ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
CgMs Consulting
for
EnergieKontor UK Ltd

Fenrother Wind Farm
Morpeth
Northumberland

geophysical survey

report 2877
March 2012

Durham University

Contents

Figures

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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 north of the village of Fenrother, near Morpeth, Northumberland. The works comprised the geomagnetic survey of 5ha of mixed use farmland.

1.2 The works were commissioned by CgMs Consulting, on behalf of EnergieKontor UK Ltd, and conducted by Archaeological Services Durham University.

Results

1.3 Probable soil-filled features such as pits, ditches and possibly postholes have been identified in the surveys. Areas T1 and T2 contain fewer potential features than the other areas.

1.4 Area T3 is particularly noisy, magnetically, but appears to contain a small square ditched feature.

1.5 Some small pits or postholes in Area T4 appear to form alignments.

1.6 Traces of former cultivation were identified in Areas T2 and T4.

1.7 Service pipes were identified in Areas T4 and T5.

2. Project background

Location (Figure 1)

2.1 The survey areas were located north of Fenrother, Morpeth, Northumberland (NGR centre: NZ 1705 9300). Five surveys of 1ha each were centred on proposed wind turbine locations (Areas T1-T5). To the west and north was open farmland, to the east was the A1 and to the south was the village of Fenrother.

Development proposal

2.2 The proposal is for the construction of a wind farm 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 survey areas, 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.

Methods statement

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

Dates

2.5 Fieldwork was undertaken on the 16th and 19th March 2012. This report was prepared for 29th March 2012.

Personnel

2.6 Fieldwork was conducted by Matt Claydon, Tony Liddell, Andy Platell and Natalie Swann (Supervisor). The geophysical data were processed by Natalie Swann. This report was prepared by Natalie Swann with illustrations by David Graham and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **MFR12**, for **M**orpeth **F**en**R**other 20**12**. The survey archive will be 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 **archaeol3-121822**.

3. Historical and archaeological background

3.1 An Iron Age or Romano-British settlement has been identified on aerial photographs 500m south of the proposed location for Turbine 5. It is sub-rectangular in shape with three enclosure ditches and an entrance causeway on the east side.

3.2 Other enclosures of possible prehistoric date have been identified at Earsdon Moor, east of the proposed development area.

3.3 Fenrother has been occupied since the medieval period, though the settlement has shrunk and remains of the medieval village have been identified west of the modern village.

3.4 Historic and modern maps show that the proposed development area has been enclosed farmland since the post-medieval period. There has been little change in the layout of the field systems since the first edition Ordnance Survey.

4. Landuse, topography and geology

4.1 At the time of fieldwork the survey areas covered parts of six fields of mixed use farmland. Area T2 was within a field of pasture; all other survey areas were in arable fields.

4.2 The site is gently sloping down from 110m OD in the north-west to 90m OD in the south-east.

4.3 The underlying solid geology of the area comprises the Stainmore Formation of mudstone, siltstone and sandstone, which is overlain by Quaternary 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* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

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 20m grid was established across each survey area using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) correction typically providing 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 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 1,600 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 (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-7; the trace plots are provided in Figure 8. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate 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
destagger	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 Colour-coded geophysical interpretations are 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

General comments

5.11 Colour-coded archaeological interpretations are provided.

5.12 Small, discrete dipolar magnetic anomalies have been detected in each survey area. 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 T1

5.13 The modern plough direction has been detected as a very weak, north-east/south-west aligned texture in the data.

5.14 Several small, discrete positive magnetic anomalies were detected in this area, which could reflect soil-filled features such as pits and postholes.

Area T2

5.15 A series of parallel alternate positive and negative magnetic anomalies were detected across this area. These anomalies almost certainly reflect former cultivation.

5.16 A few discrete positive magnetic anomalies were detected which could possibly reflect soil-filled pits or postholes.

5.17 A narrow curvilinear positive magnetic anomaly detected in the north-west corner of the survey area could possibly reflect a small soil-filled gulley.

5.18 A weak linear anomaly crossing the south-west corner of the survey could reflect a former ditch or field boundary.

Area T3

5.19 A post-and-wire fence, with adjacent ditch, crossed the northern corner of this area.

5.20 Concentrations of small, intense dipolar magnetic anomalies were detected across this area, which probably reflect concentrations of sub-surface ferrous or fired debris, possibly dumped materials or other ground disturbance.

5.21 A rectangular positive magnetic anomaly, measuring up to 10m across, and adjacent linear anomaly were detected here. These could reflect soil-filled features, perhaps former ditches or similar cur features.

Area T4

5.22 A series of parallel positive magnetic anomalies was detected across this area aligned approximately north-east/south-west; these anomalies may reflect a former plough regime.

5.23 A number of linear and curvilinear positive magnetic anomalies were detected in this area; these could reflect soil-filled ditches. Several small, discrete positive magnetic anomalies were also detected here, which could reflect small soil-filled pits or postholes; some of these appear to be in rows or form alignments.

5.24 A chain of intense dipolar magnetic anomalies was detected aligned approximately north-west/south-east; this almost certainly reflects a ferrous service pipe.

Area T5

5.25 A number of linear and curvilinear positive magnetic anomalies were detected across this survey area. Some are very weak and some are broad and diffuse but they could reflect soil-filled features. The broader anomalies may have a geological or geomorphological origin, while the narrower features are more likely to be anthropogenic. A number of discrete positive magnetic anomalies were also detected, which could reflect former pits and postholes.

5.26 A chain of dipolar magnetic anomalies was detected aligned north-south, which almost certainly reflects a ferrous service pipe.

6. Conclusions

6.1 Five hectares of geomagnetic survey was undertaken at Fenrother, near Morpeth, Northumberland, prior to proposed development.

6.2 Probable soil-filled features such as pits, ditches and possibly postholes have been identified in the surveys. Areas T1 and T2 contain fewer potential features than the other areas.

6.3 Area T3 is particularly noisy, magnetically, but appears to contain a small square ditched feature.

6.4 Some small pits or postholes in Area T4 appear to form alignments.

6.5 Traces of former cultivation were identified in Areas T2 and T4.

6.6 Service pipes were identified in Areas T4 and T5.

7. Sources

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

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

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

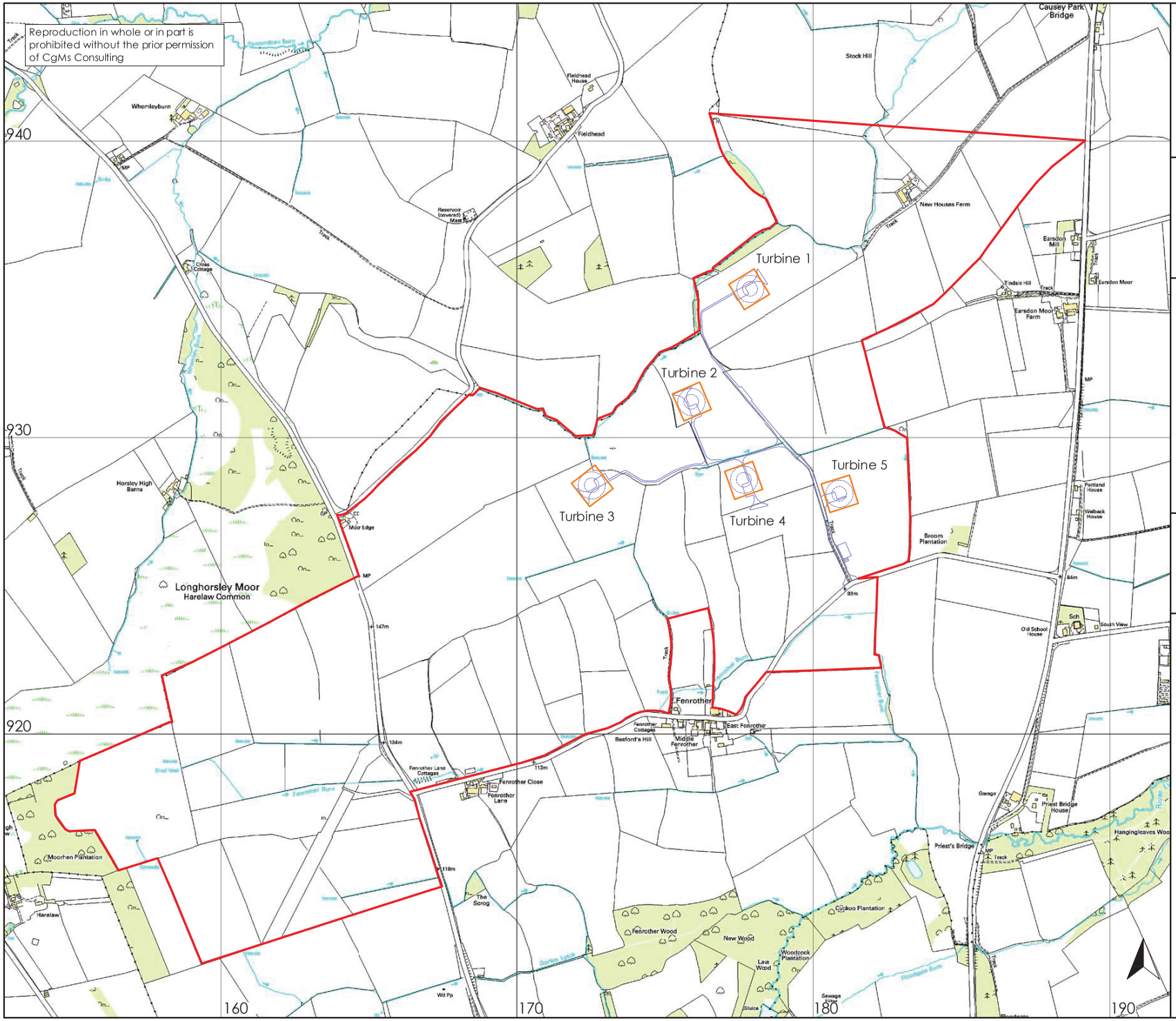

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Figure 1: Location of the geophysical survey areas

0 500m
scale 1:12 500 for A3 plot

application boundary
proposed development layout
geophysical survey area

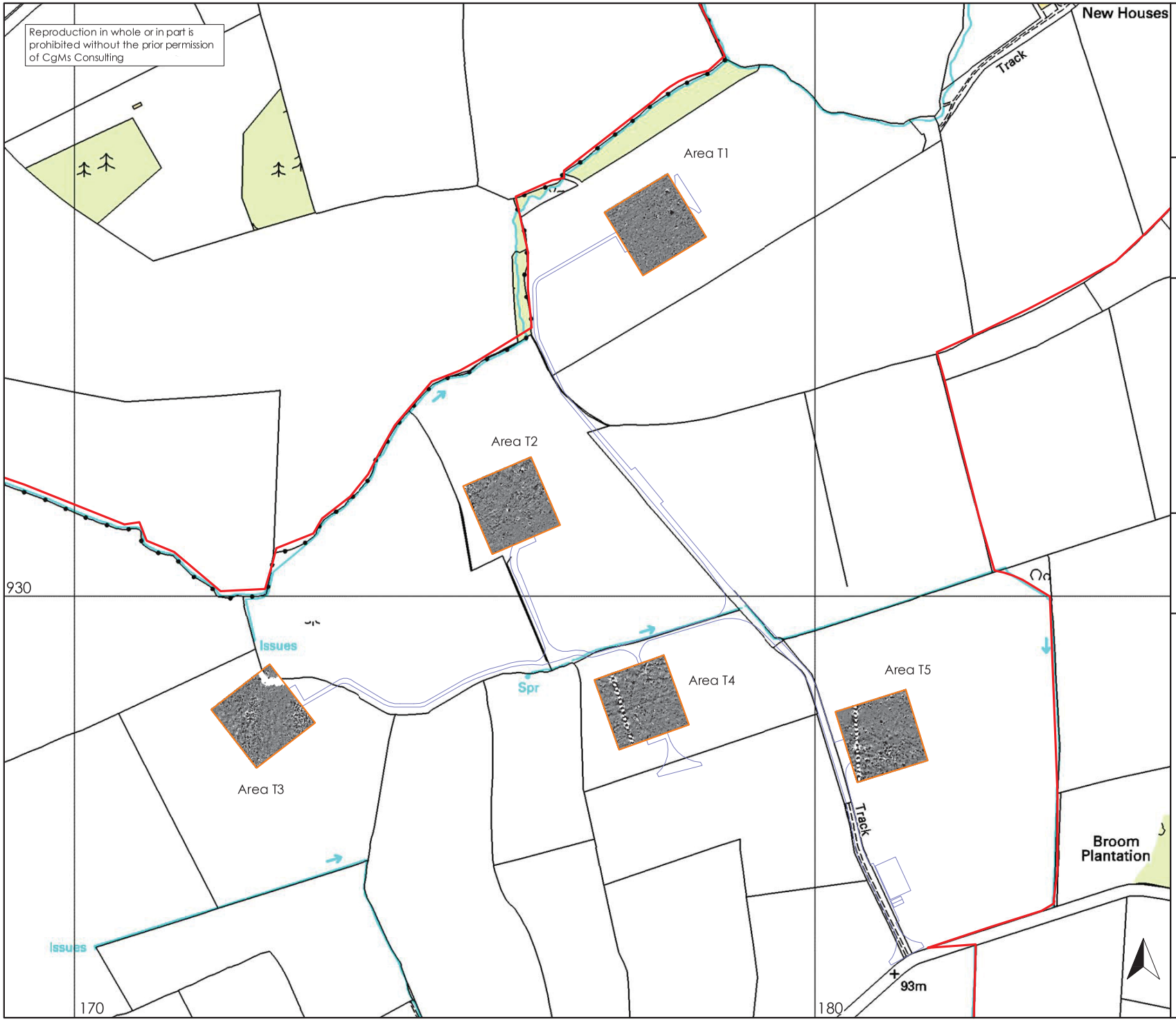

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Figure 2: Geophysical survey overview

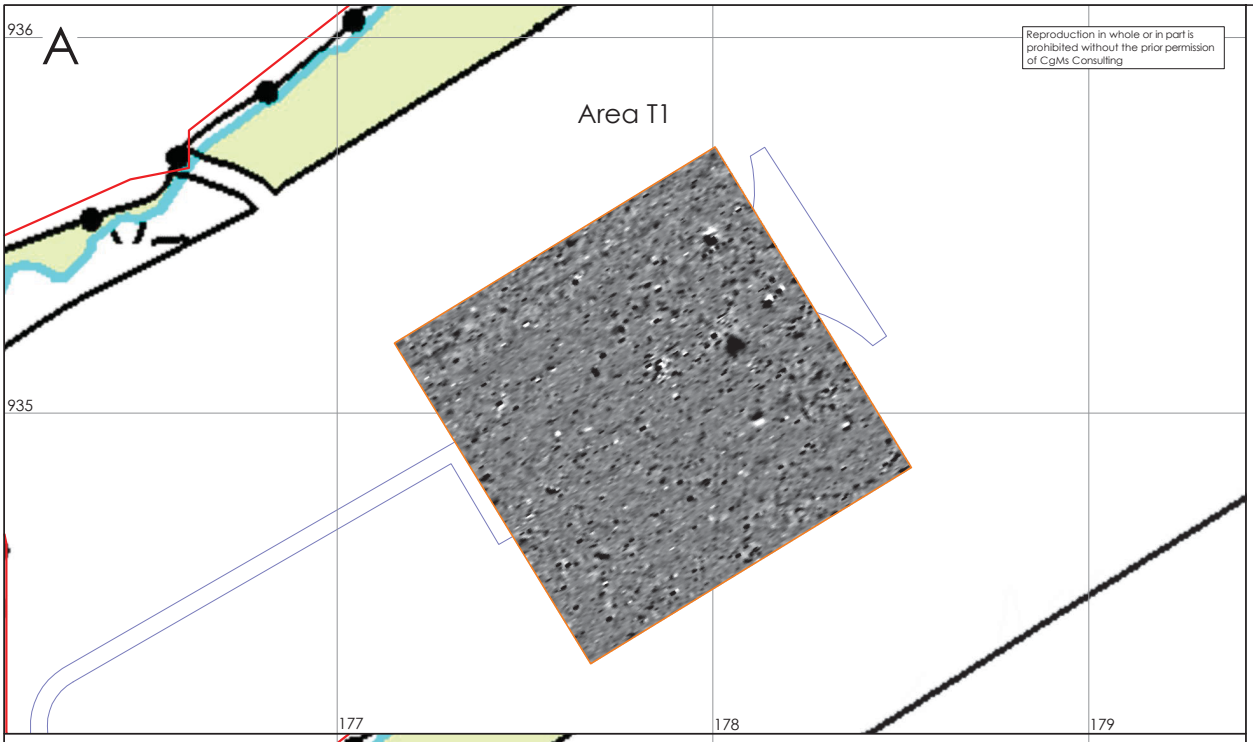
0 250m
scale 1:5000 for A3 plot

proposed development

geophysical survey area

-5 nT 5

A



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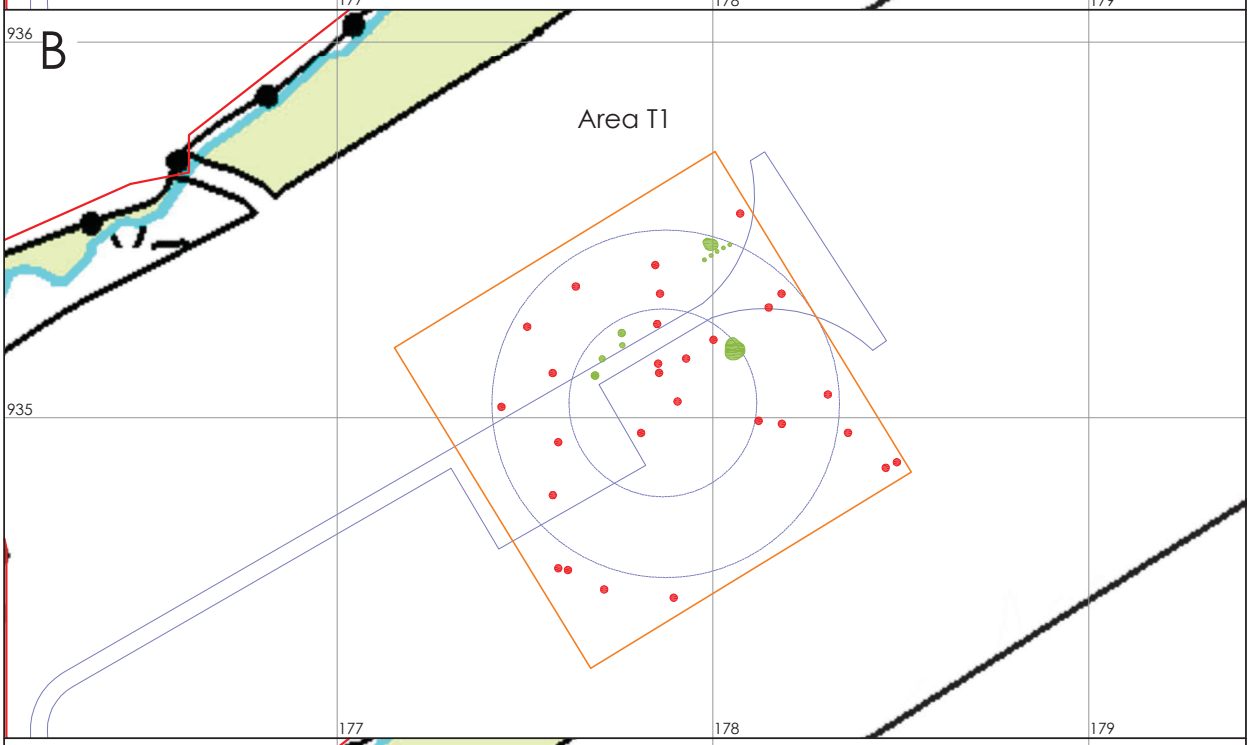

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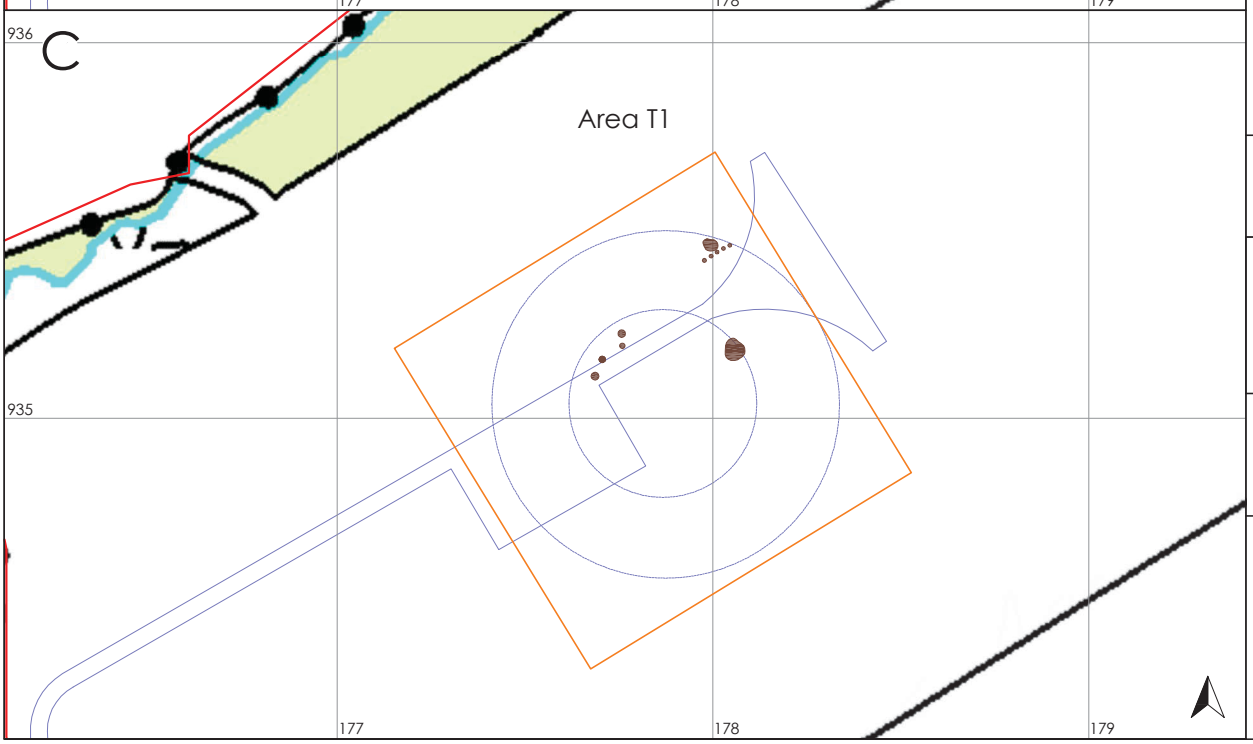

A - geophysical survey

magnetic survey

-5 nT 5

proposed development

B - geophysical interpretation

dipolar magnetic anomaly

positive magnetic anomaly

C - archaeological interpretation

soil-filled feature

0 50m

scale 1:1000 for A2 plot

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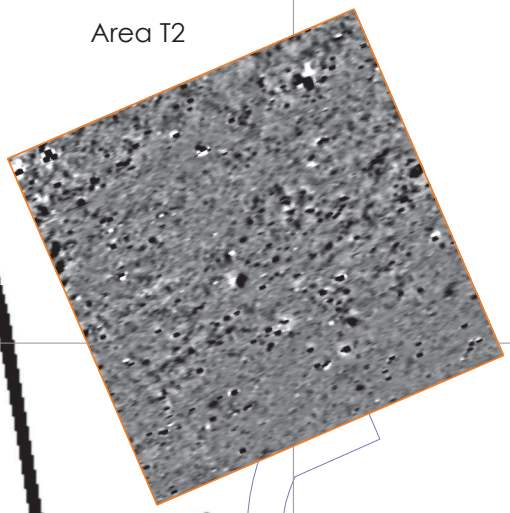
Figure 3: Area T1 geophysical survey and interpretation

A



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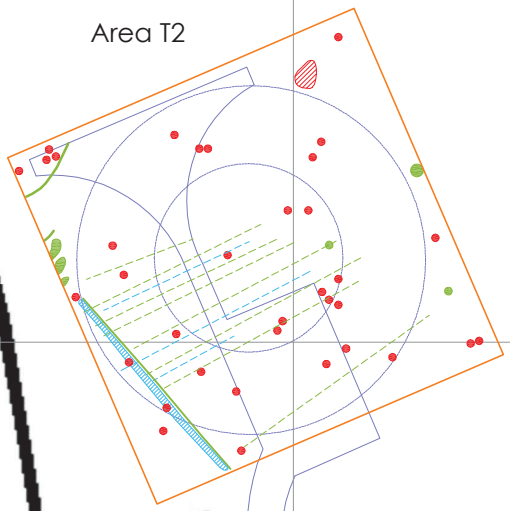

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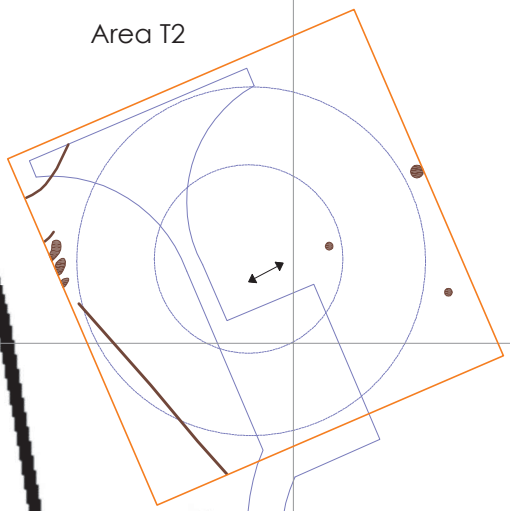

932
931
175
176
177

A - geophysical survey

magnetic survey

-5 nT 5

proposed development

B - geophysical interpretation

dipolar magnetic anomaly

positive magnetic anomaly

negative magnetic anomaly

C - archaeological interpretation

soil-filled feature

former ploughing

0 50m

scale 1:1000 for A2 plot

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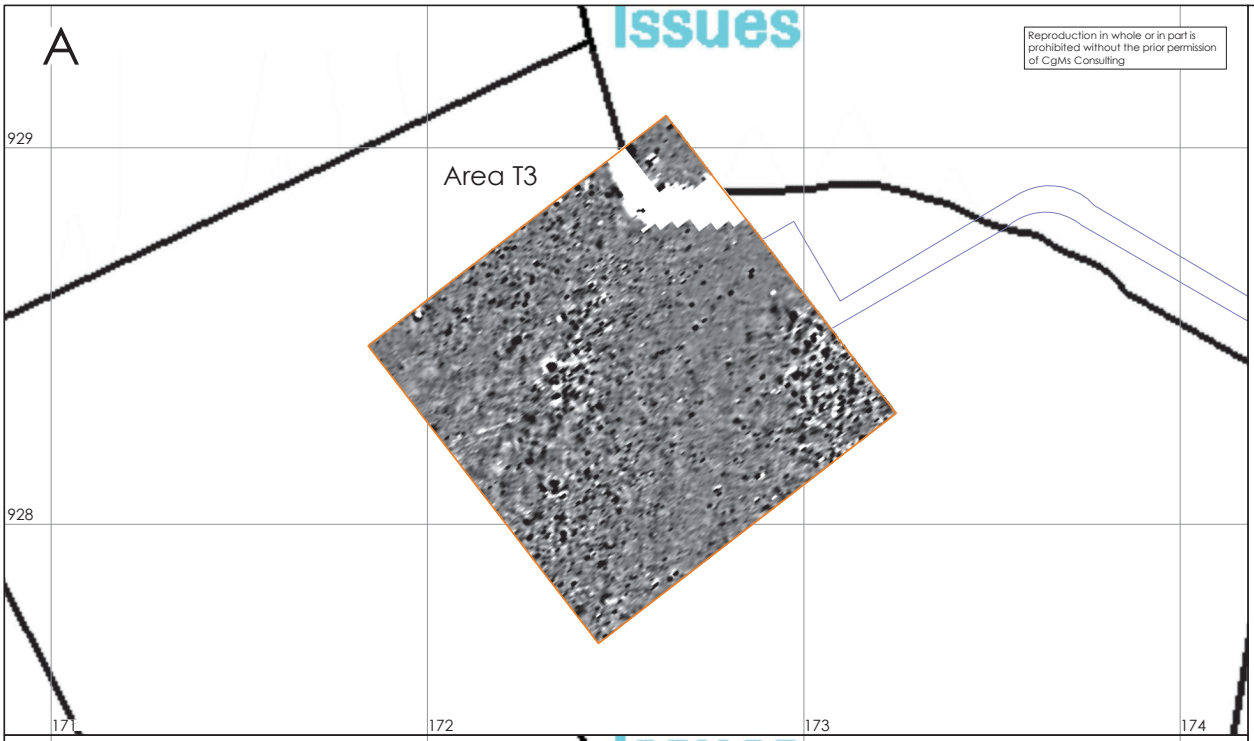
Figure 4: Area T2 geophysical survey and interpretation

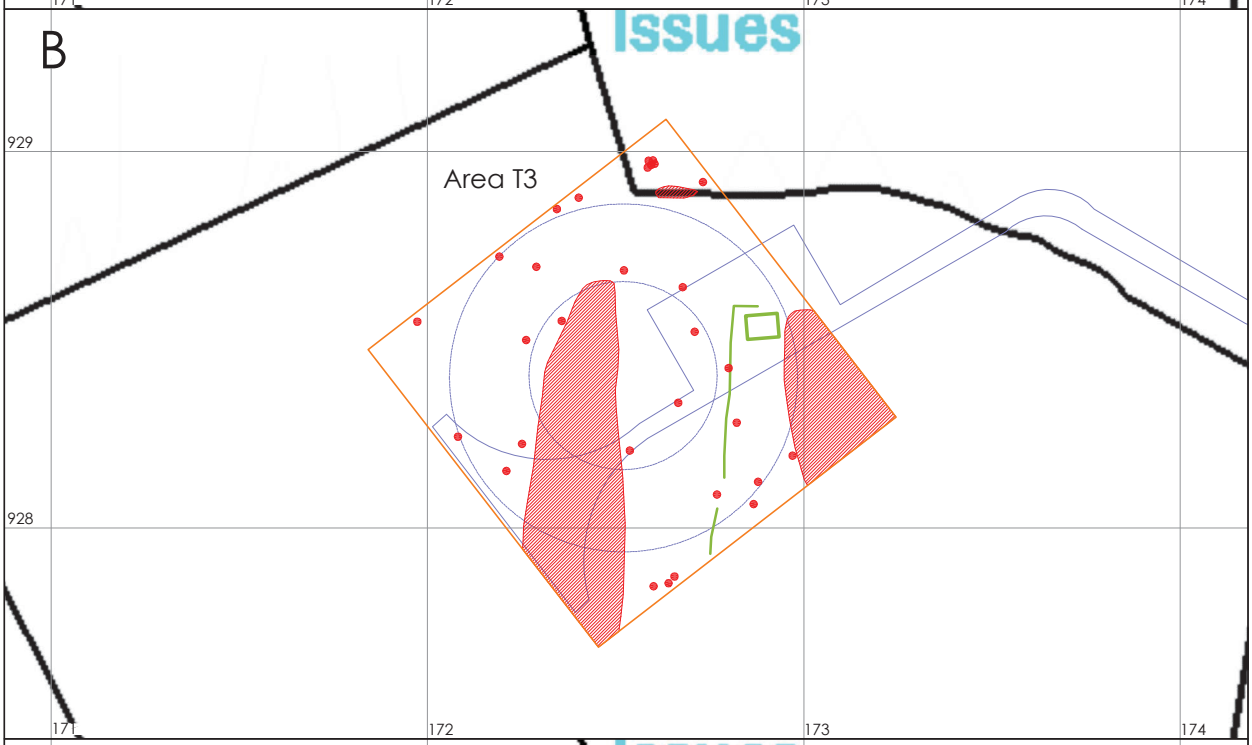
Issues

A



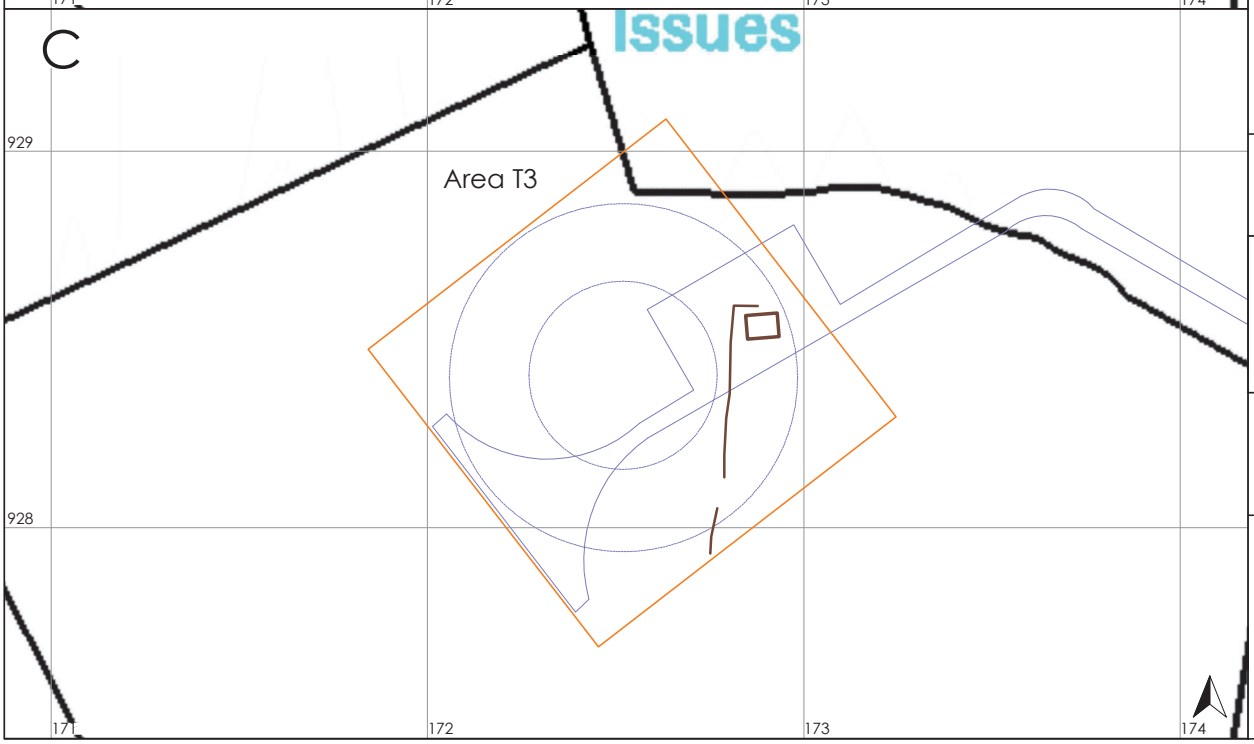
Issues

B



Issues

C



A - geophysical survey

magnetic survey

-5 nT 5

proposed development

B - geophysical interpretation

dipolar magnetic anomaly

positive magnetic anomaly

C - archaeological interpretation

soil-filled feature

0 50m

scale 1:1000 for A2 plot

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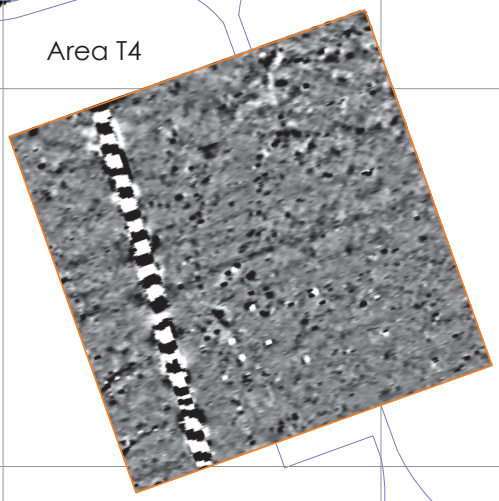
Figure 5: Area T3 geophysical survey and interpretation

A



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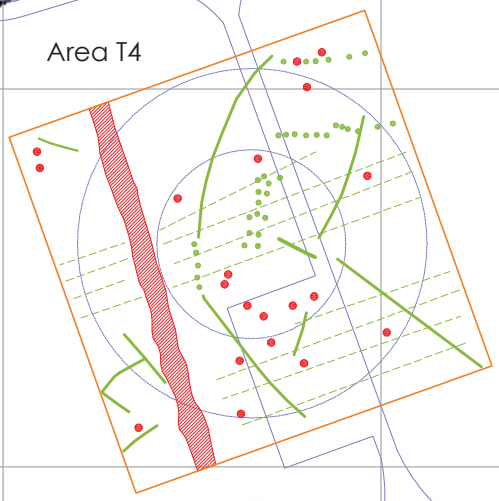

C

929
928
Spr
176
177
178
179

A - geophysical survey

magnetic survey

-5 nT 5

proposed development

B - geophysical interpretation

dipolar magnetic anomaly

positive magnetic anomaly

C - archaeological interpretation

soil-filled feature

service pipe

former ploughing

0 50m

scale 1:1000 for A2 plot

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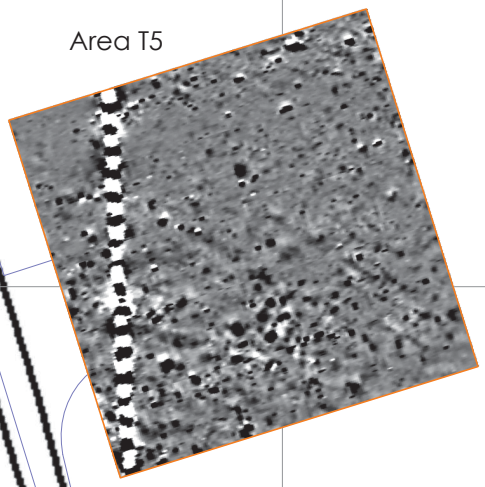
Figure 6: Area T4 geophysical survey and interpretation

A



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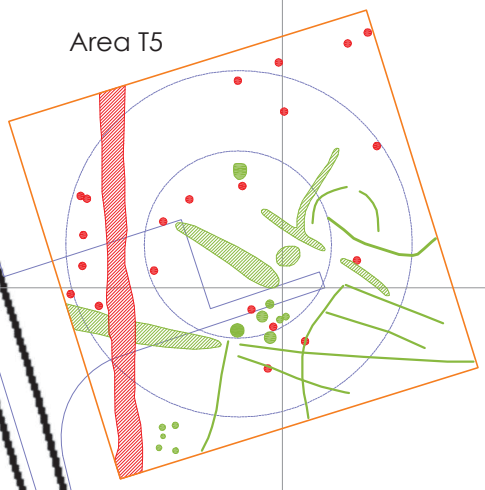

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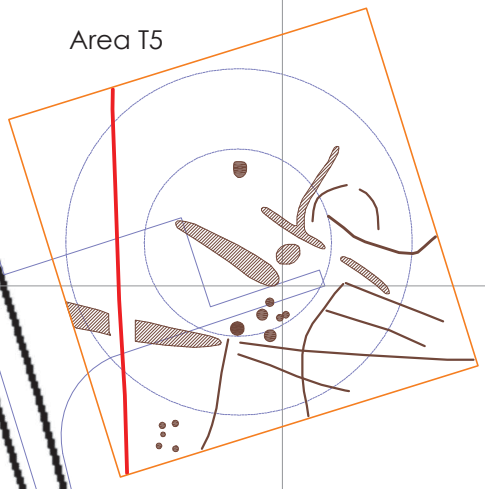

929
928
180
181
182

A - geophysical survey

magnetic survey

-5 nT 5

proposed development

B - geophysical interpretation

dipolar magnetic anomaly

positive magnetic anomaly

C - archaeological interpretation

soil-filled feature

service pipe

0 50m

scale 1:1000 for A2 plot

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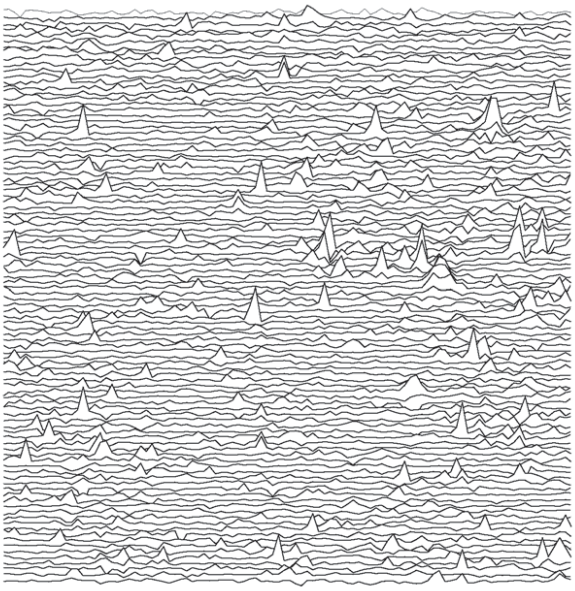
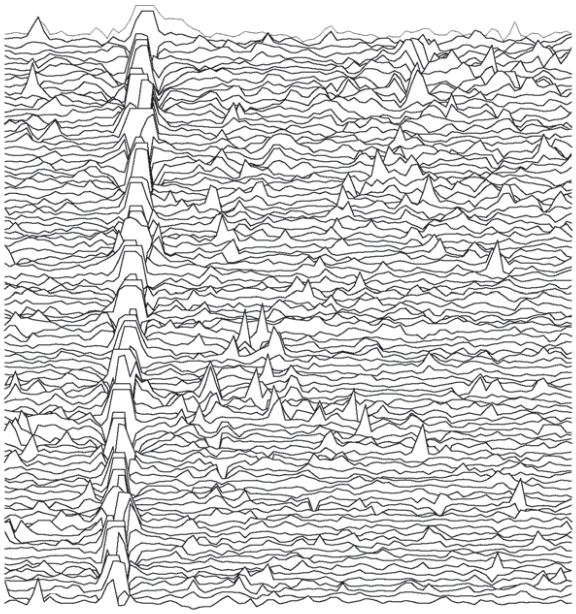
Figure 7: Area T5 geophysical survey and interpretation

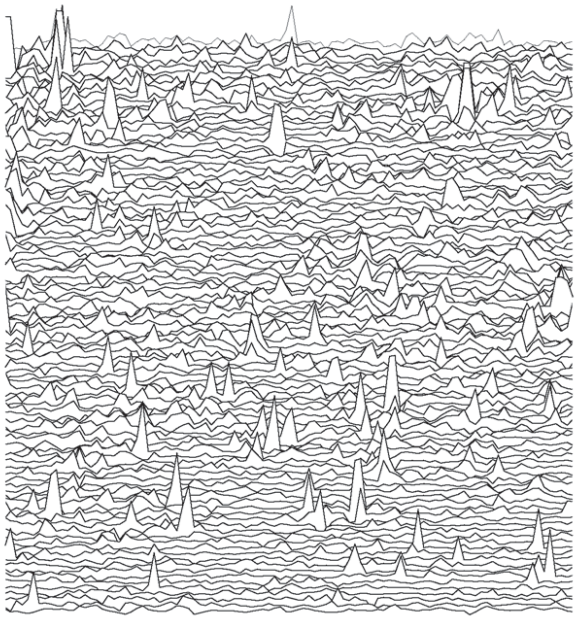
Area 1 20.00nT



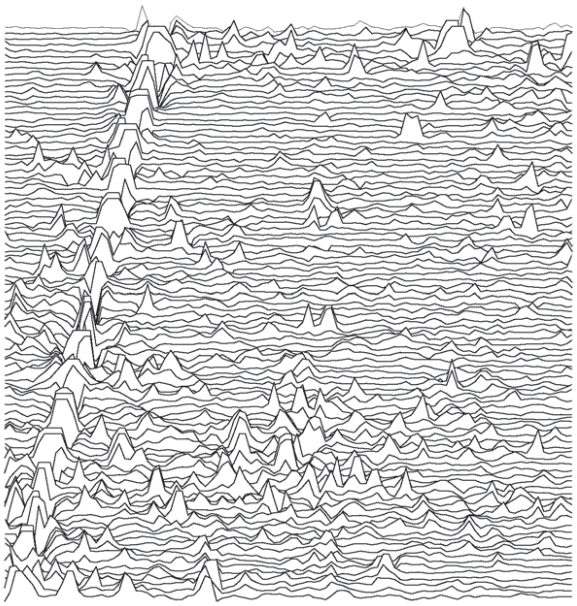
Area 4 20.00nT



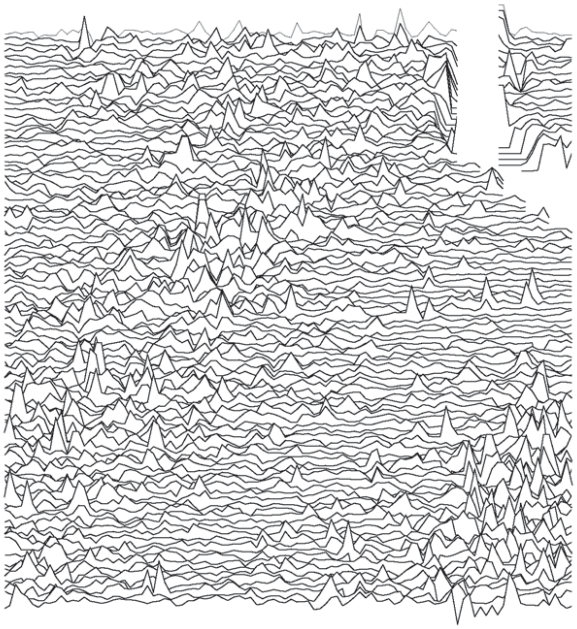
Area 2 12.00nT



Area 5 24.00nT



Area 3 12.00nT



0 50m
scale 1:1000

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Figure 8:
Trace plots of geomagnetic data