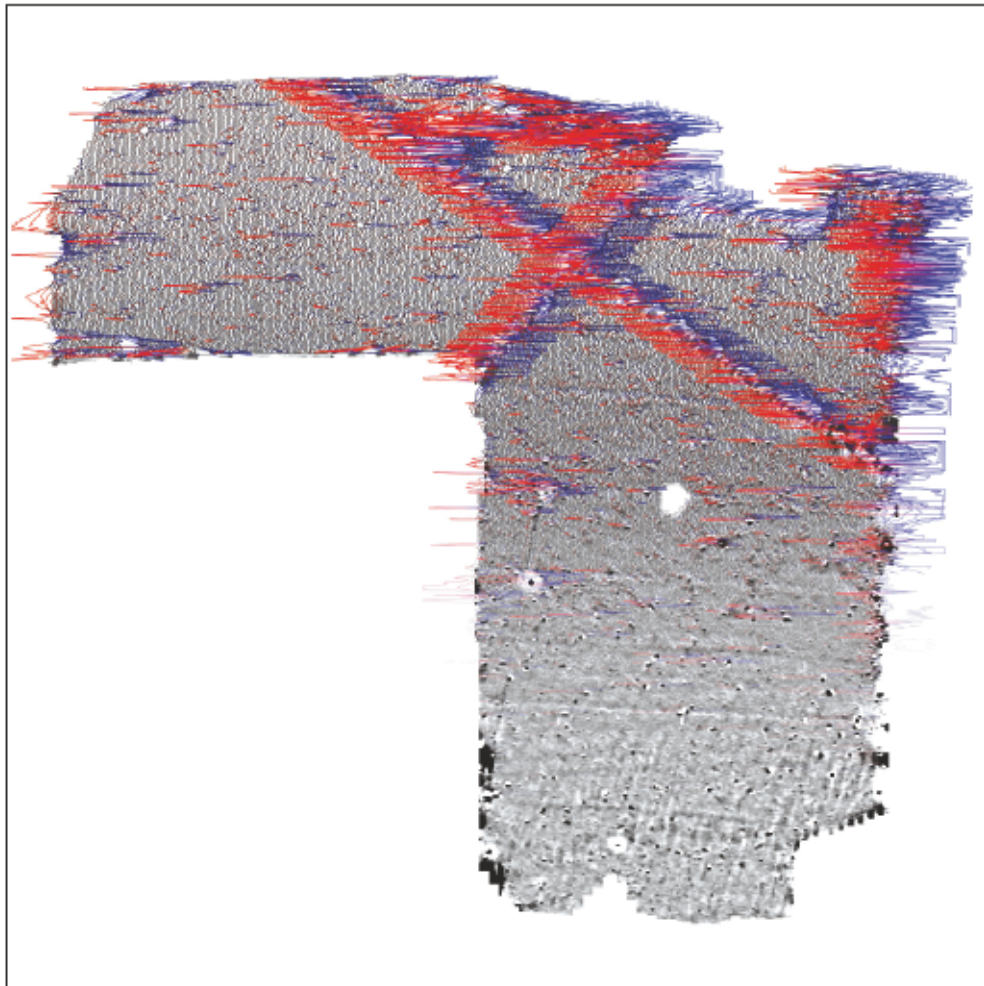




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# Land off St. Andrew's Road Warminster, Wiltshire

Detailed Gradiometer Survey Report



Ref: 102880.01  
February 2014



**Land off St. Andrew's Road  
Warminster, Wiltshire**

**Detailed Gradiometer Survey Report**

**Prepared for:**  
**CgMs Consulting**  
140 London Wall  
London  
EC2Y 5DN

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

[www.wessexarch.co.uk](http://www.wessexarch.co.uk)


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## Quality Assurance

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# Land off St. Andrew's Road Warminster, Wiltshire

## Detailed Gradiometer Survey Report

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# Land off St. Andrew's Road Warminster, Wiltshire

## Detailed Gradiometer Survey Report

### Summary

A detailed gradiometer survey was conducted over land off St. Andrews Road, Warminster, 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 a single pasture field immediately west of St. Andrews Road and north of the A36 and Folly Lane, some 2km southwest of the centre of Warminster. The Site occupies an area of relatively flat land with a gentle slope which slopes to the north. The gradiometer survey covered 7.0 ha and has demonstrated the presence of anomalies of possible archaeological interest within the survey area, along with regions of magnetic disturbance, ferrous response and modern services.

Modern services were identified running through the northern half of the Site; all three services appear to be ferrous pipes. These services are oriented roughly northwest-southeast, northeast-southwest and east-west, and they continue beyond the limits of the geophysical survey. Whilst it is not possible to determine the function of these services, the responses produced are sufficiently characteristic to indicate their locations.

Throughout the entire survey area, but particularly in the south, ploughing trends aligned NNE-SSW and northwest-southeast are clearly visible. The relatively wide spacing between the plough lines are suggestive of ridge and furrow. Given that the gradiometer survey has detected these ephemeral features, it is considered likely that more substantial archaeological features would have produced detectable magnetic anomalies, should any have been present.

Other evidence of agricultural activity at the Site is also apparent as a number of field drains can be seen running east-west across the entire site.

Pit-like responses have been classified as being of possible archaeological interest, as it is not possible to exclude this interpretation entirely; it is possible that some are the result of natural processes or agricultural activity, however.



# **Land off St. Andrew's Road Warminster, Wiltshire**

## **Detailed Gradiometer Survey Report**

### **Acknowledgements**

The detailed gradiometer survey was commissioned by CgMs Consulting, the assistance of Richard Meager is gratefully acknowledged in this regard. Wessex Archaeology extends its thanks to Redrow Homes Ltd. for financing the project.

The fieldwork was directed by Jen Smith, Alistair Salisbury and Rachel Williams. Jen Smith and Rachel Williams processed and interpreted the geophysical data, and Jen Smith wrote this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Rob Goller. The project was managed on behalf of Wessex Archaeology by Andy King.



# Land off St. Andrew's 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 of land off St. Andrew's Road in Warminster, Wiltshire (**Figure 1**), hereafter "the Site" (centred on NGR 385564 144444). 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. A previous desk-based assessment has highlighted that apart from isolated dwellings, first shown on an estate map of 1780, located close to the northern boundary of the site, the land has remained undeveloped throughout recorded history. The assessment suggested a low-moderate archaeological potential for Prehistoric and Romano-British periods and a low potential for all other periods (CgMs 2013).

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 of a single pasture field immediately west of St. Andrews Road and north of the A36 and Folly Lane, some 2km southwest of the centre of Warminster (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 7.0 ha.

1.2.2 The Site occupies an area of relatively flat land with a gentle slope which slopes to the north. The land lies at a height of 150m at the southern boundary and 135m to the north above the Ordnance datum (aOD). The survey extents are defined by Folly Road to the south, a housing estate to the east and north-west and Warminster Rugby Club to the south-west.

1.2.3 The soils underlying the Site are likely to be the typical brown earths of the 541b (Bromsgrove) 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 on 27<sup>th</sup> and 28<sup>th</sup> January 2014. 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 ( $\pm 5\text{nT}$  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 several anomalies of probable and possible archaeological interest within the Site, along with areas of magnetic disturbance and ferrous responses. 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 is displayed at  $-2\text{nT}$  (white) to  $+3\text{nT}$  (black) for the greyscale image and  $\pm 25\text{nT}$  at  $25\text{nT}$  per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of possible 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 Numerous linear trends and other linear anomalies, e.g. **4000** and **4002**, can be seen throughout the Site. To the north of the Site several of the linear trends extend ENE-WSW, with one linear trend running from northeast-southwest. These are most likely to be the result of past agricultural activity on the Site.

3.2.2 Pit-like anomalies are also located throughout the entire Site and are relatively sparse in their distribution; their form and size suggest that they may be of some archaeological interest although their origin is not conclusively archaeological and it is possible that they relate to natural features, such as tree throws, or agricultural activity.





- 3.2.3 Areas of increased magnetic response can be seen at **4001** and along the northern and southern boundaries of the Site. All appear to have components indicative of ferrous responses and are most likely to be modern in origin.
- 3.2.4 Extensive linear trends can be seen to the south of the Site **4002**. Most appear to be the result of ploughing and these are orientated NNE-SSW; more plough lines can also be seen and these appear to cross the NNE-SSW lines in a northwest-southeast direction. The relatively wide spacing between these lines is suggestive of ridge and furrow and the two sets of orientations suggest that there was more than one phase.
- 3.2.5 Several linear anomalies, which can be seen across the entire dataset, are orientated east-west respectively and are probable field drains due to their relatively even spacing throughout the field. The remaining linear trends in the south do not appear to follow the same orientation as the field drains and give weaker magnetic responses, but are still considered likely to be the result of past agricultural activity.

### **3.3 Gradiometer Survey Results and Interpretation: Modern Services**

- 3.3.1 There are at least three modern services at **4003**, **4004** and **4005** running through the northern half of the Site; all three services appear to be ferrous pipes. These services are oriented roughly northwest-southeast **4003**, northeast-southwest **4004** and east-west **4005** and they continue beyond the limits of the geophysical survey.
- 3.3.2 It is not clear from the geophysical data whether any of the services identified are in active use or not. Also 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 has been successful in detecting anomalies of possible archaeological interest within the Site, in addition to regions of increased magnetic response and several modern services.
- 4.1.2 The ploughing trends at **4002** visible within the survey area are oriented approximately NNE-SSW and northeast-southwest, and do not appear to respect the present field boundaries, suggesting that they are more likely to be historic in origin.
- 4.1.3 The probable field drains detected by the gradiometer appear to respect the current boundaries of the field which suggests that they are more likely to be modern in origin.
- 4.1.4 The relative dimensions of the modern services identified **4003**, **4004**, **4005** 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 Several clusters of isolated pit-like anomalies have been identified although it is difficult to be certain about their origins. An archaeological interpretation cannot be excluded entirely, resulting in their classification as being of possible interest. No clear coherent



spatial pattern is apparent within their distribution, however, and it is possible that they are natural or agricultural in origin.

- 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. However, the detection of ploughing trends and other weak responses suggests that more substantial archaeological features would have produced measurable magnetic anomalies.

## 5 REFERENCES

CGMS, 2013. *Archaeological Desk Based Assessment - Land West of St Andrew's Road, Warminster, Wiltshire*. Unpublished client report CB/16281.

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 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  $\pm 100$ nT 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.

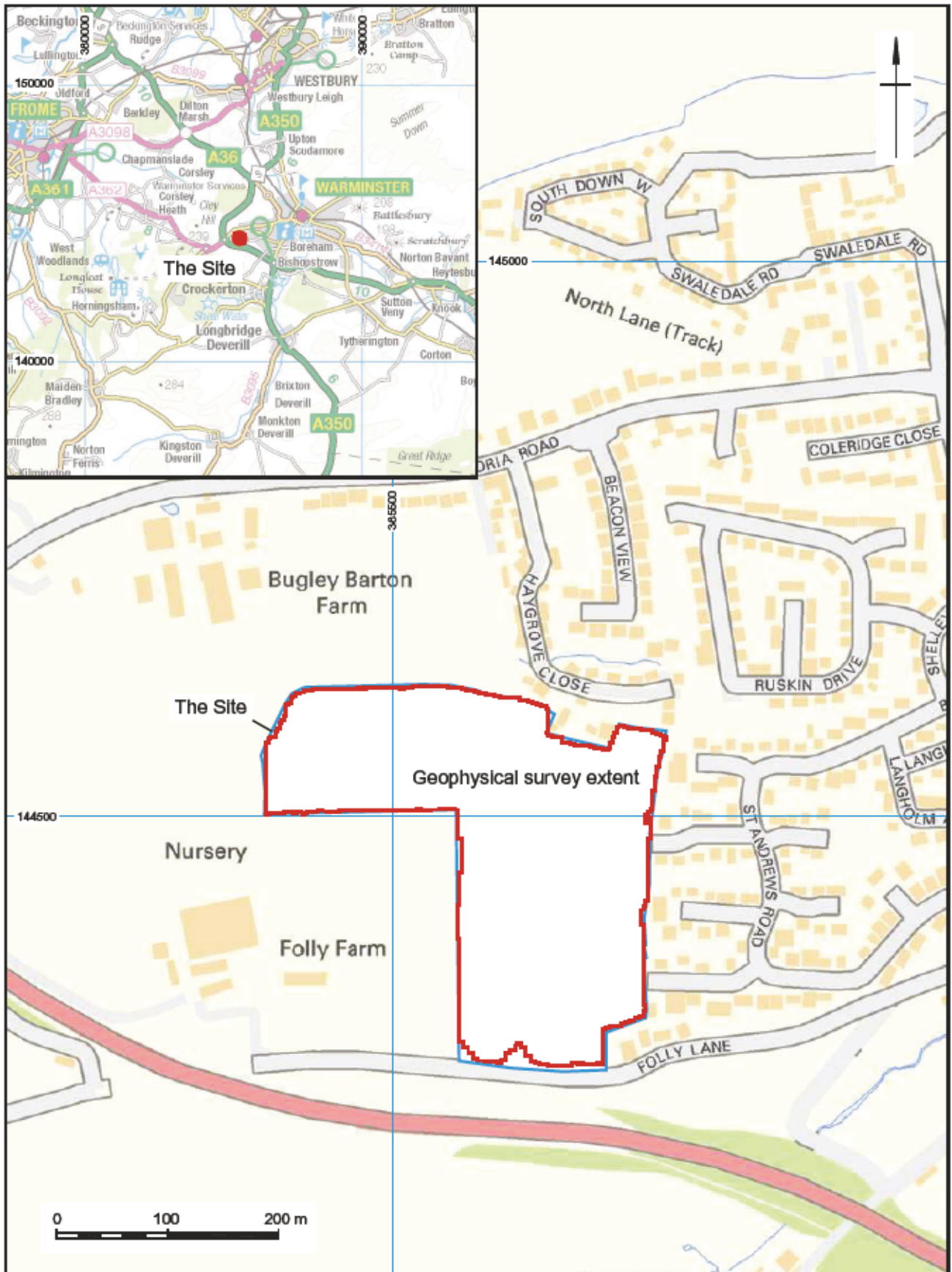
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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

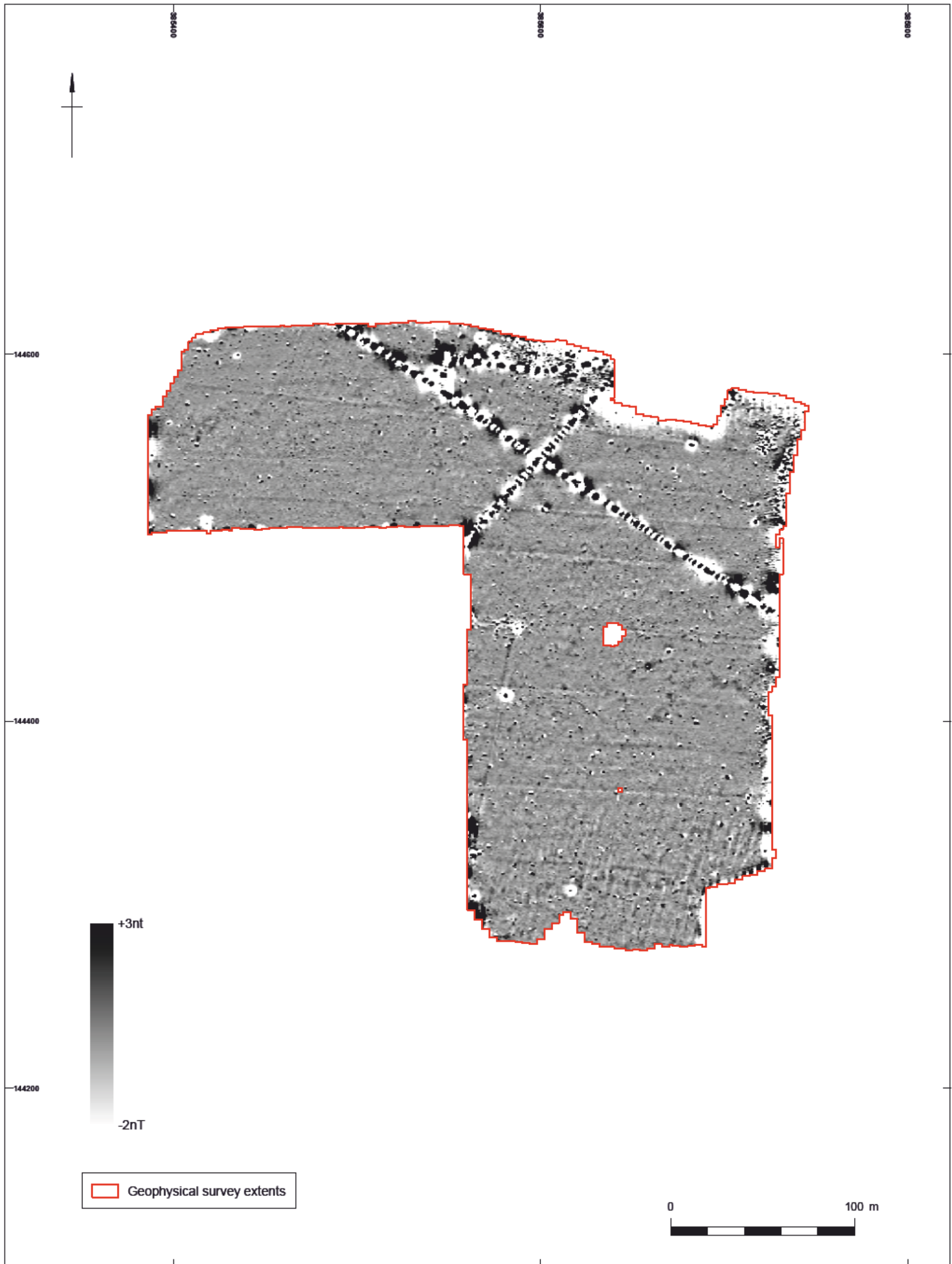
Finally, services such as water pipes are marked where they have been identified.



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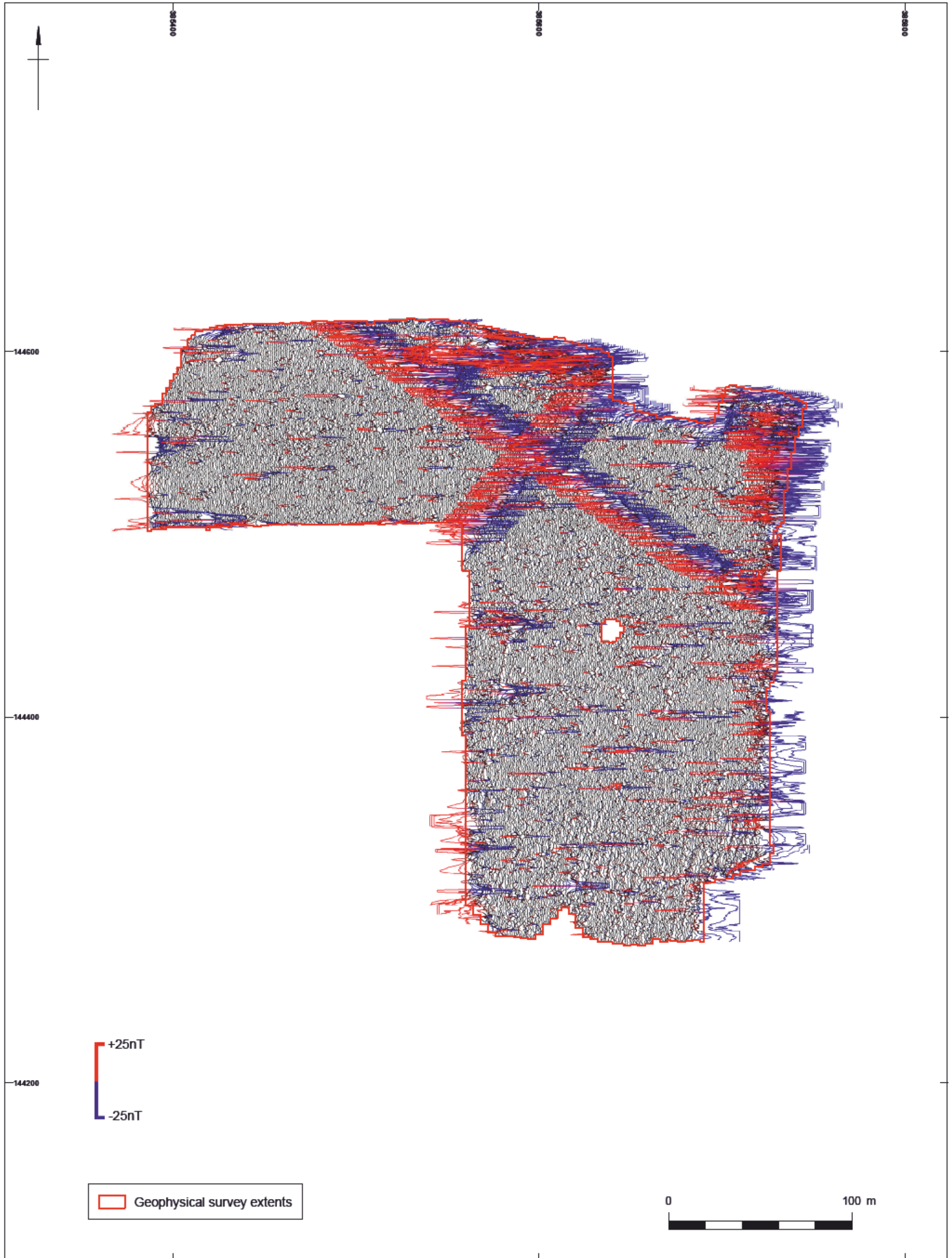
Site location map

Figure 1



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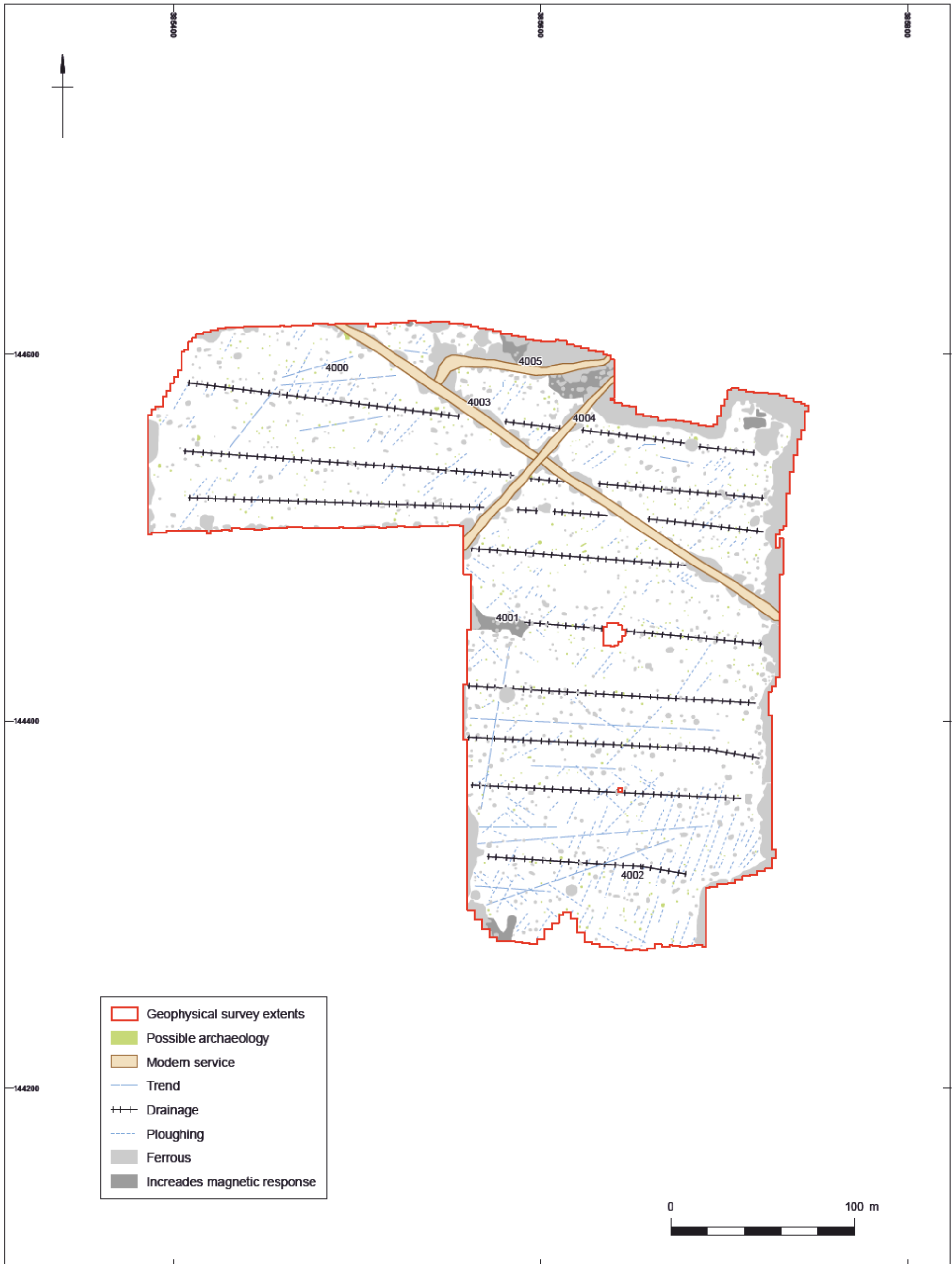
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- Geophysical survey extents
- Possible archaeology
- Modern service
- Trend
- +++ Drainage
- - - Ploughing
- Ferrous
- Increases magnetic response



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



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