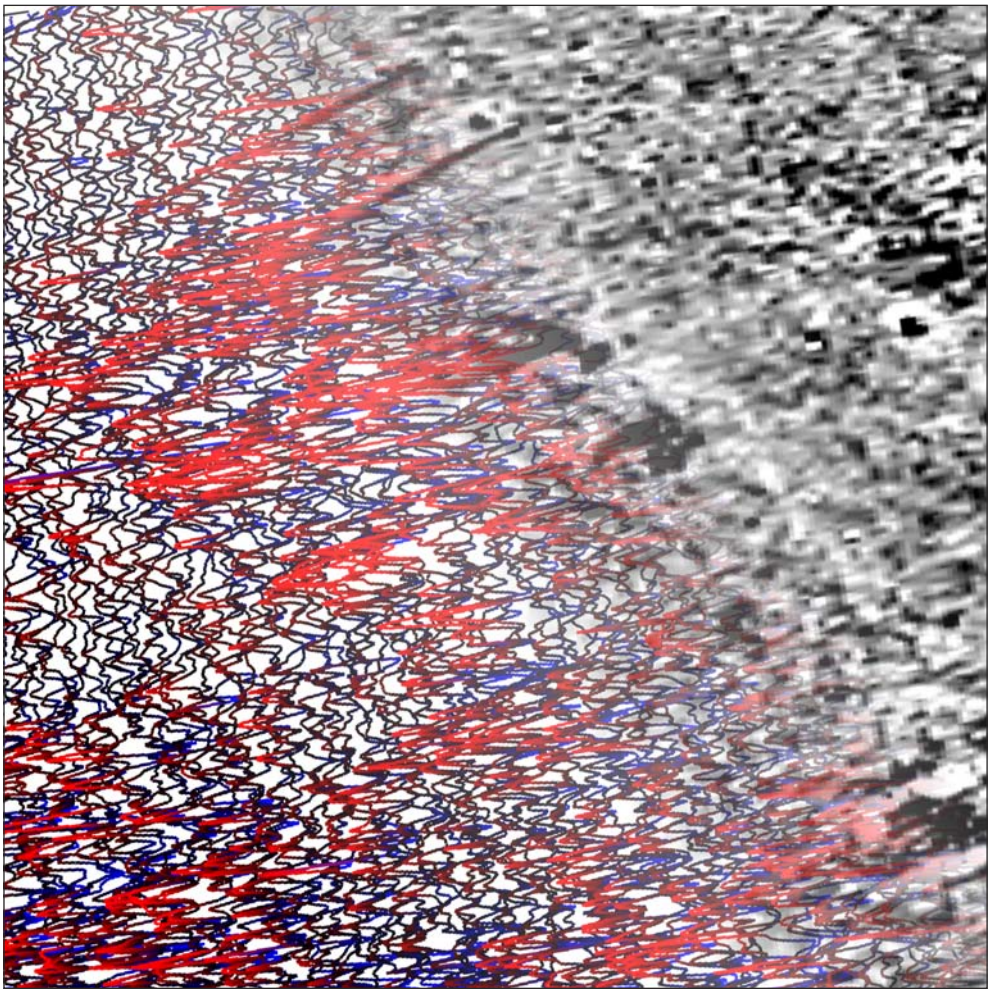
making sense of heritage

Land at Great Cocktree Farm, North Tawton, Devon

Detailed Gradiometer Survey Report



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geoservices

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North Tawton, Devon

Detailed Gradiometer Survey Report

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Summary

A detailed gradiometer survey was conducted over land at Great Cocktree Farm, North Tawton, Devon. The project was commissioned by ADAS 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 lies within two pasture fields approximately 2.25km to the south of centre of North Tawton. The site occupies the westward facing slope of a gently undulating area. The gradiometer survey covered 6ha and has demonstrated the presence of anomalies of definite, probable and possible archaeological interest within the Site, in addition to numerous trends and areas of increased magnetic response.

The archaeological features found are likely to be ditches, although there original function is unclear but they could represent anything from drainage channels to ditches defining strip fields. Similarly the nature of the trends identified across the Site is unclear but it is suspected they are created as a result of agricultural activity.

The wide spread of magnetic disturbance associated with the numerous small-scale ferrous anomalies and strong geology have reduced the area in which it is possible to detect archaeological features. It is possible that weak archaeological features could be obscured by these strong ferrous anomalies.

The geophysical survey has demonstrated a low archaeological potential overall across the Site, however, 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.

Land at Great Cocktree Farm
North Tawton, Devon

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by ADAS. The assistance of Sally Walker and Diarmuid O'Seaceachain is gratefully acknowledged in this regard.

The fieldwork was directed by Laura Andrews and assisted by Jennifer Smith. Ross Lefort processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Linda Coleman. The project was managed on behalf of Wessex Archaeology by Paul Baggaley.

Land at Great Cocktree Farm
North Tawton, Devon

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by ADAS to carry out a geophysical survey of land at Great Cocktree Farm, North Tawton, Devon (Figure 1), hereafter "the Site" (centred on NGR 266225 99475). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

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

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

1.2 The Site

1.2.1 The survey area comprises two pasture fields (**Areas A** and **B**) near Great Cocktree Farm, some 2.25km south of North Tawton (Figure 1). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 5.93ha.

1.2.2 The Site occupies the west facing slope of a hill situated in an area of undulating topography. Tributaries of the River Taw flow along the base of the hill to the south and west that meet the river to the northwest of the site. The land on site slopes from just over 155m above Ordnance Datum (aOD) in the east of the survey area to around 130m aOD in the west. The survey extents are defined by field boundaries in **Area A** and by an outline defined by the client in **Area B**.

1.2.3 The soils underlying the Site are recorded as a mix of different soil types. The majority of the site is likely to consist of pelo-stagnogley soils of the 712d (Hallsworth 1) association with typical brown alluvial soils of the 561c (Alun) association on the western edge of the survey area (SSEW 1983). There are other soil types close by with typical non-calcareous pelosols of the 421b (Halstow) association to the south and typical brown earths of the 541e (Crediton) association to the north of the survey area.

1.2.4 The bedrock geology is recorded as Mudstone Member and Crackington Formation (Carboniferous). No superficial geology is recorded across most of the survey area but alluvium (clay, silt, sand and gravel) and river terrace deposits (gravel, sand and silt) are recorded in the western part of the survey area that were formed in the Quaternary period. 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 between the 14th and 16th January 2013. Field conditions at the time of the survey were good with dry conditions making walking easier.

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 Most of the data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±8nT 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 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 1:2000 (**Figures 2**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale images 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 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

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

3.2 Gradiometer Survey Results and Interpretation

3.2.1 There are several linear positive anomalies in **Area A**; some of them are set at differing alignments to the modern field boundaries such as **4000**, **4001** and **4002** and others are aligned with the modern field boundaries such as at **4003** and **4004**. The linear features

set at a differing alignment are considered more likely to be archaeological and have been classed as definite archaeology. The features aligned with the current scheme of field divisions are considered less likely to be archaeological and have been termed probable archaeology to reflect this. All of these positive magnetic anomalies are likely to represent cut features such as ditches. There are some more isolated curvilinear positive anomalies to the southeast of **4003** and these may prove to be archaeological features.

3.2.2 There are several irregular shaped spreads of very broad bipolar anomalies (black and white) in this area that have been interpreted as geological given their form. Within these spreads there are some more regular looking features such as some well-defined linear features at **4005**; these have been classed as possible archaeology as these regular features may be a product of plough scars running through strong geology.

3.2.3 There are a couple of irregular shaped spreads of smaller scale bipolar and dipolar anomalies; these look different in form to the geological features described above such as the spread at **4004**. These features could be geological but this spread could equally represent a spread of magnetised and high-temperature fired anthropogenic material such as small ferrous objects and ceramic debris.

3.2.4 There are many trends running through this area; most of these are ploughing trends aligned with the present field boundaries. There are others that are on a different alignment and these may prove to be archaeological.

3.2.5 The remaining anomalies are small sub-oval and sub-circular positive anomalies; they form no significant patterns in their spatial distribution and are considered to be of possible archaeological interest.

3.2.6 There are several noticeable archaeological features in **Area B** with the most noticeable north of **4006**. This has been shown to be a field boundary that was removed within the last century; earlier editions of Ordnance Survey (OS) maps show this boundary in place. There are several more linear positive anomalies visible across the area such as at **4007**, **4008**, **4010** and around **4012**. These are all on different alignments and they do not appear to respect the present system of field division. These anomalies are again thought to represent ditches and are considered to be archaeological. There is a possibility that more than one phase is represented in the data with two different alignments visible. There are less extensive features present in the data that are on a different alignment to those ditches described above; they can be seen at **4009**, **4011** and **4012** and are associated with areas of increased magnetic response in two of the examples (**4009** and **4012**). It is not clear what features these anomalies represent but they are suspected to be cut features and have been termed definite and probable archaeology because of this.

3.2.7 There are no areas of geology in this area but there are several areas of increased magnetic response. Some of these areas coincide with archaeological features which may suggest they are related but it is possible that the dominance of these spreads represents a change in geology rather than an increase in human activity.

3.2.8 There are many trends running through this area; most of these are ploughing trends aligned with the present field boundaries. There are others that are on a different alignment such as at **4013** and these may prove to be archaeological.

3.2.9 The remaining anomalies are small sub-oval and sub-circular positive anomalies; they form no significant patterns in their spatial distribution and are considered to be of possible archaeological interest.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 No modern services were identified in this data. It is possible that services made from materials that are not detectable through gradiometer survey may lie in this area. 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 definite, probable and possible archaeological interest within the Site, in addition to numerous trends and areas of increased magnetic response.

4.1.2 The function of the ditches identified in the data is unclear but they could represent anything from drainage channels to ditches defining strip fields; their function is thought to be agricultural. The regular anomalies at **4009** look to be more complex than a simple agricultural feature little can be said about the identity of this feature. The nature of the trends identified is unclear but it is suspected they are created as a result of agricultural activity in these fields over time.

4.1.3 The wide spread of magnetic disturbance associated with the numerous small-scale ferrous anomalies and strong geology have reduced the area in which it is possible to detect archaeological features. It is possible that weak archaeological features could be obscured by these strong ferrous anomalies.

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.

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 5, 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 two main categories: archaeological and unidentified responses.

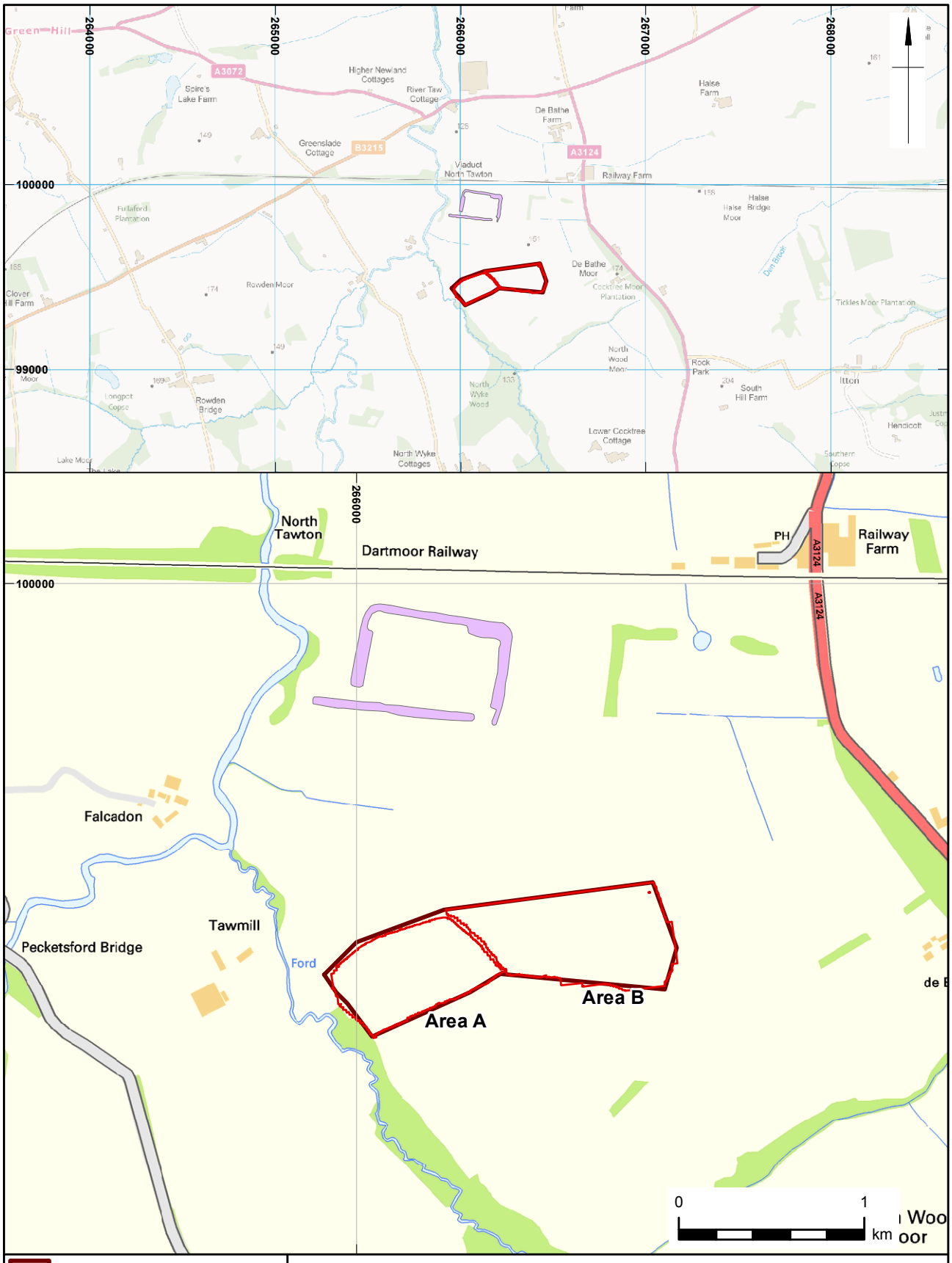
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Site Boundary

Geophysics Survey Extents

Site of Roman Fort/camp

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Site location

Figure 1

266000

266500

99500

Area A

Area B

3nT

-2nT

0

100

m

266000

266500

99500

Area A

Area B

25nT

-25nT

Geophysics Survey Extents

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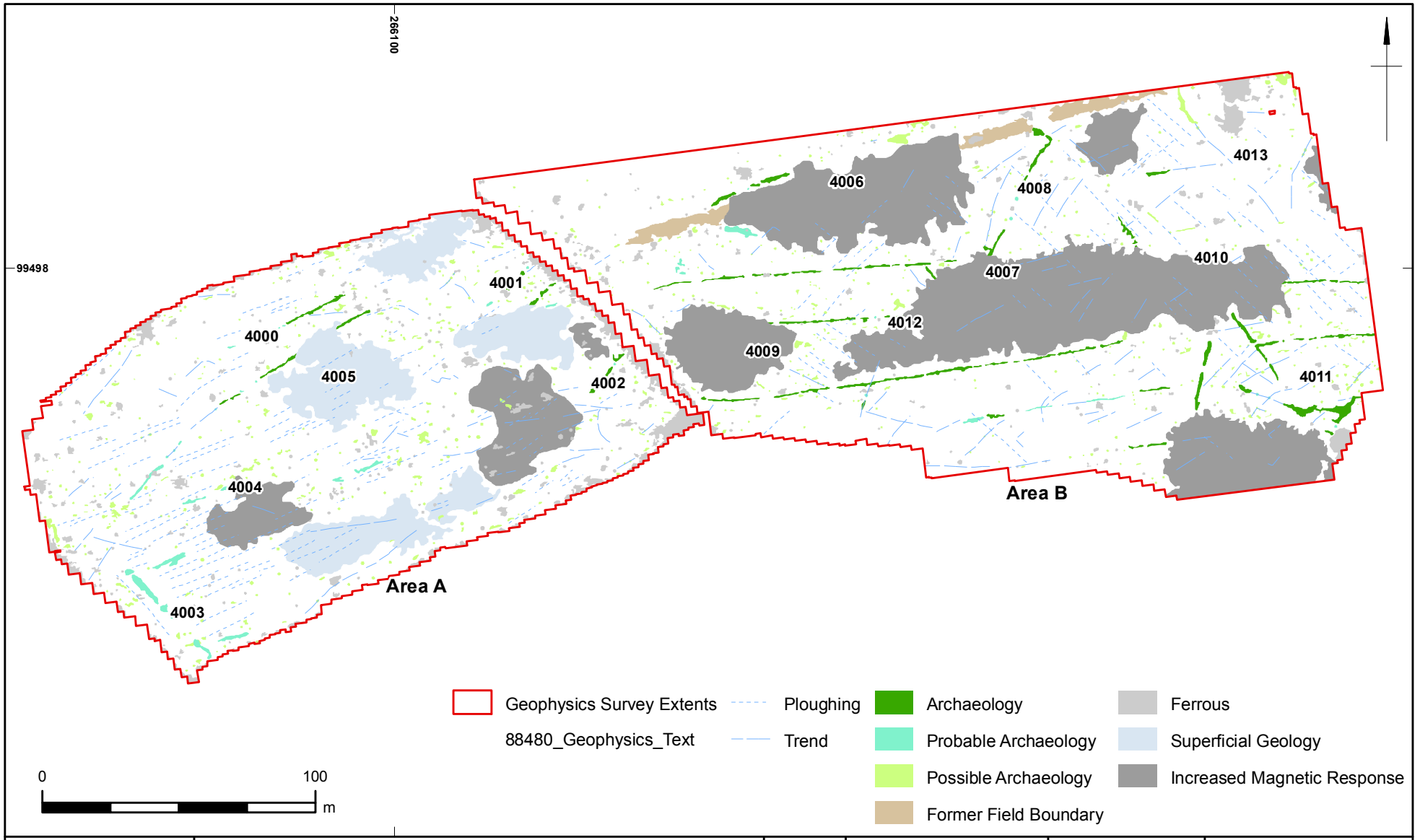
Grayscale and XY trace

Figure 2



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Interpretation

Figure 3

wessex archaeology

salisbury rochester sheffield edinburgh

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