LAND AT LADY ANN ROAD, SOOTHILL, BATLEY, WEST YORKSHIRE.

REPORT ON A GEOPHYSICAL SURVEY
OSA REPORT No: OSA18EV39 Geophysics

November 2018.

OSA

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Report Summary.

PROJECT NO:	OSA18EV39 (Geophysics).
SITE NAME:	Land at Lady Ann Road, Soothill, Batley
COUNTY:	West Yorkshire
NATIONAL GRID REFERENCE:	SE 2500 2456
ON BEHALF OF:	D Noble Ltd Noble House Perserverance Street Castleford WF10 1LD
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TIMING:	Fieldwork November 2018 Report preparation November 2018
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Table of Contents.

List of Figures.

1.0 Abstract.

A residential development is proposed for a plot of land at Lady Ann Road, Soothill, Batley. A geophysical survey of the site was carried out as an initial stage of evaluation.

West Yorkshire Archaeology Advisory Service have advised that currently unknown archaeological remains, ranging in date from the prehistoric to Post-medieval periods could exist on the site.

Magnetic survey at Lady Ann Road has not revealed any evidence for pre-modern activity on the site. The single possible linear feature almost certainly represents a late 19th to 20th century boundary.

The site is dominated by readings suggestive of a high degree of disturbance to the topsoil, unsurprising given the use of the site as allotment gardens.

Any decision regarding the need for further evaluation would be made by the West Yorkshire Archaeology Advisory Service in their role as advisors to the local planning authority. WYAAS may take the view that it may be necessary to undertake a programme of archaeological evaluation trenching. However, none of the anomalies identified by the geophysical survey are suggestive of an archaeological origin.

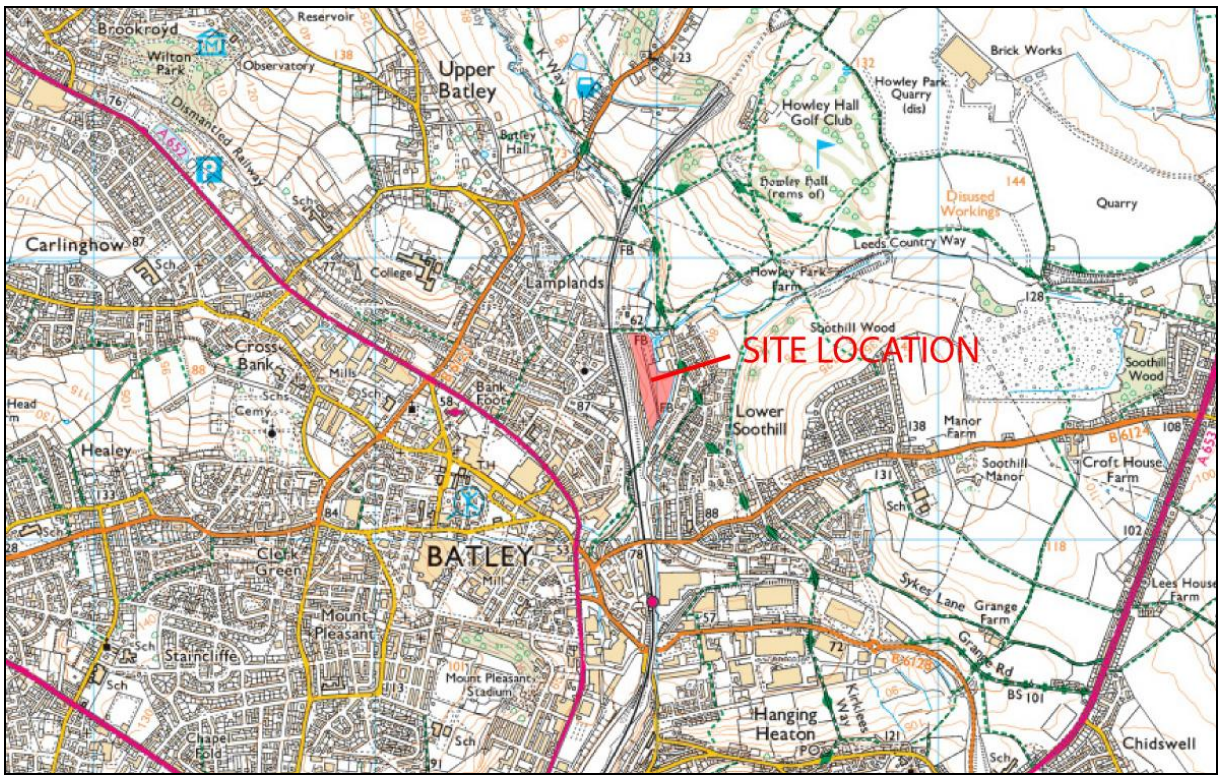

Figure 1. Site location (SE 2500 2456)

2.0 Site Location, Geology, Topography and Land Use.

The proposed development site, centred at National Grid Reference SE 2500 2456, lies to the east of the historic core of the town of Batley, West Yorkshire, within an area known as Soothill. The site lies to the west of Lady Ann Road, and top the east of properties fronting onto Primrose Hill. To the northeast of the site lies Lady Ann Business Park, which is centred around a series of historic mill buildings. The site is approximately triangular, roughly 140m from south to north and 60m from west to east at its widest point.

The site slopes significantly from west to east, from c. 71m AOD to 58m AOD. The eastern boundary of the site includes a narrow watercourse, the Howley Beck. The site had historically been agricultural land and allotments gardens but is now very overgrown and vulnerable to fly tipping.

The solid geology of the area comprises Sandstone of the Thornhill Group. Although no superficial deposits are recorded it is anticipated that alluvium is likely to be being present along the course of the beck (www.bgs.ac.uk.opengeoscience). The survey was carried out up the slope from the beck and is likely to be beyond the extent of alluvial deposits.

Figure 2. Area of site surveyed

3.0 Archaeological Background

The following section is derived from a consultation response issued by West Yorkshire Archaeology Advisory Service to Kirklees Metropolitan Council, dated 4th July 2017.

> *"The application site lies in an area dominated by 19th century industrial remains including mills, workers' housing, railways and collieries. However, the site has not been previously developed and faces southeast with Howley Beck passing along its eastern boundary. The latter are both features which would have made the site an attractive location for early communities to settle.*
>
> *A small number of flints were recovered from the vicinity although location of this find spot is not known with precision and is given as "near Howley football field" (West Yorkshire Historic Environment Record PRN 4080).*
>
> *The site of Howley Hall and park is located to the north-east of the site. The late 16th century hall, built by Sir John Savile is a designated heritage asset and scheduled ancient monument, and is located c. 550m to the north-east of the application site (National Heritage List for England No. 1,016,323 and West Yorkshire Historic Environment Record PRN 3793 and 3889). This Elizabethan house and gardens replaced an earlier medieval hall thought to lie further to the north.*
>
> *During the English Civil Wars the Savile's appear to have been reluctant to support the Royalist cause and during 22nd to 25th of June 1643 the Earl of Newcastle and his army laid siege to the house. Newcastle's army then went on from Howley to win the battle of Adwalton Moor, near Drighlington, on the 30th of June. The house was finally demolished in 1730."*

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 "Standards and Guidance for Archaeological Geophysical Survey" (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.

In this instance, there is little evidence of archaeological deposits in the immediate vicinity, due to limited opportunities for modern investigative fieldwork. However, given the historic agricultural/horticultural landuse any archaeology that is present is likely to be represented by features that are cut into the existing soils/geology. These might include features such as ditches, pits, trackways and other below-ground 'cut' features ranging in date from the prehistoric to the present day.

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, and the sandstone bedrock at Lady Ann Road is likely to produce variable results with magnetic survey (English Heritage 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. In this survey the extent of metallic pollution is very extensive.

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 site is heavily overgrown with evidence for 20th century dumping. It was therefore agreed in advance with Mr David Hunter of West Yorkshire Archaeology Advisory Service that the survey would be undertaken as a sample of the total site area in the least overgrown parts. The survey area was located predominantly within the southern half of the site and extended for a maximum length of 180m from north to south, by 60m east to west. 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* 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 6 to 8**. (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 data statistics (**Figure 3**). 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 3 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, 5, and 6** show the processed data in greyscale, 3D surface plot, and location plans respectively. The data here has been optimised to show magnetic variations in the lower *nT* range (typical occupied by geological and archaeological features).

Figure 7 shows a greyscale representation of significant anomalies with a colour-coded interpretation overlaid on the greyscale plot. **Figure 8** is a colour coded anomaly map showing interpretation of results with significant anomalies identified.

Figures 7 and 8 show an interpretation of the specific anomalies.

5.3 Summary of recorded anomalies.

Geophysical Anomalies	Description
Feature A	Linear response with occasional high magnitude dipolar responses. Possible ditch, drain or track.
Feature B	Strong dipolar responses over large areas of the survey. This section is typical of the clusters of high magnitude responses resulting from highly disturbed soils, building debris or ferrous materials in topsoil.

Feature A is the only feature of potentially archaeological origin. A review of historic Ordnance Survey maps shows a field boundary that coincides with Feature A being visible on the 25 inch map published in 1894. A portion of this feature was still visible on the 1946 published edition as the boundary of a portion of allotment gardens.

The strong dipolar responses recorded across the entire survey area are indicative of a high degree of disturbance of the site.

No features suggestive of pre-modern archaeology were present.

6.0 Discussion and Conclusions.

Magnetic survey at Lady Ann Road has not revealed any evidence for pre-modern activity on the site. The single possible linear feature almost certainly represents a late 19th to mid 20th century boundary.

The site is dominated by readings suggestive of a high degree of disturbance to the topsoil, unsurprising given the use of the site as allotment gardens. This will have been accentuated by the evidence for recent tipping of debris that is present.

Any decision regarding the need for further evaluation would be made by the West Yorkshire Archaeology Advisory Service in their role as advisors to the local planning authority. The WYAAS may take the view that it may be necessary to undertake a programme of archaeological evaluation trenching. However, none of the anomalies identified by the geophysical survey are suggestive of an archaeological origin.

7.0 Appendix 1: Methodology.

Survey area	Lady Ann Road, Soothill, Batley	
Crop types	Former agricultural and horticultural land. Currently overgrown waste ground	
Geology	Sandstone of the Thornhill Group. Possibility of alluvial deposits along the eastern boundary near Howley Beck	
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 November 2018
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 OpenGeoscience
http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html

Historic England. 2008. Geophysical Survey in Archaeological Field Evaluation. English Heritage.

11.0 Appendix 5: Figures.

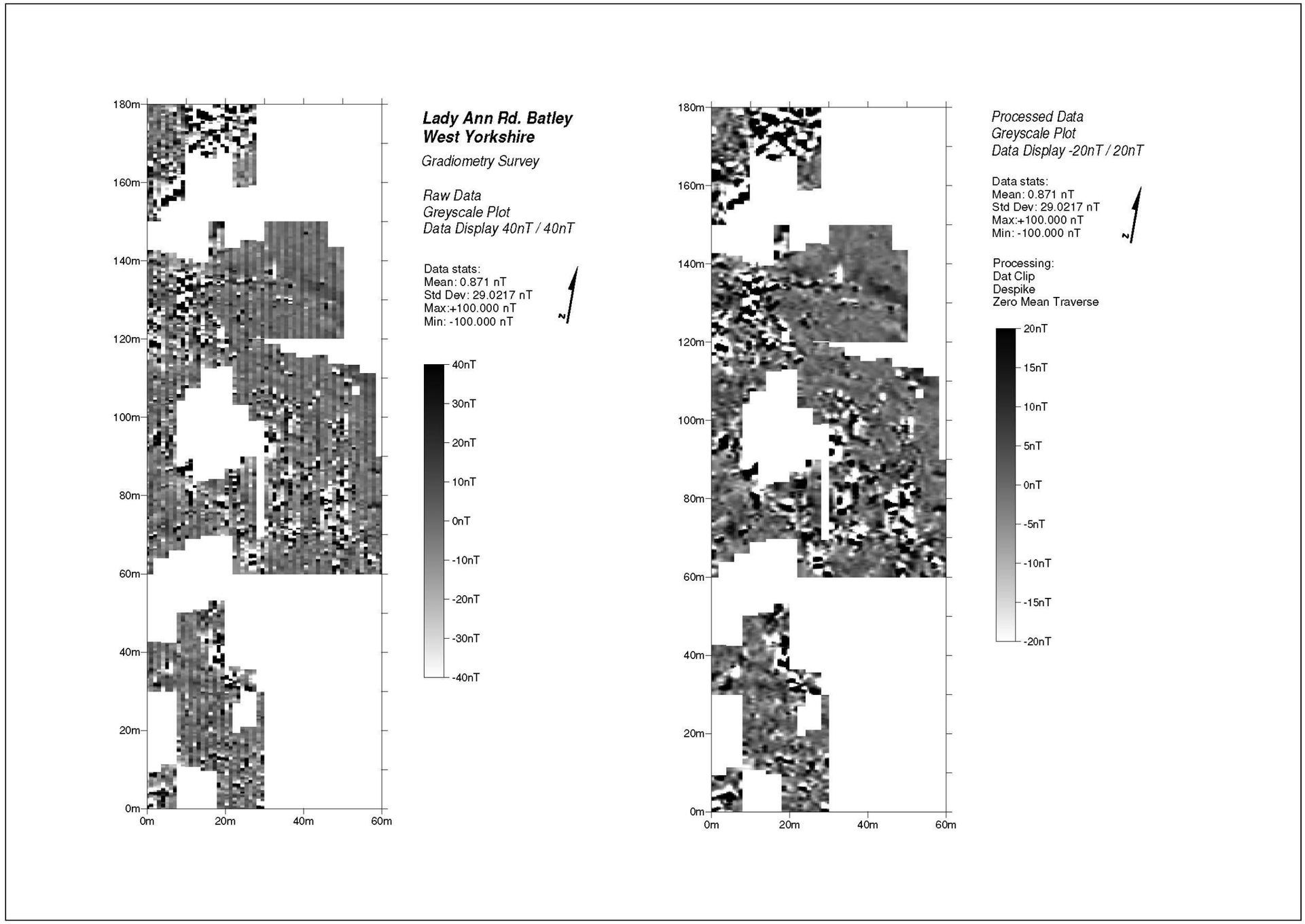

Figure 3. Greyscale plot of raw results
Figure 4. Greyscale plot of processed results

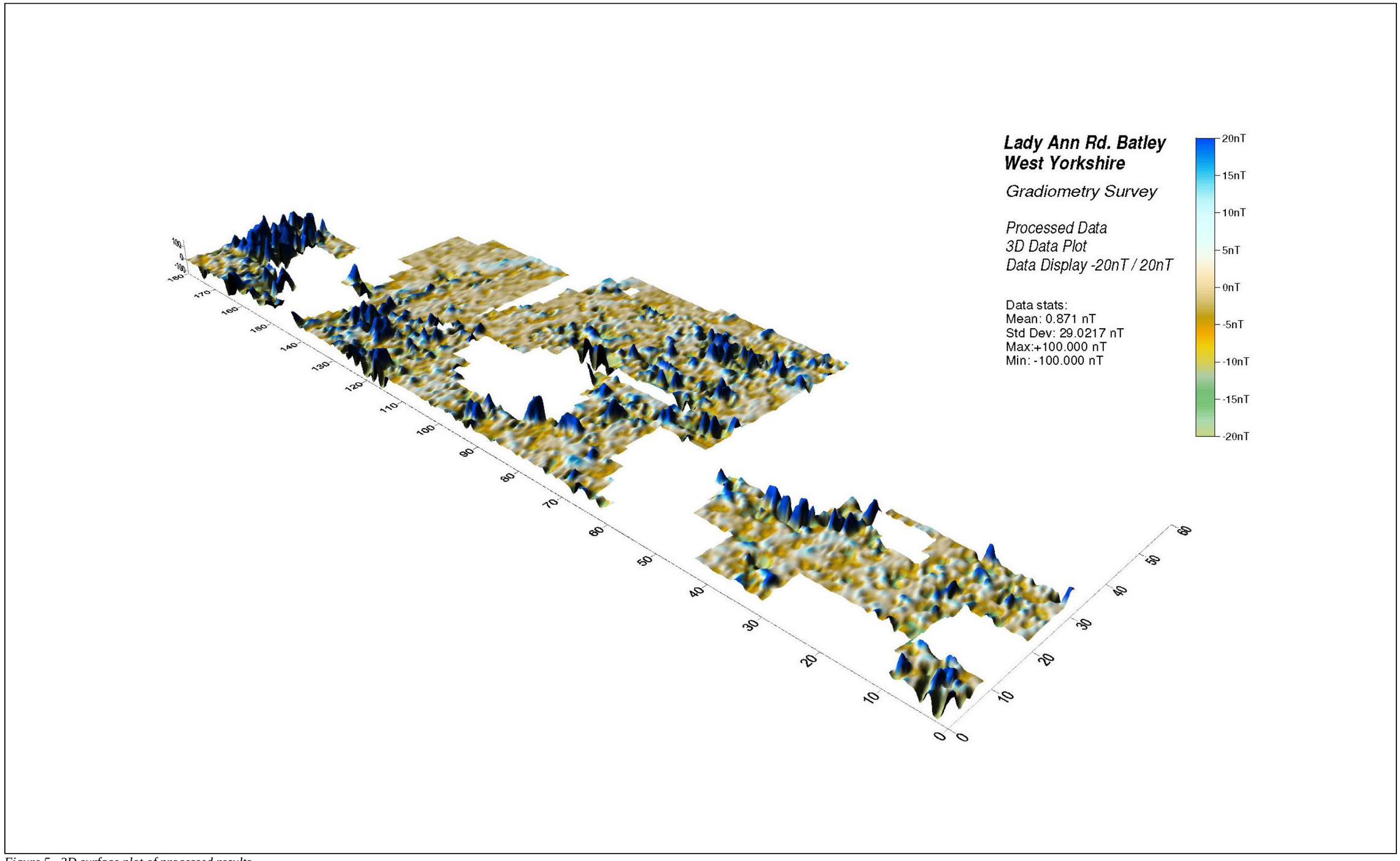

Figure 5. 3D surface plot of processed results

Figure 6. Greyscale plot of processed results with significant anomalies labelled

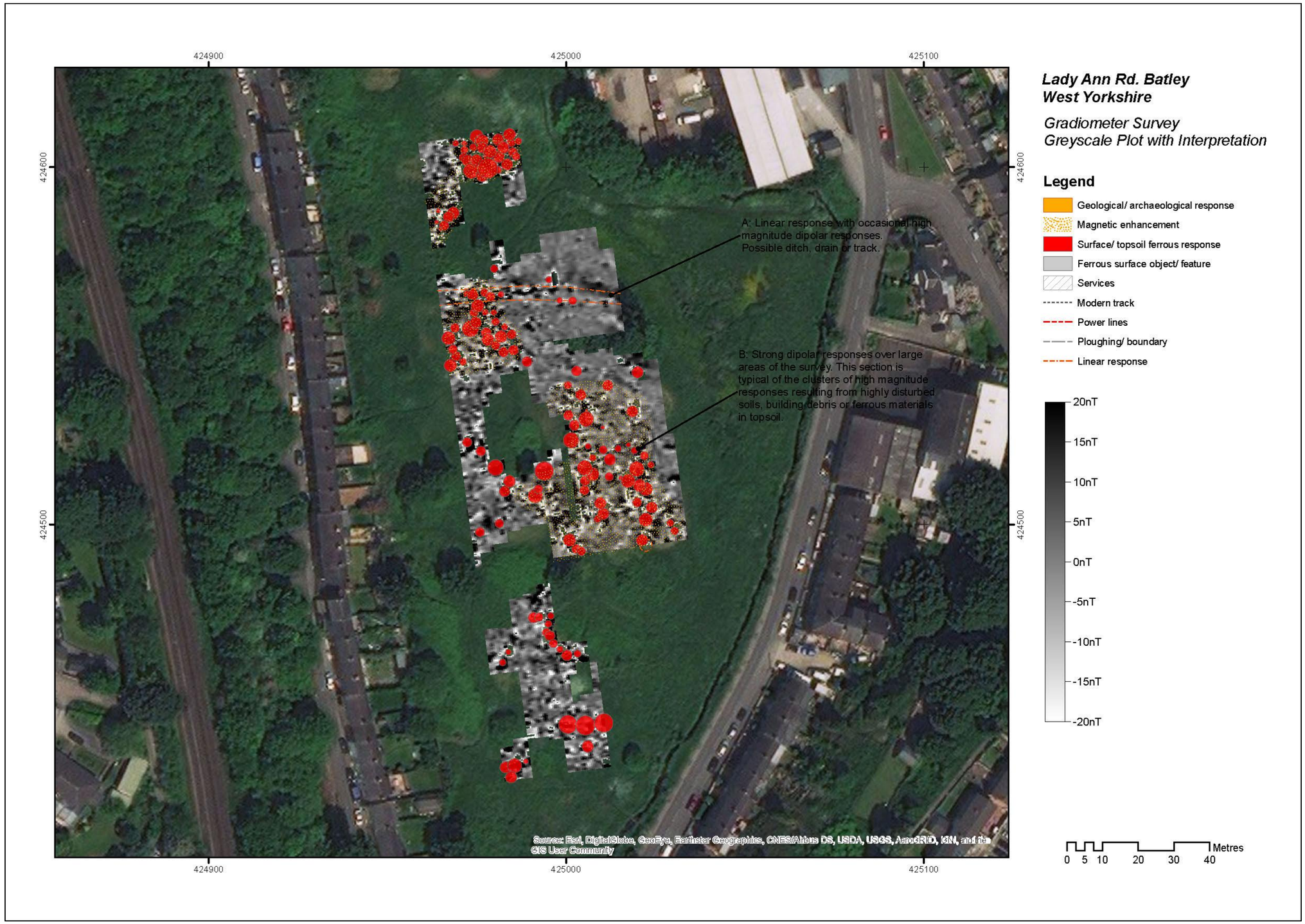

Figure 7. Greyscale plot with interpretation

Figure 8. Interpretation with significant anomalies labelled displayed on an aerial photograph of the site