ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Statera Energy Ltd

High Middlefield Farm
Thorpe Thewles
Stockton-on-Tees

geophysical survey

report 4288
October 2016

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of a geophysical survey conducted in advance of proposed development at High Middlefield Farm, Thorpe Thewles, Stockton-on-Tees. The works comprised detailed geomagnetic survey of four areas totalling 2.5ha.

1.2 The works were commissioned by Statera Energy Ltd and conducted by Archaeological Services Durham University.

Results

1.3 Former ridge and furrow cultivation has been detected across the survey area.

1.4 Features recorded on early Ordnance Survey editions, including a former field boundary and an infilled pond or former structure, have been identified in Area 4.

1.5 Small patches of disturbed ground have been identified in Area 1 and 4.

1.6 Land drains have been detected throughout the site.

2. Project background

Location (Figure 1)

2.1 The proposed development area (PDA) was located at High Middlefield Farm, Thorpe Thewles, Stockton-on-Tees (NGR centre: NZ 4114 2233). To the west and north was agricultural land, to the east were farm buildings, and to the south were the former West Hartlepool Railway and Norton Electrical Substation.

2.2 Four surveys totalling 2.5ha were conducted in four land parcels.

Development proposal

2.3 The proposal is to develop an electrical peaking plant, a 49.99MW Gas Fired Energy Reserve Facility, which would connect with Norton Substation.

Objective

2.4 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance within the PDA, 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 relation to the development.

2.5 The regional research framework *Shared Visions: The North-East Regional Research Framework for the Historic Environment* (Petts & Gerrard 2006) contains an agenda for archaeological research in the region, which is incorporated into regional planning policy implementation. In this instance, the scheme of works was designed to address the following research themes: MDi: Later medieval settlement.

Methods statement

2.6 The surveys have been undertaken in accordance with instructions from the client and national standards and guidance (see para. 5.1 below).

Dates

2.7 Fieldwork was undertaken on 30th September 2016. This report was prepared for October 2016.

Personnel

2.8 Fieldwork was conducted by Duncan Hale and Richie Villis. The geophysical data were processed by Duncan Hale. This report was prepared by Richie Villis, with illustrations by Dr Helen Drinkall, and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.9 The site code is **NHM16**, for **N**orton **H**igh **M**iddlefield Farm 20**16**. The survey archive will be retained at Archaeological Services Durham University and a copy supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University 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 **archaeol3-265561**.

Acknowledgements

2.10 Archaeological Services Durham University is grateful for the assistance of the landowners in facilitating this scheme of works.

3. Historical and archaeological background

3.1 A detailed archaeological desk-based assessment has been conducted for the proposed development (Welsh 2016). Use of satellite imagery, walkover survey and LiDAR showed a strip field system, an area of ridge and furrow, a possible enclosure and a smaller square feature of unknown type.

4. Landuse, topography and geology

4.1 At the time of survey the PDA comprised four horse paddocks divided by post and wire fences. Area 4 contained patches of nettles and thistles. Very faint traces of upstanding ridge and furrow earthworks were noted across the survey areas.

4.2 The PDA slopes gently down from north to south and from east to west with mean elevations of between 48.5m OD in the east and north to around 46.5m in the south and west.

4.3 The underlying solid geology of the area comprises late Permian to early Triassic calcareous mudstone of the Roxby Formation, which is overlain by Devensian diamicton till.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with Historic England guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Chartered Institute for Archaeologists (CIfA) *Standard and Guidance for archaeological geophysical survey* (2014); the CIfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service & Digital Antiquity *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2013).

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 suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on 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 A 30m grid was established across each survey area and related to the Ordnance Survey (OS) National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 5-10mm accuracy.

5.6 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 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 sample measurements per 30m 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 (minimally processed) data. The greyscale images and trace plots are presented in Figures 2 and 3; the interpretations are provided in Figures 4 and 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 each dataset:

clip	clips 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
de-stagger	corrects for displacement of geomagnetic 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 A colour-coded geophysical interpretation plan is provided. 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

5.11 A colour-coded archaeological interpretation plan is provided. For ease of reference, anomaly numbers shown bold in the text below (eg **a**, **b**, etc) are also shown on the interpretation plans.

5.12 Parallel positive and negative magnetic anomalies have been detected across all of the survey areas, aligned broadly north-north-east/south-south-west (**a**). These almost certainly reflect former ridge and furrow cultivation, which survives as slight earthworks in some areas.

5.13 A weak positive magnetic anomaly with associated dipolar magnetic anomalies along its length has been detected in Area 4 (**b**), in the same orientation as the former ridge and furrow cultivation. This corresponds to a former field boundary shown on historic OS editions.

5.14 A roughly rectangular concentration of dipolar magnetic anomalies (**c**) has been detected at the southern end of the former field boundary (**b**). This almost certainly reflects fired and/or ferrous debris, including possible structural debris. This corresponds to a feature shown on historic OS editions, and may represent the remains of a small structure, or possibly an infilled pond.

5.15 A series of narrow, regularly spaced, east/west aligned, parallel positive magnetic anomalies have been detected across Area 1 (**d**). These almost certainly reflect land drains. Several perpendicular positive and negative magnetic anomalies have also been detected, extending south into Areas 2, 3 and 4 (**e**). These correspond to features interpreted as strip field enclosures in the desk-based assessment, but are interpreted here as almost certainly further land drains.

5.16 Concentrations of strong dipolar magnetic anomalies have been detected in the western part of Area 4 (**f**) and in the south of Area 1 (**g**). These almost certainly reflect fired and ferrous debris, typically dumped materials or otherwise disturbed ground rather than archaeological remains. Both anomalies correspond to patches of nettles, which typically reflect disturbed areas. The anomalies in Area 4 (**f**) broadly correspond to a slightly raised area noted in the desk-based assessment as a possible enclosure and possible structure.

5.17 The only other anomalies detected here are small, discrete dipolar magnetic anomalies. 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 larger dipolar magnetic anomaly detected in the north of Area 4 (**h**) corresponds to a trough and fence post.

5.18 Strong dipolar magnetic anomalies detected along the edges of the survey areas reflect the adjacent metal fences.

6. Conclusions

6.1 Approximately 2.5ha of detailed geomagnetic survey was undertaken at High Middlefield Farm, Thorpe Thewles, Stockton-on-Tees prior to proposed development.

6.2 Former ridge and furrow cultivation has been detected across the survey area.

6.3 Features recorded on early Ordnance Survey editions, including a former field boundary and an infilled pond or former structure, have been identified in Area 4.

6.4 Small patches of disturbed ground have been identified in Area 1 and 4.

6.5 Land drains have been detected throughout the site.

7. Sources

CIfA 2014 *Standard and Guidance for archaeological geophysical survey*. Chartered Institute for Archaeologists

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. Historic England

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

Petts, D, & Gerrard, C, 2006 *Shared Visions: The North-East Regional Research Framework for the Historic Environment*. Durham

Schmidt, A, 2013 *Geophysical Data in Archaeology: A Guide to Good Practice*. Archaeology Data Service & Digital Antiquity, Oxbow

Welsh, J, 2016 *Desk-Based Assessment 2016, High Middlefield Farm, Durham Road, Thorpe Thewles, Stockton-on-Tees*. Unpublished report, AAG Archaeology

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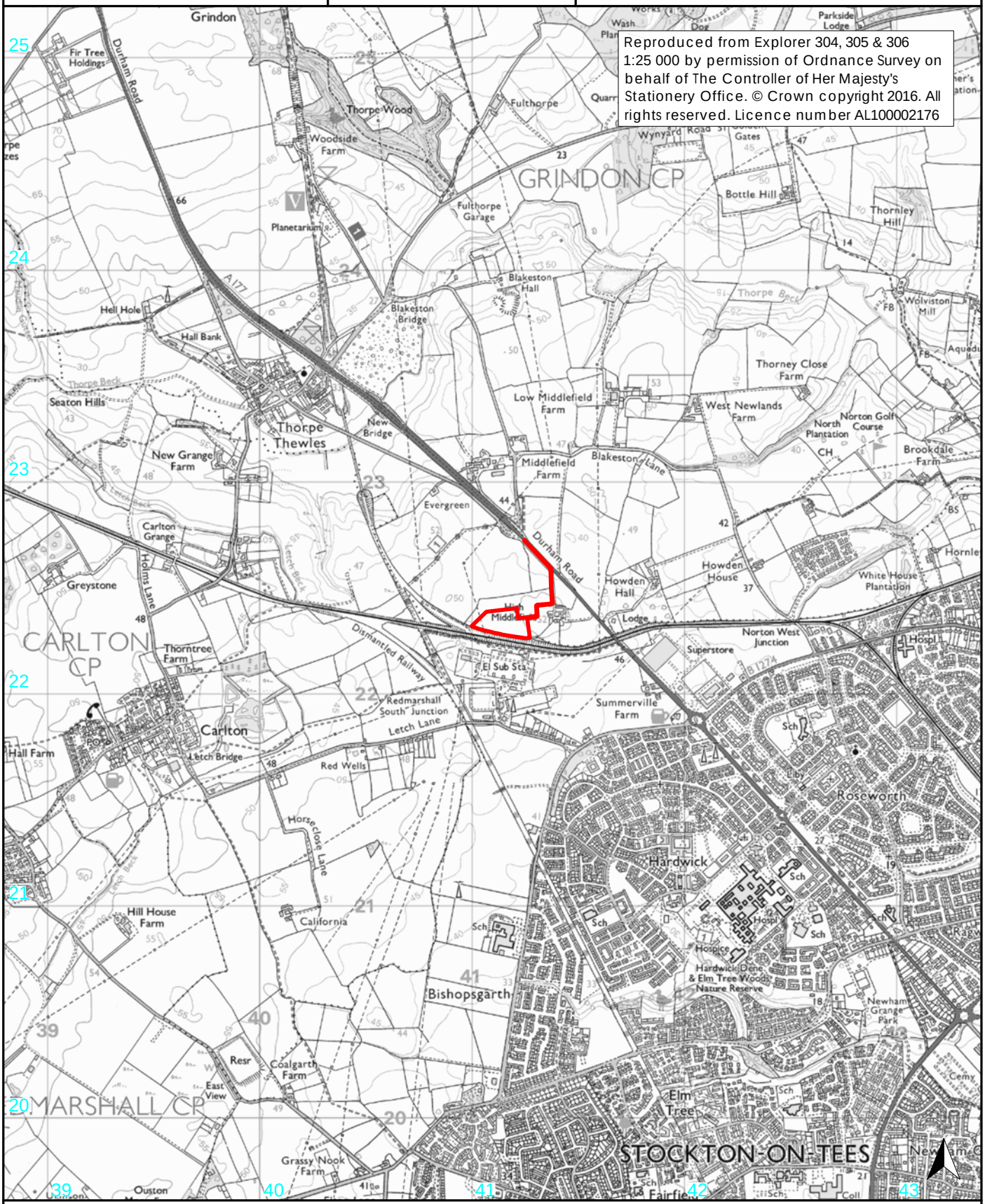
Figure 1: Site location



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site boundary

magnetic survey

-4 nT 6

0 50m
scale 1:1000 for A3 plot

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Figure 2: Geophysical survey

224

Area 1

Area 2

Area 3

Area 4

223

Und

Def

FF

410

411

412

413

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0 50m
scale 1:1000 for A3 plot

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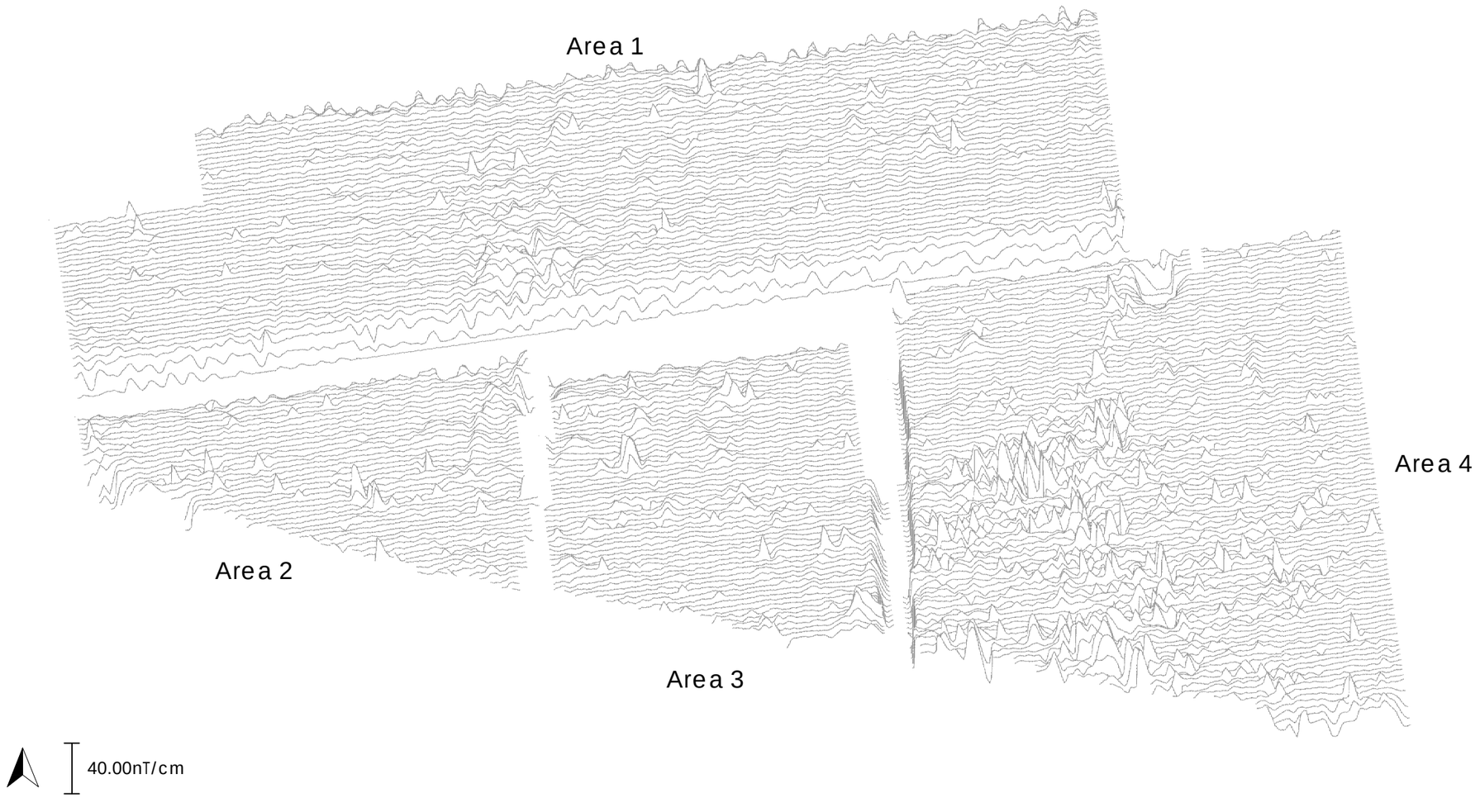
Figure 3: Trace plots of geomagnetic data



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site boundary
magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

0 50m
scale 1:1000 for A3 plot

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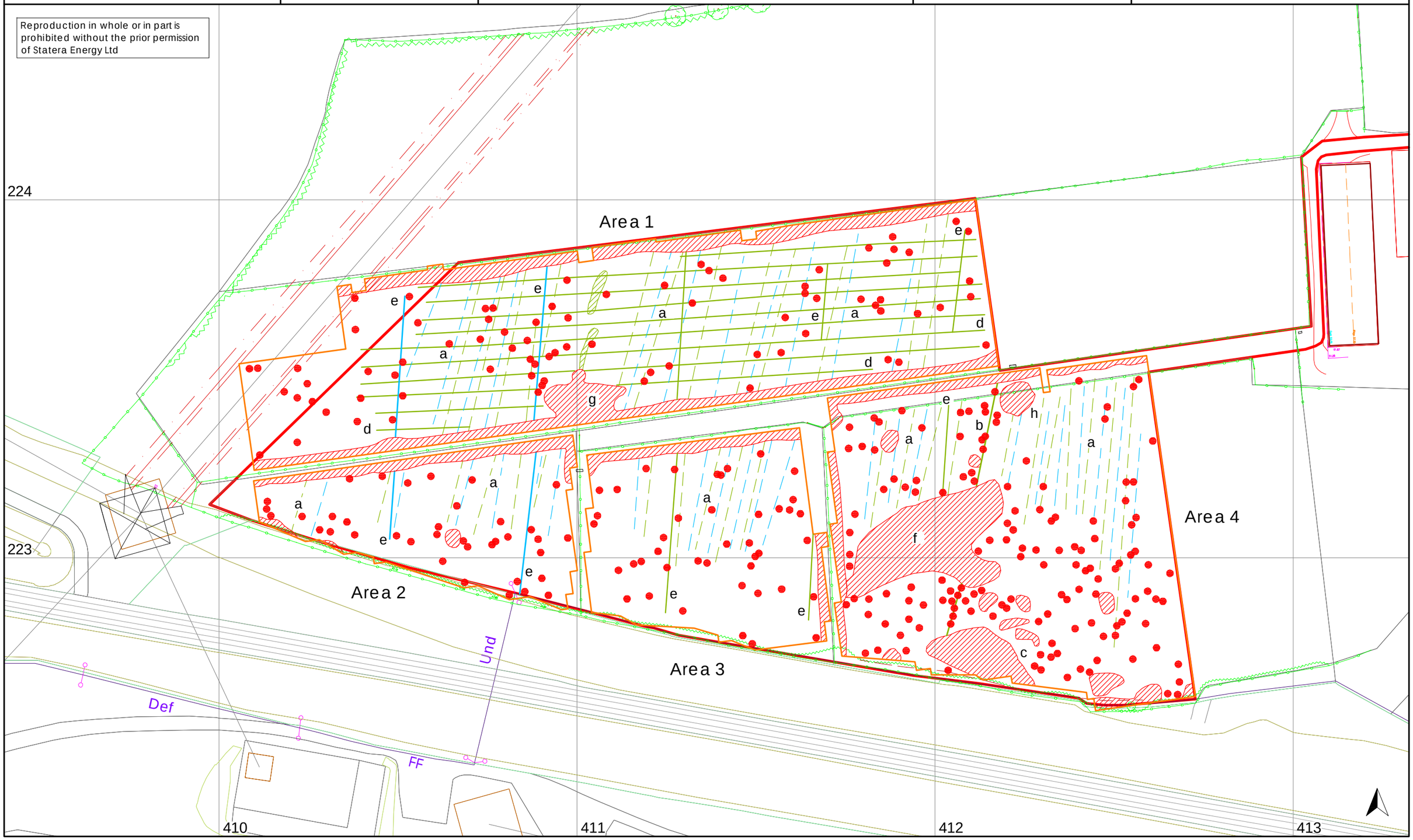
Figure 4: Geophysical interpretation



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site boundary
magnetic survey
former structure or pond
disturbed ground
land drain
former field boundary
ridge and furrow
trough

0 50m
scale 1:1000 for A3 plot

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Figure 5: Archaeological interpretation