LAND AT BILLINGLEY VIEW
BOLTON-UPON-DEARNE
SOUTH YORKSHIRE

REPORT ON A GEOPHYSICAL SURVEY

OSA Report No: OSA20EV07

March 2020

OSA

ON SITE ARCHÆOLOGY LTD

25A Milton Street • York • North Yorkshire • YO10 3EP

telephone • 01904 411673 • fax • 01904 414522

e-mail • mail@onsitearchaeology.co.uk

Report Summary.

PROJECT NO:	OSA20EV07 (Geophysics)
SITE NAME:	Billingley View, Bolton-upon-Dearne
COUNTY:	South Yorkshire
NATIONAL GRID REFERENCE:	SE 4463 0300
ON BEHALF OF:	NPS Barnsley Level 5 Gateway Plaza Sackville Street Barnsley S70 2SB
GRAPHICS:	Ben Gourley
FIELDWORK:	Caroline Emery Kate Langley
REPORT:	Kate Langley Ben Gourley
TIMING:	Fieldwork: March 2020 Report preparation: March 2020
APPROVED AND AUTHORISED BY:	Nick Pearson, MCIfA (693) On-Site Archaeology Ltd 25A Milton Street York YO10 3EP *tel* (01904) 411673 *fax* (01904) 414522 *e-mail* mail@onsitearchaeology.co.uk

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1.0 Abstract.

Residential development is proposed for land off Billingley View, Bolton-upon-Dearne in South Yorkshire. A geophysical survey of the site was carried out as an initial stage of evaluation.

The site lies within a landscape with the potential to contain remains from the prehistoric, Romano-British and medieval periods. Archaeological features from these periods have been found in the wider vicinity of the site.

The results of the geophysics revealed a single feature of potentially archaeological origin. The potential anomaly indicates a possible field boundary or trackway.

Any decision regarding the need for further investigation would be made by the South Yorkshire Archaeology Service in their role as advisors to the local planning authority. SYAS may take the view that to determine the date and significance of the identified anomalies it would be necessary to undertake a programme of archaeological evaluation trenching. In view of the limited results of the geophysics, and the potential post-medieval date of the identified linear anomaly, it may be appropriate for any such archaeological investigation to be secured through the addition of a condition to planning consent.

2.0 Site Location, Geology, Topography and Land Use.

The proposed development site comprises set-aside land, covering an area of c. 0.5ha, lying on the west side of Billingley View, on the northwestern edge the village of Bolton-upon-Dearne, South Yorkshire (NGR SE 4463 0300). At the time of the survey the site contained cut vegetation, with open field boundaries. The site is linear in form and is bounded by Billingley View to the east, Carr Head Lane to the south, an agricultural field to the west and Dearne Community Children's Centre to the north.

The land slopes from a high point around 44m AOD at the south end of the site to a low point of around 40m at the north end of site. The geology is sandstone bedrock (Mexborough Rock). No superficial deposits are recorded (http://mapapps.bgs.ac.uk).

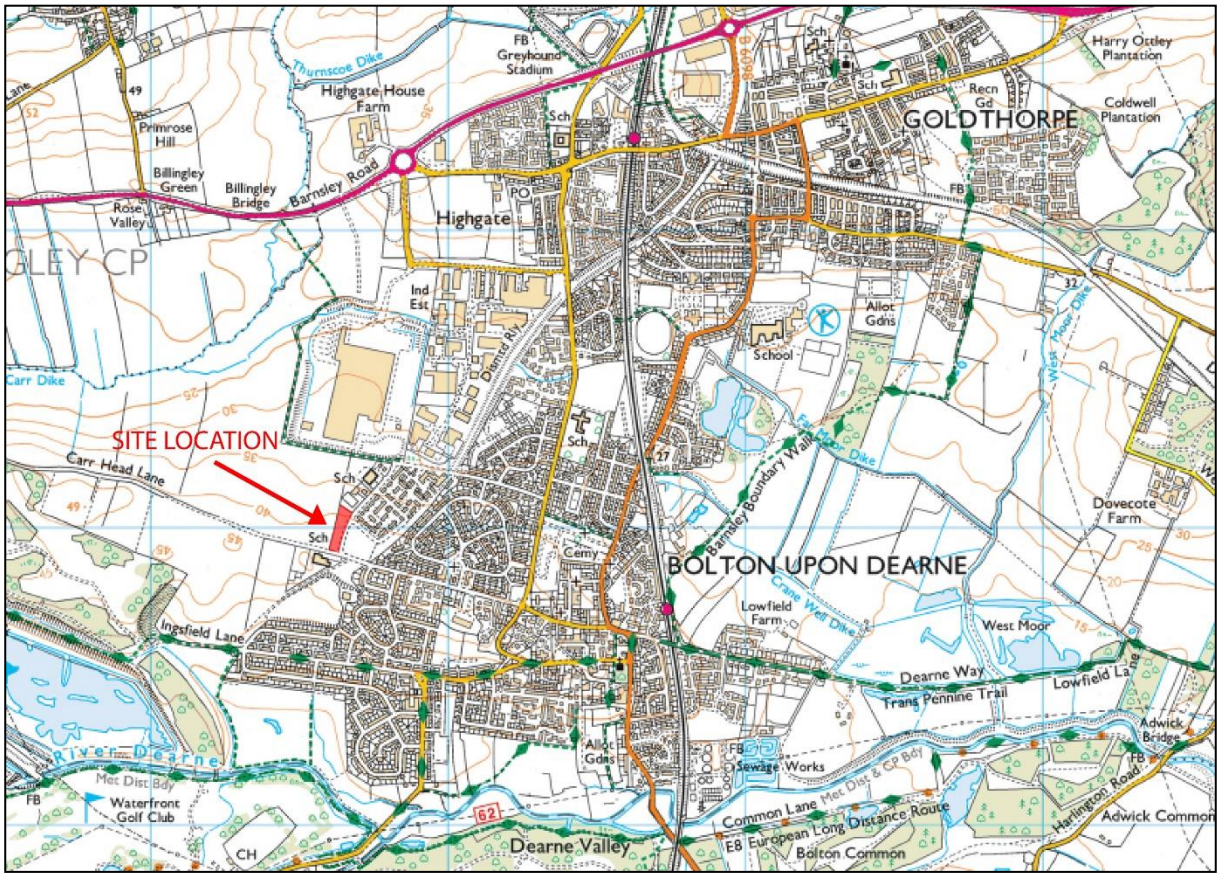

Figure 1. Site location (SE 4463 0300)

3.0 Archaeological Background

The site of the proposed development lies within a landscape of known archaeology, which contains heritage assets dating from the prehistoric, Romano-British and medieval periods.

Evidence of prehistoric activity was found just to the north of the site during investigations undertaken by NAA in 2013 during work prior to the construction of the Aldi Distribution Centre. Three Bronze Age cremation burials were found; two of which were under a stone cairn or barrow. Further pits and a single gulley were also found on this site that dated to this period.

A number of areas of cropmarks have been identified within the wider vicinity of the site and are all probably from the Iron Age or Romano-British periods. They represent trackways, ditches and enclosures. Three of these areas of cropmarks have also been subject to geophysical survey; all showing results of archaeological activity. On a site at land adjacent to Goldthorpe Industrial Estate evaluation trial trenching was conducted after the geophysical survey. A ditched field system and associated features were found during this investigation. Further work on this site undertaken by NAA in 2013 revealed a field system made up of several large fields with smaller ditches subdividing the areas. Dating evidence from this part of the investigation suggested that the field system was created during the later Iron Age or early Roman periods. Further other archaeological sites in the wider landscape have also revealed activity from this period. Notable is the site at Billingley Drive, Thurnscoe to the north of the current site (Neal and Fraser, 2004). A Romano-British farmstead was discovered containing several rectilinear enclosures, a trackway and crop drying oven. The occupation of site was dated to between the mid 2nd century and the mid 4th century.

Archaeological evidence from nearby the site dated to the early part of the medieval period comes from two corn drying ovens found on the Goldthorpe Industrial Estate. These were radiocarbon dated to the late 5th and early 6th centuries. It was also suggested the earlier field system was still in use in this period as well. Bolton upon Dearne is mentioned in the Domesday Book of 1086 as 'Bodetone' meaning 'an enclosure with buildings'. The church of St. Andrew the Apostle was founded during the Anglo-Saxon period. It still contains a Saxon nave, along with a 12th century arcade. Ridge and furrow farming is known throughout this area as cropmarks and from previous archaeological investigations.

4.0 Methodology.

4.1 General

The survey and reporting were conducted in accordance with the current professional guidelines "Geophysical Survey in Archaeological Field Evaluation" (Historic England 2008) and "Standard and Guidance for Archaeological Geophysical Survey" (Chartered Institute for Archaeologists 2013).

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 and depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

Magnetic survey is generally well suited to the detection of such features, and it is most commonly employed as a rapid means of assessing the extent of archaeological deposits across a large area, particularly where silted up or backfilled 'cut' features are thought to be present. Geological conditions play a significant part in the successful identification of deposits with this technique (Historic England 2008).

This technique is sensitive to changes in the localised magnetic field caused by ferrous material in the soil and on the surface in the immediate area. Modern services, electricity pylons, metal fences/ buildings, and any other ferrous objects in the topsoil all produce elevated magnetic responses that can confuse interpretation of results.

4.2 Fieldwork methodology

In archaeological geophysics in Britain the most frequently used magnetic technique is Fluxgate Gradiometry, a method that detects minor variations in the vertical component of the local magnetic field of near-surface soils and subsoils. These variations are caused by changes in magnetic susceptibility or permanent thermo-remnant magnetism, both of which can indicate archaeological activity. Data is collected at regular intervals over a gridded area producing a continuous coverage over the site.

The survey comprises an area of approximately 0.5ha. The site was divided into 30x30m grids and tied in to known Ordnance Survey points using a *Leica GPS900*. The *GPS900* is a real time kinemeatic GPS unit providing survey quality location information accurate to around 10mm.

Data collection was carried out using two *Bartington Grad 601-2* fluxgate gradiometers with automatic data logging facilities. Samples were recorded on an interval of 0.25 x 1 m in accordance with current archaeological guidelines (Historic England 2008), yielding 3600

measurements per 30m square. The instrument sensitivity was set to 0.03nT within a +/- 100nT range ensuring the accurate recording of small variation in the local magnetic gradient.

4.3 Processing and data treatment

Following initial field survey, data was prepared and processed using a series of software tools to eliminate data defects resulting from local conditions or field collection problems. Typically, once defects have been identified, images are prepared using a greyscale representation of the relative strength of magnetic response in the survey areas. The greyscale plots provide a graphic '2D image' of subsurface magnetic conditions and form the basis of the interpretation diagram in Figures 4-6. (Additional 'X/Y trace' plots are also included as an alternative graphic representation of results for comparison with greyscale plots).

For processing, Geoscan *Geoplot 3.0* software was used for initial data processing and Golden Software's *Surfer* used for the production of both raw and processed data plots. Maps of the site were prepared using *Esri ArcGIS* geographical informatics software.

The following processing and image enhancement functions have been applied to the data (see Appendix 1 for details):

Despike – Used to locate and reduce the effects of random ferrous responses in the survey area that most commonly result from iron objects near to the surface. NB. Some anomalies of this type cannot be successfully eliminated using 'despike' (especially if they are caused by larger iron objects in top-soils) without compromising the reading for the nearby data, and in these cases they are left in the dataset and marked in the interpretation plot accordingly.

The parameters used for the despike process were: radius of X4 x Y1 readings for local averaging with a threshold of 3.0. A 'mean spike replacement method' was applied using the despike filter in Geoplot 3.0 software.

Zero Mean Traverse – For removing striping effects in the data caused by the orientation of the instrument sensors; also removes traverse striping caused by abnormally strong responses caused by ferrous pollution. For settings see Appendix 2 below.

Interpolation – This is mostly an image optimisation process designed to create a more coherent and 'readable' graphic. Interpolating increases the number of data points in a survey on one or both axes. In this instance survey data was collected using a 0.25 x 1m sampling interval, and for final graphic preparation clipped and processed data was interpolated on the Y-axis resulting in a smoothed greyscale plot where one pixel is the equivalent to a 0.25 x 0.5m survey sample. Geoplot's *sin x/x* interpolation method was used for this process.

5.0 Results.

5.1 General

The data is presented here using greyscale and X/Y plots with minimal processing to give an impression of the full range of data statistics. Darker greys and blacks represent elevated magnetic readings, and lighter values lower readings, while middle grey indicates the 'survey average' response of the underlying geological conditions.

Magnetic values are measured here in Nanotesla (*NT)* and the Bartington is configured at a sensitivity of 0.03 *nT*, recording data within a range of -100nT/ +100nT. Within this range most archaeological and geological features occupy relatively low *nT* value with respect to the survey zero (typically between -20 and +20 *nT* and lower). *Nanotesla (nT)* values are given in relation to the survey '*zero'* or *mean.* Therefore, '*positive'* refers to elevated or enhanced magnetic values, '*negative'* refers to lower values, and '*dipolar'* refers to responses that consist of an elevated peak and a negative trough. Depending on their origin and structure, each of these can constitute linear features, localised features, or features covering an area.

Responses of very high magnitude in the top and bottom end of this scale usually result from isolated metallic objects in the topsoil or from major features with high iron content near or in, the survey area.

A combination of factors including: subsurface/surface conditions, the depth of anomaly, and material composition all affect the form of magnetic responses.

Figure 2 displays the unprocessed raw data using a greyscale gradient to represent magnetic values.

5.2 Processed Data

Processing was undertaken to eliminate data anomalies. As above these include *Despike, ZMT, and Interpolate*. Figures 4 and 5 show the processed data in greyscale and 3D surface plot. The data here has been optimised to show magnetic variations in the lower *nT* range (typical occupied by geological and archaeological features).

Figure 4 shows a greyscale representation with significant anomalies labelled.

Figure 5 shows an interpretation of the specific anomalies, and Figure 6 shows the interpretation superimposed upon a location of the site. The various categories identified in the associated legend and significant features are listed below:

5.3 Summary of recorded anomalies.

Geophysical Anomalies	**Description**
Feature A	Ferrous material at topsoil and field boundaries.
Feature B	Linear track or ditch feature.
Feature C	Area of magnetic enhancement – cut or land fill.
Feature D	Ferrous material at topsoil and field boundaries.

6.0 Discussion and Conclusions.

The geophysical survey has revealed a single feature of potentially archaeological origin. Anomaly B indicates a possible linear track or ditch feature located in the centre of the site. This linear anomaly is parallel to Carr Head Lane, which can be seen on the First Edition Ordnance Survey map. The alignment of this possible track or ditch does not appear to correspond to the Romano-British field system found to the north of this site.

The other anomalies (A, C and D) appear to represent modern disturbance of the site and ferrous material in the topsoil. The site at the time of survey contained a number of areas of dumped soils and geological natural material.

Any decision regarding the need for further investigation would be made by the South Yorkshire Archaeology Service in their role as advisors to the local planning authority. SYAS may take the view that to determine the date and significance of the identified anomalies it would be necessary to undertake a programme of archaeological evaluation trenching. In view of the limited results of the geophysics, and the potential post-medieval date of the identified linear anomaly, it may be appropriate for any such archaeological investigation to be secured through the addition of a condition to planning consent.

7.0 Appendix 1: Methodology.

Survey area	Billingley View, Bolton-upon-Dearne	
Crop types	Set-aside	
Geology	The underlying solid geology is sandstone bedrock (Mexborough Rock)	
Instrumentation	Bartington Grad 601-2 Leica GPS900	
Software	Geoplot 3.00, ArcGIS 9.3, AutoCAD 2009, ArcGIS 9.3, Surfer	
Survey	Resolution: Sample Interval: Traverse interval: Grid Size: Cell size: Traverse method Survey Date	0.03nT/m used in 100nT range 0.25m 1m 30x30m 1x0.25m Zig-Zag March 2020
Processing	Using Geoplot 3.0 software: Clip, Despike, Zero Mean Grid, Zero Mean Traverse, Interpolation	
Coordinate system	GB Ordnance Survey	

8.0 Appendix 2: Processing Methodology.

All processing and image preparation was done using Geoplot 3.00 software

Data Statistics: min/ max/mean and std. dev:

Mean: -0.004nT

Std. Dev.: 2.423 nT

Min: -100.00 nT

Max: 100.00 nT

Processing procedures:

Despike: Search radius X=4 Y=1, Threshold: 3, Replacement method: Mean

Zero mean traverse: using Threshold Standard Deviation= 0.25

Zero mean traverse: using Geoplot Presets Grid=All, LMS=On. Pos.Threshold = +5, Neg.Threshold = -5.

Interpolate Using Geoplot Sin X/X on y-axis.

9.0 Appendix 3: Equipment used.

9.1 Gradiometer

Bartington Grad601-2 fluxgate gradiometer. Data is stored in a non-volatile memory.

Technical specifications can be found at:
http://www.bartington.com/Literaturepdf/Operation%20Manuals/OM1800%20Grad601.pdf

9.2 GPS Survey

Leica GPS900 RTK GPS. The *GPS900* is a dual-frequency, geodetic, real-time-kinematic (RTK) receiver with a potential accuracy of kinematic (phase) horizontal: 10mm + 1ppm and moving mode after initialisation, vertical: 20mm + 1ppm.

Technical specifications can be found at:
http://www.leica-geosystems.us/downloads123/zz/gps/GPS900/brochures-datasheet/GPS900_technicalData_en.pdf

9.3 Software

Geoscan Research *Geoplot 3.0*.

Technical information can be found at: http://www.geoscan-research.co.uk/page9.html

10.0 Appendix 4: Bibliography.

British Geological Survey (N.D.) 'Geology of Britain Viewer'. http://mapapps.bgs.ac.uk/geologyofbritain/home.html. Accessed June 2018.

Chartered Institute for Archaeologists (2014) 'Standards and guidance for archaeological geophysical survey'.

Historic England (2008) ‘Geophysical Survey in Archaeological Field Evaluation’. English Heritage.

OSA, 2019, Land at Billingley View, Bolton upon Dearne, South Yorkshire. An Archaeological Desk Based Assessment OSA Report No: OSA19DT11.

11.0 Appendix 5: Figures.

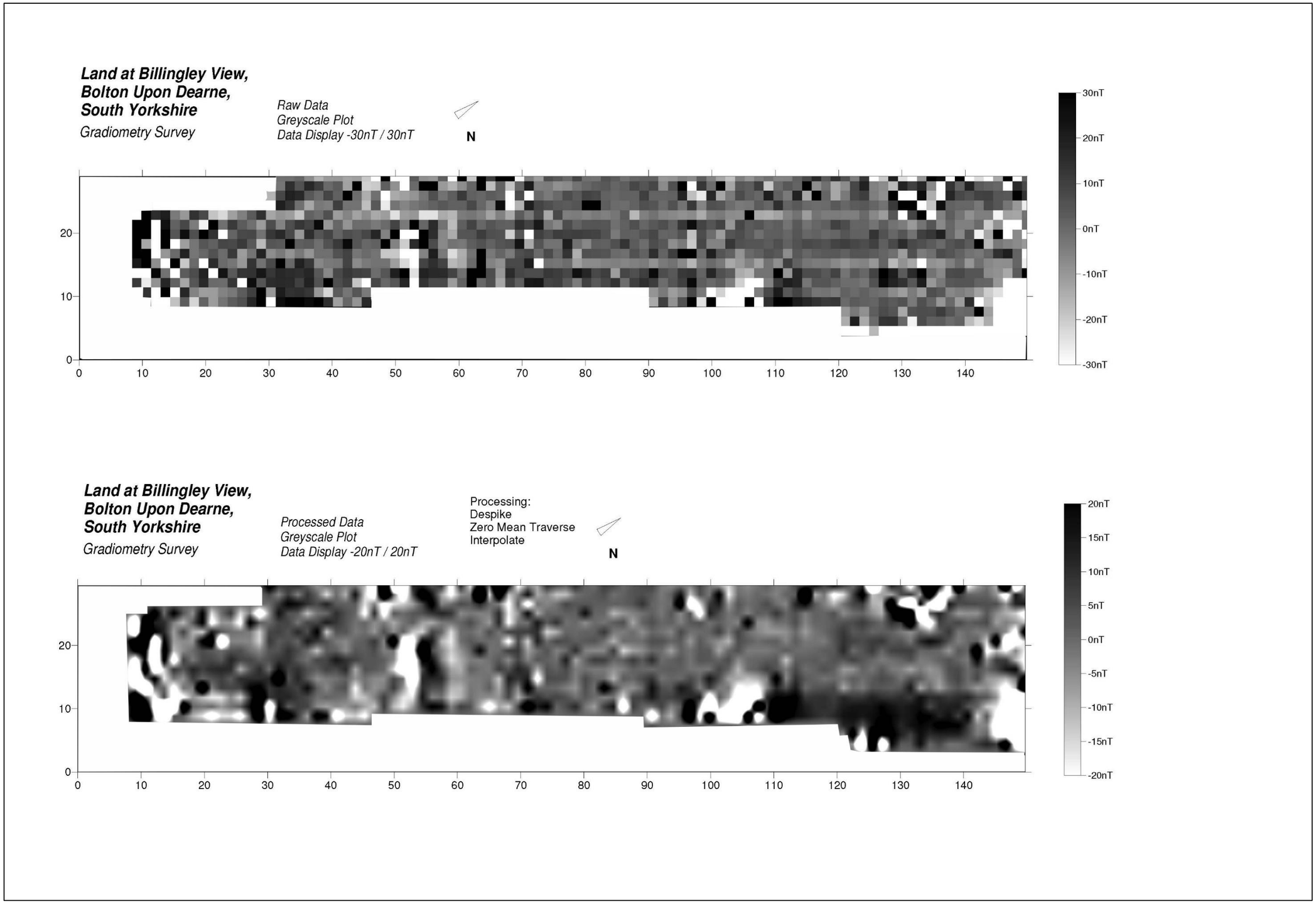

Figure 2. Greyscale plot of raw results (displayed greyscale range -10/+10nT) and Greyscale plot of processed results.

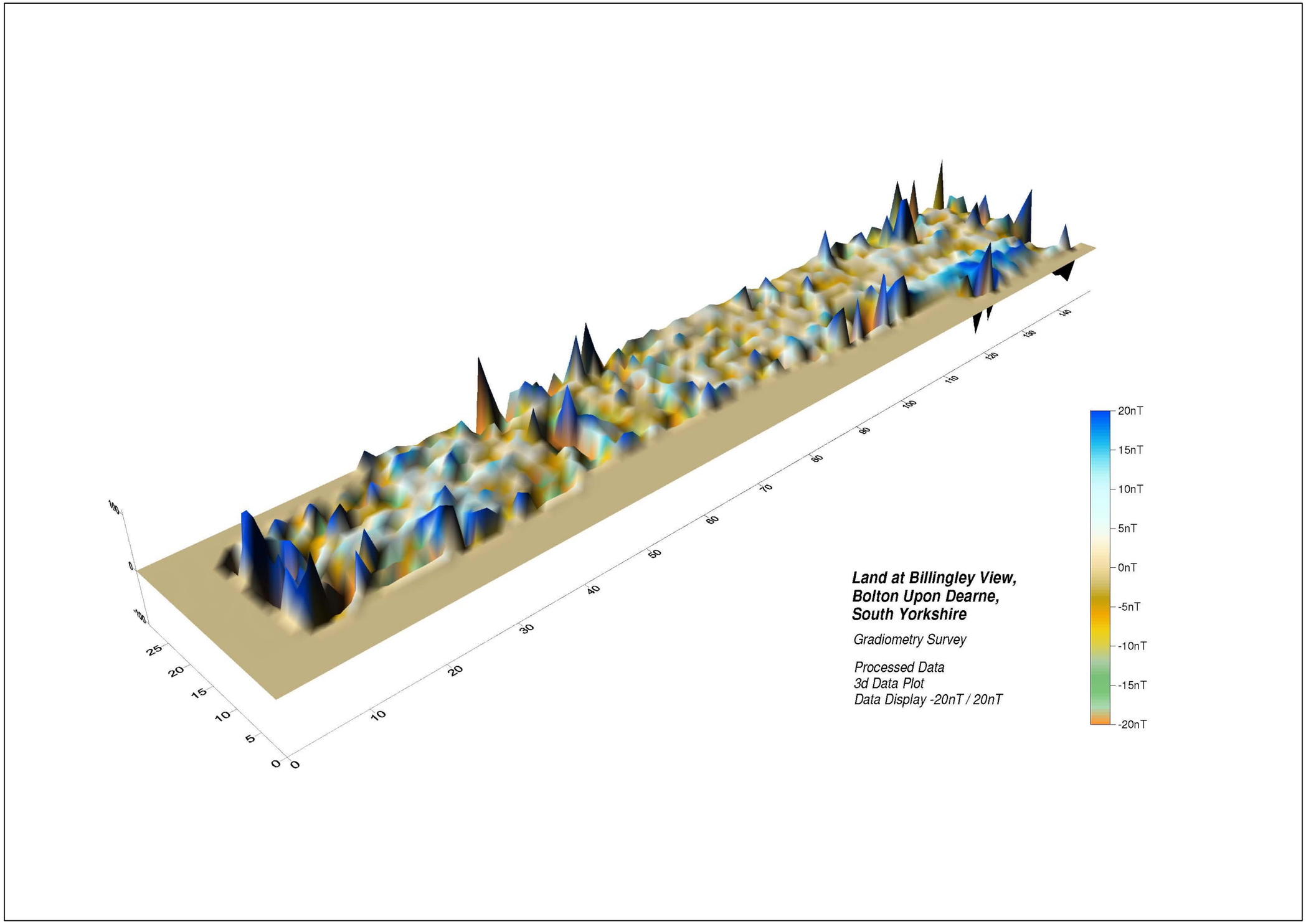

Figure 3. 3D surface plot of processed results.

Figure 4. Greyscale plot with interpretation.

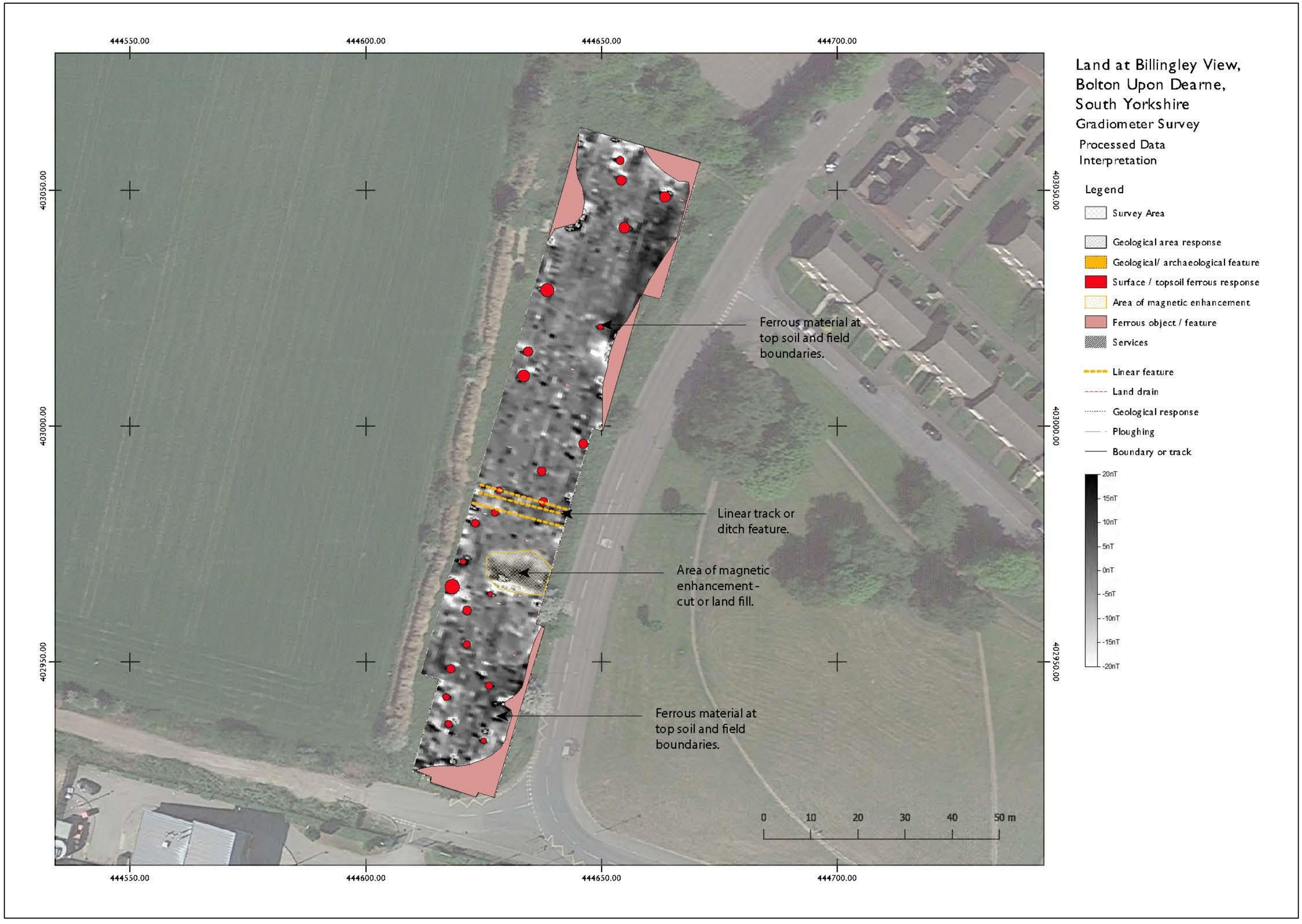

Figure 5. Interpretation with significant anomalies.

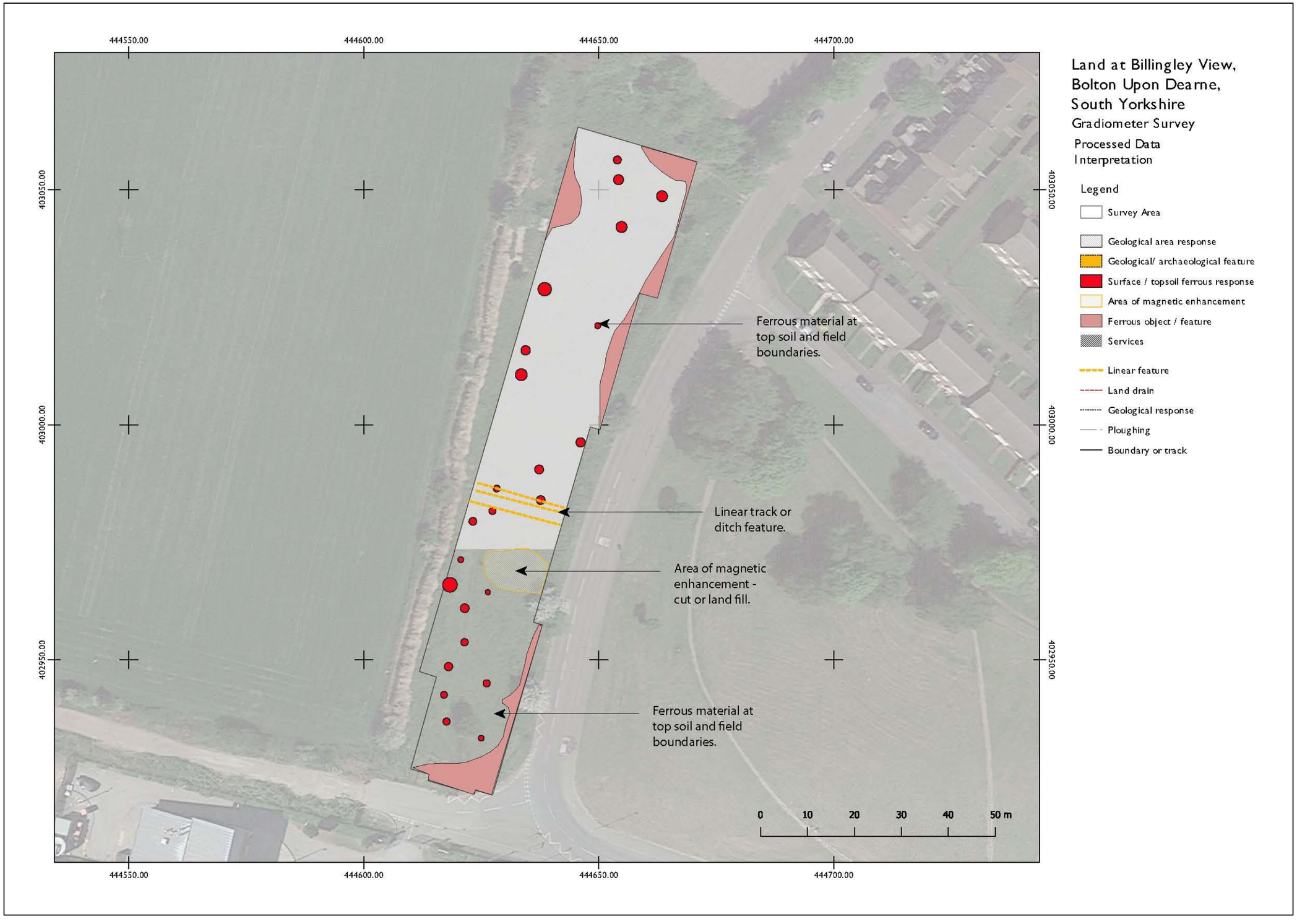

Figure 6. Interpretation with significant anomalies overlain on a location of the site