

GEOPHYSICAL SURVEY REPORT

Bretch Hill, Banbury

Client

The Environmental Dimension Partnership Ltd

For

Lone Star Land

Survey Report

09960

OASIS Ref. No.

sumogeop1-510994

Date

16 November 2022



Survey Report 09960: Bretch Hill, Banbury

Survey dates	4 November 2022
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3 SURVEY TECHNIQUE

- 3.1 Detailed magnetic survey (magnetometry) was chosen as the most efficient and effective method of locating the type of archaeological anomalies which might be expected at this survey. All survey techniques followed the guidance set out by CIFA (2014, updated 2020), Historic England (2008), and the European Archaeology Council (EAC) (2016).

Bartington Grad 601-2 Traverse Interval 1.0m Sample Interval 0.25m

The only processes performed on data are the following unless specifically stated otherwise:

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes instrument striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

4 SUMMARY OF RESULTS

- 4.1 A magnetometer survey of 4 hectares of land at Bretch Hill, Banbury has not recorded any magnetic responses which are indicative of definite archaeological features. There are several uncertain trends and discrete anomalies, localised in the northeast corner and north edge, which could be archaeological but they are more probably a result of agriculture or natural processes. Ridge and furrow ploughing is visible throughout the dataset and the route of a small pipe has also been marked.

5 INTRODUCTION

- 5.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by **The Environmental Dimension Partnership Ltd** on behalf of **Lone Star Land**.

5.2 Site Details

NGR / Postcode	SP 43771 39761 / OX16 0BQ
Location	The survey is located 4km north of Bloxham and is situated on the south-western outskirts of Banbury. The survey area is bounded to the south by Broughton Road and to the east by houses off Denbigh Close.
HER	Oxfordshire HER
OASIS Ref. No.	sumogeop1-510994
District	Cherwell District
Parish	Banbury Civil Parish
Topography	Flat
Land Use	Arable agriculture
Geology	Bedrock: Whitby Mudstone Formation - Mudstone
(BGS 2022)	Superficial: None recorded
Soils (CU 2022)	Soilscape 7: Freely draining slightly acid but base-rich soils Soilscape 18: Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	4 ha

5.3 *Archaeological Background*

- 5.3.1 An archaeological and heritage assessment was prepared by The Environmental Dimension Partnership Ltd (EDP 2021) on behalf of Lone Star Land Ltd to inform planning proposals for a residential development on Land off Balmoral Avenue, Banbury. This partly overlapped with the site. The work showed that the site does not contain any designated heritage assets. In terms of non-designated heritage assets, the site was determined to have a low potential to contain any archaeological remains, other than those of 'negligible' value related to medieval and later farming practices.
- 5.3.2 A geophysical survey (SGL 2021) was carried out in 2021 over the two fields due north, as well as part of the site itself. This data was tested through a trial trench evaluation (Border Archaeology 2022), including one trench within the site. Whilst three probable round houses/enclosures and associated features of Iron Age date were recorded on the high ground to the north, the part of the site surveyed, located on lower lying ground, was not identified as containing any archaeological remains.

5.4 ***Aims and Objectives***

- 5.4.1 To locate and characterise any anomalies of possible archaeological interest within the study area.

6 **RESULTS**

6.1 ***Probable / Possible Archaeology***

- 6.1.1 No magnetic responses have been recorded that could be interpreted as being of definite archaeological interest.

6.2 ***Uncertain***

- 6.2.1 A number of curving trends and pit-like anomalies have been detected in the magnetic data which have been assigned to the category of *Uncertain*. They are localised to the north edge and north east corner, and generally lack the defined morphology of anomalies that would ordinarily be interpreted as being of archaeological interest. However, given the responses of archaeological interest detected in the previous phase of survey in fields to the north (SGL 2021), archaeological origins for the anomalies cannot be entirely discounted. However, they are more likely to merely be the result of a combination of natural and agricultural processes.

6.3 ***Agricultural – Ridge and Furrow***

- 6.3.1 Broad parallel and widely spaced linear anomalies are visible in the survey which are due to historic ridge and furrow ploughing.

6.4 ***Service***

- 6.4.1 A strong dipolar ferrous response has been detected in the west of the survey which marks the route of a small service pipe / cable.

6.5 ***Ferrous / Magnetic Disturbance***

- 6.5.1 Ferrous responses close to boundaries are due to adjacent fences and gates. Three pylons are located within the survey which have caused strong isolated ferrous responses; the pylons are visible on aerial imagery (see Figure 04). Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

7 **DATA APPRAISAL & CONFIDENCE ASSESSMENT**

- 7.1 Historic England guidelines (EH 2008) Table 4 states that the typical magnetic response on the local soils / geology is generally good. The results from this survey indicate the presence of trends and pit-like responses; however, none of these are of a strength or nature comparable with the definite archaeological responses in the earlier phase of geophysical survey. As a consequence, there is no *a priori* reason why archaeological features would not have been detected, if present, but the ridge and furrow ploughing may have obscured weak anomalies of interest.

8 CONCLUSION

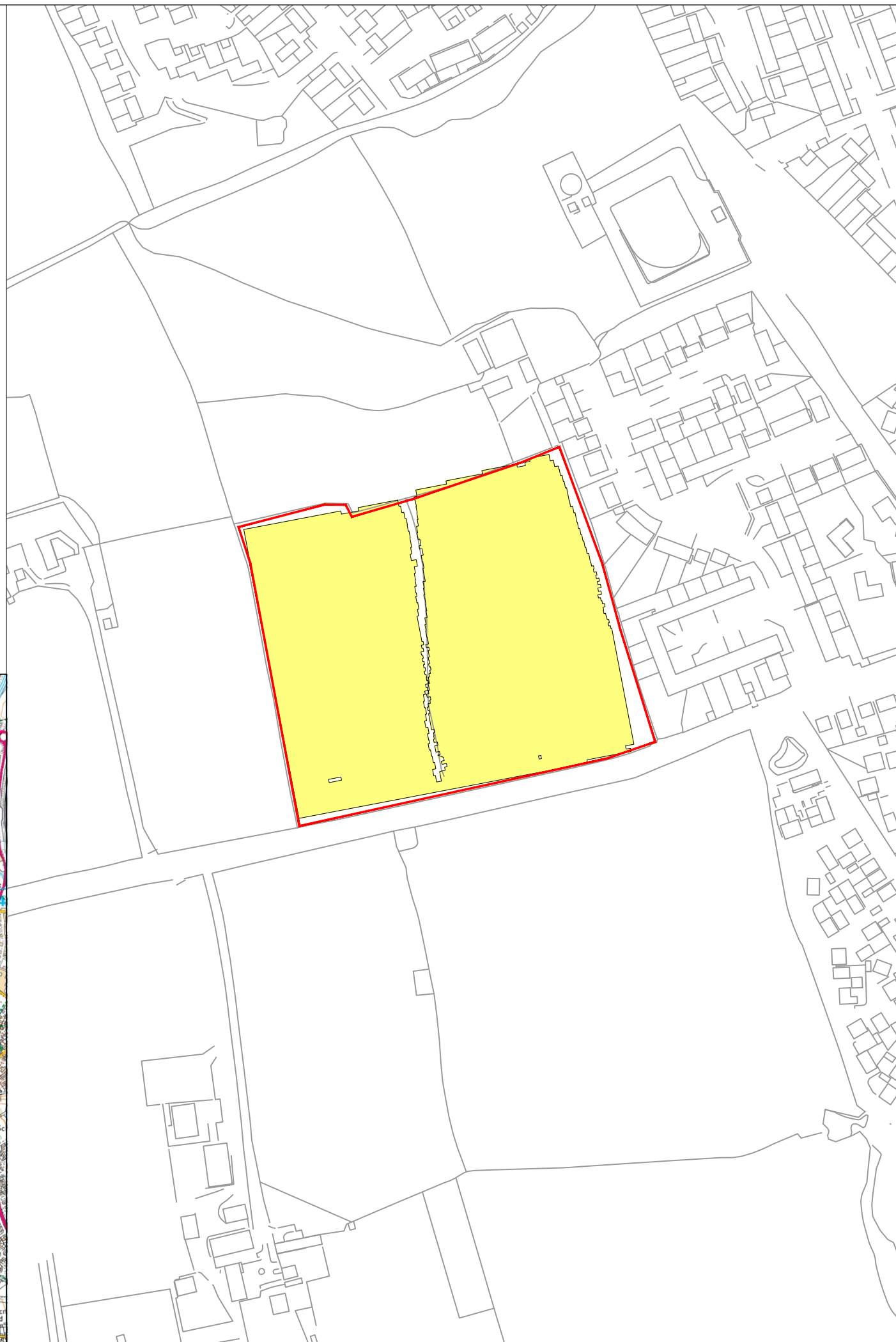
- 8.1 The magnetometer survey has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. Several pit-like responses and curving trends, which are localised to the north edge and north east corner, have been assigned to the category of uncertain. While archaeological origins cannot be entirely ruled out; they could also be due to agriculture or natural processes. Ridge and furrow ploughing is visible throughout the dataset and the route of a probable small pipe has also been marked.

9 REFERENCES

- BGS 2022 British Geological Survey, Geology of Britain viewer [accessed 15/11/2022] *website:* (<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>)
- ClfA 2014 *Standard and Guidance for Archaeological Geophysical Survey*. Amended 2020. ClfA Guidance note. Chartered Institute for Archaeologists, Reading
Amended 2020 https://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_3.pdf
- CU 2022 The Soils Guide. Available: www.landis.org.uk. Cranfield University, UK. [accessed 15/11/2022] *website:* <http://mapapps2.bgs.ac.uk/ukso/home.html>
- EAC 2016 *EAC Guidelines for the Use of Geophysics in Archaeology*, European Archaeological Council, Guidelines 2.
- EDP 2021 *Land off Balmoral Avenue, Bretch Hill, Banbury, Archaeological and Heritage Assessment. The Environmental Dimension Partnership Ltd, Cirencester*
- EH 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage, Swindon (now withdrawn, but used for evaluating suitability of soil types)
- SGL 2022 *Land off Broughton Road, Bretch Hill, Banbury Geophysical Survey Report (05534). Sumo Geophysics Limited, Upton-upon-Severn*

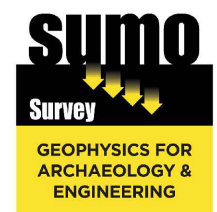
10 ARCHIVE

- 10.1 The minimally processed data, data images, XY traces and a copy of this report are stored in **SUMO Geophysics Ltd.'s** digital archive, on an internal RAID configured NAS drive in the Midlands Office. These data are also backed up to the Cloud for off-site storage.
- 10.2 The Grey Literature will be archived with OASIS and the relevant HER within a period of 12 months.

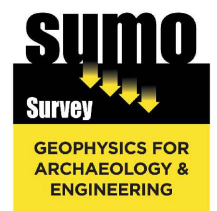
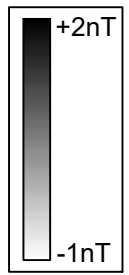


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	Survey Areas	N ↑
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Title: Survey Location	
Client: The Environmental Dimension Partnership Ltd	
Project: 09960 Bretch Hill, Banbury	
Scale: NOT TO SCALE	Fig No: 01



Title: Magnetometer Survey - Greyscale Plot

Client: The Environmental Dimension Partnership Ltd

Project: 09960 Bretch Hill, Banbury

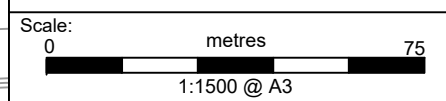
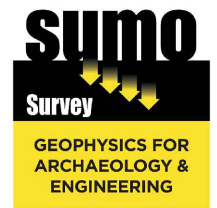
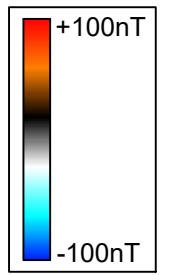
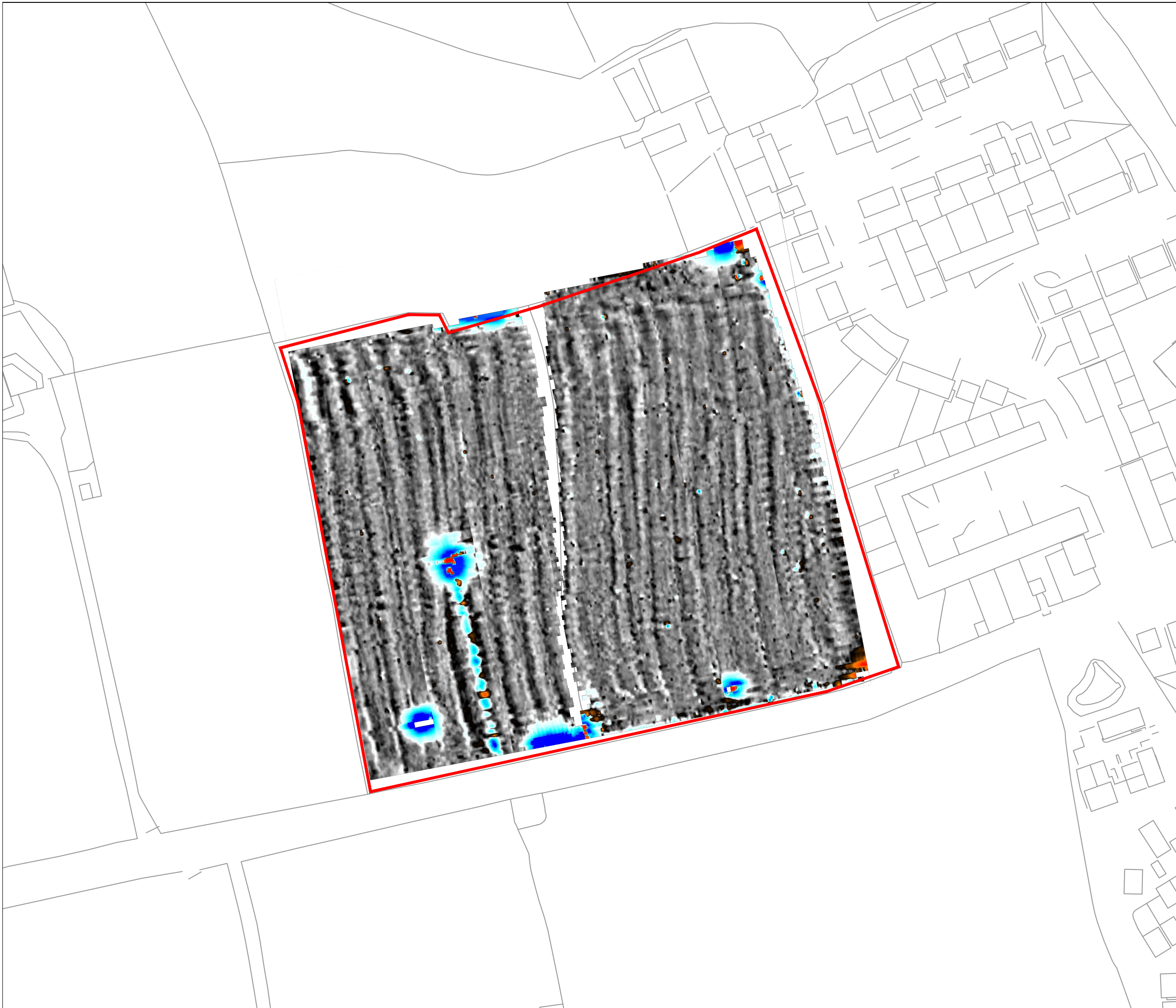


Fig No: 02



Title: Magnetometer Survey - Colour Plot

Client: The Environmental Dimension Partnership Ltd

Project: 09960 Bretch Hill, Banbury

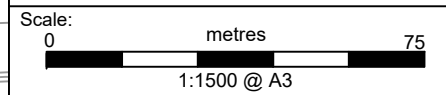




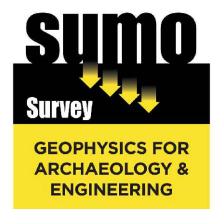


Fig No: 03



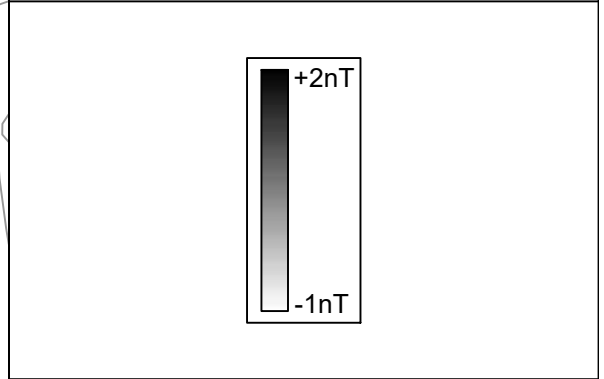
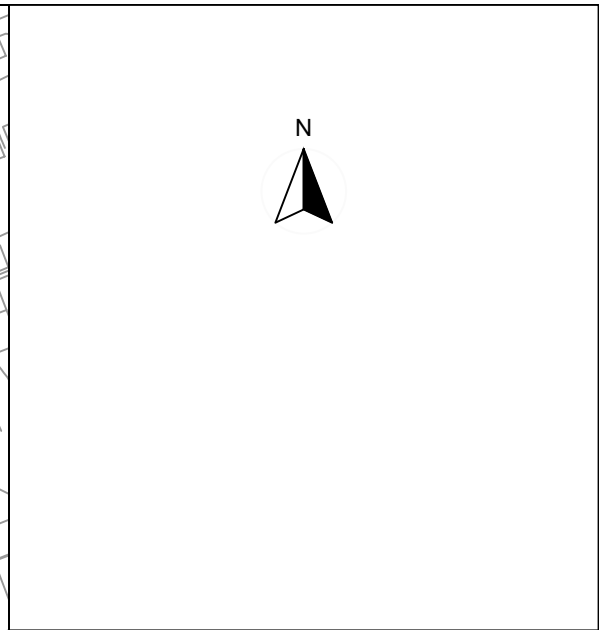
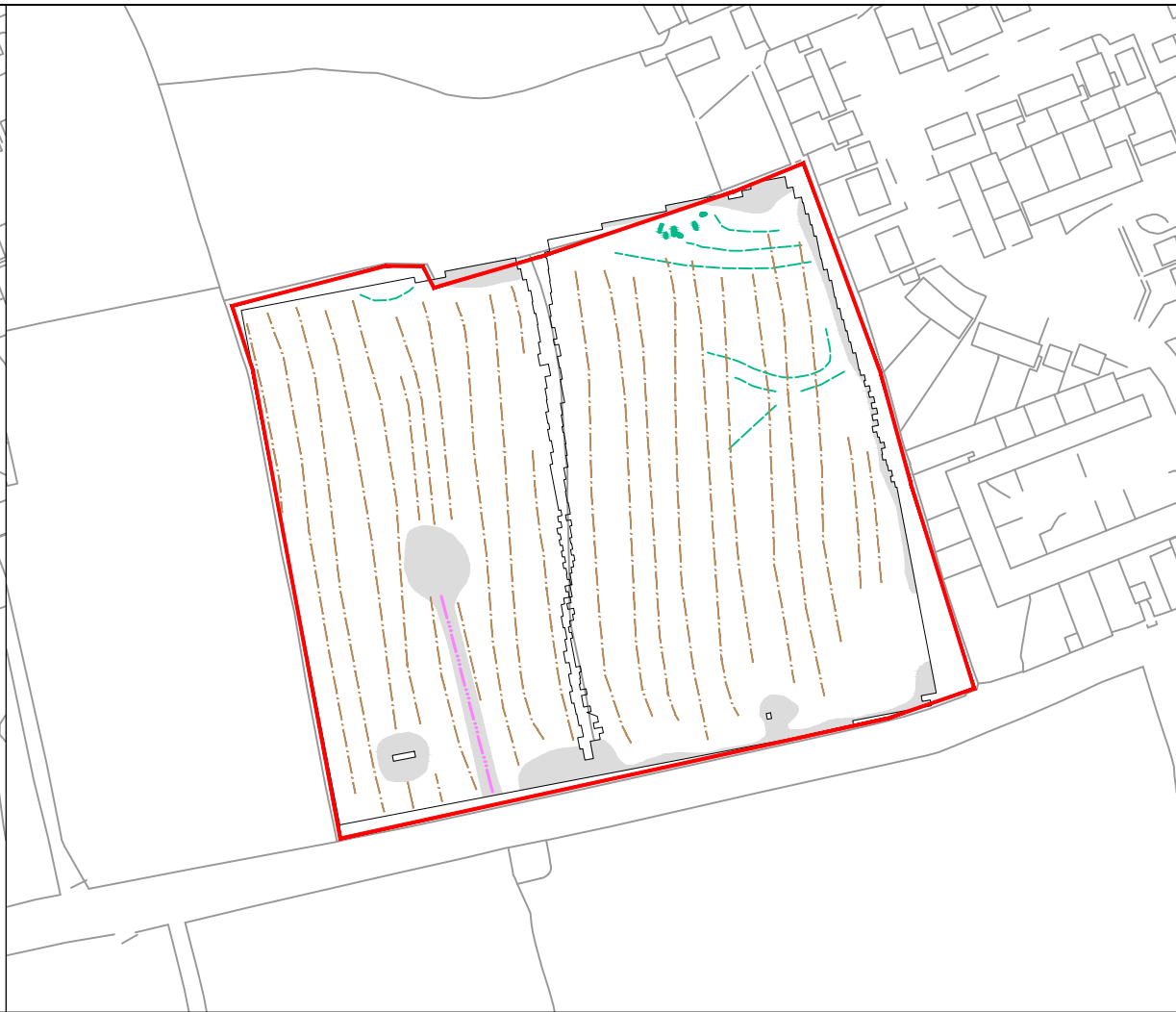
KEY

	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Service
	Ferrous



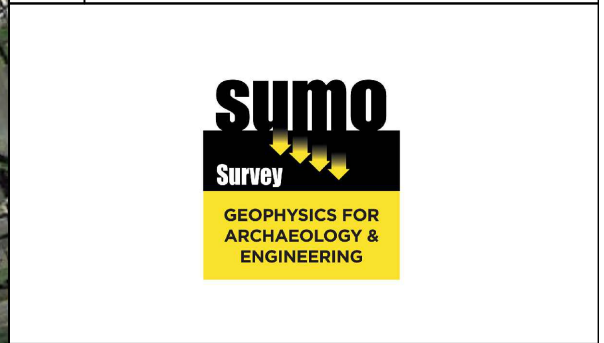
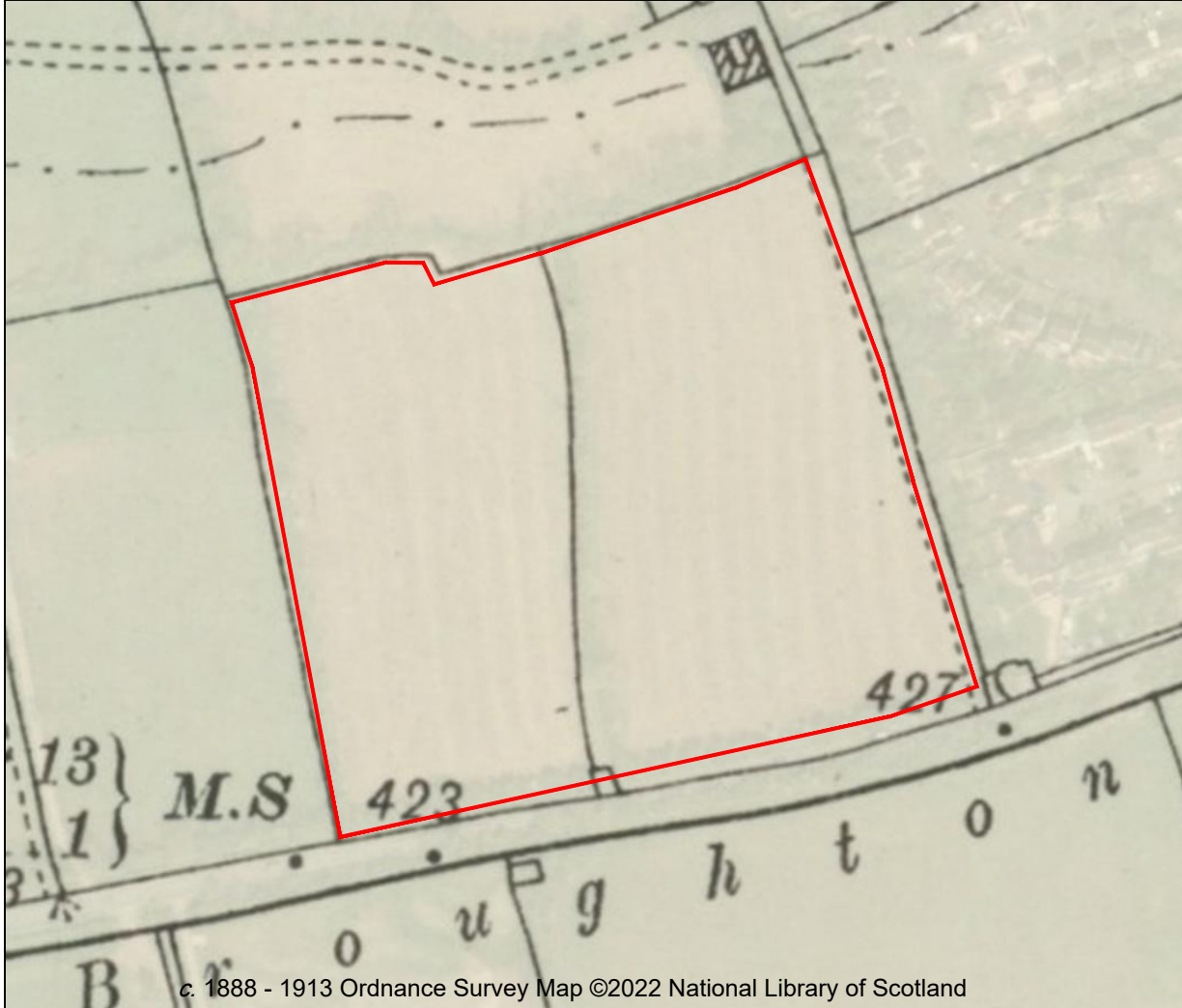
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 Client: The Environmental Dimension Partnership Ltd
 Project: 09960 Bretch Hill, Banbury

Scale: 0 metres 75
 1:1500 @ A3
 Fig No: 04



KEY

	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Service
	Ferrous

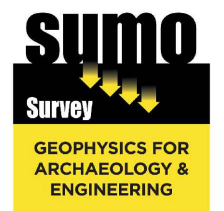
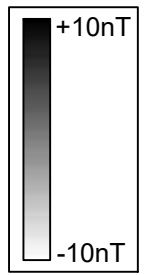


Title:
Greyscale Plot / Interpretation / c. 1888-1913
Ordnance Survey Map / 2021 Aerial Image

Client:
The Environmental Dimension Partnership Ltd

Project:
09960 Bretch Hill, Banbury

Scale: NOT TO SCALE
Fig No: 05



Title:
Minimally Processed Data - Greyscale Plot

Client:
The Environmental Dimension Partnership Ltd

Project:
09960 Bretch Hill, Banbury

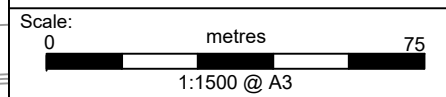
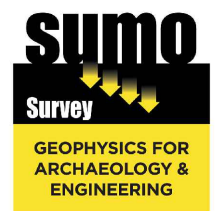


Fig No:
06



Title:
XY Trace Plots (clipped at +/-15nT)

Client:
The Environmental Dimension Partnership Ltd

Project:
09960 Bretch Hill, Banbury

Scale:
0 metres 75
1:1500 @ A3

Fig No:
07

Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1.0m	0.25m
Magnetometer	Bartington Cart System	1.0m	0.125m

Instrumentation:

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted horizontally, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths.

Bartington Grad 601-2

Hand-Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines

Bartington Cart System

Data will be collected using a cart carrying four paired Bartington magnetic sensors. Each data point is geographically referenced using an on-board Trimble RTK survey grade GPS system. Readings will be taken at 0.125m centres along traverses 1.0m apart.

Data Processing

Zero Mean	This process sets the background mean of each traverse within each grid to zero.
Traverse	The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.
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Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall, etc.*) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

<i>Archaeology / Probable Archaeology</i>	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
<i>Possible Archaeology</i>	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
<i>Industrial / Burnt-Fired</i>	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
<i>Former Field Boundary (probable & possible)</i>	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
<i>Ridge & Furrow</i>	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
<i>Agriculture (ploughing)</i>	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
<i>Land Drain</i>	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
<i>Natural</i>	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
<i>Magnetic Disturbance</i>	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
<i>Service</i>	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
<i>Ferrous</i>	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
<i>Uncertain Origin</i>	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of <i>Possible Archaeology / Natural</i> or (in the case of linear responses) <i>Possible Archaeology / Agriculture</i> ; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

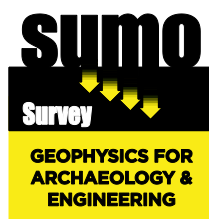
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.

Summary for sumogeop1-510994

OASIS ID (UID)	sumogeop1-510994
Project Name	Geophysical Survey, Magnetometry Survey at Bretch Hill, Banbury
Sitename	Bretch Hill, Banbury
Activity type	Geophysical Survey, Magnetometry Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	09960
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	04-Nov-2022 - 04-Nov-2022
Location	Bretch Hill, Banbury NGR : SP 43780 39752 LL : 52.0544315068089, -1.36292819971531 12 Fig : 443780,239752
Administrative Areas	Country : England County : Oxfordshire District : Cherwell Parish : Banbury
Project Methodology	A temporary grid system was established over the site and marked out using canes. The location of the grid was set out using an RTK GPS system theoretically accurate to some 0.01m and referenced to OS co-ordinates. Hand Held: Data was collected using a Bartington Grad 601-2. The instrument consists of two paired sensors and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines. Two sensors mounted 1m horizontally apart and very accurately aligned to nullify the effects of the earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background.
Project Results	The magnetometer survey has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. Several pit-like responses and curving trends have been assigned to the category of uncertain. While archaeological origins cannot be entirely ruled out; they could also be due to agriculture or natural processes. Ridge and furrow ploughing is visible throughout the dataset and the route of a probable small pipe has also been marked.
Keywords	Ridge And Furrow - MEDIEVAL - FISH Thesaurus of Monument Types Pipeline - 20TH CENTURY - FISH Thesaurus of Monument Types
Funder	
HER	Oxfordshire HER - unRev - STANDARD
Person Responsible for work	Thomas, Cockcroft
HER Identifiers	
Archives	



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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