Archaeological Services WYAS

Land south of Woburn Drive
Thorney
Peterborough

Geophysical Survey

Report no. 2391

September 2012

Client: CgMs

REGISTERED ORGANISATION IfA

Land south of Woburn Drive
Thorney
Peterborough

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 3.4 hectares, was carried out on agricultural land south of Woburn Drive, Thorney, in advance of the possible development of the site. Although the magnetic background across the whole of the survey area is extremely variable vague discontinuous linear anomalies have been identified that probably correlate with a rectangular cropmark feature that has been interpreted as an enclosure of unknown date. It is impossible to discriminate between the numerous discrete anomalies identified across the site; the overwhelming majority are likely to be due to variations in the soils but some, particularly those within the postulated enclosure, may have an archaeological origin. Magnetic anomalies locating an infilled pond and land drains have also been identified.

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Report Information

Client:	CgMs
Address:	Units 20-22 Newark Beacon, Beacon Hill Office Park, Cafferata Way, Newark, Nottinghamshire, NG24 2TN
Report Type:	Geophysical survey
Location:	Land south of Woburn Drive, Thorney
County:	City of Peterborough
Grid Reference:	SJ 495 635
Period(s) of activity: represented	Iron Age/Roman/Medieval
Report Number:	2391
Project Number:	3968
Site Code:	TNP12
OASIS ID:	archaeol11-134915
Planning Application No.:	
Museum Accession No.:	n/a
Date of fieldwork:	September 2012
Date of report:	September 2012
Project Management:	Sam Harrison BSc MSc AIfA
Fieldwork:	Christopher Sykes BA MSc Sam Harrison
Report:	Sam Harrison
Illustrations:	Sam Harrison
Photography:	Sam Harrison

Authorisation for distribution: ---

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1 Introduction

Archaeological Services WYAS was commissioned by Myk Flitcroft of CgMs Consulting to carry out a programme of non-intrusive geophysical (magnetometer) survey on land south of Woburn Drive, Thorney (see Fig. 1). The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice, in advance of the possible development of the site. The survey was carried out on September 13th 2012.

Site location, topography and land-use

The site is located on the southern edge of Thorney 0.3km east of the B1040 (see Fig. 1) and comprised a single field under arable cultivation covering approximately 3.4 hectares. The proposed development area (PDA) was bounded by housing on Woburn Drive, St Botolphs Way and St Peter's Way to the north and agricultural land to all other sides (see Fig. 2). The site was flat and situated at 5m above Ordnance Datum (aOD) and had been harvested just prior to survey (see plates).

Geology and soils

The underlying bedrock comprises Oxford Clay Formation (BGS 2012). The soils are classified in the Oxpasture association being characterised as fine loams over clay soils with slowly permeable subsoils and slight seasonal waterlogging (SSEW 1983).

2 Archaeological background

An archaeological desk-based assessment (DBA) centred on the field immediately adjoining the site to the west (CgMs 2011) records a rectangular cropmark (SMR no. 6771) in the eastern half of the current site which is described as an enclosure consisting of a bank and ditch. A rectangular shaped pond in the same general location and on the same basic alignment is also shown on Ordnance Survey maps from 1881 until 1951. A World War II prisoner of war camp (SMR no. 50565) was located immediately to the north of the PDA under what is new residential housing.

A geophysical survey of land immediately to the west of the PDA revealed an area of high resistance possibly indicating a building platform and magnetic enhancement anomalies possibly indicting a former track and field boundary (NA 2012).

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remnants identified within the specific area to be impacted by the proposed development and to help inform further strategies should they be required.

In order to achieve these aims detailed (recorded) magnetometer survey was carried out over the entire site, an area of 3.4 hectares.

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 1:50000 Ordnance Survey map is shown in Figure 1. A large scale (1:2000) site location plan showing the greyscale magnetometer data is shown in Figure 2. The data are presented in greyscale, XY trace plot and interpretation formats 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

Ferrous anomalies

Ferrous anomalies, either as individual 'spikes' or more extensive areas of magnetic disturbance, are typically caused by ferrous (magnetic) debris, either on the ground surface or mixed in with the plough-soil. 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.

Areas of magnetic disturbance have been identified along the northern periphery of the survey area. These responses are thought to be caused by the proximity of fences, buildings, and ferrous material accumulated in field boundaries and possibly a pipe along the field boundary. The strong response in the south-western corner of the site is probably also due to a pipe laid along the boundary.

A large area of magnetic disturbance adjacent to the eastern site boundary, **A**, locates a pond that has been backfilled with highly magnetic material. This pond is shown on the first edition Ordnance Survey map of 1887 and is still recorded on the 1951 edition.

Two other clusters of magnetic variation are noted; immediately south of the gate accessing the site from Woburn Drive and along the north-eastern boundary. Both clusters are thought to be caused by the accumulation of slightly magnetic material in the plough soil, probably due tipping or infilling. Neither is considered to be have any archaeological significance.

Geological anomalies

The magnetic background across the whole of the survey area is extremely variable with numerous localised areas of enhanced magnetic response, which manifest as discrete anomalies, which give the data a speckled appearance. These types of anomaly are interpreted as being due to variations within the soils and may particularly be due to the presence of localised patches of gravels which are commonly magnetic – the village of Thorney is located on a gravel island rising just above the level of the western fens. This geology makes the confident interpretation of the cause of these anomalies difficult as it is impossible to discriminate between anomalies which have an underlying geological cause and those which may be due to non-linear archaeological features. In such scenarios it is usual to ascribe an archaeological potential to those anomalies located adjacent to other anomalies of obvious potential but a geological cause to those which are far removed from any obviously archaeological features.

Agricultural anomalies

In the south of the survey area two parallel linear anomalies, **B**, aligned north-north-west/south-south-east, parallel with the field boundary just to the south, locate field drains. A third linear anomaly, **C**, may link these drains to the former pond just to the north-east.

Vague linear trend anomalies in the western half of the field also probably have an agricultural origin, either drains or ploughing trends.

?Archaeological anomalies

Vague, discontinuous linear anomalies, **D**, probably locate the infilled ditches defining a large rectilinear enclosure which have previously been identified as a cropmark (SMR no. 6771) in the east of the survey area. The long axis of the enclosure is aligned south-west/north-east and it measures approximately 100m on this orientation by 40m north-west/south-east. The anomaly defining the north-eastern side is most clearly defined with the north-western side the vaguest trace. The response from the ditch forming the south-eastern side may be masked by the much stronger response from the material used to backfill the pond which abuts the enclosure. The plethora of discrete anomalies located within the probable enclosure have been ascribed a possible archaeological cause by virtue of their location. However, it is considered highly likely that the majority of these will be due to variations in the composition of the soils (see above).

5 Conclusions

The geophysical survey has confirmed the presence of a rectilinear enclosure previously identified as a cropmark (SMR no. 6771) in the east of the survey area. This enclosure measures 100m by 40m and is on the same alignment, and immediately adjacent to, a former pond shown on Ordnance Survey maps from the late 19th century to the mid-20th century.

Throughout the survey area numerous discrete anomalies have been identified. The vast majority of these are likely to be due to variation in the composition of the soils, perhaps locating pockets of magnetic gravels, although those identified within the enclosure can be considered to have an increased archaeological potential due to their location.

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.

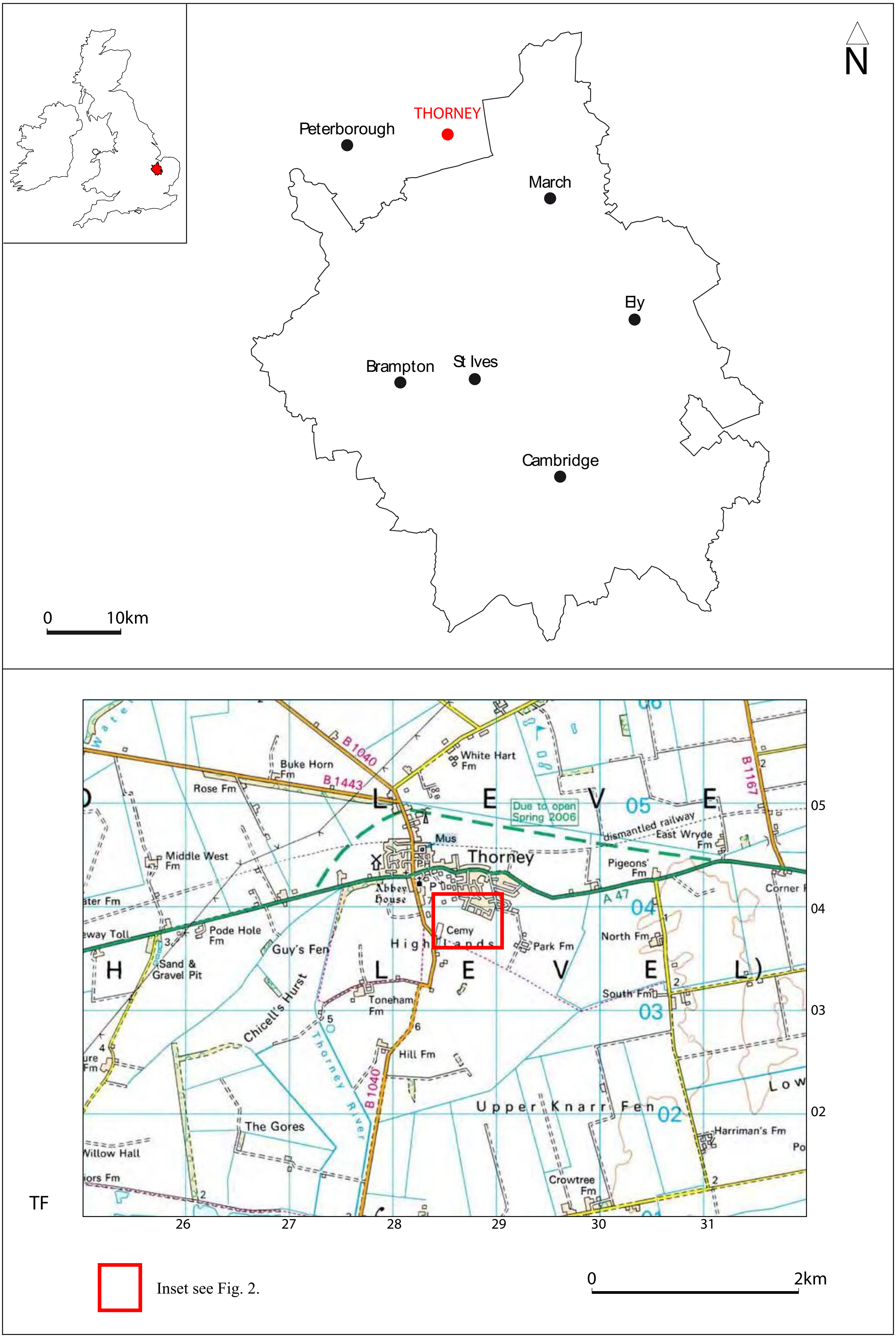

Fig. 1. Site location

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

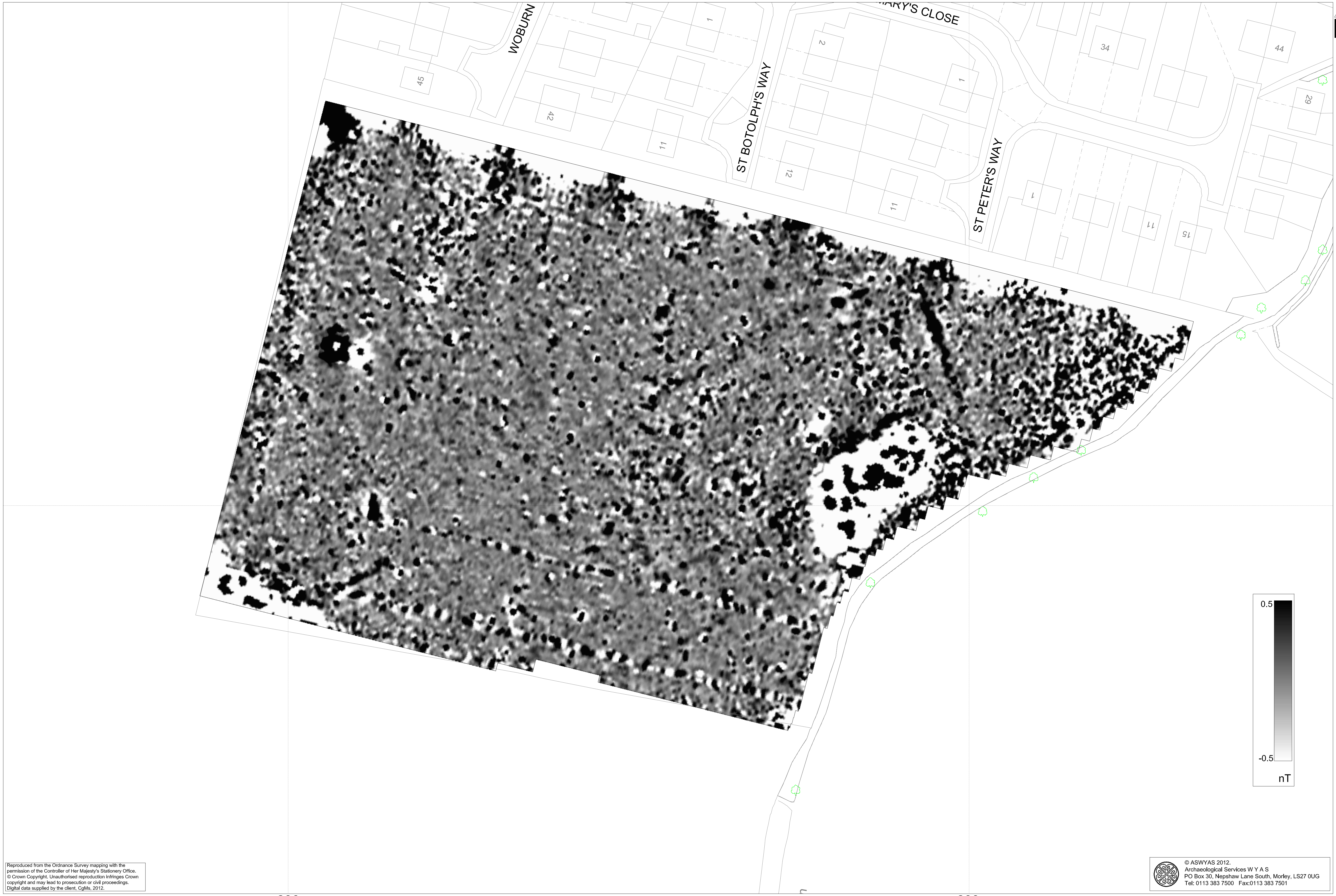

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Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

0 20m

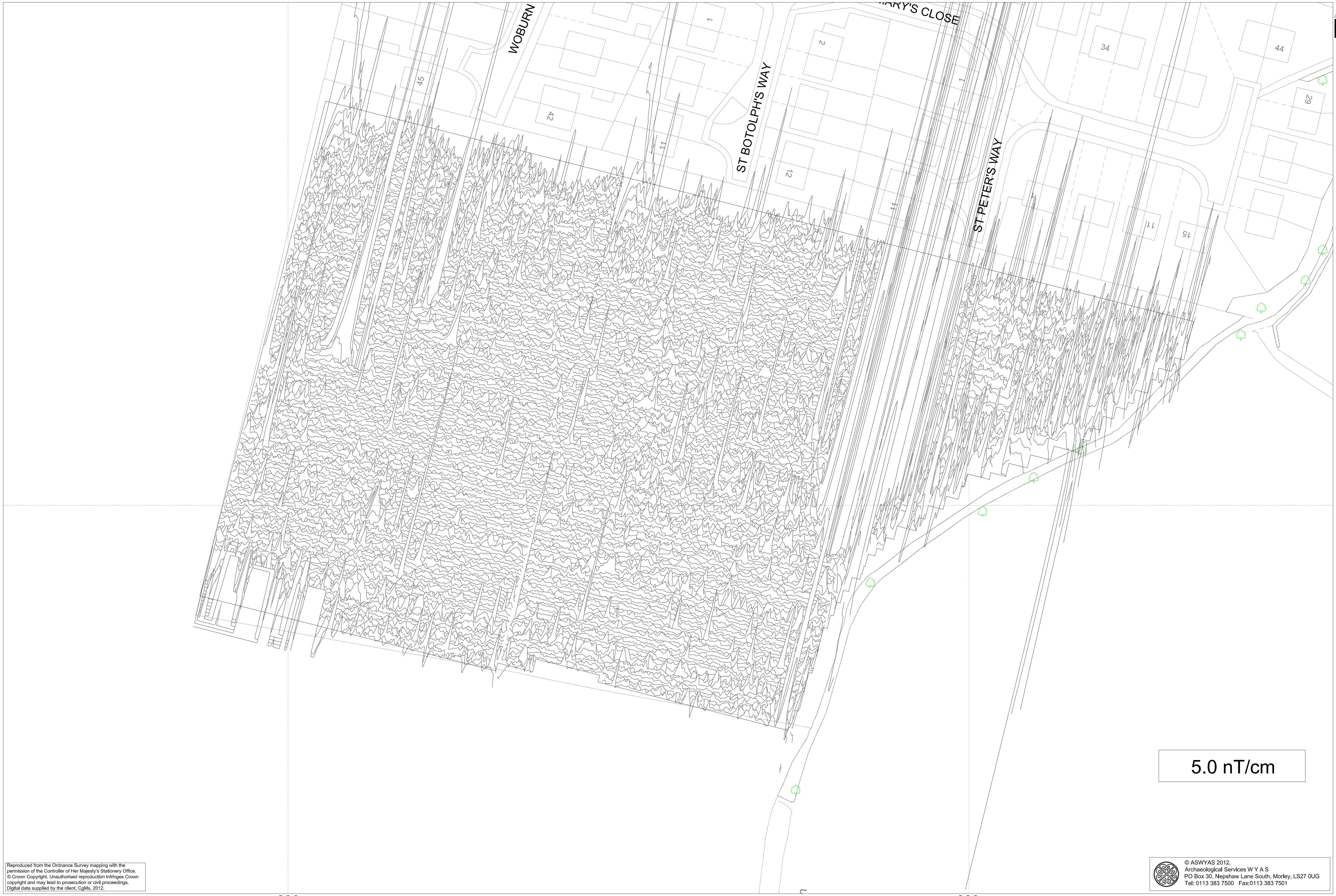

Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

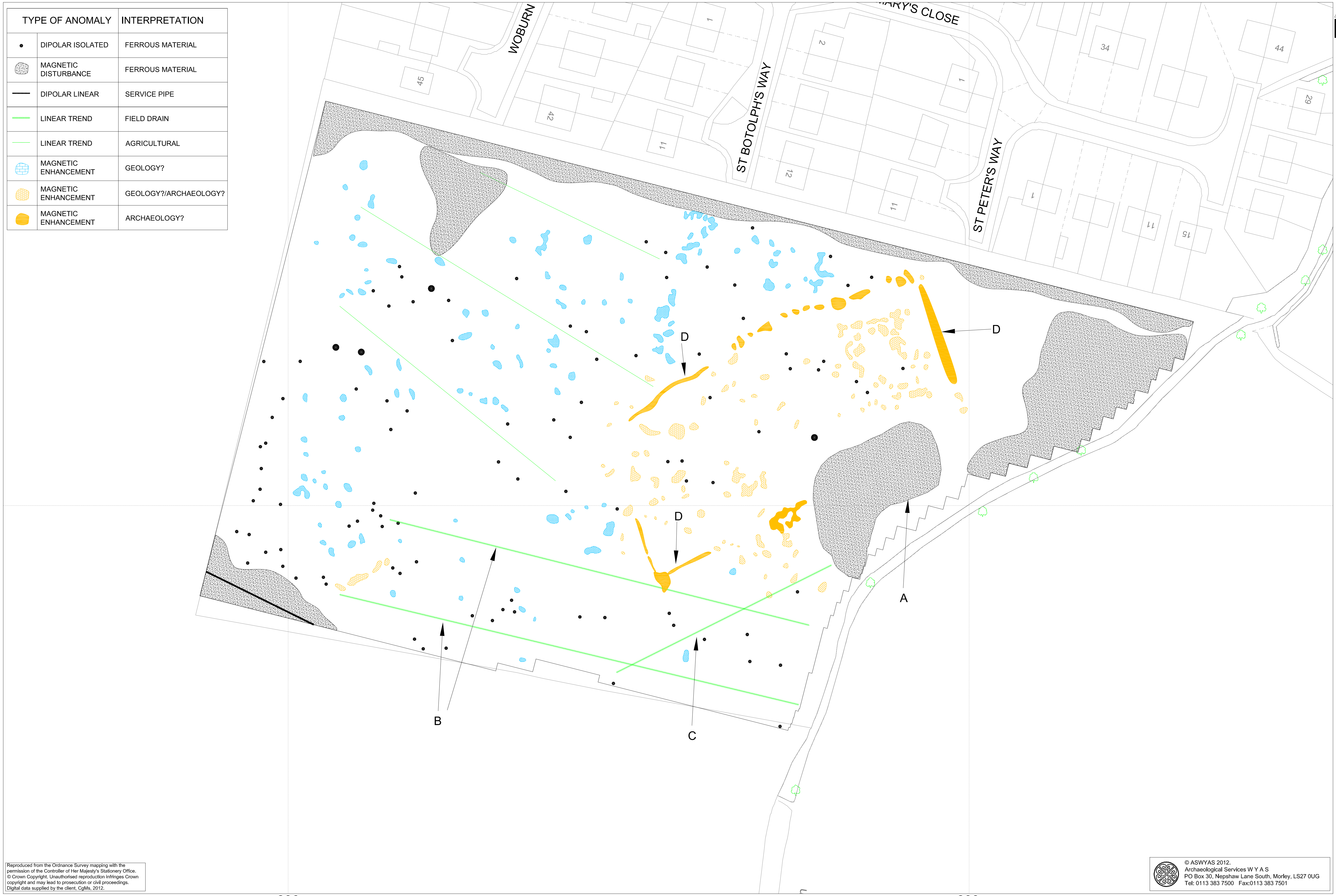

Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

0 20m


Plate 1. General view of field, looking south-east


Plate 2. General view of field, looking south-west

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 site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better then 0.01m. The survey grids were then super-imposed 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 co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party or for the removal of any of the survey reference points.

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 appropriate Historic Environment Record).

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