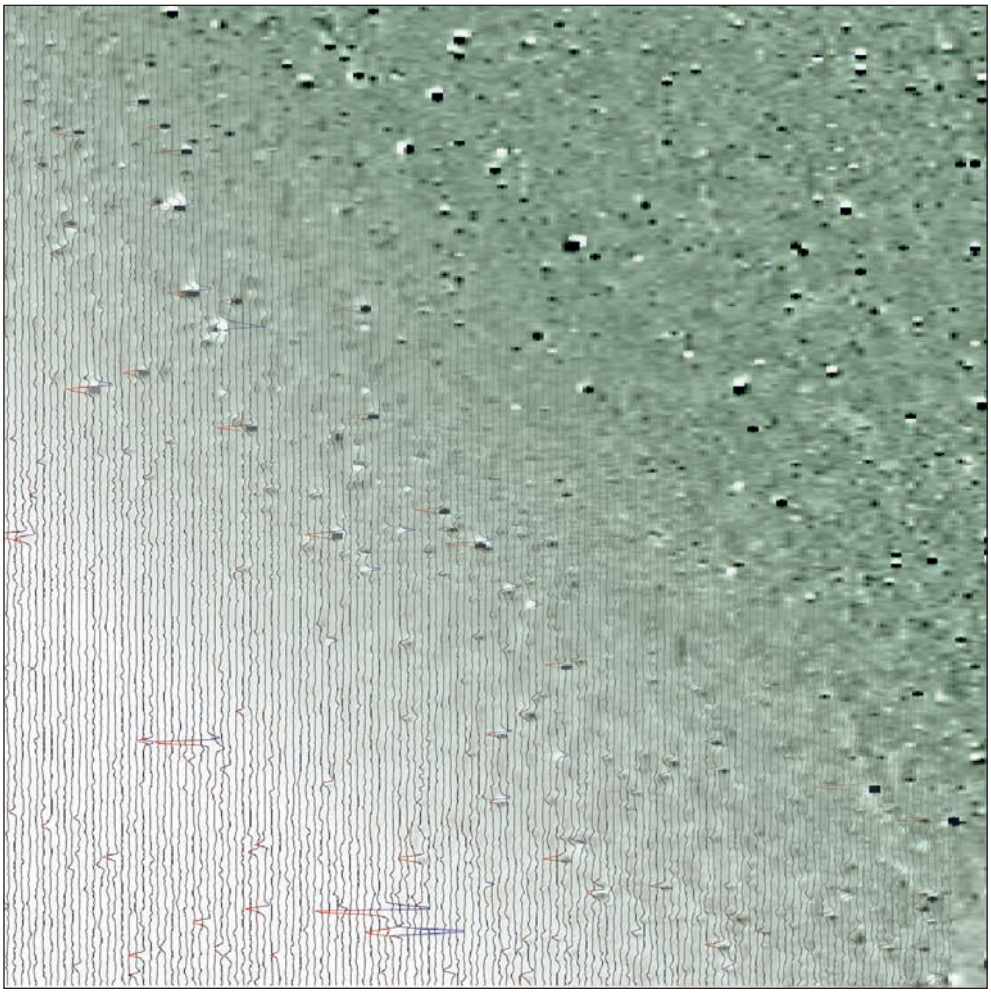
making sense of heritage

Land at High Street Linton, Derbyshire

Detailed Gradiometer Survey Report



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October 2013

geoservices

Land at High Street
Linton, Derbyshire

Detailed Gradiometer Survey Report

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* I = Internal Draft; E = External Draft; F = Final

Land at High Street
Linton, Derbyshire

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off High Street, Linton, Derbyshire (centred on NGR 426900, 316525). The project was commissioned by CgMs Consulting with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed development.

The site comprises one arable field to the west of Linton, approximately 7.8km SSE of Burton upon Trent, and occupies an area of gently sloping land over 4.4ha. The survey has demonstrated the presence of a single anomaly of possible archaeological interest, along with regions of increased magnetic response. Geological features were also identified in the gradiometer data.

The anomaly may represent a small pit of uncertain date, but aside from this feature the site appears to be devoid of any significant archaeological features, with mainly modern agricultural features detected.

The geophysical survey was undertaken on the 9th October 2013 and the archive is currently held at Wessex Archaeology's Sheffield office and will be deposited in due course if required.

Land at High Street
Linton, Derbyshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting on behalf of Gladman Developments. The assistance of Myk Flitcroft is gratefully acknowledged in this regard.

The fieldwork was directed by Phil Roberts and assisted by Michael O'Connell, Michael Keech, Jonathan Buttery, Chris Hirst and David Loeb. Ross Lefort processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Kitty Foster. The project was managed on behalf of Wessex Archaeology by Andrew Norton.

Land at High Street
Linton, Derbyshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a geophysical survey of land off of High Street, outside Linton, Derbyshire (**Figure 1**), hereafter "the Site" (centred on NGR 426900, 316525). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 Site Location, Topography and Geology

1.2.1 The survey area comprises one arable field to the west of High Street, just outside Linton, some 7.8km SSE of the centre of Burton upon Trent (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 4.4ha.

1.2.2 The Site occupies an area of gently sloping land that slopes down slightly towards the south; the land lies at a height around 110m above Ordnance Datum (aOD). A small watercourse named Pessall Brook flows past the Site to the south; this brook flows southwest before emptying into the River Mease. The survey extents are defined by the surrounding field boundaries.

1.2.3 The solid geology on Site is recorded as marl, sandstone, pebble beds and basal breccias (Triassic) (Ordnance Survey 1957). No Quaternary deposits are recorded on Site although deposits of glacial sand and gravel are present close by along with boulder clay and morainic drift (Ordnance Survey 1977).

1.2.4 The soils underlying the Site are likely to be stagnogleyic argillic brown earths of the 572c (Hodnet) association (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 METHODOLOGY

2.1 Introduction

2.1.1 The detailed magnetometer survey was conducted using a Bartington Grad601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English

Heritage guidelines (2008) and an approved Written Scheme of Investigation (WSI; Wessex Archaeology 2013).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on the 9th October 2013. Field conditions at the time of the survey were good.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).

2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. The multiply function was used to balance data collected by different operators. These three steps were applied to all survey areas, with no interpolation applied.

2.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The gradiometer survey identified an isolated anomaly of possible archaeological interest within the Site, along with several spreads of increased magnetic response. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1000 (**Figures 2** to **4**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 25nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.2 Gradiometer Survey Results and Interpretation

3.2.1 There was only a single anomaly of likely or probable archaeological interest in the geophysical data; a small sub-oval shaped positive anomaly at **4000**. The anomaly measures 3m in length and has magnetic values over +3nT. This feature may possibly represent a cut feature such as a small pit; it has been termed possible archaeology as it is small and is not associated with other features that might suggest it has any greater significance.

3.2.2 The remaining positive anomalies spread throughout the rest of the field are all a lot smaller than **4000** and may possibly represent small cut features such as postholes but more likely unusual ferrous responses, data spikes or geological features. All of these small positive anomalies have been classed as possible archaeology as there is no significant patterning in their spatial distribution.

3.2.3 There are numerous trends scattered throughout the data, most are considered to represent ploughing scars like the examples around **4001,** although other curving examples like those around **4002** and **4003** may prove to be of archaeological interest.

3.2.4 There are spreads of concentrated dipolar and bipolar responses (black and white) around the southern and eastern edges of the field such as at **4004**. These spreads are considered to represent scatters of relatively modern debris including ceramic and metallic material. There are spreads of much weaker and more diffuse bipolar responses elsewhere such as at **4005**. These areas are considered to represent geological features/variation.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There are no modern services visible in the gradiometer data however gradiometer data will not be able to locate and identify all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations, and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

4 CONCLUSION

4.1.1 The detailed gradiometer survey identified a single anomaly (**4000**) of possible archaeological interest within the Site, in addition to regions of increased magnetic response. No anomalies of likely archaeological interest were observed in the gradiometer data.

4.1.2 The remainder of the Site appears to be largely devoid of archaeological features with the majority of anomalies corresponding to use of this field for agriculture, or geological features.

5 REFERENCES

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APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey. It is also the case that strongly magnetised regions, such as certain geological formations, can mask weaker archaeological features.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

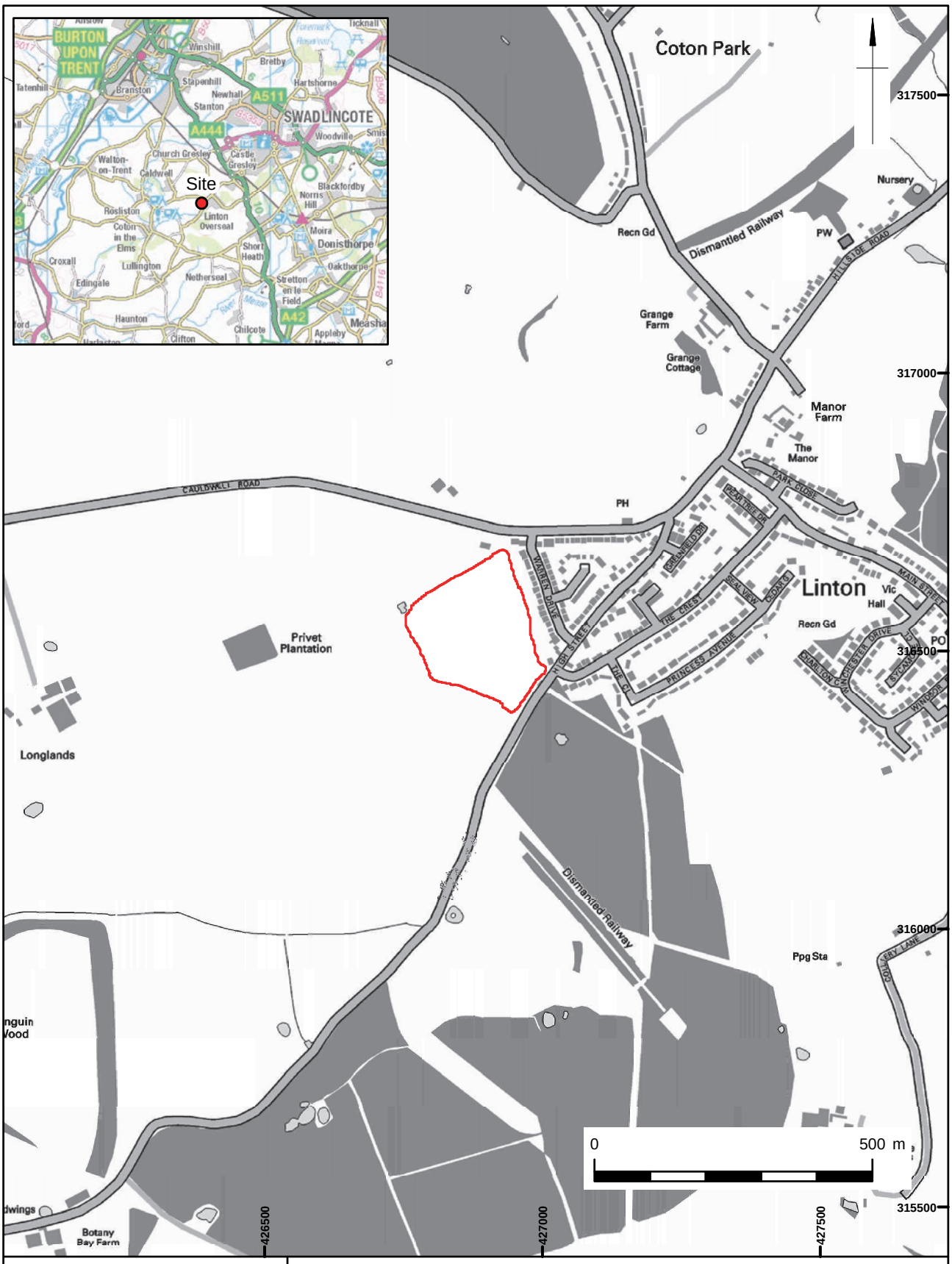
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.



Survey extents

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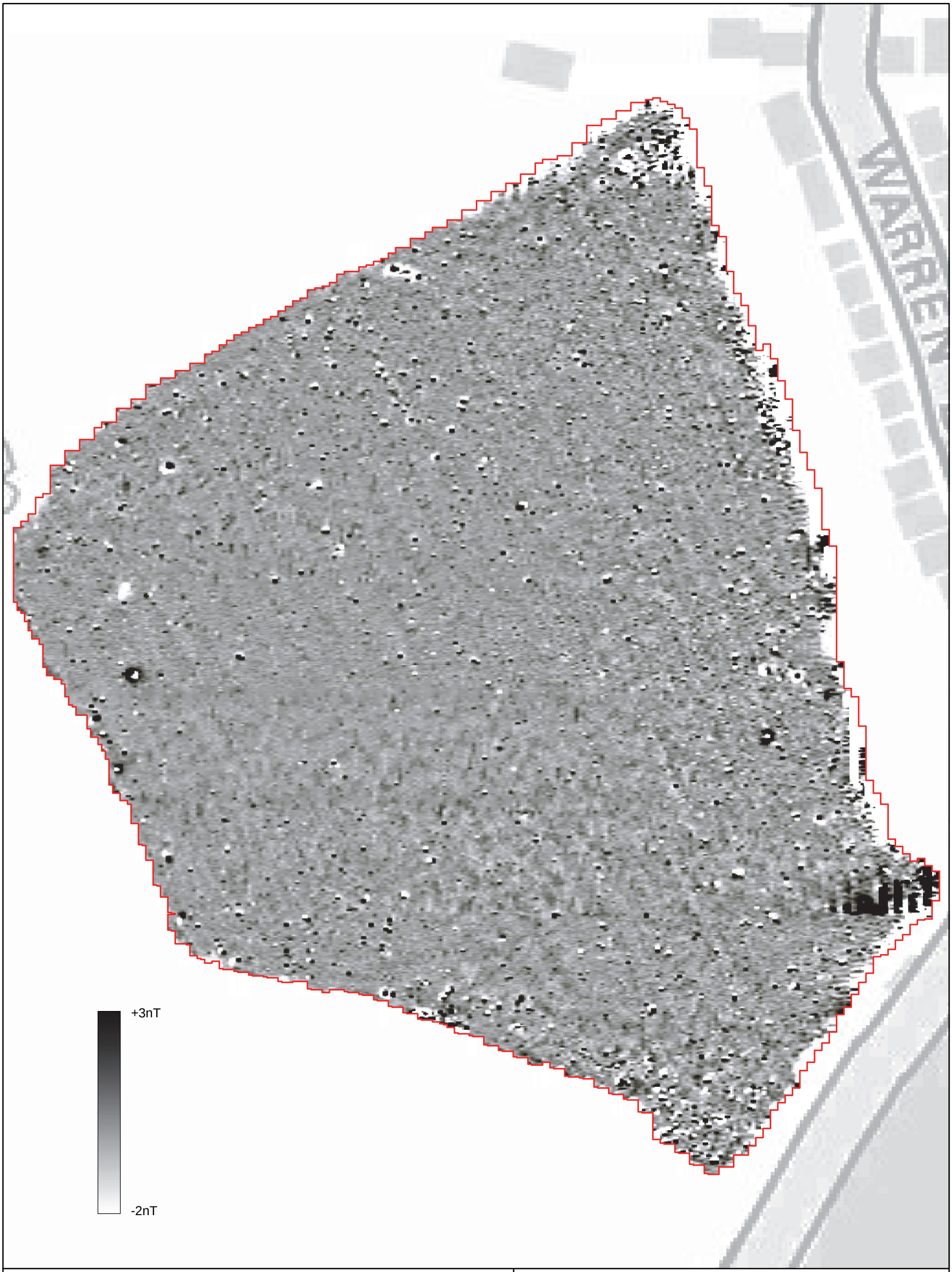
Site location

Figure 1



Survey extents

0 50 m

Date:	25/10/2013	Revision Number:	0
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Greyscale plot

Figure 2

+25nT

-25nT

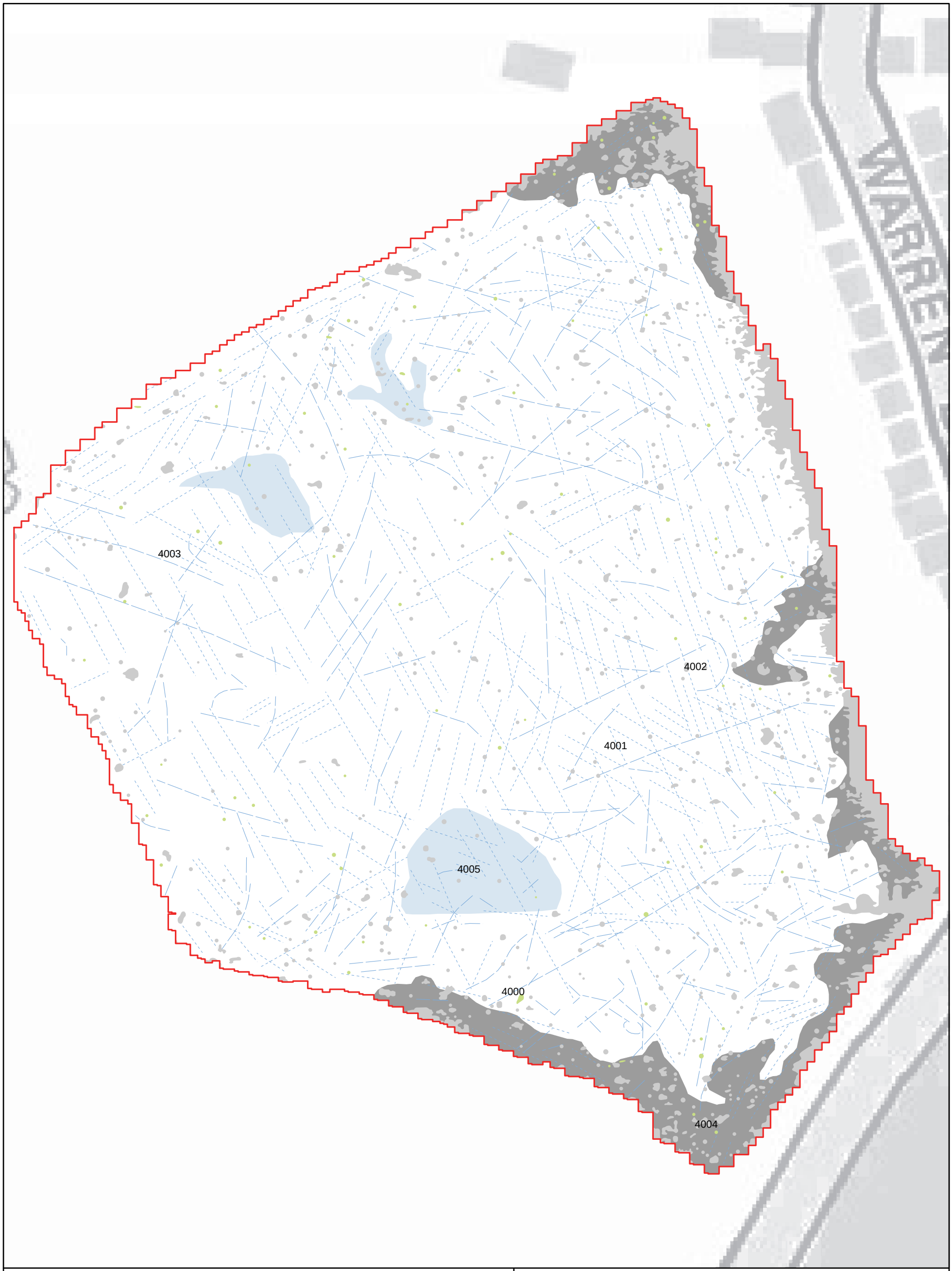
Survey extents

0 50 m

Date:	25/10/2013	Revision Number:	0
Scale:	1:1000 at A3	Illustrator:	KJF
Path:	X:\PROJECTS\101720\GIS\FigsMXD\Geophys		

XY trace

Figure 3



Survey extents
Possible Archaeology
Ferrous
Increased magnetic response
Geology
Trend
Ploughing
0
50 m

Date:	25/10/2013	Revision Number:	0
Scale:	1:1000 at A3	Illustrator:	KJF
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Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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