Archaeological Services
University of Durham

Todd Hill Wind Farm, Morpeth, Northumberland

geophysical surveys

on behalf of
Arcus Renewable Energy Consulting Ltd

Report 2108
October 2008

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of a proposed wind farm development at Todd Hill, near Morpeth, in Northumberland. The works comprised six geomagnetic surveys covering a total area of approximately 7ha.

1.2 The works were commissioned by Arcus Renewable Energy Consulting Ltd and conducted by Archaeological Services Durham University.

Results

1.3 Probable ring-ditches, which could indicate the presence of roundhouses, and enclosure ditches were identified in Area 5. Anomalies within the possible roundhouses could reflect hearths and pits or postholes.

1.4 Traces of former ridge and furrow cultivation were identified in Areas 2, 3, 4 and 5.

1.5 Discrete soil-filled pit and ditch features may have been detected in Areas 3, 4, 5 and 6.

2. Project background

Location (Figure 1)

2.1 The study area was located at Todd Hill, near Pigdon, about 5km north-west of Morpeth in Northumberland (NGR centre: NZ 1545 8940). Six surveys were conducted, comprising a total of *c.*7ha, in six land parcels.

Development proposal

2.2 The proposed development is a wind farm of four turbines, access tracks and associated infrastructure.

Objective

2.3 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance within the proposed development area, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in advance of development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions provided by the client, Arcus Renewable Energy Consulting Ltd, based on current English Heritage (2008) guidelines.

Dates

2.5 Fieldwork was undertaken between 13th and 15th October 2008. This report was prepared between 16th and 24th October 2008.

Personnel

2.6 Fieldwork was conducted by Richie Villis (Supervisor) and Edward Davies. This report was prepared by Richie Villis and Duncan Hale, the Project Manager, with illustrations by Janine Wilson.

Archive/OASIS

2.7 The site code is **MTH08**, for **M**orpeth, **T**odd **H**ill 20**08**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (OASIS). The OASIS ID number for this project is **archaeol3-50262.**

3. Archaeological and historical background

3.1 An archaeological desk-based assessment of the proposed development area and its environs was conducted by ASWYAS (2008).

3.2 The conclusions of that report are as follows:

"It is probable that the proposed development site has remained in use as mixed agricultural land since at least the medieval period. The existing field pattern within the site is a product of post-medieval enclosure, although the

curvilinear alignment of the field boundaries probably reflects the influence of earlier medieval land divisions. Apart from agricultural activity, and some minor quarrying, there is no archaeological evidence for previous activity within the proposed development site. However, no archaeological survey or excavation has been undertaken on the site, and it is possible that sub-surface features or deposits that pre-date the medieval period could survive in the area" (ASWYAS 2008, 9).

3.3 The only known prehistoric sites nearby comprise two Iron Age settlements with *c*.5km of the study site (ASWYAS 2008, 4). There are no known Roman or early medieval sites within the desk-based study area (ASWYAS 2008, 5).

3.4 There is the site of a deserted medieval village at Pigdon just to the south and several fields around there contain upstanding remains of ridge and furrow earthworks. To the east lies the village of Stanton, where a number of medieval and post-medieval structures and features survive.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised five fields of pasture and one ploughed field.

Area	Size (ha)	Landuse	Topography	NGR
1	0.68	pasture	flat	NZ 160 893
2	0.48	pasture	flat	NZ 158 893
3	1.52	pasture	gently sloping	NZ 155 894
4	1.84	pasture	gently sloping	NZ 154 891
5	1.52	pasture	steep slope to south	NZ 153 894
6	1.00	arable (ploughed)	gently sloping west	NZ 152 892

4.2 The surveys were mainly on the upper western slopes of the hill at between 100-120m OD.

4.3 The underlying solid geology of the area comprises the Namurian 'Millstone Grit Series', which is overlain by Boulder Clay and morainic drift.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines *Geophysical survey in archaeological field evaluation, 2nd edition* (David, Linford & Linford 2008); the Institute of Field Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2002).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a variety of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance it was considered likely that cut features such as ditches and pits might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.5 The study area was divided into six individual survey areas.

5.6 A 20m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system (GPS) with real-time correction providing sub-metre accuracy.

5.7 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 1600 sample measurements per 20m grid unit.

5.8 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.9 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (unfiltered) data. The greyscale images and interpretations are presented in Figures 2-5; the trace plots are provided in Figure 6. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic

anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.10 The following basic processing functions have been applied to each dataset:

clip	clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.
destagger	corrects for displacement of anomalies caused by alternate zig-zag traverses.
interpolate	increases the number of data points in a survey to match sample and traverse intervals. In this instance the data have been interpolated to 0.25 x 0.25m intervals.

Interpretation: anomaly types

5.11 Colour-coded geophysical interpretation plans are provided for each survey area. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches.
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids.
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths.

Interpretation: features

General comments

5.12 Colour-coded archaeological interpretation plans are provided.

5.13 Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as furrows, ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

5.14 Series of parallel, weak, positive magnetic anomalies, which almost certainly reflect traces of former ridge and furrow cultivation have been detected across Areas 2, 3, 4 and 5.

5.15 Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plans, however, they have been omitted from the archaeological interpretation plans and the following discussion.

Area 1

5.16 A number of small dipolar magnetic anomalies almost certainly reflect fired brick or ferrous waste.

Area 2

5.17 A large, intense dipolar magnetic anomaly detected just east of centre almost certainly reflects a ferrous pipe.

5.18 Weak linear positive magnetic anomalies relating to traces of former ridge and furrow or other former ploughing have been detected on two orientations in the western part of the survey.

Area 3

5.19 Weak linear positive magnetic anomalies detected broadly northeast-southwest across the survey area are likely to reflect former ridge and furrow cultivation.

Area 4

5.20 Weak linear negative and positive magnetic anomalies aligned broadly northeast-southwest across the survey area are likely to reflect former ridge and furrow cultivation.

5.21 Partial grids along the western edge of the survey area are due to an overgrown gorse field boundary.

5.22 A linear weak positive magnetic anomaly was detected running broadly north south along the field boundary at the west edge of the site. This reflects a farmers track and earthwork ridge running along that field boundary.

5.23 The line of dummy readings and strong dipolar magnetic anomalies aligned broadly east-west through the centre of this area correspond to a ferrous field boundary.

5.24 Strong dipolar anomalies at the extreme south of the survey area reflect a metal-fenced sheep pen.

5.25 A few small positive magnetic anomalies could reflect soil-filled pits.

Area 5

5.26 Small unsurveyed areas here correspond to boggy ground and tall vegetation.

5.27 A number of linear positive magnetic anomalies are apparent, orientated both north-south and east-west. These are likely to correspond to soil-filled features such as ditches, and could represent a series of enclosures.

5.28 There are a number of curvilinear positive magnetic anomalies in the central part of the survey. These ring-shaped anomalies are likely to reflect soil-filled ditch features, possibly construction cuts for roundhouses.

5.29 In the centres of these possible roundhouses are a number of small positive magnetic and dipolar magnetic anomalies which could reflect hearths or pits/postholes.

5.30 The central part of this survey contains a series of weak linear positive and negative magnetic anomalies which are likely to reflect former ridge and furrow. The quieter areas to the north and south are likely to represent areas of different land use or more recent ploughing activity.

Area 6

5.31 A linear positive magnetic anomaly detected in the east of the survey area could relate to a soil-filled cut feature, such as a ditch.

6. Conclusions

6.1 Seven hectares of geomagnetic survey were undertaken at Todd Hill, near Morpeth, prior to the proposed construction of a wind farm.

6.2 Probable ring-ditches, which could indicate the presence of roundhouses, and enclosure ditches were identified in Area 5. Anomalies within the possible roundhouses could reflect hearths and pits or postholes.

6.3 Traces of former ridge and furrow cultivation were identified in Areas 2, 3, 4 and 5.

6.4 Discrete soil-filled pit and ditch features may have been detected in Areas 3, 4, 5 and 6.

7. Sources

ASWYAS 2008 *Land at Todd Hill, near Pigdon, Northumberland: Archaeological Desk-based Assessment*. Unpublished ASWYAS report **1871** for Arcus Renewable Energy Consulting Ltd.

David, A, Linford, N, & Linford, P, 2008 *Geophysical survey in archaeological field evaluation, 2nd edition,* English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*, Technical Paper **6**, Institute of Field Archaeologists

Schmidt, A, 2002 *Geophysical Data in Archaeology: A Guide to Good Practice*, Archaeology Data Service, Arts and Humanities Data Service

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Figure 1
Study area

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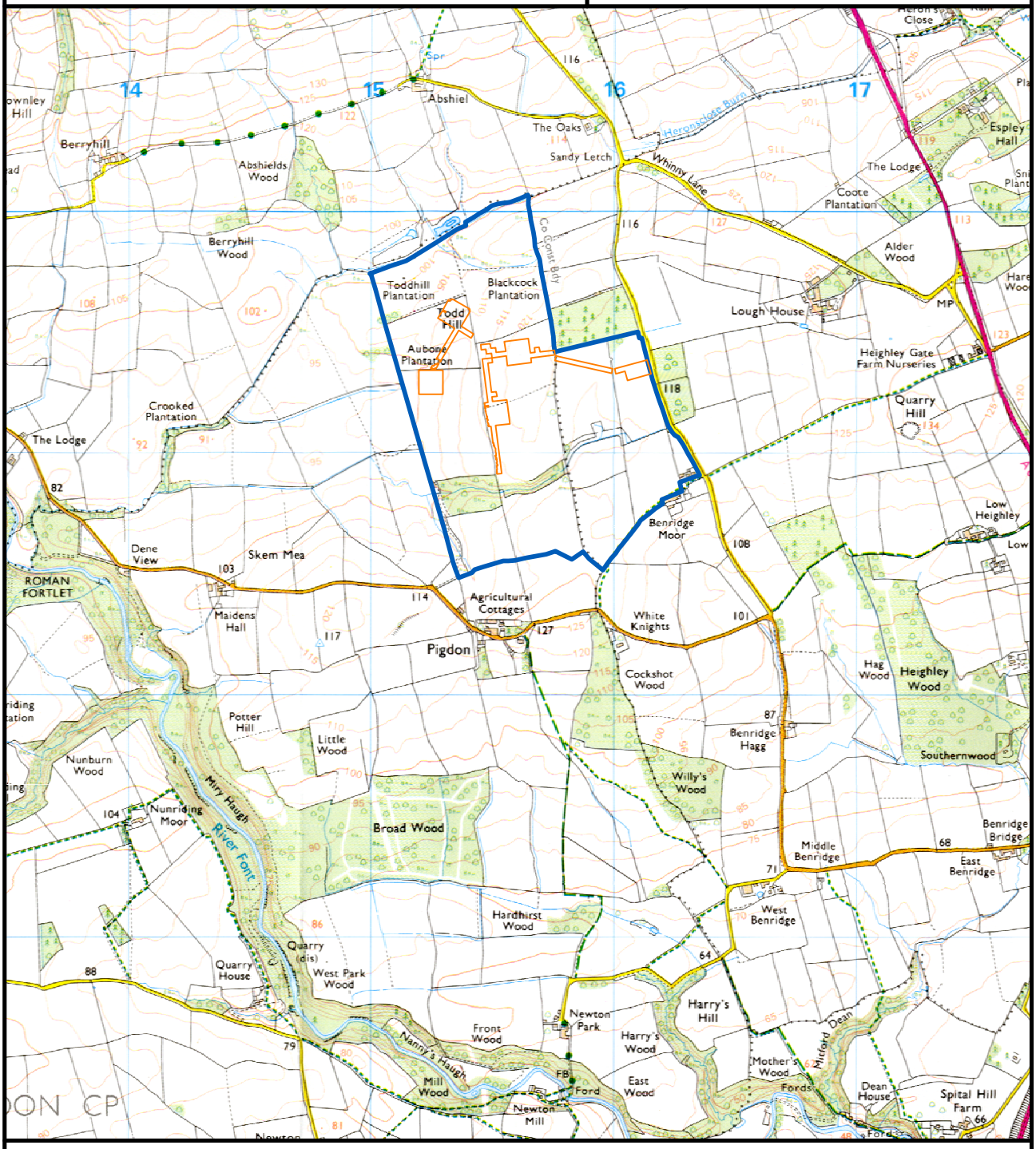

proposed development area

location of geophysical surveys

0 1km

scale 1:25 000 - for A4 plot

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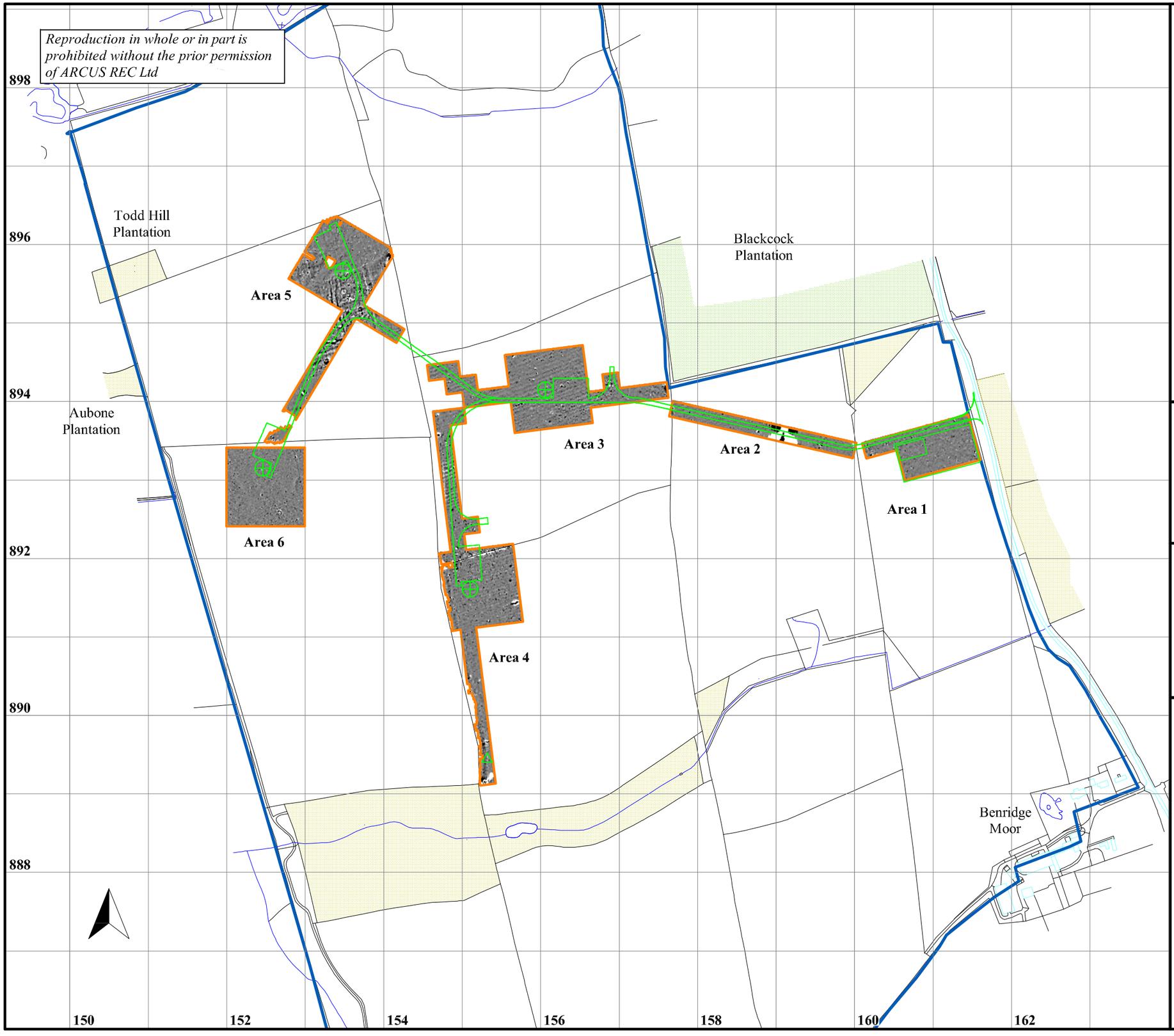

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Figure 2

Survey locations

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0 250m

scale 1:5000 - for A3 plot

- proposed development area
- outline of survey area
- proposed development

3.00
2.50
2.00
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00 nT

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Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

development area

outline of survey area

proposed development

3.00
2.50
2.00
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00 nT

0 50m

scale 1:1000 - for A1 plot

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Figure 3

Geophysical surveys

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Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

893 155 156 157 158 159 160 161

156 889 890 891 892 893 894 895

152 891 153 892 893 894 895 896 897

development area

outline of survey area

positive magnetic anomalies

negative magnetic anomalies

dipolar magnetic anomalies

0 50m

scale 1:1000 - for A1 plot

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Figure 4

Geophysical interpretations

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Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

893

155 156 157 158 159 160 161

156

889 890 891 892 893 894 895

152

891 153 892 893 894 895 896 897

development area

proposed development

outline of survey area

soil-filled features

service pipes

orientation of ridge and furrow

0 50m

scale 1:1000 - for A1 plot

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Figure 5

Archaeological interpretations

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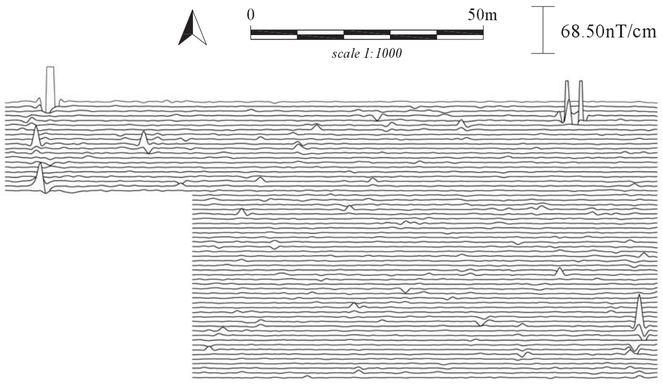
Figure 6: Trace plots of geomagnetic data

Area 1



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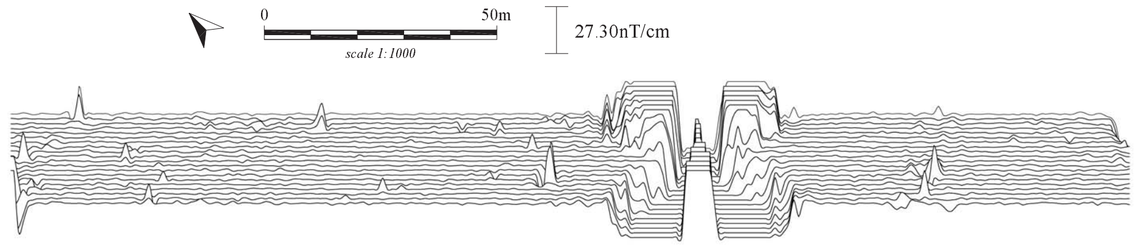

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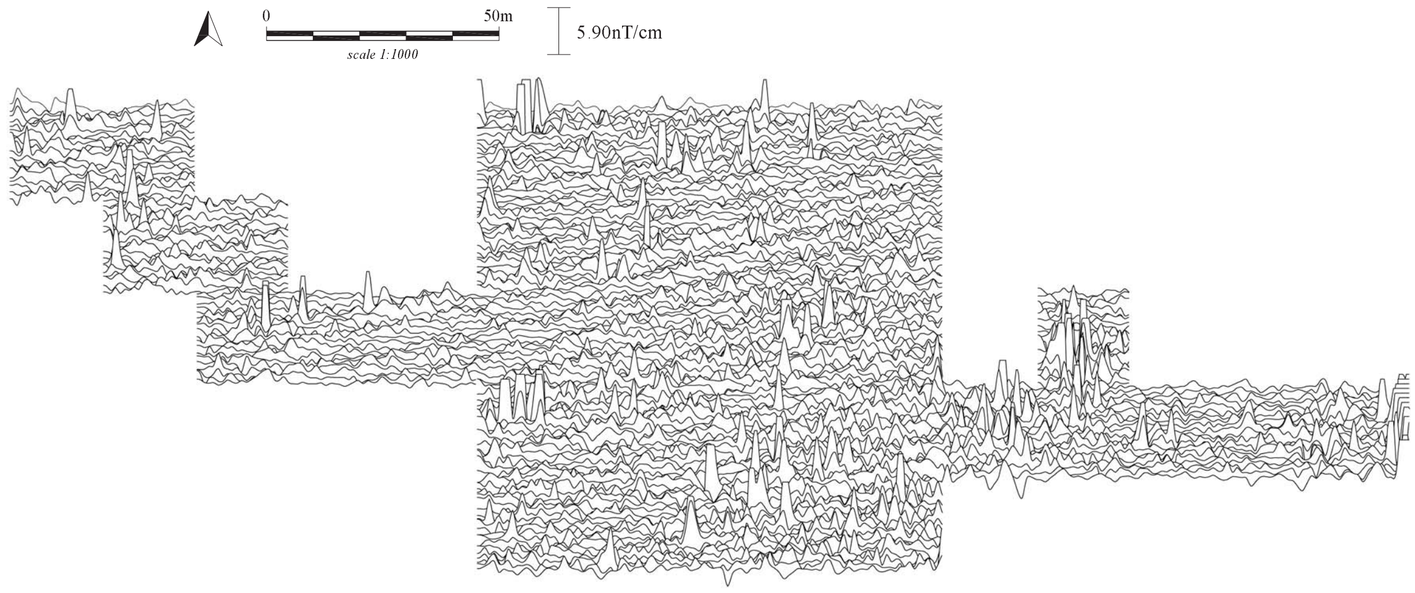

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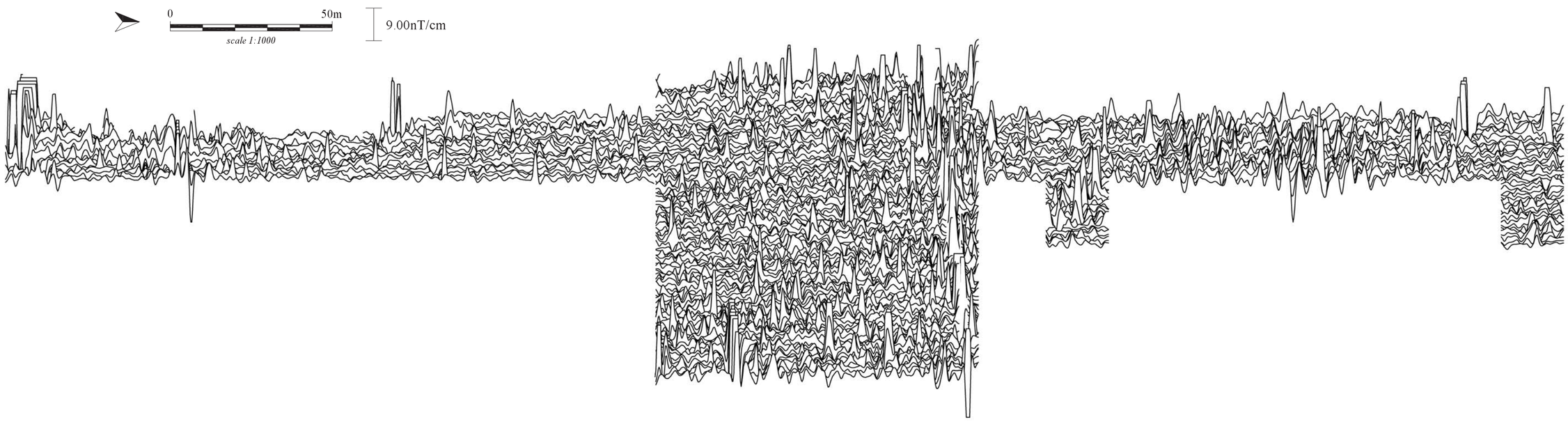

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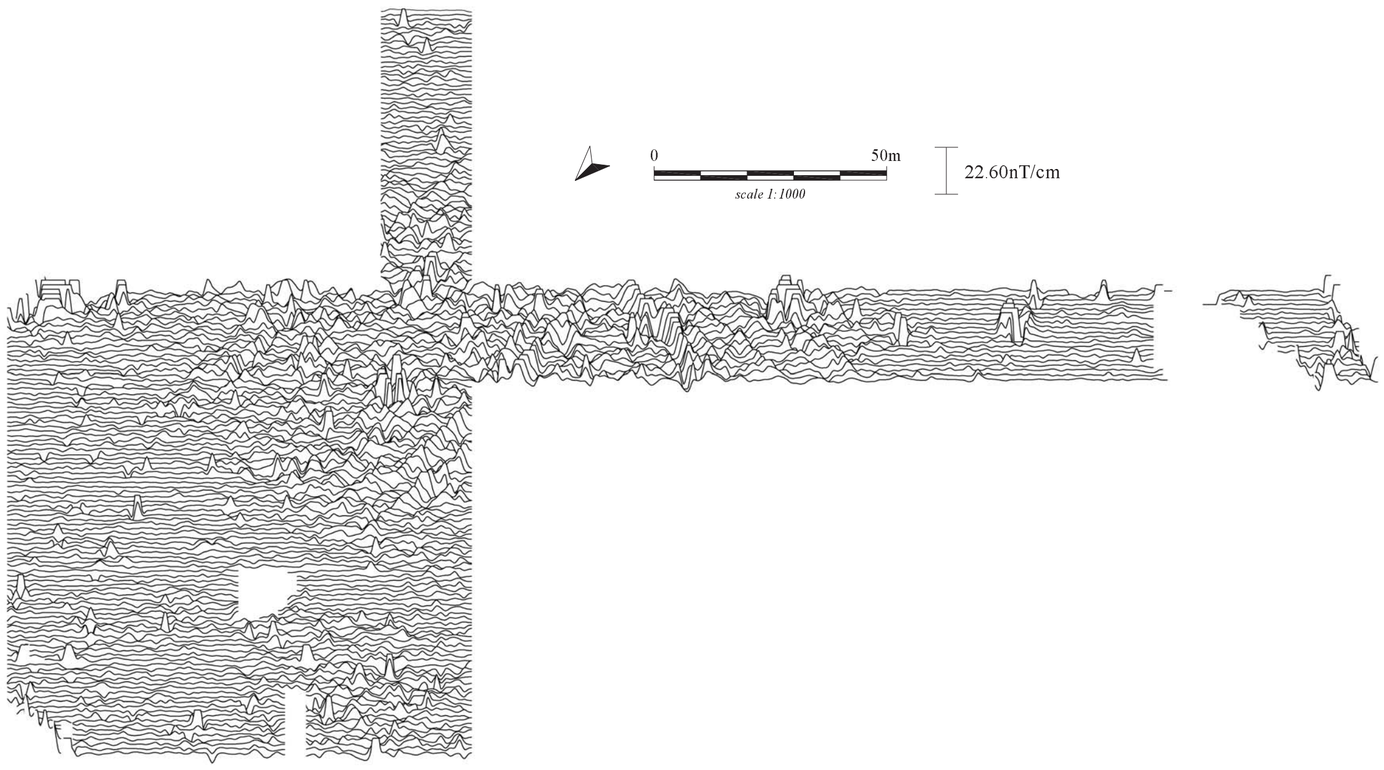

Area 6