LAND SOUTH OF LUMLEY ROAD,
KENDAL,

CUMBRIA

Geophysical Survey Report

Oxford Archaeology North

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Greenlane Archaeology

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SUMMARY

Prior to submission of a planning application, Greenlane Archaeology carried out a desk based assessment on land south of Lumley Road, Kendal, Cumbria (centred on NGR SD350886 490979). The desk based assessment identified 18 sites of archaeological interest including several cropmarks from an aerial photograph dated to 1955. Jeremy Parsons of Cumbria Historic Environment Service therefore recommended a geophysical survey and following submission of method statement to Greenlane Archaeology Ltd, Oxford Archaeology North was commissioned to carry out the survey.

A magnetometer survey was carried out on a field occupying approximately 4.6 hectares of land south of Lumley Road. The survey was undertaken between 29th of September and 1st October 2014.

For the most part, the geophysical survey identified features of mainly geological origin. Many of the discrete responses match cropmarks visible in the 1955 aerial photograph and are generally random in nature. Responses such as these are typical of the underlying geology of post-glacial gravel. The survey also identified a rectilinear positively magnetic response situated in the north-west corner of the survey area that matched the general size and shape of the southern part of a cropmark visible in a similar location on the 1955 photograph, and probably represents a ditched enclosure of potential archaeological origin.

ACKNOWLEDGEMENTS

Oxford Archaeology North (OA North) would like to thank Dan Elsworth of Greenlane Archaeology Ltd for commissioning the project and for his support and assistance in the course of the survey.

The geophysical survey was undertaken by Mike Birtles who also wrote the report. The drawings were produced by Mike Birtles and Karl Taylor. The project was managed by Karl Taylor, who also edited the report.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

1.1.1 Prior to submission of a planning application, Greenlane Archaeology carried out a desk based assessment on land south of Lumley Road, Kendal, Cumbria (centred on NGR SD350886 490979).

1.1.2 The desk based assessment identified 18 sites of archaeological interest including several cropmarks from an aerial photograph. Jeremy Parsons of Cumbria Historic Environment Service subsequently recommended a non-intrusive geophysical survey.

1.1.3 Following acceptance of a method statement (*Appendix 1),* OA North were commissioned to carry out the geophysical survey which was carried out between 29th September and 1st October 2014.

1.2 LOCATION AND BACKGROUND TO THE AREA

1.2.1 ***Location, Geology and Topography:*** The site is situated to the south of Lumley Road and to the west of Milnthorpe Road, Kendal. The River Kent is located less than 300m to the south east of the site. The field is irregular in shape and is approximately 4.6 hectares in area.

1.2.2 The underlying bedrock consists of carboniferous limestone and the overlying superficial deposits are of glacial gravel (www.bgs.ac.uk). The soils consist of freely draining loamy slightly acid base-rich (www.landis.org.uk).

1.2.3 The topography was generally flat and low lying. The field boundaries comprised a mixture of stone walls and hedges, with the former making up all of the south-east and south side. The north/north-east boundary is a mixture of walls, including some large blocks of reused (?) orangey sandstone and concrete where it is met by later walls dividing gardens for the houses beyond, and clipped beech hedges (Greenlane Archaeology 2014). Drain covers were also present on the site (*ibid*).

1.2.4 ***Background:*** The desk based assessment by Greenlane Archaeology suggests that little archaeological work was been carried out in the immediate vicinity but identifies several sites close by. Within the survey area, the assessment identifies a putative enclosure visible through cropmarks identified from aerial photographs taken in 1955. These cropmarks do not form a clear cohesive recognisable structure and are therefore difficult to date (*ibid*).

1.2.5 There are two putative prehistoric monuments on the limestone scar west of the site (SD 487938) and (SD 505915). The latter of these monuments is situated within the former Kendal racecourse but neither have been excavated or confirmed as being prehistoric (*ibid*). Slightly further south at Sizergh (SD49488684) is a cairn which when excavated in 1903, was proven to be artificial. The cairn contained burials dating to the Neolithic (*ibid*)

1.2.6 A Roman fort dating to the 1st century AD lies within a bend in the River Kent 300m to the east of the site, remains of the civilian settlement were observed in 1732 by Horsley to the west of the fort (*ibid*).

1.2.7 The nearby settlement of Helsington was recorded in the Domesday book, The name Helsington could mean 'farmstead' and may be associated with the enclosure identified in the cropmarks as seen on the aerial photograph (*ibid*)

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 A method statement was submitted by OA North (*Appendix 1*) to Greenlane Archaeology Ltd. The methodology was used as the basis for the survey, and the work was consistent with the relevant standards and procedures of English Heritage (English Heritage 2008) and the Institute for Archaeologists (IfA 2011), and generally accepted best practice.

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 more subtle 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 English Heritage (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 ***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 4.6 ha was surveyed with magnetometry (Fig 3). 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.

2.2.4 ***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 the software programme 'Geoplot' by *Geoscan Research*.

2.2.5 Final minimal processing of magnetometry raw data was undertaken off site in accordance with English Heritage guidelines (English Heritage 2008) to remove any instrument error or survey effects in order to enhance more subtle anomalies normally associated with archaeological features:

- Zero median traverse (ZMT) 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 in order to remove random spikes. Random spikes are usually caused by erroneous small ferrous objects.

2.2.6 ***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 (Fig 4)

2.3 ARCHIVE

2.3.1 A full professional archive has been compiled in accordance with current IfA and English Heritage guidelines (English Heritage 1991). The paper and digital archive will be deposited with the Cumbria Historic Environment Records (HER) office in Kendal on completion of the project. 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 IfA 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 survey was carried out over one area (Fig 2), and for the most part, the background is generally fairly 'quiet' with most responses showing fairly good contrast. Most of the visible responses are probably due to the geological/ geomorphological background of gravels. There is a single response of potential archaeological origin.

3.2 MAGNETIC SURVEY

3.2.1 The most obvious visible responses within the data are two linears consisting of strong dipolar responses running across the southern half of the survey area (Figs 3 and 4). These are due to buried metallic services, associated with two covers seen on site. Other strong dipolar responses along the edge of the northern boundary are due to the modern boundary.

3.2.2 There are several discrete areas and short linear responses of positive enhancement within the survey area. There is no obvious pattern to these and many appear to correlate with crop marks visible in the 1955 aerial photograph (*Section 1.2.4*). It is likely that all of these are a result of the underlying geology consisting of gravels, and they represent pockets of gravel. The linear response running diagonally across the survey area probably represents a palaeochannel.

3.2.3 There are other, less clearly defined areas of magnetic enhancement within the survey area (Figs 3 and 4) that are also probably due to the background geology. Within these areas there are some discrete responses, which are, again, due to the background geology.

3.2.4 In the north-west corner of the survey area is a rectilinear arrangement of positively magnetic linear responses (Figs 3 and 4). These appear to correspond to the crop mark visible in the 1955 aerial photograph (*Section 1.2.4*) and probably represent the southern extent of the cropmarks before the construction of the houses to the north of the survey area. The responses are indicative of ditches and this almost certainly represents a feature of archaeological potential.

4. CONCLUSIONS

4.1 DISCUSSION

4.1.1 For the most part, the geophysical survey has identified features of mainly geological origin. Many of the discrete responses match cropmarks visible in the 1955 aerial photograph and are generally random in nature. Responses such as these are typical of the underlying geology of post-glacial gravel. The rectilinear positively magnetic responses situated in the north-west corner of the survey area match the general size and shape of the southern part of a cropmark visible in a similar location on the 1955 photograph, and probably represents a ditched enclosure of possible archaeological origin.

5. BIBLIOGRAPHY

5.1 SECONDARY SOURCES

Clark, A, 1990 *Seeing Beneath the Soil*, London

English Heritage, 2008 *Geophysical Survey in Archaeological Field Evaluation* (2nd edition, Swindon

Greenlane Archaeology Ltd, 2014, Land South of Lumley Road, Kendal, Cumbria. Archaeological Desk-Based Assessment, unpubl.

Institute For Archaeology (IfA), 2011 *Standard and Guidance for archaeological geophysical survey,* Reading

Schmidt, A, 2002 *Geophysical Data in Archaeology: A Guide to Good Practice,* Oxford

5.2 ONLINE SOURCES

British Geological Survey www.bgs.ac.uk

Land Information System www.landis.org.uk

APPENDIX 1: PROJECT DESIGN

GEOPHYSICAL SURVEYS AT LEVENS AND KENDAL – OUTLINE METHODOLOGY

1 INTRODUCTION

1.1 This document provides the methodology for a programme of archaeological geophysical survey, reporting and archiving, to be in association with development of two sites at Lumley Road, Kendal (NGR SD 50886 90979) and Greengate Road, Levens (NGR SD 49077 86160) as requested by the client, Greenlane Archaeology Ltd. The survey work will be carried out in accordance with the current English Heritage Standards (English Heritage 2008).

1.2 Free access to the site is assumed and the site must be clear of obstructions. The survey area may be reduced due to factors beyond the control of OA North.

2 METHODS STATEMENT

2.1 INTRODUCTION

2.1.1 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.

2.1.2 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.

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

2.2 GEOPHYSICAL SURVEY

2.2.1 ***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.

2.2.2 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.

2.2.3 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.

2.2.4 ***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. The survey grids will be staked out using a Leica 1200 series RTK GPS system accurate to +/- 0.01m.

2.2.5 ***Survey Area:*** the size of the area to be surveyed at Lumley Road, Kendal is approximately 4.4 ha, while the area at Greengate Road, Levens is approximately 2.1 ha.

2.3 REPORT AND ARCHIVE

2.3.1 ***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 and sections at an appropriate scale showing the location and position of deposits and finds 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.

2.3.2 ***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.

ILLUSTRATIONS

LIST OF FIGURES

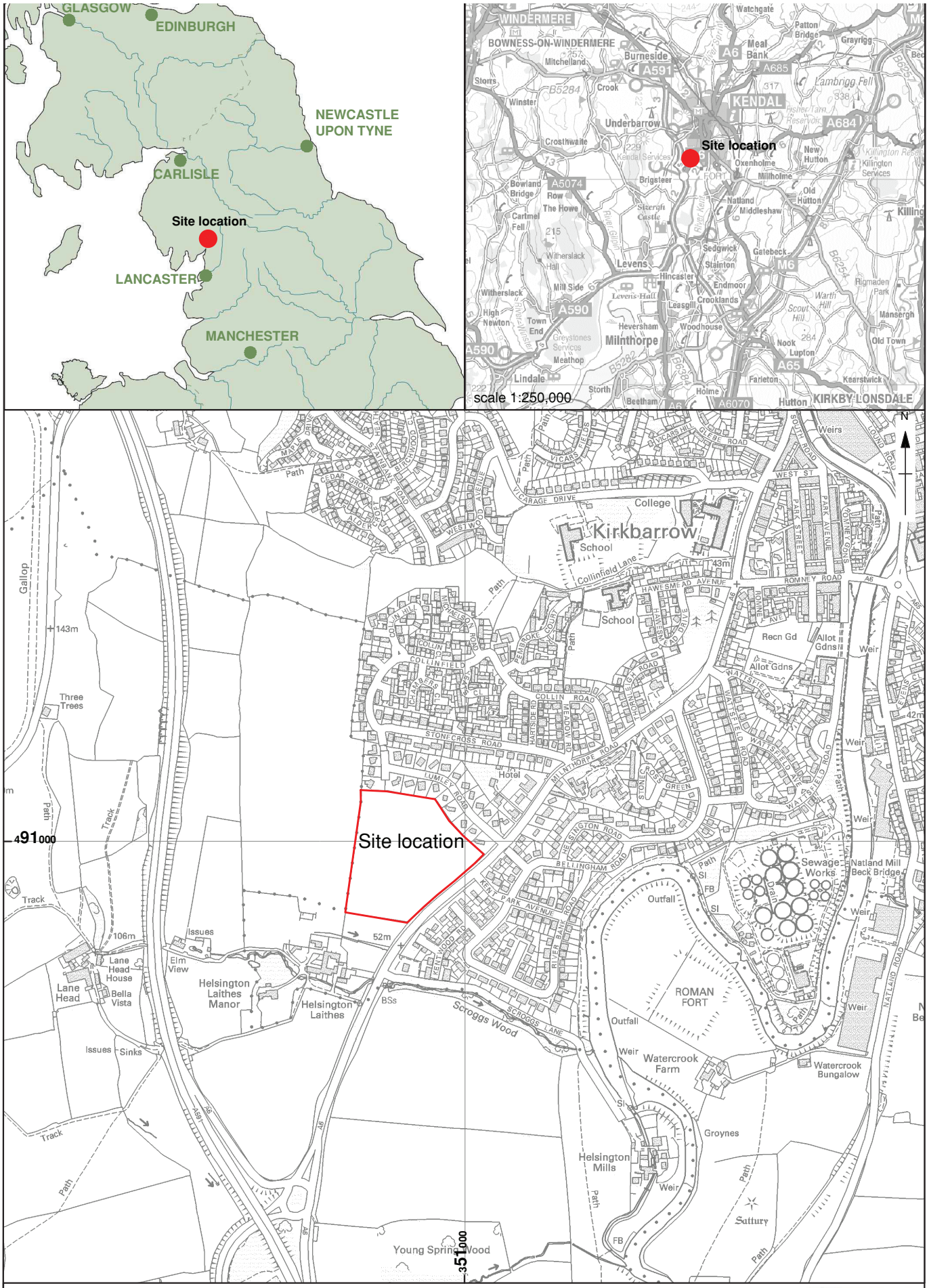

Figure 1: Site location

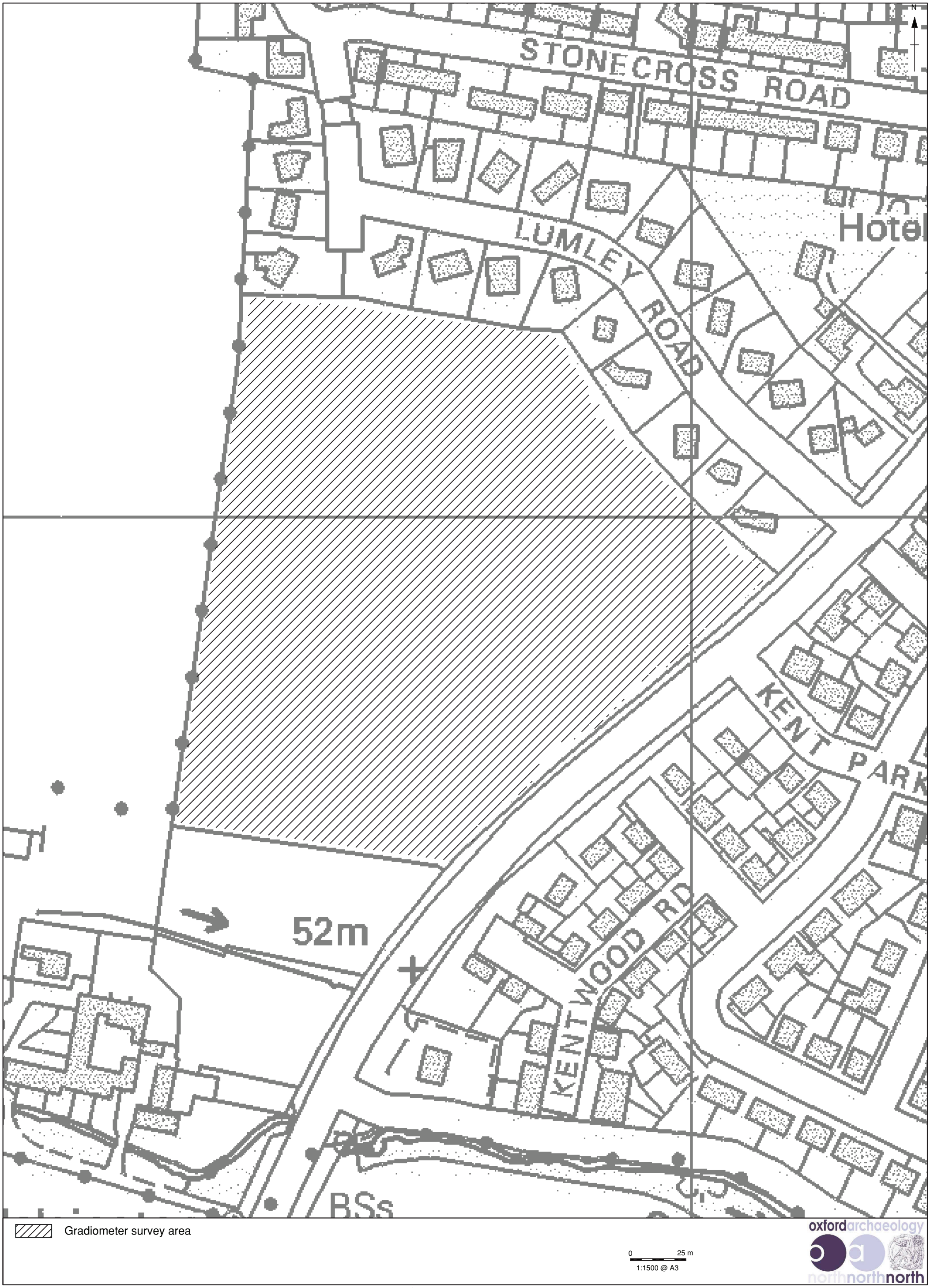

Figure 2: Extent of area surveyed by geophysical survey

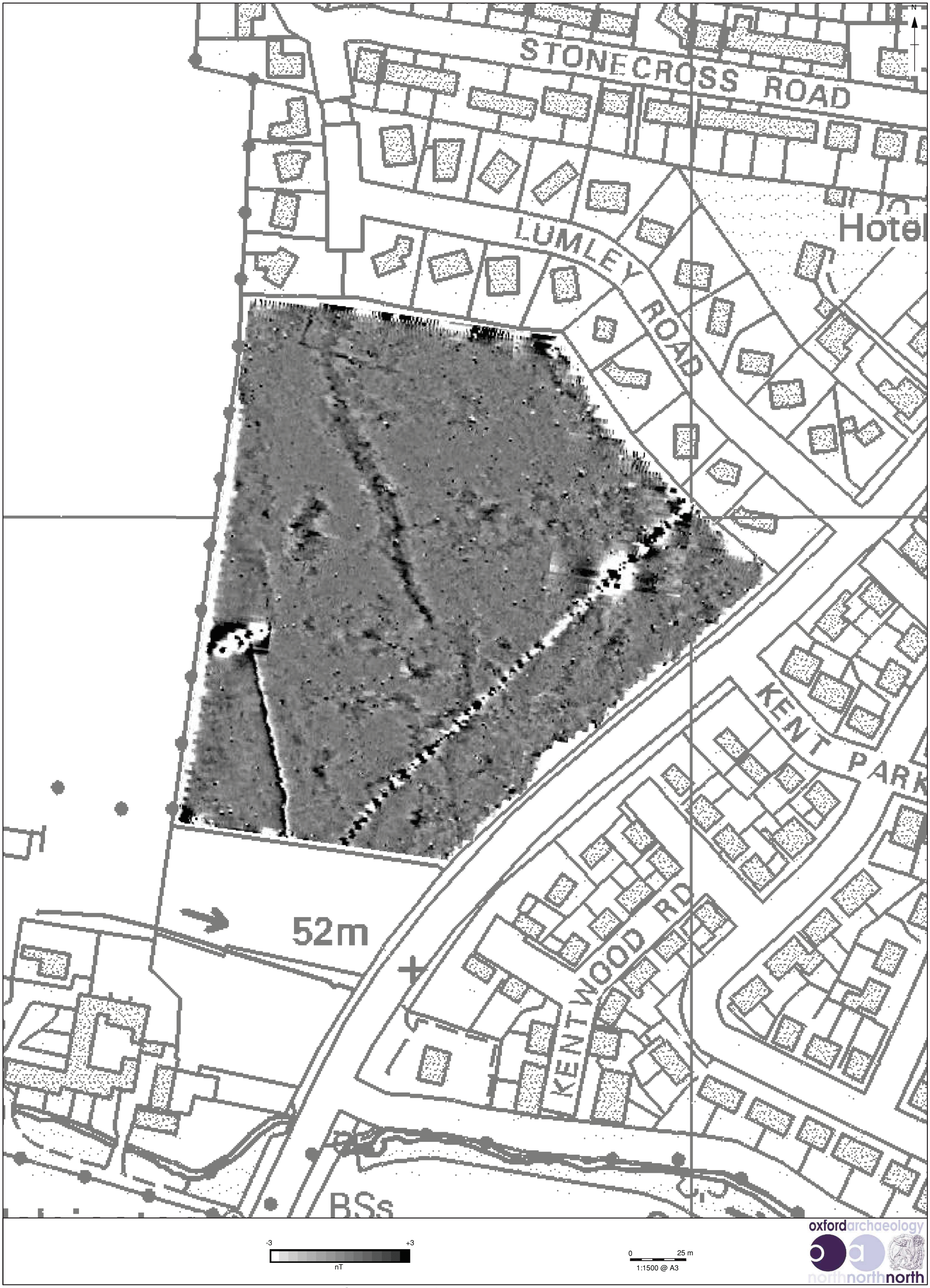

Figure 3: Greyscale plot of the processed magnetometer survey

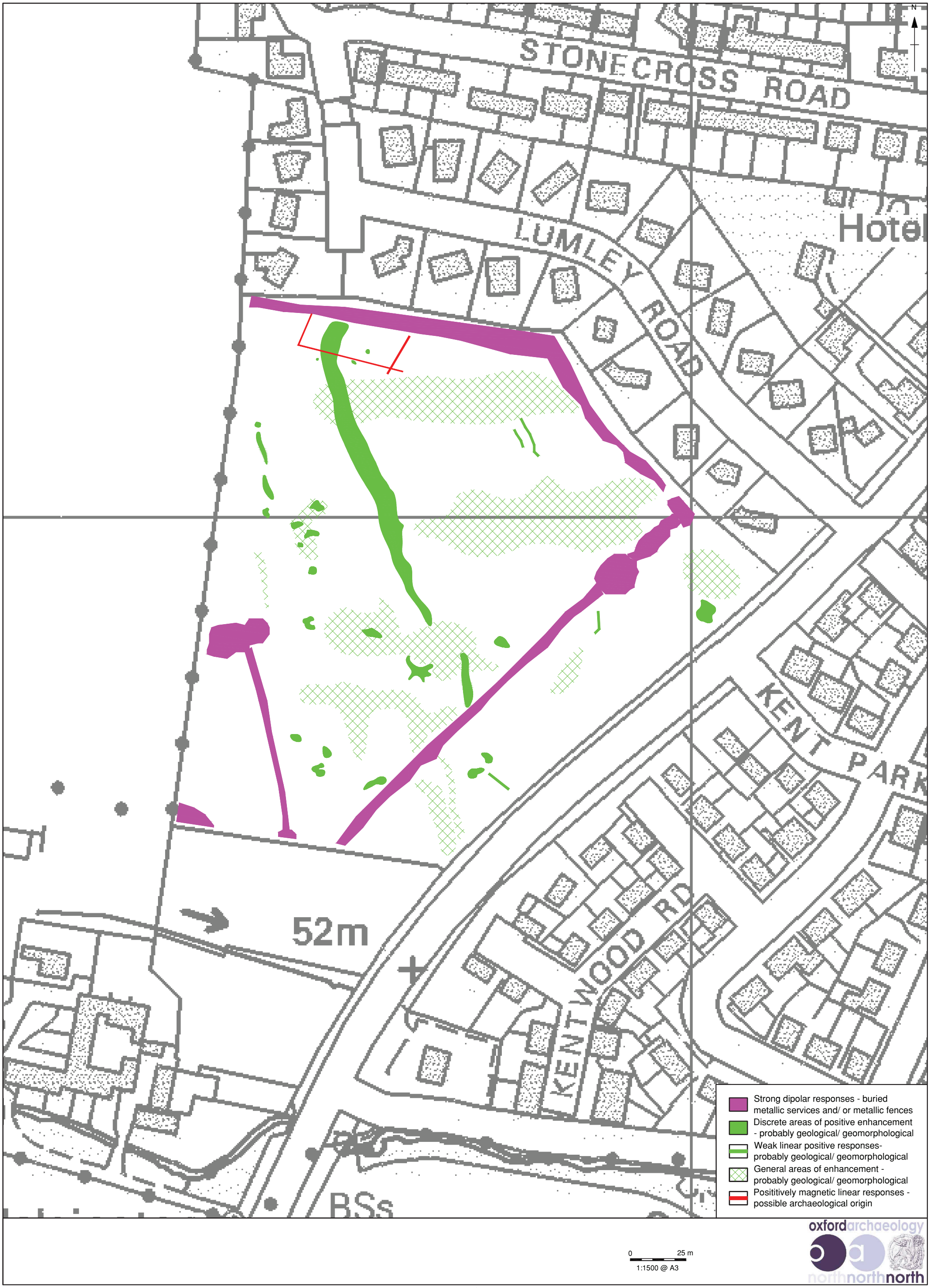

Figure 4: Interpretation plot of the magnetometer survey