FISHWICKS, BEETHAM HALL,
MILNTHORPE,

CUMBRIA

Geophysical Survey Report

Oxford Archaeology North

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Mr J A Fishwick

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AKNOWLEDGEMENTS

Oxford Archaeology North (OA North) would like to thank HM Architecture for commissioning the project on behalf of Mr John Fishwick. Particular thanks go to Mr Fishwick for his support during the course of the survey. Thanks also go to Cumbria Historic Environment Service (CHES) for outlining the condition.

The geophysical survey was carried out by Mike Birtles, who also wrote the report. The drawings were prepared by Mark Tidmarsh and Mike Birtles. The project was managed by Karl Taylor, who also edited the report.

SUMMARY

Mr J A Fishwick submitted a planning application (SL/2014/0701) to South Lakeland District Council to create a crematorium with associated landscaping and car park with access road off the A6 on land to the east of the current Grade II listed Beetham Hall Farm, Beetham, Milnthorpe, Cumbria (NGR SD 4996 7907). Beetham Hall dates from the thirteenth century (Historic Environment record no. 2518) and part of the site is also a Scheduled Monument (list entry number 1007143). As a condition of planning consent, a geophysical survey was recommended by Cumbria Historic Environment Service (CHES) to evaluate the potential for archaeological remains associated with Beetham Hall. Oxford Archaeology North (OA North) were commissioned by HM Architecture on behalf of Mr Fishwick to undertake the programme of geophysical survey, which was carried out during February and March 2016, when the ground conditions were wet.

Beetham Hall is a fortified house which was owned by the de Bethum family from the early thirteenth to late fifteenth century. A survey of 1354 referred to ‘the Hall of Bethum with other houses within the court’, suggesting some form of defensible enclosure Following the War of the Roses, Beetham passed on to the Middleton family and then to the Earl of Derby. The house was left partly in ruins following a siege during the English Civil War in either 1644 or 1651.

The results of the geophysical survey suggest that many of the responses are probably due to natural background geology and modern disturbance. However, there are several responses present in both data sets that may be archaeological in origin considering the close proximity of Beetham Hall. In particular, linear and discrete responses visible in the magnetometry data are possible candidates. An open-ended rectangle response in the south of the survey area might also be of some potential.

Several of the responses visible in the resistance data have quite clearly defined edges and square returns all roughly on the same alignment. It is likely that these are related to the background geology, but as has been already pointed out, given the potential of the site, an archaeological origin cannot entirely be ruled out.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

1.1.1 Mr J A Fishwick submitted a planning application (SL/2014/0701) to South Lakeland District Council (SLDC), to create a crematorium with associated landscaping and car park with access road off the A6 on land to the east of the current Grade II listed Beetham Hall Farm, Beetham, Milnthorpe, Cumbria (SD 4996 7907). Beetham Hall is a fortified manor-house dating from the thirteenth century (Cumbria Historic Environment Record no. 2518), additionally, part of the site is a Scheduled Monument (List entry number 1007143). As a condition of the planning consent, a geophysical survey was recommended by CHES to evaluate the potential for archaeological remains associated with Beetham Hall. OA North were commissioned by HM Architecture on behalf of Mr Fishwick to undertake a programme of geophysical survey, which was carried out on 16th February 2016 and 2nd March 2016 when the ground conditions were wet.

1.2 LOCATION AND BACKGROUND TO THE AREA

1.2.1 ***Location, Geology and Topography:*** The site is located within a field of around 1.16ha to the west of the A6, approximately 0.5km south of Beetham, Milnthorpe, Cumbria (SD 4996 7907). The area slopes gently from west to east with a maximum elevation of 25m AOD (Fig 2).

1.2.2 The underlying bedrock comprises limestone and subordinate sandstone and argillaceous rocks, whilst superficial deposits of alluvium (clay, slit, sand and gravel) lie over the eastern edge of the site (www.bgs.ac.uk). The soils are freely draining slightly acid (www.landis.org.uk).

1.2.3 The survey area lies within a single field that was laid down to pasture at the time of survey. The area is bounded to the east and the north by a dry-stone wall, to the south by a hedgerow and to the west by a wooden fence demarcating the edge of a car park.

1.2.4 ***Background:*** The following background is a precis of information gathered in order to place the results in a historical context.

1.2.5 ***Prehistoric period:*** There is no known prehistoric activity within the survey area, wider afield there have been occasional finds including a Bronze Age convex knife from Hawes Water 3km to the south-west and four Bronze Age cremations found during excavations at Milnthorpe 2km north of Beetham (OA North 2008a).

1.2.6 ***Roman period:*** There is no known Roman activity within the survey area or immediate vicinity.

1.2.7 ***Medieval Period:*** Beetham Hall is a fortified house which was owned by the de Bethum family from the early thirteenth to late fifteenth century. A survey of 1354 referred to 'the Hall of Bethum with other houses within the court', suggesting some form of defensible enclosure (OA North 2008a). Following the War of the Roses, Beetham passed on to the Middleton family and then to the Earl of Derby (*ibid*). The house was left partly in ruins following a siege during the English Civil War in either 1644 or 1651 (*ibid*).

1.2.8 ***Post-medieval period:*** By the mid-nineteenth century, Beetham Hall had become an established farmstead occupied by one John Harrison (*ibid*).

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 A method statement for the geophysical survey was provided by OA North (*Appendix 1*). The following methodology was used as the basis for the survey, and the work was consistent with the relevant standards and procedures of Historic England (English Heritage 2008) and the Chartered Institute for Archaeologists (CIfA 2014a and 2014b), and generally accepted best practice. Two techniques were used for the survey, magnetometry and electrical resistance. The method statement was adhered to in full.

2.2 GEOPHYSICAL SURVEY

2.2.1 ***Magnetometer Survey:*** the preferred geophysical technique in the detection of many archaeological remains is a magnetometer area survey, which is effective in locating 'positively magnetic' material, such as iron-based (or 'ferrous') features and objects, or those subjected to firing, such as kilns, hearths, and even the buried remains of brick walls. This technique is also widely used to locate subtler magnetic features associated with settlement and funerary remains, such as boundary or enclosure ditches and pits or post-holes, which have been gradually infilled with more humic material. The breakdown of organic matter through micro-biotic activity leads to the humic material becoming rich in magnetic iron oxides when compared with the subsoil, allowing the features to be identified by the technique. In addition, variations in magnetic susceptibility between the topsoil, subsoil and bedrock have a localised effect on the Earth's magnetic field. This enables the detection of features, such as silted-up or backfilled pits, due to the fact that the topsoil has more magnetic properties than the subsoil or bedrock, resulting in a positive magnetic anomaly. Conversely, earthwork or embankment remains can also be identified with magnetometry as a 'negative' feature due to the action in creating the earthwork of depositing the relatively low magnetic subsoil on top of the more magnetic topsoil. In this way, magnetometry is a very efficient technique and is recommended in the first instance by Historic England (2008) for such investigations.

2.2.2 ***Magnetometry Equipment:*** the strength of the present geomagnetic field in Great Britain is approximately 50,000nT (nanoTesla). Most buried archaeological features usually result in very weak changes of less than 1nT to the magnetic field (Clark 1990, 65). The instrument used for this survey was a *Bartington* Grad 601-2 dual sensor fluxgate gradiometer, which has a sensitivity of 0.1nT when used in the 100nT range setting.

2.2.3 ***Electrical Resistance or Resistivity:*** the use of electrical resistance area survey is often seen as being complementary to magnetometry and is recommended by Historic England where there is a strong presumption that buried structures or buildings are present that are not easily identifiable with magnetic methods. The technique requires injecting a small electric current into the ground via steel probes, and measuring the response with an earth resistance meter. The technique relies on the variable ability of the soil to resist an applied electrical current by the resistance meter from a pair of mobile probes to a corresponding pair of remote, static probes. The resulting resistance measurements (in ohms) can be used identify to buried features, which often have either a higher or lower resistance to the current than the background soil. Cut features that have been subsequently infilled, tend to be less resistant to the current flow and appear as low-resistance anomalies, whereas solid features such as structural remains tend to more resistant to the current flow and appear as high-resistance anomalies. One of the main disadvantages of the technique, when compared with magnetometry, is that data collection over the same size of area is a much slower process.

2.2.4 ***Resistivity Equipment:*** the instrument used for this survey was a *Geoscan Research* RM15 resistance meter with PA20 frame system set to parallel twin mode.

2.2.5 ***Sampling Interval***: the survey area was divided into 30m x 30m grids. Magnetometry sampling was at 0.25m intervals, with inter-transect distances of 1m, equating to 3600 sample readings per grid. The survey was carried out in 'zigzag' mode, with precautions to minimise any heading error during the magnetometry survey. In total, an area of approximately 0.54ha was surveyed with magnetometry (Fig 2). Resistivity sampling was at 1m intervals with inter-transect distances of 1m, equating to 900 sample readings per grid. In total, an area of 0.57ha was surveyed with resistivity (Fig 2). All survey grid nodes were staked out with canes using a *Leica* 1200 series RTK GPS system. Survey guidelines and traverse canes were then staked out.

2.2.6 ***Data Capture and Processing:*** magnetometry and resistance data were captured in the internal memories of the instruments and downloaded to a portable computer on-site and backed-up on to a USB drive. The individual grids were combined to produce an overall plan of the surveyed area, or 'composite'. The results were analysed and basic initial processing was carried out on-site using either Geoplot 3 by *Geoscan Research* or Terrasurveyor by *DW Consulting*.

2.2.7 Final processing of magnetometry raw data was undertaken off site in accordance with Historic England guidelines (English Heritage 2008) to remove any instrument error or survey effects in order to enhance subtler anomalies normally associated with archaeological features. All data were clipped by the appropriate values where necessary and the following processing steps carried out.

- Zero median grid/traverse was applied to correct slight baseline shifts between adjacent survey lines;
- The data were selectively 'de-staggered' where necessary, to remove any displacement caused by surveying in zigzag mode. This is sometimes required when surveys are carried out on boggy, wet, overgrown or steeply-sloped areas;
- The data were de-spiked where appropriate in order to remove random spikes. Random spikes are usually caused by erroneous small ferrous objects.

2.2.8 Final processing of resistivity raw data was undertaken off site in accordance with Historic England guidelines (English Heritage 2008) to remove any instrument error or survey effects in order to enhance subtler anomalies normally associated with archaeological features. All data were clipped by the appropriate values where necessary and the following processing steps carried out.

- The data sets were de-spiked in order to remove high contact readings;

- The grids were edge matched in order to correct for changes in the position of the remote probes;
- A high pass filter was applied which removes variations in the background geological response;
- A low pass filter was applied where appropriate, which can improve the visibility of weak archaeological features.

2.2.9 ***Presentation of the results and interpretation:*** the presentation of the data for the site involves a print-out of the processed data as a grey-scale plot for the magnetometry survey (Fig 3) and resistivity survey (Fig 4), together with individual (Figs 5 & 6) interpretation plots.

2.3 ARCHIVE

2.3.1 A full professional archive has been compiled in accordance with current CIfA and Historic England guidelines. The project archive represents the collation and indexing of all the data and material gathered during the course of the project.

2.3.2 The deposition of a properly ordered and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the CIfA in that organisation's code of conduct. OA North conforms to best practice in the preparation of project archives for long-term storage. OA North practice is to deposit the original record archive of projects with the appropriate repository.

2.3.3 The Arts and Humanities Data Service (AHDS) online database project *Online Access to index of Archaeological Investigations* (OASIS) will be completed as part of the archiving phase of the project.

2.3.4 The geophysical survey data will be archived with the Archaeology Data Service (ADS) in accordance with the guidelines published by the ADS (Schmidt 2002).

3. SURVEY RESULTS

3.1 General Observations

3.1.1 The magnetometry data exhibited high general background noise, and in the western third, a large septic tank and parked vehicles adjacent to the area caused a substantial magnetic halo which effectively masked any weaker responses. The high levels of magnetic background noise make detection and interpretation of weaker responses more difficult. Strong magnetic responses are present along the eastern boundary due to the field boundary with the A6 road. Additionally, numerous ferrous spikes are evident over much of the survey area. Within the resistance data, the middle-west of the area comprised moderately high and low resistance areas that appear to be geological in origin, although there are some noticeable aligned trends. Given the location of the site in relation to Beetham Hall, some of these may be of archaeological potential. The lower ground at the base of the slope was generally quiet in the resistance data which is probably due to alluvium deposits along the boundary with the A6 main road.

3.2 Results

3.2.1 The eastern half of the magnetometry survey area is defined by a series of linear responses reminiscent of agricultural activity such as ploughing (***01***) (Figs 3 and 5). More of these may be present but the high background noise has masked their appearance. There are also several very weak positive and negatively magnetic linear and curvilinear responses (***02***). These features are irregularly aligned roughly east-west down the slope of the field. It is difficult to assign a specific origin to these, but responses similar to these are sometimes due to archaeological features (Figs 3 and 5). An open-ended rectangular response towards the south end of the area (***03***), may similarly be archaeological in origin but this is conjectural.

3.2.2 Several positively magnetic discrete responses (***04***) are visible across the survey area. Responses such as these are suggestive of features such as pits and given the close proximity of Beetham Hall, they may be of archaeological potential (Figs 3 and 5).

3.2.3 An area of magnetic disturbance at the north-east corner (***05***) correlates with a stoned entry point and gate from the A6, the stoned area is also clearly visible as an area of high resistance on the resistivity data (***06***, Fig 6). A further stoned area is visible as an area of high resistance in the north-west corner, this correlates with another gated entry to the field and the septic tank (Figs 4 and 6).

3.2.4 The fairly large number of magnetic spikes scattered across the survey area are most likely due to buried and/or ground-lying ferrous objects. Often, these objects are pieces of farm equipment, for example, nuts and washers etc. They may however, sometimes be of archaeological origin and, given the close proximity of Beetham Hall, this may be the case. There is no observable pattern in the distribution, suggesting the former interpretation is most likely.

3.2.5 Several areas of high and low resistance are present in the middle of the survey area (***07***) that are probably geological in origin (Figs 4 and 6). Some of these responses have fairly square or straight edges that lie on roughly similar alignments (***08***) suggestive of non-geological origin. However, these may simply relate to the nature limestone geology of the area, but given the proximity of Beetham Hall, an archaeological origin cannot be entirely ruled out. An area of medium high resistance (***08***) at the northern end of the survey area is probably a continuation of the trackway through the field (Figs 4 and 6).

4. CONCLUSIONS

4.1 DISCUSSION

4.1.1 The results of the geophysical survey suggest that many of the responses are due to natural background geology and modern disturbance. However, there are several responses present in both data sets that may be archaeological in origin considering the close proximity of Beetham Hall. In particular, the linear and discrete responses visible in the magnetometry data are possible candidates. The open ended response in the south of the survey area might also be of some potential.

4.1.2 Several of the responses visible in the resistance data have quite clearly defined edges and square returns, all roughly on the same alignment. It is likely that these are related to the background geology, but as has been already pointed out, given the potential of the site, an archaeological origin cannot entirely be ruled out.

5. BIBLIOGRAPHY

5.1 Secondary Sources

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ILLUSTRATIONS

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APPENDIX 1

METHOD STATEMENT FOR A GEOPHYSICAL SURVEY AT FISHWICKS CREMATORIUM, BEETHAM

1 INTRODUCTION

1.1.1 The two most commonly used techniques to undertake an effective geophysical survey in the location of archaeological remains are magnetometer and electrical resistance surveys. These allow below ground remains to be located in a non-intrusive manner, and are often applied to the same site as they produce complementary results.

1.1.2 Nevertheless, the results are very much dependent on the type of instrument that is used, and the method of data collection using the chosen instrument. These choices are based on the objectives of the survey, but there are external factors including the local geographical positioning of the site and topographic features, current and past land use, the solid and drift geology, and available resources such as time and budget.

1.1.3 The techniques are defined below and will be carried out according to English Heritage Guidelines (2008).

2 GEOPHYSICAL SURVEY

2.1 ***Magnetometry:*** a magnetic, or magnetometer, survey is usually the first choice for a geophysical survey owing to its ability to be carried out relatively quickly (due to recent improvements in commercially available instruments), and is therefore more cost effective. Consequently, magnetometry is a very efficient technique and is recommended in the first instance by the English Heritage Guidelines (2008) for such investigations.

2.2 Magnetometry will easily locate 'positively magnetic' material such as iron-based features and objects, or those subjected to firing such as kilns, hearths, and even the buried remains of brick walls. Therefore, this technique is suitable in the detection of features associated with industrial activity. This technique can also be widely used to locate the more subtle magnetic features associated with settlement and funerary remains, such as boundary or enclosure ditches and pits or postholes, which have been gradually infilled with more humic material. The breakdown of organic matter through microbiotic activity leads to the humic material becoming rich in magnetic iron oxides when compared with the subsoil, allowing the features to be identified. Conversely, earthwork or embankment remains can also be identified with magnetometry as a 'negative' feature due to the action in creating the earthwork of upturning the relatively low magnetic subsoil on to the more magnetic topsoil. This technique is classed as a *passive* technique as it relies on measuring the physical attributes, or the magnetic field, of features that exist in the absence of a measuring device, such as a kiln or ferrous object.

2.3 However, the main drawback to magnetic surveys is that non-thermoremnant features, such as stone building remains, or those features with magnetic susceptibility levels similar to those of the background (particularly in areas where the parent material of the topsoil has very low magnetic susceptibility levels) will fail to be seen in the magnetic survey results. Therefore, a complementary or more suitable technique, such as an earth resistance survey, is advised in addition, given the potential for buried stone foundations at the priory site.

2.4 ***Methodology:*** a vertical gradiometer will be employed, the Bartington Grad601-2, with a sensor separation of 1.0m. The instrument is held above ground from which data are captured in the internal memory, and then downloaded to a portable computer for processing. The survey area will be divided into a 30m grid system dependant on the suitability of the site conditions. Within this grid system, sampling will be at a minimum of 0.25m intervals on a 1.0m traverse separation.

2.5 ***Electrical Resistance Survey:*** non-magnetic stone structures or megaliths cannot be easily identified with magnetometry. Therefore, stone building remains may be difficult to identify or interpret without the use of electrical resistivity.

2.6 This technique is classed as an *active* technique as it requires physically injecting a current into the ground and measuring the response. An earth resistance meter relies on the properties of the moisture retained within the soil to pass an electrical current through the ground from a pair of mobile probes, mounted on a frame, to a pair of remote probes. The resistance is measured between the probes and can identify buried remains when compared to the background resistance. Cut features that have been subsequently infilled tend to be more moisture retentive and thereby less resistant to the current. These features manifest as low resistance anomalies. Structural remains or buried megaliths are more resistant to the current flow and are seen as high resistance features.

2.7 ***Methodology:*** a Geoscan Research RM15 resistivity meter with a multiplexer will be employed. The standard methodology for an electrical resistance survey is to have four mobile probes mounted horizontally on a frame at a distance of 0.5m apart. These probes literally make contact with the ground and will produce a depth of penetration of approximately 0.5m-1.0m. The data are captured in the internal memory of the RM15 and then downloaded to a portable computer. The survey area will be divided into the same 30m grid system also used for the magnetic survey, and whichever size is deemed more suitable to the site conditions. Within this grid system, sampling will be at 1.0m intervals on a 1.0m traverse separation.

3 REPORT AND ARCHIVE

3.1 ***Report:*** a digital copy of the report will be provided. This will include the analysis and recommendations for any further work if required. The report will include;

- a site location plan related to the national grid
- a front cover to include the planning application number and the NGR
- the dates on which all elements of the fieldwork was undertaken
- a concise, non-technical summary of the results
- an explanation to any agreed variations to the brief, including any justification for any elements not undertaken
- brief historical background
- a description of the methodology employed, work undertaken and results obtained
- plans at an appropriate scale showing the location and position of anomalies located
- recommendations concerning any subsequent mitigation strategies and/or further archaeological work
- a copy of this project design, and indications of any agreed departure from that design
- the report will also include a complete bibliography of sources from which data has been derived.

3.2 ***Confidentiality:*** the final report is designed as a document for the specific use of the client, and should be treated as such; it is not suitable for publication as an academic report, or otherwise, without amendment or revision. Any requirement to revise or reorder the material for submission or presentation to third parties beyond the project brief and project design, or for any other explicit purpose, can be fulfilled, but will require separate discussion and funding.

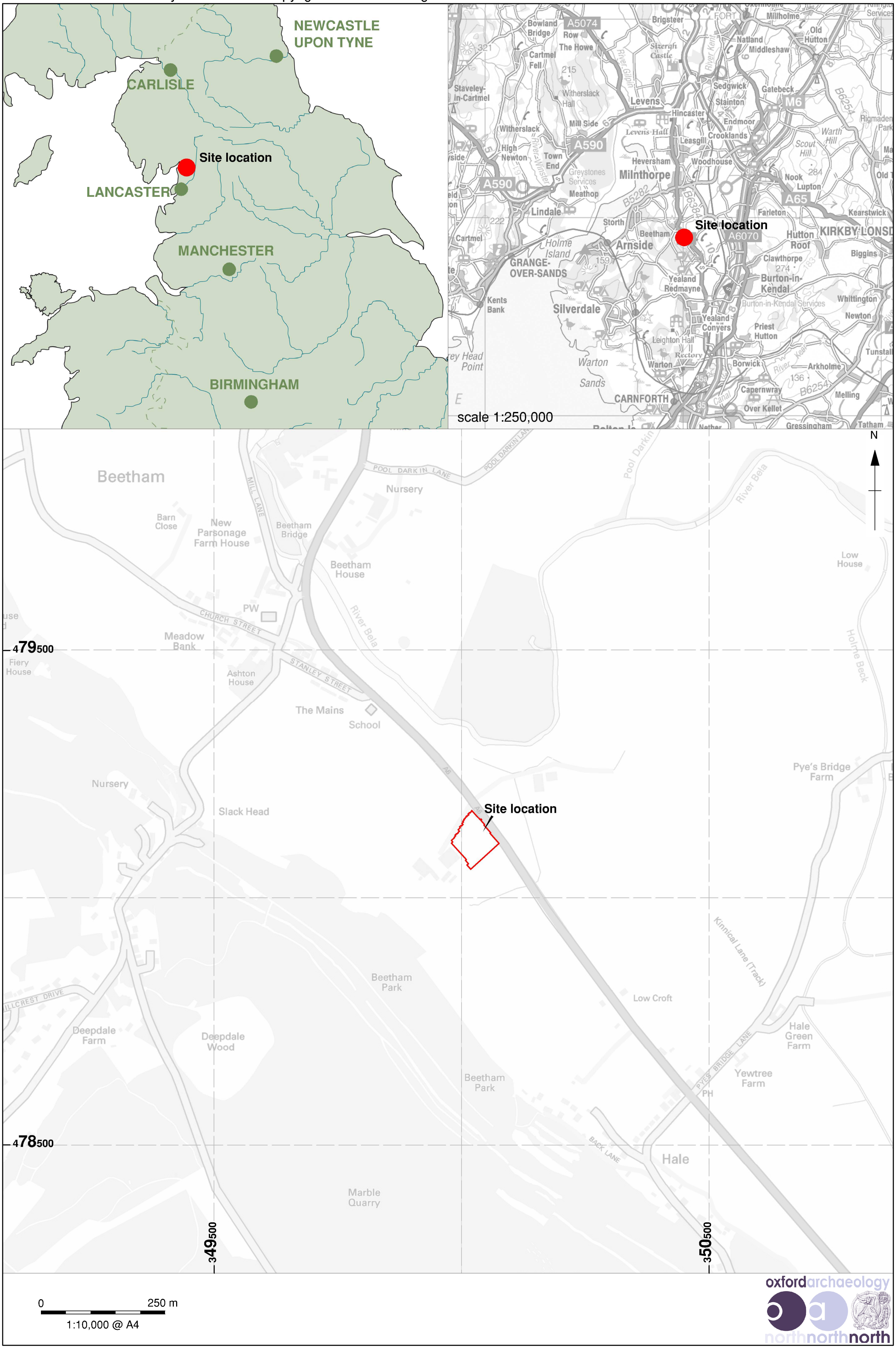

Figure 1: Site location

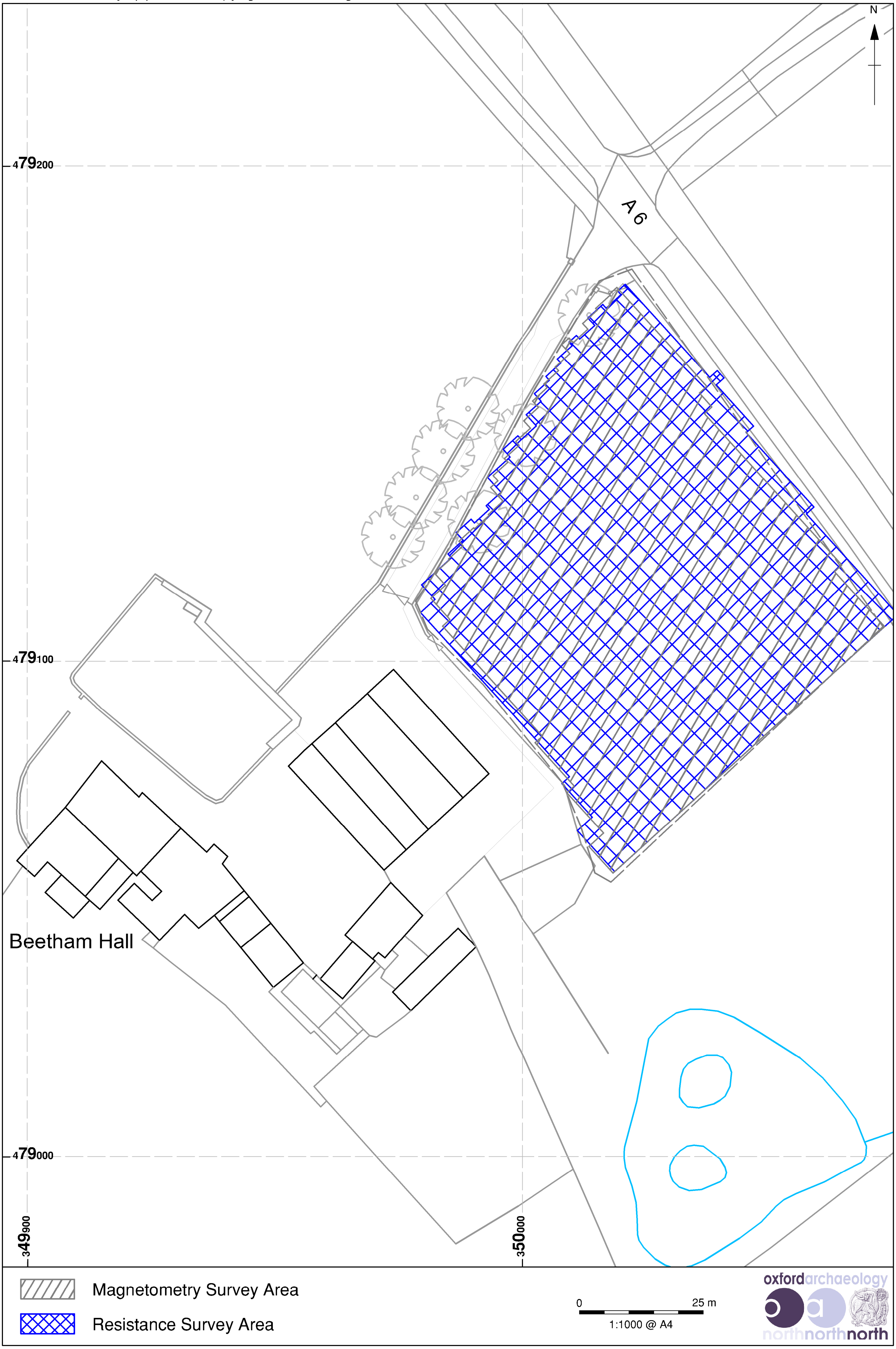

Figure 2: Extent of the geophysical survey area

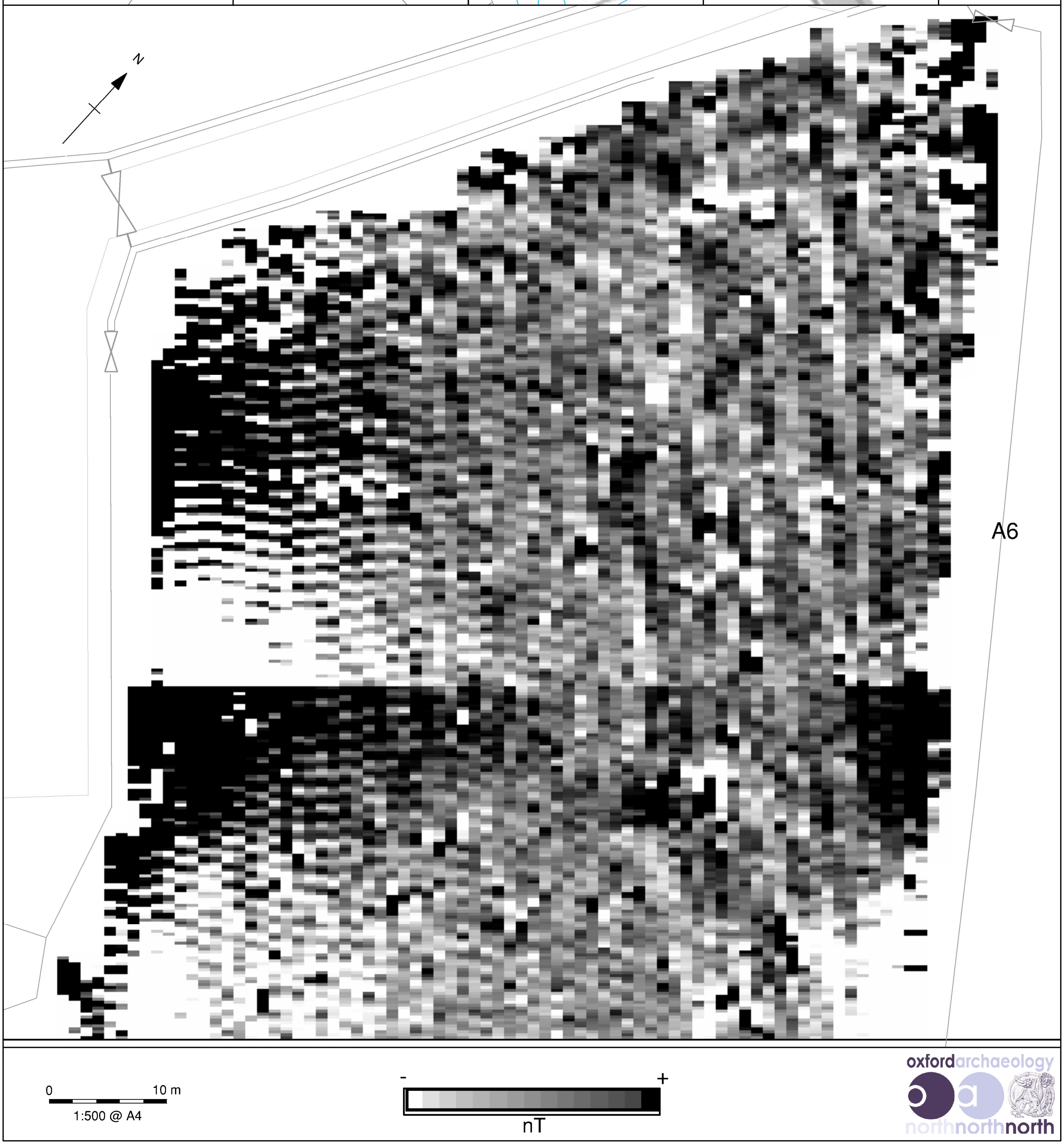

Figure 3: Greyscale plot of the processed magnetometer data

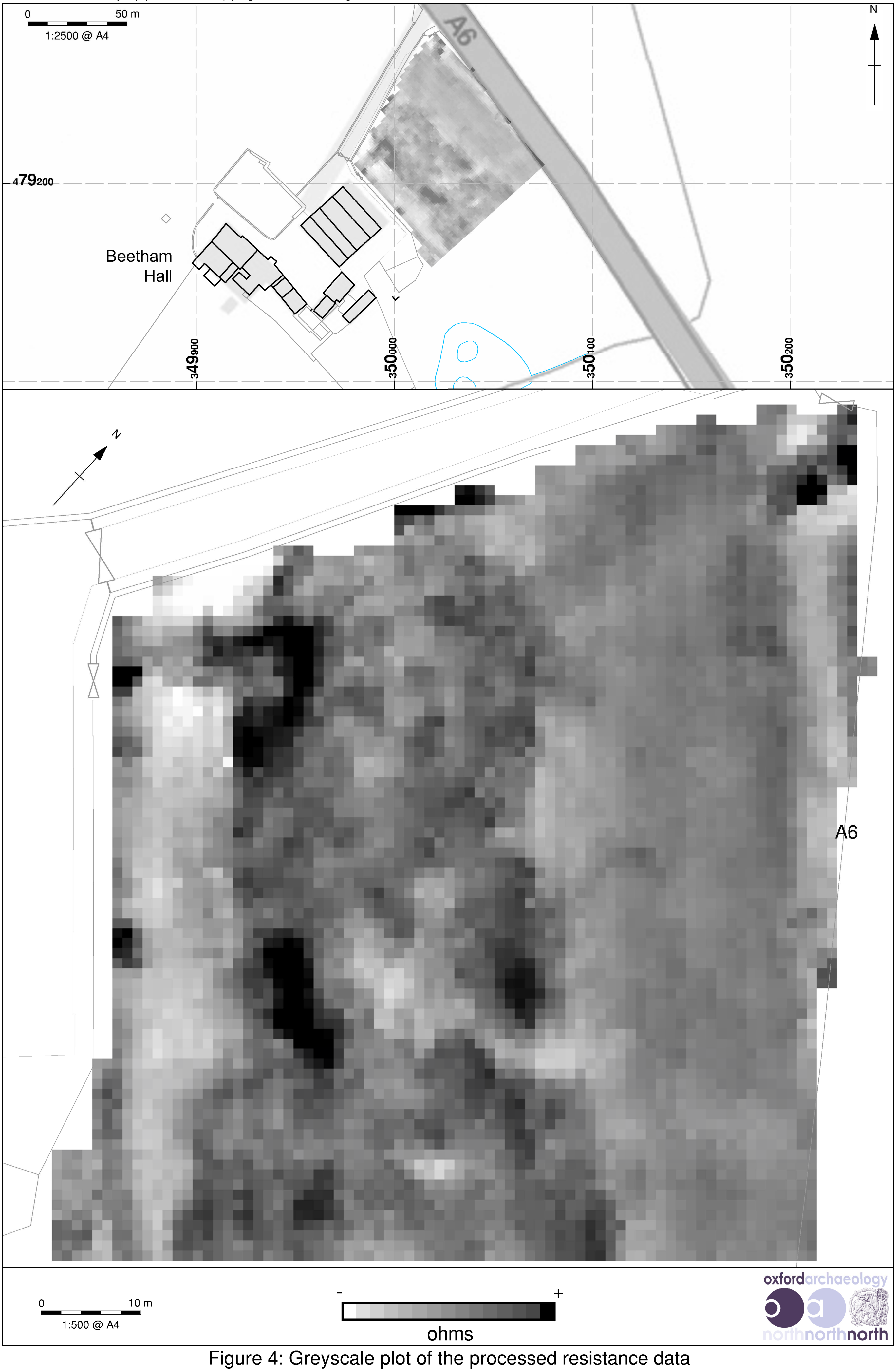

Figure 4: Greyscale plot of the processed resistance data

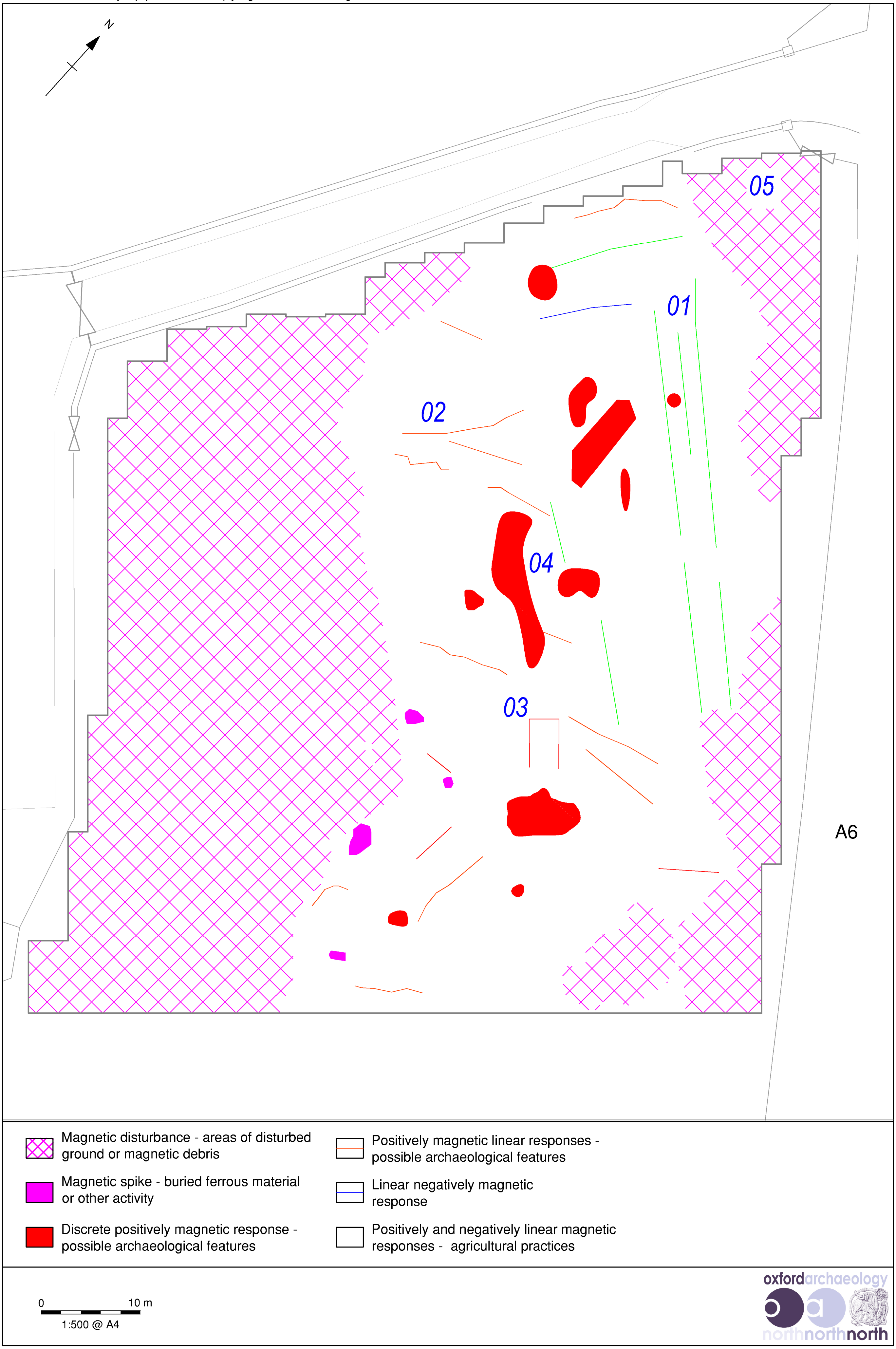

Figure 5: Interpretation plot of the processed magnetometer data

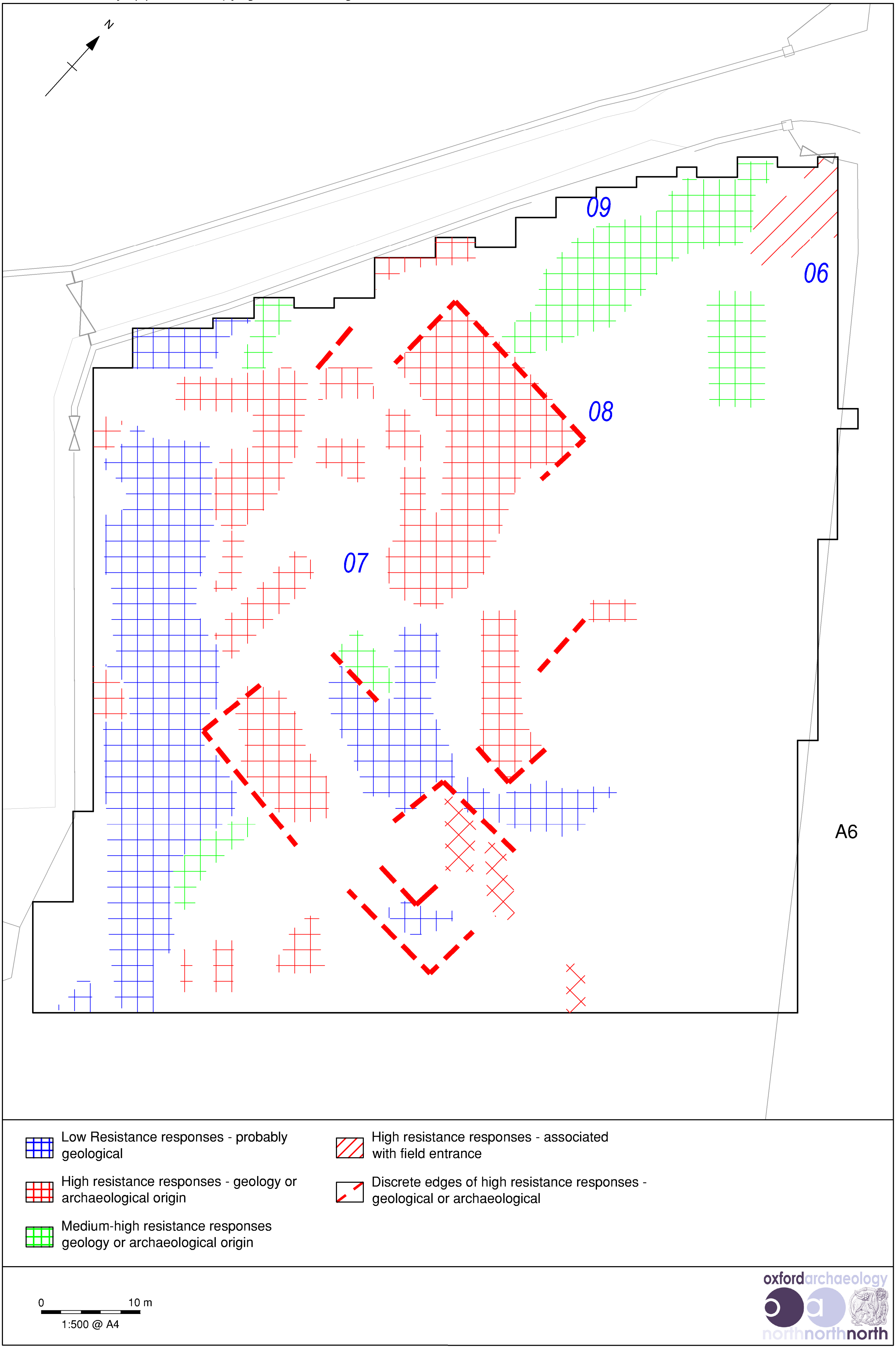

Figure 6: Interperetation plot of the processed resistivity data

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