

Proposed Steads Burn OCCS, land north and south of Felton Lane, Widdrington, Morpeth, Northumberland

geophysical surveys

on behalf of

Tyne and Wear Museums, Archaeology Department

Report 1412
February 2006

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1. Summary

The project

- 1.1 This report presents the results of geophysical surveys conducted in advance of a planning application for the extraction of coal and fireclay on land north and south of Felton Lane, Widdrington, Northumberland.
- 1.2 The works were commissioned by Tyne and Wear Museums and conducted by Archaeological Services in accordance with a project design provided by Archaeological Services.

Results

- 1.3 Evidence of ridge and furrow cultivation, which can date from the medieval period to the late 19th century, has been detected throughout the study area.
- 1.4 Soil-filled features, possibly ditches, have been detected in Areas 1, 2, 3, 4 and 6. The soil-filled features detected in Area 6 may be ditches although it is also possible they reflect former palaeochannels and associated geomorphological features.

2. Project background

Location (Figure 1)

- 2.1 The study area was located north and south of Felton Lane, Widdrington, Morpeth, Northumberland (NGR centre: NZ 235 959). It measured approximately 31ha in total, which comprised pasture and arable fields bounded by hedgerows (Table 1).

Development proposal

- 2.2 The surveys have been carried out in advance of a planning application for the extraction of coal and fireclay and the provision of associated earthworks and infrastructure on land north and south of Felton Lane.

Objective

- 2.3 The principal aim of the surveys was to determine the extent and nature of any sub-surface features of archaeological potential within the development area, in order to inform and advise any further scheme of archaeological works that may be required in advance of development.

Dates

- 2.4 Fieldwork was undertaken between the 7th and 13th February 2006. This report was prepared between the 15th and 28th February 2006.

Personnel

- 2.5 Fieldwork was conducted by Graeme Attwood, Edward Davies, Louise Robinson, Natalie Swann and supervised by Lorne Elliott. This report was prepared by Lorne Elliott, with illustrations by David Graham. The Project Manager was Duncan Hale.

Archive/OASIS

- 2.6 The site code is **WSB06**, for **Widdrington, Steads Burn 2006**. The archive is currently held by Archaeological Services. Archaeological Services is registered with the **Online Access** to the **Index** of archaeological investigation**S** project (OASIS). The OASIS ID number for this project is **archaeol3-13048**.

3. Archaeological and historical background

- 3.1 A desk-based assessment undertaken in November 2004 indicates that although much of the present application area has been impacted by previous mining activity, some areas of archaeological potential remain undisturbed. The coastal plain of Northumberland is known to be rich in archaeological features and deposits of all periods and a number of prehistoric and medieval settlement sites are known in the locality of the site. Most notable among these was the discovery in 1998 of four Iron Age roundhouses and ditched enclosure 2km north of the application area at Chevington. Probable prehistoric settlement remains were also identified near to the site of Widdrington Castle

1km to the east, where a previous archaeological evaluation identified a ring gully of at least pre-medieval date.

- 3.2 Place-name evidence suggests that the nearby settlements at Stobswood, Chevington and Widdrington may all have Saxon origins, though the earliest documentary evidence (a licence to crenellate at Widdrington Castle) derives from 1272. A medieval church was constructed at Widdrington in the late 12th century, and a former medieval village is thought to have occupied the site of the present coal sorting yard.
- 3.3 The modern history of the site is one of sporadic coal extraction and processing, a number of collieries having operated within and adjacent to the site during Victorian and modern periods. The site is now dominated by the Widdrington Disposal Point, constructed between 1947 and 1958 to allow the transfer by rail of coal extracted on site. Evidence of historic mining activity is also likely to survive within the site.

4. Landuse, topography and geology

- 4.1 At the time of survey the proposed development area comprised fields of pasture, arable crops and rough grassland, as follows:

Table 1: Size and location of areas surveyed

Area	Size (ha)	NGR	Landuse
1	4.2	NZ 247 961	arable
2	5.6	NZ 245 961	pasture
3	6.6	NZ 243 960	pasture
4	5.8	NZ 235 959	arable/rough grassland
5	0.9	NZ 233 956	pasture
6	4.2	NZ 230 955	pasture
7	0.7	NZ 234 957	rough grassland
8	0.8	NZ 233 957	bog/rough grassland

- 4.2 The survey area was predominantly level at a mean elevation of c.30m OD.
- 4.3 The underlying solid geology of the area comprises Carboniferous Coal Measures, overlain by glacial clays and sands.

5. Geophysical survey methods

Standards

- 5.1 The surveys and reporting were conducted in accordance with English Heritage (David 1995) Research and Professional Services Guideline No.1, *Geophysical survey in archaeological field evaluation*; the Institute of Field Archaeologists (Gaffney et al 2002) Technical Paper No.6, *The use of*

geophysical techniques in archaeological evaluations; and the Archaeology Data Service (Schmidt 2001) Geophysical Data in Archaeology: A Guide to Good Practice.

Technique selection

- 5.2 Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistivity, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.
- 5.3 In this instance, it was considered likely that cut features, such as ditches and pits, might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.
- 5.4 Given the anticipated shallowness of the targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate. This technique involves the use of hand-held magnetometers to detect and record minute perturbations, or 'anomalies', in the vertical component (i.e. gradient) of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect each of the types of feature mentioned above.

Field methods

- 5.5 The study area was divided into eight separate areas for survey purposes (Figure 1).
- 5.6 A 30m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS50 global positioning system (GPS).
- 5.7 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601 and Geoscan FM36/FM256 fluxgate gradiometers with automatic datalogging facilities. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 3600 sample measurements per 30m grid unit.
- 5.8 Data were downloaded on-site into laptop computers for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

- 5.9 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw data. The greyscale images and interpretations are presented in Figures 2-25; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

- 5.10 The following basic processing functions have been applied to each dataset:

Clip – clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.

Zero mean traverse – sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.

Destagger – corrects for displacement of anomalies caused by alternate zig-zag traverses.

Despike – locates and suppresses random iron spikes in gradiometer data.

Low pass filter – is useful for smoothing data or for enhancing larger weak features.

Interpolate – increases the number of data points in a survey to match sample and traverse intervals. In this instance the gradiometer data have been interpolated to 0.25 x 0.25m intervals.

Anomaly types

- 5.11 Colour-coded geophysical interpretation plans are provided for each survey area. Two types of geomagnetic anomaly have been distinguished in the data:

positive magnetic regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches.

dipolar magnetic paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths.

6. Geophysical survey results

- 6.1 A compilation of the individual survey area greyscales is presented in Figure 1. Colour-coded geophysical and archaeological interpretation plans are provided for each survey area.

Area 1 (Figures 2-4)

- 6.2 A series of weak linear positive magnetic anomalies on an approximate northeast-southwest alignment and spaced at varying intervals was detected in the northwest corner of the survey area. These reflect soil-filled features, possibly a continuation of the ridge and furrow detected in Area 2.
- 6.3 A linear positive magnetic anomaly in the south of the survey and on a northwest-southeast alignment reflects a possible soil-filled feature.
- 6.4 Two dipolar magnetic anomalies on the northern boundary, one in the northeast corner and the other towards the middle, correspond to manhole covers. A scatter of small, discrete dipolar magnetic anomalies reflects fired and ferrous debris, such as horseshoes and brick fragments within the topsoil. A sample of these is highlighted in the geophysical interpretation. A larger dipolar anomaly in the southeast corner of the survey area is likely to reflect a larger piece of ferrous debris.
- 6.5 The only other anomalies in this area are dipolar magnetic anomalies along the periphery of the survey area reflecting wire fences along the field boundaries

Area 2 (Figures 5-7)

- 6.6 Ridge and furrow cultivation was detected across the whole of the survey area, though more evident in the east. This was detected as a series of parallel positive magnetic anomalies on an approximate east-west alignment and spaced at 5-6m intervals.
- 6.7 Two rectilinear positive magnetic anomalies in the north of the survey area almost certainly reflect soil-filled ditch features. Small curvilinear features in the west of the area could reflect further soil-filled features.
- 6.8 A scatter of discrete dipolar magnetic anomalies again reflects fired and ferrous debris within the topsoil. The larger dipolar magnetic anomalies to the south of the area are likely to reflect larger ferrous objects within the topsoil.
- 6.9 An intense, discontinuous, linear dipolar magnetic anomaly aligned roughly north-south across the central part of the survey area may represent a service or former fence line.

Area 3 (Figures 8-10)

- 6.10 Ridge and furrow cultivation was detected across the survey area. This is identified by a series of parallel positive magnetic anomalies on an approximate east-west alignment and spaced at intervals of between 5-7m.

- 6.11 A series of linear and curvilinear positive magnetic anomalies in the northern part of the survey area may reflect ditches or other soil-filled features.
- 6.12 A discontinuous, linear positive magnetic anomaly aligned roughly north-south along the western boundary may reflect a former field boundary.
- 6.13 A dipolar magnetic anomaly in the northeast corner of the survey area corresponds to a manhole cover.
- 6.14 A scatter of small discrete dipolar magnetic anomalies again reflects the fired and ferrous debris within the topsoil.

Area 4 (Figures 11-13)

- 6.15 Ridge and furrow remains were detected across the survey area. These were detected as a series of positive magnetic anomalies on an approximate north-south alignment and spaced at 4-6m intervals.
- 6.16 Two weak linear positive magnetic anomalies, with an east-west orientation, were detected across the middle of the survey area. The northerly of the two linear anomalies reflects the present day change in land use from arable in the south to grassland in the north. The southerly of the linear anomalies may be a former field boundary.
- 6.17 Curvilinear positive magnetic anomalies in the northern part of the survey area may reflect soil-filled features such as ditches although it is also possible they reflect former palaeochannels and associated geomorphological features.
- 6.18 Chains of intense dipolar magnetic anomalies aligned broadly east-west and north-south in the southern half of the survey area almost certainly represent service pipes.
- 6.19 Positive linear magnetic anomalies running east-west to the south of the stream may reflect ridge and furrow. A small group of positive and dipolar magnetic anomalies along the side of the stream may be due to straightening of the watercourse.
- 6.20 The only other anomalies in this area comprise a scatter of dipolar magnetic anomalies reflecting soil litter.

Area 5 (Figures 14-16)

- 6.21 A series of strong positive magnetic anomalies aligned both northwest-southeast and northeast-southwest almost certainly reflect fired clay land drains.
- 6.22 An intense dipolar magnetic anomaly on the northern boundary corresponds to a trough.
- 6.23 The only other anomalies in this area are dipolar magnetic anomalies along the

periphery of the survey area reflecting wire fences along the field boundaries and a scatter of dipolar magnetic anomalies reflecting soil litter.

Area 6 (Figures 17-19)

- 6.24 Probable ridge and furrow was detected across the survey area. This was detected as two series of linear positive magnetic anomalies on approximate northeast-southwest and northwest-southeast alignments and spaced at regular intervals. These anomalies appear to overlap in the west of the survey area.
- 6.25 Several small positive magnetic anomalies in this area may reflect pit-like features. Linear and curvilinear positive magnetic anomalies along the eastern boundary may also reflect soil-filled features.
- 6.26 A spread of dipolar magnetic anomalies is in evidence across the area, representing near-surface litter of fired and ferrous materials.

Area 7 (Figures 20-22)

- 6.27 Narrow ridge and furrow remains were detected across the survey area as a series of weak positive magnetic anomalies on an approximate northwest-southeast alignment. Parallel linear anomalies aligned northeast-southwest at wider intervals may reflect land drains.
- 6.28 A strong dipolar magnetic anomaly along the southern boundary almost certainly reflects a service pipe.
- 6.29 A discontinuous, linear positive magnetic anomaly aligned roughly north-south may reflect a former fence line, or possibly an alignment of pits.
- 6.30 A scatter of small discrete dipolar magnetic anomalies again reflects fired and ferrous debris within the topsoil.
- 6.31 A dipolar magnetic anomaly in the southeast corner of the survey area corresponds to a manhole cover.

Area 8 (Figures 20-22)

- 6.32 This area has a concentration of strong dipolar magnetic anomalies, almost certainly reflecting near-surface ferrous items. Large intense anomalies in the south of the survey area represent large metal debris including an oil drum. The strong positive anomaly in the west of the area is reflects a large shed on the field boundary.
- 6.33 An irregular large dipolar magnetic anomaly detected in the north of the survey area represents a concentration of fired and ferrous debris within an open drain.
- 6.34 The southeast corner of the survey area was inaccessible due to deep bog and scrubland conditions.

7. Conclusions

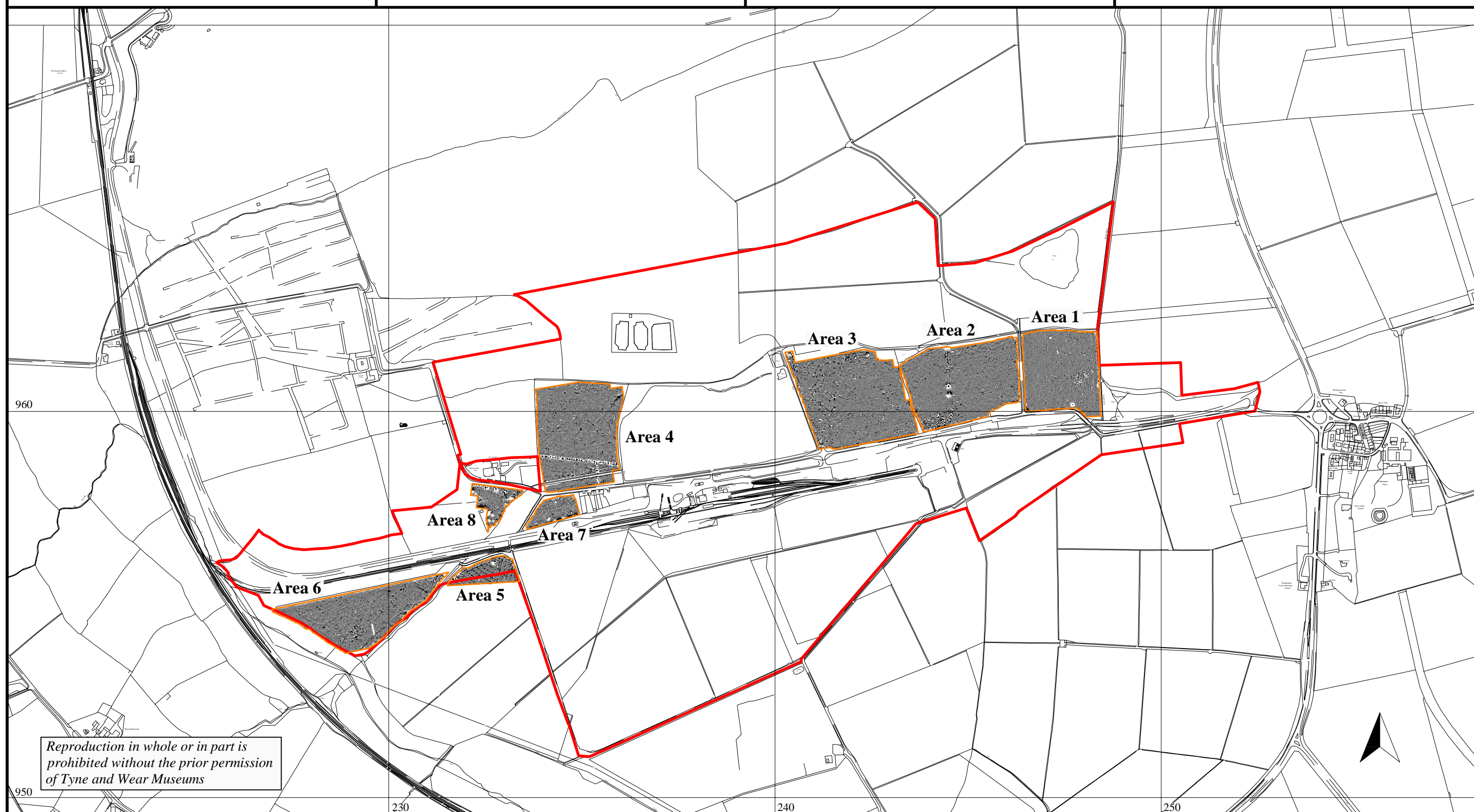
- 7.1 Fluxgate gradiometer surveys have been undertaken on land north and south of Felton Lane, Widdrington, Northumberland, in order to assess the potential survival of archaeological features prior to proposed coal and fireclay extraction.
- 7.2 Evidence of ridge and furrow cultivation, which can date from the medieval period to the late 19th century, has been detected throughout the study area.
- 7.3 Soil-filled features, possibly ditches have been detected in Areas 1, 2, 3, 4 and 6. The soil-filled features detected in Area 6 may be ditches although it is also possible they reflect former palaeochannels and associated geomorphological features. Some of these features may warrant further investigation by means of trial trenching.

8. Sources

Schmidt, A, 2001 *Geophysical Data in Archaeology: A Guide to Good Practice*, Arts and Humanities Data Service, Archaeology Data Service.

David, A, 1995 *Geophysical survey in archaeological field evaluation*, Research and Professional Services Guideline **1**, English Heritage.

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*, Technical Paper **6**, Institute of Field Archaeologists.



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Area 1

962

961

960

247

248

Steads Burn



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Figure 2
Area 1, geophysical survey

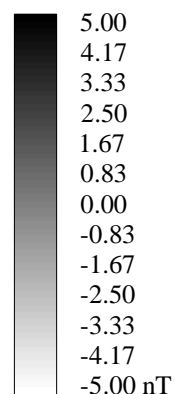
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scale 1:1000 - for A3 plot

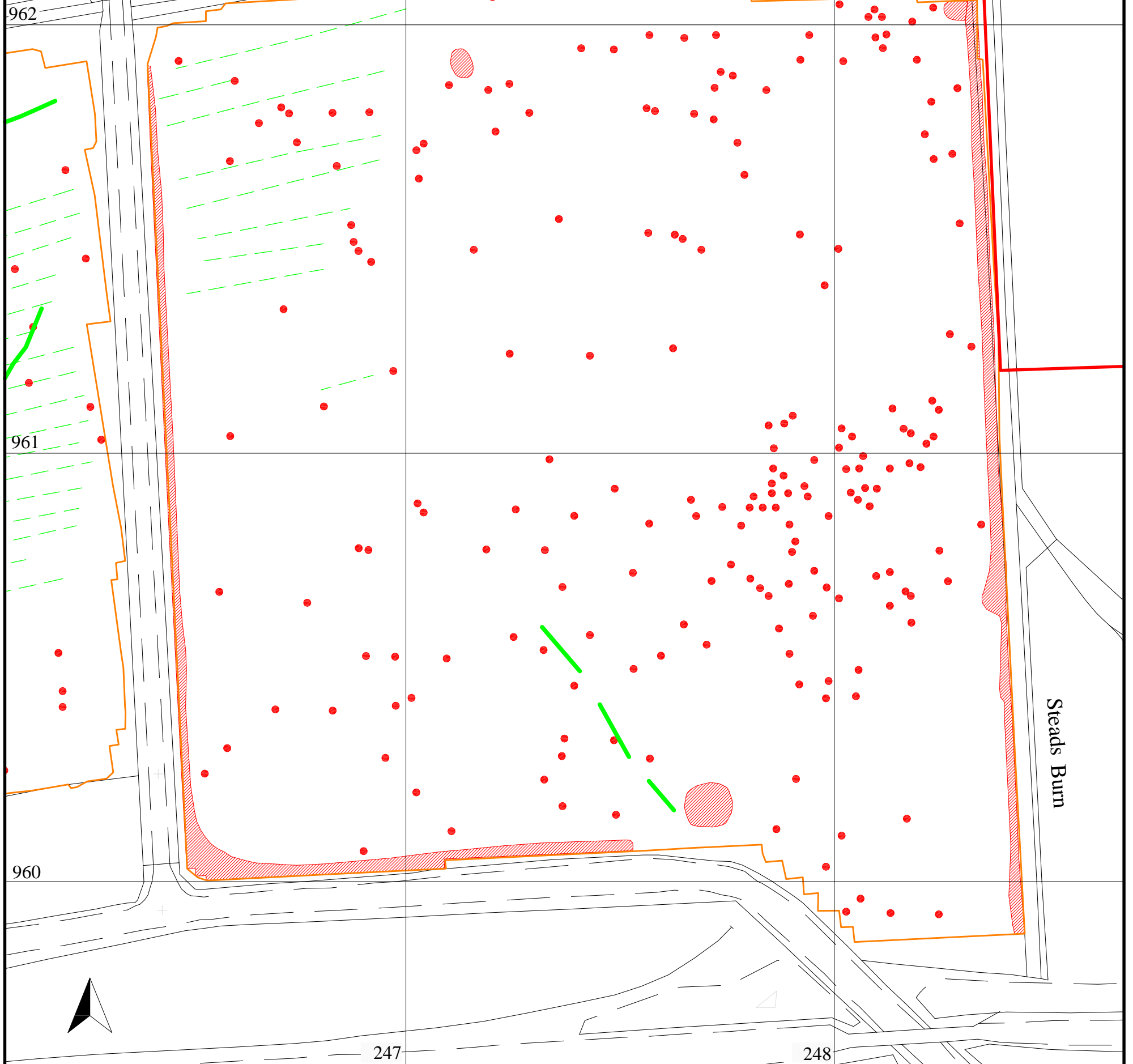


outline of survey area



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Area 1



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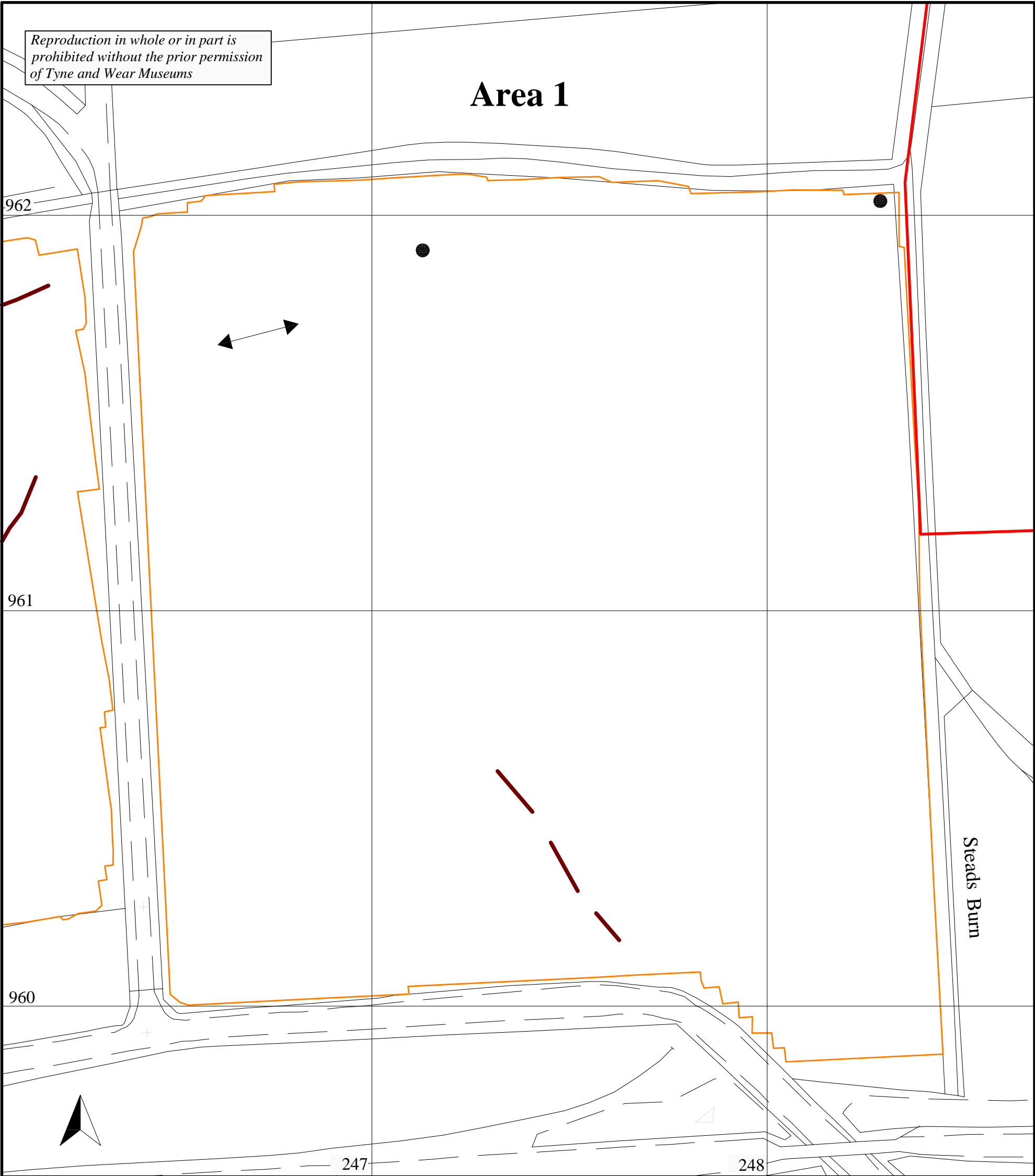
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Figure 3
Area 1, geophysical interpretation

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scale 1:1000 - for A3 plot

- outline of survey area
- positive magnetic anomalies
- negative magnetic anomalies
- dipolar magnetic anomalies



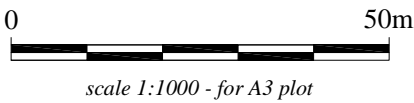
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Figure 4
Area 1, archaeological interpretation

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outline of survey area



soil-filled features



manhole cover



orientation of ridge and furrow



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scale 1:1250 - for A3 plot



outline of survey area

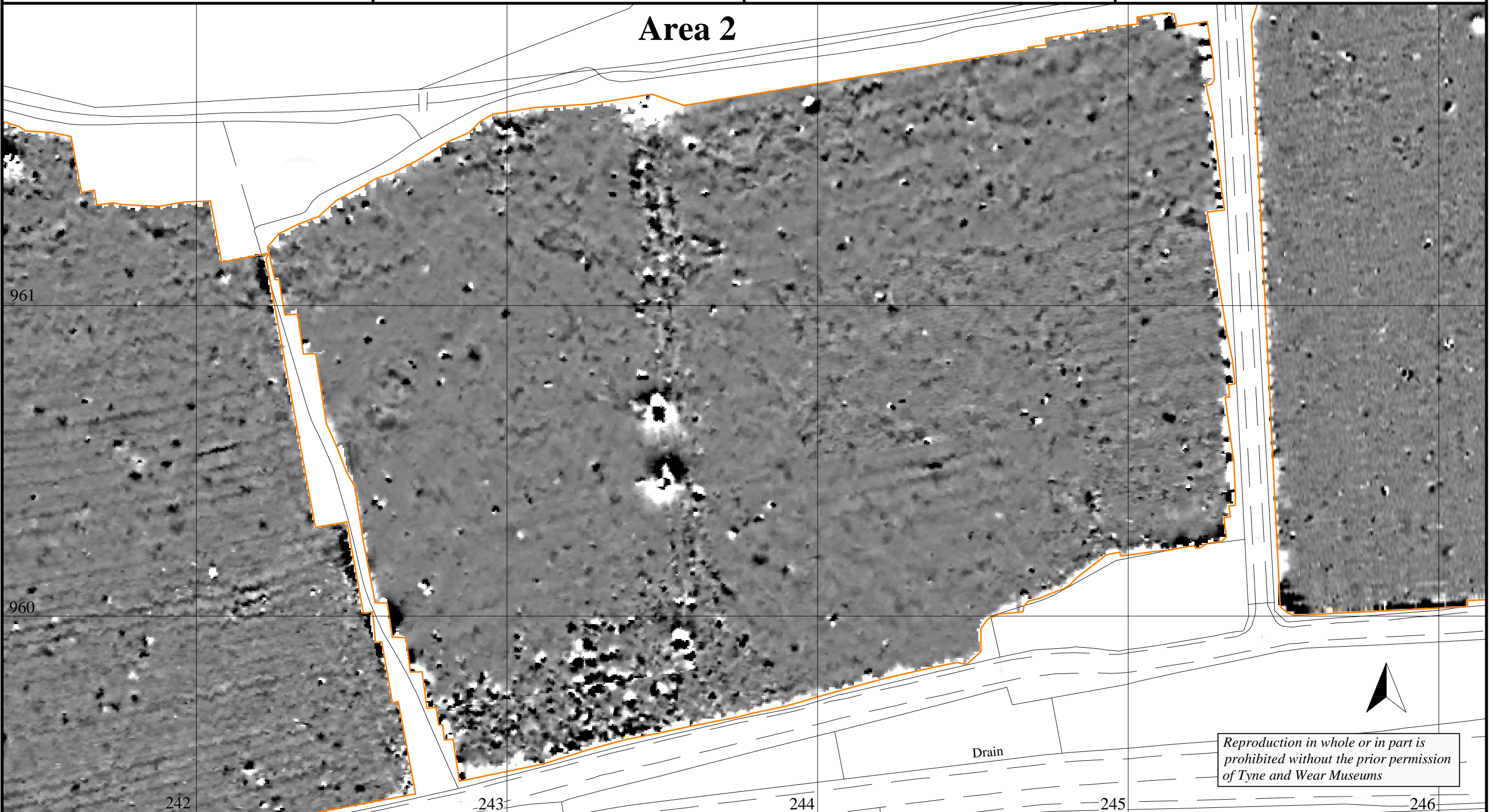
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-1.67
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-4.17
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Figure 5
Area 2, geophysical survey

Area 2



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outline of survey area



positive magnetic anomalies



negative magnetic anomalies

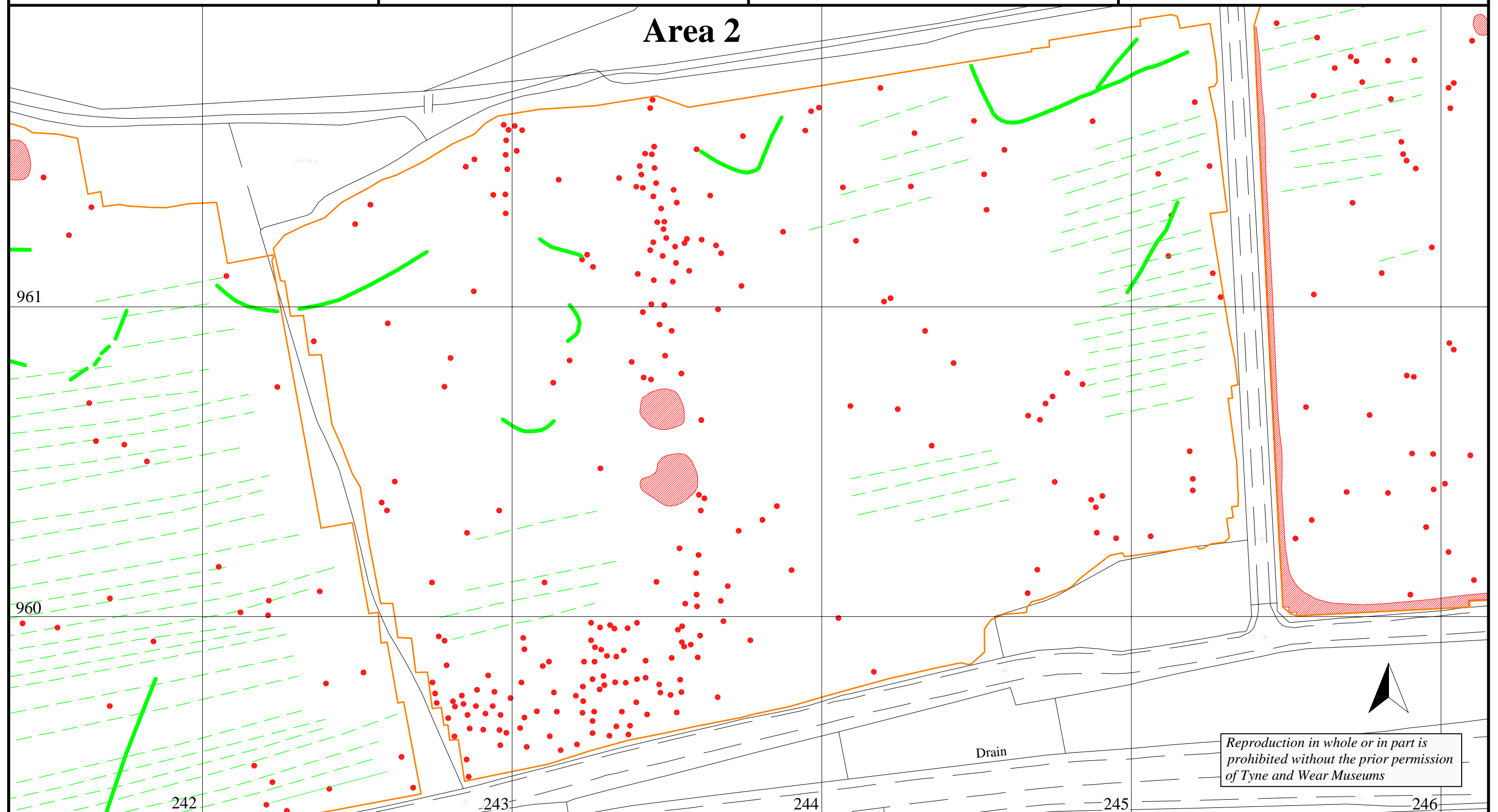


dipolar magnetic anomalies

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Figure 6
Area 2, geophysical interpretation





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scale 1:1250 - for A3 plot

- outline of survey area
- soil-filled features
- service pipes
- orientation of ridge and furrow

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Figure 7
Area 2, archaeological interpretation





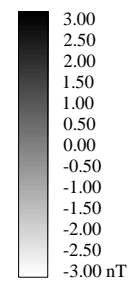
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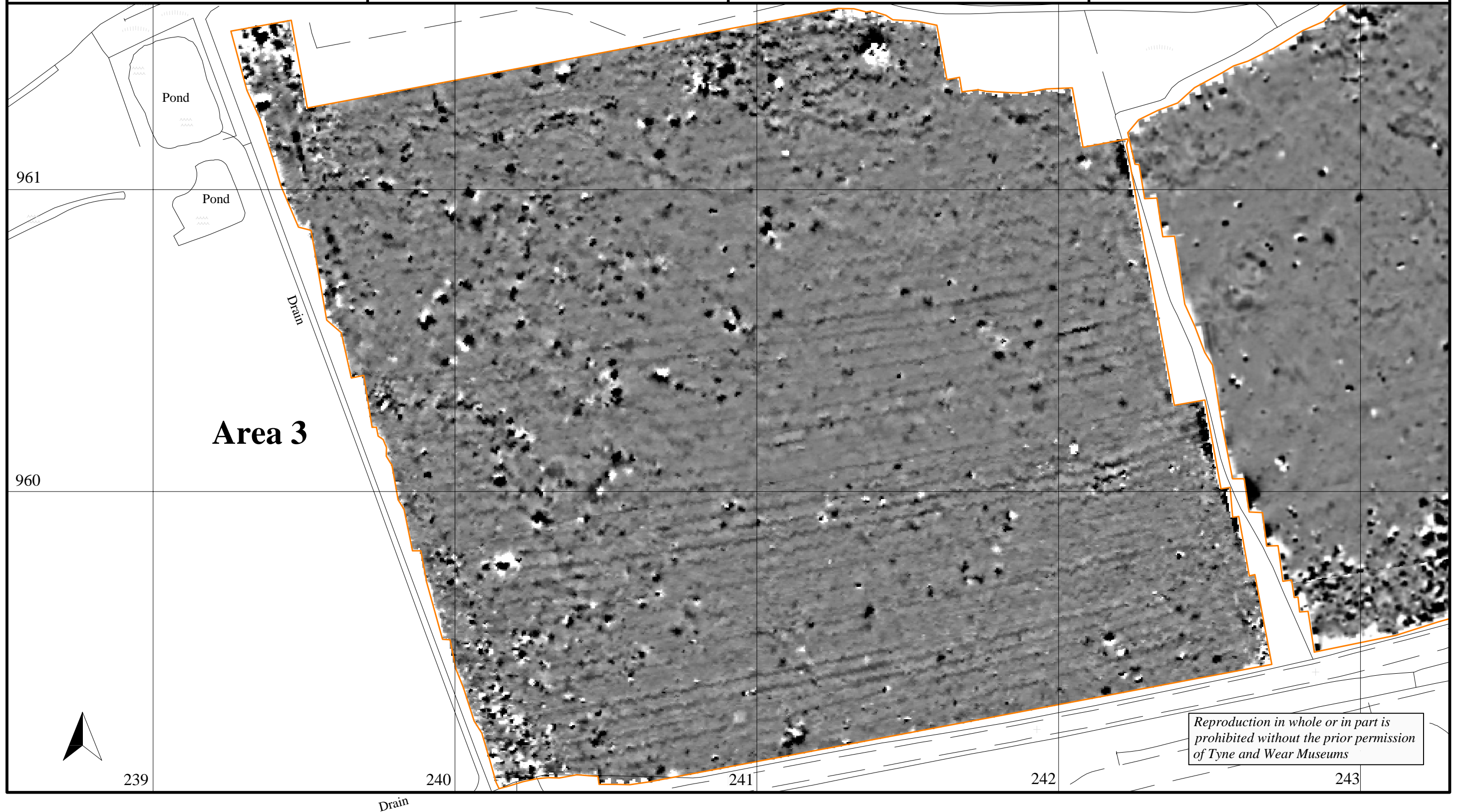
outline of survey area



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Figure 8
Area 3, geophysical survey





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scale 1:1250 - for A3 plot



outline of survey area



positive magnetic anomalies



negative magnetic anomalies



dipolar magnetic anomalies

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Figure 9
Area 3, geophysical interpretation



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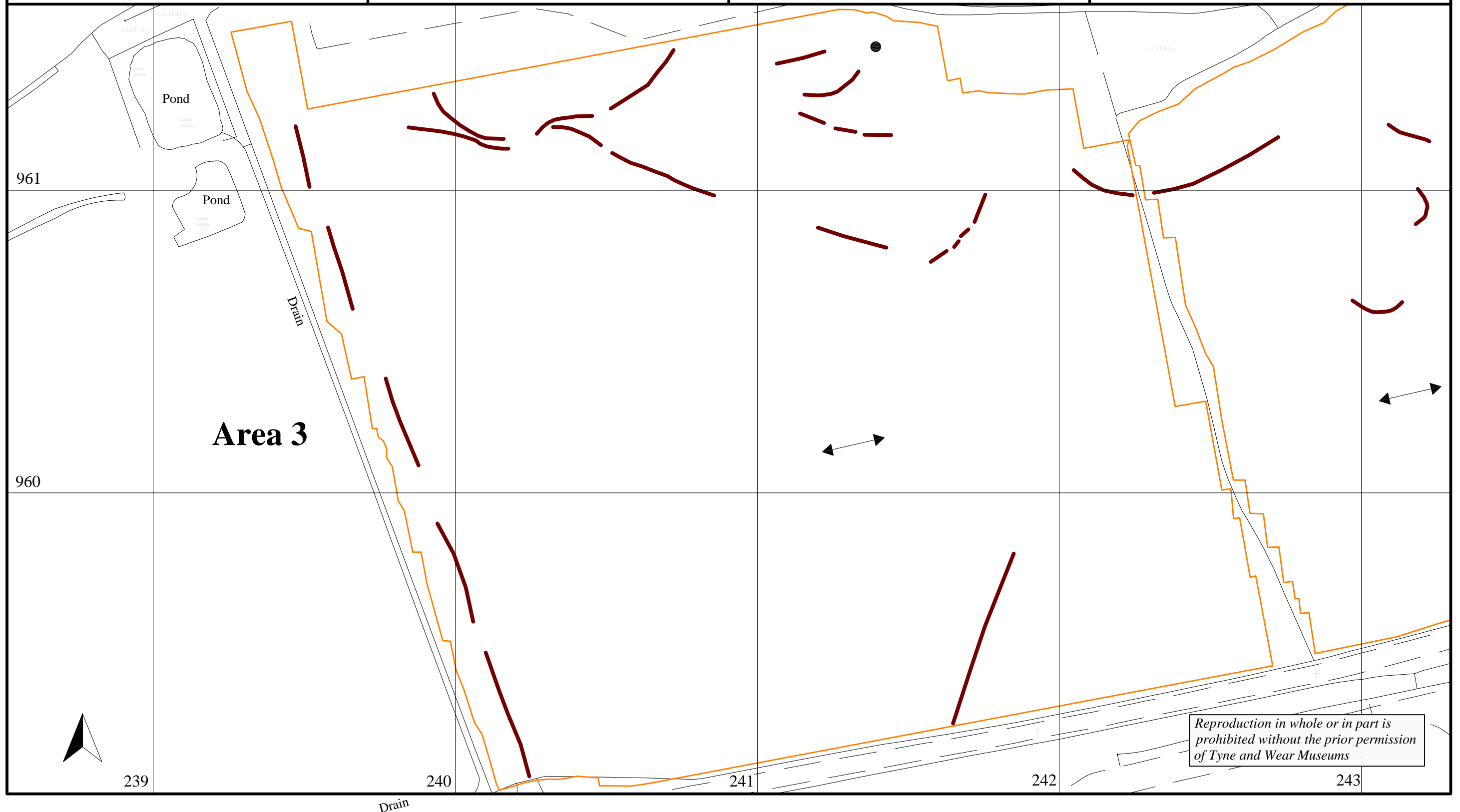
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- outline of survey area
- soil-filled features
- service pipes
- orientation of ridge and furrow
- manhole cover

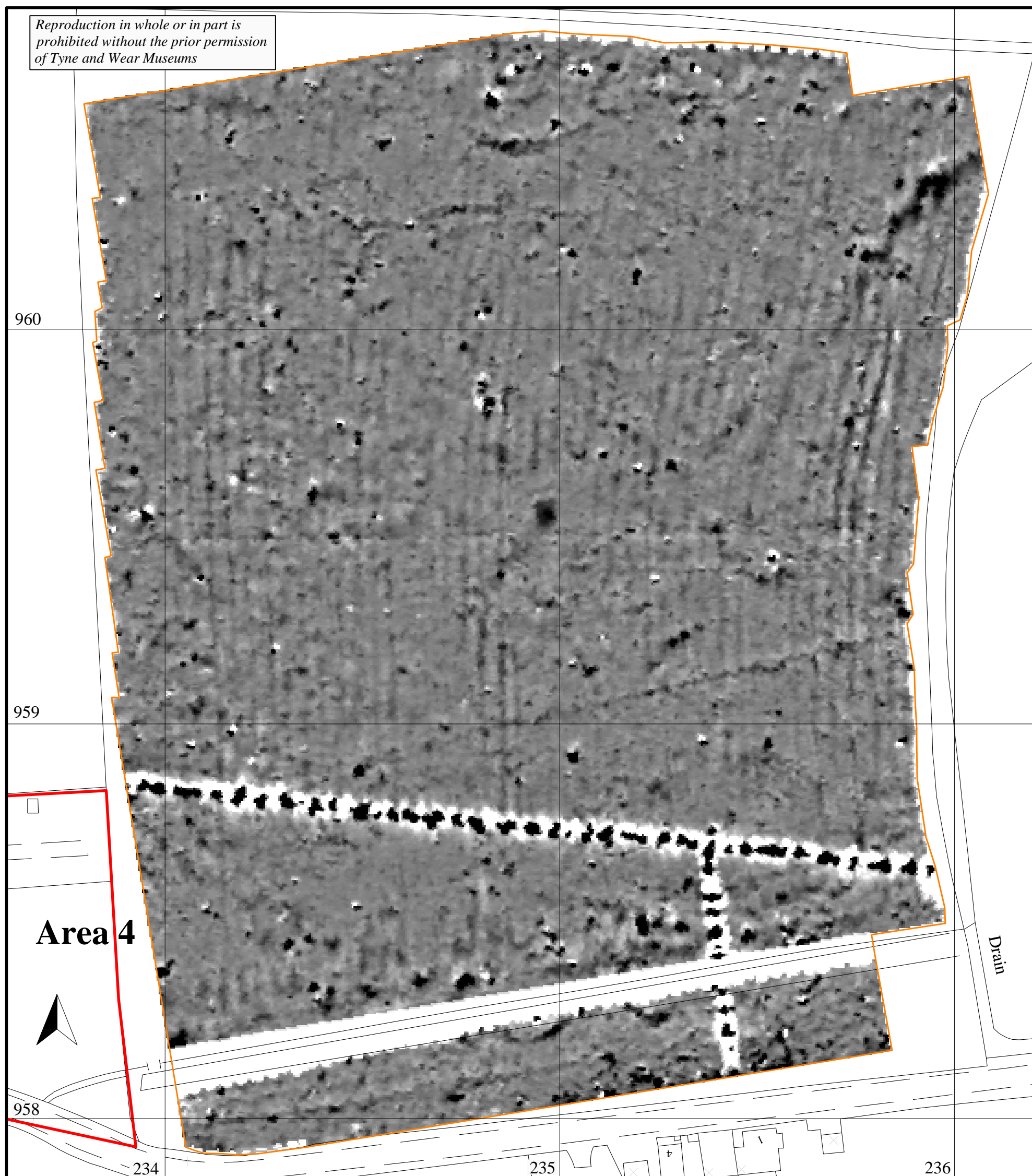
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Figure 10
Area 3, archaeological interpretation



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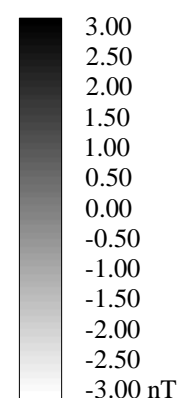
Figure 11
Area 4, geophysical survey

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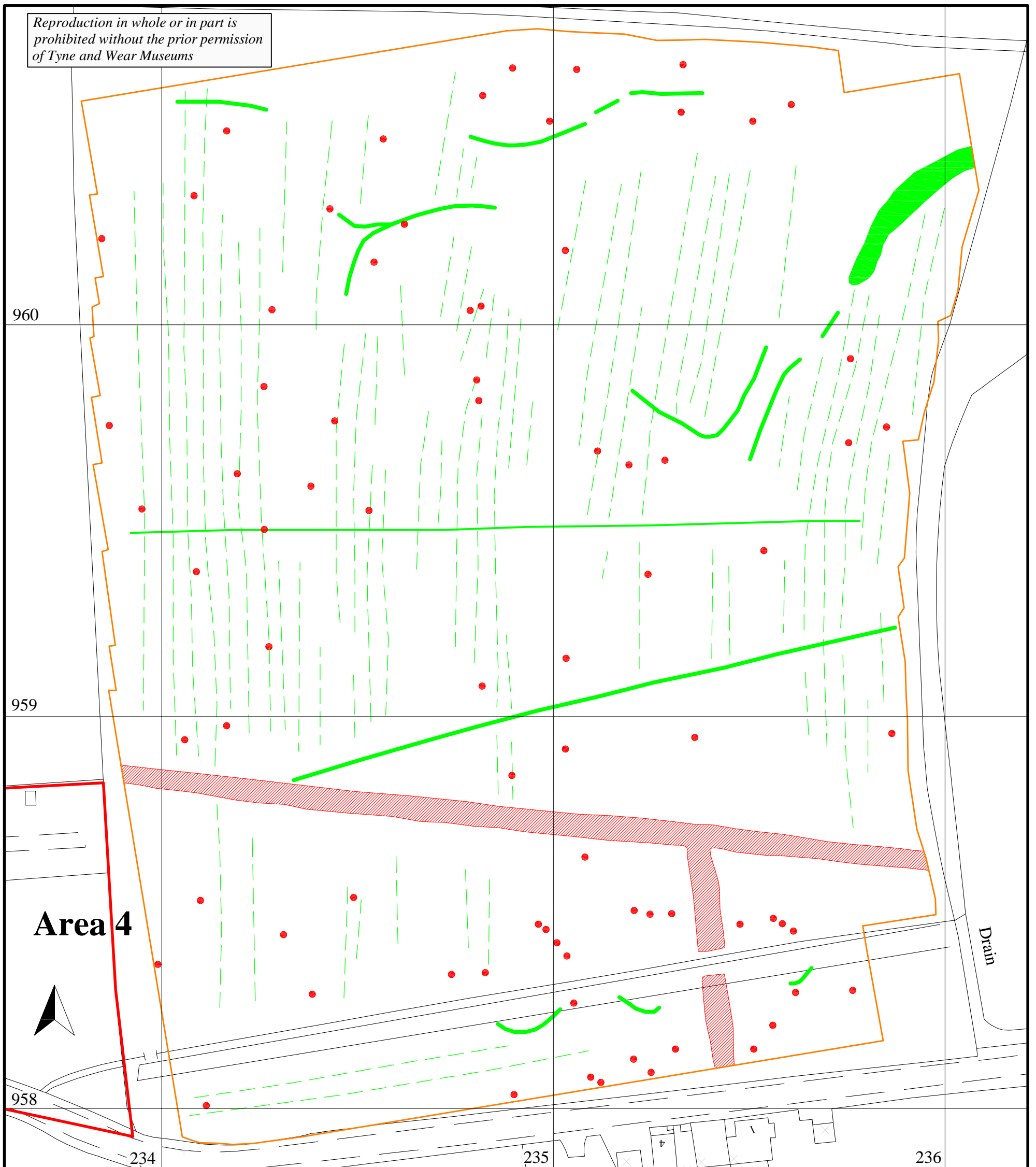
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outline of survey area



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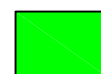
Figure 12
Area 4, geophysical interpretation

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outline of survey area



positive magnetic anomalies

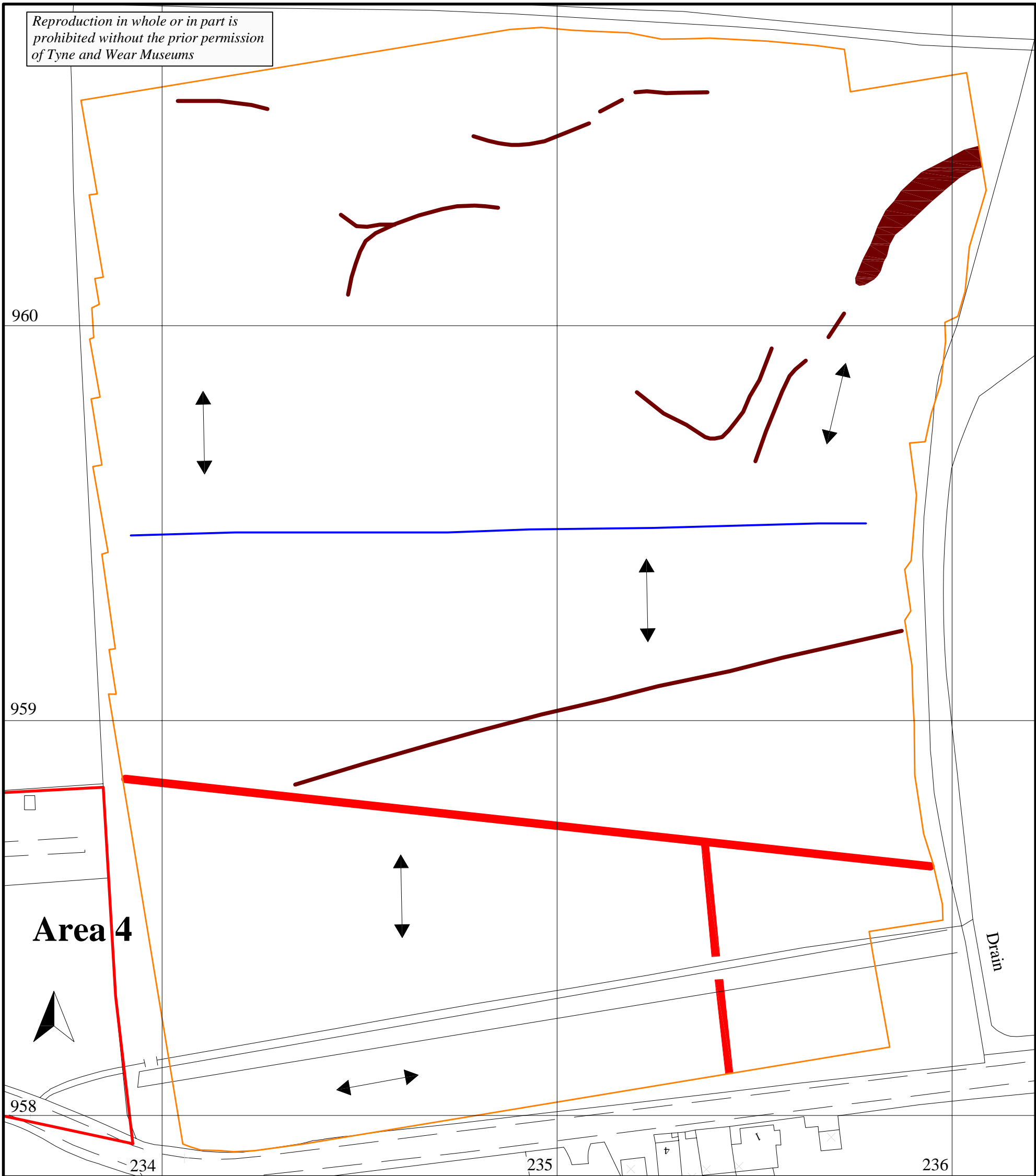


negative magnetic anomalies



dipolar magnetic anomalies

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Area 4



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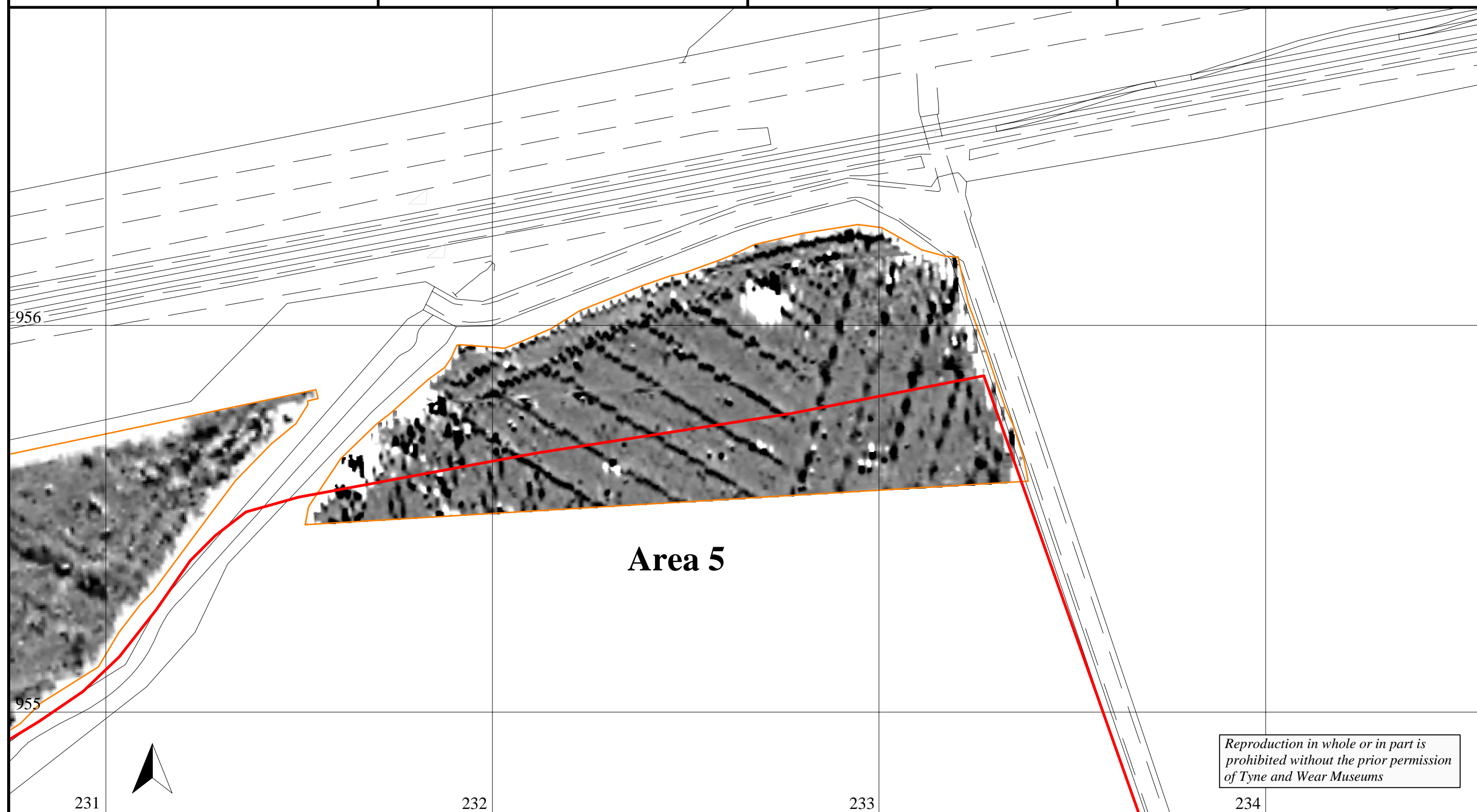
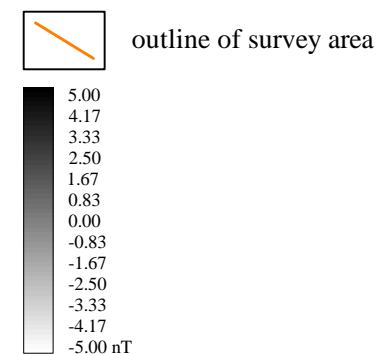
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Figure 13
Area 4, archaeological interpretation

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0 50m
scale 1:1000 - for A3 plot

- outline of survey area
- soil-filled features
- service pipes
- orientation of ridge and furrow
- change in landuse





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scale 1:1000 - for A3 plot



outline of survey area



positive magnetic anomalies



negative magnetic anomalies



dipolar magnetic anomalies






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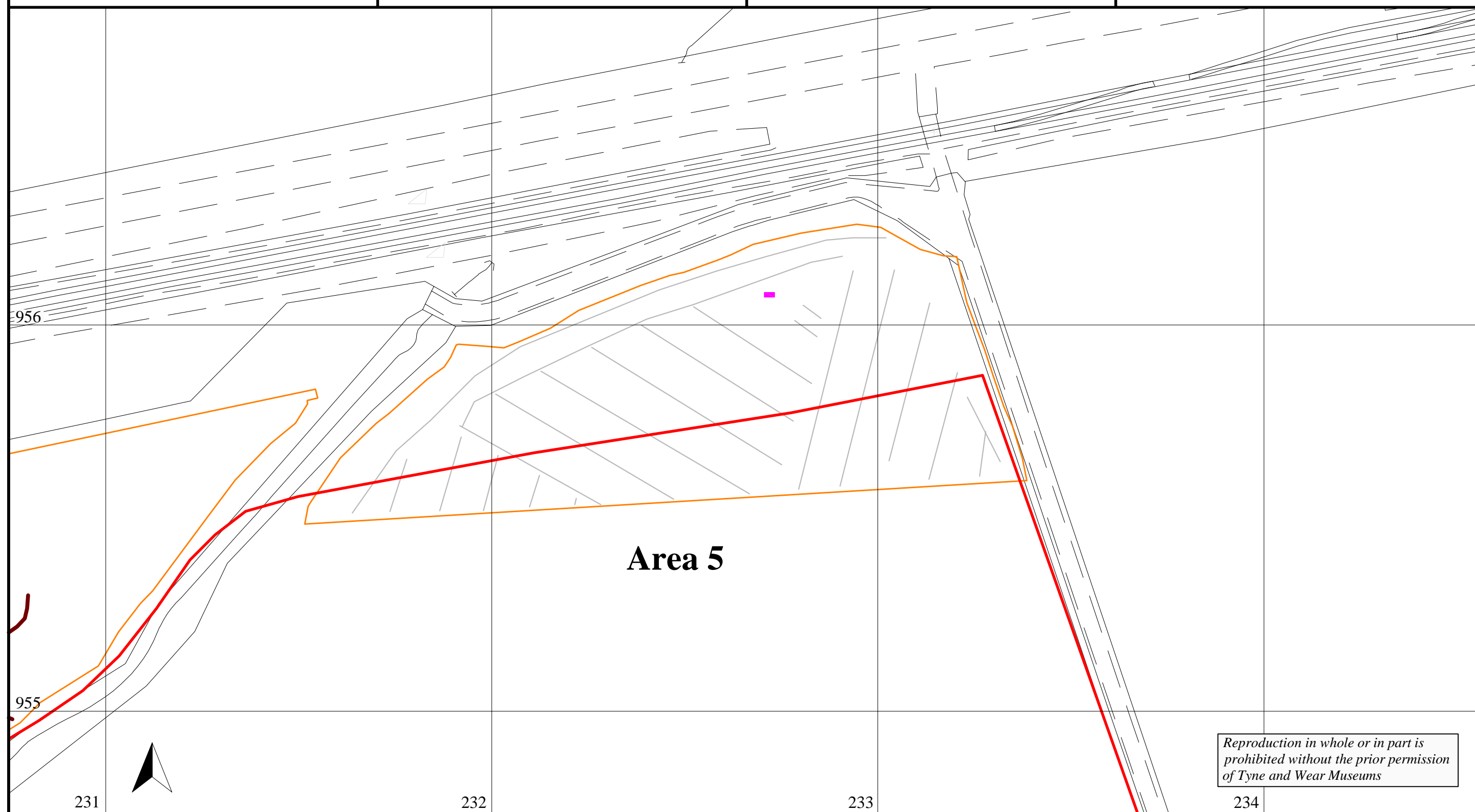
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Figure 15
Area 5, geophysical interpretation



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-  outline of survey area
-  soil-filled features
-  trough
-  orientation of ridge and furrow
-  land drains





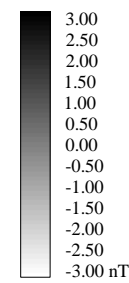
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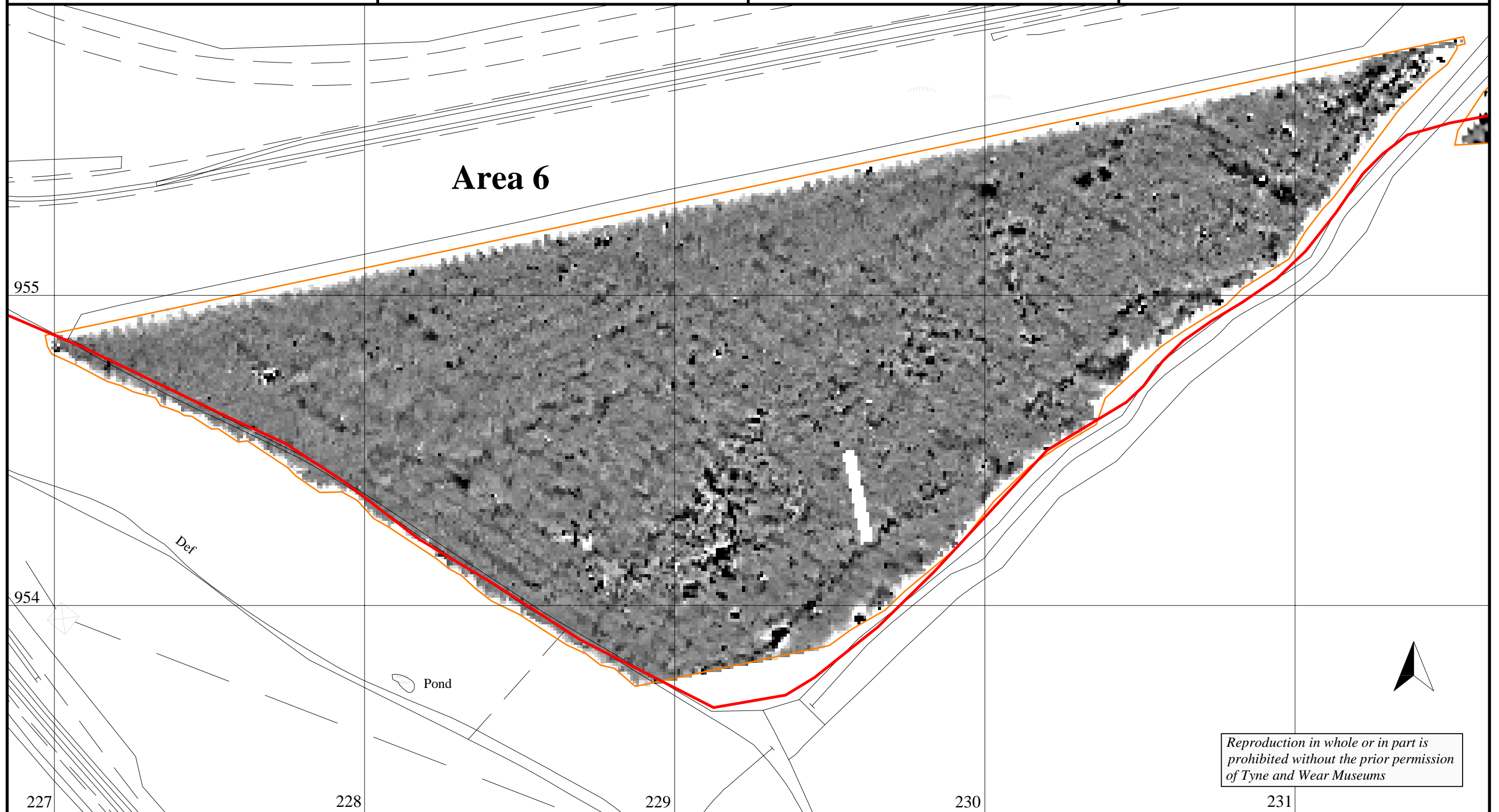
outline of survey area



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Figure 17
Area 6, geophysical survey



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scale 1:1250 - for A3 plot



outline of survey area



positive magnetic anomalies



negative magnetic anomalies

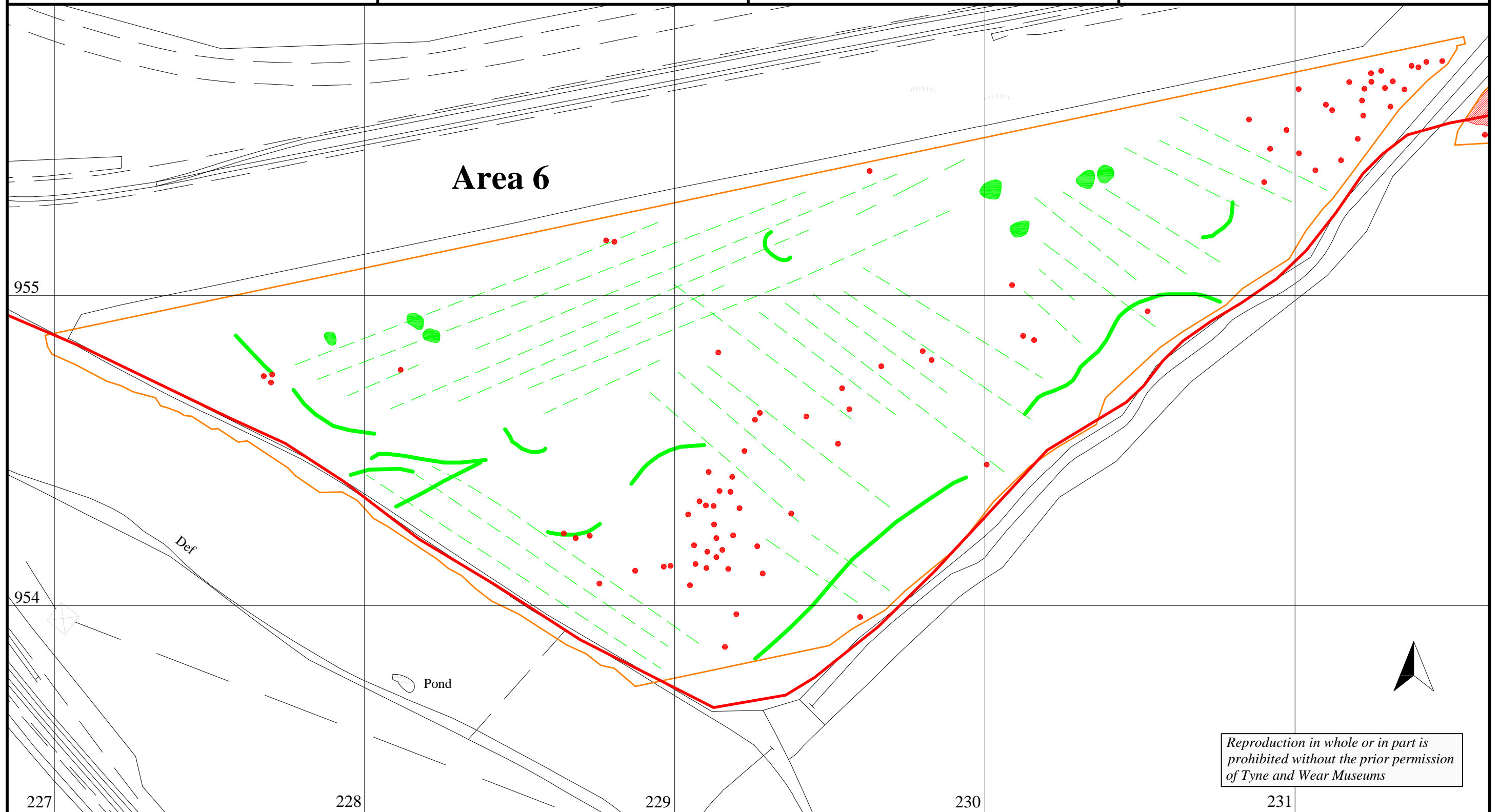


dipolar magnetic anomalies

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Figure 18
Area 6, geophysical interpretation



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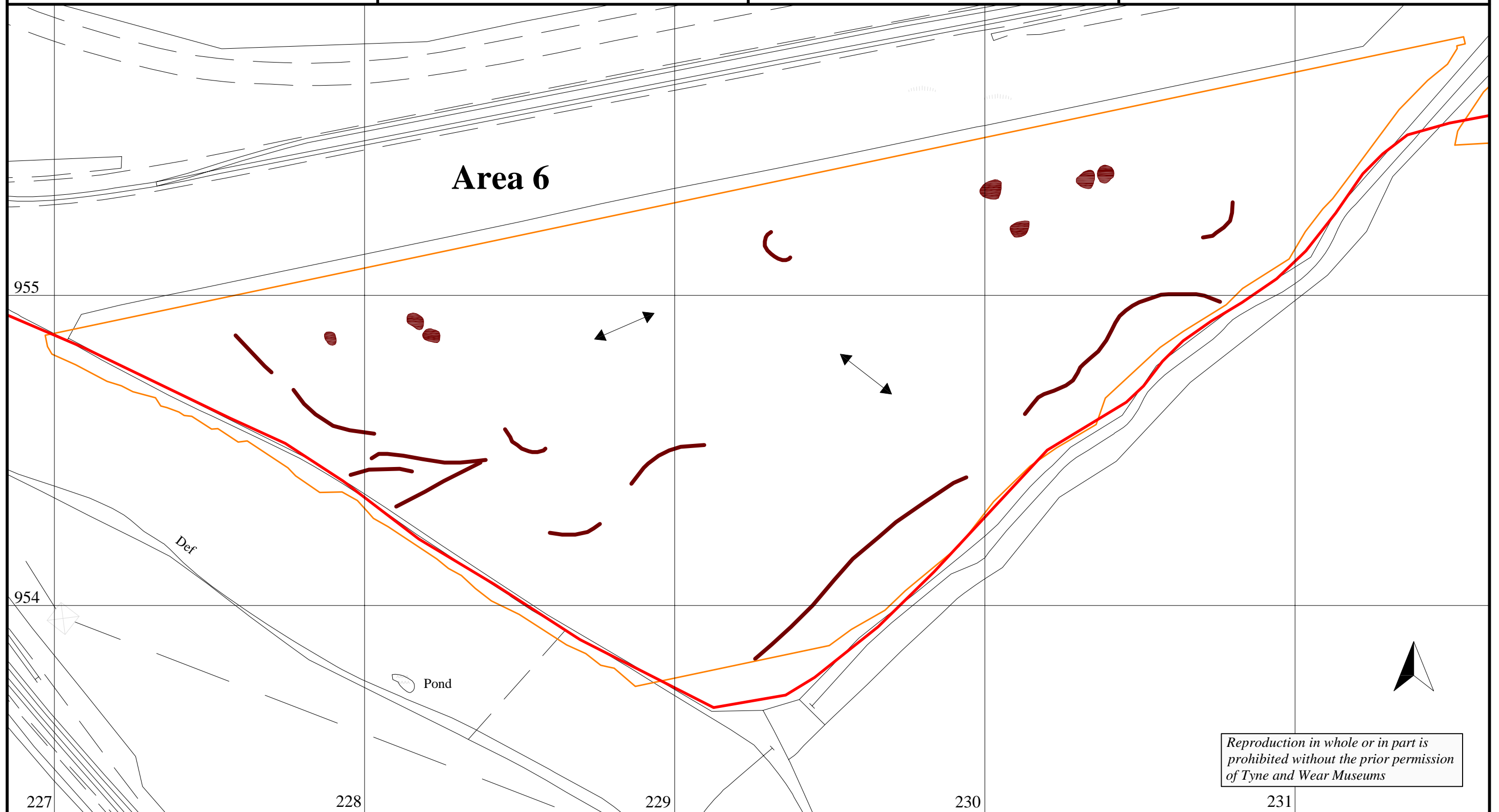
0 50m
scale 1:1250 - for A3 plot

- outline of survey area
- soil-filled features
- service pipes
- orientation of ridge and furrow

**Proposed Steads Burn OCCS,
Northumberland
geophysical surveys**

Report 1412

Figure 19
Area 6, archaeological interpretation





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University of Durham

on behalf of
**Tyne and Wear Museums,
Archaeology Department**

0 50m

scale 1:1000 - for A3 plot



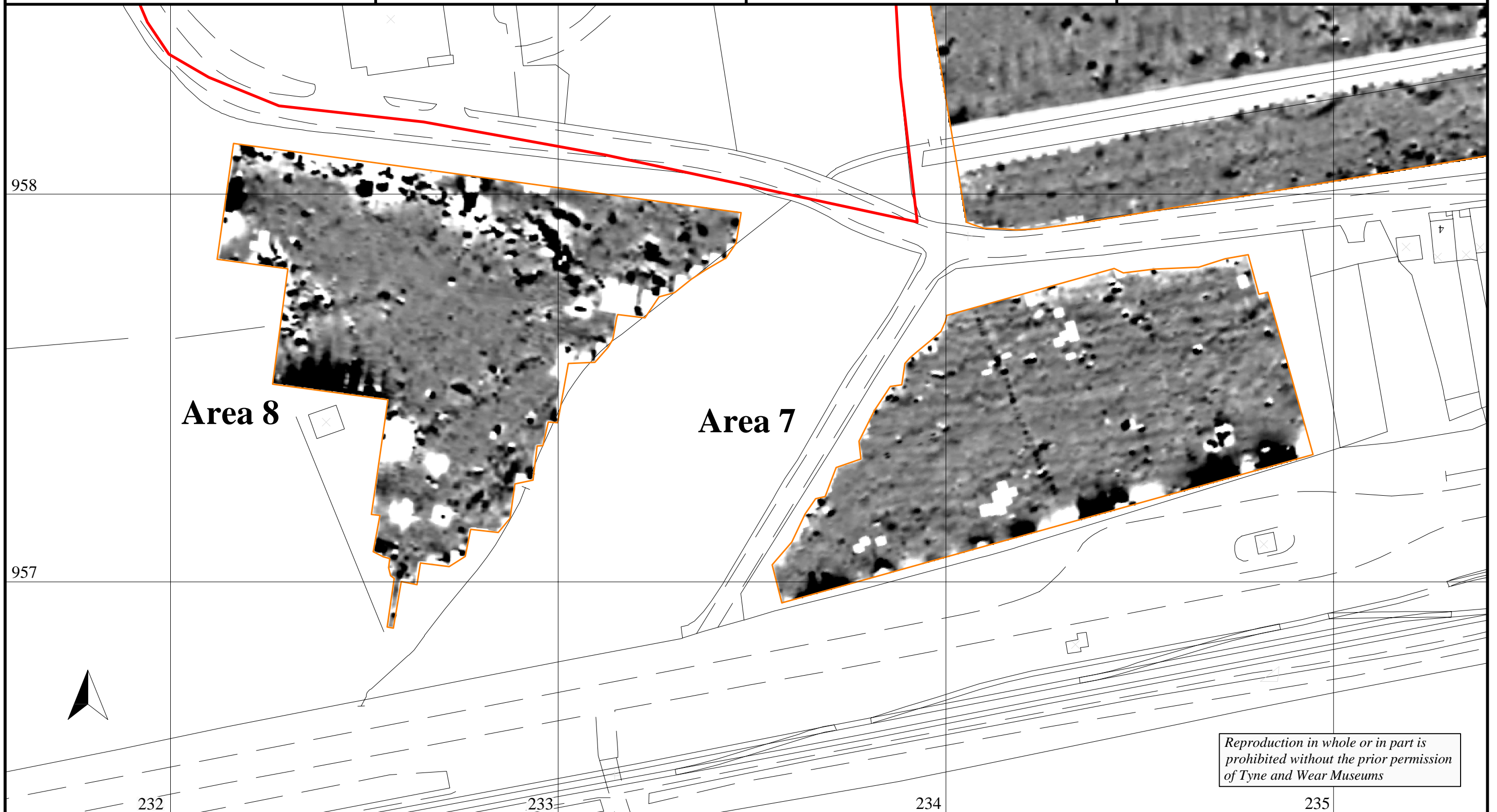
outline of survey area

3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00 nT

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Figure 20
Areas 7 and 8, geophysical surveys





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**Tyne and Wear Museums,
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0 50m
scale 1:1000 - for A3 plot



outline of survey area



positive magnetic anomalies



negative magnetic anomalies

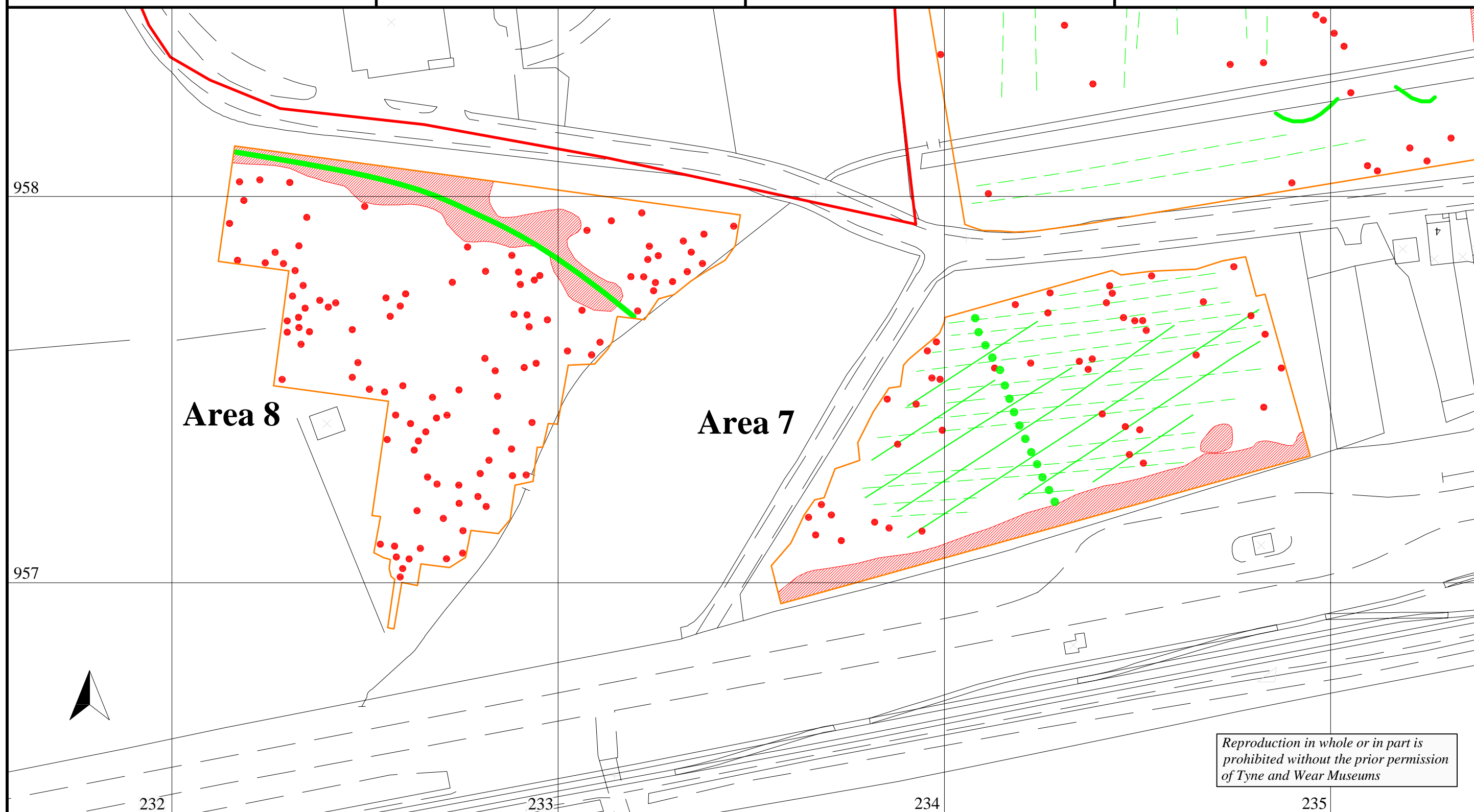


dipolar magnetic anomalies

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Figure 21
Areas 7 and 8, geophysical interpretations





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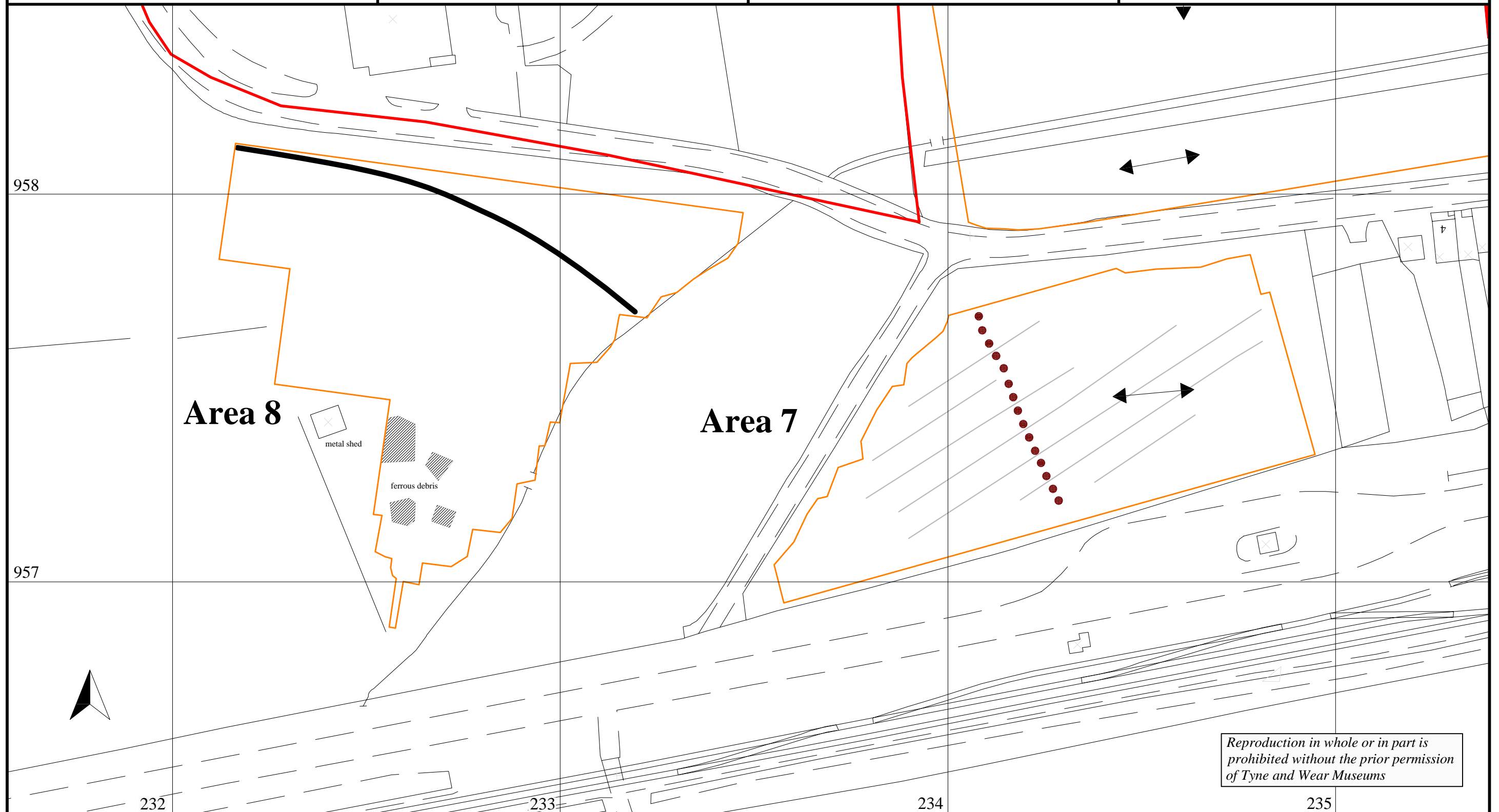
0 50m
scale 1:1000 - for A3 plot

- outline of survey area
- open drain
- fence line/?pit alignment
- orientation of ridge and furrow
- land drain

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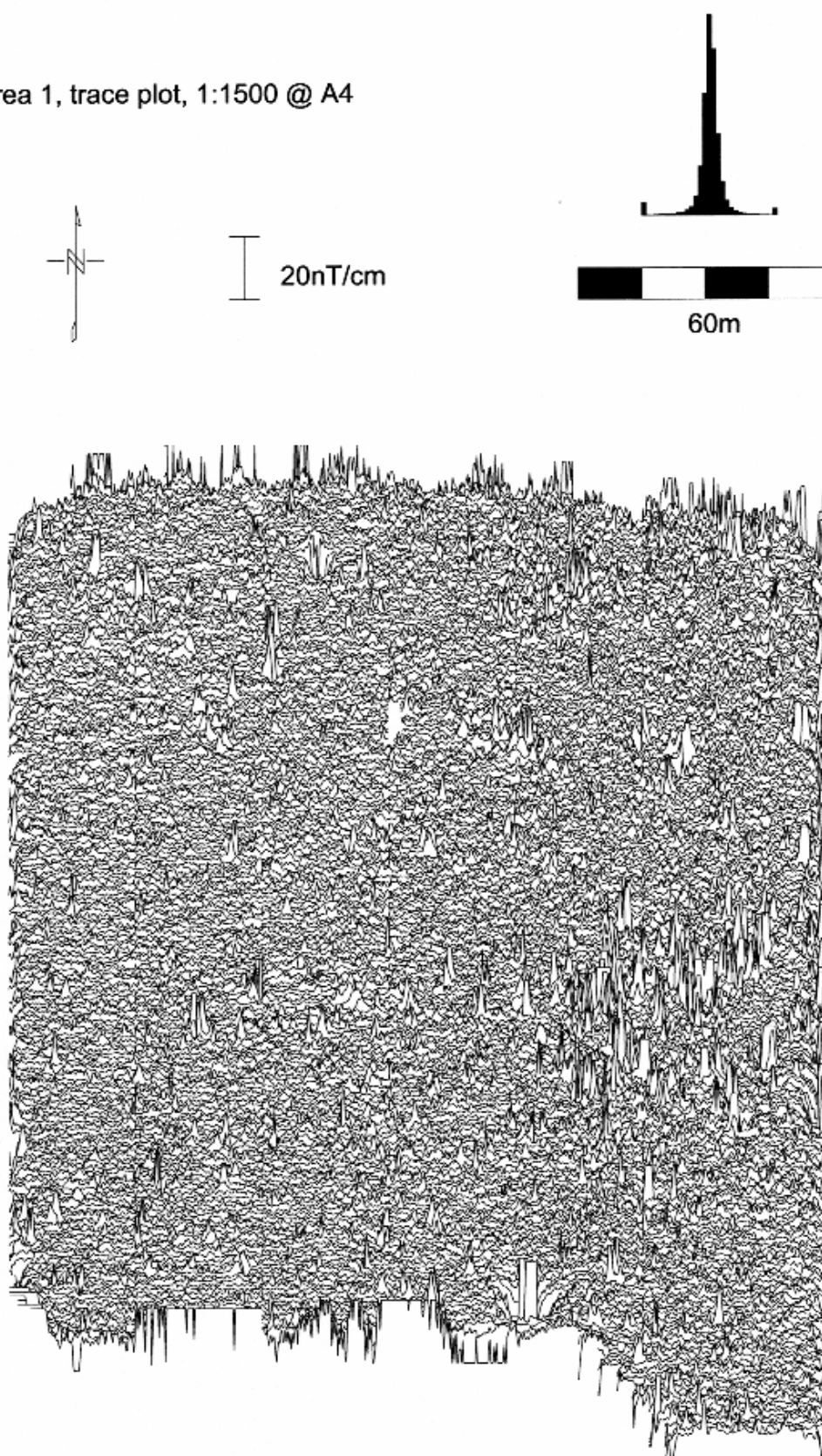
Figure 22
Areas 7 and 8, archaeological interpretation



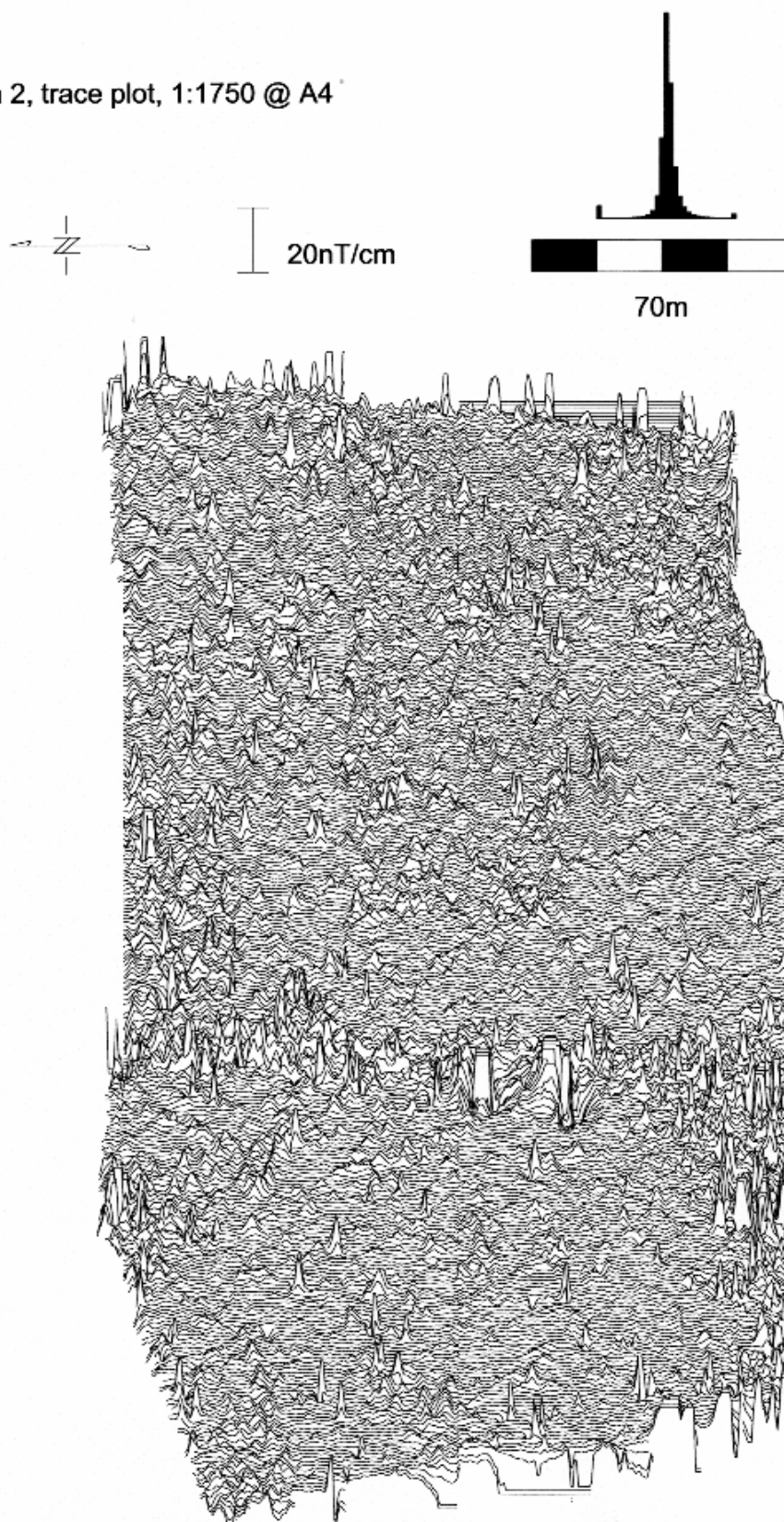
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9. **Appendix I:** Trace plots of geophysical data

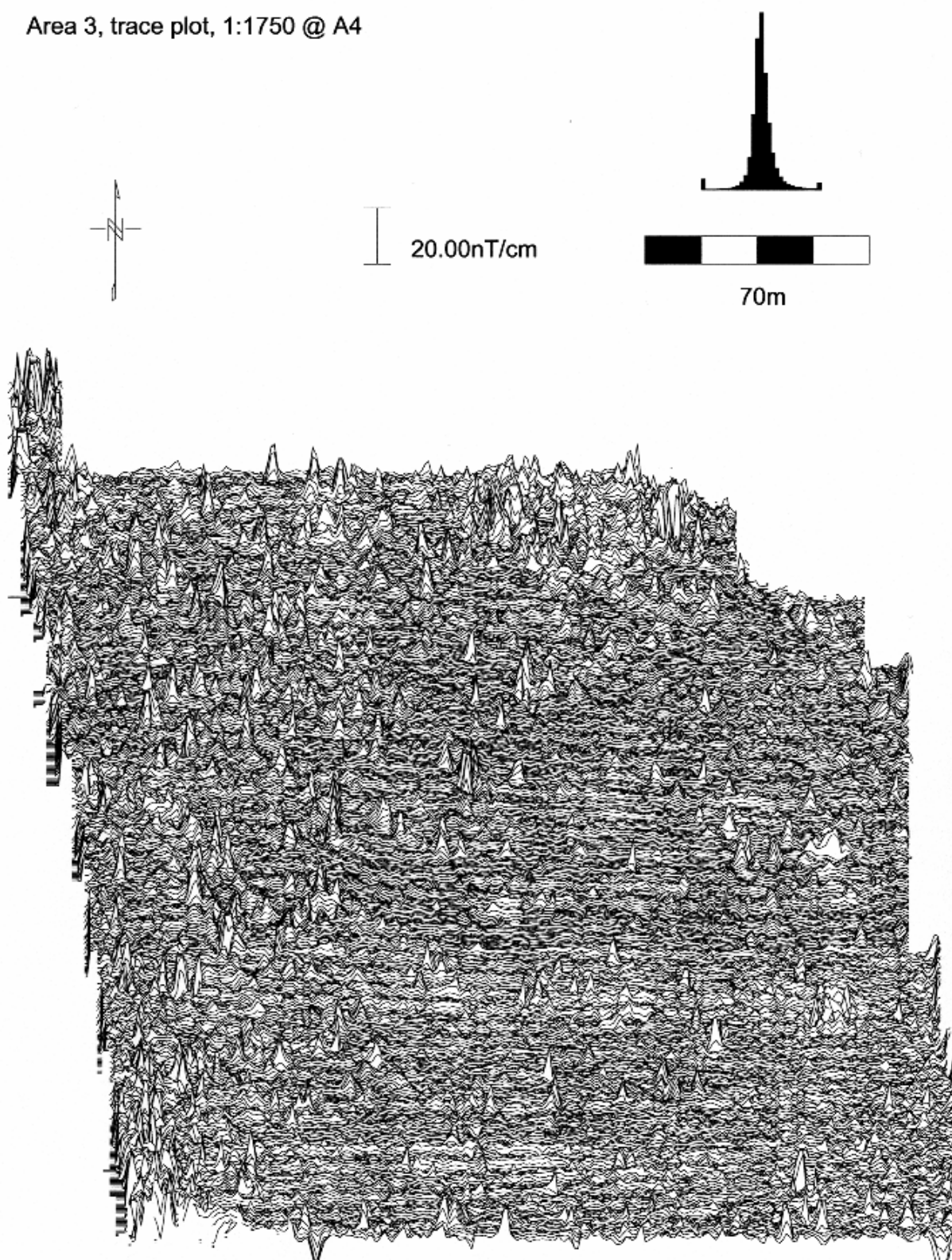
Area 1, trace plot, 1:1500 @ A4



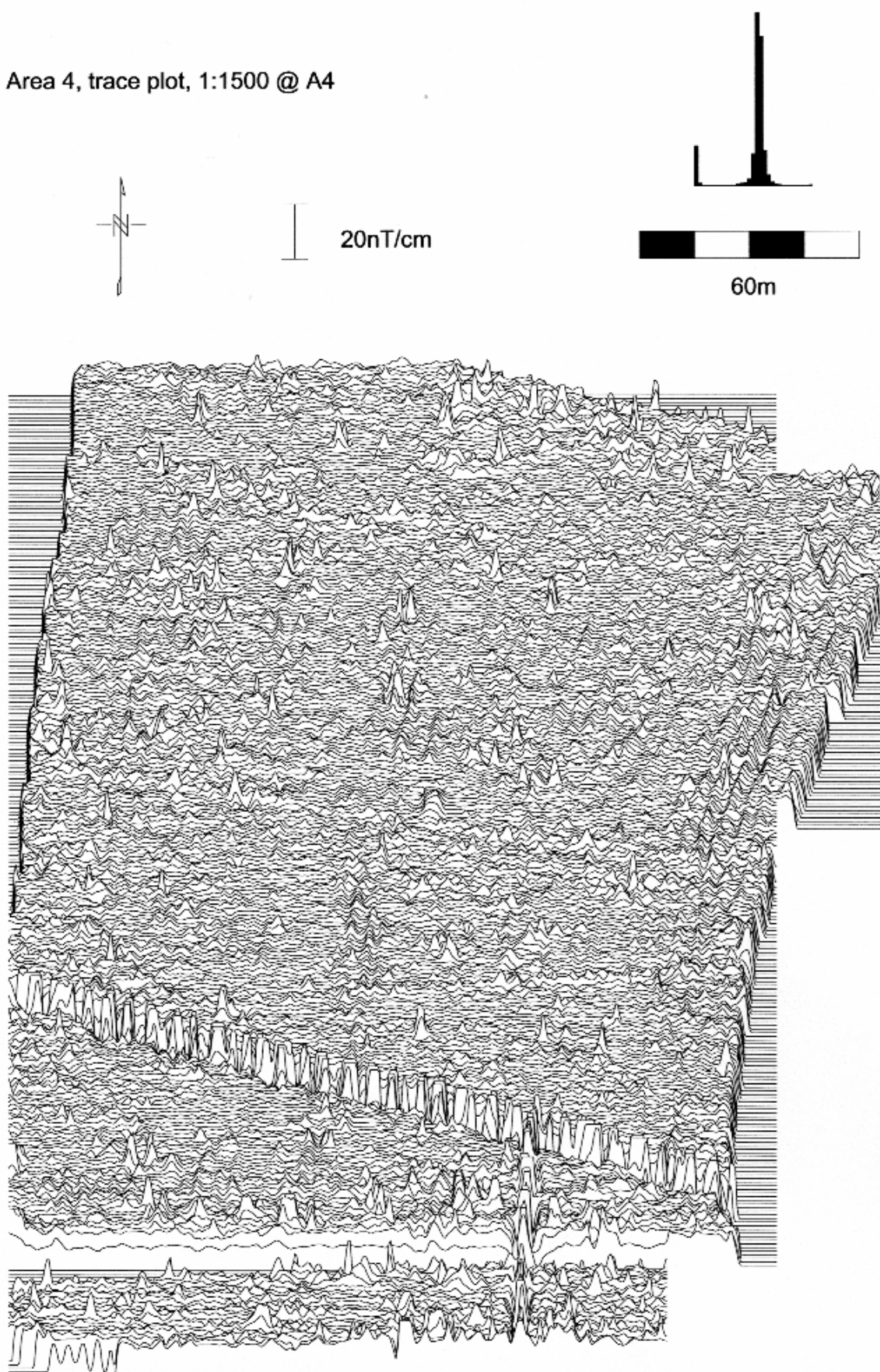
Area 2, trace plot, 1:1750 @ A4



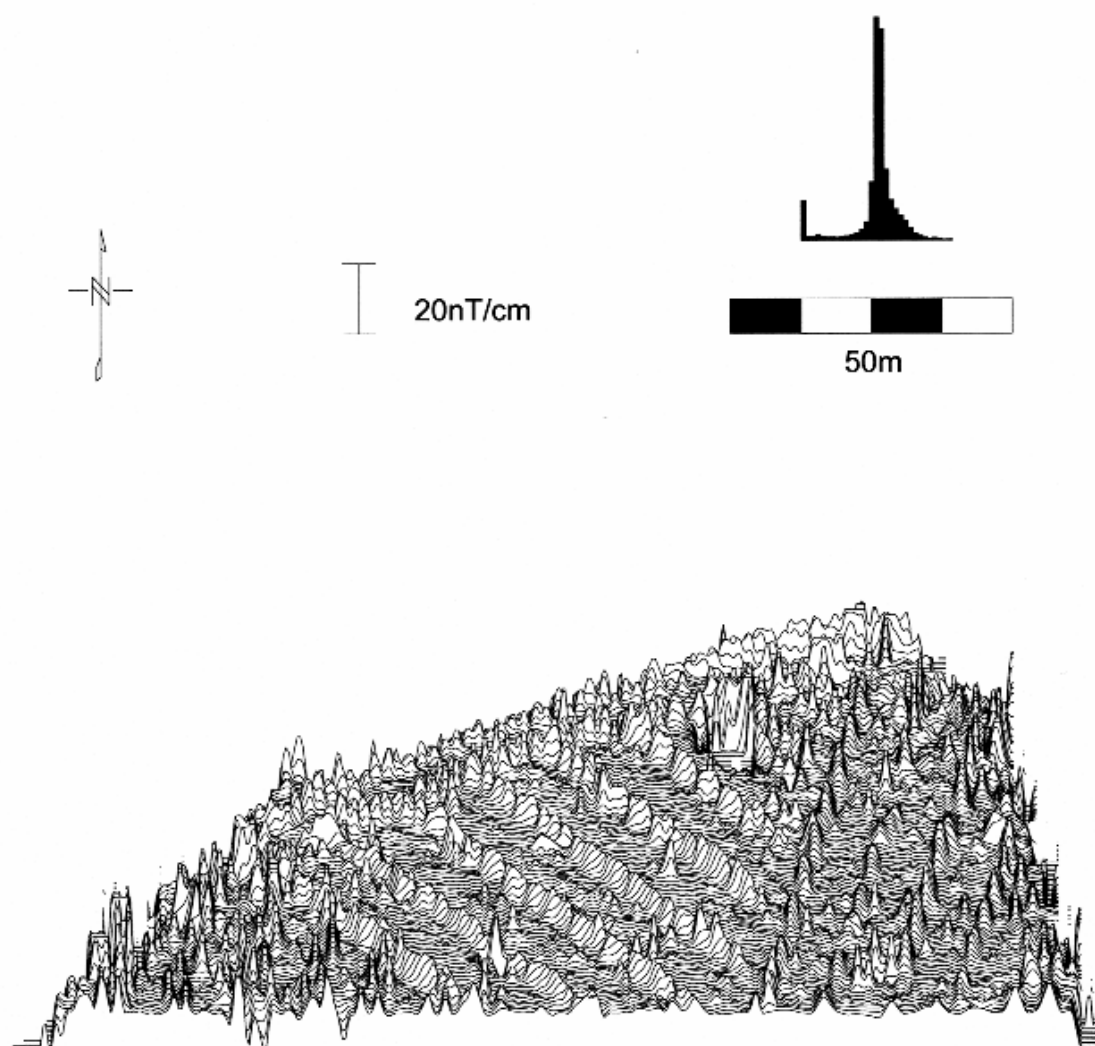
Area 3, trace plot, 1:1750 @ A4



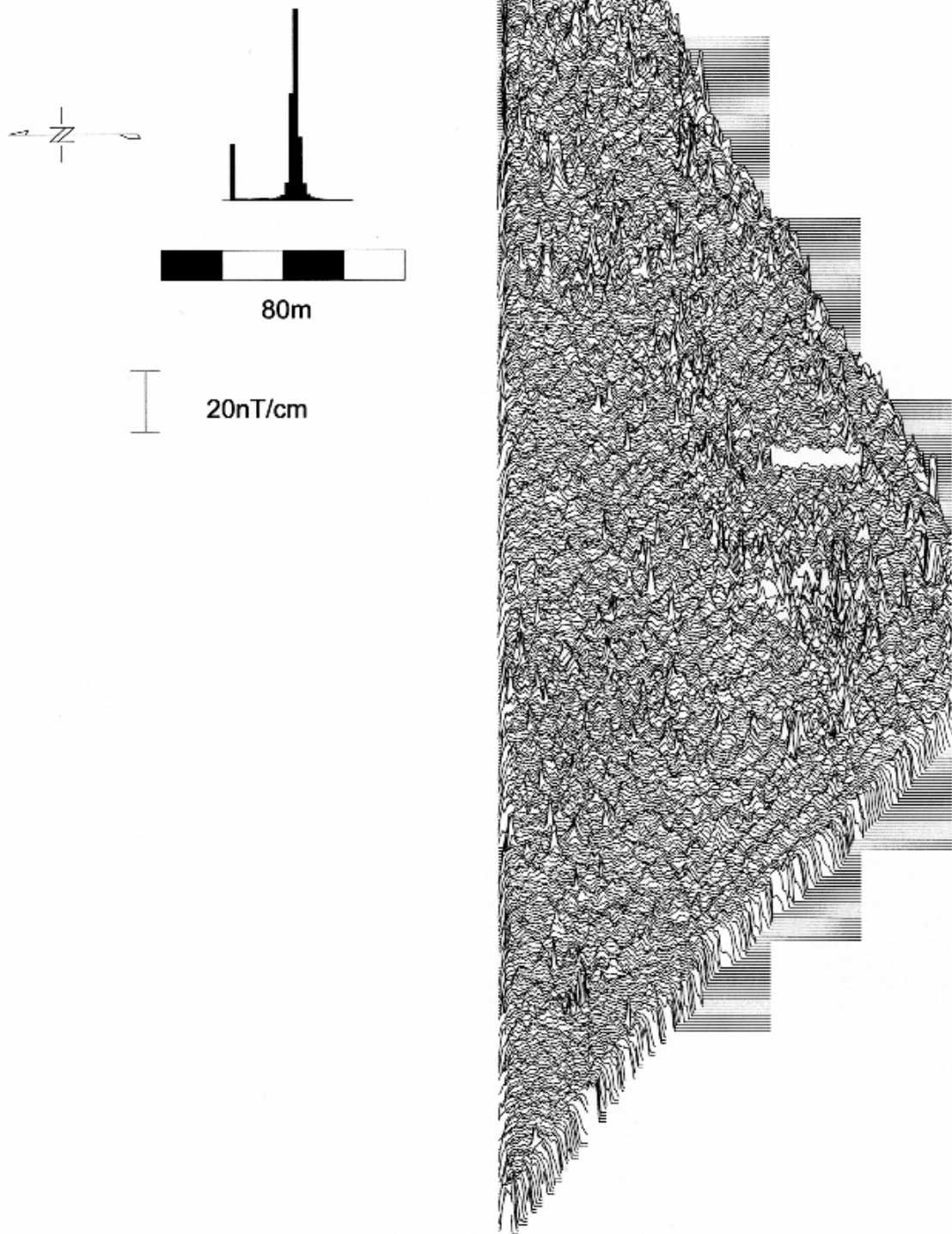
Area 4, trace plot, 1:1500 @ A4



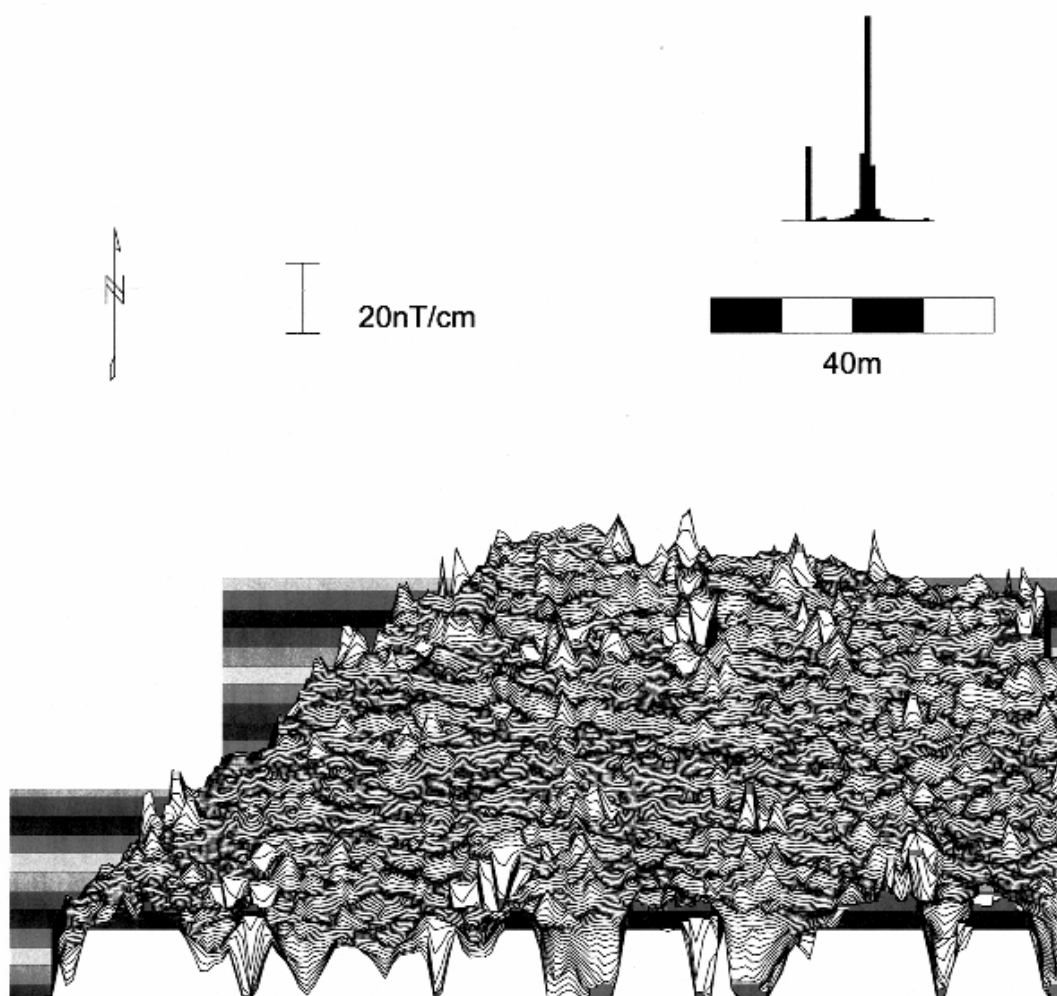
Area 5, trace plot, 1:1250 @ A4



Area 6, trace plot, 1:2000 @ A4



Area 7, trace plot, 1:1000 @ A4



Area 8, trace plot, 1:1000 @ A4

