West Burton Solar Project

Environmental Statement

Appendix 13.2: Archaeological Geophysical Survey Report (Part 2 of 6)

Prepared by: ASWYAS

March 2023

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APFP Regulation 5(2)(a)

West Burton
SOLAR PROJECT

Appendix 1

West Burton 1 Solar Site Geophysics Report (ASWYAS 2022)

WYAS Archaeological Services

West Burton Solar Project

West Burton 1

Lincolnshire

Geophysical Survey

Report no. 3743
March 2022

Client: West Burton SOLAR PROJECT

West Yorkshire Joint Services

West Burton Solar Project
West Burton 1
Lincolnshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey was undertaken on approximately 89 hectares of land located to the east of Broxholme, Lincolnshire. The majority of the anomalies recorded are agricultural including field drains, ridge and furrow cultivation, modern ploughing and former field boundaries. Based on the geophysical survey the archaeological potential of this site is deemed to be low.

WYAS
Archaeological
Services

Report Information

Client:	West Burton Solar Project Limited
Report Type:	Geophysical Survey
Location:	West Burton 1
County:	Lincolnshire
Grid Reference:	SK 9154 7844
Period(s) of activity:	medieval/post-medieval - modern
Report Number:	3743
Project Number:	XB85
Site Code:	CWB21
OASIS ID:	archaeol11-505405
Date of fieldwork:	November 2021
Date of report:	March 2022
Project Management:	Emma Brunning BSc MCIfA
Fieldwork:	Alastair Trace BSc MSc
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Photography:	Jake Freeman, Alastair Trace
Report:	Emma Brunning

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

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Document Issue Record

Ver	Author(s)	Reviewer	Approver	Date
1.0	EB	DW	DW	March 2022

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1 Introduction

Archaeological Services ASWYAS has been commissioned by Lanpro Services on behalf of their client, West Burton Solar Project Limited to undertake a geophysical survey in advance of the Cottam and West Burton Solar Scheme, North Lincolnshire. This survey relates to the West Burton 1 parcel of land. This was undertaken in line with current best practice (CIfA 2014; Schmidt *et al.* 2015). The survey was carried out between the 8th and 15th November 2021 to provide additional information on the archaeological resource of the study site.

Site location, topography and land-use

The study site comprises *c*. 89ha split over 5 areas (M1-M5) centred at approximately SK 9154 7844 located to the east of Broxholme in the district of West Lindsey (see Fig. 1).

The study site consisted of arable land, and at the time of survey was a young crop. Further arable land surrounds the study site with a drain bounding the northern limits. The river Till lies to the west and the A1500 to the north. The study site is generally level lying at approximately 7m aOD (above Ordnance Datum) and as shown by the elevation map in Figure 26.

Soils and geology

The recorded bedrock geology comprises Charmouth Mudstone Formation, a sedimentary bedrock that formed approximately 183 to 199 million years ago in the Jurassic Period. Superficial deposits have been recorded as in the eastern areas as Till, comprising mid-Pleistocene Diamicton deposits formed up to 2 million years ago in the Quaternary Period. Superficial deposits have not been recorded in the north and western areas (BGS 2022). Soils are described as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (Soilscape 18) (CSAI 2022).

2 Archaeological Background

The archaeological background below is taken from an archaeological desk based assessment prepared by Lanpro Services. This included a review of monuments and events within the Site boundary and also a 1km search area around the Site.

Designated heritage assets

There is one Scheduled Monument within the search area, relating to the site of the Broxholme medieval settlement and cultivation remains (NHLE1016797), which lies adjacent to the south-western corner of the study site.

There are seven Listed Buildings within the search area, all of which are Grade II Listed, and all relate to late-post medieval or 19th century buildings.

Prehistoric Period (c. 9500 BC – c. AD 43)

There is a single record relating to prehistoric activity within the West Burton 1 study site: the chance discovery of a Neolithic polished stone axe on the north-western edge of the study site in Field M1 (MLI51515).

Evidence for prehistoric activity across the wider search area is limited to chance finds, comprising a Neolithic or Early Bronze Age flint axe found in a field about 185m to west of the north-western edge of the study site (MLI50606), a flint axe found c.450m to the north-west of the study site (MLI52152), and a possible Bronze Age flint discovered within the area of the Broxholme deserted medieval settlement, around 70m to the south-west of the study site.

Roman Period (c. AD 43 – c. AD 410)

There is no recorded evidence for Roman period activity within the West Burton 1 study site.

The only evidence for Roman period activity within the wider search area relates to the line of the Roman road (MLI50575), the route of which is preserved by Till Bridge Lane (A1500), which cuts across the northern side of the search area, approximately 340m from the study site at its nearest point.

Early Medieval and Medieval Periods (c. AD 410– c. 1540)

There is no recorded evidence for early medieval activity within the West Burton 1 study site. The documentary and archaeological evidence for the area around the West Burton 1 study site suggests that the present settlement pattern is likely to broadly represent the pattern of Late Anglo-Saxon period occupation.

A settlement at Broxholme is likely to have occurred since at least the early medieval period; etymology of the place name suggests Broxholme has Old Norse origins meaning raised ground in marsh or a river meadow. Broxholme (MLI50523) is first recorded as part of the Domesday survey of 1086 (Williams and Martin 1992, 916), at which time it contained 26 households and a church. The village of Broxholme appears to have originally been focused around an original core near its church, expanding through the medieval period into an average sized settlement, and it appears to have been little affected by the Black Death of the mid-14th century (NHLE 1016797; MLI50523). The surviving earthwork remains of the medieval village are situated on the east side of Main Street between the Church of All Saints and Manor Farm. The earthworks include a large rectangular enclosure on the settlement's north-western corner, a broad hollow way marking the main road through the medieval village to the south, and to the east by a ditch representing the course of a former track. To the east are a series of depressions which mark the remains of further house plots fronting

onto the main hollow way and the track running north from it. To the south of these features is a linear depression running roughly east-west and representing a hollow way which is thought to indicate the southernmost extent of the earliest part of the medieval village. In the central part of the settlement the main hollow way extends on a north-south alignment roughly parallel with Main Street. Along its eastern side are a series of small rectangular enclosures representing house plots which were occupied throughout the medieval and post-medieval periods.

The western and southern areas of the settlement are occupied by the substantial earthwork remains of medieval ridge and furrow cultivation. These represent the only surviving remains of a large open field which extended to the west of the medieval settlement and was cut through in the post-medieval period by the present Main Street. The ridges, which are aligned east-west, stand up to 0.3m in height and are bounded on the east by a headland which stands up to 2m above the adjacent hollow way. Near the centre they have been cut into by a later pond. The hollow way extends to the south and was formerly adjoined on the south east by further settlement enclosures; these features, which are thought to have marked a relatively short-lived expansion of the village onto earlier arable land, are no longer evident.

Further to the north-west of the West Burton 1 study site, the village of Bransby (MLI50315) was also recorded in the Domesday Book (Williams and Martin 1992, 916). Bransby appears to have remained a relatively small settlement throughout the medieval period, although its former extent may be reflected in possible former property boundaries identified on aerial photographs and the presence of earthworks which may represent a former moated site (MLI50315). To the east of the village, two area of former ridge and furrow have been identified on aerial photographs (MLI52513; 52515).

A bridge over the River Till, c.750m to the north-west of the study site is documented in the 14th century (MLI52170), and there appears to have been an adjacent settlement here, and the earthwork remains of a hollow way and ridge and furrow have been recorded to the east of the bridge (MLI52619).

Based on the archaeological and cartographic evidence, the West Burton 1 study site appears to have been largely outside the core area of medieval settlement at Broxholme. Instead, it is likely to have had a primarily agricultural use since the early medieval period.

3 Aims, Methodology and Presentation

The aims and objectives of the programme of geophysical survey were to gather sufficient information to establish the presence/absence, character and extent, of any archaeological remains within the specific area and to inform an assessment of the archaeological potential of the site. To achieve this aim, a magnetometer survey covering all amenable parts of the Site was undertaken (see Fig. 2).

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

The cart-based survey was undertaken using an eight channel SenSYS MX V3 system containing eight FGM650 sensors. Readings are taken every 20MHz (between 0.05 and 0.1m). Data were recorded onto a device, using a Carlson GNSS Smart antenna, for centimetre accuracy. These readings were stored in the memory of the instrument and downloaded for processing and interpretation. DLMGPS and MAGNETO software, alongside bespoke in-house 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 displays the location of the survey areas at a scale of 1:7500. Figure 3 shows the processed magnetometer data at a scale of 1:5000 whilst Figure 4 shows an overview of the interpretation at the same scale. Processed and minimally processed data, together with interpretation of the survey results are presented in Figures 5 to 25 inclusive at a scale of 1:1500. Figure 26 shows the elevation of the study site.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1. Technical information on locating the survey area is provided in Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 4.

The survey methodology, report and any recommendations comply with guidelines outlined by the European Archaeological Council (Schmidt *et al*. 2015) 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 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 5 to 25)

Ferrous anomalies and magnetic disturbance

Ferrous anomalies, as individual 'spikes', or as large discrete areas 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 in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Large circular areas of magnetic disturbance in areas M2 and M3 correspond to electricity pylons which cross the southern part of the survey area.

Magnetic disturbance along the limits of the survey areas are due to be linked to metal fencing within the field boundaries.

Along the northern boundary of M3 a linear dipolar trend has been recorded which relates to a buried service, this can be seen extending north into M5.

Geological anomalies

The survey has detected a handful of anomalies that have been interpreted as geological in origin. It is thought that the responses have been detected because of the variation in the composition and depth of the deposits of superficial material in which they derive.

Agricultural anomalies

Former field boundaries have been recorded in all the areas which correspond to the first edition Ordnance Survey mapping dating from 1885. The boundaries are still visible on the historic map published 1956 (NLS 2022). The service pipe in M5 relates to the location of a former boundary so it is likely that the service was placed in the boundary ditch.

Field drains can be seen within all areas, of differing magnetic strength which is likely to be associated with the construction of the drains. The magnetic strength of those in the northeast of M1 and in the east of M4 are particularly strong suggesting these are of a fired clay construction.

Medieval or post-medieval ridge and furrow cultivation have been recorded in Areas M1, M2, M4 and M5. Ridge and furrow in the southeast of Area M5 abuts to its north at linear response **U6**, mentioned below, and is presumably a field boundary which is contemporaneous.

Other parallel linear trends can be seen within all areas and are associated with modern ploughing. Only a selection of these have been highlighted on the interpretation diagrams to show the direction of the plough lines.

Uncertain anomalies

A group of linear and short ditch-like anomalies (**U1**) have been recorded in west of M2. Due to the location of the medieval village of Broxholme, to the immediate southwest an archaeological origin is possible and they may represent the remains of house plots. However, it is also likely that they are agricultural and could be animal corrals and as such an uncertain interpretation has been given.

Linear anomalies (**U2**, **U3** and **U4**) in the east of M3 may be contemporary and form part of a field system. Anomaly **U4** is parallel with **U7** in Area M5 to the north.

A linear trend (**U5**) in Area M4 is perpendicular to a former boundary to its immediate east. It is possible that this represents a former boundary predating available historic mapping.

Further linear anomalies (**U6**) in Area M5 along with **U7** possibly form further field systems. The ridge and furrow cultivation in the south east of M5 stops at the linear trend **U6**.

5 Conclusions

The geophysical survey has detected a number of magnetic anomalies associated mainly with an agricultural landscape including former field boundaries, medieval/post-medieval ridge and furrow cultivation, modern ploughing and land drains.

Uncertain anomalies within the dataset may have an archaeological origin; those in the west of the survey area may be associated with the medieval village of Broxholme whilst others may represent field systems.

Circular areas of magnetic disturbance relate to electricity pylons and a service pipe has also been recorded. Based on the geophysical survey the archaeological potential of the study site is deemed to be low.

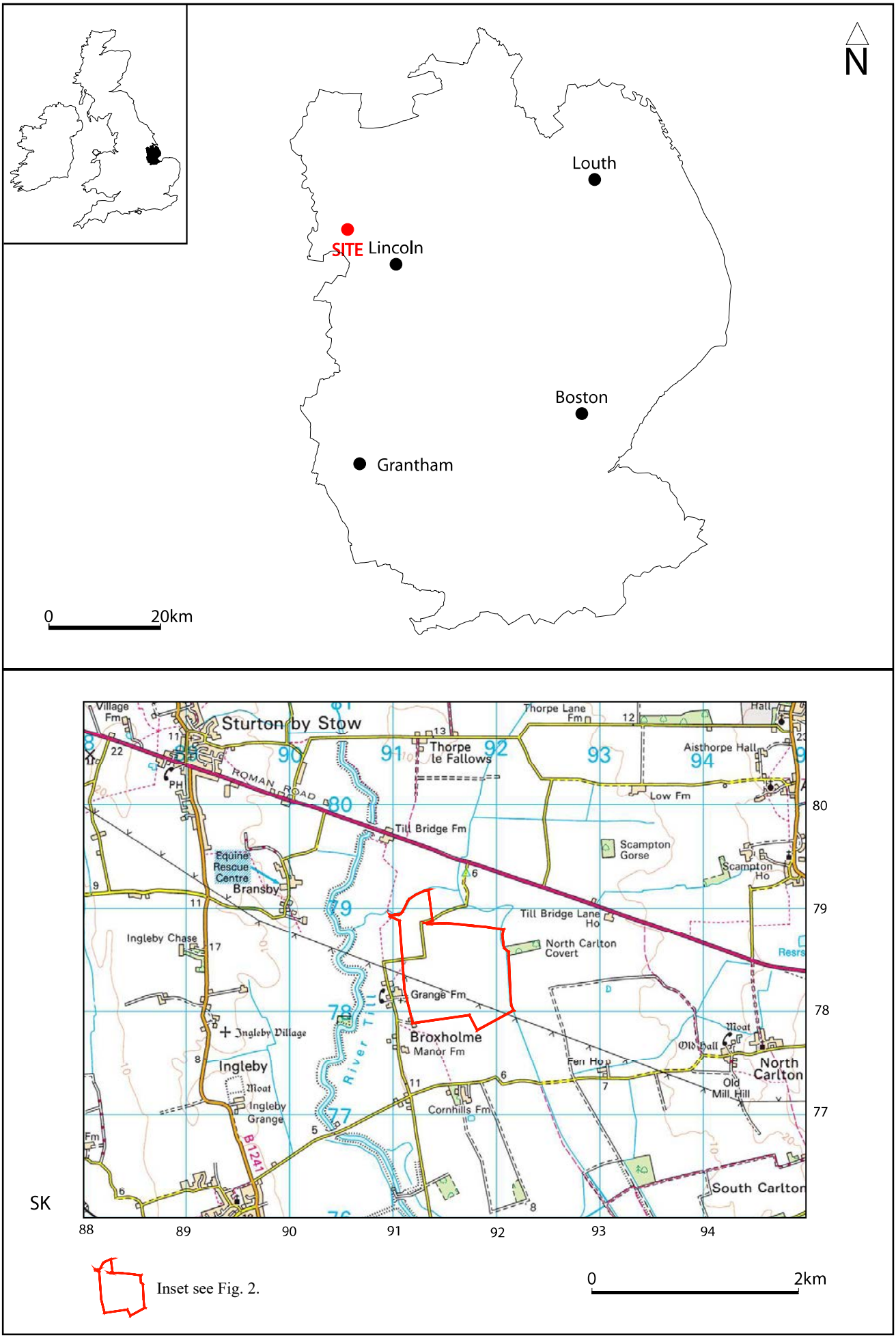

Fig. 1. Site location

N

SECTOR 1
SEE FIGS 5-7

SECTOR 3
SEE FIGS 11-13

M1

M4

SECTOR 2
SEE FIGS 8-10

SECTOR 4
SEE FIGS 14-16

M2

M5

SECTOR 5
SEE FIGS 17-19

M3

Broxholme

SECTOR 6
SEE FIGS 20-22

SECTOR 7
SEE FIGS 23-24

379000

378000

491000

492000

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Location of survey areas

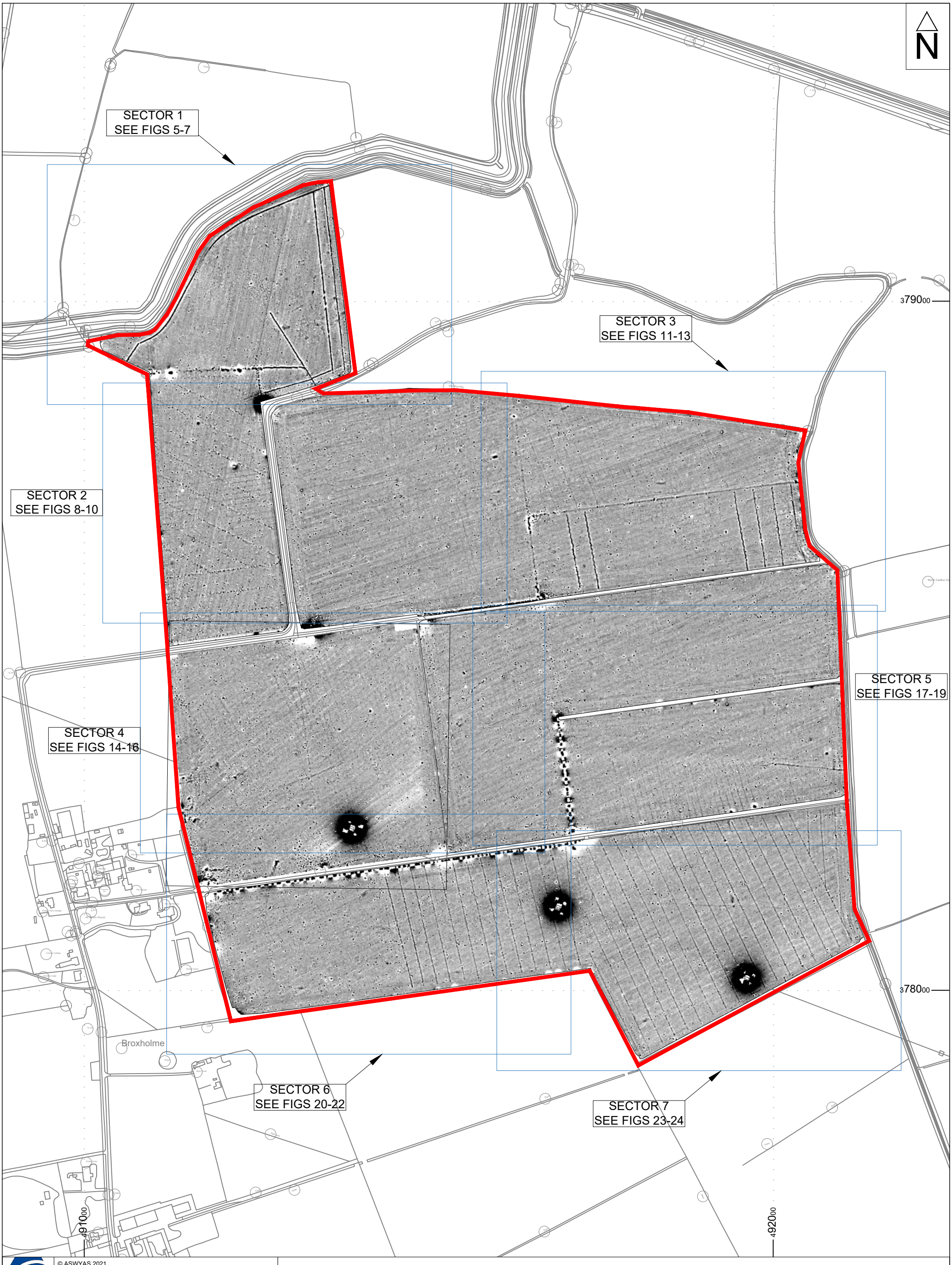
Fig.2

Title

	SURVEY AREA
M1	FIELD NUMBERS
	SCHEDULED MONUMENT

0 300m

1:7500 @ A3



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Survey location showing processed magnetomer data

Fig.3

Title

SURVEY AREA

SECTOR BOUNDARY

nT -1.0 1.0

0 200m

1:5000 @ A3

SECTOR 1
SEE FIGS 5-7

SECTOR 3
SEE FIGS 11-13

SECTOR 2
SEE FIGS 8-10

SECTOR 5
SEE FIGS 17-19

SECTOR 4
SEE FIGS 14-16

SECTOR 6
SEE FIGS 20-22

SECTOR 7
SEE FIGS 23-24

N

3790 00

3780 00

4910 00

4920 00

Broxholme

U1 U2 U3 U4 U5 U6 U7

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Overall interpretation of magnetomer data

Fig.4

Interpretation

FERROUS	AGRICULTURAL
MAGNETIC DISTURBANCE	FORMER FIELD BOUNDARY
FIELD DRAIN	GEOLOGY
RIDGE & FURROW	UNCERTAIN

0 200m

1:5000 @ A3

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Processed greyscale magnetometer data; Sector 1

Fig. 5

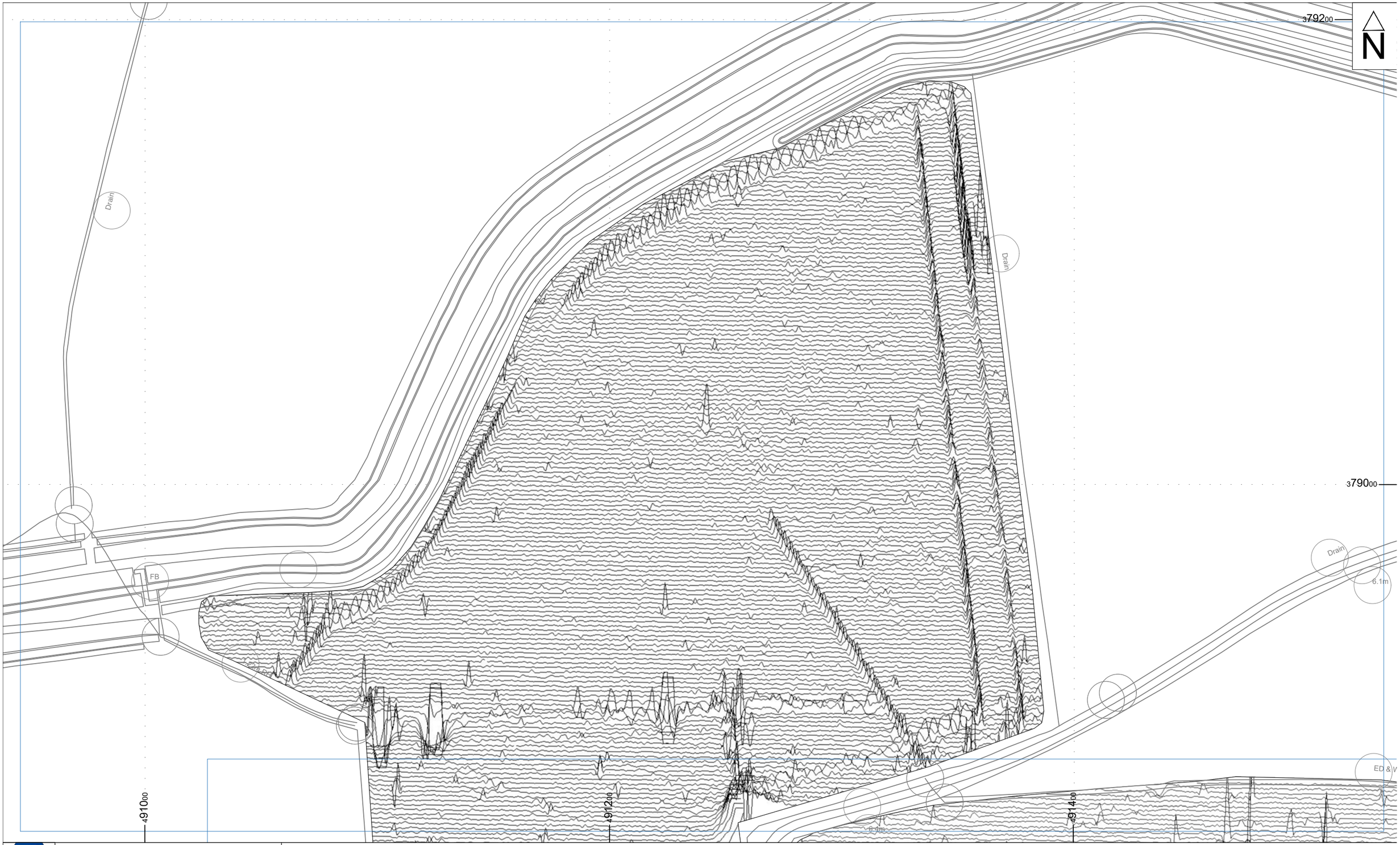
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 1

Fig. 6

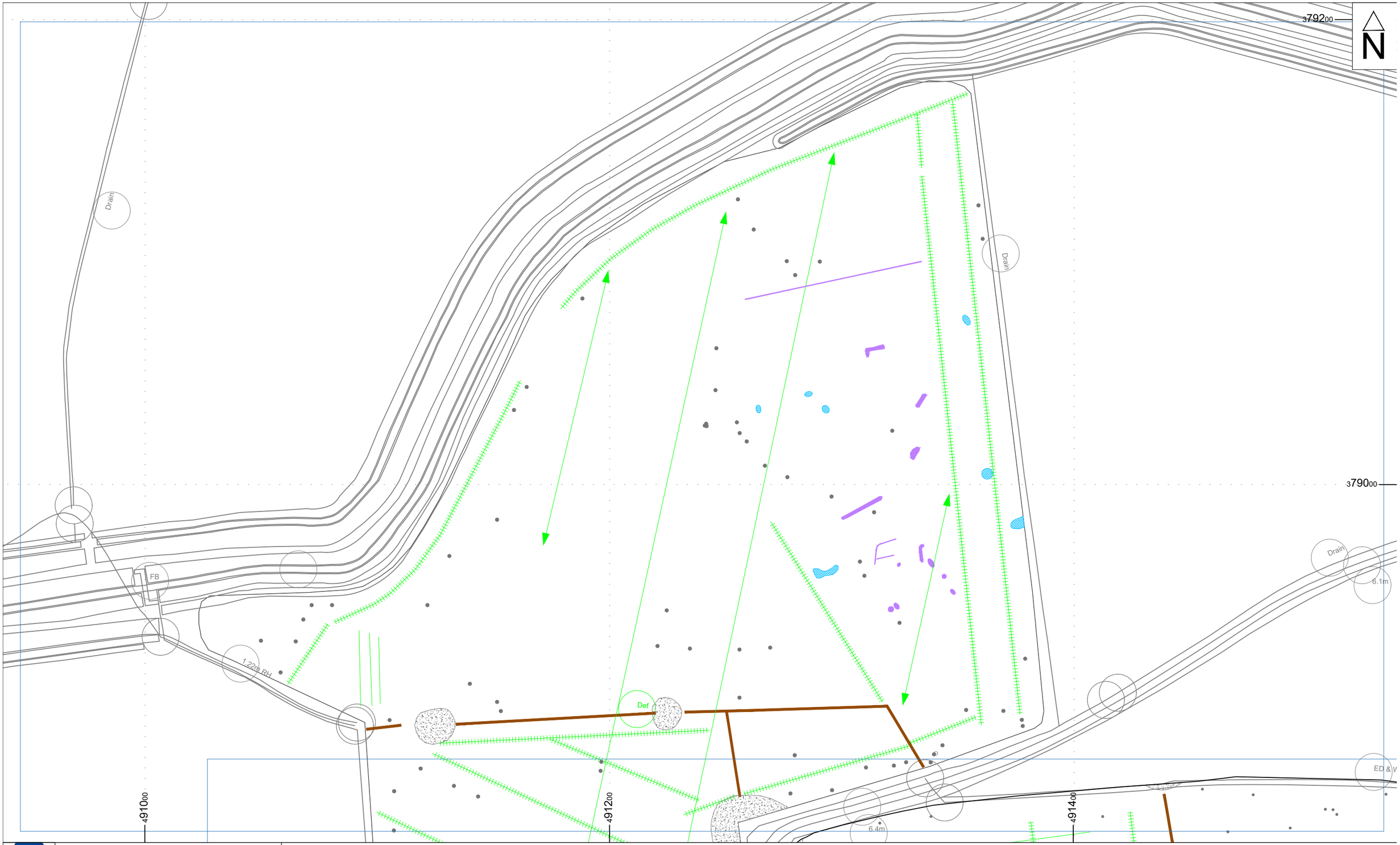
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 1

Fig. 6

Title

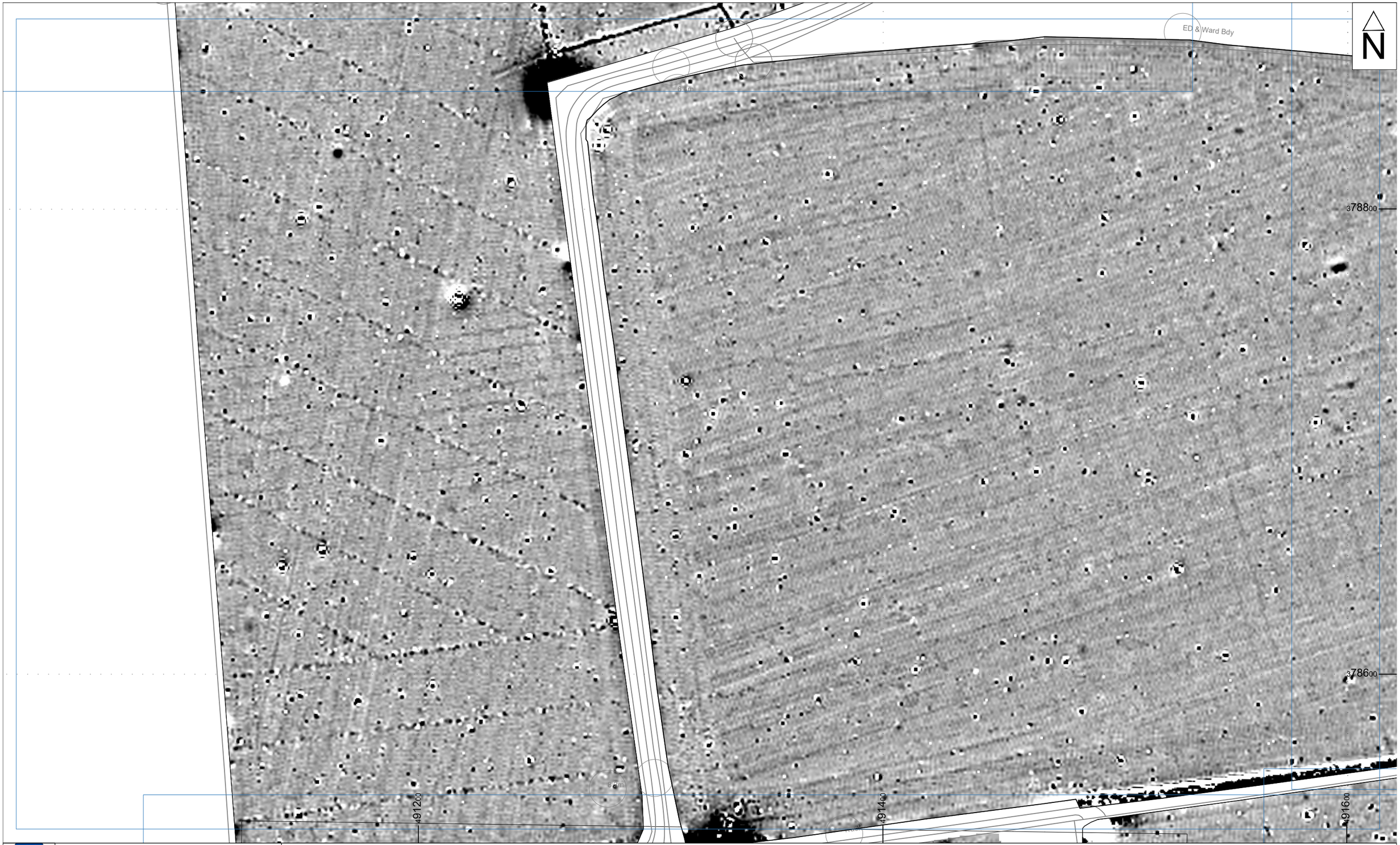
- SECTOR BOUNDARY

Interpretation

- FERROUS
- MAGNETIC DISTURBANCE
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3



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Processed greyscale magnetometer data; Sector 2

Fig. 8

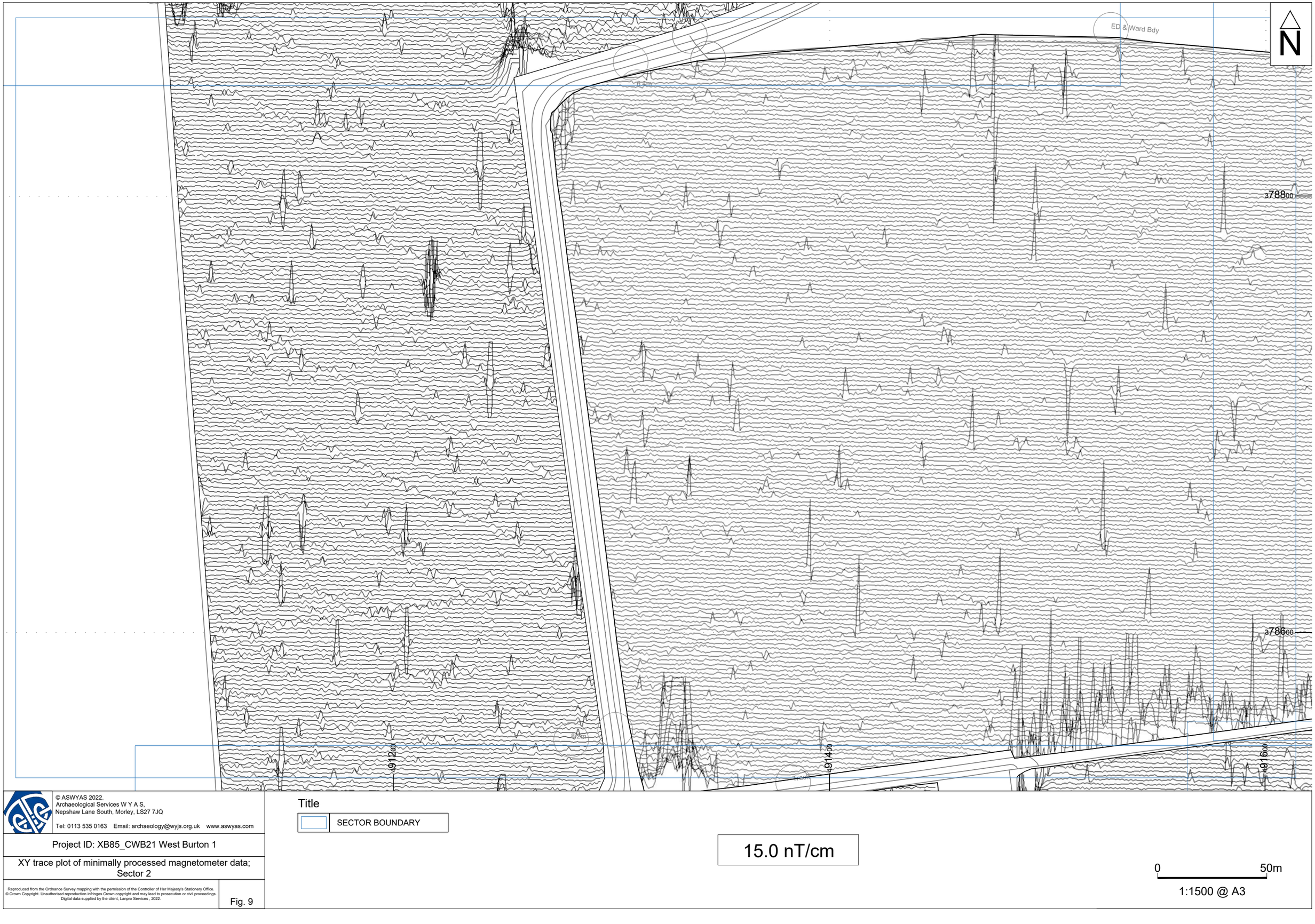
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 2

Fig. 9

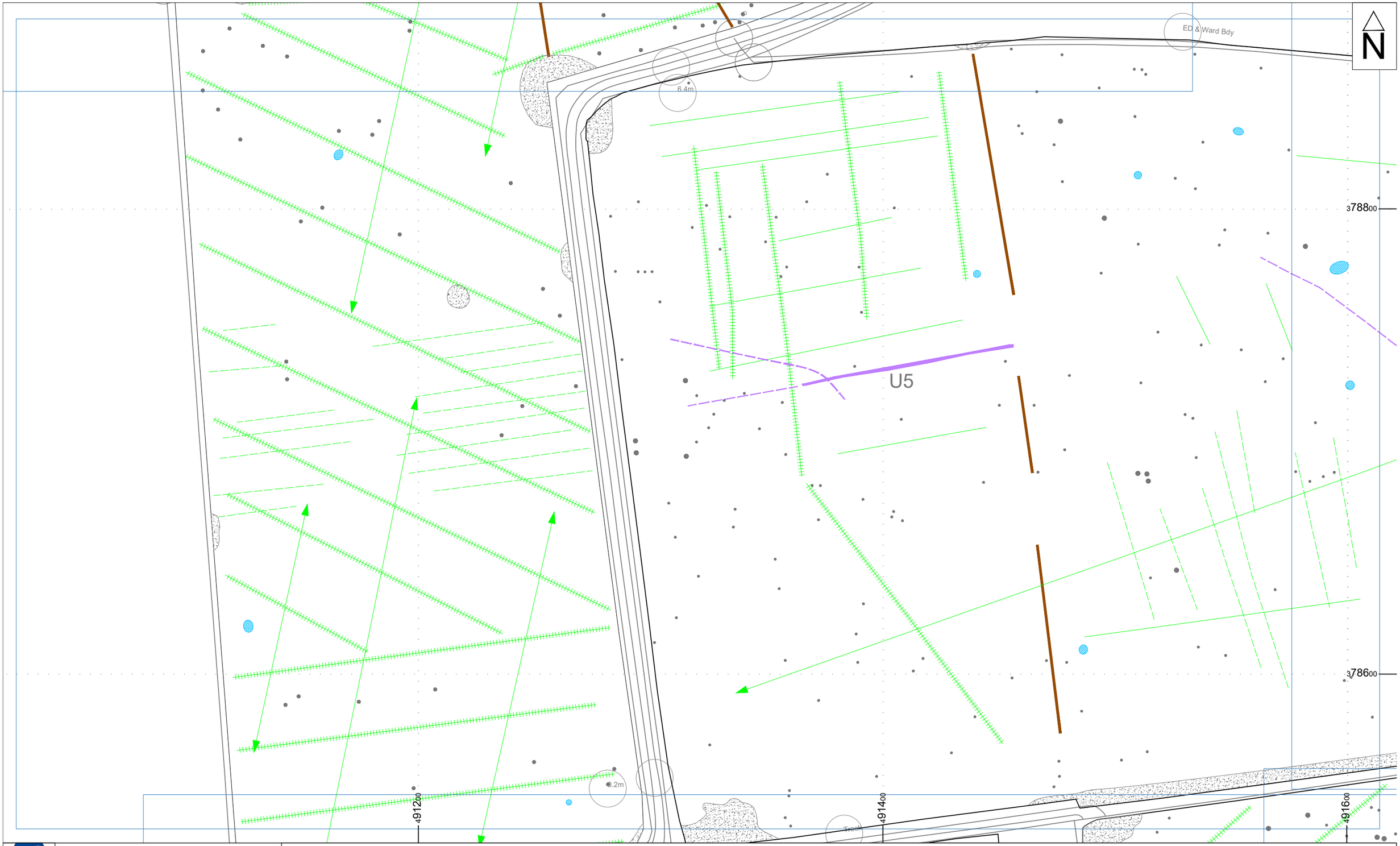
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3



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Interpretation of magnetometer data; Sector 2

Fig. 10

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3

N

3788$_{00}$

3786$_{00}$

Drain

4916$_{00}$

4918$_{00}$

4920$_{00}$

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Processed greyscale magnetometer data; Sector 3

Fig. 11

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3

N

3788 00

3786 00

4916 00

4918 00

4920 00

Drain

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XY trace plot of minimally processed magnetometer data; Sector 3

Fig. 12

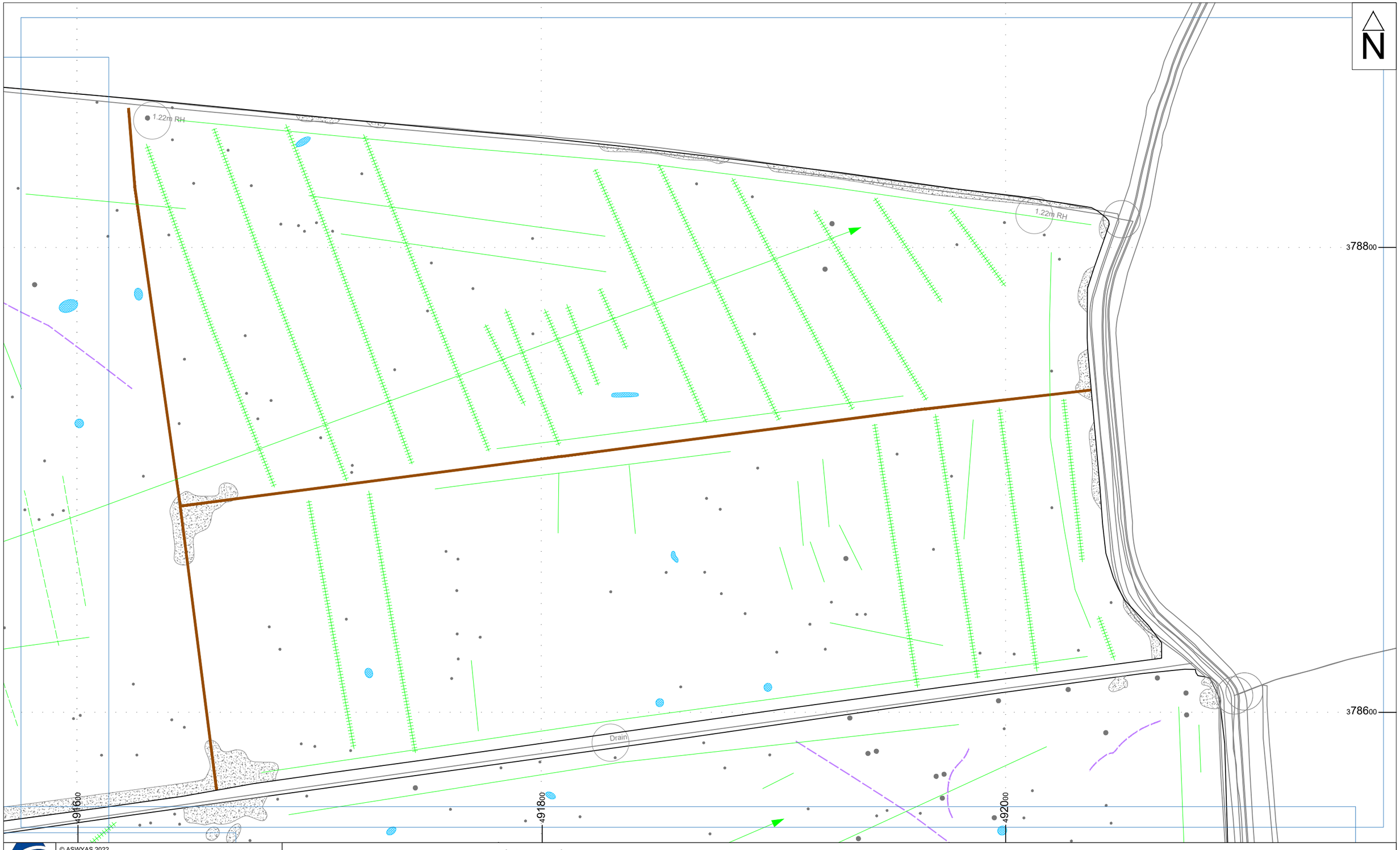
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3



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Interpretation of magnetometer data; Sector 3

Fig. 13

Title

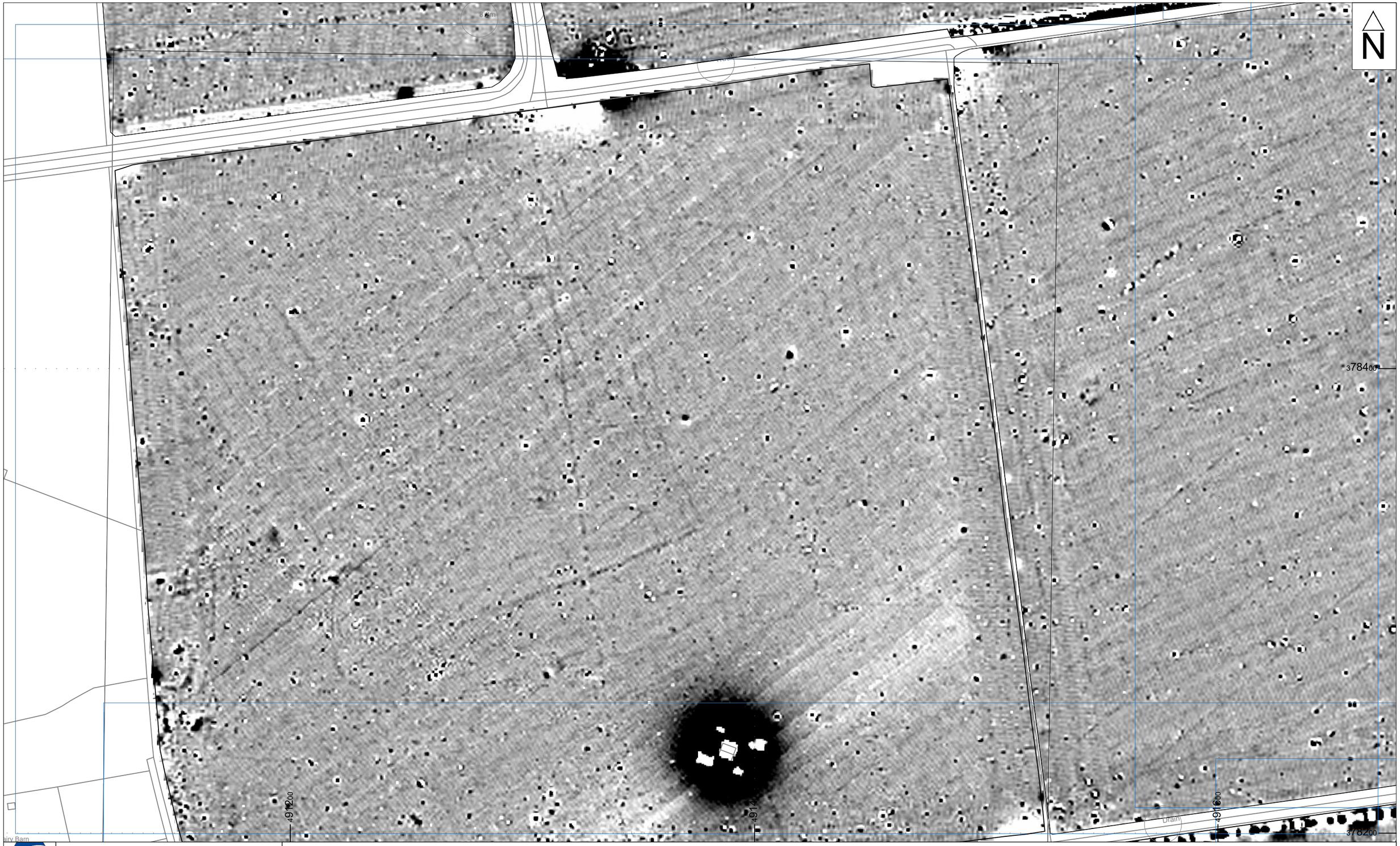
- SECTOR BOUNDARY

Interpretation

- FERROUS
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3



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Processed greyscale magnetometer data; Sector 4

Fig. 14

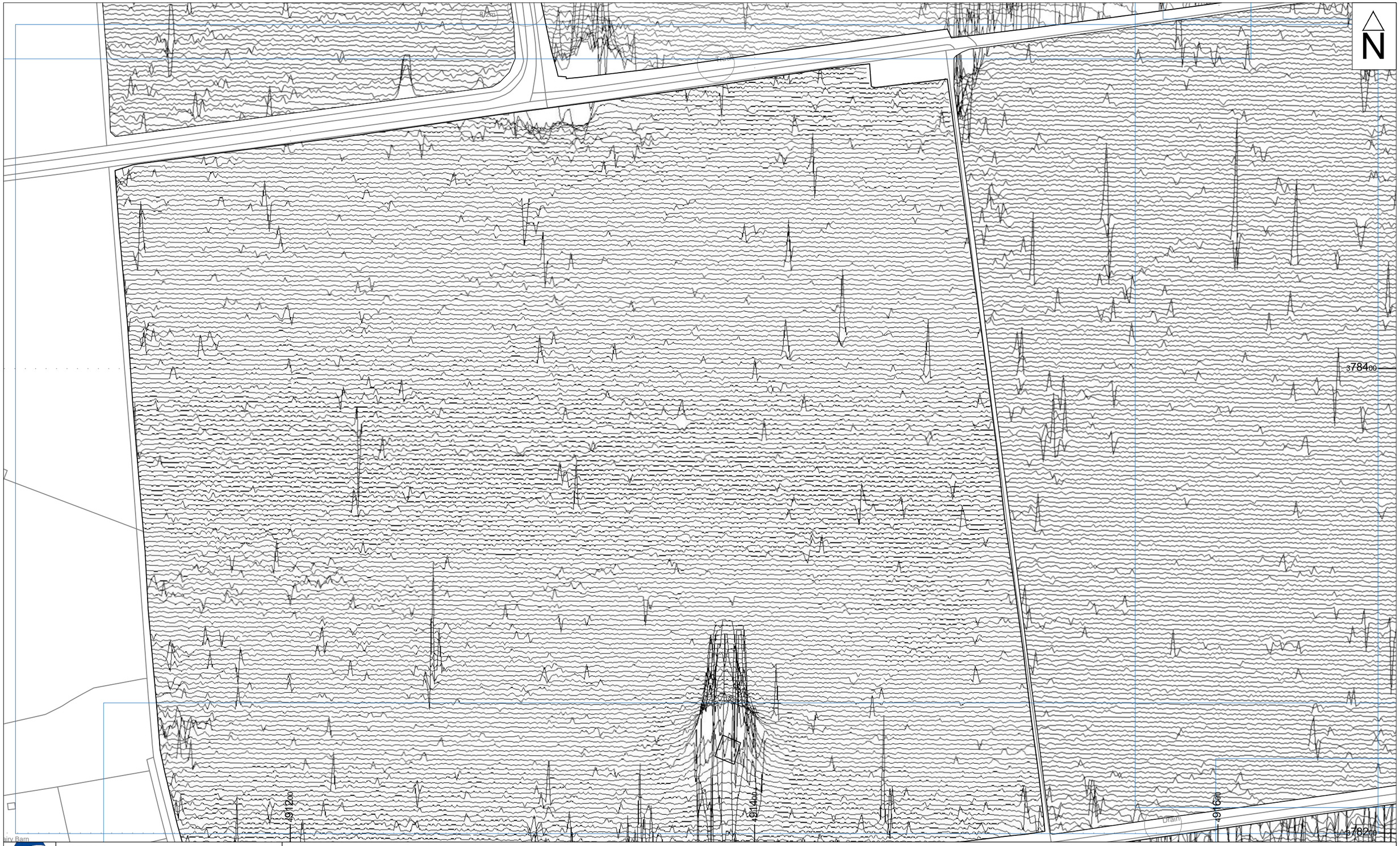
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 4

Fig. 15

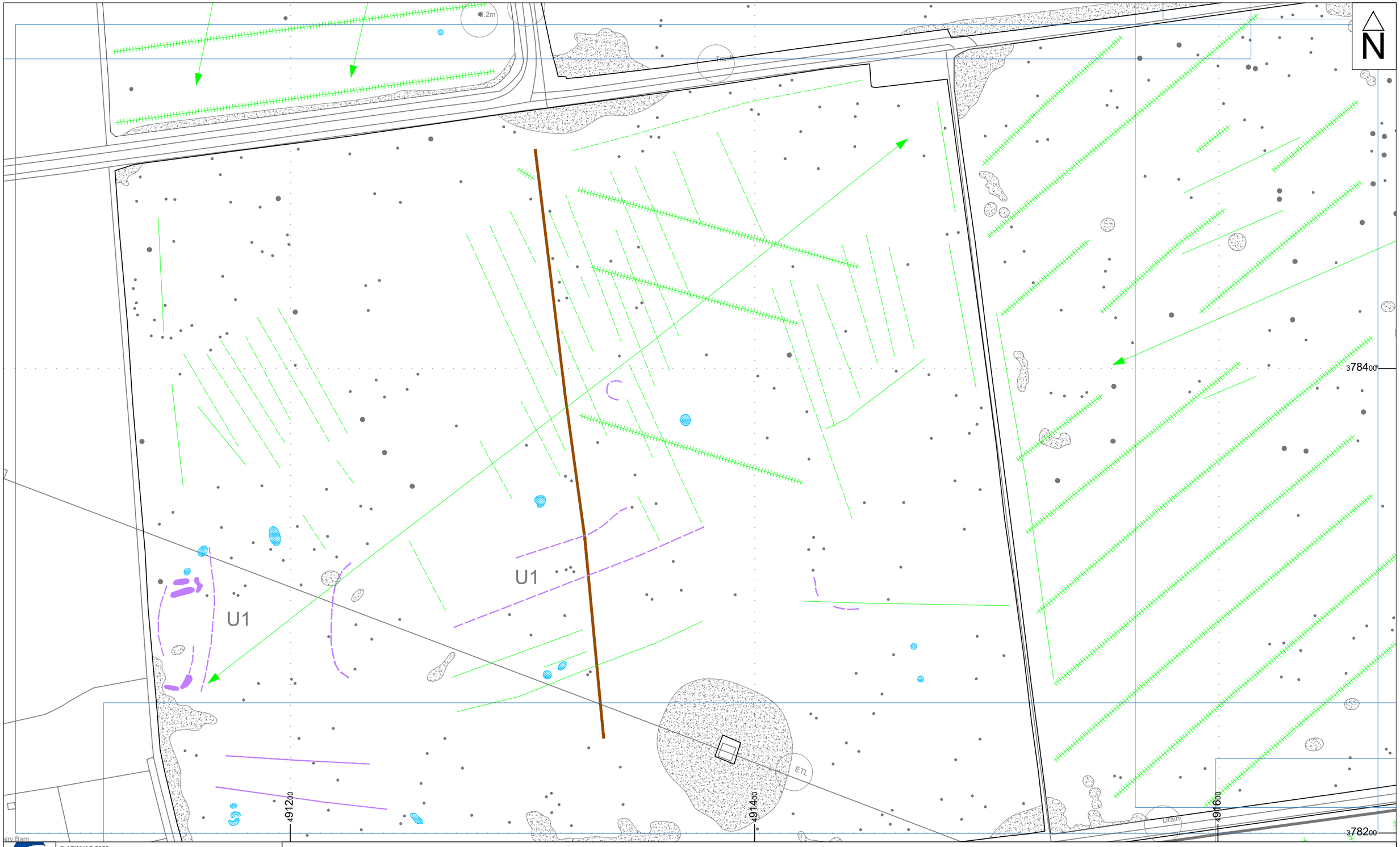
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3



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Interpretation of magnetometer data; Sector 4

Fig. 16

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3

N

Drain

Drain

Drain

Drain

3784 00

4916 00

4918 00

4920 00

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Processed greyscale magnetometer data; Sector 5

Fig. 17

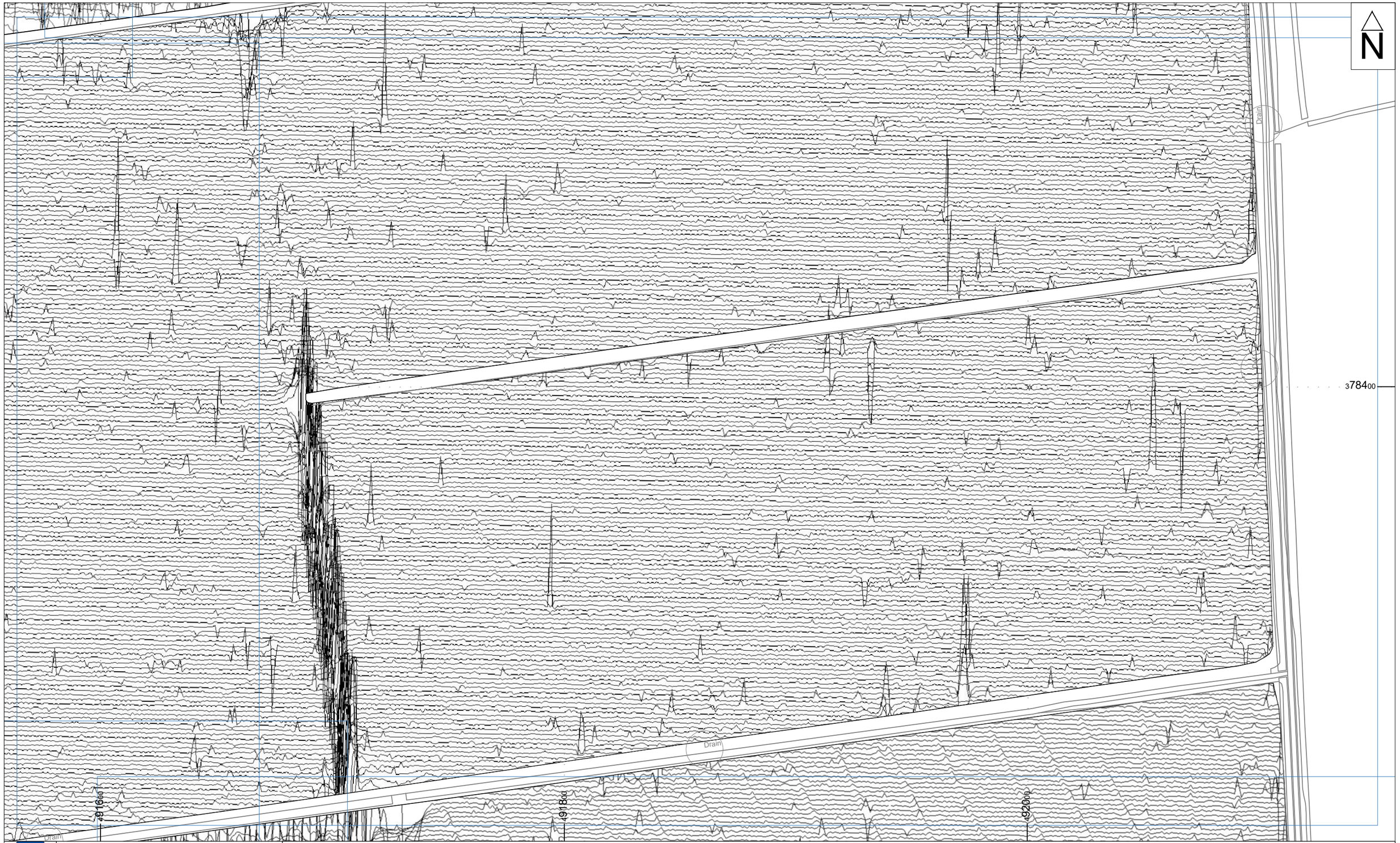
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 5

Fig. 18

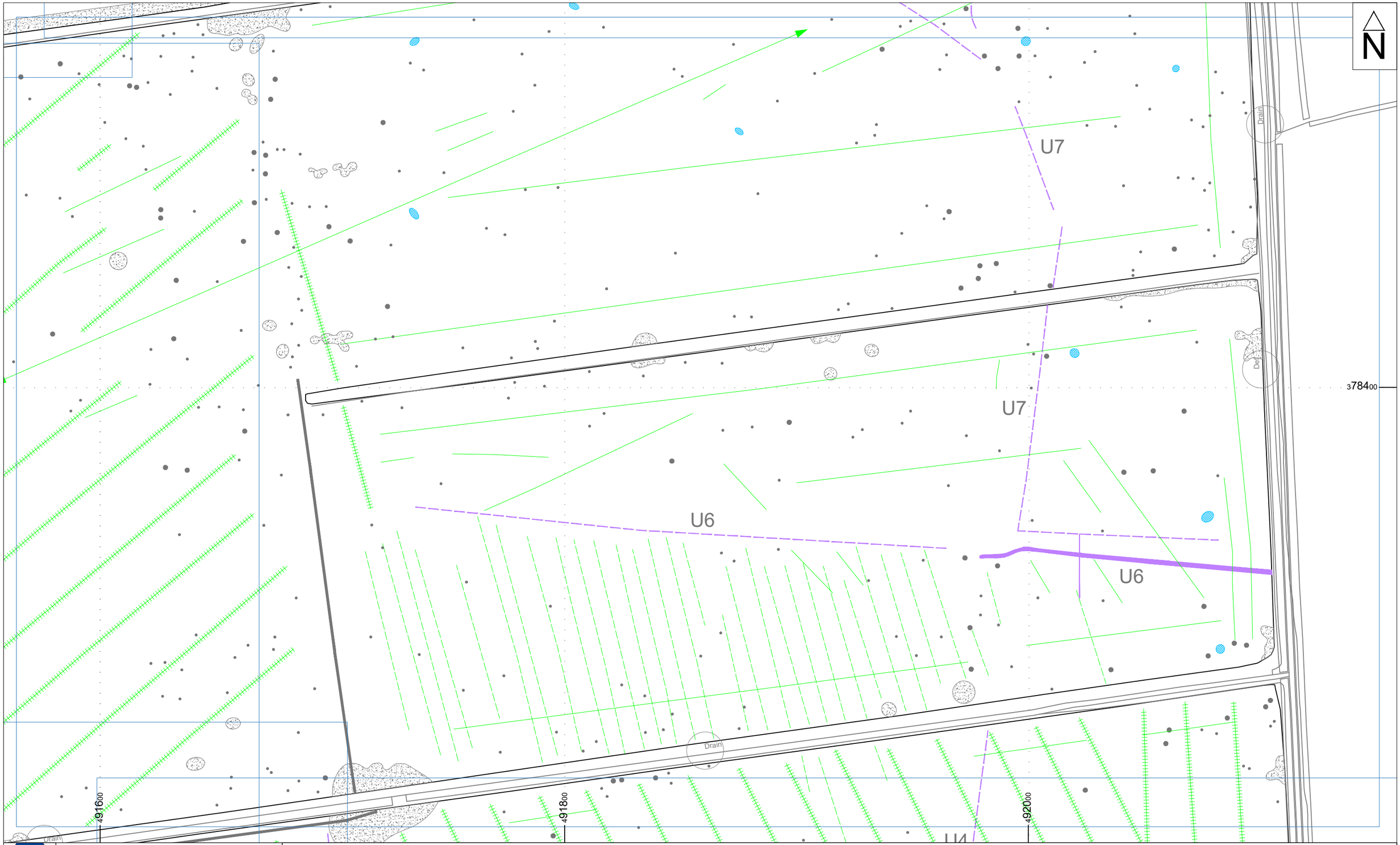
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3



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Project ID: XB85_CWB21 West Burton 1

Interpretation of magnetometer data; Sector 5

Fig. 19

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3

Archaeological Services W Y A S,
Nepshaw Lane South, Morley, LS27 7JQ
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Project ID: XB85_CWB21 West Burton 1

Processed greyscale magnetometer data; Sector 6

Fig. 20

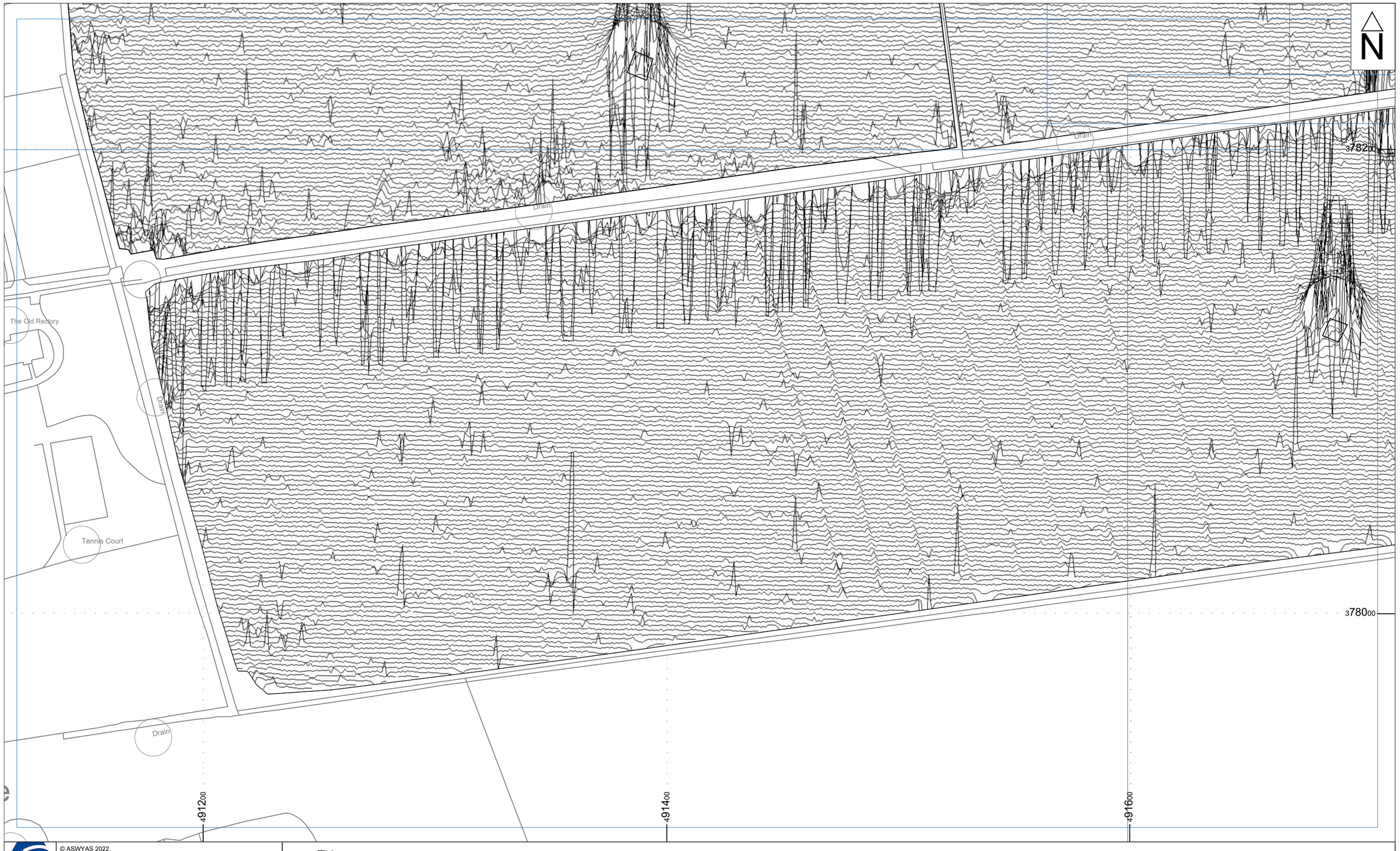
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



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Project ID: XB85_CWB21 West Burton 1

XY trace plot of minimally processed magnetometer data; Sector 6

Fig. 21

Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3

N

U1

U3

ETL

Drain

Drain

Drain

Drain

The Old Rectory

Tennis Court

3782$_{00}$

3780$_{00}$

4912$_{00}$

4914$_{00}$

4916$_{00}$

Archaeological Services W Y A S,
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Project ID: XB85_CWB21 West Burton 1

Interpretation of magnetometer data; Sector 6

Fig. 22

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3

N

3782 00

3780 00

4916 00

4918 00

4920 00

Archaeological Services W Y A S,
Nepshaw Lane South, Morley, LS27 7JQ

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Project ID: XB85_CWB21 West Burton 1

Processed greyscale magnetometer data; Sector 7

Fig. 23

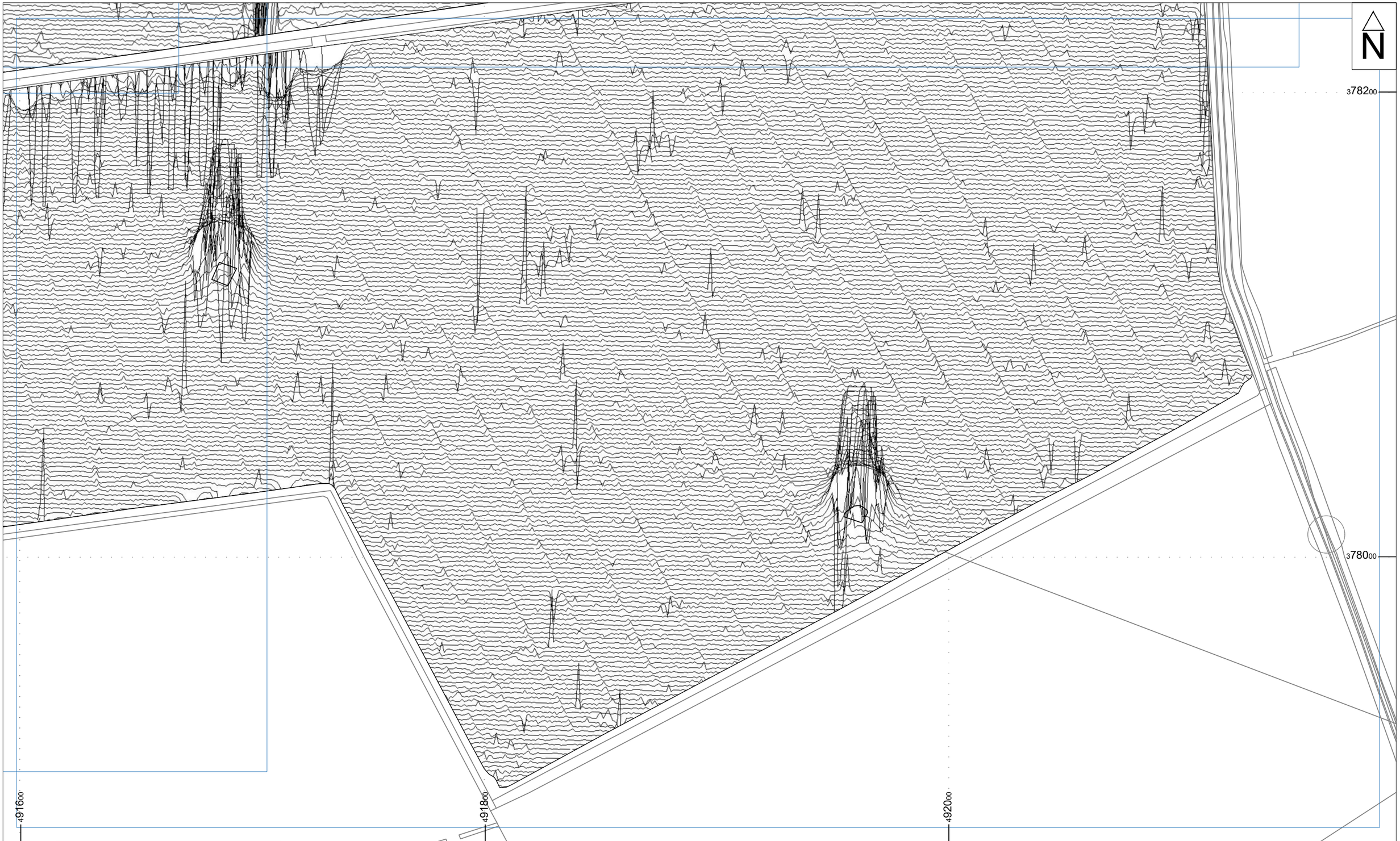
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1500 @ A3



Archaeological Services W Y A S,
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Project ID: XB85_CWB21 West Burton 1

XY trace plot of minimally processed magnetometer data; Sector 7

Fig. 24

Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1500 @ A3

N

U3

U4

U2

3782 00

3780 00

4916 00

4918 00

4920 00

Archaeological Services W Y A S,
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Project ID: XB85_CWB21 West Burton 1

Interpretation of magnetometer data; Sector 7

Fig. 25

Title

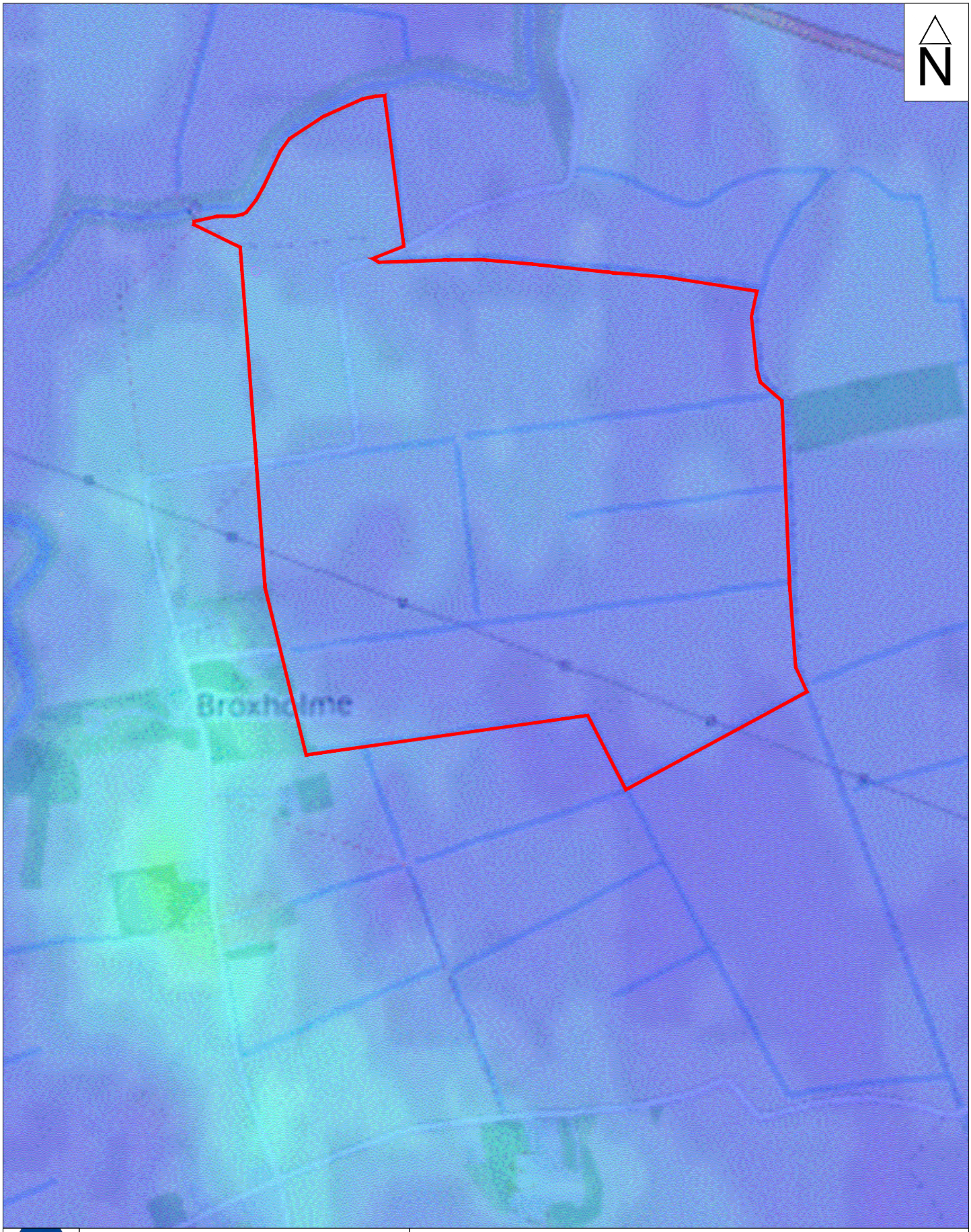
- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- RIDGE & FURROW
- FIELD DRAIN
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- UNCERTAIN

0 50m

1:1500 @ A3



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Project ID: XB85_CWB21 West Burton 1

Topographic map, elevation relief

4m 17m

Reproduced from https://en-gb.topographic-map.com/maps 2022

Fig. 26

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.

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 on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have 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.

Appendix 2: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment 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 and metadata

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 Lincolnshire Historic Environment Record).

Area M1

filename	XB85_1_2.xcp
instument	Sensys DLMGPS
units	nT
survey coordinates:	
SW	491013.010, 378500.511
NE	491393.414, 379174.321
dummy value	2047.5
source GPS points	9085340
survey size	371 m x 679 m
x and y interval	1m
stats:	
max	877.04
min	-958.72
std dev	5.90
mean	0.07
median	-0.03
composite area	25.191 ha
surveyed area	12.991 ha
program	TerraSurveyorPre Version:3.0.37.12
GPS based processes	Base Layer
	Interpolate: X & Y Doubled.

Area M2

filename	XB85_4.xcp
instument	Sensys DLMGPS
units	nT
survey coordinates:	
SW	491118.648, 378152.037
NE	491530.960, 378531.342
dummy value	2047.5
source GPS points	7094154
survey size	407 m x 385 m
x and y interval	1m
stats:	
max	235.32
min	-392.29
std dev	3.80
mean	0.08
median	-0.06
composite area	15.67 ha
surveyed area	12.469 ha
program	TerraSurveyorPre Version:3.0.37.12
GPS based processes	Base Layer
	Interpolate: X & Y Doubled.

Area M3

filename	XB85_6.xcp
instument	Sensys DLMGPS
units	nT
survey coordinates:	
SW	491170.742, 377908.036
NE	492134.907, 378273.696
dummy value	2047.5
source GPS points	12509404
survey size	959 m x 379 m
x and y interval	1m
stats:	
max	643.60
min	-650.82
std dev	9.46
mean	0.12
median	-0.06
composite area	36.346 ha
surveyed area	20.488 ha
program	TerraSurveyorPre Version:3.0.37.12
GPS based processes	Base Layer
	Interpolate: X & Y Doubled.

Area M4

filename	XB85_3.xcp
instument	Sensys DLMGPS
units	nT
survey coordinates:	
SW	491266.789, 378524.196
NE	492071.886, 378866.368
dummy value	2047.5
source GPS points	12108943
survey size	803 m x 355 m
x and y interval	1m
stats:	
max	501.94
min	-443.68
std dev	4.91
mean	0.08
median	-0.02
composite area	28.507 ha
surveyed area	21.622 ha
program	TerraSurveyorPre Version:3.0.37.12
GPS based processes	Base Layer
	Interpolate: X & Y Doubled.

Area M5

filename	XB85_5.xcp
instument	Sensys DLMGPS
units	nT
survey coordinates:	
SW	491479.878, 378199.043
NE	492111.936, 378620.087
dummy value	2047.5
source GPS points	12372194
survey size	626 m x 430 m
x and y interval	1m
stats:	
max	406.61
min	-908.97
std dev	5.72
mean	-0.07
median	-0.04
composite area	26.918 ha
surveyed area	20.175 ha
program	TerraSurveyorPre Version:3.0.37.12
GPS based processes	Base Layer
	Interpolate: X & Y Doubled.

Appendix 4: Oasis form

Summary for archaeol11-505405

OASIS ID (UID)	archaeol11-505405
Project Name	Geophysical Survey at West Burton 1
Sitename	
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	
Planning Id	
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	Archaeological Services WYAS
Project Dates	08-Nov-2021 - 15-Nov-2021
Location	West Burton 1 NGR : SK 91540 78440 LL : 53.2950213100435, -0.628062293274262 12 Fig : 491540,378440
Administrative Areas	Country : England County : Lincolnshire District : West Lindsey Parish : Broxholme
Project Methodology	The cart-based survey was undertaken using an eight channel SenSYS MX V3 system containing eight FGM650 sensors. Readings are taken every 20MHz (between 0.05 and 0.1m). Data were recorded onto a device, using a Carlson GNSS Smart antenna, for centimetre accuracy. These readings were stored in the memory of the instrument and downloaded for processing and interpretation. DLMGPS and MAGNETO software, alongside bespoke in-house software was used to process and present the data.
Project Results	A geophysical (magnetometer) survey was undertaken on approximately 89 hectares of land located to the east of Broxholme, Lincolnshire. The majority of the anomalies recorded are agricultural including field drains, ridge and furrow cultivation, modern ploughing and former field boundaries. Anomalies of an uncertain origin have been recorded which may be of some archaeological interest. Based on the geophysical survey the archaeological potential of this site is deemed to be low.
Keywords	
Funder	
HER	Lincolnshire HER - unRev - STANDARD
Person Responsible for work	Emma, Brunning
HER Identifiers	
Archives	

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