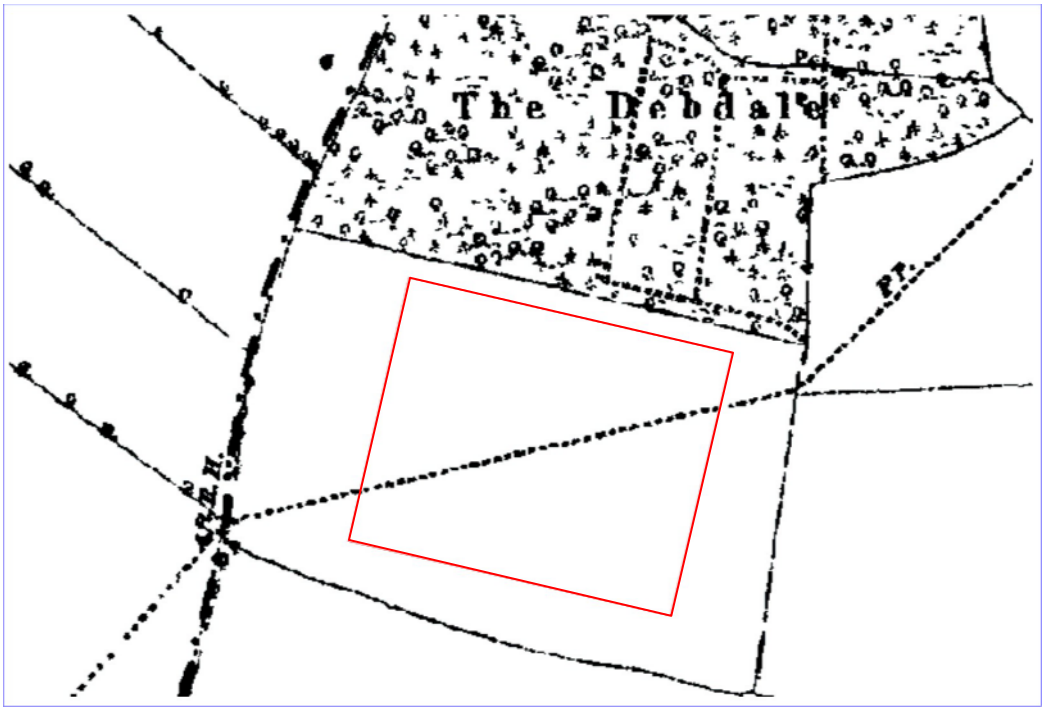
ARCHAEOLOGICAL EVALUATION REPORT: FLUXGATE GRADIOMETER SURVEY AT COX'S WALK FARM, SEDGEBROOK, LINCONSHIRE

Planning Reference: Pre-Planning

NGR: SK 83617 38815

AAA Report Number: 2008/001



Report prepared for

Mr Blackburn

by

Allen Archaeological Associates and Grid Nine Geophysics

January 2008

GRID NINE
FREELANCE ARCHAEOLOGICAL GEOPHYSICS
(FLUXGATE GRADIOMETER & RESISTANCE)

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Element	Name	Date
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Cover image: First Edition Ordnance Survey map of Sedgebrook (1892) with site outlined in red

Summary

A geophysical survey was undertaken on agricultural land at Cox's Walk Farm, Sedgebrook, Lincolnshire by Grid Nine Geophysics, in partnership with Allen Archaeological Associates, and on the behalf of the landowner, Mr Blackburn. The survey was undertaken in advance of a planning application to excavate a series of ponds and scrapes on the site.

The survey revealed several linear anomalies likely to be of archaeological origin and two amorphous areas of enhanced magnetism likely to be attributable to dumping or filling. There are many dipole responses which are likely to have been caused by ferrous detritus.

A prominent, wide linear area of enhanced magnetic noise across the site is likely to be attributable to a former footpath that is shown on early Ordnance Survey maps.

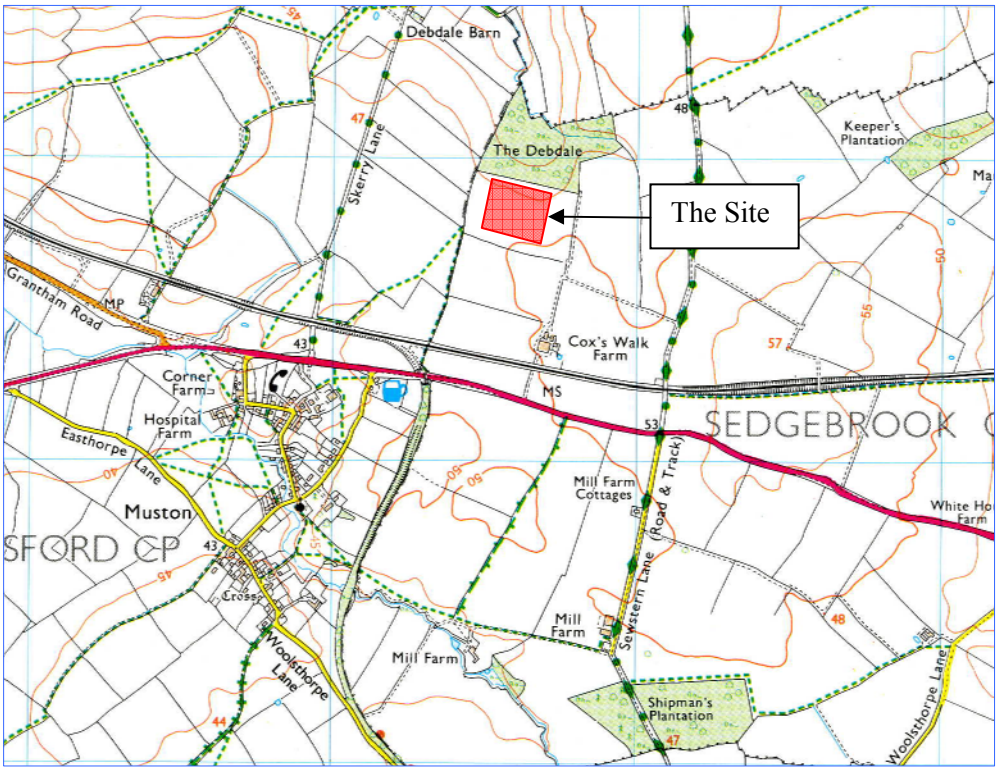

Figure 1: Survey location in red at scale 1:25,000

1.0 Introduction

1.1 Allen Archaeological Associates, in partnership with Grid Nine Geophysics, was commissioned by Mr Blackburn to carry out detailed gradiometer survey in advance of a planning application for the excavation of a series of ponds and scrapes.

1.2 The site works and reporting conform to current national guidelines, as set out in the Institute for Field Archaeologists '*Standards and guidance for archaeological evaluations*' (IFA 2001) and the English Heritage document '*Geophysical Survey in Archaeological Field Evaluation*' (David 1995), procedures that are set out in the Lincolnshire County Council publication *Lincolnshire Archaeological Handbook: A Manual of Archaeological Practice* (LCC 1998), and a specification prepared by this company (Allen 2007).

2.0 Site location and description

2.1 Sedgebrook is in the administrative district of South Kesteven, approximately 6.1km northwest of Grantham. The site lies approximately 1.5km to the west of the village and c.0.4km north-north-west of Cox's Walk Farm, at NGR SK 83617 38815. The proposed development area comprises a sub-rectangular block of land of c.4 hectares within an 8 hectare field, immediately to the south of The Debdale Wood. The site is fairly flat, with some microtopographical variation. The local geology is relatively complex, with the site lying on the boundary between Jurassic Beckingham Member Limestone and Stubton Limestone (British Geological Survey 1996). Soils comprise heavy clays and loams, with no evidence for limestone, indicating a clay geology overlies the limestone on the site.

3.0 Planning background

3.1 The geophysical survey was commissioned following a pre-planning enquiry with regard to the excavation of a series of scrapes and ponds on agricultural land at Cox's Wood Farm. The South Kesteven Planning Archaeologist requested the geophysical survey in advance of the submission of a planning application as the site lies within a landscape of archaeological interest/importance (Young 2007).

4.0 Archaeological and historical background

4.1 Aerial photographs show possible prehistoric settlement comprising enclosures and trackways are likely to exist within fields immediately to the southwest and northeast of the site. These cropmarks are part of a much wider landscape of remains that follow a broadly north-east to south-west alignment.

5.0 Methodology

5.0.1 A Level II magnetometer survey (Gaffney and Gater 1993) using a fluxgate gradiometer was chosen as the most appropriate geophysical technique to use. This was due to the nature of the potential archaeology likely to be exposed within the survey area and the sedimentary geology of the site (David 1995).

5.0.2 The combination of the superficial and solid geologies found on the site, although relatively complex in this instance, is known to give variable to good results from magnetic surveying. The clay deposits can give variable results depending on the depth

and nature of the anomaly, and limestones usually respond well, as do most sedimentary parents (Gaffney and Gater 2003; Clark 1996).

5.0.3 Although no reported surveys could be found in the public domain from the general area around the site, the geology, being limestone and clay, is common and results from magnetic surveys over these geologies are well documented. Many survey reports encountering these geologies are held by the English Heritage Geophysical Survey Database.

5.0.4 The magnetic 'signature' from certain anomalies, for example from a ditch or kiln, is often very characteristic to that type of known feature. This can assist with providing an informed, but quantative rather than qualitative interpretation to certain anomalies.

5.0.5 The survey was carried out using a Bartington Grad601-2 Dual Fluxgate Gradiometer with an onboard automatic DL601 data logger. This instrument is a highly stable magnetometer which utilises two vertically aligned fluxgates, one positioned 1m above the other. This arrangement is then duplicated and separated by a 1m cross bar. The 1m vertical spacing of the fluxgates provides for deeper anomaly detection capabilities than 0.5m spaced fluxgates. The dual arrangement allows for rapid assessment of the archaeological potential of the site. Data storage from the two fluxgate pairs is automatically combined into one file and stored using the onboard data logger.

5.1 Summary of survey parameters

Instrument:	Bartington Grad601-2 Fluxgate Gradiometer
Sample interval:	0.25m
Traverse interval:	1.00m
Traverse separation:	1.00m
Traverse method:	Zigzag
Resolution:	0.1 nT
Processing software:	ArchaeoSurveyor 2.2.0.X
Weather conditions:	Overcast, damp. Very strong south-west wind
Surface conditions:	Ploughed and seeded to south, grassed to north. Standing water in some plough ruts
Area surveyed:	3.96 hectares (39600 sq.m)
Surveyors	David Charles Hibbitt PIFA and Angela Hazel Hibbitt
Data interpretation:	David Charles Hibbitt PIFA and Mark Allen MIFA
Date of survey:	Between 28th and 31st December 2007

5.2 Data collection and processing

5.2.1 The site was marked out with a series of 20m x 20m grids aligned broadly north – south and east – west. The grid orientation was aligned with the southern boundary of Debdale Wood. This gave a north – south grid orientation of 13^0 from magnetic north. Any enhancement to the magnetic field caused by buried features are mapped increasingly stronger the closer the traverse direction can get to a magnetic north – south direction (Scollar 1990). Data was collected by making successive parallel traverses across each grid in a zigzag pattern, as close to a magnetic north – south alignment as practicable.

5.2.2 The data collected from the survey has been analysed using the current version of ArchaeoSurveyor 2 (2.2.0.X). The resulting data set plot is presented with positive nT mapped as black and negative nT mapped as white. The data has been corrected and processed using the following filters:

- De-spike
- De-stripe (also known as Zero Mean Traverse or ZMT)
- De-stagger

5.2.3 The de-spike process is used to remove spurious or extreme high intensity anomalies or datapoint values, often caused by ferrous objects, which may affect subsequent filter use, data enhancement and interpretation.

5.2.4 The de-stripe process is used to equalise underlying differences between grids. Differences are most often caused by directional effects inherent to magnetic surveying instruments, instrument drift, instrument orientation (such as off-axis surveying or heading errors) and delays between surveying adjacent grids. The destripe process is used with care as it can sometimes have an adverse effect on linear features that run parallel to the orientation of the process.

5.2.5 The de-stagger process compensates for data collection errors by the operator. Such errors can be caused by unsuitable or uneven surface conditions, such as a ploughed site or a very windy hillside, where the operator may start recording traverses too soon or too late.

5.2.6 Plots of the data are presented in raw linear greyscale, processed and interpolated linear greyscale and trace plot form with any corrections to the measured values or filtering processes noted, and as a separate (David 1995) simplified graphical summary of the main magnetic anomalies detected.

6.0 Results (See Figures 3 – 8; numbered anomalies in bold below are shown on Figure 6)

6.1 The results are clearly dominated by a c.10m wide linear band of magnetic noise **[1]**, running approximately north-east to south-west across the site. This anomaly correlates with a former footpath which is shown on early Ordnance Survey maps of the area (Figure 9). The response is likely to be the result of magnetically enhanced 'metalling' on the footpath being scattered by later ploughing. Fragments of ceramic building material (hereafter CBM), isolated cobbles and several lumps of iron slag were noted on the surface of the field at a number of locations along the course of the former footpath. Such material or material spreads can give a characteristic 'noisy' response which is made up of pairs of peaks, often referred to as 'spikes' of both positive and negative nT values of varying magnitude (Clark, 1996).

6.2 The modern ploughing trend can be seen running approximately east – west on the surface, and is represented in the data as thin, well defined negative parallel lines **[2]**. There may also be evidence of former ploughing, i.e. ridge and furrow, visible in the data as broad but faint negative striations at the south-west **[3]**, north-east **[4]** and south-east **[5]** of the survey. These ploughing trends appear to follow at least two different alignments, which may suggest the division of the land into separate fields, or several phases of ploughing activity.

6.3 An area of magnetic disturbance **[6]** has been recorded to the north of the footpath response, with peak positive and negative strengths in the region of 100nT and the majority in the region of 10-50nT. The cause of this anomaly cannot be concluded with confidence at this stage, although the magnitude of the response may suggest a deposit of extremely magnetically enhanced material, possibly to fill a waterlogged or low spot in the field. It would appear that the area has been affected by ploughing as striations can be seen through the anomaly consistent with the modern ploughing trend. This would also suggest the anomaly is fairly close to the surface.

6.4 Several positive linear anomalies have been detected by the survey. To the north-west are two ephemeral anomalies **[7]** and **[8]** that may be associated, forming an L-shaped linear, possibly heading towards the northern and western boundary of the survey area. A series of faint positive linear and curvilinear anomalies **[9]** are apparent in the data immediately south of the previously mentioned anomalies. In the north-west corner of the survey there is an area containing several positive curvilinear and linear anomalies, the strongest of which are shown at **[10].** These may be of archaeological origin, although it is also possible that they are the result of geomorphological action.

6.5 A linear positive anomaly **[11]** runs in a south-east to north-west direction from the eastern boundary of the survey and beyond the northern boundary towards The Debdale Wood. The magnitude of this anomaly peaks at around 0.5nT but is generally lower at around 0.10nT. This may possibly represent evidence of an early boundary ditch with fills of higher magnetic susceptibility than the surrounding soil. There is a faint trace close to the eastern boundary of the survey of possibly a parallel positive anomaly that may be associated, although the ephemeral nature of this anomaly makes any association tenuous at this stage. It is possible that **[11]** pre-dates the likely ridge and furrow **[4]** to the north east of the survey, as it appears the ridge and furrow here either cuts through the linear anomaly or is overlying it, however, the relative dating of geophysical anomalies must be viewed with some caution, and can only be confirmed by intrusive methods.

6.6 Further positive linear and curvilinear anomalies, all with peak magnitudes generally <1nT, are visible in the data at **[11a -11f].** The relationship of **[11a]** with the footpath response **[1]** is of interest as the data suggests that **[11a]** cuts through the footpath**,** although the modern date of the footpath anomaly would suggest the opposite is the most likely.

6.7 A number of small, but strong responses have been recorded scattered randomly throughout the data. The characteristic dipole response of pairs of positive and negative 'spikes' suggests near-surface ferrous material (Clarke 1996). Examples of the stronger responses are shown by **[12].** Several scatters of rubbish were noted on the site including one deposit spread over several square metres **[13]** which included rusted cans, wire, burnt wood fragments and modern ceramic building material. Positive and negative spikes of 3000nT were collected from this area which is the maximum nT values the instrument can detect.

6.8 Visible throughout the data are a number of discrete positive magnetic anomalies **[14]** which may represent pits. Although the general magnitude of these anomalies is <2nT, there is one with a magnetic signature of 7.5nT **[14a].** This high magnitude suggests a fill of magnetically enhanced material.

6.9 Two recent geotechnical pits appear to have been excavated on the site and these can be seen in the data at **[15]** and **[16].** (M. Allen *pers. comm*.).

6.10 Many intact and fragmented clay pigeons were found on the surface of the surveyed area. Their magnetic properties were tested by setting up the magnetometer in 'scan' mode, and passing one, then a stack of ten of the intact clay pigeons close to one of the fluxgates of the magnetometer (distances of <100mm, then <10mm were used). This resulted in no observed variation to the displayed nT value on the instrument. These field tests allowed the clay pigeons to be ruled out as causes of extreme dipole responses (or 'spikes') in the data. However, the presence of clay pigeons would also suggest that there are likely to be spent cartridge casings scattered throughout the survey area, which may have contributed to the overall ferrous detritus on the site.

7.0 Conclusions

7.1 The geophysical survey has shown the development area lies within an area containing some anomalies of possible archaeological origin. The footpath that is marked on the 1892 First Edition Ordnance Survey map is clearly depicted in the survey, and there are at least two trends of former ploughing evident. A number of faint linear and pit-like anomalies were noted throughout the data set; these may be of archaeological interest, however the ephemeral nature of the results means any interpretation at this stage should be treated with caution.

8.0 Effectiveness of methodology

8.1 The non-intrusive evaluation methodology employed was appropriate to the scale and nature of the proposed development. The survey has shown that archaeological remains may exist across the development area.

8.2 Although magnetic surveying is usually the preferred method for the majority of surveying of this kind (David 1995) there are well documented limitations of the survey technique. The use of resistance surveying over the most intense areas of activity, and also over the tentative magnetic anomalies identified by the magnetic survey, may possibly help to define the anomalies further, and possibly provide further information on their origin. However, the presence/absence and date of these features can only be confirmed by intrusive means.

9.0 Acknowledgements

9.1 Allen Archaeological Associates would like to thank Mr Blackburn for this commission. Ms Judith Smith is also thanked for her assistance throughout the project.

10.0 References

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The following Ordnance Survey maps were viewed on-line at www.old-maps.co.uk:

1888 Ordnance Survey map 1:10,560
1891 Ordnance Survey map 1:2500
1905 Ordnance Survey map 1:10,560
1951 Ordnance Survey map 1:10,560

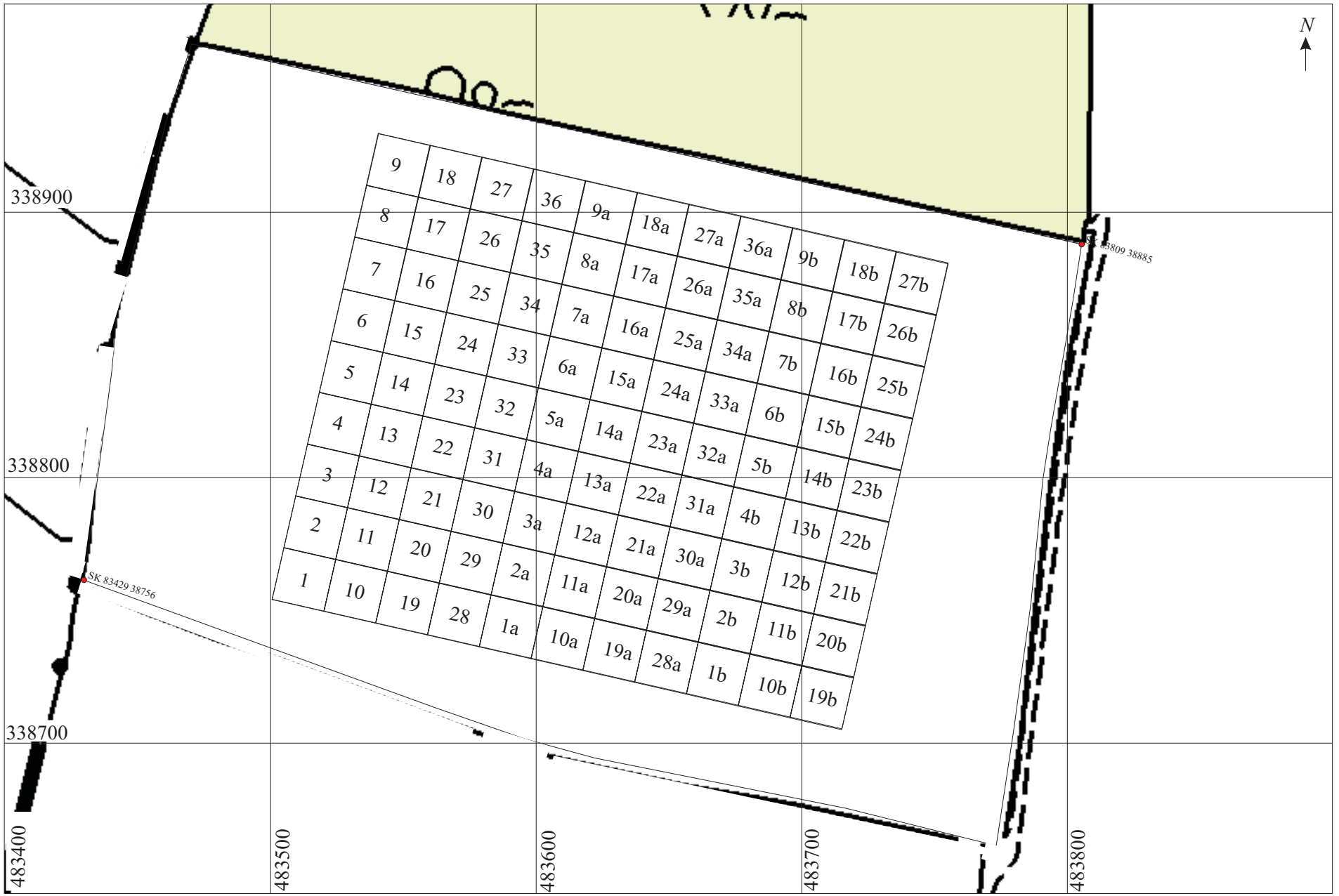

Figure 2: Geophysical survey area at scale 1:2000, with OS coordinates and grid numbering system shown

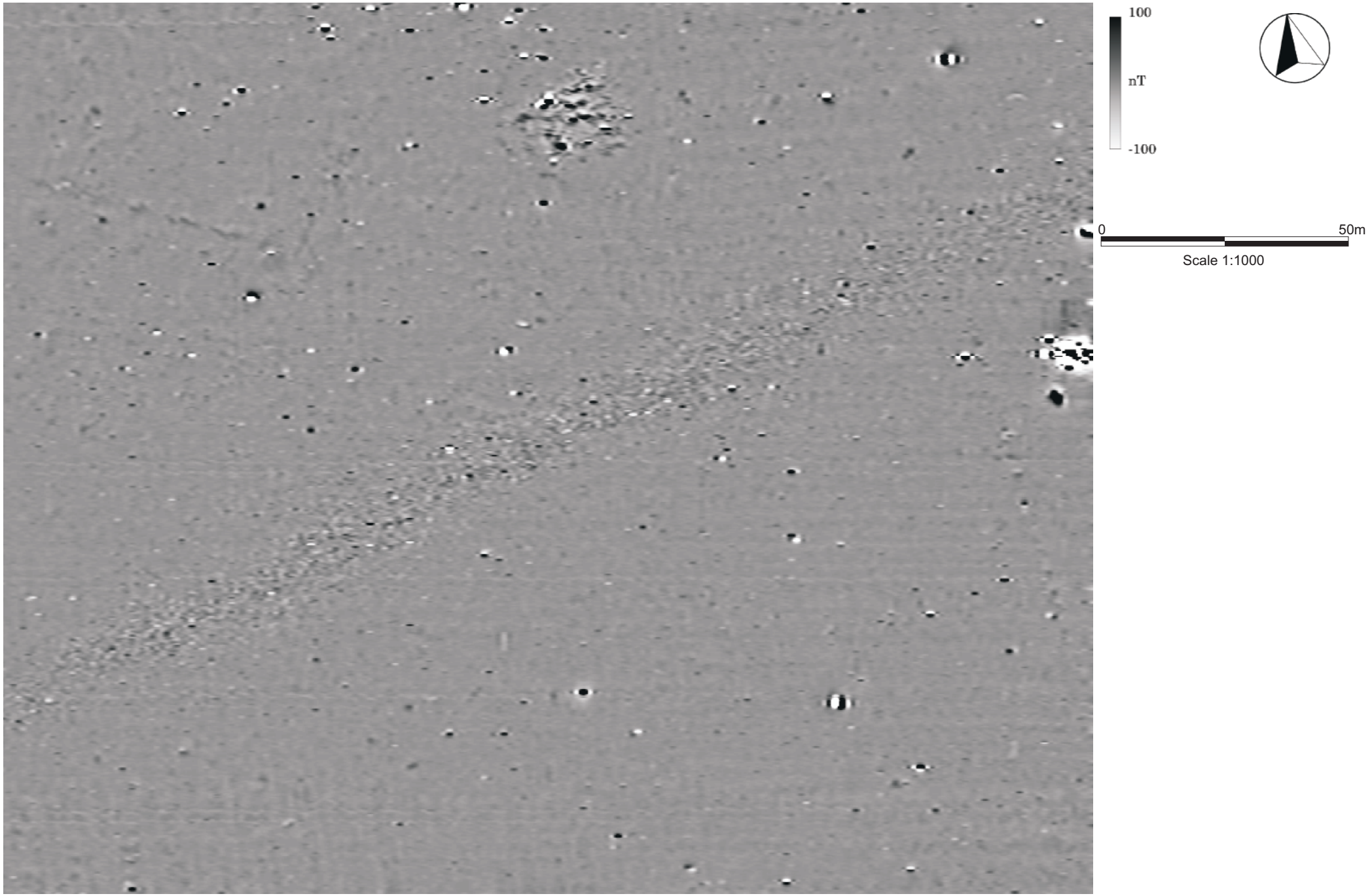

Figure 3: Raw greyscale (block) plot with ZMT applied and clipped to -100nT to 100nT (scale 1:1000)

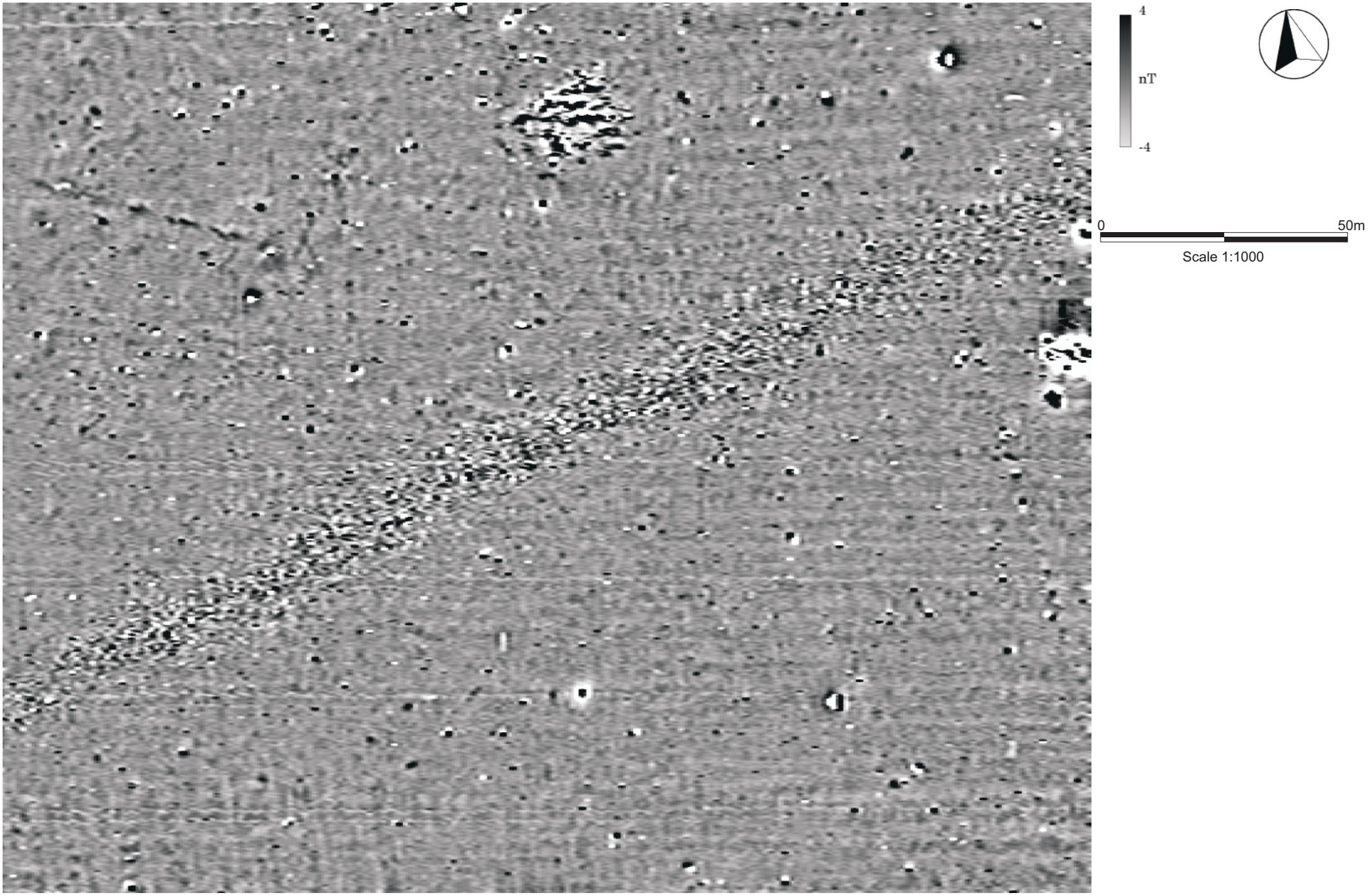

Figure 4: Processed greyscale (block) plot. As figure 3 except additional de-staggering applied and clipped to -4nT to 4nT (scale 1:1000)

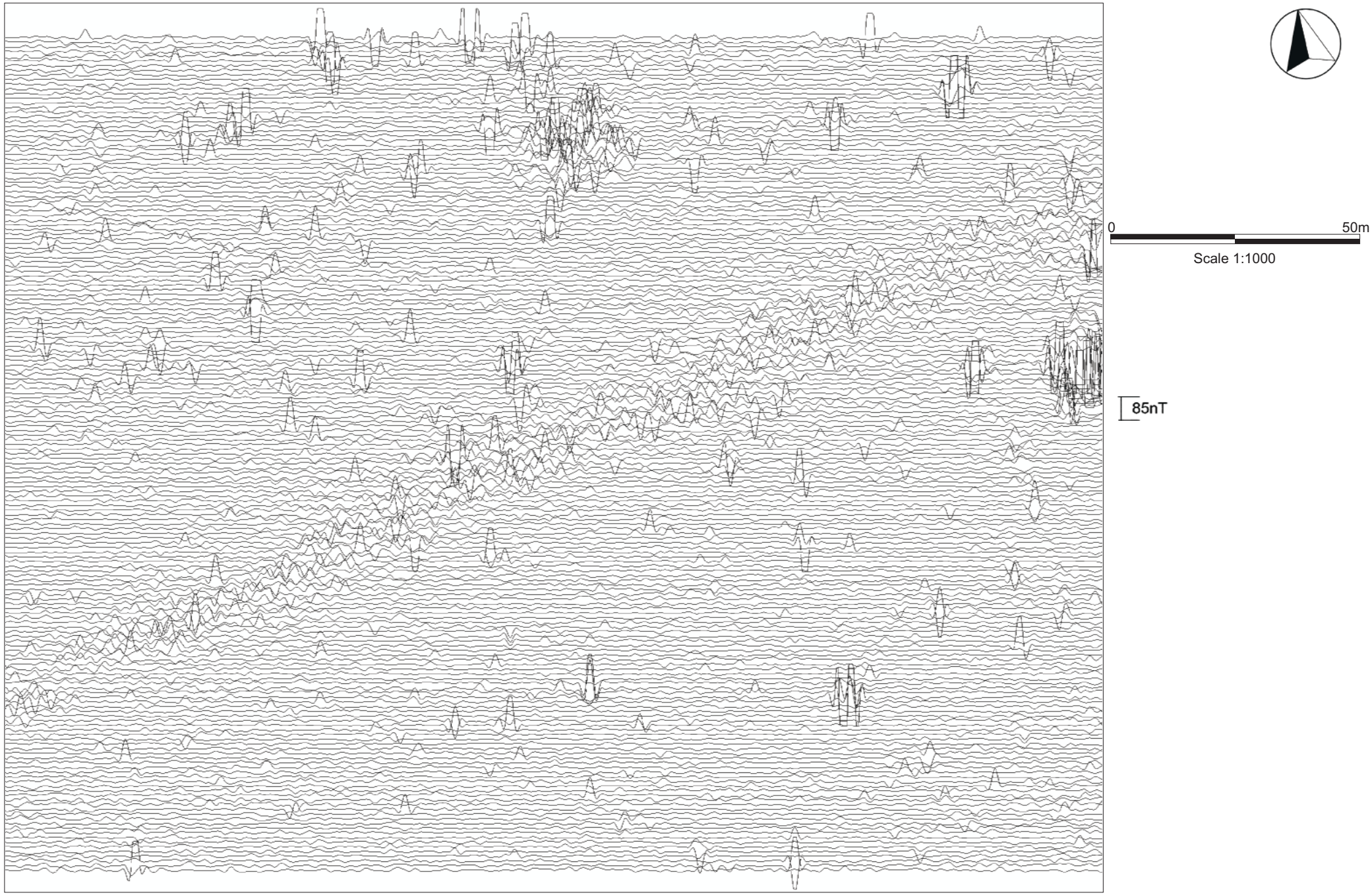

Figure 5: Trace plot of processed data at scale 1:1000

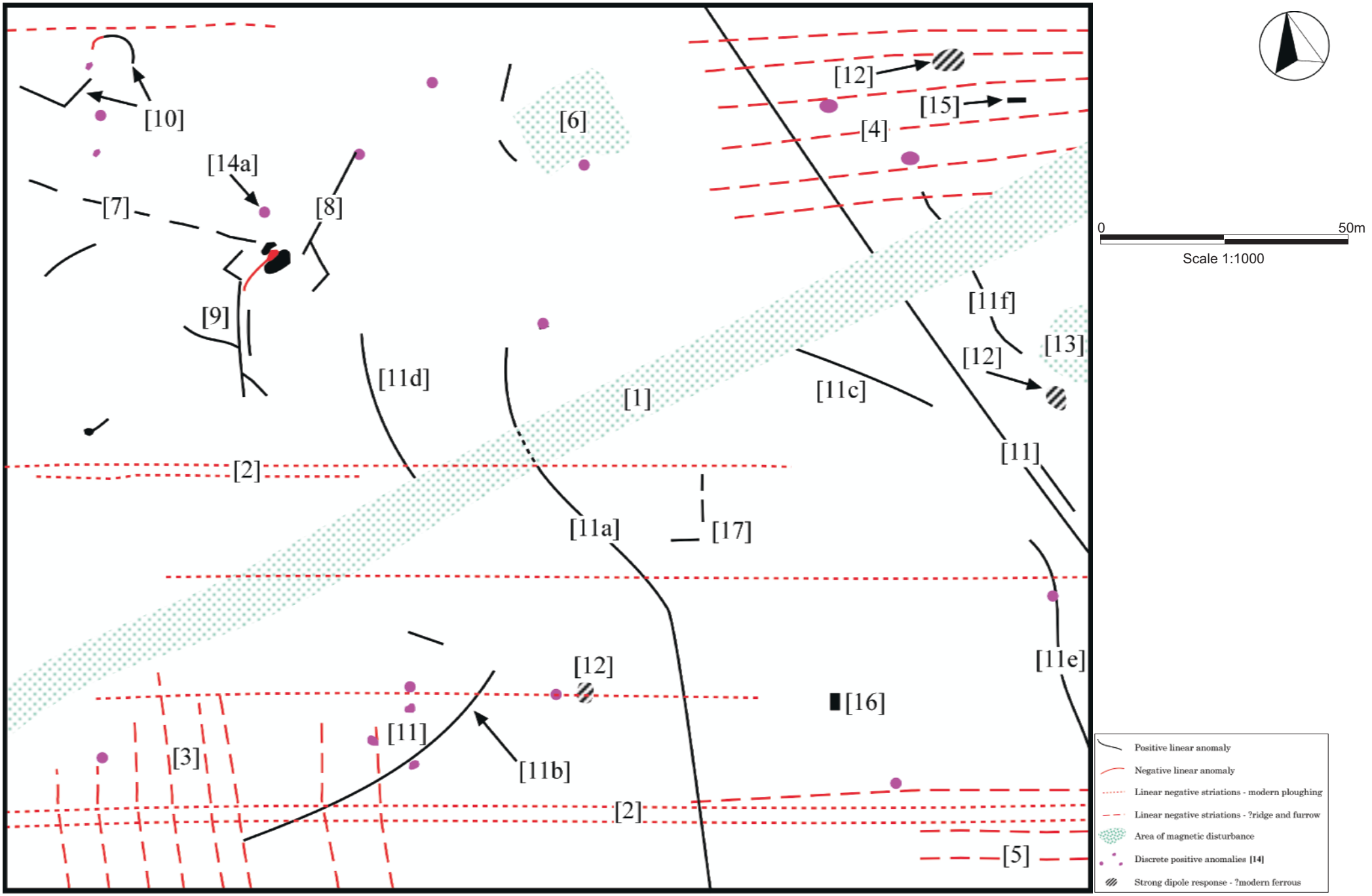

Figure 6: Summary of anomalies detected at scale 1:1000

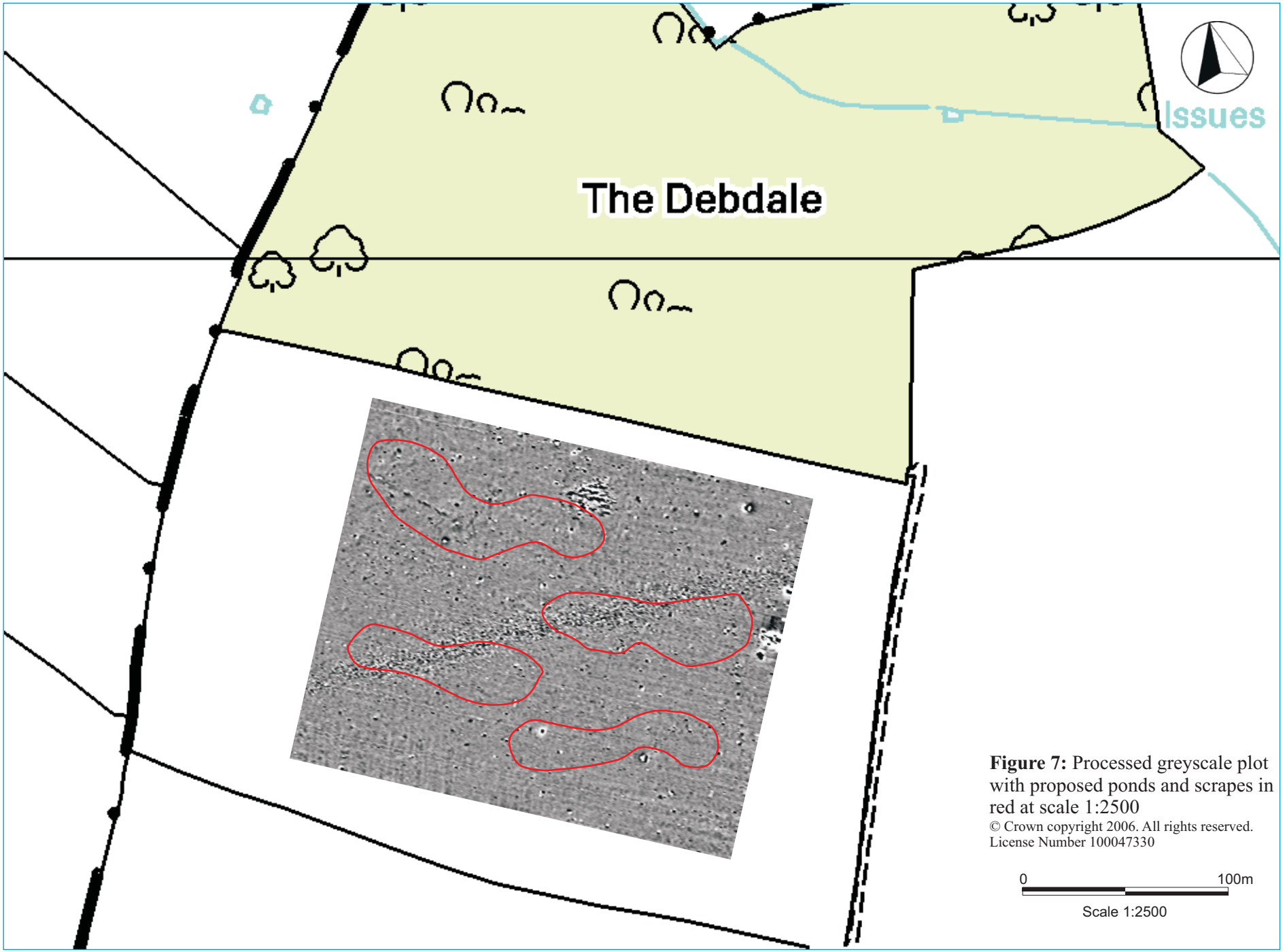

Figure 7: Processed greyscale plot with proposed ponds and scrapes in red at scale 1:2500

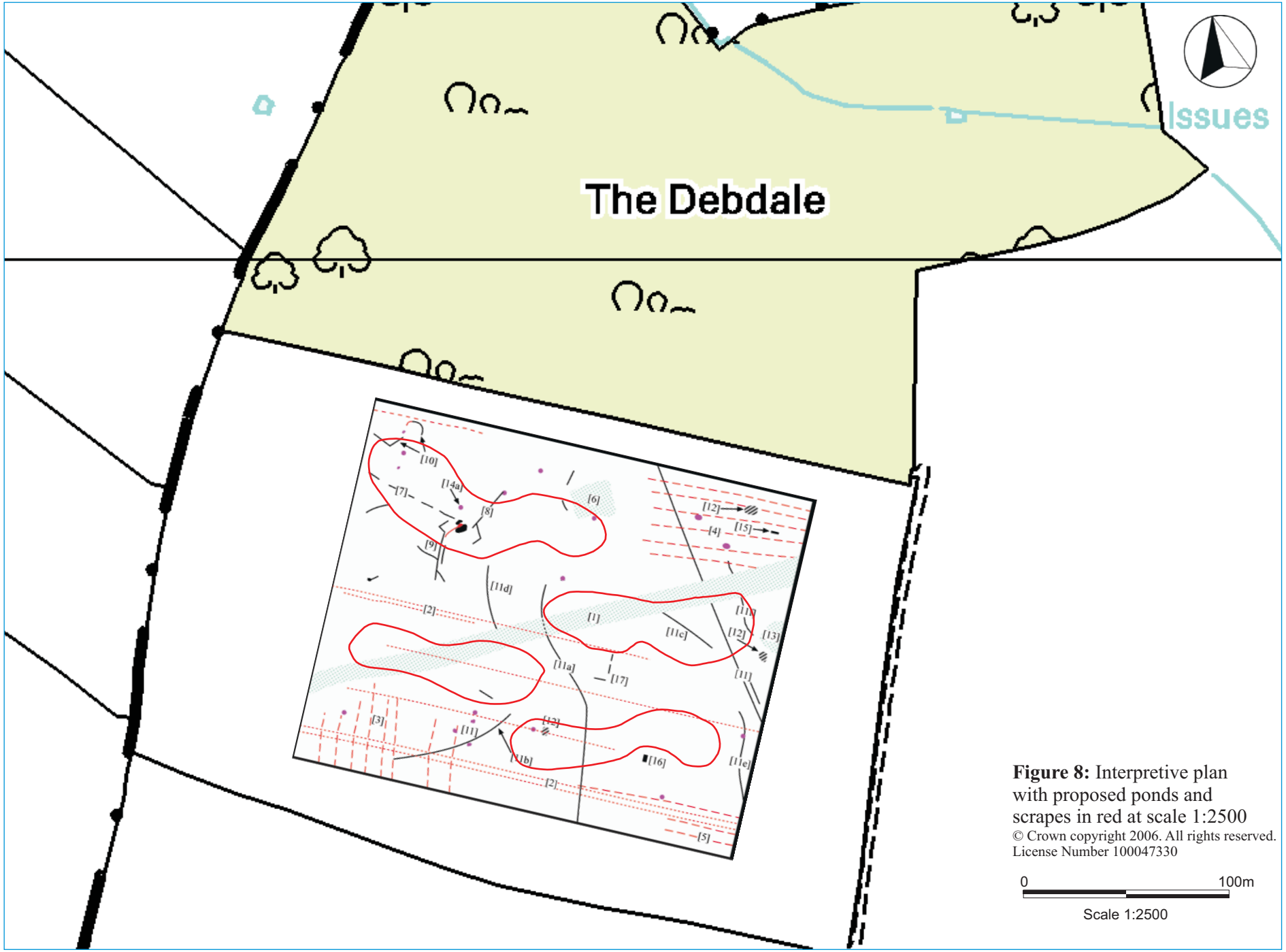

Figure 8: Interpretive plan with proposed ponds and scrapes in red at scale 1:2500

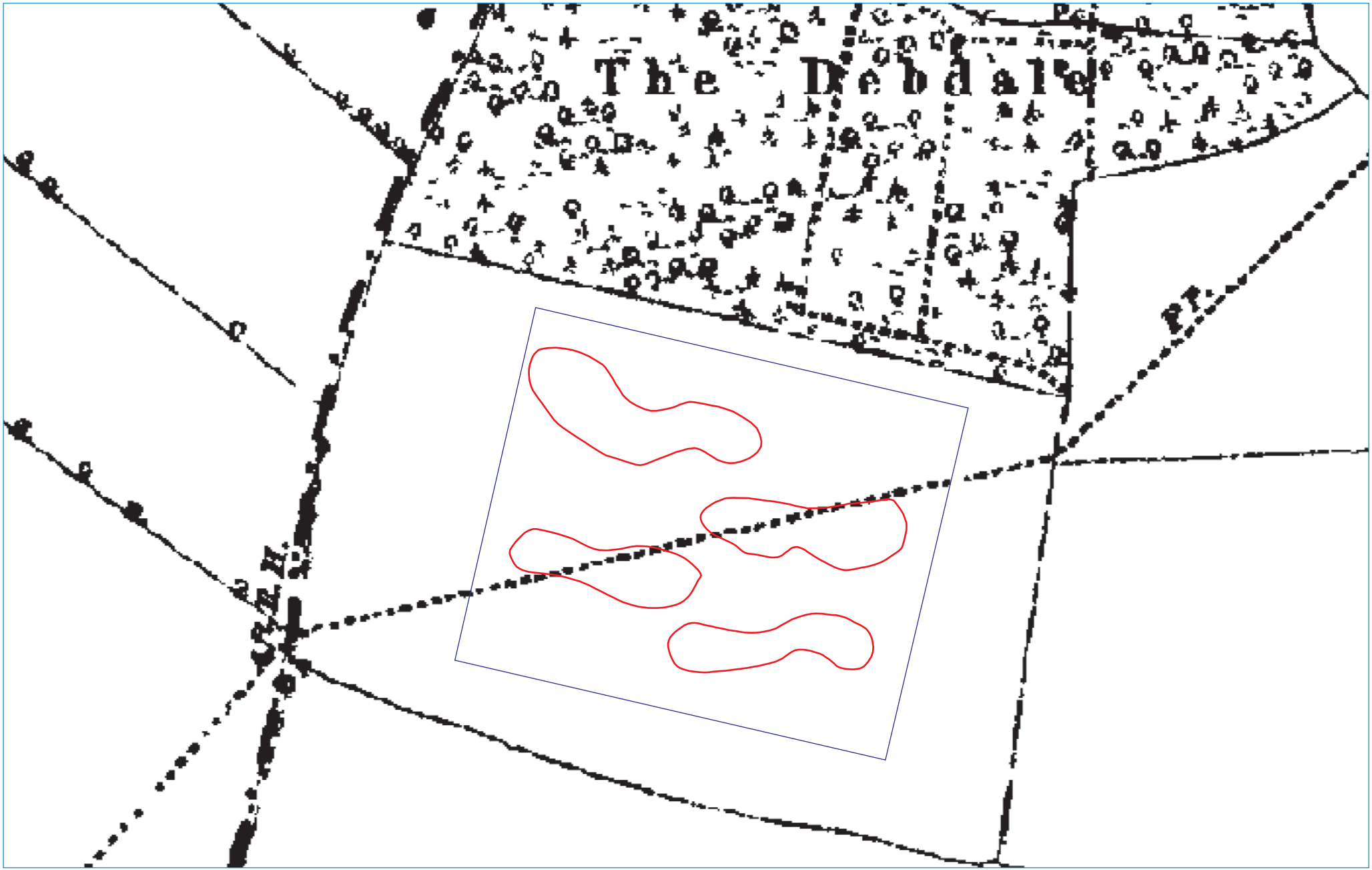

Figure 9: First edition Ordnance Survey Map of 1892 showing proposed ponds and scrapes outlined in red, and survey area outlined in blue (Scale 1:2500)