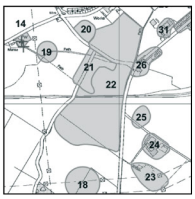
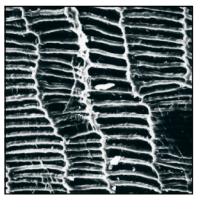
BLCE/01










BULL'S LODGE 400KW SUBSTATION, CHELMSFORD, ESSEX

Geophysical Survey

commissioned by National Grid

September 2015

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

BULL'S LODGE 400KW SUBSTATION, CHELMSFORD, ESSEX

Geophysical Survey

commissioned by National Grid

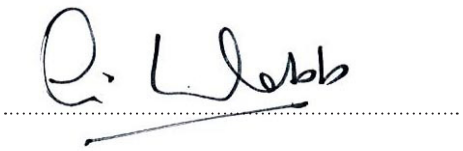
September 2015

project info

HA JOB NO.	BLCE/01
NGR	TL 75080 10540
PARISH	Springfield
LOCAL AUTHORITY	Essex County Council
OASIS REF.	Headland5-223441

project team

PROJECT MANAGER	Alistair Webb
AUTHOR	Alistair Webb
FIELDWORK	Sam Harrison
GRAPHICS	Caroline Norrman, Sam Harrison
APPROVED BY	Alistair Webb – Project Manager



NORTH
Headland Archaeology
Unit 16, Hillside, Beeston Road
Leeds, LS11 8ND

0113 387 6430
north@headlandarchaeology.com

www.headlandarchaeology.com

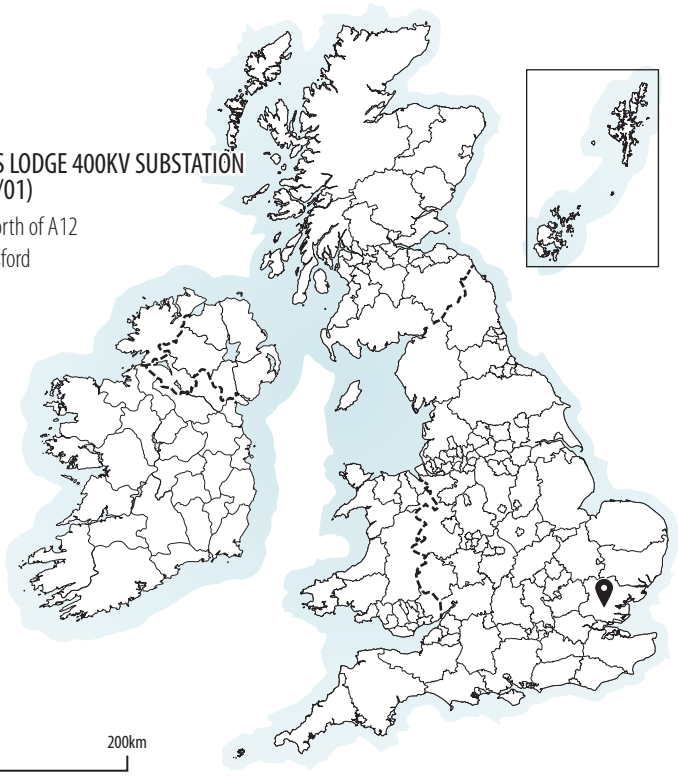
REGISTERED · CIfA · ORGANISATION

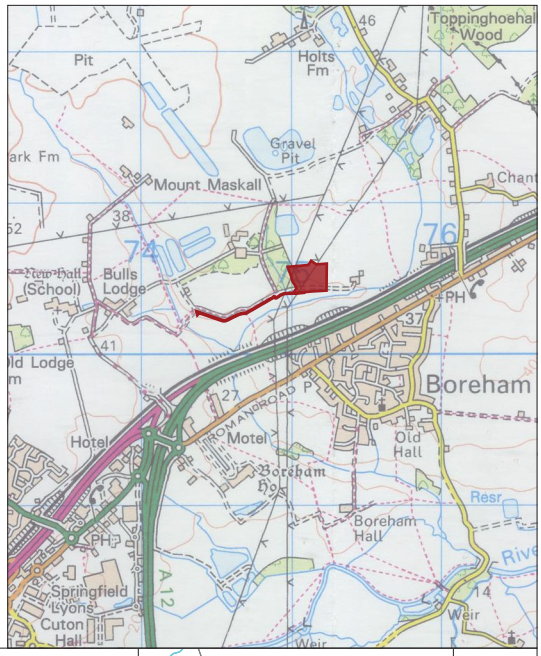
CONTENTS

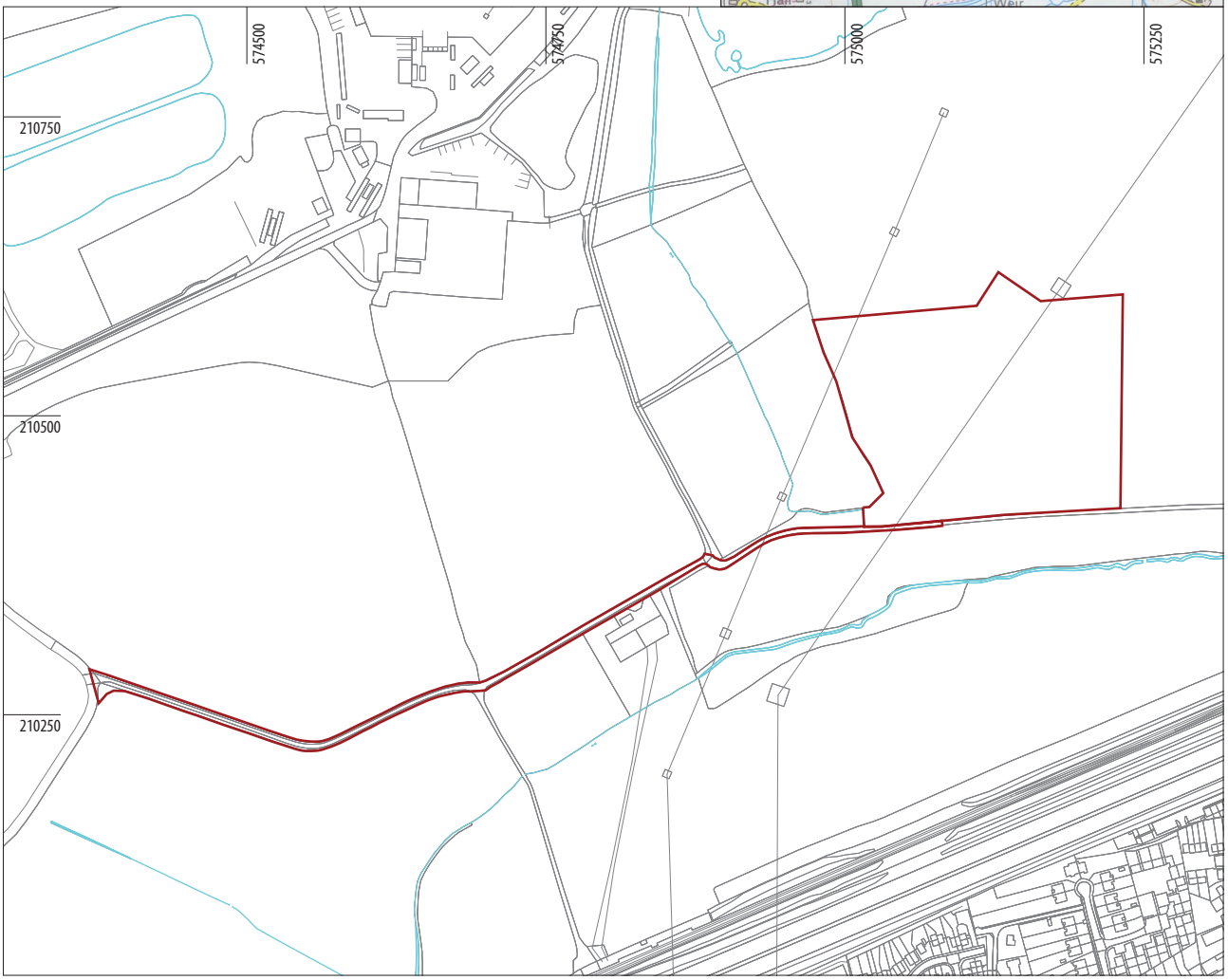
LIST OF ILLUSTRATIONS

BULL'S LODGE 400KV SUBSTATION (BLCE/01)

land north of A12
Chelmsford
Essex

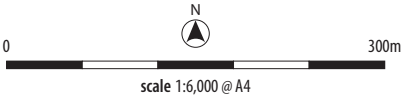






KEY

development boundary



scale 1:6,000 @ A4

HEADLAND ARCHAEOLOGY

NORTH

Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 1

Site location

BULL'S LODGE 400KW SUBSTATION, CHELMSFORD, ESSEX

Geophysical Survey

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering approximately 3 hectares on agricultural land to the east of Chelmsford, Essex, to provide information about the archaeological potential of land where it is proposed to build a new 400kV electricity substation. The survey has identified only anomalies caused by geological variation, 19th century boundaries and modern activity. No anomalies of obvious archaeological potential have been recorded. There is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the sub-surface conditions within the proposed development area. Therefore, based solely on the results and interpretation of the data, the archaeological potential of the site is considered to be low, corroborating the conclusions of a previous desk-based assessment.

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Hyder Consulting (UK) Ltd on behalf of National Grid to undertake a geophysical (magnetometer) survey on land where it is proposed to build a new 400kV electricity substation at Bull's Lodge. The work was undertaken in accordance with guidance within the National Planning Policy Framework (DCLG 2012) and in line with current best practice (David et al. 2008). The survey was carried out on September 3rd 2015 in order to provide additional information on the archaeological potential of the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The proposed development area (PDA) is located approximately 0.3km north of Boreham and 2km east of Chelmsford at Bull's Lodge, centred at NGR 575080 210540, and lies north of the A12 and the Great Eastern Main Line (see **Illus 1**). Woodland borders the site to the west, by an access track to Brick House Farm to the south and to the east and north by agricultural fields. The survey area comprised part of a single arable field which was fallow at the time of survey. A ground investigation team was carrying out a borehole survey on the northern edge of the PDA (see **Illus 2**) precluding survey in this part of the site.

The PDA is set within a gently undulating landscape varying in height between 30m above Ordnance Datum (aOD) and 35m aOD.

1.2 GEOLOGY AND SOILS

The underlying bedrock comprises London Clay Formation (clay, silt and sand). This is overlain by Lowestoft Formation – Diamicton (British Geological Survey 2015). The soils are classified in the Soilscape 9 association, characterised as lime rich, loams and clays with impeded drainage (Landis 2015).

2 ARCHAEOLOGICAL BACKGROUND

A Cultural Heritage Desk-Based Assessment (Hyder Consulting 2015), undertaken to comply with the National Planning Policy Framework (NPPF), identified that 'no designated assets are present within the site or its immediate proximity'. Also that 'the site contains no non-designated assets identified by Essex Historic Environment Record'. Consequently the conclusion reached in the assessment was that the site has 'a low potential for currently undiscovered buried archaeological evidence for the prehistoric period' with a low potential also 'for all other periods with the exception of possible remains of agricultural origin'.

ILLUS 2

General view of survey area, looking E

3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of any proposed development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended.

The general archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore model the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. Features such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the Earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney and Gater, 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data.

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model).

3.2 REPORTING

A general site location plan is shown in **Illus 1** at a scale of 1:6,000. **Illus 2** is a general site location photograph. **Illus 3** is a large scale (1:4,000) survey location plan displaying the processed greyscale magnetometer data. Detailed data plots ('raw' and processed) and interpretative illustrations are presented at a scale of 1:1,000 in **Illus 4**, **5** and **6**.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2

details the survey location information and Appendix 3 describes the composition and location of the site archive. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 4.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David et al. 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (Ó Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

Generally, the magnetic background across the survey area is homogenous. Against this uniform background several anomalies are identified, discussed below and cross-referenced to specific examples depicted on the interpretative figure, where appropriate.

4.1 FERROUS/MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on most sites, often being present as a consequence of manuring or tipping/infilling.

A large area of magnetic disturbance, A, along the southern boundary of the survey area is likely to be due to modern tipping, probably associated with the creation of the raised hardcore track which forms the southern limit of the survey.

Three other large iron spike anomalies, B, C and D, are identified. No obvious surface feature was apparent to explain these high magnitude ferrous responses and in the absence of any archaeological context these anomalies are also interpreted as of likely modern ferrous origin; anomalies C and D are immediately adjacent to former field boundaries (see below) and may be associated with the removal of these boundaries.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical OS mapping indicates that two boundaries shown on the first edition (1874) map are no longer extant; both were still present up until the 1952 edition but are not recorded on subsequent editions. These former features manifest in the data as weak linear anomalies, E and F, emphasised by the intermittent presence of 'spike' anomalies along the line of the former field boundary. No anomalies have been identified to indicate any former cultivation within the survey area.

4.3 GEOLOGICAL ANOMALIES

Throughout the site several broad, low magnitude, anomalies have been identified, the most extensive and prominent of which is identified as anomaly G. It is likely that this and the other similar anomalies are caused by variations in the composition of the soils and superficial deposits from which they derive.

4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

No anomalies of obvious archaeological potential have been identified by the survey.

5 CONCLUSION

The geophysical survey has identified anomalies locating former field boundaries, geological variation and modern activity. No anomalies of obvious archaeological potential have been identified by the survey.

There is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the sub-surface conditions within the proposed development area. Therefore, based solely on the results and interpretation of the data, the archaeological potential of the site is considered to be low.

6 REFERENCES

British Geological Survey 2015 Available: www.bgs.ac.uk/discoveringGeology/geology_OfBritain/viewer.html Viewed: July 30th 2015.

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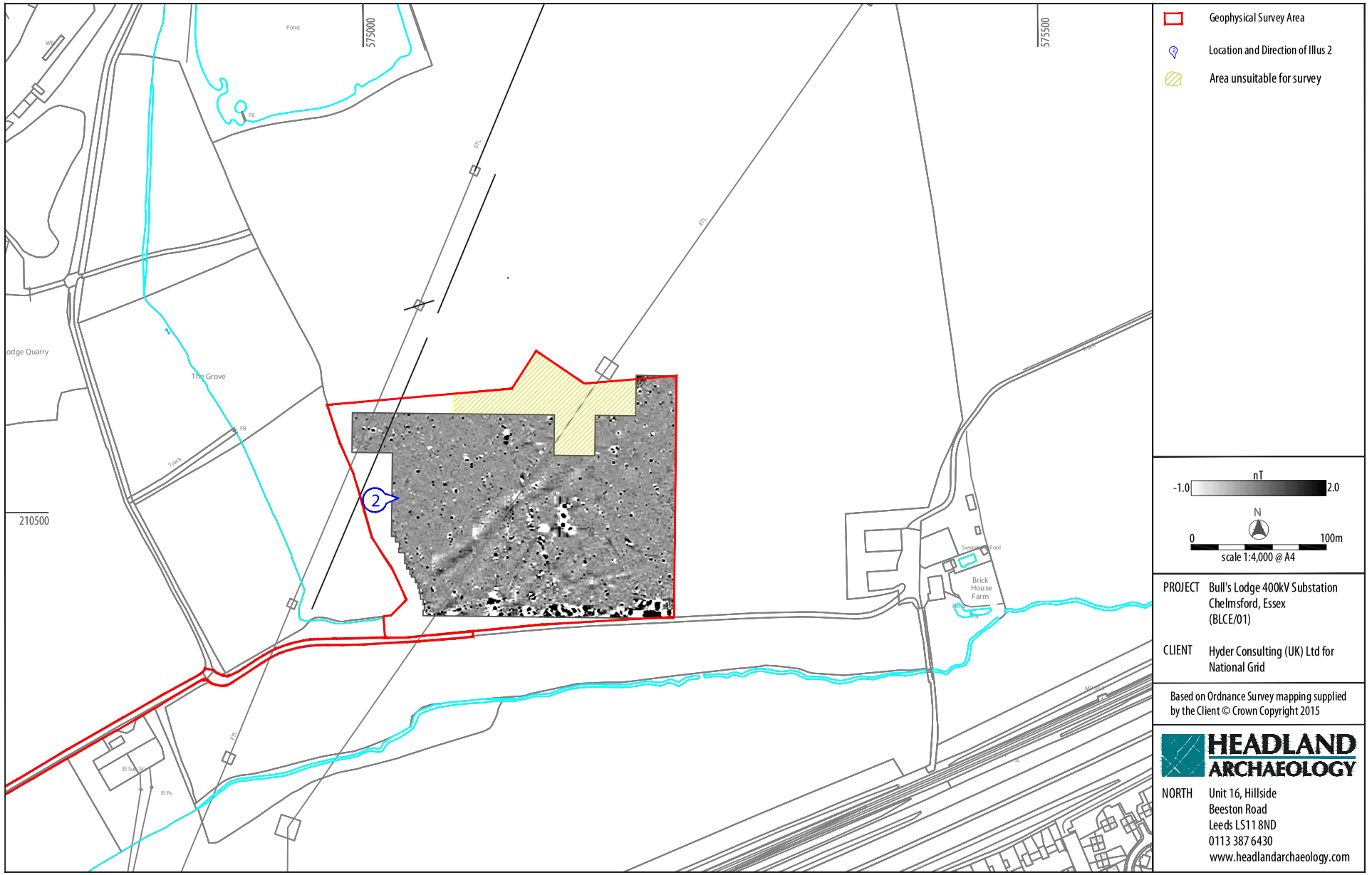
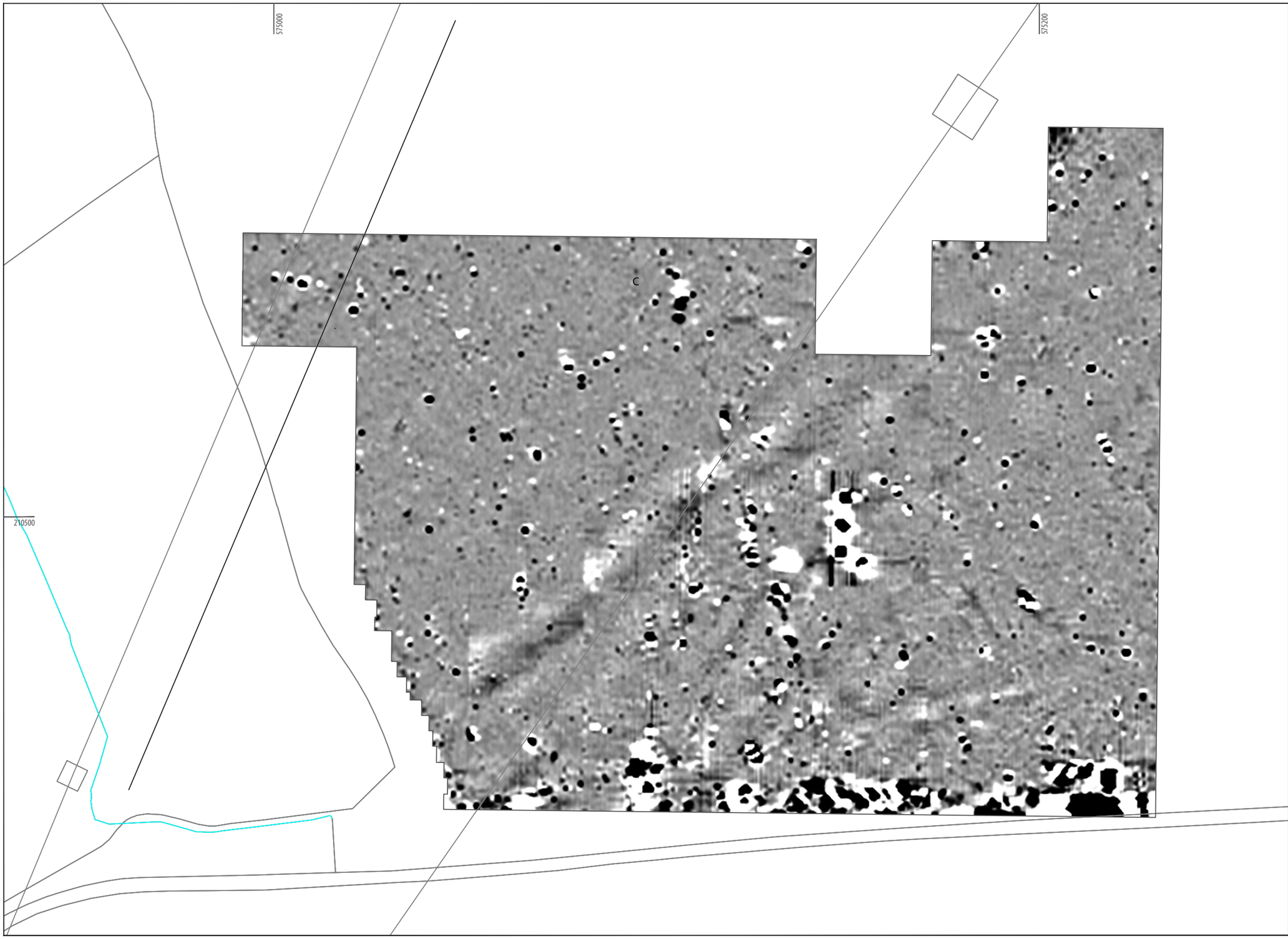


ILLUS 3

Survey location showing processed greyscale magnetometer data (1:4,000)



-1.0 2.0

N

0 25m

scale 1:1,000 @ A4

PROJECT Bull's Lodge 400kV Substation
Chelmsford, Essex
(BLCE/01)

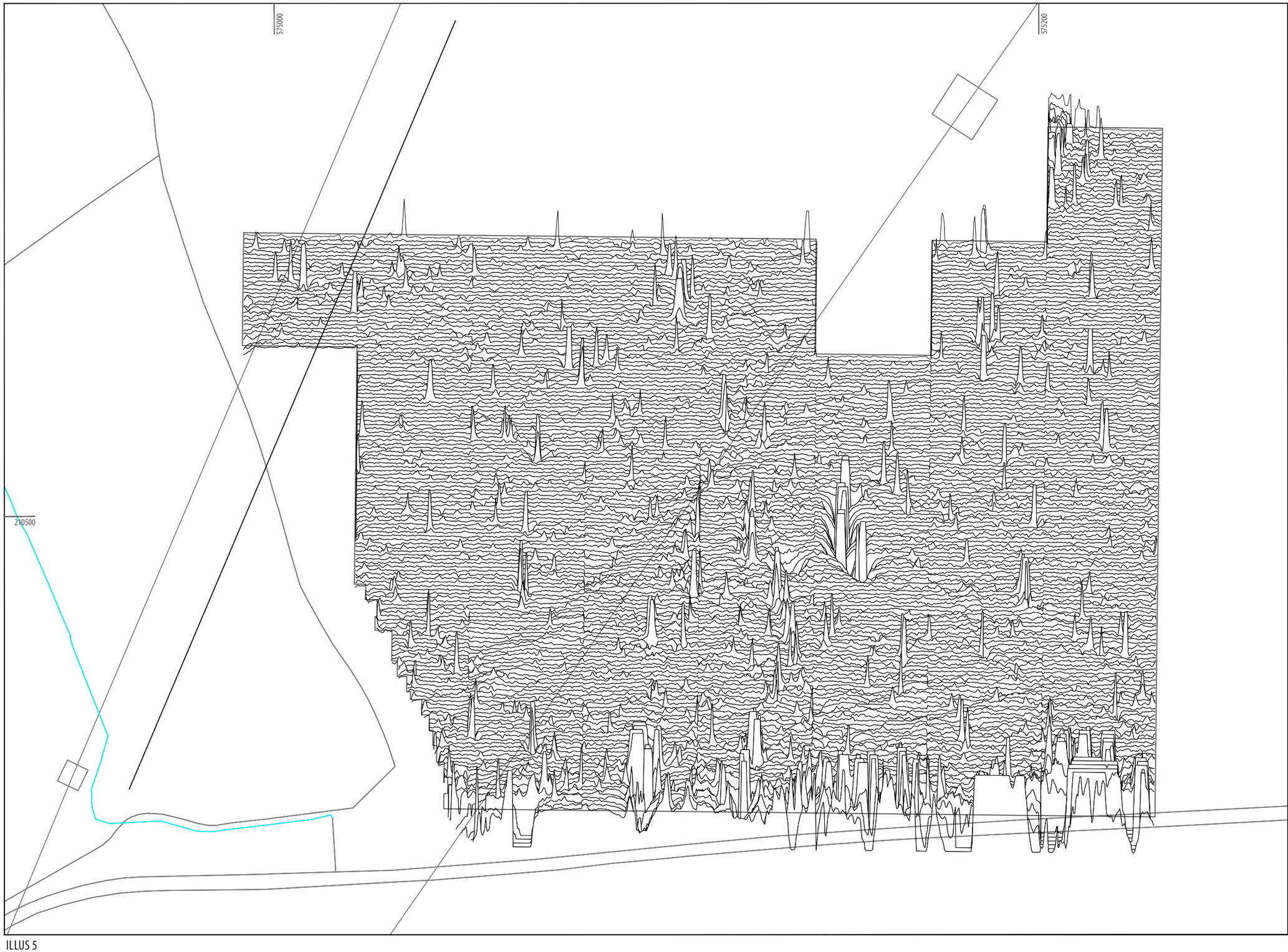
CLIENT Hyder Consulting (UK) Ltd for
National Grid

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 4

Processed greyscale magnetometer data (1:1,000)



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N

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PROJECT Bull's Lodge 400kV Substation
Chelmsford, Essex
(BLCE/01)

CLIENT Hyder Consulting (UK) Ltd for National Grid

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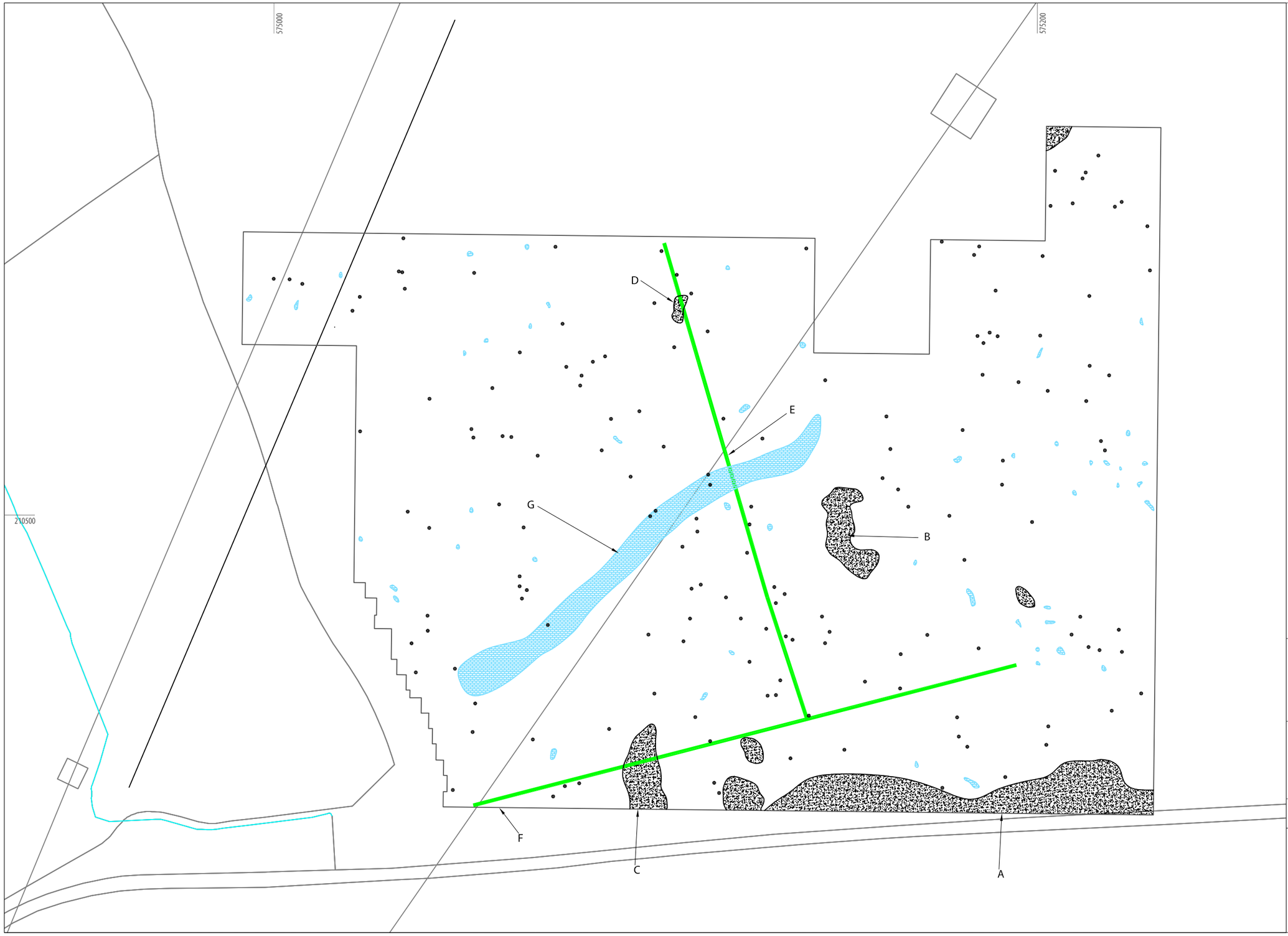
NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 5

XY trace plot of minimally processed magnetometer data (1:1,000)



TYPE OF ANOMALY	INTERPRETATION
Dipolar Isolated	Ferrous Material
Magnetic Disturbance	Ferrous Material
Linear	Former Field Boundary
Magnetic Enhancement	Geology

N

0 25m

scale 1:1,000 @ A4

PROJECT Bull's Lodge 400kV Substation
Chelmsford, Essex
(BLCE/01)

CLIENT Hyder Consulting (UK) Ltd for National Grid

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 6

Interpretation of magnetometer data (1:1,000)

7 APPENDICES

APPENDIX 1 MAGNETIC SUSCEPTIBILITY AND SOIL MAGNETISM

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features

that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model). The accuracy of this equipment is better than 0.01m. The survey grids were then superimposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises:

- an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: Headland5-223441

PROJECT DETAILS	
Project name	Bull's Lodge 400kV Substation, Springfield, Essex
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering approximately 3 hectares on agricultural land to the east of Chelmsford, Essex, to provide information about the archaeological potential of land where it is proposed to build a new 400kV electricity substation. The survey has identified only anomalies caused by geological variation, 19th century boundaries and modern activity. No anomalies of obvious archaeological potential have been recorded. There is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the subsurface conditions within the proposed development area. Therefore, based solely on the results and interpretation of the data, the archaeological potential of the site is considered to be low, corroborating the conclusions of a previous deskbased assessment.
Project dates	Start: 05092015 End: 05092015
Previous/future work	Not known / Not known
Any associated project reference codes	BLCE (Site code)
Any associated project reference codes	223441 OASIS form ID
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 3 Operations to a depth more than 0.25m
Monument type	None
Monument type	None
Significant Finds	None
Significant Finds	None
Methods & Techniques	Geophysical Survey
Development type	Pipelines/cables (e.g. gas, electric, telephone, TV cable, water, sewage, drainage etc.)
Prompt	National Planning Policy Framework NPPF
Position in the planning process	Not known / Not recorded

PROJECT LOCATION	
Country	England
Site location	ESSEX CHELMSFORD SPRINGFIELD Bull's Lodge, Springfield, Essex
Post code	CM1 6AP
Study area	4 Hectares
Site coordinates	TL 750800 105400 51.765621484034 0.537520450549 51 45 56 N 000 32 15 E Point
Height OD / Depth	Min: 30m Max: 35m

PROJECT CREATORS	
Name of organisation	Headland Archaeology
Project brief originator	Consultant
Project design originator	Headland Archaeology
Project director/manager	Alistair Webb

PROJECT CREATORS	
Project supervisor	Sam Harrison
Type of sponsoring/funding body	Developer
Name of sponsor/funding body	National Grid

PROJECT ARCHIVES	
Physical Archive exists?	No
Digital Archive recipient	In house
Digital Media available	Geophysics
Paper Archive exists	In house
Paper Media available	Report

ENTERED BY	Alistair Webb (alistair.webb@headlandarchaeology.com)
ENTERED ON	14 September 2015

SOUTH & EAST
Headland Archaeology
Building 68C, Wrest Park, Silsoe
Bedfordshire MK45 4HS

T 01525 861 578
E southandeast@headlandarchaeology.com

MIDLANDS & WEST
Headland Archaeology
Unit 1, Premier Business Park, Faraday Road
Hereford HR4 9NZ

T 01432 364 901
E midlandsandwest@headlandarchaeology.com

NORTH
Headland Archaeology
Unit 16, Hillside, Beeston Road
Leeds LS11 8ND

T 0113 387 6430
E north@headlandarchaeology.com

SCOTLAND
Headland Archaeology
13 Jane Street
Edinburgh EH6 5HE

T 0131 467 7705
E scotland@headlandarchaeology.com

www.headlandarchaeology.com