

**Land North of Folly View
Willersey
Gloucestershire**

MAGNETOMETER SURVEY REPORT

for

Blue Cedar Homes Limited

Kerry Donaldson & David Sabin

May 2025

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ARCHAEOLOGICAL SURVEYS LTD

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Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

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CONTENTS

SUMMARY.....	1
1 INTRODUCTION.....	1
1.1 Survey background.....	1
1.2 Survey objectives and techniques.....	1
1.3 Standards, guidance and recommendations for the use of this report.....	1
1.4 Site location, description and survey conditions.....	2
1.5 Site history and archaeological potential.....	3
1.6 Geology and soils.....	4
2 METHODOLOGY.....	4
2.1 Technical synopsis.....	4
2.2 Equipment configuration, data collection and survey detail.....	5
2.3 Data processing and presentation.....	5
2.4 Supplementary measurement of magnetic susceptibility.....	7
3 RESULTS.....	8
3.1 General assessment of survey results.....	8
3.2 Data quality and factors affecting the interpretation or formation of anomalies.....	8
3.3 Data interpretation.....	8
3.4 List of anomalies.....	9
4 DISCUSSION.....	11
5 CONCLUSION.....	11
6 REFERENCES.....	12
Appendix A – basic principles of magnetic survey.....	13
Appendix B – data processing notes.....	13

Appendix C – survey and data information.....13
Appendix D – digital archive.....14
Appendix E – copyright and intellectual property.....14

LIST OF FIGURES

Fig 01 Map of survey area (1:25 000)
Fig 02 Referencing information (1:1000)
Fig 03 Greyscale plot of minimally processed magnetometer data (1:1000)
Fig 04 Greyscale plot of minimally processed magnetometer data with extreme values highlighted (1:1000)
Fig 05 Abstraction and interpretation of magnetic anomalies (1:1000)

LIST OF PLATES

Plate 1: Survey area looking east.....3

LIST OF TABLES

Table 1: List and description of interpretation categories.....9
Table 2: Archive metadata.....14

SUMMARY

Archaeological Surveys Ltd carried out 2.7 ha of magnetometry over land immediately to the west of Willersey in Gloucestershire. The results demonstrate the presence of numerous anomalies relating to features of archaeological potential and include ring ditches, enclosures and other former boundary ditches. The anomalies are consistent with a small settlement likely to be late prehistoric in date, although there appears to be a number of phases which may suggest a long period of use.

1 INTRODUCTION

1.1 *Survey background*

1.1.1 Archaeological Surveys Ltd was commissioned by Blue Cedar Homes Limited to undertake a magnetometer survey of an area of land at Willersey in Gloucestershire. The site has been outlined for a proposed residential development and the survey forms part of an archaeological assessment.

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. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 *Standards, guidance and recommendations for the use of this report*

1.3.1 Archaeological Surveys Ltd is a Registered Organisation with the Chartered Institute for Archaeologists (CIfA) and both company directors are Members of the Chartered Institute for Archaeologists (MCIfA) and have therefore been assessed for their technical competence and ethical suitability and abide by the CIfA Codes of Conduct. The survey and report follow the recommendations set out by: European Archaeological Council (2015) Guidelines for the Use of Geophysics in Archaeology; Institute for Archaeologists (2002) The use of Geophysical Techniques in Archaeological Evaluations. The work has been carried out to the Chartered Institute for Archaeologists (2014, updated 2020) Standard and Guidance for Archaeological Geophysical Survey.

- 1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.
- 1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.
- 1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.
- 1.3.5 Magnetic anomalies may relate to features within the topsoil, subsoil or within the underlying solid or superficial geology. Anomalies are created by contrasting magnetic susceptibility; however, this is not necessarily consistent with changes in soil texture or colour and may not be contained within well defined features. Magnetic contrast and the magnitude of anomalies does not necessarily correlate with the volume or thickness of magnetic material present. The vertical component of the magnetic field is measured by the magnetometer and this falls rapidly with distance from the sensor, it may not be possible to distinguish weak features within the topsoil from deeper features containing more magnetic material.
- 1.3.6 Interpretation of anomalies relies on detailed analysis of the data. The morphology of anomalies and their magnitude are important factors in the interpretation process. Wherever possible, supporting information is used, e.g. LiDAR, early mapping and desk-based assessments. However, anomalies often cannot be confidently interpreted without intrusive investigation and as such are categorised as of uncertain origin; this classification may include anomalies relating to archaeological features.

1.4 *Site location, description and survey conditions*

- 1.4.1 The site is located on the western edge of Willersey in Gloucestershire, 160m east of the border with Worcestershire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SP 10220 39340, see Figs 01 and 02.
- 1.4.2 The geophysical survey covers approximately 2.7ha covering the majority of a

pasture field that lies west of residential dwellings along Field Lane and north of the recent residential development of Folly View. A farmyard and industrial buildings are located to the north west with further agricultural land to the north and west. The land is generally level ground at approximately 75m AODN although a low bank runs along the eastern boundary. Field boundaries are a combination of hedgerows with mature trees and wire fencing.

- 1.4.3 The ground conditions across the site were generally considered to be suitable for the collection of magnetometry data, although the southern part of the site contained tall grass which was difficult to traverse. Weather conditions during the survey were fine.



Plate 1: Survey area looking east

1.5 Site history and archaeological potential

- 1.5.1 The site lies within a wider landscape that contains medieval ridge and furrow (Gloucestershire HER no. 51201) and although this is not clearly defined within the survey area, the field immediately to the north contains well preserved earthwork examples. A geophysical survey and subsequent trial trench evaluation were carried out within the field to the north and they both revealed only a small number of features, including 2 undated gullies in the northern part of the field that were likely to relate to medieval/post medieval land use.

1.6 *Geology and soils*

- 1.6.1 The underlying geology is mudstone from the Blue Lias Formation and Charmouth Mudstone Formation (BGS, 2025).
- 1.6.2 The overlying soil across the site is from the Evesham 2 association (411b) and is a typical calcareous pelosol. It consists of a slowly permeable, calcareous, clayey soil (Soil Survey of England and Wales, 1983). However, a topsoil sample indicated a silty, sandy soil not consistent with the mapped association which may be indicative of unmapped superficial deposits. Approximately 400m west of the site there are mapped superficial deposits consisting of Head – gravel, sand, silt and clay and it would appear likely that these extend into the survey area but are not thick enough to have been mapped. The Head deposits are mapped over a wide area to the north and north east of Willersey.
- 1.6.3 Magnetometry carried out over similar geology and soil has produced good results. The site is, therefore, considered suitable 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 (also known as thermoremanence) are factors associated with the formation of localised magnetic fields.
- 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 positive magnetic anomalies that can be mapped by magnetic prospection. In addition, where soil is displaced by material of comparatively low magnetic susceptibility, such as many types of sedimentary rock, anomalies of negative value may occur which could be indicative of structural remains.
- 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). Additional details are set out in 2.2 below and

within Appendix A.

2.2 Equipment configuration, data collection and survey detail

- 2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO® MX V3 6 channel cart-based system. The instrument has 6 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20Hz which equates to a survey resolution of 0.5m by 0.15m. The cart is pushed at walking speed and not towed. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a recorded range of $\pm 3000\text{nT}$, and resolution is approximately 0.1nT. They are linked to a Leica GS10 RTK GNSS with data recorded by SENSYS MonMX software on a rugged notebook computer system.
- 2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.
- 2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).
- 2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

- 2.3.1 Magnetic data collected by the MAGNETO® MX V3 cart-based system are initially prepared using SENSYS MAGNETO® DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The

offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

- 2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of the offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.
- 2.3.3 The minimally processed data are collected between limits of $\pm 3000\text{nT}$ and clipped for display at $\pm 10\text{nT}$ (Fig 03) and also at $\pm 30\text{nT}$, with values over $+26\text{nT}$ in red and under -26nT in blue (Fig 04). Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.
- 2.3.4 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on processing.
- 2.3.5 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. Minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.
- 2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2021, creating DWG (2018) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GNSS, resection method, etc.

- 2.3.7 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.
- 2.3.8 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 the 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.
- 2.3.9 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

2.4 *Supplementary measurement of magnetic susceptibility*

- 2.4.1 Magnetic susceptibility is an important factor in the formation of magnetic anomalies located by a magnetometry survey, see 2.1. Accurate measurement of the magnetic susceptibility of soil, subsoil and underlying geology may enhance the results of the magnetometry survey by providing an assessment of magnetic contrast within a site. Where sampling of topsoil only is possible, measurement may assist in understanding whether the soil is likely to be associated with strong, moderate or weak anomalies, which may be a result of low levels of iron minerals, waterlogging, etc. Accurate measurement may also assist in determining industrial activity and the presence of layers or features not visually or texturally apparent on excavation.
- 2.4.2 Supplementary measurement of soil magnetic susceptibility is not considered part of the main objective of the survey and is discussed in section 3.2 below as a factor influencing the formation of anomalies.
- 2.4.3 Measurements are achieved using a Bartington MS2 Magnetic Susceptibility Meter with MS2B sensor. Small soil samples are measured in 10 cubic centimetre plastic pots after accurately weighing, generally each sample is subdivided and at least 3 separate measurements are made in order to provide a mean value, or assess variability due to ferrous contamination and other factors. Measurement can be made at low or high frequency, generally low frequency measurements are made but occasionally high frequency measurements are also recorded as the frequency dependence of a soil may be informative.
- 2.4.4 The measurements are converted to mass specific readings using SI units for bulk density. Archaeological Surveys express the measurements as X_{lf} or X_{hf} for low frequency or high frequency magnetic susceptibility respectively with units of $10^{-8}m^3kg^{-1}$.

3 RESULTS

3.1 *General assessment of survey results*

- 3.1.1 The detailed magnetic survey was carried out over approximately 2.7ha within a single survey area.
- 3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of archaeological potential, positive linear anomalies of an uncertain origin, 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.
- 3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 below with subsequent discussion in Section 4.

3.2 *Data quality and factors affecting the interpretation or formation of anomalies*

- 3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset; however, severe magnetic disturbance associated with a steel gas pipeline was encountered in the eastern part of the field. The disturbance has the potential to obscure anomalies of archaeological significance along a corridor approximately 25m wide.
- 3.2.2 A number of anomalies of archaeological potential were located and these demonstrate strong contrast within a core area of activity and settlement which becomes moderate and weak with increasing distance away from the core zone.
- 3.2.3 In order to provide further understanding of the magnetic characteristics of the soil, a single topsoil sample was taken from the western side of the survey area, away from anomalies of archaeological potential, and its mass specific magnetic susceptibility was measured, see 2.4. The sample produced an average low frequency mass specific magnetic susceptibility (X_{lf}) of $61.83 \cdot 10^{-8} \text{m}^3 \text{kg}^{-1}$. The value obtained is significantly high and consistent with soils altered by anthropogenic activity and habitation. The soil does not seem to be consistent with the mapped association which may relate to the presence of superficial Head deposits, see 1.6.2.

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 general explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	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> . Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. 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 with an agricultural origin	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. This category <u>does not include</u> agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are related to magnetically thermoremanent materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, hearths and nail spreads from former wooden structures or rooves 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	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 these 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 adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 410220 239340, see Figs 03 – 05.

Anomalies of archaeological potential

(1 & 2) – A number of positive rectilinear, curvilinear and irregularly shaped anomalies relate to small enclosures associated with a multi-phase settlement. They are generally very magnetically enhanced suggesting an association with burnt material. Anomaly (2) appears to contain a complex number of both positive and negative anomalies, and while it is possible that some relate to earlier features, such as other fragments of ring ditches, they do appear to relate to internal features.

(3) – A number of phases of ring ditches can be seen within the site and these may relate to Iron Age round houses. They are generally incomplete, having been truncated by the later enclosures (1) and also ridge and furrow (12). There are at least 8 responses that can be characterised as ring ditches; however, some of the other curvilinear responses (8) identified within the settlement could relate to further

examples.

(4, 5 & 6) – Positive linear anomalies form the northern (4) and western (6) ditches that bound the settlement. The irregular enclosures (1) form a later southern boundary with linear anomaly (5).

(7) – A number of weakly positive linear anomalies can be seen in the northern part of the site. They are less enhanced (2-4nT) than the majority of the anomalies within the settlement, indicating that they could be more transient features and/or that they contain less magnetically enhanced material derived from occupation, suggesting perhaps that they are more on the periphery of the settlement.

(8) – The settlement contains a number of discrete positive responses relating to pit-like features as well as short or fragmented positive linear, rectilinear and curvilinear anomalies. It is possible that the curvilinear responses represent further examples of fragments of former ring ditches.

(9) – A discrete positive response has a magnetic response of over 75nT, indicating that it has an association with intense burning.

(10) – A small number of discrete positive anomalies can be seen in the north western part of the survey area. These appear to relate to pit-like features outside of the main core of the settlement.

Anomalies with an uncertain origin

(11) – A small number of weakly positive linear anomalies can be seen in the southern part of the site. It is not clear if they relate to cut features.

Anomalies with an agricultural origin

(12) – The survey area contains a series of parallel linear anomalies relating to ridge and furrow.

Anomalies associated with magnetic debris

(13) – A linear bank is situated along the eastern edge of the field, this is associated with magnetic debris and likely to be of modern origin.

Anomalies with a modern origin

(14) – A steel gas pipeline extends through the eastern part of the survey area. This has not only truncated the archaeological features, but the very highly magnetic response has resulted in widespread magnetic disturbance which has obscured weaker anomalies along a corridor up to 25m in width.

4 DISCUSSION

- 4.1.1 A multi-phase settlement has been identified within the site. This includes a group of ring ditches relating to at least 8 probable Iron Age round houses (3), although they appear to be phased. They lie within a zone that is bounded by linear ditches to the north (4) and west (6) that converge to form a trackway that leads towards the settlement from the north west. A further ditch extends northwards from (4) but there has been truncation by ridge and furrow (12), which can also be seen with anomaly (6) which has been heavily truncated.
- 4.1.2 It appears that a later series of rectilinear, curvilinear and irregularly shaped enclosures (1) & (2) have truncated the ring ditches. An irregular southern boundary ditch (5) appears to be associated with this phase of settlement. The enclosures vary in shape and size but all are between 10-21m wide by 15-23m in length. Anomaly (2) appears to contain a complex number of both positive and negative anomalies and while it is possible that some relate to earlier features, such as fragments of further ring ditches, they do appear to relate to internal divisions. The negative anomalies appear to relate to discrete internal features with a response to material with lower magnetic susceptibility than the surrounding soil, such as stone or subsoil. The enclosure ditches are very magnetically enhanced (40-60nT) indicating that there is an association with material derived through long-term occupation and burning.
- 4.1.3 Further linear and rectilinear ditches (7) can be seen to the north of the main settlement but these are generally much weaker (2-4nT) and may indicate that they are short term features and/or features that are outside of the main core of the settlement and do not contain such magnetically enhanced material.
- 4.1.4 The strongest response (>75nT) relates to a discrete feature (9) situated 33m south of (5) and 23m east of (4). It appears as a generally isolated feature outside of the main core of the settlement and the strong response indicates that it may have an association with intense burning, possibly suggesting a feature such as an oven or furnace.

5 CONCLUSION

- 5.1.1 The geophysical survey has located a previously unrecorded multi-phase settlement within the site. A number of fragmented ring ditches relate to phases of round houses and several rectilinear, curvilinear and irregularly shaped small enclosures appear to relate to later phases of occupation. The site is bounded by linear ditches that converge to form a trackway that extends towards it from the north west. The site also contains ridge and furrow and a gas pipeline which have both truncated the archaeology in places.

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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 thermoremanent 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. Thermoremanent 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. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent 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 SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm 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 magnetic field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

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. 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 data from 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 differences between the offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Minimally processed data	Source GPS Points: Active: 871853, Recorded: 871859	2 Unit Conversion Layer (UTM to OSGB36).
Filename: J1044-mag-proc.xcp	Stats	3 DeStripe Median Traverse:
Instrument Type: Sensys DLMGPS	Max: 11.05	4 Clip from -10.00 to 10.00 nT
Units: nT	Min: -11.00	
UTM Zone: 30U	Std Dev: 4.76	Stats
Survey corner coordinates (X/Y): OSGB36	Mean: 0.07	Max: 33.15
Northwest corner: 410123.10, 239455.85 m	Median: 0.00	Min: -33.00
Southeast corner: 410312.70, 239222.00 m	Composite Area: 4.4338 ha	Std Dev: 10.03
Collection Method: Randomised	Surveyed Area: 2.695 ha	Mean: 0.20
Sensors: 6	PROGRAM	Median: -0.01
Dummy Value: 32702	Name: TerraSurveyor	1 Base Layer.
Dimensions	Version: 3.0.37.0	2 Unit Conversion Layer (UTM to OSGB36).
Survey Size (meters): 190 m x 234 m	GPS based Proce4	3 DeStripe Median Traverse:
X&Y Interval: 0.15 m	1 Base Layer.	4 Clip from -30.00 to 30.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. 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.

A copy of the report in PDF/A format will be supplied to the Gloucestershire Historic Environment Record, together with a DXF of the survey boundary. In order to comply with the Gloucestershire Archaeological Archive Standards (Paul, 2018) the data will be archived with the Archaeology Data Service (ADS) and the report will also be uploaded to OASIS, the online system for reporting archaeological investigations and linking research outputs and archives.

Archive contents:

File type	Naming scheme	Description
Data	J1044-mag.asc J1044-mag.xcp J1044-mag-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J1044-mag-proc.tif	Image in TIF format
Drawing	J1044-[version number].dwg	CAD file in 2018 dwg format
Report	J1044 report.odt	Report text in LibreOffice odt format

Table 2: Archive metadata

Appendix E – copyright and intellectual property

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**Geophysical Survey
Land North of Folly View
Willessey
Gloucestershire**

Map of survey area

Survey location



● Survey location

Site centred on OS NGR
SP 10220 39340

SCALE 1:25 000



SCALE TRUE AT A3

**Geophysical Survey
Land North of Folly View
Willesley
Gloucestershire**

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

- 410200 239300
- Survey tracks
- - - Survey track start
- - - Survey track stop

SCALE 1:1000

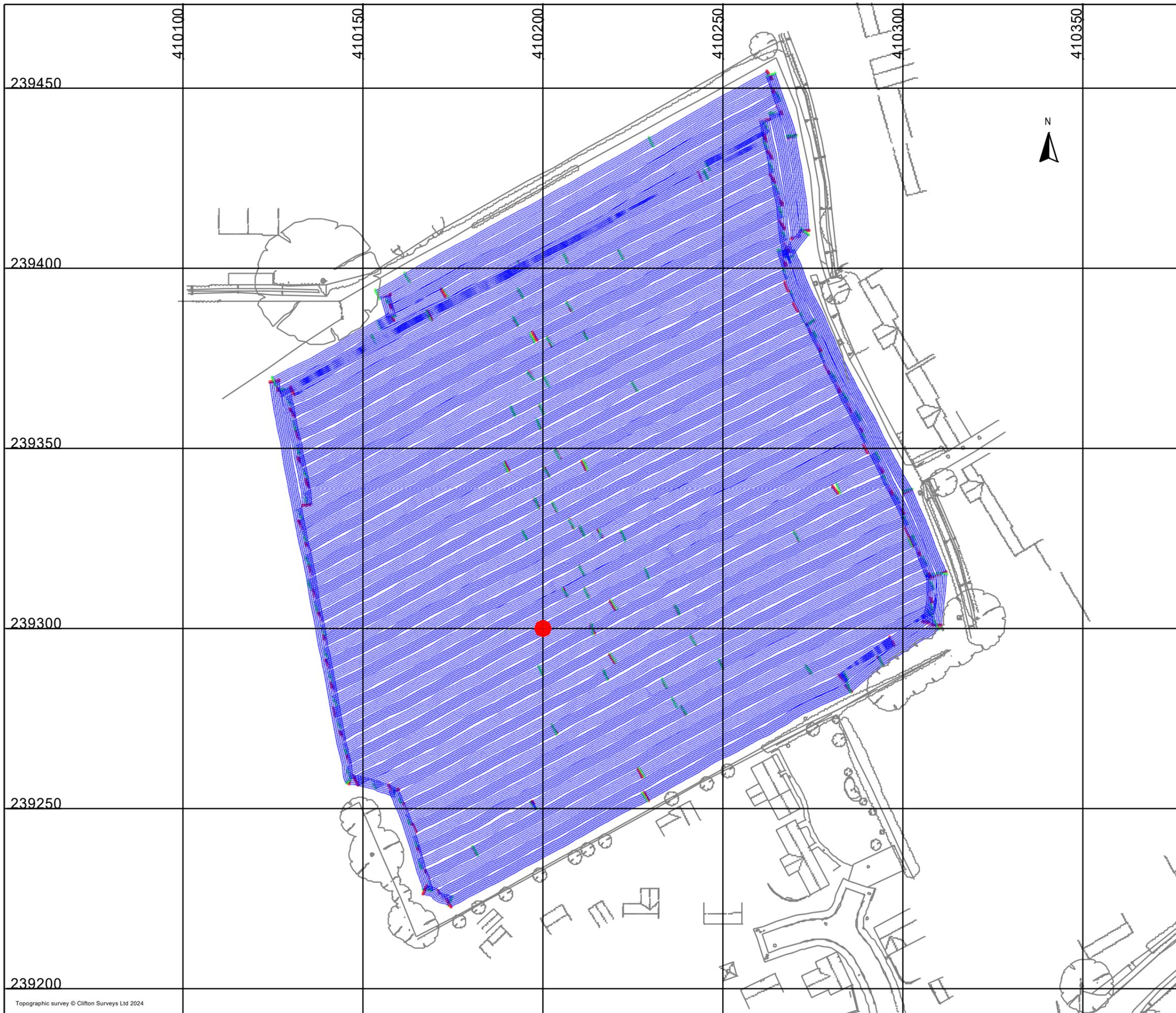


SCALE TRUE AT A3

DRAWN BY
KTD

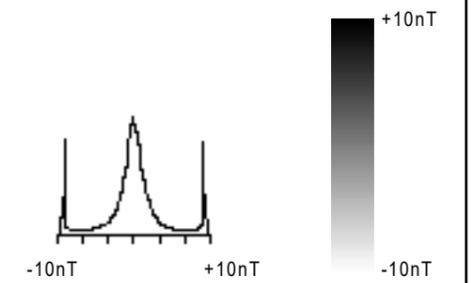
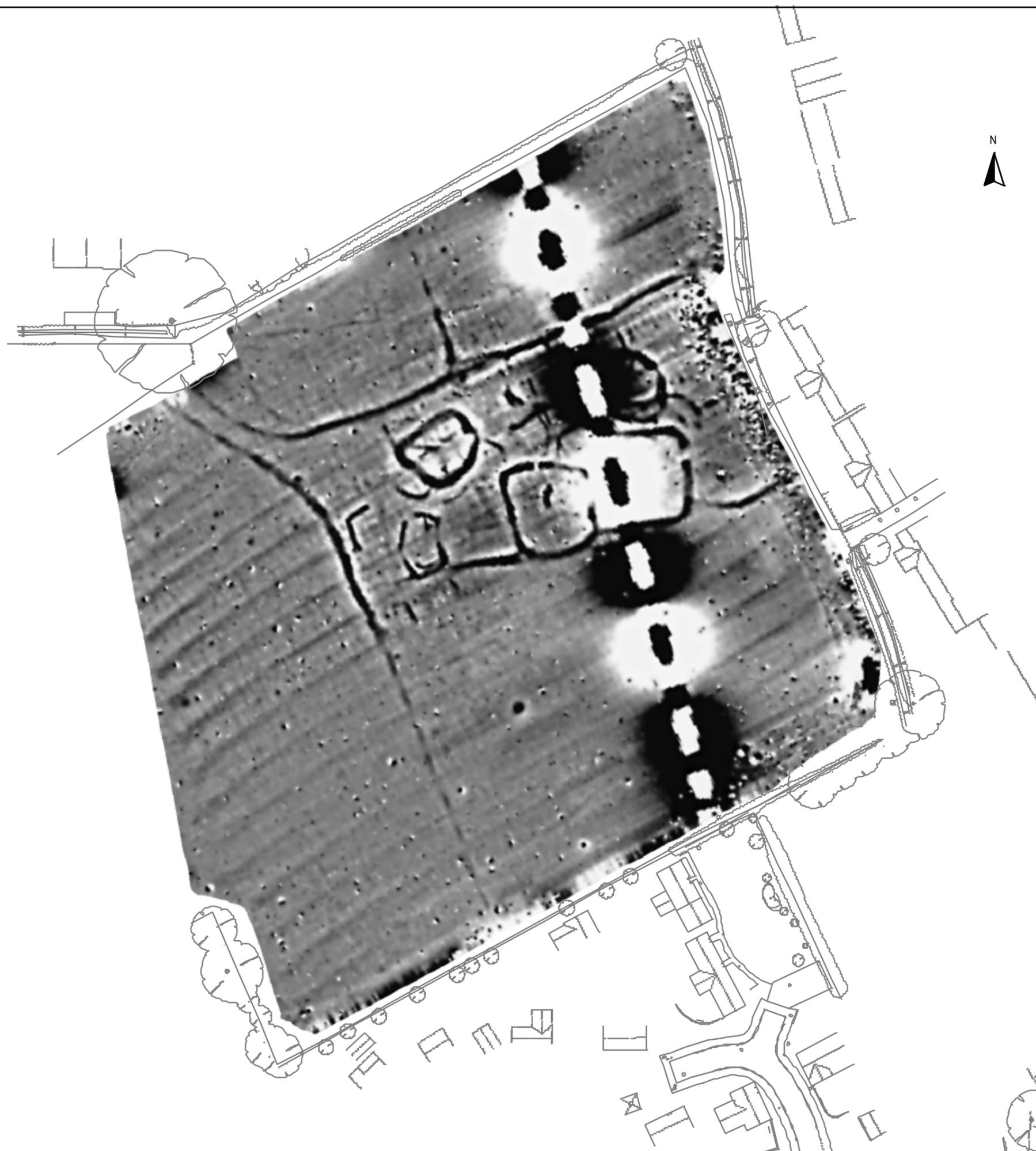
CHECKED BY
DJS

FIG 02



**Geophysical Survey
Land North of Folly View
Willesley
Gloucestershire**

**Greyscale plot of minimally
processed magnetometer data**



SCALE 1:1000



SCALE TRUE AT A3

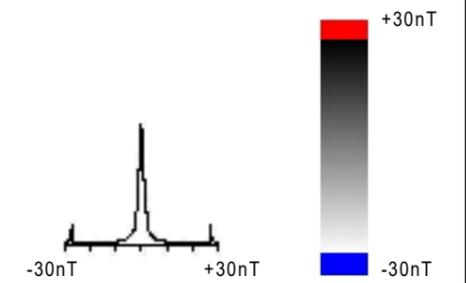
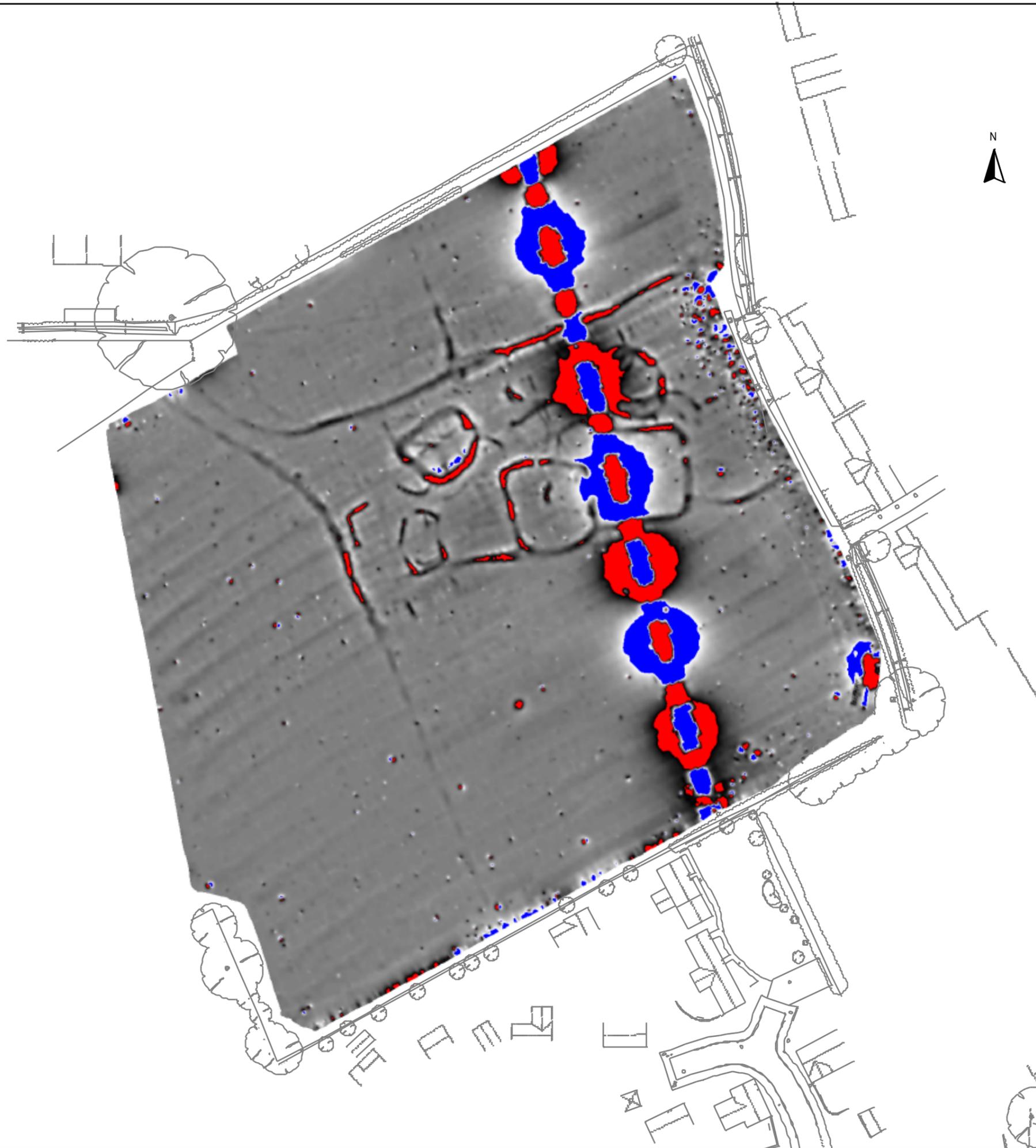
DRAWN BY
KTD

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DJS

FIG 03

**Geophysical Survey
Land North of Folly View
Willesley
Gloucestershire**

**Greyscale plot of
minimally processed
magnetometer data with
extreme values highlighted**



SCALE 1:1000



SCALE TRUE AT A3

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FIG 04

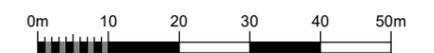
**Geophysical Survey
Land North of Folly View
Willesley
Gloucestershire**

**Abstraction and interpretation of
magnetic anomalies**



- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear/rectilinear anomaly - enclosure ditch
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature of archaeological potential
- Discrete negative anomaly - of archaeological potential
- ▨ Magnetic debris - spread of magnetically thermoremanent/ferrous material
- ▨ Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - gas pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000



SCALE TRUE AT A3

DRAWN BY
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FIG 05