Archaeological Services
University of Durham

White Hill Woods, Easington Lane, Tyne & Wear and County Durham

geophysical surveys phase 2

on behalf of
The Woodland Trust

Report 2151
March 2009

Archaeological Services
Durham University
South Road
Durham DH1 3LE
Tel: 0191 334 1121
Fax: 0191 334 1126
archaeological.services@durham.ac.uk
www.durham.ac.uk/archaeological.services

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Autumn Park, Dysart Road, Grantham, Lincolnshire NG31 6LL

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1. Summary

The project

1.1 This report presents the results of a second phase of geophysical survey conducted in advance of a tree planting scheme at White Hill Woods, Easington Lane. The study area spans the border between Tyne & Wear and County Durham. This phase of work comprised detailed geomagnetic survey of two areas in order to confirm the reliability of the earlier magnetic susceptibility survey.

1.2 The works were commissioned by The Woodland Trust and conducted by Archaeological Services Durham University.

Results

1.3 Area 4 was within the zone of anomalously high magnetic susceptibility (MS) values recorded in the earlier MS survey, and just south of at least one enclosure and other features of probable archaeological significance detected in the earlier detailed gradiometer survey. Detailed gradiometry of Area 4 has now recorded a large number of probable pits, similar to those detected just to the north in the earlier detailed survey.

1.4 Probable traces of former ridge and furrow cultivation have also been detected across Area 4.

1.5 In contrast, only two potential pit features were detected in Area 3, where consistently low magnetic susceptibility values had previously been recorded.

1.6 This phase of detailed geomagnetic survey has confirmed the reliability and interpretation of the earlier magnetic susceptibility survey.

1.7 Based on geophysical evidence, the potential for the presence of archaeological features is highest in the north, north-west and north-east of the development area, where detailed survey has already identified probable enclosures and other features. The archaeological potential of areas in the eastern and southern parts of the site could be considered to be medium, whilst the triangular area in the west-central part of the site can be considered as having low archaeological potential.

2. Project background

Location (Figures 1 & 2)

2.1 The site comprises land at White Hill, to the south of Easington Lane and north of Pig Hill, spanning the border between Tyne & Wear and County Durham (NGR centre: NZ 3677 4511). It is bounded by Salter's Lane (B1280) to the east and by a track and Coldwell Burn to the south, with areas of woodland to the west. The northern boundary is the rear of properties on South View, Easington Lane. The total area of the site is 82ha, of which 9.5ha consists of existing woodland. An earlier phase of survey using magnetic susceptibility (MS) and detailed gradiometry covered approximately 73ha (Archaeological Services 2008b). This second phase comprised the detailed survey of two areas measuring one hectare each, in order to test the results of the earlier MS survey.

Development proposal

2.2 The Woodland Trust are proposing to create native woodland. The scheme will involve some deep ploughing (five and three hectares in the northern and southern parts of the area respectively) and both grassland seeding and tree planting.

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 requested in advance of development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from The Woodland Trust, following a specification previously supplied by Durham County Council Archaeology Section.

Dates

2.5 Fieldwork was undertaken on 27th October 2008. This report was prepared between then and 4th March 2009.

Personnel

2.6 Fieldwork was conducted by David Graham and Andy Platell. This report was prepared by Duncan Hale, the Project Manager, with illustrations by Edward Davies.

Archive/OASIS

2.7 The site code is **WHW08-2**, for **W**hite **H**ill **W**oods 20**08** phase **2**. The survey archive will be supplied on CD to the Bowes Museum on completion of the project. Archaeological Services is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (OASIS). The OASIS ID

numbers for this project are **archaeol3-56355** (Co Durham) and **56352** (Tyne & Wear).

3. Archaeological and historical background

3.1 An archaeological desk-based assessment for the proposed woodland scheme was conducted by Archaeological Services Durham University on behalf of The Woodland Trust (Archaeological Services 2008a).

3.2 In summary, the assessment indicated that the proposed development might impact upon unknown archaeological resources most likely dating to the prehistoric/Romano British periods in terms of agricultural remains and settlement. Analysis of sites in the vicinity has indicated a high potential for potential prehistoric features.

3.3 Geophysical investigations comprising 65ha of topsoil MS survey and 8ha of detailed fluxgate gradiometer survey were undertaken in September-October 2008 (Archaeological Services 2008a). These surveys detected the probable presence of archaeological features across Area 1 in the north, including at least one enclosure, and the likelihood for further archaeological features in Area 2 in the south. The MS survey of the area in between indicated a higher potential for further archaeological features to survive in the northern and north-western parts of the area, with slightly raised values in the eastern and east-central parts. A roughly triangular area of particularly low MS values, and hence low archaeological potential, was identified in the west-central part of the site.

4. Landuse, topography and geology

4.1 At the time of survey, the bulk of the site (73ha) was in use as arable land with 9.5ha of mature woodland in the west.

4.2 The land slopes gradually down to Coldwell Burn in the south. To the north is the village of Easington Lane. The mean elevation on the northern-eastern part of the site is 133m OD, and at Coldwell Burn 115m OD.

4.3 The underlying solid geology of the area is Magnesian Limestone which is overlain by boulder clay and morainic drift (glacial till).

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, the efficacy of detailed fluxgate gradiometer survey had already been demonstrated, and the technique was now required to test the results of the MS survey.

5.4 Fluxgate gradiometry 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 A 30m grid was established over each of the two areas and tied-in to known, mapped Ordnance Survey points.

5.6 Measurements of vertical geomagnetic field gradient were determined using Geoscan Research FM256 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.

5.7 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

5.8 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 3 & 4; the trace plots are provided in Figure 5. 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.

5.9 The following basic processing functions have been applied to the data:

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.
despike	locates and suppresses iron spikes in gradiometer data.
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 0.25m x 0.25m intervals.

Interpretation: anomaly types

5.10 Two types of geomagnetic anomaly have been identified 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.
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired debris and/or fired structures such as kilns or hearths.

Interpretation: features

5.11 A scatter of small, discrete dipolar magnetic anomalies has been detected across each survey area. These anomalies 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. They have been omitted from the archaeological interpretation plans and the following discussion.

5.12 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, as above, by decomposed organic matter or by burning.

Area 3

5.13 Two discrete positive magnetic anomalies were detected here. These anomalies could reflect soil-filled features such as pits.

Area 4

5.14 A relatively high concentration of positive magnetic anomalies was detected across this area. These could similarly reflect features such as pits and occasional possible remains of ditches. The date and function of these features is not known.

5.15 A number of weak, parallel, positive magnetic anomalies were also detected across this area. The anomalies are slightly arcuate and fairly evenly spaced at

6-7m intervals. These anomalies almost certainly reflect former ridge and furrow cultivation.

6. Discussion and conclusions

6.1 Detailed geomagnetic surveys were undertaken over two sample areas at White Hill, Easington Lane, in order to test the efficacy of the earlier magnetic susceptibility survey prior to proposed deep-ploughing and tree-planting. The 65ha MS survey identified broad areas of anomalously high and low MS values, which could reflect higher and lower levels of past human activity respectively.

6.2 The survey within the area of anomalously low MS values detected only two anomalies reflecting features of possible archaeological origin and confirmed the low potential for survival of archaeological remains in that area, as indicated by the MS survey.

6.3 The survey within the area of anomalously high MS values on the other hand detected many probable soil-filled features of possible archaeological origin, as well as probable traces of former ridge and furrow cultivation. This also confirms the reliability and interpretation of the MS survey.

6.4 In conclusion, based on geophysical evidence, the potential for the presence of archaeological features is highest in the north, north-west and north-east of the development area, where detailed survey has already identified probable enclosures and other features. The archaeological potential of areas in the eastern and southern parts of the site could be considered to be medium, whilst the triangular area in the west-central part of the site can be considered as having low archaeological potential.

6.5 A programme of archaeological trial trenching could be used to try to establish the functions, dates, depths and preservation states of sub-surface features. It may then be possible and appropriate to re-define the areas proposed for deep ploughing and tree or grassland planting schemes based on the depths to archaeological features, where present, in different parts of the site.

7. Sources

Archaeological Services 2008a *White Hill Woods, Easington Lane, Tyne & Wear and County Durham: archaeological desk-based assessment*. Unpublished report **2024** for The Woodland Trust, Archaeological Services Durham University

Archaeological Services 2008b *White Hill Woods, Easington Lane, Tyne & Wear and County Durham: geophysical surveys*. Unpublished report **2100** for The Woodland Trust, Archaeological Services Durham University

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
Site location

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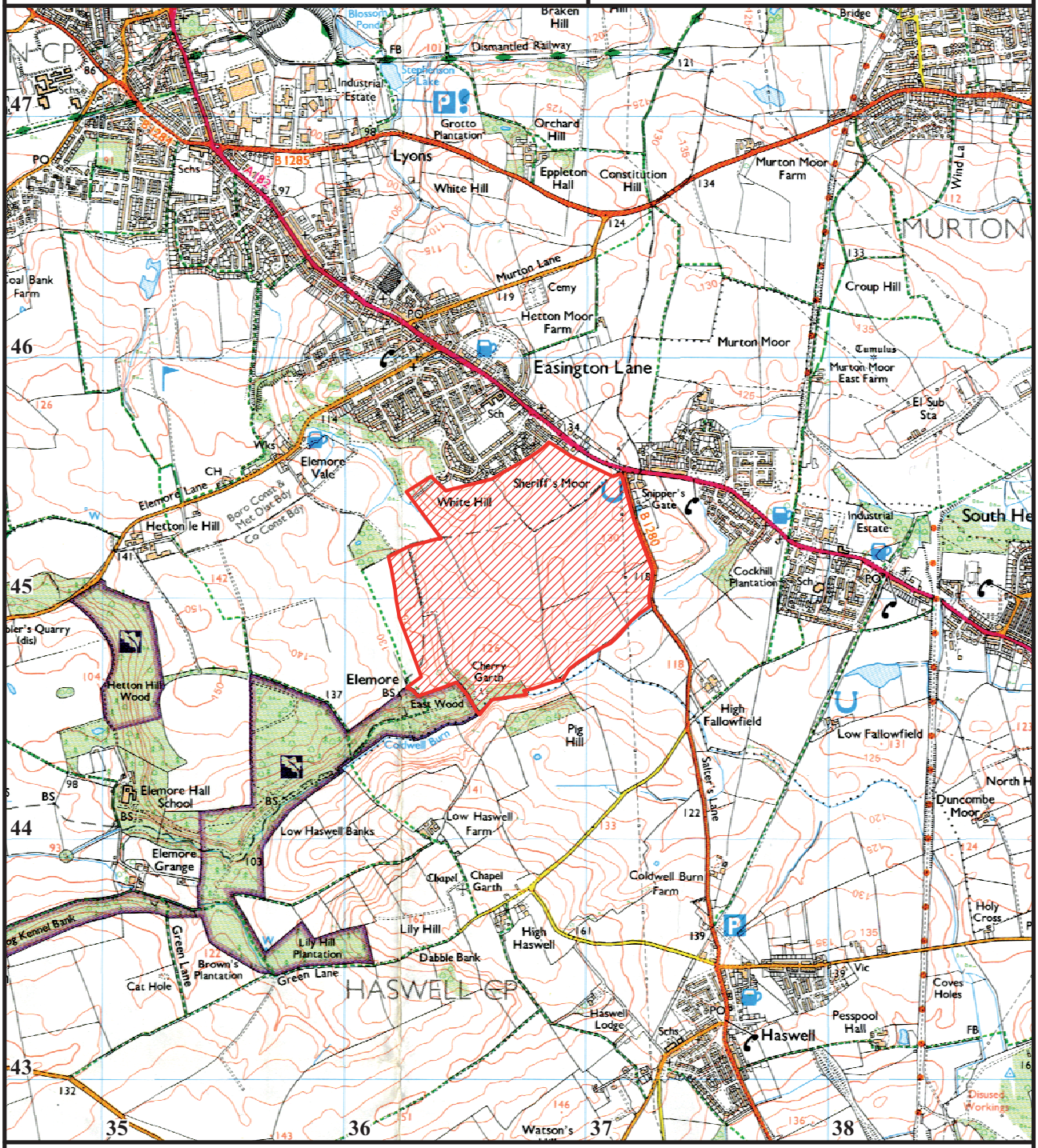

proposed development area

0 1km

scale 1:25 000 - for A4 plot

Area 1

Area 4

Area 3

Area 2

45

37

Elemore

Cherry Garth

East Wood

Elmore Wood

Coldwell Burn

Pig Hill

A182 SOUTH DURHAM ROAD

Whitegates Equestrian Centre

Ullswater Terrace

Hallwick Terrace

Ashley House

Ashley Terrace

Regent Terrace

Kennels

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Figure 2

Overview of results

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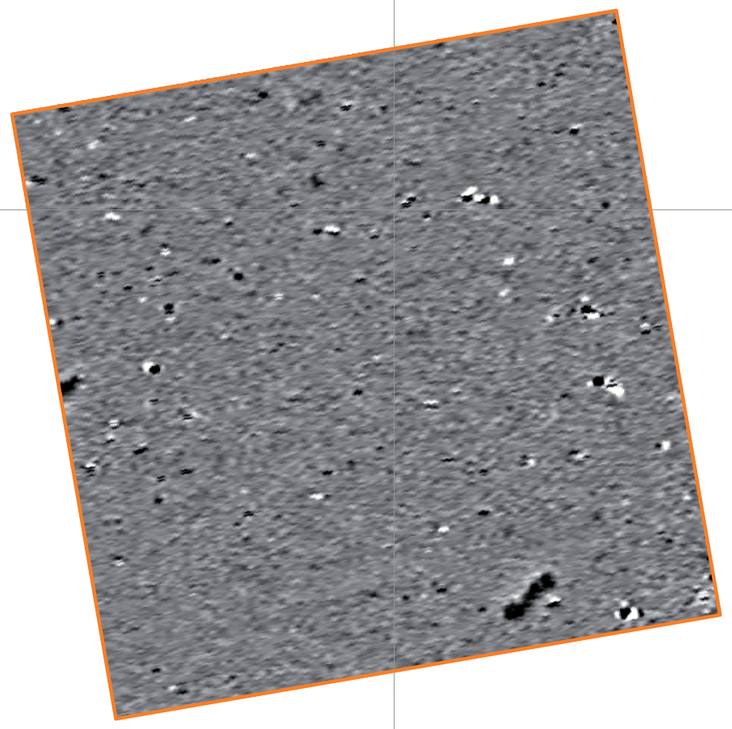
0 250m

scale 1:5000 - for A3 plot

proposed development area

survey area

proposed deep ploughing area



452

451

367

Area 3

452

451

367

Area 3

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Figure 3

Area 3 magnetic survey results and archaeological interpretation

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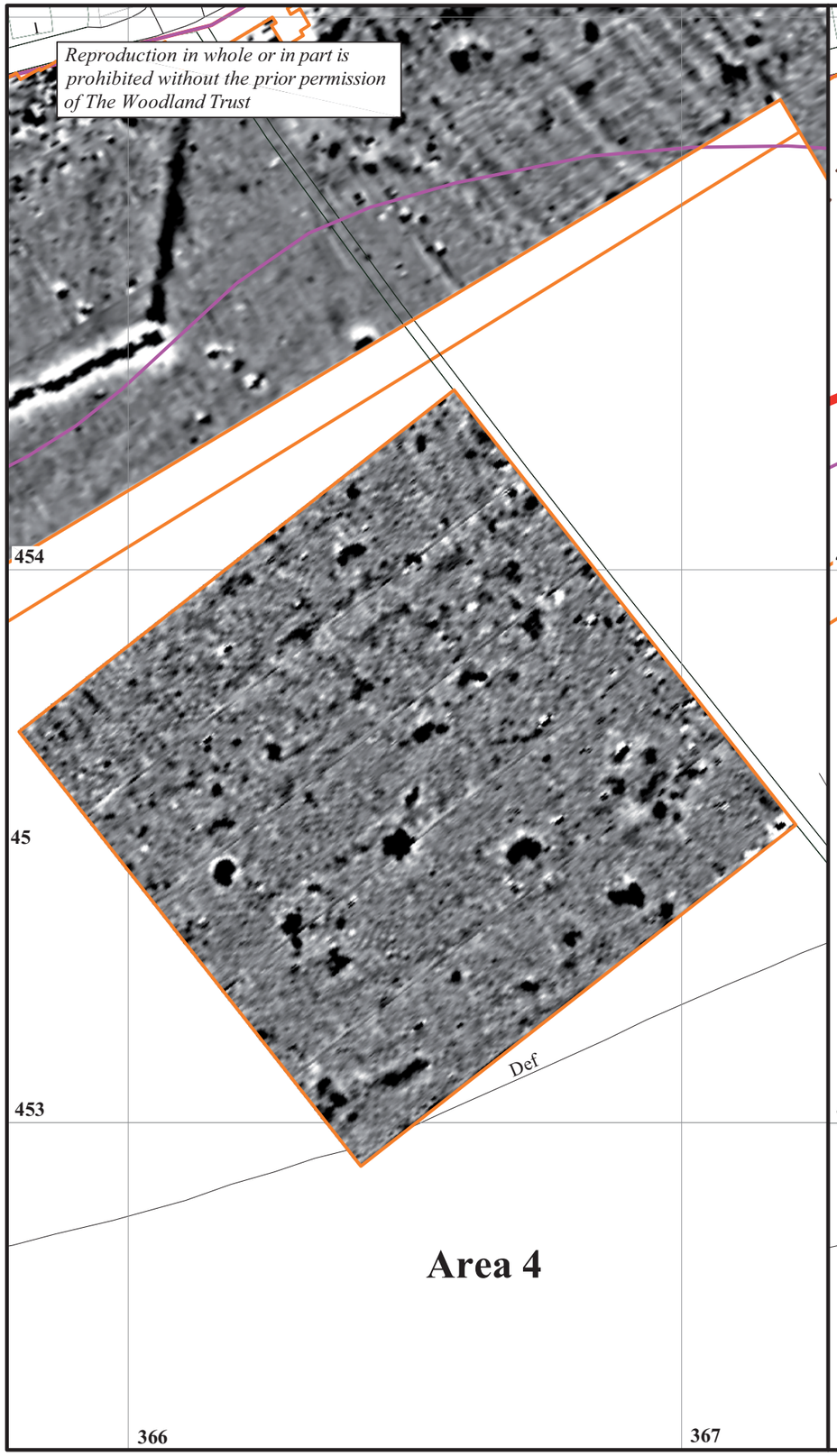
0 50m

scale 1:1000 - for A3 plot

survey area

soil-filled features

5.00
4.17
3.33
2.50
1.67
0.83
0.00
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT



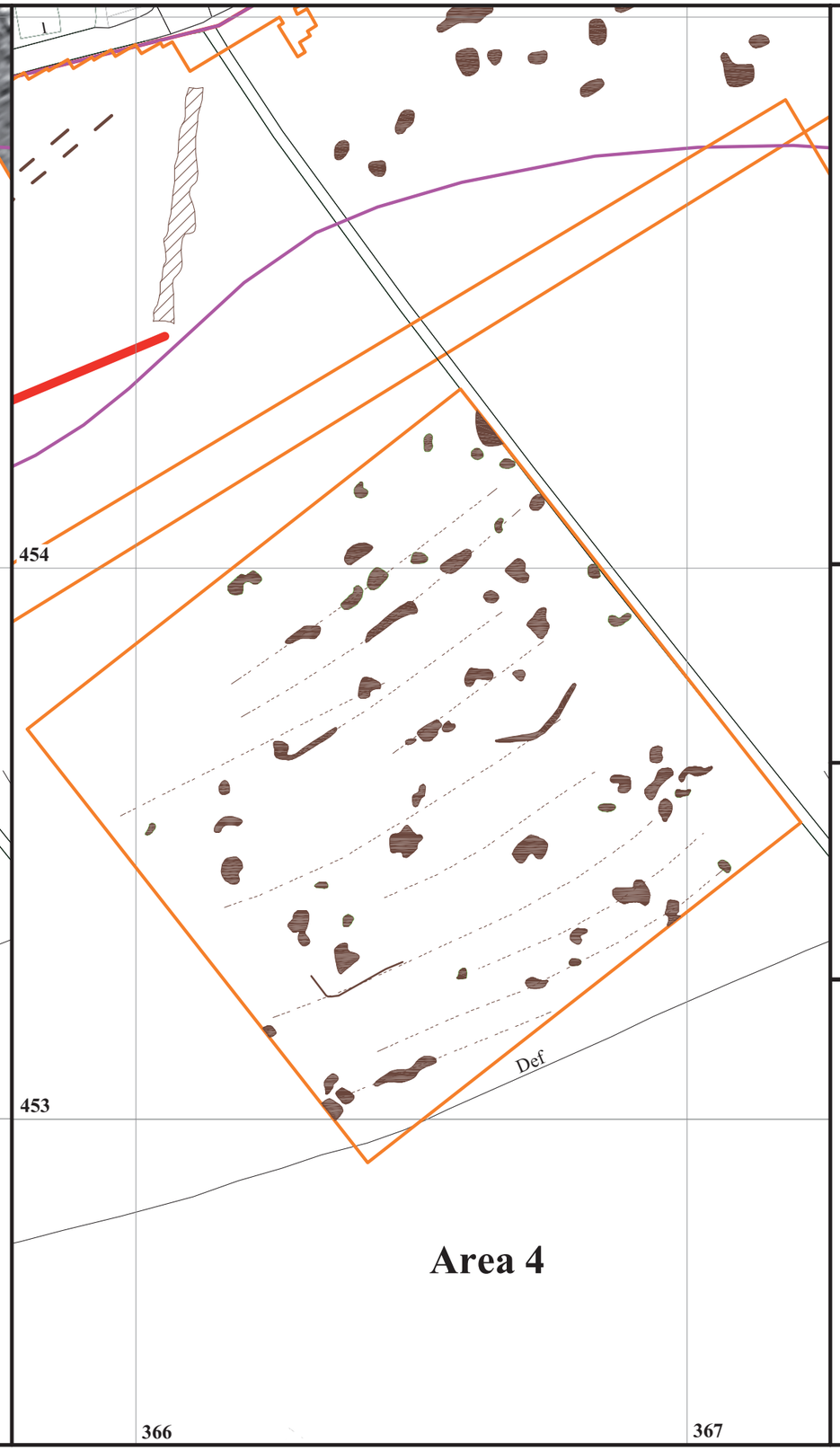


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Figure 4

Area 4 magnetic survey results and archaeological interpretation

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0 50m

scale 1:1000 - for A3 plot

survey area

area of deep ploughing

soil-filled features

service pipes

orientation of ridge and furrow

5.00
4.17
3.33
2.50
1.67
0.83
0.00
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

Figure 5: Trace plots of geomagnetic data