LAND OFF GREENGATE ROAD,
LEVENS,

CUMBRIA

Geophysical Survey Report

Oxford Archaeology North

October 2014

Greenlane Archaeology ltd

Issue No: 2014-15/1573
OA North Job No L10797
NGR: SD 49077 86160

Document Title: **LAND OFF GREENGATE ROAD LEVENS, CUMBRIA**

Document Type: **Geophysical Survey Report**

Client Name: Greenlane Archaeology Ltd

Issue Number: **2014-15/1573**
OA Job Number: L10797
National Grid Reference: SD 49077 86160

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SUMMARY

Prior to submission of a planning application, Greenlane Archaeology carried out a desk based assessment on off Greengate Road, Levens, Cumbria (centred on NGR SD 49077 86160). The desk based assessment identified 29 sites of archaeological interest including a late prehistoric settlement site, Medieval or Post Medieval ridge and furrow ploughing and two Bronze Age burial monuments. 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 undertaken on three fields occupying approximately 2.1 hectares of land. The survey was carried out between 2nd and 3rd October 2014.

In general, the background magnetic response was fairly high and in some areas, the data was fairly 'noisy'. It was clearly seen that the area had obviously been subject to ploughing, with very distinctive parallel responses visible in the data. Despite this, there were several discrete responses of probable and possible archaeological origin. The most convincing took the appearance of rectilinear or square features and may be evidence of ditched enclosures although parts of these appear to have been damaged by the ploughing. Other responses of possible archaeological origin appeared to be aligned with the plough lines but this may be due to the dragging effect that modern ploughing tends to have on buried features. Despite this, they may yet be of archaeological origin.

The northern part of the survey area exhibited areas of strong dipolar responses due to modern above ground metallic objects. Responses indicative of a relict field boundary were also present in the southern part of the survey together with a small area of possible thermo-remnant material.

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 Karl Taylor and Mike Birtles. 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 Greengate Road, Levens, Cumbria (centred on NGR SD 49077 86160).

1.1.2 The desk based assessment identified 29 sites of archaeological interest including a late prehistoric settlement site, Medieval or Post Medieval ridge and furrow ploughing and two Bronze Age burial monuments. Subsequently Jeremy Parsons of the Cumbria Historic Environment Service recommended a 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 undertaken between 2nd and 3rd October 2014.

1.2 LOCATION AND BACKGROUND TO THE AREA

1.2.1 ***Location, Geology and Topography:*** The site is situated to the north-west of Greengate Crescent, Levens, Cumbria. The survey area is approximately 2.1 hectares in area and is divided into three fields by metal fencing. The largest of the fields is used as pasture and slopes moderately from the northwest to south east. The remaining two fields are partially separated by a stone wall with moderately dense undergrowth and trees. The field to the west of these has been disturbed recently for installation of a high voltage electricity pylon. The site was approximately 2.1 hectares in area.

1.2.2 The underlying bedrock consists of carboniferous limestone and the overlying superficial deposits are of glacial till (www.bgs.ac.uk). The soils consist of very acid loamy upland type with a wet peaty surface (www.landis.org.uk).

1.2.3 ***Background:*** The desk based assessment by Greenlane archaeology (Greenlane Archaeology 2014) identified 6 episodes of previous archaeological excavation. An excavation in 2002 in Nelson Square, Levens, revealed four crouched inhumations interred in small hollows in the limestone bedrock, these were dated to the Iron Age (*ibid*).

1.2.4 Approximately 2km north east of the site at Sizergh (SD 49488684) is a cairn which when excavated in 1903, was proven to be artificial. The cairn contained burials dating to the Neolithic (*ibid*).

1.2.5 There is very little evidence to suggest that Levens was occupied during the Romano-British period (*ibid*).

1.2.6 Levens was mentioned in the Domesday survey on 1087 with both Levens Hall and Sizergh Castle established during the Medieval period (*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 a 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 2.1 ha was surveyed with magnetometry (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.

2.2.4 ***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 grey-scale plots for the magnetometry (Figs 3 and 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 in the Cumbria Historic Environments 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 three areas (Fig 2) and in general, the background magnetic response was fairly high and in some areas, the data was fairly 'noisy'. It can clearly be seen that the area has obviously been subject to ploughing, with very distinctive parallel responses visible in the data (Fig 3). Despite this, there are several discrete responses that may be of archaeological origin. The northern part of the survey are exhibits areas of strong dipolar responses due to modern above ground metallic objects.

3.2 MAGNETIC SURVEY

3.2.1 The most obvious characteristic of the data are the parallel responses running along the long axis of the southern field (Figs 3 and 4). These are typical of modern ploughing and are probably indicative of a fairly deep ploughing regime. Ploughing such as this tends to mask weaker responses such as those of potential archaeological origin, particularly linear features that run parallel to the plough lines. In this case however, there are numerous discrete positively magnetic responses visible in the data, several of which may be of archaeological potential. In particular, a series of responses in the centre of the southern part of the survey area (M1 – M5 Fig 4) may be archaeological in origin although M1 appears to have been elongated due to the action of ploughing. M4 is intermittent, again due to the action of ploughing destroying part of the buried feature. Responses M2, M3 and M4 appear to be of rectilinear or square appearance. There is an area of magnetic disturbance situated in between M3 and M2, which may be due to buried thermo-remnant material.

3.2.2 The other discrete responses of possible archaeological origin all appear to be aligned with the plough lines but this may be due to the dragging effect that modern ploughing tends to have on buried features. Despite this, they may yet be of archaeological origin.

3.2.3 A parallel linear arrangement of negatively and positively magnetic responses can be seen to follow an intermittent course up the field (M5). These are probably due to a relict field boundary observed on historic and later maps (Greenlane Archaeology 2014). Running along the western boundary of the survey area is a series of fairly strong positive and negative responses, the origin of these is unknown but they may be associated with the construction of the adjacent housing estate. Other responses such as the strong dipolar areas and dipolar spikes are due to modern field boundaries and extant metallic objects and buried ferrous objects.

4. CONCLUSIONS

4.1 DISCUSSION

4.1.1 The geophysical survey has revealed that the survey area has been subject to agricultural activity, in the form of deep ploughing. Despite this there are several responses that may be of archaeological origin, particularly in the centre of the southern field. These take the appearance of rectilinear or square features and may be evidence of ditched enclosures. Other less convincing responses may also be of archaeological potential. Other responses such as the parallel positive and negative linear and strong dipolar responses are due to a removed field boundary and extant modern metallic objects. The area of magnetic disturbance in the centre of the site may be evidence of a thermo-remnant feature such as an area of burning.

5. BIBLIOGRAPHY

5.1 SECONDARY SOURCES

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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

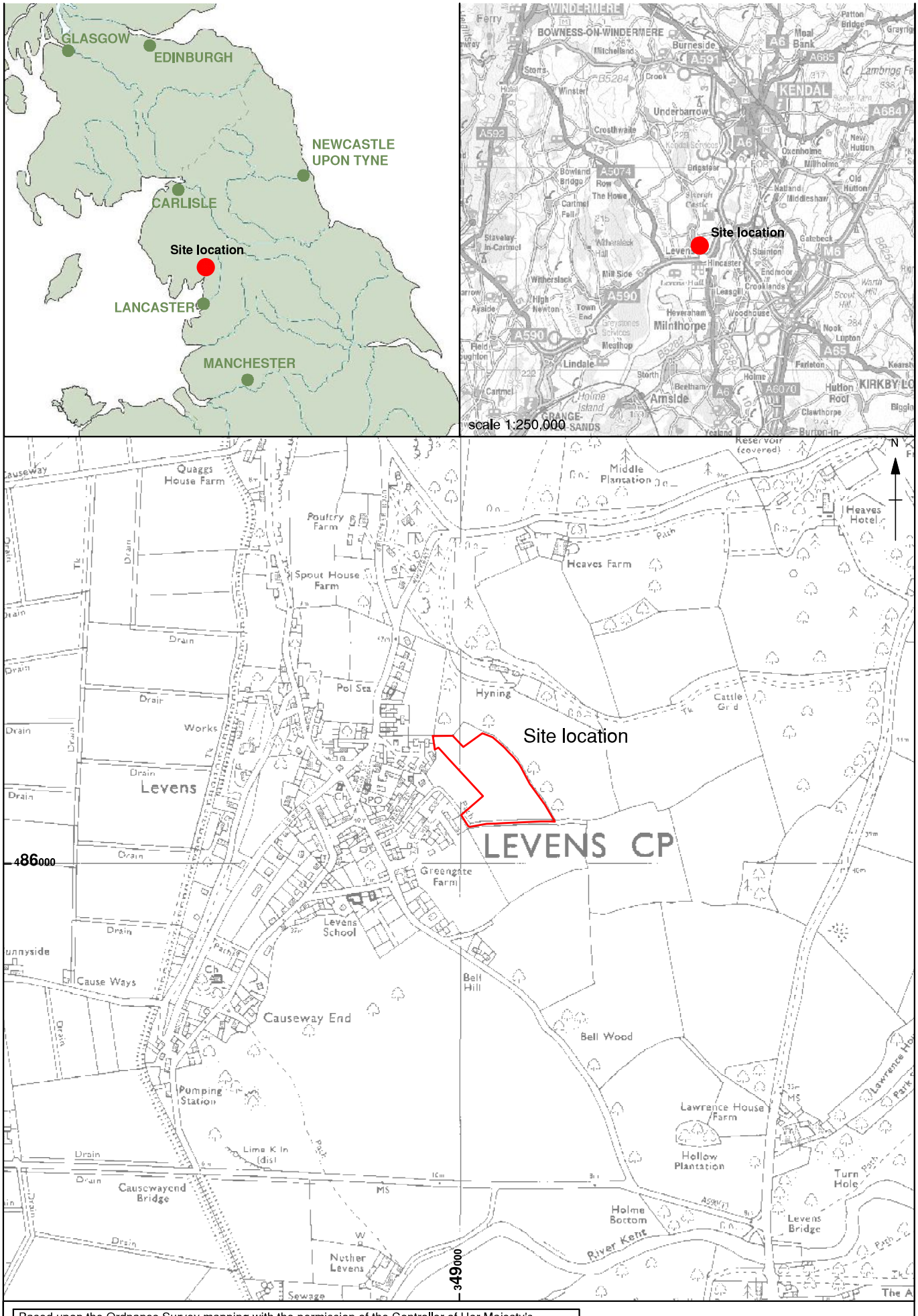

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Figure 1: Site location

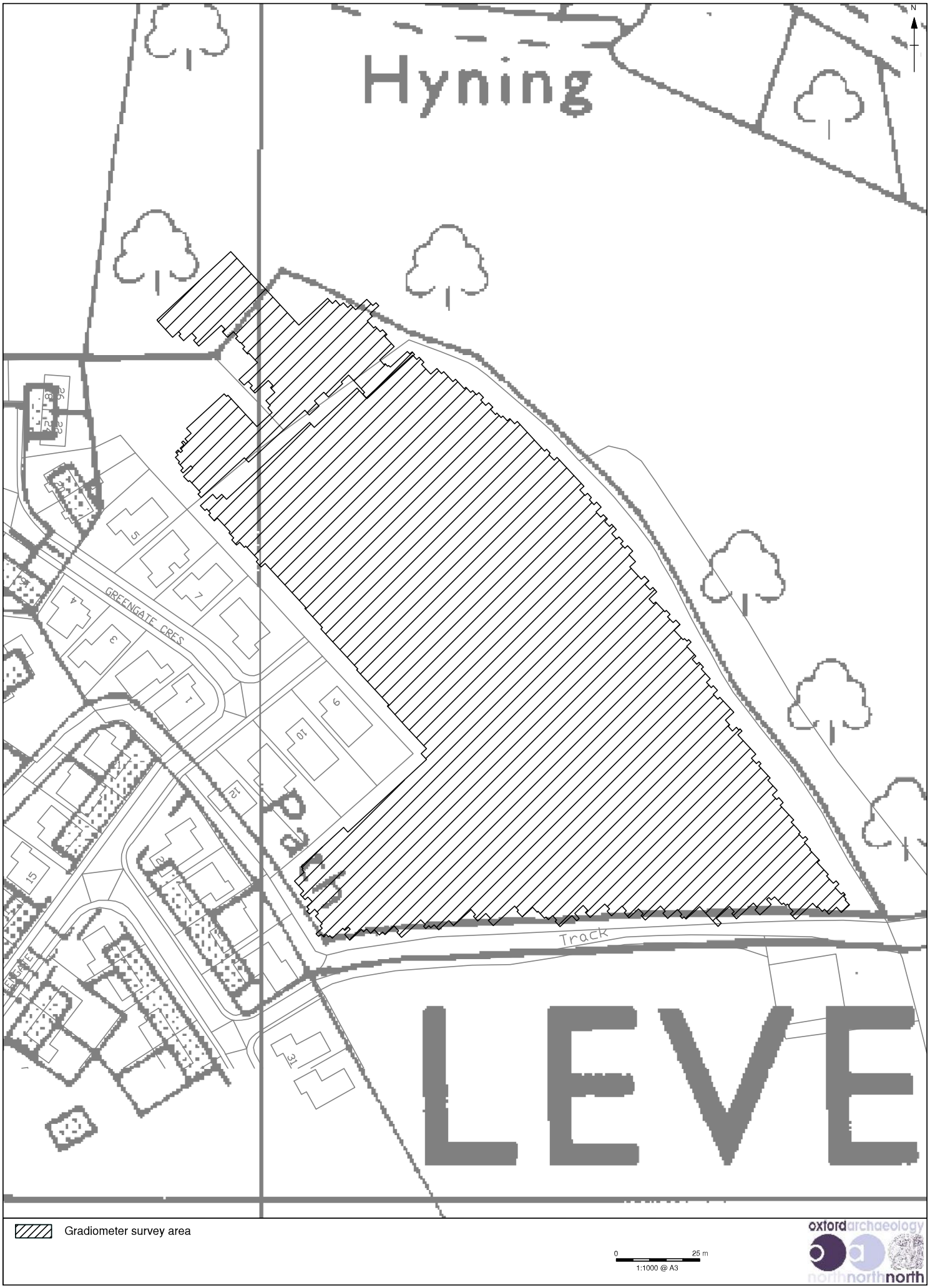

Figure 3: Extent of area surveyed by geophysical survey

Figure 4: Greyscale plot of the processed magnetometer survey

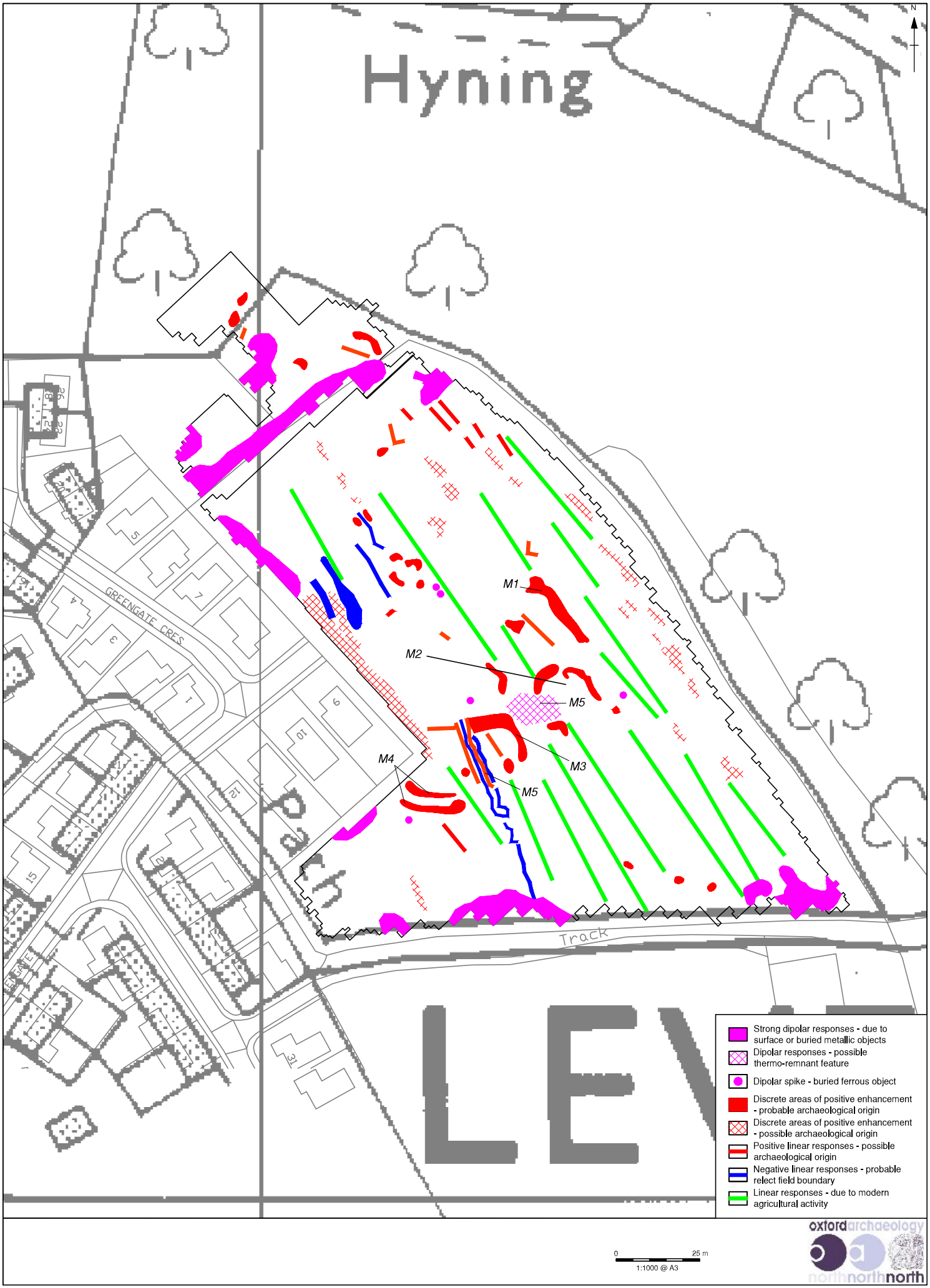

Figure 5: Interpretation plot of the magnetometer survey