ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Halcrow Group Limited
for
Environment Agency

Morpeth Flood Alleviation Scheme
Morpeth
Northumberland

geophysical survey

report 2919
June 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 proposed development of land south-west of Mitford, near Morpeth, Northumberland. The works comprised geomagnetic survey of ten areas totalling approximately 21ha in six land parcels.

1.2 The works were commissioned by Halcrow Group Limited for the Environment Agency and conducted by Archaeological Services Durham University.

Results

1.3 Possible soil-filled features have been identified, some of which may be anthropogenic (such as enclosure ditches and ring-ditches); these are largely concentrated in Areas 8, 9 and 10 in the south.

1.4 Former ridge and furrow cultivation has been identified in Areas 2 and 7.

1.5 Former field boundaries and tracks, as shown by Ordnance Survey maps, have been identified.

1.6 A palaeochannel has almost certainly been detected in the north end of Area 2.

1.7 Traces of modern agricultural practices have been detected.

2. Project background

Location (Figure 1)

2.1 The proposed development area was located south-west of the village of Mitford, near Morpeth, Northumberland (NGR centre: NZ 1537 8517). Ten surveys totalling 21ha were conducted in six land parcels. To the north was the B6343 road, with the River Wansbeck flowing from west to east in the north of the proposed development area. Open farmland surrounded the surveys in all directions.

Development proposal

2.2 The proposed development is a flood alleviation scheme for Morpeth, sited on the River Wansbeck. The proposals include the creation of an upstream storage area at Lightwater Cottage, where an earth dam will be built. The areas that will be affected by this scheme are a level field on the floodplain, together with a small bluff on the south side of the valley; a construction access route in a field on the north side of the river; construction and maintenance access on the south bank; and two large borrow pits between the valley and the Mitford-Meldon lane.

Objective

2.3 The principal aim of the survey 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 relation to the development.

Methods statement

2.4 The geophysical surveys were undertaken in accordance with instructions from the client and national standards and guidance (below, para. 5.1).

Dates

2.5 Fieldwork was undertaken between 24th and 31st May 2012. This report was prepared for 14th June 2012.

Personnel

2.6 Fieldwork was conducted by Catrin Jenkins, Tony Liddell, Natalie Swann (Supervisor), Nathan Thomas and Richie Villis (Supervisor). The geophysical data were processed by Richie Villis. This report was prepared by Richie Villis with illustrations by Tony Liddell and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **MFA12**, for **M**orpeth **F**lood **A**lleviation Scheme 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 **archaeol3-128155**.

Acknowledgements

2.8 Archaeological Services Durham University is grateful for the assistance of landowners, agents and tenants in facilitating this scheme of works.

3. Historical and archaeological background

3.1 An Environmental Impact Assessment (EIA) is being prepared which will contain a detailed cultural heritage assessment of the site. The following briefly summarises information from the forthcoming EIA.

3.2 None of the affected areas contains any known historic assets, but in the surrounding area there are a number of cropmark and earthwork sites of the Iron Age and Romano-British periods. The site of a deserted medieval village lies about 1.6km upstream at Rivergreen, and ridge and furrow is visible at numerous locations around the proposed dam site. The dam site is close to an old ford across the Wansbeck. There is still a river crossing here, with modern concrete stepping stones. Tithe maps of the 1840s mark a path between the Mitford-Meldon road and Newton Underwood; this ran between the proposed borrow pit fields and crossed the river at the ford. This route is still a byway today.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised five arable fields of tall wheat and one pasture field grazed by sheep.

Area	Size (ha)	Landuse	Topography	NGR
1	1.6	arable – wheat	flat	NZ 1536 8526
2	1.4	pasture – sheep	steep slopes with extant ridge and furrow earthworks	NZ 1537 8512
3	0.2	arable – wheat	flat	NZ 1537 8562
4	0.3	arable – wheat	gentle slope	NZ 1542 8553
5	0.2	arable – wheat	gentle slope	NZ 1539 8548
6	0.2	arable – wheat	gentle slope	NZ 1531 8546
7	0.8	pasture – sheep	steep and gentle slopes with extant ridge and furrow earthworks	NZ 1536 8494
8	6.0	arable – wheat	gently undulating	NZ 1534 8454
9	3.0	arable – wheat	gently undulating	NZ 1550 8452
10	7.0	arable – wheat	gently undulating	NZ 1559 8468

4.2 Area 1 occupied the flood plain of the River Wansbeck and Areas 2-10 the higher ground to the north and south of the river. Elevations varied between 50m to 75m OD. It was not possible to collect data at the very north end of Area 2 due to the steepness of the slope. Area 5 was relocated 5m north-east of its original location due to the steep wooded slope down to the River Wansbeck. Areas 9 and 10 were divided by Harestane Burn.

4.3 The underlying solid geology of the area comprises Namurian mudstone, sandstone and limestone of the Stainmore Formation, which are overlain by undifferentiated River Terrace Deposits of gravel, sand and silt in Area 1 and till in Areas 2–10. A spur of glaciofluvial sand and gravel is present at the north end of Area 2.

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 possible 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) could 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 and related to known, mapped Ordnance Survey (OS) points using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections 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 2–8; the trace plots are provided in Figure 9. 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 interpretation plans 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

Interpretation: features

General comments

5.11 Colour-coded archaeological interpretation plans are provided.

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

5.13 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

5.14 A diffuse linear positive magnetic anomaly, with associated dipolar anomalies, has been detected aligned broadly east/west in this area. This corresponds to the location of a former field boundary as shown by OS map editions from 1866 to 1974. A tree, marked by 'dummy' data readings, is located on the line of this former boundary.

5.15 Weak dipolar magnetic anomalies, especially close to the glaciofluvial spur at the south end, are likely to reflect a weak natural magnetism, such as a small ferrous conten, of the natural stone.

5.16 The discrete, strong dipolar magnetic anomaly detected in the centre of the northern boundary of the area corresponds to a geotechnical borehole. Dipolar magnetic anomalies detected along the southern edge and north-west corner of the area reflect the adjacent wire fences.

Area 2

5.17 A curvilinear strong positive magnetic anomaly has been detected at the north of this area. This corresponds to the lowest, wet and boggy, point in between two steep slopes and follows the line of a contour to the east. This anomaly almost certainly reflects a palaeochannel, a former course of the Molesden Burn which continued eastward to join the Wansbeck at Bare Scar.

5.18 North-west/south-east aligned, parallel, alternate negative and positive magnetic anomalies have been detected across the south of the area. These correspond to earthworks of former ridge and furrow cultivation. Similar anomalies have been detected perpendicular to the ridge and furrow at its north end, and correspond to earthworks on the ground. These may relate to headlands.

Area 3

5.19 Linear, weak, positive and negative magnetic anomalies have been detected in this area. These reflect the modern ploughing regime.

5.20 Strong dipolar magnetic anomalies detected along the north side of the area reflect a wire fence.

Area 4

5.21 Linear, weak, positive and negative magnetic anomalies have been detected in this area. These reflect the modern ploughing regime.

5.22 Strong dipolar magnetic anomalies at the eastern limit of the area reflect a wire fence.

Area 5

5.23 Several very weak curvilinear positive magnetic anomalies have been detected in this area. These may reflect soil-filled features, however, their origin is uncertain.

5.24 The discrete strong dipolar magnetic anomaly detected near the southern boundary of the survey corresponds to a geotechnical borehole.

Area 6

5.25 A weak positive magnetic anomaly has been detected near the southern edge of this are; this may reflect a soil-filled feature. As in Area 5 the origin of this potential feature remains unclear. Given it is located at the edge of a field and at the top of a steep slope it may reflect natural soil-creep.

5.26 Strong dipolar magnetic anomalies in the south-west corner of the area reflect an adjacent wire fence.

Area 7

5.27 Parallel, slightly curving, alternate positive and negative magnetic anomalies have been detected, aligned broadly north-west/south-east, across this area. These anomalies almost certainly reflect former ridge and furrow cultivation, a continuation of that recorded in Area 2.

5.28 A narrow band of dipolar magnetic anomalies has been detected in the north-west of the area. This follows the line of the field boundary and track to the west, and almost certainly reflects a former track.

5.29 A small area of 'dummy' data in the south of the area corresponds to a pool of standing water. Dipolar magnetic anomalies at this end reflect an area of hardstanding associated with access to the field.

Area 8

5.30 Several, often diffuse, linear and curvilinear positive magnetic anomalies have been detected in this area. These could possibly reflect anthropogenic soil-filled features, such as enclosure ditches and pits.

5.31 A narrow band of strong dipolar magnetic anomalies has been detected along the eastern edge of the survey area. This reflects an existing farm track. A curvilinear anomaly has been detected just to the west of this, which could reflect a former course of the track, or a former field boundary.

5.32 A north/south aligned 'texture' across the area reflects the modern plough regime; tramlines have been detected in the data as pairs of narrow linear negative magnetic anomalies.

Area 9

5.33 As in Area 8 to the west, several positive magnetic anomalies have been detected which could reflect soil-filled features in this area.

5.34 A number of the anomalies appear likely to be anthropogenic due to their more regular nature. At least two potential small rectilinear enclosures have been identified as well as several sub-circular anomalies which could reflect ring-ditches.

5.35 A very weak texture in the data reflects the current plough direction.

5.36 A former field boundary is shown by OS maps of the area, aligned broadly east/west across the centre of the area; this has not been identified in the data.

Area 10

5.37 Positive magnetic anomalies with similar characteristics to those identified in Areas 8 and 9 have also been detected in this area. These are also likely to reflect soil-filled features, however, as in the other areas the exact nature and origin of these features remains unclear. At least one potential rectilinear enclosure may have been detected and two possible small ring-ditches.

5.38 As in Areas 8 and 9 the modern plough regime can be identified as a weak 'texture' in the data.

6. Conclusions

6.1 Approximately 21ha of geomagnetic survey was undertaken on land to the south-west of Mitford, near Morpeth, Northumberland, prior to the development of a flood alleviation scheme.

6.2 Possible soil-filled features have been identified, some of which may be anthropogenic (such as enclosure ditches and ring-ditches); these are largely concentrated in Areas 8, 9 and 10 in the south.

6.3 Former ridge and furrow cultivation has been identified in Areas 2 and 7.

6.4 Former field boundaries and tracks, as shown by Ordnance Survey maps, have been identified.

6.5 A palaeochannel has almost certainly been detected in the north end of Area 2.

6.6 Traces of modern agricultural practices have been detected.

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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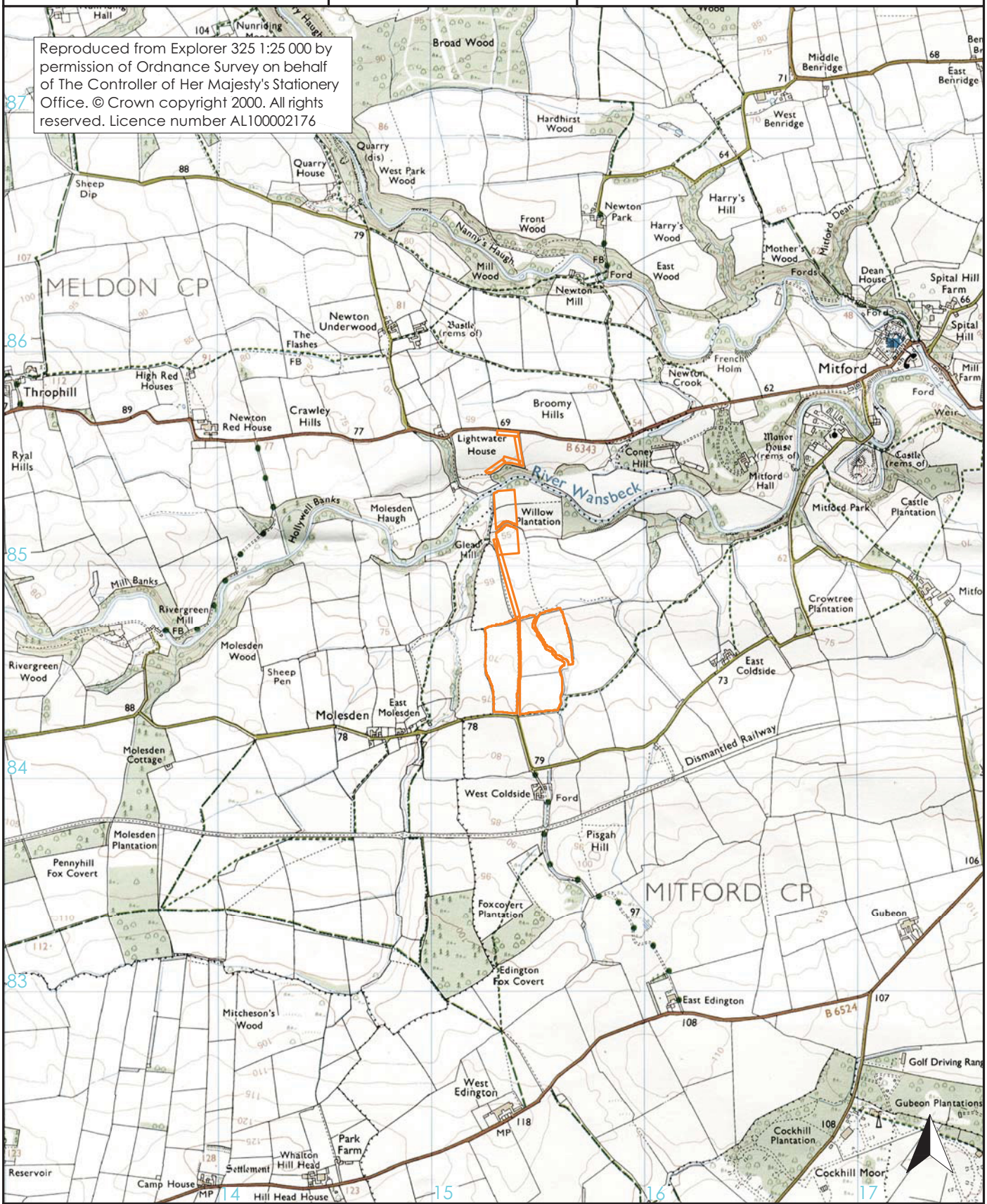
Figure 1: Site location



survey location

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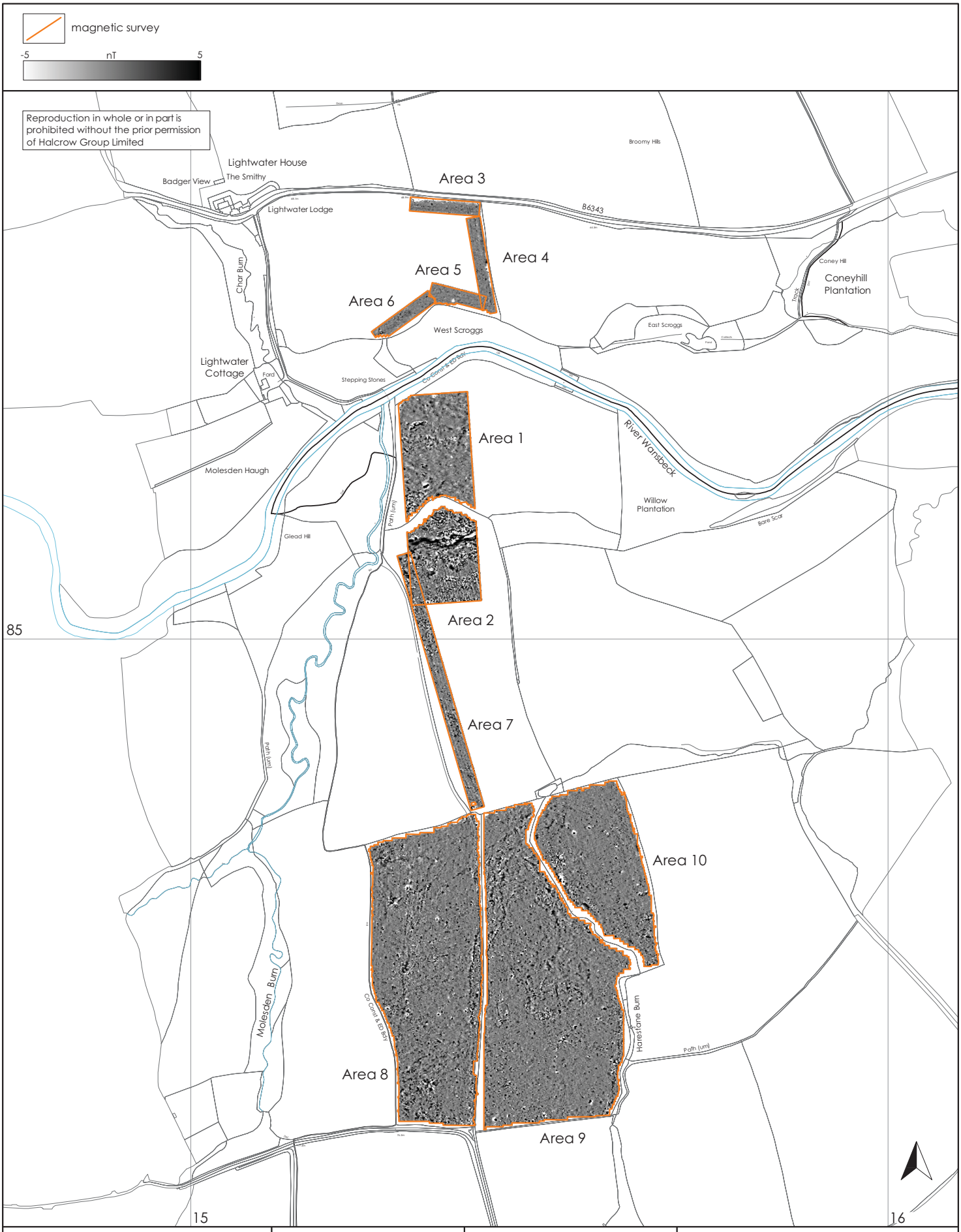
scale 1:25 000 for A4 plot



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0 250m
scale 1:5000 for A3 plot

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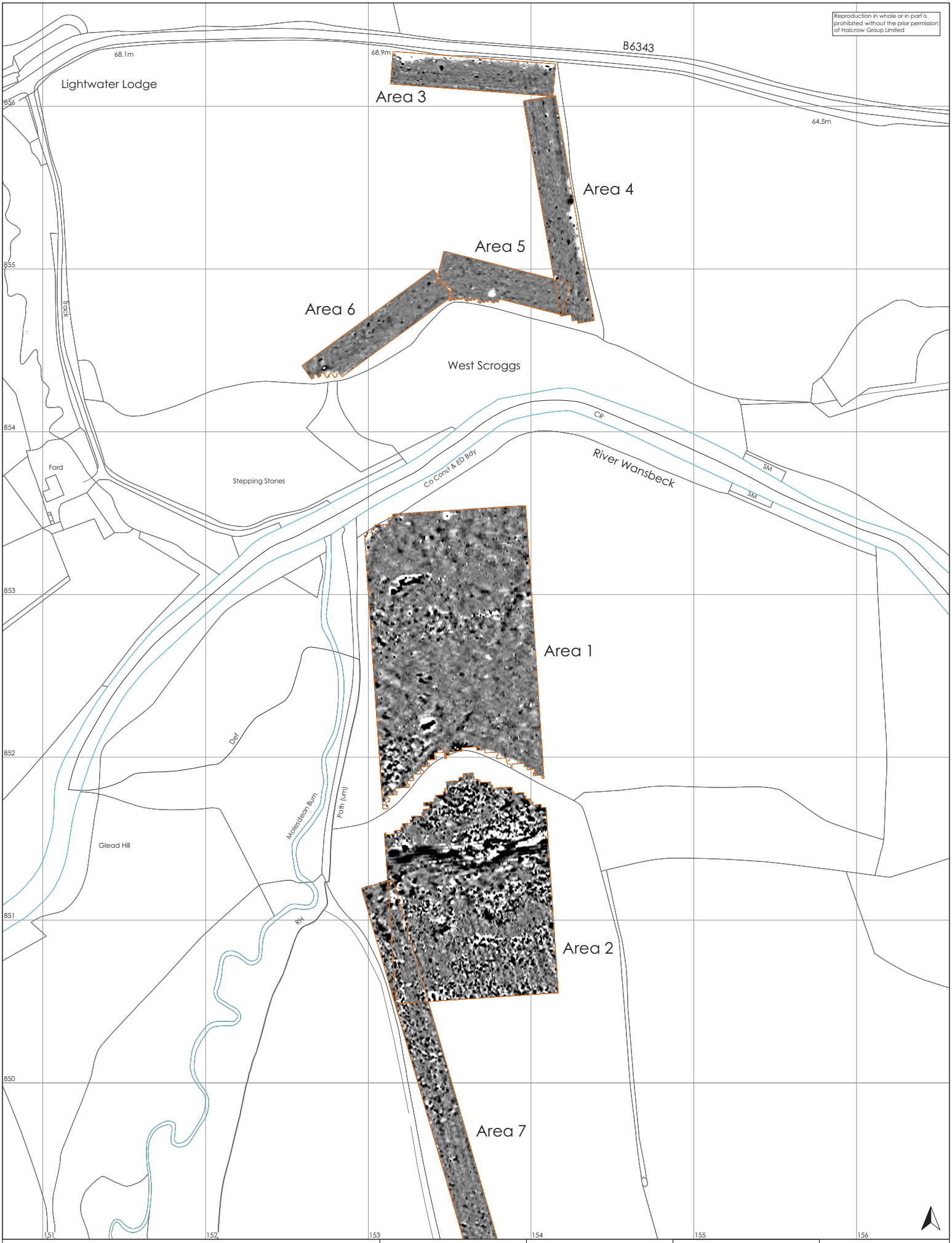
Figure 2: Geophysical survey overview



magnetic survey
-5 nT 5

scale 1:1000 for A1 plot

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Figure 3: Geophysical surveys north (Areas 1-7)

magnetic survey
-5 nT 5

scale 1:1000 for A1 plot

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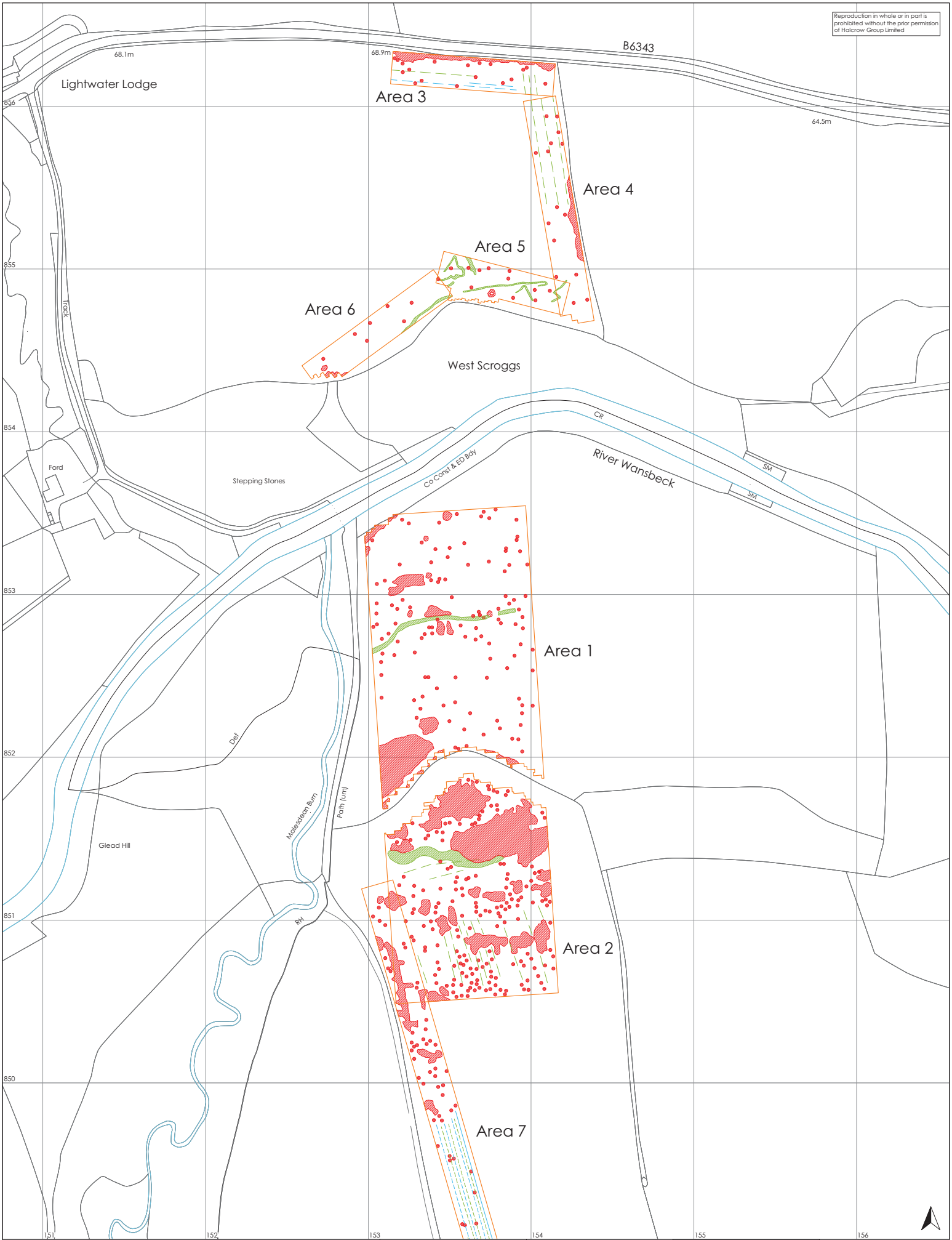
Figure 4: Geophysical surveys south (Areas 7-10)



magnetic survey

dipolar magnetic anomaly

positive magnetic anomaly

negative magnetic anomaly

0 50m
scale 1:1000 for A1 plot

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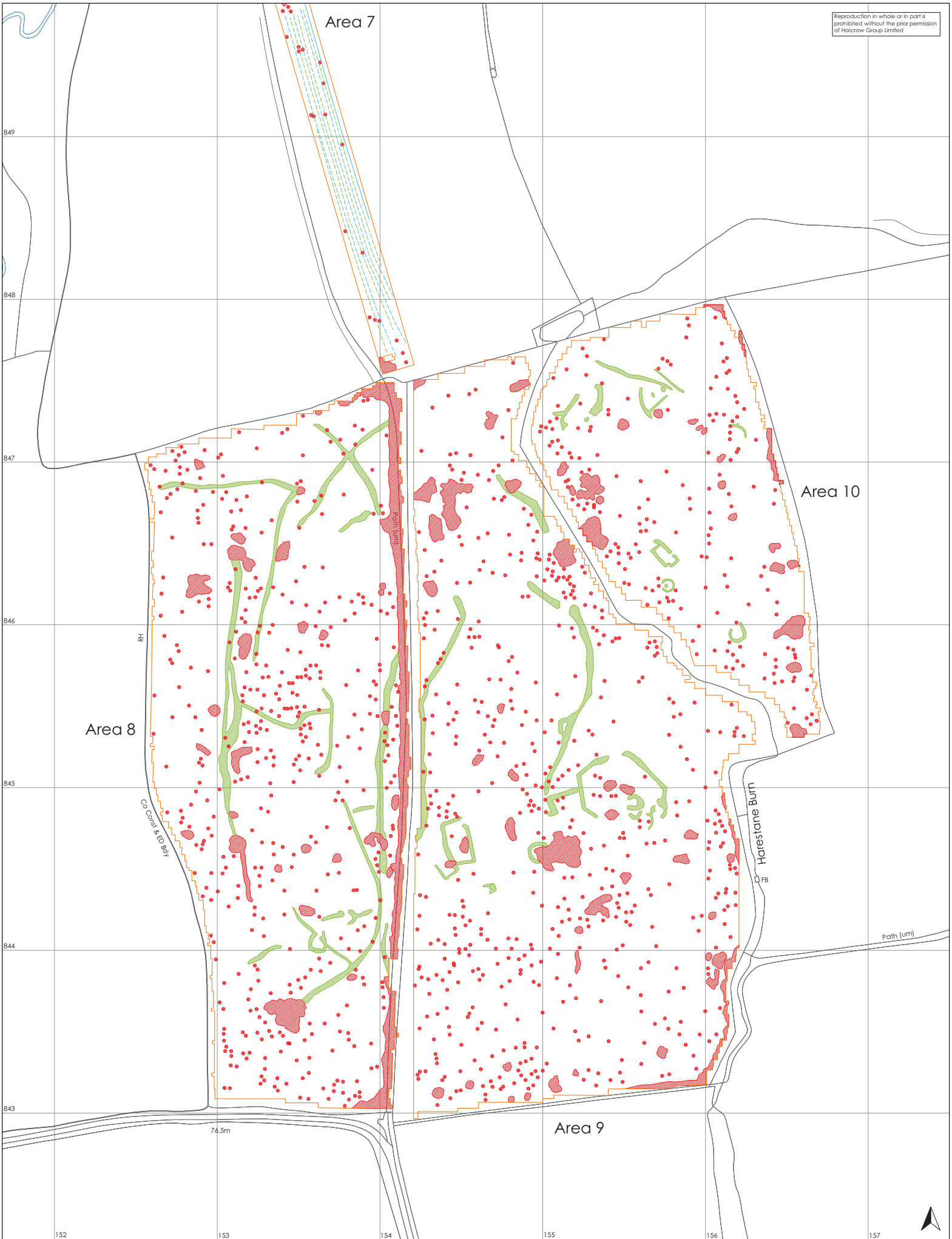
Figure 5: Geophysical interpretations north (Areas 1-7)



magnetic survey

dipolar magnetic anomaly

positive magnetic anomaly

negative magnetic anomaly

0 50m

scale 1:1000 for A1 plot

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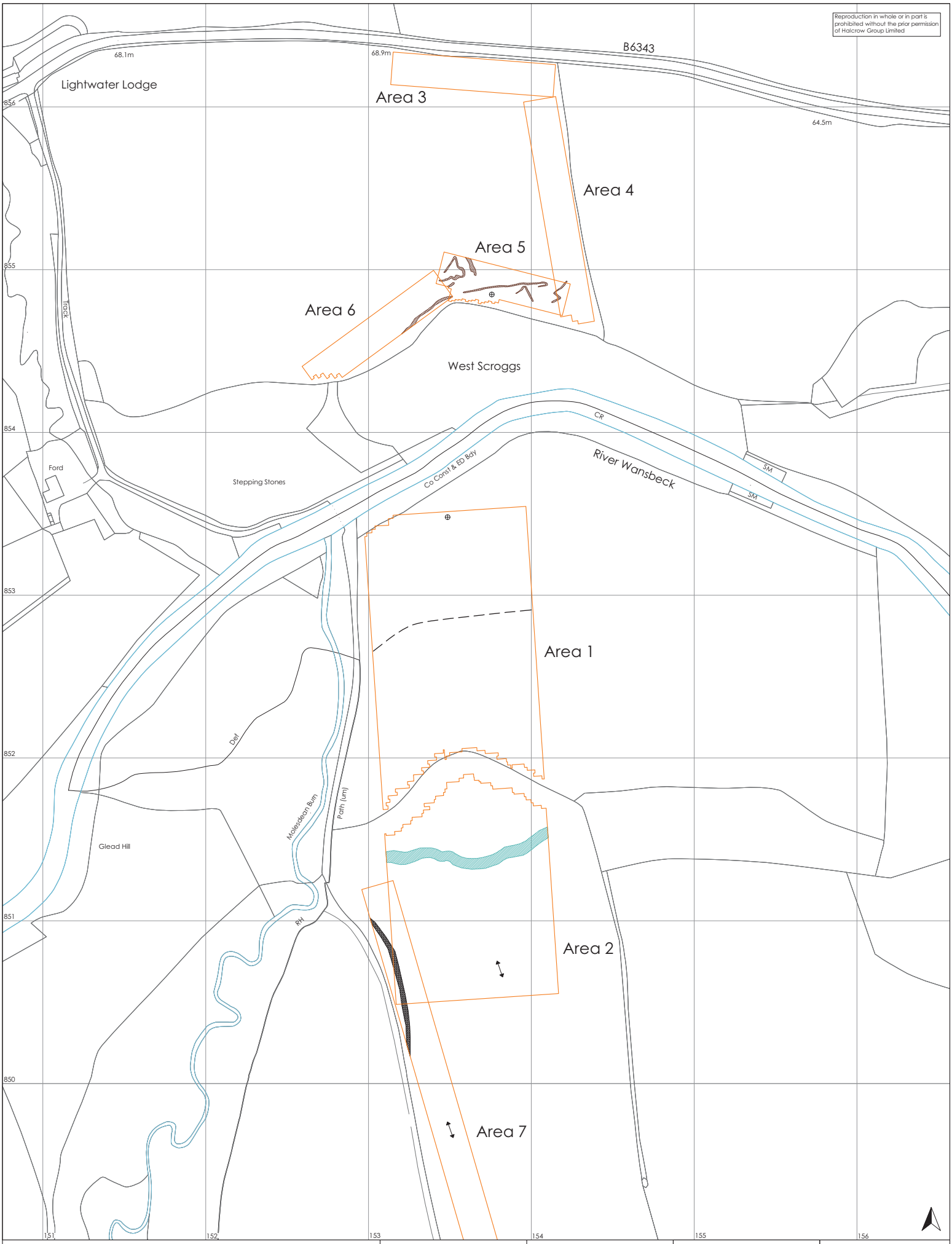
Figure 6: Geophysical interpretations south (Areas 7-10)



magnetic survey
soil-filled feature
palaeochannel
ridge and furrow
former field boundary
former track
borehole

scale 1:1000 for A1 plot

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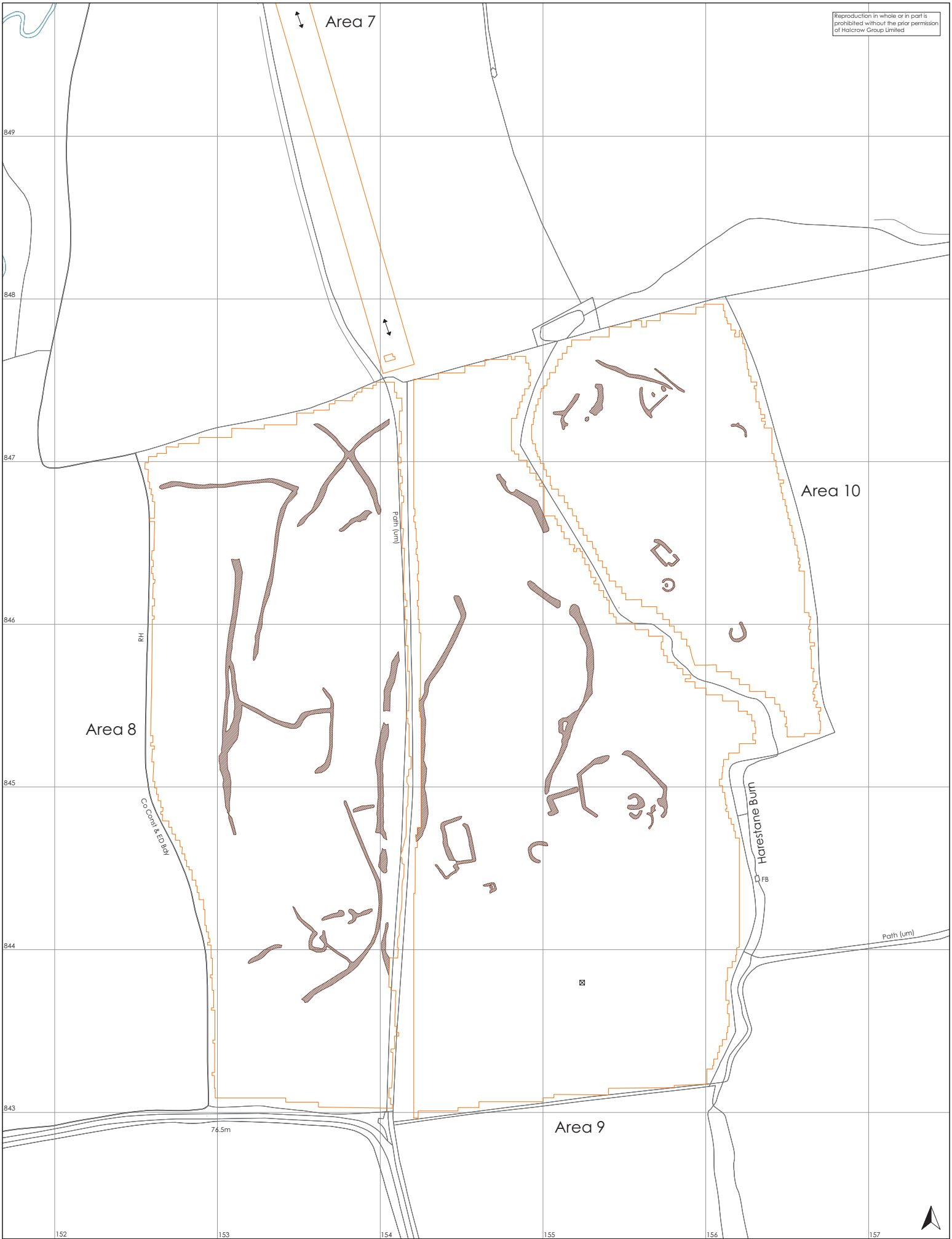
Figure 7: Archaeological interpretations north (Areas 1-7)



magnetic survey

soil-filled feature

ridge and furrow

telegraph pole

scale 1:1000 for A1 plot

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Figure 8: Archaeological interpretations south (Areas 7-10)

0 50m
scale 1:1000 for A1 plot

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Figure 9: Traceplots of geomagnetic data