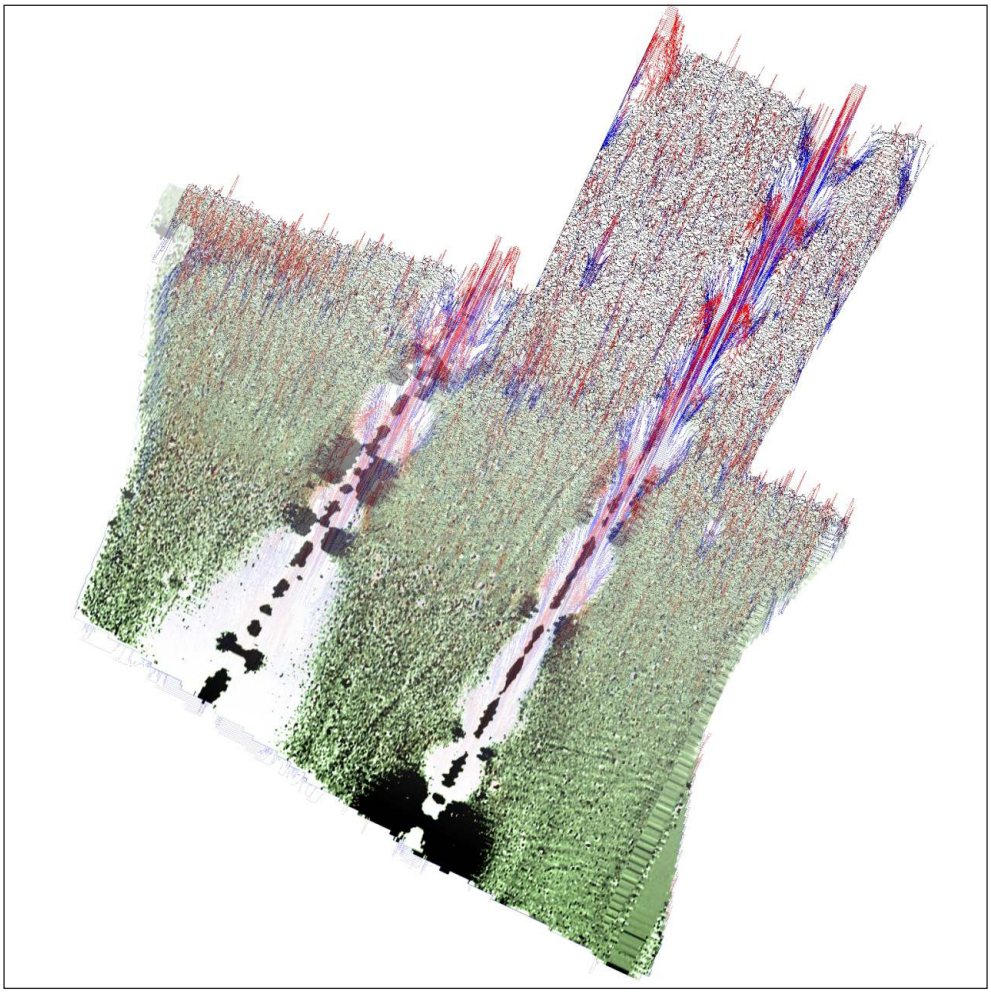
making sense of heritage

Gravesham Memorial Park
Gravesend Road, Chalk, Kent

Detailed Gradiometer Survey Report



Ref: 101220.02
September 2013

geoservices

Gravesham Memorial Park
Gravesend Road
Chalk
Kent

Detailed Gradiometer Survey Report

Prepared for:
Mercia Crematoria Developments Ltd.
6 Lower Farm Barns
Bainton Road
Bucknell
Bicester
Oxon
OX27 7LT

Prepared by:
Wessex Archaeology
Bridgewood House
8 Laker Road
Rochester Airport Industrial Estate
Rochester
Kent
ME1 3QX

www.wessexarch.co.uk

September 2013

101220.02

Quality Assurance

Project Code	101220	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	568699 172440		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*SM*	*MW*		
File:	R:\PROJECTS\T17549\Geophysics\Report\Working Versions				
File:					
File:					
File:					
File:					

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

Gravesham Memorial Park
Gravesend Road
Chalk
Kent

Detailed Gradiometer Survey Report

Contents

Figures

Gravesham Memorial Park
Gravesend Road
Chalk
Kent

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land to the north of Gravesend Road (A226), near Chalk, Kent. The project was commissioned by Mercia Crematorium Developments Ltd. with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the Site ahead of a proposed development. Alongside an archaeological desk-based assessment, the geophysical survey form part of a pre-planning report for the development of the Site into a crematorium, cemetery, woodland burial area and nature reserve.

The Site comprises an arable field to the north of Gravesend Road (A226), approximately 7km north east of Rochester, 2.6km to the south east of the town of Gravesend, and 500m from the centre of the village of Chalk. The Site lies upon a gradual slope from west to east with a gradual downward slope towards the north of the Site, and had been recently drilled and rolled at the time of survey. The gradiometer survey covered 11.3ha and has demonstrated the presence of anomalies of probable archaeological interest within the survey area, along with regions of increased magnetic response and two modern services.

Two ditch-like anomalies were identified oriented parallel with the southeastern boundary, and it is possible that they represent a former field boundary. Towards the northwestern extent of the survey area, ploughing trends aligned with the current agricultural regime are apparent. Weak linear and curvilinear trends were observed throughout the dataset, although their origins are unclear.

Two modern services were detected within the Site, oriented N-S across the centre of the survey area.

Extensive magnetic disturbance associated with the services and numerous small-scale ferrous responses were seen throughout the dataset. Along the eastern boundary, magnetic interference caused by overhead power lines affected the dataset.

The geophysical survey has demonstrated a low archaeological potential across the Site and it is considered that no further archaeological evaluation is required to inform the planning application. If any archaeological mitigation is deemed necessary, e.g. watching brief, it could be secured as a condition of any planning permission granted for the proposed development.

Gravesham Memorial Park
Gravesend Road
Chalk
Kent

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Mercia Crematoria Developments Ltd. The assistance of Andy Marshall is gratefully acknowledged in this regard.

The fieldwork was directed by Sarah Mounce and assisted by Jo Lathan and Chris Cole. Sarah Mounce 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 Ken Lymer. The project was managed on behalf of Wessex Archaeology by Mark Williams.

Gravesham Memorial Park
Gravesend Road
Chalk
Kent

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) was commissioned by Mercia Crematoria Developments Ltd to carry out a geophysical survey of land off Gravesend Road (A226), Chalk, Kent (**Figure 1**), hereafter "the Site" (centred on NGR 568699 172440). The survey will support a planning application for the development of the Site into a crematorium, cemetery, woodland burial area and nature reserve to be submitted to Kent County Council in addition to an archaeological desk-based assessment (WA 2013) of the area for development.

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 The Site

1.2.1 The survey area comprises a single arable field to the north of Gravesend Road (A226), approximately 7km north east of Rochester, 2.6km to the south east of the town of Gravesend, and 500m from the centre of the village of Chalk (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 11.3ha.

1.2.2 The survey area comprises a sub-rectangular parcel of land. The Site is delineated on most sides by hedgerow with the exception of the north eastern boundary which is arbitrary. Beyond the boundary the Site is bound by Gravesend Road A226 to the south, arable fields to the east and north and St Mary's Church and Church Lane to the west.

1.2.3 The Site lies on the northern periphery of the north Kent plain 2km south of the River Thames and 1km south of the Filborough Marshes. The north Kent plain is characterised by an undulating landscape and areas of ancient woodland. The Site lies upon a gradual slope from west to east, approximately 40m to 27m above Ordnance Datum, with the crest of the hill at St Mary's Church adjacent to the western boundary of the Site. The gradual slope at the Site forms a distinct valley along Green Lane where the land rises again to the east of Green Lane. There is also a gradual downward slope towards the north of the Site, 24m aOD, where is flattens out onto the Thames Estuary flood plain beyond the Site boundary.

1.2.4 The soils underlying the Site are likely to be typical brown 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.

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).

2.1.2 The geophysical survey was undertaken by WA's in-house geophysics team from 3rd to 9th September 2013. Field conditions at the time of the survey were good, with the crop covering the area having been harvested prior to the survey.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS system, 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 (ZMT) function (±10nT 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 three steps were applied to the entire survey area, with no interpolation applied. The deslope function was applied to selected grids to balance out minor grid edge errors that were created by the ZMT method.

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 archaeological interest across the Site, along with a number of modern services. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:2,000 (**Figures 2** and **3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and 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 Towards the centre of the survey area at **4005** and **4006**, a group of sinuous linear positive anomalies is apparent roughly aligned northeast-southwest. These linears extend across two spreads of increased magnetic response at **4000** and **4002**, to a maximum length of 200m. These anomalies are considered likely to represent ditches and have been classed as probable archaeology.

3.2.2 Towards the southeast corner of the survey area is a linear positive anomaly at **4008** which is aligned roughly east-west and extends westwards into anomaly **4000** and possibly across modern service **4007** where it is recorded as a weaker trend. This feature is considered to be a ditch and is classed as probable archaeology.

3.2.3 Within the southwest corner of the Site at **4000**, a large rectangular shaped area of increased magnetic response is recorded extending along the southern boundary towards the southeast corner. This area comprising a noisier magnetic background suggests a separate region of activity to that to the north and appears to demarcate a separate field. An aerial photograph taken in 1961 (WA 2013) records a former field division demarking the same area as **4000**.

3.2.4 Located to the north of anomaly **4000** is an interrupted linear anomaly of increased magnetic response at **4002** which runs on a northwest-southeast alignment from the western end of the survey area to the eastern end; its response is masked by strong magnetic disturbance at its western extent (**4000**) and in the vicinity of the two services (**4004** and **4007**). The anomaly is consistent with a field boundary, although it is not clearly defined, suggesting it has been heavily ploughed out since it was recorded on an aerial photograph taken in 1961 (WA 2013).

3.2.5 A third spread of increased magnetic response is recorded at the northern end of the survey area, extending southwards from the northern site boundary at **4012**. This spread may relate to another field division as recorded in the 1961 aerial photograph (WA 2013).

3.2.6 Observed across the majority of the Site are sinuous parallel striations around **4003**, **4009** and **4011**. These positive anomalies are unlikely to be the result of ridge and furrow as they do not form a regular pattern as observed elsewhere within the dataset. It is likely that these striations relate to the underlying geology, which is known to be a chalk formation. Given the orientation of the trends and the aspect of the slope on which they are located, it is possible that they are the result of natural movement of the sediments.

3.2.7 Scattered across the Site are small irregular positive anomalies of possible archaeological origin which may represent small pits or tree throws. A number of faint linear and curvilinear trends also appear across the dataset which may be archaeological in origin but more likely to be the result of agricultural activity.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 Two modern services have been identified in the data at **4004** and **4007**; both services are aligned north-south and relate to the two known high pressure gas mains running across the Site.

3.3.2 Extending along the eastern boundary of the Site were overhead power lines which interfered with the dataset and is reflected in anomaly **4010**.

3.3.3 It is not clear from the geophysical data whether the below ground services identified are in active use or not, and the extents of the magnetic anomalies may not reflect the

physical dimensions of the services. It should be noted that gradiometer survey may not be able to locate and identify all services present on Site. This report and accompanying illustrations therefore should not be used as the sole source for the service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any ground works take place on Site.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of probable archaeological interest within the Site, in addition to regions of increased magnetic response and two modern services.

4.1.2 The nature and date of the group of sinuous ditches, labelled as **4005** and **4006** is unclear. Given their location and orientation parallel with the extant boundaries to the east and west, it is considered possible that they represent former field boundaries.

4.1.3 The spreads of increased magnetic response, labelled as **4000** and **4002**, appear to demarcate separate fields and can be associated with the field boundaries recorded on the 1961 aerial photograph.

4.1.4 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; it is assumed that the centreline of services is coincident with the centreline of their anomalies, however. Similarly, it is difficult to estimate the depth of burial of the services through gradiometer survey.

4.1.5 The extent of magnetic disturbance associated with the services and the frequency of small-scale ferrous anomalies have reduced the area in which it is possible to detect archaeological features.

4.1.6 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.

5 REFERENCES

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

Soil Survey of England and Wales, 1983. *Sheet 6, South East England*. Ordnance Survey, Southampton.

Wessex Archaeology, 2013. *Gravesham Memorial Park, Gravesend Road, Chalk, Kent. Archaeological Desk-Based Assessment.* Report Ref.: 101220

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 two main categories: archaeological and unidentified responses.

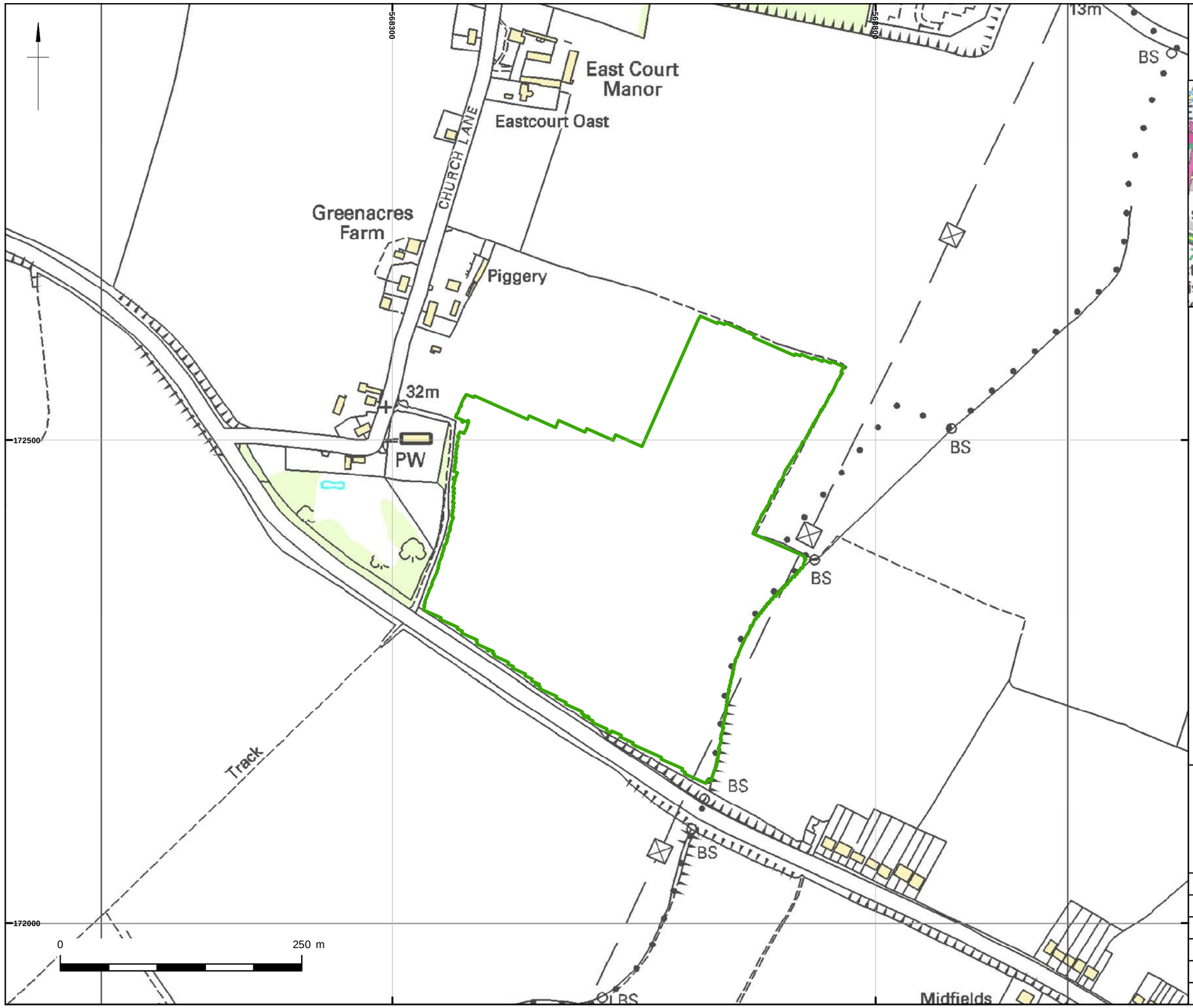
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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

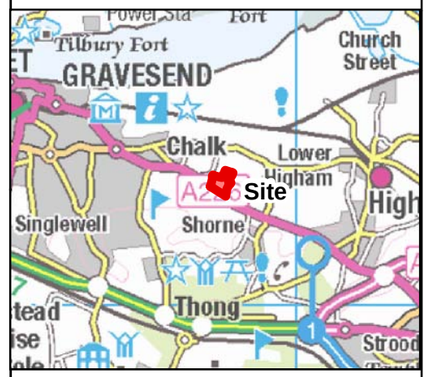
- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern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



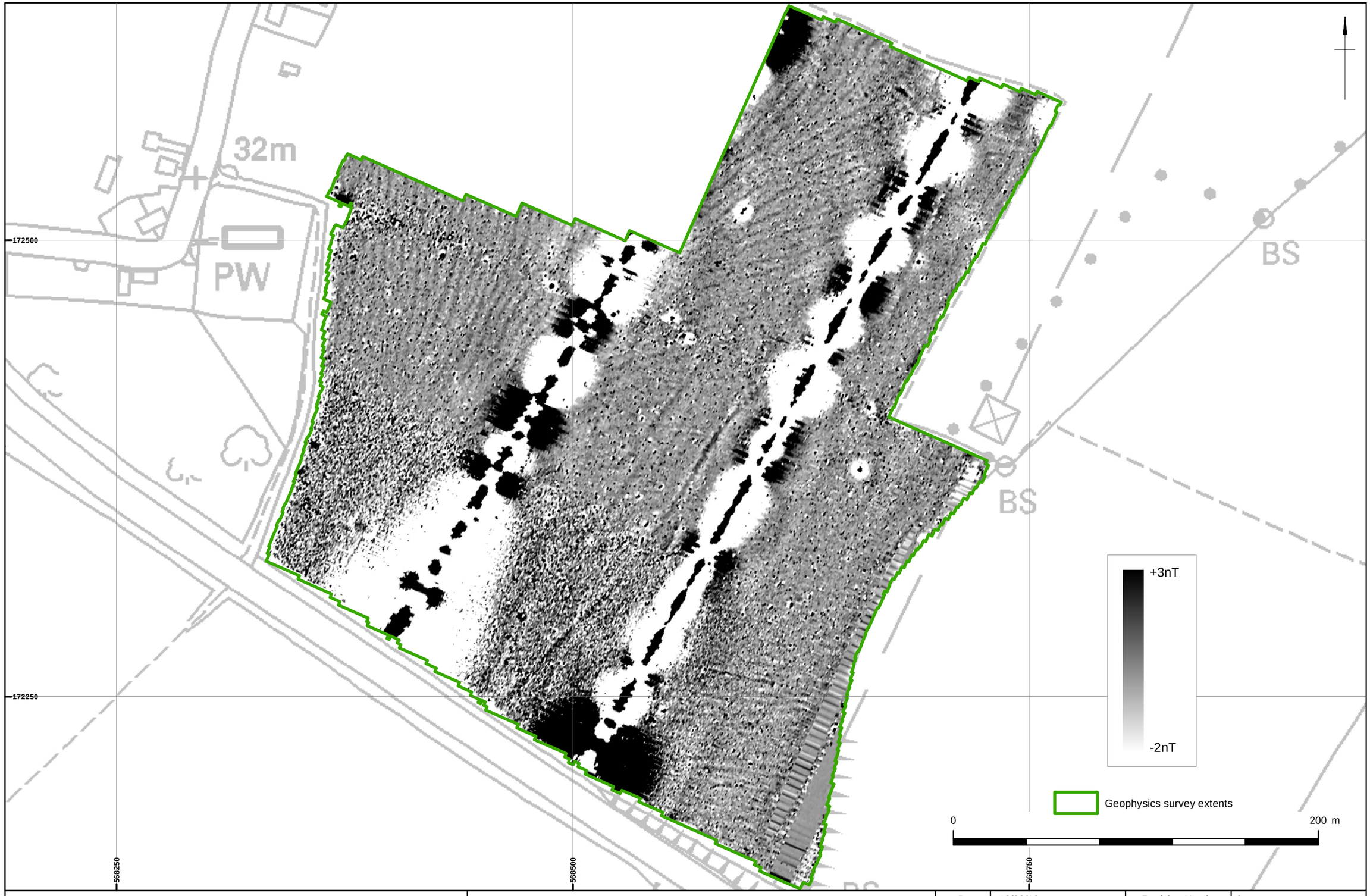


Geophysics survey extents

Date:	12/09/13
Revision Number:	0
Scale:	1:4,000 at A3
Illustrator:	KL
Path:	R:\PROJECTS\T17549\GIS
	\Figs MXD\Geophys\Geophys_Fig01.mxd

Site location and survey extents

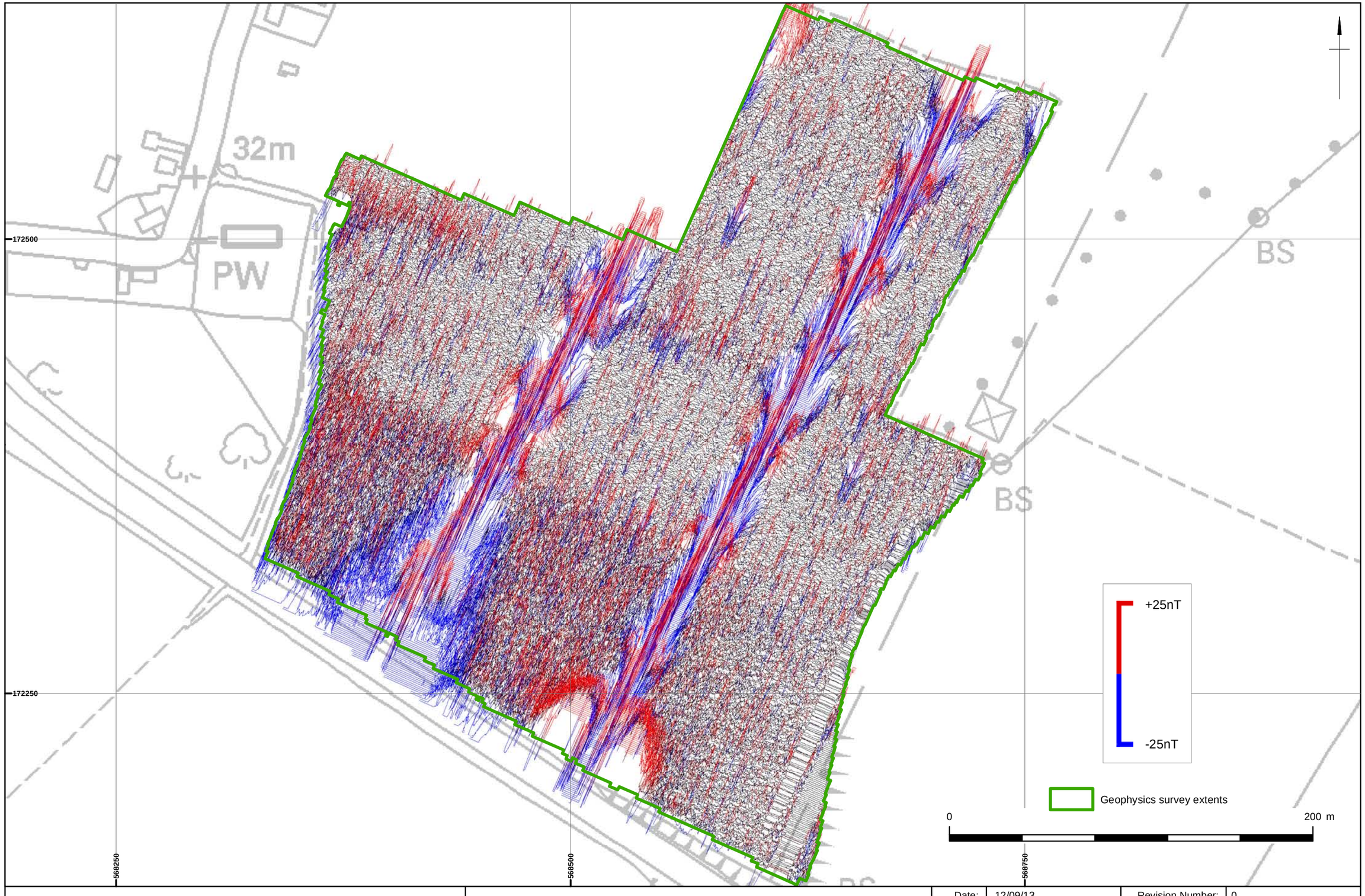
Figure 1



Date:	12/09/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL
Path:	R:\PROJECTS\T17549\GIS\Figs MXD\Geophys\Geophys_Fig02.mxd		

Greyscale

Figure 2



Date:	12/09/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL
Path:	R:\PROJECTS\T17549\GIS\Figs MXD\Geophys\Geophys_Fig03.mxd		

XY trace

Figure 3

Date:	123/09/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL
Path:	R:\PROJECTS\T17549\GIS\Figs MXD\Geophys\Geophys_Fig04.mxd		

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