# M3 Junction 9 Improvement

# Scheme Number: TR010055

# 6.3 Environmental Statement Appendix 6.5 - Geophysical Survey Report - 2021

**APFP Regulation 5(2)(a)**

**Planning Act 2008**

**Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

**Volume 6**

November 2022

Infrastructure Planning

Planning Act 2008

**Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

M3 Junction 9 Improvement
Development Consent Order 202[x]

# 6.3 ENVIRONMENTAL STATEMENT- APPENDIX 6.5: GEOPHYSICAL SURVEY REPORT 2021

| | |
|---|---|
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| **Planning Inspectorate Scheme Reference:** | TR010055 |
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| **Author:** | M3 Junction 9 Improvement Project Team, Highways England |

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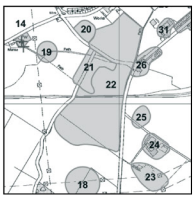
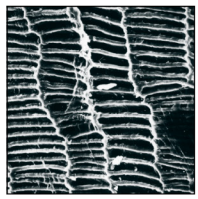
| Rev 0 | November 2022 | Application Submission |

MTJN21










# M3 JUNCTION 9 IMPROVEMENT SCHEME, WINCHESTER, HAMPSHIRE

## GEOPHYSICAL SURVEY REPORT

PLANNING REF. PRE-APPLICATION
BIM NO. HE551511-VFK-HER-X_XXXX_XX-RP-LH-0003

commissioned by Volker Fitzpatrick
on behalf of Highways England

August 2021

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

# M3 JUNCTION 9 IMPROVEMENT SCHEME, WINCHESTER, HAMPSHIRE

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This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **MTJN21** / NGR **NGR 50001 29978** / Parish **Winchester: St John the Baptist with St Martin Winnall and All Saints, Winchester with St Andrew, Chilcomb with St Peter, Chesil** / Local Authority **Winchester City Council** / Fieldwork Date **19.04.21–24.04.21** / OASIS Ref. **headland1-502173**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **Matthew Berry** / Fieldwork **Becky Casement, Neil Paveley, Ross Bishop** / Graphics **Dunia Sinclair, Eleanor Winter, Matthew Berry**

Approved by **Sam Harrison** [redacted] .....

**Headland Archaeology** Yorkshire & North
Units 23–25 & 15 | Acorn Business Centre | Balme Road | Cleckheaton BD19 4EZ
t 0127 493 8019
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

HEADLAND ARCHAEOLOGY

part of the RSK Group

REGISTERED ORGANISATION CIfA

# PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 50 hectares on land adjacent to the M3 east of Winchester, Hampshire as part of the M3 Junction 9 Improvement Scheme. The survey was undertaken to assess the impact of the proposed development on the historic environment with the results informing future archaeological strategy on the Scheme.

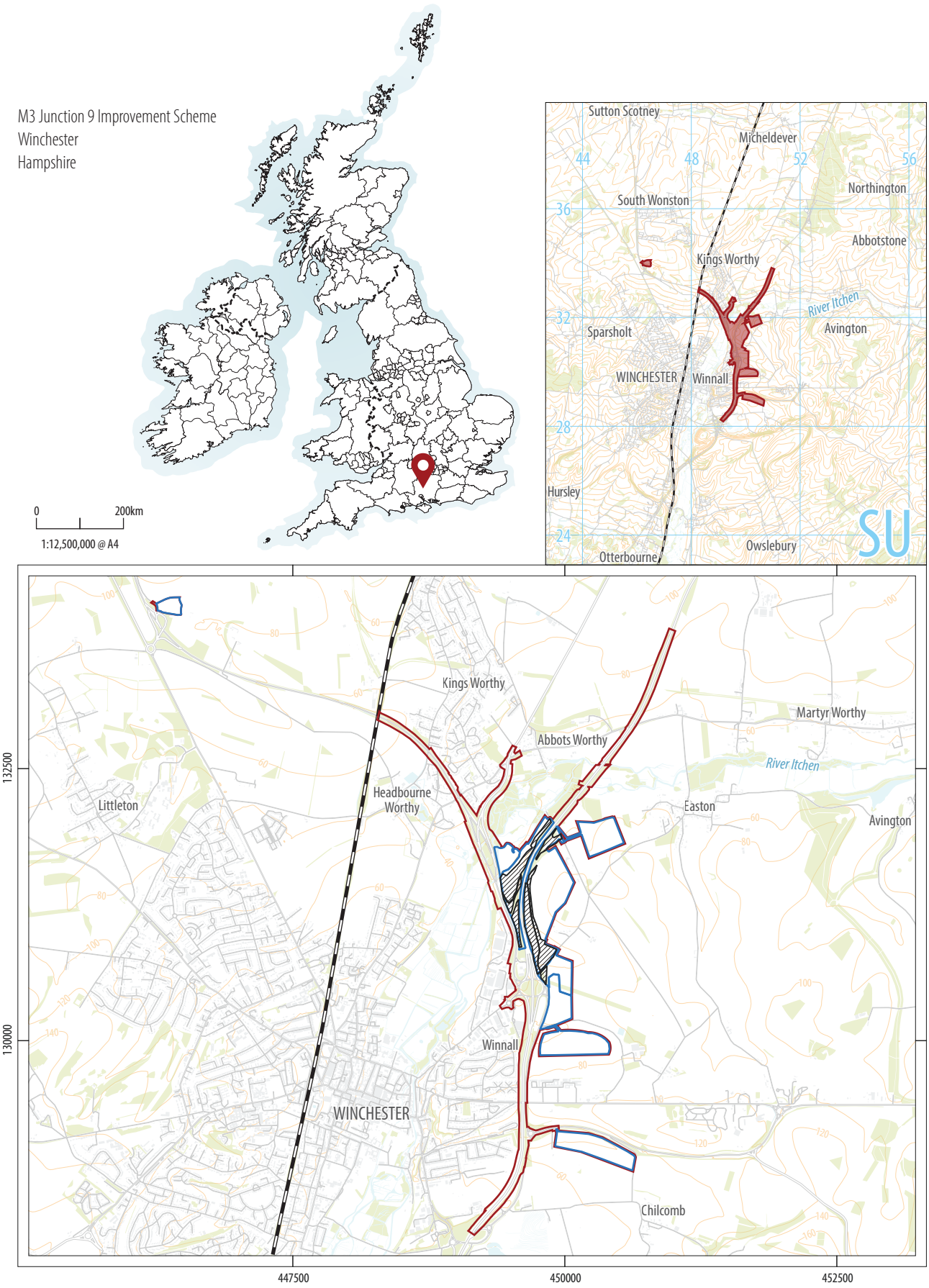
The survey has successfully evaluated the Proposed Development Area (PDA) and identified a range of anomalies both archaeological and natural in origin against a variable magnetic background. The most conspicuous findings include an area of settlement activity identified by ditches and pit like features marking the continuation of a settlement site spanning the Bronze Age to Romano-British period excavated in the 1970's, a ring ditch and linear anomalies of varying strengths matching known cropmarks of an extensive prehistoric field system.

Elsewhere linear, curvilinear and circular trend anomalies of possible archaeological origin are tentatively suggested and former field boundaries, extractive pits, cultivation effects, service pipes and natural/geological features are also identified.

Generally the findings of the geophysical survey are consistent with the known archaeological activity within the vicinity of the scheme. Based on these results the PDA is assessed as having a widely low archaeological potential for significant archaeological remains however findings of higher significance have been recorded in two localised areas.

# CONTENTS

# LIST OF ILLUSTRATIONS




HEADLAND ARCHAEOLOGY
**Headland Archaeology** Yorkshire & North
Units 23–25 & 15 | Acorn Business Centre | Balme Road | Cleckheaton BD19 4EZ
t 0127 493 8019
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

**ILLUS 1** Site location

# M3 JUNCTION 9 IMPROVEMENT SCHEME, WINCHESTER, HAMPSHIRE

## GEOPHYSICAL SURVEY REPORT

## 1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Volker Fitzpatrick (the delivery partner ), on behalf of Highways England (The Client) to undertake a geophysical (magnetometer) survey on land associated with the M3 Junction 9 Improvement Scheme east of Winchester, Hampshire (Illus 1).

The Proposed Development Area (PDA) consists of six separate areas (Areas 1-4 and 7-8; Illus 11-25) covering approximately 50 hectares located on the eastern side of the A34 and M3 highways, to the north and east of Winchester. The survey was undertaken to assess the impact of the proposed development on the historic environment with the results informing future archaeological strategy for the site, if required and the forthcoming Cultural Heritage ES chapter which will be submitted as part of the DCO submission.

The survey was undertaken in accordance with an Archaeological Written Scheme of Investigation (WSI; Headland Archaeology 2021), with the requirements of the National Policy Statement for National Networks (NPS NN) (2014) and in line with current best practice (Chartered Institute for Archaeologists 2014, Europae Archaeologia Consilium 2016).

The survey was carried out between April 19th and April 24th 2021.

### 1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

As stated the six separate areas comprising the PDA are the located on the eastern side of the A34 and M3 highways, to the north and east of Winchester. The landscape surrounding the PDA generally consists of well-drained rolling chalkland along the upper slopes of the Itchen valley. The River Itchen flows through the northern part of the site adjacent to Area 1 where the ground level is approximately 45m above Ordnance Datum (aOD). The remainder of the PDA to the south undulates between 60m and 75m aOD. The valley sides rise to approximately 80m and 90m aOD and the carriageway at the M3 Junction 9 lies approximately at 59m aOD.

Fields within the PDA primarily consist of agricultural land under arable cultivation. All fields were suitable for hand carried magnetometer survey with crops present in Areas 2, 4, 7 and 8, at the time of survey less than 0.4m in height and Area 3 containing potato ridges (Illus 2-5).

### 1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises Seaford Chalk Formation – Chalk across the majority of the areas, with Holywell Nodular Chalk Formation in the eastern half of Area 2 and New Pit Chalk Formation and Holywell Nodular Chalk Formation in Area 8. There are no recorded superficial deposits except in the east of Area 2 where the Clay-with-flints Formation has been recorded and deposits of Head in Areas 7 and 8 (UKRI 2021).

The soils are classified in the Soilscape 3 Association, being characterised as freely-draining shallow, lime-rich loamy soils over chalk or limestone (Cranfield University 2021).

## 2 ARCHAEOLOGICAL BACKGROUND

The known archaeology of the PDA has been recorded in a Cultural Heritage Desk-based Assessment (WSP 2017) and a Detailed Cultural Heritage Baseline (DCHB) (Stantec 2020) and is only summarised herein.

The detailed baseline updated the results of previous work and included up-to-date historic environment record (HER) data from previous archaeological work carried out on the proposed scheme. The DCHB (Stantec 2020) highlights that previous archaeological investigations within a 300m study area demonstrated that the M3 J9 Improvement site lies within an archaeologically sensitive area and is considered to have a high potential to contain as yet unknown archaeological remains.

The DCHB (Stantec 2020) states there exists a high potential for further previously unknown archaeological remains dating to the later prehistoric period to be present within the M3 J9 Improvement site as previous archaeological investigations within a 300m study area suggest the River Itchen and the adjacent Downs were part of an extensively settled and farmed landscape during the later prehistoric period (Neolithic, Bronze Age and Iron Age).

There is considered to be a moderate potential for further previously unrecorded Romano-British and unknown early medieval remains but a low potential for medieval and previously unrecorded post-medieval settlement remains to be present within the M3 J9 Improvement site.

The most significant previous archaeological investigations within and adjacent to the PDA (Area 4) were carried out at Easton Lane Interchange (HER EWC10630 and EWC 9045-79) and Winnall Down (HER EWC10631, EWC1135-46, EWC9101 and EWC9080) during the late 1970's and early 1980's respectively. Excavations at Winnall Down recorded continuous, dense settlement activity spanning the Bronze Age to Romano-British period. Features recorded in this location included Bronze Age post-built roundhouses and possible fence-lines (HER MWC6593), an early Iron Age D-shaped enclosure (HER WMC1136) with causewayed entrance defended by a timber gate structure containing roundhouses, four-post structures, pits, posthole fence lines, evidence of quarrying and disarticulated human skeletal remains.

This early Iron Age enclosure was superseded in the middle Iron Age by an unenclosed settlement containing roundhouses, storage pits, posthole fence lines, four post structures a large rectangular structure and inhumation burials. A series of four ditched enclosures (HER MWC6504 and MWC6691) aligned north-south and linked by a ditched trackway continued in use into the Romano-British period where a number of pits, inhumations and a cremation were also dated to this period. It is noted the extent of the prehistoric settlement activity was not fully revealed within the boundaries of the previous work and further remains likely exist in this location at Area 4 of the present work.

Two recent geophysical surveys (SUMO 2018 ad 2019) and an intrusive programme of trial trenching and geotechnical pit monitoring (Wessex Archaeology 2019) identified the partial remains of a ring ditch, probable pits, former field boundaries and some linear anomalies of unknown origin within (along the western boundary of) Area 2.

# 3 AIMS, METHODOLOGY AND PRESENTATION

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

The specific archaeological objectives of the geophysical survey were:

- to gather enough information to inform the extent, condition, character and date (as far as circumstances permit) of any archaeological features and deposits within the PDA;
- to obtain information that will contribute to an evaluation of the significance of the scheme upon cultural heritage assets; and
- to prepare a report summarising the results of the survey.

## 3.1 MAGNETOMETER SURVEY

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

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

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.37.0 (DWConsulting) software was used to process and present the data.

## 3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:50,000. Illus 2 to Illus 5 are site condition photographs. Illus 6 shows the GPS swaths and photo locations at 1:20,000. Overall greyscale data plots and interpretation are included as Illus 7 and Illus 8 and with the South Downs National Park Mapping Programme Data included in Illus 9 and Illus 10 at a scale of 1:10,000. Fully processed (greyscale) data, minimally processed data (XY trace plot) and interpretative plots are presented at a scale of 1:2,500, by sector, in Illus 11 to Illus 25



**ILLUS 2** Area 2 looking south **ILLUS 3** Area 3 looking north-west

inclusive with an Area of Archaeological Activity (AAA – see below) presented at a scale of 1:1,000 in Illus 26 to Illus 28 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 2021), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to display and interpret the data to best effect. The interpretations are based on the experience and knowledge of management and reporting staff.

## 4 RESULTS AND DISCUSSION

Ground conditions at the time of survey were very good leading to a high standard of data acquisition requiring minimal processing. Areas not surveyed include Area 5 which was unsuitable for survey being a motocross circuit and access to Area 6 was not granted. Elsewhere the PDA was surveyed in full except for a small area in the south-west corner of Area 3 where there was tree cover.

The underlying chalk geology and areas of superficial head - clay, silt sand and gravel deposits have generally proved adequate for

magnetic prospection despite producing a variable magnetic background containing a range of discrete, amorphous and broad high magnitude anomalies. Possible anomalies of interest remain difficult to differentiate from the natural background in some areas. Despite this, a number of magnetically enhanced anomalies have been identified which are thought to provide a reliable indication of the extent of any sub-surface features. The anomalies can be classified into categories (see below).

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

Strongly magnetic linear anomalies indicative of buried service pipes or cables are evident in Area 1 (SP1; Illus 11-13), the southern part of Area 2 (SP2; Illus 14-16), Area 4 (SP3-SP6; Illus 17-22) and Area 7 (SP7; Illus 20-22).

Magnetic disturbance in areas adjacent the M3 Motorway, A272, National Cycle Route 23 and around the periphery of some of the fields within the PDA is due to ferrous material within, or adjacent to, the boundaries and is of no archaeological interest.

## 4.2 AGRICULTURAL ANOMALIES

Elongated, closely spaced, parallel, low magnitude anomalies, aligned parallel with extant field boundaries are effects resulting from modern cultivation techniques and are visible in most fields to varying degrees of the PDA.

Three former field boundaries (FB1 and FB2 Area 2; Illus 14-16 and FB3 Area 7; Illus 20-22) aligned roughly east/west extending across Areas 2 and 7 are identified as a high magnitude and weak trend linear anomalies. From historic OS mapping it is evident the boundaries were removed sometime during the early and later parts of the 20th century for Area 7 and Area 2 respectively.

## 4.3 GEOLOGICAL ANOMALIES

Occasional and sporadic discrete low magnitude anomalies visible throughout the PDA and amorphous areas of enhanced magnetic response located particularly in the northern half of the PDA in Area 2, are due to localised variations in the underlying chalk geology and depth and composition of the topsoil and superficial deposits and are not thought to be of any archaeological potential. Only the most conspicuous of these anomalies have been shown on the interpretation graphic. Trenches excavated in adjacent areas to the west in Area 2 (Wessex Archaeology 2019) record the presence of solution hollows and periglacial striations which could account for some of the anomalies recorded in this Area.

## 4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

Amongst a range of less coherent, broad, sinuous anomalies likely natural in origin spread across Area 2, are a series of widely spaced more well-defined linear anomalies (L1-L5; Illus 11-16) of varying strengths and clarity sharing an approximate alignment west-northwest/east-southeast and north-northeast/south-southwest. Many of these magnetically enhanced linear anomalies on this alignment correlate to cropmarks recorded in the South Downs National Park Mapping Programme Data (Illus 9-10) relating to a wider network of extensive bank and ditch field systems likely prehistoric in origin but used continually until post medieval/modern times. These linear anomalies are also consistent with the findings of an earlier adjacent geophysical survey to the west (SUMO 2019). Linear anomaly L4 (Illus14-16) may also relate in part to a former boundary (FB1; Illus 14-16) recorded in this location.

An amorphous area of high magnitude responses towards the north-east corner of Area 2 (ME1; Illus 11-13) identify an area of quarrying and two extractive pits of probable post medieval date. This anomaly correlates to cropmarks recorded in the South Downs National Park Mapping Programme.

Perpendicular linear anomalies in Area 3 (L6; Illus 16-19) share an alignment with those identified further north in Area 2 and are likely further ditch-like anomalies associated with the broader Celtic field system and prehistoric settlement identified 280m to the south at Winnall Down. An isolated discrete low magnitude anomaly of unclear origin (P?1; Illus 16-19) west of centre in Area 3 is distinguishable against a variable magnetic background and could represent a pit-like feature, small area of localised extraction or be natural in origin.

Further linear and curvilinear anomalies of varying strengths in Area 7 (L9-L11; Illus 20-22) aligned east-west and northwest/southeast may be further examples of ditches associated with the prehistoric field system and settlement activity at Winnall Down approximately 250m to the north and which also partially correlate to cropmarks in the South Downs National Park Mapping Programme Data (Illus 9-10).

A small area of high magnitude responses (ME2; Illus 20-22) located towards the northeast corner of Area 7 is indicative of localised extraction though a natural cause cannot be discounted.

Along the southern limit and in the eastern half of Area 7 are two very faint low amplitude circular trend anomalies measuring 14m and 18m in diameter respectively possibly marking the location of ring ditches (RD?1 and RD?2; Illus 20-22). The ephemeral nature of the anomalies and discrete low magnitude anomalies within restricts a more confident interpretation.

A coherent linear anomaly (L12; Illus 22-25) aligned north-northeast/south-southwest is located at the centre of Area 8 and is likely associated with a prehistoric settlement comprising a double ditched trackway flanked on each side by rectilinear ditched



**ILLUS 4** Area 7 looking west **ILLUS 5** Area 8 looking north-west

enclosures and associated pits recorded in the South Downs National Park Mapping Programme Data (Illus 9-10) approximately 90m to the south. Seemingly linked to the northern segment of L12 is an area magnetic enhancement (ME3; Illus 22-25) indicative of localised extraction/quarrying.

Parallel curving linear anomalies oriented roughly east-west, (L13; Illus 22-25) may identify further examples of field systems or enclosure known to be prevalent in the area. There is however little correlation with these anomalies to cropmarks recorded in the South Downs National Park Mapping Programme Data (Illus 9-10).

## 4.5 AREAS OF ARCHAEOLOGICAL ACTIVITY

Unless specified all the linear anomalies described are likely to be due to soil filled cut features, such as ditches, forming clear patterns of enclosure and land division. With the variable magnetic background it is difficult to confidently discriminate between discrete features, such as pits, which may be indicative of occupational activity, and those that are probably due to localised geological variation. For this reason, most of the discrete anomalies within enclosures have been ascribed a possible archaeological origin with those outside, except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.

AAA1 (Illus 26 to 28)

At the centre of the western boundary of Area 4 the survey has identified a concentration of high magnitude linear and discrete anomalies indicative of enclosure ditches and pits representing dense settlement activity oriented north-northeast/south-southwest covering an area approximately 60m x 150m. These findings record the continuation of settlement activity dating from the Bronze Age to Romano-British period excavated at Winnall Down during the late 1970's and are entirely consistent with information held in the Winchester Historic Environment Record (WHER) and described within the Detailed Cultural Heritage Baseline (DCHB) (Stantec 2020).

Though difficult to distinguish some anomalies of a potential archaeological origin from a strong variable background in this field, the survey results generally correlate well with cropmark data from the South Downs National Park Mapping Programme (Illus 10) and has likely identified the extent of the settlement activity which appears confined to the western part of this area. Ephemeral linear and curvilinear anomalies (L7 and L8; Illus 17-19 and Illus 26-28) just to the east may represent further associated features such as a trackway and ditches though the faint response restricts a more confident interpretation.

In addition to the area of settlement activity described above located approximately 80m to the south-east is an isolated ring ditch (RD1; Illus 20-22 and Illus 26-28) 12m in diameter which appears as an enhanced circular magnetic anomaly containing three discrete high magnitude pit-like anomalies.

# 5 CONCLUSION

The survey has successfully evaluated the proposed development area and identified a range of anomalies both archaeological and natural in origin against a variable magnetic background. The most conspicuous findings include an area of settlement activity at Winnall Down identified by ditch and pit like features marking the continuation of a long-lived settlement site spanning the Bronze Age to Romano-British period excavated in the 1970's, a ring ditch and linear anomalies of varying strengths matching known cropmarks of an extensive prehistoric Celtic field system. Linear, curvilinear and circular trend anomalies of possible archaeological origin are tentatively suggested in places but remain difficult to differentiate from the variable magnetic background.

Elsewhere geophysical anomalies denoting former field boundaries, extractive pits, cultivation effects, service pipes and natural/ geological features are also identified.

Generally, the findings of the geophysical survey are consistent with the known archaeological activity within the vicinity of the scheme. Based on these results the PDA is assessed as having a widely low archaeological potential for significant archaeological remains however findings of higher significance have been recorded in two localised areas.

# 6 REFERENCES

Chartered Institute for Archaeologists (ClfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) https://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_3.pdf accessed 3rd March 2021

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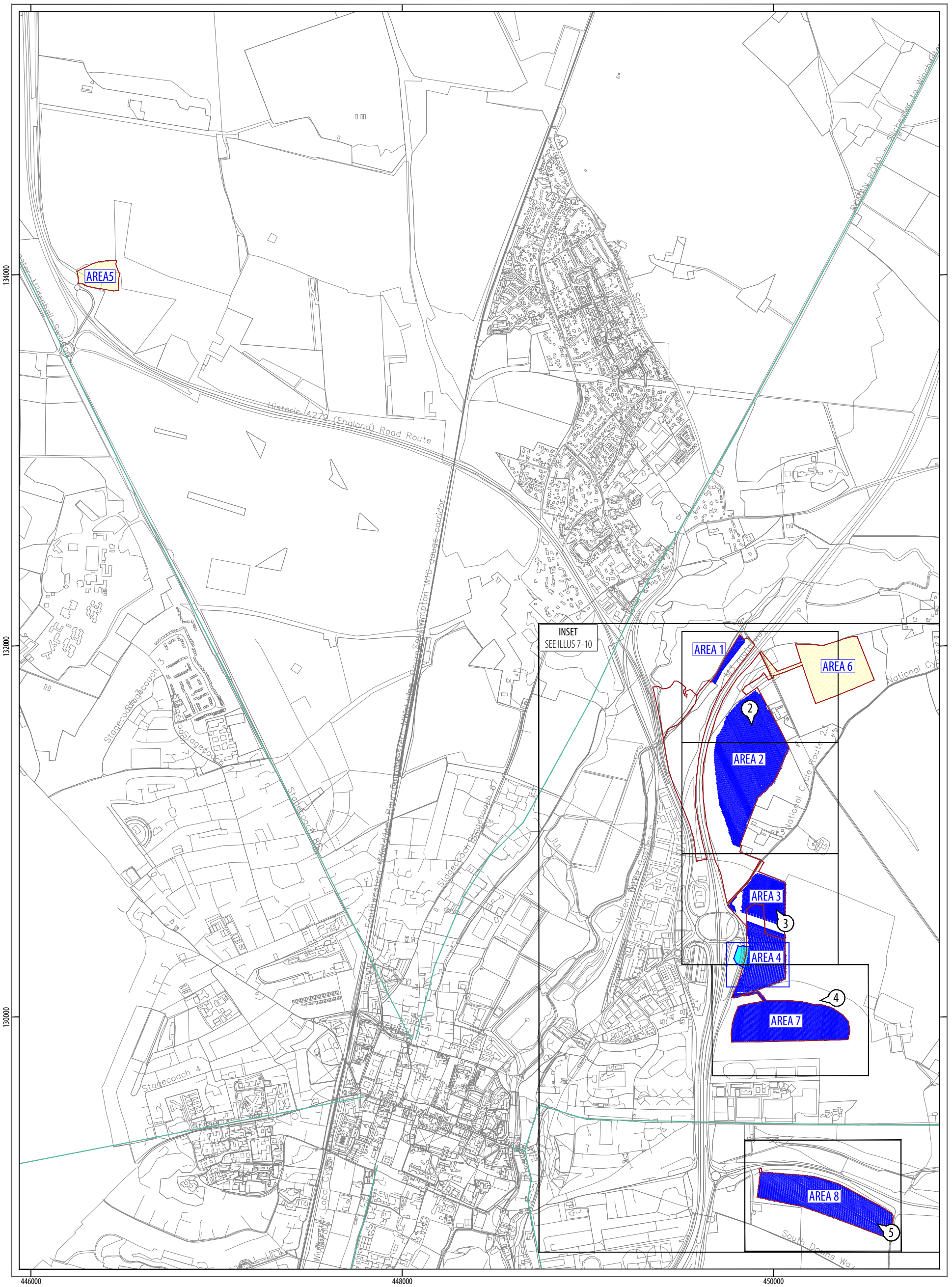
Wessex Archaeology 2019 ***M3 Junction 9, Winchester, Hampshire Archaeological Evaluation*** [unpublished client document] Document Number: HE551511-SUM-VES-0_00_00-RP-LE-0001, Report Ref: 217350.3

WSP 2017 ***M3 Junction 9 Improvement Scheme. Cultural Heritage Desk-Based Assessment*** [unpublished client document] Document number: HE551511-WSP-GEN-M3J9PCF3-RP-LH-00002 - P02




- geophysical survey area
- GPS swaths
- area unsuitable for survey
- Winnall Down 1976-77 excavation boundary
- location and direction of ILLUS 2-5

0 400m
1:20,000 @ A3

PROJECT MTJN21
M3 Junction 9 Improvement Scheme
Winchester, Hampshire

CLIENT Volker Fitzpatrick on behalf of Highways England

HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Units 23-25 | Acorn Business Centre | Balme Road
Cleckheaton | BD19 4EZ
t 0127 493 8019
w www.headlandarchaeology.com

**ILLUS 6** Survey location showing GPS swaths and photo locations

SECTOR 1
SEE ILLUS 11-13

AREA 1

SECTOR 2
SEE ILLUS 14-16

AREA 2

SECTOR3
SEE ILLUS 17-19

AREA 3

AAA1
SEE ILLUS 26-28

AREA 4

SECTOR 4
SEE ILLUS 20-22

AREA 7

SECTOR 5
SEE ILLUS 23-25

AREA 8

M3 motorway

National Cycle Route 23

Itchen Abbas Castles Path

South Dow

132000
131000
130000
129000
449000
450000
451000

nT
-1.0
2.0

0
200m
1:10,000 @ A3

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Winchester, Hampshire

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HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Units 23-25 | Acorn Business Centre | Balme Road
Cleckheaton | BD19 4EZ
t 0127 493 8019
w www.headlandarchaeology.com

**ILLUS 7** Overall greyscale plot of processed magnetometer data


| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| dipolar linear | service pipe |
| magnetic enhancement | quarrying(?) |
| linear trend | agricultural |
| linear | former field boundary |

| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| linear trend | geological variation |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |
| magnetic enhancement | archaeology |

0 200m
1:10,000 @ A3

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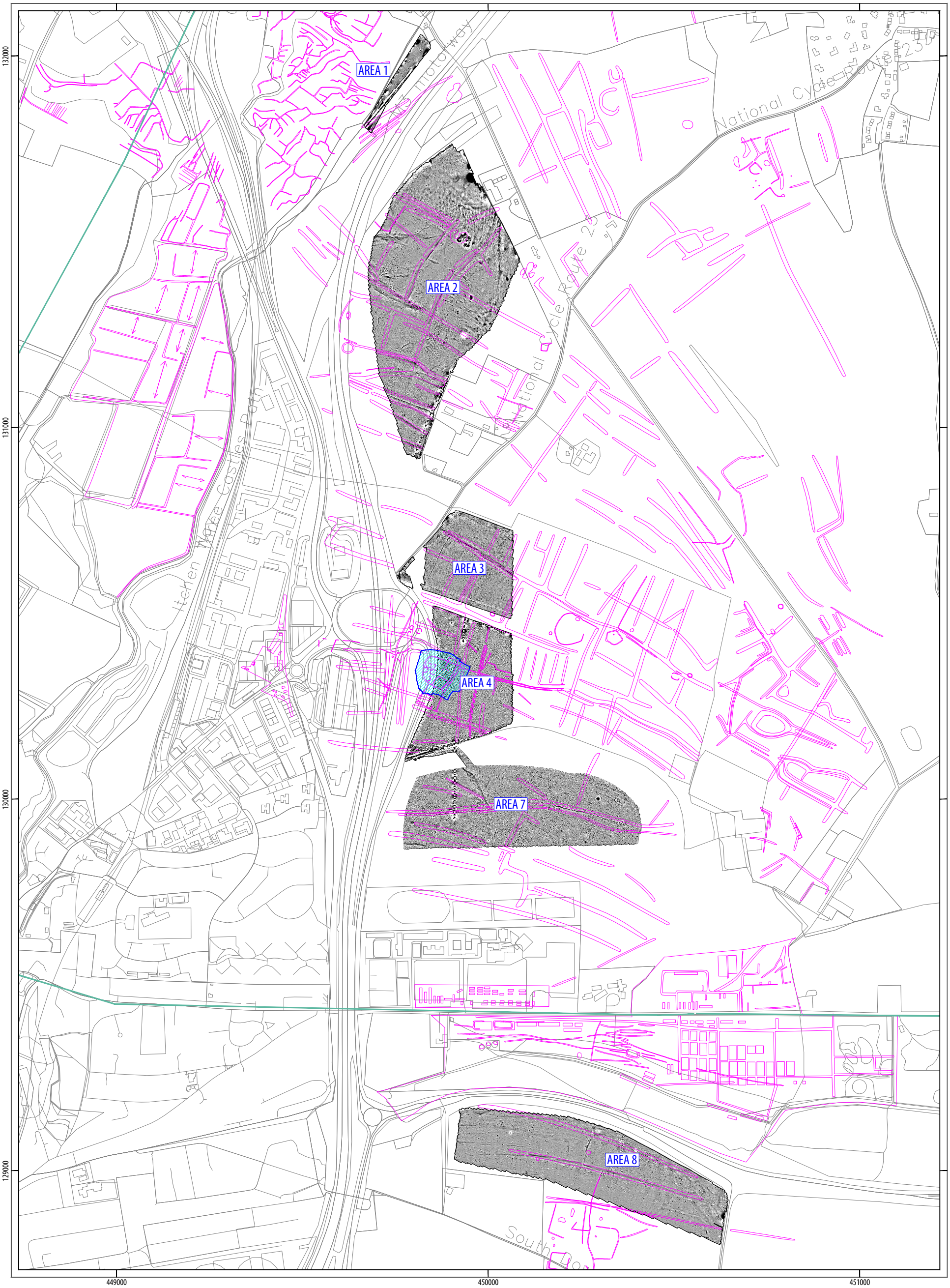
HEADLAND ARCHAEOLOGY
Headland Archaeology Yorkshire & North
Units 23-25 | Acorn Business Centre | Balme Road
Cleckheaton | BD19 4EZ
t 0127 493 8019
w www.headlandarchaeology.com

**ILLUS 8** Overall interpretation of magnetometer data




South Downs National Park Mapping Programme Data

Winnall Down 1976-77 excavation boundary

nT
-1.0 2.0

0 200m
1:10,000 @ A3

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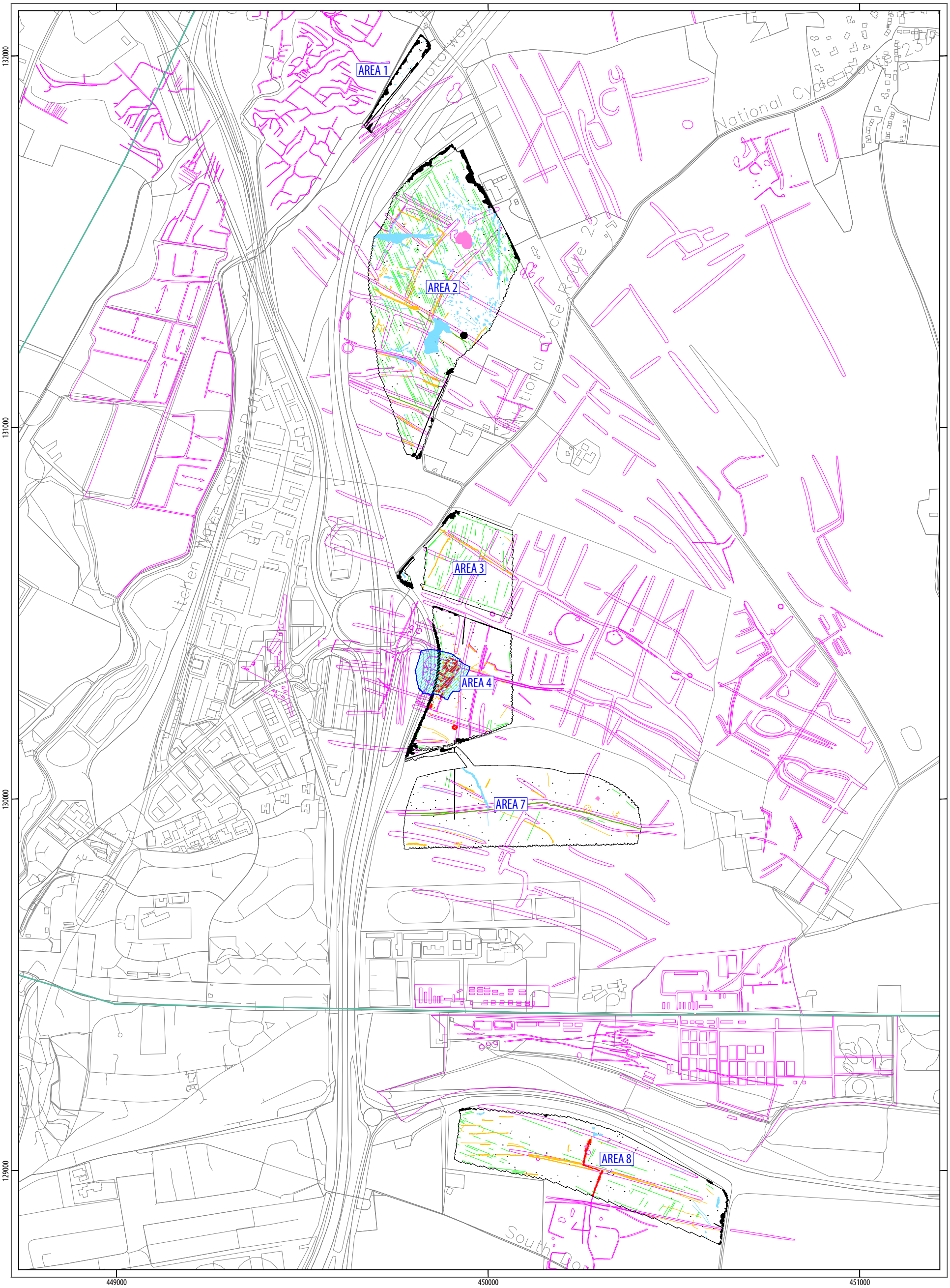
Headland Archaeology Yorkshire & North
Units 23-25 | Acorn Business Centre | Balme Road
Cleckheaton | BD19 4EZ
t 0127 493 8019
w www.headlandarchaeology.com

**ILLUS 9** Overall greyscale plot of processed magnetometer data and South Downs National Park Mapping Programme Data




| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| dipolar linear | service pipe |
| magnetic enhancement | quarrying(?) |
| linear trend | agricultural |
| linear | former field boundary |

| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| linear trend | geological variation |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |
| magnetic enhancement | archaeology |

South Downs National Park Mapping Programme Data

Winnall Down 1976-77 excavation boundary

0 200m

1:10,000 @ A3

**PROJECT** MTJN21
M3 Junction 9 Improvement Scheme
Winchester, Hampshire

**CLIENT** Volker Fitzpatrick on behalf of Highways England

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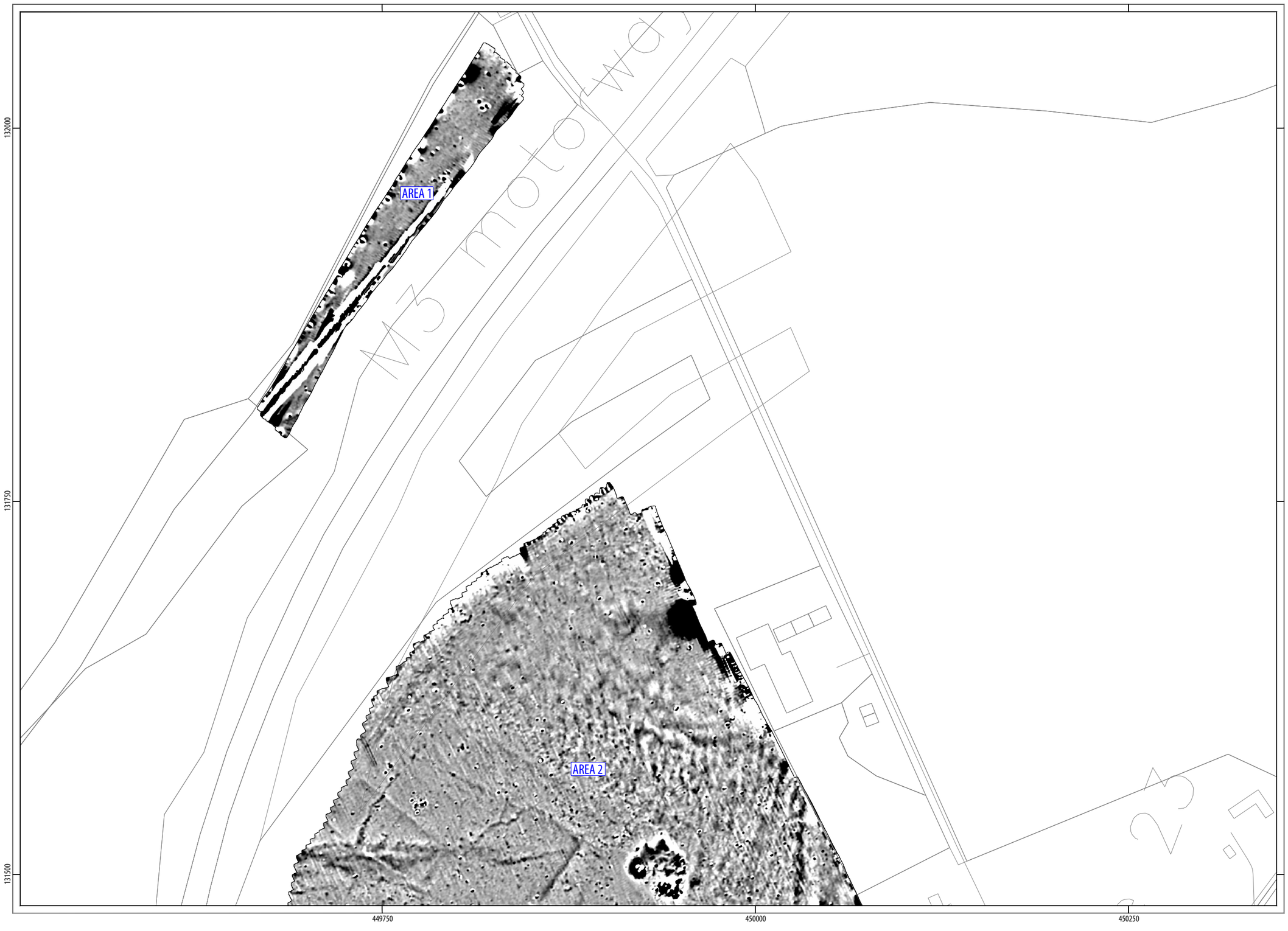
**ILLUS 10** Overall interpretation of magnetometer data and South Downs National Park Mapping Programme Data




nT
-1.0 2.0

0 50m
1:2,500 @ A3

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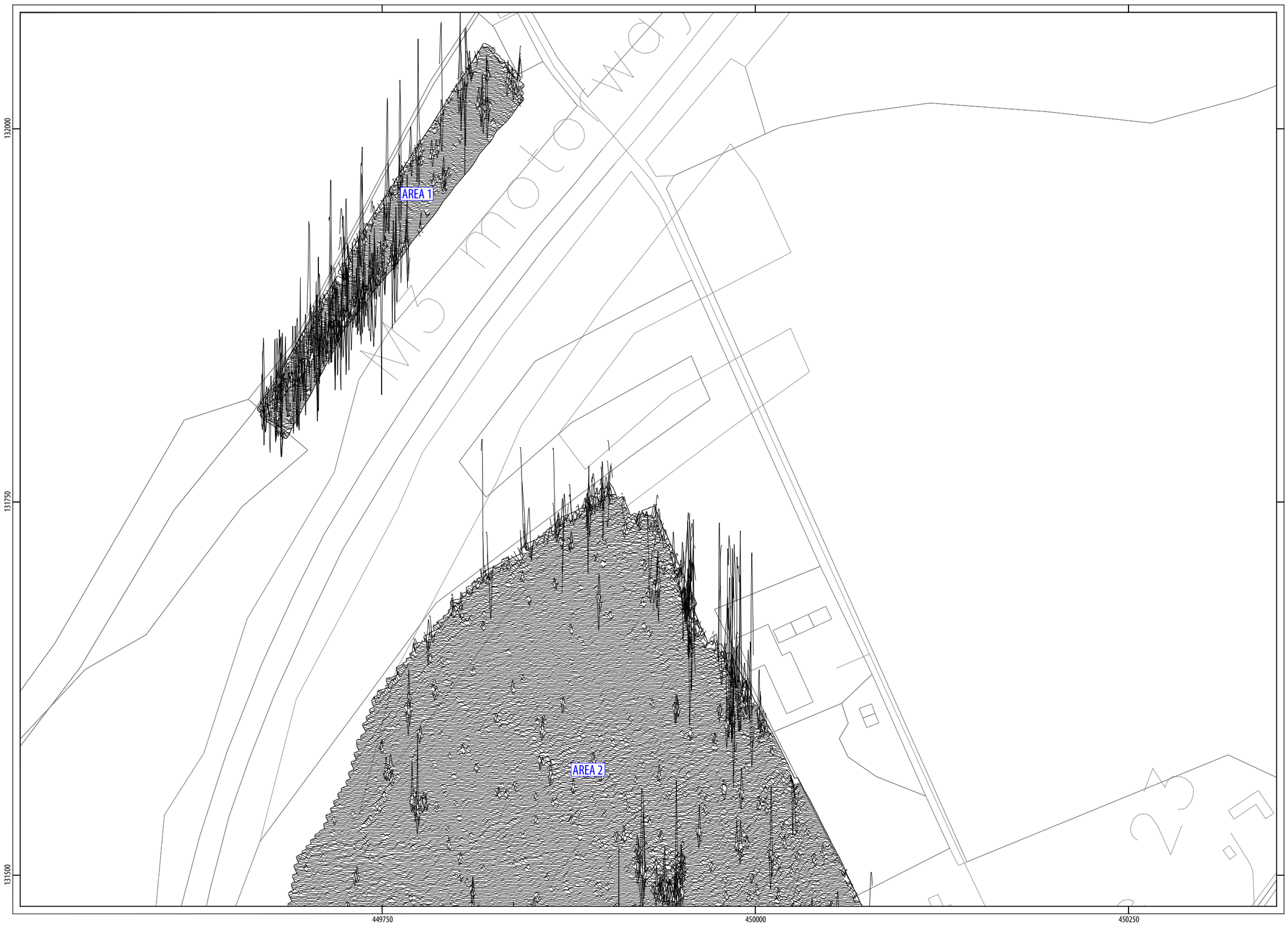
**ILLUS 11** Processed greyscale magnetometer data; Sector1




25.0nT/cm

0 50m

1:2,500 @ A3

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**ILLUS 12** XY trace plot of minimally processed magnetometer data; Sector1


| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| dipolar linear | service pipe |
| magnetic enhancement | quarrying(?) |
| linear trend | agricultural |
| linear trend | geological variation |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |

ABBREVIATIONS

| | |
|---|---|
| SP | service pipe |
| L | linear |
| ME | magnetic enhancement |

0 50m
1:2,500 @ A3

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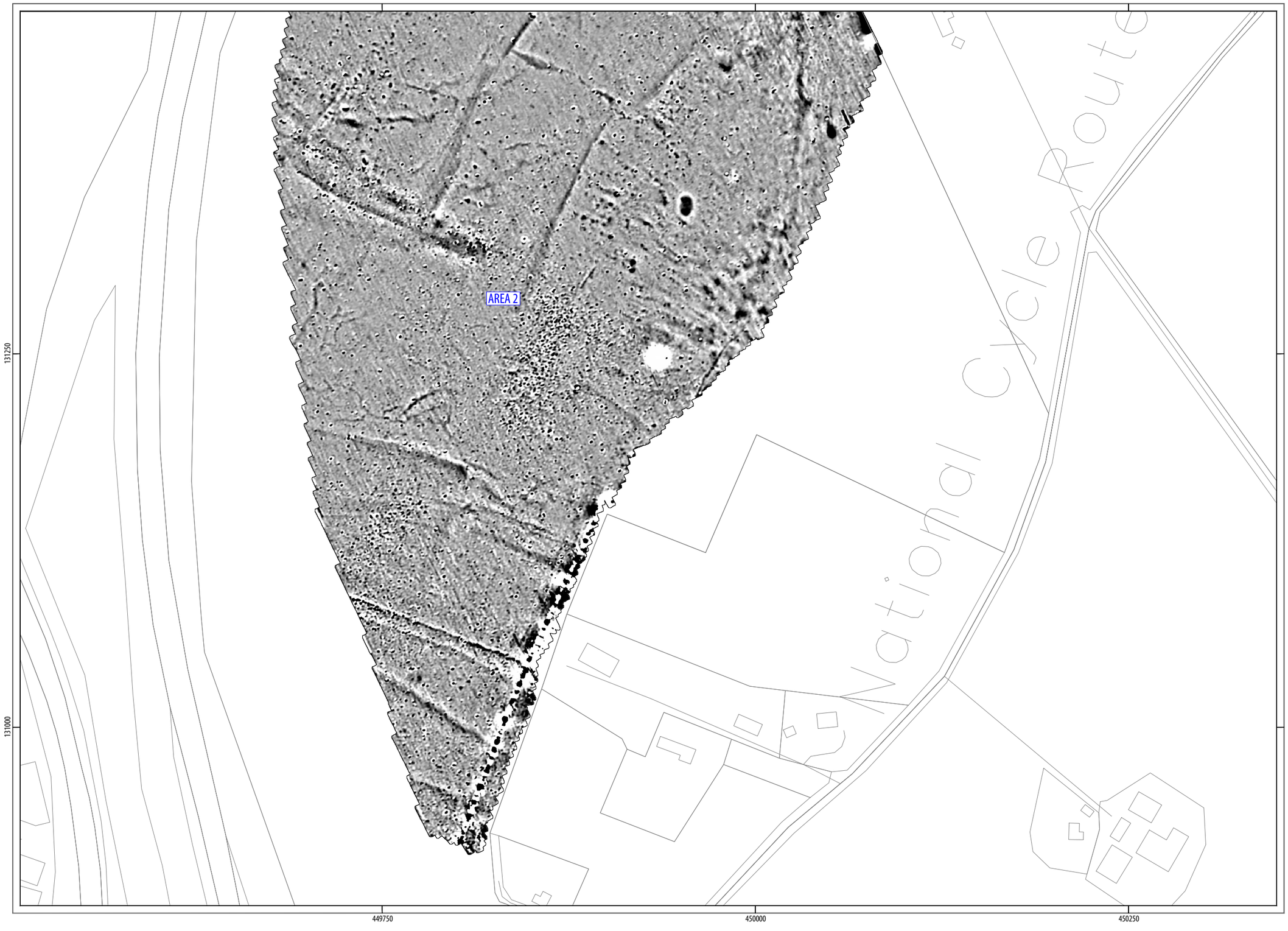
**ILLUS 13** Interpretation of magnetometer data; Sector1

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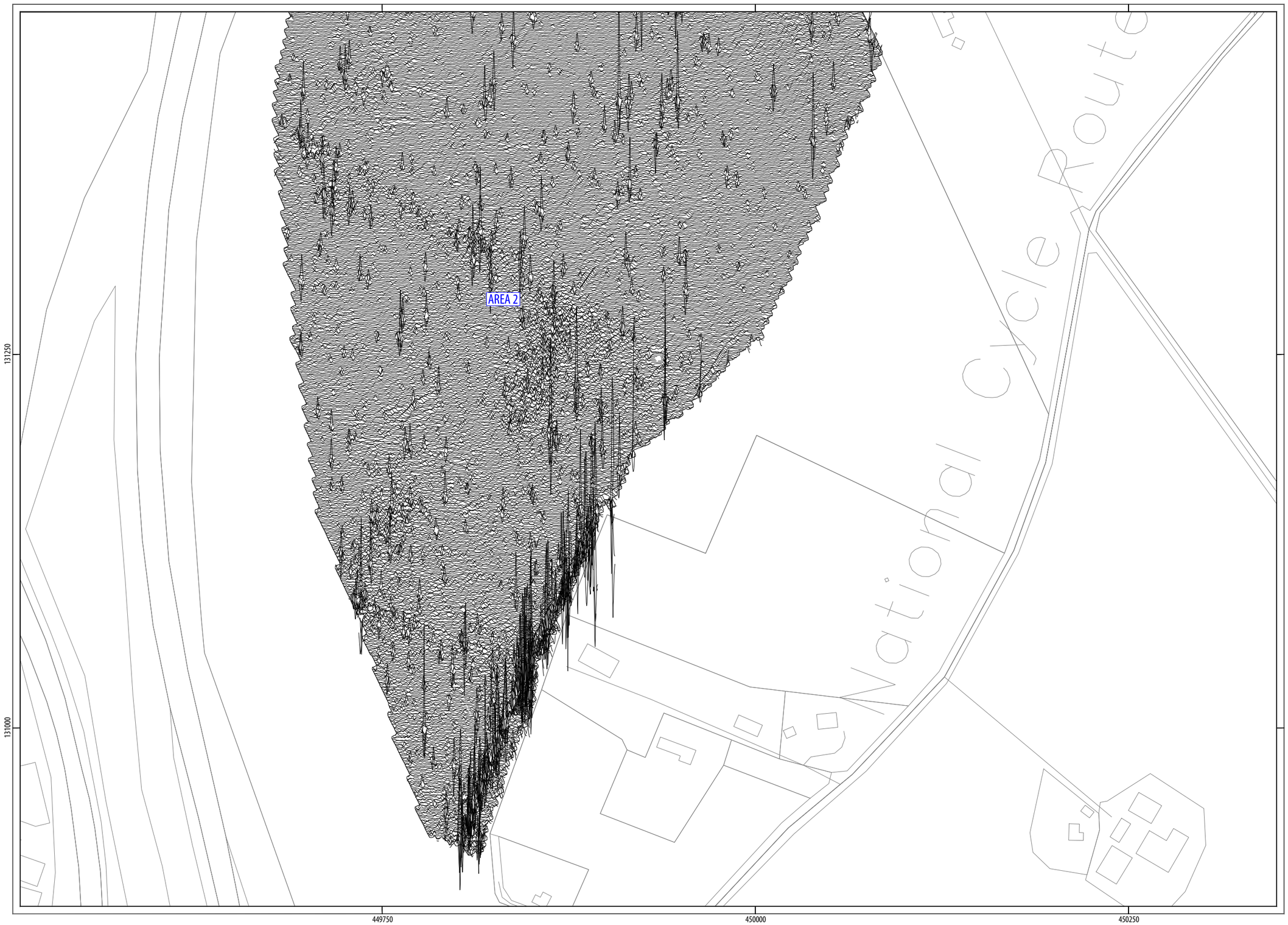
**ILLUS 14** Processed greyscale magnetometer data; Sector2




25.0nT/cm

0 50m

1:2,500 @ A3

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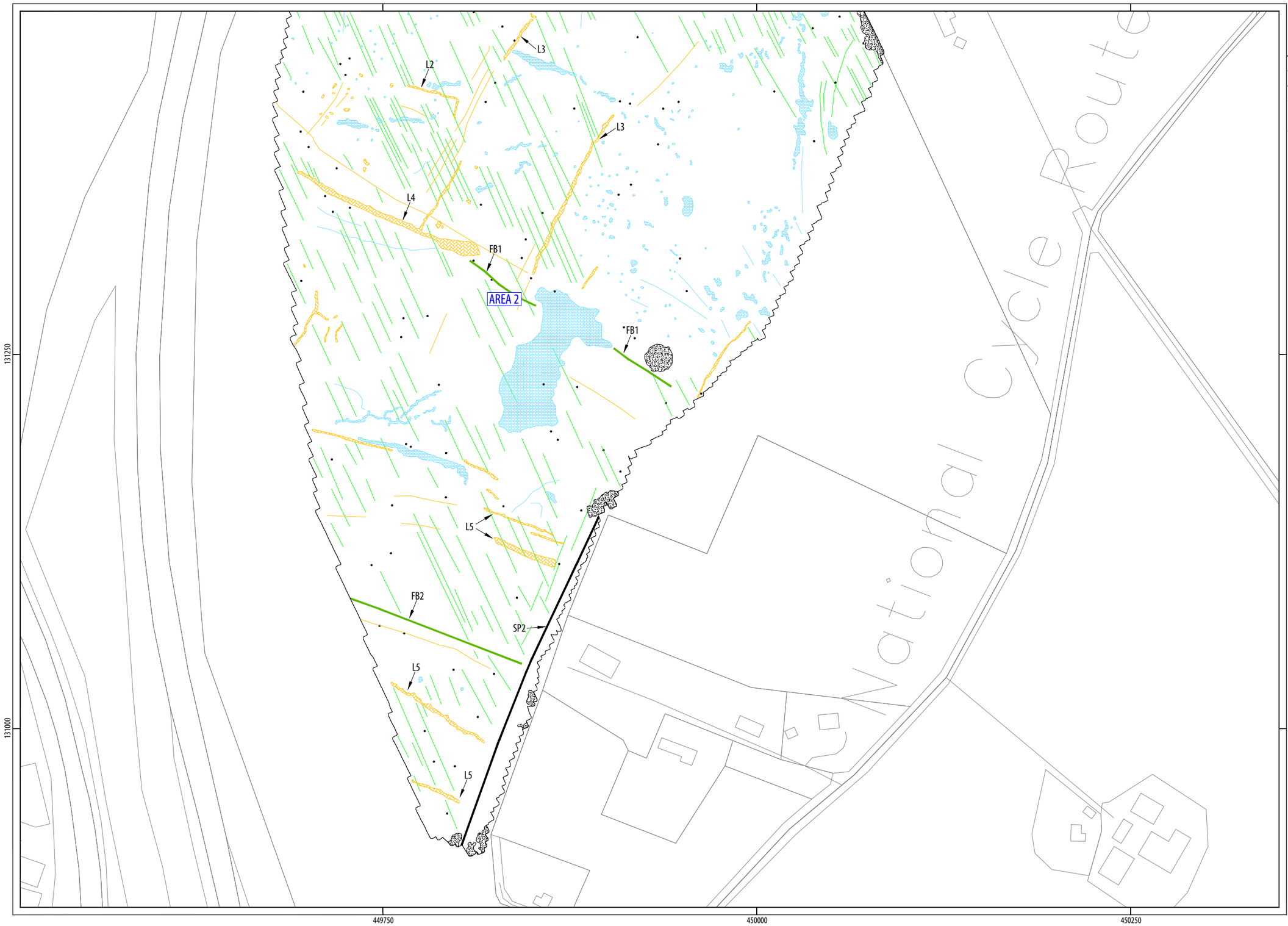
**ILLUS 15** XY trace plot of minimally processed magnetometer data; Sector2




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

ABBREVIATIONS

| | |
|---|---|
| SP | service pipe |
| FB | former boundary |
| L | linear |

0 50m
1:2,500 @ A3

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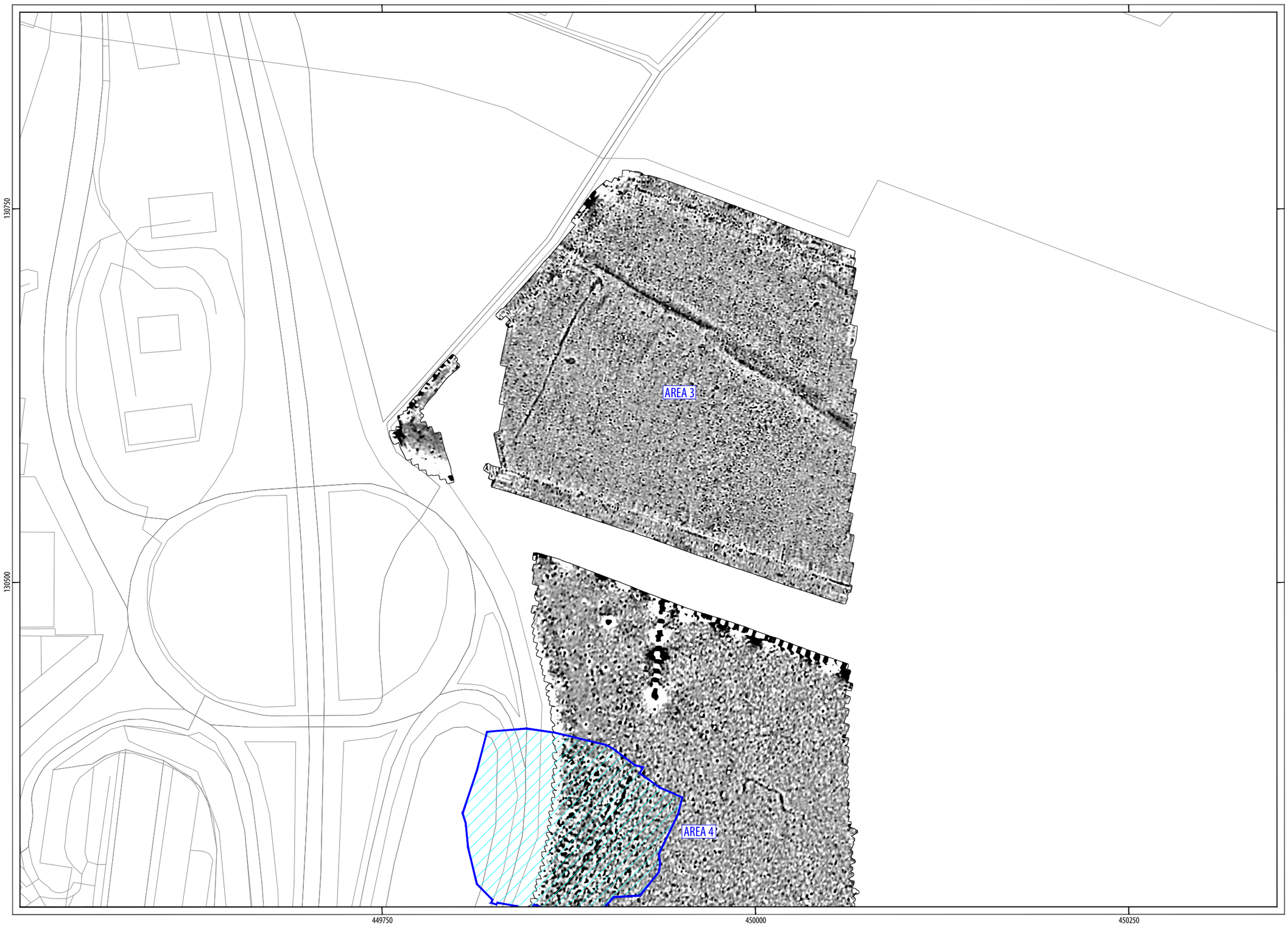
**ILLUS 16** Interpretation of magnetometer data; Sector2

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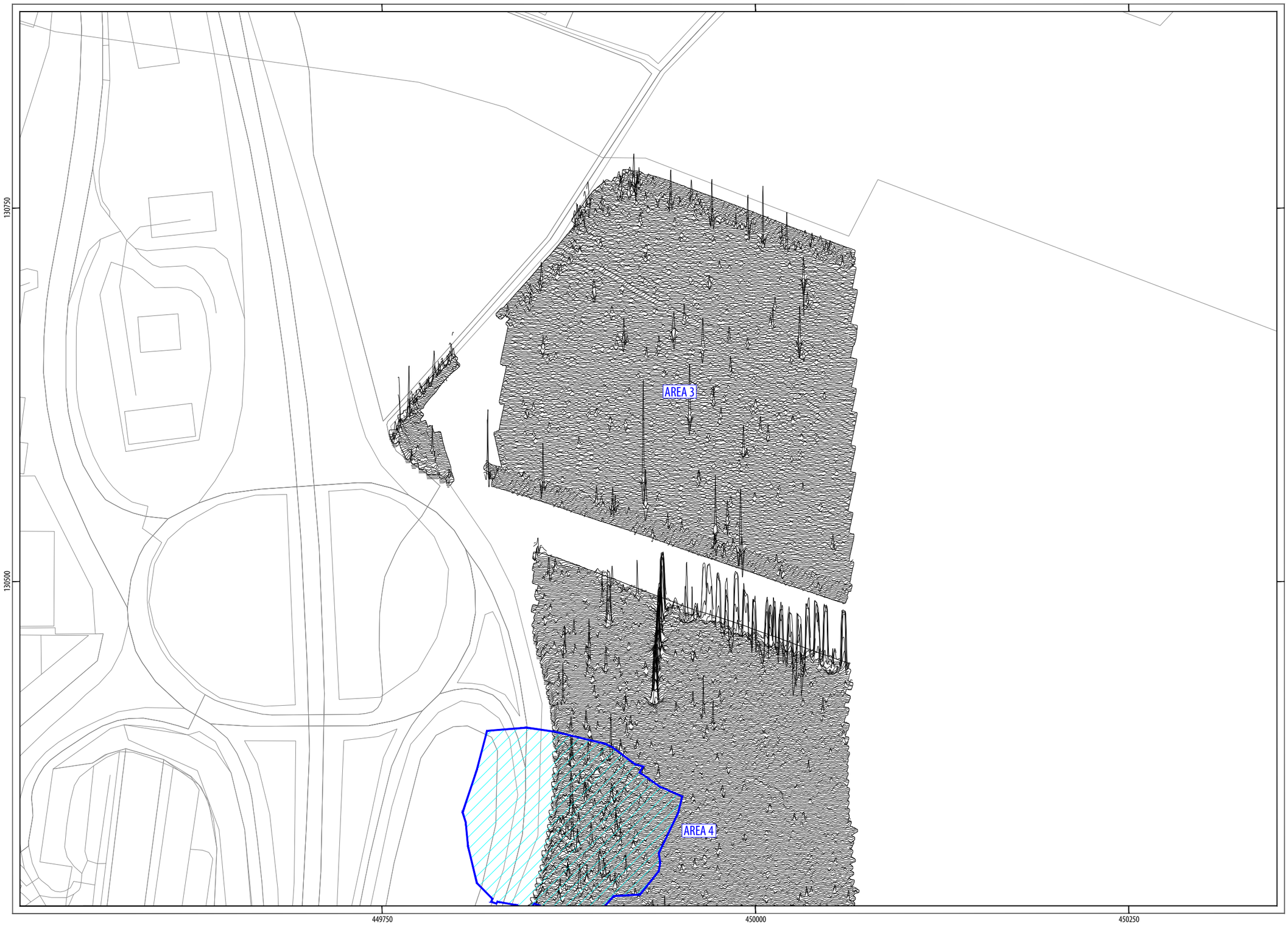
**ILLUS 17** Processed greyscale magnetometer data; Sector3




Winnall Down 1976-77 excavation boundary

25.0nT/cm

0 50m

1:2,500 @ A3

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M3 Junction 9 Improvement Scheme
Winchester, Hampshire

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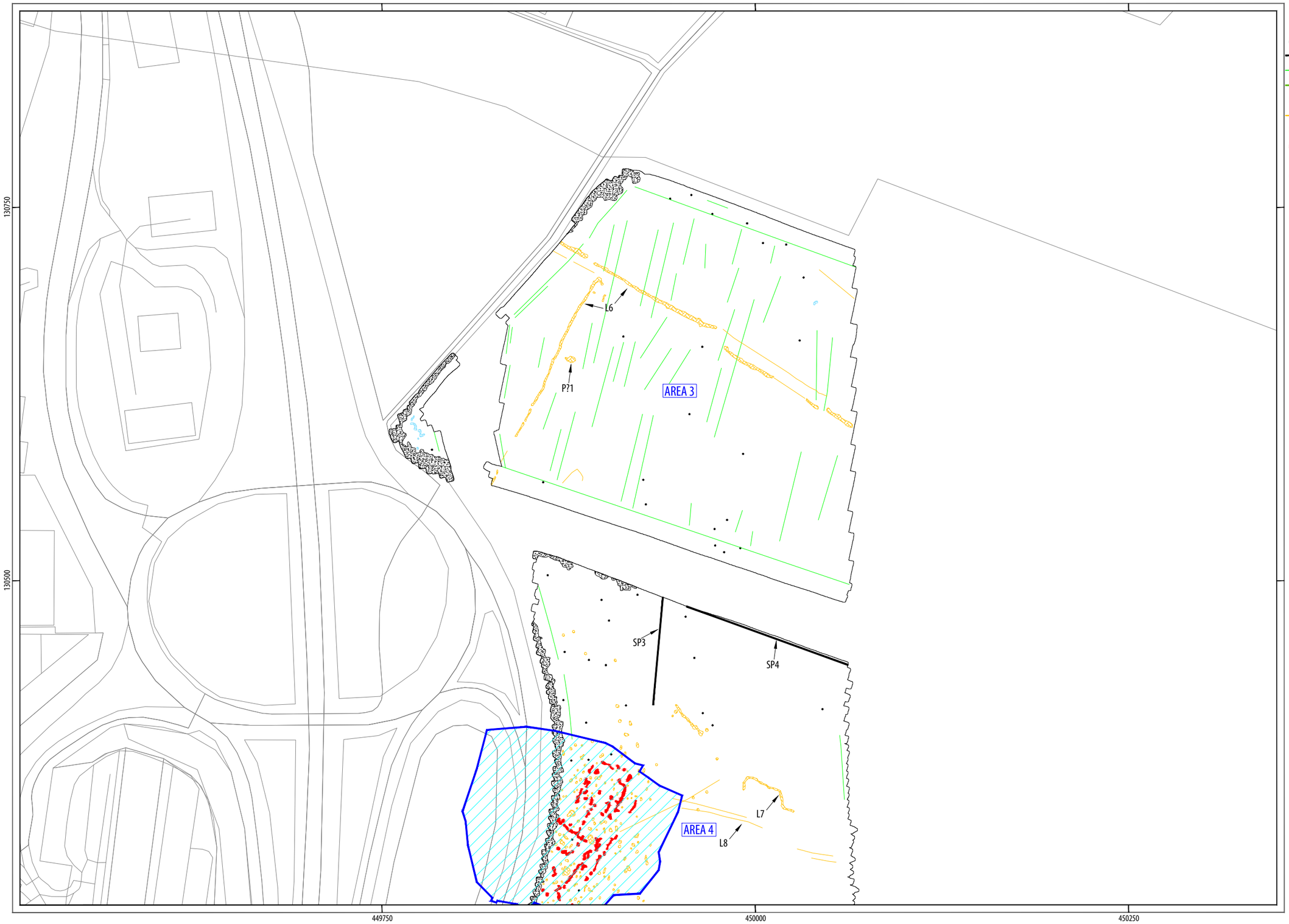
**ILLUS 18** XY trace plot of minimally processed magnetometer data; Sector3




| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| dipolar linear | service pipe |
| linear trend | agricultural |
| linear | former field boundary |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |
| magnetic enhancement | archaeology |

Winnall Down 1976-77 excavation boundary

ABBREVIATIONS

| | |
|---|---|
| SP | service pipe |
| L | linear |
| P? | pit? |

0 50m
1:2,500 @ A3

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M3 Junction 9 Improvement Scheme
Winchester, Hampshire

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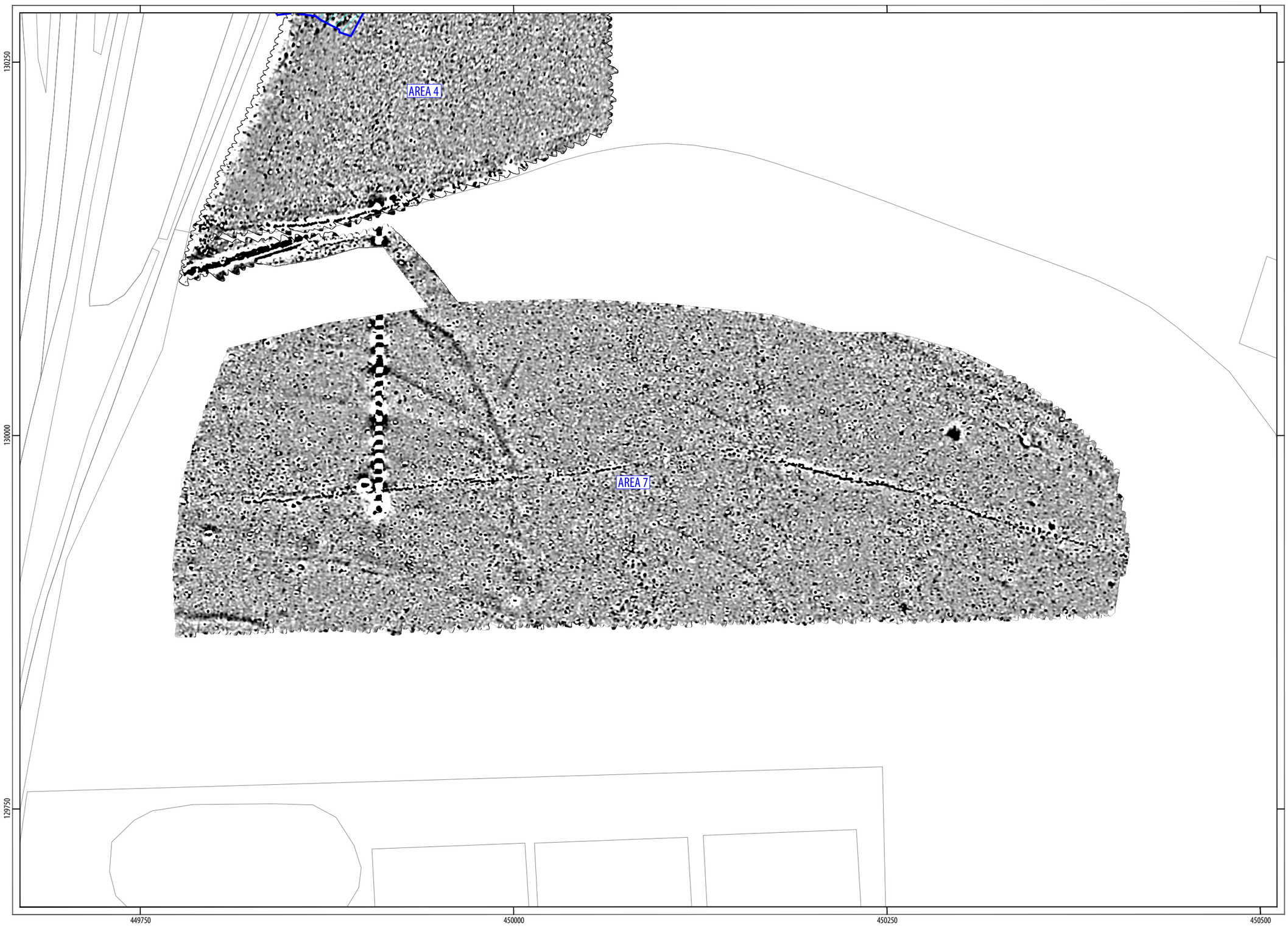
**ILLUS 19** Interpretation of magnetometer data; Sector3




Winnall Down 1976-77 excavation boundary

nT
-1.0
2.0

0
50m
1:2,500 @ A3

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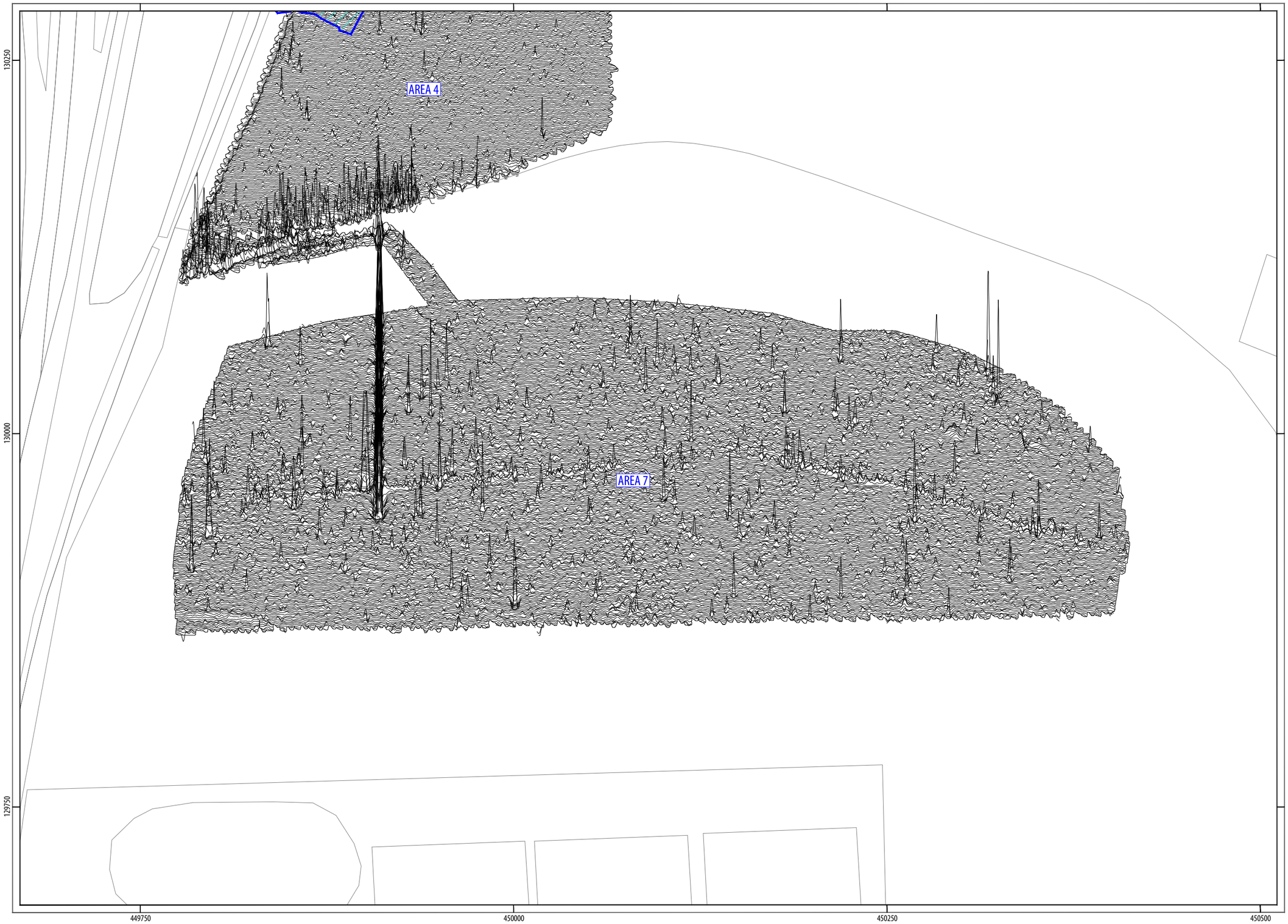
**ILLUS 20** Processed greyscale magnetometer data; Sector4




Winnall Down 1976-77 excavation boundary

25.0nT/cm

0 50m

1:2,500 @ A3

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**ILLUS 21** XY trace plot of minimally processed magnetometer data; Sector4


| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| dipolar linear | service pipe |
| magnetic enhancement | quarrying(?) |
| linear trend | agricultural |
| linear | former field boundary |
| linear trend | geological variation |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |
| magnetic enhancement | archaeology |

Winnall Down 1976-77 excavation boundary

ABBREVIATIONS

| | |
|---|---|
| SP | service pipe |
| FB | former boundary |
| RD | ring ditch |
| RD? | ring ditch? |
| L | linear |
| ME | magnetic enhancement |

0 50m
1:2,500 @ A3

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M3 Junction 9 Improvement Scheme
Winchester, Hampshire

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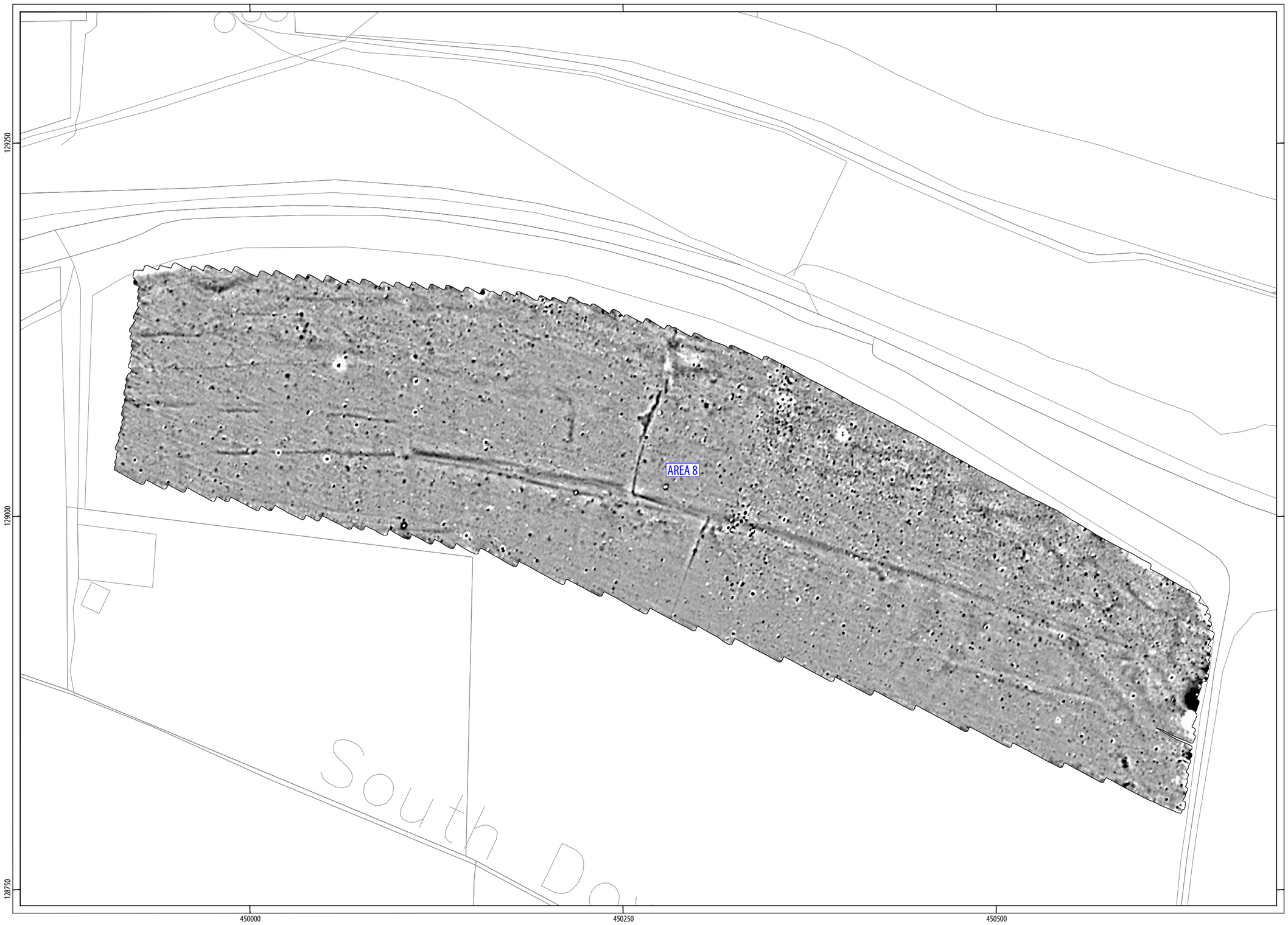
**ILLUS 22** Interpretation of magnetometer data; Sector4




-1.0 nT 2.0

0 50m

1:2,500 @ A3

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Winchester, Hampshire

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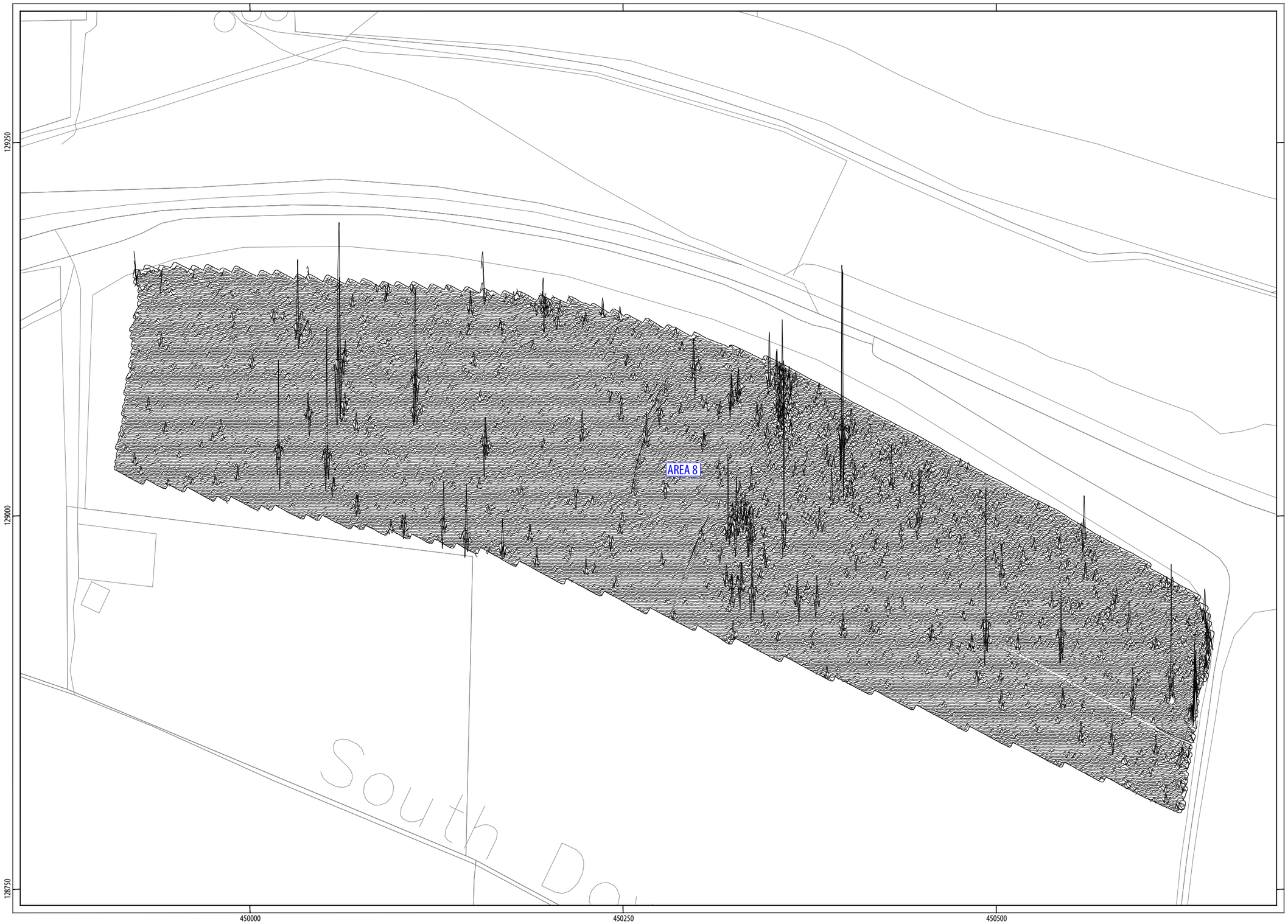
**ILLUS 23** Processed greyscale magnetometer data; Sector5




25.0nT/cm

0 50m

1:2,500 @ A3

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Winchester, Hampshire

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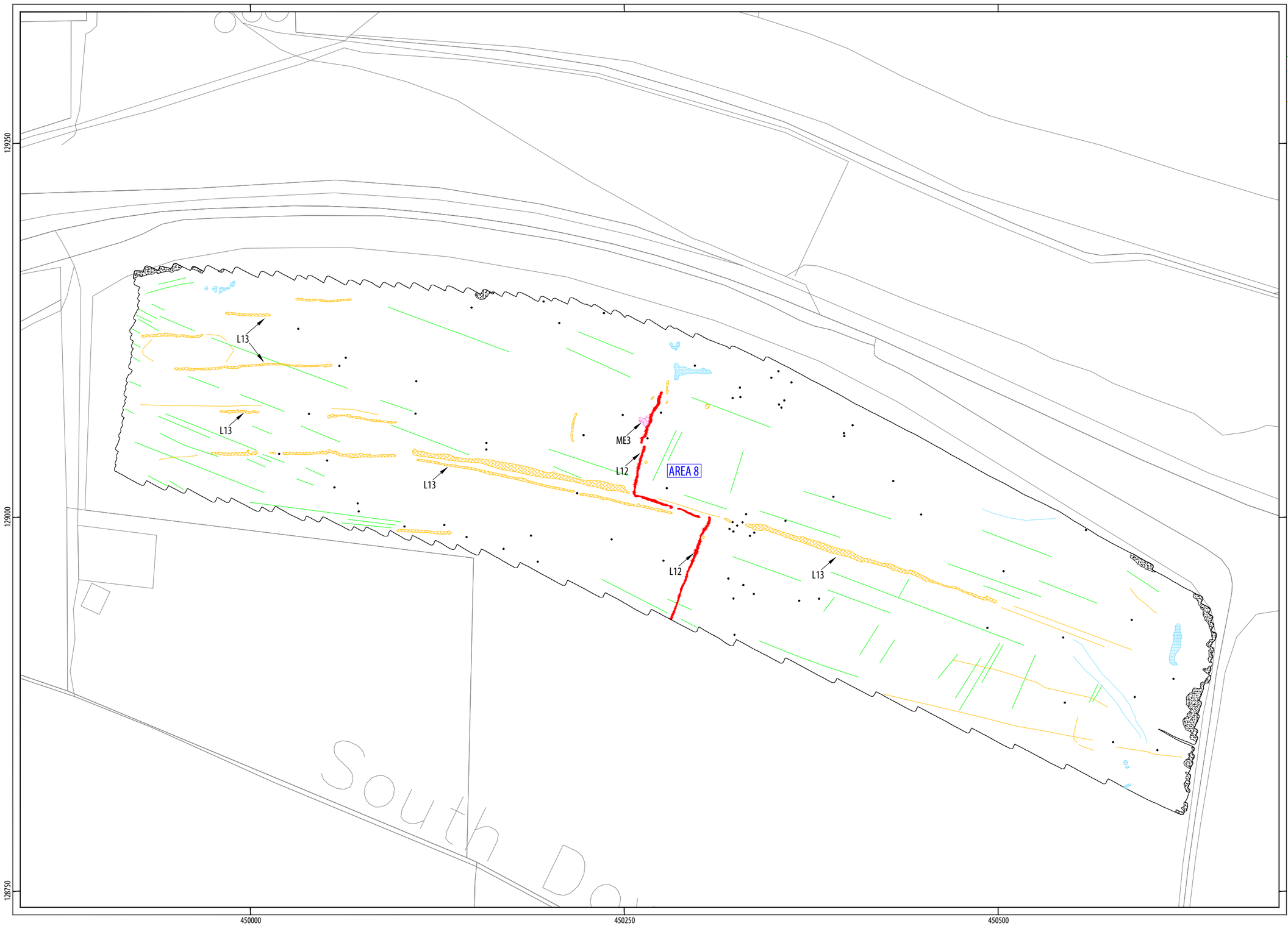
**ILLUS 24** XY trace plot of minimally processed magnetometer data; Sector5




| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| dipolar isolated | ferrous material |
| magnetic disturbance | ferrous material |
| linear trend | agricultural |
| linear trend | geological variation |
| magnetic enhancement | geology |
| linear trend | archaeology? |
| magnetic enhancement | archaeology? |
| magnetic enhancement | archaeology |

ABBREVIATIONS

| | |
|---|---|
| L | linear |
| ME | magnetic enhancement |

0 50m

1:2,500 @ A3

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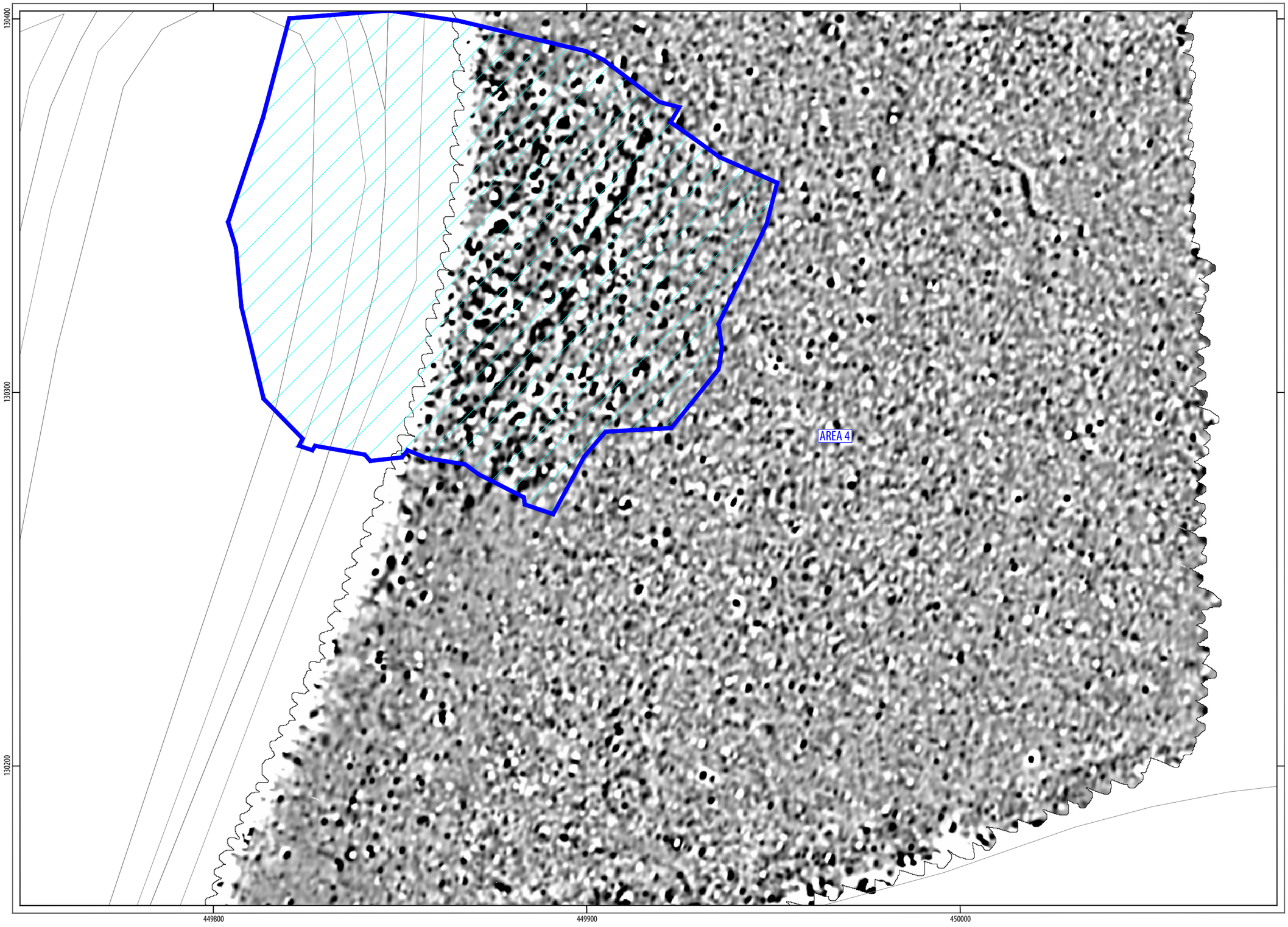
**ILLUS 25** Interpretation of magnetometer data; Sector5




Winnall Down 1976-77 excavation boundary

nT
-1.0
2.0

0
25m
1:1,000 @ A3

PROJECT MTJN21
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Winchester, Hampshire

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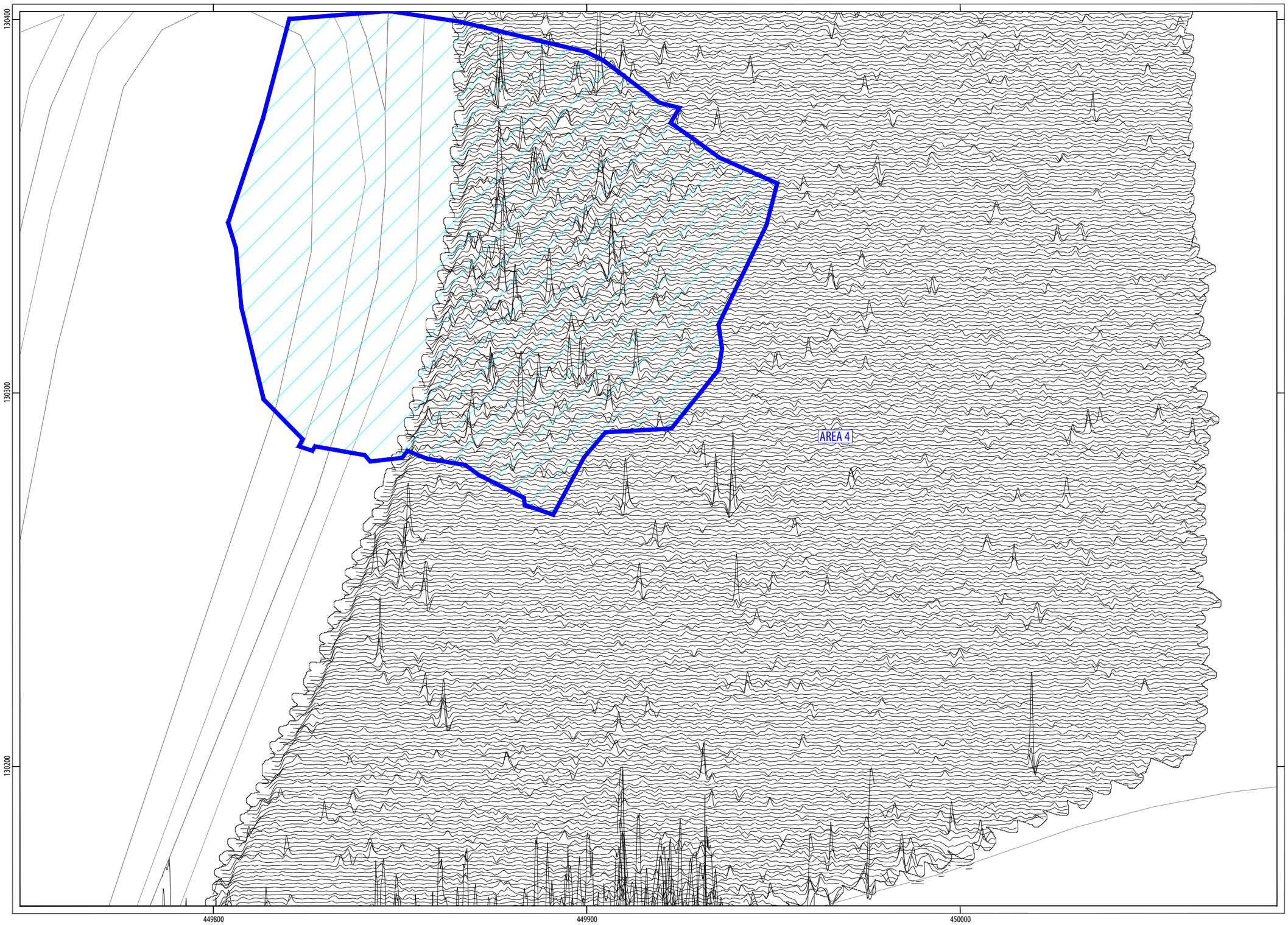
**ILLUS 26** Processed greyscale magnetometer data; AAA1




Winnall Down 1976-77 excavation boundary

25.0nT/cm

0 25m

1:1,000 @ A3

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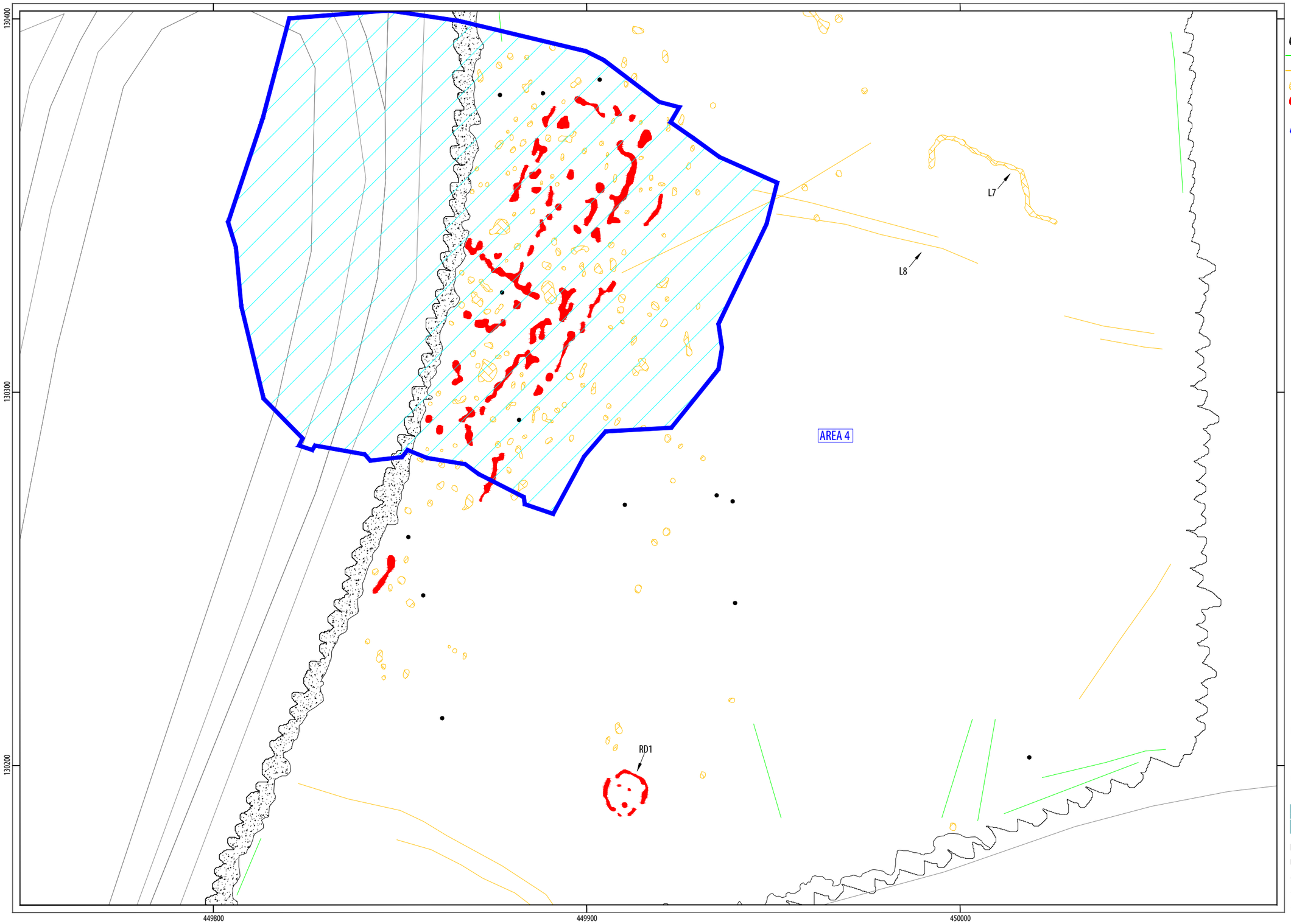
**ILLUS 27** XY trace plot of minimally processed magnetometer data; AAA1




TYPE OF ANOMALY | INTERPRETATION

- dipolar isolated | ferrous material
- magnetic disturbance | ferrous material
- linear trend | agricultural
- linear trend | archaeology?
- magnetic enhancement | archaeology?
- magnetic enhancement | archaeology

Winnall Down 1976-77 excavation boundary

ABBREVIATIONS

| | |
|---|---|
| L | linear |
| RD | ring ditch |

0 25m
1:1,000 @ A3

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Winchester, Hampshire

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Cleckheaton | BD19 4EZ
t 0127 493 8019
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**ILLUS 28** Interpretation of magnetometer data; AAA1

# 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.

**Lightning-induced remnant magnetisation** LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical current associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

**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 de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

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

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

# APPENDIX 5 OASIS ARCHIVE

## *OASIS ID (UID): headland1-502173*

| | |
|---|---|
| **Project Name:** | Geophysical Survey, Magnetometry Survey at M3 Junction 9 Improvement Scheme, Winchester, Hampshire |
| **Activity type:** | Magnetometry Survey, Geophysical Survey, MAGNETOMETRY SURVEY |
| **Project Identifier(s):** | P21-111 |
| **Reason for Investigation:** | Planning: Pre application |
| **Organisation Responsible for work:** | Headland Archaeology (UK) Ltd |
| **Project Dates:** | 9-Apr-2021 – 24-Apr-2021 |
| **HER:** | Winchester HER |
| **Project Methodology:** | The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point. MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.37.0 (DWConsulting) software was used to process and present the data. |
| **Project Results:** | Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 50 hectares on land adjacent to the M3 east of Winchester, Hampshire as part of the M3 Junction 9 Improvement Scheme. The survey was undertaken to assess the impact of the proposed development on the historic environment with the results informing future archaeological strategy on the Scheme. The survey has successfully evaluated the Proposed Development Area (PDA) and identified a range of anomalies both archaeological and natural in origin against a variable magnetic background. The most conspicuous findings include an area of settlement activity identified by ditches and pit like features marking the continuation of a settlement site spanning the Bronze Age to Romano-British period excavated in the 1970's, a ring ditch and linear anomalies of varying strengths matching known cropmarks of an extensive prehistoric field system. Elsewhere linear, curvilinear and circular trend anomalies of possible archaeological origin are tentatively suggested and former field boundaries, extractive pits, cultivation effects, service pipes and natural/geological features are also identified. Generally the findings of the geophysical survey are consistent with the known archaeological activity within the vicinity of the scheme. Based on these results the PDA is assessed as having a widely low archaeological potential for significant archaeological remains however findings of higher significance have been recorded in two localised areas. |
| **Keywords:** | – |
| **Archive:** | – |

part of the RSK Group

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

**Headland Archaeology** Yorkshire & North
Units 23–25 & 15 | Acorn Business Centre | Balme Road
Cleckheaton BD19 4EZ
t 0127 493 8019
e yorkshireandnorth@headlandarchaeology.com

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

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

**Headland Archaeology** North West
Fourways House | 57 Hilton Street
Manchester M1 2EJ
t 0161 236 2757
e northwest@headlandarchaeology.com

www.headlandarchaeology.com