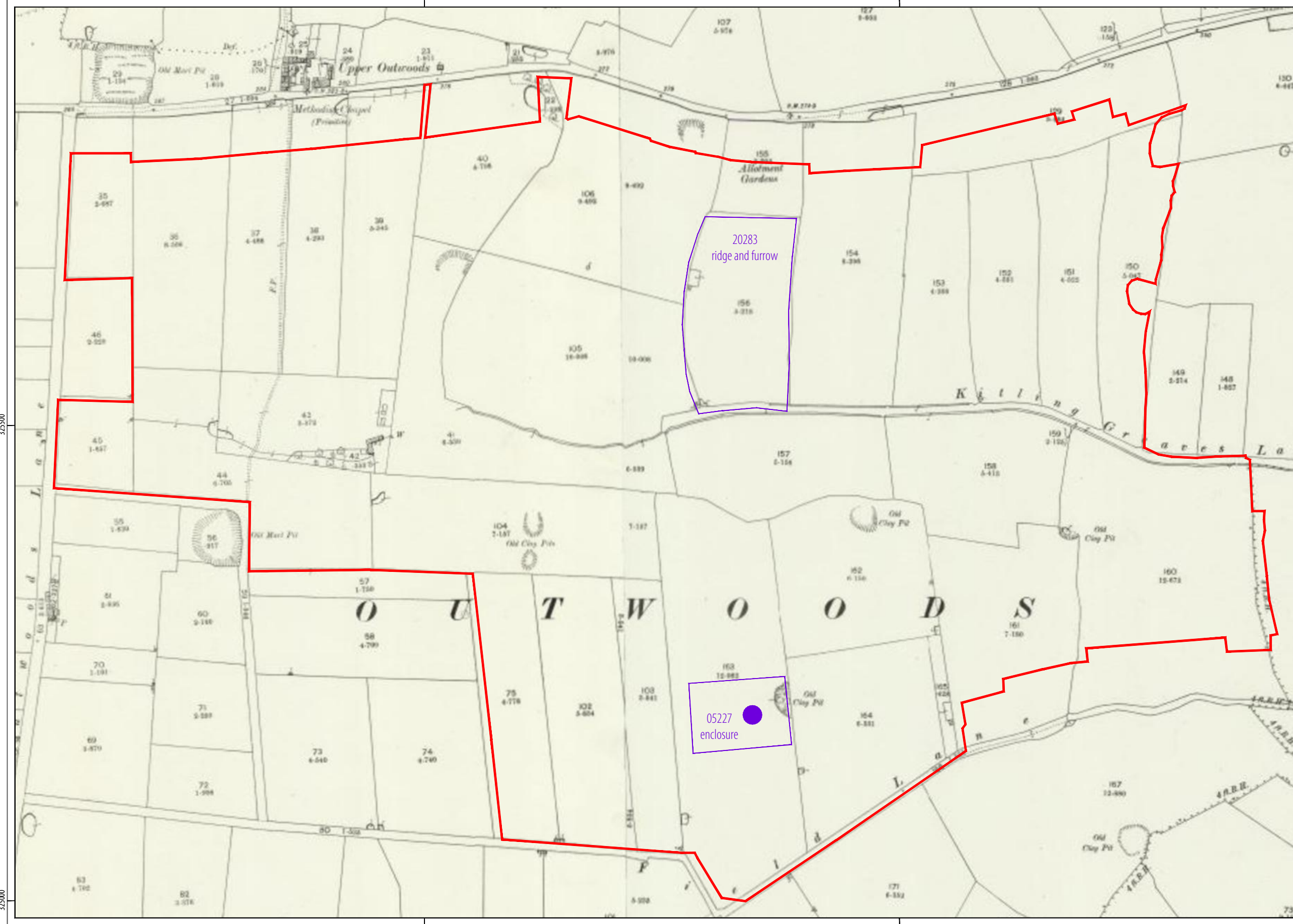
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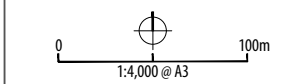


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ILLUS 4 Survey location showing GPS swaths



proposed development area
Staffordshire HER data



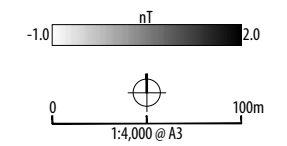
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TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— dipolar linear	service pipe
— linear trend	culvert
● magnetic disturbance	farm track
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
● magnetic enhancement	geology
● magnetic disturbance	quarrying
● magnetic enhancement	archaeology?

ABBREVIATIONS	INTERPRETATION
B	former building
D	ditch
FB	former boundary
FP	former pond
FT	farm track
Q	quarry pit/marl pit
SP	service pipe



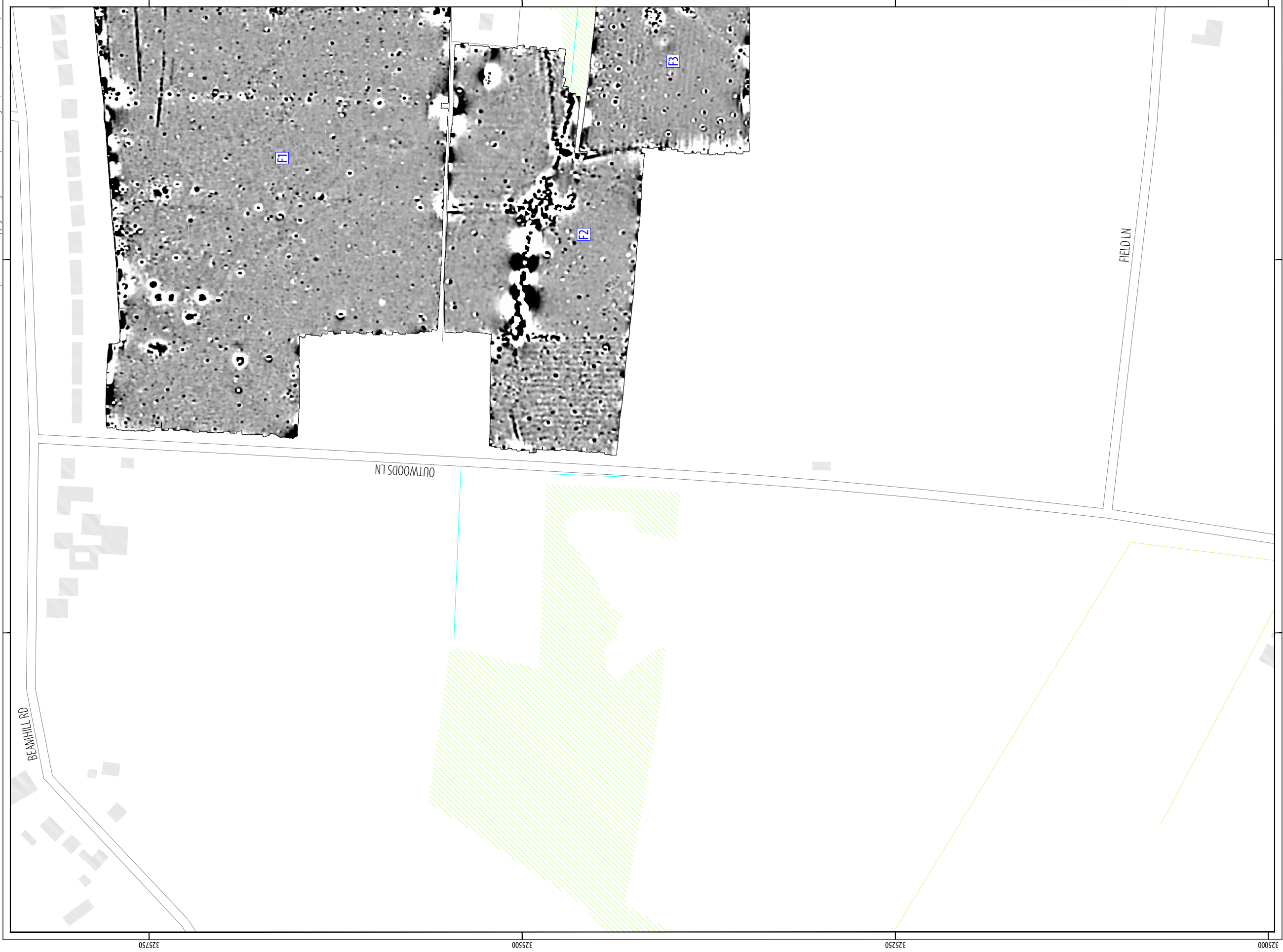
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ILLUS 7 Overall interpretation of magnetometer data



Scale bar: 0 to 2.0 nT

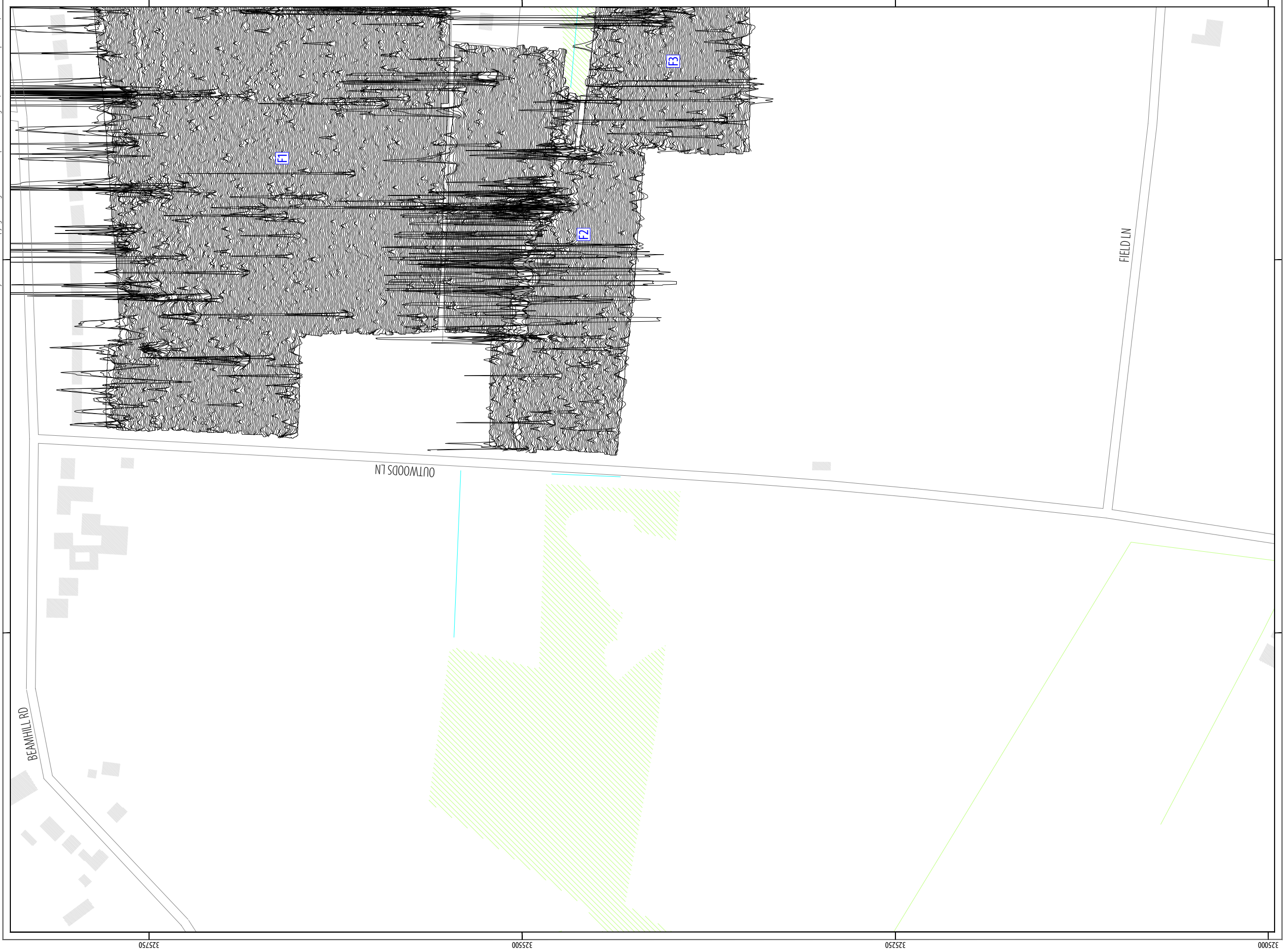
North arrow: 0 to 50m, 1:2,500 @ A3

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ILLUS 8 Processed greyscale magnetometer data; Sector 1



12.5m/cm

0 50m

1:2,500 @ A3

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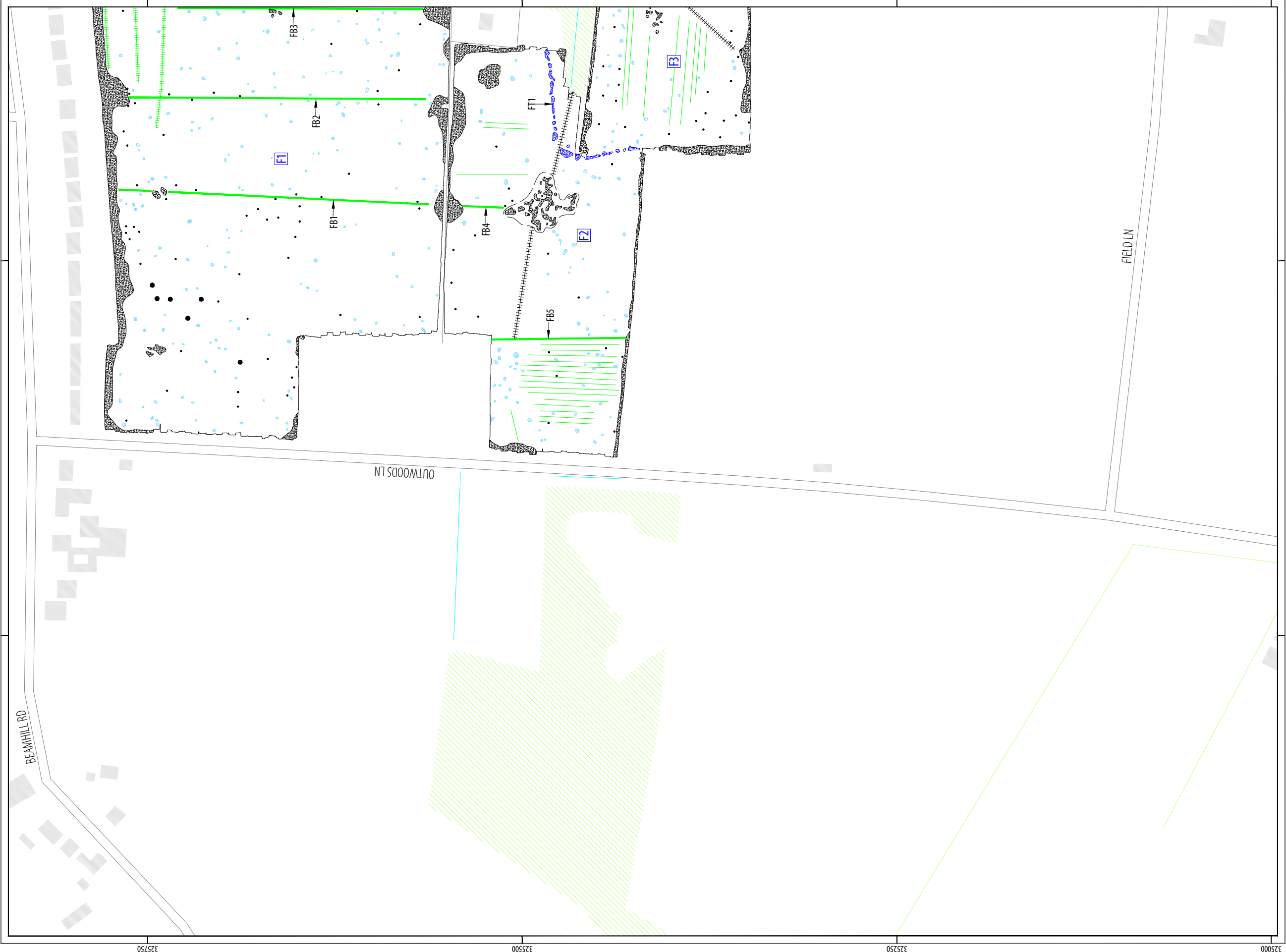
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ILLUS 9 XY trace plot of minimally processed magnetometer data, Sector 1



TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION	ABBREVIATIONS
dipolar isolated	ferrous material	linear	former field boundary	FB
magnetic disturbance	ferrous material	magnetic enhancement	geology	FP
linear trend	culvert			FT
magnetic disturbance	farm track			
linear trend	agricultural			
linear trend	field drain			

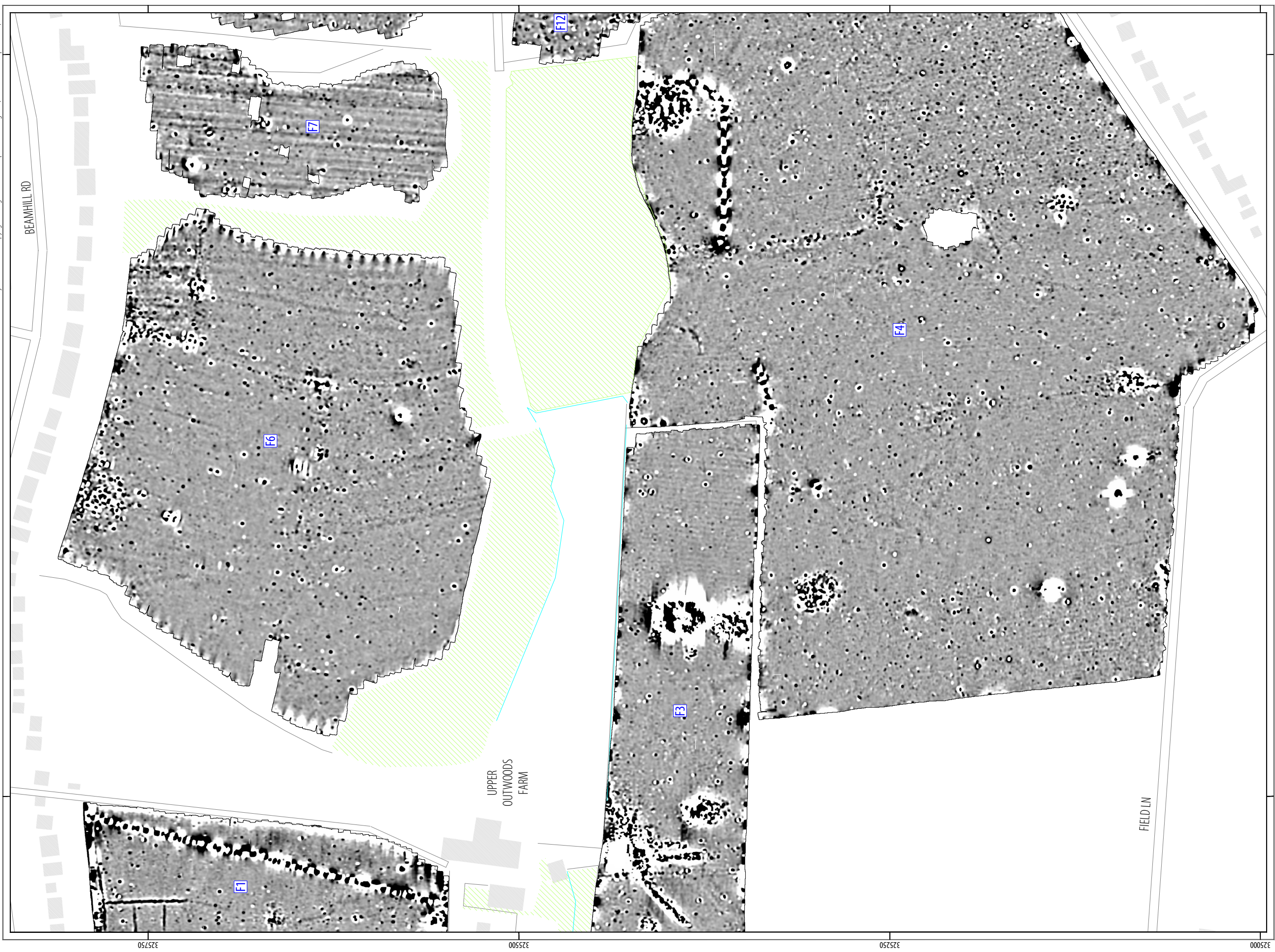
TYPE OF ANOMALY	INTERPRETATION	ABBREVIATIONS
linear	former field boundary	FB
magnetic enhancement	geology	FP
		FT

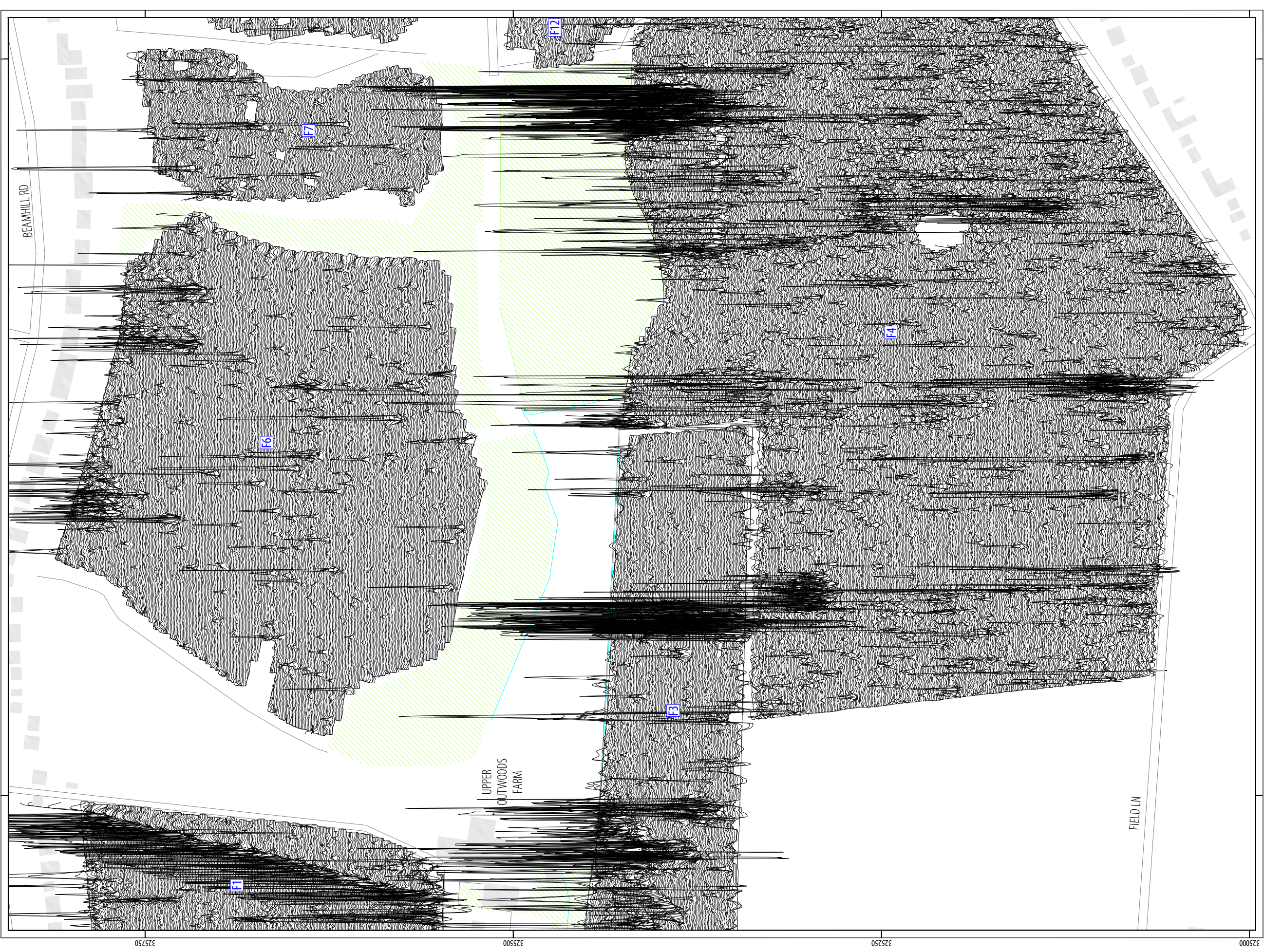
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0 50m
1:2,500 @ A3

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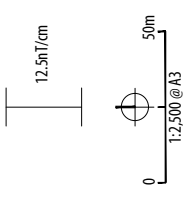
ILLUS 10 Interpretation of magnetometer data, Sector 1



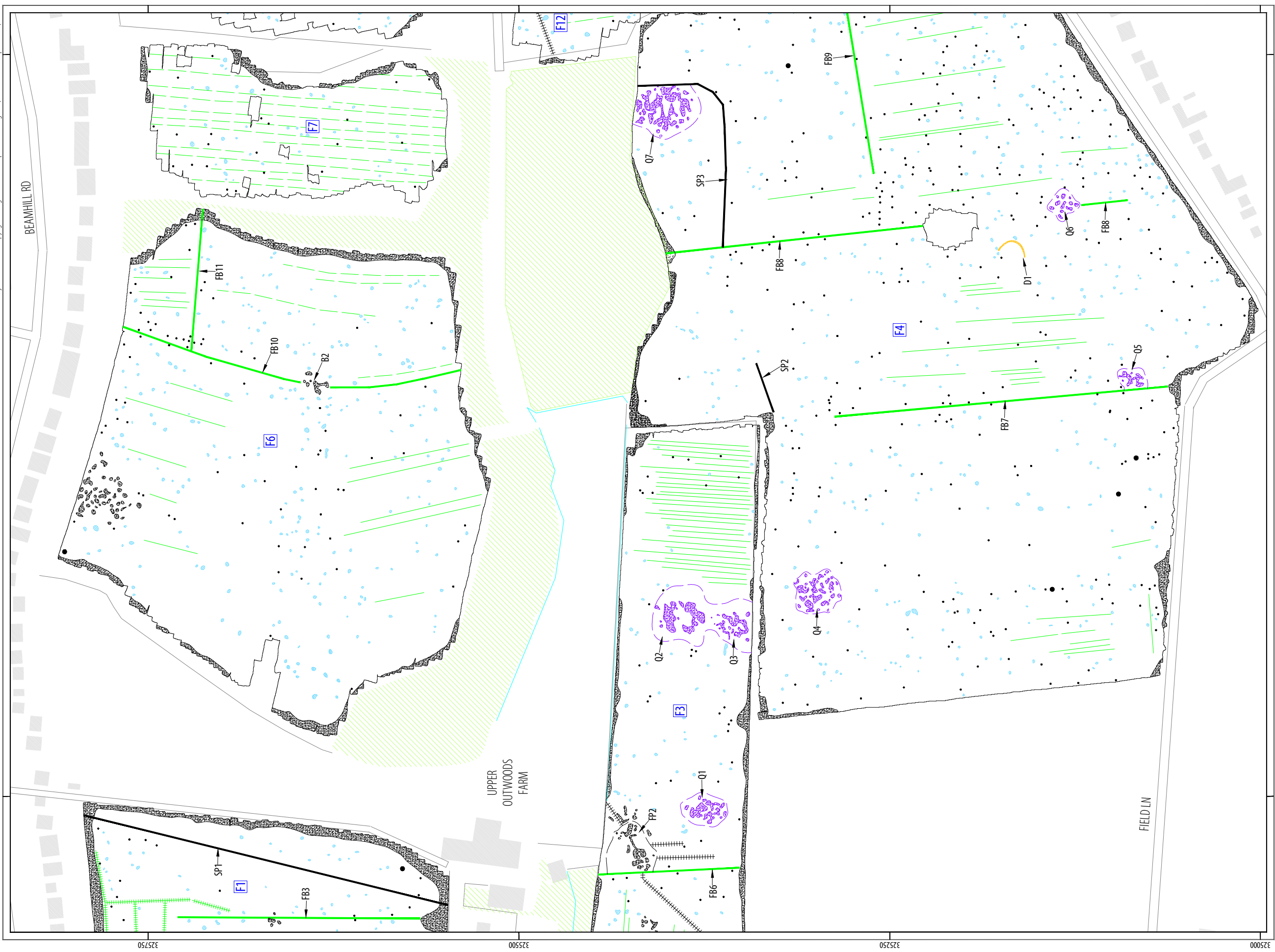


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ILLUS 12 XY trace plot of minimally processed magnetometer data, Sector 2



ILLUS 13 Interpretation of magnetometer data, Sector 2



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Scale: 1:2,500 @ A3
0 50m

NT
-1.0 2.0

ILLUS 14 Processed greyscale magnetometer data; Sector 3



12.5m/cm

0 50m

1:2,500 @ A3

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ILLUS 15 XY trace plot of minimally processed magnetometer data, Sector 3



TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION	ABBREVIATIONS
dipolar isolated	ferrous material	linear	former field boundary	B former building
magnetic disturbance	ferrous material	magnetic enhancement	geology	FB former boundary
linear trend	culvert			
linear trend	ridge and furrow			
linear trend	agricultural			
linear trend	field drain			

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 Leeds LS11 8ND
 0113 387 6430
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ILLUS 16 Interpretation of magnetometer data, Sector 3

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

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 haematite. 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. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

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.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data 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 coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associated world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: *headland5-300180*

Project details	
Project name	Upper Outwoods Farm, Burton upon Trent
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of a 68 hectare site, north-east of Burton upon Trent, to inform planning proposals for a proposed residential development. The survey has successfully evaluated the site identifying anomalies consistent with the post-medieval and modern agricultural landscape including backfilled marl pits, ponds, agricultural buildings/barns, former field boundaries and isolated areas of ridge and furrow cultivation. No anomalies of clear archaeological potential have been identified in any part of the site, and only a vague curving anomaly of uncertain origin has been identified 40m from an undated cropmark enclosure which is recorded on the Staffordshire HER. Therefore, on the basis of the magnetic survey the site is assessed as of low archaeological potential, corroborating the results of the Desk-Based Assessment.
Project dates	Start: 05-10-2017 End: 20-10-2017
Previous/future work	Not known / Not known
Any associated project reference codes	OFBS-01 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Current Land use	Grassland Heathland 5 - 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	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Mercia Mudstone
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry
Project location	
Country	England
Site location	STAFFORDSHIRE EAST STAFFORDSHIRE OUTWOODS Upper Outwoods Farm, Burton upon Trent
Study area	48 Hectares
Site coordinates	SK 2271 2544 52.825680984997 -1.662925158628 52 49 32 N 001 39 46 W Point
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	Orion Heritage
Project design originator	Headland Archaeology
Project director/manager	Harrison, D
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer

Project archives	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No
Project bibliography 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Upper Outwoods Farm, Burton upon Trent, Staffordshire; Geophysical Survey
Author(s)/Editor(s)	Harrison, D.
Date	2017
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	A4 comb bound report
Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	6 November 2017



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Headland Archaeology South & East
Building 68C | Wrest Park | Silsoe | Bedfordshire MK45 4HS
t 01525 861 578
e southandeast@headlandarchaeology.com

Headland Archaeology Midlands & West
Unit 1 | Clearview Court | Ivyford Rd | Hereford HR2 6JR
t 01432 364 901
e midlandsandwest@headlandarchaeology.com

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com

Headland Archaeology Scotland
13 Jane Street | Edinburgh EH6 5HE
t 0131 467 7705
e scotland@headlandarchaeology.com

www.headlandarchaeology.com