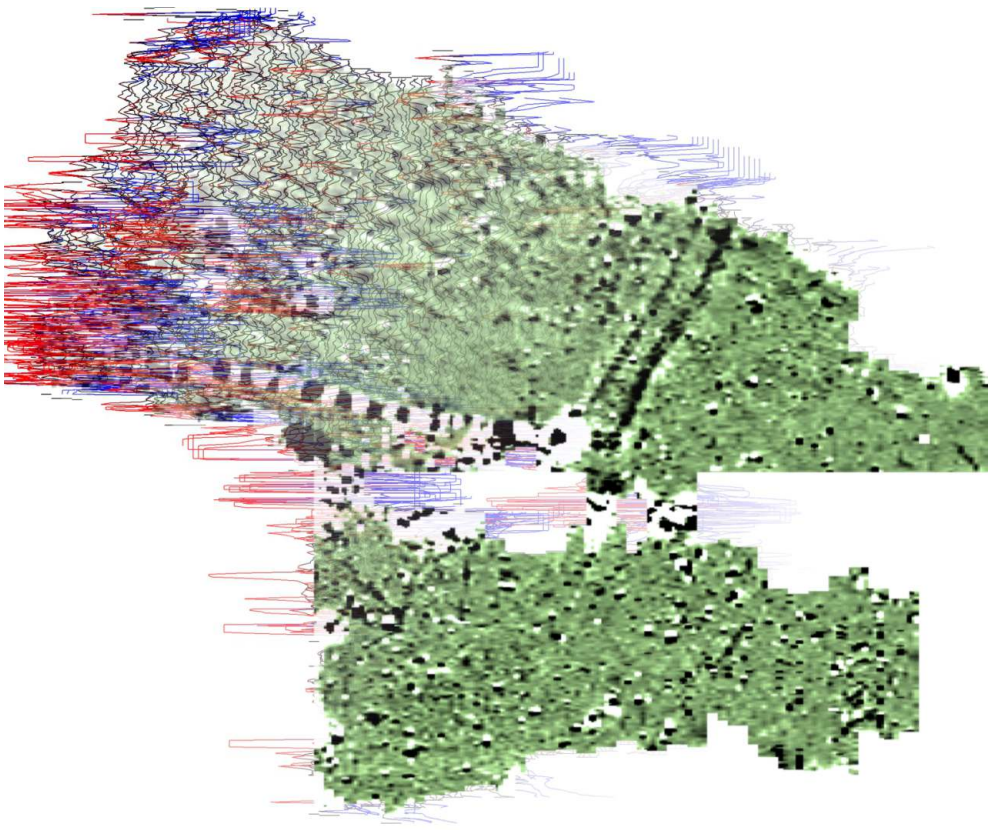

Land off Gravelye Lane
Lindfield, West Sussex

Detailed Gradiometer Survey Report

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January 2014

Report Ref. 102490.01

Quality Assurance

Project Code	102490	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	535180 124280		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	E	*BCU*	*PAB*		31/01/2014
File:	X:\PROJECTS\102490\Geophysics\Report\102490_Geophysics_Report.Docx				
File:					
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* I = Internal Draft; E = External Draft; F = Final

Land off Gravelye Lane
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Detailed Gradiometer Survey Report

Contents

Figures

Land off Gravelye Lane
Lindfield, West Sussex

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off Gravelye Lane, Lindfield near Haywards Heath in West Sussex. 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 pasture fields to the east of Gravelye Lane, approximately 2km east of the centre of Haywards Heath. The site occupies the east-facing slope of a low ridge, sloping downwards from the southwestern corner to the north and west. The southernmost portion of the survey area was covered in dense undergrowth and trees at the time of survey, reducing the area of the site accessible. The gradiometer survey covered 6.5 hectares and has demonstrated the presence of anomalies of probable and possible archaeological interest within the survey area, along with several modern services.

Two parallel ditch-like anomalies were identified north of the centre of the survey area, extending NE-SW; they are consistent with a former field boundary or track, although it is not clear from what period they date and are therefore considered to be of probable archaeological interest.

Several linear anomalies have been detected that are of possible archaeological interest, although they are largely oriented parallel with nearby drainage and other agricultural trends, suggesting that they may be of a similar origin. Numerous isolated pit-like anomalies have been noted throughout the dataset and, whilst an archaeological interpretation cannot be ruled out entirely, many are likely to be the result of near-surface natural or geological features.

The central portion of the survey area exhibits parallel linear trends typical of agricultural activity. In places these responses are consistent with the remnants of ridge and furrow and in others more characteristic of drainage trenches.

A number of modern services were detected within the Site, predominantly oriented NE-SW across the eastern portion of the survey area, with further services noted towards the northwest and centre of the site.

Land off Gravelye Lane
Lindfield, West Sussex

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting. The assistance of Duncan Hawkins is gratefully acknowledged in this regard.

The fieldwork was directed by Andrew Reid and assisted by Phillip Maier and Mike O'Connell. Ben Urmston processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Paul Baggaley. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Andy Crockett.

Land off Gravelye Lane
Lindfield, West Sussex

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 Gravelye Lane in Lindfield, West Sussex (**Figure 1**), hereafter "the Site" (centred on NGR 535180 124280). 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. A Written Scheme of Investigation (WSI) was prepared prior to the survey, outlining the proposed methodology and survey areas, which was approved by West Sussex County Council's heritage advisors.

1.2 The Site

1.2.1 The survey area comprises pasture fields to the east of Gravelye Lane in Lindfield, some 2km ENE of the centre of Haywards Heath, West Sussex (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 6.5 ha.

1.2.2 The Site occupies the eastern slope of a low ridge extending approximately N-S and situated on the eastern outskirts of the town. The Site slopes from west to east, and from 50m above Ordnance Datum (aOD) at the southern extent to 35m aOD along the southeastern boundary. The survey area was bounded by properties off Gravelye Lane to the west, by Lyoth Lane to the southwest, the B2111 to the north and a stream to the east. Further pasture and arable fields lie to the north and east, with urbanised development to the west and south.

1.2.3 The soils underlying the Site are likely to be stagnogleyic argillic brown earths of the 572i (Curtisden) 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).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team from 6th to 10th January 2014. Field conditions at the time of the survey were reasonable, although densely overgrown boundaries prevented survey, particularly along the eastern perimeter of the Site. Further dense undergrowth was encountered in the southernmost survey area, with frequent bushes and trees impeding access. Survey was undertaken over as much of the area as was practicable.

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 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 At the very northern extent of the Site, immediately south of the B2111, the short track shows strong magnetic disturbance, presumably associated with its construction; within the field at the end of the track, the magnetic background is much quieter, e.g. **4000**. Whilst several pit-like anomalies are visible, it is difficult to determine their origins and an archaeological interpretation cannot be ruled out. A number of trends are visible, the majority of which are parallel and oriented NE-SW; it is possible that these relate to

agricultural activity. Parallel with the eastern boundary, it is possible to see magnetic disturbance associated with a modern service.

3.2.2 Further to the west, a cluster of pit-like anomalies **4001** is visible near the northwestern extent of the Site. The cluster is apparently unenclosed, although there is a pair of linear trends extending NW-SE immediately to the south. Near the centre of the field, sub-annular anomaly **4002** is of possible archaeological interest due to its shape in plan, although magnetic disturbance immediately to the west reduces confidence in this interpretation; it is of a size consistent with a roundhouse or small barrow, although there is no other evidence to support this. Parallel curvilinear anomalies **4003** are consistent with ditches extending NE-SW across the survey area; it is possible that these anomalies represent part of a former boundary or trackway, although there are no visible anomalies on the same alignments to the northeast or southwest. Modern service **4004** is visible extending across the southern extent of this field, although it appears to terminate north of the field boundary, within the field itself; it is therefore possible that this service relates to a water pipe leading to a former trough.

3.2.3 Interrupted linear anomaly **4005** lies to the south of the nearby field boundary and its origins are unclear; an archaeological interpretation cannot be excluded entirely. At the eastern extent of this field, cluster of small pit-like anomalies **4006** is of possible archaeological interest, although it is conceivable that these responses are the result of near-surface geological changes.

3.2.4 Near the centre of the Site, linear and pit-like anomalies **4007** lie within a region of strong ploughing trends; whilst the more clearly defined anomalies have been interpreted as being of possible archaeological interest, it is possible that they are associated with agricultural activity. The ploughing trends, oriented E-W, are consistent with the remnants of ridge and furrow. Two modern services are visible; **4008** extends southwards from the northern boundary, apparently terminating in the centre of the survey area; **4009** is oriented NNE-SSW and is likely to be associated with the services seen immediately to the south (**4013**) and in the northernmost survey area.

3.2.5 The largest survey area, south of the centre of the Site, shows clear evidence of agricultural activity throughout; linear trends consistent with drainage can be seen and the responses suggest that plastic pipes or porous backfill has been installed in a series of parallel trenches oriented NW-SE. It is possible that these trends are the result of ploughing, although this is considered less likely. Several fragmentary linear anomalies can be seen, e.g. **4010**, which are of possible archaeological interest and a loose cluster of pit-like anomalies can be seen near the northwestern extent of the survey area. A further group of pit-like anomalies **4011** can be seen towards the southwest. Near the southern boundary, an indistinct linear band **4012** is consistent with a geological feature and it is possible that this represents a former channel or stream. Modern service **4013** is visible at the northeastern extent of the survey area, extending N-S and presumably associated with **4009** to the north.

3.2.6 Within the southernmost survey area, the magnetic background appears to be fairly quiet with occasional anomalies of possible archaeological interest, e.g. **4014**. It is difficult to assess the magnetic background fully through the numerous gaps in data collection caused by the presence of existing trees and other undergrowth, and this has reduced confidence in the interpretation in this area. Magnetic disturbance associated with the former track can be seen at **4015** and **4016**.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of probable and possible archaeological interest within the Site, in addition to several modern services and probable agricultural activity.

4.1.2 The only anomalies considered to be of probable archaeological interest comprise a pair of curvilinear ditches within the northern portion of the survey area. It is not possible to determine from what period they date, although their location suggests that they may relate to a former boundary or track. Comparison with a historic map regression would clarify the historic provenance for this anomaly.

4.1.3 Elsewhere, the magnetic background across the Site is relatively quiet, with numerous isolated pit-like responses visible. Given their form, it is difficult to determine conclusively the origins of such anomalies; it is equally possible that the response could be caused by a natural feature, such as a tree throw, agricultural activity or archaeological pitting. Several linear anomalies have been identified, although these are largely oriented parallel with nearby ploughing or drainage anomalies, thereby weakening their archaeological interpretation. A poorly-defined sub-annular anomaly lies north of centre near a cluster of possible pits; whilst its form and size are consistent the characteristics of an archaeological feature, the lack of definition makes conclusive interpretation difficult.

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 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. However, the range of responses from anomalies detected within the dataset suggests that substantial archaeological features would have produced measurable magnetic anomalies, should any have been present.

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, 2014. *Gravelye Lane, Lindfield, West Sussex: Written Scheme of Investigation for Geophysical Survey*. WSI ref. T18143.01

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.

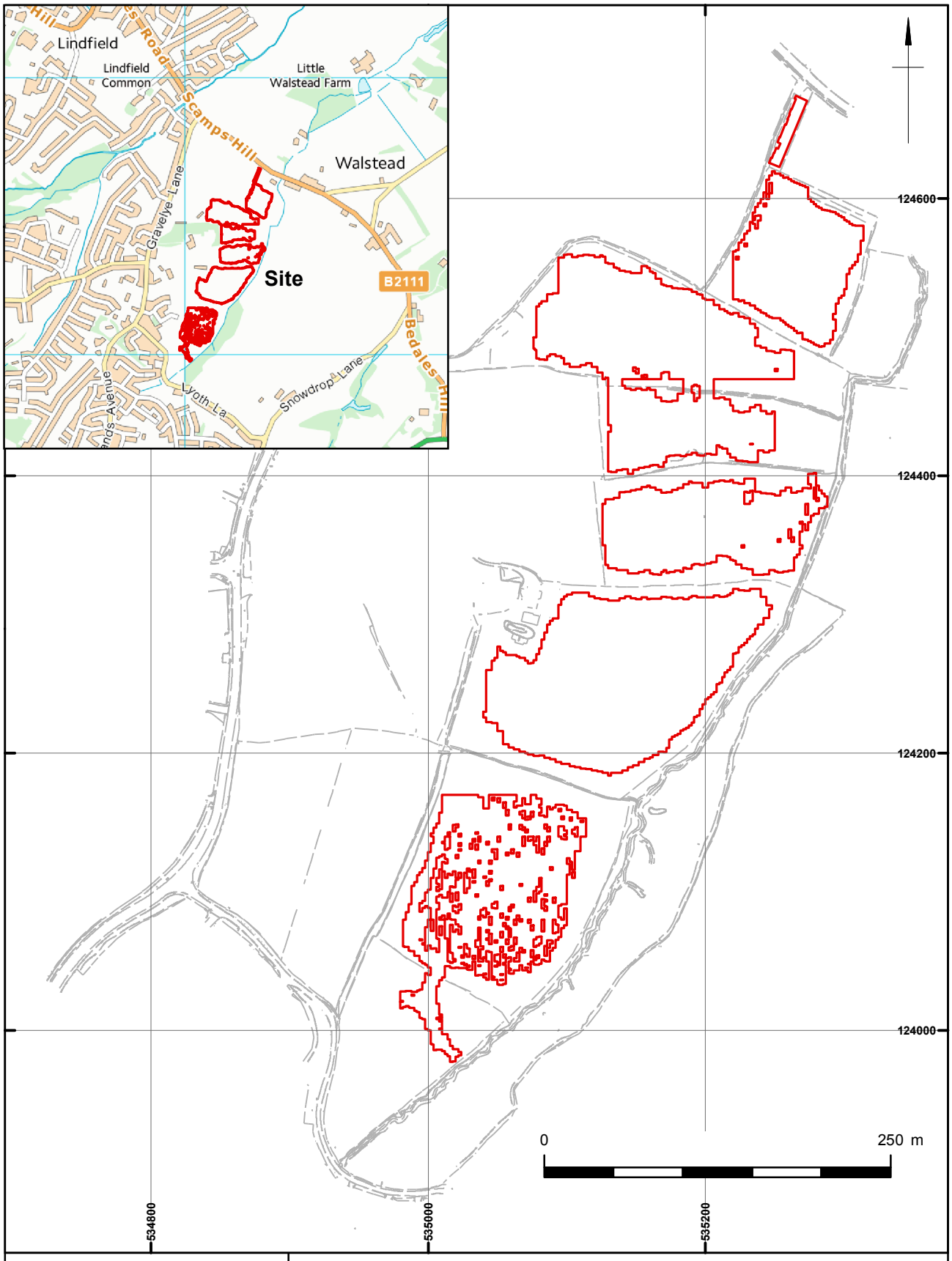
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Geophysical survey extents

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Scale:	1:4000 at A4	Illustrator:	KL
Path:	X:\PROJECTS\102490\GIS\FigsMXD\geophys\Fig01.mxd		

Site location and survey extents

Figure 1

535000

535200

124600

124400

124200

124000

+3nT

-2nT

0

200 m

Survey digital data supplied by the Client.
This material is for client report only

Geophysical survey extents

Date:	31/01/14	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102490\GIS\FigsMXD\geophys\Fig02.mxd		

Greyscale

Figure 2

535000

535200

124600

124400

124200

124000

+50nT

-50nT

0

200 m

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Geophysical survey extents

Date:	31/01/14	Revision Number:	0
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Path:	X:\PROJECTS\102490\GIS\FigsMXD\geophys\Fig03.mxd		

XY plot

Figure 3

535000

535200

124600

124400

124200

124000

4000

4001

4002

4003

4004

4005

4006

4007

4008

4009

4010

4011

4012

4013

4014

4015

4016

Geophysical survey extents

Possible archaeology

Probable archaeology

Modern service

Ferrous

Trend

Agricultural

Superficial geology

0

200 m

Geophysical survey extents

Date:	31/01/14	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102490\GIS\FigsMXD\geophys\Fig04.mxd		

Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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