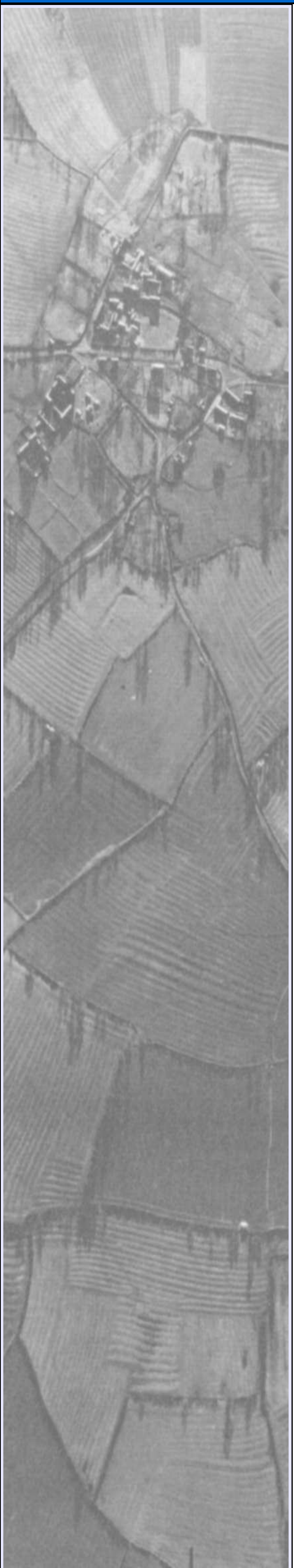
Archaeological Surveys Ltd



Baydon Tower
Water Pipeline Route
Wiltshire/West Berkshire

MAGNETOMETER SURVEY REPORT

for

Optimise

David Sabin and Kerry Donaldson

March 2012

Ref. no. 398

ARCHAEOLOGICAL SURVEYS LTD

Baydon Tower
Water Pipeline Route
Wiltshire/West Berkshire

Magnetometer Survey

for

Optimise

Fieldwork by David Sabin and Jack Cousins
Report by David Sabin BSc (Hons) MIFA and Kerry Donaldson BSc (Hons)

Survey dates – **12th & 13th March 2012**
Ordnance Survey Grid Reference – **SU 287 790**

Archaeological Surveys Ltd
PO Box 2862, Castle Combe, Chippenham, Wiltshire, SN14 7WZ
Tel: 01249 782234 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd at the request of Optimise, along the route of a proposed new water pipe leading from Bailey Hill Reservoir to Baydon Tower in Wiltshire. The survey corridor corresponded with the 20m working width of the pipeline route and extended from the Bailey Hill Reservoir to the M4, a distance of approximately 1600m. The majority of the survey corridor lies within Wiltshire, with a short section crossing into West Berkshire to avoid an active badger sett.

The results indicate the presence of several broad negative and some positive linear anomalies that may correspond to early field boundaries within several parts of the survey corridor. Several other positive linear and “L” shaped anomalies were located; however, they extend beyond the boundary of the survey corridor and, as a consequence, interpretation is limited. Along the entire route, positive linear, discrete and amorphous anomalies were located. It is likely that these represent both natural and anthropogenically formed features.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Optimise to undertake a magnetometer survey of a corridor of land between Bailey Hill Reservoir and the M4 to the north of Baydon, Wiltshire. The survey area comprises the 20m working width of a proposed water pipeline route between Bailey Hill Reservoir and Baydon Tower. The majority of the survey is in Wiltshire, with a short section just into West Berkshire. The survey forms part of an archaeological assessment of the pipeline route.

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 installation of the water pipe.

1.2.2 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 to the north of Baydon, Wiltshire and comprises a 20m by 1600m corridor between Bailey Hill Reservoir and the M4. The pipeline route continues south of the M4 to Baydon water tower although this land was unsuitable for survey. The majority of the corridor lies within Wiltshire, with a 260m section just within West Berkshire. The site lies between Ordnance Survey National Grid Reference (OS NGR) SU 28455 79735 at the northern end and SU 28597 78295 at the southern end, see Figures 01 and 02.

1.3.2 The geophysical survey covers approximately 3.3ha, within three fields, but split into eight areas by changes in the direction of the water pipe route. Areas 1-6 were arable land and Area 7 and the compound were within pasture. A composite data file has to be produced every time the route changes direction, and these relate to the separate survey area names.

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. The survey was conducted in fog.

1.4 Site history and archaeological potential

1.4.1 The survey corridor is in the vicinity of a widespread field system that is recorded within Wiltshire and West Berkshire. The field system covers over 60ha and includes some field banks and lynchets up to 1.2m high (Wiltshire SMR no. SU27NE618). Much of the field system is recorded from soilmarks and cropmarks on aerial photographs.

1.5 Geology and soils

1.5.1 The underlying geology is Seaford Chalk Formation (BGS, 2012). The overlying soils across the site are mainly rendzinas; calcareous soils formed over the chalk, some of which are prone to soil patterns forming. Towards the southern end of the survey corridor the soils are a paleo-argillic brown earths, formed from clay-with-flints deposits located on the highest ground.

1.5.2 Previous magnetometer surveys over similar soils and geology have produced good results with often a strong contrast between the fill of cut features and the chalk. However, the soils are often subject to soil patterning and other natural features.

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 a Bartington Grad 601-2 gradiometer. The instrument effectively measures 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 instrument is extremely sensitive and is 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 instrument is 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 gradiometer undergoes regular servicing and calibration by the manufacturer. A current assessment of the instrument 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)
Bandwidth	12Hz (100nT range) both sensors
Noise	<100pT peak to peak
Adjustable errors	<2nT

Table 1: Bartington fluxgate gradiometer sensor calibration results

The instrument was 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 20m by 20m grids (400m²) giving 1600 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. They were set out within the 20m working width of the pipeline except for where this was centred over a fence, in which case the survey area was then located to one side. The GPS is used in conjunction with Leica's SmartNet 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).

2.3 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 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.

2.3.4 The main form of data display prepared for this report is the greyscale plot. For the purposes of this report 'processed' data have been shown followed by an abstraction and interpretation plot. Each survey area has been shown at a scale of 1:1000 for A3. 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. Prior to displaying against base mapping and upon insertion into AutoCAD raster graphics require a rotation restore north to the top of the image.

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.

2.3.7 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out within a 20m wide corridor with several changes of direction forming survey areas that are labelled Areas 1-7, with the addition of a compound. The survey covered approximately 3.3ha.

3.1.2 Magnetic anomalies located can be generally classified as, positive and negative linear anomalies of an uncertain origin, 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.

3.2 Statement of data quality

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset. Minor areas of magnetic disturbance are unlikely to have obscured anomalies of archaeological potential.

3.3 Data interpretation

3.3.1 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 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 AS-ABST MAG NEG 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	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.
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

3.4 List of anomalies - Area 1

Area centred on OS NGR 428539 179700, see Figures 03 & 10.

Anomalies with an uncertain origin

(1) – Positive and negative linear, curvilinear, amorphous and discrete anomalies located towards the western end of the survey area. Although some of these may appear pit-like and ditch-like, it is possible that many are a response to natural features.

(2) – Two very weakly negative bands may relate to material with a low magnetic susceptibility, such as subsoil or chalk. The easternmost anomaly is in the vicinity of a former lynchet or boundary seen as a soil mark on aerial photographs, and it is possible that one or both anomalies are associated with this feature.

(3) – Discrete positive anomalies may indicate pit-like features. It is possible that these have a natural origin, but this is not certain.

Anomalies with an agricultural origin

(4) – Closely spaced parallel linear anomalies have been formed by agricultural activity.

Anomalies with a modern origin

(5) – Two linear areas of magnetic disturbance at the western end and centre of the survey area are a response to buried pipelines/services.

3.5 List of anomalies - Area 2

Area centred on OS NGR 428636 179551, see Figures 04 & 11.

Anomalies with an uncertain origin

(6) – Weakly positive linear anomalies of uncertain origin can be seen in the northern part of the survey area.

(7) – Discrete positive anomalies appear to relate to pit-like features. It is possible that they are natural in origin.

Anomalies associated with land management

(8) – A positive linear anomaly with some associated negative response appears to relate to a former land boundary. The magnitude of the anomaly is up to 7nT, possibly indicating a cut feature containing magnetically enhanced material.

Anomalies with an agricultural origin

(9) – A positive linear anomaly may indicate a former cultivation edge; other linear anomalies are parallel with it and relate to the plough trend.

Anomalies with a modern origin

(10) – Multiple dipolar linear anomaly, located in the southern part of Area 2 may relate to a ceramic pipe or drain.

3.6 List of anomalies - Area 3

Area centred on OS NGR 428676 179286, see Figures 05 & 12.

Anomalies with an uncertain origin

(11) – Discrete positive anomalies appear pit-like but may relate to natural features.

(12) – Weakly positive anomalies may relate to natural features.

(13) – Negative linear anomalies may relate to agricultural activity.

(14) – Several positive linear anomalies can be seen extending across the survey area from the eastern edge. Two are heading north west, one to the south west. Other positive linear anomalies are also evident in the area. Although their origin is uncertain, they probably indicate ditch-like features.

3.7 List of anomalies - Area 4

Area centred on OS NGR 428725 179094, see Figures 06 & 13.

Anomalies with an uncertain origin

(15) – A broad negative linear anomaly extends across the northern part of Area 4. It is likely to relate to a relatively recently removed field boundary.

(16) – Positive anomalies with an uncertain origin.

3.8 List of anomalies - Area 5

Area centred on OS NGR 428740 178928, see Figures 07 & 14.

Anomalies with an uncertain origin

(17) – Area 5 contains widespread weakly positive anomalies, only some of which have been abstracted. It is likely that they relate to naturally formed anomalies such as periglacial and/or colluvial features.

Anomalies with an agricultural origin

(18) – Linear anomalies extending the length of the survey area relate to agricultural activity.

3.9 List of anomalies - Area 6

Area centred on OS NGR 428777 178689 (West Berkshire), see Figures 08 & 15.

Anomalies with an uncertain origin

(19) – Very weakly positive linear anomalies may form an “L” shaped feature towards the northern part of the survey area.

(20) – An “L” shaped feature formed by positive linear anomalies is located in the southern part of the survey area. The response may indicate that magnetically enhanced material has become incorporated into a ditch-like feature.

(21) – A weakly positive anomaly appears to be crossed by anomaly (20). This anomaly is in the vicinity of a linear soil mark seen on Google Earth aerial images.

(22) – The survey area contains several weakly positive linear anomalies with a north west to south east orientation. A similar orientation is also evident in

anomalies (19) and (20) all of which are broadly parallel with the southern field boundary.

Anomalies with an agricultural origin

(23) – Positive and adjacent negative linear anomaly extends along the length of the survey area and is likely to have been caused by agricultural activity.

Anomalies associated with magnetic debris

(24) – A zone of magnetic debris can be seen adjacent to the western field boundary and is likely to relate to weakly magnetically thermoremant material.

3.10 List of anomalies - Area 7 and compound

Area centred on OS NGR 428682 178429, see Figures 09 & 16.

Anomalies with an uncertain origin

(25) – Moderately strongly positive anomalies with associated negative response are located towards the southern end of the survey area. The strength of the anomalies tends to suggest an anthropogenic origin.

(26) – An amorphous positive anomaly appears to join anomaly (27) to form an “L” shape; however this is unclear due to the narrow width of the survey area. Although of uncertain origin, this anomaly is parallel with anomaly (28) and may either be associated with a former road, or relate to an agricultural headland.

(27) – A positive linear anomaly appears to head towards anomaly (26), possibly joining it. The survey area contains several other parallel, weak, linear anomalies, possibly indicating an agricultural origin.

(28) – Positive discrete anomalies appear to form circular pit-like features. Two have a 2.5m diameter, the largest is 7m in diameter. Although it is possible that they relate to natural features, an anthropogenic origin cannot be ruled out.

(29) – A positive linear anomaly with parallel negative response can be seen in the north eastern corner of the compound area. It does not appear to extend north eastwards into the northern part of Area 7. It is parallel with the line of the former road, possibly indicating an agricultural origin.

Anomalies associated with magnetic debris

(30) – A zone of magnetic debris crosses the centre of the survey area. This may relate to strongly magnetically thermoremnant material used in construction of or to fill in the former line of a road which was redirected when the M4 was constructed.

Anomalies with a modern origin

(31) – Two strong multiple dipolar linear anomalies relate to buried services/pipelines.

4 DISCUSSION

4.1.1 The northern part of the pipeline corridor contains some evidence of former field boundaries, seen as negative anomalies in Area 1 and a positive linear anomaly in Area 2. All parts of the survey corridor contain positive and negative anomalies which cannot be confidently interpreted due to the limited width of the survey corridor. Many of these anomalies are likely to relate to natural features such as patterned ground, colluviation, and tree throw pits; however, an anthropogenic origin should also be considered.

4.1.2 In the the central part of the survey corridor, Area 3 contains several positive linear anomalies indicating possible ditch-like features containing magnetically enhanced material. Area 4 contains some evidence for a former field boundary marked on Ordnance Survey mapping. Area 5 appears likely to contain positive anomalies relating to natural features.

4.1.3 Area 6 lies within West Berkshire and contains positive linear anomalies, some of which appear to form “L” shaped features. They may relate to ditches, although several are parallel with the extant southern field boundary and an agricultural origin is possible.

4.1.4 In the southern part of the survey corridor, Area 7 contains widespread positive linear, amorphous and discrete anomalies of uncertain origin. The former line of Folly Road can be seen in the data as a zone of strongly magnetic debris, and linear anomalies are generally orientated parallel or perpendicular to it.

5 CONCLUSION

5.1.1 The detailed magnetometer survey located anomalies of uncertain origin within all the surveyed sections of the water pipeline corridor. It is likely that both natural and anthropogenically formed features are present. No anomalies were confidently interpreted as archaeological in origin although several linear features may relate to former early land boundaries. Interpretation is limited by the restricted width of the survey corridor and the incomplete morphology of many of the anomalies.

6 REFERENCES

British Geological Survey, 2012. *Geology of Britain viewer, 1:50 000 scale [online]* available from http://maps.bgs.ac.uk/geologyviewer/ [accessed 14/3/2012].

English Heritage, 2008. *Geophysical survey in archaeological field evaluation. Research and Professional Service Guideline No.1.* 2nd ed. Swindon: English Heritage.

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IFA Paper No. 6. IFA, University of Reading.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England.*

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.

Edge Match

Calculates the mean of the 2 lines (rows or columns) of data either side of the edge to match. It then subtracts the difference between the means from all datapoints in the selected area.

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 processed data

COMPOSITE
Filename: J398-mag-Area1-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 12/03/2012
Assembled by: on 12/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 180
Survey Size (meters): 20 m x 180 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.61
Mean: -0.14
Median: -0.09
Composite Area: 0.36 ha
Surveyed Area: 0.35445 ha

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Mean Traverse: Grids: All Threshold: 0.5 SDs
4 Clip from -3.00 to 3.00 nT

Source Grids: 9
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd
5 Col:0 Row:4 grids\05.xgd
6 Col:0 Row:5 grids\06.xgd
7 Col:0 Row:6 grids\07.xgd
8 Col:0 Row:7 grids\08.xgd
9 Col:0 Row:8 grids\09.xgd

Area 2 processed data

COMPOSITE
Filename: J398-mag-Area2-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 12/03/2012
Assembled by: on 12/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 260
Survey Size (meters): 20 m x 260 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.84
Mean: 0.04
Median: 0.00
Composite Area: 0.52 ha
Surveyed Area: 0.52 ha

Processes: 4
1 Base Layer
2 Clip from -18.85 to 30.00 nT
3 DeStripe Median Traverse: Grids: All
4 Clip from -3.00 to 3.00 nT

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

Area 3 processed data

COMPOSITE
Filename: J398-mag-Area3-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 12/03/2012
Assembled by: on 12/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 300
Survey Size (meters): 20 m x 300 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.69
Mean: 0.05
Median: 0.00
Composite Area: 0.6 ha
Surveyed Area: 0.584 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

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

Area 4 processed data

COMPOSITE
Filename: J398-mag-Area4-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 13/03/2012
Assembled by: on 13/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702
Dimensions
Composite Size (readings): 80 x 100
Survey Size (meters): 20 m x 100 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.80
Mean: 0.01
Median: 0.00
Composite Area: 0.2 ha
Surveyed Area: 0.1885 ha

Processes: 4
1 Base Layer
2 Clip from -28.67 to 30.00 nT
3 DeStripe Median Traverse: Grids: All
4 Clip from -3.00 to 3.00 nT

Source Grids: 5
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd
5 Col:0 Row:4 grids\05.xgd

Area 5 processed data

COMPOSITE
Filename: J398-mag-Area5-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 13/03/2012
Assembled by: on 13/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 240
Survey Size (meters): 20 m x 240 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.92
Mean: 0.02
Median: 0.00
Composite Area: 0.48 ha
Surveyed Area: 0.4193 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

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

Area 6 processed data

COMPOSITE
Filename: J398-mag-Area6-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 13/03/2012
Assembled by: on 13/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 260
Survey Size (meters): 20 m x 260 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.82
Mean: 0.00
Median: 0.00
Composite Area: 0.52 ha
Surveyed Area: 0.45295 ha

Processes: 6
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
5 De Stagger: Grids: All Mode: Both By: 1 intervals
6 Clip from -3.00 to 3.00 nT

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

Area 7 processed data

COMPOSITE
Filename: J398-mag-Area7-proc.xcp
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 12/03/2012
Assembled by: on 12/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 80 x 320
Survey Size (meters): 20 m x 320 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.49
Mean: 0.00
Median: -0.03
Composite Area: 0.64 ha
Surveyed Area: 0.61105 ha

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Mean Traverse: Grids: All Threshold: 0.5 SDs
4 Clip from -3.00 to 3.00 nT

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

Compound processed data

COMPOSITE
Filename: J398-mag-compound-proc.xcp
Description:
Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 12/03/2012
Assembled by: on 12/03/2012
Direction of 1st Traverse: 90 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 160 x 60
Survey Size (meters): 40 m x 60 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.77
Mean: -0.30
Median: -0.04
Composite Area: 0.24 ha
Surveyed Area: 0.2 ha

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Mean Traverse: Grids: All Threshold: 0.5 SDs
4 Clip from -3.00 to 3.00 nT

Source Grids: 6
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:1 Row:0 grids\04.xgd
5 Col:1 Row:1 grids\05.xgd 6 Col:1 Row:2 grids\06.xgd

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.

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 2.5.14.0 (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 produced by the survey and report include 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.