ARCHAEOLOGICAL SERVICES WYAS

Land south of Cutsyke Road
Normanton
West Yorkshire

Geophysical Survey

Report no. 2358

July 2012

Client: West Yorkshire Archaeology Advisory Service

REGISTERED ORGANISATION IfA

Land south of Cutsyke Road
Normanton
West Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey was carried out south-west of Low Laithe Farm, Normanton on behalf of the West Yorkshire Archaeology Advisory Service in order to provide additional information about the archaeological potential of three monuments identified as cropmarks and recorded on the West Yorkshire Historic Environment Record. The cropmarks have been interpreted as a possible Neolithic cursus, an Iron Age-Romano British settlement and a possible Neolithic enclosure. The survey has identified numerous anomalies confirming and enhancing the cropmark data. Numerous discrete anomalies within a large, sub-divided, enclosure, may be indicative of settlement activity. Adjacent linear anomalies suggest a bordering trackway and associated field system. Anomalies defining a much smaller D-shaped enclosure are located to the north and correspond with the cropmark feature interpreted as a possible Neolithic enclosure. However, no anomalies corresponding with the cropmarks interpreted as a possible Neolithic cursus have been located.

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Report Information

Client:	West Yorkshire Archaeology Advisory Service
Address:	Registry of Deeds, Newstead Road, Wakefield Road, West Yorkshire, WF1 2DE
Report Type:	Geophysical survey
Location:	Normanton
County:	West Yorkshire
Grid Reference:	SE 418 232
Period(s) of activity: represented	prehistoric/Romano-British?
Report Number:	2358
Project Number:	3659
Site Code:	WRP11
OASIS ID:	129109
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	August 2011
Date of report:	July 2012
Project Management:	Alistair Webb BA MIfA
Fieldwork:	Sam Harrison BSc MSc AIfA
	David Williams BA PIfA
Report:	David Harrison BA MSc MIfA
	Sam Harrison
Illustrations:	Sam Harrison
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Photography:	Sam Harrison
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Ian Sanderson, Principal Archaeologist of the West Yorkshire Archaeology Advisory Service to undertake a geophysical (magnetometer) survey on land south of Cutsyke Road, Normanton, West Yorkshire (see Fig. 1), where the interpretation and analysis of air photographs has lead to the identification of three monuments visible as cropmarks. The survey was carried out on August 18th 2011.

Site location, topography and land-use

The site is situated on agricultural land directly south-west of Low Laithes Farm, 3km south of Castleford and 3.5km east of Normanton, and is centred on SE 418 232 (see Fig. 1). It is bound to the east by the B6421 Cutsyke Road, to the west by the A6539 Castleford Lane and by agricultural land to the south. The survey comprised a single block measuring 2.5ha which was positioned to target the three recorded monuments (see Fig. 2).

The topography of the site rises gently to the south-east, at approximately 50m above Ordnance Datum (aOD). The survey area was contained within a single field which was under arable production at the time of survey (see Plate 1).

Geology and soils

The underlying geology comprises Acker Rock sandstone with no superficial deposits (BGS 2012). The soils in this area are classified in the Rivington 1 association, characterised as well drained coarse loams (SSEW 1983).

2 Archaeological background

Cropmarks interpreted as representing three distinct archaeological features have been identified on air photographs taken over the site (see Fig. 2). The first of the three features is a possible Neolithic cursus (Monument No 1390677). This is located in the eastern half of the survey area and measures 35m by 162m and is aligned in a north/south direction. It is similar in appearance to the Barnack short cursus in Cambridgeshire. A closer parallel has been suggested with a site at Swillington Common, 10km to the north-east, although excavation of this site suggested a post-Roman date (Roberts, 2010). Across the whole of the survey area a number of features, including three rectilinear enclosures, a trackway and field boundaries, collectively interpreted as an Iron Age/Roman settlement (Monument No 1390692), have been identified. A potential Neolithic date has been suggested for another, much smaller sub-oval enclosure, approximately 20m to the west of the possible cursus (Monument No 1390685), the third and final feature thought to be present within the survey area.

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the nature and possible interpretation of any magnetic anomalies identified over the known cropmarks and to therefore determine the presence/absence and extent of any buried archaeological features.

Specifically, the survey aimed to provide detailed information about the presence/absence of the possible Neolithic cursus and further define the extent of the probable settlement activity as defined by the various cropmark enclosures.

In order to achieve these aims detailed (recorded) magnetometer survey was undertaken centred on the cropmark features. The survey covered an area of 2.5 hectares. The results of the survey will help inform the West Yorkshire Archaeology Advisory Service.

Magnetometer survey

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. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the Ordnance Survey map, is shown in Figure 1. Figure 2 is a large scale (1:2000) site location plan showing the greyscale magnetometer data and cropmark detail. The processed and minimally processed data, together with an interpretation graphic of the survey results, are presented in Figures 3, 4 and 5 at a scale of 1:1000.

Further technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The geophysical survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2010). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures 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 figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion

As with the majority of surveys carried out in an agricultural setting 'iron spike' anomalies, typically caused by ferrous (magnetic) debris either on the ground surface or mixed in with the plough-soil, have been recorded across the survey area. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris is common on rural sites, often being present as a consequence of manuring or tipping/infilling. On this site, however, there are relatively few such anomalies and no clusters to suggest anything other than a low level, random distribution of ferrous debris.

Linear trend anomalies aligned south-west/north-east are present across the whole of the survey area, often on the same alignment as archaeological anomalies. However, these trends are due to the former agricultural practice of ridge and furrow ploughing.

Several linear and rectilinear anomalies correspond closely with the cropmarks and are caused by infilled ditches that form enclosures and field divisions of probable Iron Age/Romano-British date (see Figure 5). A probable trackway, defined by parallel linear anomalies, **A**, is identified running broadly parallel with the south-eastern limits of the survey area. Appended to the north-west of the trackway is a rectangular enclosure, **B**. The enclosure is sub-divided into at least four sub-enclosures, **C**, **D**, **E** and **F**, perhaps to facilitate differing land use. A concentration of discrete anomalies within sub-enclosure **E** may indicate occupational features such as pits and post-holes. Another possible smaller rectangular enclosure, **G**, attached to the north-west of **B,** has also been identified. Linear anomalies, **H** and **I**, are also interpreted as ditches perhaps forming other enclosures or defining fields extending to the north-east and north-west of the main enclosure (**B**).

To the north of **B** a much smaller D-shaped enclosure, **J**, has been identified that corresponds with the cropmark interpreted as a possible Neolithic enclosure (Monument No. 1390685). Linear anomaly **K** seems to connect this enclosure with the field defined by anomaly **H**.

No anomalies corresponding with the postulated Neolithic cursus (Monument No. 1390677), visible as a cropmark, have been identified.

Across all parts of the survey area numerous discrete anomalies of varying magnitude have been identified. These have been ascribed a possible archaeological origin given the local archaeological context. However, in the absence of any obvious archaeological pattern a geological origin for these anomalies remains a plausible interpretation.

5 Conclusions

The geophysical survey has confirmed the presence of a large sub-divided enclosure with a much smaller D-shaped enclosure immediately to the north confirming the cropmark data. It is not clear from the survey whether these two features and the associated field divisions and trackway are contemporary. In addition the survey has revealed further internal detail on both features and the number of discrete anomalies, particularly to the eastern corner of the larger enclosure, suggests activity in this part of the enclosure. However, no archaeological anomalies have been identified corresponding to the location of the possible Neolithic cursus cropmark.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

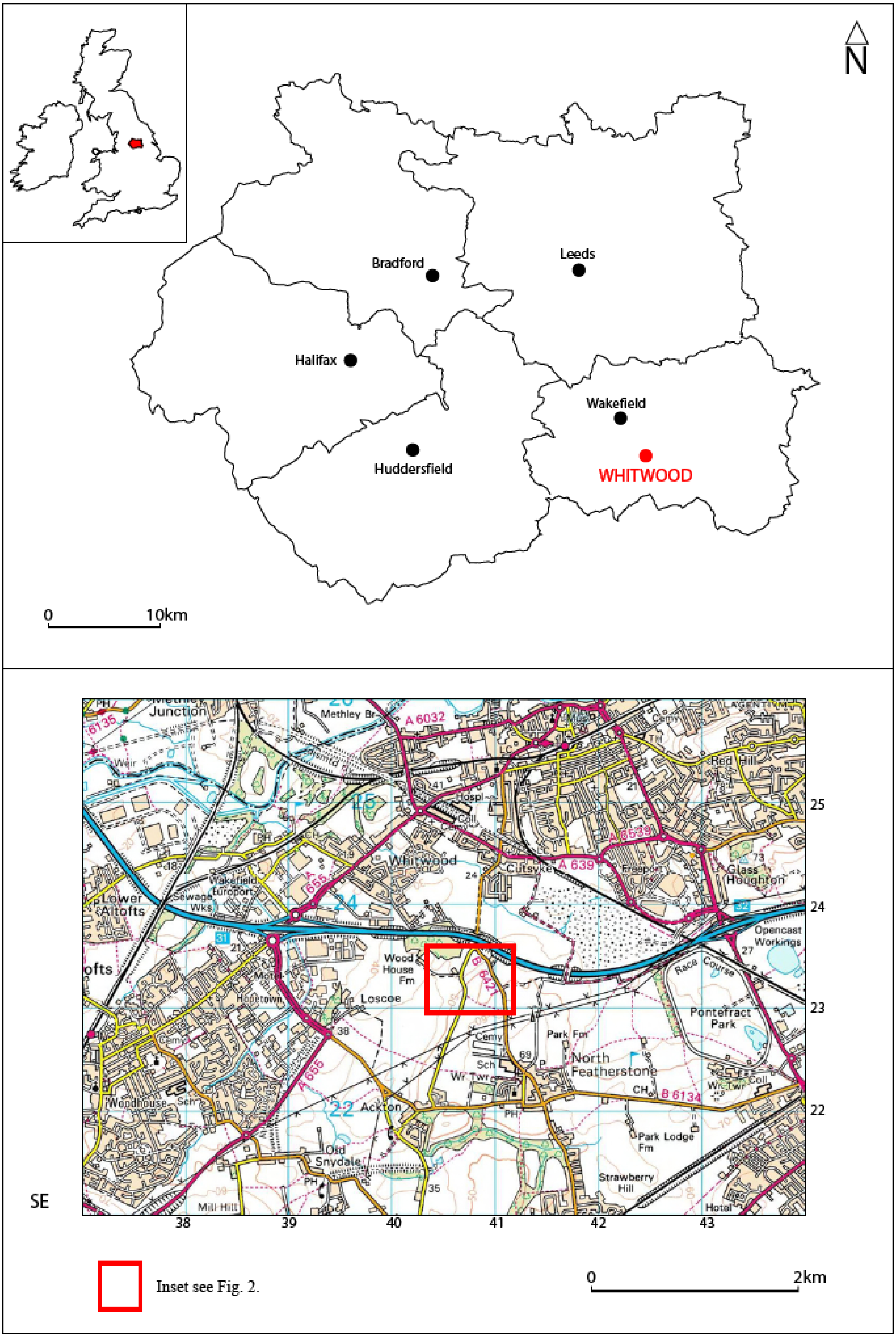
N
Bradford
Leeds
Halifax
Wakefield
Huddersfield
WHITWOOD
0
10km
Whitwood
Cutsyke
Glass Houghton
Lower Altofts
Wakefield Europort
Wood House Fm
Loscoe
Hopetown
Ackton
Old Snydale
North Featherstone
Park Fm
Pontefract Park
Race Course
Opencast Workings
Red Hill
Methley Br
Woodhouse
Park Lodge Fm
Strawberry Hill
Mill Hill
A 6032
A 639
A 6539
A 655
B 6134
SE
38
39
40
41
42
43
25
24
23
22
Inset see Fig. 2.
0
2km

Fig. 2. Site location showing greyscale magnetometer data and cropmark detail (1:2000 @ A3)

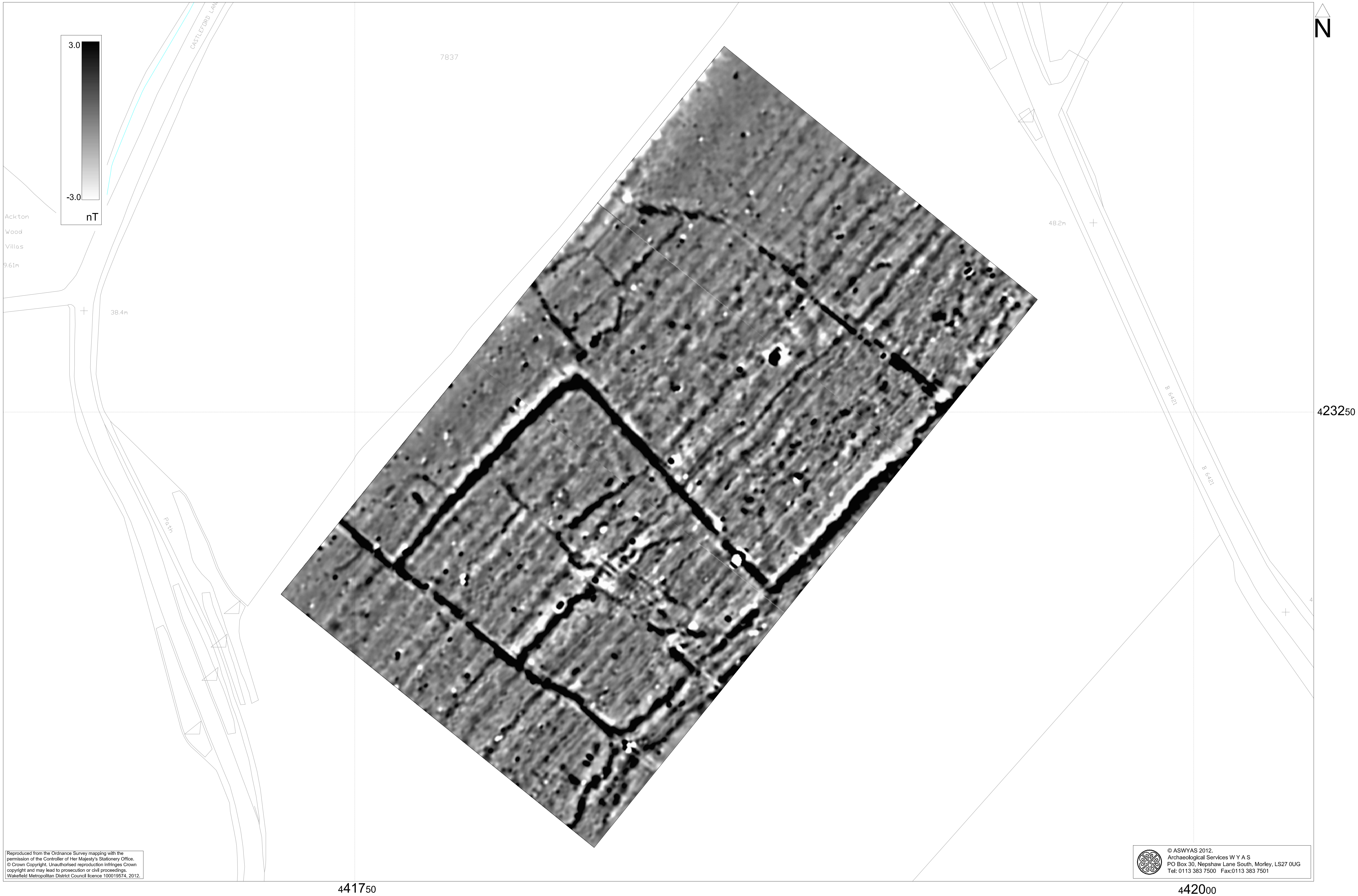

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

0 50m

Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

Appendix 1: Magnetic survey - technical information

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 and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

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.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a 'negative' scanning result should be validated by sample detailed magnetic survey (see below).

The second method is referred to as ***detailed survey*** and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2: Survey location information

The survey grid was laid out using a Geodimeter 600s total station theodolite and tied in to permanent landscape features and to temporary reference objects (survey marker stakes) that were established and left in place following completion of the fieldwork for accurate geo-referencing. The locations of the temporary reference points are shown on Figure 2 and the Ordnance Survey grid co-ordinates tabulated below. The survey grids were then super-imposed onto a base map 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 co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Station	Easting	Northing
A	441953.2819	423327.2835
B	441841.2934	423341.1617
C	441721.7483	423160.7287

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the West Yorkshire Historic Environment Record).

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