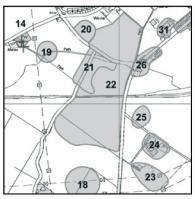
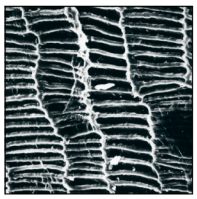
RIPD/01










ROSSINGTON INLAND PORT PHASE 2B, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by CgMs Consulting

09/00190/OUTA

December 2016

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

ROSSINGTON INLAND PORT PHASE 2B, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by CgMs Consulting

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December 2016

project info

HA JOB NO.	RIPD/01
NGR	SK 5926 9779
PARISH	Wadworth, Tickhill
LOCAL AUTHORITY	South Yorkshire
OASIS REF.	headland5- 271239

project team

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APPROVED BY	Sam Harrison – Project Manager

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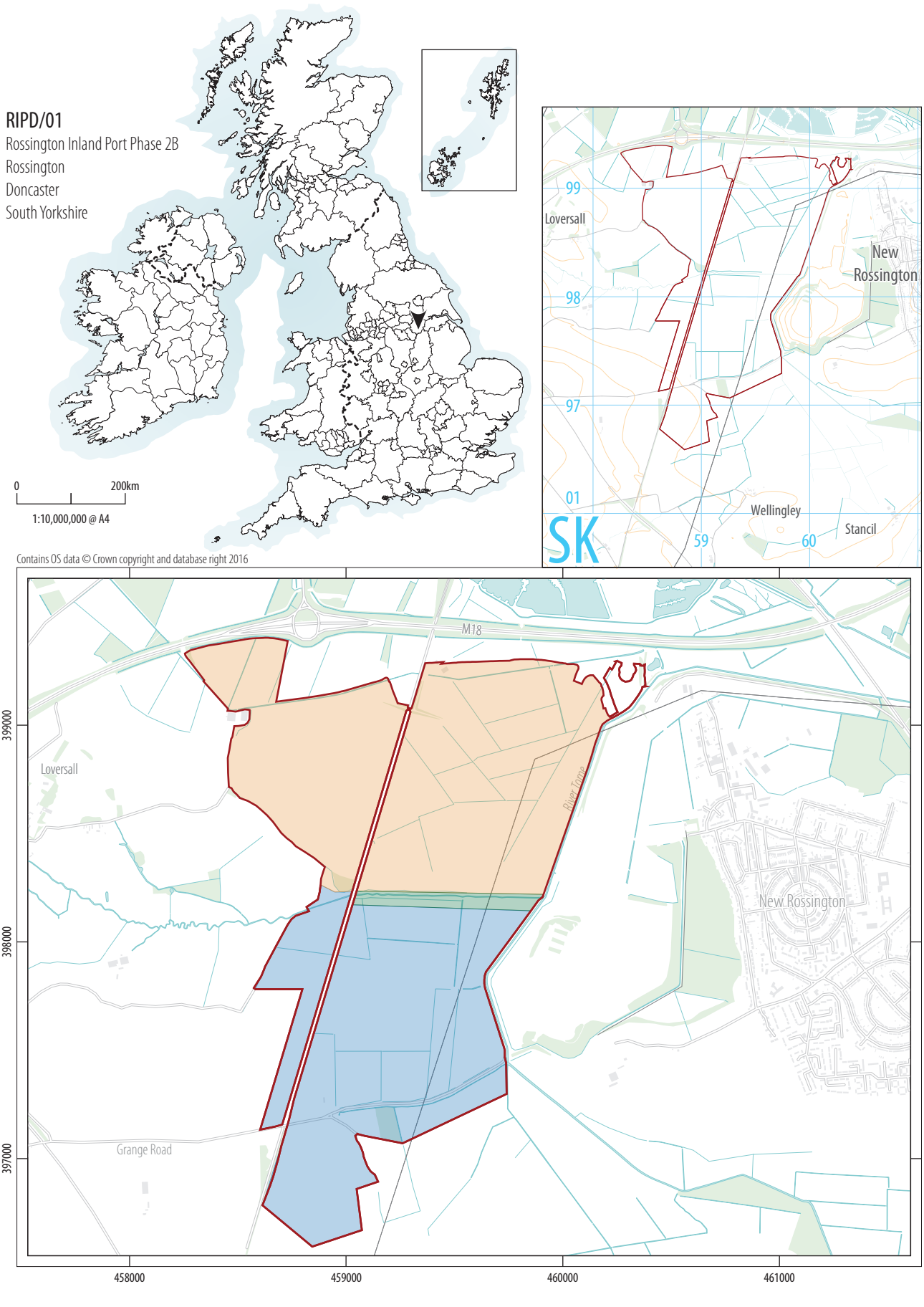
PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering 123 hectares, on land at Rossington, South Yorkshire, to inform an outline planning application for the proposed development of Rossington Inland Port Phase 2B. The survey has identified a number of linear anomalies across the western part of the site which confirm and enhance the cropmark data. These anomalies, due to soil-filled ditches, form a system of land division and enclosure, including at least one localised area of possible settlement activity, which probably date to the later Iron Age or Romano-British period. The survey has demonstrated a correlation between the archaeological anomalies and the superficial deposits of sand and gravel with a relative absence of anomalies of archaeological potential on the lower-lying alluvial deposits in the north and the east. It is not clear whether the fragmentary nature of the archaeological anomalies is a true assessment of the below ground remains or whether possible archaeological features may be masked by low magnetic contrast within the alluvial soils. It seems likely, given the nature and scale of the surrounding cropmarks, that some archaeological features, particularly over areas of alluvium, may not have been detected by the survey. Nevertheless, on the basis of the geophysical survey, the archaeological potential within the east of the proposed development area is assessed as moderate, and locally high, whereas the western half of the site is assessed as having low archaeological potential, corroborating the results of the Desk Based Assessment.

CONTENTS

LIST OF ILLUSTRATIONS

RIPD/01
Rossington Inland Port Phase 2B
Rossington
Doncaster
South Yorkshire



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ILLUS 1 Site location

ROSSINGTON INLAND PORT PHASE 2B, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by CgMs Consulting to undertake a geophysical (magnetometer) survey of land west of Rossington, South Yorkshire. The results of the survey will inform forthcoming archaeological strategy in support of an outline planning consent for the proposed development of Rossington Inland Port Phase 2B (ref. 09/00190/OUTA).

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2016), submitted to CgMs and approved by Andrew Lines (South Yorkshire Archaeology Service), and was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012). All work was also undertaken in line with current best practice (English Heritage 2008; CIfA 2014).

The survey was carried out between September 26th and October 21st 2016 in order to provide information on the archaeological potential of the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

Rossington Inland Port covers an area of 397 hectares to the west of Rossington, Doncaster (see Illus 1). This report is concerned with Phase 2B of the development, an area of 123 hectares centred at SK 5926 9779, and hereafter referred to as the proposed development area (PDA). It comprises an irregular shaped parcel of land which is bound to the north by St Catherine's Well Stream, to the east by the River Torne, to the north-west by Daw Lane and by agricultural land on all other sides. A freight railway line (formerly the South Yorkshire Joint Railway) passes north/south through the west of the PDA whilst the south of the site is divided by Carr Bank, and Stancil Lane/ Egg Lane.

Most of the PDA falls within the Humber Wetlands lying below 10m above Ordnance Datum (AOD) within the watershed of the River Humber. The land rises gently in the south-west to 15m AOD south of Carr Bank.

The PDA comprises 23 fields (F1-F23). At the time of the survey they were either under short pasture or were fallow following harvest, with the exception of F5 which had been stripped of topsoil (see Illus 2 to Illus 5). A broad area (3ha) within the south of F5 contained a topsoil bund and was unsuitable for survey. Buildings and gardens and an area of woodland along Carr Lane and Egg Lane prevented survey in these locations whilst overgrown vegetation restricted survey in the east of F23. No survey was undertaken in F1.

1.2 GEOLOGY AND SOILS

The bedrock mainly consists of Nottingham Castle Sandstone Formation (sandstone) with north/south bands of Roxby Formation (mudstone), Brotherton Formation (limestone) and Lenton Sandstone Formation (sandstone) in the west. The bedrock is mainly overlain by alluvium with till being recorded within the west (see Illus 7). River Terrace Deposits (sand and gravel) are recorded locally in the north (centre) with a small area of peat to the south-east (NERC 2016). Only a small area within the south-west of the PDA, on the northern side of Carr Bank, is devoid of superficial deposits.

The soils in the north and east of the PDA are classified in the Soilscape 18 association, characterised as slowly permeable, seasonally wet, slightly acid but base rich loams and clays. The soils in the north-west are classified in the Soilscape 20 association, characterised as loamy and clayey floodplain soils with a naturally high groundwater. Freely draining lime-rich loams of the Soilscape 5 association are recorded in the south-west (Cranfield University 2016).

2 ARCHAEOLOGICAL BACKGROUND

An Archaeological Desk Based Assessment (CgMs 2001) for the wider scheme concluded that a number of cropmarks within the site and the wider landscape, provide evidence of probable late prehistoric/ Romano-British field systems. These cropmarks have been mapped by the National Mapping Programme (NMP) (see Illus 8). An irregular cropmark with an annexe is recorded close to the south-western site

ILLUS 2 Field 1, looking east

boundary (SMR ref 00068/01; see Illus 8). The assessment identified an archaeologically 'blank' area through the centre and north-eastern part of the site which correlates with a band of Holocene alluvium. In those areas of the application site not occupied by deep deposits of alluvium the potential for the presence of Late Iron Age/ Romano British is considered to be moderate and locally high. The assessment considered the potential for the presence of features from the Saxon, Medieval and Post-Medieval periods to be low.

Analysis of historical mapping (Old-maps 2016) indicates that the division and layout of land within the PDA has undergone considerable change since the publication of the first edition Ordnance Survey (OS) map in 1854. Numerous field boundaries have been removed to create larger fields, eighteen of which have been identified in the data as linear anomalies.

3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of any proposed development on any sub-surface archaeological remains, if present.

The general 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. Features 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 and 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 is programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses 4m apart. These readings are stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system is 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.

ILLUS 3 Field 5 (west), looking north

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software has been used to collect and export the data. Terrasurveyor V3.0.31.0 (DWConsulting) software has been used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:25,000. Illus 2 – Illus 5 are site condition photographs. Illus 6 is a 1:7,500 scale location plan showing the GPS track data, the location and direction of the site condition photographs and the location of Illus 12 to Illus 29. Illus 7 shows the survey location overlain by superficial geology data and Illus 8 shows the NMP cropmark data overlying the 1893-4 six inch OS map. Fully processed greyscale data and accompanying interpretative drawings, both at a scale of 1:7,500, are shown as Illus 9 and Illus 10 respectively. An archaeological interpretation overlying the superficial geology data is presented as Illus 11.

Detailed data plots (greyscale and XY trace) and interpretative illustrations, of the six sectors into which the site is broken down, are presented at a scale of 1:2,000 in Illus 12 to Illus 29 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 the Written Scheme of Investigation (Headland Archaeology 2016) and guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations reproduced from Ordnance Survey mapping are 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

The magnetic background varies greatly across the PDA most notably in the north and east where broad sinuous anomalies are caused by the accumulation of enhanced silts and sediments within former water channels. Areas of variation are also caused by different agricultural activities, ground cover and superficial deposits. This variation is often exacerbated by the plethora of criss-crossing land drains which have been identified across the lower-lying parts of the site. One notable exception to these conditions can be seen within F5 where the topsoil had been removed prior to survey (see Illus 3) resulting in a relatively homogenous magnetic background free from ferrous 'spike' anomalies and discrete anomalies caused by variations in the topsoil. Ground conditions were generally good across the

ILLUS 4 Field 14, looking south-west

site and the data quality was correspondingly good throughout. It is therefore assessed that the results provide a reliable indication of the extent of the sub-surface archaeological remains, except on the alluvium, where detection of soil-filled features may be hampered by low magnetic contrast in the surrounding soils.

Against this variable background numerous linear and discrete anomalies have been identified including two areas of archaeological potential which broadly correspond to slightly elevated positions (above 5m AOD) over the sand and gravel till superficial deposits in the south-west and the north-west. These are discussed below and cross-referenced to specific anomalies on the interpretative illustrations, where appropriate.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on most sites, often being present as a consequence of manuring or tipping/infilling. This practice is particularly evident within the east of F19 (see Illus 10) where the ferrous anomalies coalesce into linear bands of magnetic disturbance.

Discrete high magnitude dipolar anomalies (Illus 10 – TP) locate wooden telegraph poles. A line of telegraph poles is identified aligned north-east/south-west crossing F6 and F14 and a single telegraph pole is identified within the west of F2 (see Illus 2). Broad areas of magnetic disturbance (Illus 10 – PY) on the same alignment are due to pylons carrying electrical cables (see Illus 4).

Two pipes (Illus 10 – SP1 and SP2) are identified as high magnitude dipolar linear anomalies. SP1 locates a gas main and is identified traversing the entire PDA on a north-east/south-west orientation. SP2 is identified on a north-east/south-west within F16 and on a north-west/south-east alignment across F16.

A localised area of magnetic disturbance (Illus 10 – BP) within the north-west of F11corresponds to a rectangular pond which is depicted on the first edition OS map. The disturbance is caused by magnetically-enhanced materials, such as brick, concrete etc, used to backfill the pond.

Magnetic disturbance around the field edges and along the route of the freight railway line is due the proximity of perimeter fencing and other ferrous material within or close to the field boundaries.

4.2 AGRICULTURAL ANOMALIES

Eighteen former field boundaries (FB1–FB18), depicted on early OS maps, have been identified as faint low magnitude linear anomalies but some, mainly within F19 and F20, have not been detected by the survey. This is probably due to the removal of these boundaries by ploughing rather than a lack of magnetic contrast.

The datasets are characterised by numerous parallel linear anomalies on various alignments. The most frequently occurring agricultural

ILLUS 5 Field 15, looking north

anomalies are the broadly-spaced parallel linear anomalies which are slightly speckled in appearance. These are due to field drains. Less broadly-spaced parallel trends aligned north/south within F15 and F19 and north-east/south-west within F20 are caused by the medieval and post-medieval agricultural practice of ridge and furrow cultivation. The striped appearance in the data is due to the magnetic contrast between former ridges and the soil-filled furrows. The ridge and furrow is no longer extant and is unlikely to be considered to be of anything more than of local historical interest. The much straighter and more closely spaced parallel linear anomalies throughout F1 – F13 are characteristic of modern cultivation.

4.3 GEOLOGICAL ANOMALIES

The northern and eastern parts of the PDA are characterised by broad and amorphous anomalies coalescing into sinuous bands. The anomalies are caused by the accumulations of alluvial clays and silts within the former winding channels of the Humber Wetland prior to their drainage.

Numerous discrete anomalies are visible throughout the magnetic datasets. These are interpreted as geological in origin and are due to minor variations in the depth and composition of the upper soil horizons and superficial deposits.

4.4 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

Unless otherwise stated all the described anomalies are caused by soil-filled features, predominantly ditches forming boundaries or enclosures for settlement and/or stock management.

The archaeological and possible archaeological anomalies correspond closely to the cropmark data and can be broadly separated into two areas. The first being largely located on slightly elevated sand and gravel superficial deposits in the north-north-west of the PDA (see Illus 11). The obvious exception to this are three rectangular enclosures (E1 – E3) located within low-lying alluvial deposits within F2, centred at SK 5884 9804. The enclosures are likely to have functioned for stock management. Within the south-east of F3 rectilinear cropmarks and faint linear anomalies appear to form the north-eastern corner of an enclosure (E4) centred at SK 5869 9782. A sub circular anomaly (E5) and an oval anomaly (E6) are identified within the south-east corner of the enclosure each measuring approximately 10m in diameter. Towards the north (centre) of the PDA at least six enclosures (E7 – E12) are identified appended either side of parallel curvilinear anomalies (TR1) which are thought to be ditches flanking a trackway. The enclosures are largely devoid of discrete anomalies apart from E8, centred at SK 5918 9790, which contains a notable concentration of pit-type anomalies. E8 is located on a small 'island' of sand and gravel river terrace deposits which rise above the alluvial deposits to 7m AOD. It is possible that the pit-type anomalies indicate localised settlement activity although a geological origin cannot be dismissed, perhaps being due to variations in the composition of the superficial deposits.

The second broad area of archaeological potential is located within the south-west of the PDA and is characterised by at least eight enclosures (E13 – E20) on a north-east/south-west orientation. A clear sub-circular anomaly within F15, centred at SK 5865 9727, corresponds to SMR 00068/01 (see Illus 8) and to the cropmark data forming the eastern extent of a sub-circular enclosure (E13) measuring 60m in diameter. Numerous discrete anomalies are identified within the interior of the enclosure and are thought to be due to settlement activity including pits and spreads of archaeological material. It is worth noting that the enclosure is located in the only part of the PDA which is devoid of any superficial deposits, perhaps contributing to the clarity of the enclosure in F15. Two smaller trapezoidal-shaped enclosures (E14 and E15) are annexed to the eastern side of E13 with a further three larger sub-square field enclosures (E16 - E18) appended to the annexe in F16 and F19.

In the north of F16 two further probable enclosures (E19 and E20) are identified on the same north-east/south-west orientation centred at SK 5890 9745). The enclosures are appended to the northern side of a possible trackway (TR2) with another trackway (TR3) appearing to extend south-westwards from the south-west corner of E20.

Within the south of the PDA two isolated trackways (TR4 and TR5) characterised by parallel linear anomalies (ditches) are identified aligned east/west and north-west/south-east respectively.

Elsewhere, occasional isolated linear and curvilinear anomalies have been ascribed a possible archaeological interpretation since they cannot be easily explained as either modern, geological or agricultural in origin. For this reason, an archaeological origin cannot be dismissed.

No anomalies of archaeological potential have been identified in the vicinity of a cluster of cropmarks within the south (centre) of the PDA, centred in F21. The cropmarks are located over alluvial deposits and it is possible that there is insufficient magnetic contrast for soil-filled features to manifest in the data as magnetic anomalies. However, it is notable that some of the cropmarks appear on the same north-east/south-west alignment as a gas main, SP1, which traverses the site and therefore possible that some of the cropmarks are caused by the gas main and associated activity.

5 CONCLUSION

The geophysical survey has successfully evaluated the PDA, identifying anomalies of obvious archaeological potential in two broad areas within the PDA, mainly within the west of the PDA, above 5m AOD and upon superficial deposits of sand and gravel. Conversely, few anomalies of archaeological potential have been identified over the alluvial deposits which cover the eastern half of the site. It is not clear whether possible archaeological features may be masked by low magnetic contrast within the alluvial soils although it seems likely, given the nature and scale of the surrounding cropmarks, that some archaeological features, particularly over areas of alluvium, may not have been detected by the survey.

The survey has accurately located a probable settlement site within the south-west of the PDA along with at least a further nineteen enclosures, probably functioning for later Iron Age/Romano-British stock and crop management. Many of the identified anomalies had been previously identified as cropmarks although the survey has also enhanced the archaeological record by identifying previously unrecorded elements of the field system.

No anomalies of archaeological potential have been identified in the vicinity of a cluster of cropmarks east of the junction of Carr Bank and Egg Lane. However some of the cropmarks correspond closely to the route of a gas main which may account for their presence.

Therefore, on the basis of the geophysical survey, the archaeological potential in the west of the PDA is assessed as being moderate and locally high, whereas a low archaeological potential is ascribed to the lower lying former wetland in the east, confirming the results of the Desk Based Assessment.

6 REFERENCES

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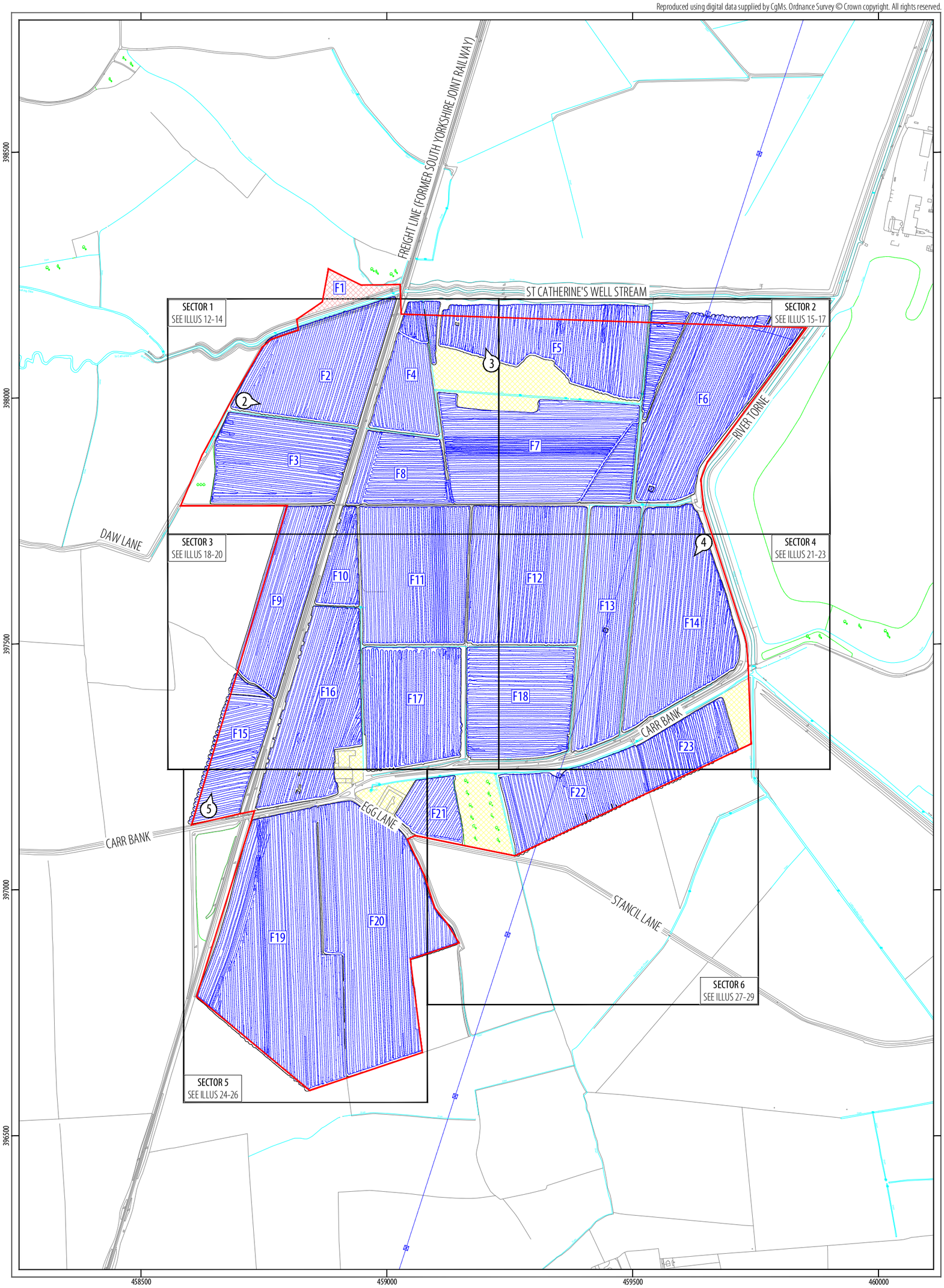

- proposed development area
- GPS track data
- area unsuitable for survey
- area not surveyed
- location and direction of ILLUS 2-5

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PROJECT RIPD/01
Rossington Inland Port Phase 2B
Rossington
South Yorkshire

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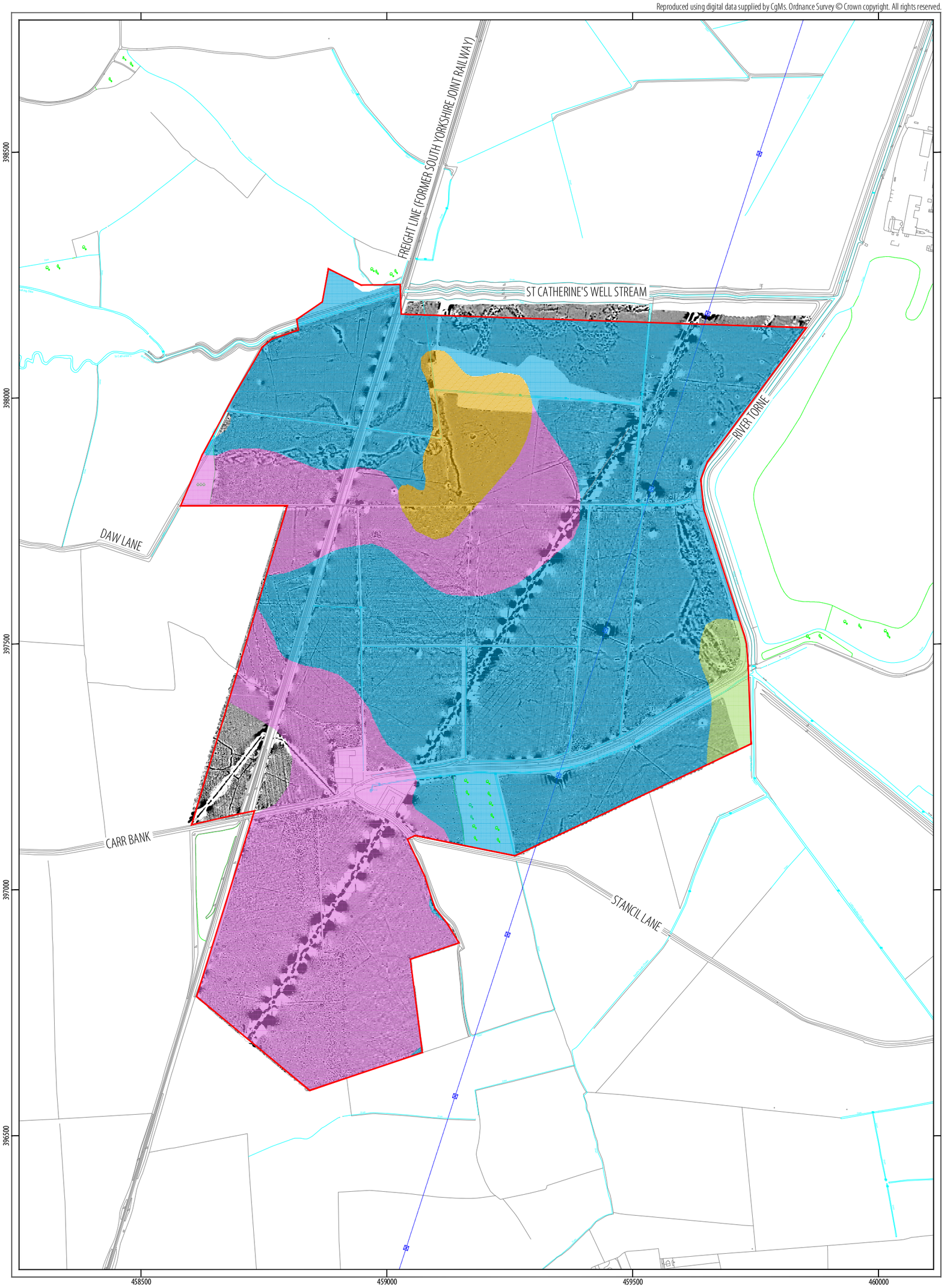
ILLUS 6 Survey location showing GPS tracks



proposed development area

SUPERFICIAL GEOLOGY

- Alluvium - clay, silt, sand and gravel
- Peat - peat
- River Terrace Deposits (undifferentiated) - sand and gravel
- Till - diamicton - sand and gravel

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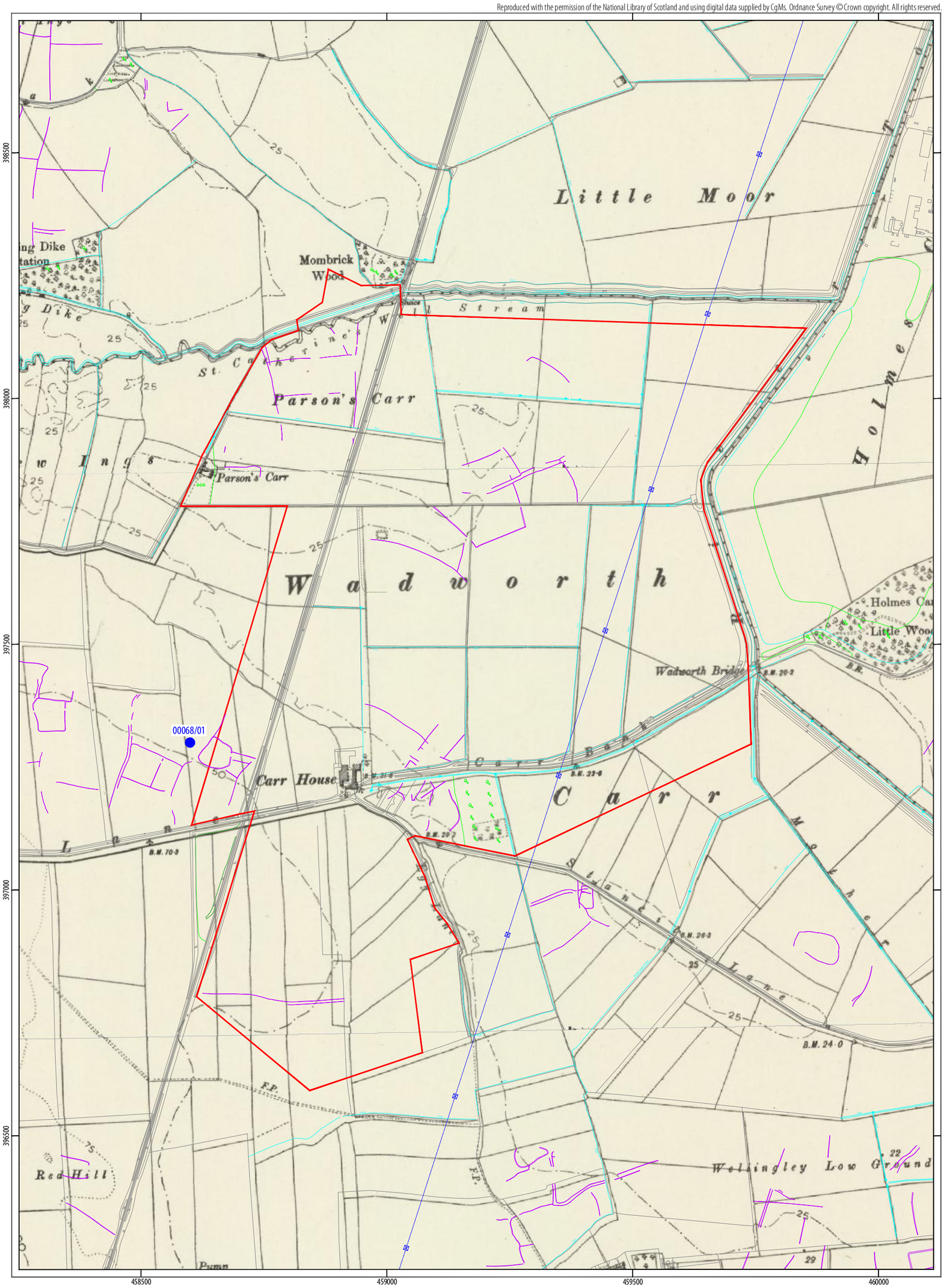
ILLUS 7 Survey location showing geology data



proposed development area
NMP data
South Yorkshire SMR data

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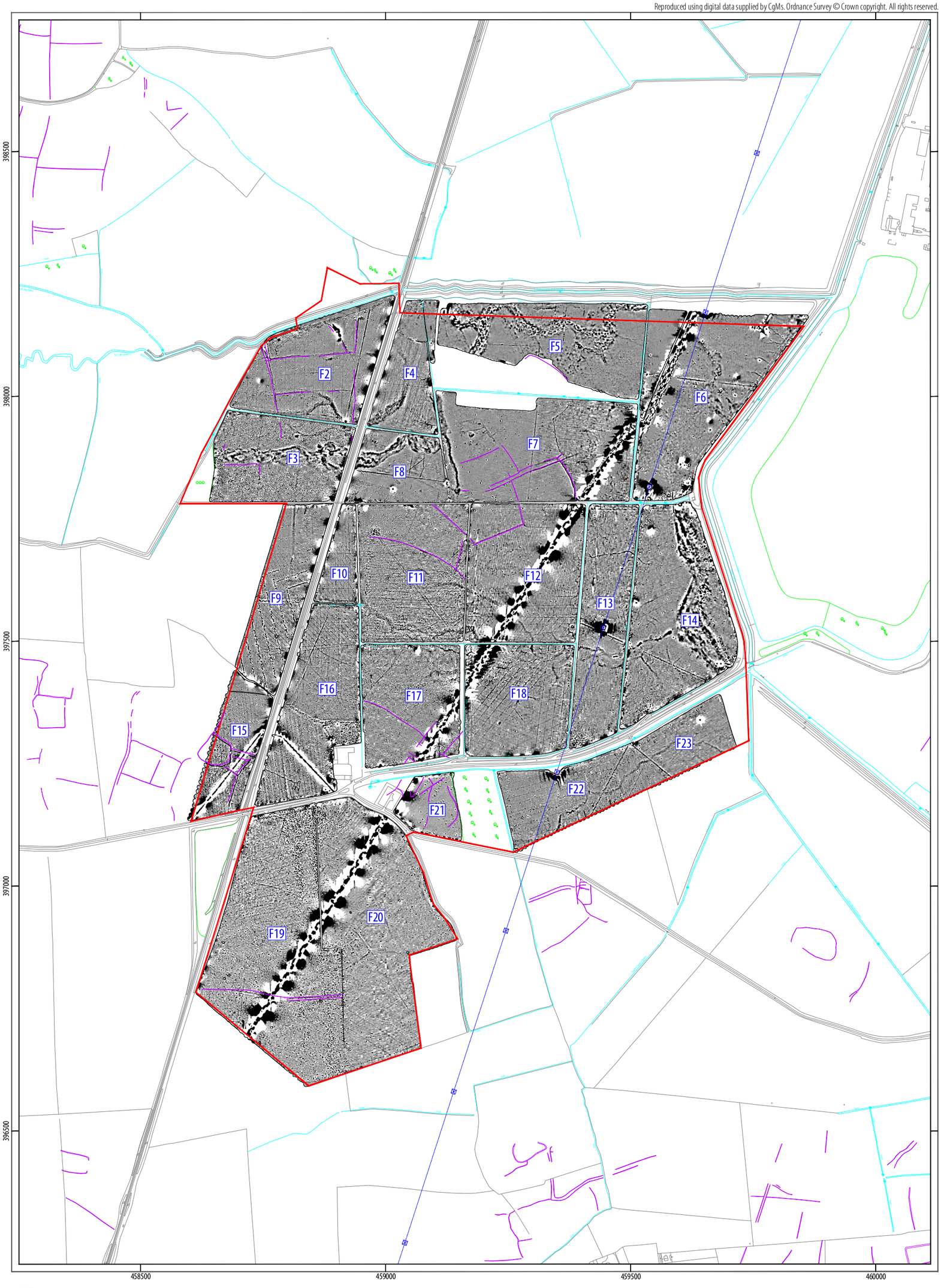
ILLUS 8 Survey location showing 1893-4 six inch OS map and NMP cropmark data



proposed development area
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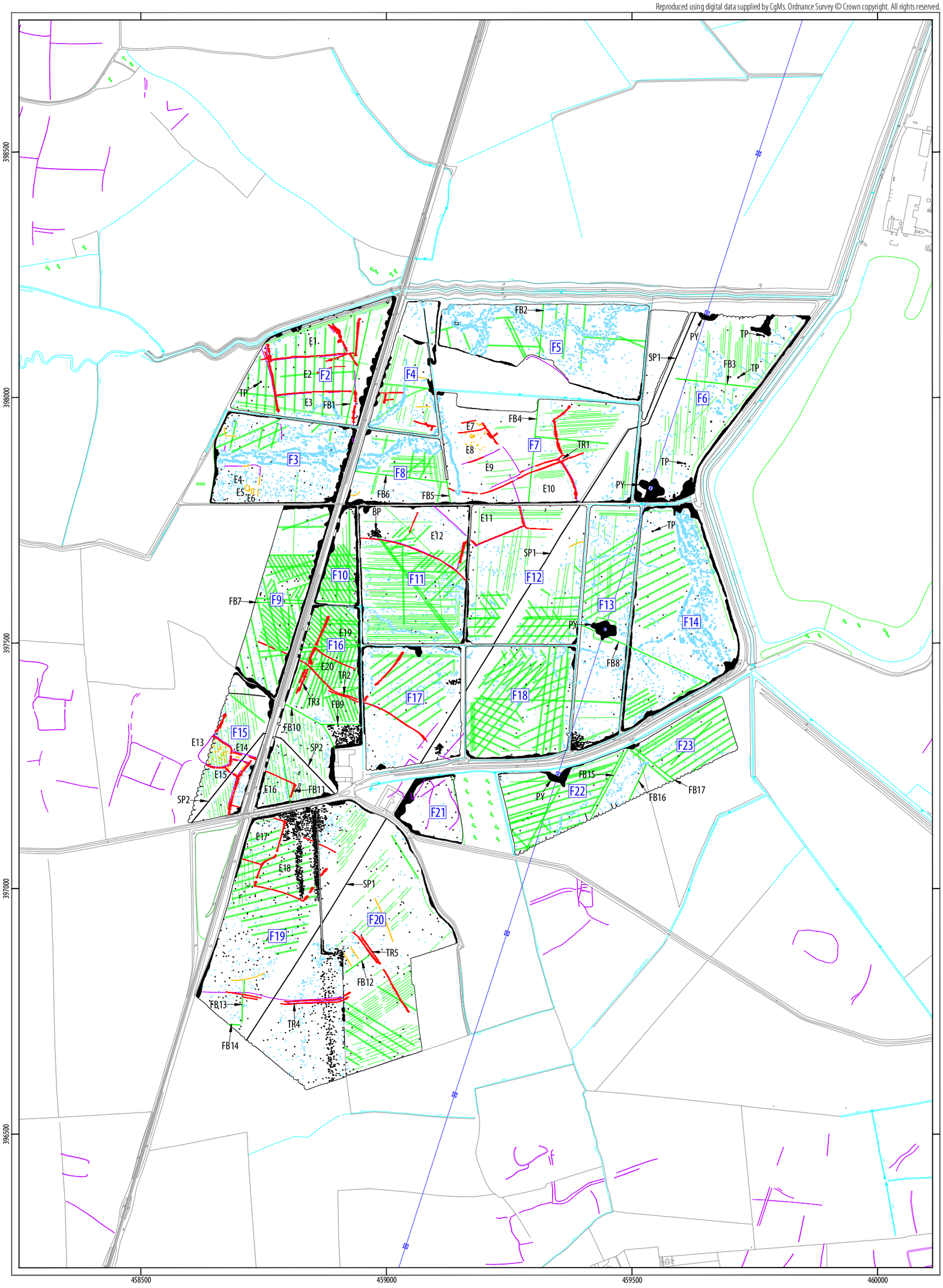
ILLUS 9 Overall processed greyscale magnetometer data



NMP data

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural

TYPE OF ANOMALY	INTERPRETATION
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

BP	backfilled pond	SP	service pipe
E	enclosure	TP	telegraph pole
FB	former boundary	TR	trackway
PY	pylon		

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0 200m

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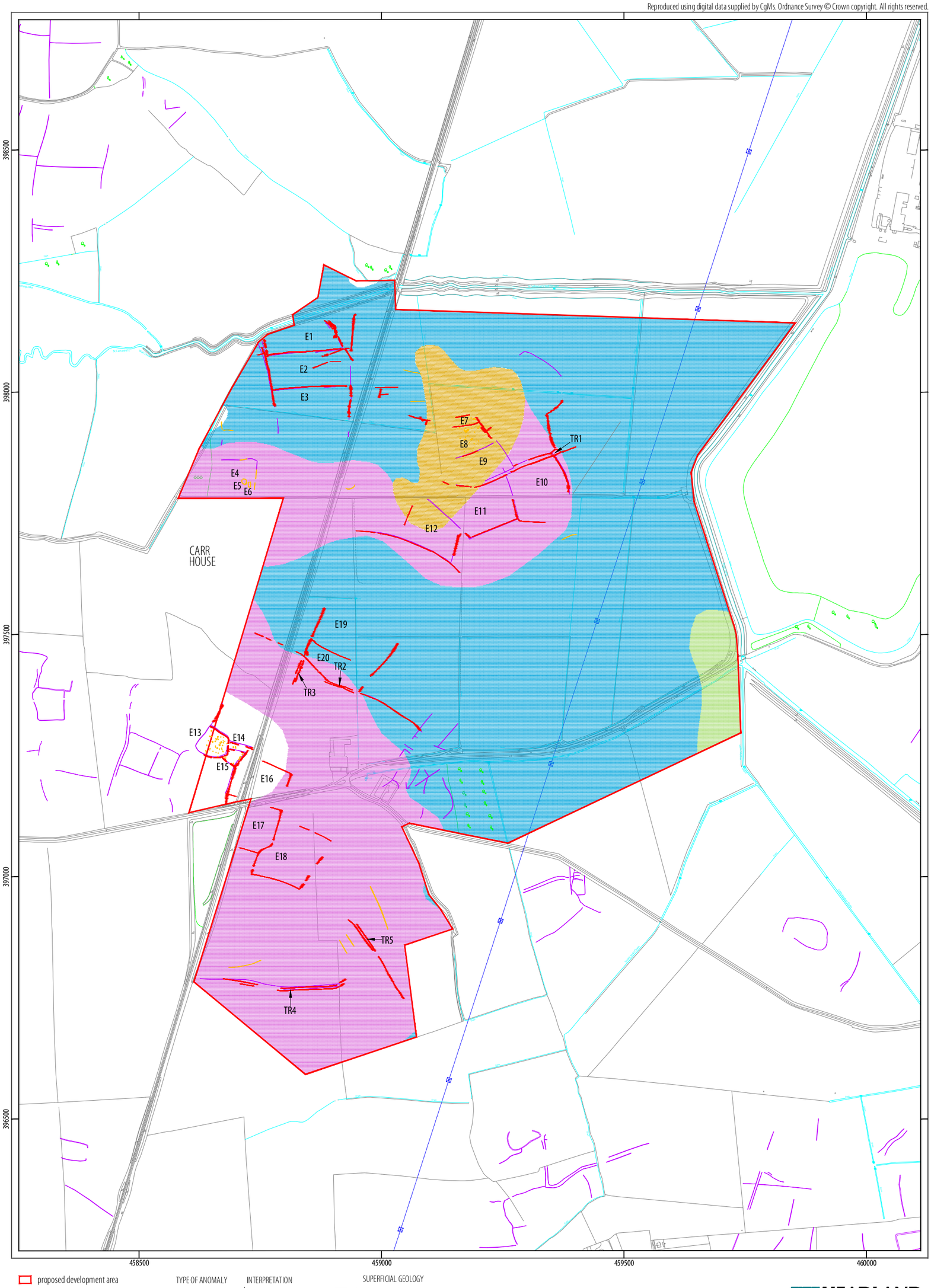
ILLUS 10 Overall interpretation of magnetometer data



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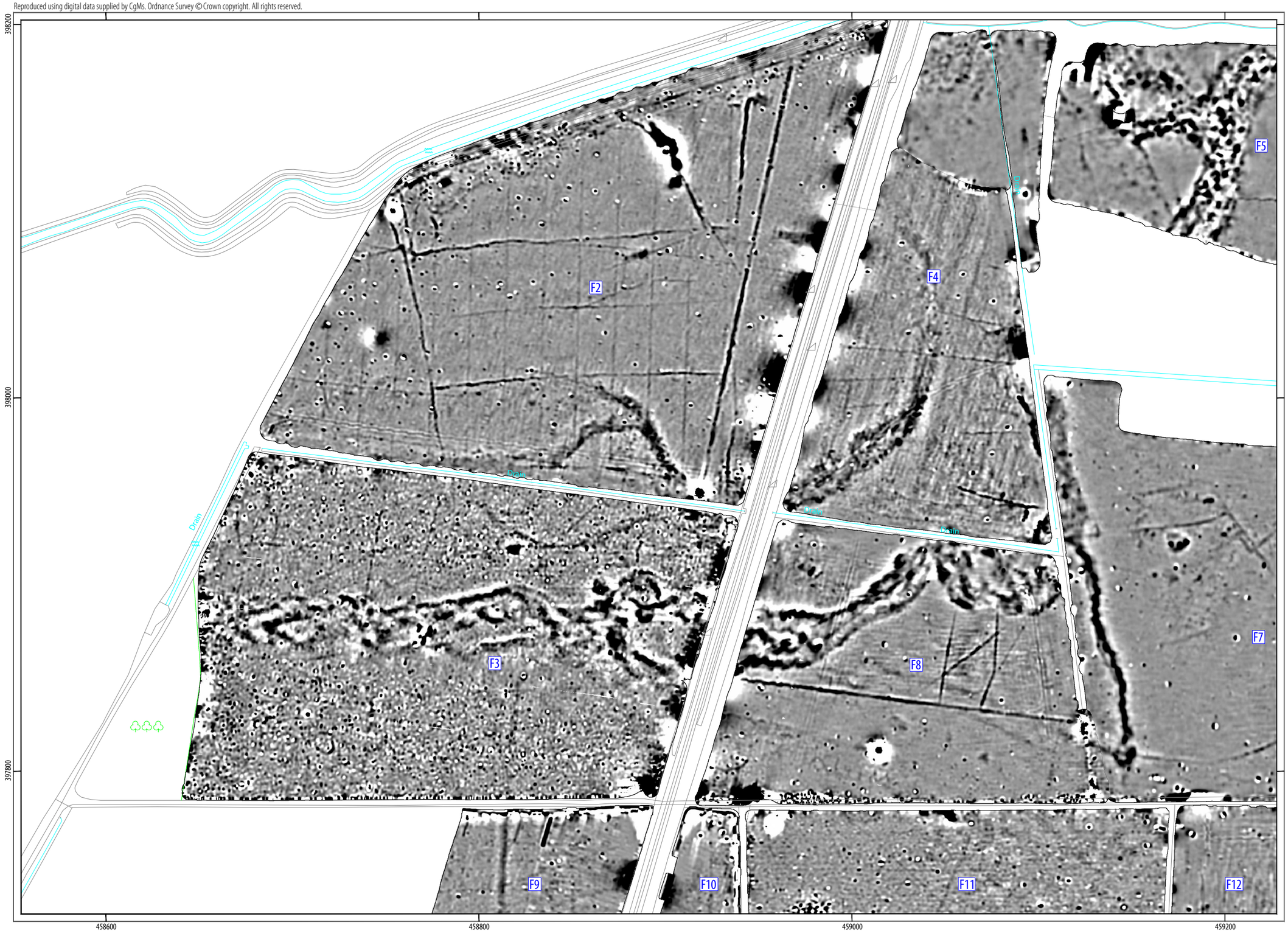
ILLUS 11 Archaeological interpretation showing geology data



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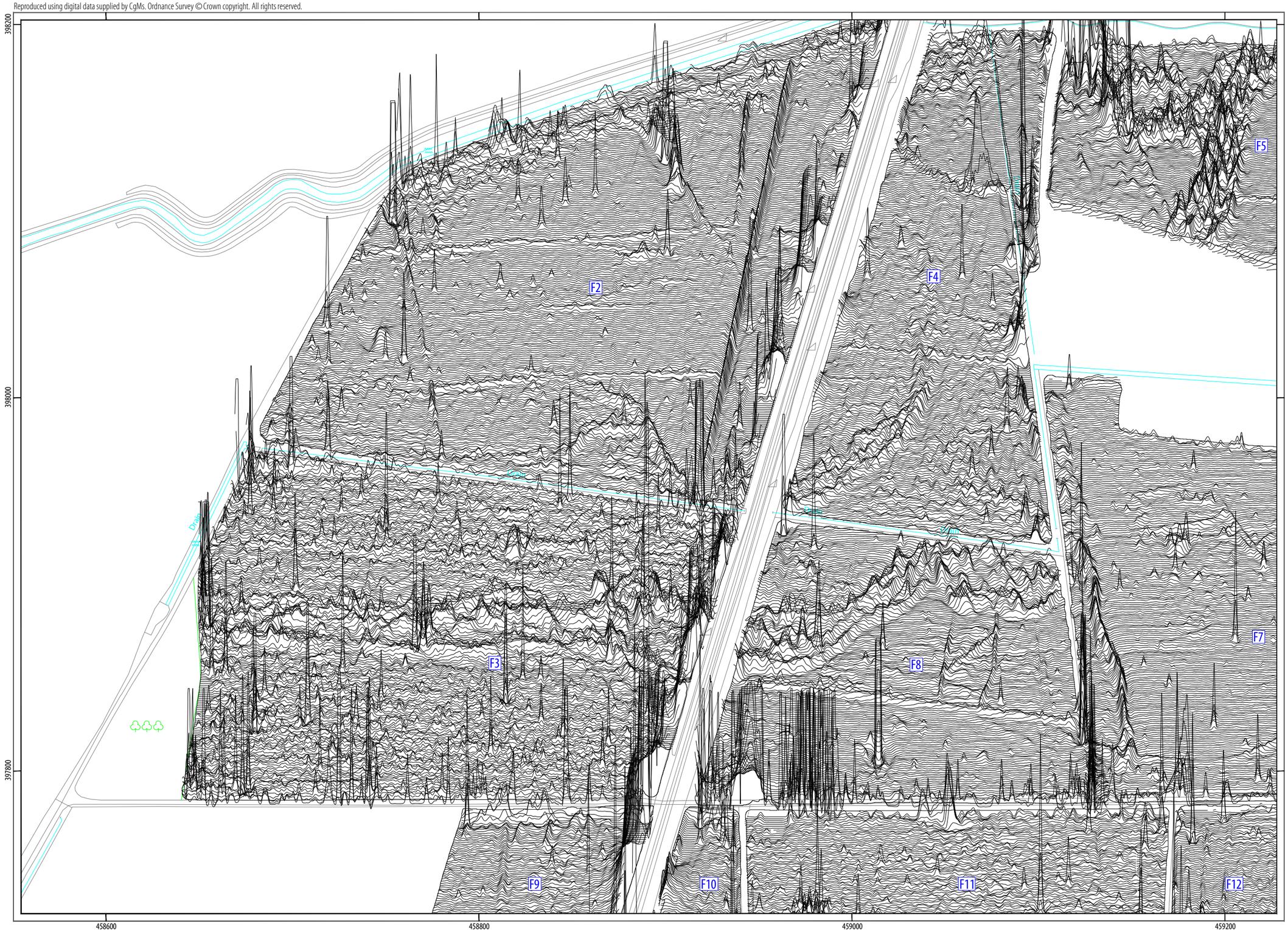
ILLUS 12 Processed greyscale magnetometer data; Sector 1



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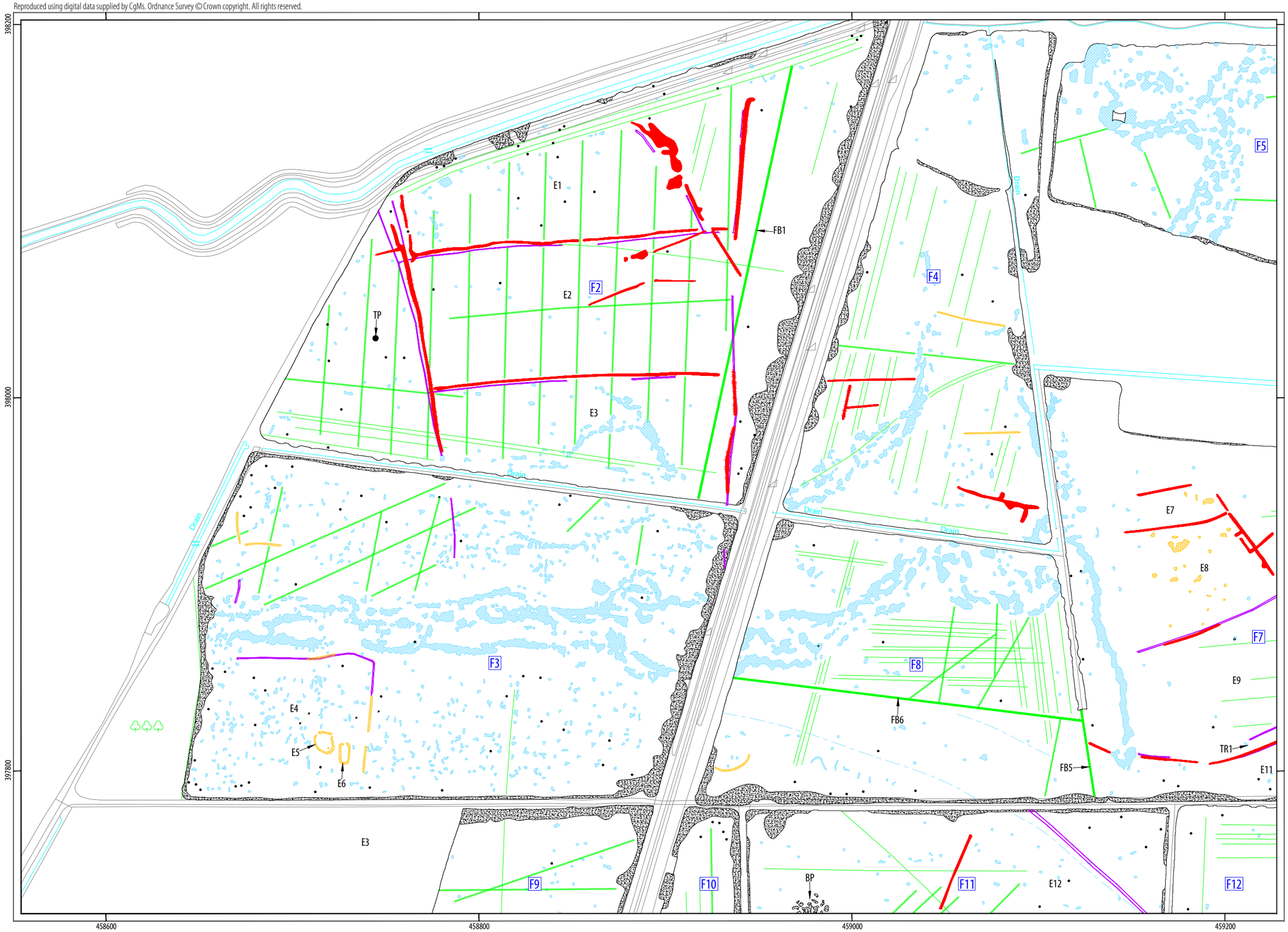
ILLUS 13 XY trace plot of minimally processed magnetometer data; Sector 1



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

BP	backfilled pond	TP	telegraph pole
E	enclosure	TR	trackway
FB	former boundary		

N

0 50m

scale 1:2,000 @ A3

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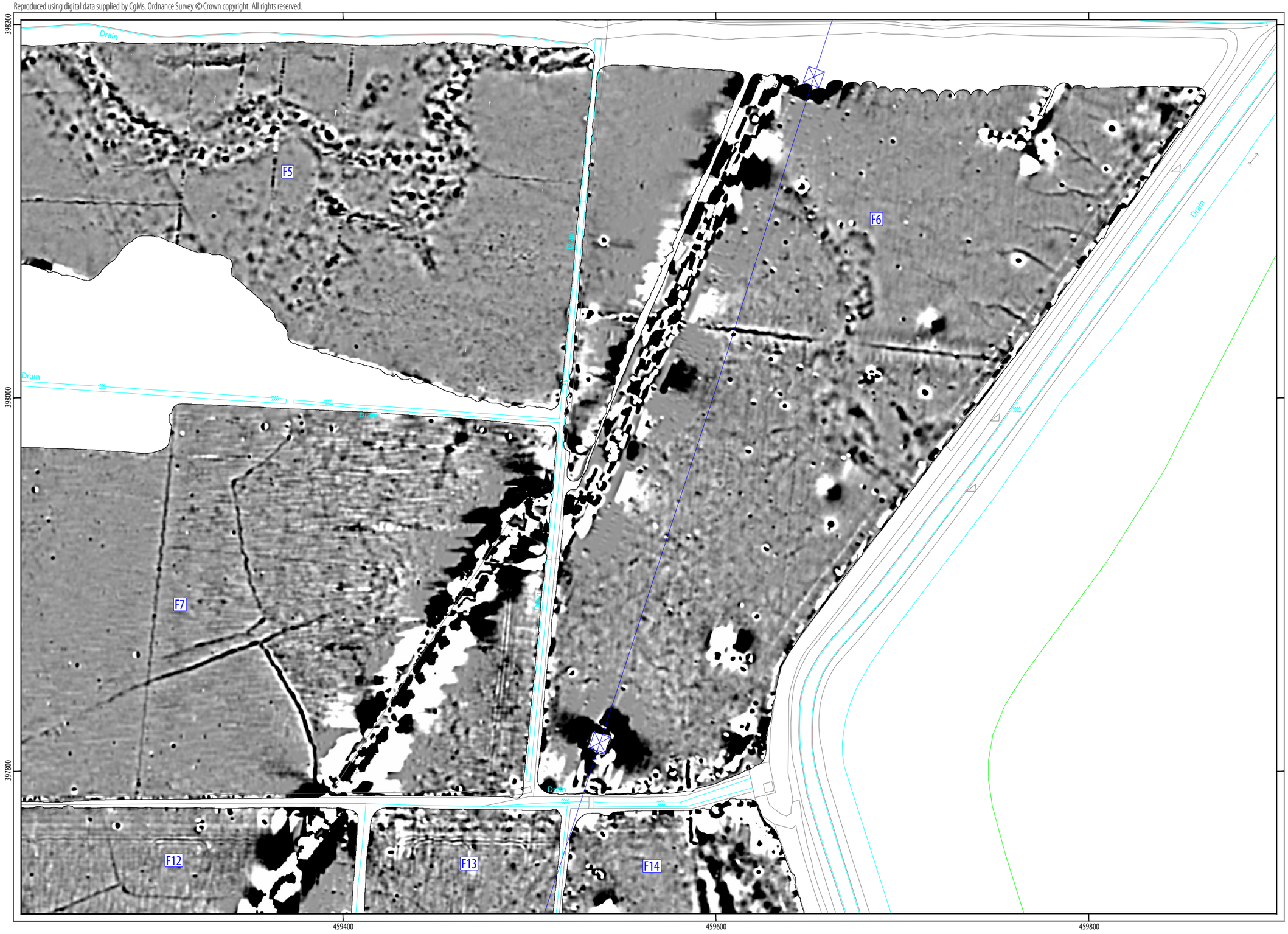
ILLUS 14 Interpretation of magnetometer data; Sector 1



nT
-2.0
3.0

N
0
50m
scale 1:2,000 @ A3

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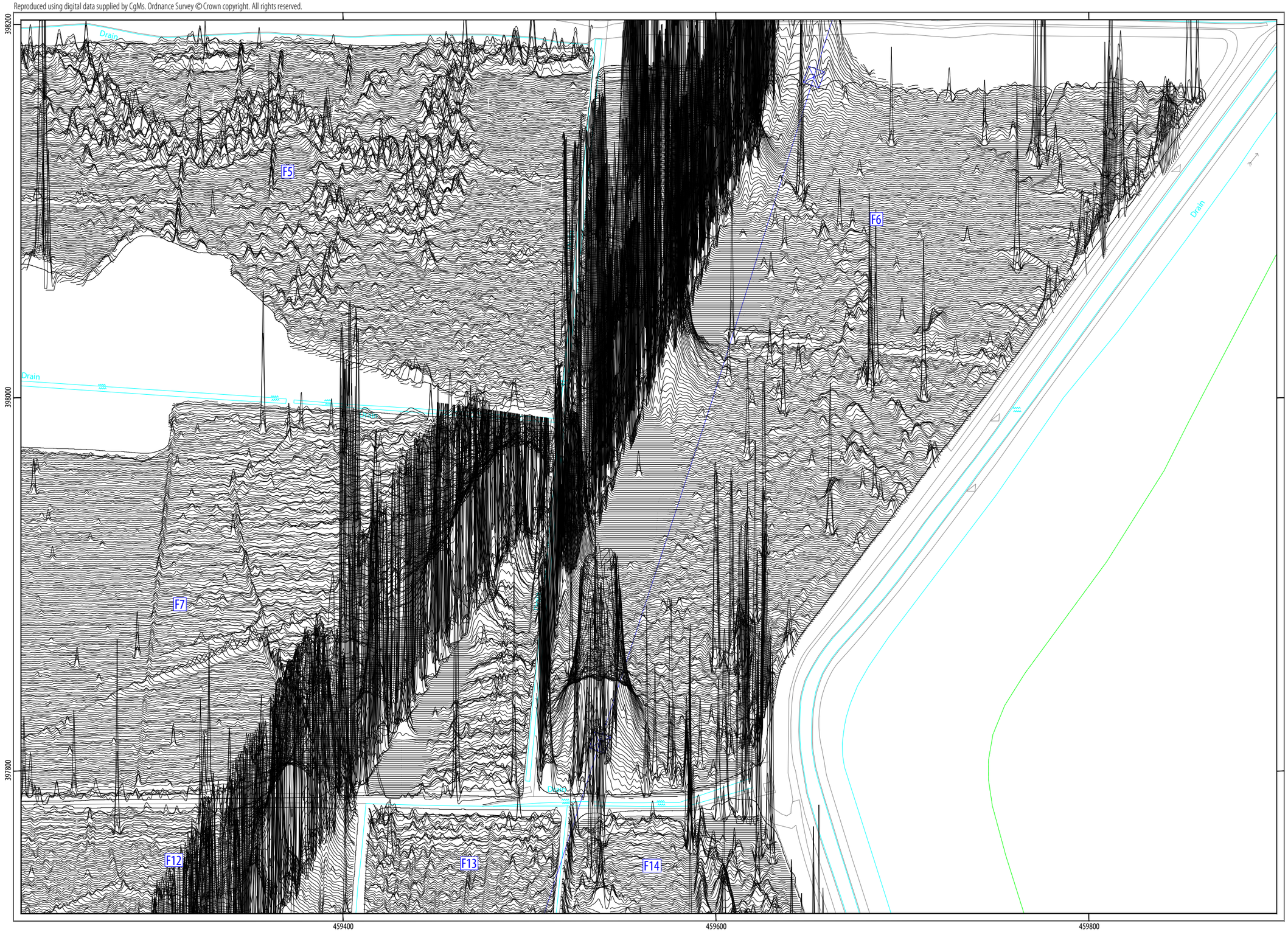
ILLUS 15 Processed greyscale magnetometer data; Sector 2



20.0nT/cm

N

0 50m

scale 1:2,000 @ A3

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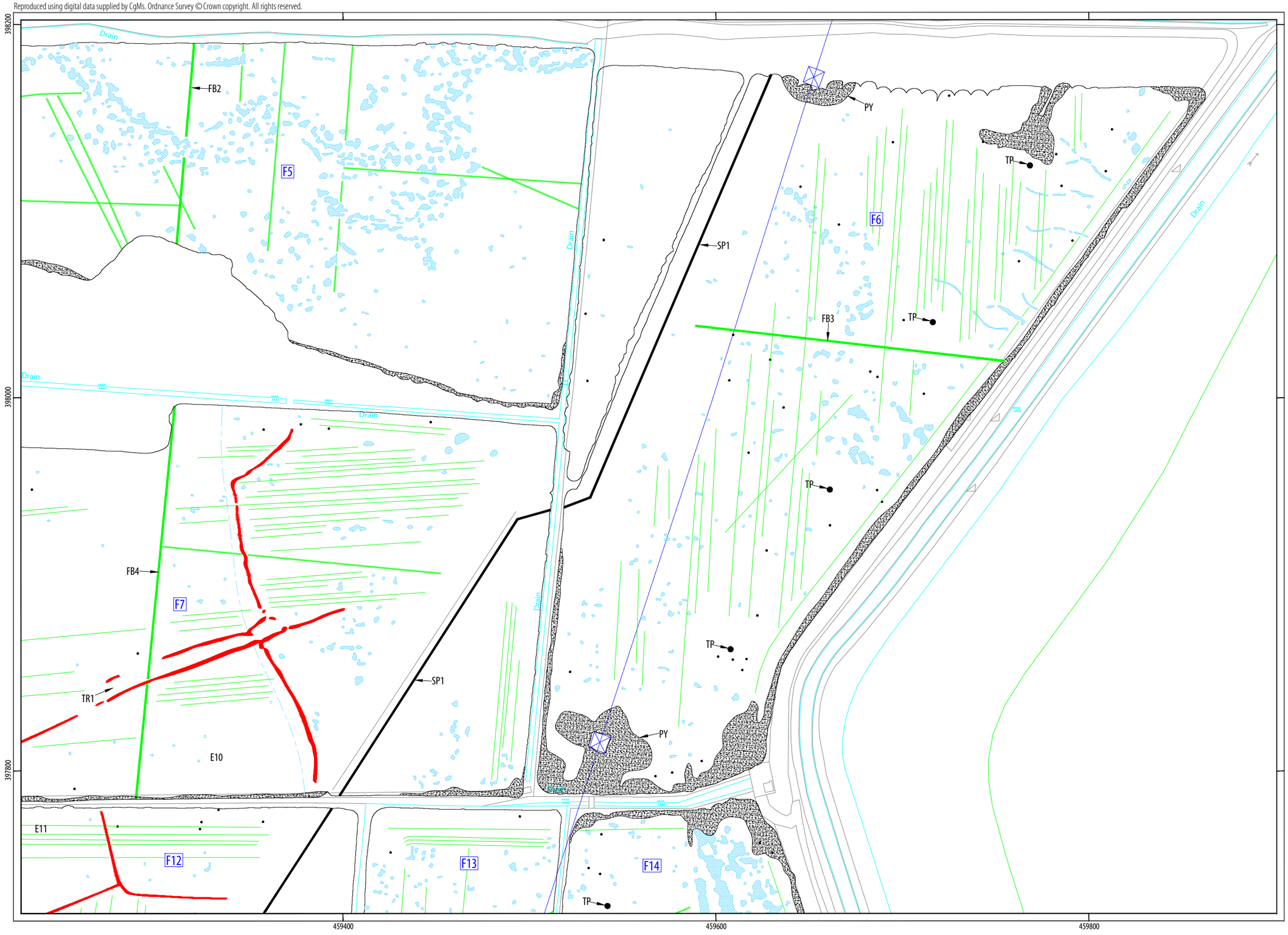
ILLUS 16 XY trace plot of minimally processed magnetometer data; Sector 2



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

E enclosure	**SP** service pipe
FB former boundary	**TP** telegraph pole
PY pylon	**TR** trackway

N

0 50m

scale 1:2,000 @ A3

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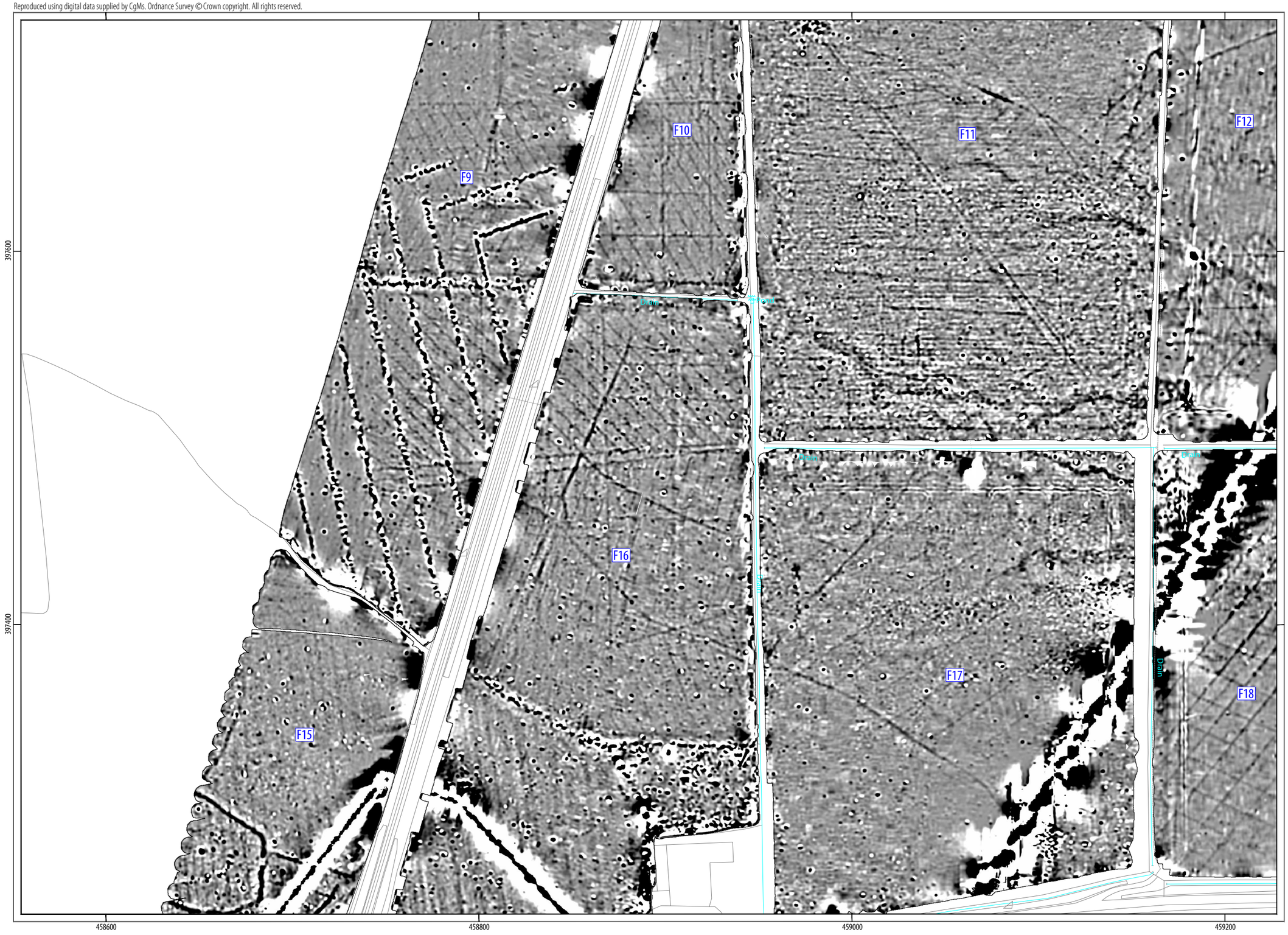
ILLUS 17 Interpretation of magnetometer data; Sector 2



nT
-2.0
3.0

N
0
50m
scale 1:2,000 @ A3

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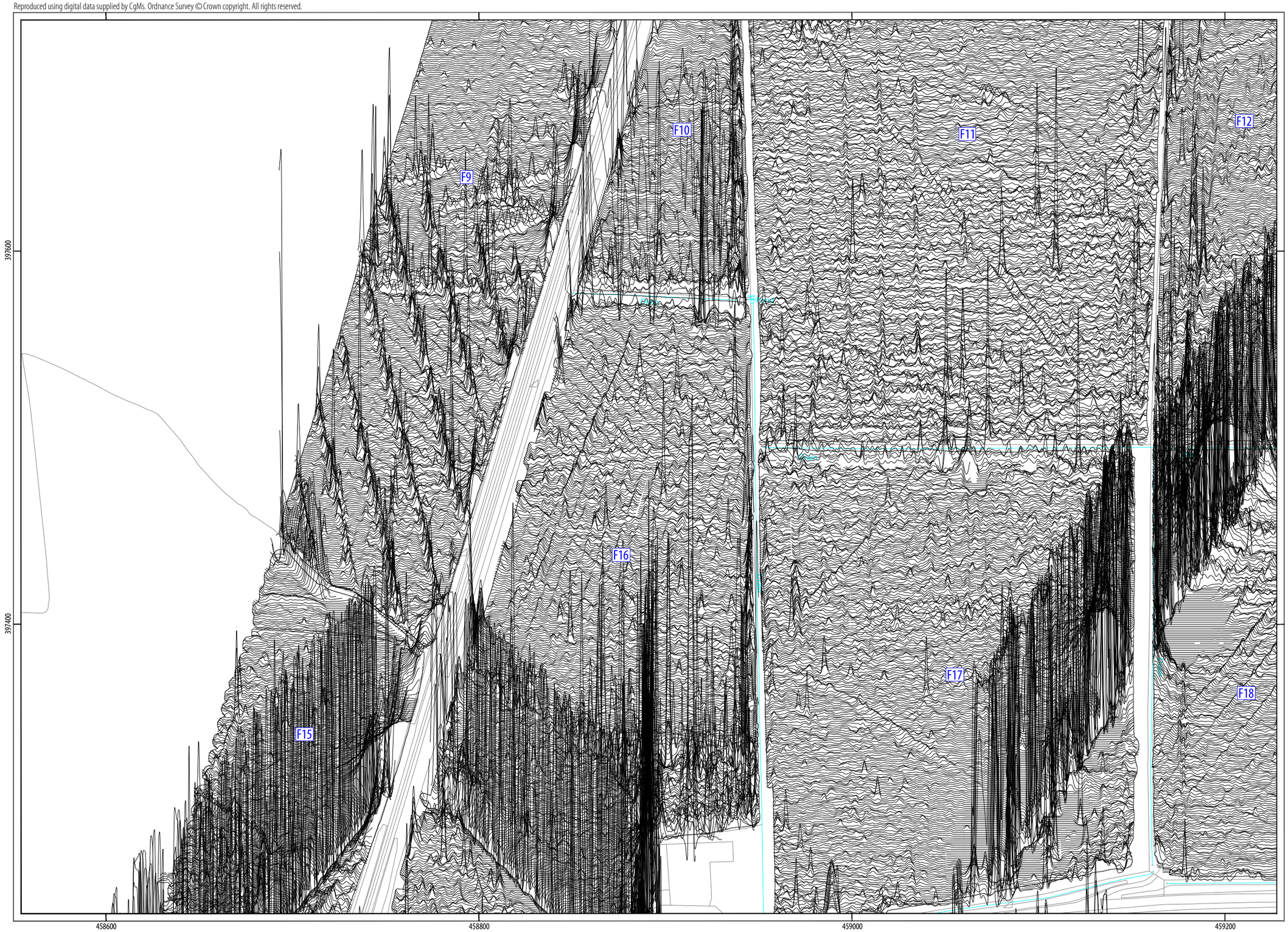
ILLUS 18 Processed greyscale magnetometer data; Sector 3



20.0nT/cm

N

0 50m

scale 1:2,000 @ A3

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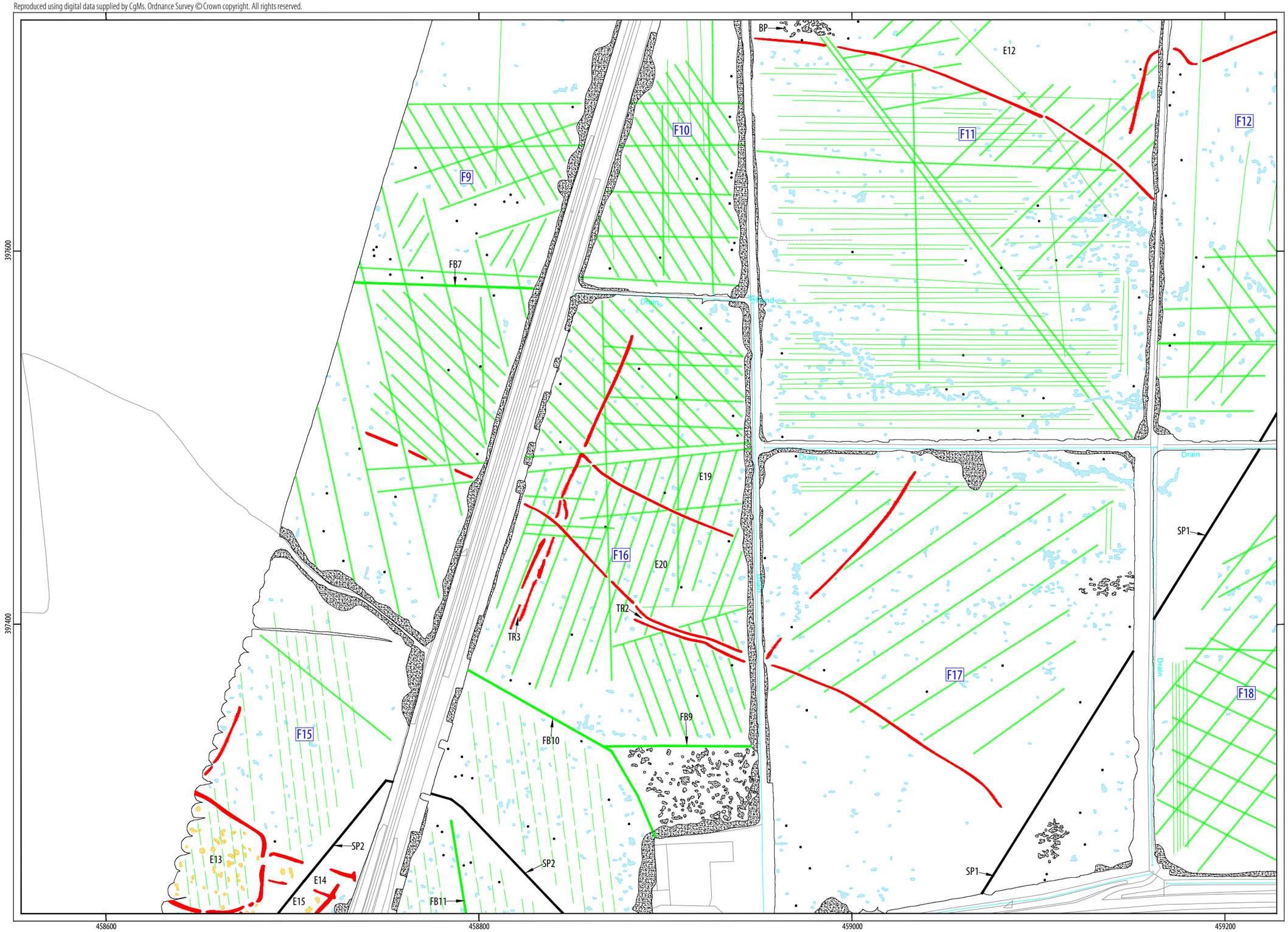
ILLUS 19 XY trace plot of minimally processed magnetometer data; Sector 3



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

ABBREVIATIONS

BP backfilled pond
E enclosure
FB former boundary
SP service pipe

N

0 50m

scale 1:2,000 @ A3

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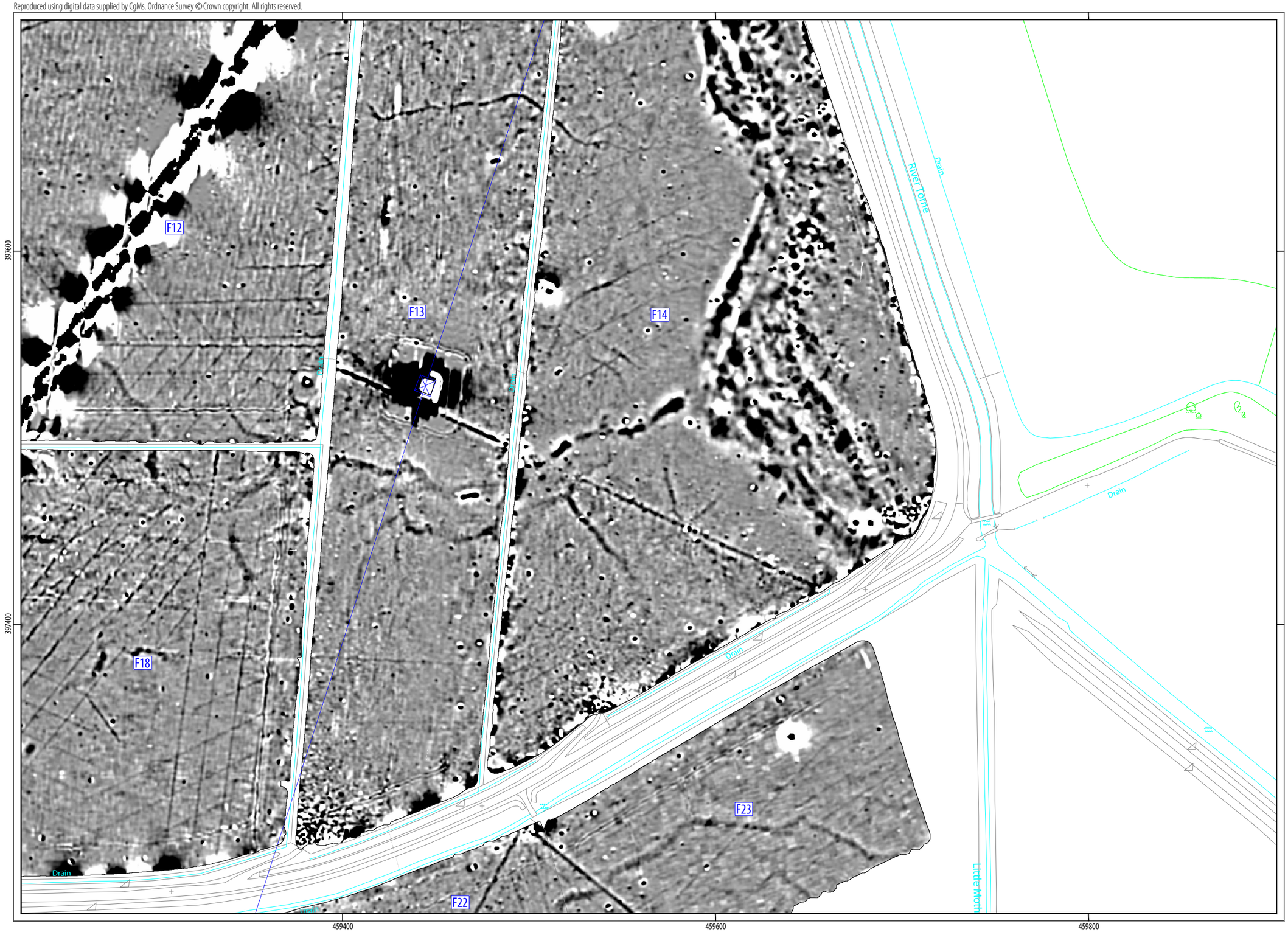
ILLUS 20 Interpretation of magnetometer data; Sector 3



-2.0 nT 3.0

N

0 50m

scale 1:2,000 @ A3

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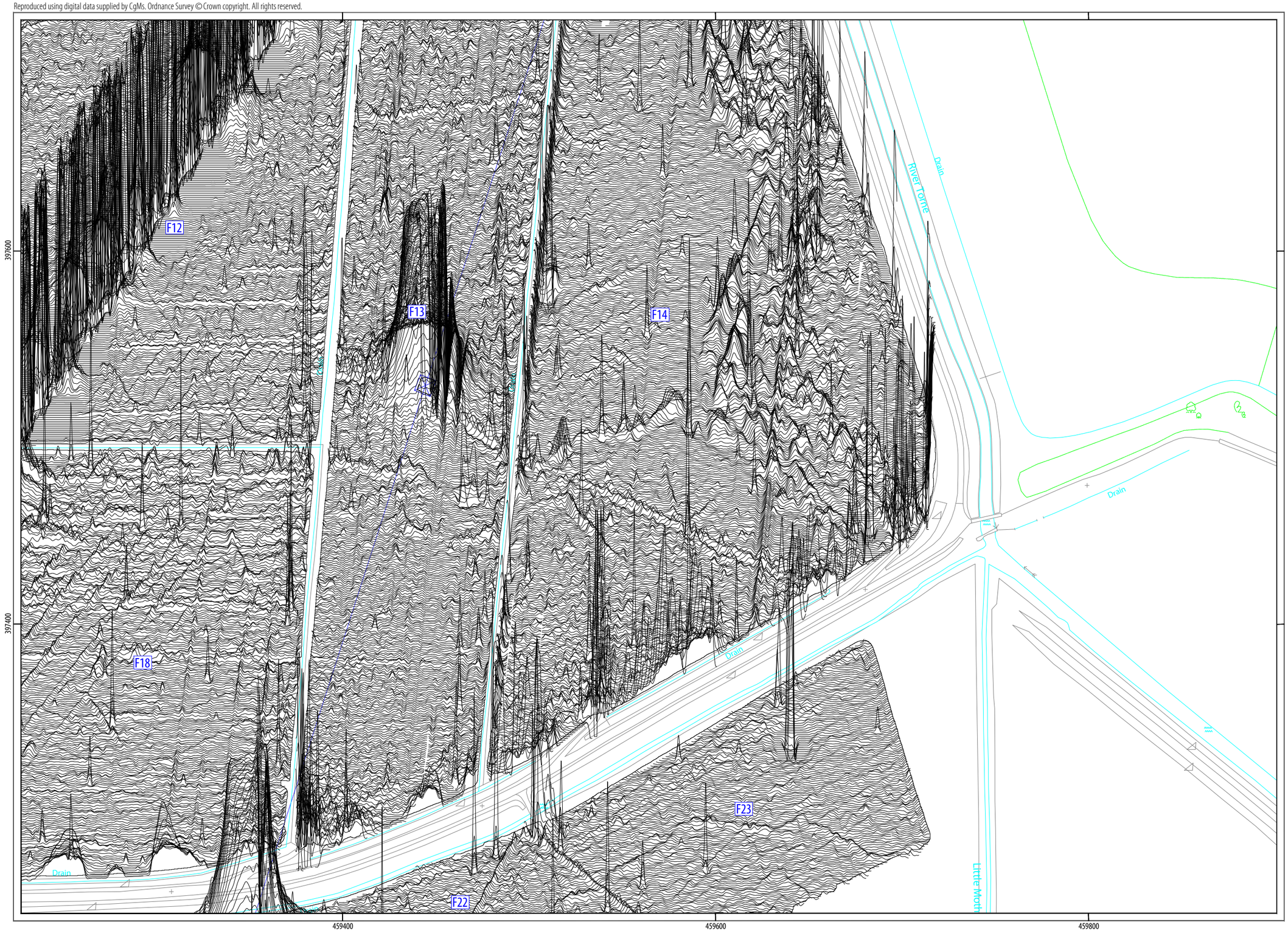
ILLUS 21 Processed greyscale magnetometer data; Sector 4



20.0nT/cm

N

0 50m

scale 1:2,000 @ A3

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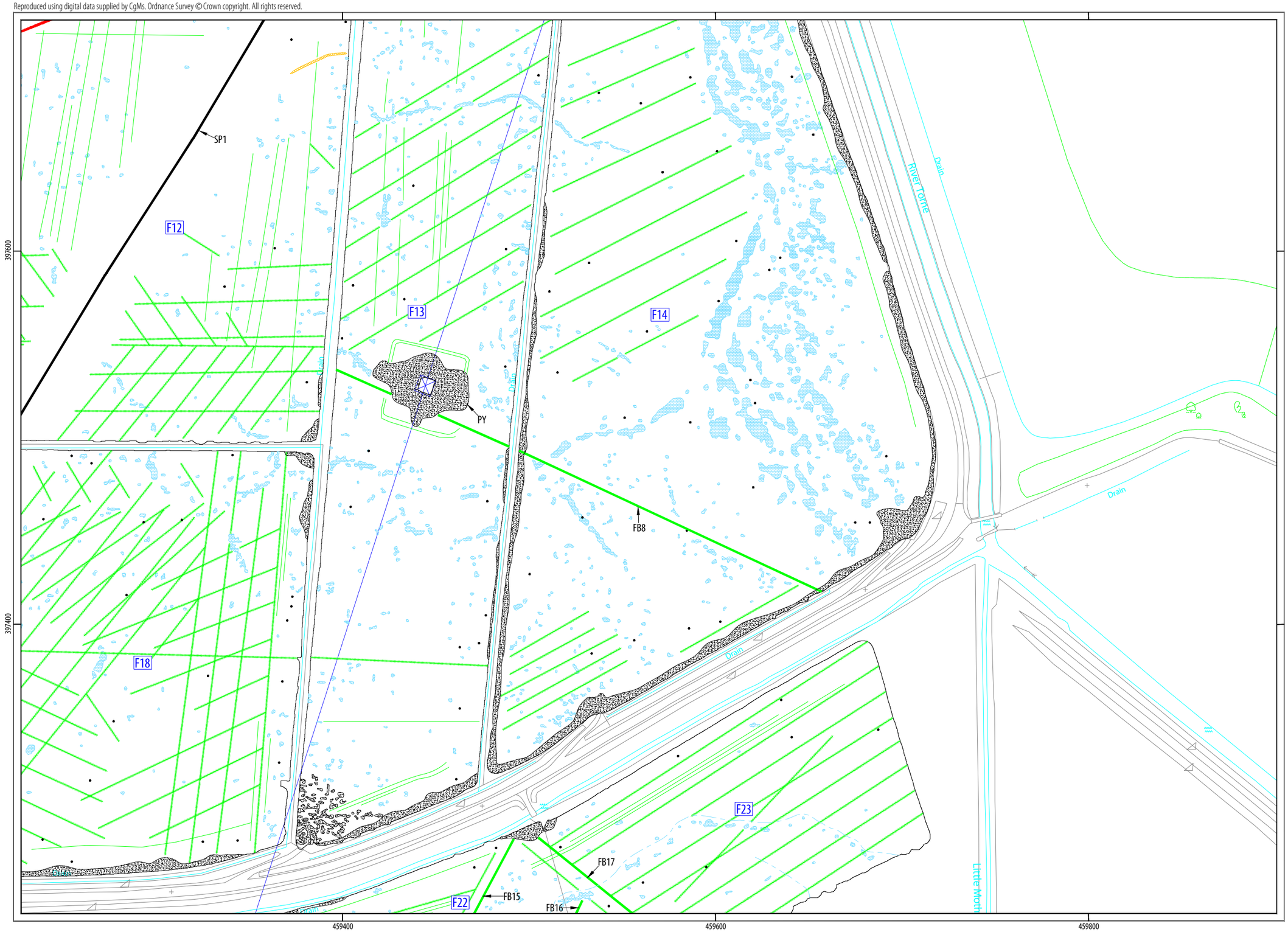
ILLUS 22 XY trace plot of minimally processed magnetometer data; Sector 4



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

ABBREVIATIONS

FB former boundary **SP** service pipe
PY pylon

N
0 50m
scale 1:2,000 @ A3

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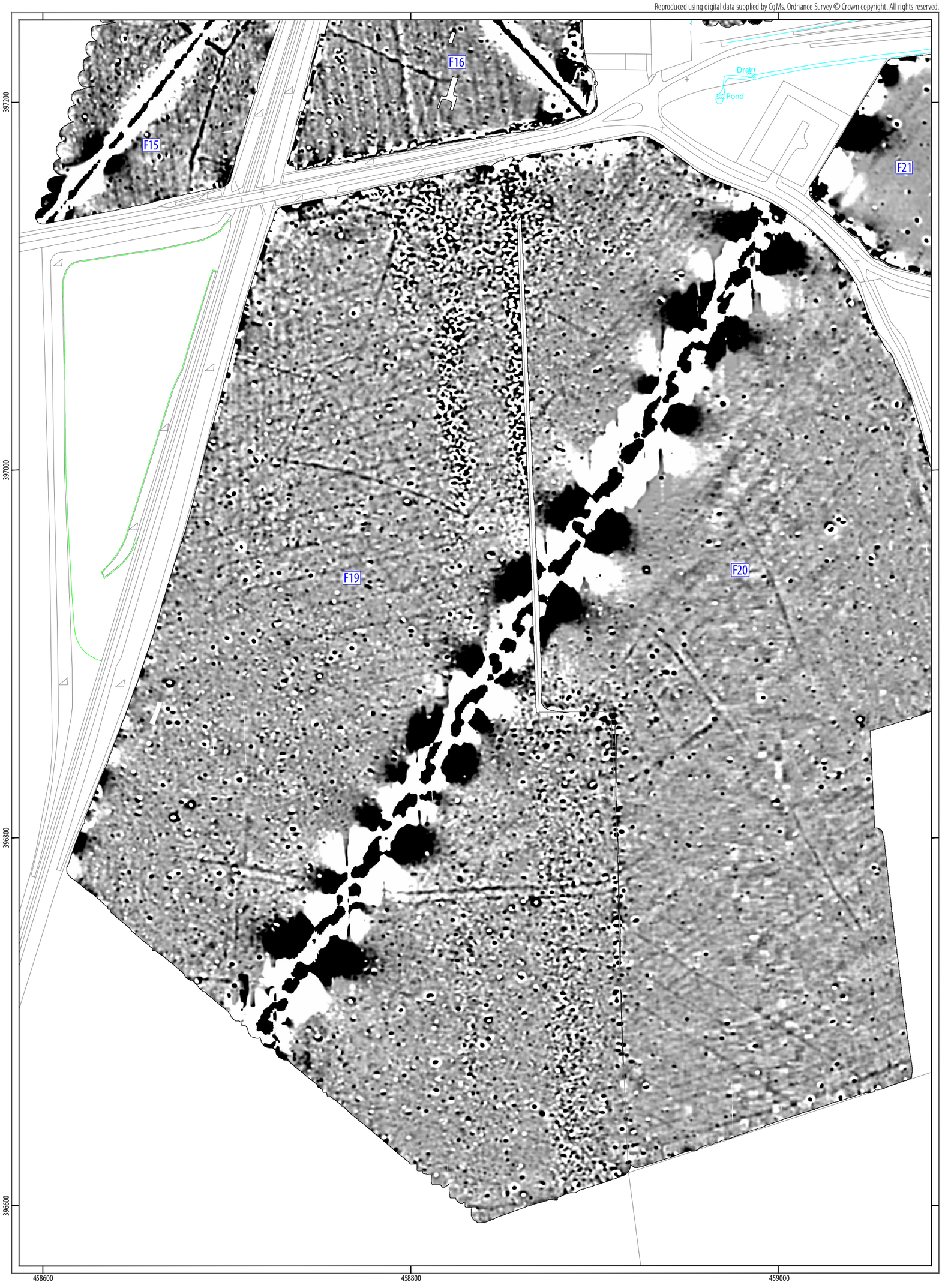
ILLUS 23 Interpretation of magnetometer data; Sector 4



nT
-2.0
3.0

N
0
50m
scale 1:2,000 @ A3

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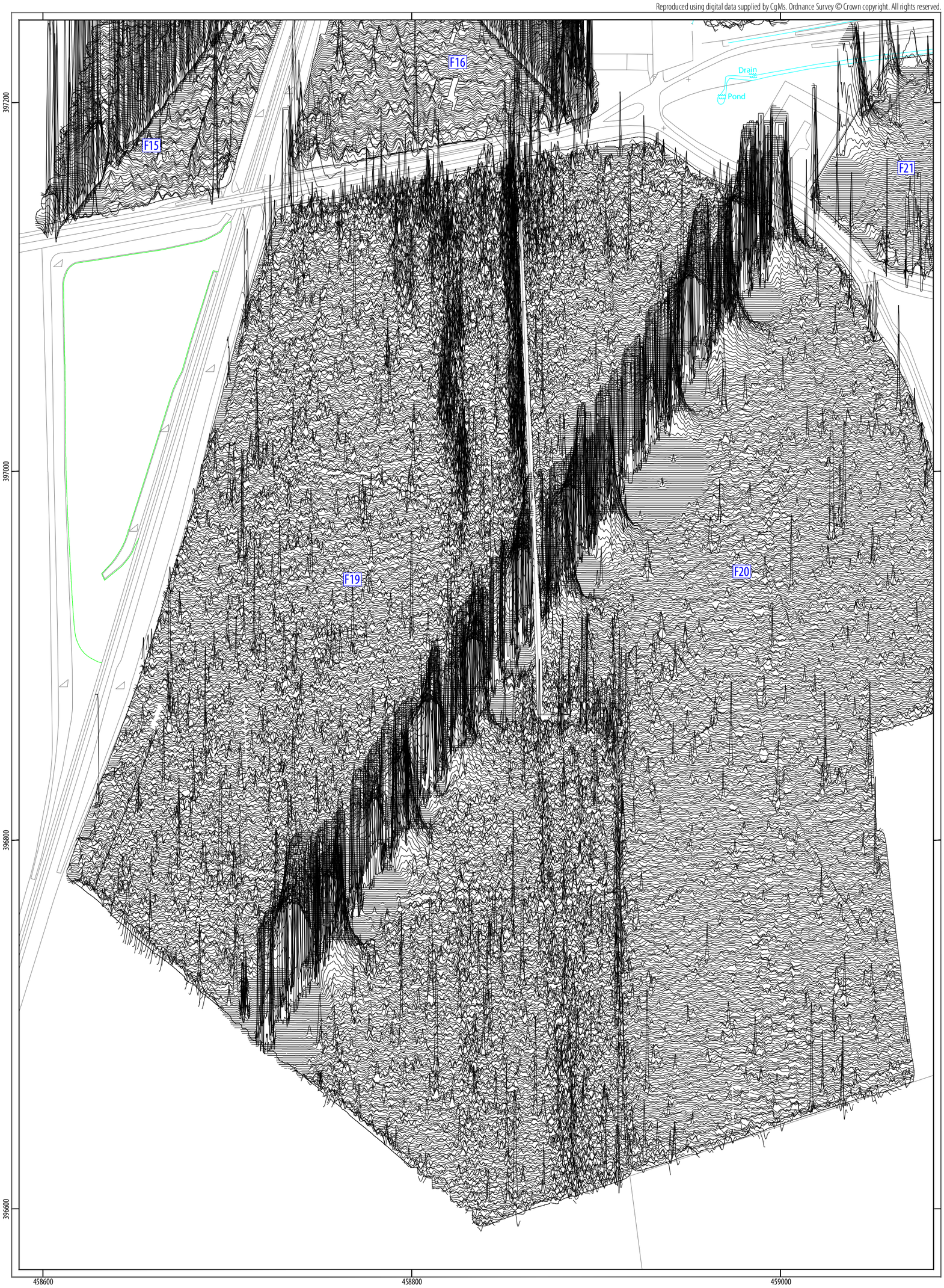
ILLUS 24 Processed greyscale magnetometer data; Sector 5



20.0nT/cm

N

0 50m

scale 1:2,000 @ A3

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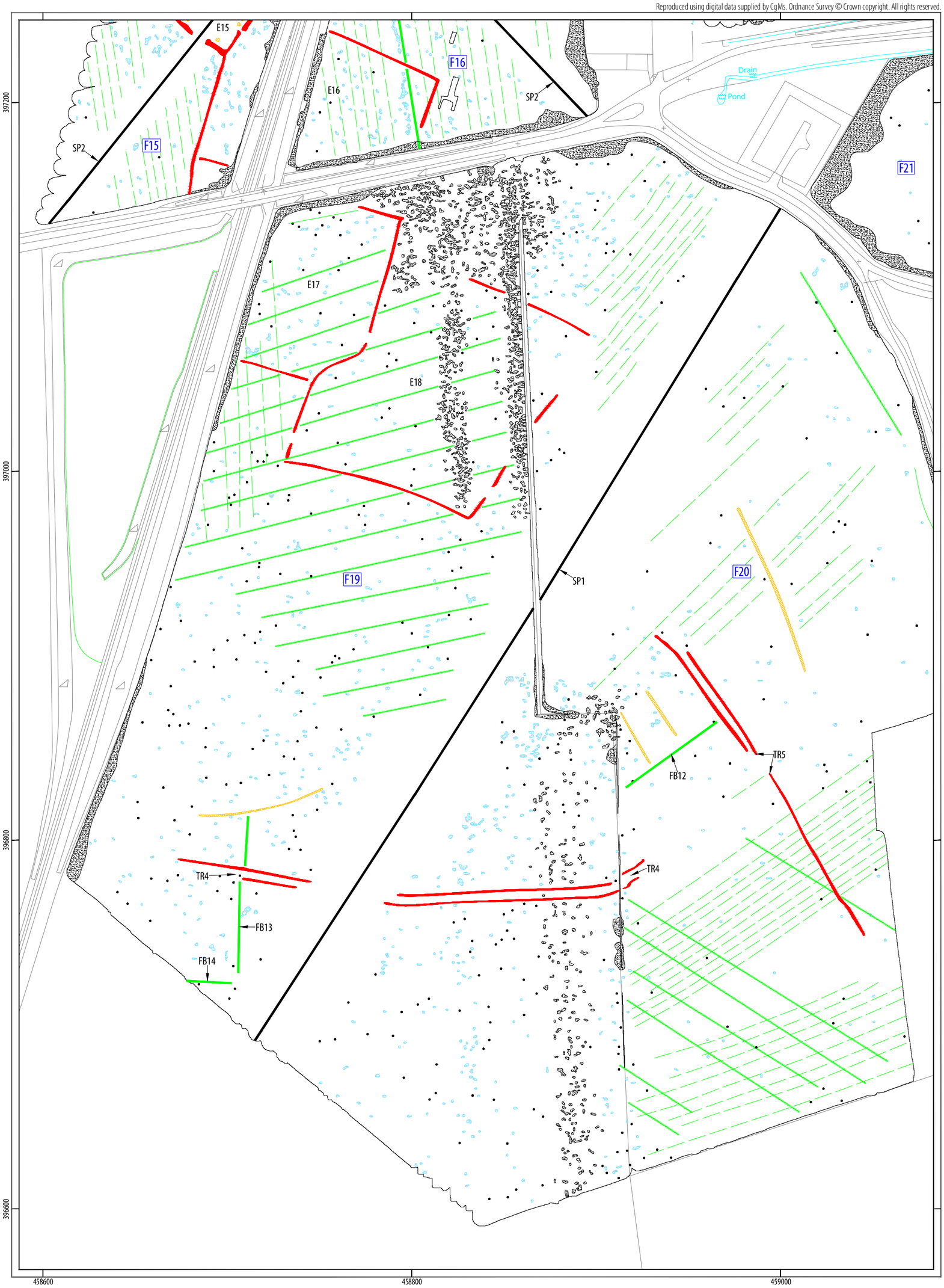
ILLUS 25 XY trace plot of minimally processed magnetometer data; Sector 5



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

E	enclosure	SP	service pipe
FB	former boundary	TR	trackway

N

0 50m

scale 1:2,000 @ A3

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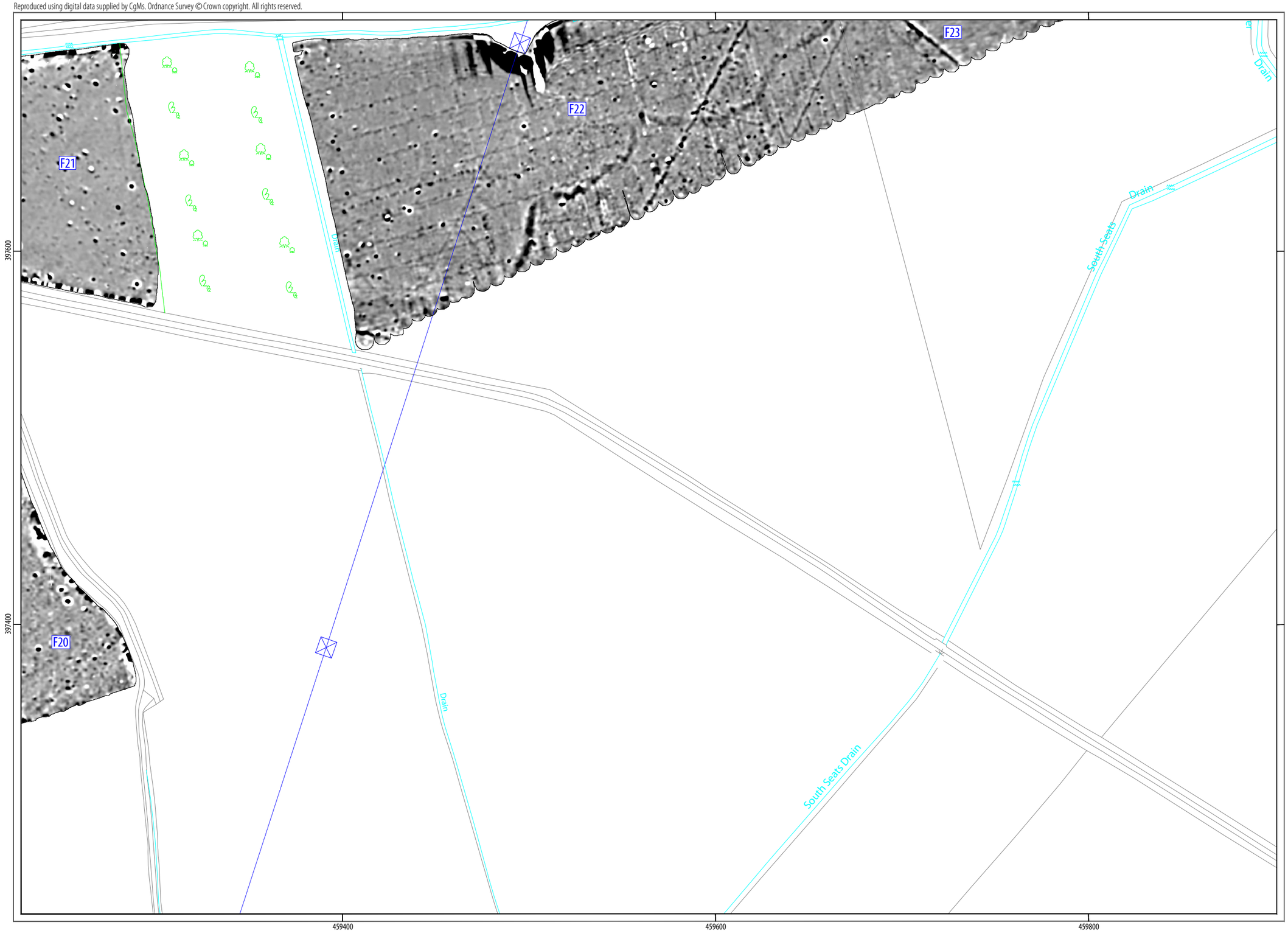
ILLUS 26 Interpretation of magnetometer data; Sector 5



nT
-2.0
3.0

N
0
50m
scale 1:2,000 @ A3

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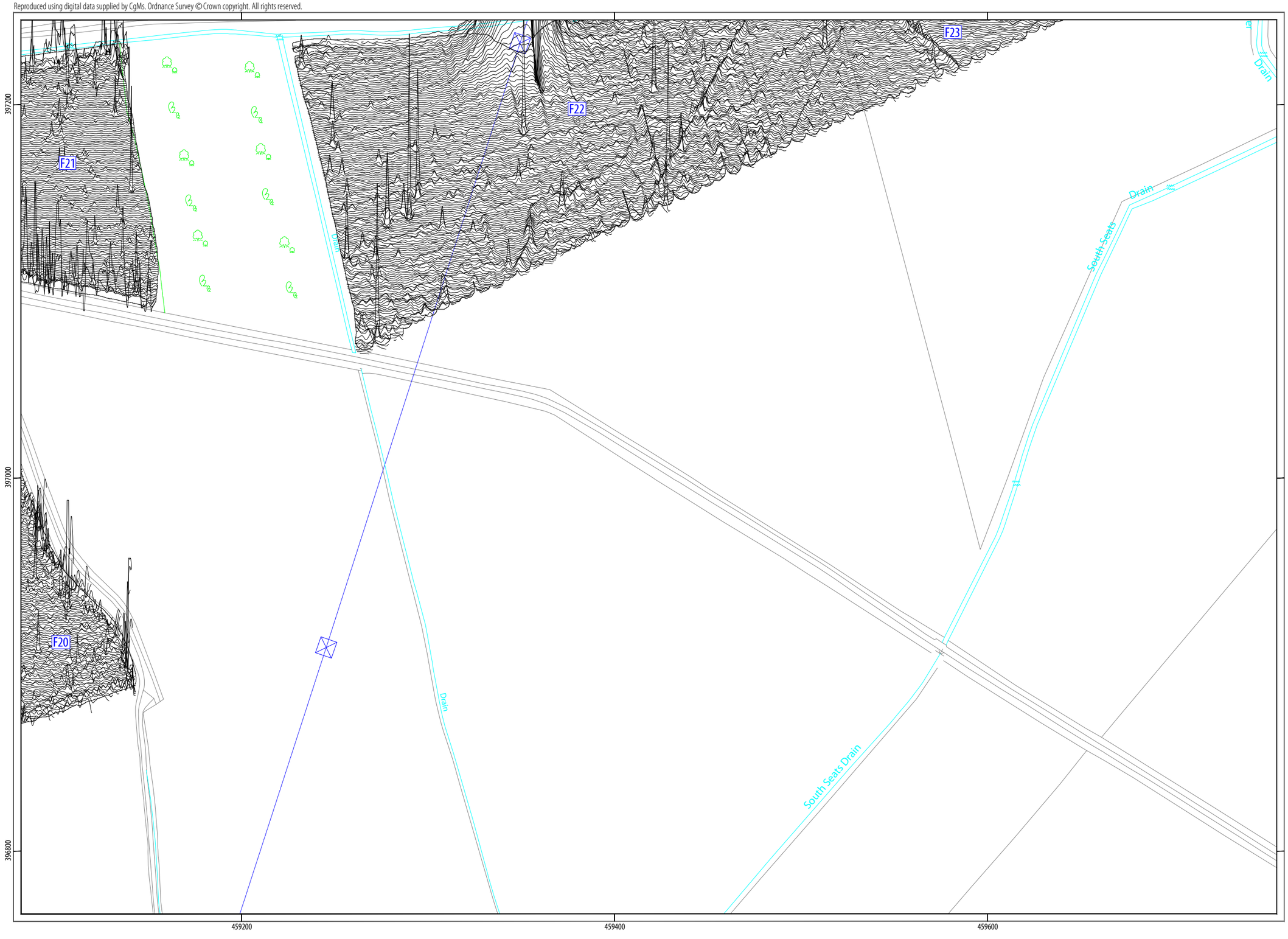
ILLUS 27 Processed greyscale magnetometer data; Sector 6



20.0nT/cm

N

0 50m

scale 1:2,000 @ A3

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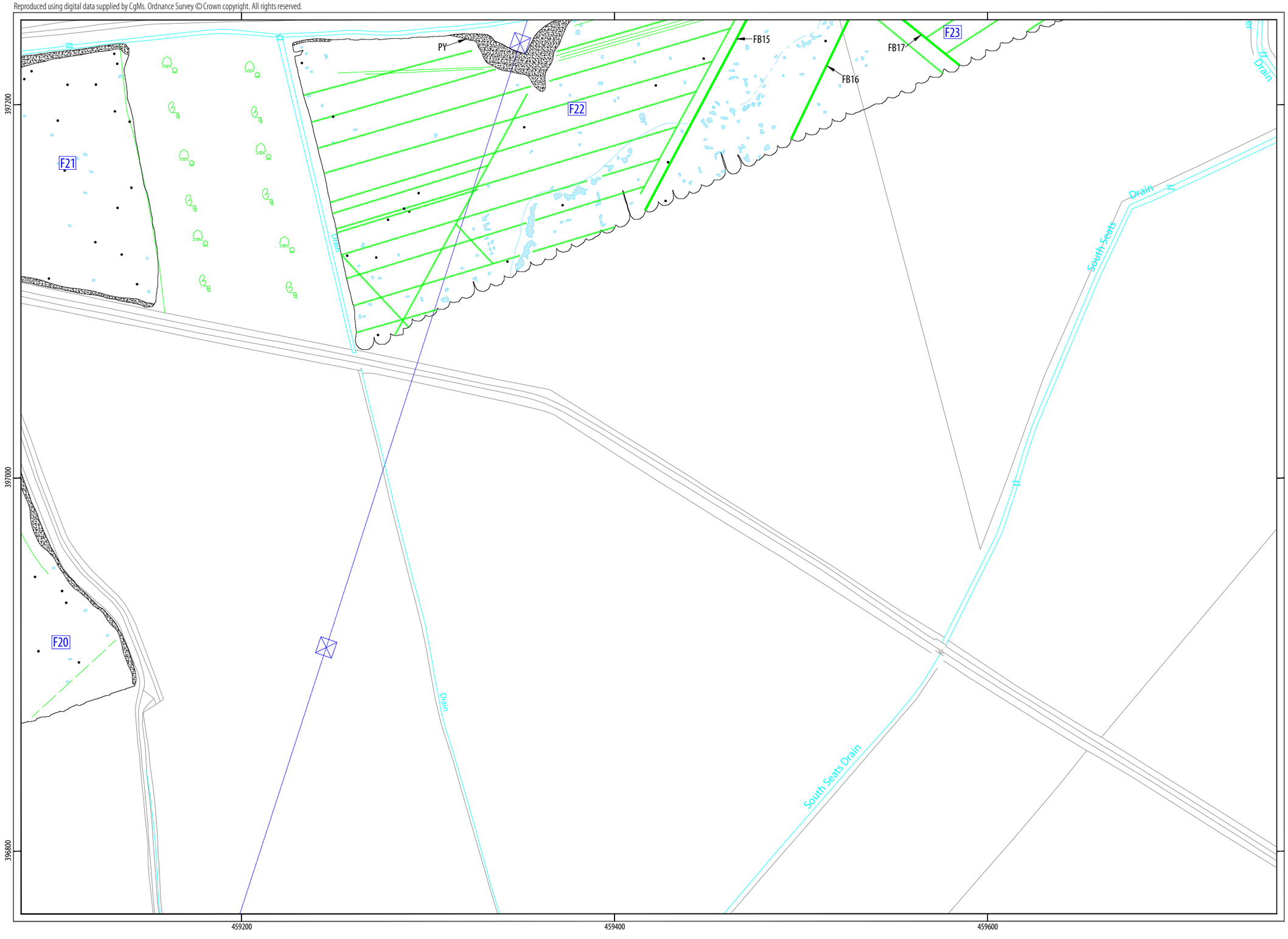
ILLUS 28 XY trace plot of minimally processed magnetometer data; Sector 6



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear trend	field drain
linear	former field boundary
linear	geology
magnetic enhancement	geology

ABBREVIATIONS

FB former boundary

PY pylon

N

0 50m

scale 1:2,000 @ A3

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ILLUS 29 Interpretation of magnetometer data; Sector 6

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 associate 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 destriped 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.

Data is also clipped to remove extreme values and to improve data contrast.

APPENDIX 5 APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-271239

PROJECT DETAILS	
Project name	Rossington Inland Port, Phase 2B
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering 123 hectares, on land at Rossington, South Yorkshire, to inform an outline planning application for the proposed development of Rossington Inland Port Phase 2B. The survey has identified a number of linear anomalies across the western part of the site which confirm and enhance the cropmark data. These anomalies, due to soil-filled ditches, form a system of land division and enclosure, including at least one localised area of possible settlement activity, which probably date to the later Iron Age or Romano-British period. The survey has demonstrated a correlation between the archaeological anomalies and the superficial deposits of sand and gravel with a relative absence of anomalies of archaeological potential on the lower-lying alluvial deposits in the north and the east. It is not clear whether the fragmentary nature of the archaeological anomalies is a true assessment of the below ground remains or whether possible archaeological features may be masked by low magnetic contrast within the alluvial soils. It seems likely, given the nature and scale of the surrounding cropmarks, that some archaeological features, particularly over areas of alluvium, may not have been detected by the survey. Nevertheless, on the basis of the geophysical survey, the archaeological potential within the east of the proposed development area is assessed as moderate, and locally high, whereas the western half of the site is assessed as having low archaeological potential, corroborating the results of the Desk Based Assessment.
Project dates	Start: 26-09-2016 End: 21-10-2016
Previous/future work	No / Yes
Any associated project reference codes	RIPD/01 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 2 - Operations to a depth less than 0.25m
Monument type	CROPMARK Late Iron Age
Monument type	CROPMARK Roman
Significant Finds	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Extensive green field commercial development (e.g. shopping centre, business park, science park, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	After outline determination (eg. As a reserved matter)
Solid geology (other)	Nottingham Castle Sandstone
Drift geology	ALLUVIUM
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	SOUTH YORKSHIRE DONCASTER ROSSINGTON Rossington Inland Port, Phase 2B
Postcode	DN11 9DX
Study area	123 Hectares
Site coordinates	SK 5926 9779 53.473248656533 -1.10708734236 53 28 23 N 001 06 25 W Point
Height OD / Depth	Min: 10m Max: 15m

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Consultant
Project design originator	Headland Archaeology
Project director/manager	Alistair Webb
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
Name of sponsor/funding body	CgMs Consulting

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive recipient	in house
Paper Contents	"Survey"
Paper Media available	"Survey"

Entered by	Alistair Webb (alistair.webb@headlandarchaeology.com)
Entered on	14 December 2016

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midlandsandwest@headlandarchaeology.com

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