Canworthy Water Solar Farm

Launceston

Cornwall

Geophysical Survey

Report no. 3781
May 2022

Client: Windel Solar 4 Ltd

Canworthy Water Solar Farm

Launceston

Cornwall

Geophysical Survey

Summary

A geophysical (magnetometer) survey was undertaken on approximately 69ha of land proposed for solar development within a larger redline area located to the north of Canworthy Water, Launceston, Cornwall. Anomalies of both a definite and a possible archaeological origin have been detected including ring ditches, a 'D' shaped enclosure, ditches, pits, field systems and possible trackways indicative of a prehistoric landscape. Medieval/post-medieval ridge and furrow cultivation has also been detected along with former field boundaries, in a typical Cornish construction. Geological responses can be seen throughout and are typically noisy given the magnetic Cornish soils. Magnetic disturbance within the Site can be assigned to noise from adjacent farm buildings, electricity pylons and metal fencing in the boundaries. Based on the geophysical survey, the archaeological potential of the Site is high in the southeast and moderate to low elsewhere.

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Services

Report Information

Client:	Windel Solar 4 Ltd
Address:	S10, Blyth Workspace, Commissioners Quay, Quay Road, Blyth, NE24 3AG
Report Type:	Geophysical Survey
Location:	Launceston
County:	Cornwall
Grid Reference:	SX 2293 9280
Period(s) of activity:	Prehistoric/medieval/modern
Report Number:	3781
Project Number:	XE20
Site Code:	HGW22
OASIS ID:	archaeol11-506992
Date of fieldwork:	April and May 2022
Date of report:	May 2022
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1 Introduction

Archaeological Services ASWYAS has been commissioned by Pegasus Group on behalf of Windel Solar 4 Ltd to undertake a geophysical survey at land at Higher Witheven and Canworthy Farms, Cornwall. This was undertaken in line with current best practice (CIfA 2020; Schmidt *et al.* 2016). The survey was carried out between 25th of April and 6th May 2022 to provide additional information on the archaeological resource of the Site.

Site location, topography and land-use

The Site is located to the north of Canworthy Water, centred at SX 2293 9280 (see Fig. 1). The survey area consists of approximately 69ha over 16 fields of pasture land (see Plates 1-13, which are proposed for solar arrays and associated infrastructure. The remaining land of the application area (See Fig. 2) is intended for landscape/ecological mitigation and so is excluded from the scope of the survey.

The survey area is surrounded by pasture land and is bounded to the east by Exe Water, to the northeast by a solar farm and to the south by Higher Witheven and Canworthy Farms. The above Ordnance Datum (aOD) varies across the Site, lying at approximately 127m aOD in the north and 141m aOD in the south.

Soils and geology

The underlying bedrock of the survey area comprises mudstone and siltstone of the Crackington Formation, a sedimentary bedrock formed approximately 318 to 328 million years ago in the Carboniferous Period. Superficial deposits have not been recorded (BGS 2022). Soils of the survey area belong to the Neath Association (541h), which are described as well drained fine loamy soils often over rock with small patches of similar soils with slowly permeable subsoils and slight seasonal waterlogging (SSEW 1983).

2 Archaeological Background

The following archaeological background is an extract provided by Pegasus Group from their draft Heritage Desk-Based Assessment, which is informed by Cornwall Historic Environment Record data and other sources of information.

Eight possible locations of Bronze Age burial mounds, known as barrows, are recorded within the study area. Three lie within the eastern part of the Site and apparently have been identified from cropmarks visible on historic aerial photographs. The cropmarks are described by the HER as a sub-circular hollow measuring 21m in diameter (MCO36417), a sub-circular mound measuring 26m in diameter (MCO36418), and a sub-oval hollow measuring 34m by 28m (MCO36421).

The cropmarks were not identified on any of the historic aerial photographs consulted at Historic England Archives for this assessment. However it was noted that the field containing the cropmarks comprised four fields in 1946 and then two plus a small subdivided plantation or scrubby enclosure in the 1960s, with cropmark MCO36417 situated at or near the field/plantation boundary. By 1996 the vegetation had been cleared and a pylon had been erected.

Several features of possible early medieval origin are recorded within the study area. Cropmarks of linear ditches recorded within the southern-central and western-central parts of the Site are interpreted by the HER as representing the buried remains of former field boundaries or paths (MCO36410, MCO36413). No surface remains of these features were identified during the Site walkover survey carried out for this assessment.

Records from the 13th and 14th centuries name Gorracott, Castle Millford, Canworthy, Higher Witheven, Witheven (Bridge), Lower Exe, Higher Exe, Langdon, Higher Langdon, South Wheatley, and Pattacott. There are possible earthwork remains of deserted medieval settlement at Higher Exe *c*. 450m north of the Site (MCO36440) and at Witheven *c*. 370m south-west of the Site (MCO36362). Extant field boundaries at Higher Exe *c*. 450m north of the Site (MCO22462) and South Wheatley Farm *c*. 850m east of the Site may be of medieval origin (MCO36408).

Other ‘monuments’ within the study area and attributed to the post-medieval and modern periods comprise farmsteads, domestic buildings, and bridges; and earthwork and cropmark evidence of historic land use, namely agricultural activity and quarrying. These include ridge and furrow and/or drains (MCO36412) and a well (MCO22460) in the southern part of the Site to the east of Higher Witheven; and possible drainage system in the north-western part of the Site (MCO36422).

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 survey area 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 shows the survey location at a scale of 1:7500. Figure 3 displays processed magnetometer data at a scale of 1:6000 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 37 inclusive at a scale of 1:1250.

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 2020). 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 37)

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.

A large area of magnetic disturbance in the west of Area 2a may be associated with modern burnt/fired debris due to the ferrous content. Due to the nature of the Cornish geology (being generally magnetically noisy), a geological origin is also possible.

Magnetic disturbance in the east of Area 2b and in the south of Area 10 are due to the locations of large electricity pylons as shown on the digital mapping.

Magnetic disturbance in the south of Area 4, in the west of Area 10 and the west of Area 11 are due to nearby farm buildings.

Magnetic disturbance along the limits of the survey areas are due to metal fencing within the field boundaries and interference from the adjacent roads.

Bisecting the western half of Areas 11 and 12, linear dipolar trends have been recorded which relate to buried services.

Geological anomalies

The survey has detected a number 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. The geology of Cornwall is known for its magnetic nature which causes an increase in the background noise and can mask archaeological responses.

The interpretation figures show the geological responses divided into three categories; representing a zone of geology (where there are large areas of increased geological responses), discrete anomalies and trends.

The majority of the archaeological responses recorded during this survey have been located within the ‘geological zones’ and will be discussed more below.

Agricultural anomalies

A number of former field boundaries have been recorded throughout the site. Historic Cornish field boundaries often result in a positive-negative-positive response which equates to a ditch-bank/wall-ditch arrangement.

Linear trend **FFB1** in Area 1 (Sector 1) is shown as a weak negative-positive linear and is likely to be a former boundary which pre-dates any available historic mapping. **FFB1** lies on the same alignment as the current field boundaries to the north and south therefore adding weight to the interpretation.

Boundary **FFB2** in Area 2b (Sector 2) corresponds to historic mapping dated 1875 (CC 2022) and has been removed by 1963 (NLS 2022).

Another possible boundary (**FFB3**) which is not depicted on historic mapping lies in the south of Area 5 (Sector 3). The response is shown as a short trend and the whole of the boundary is likely to have been masked by the geology in the vicinity.

Classic Cornish boundary **FFB4** in Area 7 (Sector 4) corresponds with a former boundary shown on the Warbstow Tithe map (CC 2022). The response is very strong, suggesting that the ditches are filled with the increased magnetic soils within the field. Two linear trends to the east of **FFB4** may be indicative of field boundaries although another agricultural origin is also possible such as deep tractor ruts.

A small section of a former boundary (**FFB5**) has been recorded in the west of Area 8 (Sector 6). It is possible that this boundary was not of the classic Cornish style and has been completely removed hence the lack of further responses.

The survey within Area 9 (Sector 7) has recorded further Cornish boundaries (**FFB6-8**). Boundaries **FFB6** and **FFB7** correspond to those shown on the Warbstow Tithe map. By 1906 **FFB7** has been removed (CC2022); **FF6** was removed by the 1963 map (NLS 2022). There is no corroborative evidence for **FFB8** but it is clearly a boundary pre-dating the tithe map.

The corner of a boundary (**FFB9**) in the north of Area 10 (Sector 7) and a short section of a boundary (**FFB10**) appear on the Tithe map only. Boundary **FFB11** is also shown on the Tithe map but has been removed by 1906 (CC 2022).

The boundaries (**FFB11**) within Area 11 (Sector 8) correspond with the Tithe map and are *in situ* until the map dated 1963 (NLS 2022). Boundaries **FFB12** and **FFB13** in Area 12 (Sectors 8 and 9) also are shown on the Tithe map, with **FFB12** being removed by 1963 and **FFB13** still being shown on the 1963 map (NLS 2022).

Sections of former boundaries (**FFB14** and **FFB15**) in Area 14 (Sector 10) also correspond to the historic field system recorded by the Tithe map. Boundary **FFB14** has been removed by 1906 whilst **FFB15** still appears on the 1963 map.

Boundary **FFB17** in the south of Area 15 corresponds with the Tithe map only (CC 2022).

Medieval or post-medieval ridge and furrow cultivation has been recorded in Areas 3, 6, 7, 9, 10, 11 and 12. Some of the cultivation is just visible within the data, such as those in Areas 11 and 12.

Linear trends **A1**, **A2, A3** and **A4** in Areas 1, 2a, 2b and 4 (Sectors 1-3) respectively correspond to footpaths which were noted in the field and can also be seen on aerial images.

Field drains have been recorded in Areas 1, 3, 4 and 13.

Trends associated with an agricultural origin have been recorded throughout the survey area and may be associated with past ploughing, tractor movement and possible drains.

Uncertain anomalies

Anomalies with an uncertain interpretation have been recorded in a number of areas. These have proven difficult to ascertain an origin and cause due to ill-defined responses or disturbance from nearby responses and geology. Due to the amount of archaeological responses within the Site, an archaeological origin for any of these anomalies is possible.

A group of linear and pit-like responses (**U1**) have been recorded in the north of Area 2b (Sector 2). The magnetic strength of these and their rectilinear pattern suggest archaeological featuers but the overlapping responses makes an interpretation difficult.

Linear trends **U2** in Area 4 (Sector 3) are in the vicinity of possible archaeological anomalies (**P3**) and may be a continuation or have an association with the more certain features. Uncertain responses to the south of **U2** are located within the geological zone and it is difficult to determine their origin.

Three linear trends in Area 5 (Sector 3) with an uncertain interpretation lie on a northwest to southeast alignment. They may have an archaeological origin but are more likely to be agricultural.

Curving trend **U3** in Area 6 (Sector 5) has been difficult to determine an origin due to the geological noise and also the ridge and furrow in this area. An archaeological origin is plausible due to the locations of the possible archaeological features in the area. There are other indistinct trends within Area 6 and these are probably anthropogenic but it is unclear if they are modern or archaeological.

A small group of anomalies (**U4**) in Area 8 (Sector 6) have been recorded to the immediate south of **FFB5** and have a strong magnetic response. It is possible these represent pits of some sort but they are also recorded within geological responses and hence **U4** may be geological too.

Linear trends and ditch like anomalies, **U5**, are on the same alignment as the former field boundary shown on the historic maps and by **FFB5**. They are located with an area of marshy ground depicted on the 1906 map. It is possible that they are former boundaries, creating strip fields or that they represent drainage to manage and reclaim the wet ground. Anomaly **U6** has a stronger magnetic signature, possibly representing a clay drain.

In the southwest of Area 9 (Sector 7) linear responses and anomalies **U7** have been recorded which have been difficult to determine an origin. Whilst an archaeological origin is likely, an agricultural origin is also possible. Within Area 9, five trends (**U8**) running through the area on a northeast to southeast alignment can also be seen. An agricultural origin for these is highly likely and they may represent field drains. It has also been noted that the westernmost trends stop at the southern response of **U7**.

Anomalies (**U9**) in the southwest of Area 10 (Sector 5) appear to consist of curving and linear responses. Due to the location of the watercourse to the immediate west, a natural origin is possible although an archaeological one cannot be ruled out entirely.

Uncertain anomalies in Area 12, such as those at **U10** have been recorded within the geological noise which makes interpretation difficult. Due to the amount of archaeological responses in this area, an archaeological origin is also possible, but an agricultural or geological origin may also be applied.

Anomalies that have not been mentioned above but have been recorded as uncertain on the interpretation diagrams are likely to be agricultural, modern or geological. However anomalies with a close proximity to the archaeological responses may be of some interest.

Possible and definite archaeological anomalies

Anomalies of both a definite and possible archaeological origin have been recorded throughout the dataset. The most prominent of these lie in the southeast of the Site and comprise ring ditches, linear ditches and enclosures.

Six complete ring ditches (**D1**-**D6**) have been recorded in Areas 11-13 (Sectors 8 and 9). Ring ditches **D1**-**D3** measure approximately 15m in diameter with **D2** showing a possible entrance in the east and two internal pits. **D3** shows a possible entrance in the southwest.

A smaller ring ditch (**D4**) in the south of Area 12 measures approximately 12m in diameter with an entrance to the east and appears to abut linear ditch **D11**. To the southeast of **D4**, **D5** measures approximately 17m in diameter with a clear entrance in the east. A similar size ring ditch (**D6**) lies in Area 13, again with a clear entrance to the east.

Incomplete ring ditches (**D7**-**D9**) have been recorded in Area 11, measuring between 12m and 15m in diameter. It is quite possible that further ring ditches lie within these fields and have been masked by the geology.

Located in the south of Area 12 is a ‘D’ shaped enclosure (**D10**) which measures 32m by 26m. Linear ditch **D11** makes up the enclosures northern boundary which runs on an approximate east to west alignment for at least 190m. The ‘D’ shaped enclosure has possible internal features and is likely to cut through the ring ditch **D5**, although this is impossible to say without further investigation.

Linear ditch **D12** in Area 12 runs from ditch **D11** on a northeast trajectory to the northern field boundary and perhaps suggest part of an ancient field system.

Linear responses (**D13**) also in Area 12 have been recorded either side of **FFB14**. It is possible that these form a hollow way or a double boundary with the former field boundary utilising this section of the field.

Part of an enclosure (**D14**) has been recorded in the south of Area 13 along with ditches and linear trends. A pair of ditches (**D15**) may represent a trackway and turn towards the north (**D16**), at the north-western corner of **D14**.

Truncated linear responses (**P1**) in Area 1 (Sector 1) appear to form rectilinear patterns and may represent part of an enclosure or field division. These responses are not as well defined as the definite archaeological anomalies recorded elsewhere, hence the possible archaeological interpretation.

Short linear ditch-like responses and trends (**P2**) in the north of Area 3 (Sector 3) may have an archaeological origin as they are of a slighter higher magnetic strength than the agricultural anomalies within this area. As there are no other anomalies of a similar origin within this field, however, the interpretation is cautious.

Linear anomalies **P3** in Area 4, **P4** in Area 5 (Sector 3) and **P5** and **P6** in Area 6 (Sector 5) may all be associated with a former field system.

Curving response **P7** in Area 8 (Sector 6) could possibly be part of a ring ditch although due to the proximity of the water course to the west it may also be of a natural response. An archaeological origin is preferred though.

Linear anomaly **P8** in Area 8 (Sector 6) represents a clear defined magnetic response and may be associated with a former field system. The same interpretation can also be applied to anomaly **P9** in Area 10 (Sector 7).

A number of responses within Areas 11 and 12 (Sectors 8 and 9) have been interpreted as a possible archaeological origin. These are mainly within the ‘geological zone’ in these areas but surround the definite archaeological features. A possible trackway (**P10**) has been identified in the northeast of Area 11.

Short ditch lengths and linear trends (**P11**) in Area 12 (Sector 8) appear to form a triple ditch feature of some sort which pass ring ditch **D3**. There may be a correlation between these two features but it is difficult to be certain.

A small circular trend (**P12**) in Area 13 (Sector 9) is just visible above the magnetic background levels and may represent a small ring ditch. It measures approximately 8m in diameter.

Linear trends **P13** in Area 13 (Sector 9) and **P14** in Area 15 (Sector 11) are magnetically stronger than the agricultural responses in these areas and may represent a former field system.

5 Conclusions

The geophysical survey has detected a number of magnetic anomalies associated with archaeological and possible archaeological origins in the form of six complete ring ditches, another three partial ones and the possibility of further ring ditches. A ‘D’ shaped enclosure has also been recorded along with ditches, pits, possible trackways and ancient field systems.

Medieval or post-medieval ridge and furrow cultivation has been recorded within some of the areas, along with former field boundaries, many of which are in the typical Cornish construction, and field drains.

Geological anomalies have been recorded throughout in ‘zones’ of increased magnetism, which reflect the local soils.

Magnetic disturbance is associated with adjacent farm buildings, electricity pylons and around the periphery of the fields are due to metal fencing within the boundaries.

Based on the geophysical survey the archaeological potential of the Site is deemed to be high in the southeast and moderate to low elsewhere.

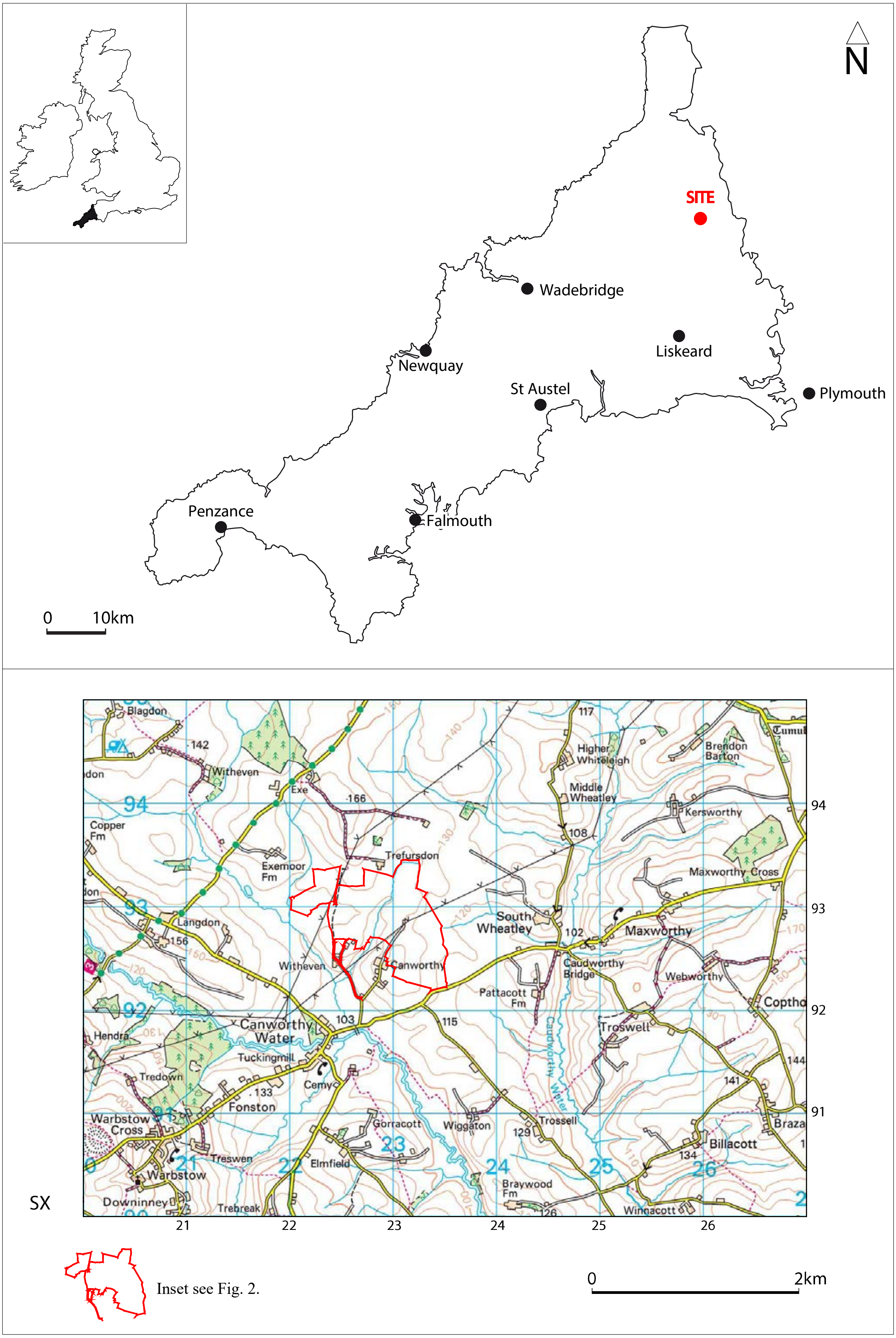
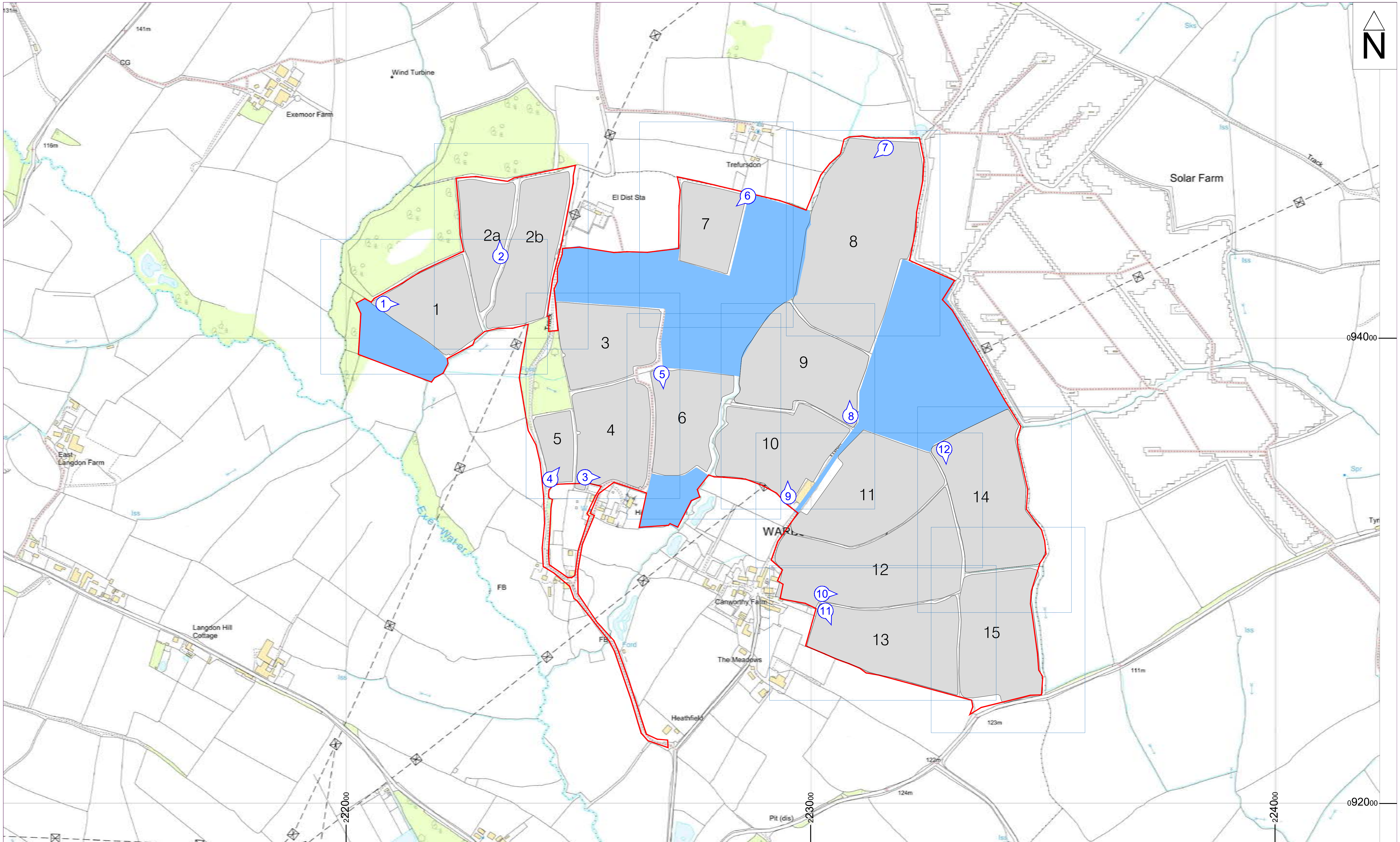


Fig. 1. Site location



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Survey location

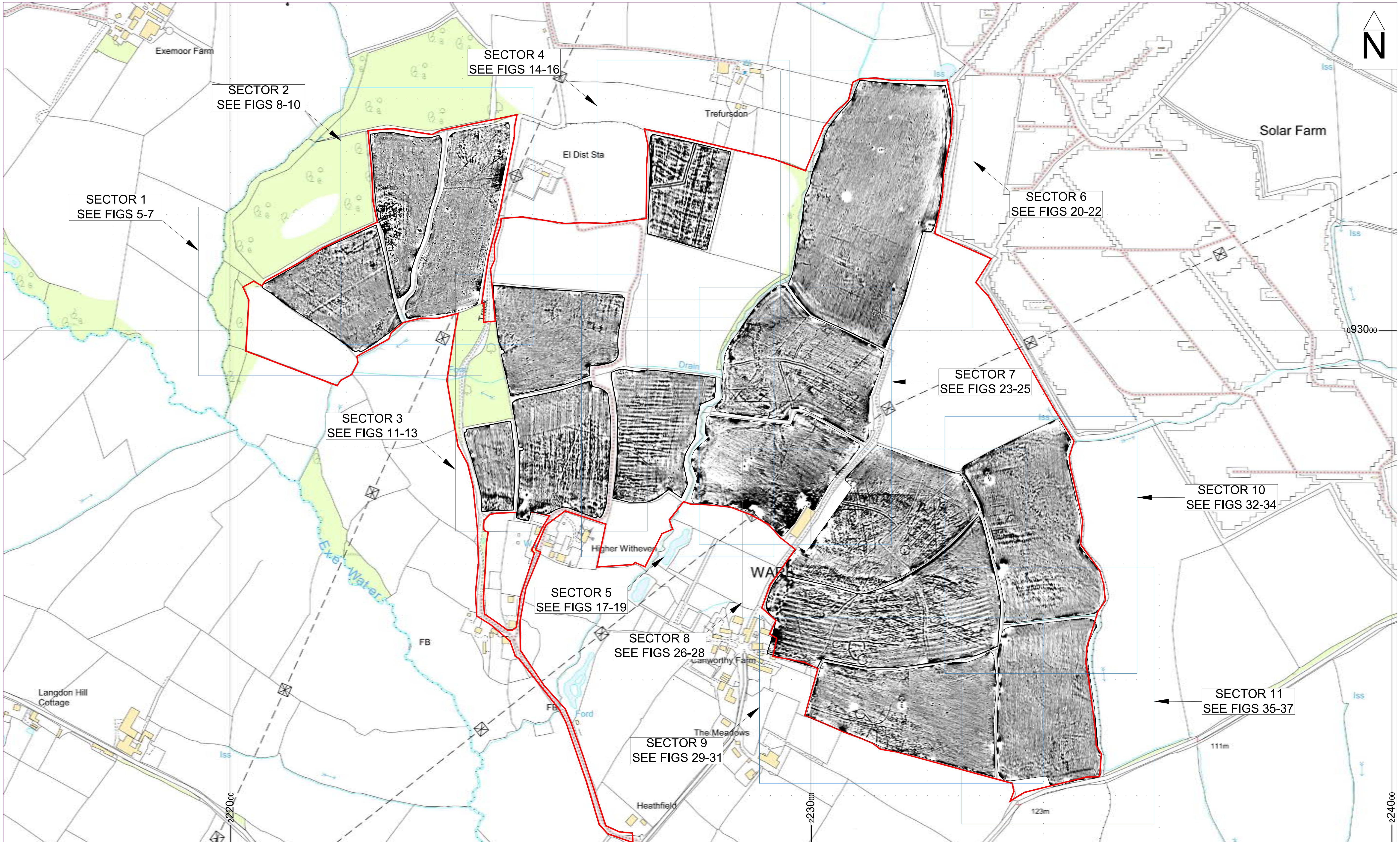
Fig.2

Title

	APPLICATION AREA	1	AREA NUMBERS
	SECTOR BOUNDARY		AREAS EXCLUDED FROM SURVEY
1	PHOTO LOCATIONS		

0 300m

1:7500 @ A3



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Overall processed greyscale magnetometer data

Fig. 3

Title

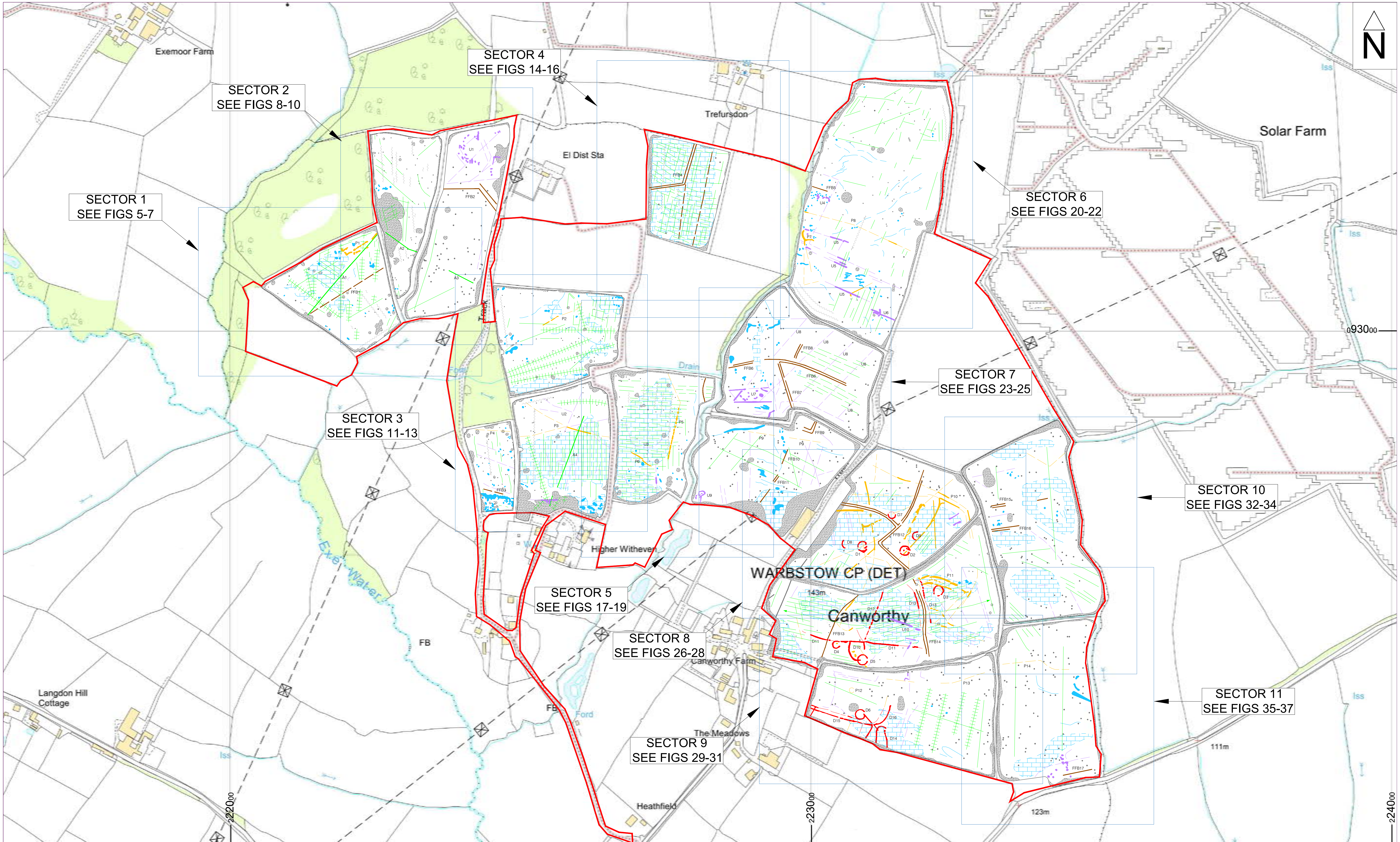
APPLICATION AREA

SECTOR BOUNDARY

nT -1.0 2.0

0 200m

1:6000 @ A3



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Title

Overall interpretation of magnetometer data

Fig. 4

APPLICATION AREA	SECTOR BOUNDARY

Interpretation

FERROUS	RIDGE & FURROW	UNCERTAIN	
SERVICE PIPE	AGRICULTURAL	ARCHAEOLOGY?	
MAGNETIC DISTURBANCE	FORMER FIELD BOUNDARY	ARCHAEOLOGY	
FIELD DRAIN	GEOLOGY	INTERFERENCE	

0 200m

1:6000 @ A3

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Processed greyscale magnetometer data; Sector 1

Fig. 5

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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XY trace plot of minimally processed magnetometer data; Sector 1

Fig. 6

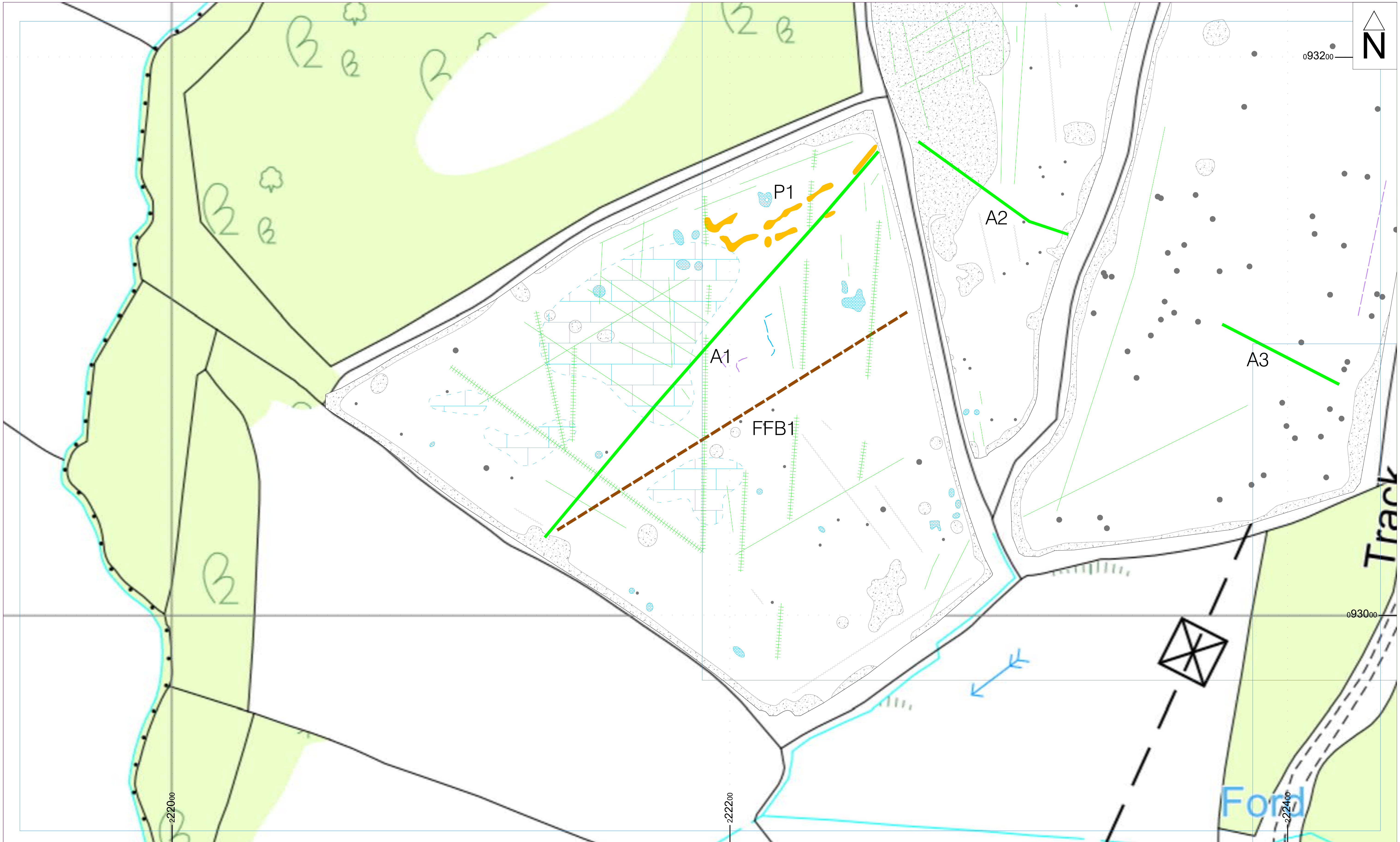
Title

	SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Interpretation of magnetometer data; Sector 1

Fig. 7

Title

SECTOR BOUNDARY

Interpretation

FERROUS
SERVICE PIPE
MAGNETIC DISTURBANCE
FIELD DRAIN
AGRICULTURAL
FORMER FIELD BOUNDARY
GEOLOGY
ARCHAEOLOGY?
INTERFERENCE

0 50m

1:1250 @ A3

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Processed greyscale magnetometer data; Sector 2

Fig. 8

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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XY trace plot of minimally processed magnetometer data; Sector 2

Fig. 9

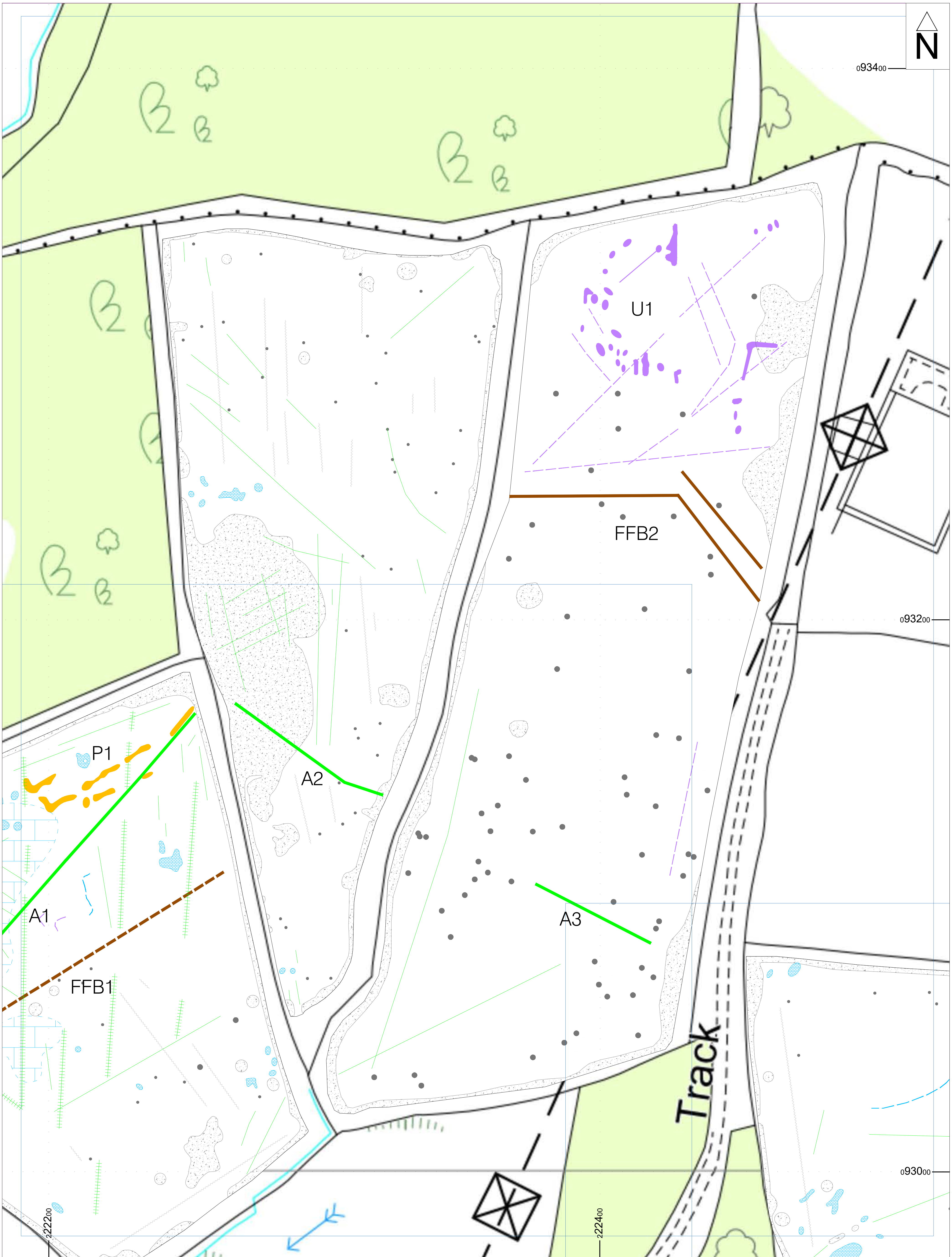
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Interpretation of magnetometer data; Sector 2

Fig. 10

Interpretation

FERROUS
MAGNETIC DISTURBANCE
FIELD DRAIN
AGRICULTURAL
FORMER FIELD BOUNDARY
GEOLOGY
UNCERTAIN
ARCHAEOLOGY?
INTERFERENCE

0 50m

1:1250 @ A3

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Processed greyscale magnetometer data; Sector 3

Fig. 11

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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XY trace plot of minimally processed magnetometer data; Sector 3

Fig. 12

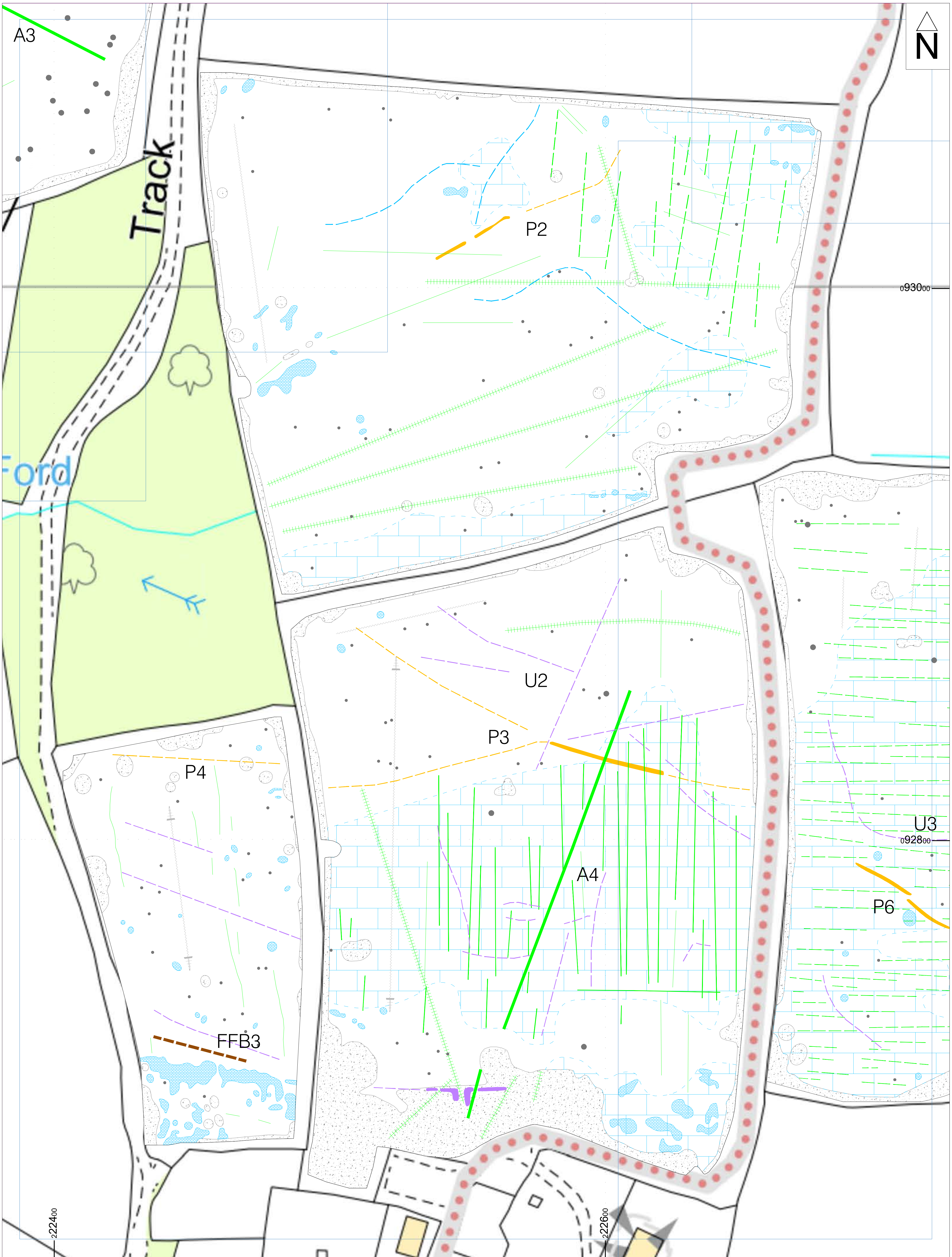
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Interpretation of magnetometer data; Sector 3

Fig. 13

Interpretation

FERROUS	AGRICULTURAL	UNCERTAIN
MAGNETIC DISTURBANCE	FORMER FIELD BOUNDARY	ARCHAEOLOGY?
FIELD DRAIN	GEOLOGY	INTERFERENCE

0 50m

1:1250 @ A3

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Processed greyscale magnetometer data; Sector 4

Fig. 14

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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XY trace plot of minimally processed magnetometer data; Sector 4

Fig. 15

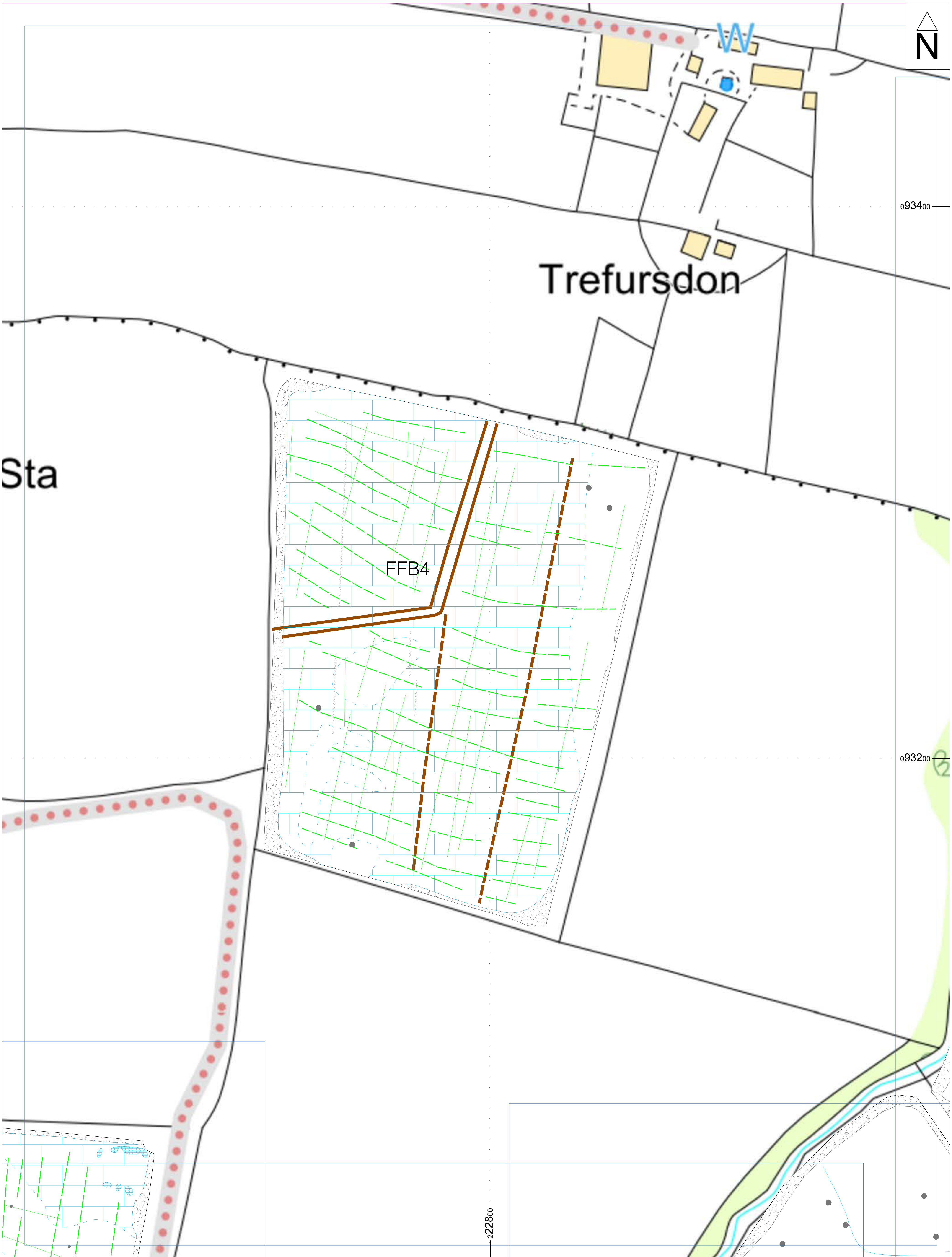
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 4

Fig. 16

Interpretation

FERROUS	AGRICULTURAL	UNCERTAIN
MAGNETIC DISTURBANCE	FORMER FIELD BOUNDARY	ARCHAEOLOGY?
FIELD DRAIN	GEOLOGY	INTERFERENCE

0 50m

1:1250 @ A3

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Processed greyscale magnetometer data; Sector 5

Fig. 17

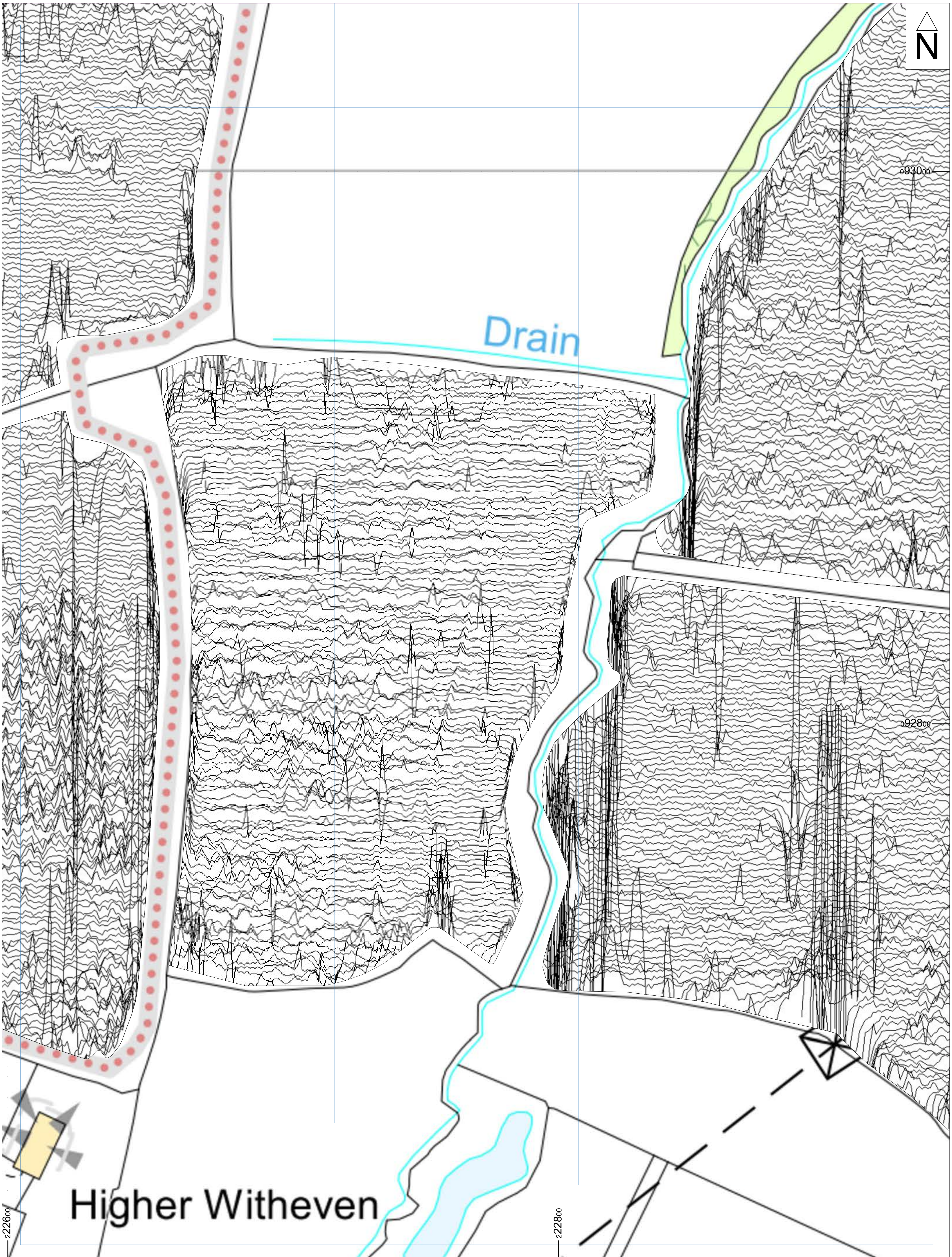
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 5

Fig. 18

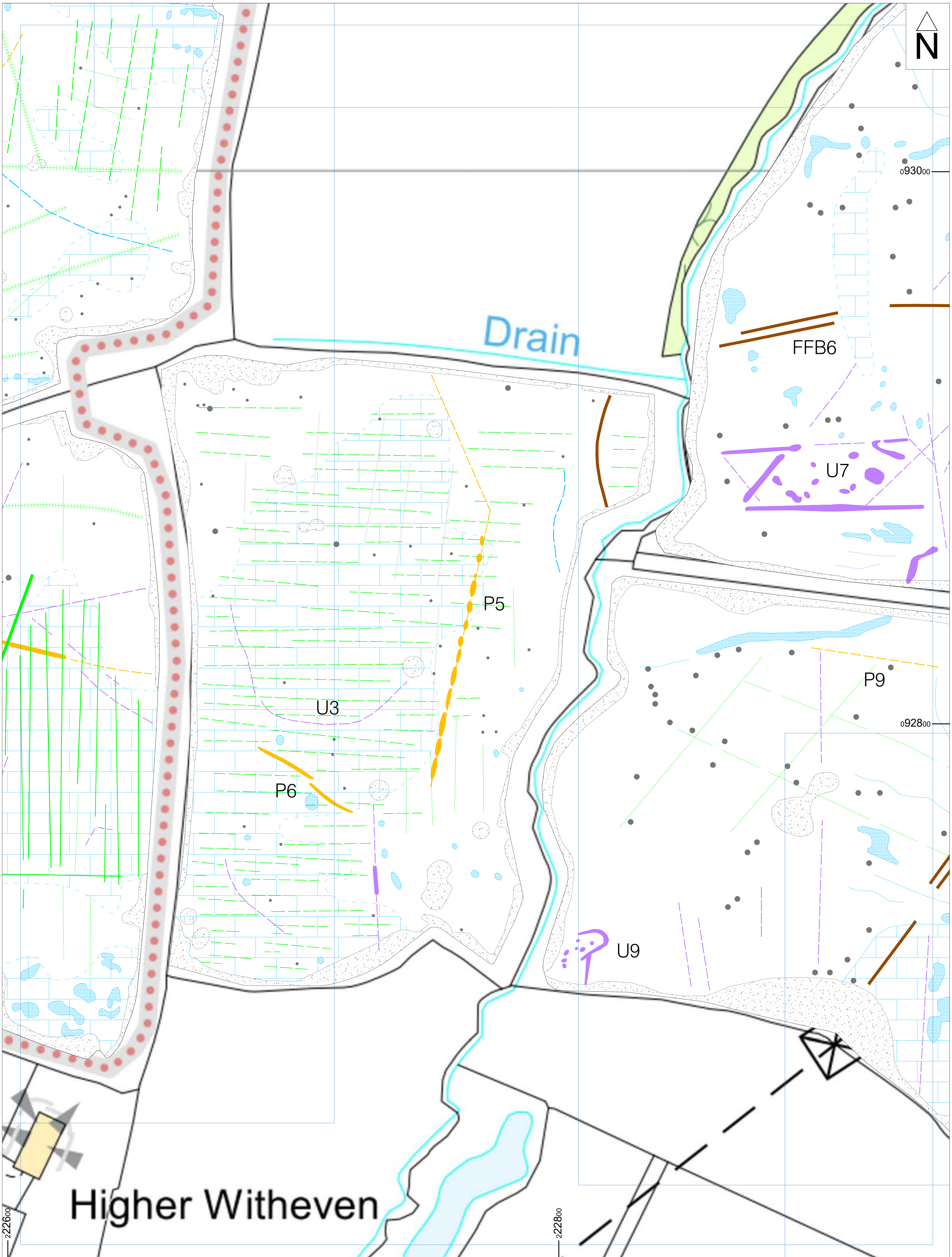
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 5

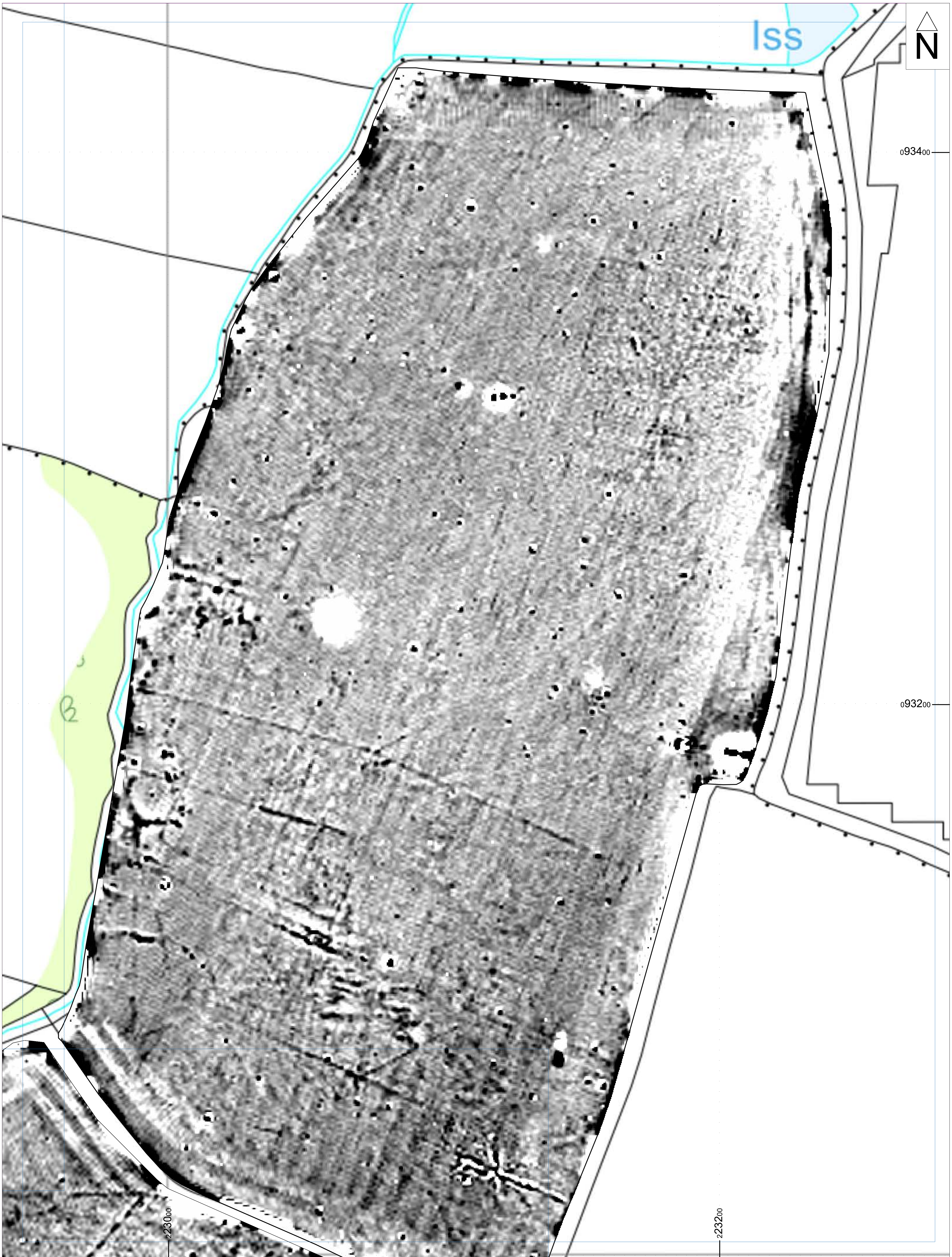
Fig. 19

Interpretation

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

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 6

Fig. 20

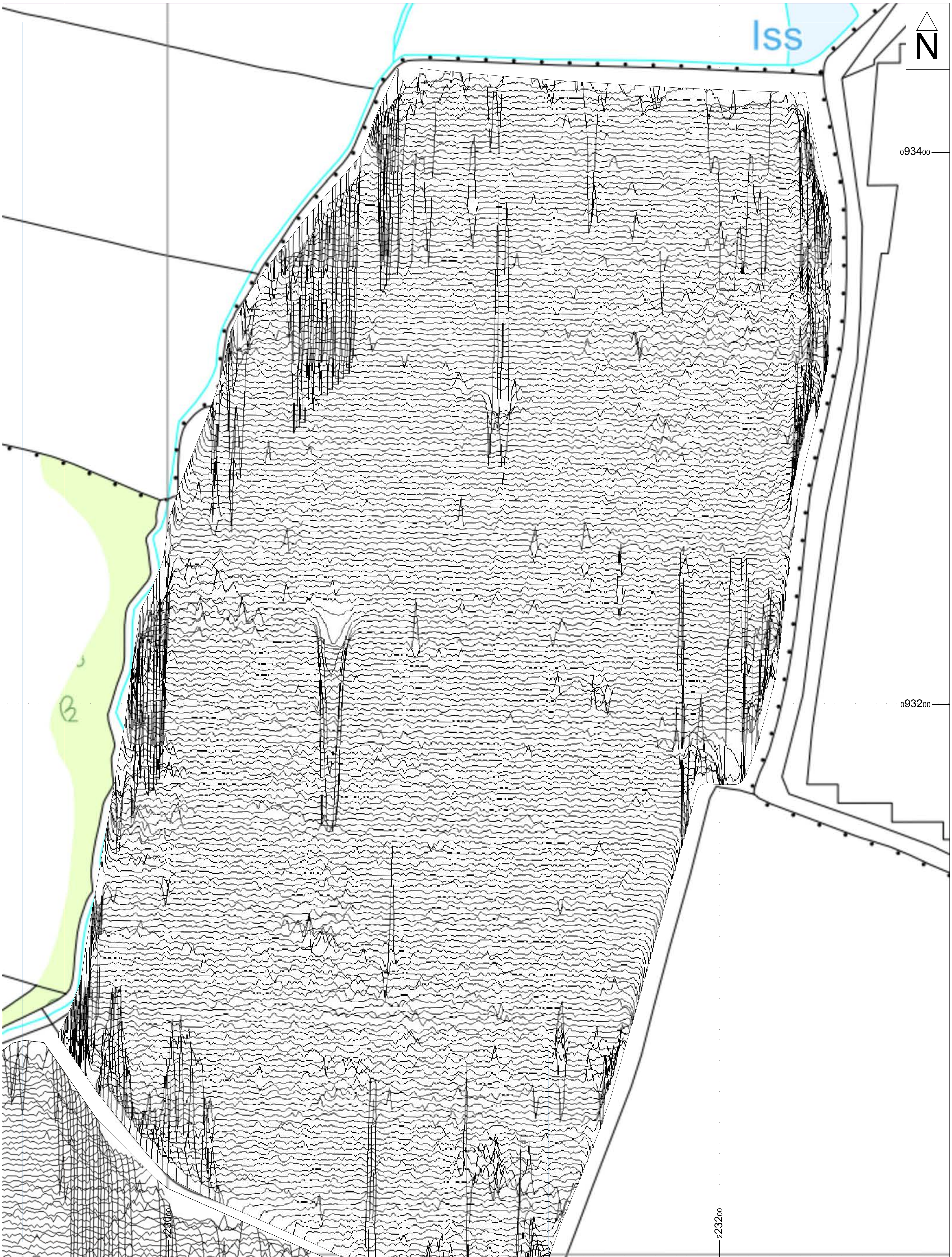
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 6

Fig. 21

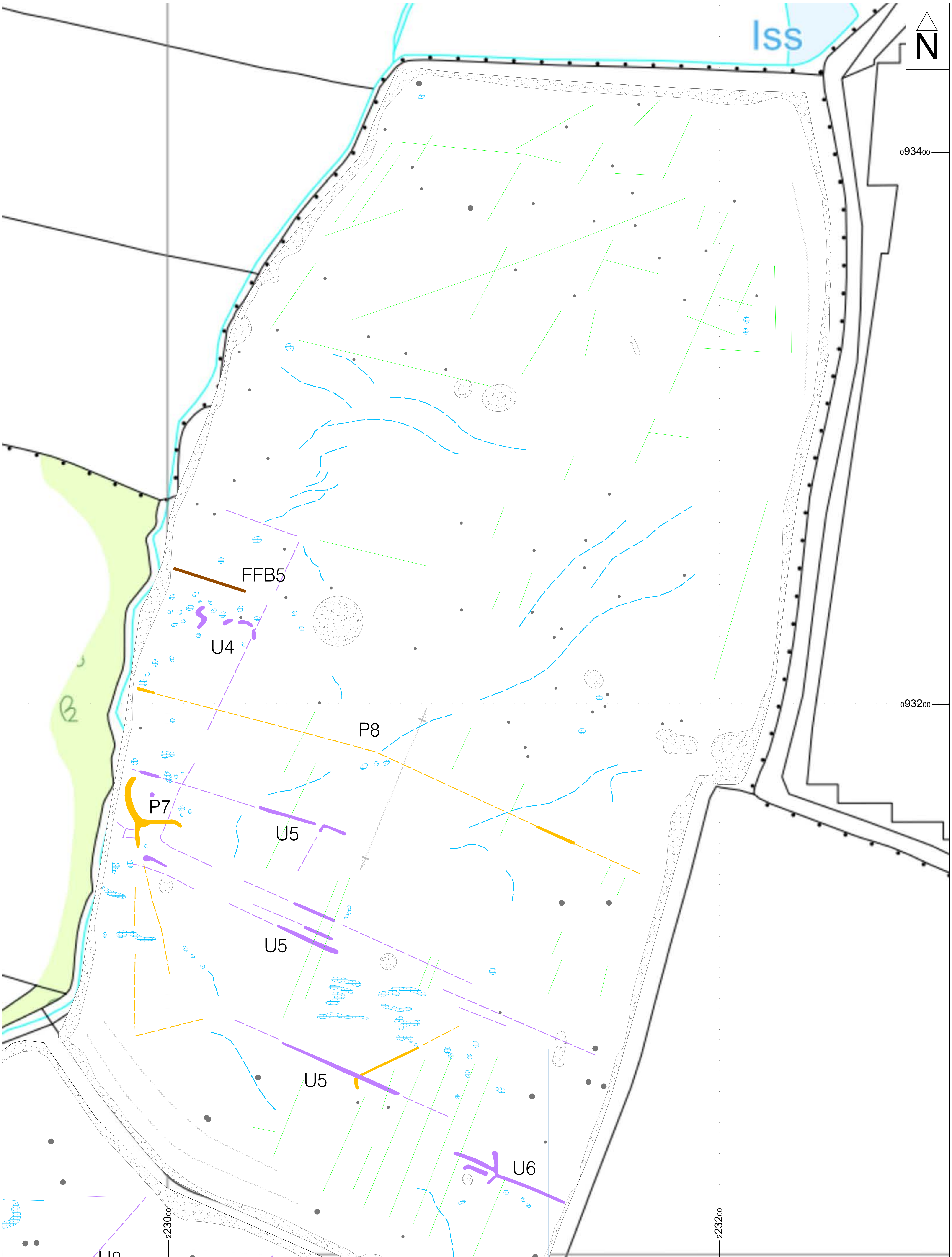
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 6

Fig. 22

Interpretation

FERROUS	FORMER FIELD BOUNDARY	ARCHAEOLOGY?
MAGNETIC DISTURBANCE	GEOLOGY	INTERFERENCE
AGRICULTURAL	UNCERTAIN	

0 50m

1:1250 @ A3

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Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 7

Fig. 23

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 7

Fig. 24

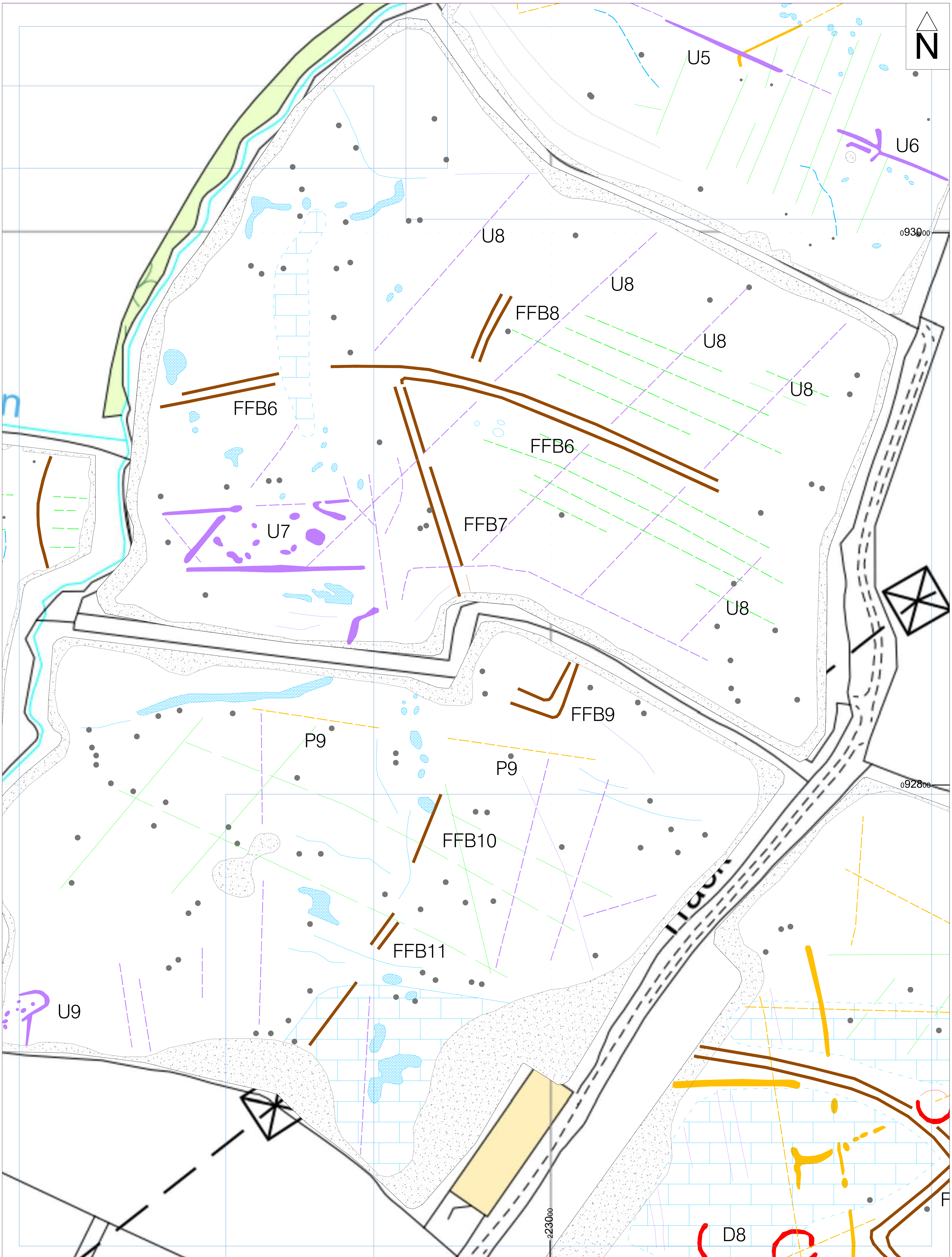
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



Interpretation

FERROUS	AGRICULTURAL	UNCERTAIN	INTERFERENCE
MAGNETIC DISTURBANCE	FORMER FIELD BOUNDARY	ARCHAEOLOGY?	
RIDGE & FURROW	GEOLOGY	ARCHAEOLOGY	

0 50m

1:1250 @ A3

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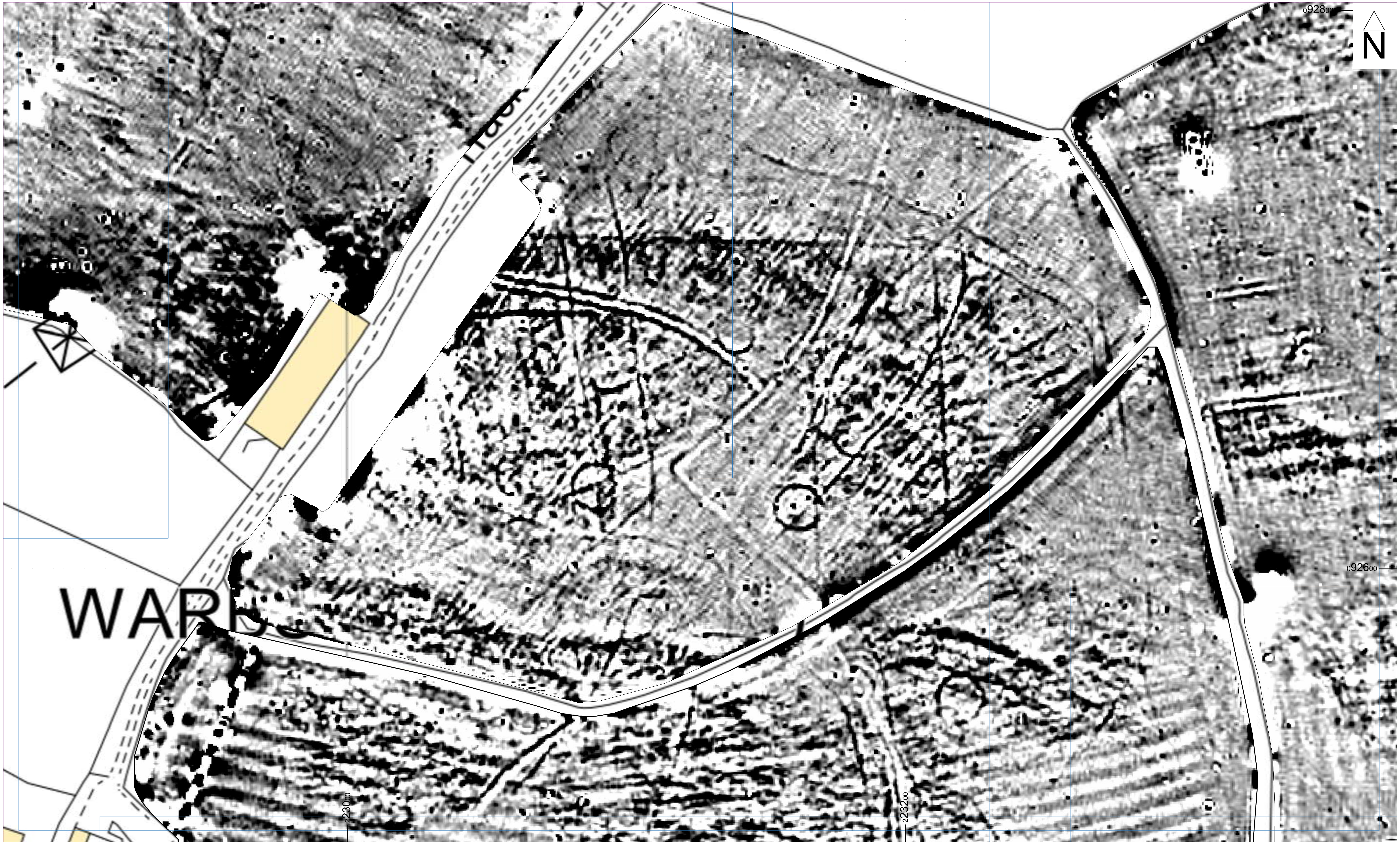
Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 7

Fig. 25



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Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 8

Fig. 26

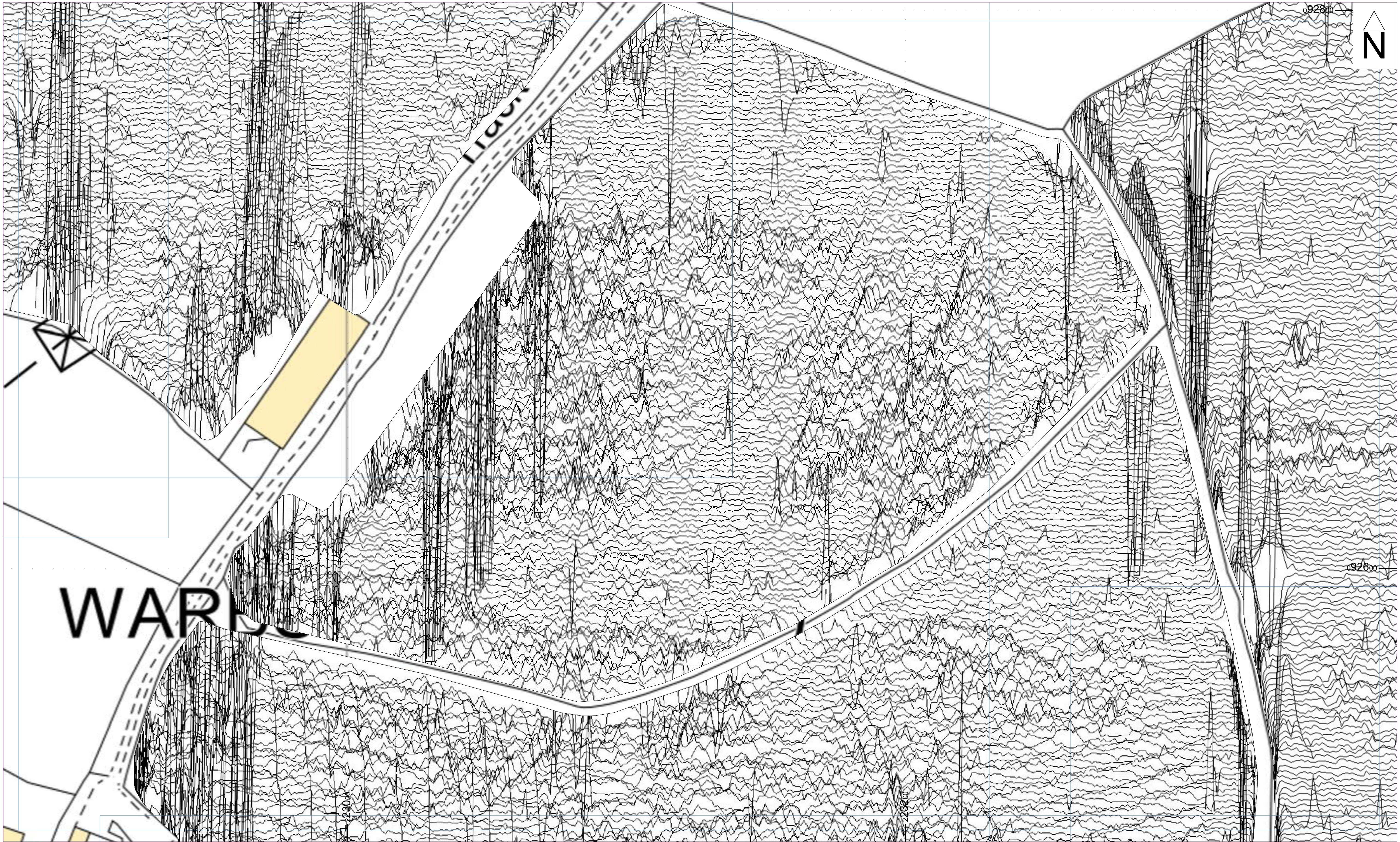
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 8

Fig. 27

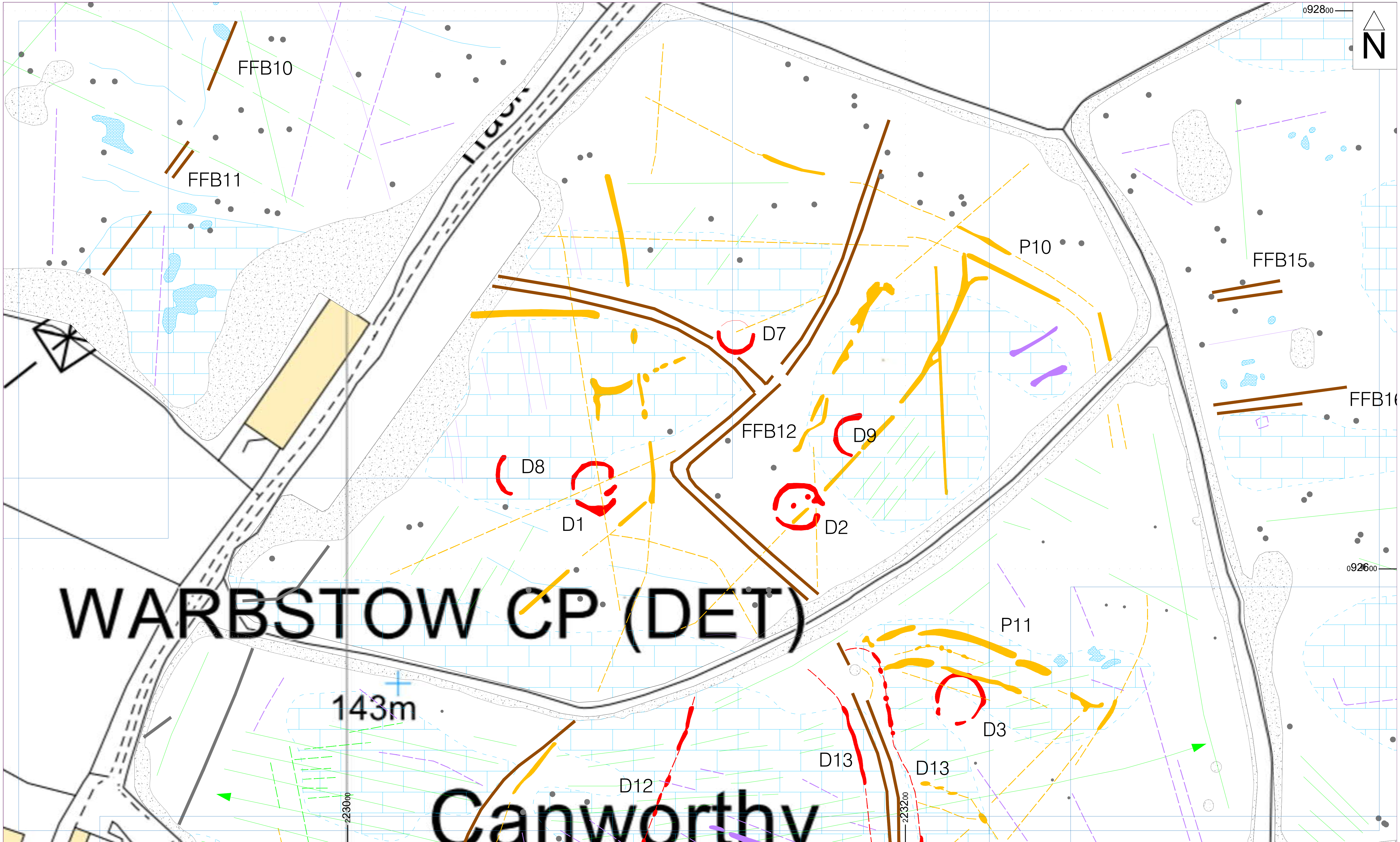
Title

	SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



Title

- SECTOR BOUNDARY

Interpretation

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

0 50m

1:1250 @ A3

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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 8

Fig. 28

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Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 9

Fig. 29

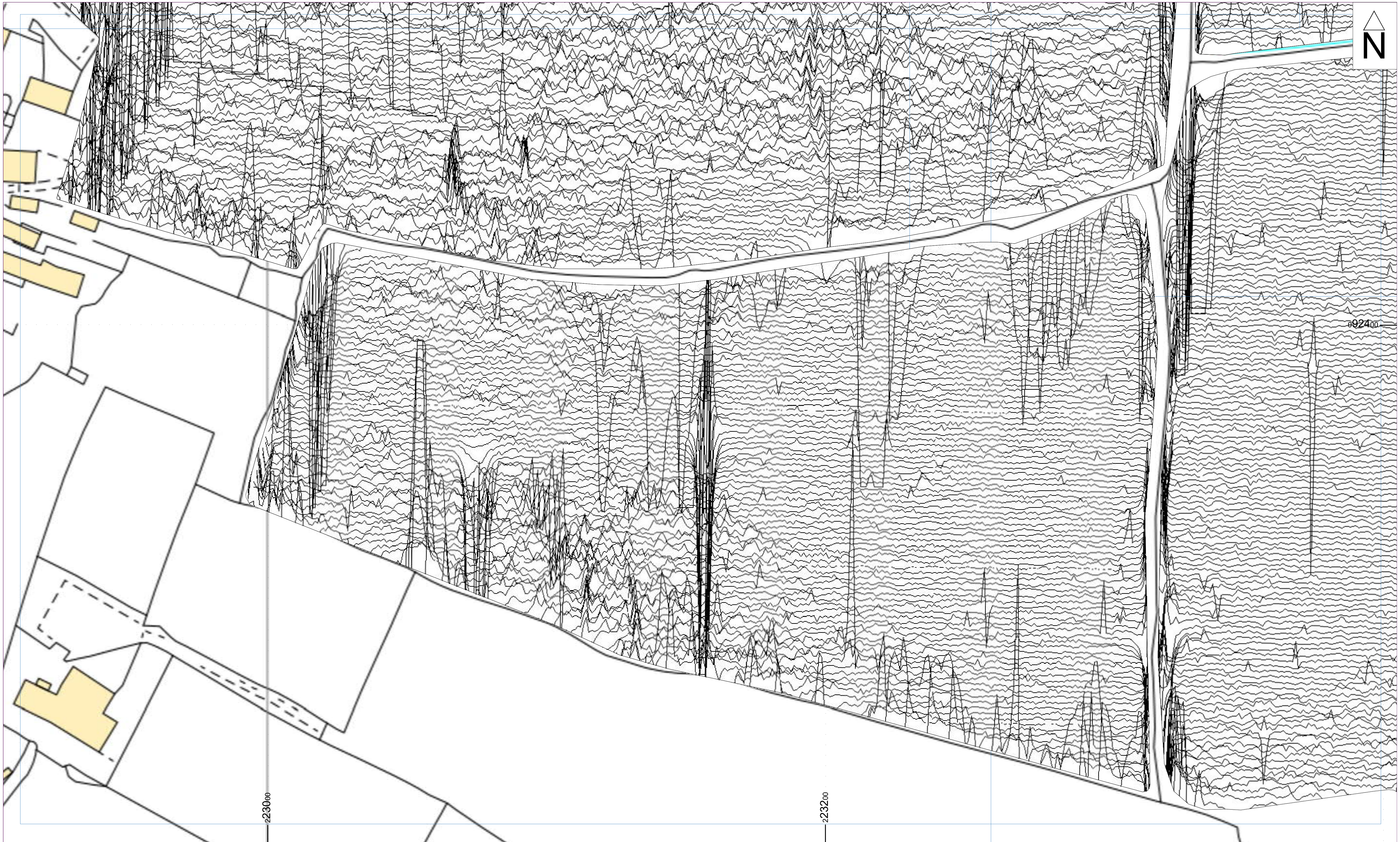
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 9

Fig. 30

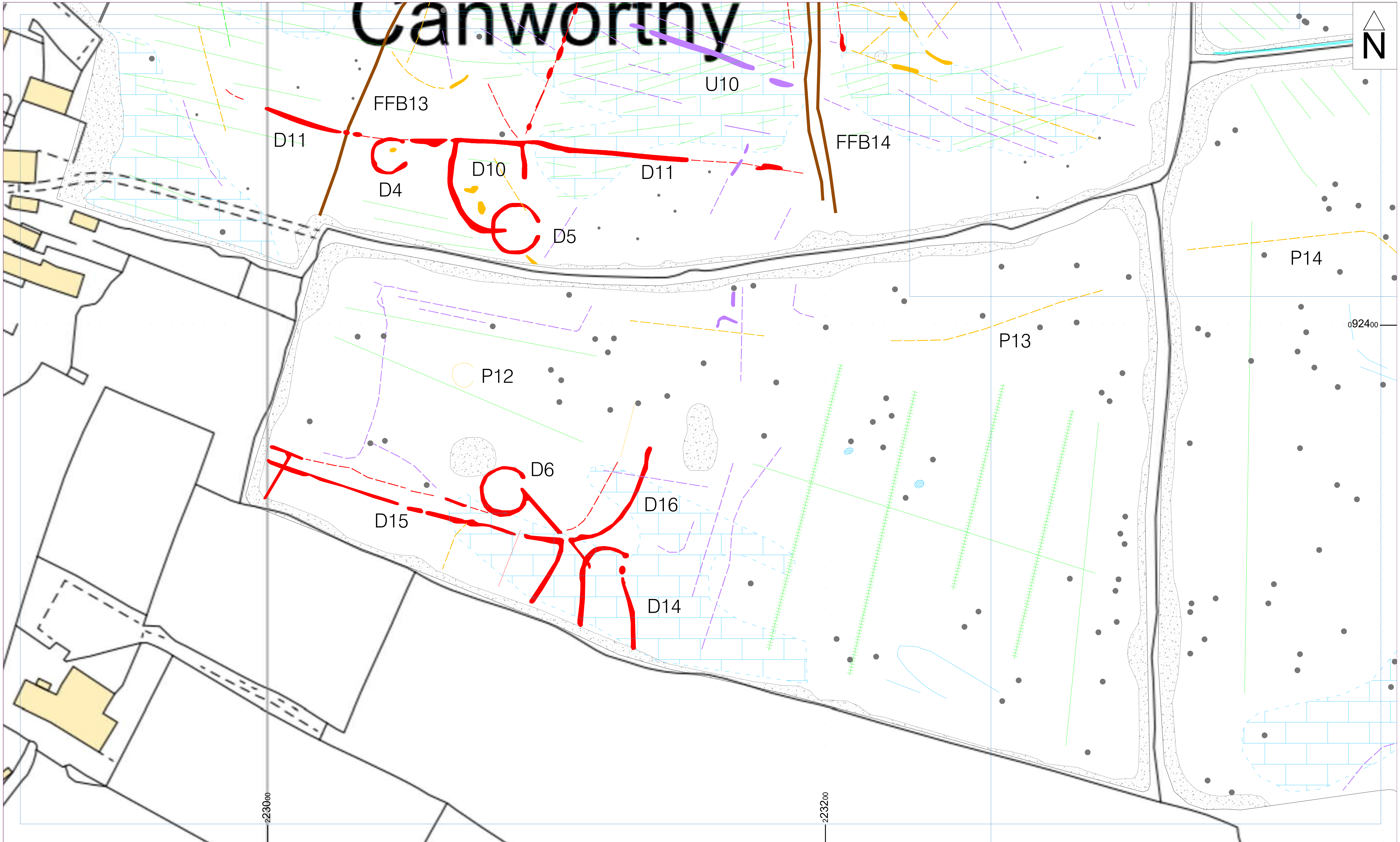
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 9

Fig. 31

Title

SECTOR BOUNDARY

Interpretation

FERROUS	AGRICULTURAL	UNCERTAIN
SERVICE PIPE	FORMER FIELD BOUNDARY	ARCHAEOLOGY?
MAGNETIC DISTURBANCE	GEOLOGY	ARCHAEOLOGY
RIDGE & FURROW		

0 50m

1:1250 @ A3

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Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 10

Fig. 32

Title

	SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

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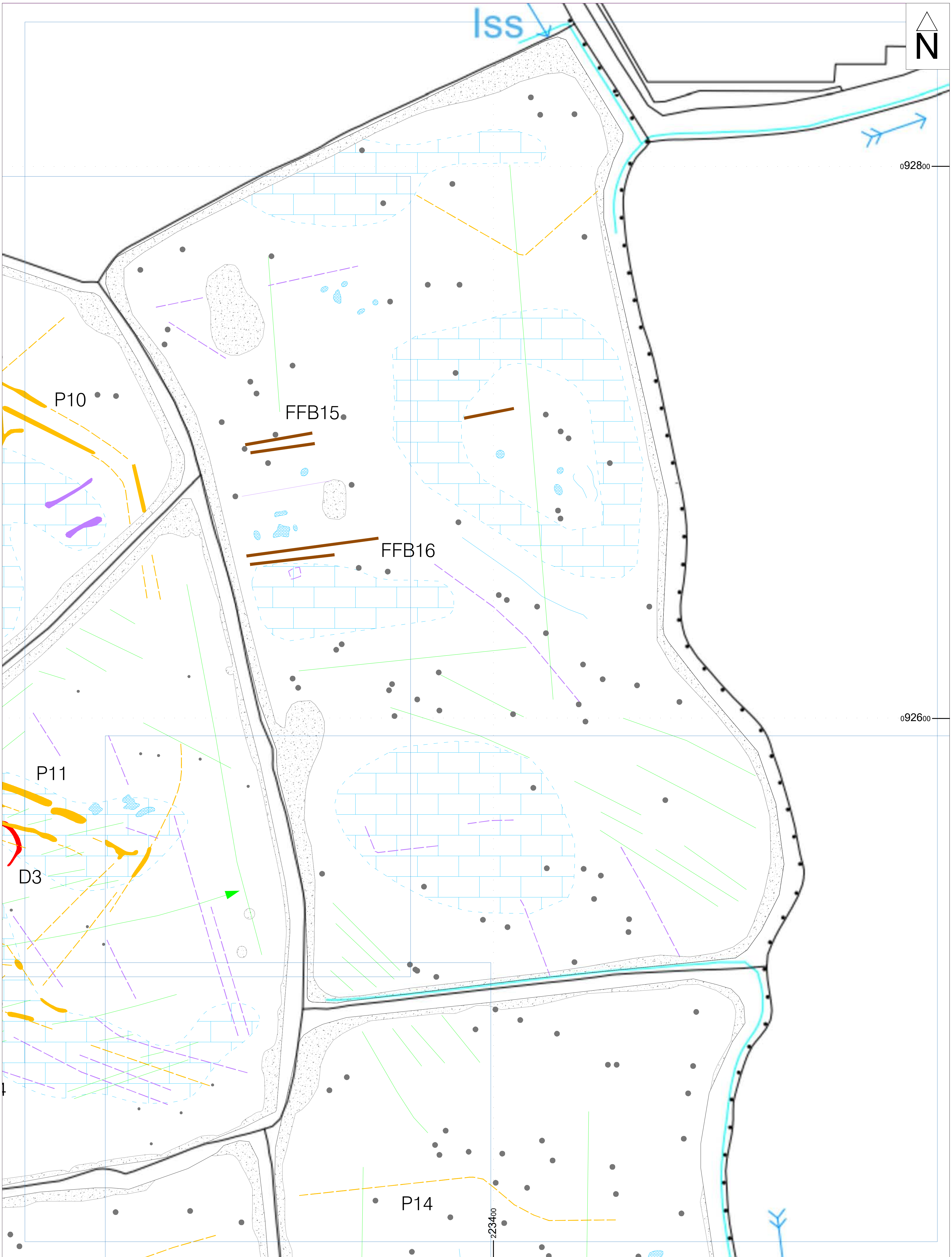
Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 10

Fig. 33

Title

SECTOR BOUNDARY



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 10

Fig. 34

Interpretation

FERROUS	FORMER FIELD BOUNDARY	ARCHAEOLOGY?
MAGNETIC DISTURBANCE	GEOLOGY	ARCHAEOLOGY
AGRICULTURAL	UNCERTAIN	

0 50m

1:1250 @ A3

Project ID: XE20_HGW22

Processed greyscale magnetometer data; Sector 11

Fig. 35

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1250 @ A3

Project ID: XE20_HGW22

XY trace plot of minimally processed magnetometer data; Sector 11

Fig. 36

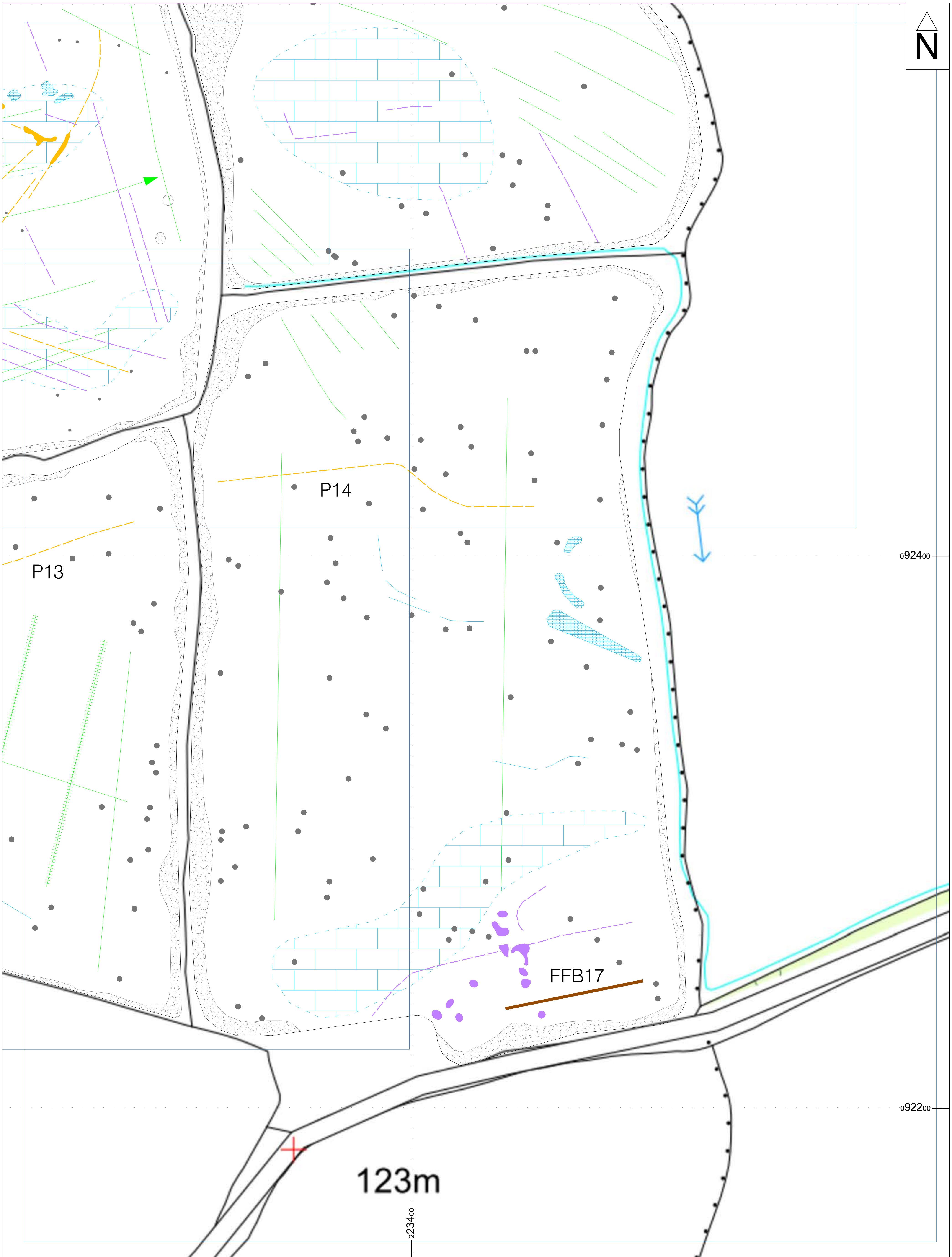
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1250 @ A3



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Project ID: XE20_HGW22

Interpretation of magnetometer data; Sector 11

Fig. 37

Interpretation

FERROUS
MAGNETIC DISTURBANCE
FIELD DRAIN
AGRICULTURAL
FORMER FIELD BOUNDARY
GEOLOGY
UNCERTAIN
ARCHAEOLOGY?

0 50m

1:1250 @ A3

Plate 1. General view of Area 1, looking east

Plate 2. General view of Area 2, looking north

Plate 3. General view of Area 4, looking east

Plate 4. General view of Area 5, looking northeast

Plate 5. General view of Area 5, looking northeast

Plate 6. General view of Area 6, looking south

Plate 7. General view of Area 7, looking southwest

Plate 8. General view of Area 8, looking southwest

Plate 9. General view of Area 9, looking north

Plate 10. General view of Area 10, looking north

Plate 11. General view of Area 12, looking east

Plate 12. General view of Area 13, looking southeast

Plate 13. General view of Area 14, 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.

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 an eight channel Sensys MX V3 system containing eight FGM650 sensors was also used which was towed across the area using an ATV. Readings were taken every 20MHz (between 0.05 and 0.1m). Data was be 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

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

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2003), and graphics files (Adobe Illustrator CS6 and AutoCAD 2017) 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 Cornwall Historic Environment Record).

Appendix 4: Oasis form

Summary for archaeol11-506992

OASIS ID (UID)	archaeol11-506992
Project Name	Geophysical Survey at Land at Higher Witheven and Canworthy Farms
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	25-Apr-2022 - 05-May-2022
Location	Land at Higher Witheven and Canworthy Farms NGR : SX 22477 92605 LL : 50.705912198515, -4.51550578838854 12 Fig : 222477,92605 NGR : SX 22900 92863 LL : 50.7083581270766, -4.50964464105253 12 Fig : 222900,92863
Administrative Areas	Country : England County : Cornwall District : Cornwall Parish : Warbstow Parish : North Petherwin Parish : Week St. Mary
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 69 hectares of land located to north of Canworthy Water, Launceston, Cornwall. Anomalies of both a definite and a possible archaeological origin have been detected including ring ditches, a ‘D’ shaped enclosure, ditches, pits, field systems and possible trackways indicative of a prehistoric landscape. Medieval/post-medieval ridge and furrow cultivation has also been detected along with former field boundaries, in a typical Cornish construction. Geological responses can be seen throughout and are typically noisy given the magnetic Cornish soils. Magnetic disturbance within the Site can be assigned to noise from adjacent farm buildings, electricity pylons and metal fencing in the boundaries. Based on the geophysical survey, the archaeological potential of the Site is high in the southeast and moderate to low elsewhere.

Keywords	Ring Ditch - EARLY PREHISTORIC - FISH Thesaurus of Monument Types D Shaped Enclosure - LATER PREHISTORIC - FISH Thesaurus of Monument Types Field System - UNCERTAIN - FISH Thesaurus of Monument Types Cornish Hedge - POST MEDIEVAL - FISH Thesaurus of Monument Types
Funder	
HER	Cornwall and Scilly HER - unRev - STANDARD
Person Responsible for work	Emma, Brunning
HER Identifiers	
Archives	

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