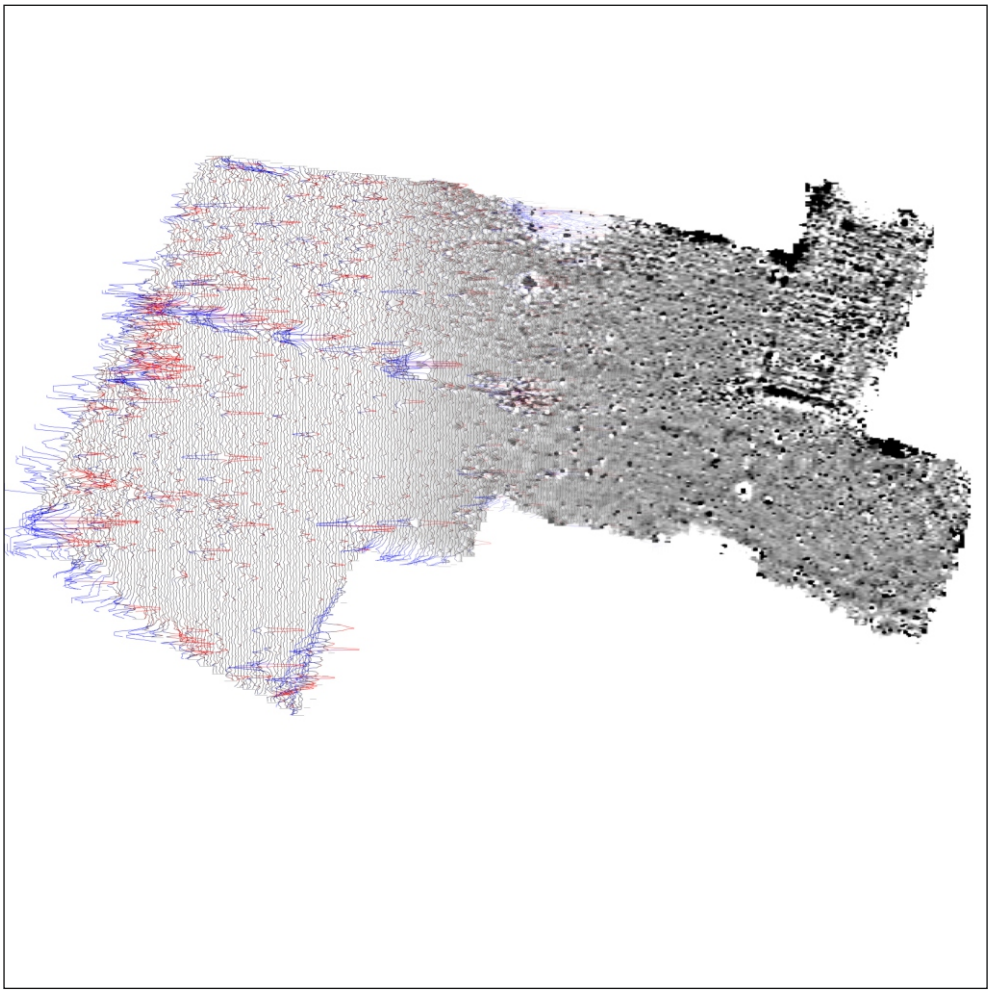
making sense of heritage

Land off Boreham Road Warminster, Wiltshire

Detailed Gradiometer Survey Report



Ref: 104520.01
June 2014

geoservices

Land off Boreham Road
Warminster, Wiltshire

Detailed Gradiometer Survey Report

Prepared for:
CgMs Consulting
7th Floor
140 London Wall
London
EC2Y 5DN

Prepared by:
Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
SP4 6EB

www.wessexarch.co.uk

June 2014

Report Ref. 104520.01

Quality Assurance

Project Code	104520	**Accession Code**		**Client Ref.**	104520.01
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	389400, 144275		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*JS/RDL*	*BCU*		06/06/2014
File:	\\Projectserver\Wessex\Projects\104520\Geophysics\Report\104520_Geophysics_Report_RDL.Docx				

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

Land off Boreham Road
Warminster, Wiltshire

Detailed Gradiometer Survey Report

Contents

Figures

Land off Boreham Road
Warminster, Wiltshire

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land north off Boreham Road, near Warminster, south-west Wiltshire. 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 of a single arable field directly north of Boreham Road, some 2.2 km to the south-east of the centre of Warminster and 1.9 km north-west of Norton Bavant. The Site occupies an area of relatively flat land with a shallow slope which slopes to the north. The gradiometer survey covered 3.5 ha and has demonstrated the presence of anomalies of probable and possible archaeological interest within the survey area, along with regions of magnetic disturbance.

A clear ditch and several probable pits were seen in the data along with a C-shaped anomaly. This C-shaped anomaly was detected towards the northern extent of the survey area although the response was weak and not clearly defined from the general magnetic background. This faint anomaly and others seen throughout the data may indicate that some plough damage has taken place.

Several linear features are visible in the dataset that are consistent with former field boundaries visible on historic mapping. Extensive magnetic disturbance associated with agricultural processes and numerous small-scale ferrous responses were seen throughout the dataset.

The geophysical survey was undertaken on 21st May 2014.

Land off Boreham Road
Warminster, Wiltshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting. The assistance of Rob Bourn and Sally Dicks is gratefully acknowledged in this regard.

The fieldwork was directed by Jen Smith and Alistair Salisbury. Ross Lefort and Jen Smith processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley and Ben Urmston. Illustrations were prepared by Ross Lefort and Karen Nichols. The project was managed on behalf of Wessex Archaeology by Ben Urmston.

Land off Boreham Road Warminster, Wiltshire

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 on land off Boreham Road, Warminster, southwest Wiltshire (**Figure 1**), hereafter "the Site" (centred on NGR 389400 144275). 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 An archaeological Desk-Based Assessment (DBA) was carried out by CgMs Consulting (2014) for the project and will be referred to in relation to the interpretation of certain geophysical anomalies.

1.1.4 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 and Topography

1.2.1 The survey area comprises of a single arable field directly north of Boreham Road, some 2.2 km to the south-east of the centre of Warminster, 2.9 km north of Sutton Veny and 1.9 km north-west of North Bavant (**Figure 1**).

1.2.2 The Site occupies an area of relatively flat land with a shallow slope which slopes to the north. The land lies at a height of approximately 108m above the Ordnance datum (aOD). The survey extents are defined by the surrounding field boundaries, as well as a housing estate to the west, south and north, a farm B&B to the north-east and an unnamed track to the east.

1.3 Soils and Geology

1.3.1 The Site bedrock geology is composed of sandstone belonging to the Boyne Hollow chert member, forming in the Cretaceous period. Other sandstone of the Shaftesbury and Melbury sandstone members are recorded very close by. No superficial deposits are recorded on Site although alluvial and river terrace deposits are recorded a short distance to the south (BGS).

1.3.2 The soils underlying the Site are likely to be typical calcareous earths of the 511f (Coombe 1) association (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts suitable for the detection of archaeological remains through magnetometer survey.

1.4 Archaeological and Historic Background

1.4.1 The following information is summarised from the CgMs DBA (2014) carried out for the proposed survey area and a 1km zone surrounding its boundary. The Site has been subject to previous archaeological work including fieldwalking in 1977, a geophysical survey and an archaeological evaluation in 1998 (CgMs 2014).

1.4.2 The only recorded heritage assets very close to or within the Site include Late Mesolithic/Early Neolithic flints found during the evaluation, a Roman coin findspot, Saxon pottery sherds found during the fieldwalking and records of medieval earthworks possibly related to a recorded settlement at Boreham (CgMs 2014).

2 METHODOLOGY

2.1 Introduction

2.1.1 The detailed magnetometer survey was conducted using Bartington Grad601-2 dual fluxgate gradiometer systems. The survey was conducted in accordance with English Heritage guidelines (2008).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 21st and 22nd May 2014. Field conditions at the time of the survey were good, with firm ground under foot. Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 3.5ha.

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. These two 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 has been successful in identifying anomalies of probable and possible archaeological interest across the Site, along with a number of former field boundaries. Results are presented as a series of greyscale plots, XY trace plots, and archaeological interpretations, at a scale of 1:1250 (**Figures 2** to **4**). The data is 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 A linear positive anomaly is visible at the northernmost corner of the site at **4000**; it has magnetic values over +3nT and does not appear to link up with any mapped former field boundaries. This feature has been interpreted as probable archaeology and is likely to represent a ditch.

3.2.2 Another weaker C-shaped ditch-like anomaly is visible in the data at **4001**; this has magnetic values less than +1nT but forms a very regular shape. This feature has been interpreted as probable archaeology due to its very regular shape in plan.

3.2.3 Four sub-oval shaped pit-like anomalies are visible in the data around **4002** and **4003**; all have magnetic values over +3nT and they all have lengths between 3m and 4.5m. These anomalies are considered to represent cut features such as pits and all are classed as probable archaeology.

3.2.4 There are some positive linear and curvilinear anomalies at **4004** to **4006** with very diffuse edges and weak responses measuring less than +1nT. It is unclear whether these features represent ephemeral archaeological features or are geological in origin. These anomalies have been classed as possible archaeology as a result of this uncertainty in their interpretation.

3.2.5 A series of former field boundaries are visible in the data at **4007** to **4011**; all have weak positive values over +1nT and all correspond to features on historic maps shown in the DBA (CgMs 2014). These anomalies have been classed as former field boundaries.

3.2.6 In addition to these boundaries are similar anomalies such as at **4012** and **4013** that cannot be linked to mapped field boundaries. These linear anomalies run parallel to known field boundaries and have been interpreted as agricultural, possibly representing unmapped former boundaries or remnant ridge and furrow.

3.2.7 Other agricultural features detected include the numerous ploughing scars visible running across the site along with a few ceramic field drains such as the example at **4014**. There is a line of regularly spaced ferrous responses running from **4015** to **4016** that follows the line of the former field boundary. These features are considered to be relatively modern and are of uncertain origin.

3.2.8 There are several spreads of increased magnetic response scattered across the data. The spread contained within the former field defined by **4007** is likely to be the result of different agricultural practices carried out in this field with magnetically enhanced debris added to this field along with manure. Another small spread around **4017** corresponds to a feature recorded on the 1889 map consulted in the DBA (CgMs 2014); the identity of this map feature is unclear but is likely to relate to agricultural activity.

3.2.9 The remaining anomalies are weak linear trends and small positive anomalies of possible archaeological interest. These features do not form any significant patterns in their spatial distribution and their origin is considered less certain.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 No clear modern services have been identified in the geophysical data. It should be noted that gradiometer survey may not detect 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 has been successful in detecting a few anomalies of probable and possible archaeological interest within the Site, in addition to regions of increased magnetic response and several former field boundaries.

4.1.2 The few anomalies of possible archaeological interest include short ditch sections and pits. Nothing has been detected that suggests concentrated settlement activity although the C-shaped feature at **4001** may prove to be the most interesting feature detected. Given the proximity of a long barrow and a number of other round barrows within 250m of the Site, it is possible that this anomaly relates part of a barrow ditch, an interpretation consistent with its shape and diameter; however, the magnetic response is weak and there is little direct corroborating evidence apart from the presence of similar monuments nearby.

4.1.3 The remaining anomalies detected appear to be agricultural in origin with possible drainage features, former field boundaries and ploughing trends detected across the remainder of the survey area. There are some ditches radiating from the settlement enclosure that may represent a former field system although they all fade out a short distance from the enclosure.

4.1.4 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. This is particularly true at this Site as there are some concentrated areas of strong geological responses concentrated over the eastern half of the site in particular that could easily obscure archaeological features.

5 REFERENCES

5.1 Bibliography

CgMs Consulting Ltd, 2014: *Land at Warminster, Wiltshire: Archaeological Desk-Based Assessment*, client report ref. RB/KB/9926

English Heritage, 2008: Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline No 1, 2nd edition.

5.2 Cartographic Sources

British Geological Survey
http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html

Soil Survey of England and Wales (SSEW), 1983: Sheet 5, Soils of South West England. Ordnance Survey: Southampton.

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.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

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 modern category is used for anomalies that are presumed to be relatively modern in date:

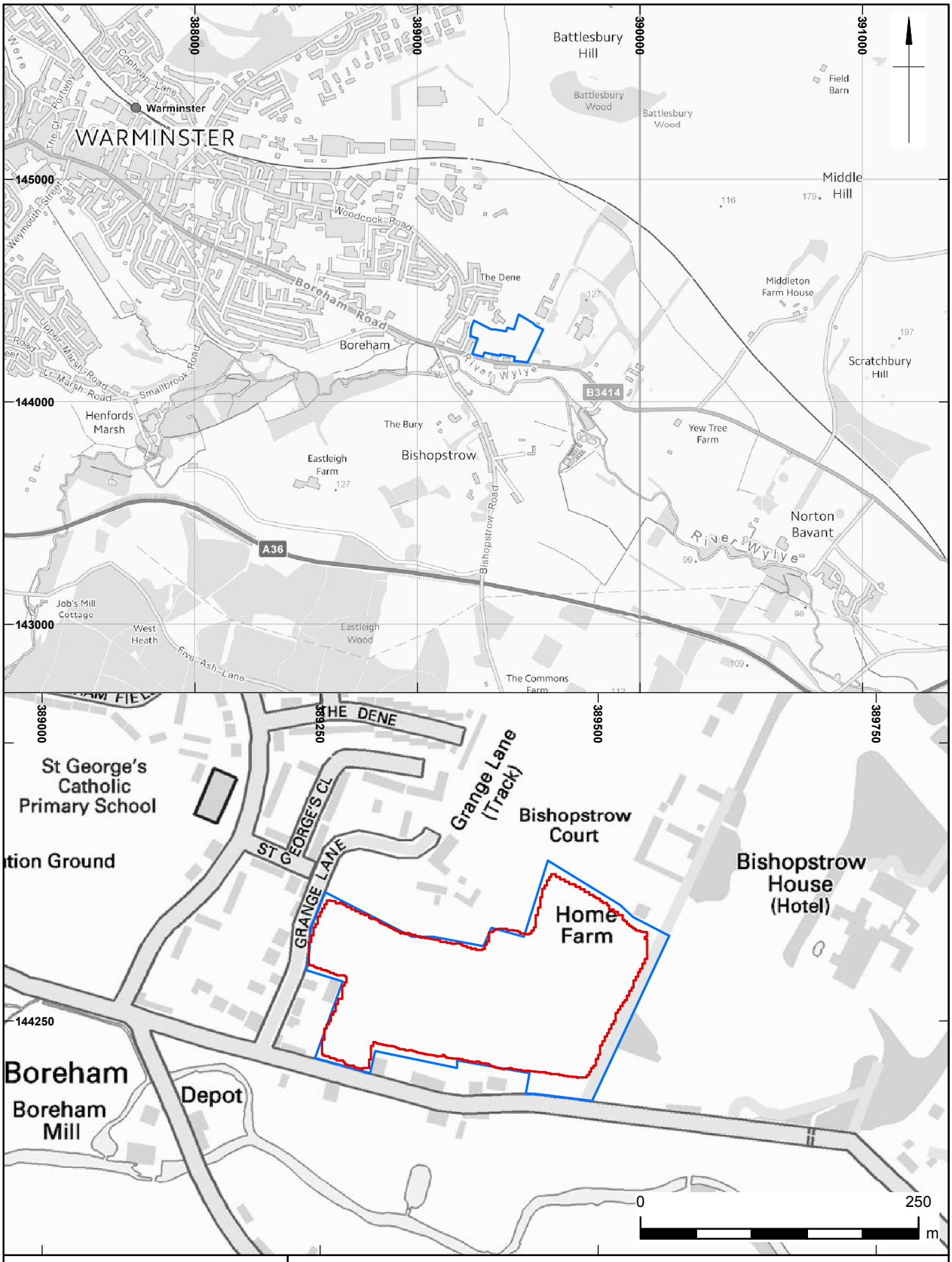
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Agricultural ditches – used for ditch sections that are aligned parallel to existing boundaries and former field boundaries that are not considered to be of archaeological significance.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological 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.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



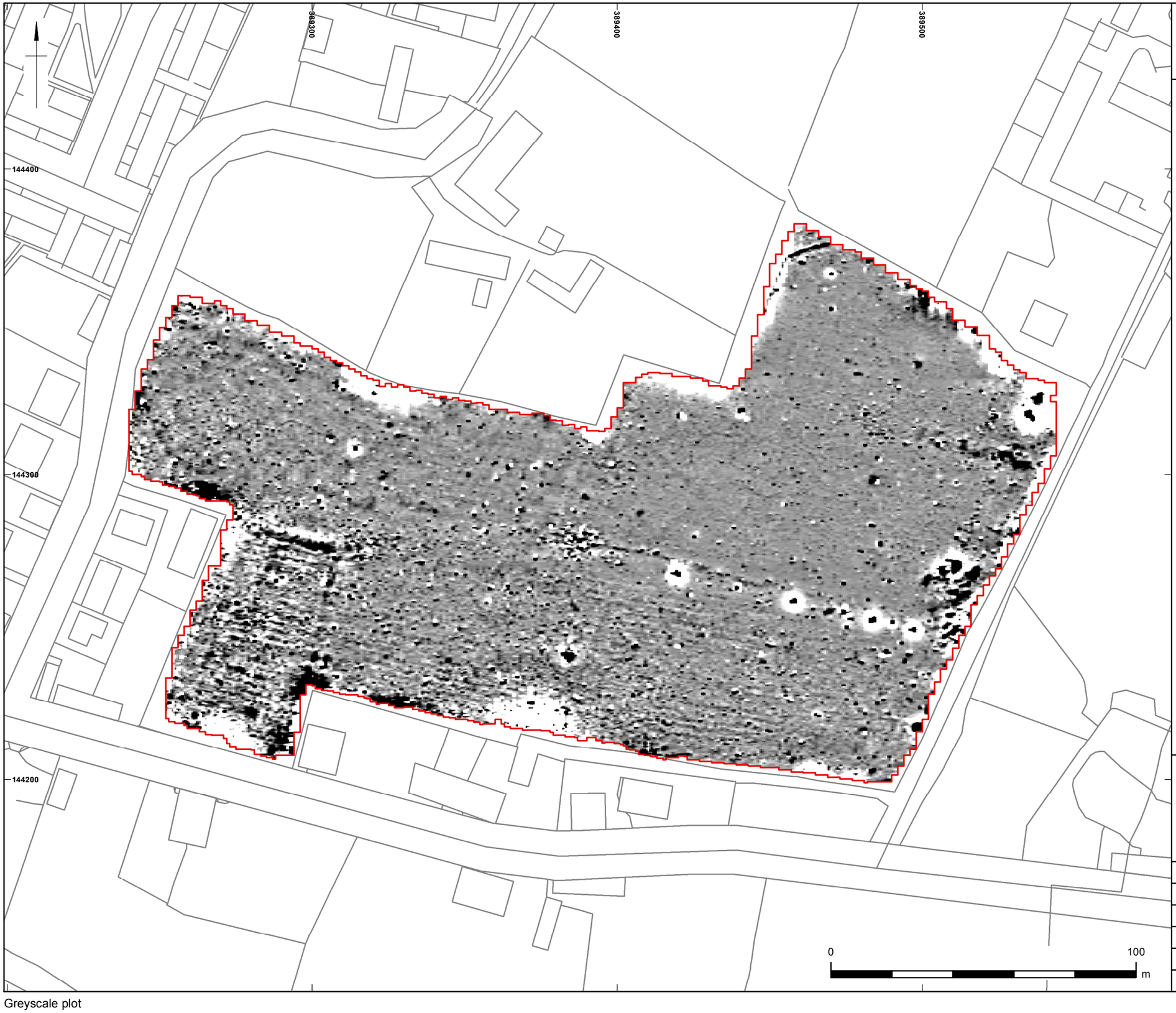
Detailed Survey Extents

Site Boundary

Date:	03/06/2014	Revision Number:	0
Scale:	1:25000 and 1:5000 at A4	Illustrator:	RDL
Path:	X:\PROJECTS\104520\GIS\Figs PDF		

Site location and detailed survey extents

Figure 1



Detailed Survey Extents

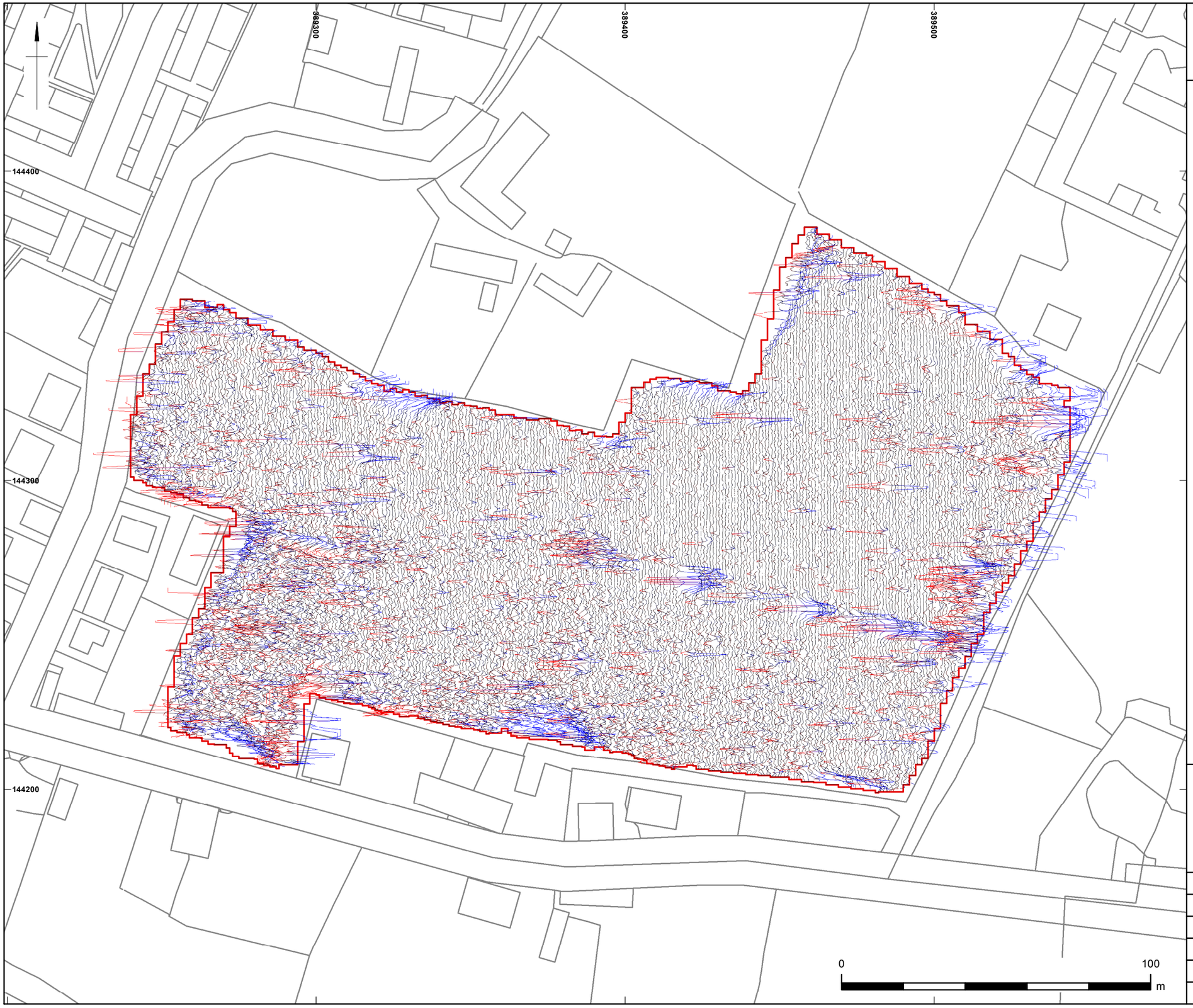
+3nT

-2nT

Date:	03/06/2014
Revision Number:	0
Scale:	1:1250 at A3
Illustrator:	RDL
Path:	X:\PROJECTS\104520\GIS\Figs PDF

Greyscale plot

Figure 2



Detailed Survey Extents

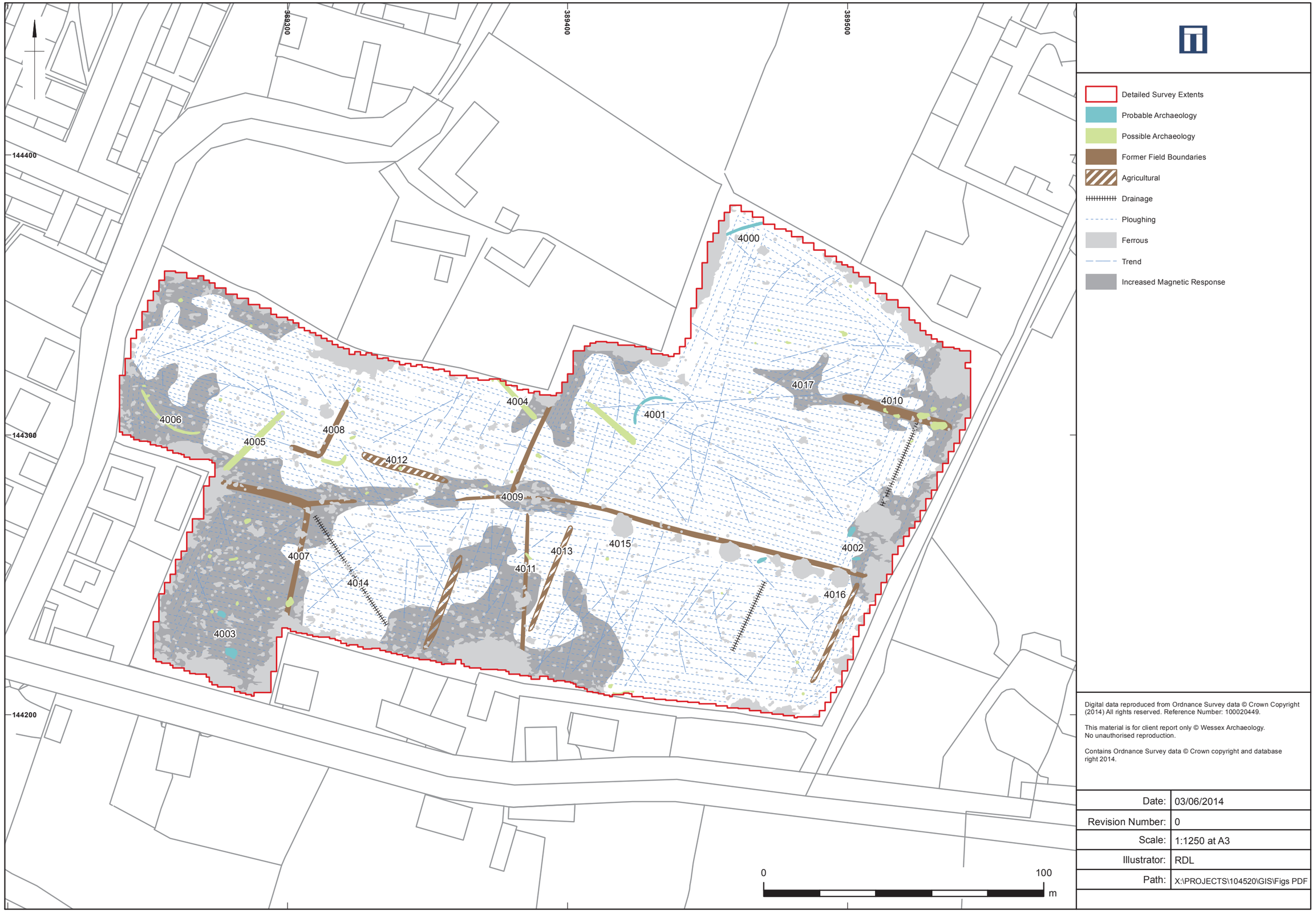
+25nT

-25nT

Date:	03/06/2014
Revision Number:	0
Scale:	1:1250 at A3
Illustrator:	RDL
Path:	X:\PROJECTS\104520\GIS\Figs PDF

XY trace plot

Figure 3



Detailed Survey Extents
Probable Archaeology
Possible Archaeology
Former Field Boundaries
Agricultural
Drainage
Ploughing
Ferrous
Trend
Increased Magnetic Response

Date:	03/06/2014
Revision Number:	0
Scale:	1:1250 at A3
Illustrator:	RDL
Path:	X:\PROJECTS\104520\GIS\Figs PDF

Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk