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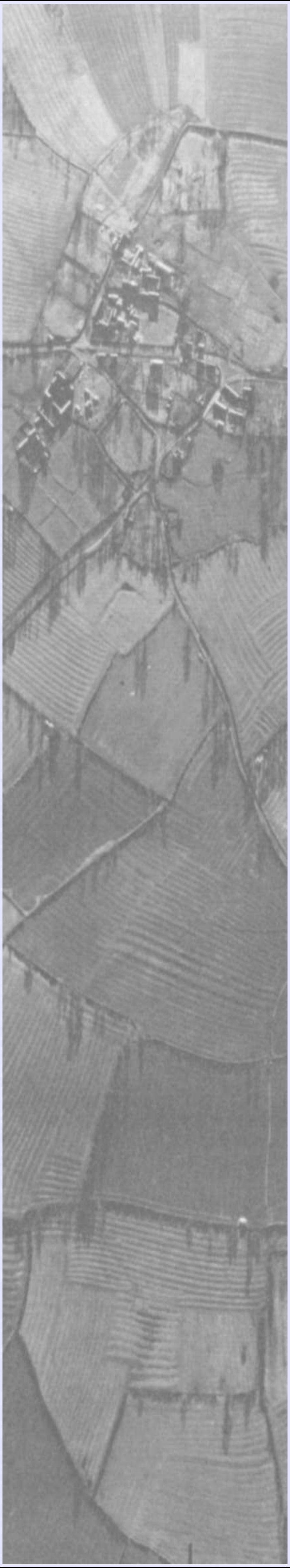

Hawkeridge Farm
Westbury
Wiltshire

MAGNETOMETER SURVEY REPORT

for

HPH Ltd

David Sabin and Kerry Donaldson

January 2011

Ref. no. 348

ARCHAEOLOGICAL SURVEYS LTD

Hawkeridge Farm, Westbury, Wiltshire

Magnetometer Survey

for

HPH Ltd

Fieldwork by David Sabin, Francis Sabin, Jack Cousins and Richard Grove
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Survey date - **from 23rd December 2010 to 10th January 2011**
Ordnance Survey Grid Reference - **ST 865 532**

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SUMMARY

Archaeological Surveys Ltd was commissioned by HPH Ltd to undertake a magnetometer survey of an area of land at Hawkeridge Farm near Westbury, Wiltshire. The site has been outlined for the installation of solar arrays within the proposed Hawkeridge Solar Park. The survey forms part of an archaeological assessment of the site prior to lodging a planning application with the local authority.

The geophysical survey was conducted over 13ha and located a number of anomalies of archaeological potential within the northern part of the site (Area 3). Positive linear, discrete and rectilinear anomalies are possibly associated with zones of magnetic debris and may correspond to spreads of Medieval and Post-Medieval pottery seen at the time of survey. It is possible that these anomalies relate to former settlement sites/structures given the nature of the cultural material.

The route of a former droveway, still used as a public footpath across the site, was defined by two positive linear anomalies relating to former field boundaries and a zone of magnetic debris, possibly indicating material used in ground consolidation. The zone appears to correlate with a linear spread of limestone fragments, many of which appeared burnt.

The site contains a number of linear anomalies of uncertain origin. It is likely that many relate to former agricultural activity and infilled field boundary ditches.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by HPH Ltd to undertake a magnetometer survey of an area of land at Hawkeridge Farm near Westbury, Wiltshire. The site has been outlined for the installation of solar arrays within the proposed Hawkeridge Solar Park. The survey forms part of an archaeological assessment of the site.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2010) and approved by David Vaughan, Assistant County Archaeologist for Wiltshire Council.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin, so that they may be assessed prior to development of the site.

1.2.2 The survey would inform decision-making as to further archaeological evaluation work prior to determination and/or archaeological mitigation should planning permission be awarded, in line with the requirements of Planning Policy Statement (PPS) 5 policy HE6.1.

1.2.3 The methodology is considered an efficient and effective approach to archaeological prospection. The survey and report generally follow the recommendations set out by: English Heritage, 2008, *Geophysical survey in archaeological field evaluation* and Institute for Archaeologists, 2002, *The use of Geophysical Techniques in Archaeological Evaluations*.

1.3 Site location, description and survey conditions

1.3.1 The site is located at Hawkeridge Farm, within the parish of Heywood to the north of Westbury in Wiltshire. It is centred on Ordnance Survey National Grid Reference (OS NGR) ST 865 532, see Figures 01 and 02.

1.3.2 The geophysical survey covers approximately 13ha of farmland that crosses four fields, labelled Areas 1-4. Areas 1-3 contained an emerging crop and Area 4 contained pasture at the time of survey.

1.3.3 The ground conditions across the site were generally very difficult for the collection of magnetometry data due to ground saturation and heavy clay soil. Weather conditions during the survey were variable with periods of snow, heavy rain and high winds.

1.4 Site history and archaeological potential

1.4.1 The northern part of the site contains evidence for a series of cropmarks relating to an undated field system, with a further cropmark of unknown origin in the southern part of the site. Within the surrounding area there are several archaeological sites and findspots which relate to prehistoric and Romano-British activity and settlement.

1.4.2 There is also some evidence of Medieval and Post-Medieval activity in the vicinity of the site. The 1842 Westbury tithe map indicates that the northern part of the site contains a former droveway and Hawkeridge Fulling Mill lies to the east.

1.4.3 Observation of the soil's surface in the northern part of the site revealed concentrations of Late-Medieval and early Post-Medieval pottery sherds, most notable in the eastern part of Area 3. Early-Medieval sherds were also noted within the area. The course of a former droveway (see 1.4.2) appears to be defined by a linear spread of limestone fragments, fire-reddened pieces were commonly observed.

1.5 Geology and soils

1.5.1 The underlying solid geology across the site is Oxford Clay mudstone, with overlying alluvial deposits towards the eastern side of the site (BGS, 2010) . The soils are from the Denchworth association which are pelo-stagnogley soils and consist of slowly permeable, seasonally waterlogged, clayey soils (Soil Survey of England and Wales, 1983).

1.5.2 Magnetometry survey carried out across similar soils in the area has produced good results where archaeological features exist. The underlying geology and soils are therefore considered acceptable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using Bartington Grad601-2 gradiometers. The instruments effectively measure a magnetic gradient between two fluxgate sensors mounted vertically 1m apart. Two sets of sensors are mounted on a single frame 1m apart horizontally.

2.2.2 The instruments are extremely sensitive and are able to measure magnetic variation to 0.01nanoTesla (nT), with an effective resolution of 0.03nT. The data are limited to ±100nT when surveying with the highest sensitivity. All readings are saved to an integral data logger for analysis and presentation.

2.2.3 The instruments are operated according to the manufacturer's instructions with consideration given to the local conditions. An adjustment procedure is required, prior to collection of data, in order to balance the sensors and remove the effects of the Earth's magnetic field; further adjustment is required during the survey due to instrument drift often associated with temperature change.

2.2.4 It can be very difficult to obtain optimum balance for the sensors due to localised magnetic vectors that may be associated with large ferrous objects, geological/pedological features, 'magnetic debris' within the topsoil and natural temperature fluctuations. Imperfect balance results in a heading error often visible as striping within the data; this can be effectively removed by software processing and generally has little effect on the data unless extreme.

2.2.5 The Bartington gradiometers undergo regular servicing and calibration by the manufacturer. A current assessment of the instruments is shown in Table 1 below.

Sensor type and serial numbers	Bartington Grad - 01 – 1000 Nos. 084, 085, 242 and 396
Date of certified calibration/service	Sensors 084 and 085 - 6th August 2010 (due Aug 2012) Sensors 242 and 396 - 3rd December 2009 (due Dec 2011)
Bandwidth	12Hz (100nT range) both sensors
Noise	<100pT peak to peak
Adjustable errors	<2nT

Table 1: Bartington fluxgate gradiometer sensor calibration results

The instruments were considered to be in good working order prior to the survey, with no known faults or defects.

2.2.6 Data were collected at 0.25m centres along traverses 1m apart. The survey area was separated into 40m by 40m grids (1600m²) giving 6400 measurements per grid. This sampling interval is very effective at locating archaeological features and is the recommended methodology for archaeological prospection (English Heritage, 2008).

2.2.7 The survey grids were set out to the Ordnance Survey OSGB36 datum using a Penmap RTK GPS. The GPS is used in conjunction with Topcon's TopNet service, where positional corrections are sent via a mobile telephone link. Positional accuracy of around 10 – 20mm is possible using the system. The instrument is regularly checked against the ETRS89 reference framework using Ordnance Survey ground marker C1ST7784 (Horton).

2.2.8 The fixed orientation of survey grids based on the OSGB36 datum was considered appropriate given that the orientation of land boundaries was variable and consequently partial survey grids were unavoidable. In addition, there is an optimum north – south traverse direction for magnetic survey (English Heritage, 2008). Survey in this direction can produce anomalies with a higher contrast when compared to other orientations; this is a function of their presence within the Earth's magnetic field. A fixed grid across the site also simplifies its relocation should that be required.

2.3 Data processing and presentation

2.3.1 Magnetometry data downloaded from the Grad 601-2 data logger are analysed and processed in specialist software known as ArcheoSurveyor. The software allows greyscale and trace plots to be produced for presentation and display. Survey grids are assembled to form an overall composite of data (composite file) creating a dataset of the complete survey area. Appendix C contains specific information concerning the survey and data attributes and is derived directly from ArcheoSurveyor; this should be used in conjunction with information provided by Figure 02.

2.3.2 Only minimal processing is carried out in order to enhance the results of the survey for display. Raw data are always analysed, as processing can modify anomalies. The following schedule sets out the data and image processing used in this survey:

- clipping of the raw data at ±30nT to improve greyscale resolution,
- clipping of processed data at ±3nT to enhance low magnitude anomalies
- zero median/mean traverse is applied in order to balance readings along each traverse.

Reference should be made to Appendix B for further information on the specific processes carried out on the data. Appendix C metadata includes details on the processing sequence used for each survey area.

2.3.3 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.

2.3.4 The main form of data display prepared for this report is the greyscale plot. Both 'raw' and 'processed' data have been shown followed by an abstraction and interpretation plot. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.5 Graphic raster images in bitmap format (.BMP) are initially prepared in ArcheoSurveyor. Regardless of survey orientation, data captured along each traverse are displayed and processed by ArcheoSurveyor from left to right; this corresponds to a direction of south to north in the field. Prior to displaying against base mapping, raster graphics require a rotation of 90° anticlockwise to restore north to the top of the image. Greyscale images are rotated by AutoCAD.

2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2009 and AutoCAD LT 2007, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.. A digital archive, including raster images, is produced with this report allowing separate analysis if necessary, see Appendix D below.

3 RESULTS

3.1 General overview

3.1.1 The detailed magnetic survey was carried out over a total of four survey areas covering approximately 13ha. Geophysical anomalies located can be generally classified as positive linear and discrete positive responses of archaeological potential, positive and negative linear anomalies of an uncertain origin, linear anomalies relating to land management, linear anomalies of an agricultural origin, areas of magnetic debris and disturbance, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines. Anomalies located within each survey area have been numbered and are described below with subsequent discussion in Section 4.

3.1.2 Data quality is generally good with little evidence for positional errors despite very difficult traversing conditions encountered within Areas 2 and 3. Modern ferrous objects and services have caused localised areas of magnetic disturbance, although disturbance within Area 1 was particularly severe and may obscure low magnitude anomalies.

3.1.3 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics for each survey area.

Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
Anomalies with archaeological potential AS-ABST MAG POS LINEAR ARCHAEOLOGY	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc..
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG NEG LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN AS-ABST MAG POS AREA UNCERTAIN	The category applies to a range of anomalies where <u>there is not enough evidence to confidently suggest an origin</u>. Anomalies in this category <u>may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered</u>. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management AS-ABST MAG BOUNDARY AS-ABST MAG LAND DRAIN	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates a ceramic land drain.
Anomalies with an agricultural origin AS-ABST MAG AGRICULTURAL	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing.
Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and <u>may therefore be archaeologically significant</u>. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin AS-ABST MAG DISTURBANCE AS-ABST MAG SERVICE	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically and with hysteresis adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 2: List and description of interpretation categories

3.2 List of anomalies - Area 1

Area centred on OS NGR 386530, 153120, see Figures 03 – 05.

Anomalies with an uncertain origin

(1) – A weak, positive linear anomaly appears to relate to a reversed “L” shaped possible ditch-like feature. Further positive anomalies are located immediately to the east. It is possible that these anomalies relate to the cropmarks seen within aerial photographs of the area.

(2) – Several weak positive linear anomalies extend approximately north to south in the central northern part of the survey area.

(3) – A positive linear anomaly that may relate to a ditch-like feature of uncertain origin.

(4) – A broad, positive linear anomaly located close to, but not exactly parallel with the southern field boundary. Although it is possible that this anomaly relates to a former trackway or ditch-like feature, its origin is uncertain.

(5) – Several weak positive linear anomalies can be seen within the survey area with a east-north-east to west-south-west orientation.

(6) – Weak, discrete positive anomalies may relate to pit-like features; however, their origin cannot be determined.

(7) – Weak, amorphous anomalies that may have a similar origin to (6).

Anomalies associated with land management

(8) – Linear areas of magnetic debris are associated with the removed line of former field boundaries.

Anomalies with an agricultural origin

(9) – A series of very weak parallel linear anomalies, located in the south eastern part of the survey area, have been caused by agricultural activity.

Anomalies associated with magnetic debris

(10) – A linear zone of magnetic debris, located in the northern part of the survey area, is a response to magnetically thermoremant material, such as brick, tile, slag. It appears that this may relate to infilling material, ground make-up or a former hard surface.

(11) – A patch of magnetic debris containing some very strong responses appears likely to relate to magnetically thermoremnant material associated with former

hardstanding/farm buildings.

(12) – The survey area contains widespread magnetic debris which is likely to have been caused by magnetically thermoremnant material that includes brick, tile and slag.

(13) – Strong, discrete dipolar anomalies are a response to ferrous objects within the topsoil.

Anomalies with a modern origin

(14) – Widespread magnetic disturbance along the southern field boundary is a response to ferrous material within the boundary or to underground services.

3.3 List of anomalies - Area 2

Area centred on OS NGR 386640, 153215, see Figures 03 – 05.

Anomalies with an uncertain origin

(15) – A series of weakly positive linear and rectilinear anomalies situated in the northern part of the survey area. It is possible that they relate to ditch-like features.

(16) – Positive linear anomalies located in the southern half of the survey area are uncertain in origin.

(17) – The survey area contains several discrete positive anomalies that may relate to pit-like features, although their origin cannot be determined.

Anomalies associated with land management

(18) – A positive linear anomaly is likely to be associated with a removed field boundary.

Anomalies associated with magnetic debris

(19) – A patch of magnetic debris is located directly to the north of the bend in anomaly (18) and is bounded to the east by a positive linear anomaly. Leading to the north of this is a linear zone of magnetic debris (20), and it is possible that (19) relates to material within an infilled pond or depression.

(20) – A linear zone of magnetic debris may relate to a buried ceramic drain or service.

(21) – Strong, discrete dipolar anomalies are a response to ferrous material within the topsoil.

Anomalies with a modern origin

(22) – A zone of magnetic disturbance is located along the eastern and southern edges of the survey area. It is possible that this relates to a buried service or material used within the construction of the field boundary or railway line to the east.

3.4 List of anomalies - Area 3

Area centred on OS NGR 386420, 153440, see Figures 06 – 08.

Anomalies of archaeological potential

(23) – Positive linear and rectilinear anomalies located close to the northern field boundary may relate to cut features with archaeological potential. A patch of magnetic debris (38) may be associated with these anomalies. A small parcel of land is shown on mapping between at least 1842 and 1961, with subsequent removal by 1971. Widespread Late-Medieval and Post-Medieval pottery was visible on the ground at the time of survey and it is possible that anomalies (23) and (38) relate to a former building or buildings not indicated on mapping from or after 1842.

(24) – Positive linear and possible discrete anomalies, located approximately 40m to the south west of anomalies (23), may indicate a former structure. The anomalies also appear to be associated with a patch of magnetic debris (37).

Anomalies with an uncertain origin

(25) – A positive, curving linear anomaly appears to bound anomalies (24) and (37), indicating a possible ditch-like feature.

(26) – A positive curvilinear anomaly, located close to the north eastern corner of the survey area, may be natural in origin; however a “cut” feature of anthropogenic origin cannot be ruled out.

(27) – A weak positive amorphous anomaly extends across the south eastern corner of the survey area with a north east to south west orientation. The south western part of the anomaly may relate to a former land boundary and be associated with anomaly (28).

(28) – A weak positive linear anomaly, parallel to and 35m west of the southern part of anomaly (33). This anomaly may relate to the western field boundary of a parcel of land mapped as The Paddock in 1842. It is possible that the southern part of anomaly (27) forms the northern edge of this land parcel.

(29) – A positive discrete and an amorphous anomaly located parallel with, and approximately 25m to the north west of, anomaly (27). They are also parallel with agricultural anomalies (36) and may have a similar origin.

(30) – Weakly positive linear anomalies within the southern and western parts of the survey area. These may indicate ditch-like features; however, an agricultural origin should be considered.

(31) – Discrete positive anomalies located close to the western field boundary, may indicate pit-like features.

(32) – Two parallel negative linear anomalies, located in the central southern part of the survey area, are a response to material with low magnetic susceptibility, such as rock or subsoil.

Anomalies associated with land management

(33) – Two broadly parallel linear anomalies relate to removed field boundaries associated with the former droveway, known as North House Drove in 1842, although at this time is was divided into three parcels of pasture land. The western field boundary was removed by 1889, while the eastern one was still extant in 1989.

(34) – A positive rectilinear anomaly in the central northern part of the survey area is likely to relate to a former field boundary known as Cunridges Paddock in 1842.

(35) – A series of parallel anomalies, oriented north west to south east and located in the western half of the survey area, are a response to land drains. Two others can be seen, oriented east-west close to the south western corner of the survey area.

Anomalies with an agricultural origin

(36) – A series of parallel linear anomalies located in the eastern part of the survey area have been caused by agricultural activity. This part of the site was a separate field know as Coles and was an arable field in 1842.

Anomalies associated with magnetic debris

(37) – A patch of magnetic debris directly associated with anomalies (24) and defined within the southern edge of anomaly (34) and (25). Medieval and Post-Medieval pottery was visible on the ground at the time of survey, and it is possible this is a response to a former building and associated magnetically thermoremnant material.

(38) – A patch of magnetic debris associated with anomaly (23) may have a similar origin to (37).

(39) – Magnetic debris confined within the former land boundaries (33) associated with the droveway. Burnt limestone was visible on the ground at the time of survey, and this may indicate an attempt to improve the passage of people and animals over very sticky clayey soil.

(40) – A patch of magnetic debris to the south of anomaly (27). Medieval pottery

was visible on the surface at the time of survey.

(41) – A patch of magnetic debris, bounded to the west by anomaly (28), to the east by anomaly (33) and to the north by anomaly (27).

(42) – Magnetic debris close to the field entrance in the south eastern corner of the survey area, is likely to relate to material used in ground consolidation.

(43) – The site contains numerous strong discrete dipolar anomalies which indicate ferrous objects within the topsoil.

Anomalies with a modern origin

(44) – A strong, multiple dipolar linear anomaly extends in a north westerly direction across the western part of the field and relates to a modern service.

3.5 List of anomalies - Area 4

Area centred on OS NGR 386400, 153280, see Figures 06 – 08.

Anomalies with an uncertain origin

(45) – The survey area contains several weak positive linear anomalies. Although uncertain in origin, it appears possible that some may relate to land drainage or other agricultural activity.

Anomalies associated with land management

(46) – A group of positive rectilinear anomalies, located on the western edge of the survey area, relate to land divisions associated with former allotments mapped here between at least 1842 and 1961.

(47) – A series of parallel linear anomalies, oriented north west to south east, are a response to land drains.

Anomalies with an agricultural origin

(48) – Linear anomalies associated with cultivation in the former allotments defined by anomalies (46).

Anomalies associated with magnetic debris

(49) – Patches of magnetic debris are likely to relate to magnetically thermoremnant material used in ground consolidation in waterlogged areas.

Anomalies with a modern origin

(50) – A strong, multiple dipolar linear anomaly extends across the centre of the field and relates to a modern service seen continuing north westwards into Area 3.

4 DISCUSSION

4.1.1 Undated cropmarks seen on aerial photographs within Area 1 have been located by the geophysical survey as weak positive linear anomalies (1). Due to their low magnitude and fragmented form, they cannot be confidently interpreted. It is possible that they relate to cut ditch-like features with an anthropogenic origin but this is not certain from the results.

4.1.2 A moderately strongly enhanced linear anomaly has been located along the southern edge of Area 1. This type of anomaly may indicate a ditch-like feature, or even a trackway, although there is no clear evidence for this on the ground or from earlier mapping. Strong magnetic disturbance has partially obscured this anomaly.

4.1.3 Area 1 contains widespread magnetic debris and disturbance from strongly magnetically enhanced material. Some of this material appears to have been derived from a former building or area of hardstanding along the northern edge of the survey area. Much of the material may be a response to iron slag which was visible across the survey area at the time of survey.

4.1.4 Area 2 contains evidence for a former field boundary visible on early Ordnance Survey mapping, and also several very weakly positive linear anomalies. Although these anomalies may relate to ditch-like features, their strength and form do not allow for confident interpretation.

4.1.5 Area 3 contains several anomalies with archaeological potential primarily located in the northern part of the survey area, but with some potential in the south eastern part of the survey area also. Positive linear, discrete and rectilinear anomalies, together with spreads of magnetic debris may indicate former dwellings and occupational debris. These correspond to zones of Late Medieval and Post-Medieval pottery visible on the ground at the time of survey.

4.1.6 A linear zone of magnetic debris, flanked by two positive linear anomalies appear to be associated with a former droveway, North House Drove, that is still in use as a public footpath. The magnetic debris is contained between the linear anomalies, indicating that magnetically thermoremnant material was probably deposited as part of ground consolidation. Many fragments of burnt limestone were visible within the linear zone.

5 CONCLUSION

5.1.1 The geophysical survey located a number of anomalies with archaeological potential in the northern part of the site. Area 3 contains positive linear anomalies relating to former field boundaries and also spreads of magnetic debris and positive linear, discrete and rectilinear anomalies that may indicate former structural remains and occupational debris. Pottery scatters, visible on the field surface in the vicinity of the anomalies, appear to date mainly from the Late Medieval and earlier Post-Medieval with a small number of sherds possibly attributable to the Early Medieval period. The area also contains geophysical evidence of a former droveway, the interpretation supported by a linear spread of limestone along the route.

5.1.2 Anomalies of uncertain origin were located across much of the site. Many may relate to former agricultural activity and infilled field ditches. Zones of magnetic debris within Areas 1, 2 and 4 are considered unlikely to be archaeologically significant. Zones of severe magnetic disturbance were encountered within Area 1 and it is possible that more minor anomalies have been obscured.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature. If no enhanced feature is present the field measured by both sensors will be similar and the difference close to zero.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±5nT and ±1nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise slight differences between the set-up and stability of gradiometer sensors and can remove striping. The process can remove archaeological features that run along a traverse so data analysis is also carried out prior its application.

De-stagger

Compensates for small positional errors within data collection by shifting the position of the readings along each traverse by a specified amount. Data lost at the end of each traverse are extrapolated from adjacent value in the same row.

Deslope

Corrects for striping and distortion caused by metal objects/services etc.. The process calculates a curve based on a polynomial best fit mathematical function for each traverse. This curve is then subtracted from the actual data.

FFT (Fast Fourier Transform) spectral filtering

A mathematical process used to determine the frequency components of a traverse. Repetitive features, such as plough marks, produce characteristic spectral zones that can be suppressed allowing greyscale images to appear clearer.

Appendix C – survey and data information

Area 1 raw data

COMPOSITE
Filename: J348-mag-Area1-raw.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 29/12/2010
Assembled by: on 29/12/2010
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 960 x 360
Survey Size (meters): 240 m x 360 m
Grid Size: 40 m x 40 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 5.53
Mean: 0.18
Median: 0.03
Composite Area: 8.64 ha
Surveyed Area: 3.8009 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 38
1 Col:0 Row:3 grids\18.xgd
2 Col:0 Row:4 grids\31.xgd
3 Col:0 Row:5 grids\32.xgd
4 Col:0 Row:6 grids\33.xgd
5 Col:0 Row:7 grids\38.xgd
6 Col:1 Row:2 grids\16.xgd
7 Col:1 Row:3 grids\17.xgd
8 Col:1 Row:4 grids\28.xgd
9 Col:1 Row:5 grids\29.xgd
10 Col:1 Row:6 grids\30.xgd
11 Col:1 Row:7 grids\36.xgd
12 Col:1 Row:8 grids\37.xgd
13 Col:2 Row:1 grids\13.xgd
14 Col:2 Row:2 grids\14.xgd
15 Col:2 Row:3 grids\15.xgd
16 Col:2 Row:4 grids\25.xgd
17 Col:2 Row:5 grids\26.xgd
18 Col:2 Row:6 grids\27.xgd
19 Col:2 Row:7 grids\34.xgd
20 Col:2 Row:8 grids\35.xgd
21 Col:3 Row:0 grids\09.xgd
22 Col:3 Row:1 grids\10.xgd
23 Col:3 Row:2 grids\11.xgd
24 Col:3 Row:3 grids\12.xgd
25 Col:3 Row:4 grids\22.xgd
26 Col:3 Row:5 grids\23.xgd
27 Col:3 Row:6 grids\24.xgd
28 Col:4 Row:0 grids\03.xgd
29 Col:4 Row:1 grids\04.xgd
30 Col:4 Row:2 grids\05.xgd
31 Col:4 Row:3 grids\06.xgd
32 Col:4 Row:4 grids\20.xgd
33 Col:4 Row:5 grids\21.xgd
34 Col:5 Row:0 grids\01.xgd
35 Col:5 Row:1 grids\02.xgd
36 Col:5 Row:2 grids\07.xgd
37 Col:5 Row:3 grids\08.xgd
38 Col:5 Row:4 grids\19.xgd

Area 1 processed data

COMPOSITE
Filename: J348-mag-Area1-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.47
Mean: 0.13
Median: 0.03
Composite Area: 8.64 ha
Surveyed Area: 3.8009 ha

Processes: 24
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: 29.xgd 30.xgd 26.xgd 27.xgd 23.xgd 24.xgd 21.xgd
4 DeStripe Median Traverse: Grids: 22.xgd
5 DeStripe Mean Traverse: Grids: 19.xgd Threshold: 1 SDs
6 DeStripe Median Sensors: 20.xgd
7 DeStripe Median Sensors: 12.xgd
8 DeStripe Median Sensors: 25.xgd
9 DeStripe Median Sensors: 06.xgd
10 DeStripe Median Sensors: 11.xgd
11 DeStripe Median Sensors: 05.xgd
12 DeStripe Median Sensors: 03.xgd 04.xgd
13 DeStripe Median Sensors: 15.xgd
14 DeStripe Median Sensors: 34.xgd
15 DeStripe Mean Traverse: Grids: 36.xgd Threshold: 0.25 SDs
16 Range Match (Area: Top 280, Left 160, Bottom 319, Right 319) to Right edge
17 DeStripe Median Sensors: 28.xgd
18 DeStripe Mean Traverse: Grids: 17.xgd Threshold: 0.5 SDs
19 DeStripe Mean Traverse: Grids: 14.xgd Threshold: 0.25 SDs
20 DeStripe Mean Traverse: Grids: 14.xgd Threshold: 0.5 SDs
21 DeStripe Mean Traverse: Grids: 10.xgd Threshold: 0.25 SDs
22 DeStripe Mean Traverse: Grids: 16.xgd Threshold: 0.25 SDs
23 DeStripe Mean Traverse: Grids: 16.xgd Threshold: 0.5 SDs
24 Clip from -3.00 to 3.00 nT

Area 2 raw data

COMPOSITE
Filename: J348-mag-Area2-raw.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 03/01/2011
Assembled by: on 03/01/2011
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 1120 x 200
Survey Size (meters): 280 m x 200 m
Grid Size: 40 m x 40 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 4.03
Mean: -0.39
Median: 0.00
Composite Area: 5.6 ha
Surveyed Area: 2.8312 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 26
1 Col:0 Row:3 grids\11.xgd
2 Col:0 Row:4 grids\12.xgd
3 Col:1 Row:2 grids\25.xgd
4 Col:1 Row:3 grids\09.xgd
5 Col:1 Row:4 grids\10.xgd
6 Col:2 Row:1 grids\23.xgd
7 Col:2 Row:2 grids\24.xgd
8 Col:2 Row:3 grids\07.xgd
9 Col:2 Row:4 grids\08.xgd
10 Col:3 Row:0 grids\13.xgd
11 Col:3 Row:1 grids\14.xgd
12 Col:3 Row:2 grids\15.xgd
13 Col:3 Row:3 grids\21.xgd
14 Col:3 Row:4 grids\22.xgd
15 Col:4 Row:0 grids\16.xgd
16 Col:4 Row:1 grids\17.xgd
17 Col:4 Row:2 grids\18.xgd
18 Col:4 Row:3 grids\05.xgd
19 Col:4 Row:4 grids\06.xgd
20 Col:5 Row:1 grids\19.xgd
21 Col:5 Row:2 grids\20.xgd
22 Col:5 Row:3 grids\03.xgd
23 Col:5 Row:4 grids\04.xgd
24 Col:6 Row:2 grids\26.xgd
25 Col:6 Row:3 grids\01.xgd
26 Col:6 Row:4 grids\02.xgd

Area 2 processed data

COMPOSITE
Filename: J348-mag-Area2-proc.xcp
Stats
Max: 3.00
Min: -3.00
Std Dev: 0.94
Mean: 0.00
Median: 0.00
Composite Area: 5.6 ha
Surveyed Area: 2.8312 ha

Processes: 12
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 Clip from -10.00 to 10.00 nT
4 DeStripe Median Traverse: Grids: All
5 DeStripe Median Traverse: Grids: 11.xgd 25.xgd 09.xgd 23.xgd 24.xgd 07.xgd 13.xgd 14.xgd 15.xgd 21.xgd 16.xgd 17.xgd 18.xgd 05.xgd
6 DeStripe Median Traverse: Grids: 19.xgd
7 DeStripe Median Traverse: Grids: 03.xgd 04.xgd
8 DeStripe Median Traverse: Grids: 02.xgd
9 DeStripe Mean Traverse: Grids: 20.xgd 26.xgd Threshold: 2 SDs
10 DeStripe Mean Traverse: Grids: 01.xgd Threshold: 2 SDs
11 DeStripe Mean Traverse: Grids: 12.xgd 10.xgd 08.xgd 22.xgd 06.xgd Threshold: 2 SDs
12 Clip from -3.00 to 3.00 nT

Area 3 raw data

COMPOSITE
Filename: J348-mag-Area3-raw.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 10/01/2011
Assembled by: on 10/01/2011
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 960 x 360
Survey Size (meters): 240 m x 360 m
Grid Size: 40 m x 40 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 3.58
Mean: -0.30
Median: -0.20
Composite Area: 8.64 ha
Surveyed Area: 5.0366 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 45
1 Col:0 Row:1 grids\01.xgd
2 Col:0 Row:2 grids\02.xgd
3 Col:0 Row:3 grids\17.xgd
4 Col:0 Row:4 grids\18.xgd
5 Col:0 Row:5 grids\19.xgd
6 Col:0 Row:6 grids\45.xgd
7 Col:1 Row:0 grids\03.xgd
8 Col:1 Row:1 grids\04.xgd
9 Col:1 Row:2 grids\05.xgd
10 Col:1 Row:3 grids\20.xgd
11 Col:1 Row:4 grids\21.xgd
12 Col:1 Row:5 grids\22.xgd
13 Col:1 Row:6 grids\42.xgd
14 Col:1 Row:7 grids\43.xgd
15 Col:1 Row:8 grids\44.xgd
16 Col:2 Row:0 grids\06.xgd
17 Col:2 Row:1 grids\07.xgd
18 Col:2 Row:2 grids\08.xgd
19 Col:2 Row:3 grids\23.xgd
20 Col:2 Row:4 grids\24.xgd
21 Col:2 Row:5 grids\25.xgd
22 Col:2 Row:6 grids\39.xgd
23 Col:2 Row:7 grids\40.xgd
24 Col:2 Row:8 grids\41.xgd
25 Col:3 Row:0 grids\09.xgd
26 Col:3 Row:1 grids\10.xgd
27 Col:3 Row:2 grids\11.xgd
28 Col:3 Row:3 grids\26.xgd
29 Col:3 Row:4 grids\27.xgd
30 Col:3 Row:5 grids\28.xgd
31 Col:3 Row:6 grids\36.xgd
32 Col:3 Row:7 grids\37.xgd
33 Col:3 Row:8 grids\38.xgd
34 Col:4 Row:1 grids\12.xgd
35 Col:4 Row:2 grids\13.xgd
36 Col:4 Row:3 grids\29.xgd
37 Col:4 Row:4 grids\30.xgd
38 Col:4 Row:5 grids\31.xgd
39 Col:4 Row:6 grids\34.xgd
40 Col:4 Row:7 grids\35.xgd
41 Col:5 Row:3 grids\14.xgd
42 Col:5 Row:4 grids\15.xgd
43 Col:5 Row:5 grids\16.xgd
44 Col:5 Row:6 grids\32.xgd
45 Col:5 Row:7 grids\33.xgd

Area 3 processed data

COMPOSITE
Filename: J348-mag-Area3-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.12
Mean: 0.03
Median: 0.00
Composite Area: 8.64 ha
Surveyed Area: 5.0366 ha

Processes: 3
1 Base Layer
2 DeStripe Median Traverse: Grids: All
3 Clip from -3.00 to 3.00 nT

Area 4 raw data

COMPOSITE
Filename: J348-mag-Area4-raw.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 07/01/2011
Assembled by: on 07/01/2011
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 640 x 240
Survey Size (meters): 160 m x 240 m
Grid Size: 40 m x 40 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 4.37
Mean: 0.47
Median: 0.45
Composite Area: 3.84 ha
Surveyed Area: 1.3002 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 19
1 Col:0 Row:1 grids\06.xgd
2 Col:0 Row:2 grids\07.xgd
3 Col:0 Row:3 grids\08.xgd
4 Col:1 Row:0 grids\04.xgd
5 Col:1 Row:1 grids\05.xgd
6 Col:1 Row:2 grids\09.xgd
7 Col:1 Row:3 grids\10.xgd
8 Col:1 Row:4 grids\11.xgd
9 Col:2 Row:0 grids\01.xgd
10 Col:2 Row:1 grids\02.xgd
11 Col:2 Row:2 grids\12.xgd
12 Col:2 Row:3 grids\13.xgd
13 Col:2 Row:4 grids\14.xgd
14 Col:2 Row:5 grids\19.xgd
15 Col:3 Row:1 grids\03.xgd
16 Col:3 Row:2 grids\15.xgd
17 Col:3 Row:3 grids\16.xgd
18 Col:3 Row:4 grids\17.xgd
19 Col:3 Row:5 grids\18.xgd

Area 4 processed data

COMPOSITE
Filename: J348-mag-Area4-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.28
Mean: 0.06
Median: 0.00
Composite Area: 3.84 ha
Surveyed Area: 1.3002 ha

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: All
4 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at Castle Combe, Wiltshire (see inside cover for address). Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site. Digital data are also supplied to the client on CD ROM, see below.

Surveys are reported on in hardcopy (recycled paper) using A4 for text and A3 for plots (all plots are scaled for A3). The distribution of both hardcopy report and digital data is considered the responsibility of the Client unless explicitly stated in the survey Brief, Written Scheme of Investigation or other contractual agreement.

This report has been prepared using the following software on a Windows XP platform:

- ArcheoSurveyor version 2.5.8.46(geophysical data analysis),
- ProgeCAD Professional 2009 (report graphics),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF archive).

Digital data are supplied on CD ROM which includes the following files:

- ArcheoSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF,
- PDFs of all figures.

The CD ROM structure is formed from a tree of directories under the title J348 Hawkeridge – CD. Directory titles include Data, Documentation, CAD and PDFs. Multiple directories exist under Data and hold Grid, Composite and Graphic files with CSV composite data held in Export.

The CAD file contains externally referenced graphics that are rotated with separate A3 size layouts for each figure. Layouts are fixed using frozen layers and named views allowing straightforward plotting or analysis on screen. (Note – CAD files are prepared using AutoCAD's e Transmit function to produce a directory containing the digital drawing along with any externally referenced graphics which may need reloading).