

**ARCHAEOLOGICAL EVALUATION REPORT:**  
**GEOPHYSICAL SURVEY BY MAGNETOMETRY ON LAND AT BELTON HOUSE, GRANTHAM, LINCOLNSHIRE**

NGR: SK 9308 3914  
AAL Site Code: BEHO 16  
OASIS Reference Number: allenarc1-255111



Report prepared for the National Trust

By  
Allen Archaeology Limited  
Report Number AAL 2016093

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Allenarchaeology



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*Cover image: View across the surveyed area towards Belton House, looking northwest*

## Executive Summary

- Allen Archaeology Limited were commissioned by the National Trust to undertake a geophysical survey using magnetometry on land at Belton House near Grantham, Lincolnshire, as part of a scoping and feasibility study for a proposed ground sourced heat pump.
- The site lies in an area of archaeological interest, with evidence of activity from the prehistoric through to the post-medieval periods in the vicinity of Belton House. The house itself was constructed between 1684 and 1688.
- The survey has revealed a number of features of potential archaeological interest across the survey area. Across most of the southern half of the survey area there are linear positive and negative features that are likely to represent ridge and furrow cultivation of a medieval date. Two linear positive features also cross this area, and one may relate to a former path to the house shown on a sketch of the estate dating to 1778.
- In the northern part of the site, a series of linear anomalies closely correspond to features forming part of the former layout of the estate at Belton House, as shown on a map of 1717. These features include a possible boundary wall defining the southern edge of the formal gardens, a boundary between an area of formal garden and a bowling green, and elements of a stellate pattern of formal garden features.
- There are two of areas of magnetic noise in the southern half of the survey area that remain unexplained but may represent dumping of modern detritus, ferrous or highly fired material. The magnetic noise could potentially mask any underlying archaeological features in these areas.

## 1.0 Introduction

- 1.1 Allen Archaeology Limited (AAL) was commissioned by the National Trust, to undertake a geophysical survey using magnetometry on land at Belton House near Grantham, Lincolnshire, as part of a scoping and feasibility study for a proposed ground sourced heat pump.
- 1.2 The site works and reporting conform to current national guidelines as set out in '*Geophysical Survey in Archaeological Field Evaluation*' (English Heritage 2008), '*The Use of Geophysical Techniques in Archaeological Evaluations*' (Gaffney *et al.* 2002), and the Chartered Institute for Archaeologists '*Standard and guidance for archaeological geophysical survey*' (CIfA 2014).

## 2.0 Site Location and Description

- 2.1 Belton House lies approximately 3.8km to the northeast of the centre of Grantham, and roughly 0.6km to the south of the village of Belton. The survey area comprises a broadly rectangular block of land of roughly 3 hectares, immediately to the southeast of the main house and directly east of the cricket pitch, centred on NGR SK 9308 3914.
- 2.2 The bedrock geology comprises Charmouth Mudstone Formation, with superficial deposits of Belton Sand and Gravel (<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>).

## 3.0 Planning Background

- 3.1 This scheme of work forms part of a feasibility study that may be used to inform a future planning application should the project be deemed viable.
- 3.2 The approach adopted is consistent with the recommendations of the National Planning Policy Framework (NPPF), with the particular chapter of relevance being '*Chapter 12: Conserving and enhancing the historic environment*' (Department for Communities and Local Government 2012).

## 4.0 Archaeological and Historical Background

- 4.1 A full history of the parkland is detailed in the Parkland Management Plan (Hilary Taylor Landscape Associates Ltd 2011), and as such it is summarised here. Prehistoric activity has been recorded to the south-southeast of Belton House, in the area around Belton Golf Club, where Mesolithic and Bronze Age flint tools have been recovered (Hall 2008). May (1976) also records Bronze Age pottery from Belton, although its exact provenance is unknown.
- 4.2 Romano-British activity is limited to a scatter of 2<sup>nd</sup> to 3<sup>rd</sup> century AD greyware pottery sherds found c.500m to the north of the site (Lincolnshire Historic Environment Record Reference 30439) (hereafter LHER).
- 4.3 Iron objects of Anglo-Saxon date have been found in the far north of the estate, in the garden of the Rectory. The finds comprised at least five knives and part of a spearhead, and may suggest a possible cemetery in the area (LHER Reference 30433).
- 4.4 In the Domesday Book of 1086, Belton appears as *Beltone*, a name deriving from Old English elements *bel-*, meaning 'a piece of dry ground in the fen', and *-tun*, 'a farmstead, village' (Cameron 1998). There are numerous landowners listed for Belton parish: the King had land in Belton which was managed from an estate in Grantham, with further land owned by Guy of Raimbeaucourt, Guy

of Craon, Kolgrimr and Walter of Aincourt. Kolgrimr's estate included two mills (probably water mills on the Witham), whilst Walter of Aincourt controlled three more mills and a church (Morgan and Thorn 1986).

- 4.5 The Domesday Book also records a village called Towthorpe, the precise location of which is unknown, although it is believed to be located within the grounds of the Belton Estate, to the southwest of the proposed development area (LHER Reference 30434). The name is Old Norse in origin, derived from a personal name, *Tovi*, and the *-thorpe* suffix meaning an outlying settlement, which perhaps refers to its relationship to Belton (Mills 1993). Kolgrimr and Guy of Craon also owned land at Towthorpe, including three mills and a church with a priest (Morgan and Thorn 1986). Areas of ridge and furrow earthworks to the north, northeast and south of the site further attest to medieval activity in the area (LHER References 36396, 36400 and 36402).
- 4.6 Belton House was constructed between 1684 and 1688, on the orders of Sir John Brownlow, following his inheritance of the land. The house and estate underwent many changes in line with the fashions of the age, including the development of a less formal garden area called 'The Wilderness' in the mid 18<sup>th</sup> century, located to the west of the main house (Hall 2008).

## 5.0 Methodology

- 5.1 The geophysical survey consisted of a detailed gradiometer survey of the site, totalling approximately 2.7 hectares. The survey was undertaken in a series of 30m grids across the site.
- 5.2 The fieldwork was carried out by a team of two experienced geophysicists on Monday 13<sup>th</sup> June 2016. The survey area was located using a Leica GS08 RTK NetRover GPS. This accurately 3D plotted the area of investigation and tied it into the National Grid.
- 5.3 The survey was carried out using a Bartington Grad601-2 Dual Fluxgate Gradiometer with an on-board automatic DL601 data logger. This instrument is a highly stable magnetometer which utilises two vertically aligned fluxgates, one positioned 1m above the other. This arrangement is then duplicated and separated by a 1m cross bar. The 1m vertical spacing of the fluxgates provides for deeper anomaly detection capabilities than 0.5m spaced fluxgates. The dual arrangement allows for rapid assessment of the archaeological potential of the site. Data storage from the two fluxgate pairs is automatically combined into one file and stored using the on-board data logger.
- 5.4 Data collection was undertaken in a zigzag traverse pattern, using a sample interval of 0.25m and a traverse interval of 1m.

### **Summary of Survey Parameters**

#### 5.5 Fluxgate Magnetometer

Instrument:	Bartington Grad601-2 Dual Fluxgate Gradiometer
Sample Interval:	0.25m
Traverse Interval:	1.00m
Traverse Separation:	1.00m
Traverse Method:	Zigzag
Resolution:	0.01nT
Processing Software:	3.0.29.3
Surface Conditions:	Short grass
Area Surveyed:	2.7 hectares

Date Surveyed: Monday 13<sup>th</sup> June 2016  
Surveyor: Robert Evershed BSc (Hons)  
Survey Assistant: Ryan Godbold  
Data Interpretation: Robert Evershed BSc (Hons)

### ***Data Collection and Processing***

5.6 The grids were marked using pre-programmed grids on the Leica GS08 Net rover. Magnetic data was collected on a north-northeast to south-southwest alignment. A traverse pattern close to north-south is preferable as the fluxgate gradiometer is set up and balanced with respect to the cardinal points. Since the data is plotted as north-south traverses there is considerable merit sampling the north-south response of a magnetic anomaly with as many data points as is possible, this is accomplished as the density collected along the traverse line is greater than that between traverses (Aspinall *et al.* 2008).

5.7 The data collected from the survey has been analysed using Terrasurveyor 3.0.29.3. The resulting data set plots are presented with positive nT/m values and high resistance as black and negative nT/m values and low resistance as white.

The data sets have been subjected to processing using the following filters:

- De-stripping
- Clipping
- De-staggering

5.8 The de-stripe process is used to equalise underlying differences between grids or traverses. Differences are most often caused by directional effects inherent to magnetic surveying instruments, instrument drift, instrument orientation (for example off-axis surveying or heading errors) and delays between surveying adjacent grids. The de-stripe process is used with care as it can sometimes have an adverse effect on linear features that run parallel to the orientation of the process.

5.9 The clipping process is used to remove extreme data point values which can mask fine detail in the data set. Excluding these values allows the details to show through.

5.10 The de-staggering process compensates for data correction errors caused by the operator commencing the recording of each traverse too soon or too late. It shifts each traverse either forward or backwards by a specified number of intervals.

5.11 Plots of the data are presented in processed linear greyscale (smoothed) with any corrections to the measured values or filtering processes noted, and as separate simplified graphical interpretations of the main anomalies detected.

## **6.0 Results**

6.1 For the purposes of interpreting the anomalies, the survey data has been processed to the values of -5 to 5 nT/m (Figure 3). This enhances faint anomalies that may otherwise not be noted in the data, with a number of anomalies identified across the data set, and these are discussed in turn and noted as single or double digit numbers in square brackets.

- 6.2 There is an area of magnetic noise along the north edge of the survey area [1], producing magnetic readings of +/- 100 nT/m. This response is the result of a metal fence along this border.
- 6.3 The linear area of magnetic noise [2], aligned roughly west-northwest to east-southeast close to the north edge of the site relates to a footpath.
- 6.4 There are two further areas of magnetic noise in the southern part of the survey area, one extending from the western edge [3] and one from the eastern edge [4]. Both areas produced readings of mostly between -10 and 20 nT/m, with some areas as high as 80 nT/m. Both areas of magnetic noise appear to be made up of large amounts of individual dipolar spikes, possibly suggesting a dump of modern detritus/ferrous or highly fired material. The edges of the areas appear remarkably clear and well-defined, possibly suggesting the material has not moved or been spread from where it was initially dumped.
- 6.5 There are two, short, linear dipolar features, one close to the southwest corner of the survey area [5] and one close to the centre of the survey area [6]. These have produced readings of between -10 and 80 nT/m and -20 and 40 nT/m respectively. These could represent modern service pipes or land drains.
- 6.6 Crossing the site from the northwest edge to the southeast edge is a long curvilinear positive feature [7]. At the northern end this has produced readings of up to 8 nT/m, whilst at the southern end readings are of 3 to 4 nT/m. Whilst this could represent a former ditch, it is more likely that it relates to a former path or track leading up to the main house.
- 6.7 Close to the southeast corner of the survey area there is a linear positive feature aligned roughly northeast to southwest [8]. This has produced a reading of up to 5 nT/m. It likely represents a former ditch, path or track. Slightly to the southeast is a potential positive curvilinear feature, 3 to 4 nT/m, which could represent a small enclosure ditch, although it is a faint anomaly at the edge of the survey area, thus limiting the interpretive potential.
- 6.8 At the northern end of the survey area there are two parallel positive linear features [9]. The western linear produced readings of 2 to 10 nT/m, the eastern linear anomaly 10 to 15 nT/m. These could represent parallel ditches or paths, but may relate to some sort of drainage feature.
- 6.9 The short positive linear anomaly [10] in the northwest corner of the site produced readings of 7 to 10 nT/m. Similar in character to [9], this could represent a ditch or path or some sort of drainage or modern service. The positive curvilinear/amorphous features slightly to the southwest of [10], 3 to 5 nT/m, could represent pits, ditches or soil-filled hollows/former ponds.
- 6.10 Across the centre of the site, aligned roughly east-southeast to west-northwest, [11] is a positive linear feature, 6 to 8 nT/m. This could be part of a cultivation trend, but may represent a former boundary ditch or path.
- 6.11 A series of roughly parallel positive and negative linear features [12], aligned roughly east to west across the site, have produced readings of -2 to -3 nT/m and 3 to 4 nT/m respectively. These are most likely representing cultivation trends, probably medieval ridge and furrow ploughing.
- 6.12 The large amorphous positive features [13] (6 to 8 nT/m), [14] and [15] (8 to 10 nT/m) and [16] (6 to 12 nT/m) are likely to represent pits, soil-filled hollows or former ponds.
- 6.13 Close to northeast corner of the survey area there is a collection of small negative and positive amorphous and linear features [17]. These have produced readings of -6 to -8 nT/m and 6 to 10 nT/m respectively. These correspond to 18<sup>th</sup> century formal garden features (see below).

- 6.14 The potential group of short negative and positive linear features [18], roughly aligned north to south, and reading -3 nT/m and 3 to 4 nT/m respectively may represent the edge of a former bowling green.
- 6.15 Scattered randomly throughout the site are a large number of strong and weak dipolar responses, examples of which are highlighted as [19]. The characteristic dipolar response of pairs of positive and negative 'spikes' suggest near-surface ferrous metal or other highly fired material in the ploughsoil.

## **7.0 Discussion and Conclusions**

- 7.1 The survey has revealed a number of features of potential archaeological interest. Across most of the southern half of the site there are linear positive and negative features that are likely to represent ridge and furrow cultivation of medieval date, no longer noticeable above ground.
- 7.2 Two linear positive features run across this area of ridge and furrow, one running southeast from the northwest corner of the site, another in the southeast corner of the site heading southwest. These may represent former paths or tracks, the former running in the direction of the house. A sketch drawing of the house and gardens from 1778 potentially identifies this track (National Trust 1986).
- 7.3 The linear positive anomaly [11] roughly aligned west to east and crossing the centre of the site, is likely to relate to the boundary wall of the house's former formal gardens, as shown on a 1717 plan drawn by Colen Campbell and engraved by Hulsbergh (Figure 8, after Hilary Taylor Landscape Associates Ltd 2011).
- 7.4 The group of positive and negative features [17], also correspond closely with a stellate (star-shaped) pattern of paths and flowerbeds which formed part of the former formal gardens of the house, and can also be identified from the 1717 plan (Figure 8). The 1717 plan also shows the former bowling green to the west of these gardens, and the location of the positive and negative short linear features [18] corresponds closely to the boundary between the bowling green and the gardens.
- 7.5 There are a number of amorphous positive anomalies across the site that could represent pits, soil-filled hollows or former ponds. These could represent landscaping of the land, associated with the construction of the house and gardens, or could potentially pre-date the house.
- 7.6 There are two areas of magnetic noise in the southern half of the site that may represent dumping of modern detritus, ferrous or highly fired material. The magnetic noise could potentially mask any underlying archaeological features in these areas.

## **8.0 Effectiveness of Methodology**

- 8.1 The non-intrusive evaluation methodology employed was particularly appropriate to the scale and nature of the site to be surveyed. Magnetometry was the prospection technique best suited to the identification of archaeological remains on the site and has shown that evidence of former garden features remains below ground. Other techniques would have required further justification and may have proved too time consuming or cost-prohibitive.



## 9.0 Acknowledgements

9.1 Allen Archaeology Limited would like to thank the National Trust for this commission.

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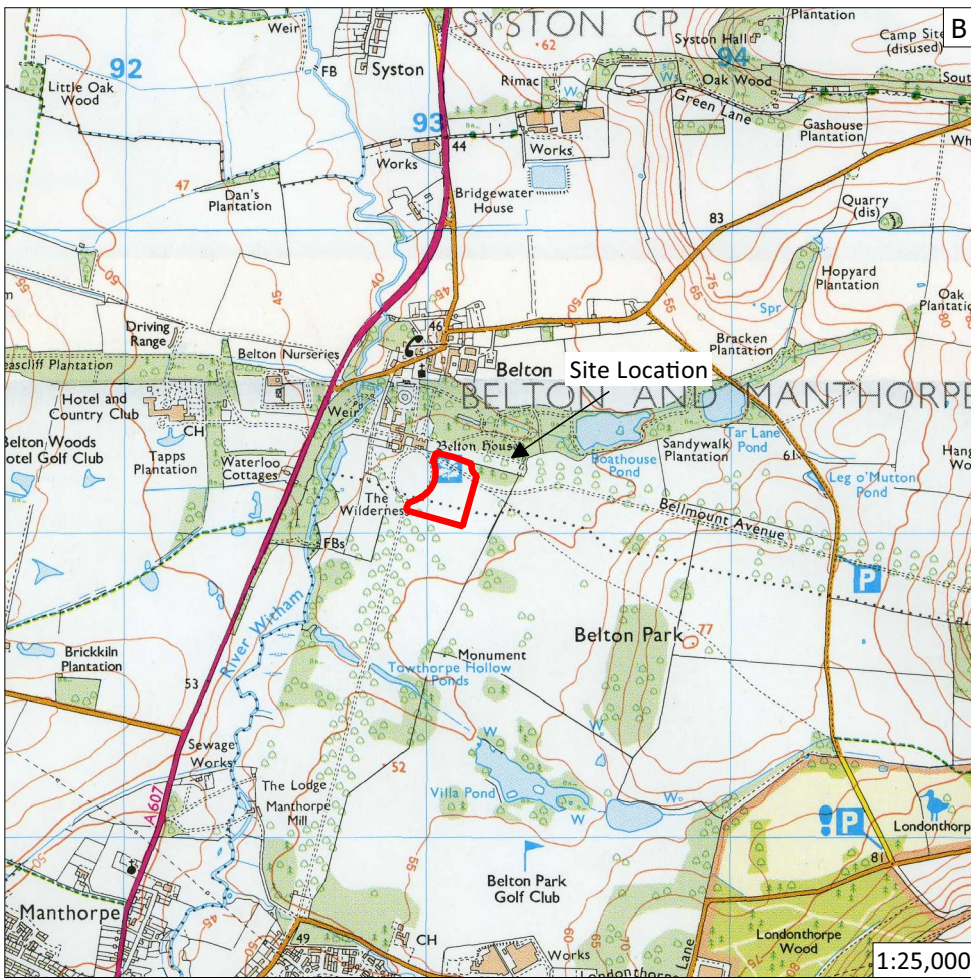
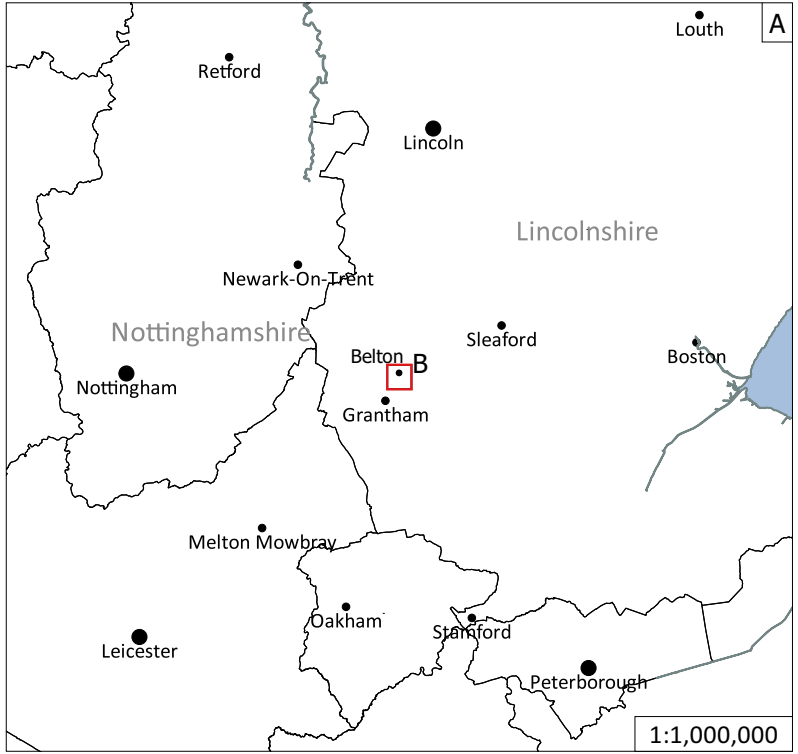
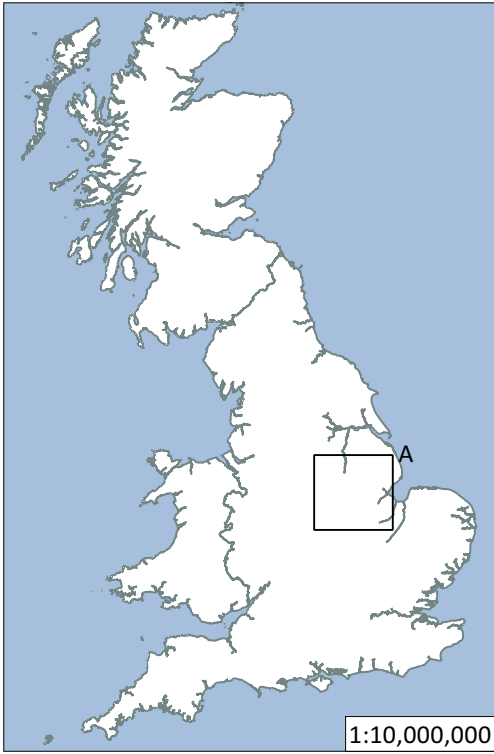
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**Figure 1:** Site location outlined in red

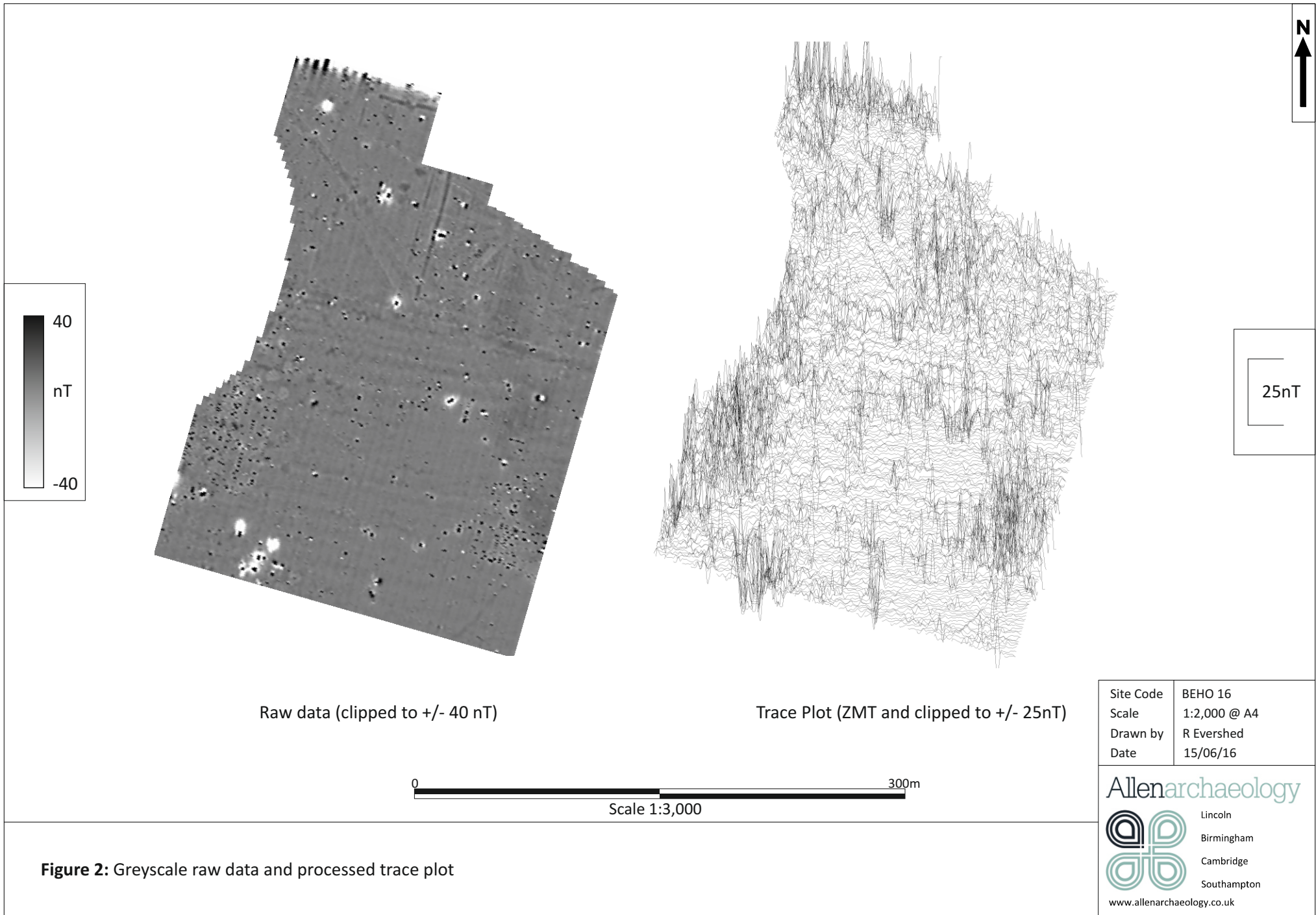
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Drawn by	R Evershed
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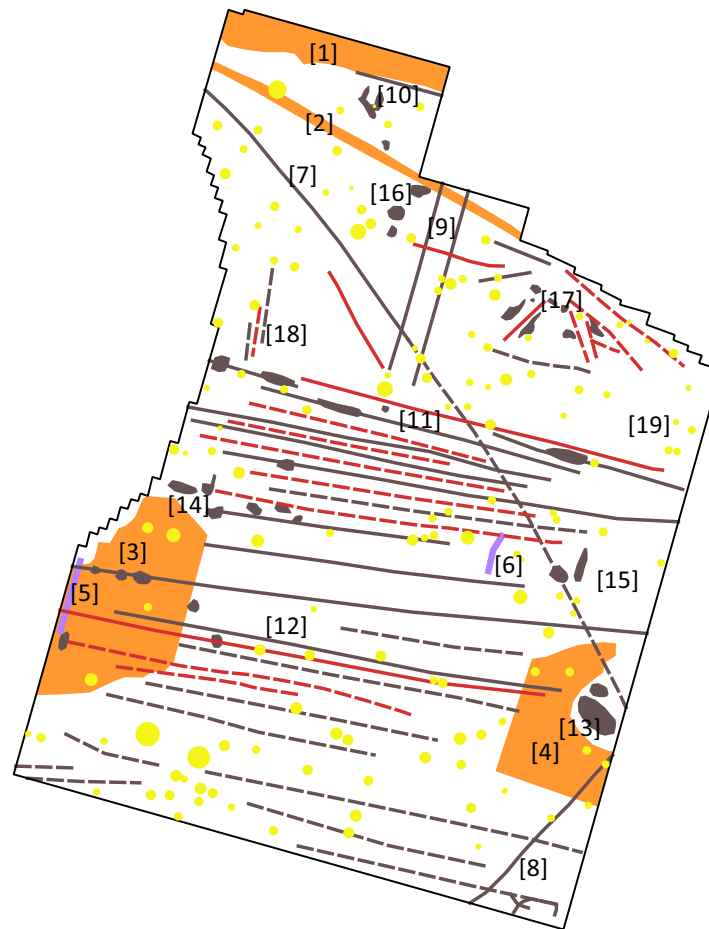
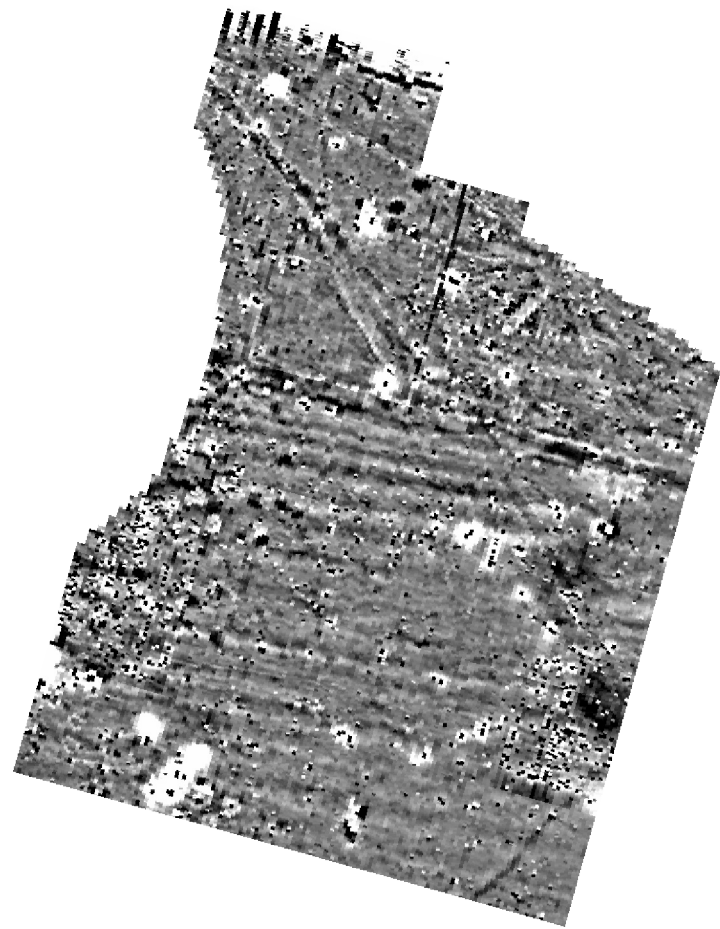
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**Figure 2:** Greyscale raw data and processed trace plot

Processed greyscale (De-stripped and clipped to  $\pm 5$ nT)

Interpretation of survey results



Key

- Positive anomaly
- Negative anomaly
- Magnetic noise
- Dipolar anomaly
- Linear dipolar anomaly
- Survey Boundary



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Figure 3: Processed greyscale plot and interpretation



Figure 4: Processed greyscale location



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Site Code	BEHO 16
Scale	1:2,000 @ A4
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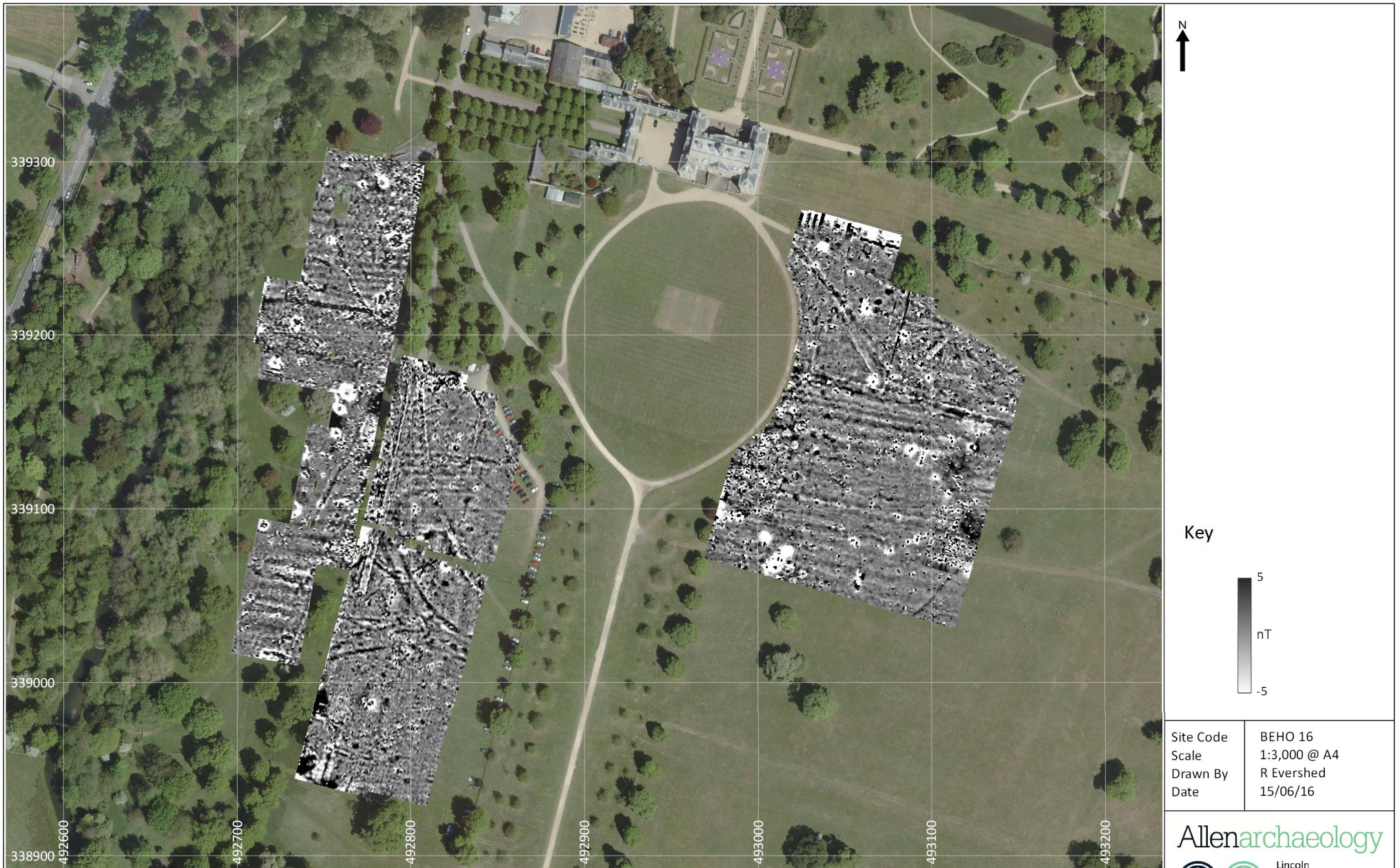
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Figure 5: Geophysical interpretation location







**Figure 7:** Combined geophysical surveys superimposed over aerial photographs



Key



Site Code	BEHO 16
Scale	1:3,000 @ A4
Drawn By	R Evershed
Date	15/06/16

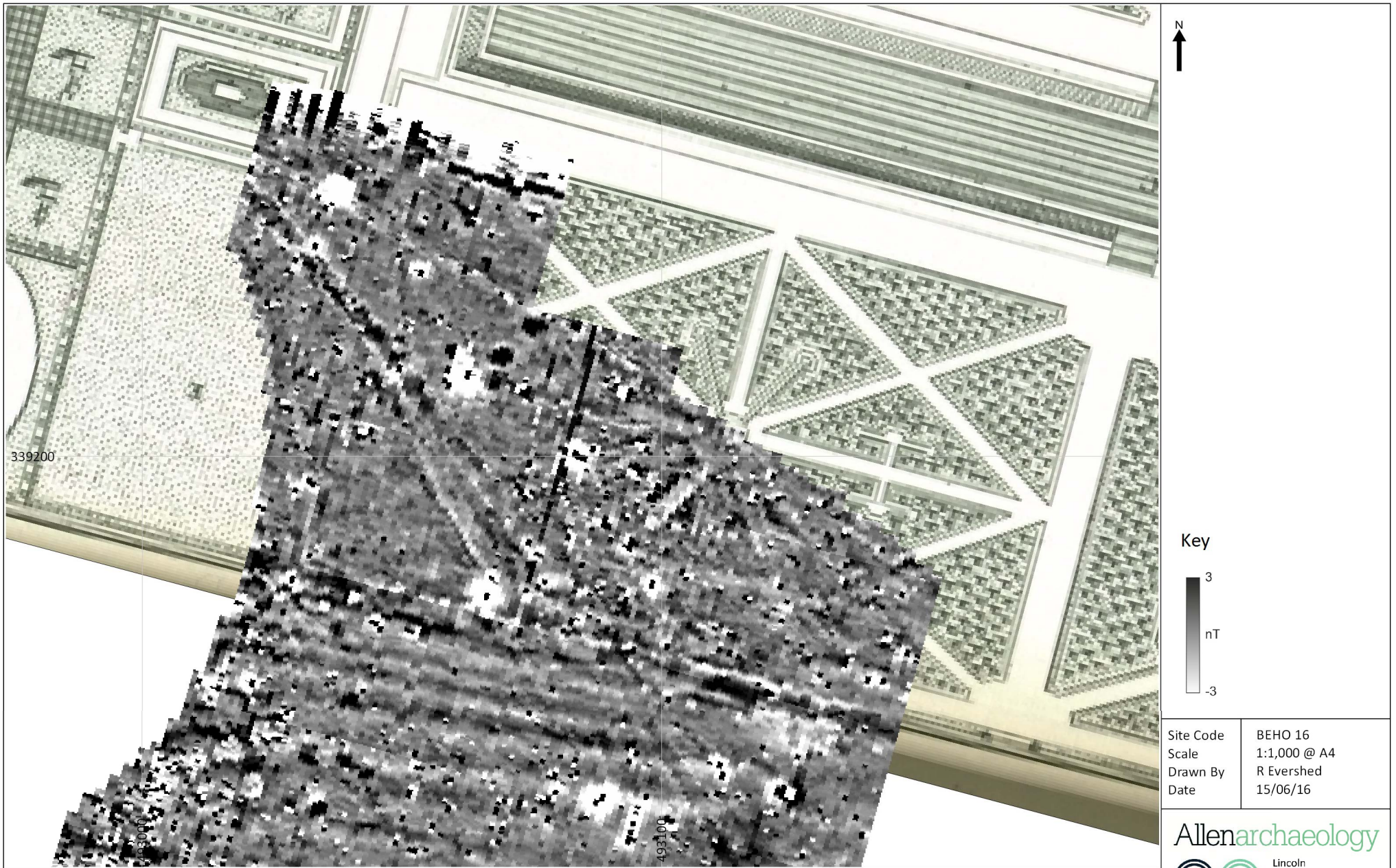
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**Figure 8:** Processed greyscale superimposed over 1717 plan of the house and gardens



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