

GEOPHYSICAL SURVEY REPORT

Nuneham Courtenay, Oxfordshire

Client

Pegasus Group

Survey Report

09575

OASIS Ref. No.

sumogeop1-513908

Date

15 March 2023



Survey Report 09575: Nuneham Courtenay, Oxfordshire

Survey dates 24 November - 7 December, 15 December 2022
27 - 28 February 2023

Field co-ordinator Simon Lobel BSc
Jordan Morris BA
Robert Knight BA MA

Field Team Robert Ottolangui MSc
Joshua Retter BA MA
Andrew Turnbull MA
Charlotte Mawdsley MA
Stephen Weston BA

Report Date 15 March 2023

CAD Illustrations Rebecca Fradgley BSc (Hons) ACIfA

Report Author Rebecca Fradgley BSc (Hons) ACIfA

Project Manager Simon Haddrell BEng AMBCS PCIfA

Report approved Dr John Gater BSc DSc(Hon) MCIfA FSA

SUMO Geophysics Ltd
Vineyard House
Upper Hook Road
Upton upon Severn
Worcestershire
WR8 0SA

T: 01684 592266

www.sumoservices.com
geophysics@sumoservices.com

TABLE OF CONTENTS

1	LIST OF FIGURES.....	3
2	LIST OF APPENDICES	3
3	SURVEY TECHNIQUE	4
4	SUMMARY OF RESULTS	5
5	INTRODUCTION.....	5
6	RESULTS.....	6
7	DATA APPRAISAL & CONFIDENCE ASSESSMENT	6
8	CONCLUSION	7
9	REFERENCES.....	8
10	ARCHIVE	8

1 LIST OF FIGURES

Figure 01	NTS	Site Location
Figure 02	1:5000	Magnetometer Survey - Greyscale Plots – Overview
Figure 03	1:5000	Magnetometer Survey - Colour Plots – Overview
Figure 04	1:5000	Magnetometer Survey – Interpretation – Overview
Figure 05	1:2000	Magnetometer Survey - Greyscale Plots – Areas 1 and 9 (Scheduled Monument Area)
Figure 06	1:2000	Magnetometer Survey - Colour Plots – Areas 1 and 9 (Scheduled Monument Area)
Figure 07	1:2000	Magnetometer Survey – Interpretation – Areas 1 and 9 (Scheduled Monument Area)
Figure 08	1:2500	Magnetometer Survey - Greyscale Plots – Areas 2 and 3
Figure 09	1:2500	Magnetometer Survey - Colour Plots – Areas 2 and 3
Figure 10	1:2500	Magnetometer Survey – Interpretation – Areas 2 and 3
Figure 11	1:2500	Magnetometer Survey - Greyscale Plots – Areas 4, 5 and 6
Figure 12	1:2500	Magnetometer Survey - Colour Plots – Areas 4, 5 and 6
Figure 13	1:2500	Magnetometer Survey – Interpretation – Areas 4, 5 and 6
Figure 14	1:2500	Magnetometer Survey - Greyscale Plots – Areas 6, 7 and 8
Figure 15	1:2500	Magnetometer Survey - Colour Plots – Areas 6, 7 and 8
Figure 16	1:2500	Magnetometer Survey – Interpretation – Areas 6, 7 and 8
Figure 17	NTS	Greyscale Plots, 2020 Aerial Image, c. 1892-1914 Ordnance Survey Map and Interpretation
Figure 18	1:5000	Minimally Processed Data - Greyscale Plots
Figure 19	1:5000	XY Trace Plots (clipped at +/-15nT)

2 LIST OF APPENDICES

Appendix A	Technical Information: Magnetometer Survey Methods, Processing and Presentation
Appendix B	Technical Information: Magnetic Theory
Appendix C	OASIS Data Collection Sheet
Appendix D	Section 42 Summary Sheet

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 site. 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
Bartington Cart System	Traverse Interval 1.0m	Sample Interval 0.125m

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 conducted over approximately 69 hectares at Nuneham Courtenay has identified an extensive complex of archaeological responses, forming a continuation of the scheduled Romano-British site recorded immediately to the north. The complex comprises rectilinear enclosures, ditches, trackways, pits and possible kilns along with a wider field system. Former ridge and furrow cultivation is evident across much of the site, along with numerous systems of land drains, underground services and areas of magnetic disturbance from nearby ferrous objects.

5 INTRODUCTION

- 5.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for solar development. This survey forms part of an archaeological investigation being undertaken by **Pegasus Group**.

- 5.1.1 An Historic England Section 42 licence was obtained by the client **Pegasus Group** on 31 January 2023 in order to conduct a geophysical survey at the Lower Farm, Nuneham Courtenay (NHLE 1471867).

5.2 Site Details

NGR / Postcode	OX44 9NZ / SU 5436 9991
Location	The site is located at Nuneham Courtenay, which lies approximately 6km south of Oxford city centre. The A4074 forms the eastern boundary of the site, with agricultural fields to the north, west and south.
HER	Oxfordshire
OASIS Ref. No.	sumogeop1-513918
District	South Oxfordshire
Parish	Nuneham Courtenay
Topography	Slightly undulating
Land Use	Arable
Geology (BGS 2022)	Bedrock: Ampthill Clay Formation and Kimmeridge Clay Formation – mudstone is recorded across the majority of the site, with Portland Group – limestone and calcareous sandstone present in the southeast and Ampthill Clay Formation – mudstone in the northwest. A band of Kimmeridge Clay Formation – siltstone and sandstone runs approximately north-south through the centre of the area. Superficial: Head – clay, silt, sand and gravel is recorded across the north of the area, with no other superficial deposits present across the site.
Soils (CU 2022)	Soilscape 18: slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	c. 69 ha

5.3 **Archaeological Background**

- 5.3.1 The survey area occupies part of the Scheduled Monument (NHLE 1471867) which comprises prehistoric ring-ditches and enclosures, a Romano-British pottery site, and medieval ridge and furrow at Lower Farm, Nuneham Courtenay. The Romano-British kiln site at Lower Farm, Nuneham Courtenay was partly excavated by the Oxford Archaeological Unit (OAU) in 1991 after being discovered during the laying of the Didcot to Oxford water main where it crossed a field of medieval ridge and furrow. Geophysical surveys revealed a pattern of rectangular enclosures and roadways, with further survey work identifying prehistoric features, including a west-east aligned complex of enclosures lying both sides of a ditched trackway. Clusters of anomalies, interpreted as pottery kilns numbering between 40 and 50, were located within some of the enclosures. Fieldwalking recovered a dense spread of pottery, while excavations identified ditches, pits, postholes, burials and a workshop area (HE 2023).

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 *The survey has been divided into nine survey areas (Areas 1-9) and specific anomalies have been given numerical labels [1] [2] which appear in the text below, as well as on the Interpretation Figure(s).*

6.2 **Probable / Possible Archaeology**

- 6.2.1 A dense concentration of ditch-type responses, linear trends and pit-like anomalies [1] is visible in Area 1 which appear to mark an area of former settlement activity, covering at least 4.5 hectares. The responses comprise adjoining rectilinear enclosures, on a broad northwest-southeast alignment, some with smaller annexed enclosures, internal divisions and discrete features. A probable trackway [1a] can be seen extending from the northeast of the complex, with separate areas of strong magnetic anomalies, indicative of possible kilns or industrial activity [1b], visible at the southeast of a sub-oval enclosure. Several of the features detected are visible as cropmarks on aerial imagery dating to 2019 (see Plate 1, below).



Plate 1: 2019 aerial image with cropmarks of rectilinear enclosures

- 6.2.2 Larger rectilinear and sub-rectangular enclosures [2] extend to the west and southwest from the settlement core [1] in Areas 1 and 3 and are likely to be indicative of an associated wider

field system, with peripheral settlement evidence perhaps indicated by a partial sub-circular feature [3], some 36m in diameter, in the northwest of Area 1. The responses demonstrate a classic magnetic 'habitation' effect, whereby the ditch fills near a settlement core tend to be more enhanced than similar ditches at a distance from the core; the latter lack midden or burnt deposits which contribute to the stronger magnetic responses.

- 6.2.3 A further 250m to the south of the probable field system [2], weaker linear and curvilinear trends, plus discrete positive anomalies, [4], have been identified. It is possible that these indicate a small, sub-circular enclosure however, their isolation from the main zone of settlement and weak nature of the responses has led to their classification as having a *Possible* archaeological origin.

6.3 ***Uncertain***

- 6.3.1 A couple of weak linear and curvilinear trends [5] have been detected in Area 5 (east) which have been assigned to the category of *Uncertain*; they generally lack the defined morphology of anomalies that would usually be interpreted as being of archaeological interest. They are likely to be due to natural or agricultural processes, however the proximity of Romano-British settlement evidence suggests that an archaeological explanation cannot be entirely ruled out.

6.4 ***Agricultural – Ridge and Furrow / Land Drains***

- 6.4.1 Widely spaced, slightly curving, parallel linear anomalies can be seen in the results across the majority of the site, and they are indicative of former ridge and furrow cultivation.
- 6.4.2 Linear anomalies comprising positive and negative components are visible in several areas and are typical of the responses associated with modern land drains. Some of the responses in Area 6 appear to be slightly curved, and it is possible that drains in this location have been laid in furrows of the former cultivation. s

6.5 ***Service***

- 6.5.1 Strong bipolar linear anomalies have been mapped running across Areas 1, 2, and 6. These are a result of underground services, such as pipes.

6.6 ***Ferrous / Magnetic Disturbance***

- 6.6.1 Ferrous responses close to boundaries are due to adjacent fences and gates. 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 variable. The results from this survey indicate the presence of a complex of archaeological features, including enclosures, pits and ditches, along with extensive former ridge and furrow. As a consequence, the survey is deemed to have been effective.

8 **CONCLUSION**

- 8.1 The magnetometer survey at Nuneham Courtenay has recorded a dense complex of magnetic responses which have been interpreted as being of definite archaeological origin. A series of adjoining rectilinear enclosures, ditches, pits, possible kilns, a trackway and a field system have all been mapped; they appear to form a continuation of the scheduled Romano-British pottery production site immediately to the north (NHLE 1471867) and they are also partly visible as cropmarks on aerial imagery. Additional weaker linear and curvilinear trends could represent

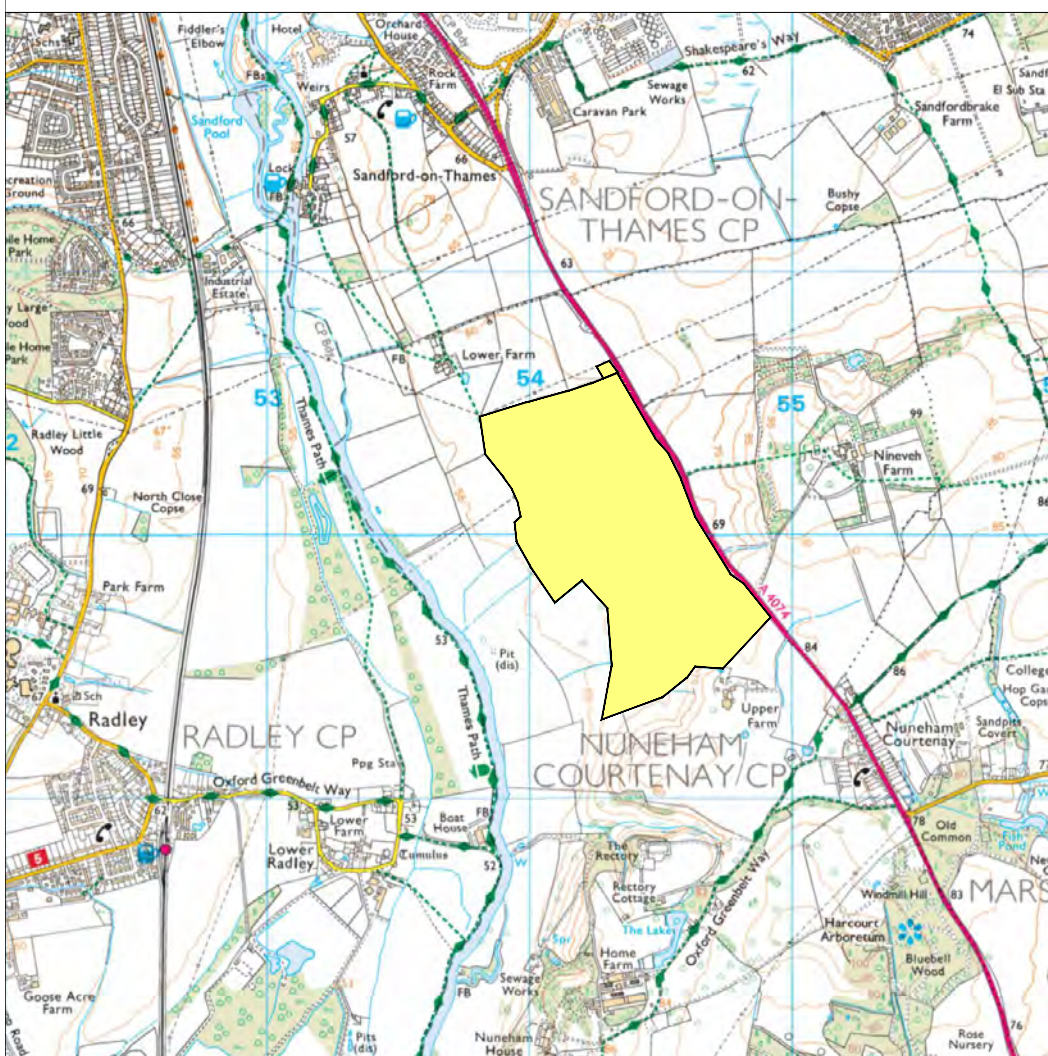
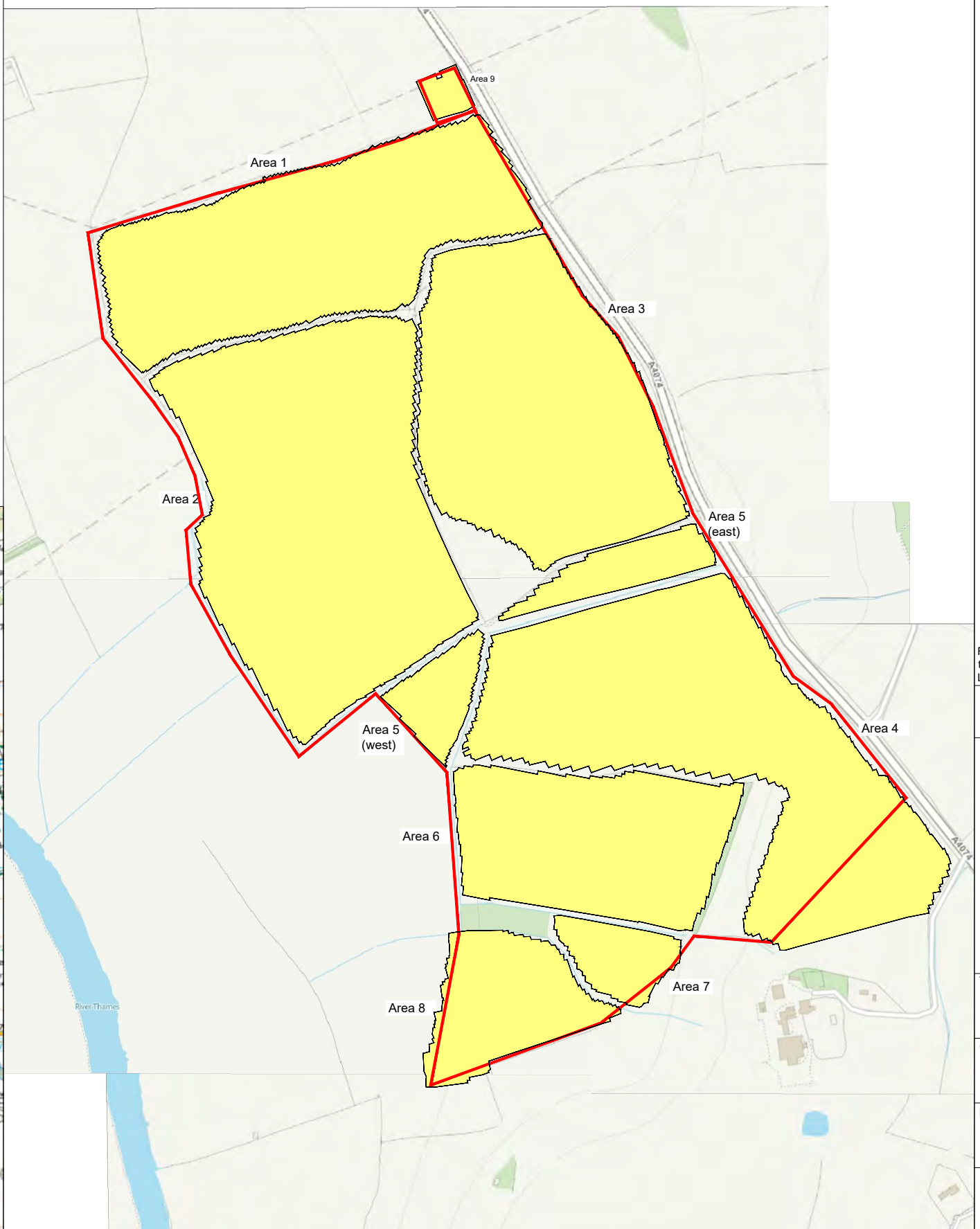
peripheral activity, or other elements of the associated field system. Extensive evidence for ridge and furrow is has been mapped across the site, with a large number of modern field drains also visible. Underground services and areas of magnetic disturbance are also present in the data.

9 REFERENCES

- BGS 2022 British Geological Survey, Geology of Britain viewer [accessed 15/03/2023] *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 15/03/2023] *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.
- EH 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage, Swindon (now withdrawn, but used for evaluating suitability of soil types)
- HE 2023 Historic England - National Heritage List for England: Romano-British pottery site, prehistoric ring-ditches and enclosures, including medieval ridge and furrow, Lower Farm, Nuneham Courtenay. NHLE 1471867. *website:* <https://historicengland.org.uk/listing/the-list/list-entry/1471867?section=official-list-entry>

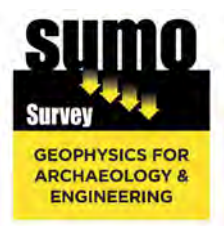
10 ARCHIVE

- 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.



Reproduced from Ordnance Survey's 1:25 000 map of 1998 with the permission of the controller of Her Majesty's Stationery Office. Crown Copyright reserved. Licence No: 100018665

	Survey Areas	N
--	--------------	---

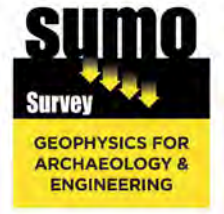
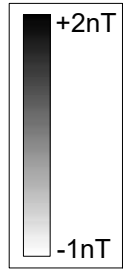


Title: Site Location

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: NOT TO SCALE	Fig No: 01
---------------------	------------



Title: Magnetometer Survey - Greyscale Plots - Overview

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

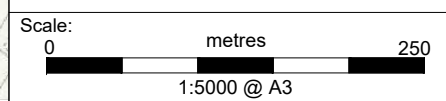
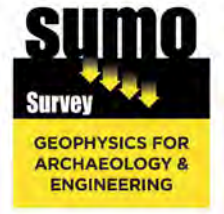
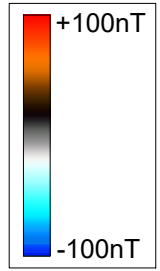
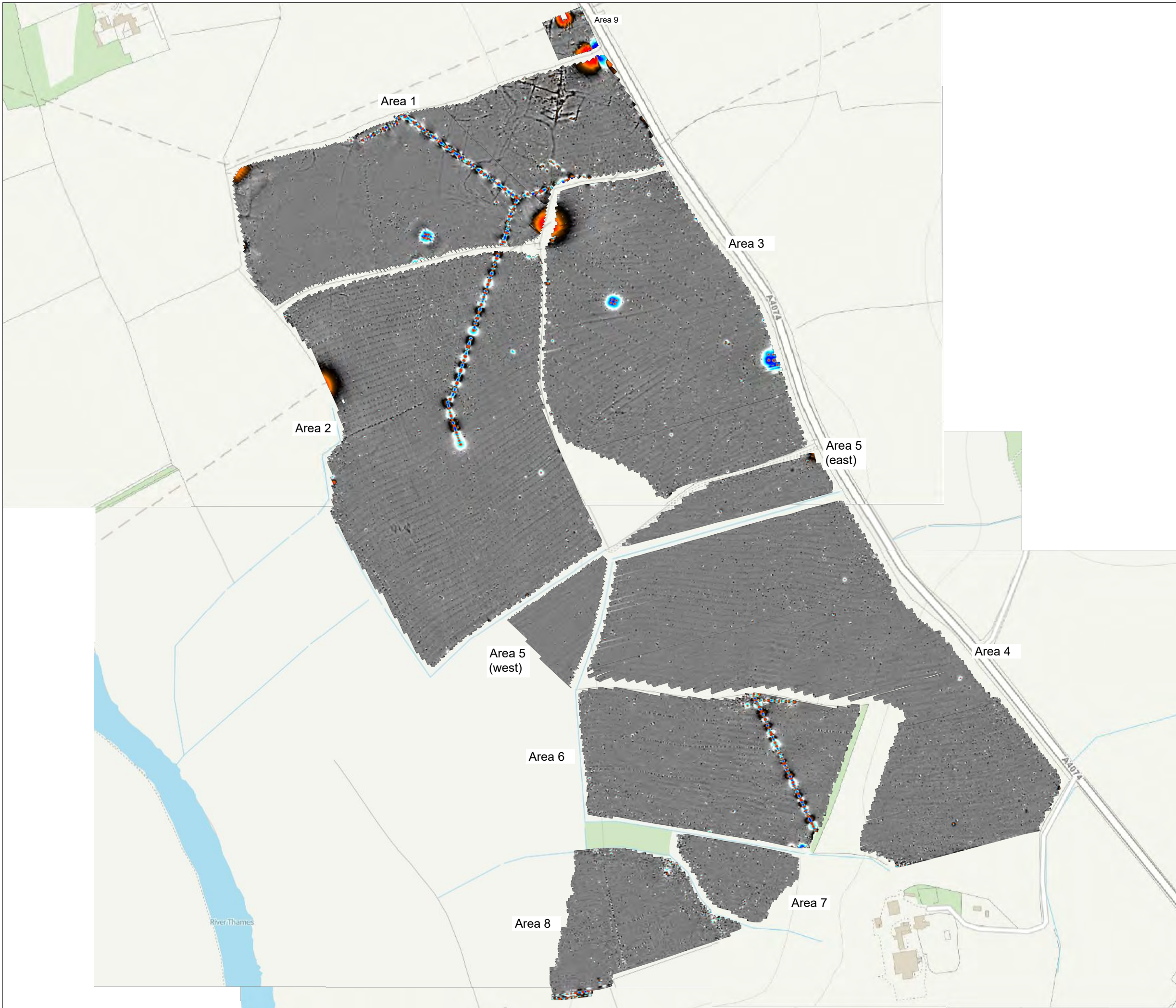


Fig No: 02



Title:
Magnetometer Survey - Colour Plots - Overview

Client:
Pegasus Group

Project:
09575 - Nuneham Courtenay, Oxfordshire

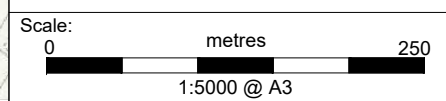
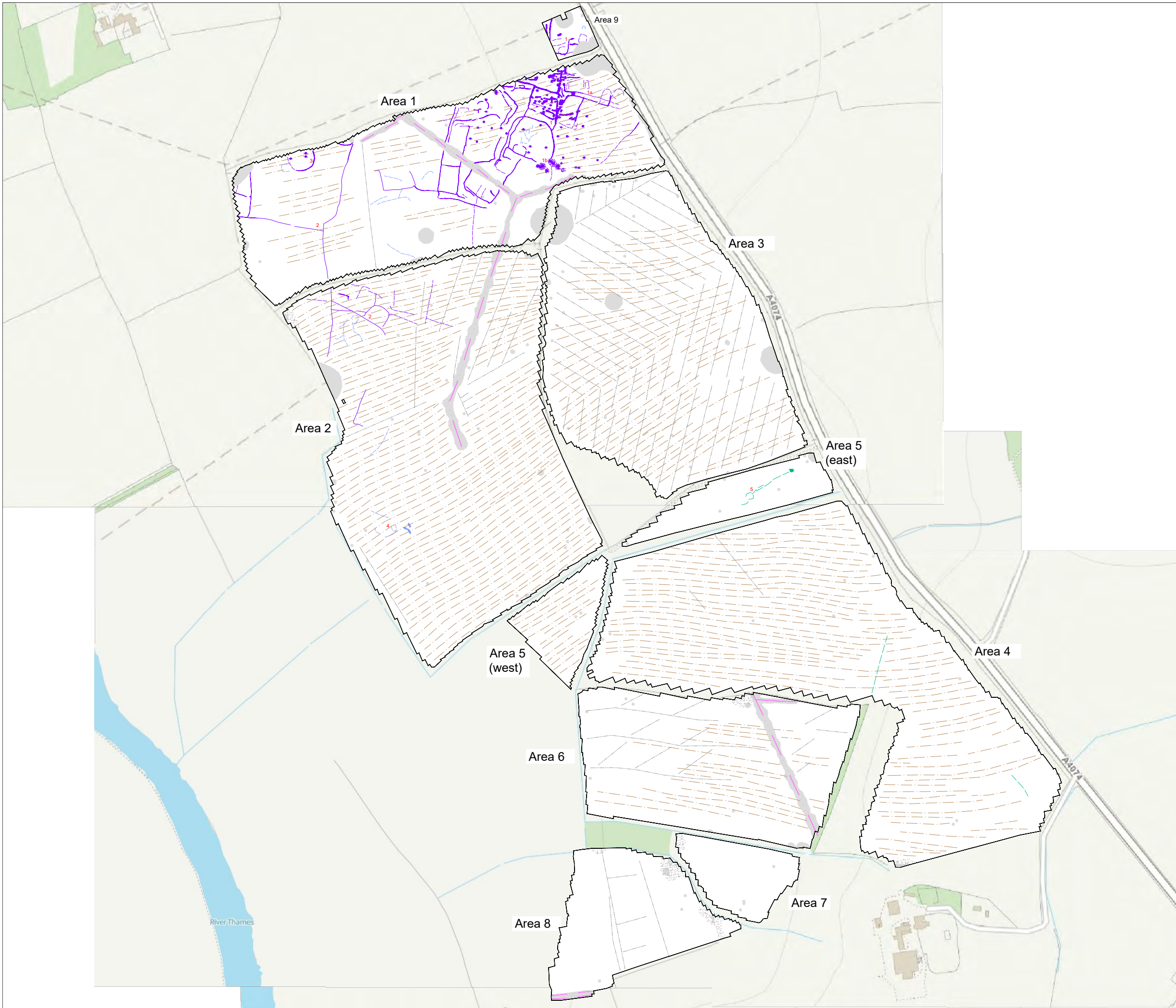


Fig No:
03



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



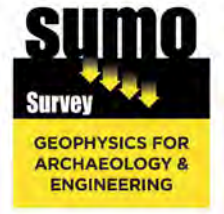
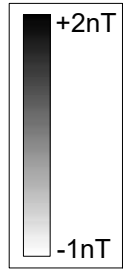
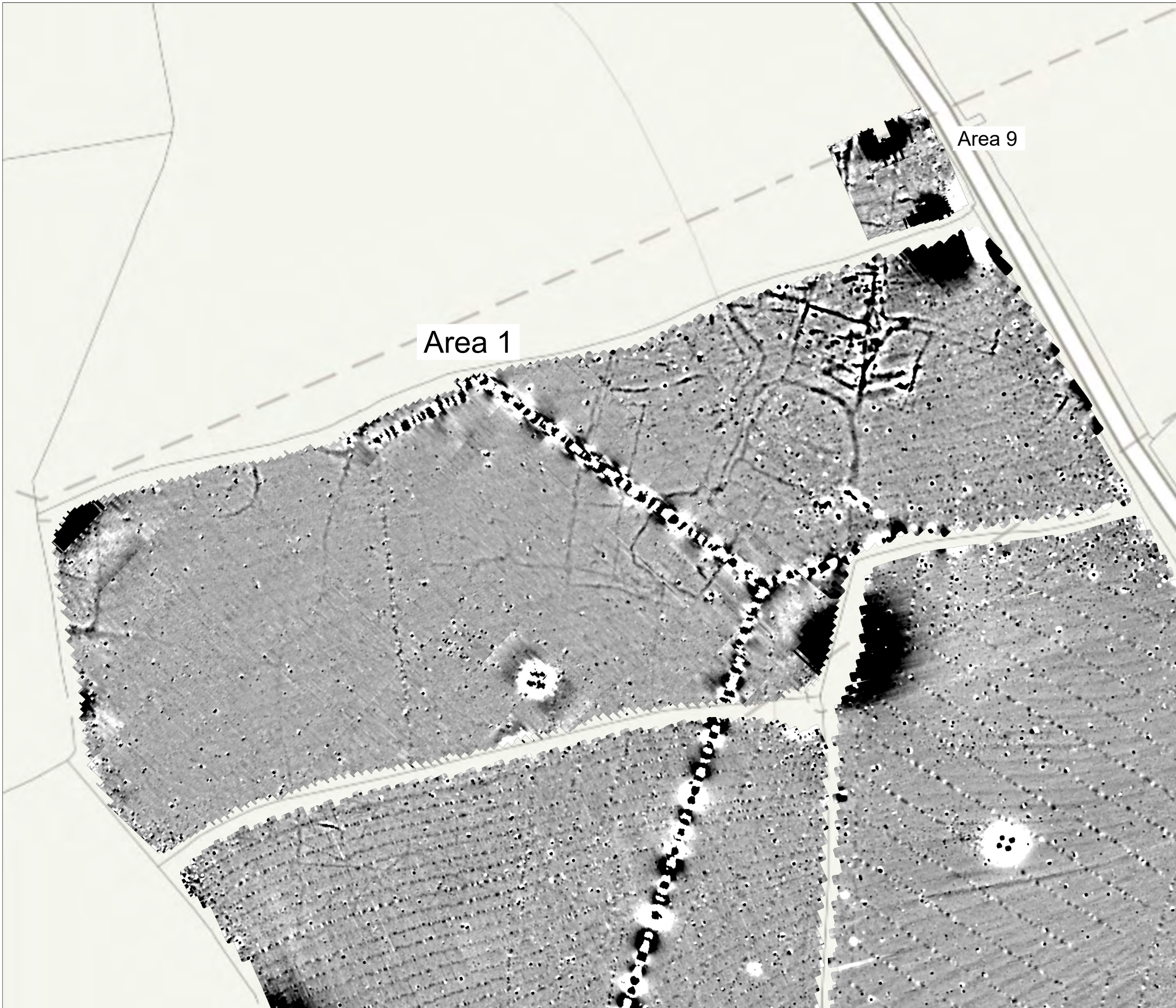
Title: Magnetometer Survey - Interpretation - Overview

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 250
1:5000 @ A3

Fig No: 04



Title: Magnetometer Survey - Greyscale Plots - Area 1 and Area 9 (Scheduled Monument Area)

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

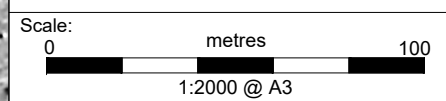
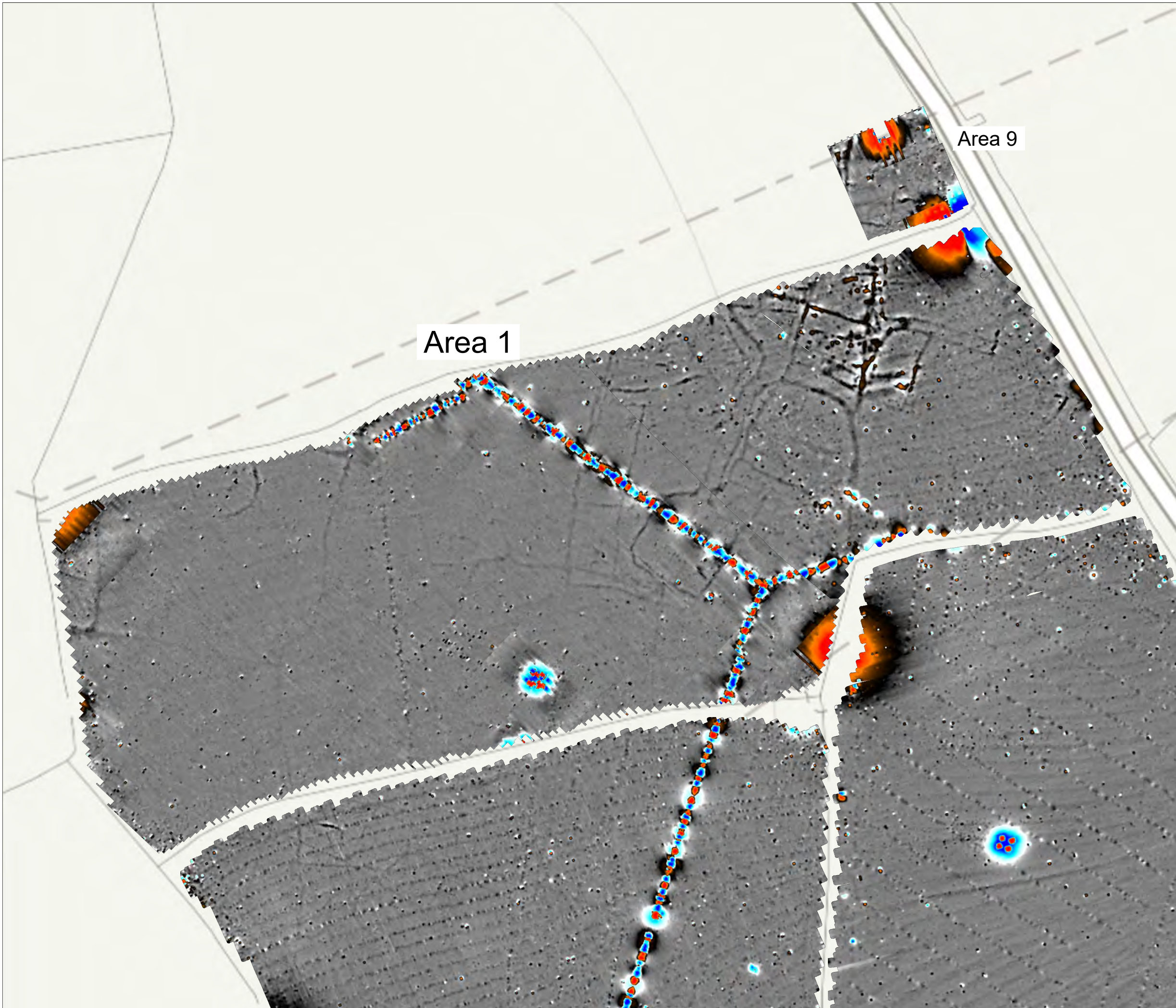
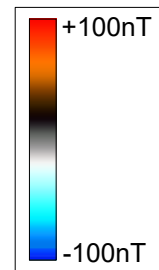


Fig No: 05



Area 1

Area 9



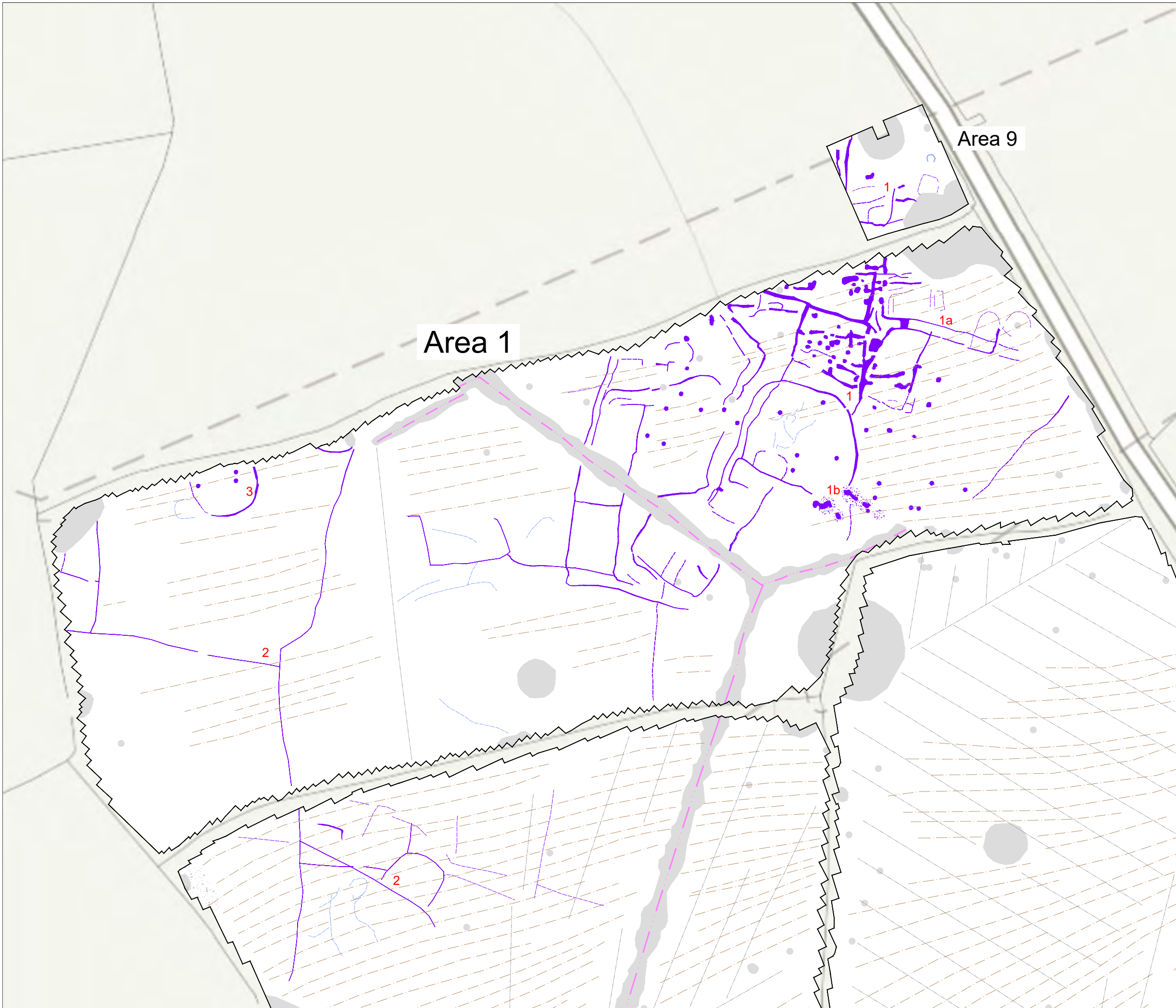
Title: Magnetometer Survey - Colour Plots - Area 1 and Area 9 (Scheduled Monument Area)

Client: Pegasus Group









Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 100
1:2000 @ A3

Fig No: 06



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



Title: Magnetometer Survey - Interpretation - Area 1 and Area 9 (Scheduled Monument Area)

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 100
1:2000 @ A3

Fig No: 07

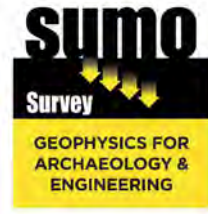
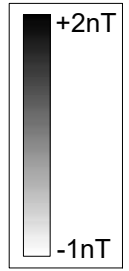


Area 3

Area 2

Area (east)

Area 5 (west)



Title: Magnetometer Survey - Grayscale Plots - Areas 2 and 3

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

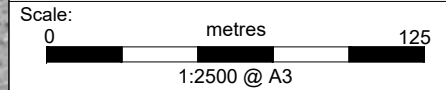
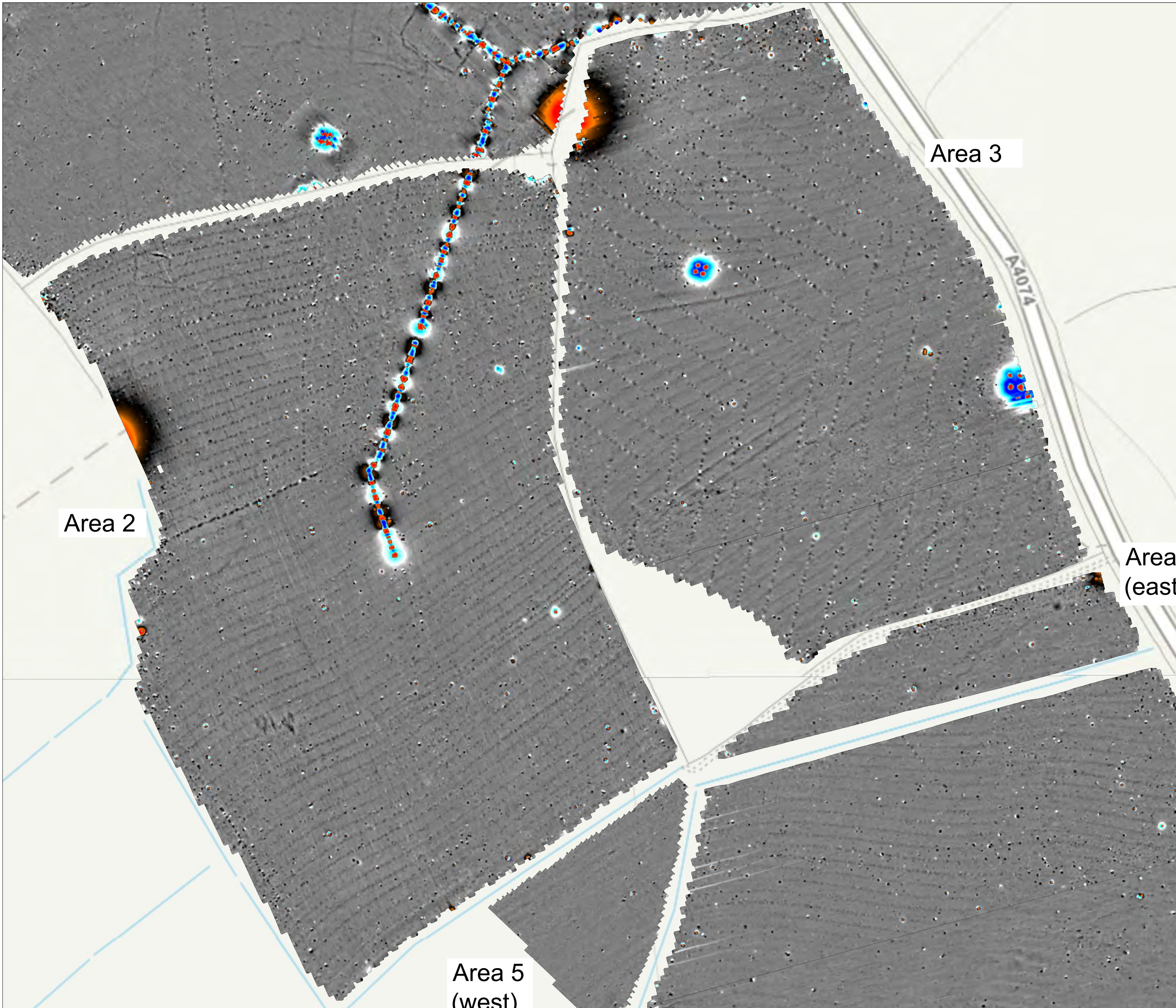


Fig No: 08

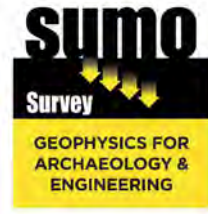
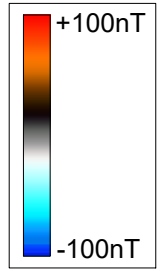


Area 3

Area 2

Area
(east)

Area 5
(west)



Title: Magnetometer Survey - Colour Plots - Areas 2 and 3

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

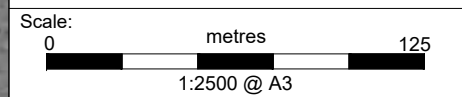
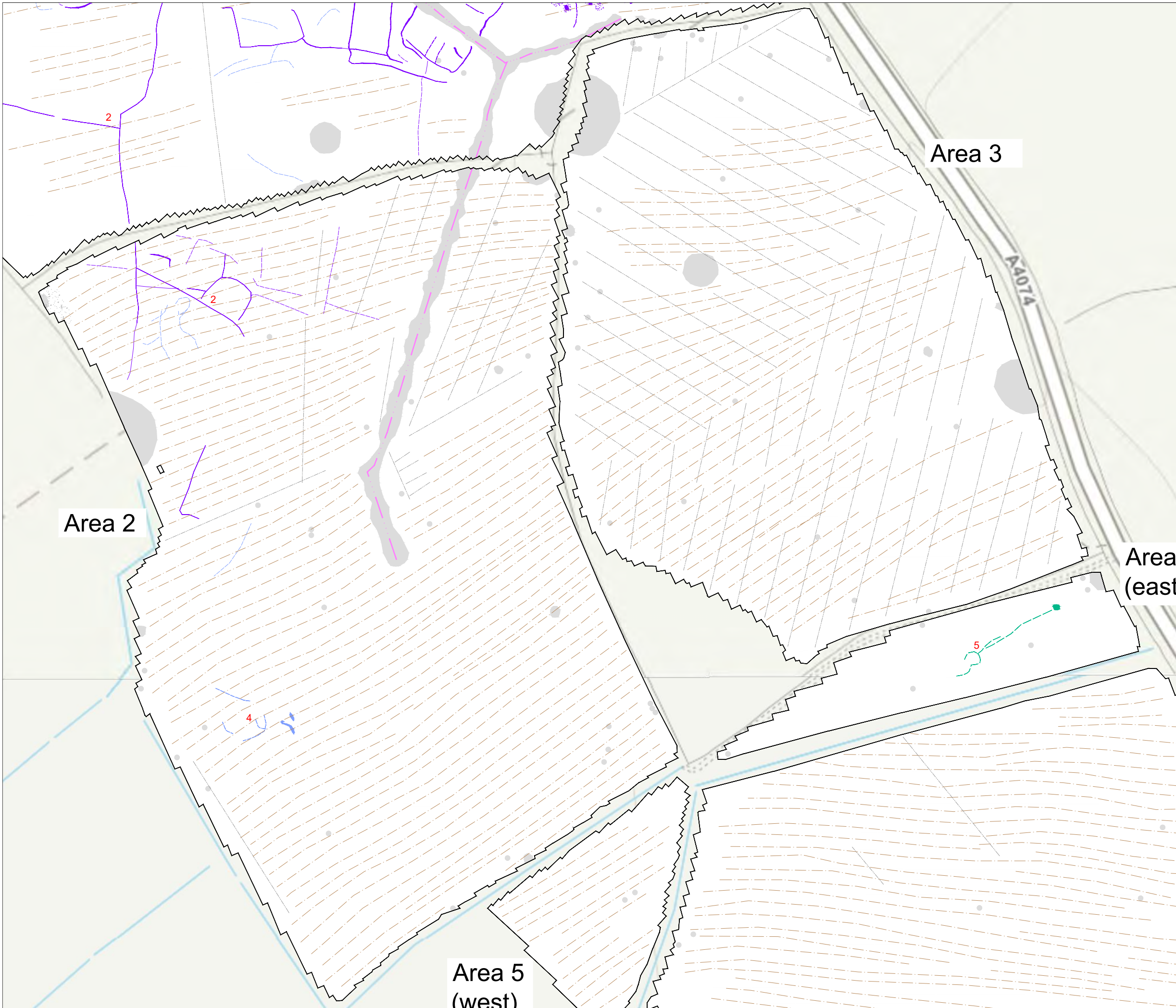


Fig No: 09



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



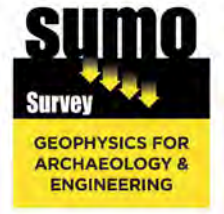
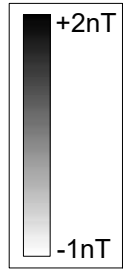
Title: Magnetometer Survey - Interpretation - Areas 2 and 3

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 125
1:2500 @ A3

Fig No: 10



Title: Magnetometer Survey - Greyscale Plots - Areas 4, 5 and 6

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

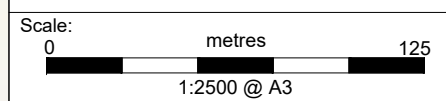
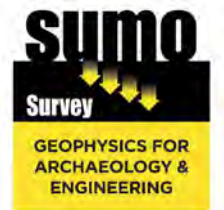
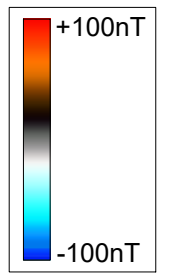


Fig No: 11



Title: Magnetometer Survey - Colour Plots - Areas 4, 5 and 6

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

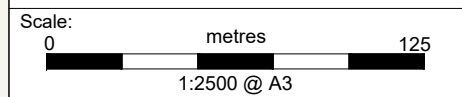
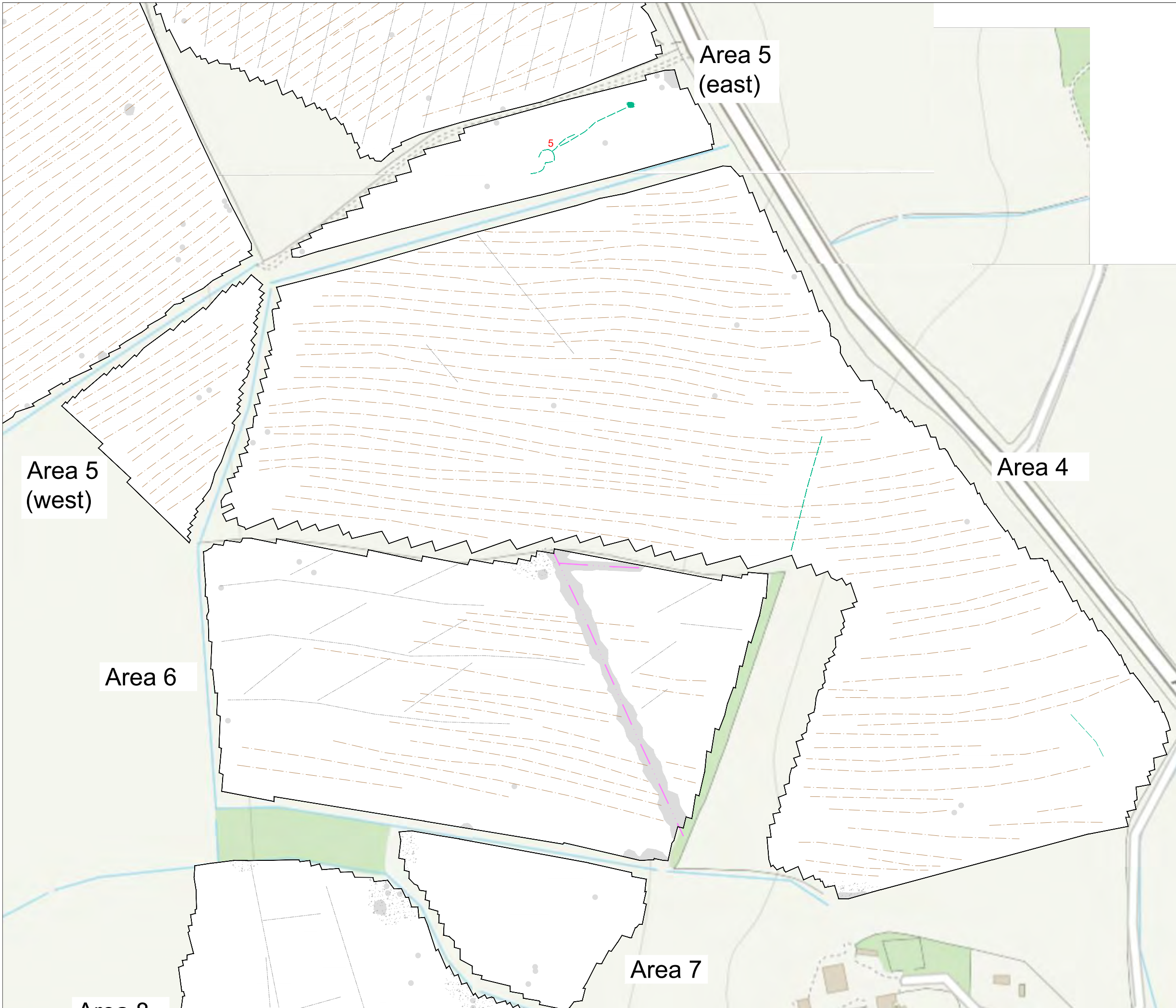








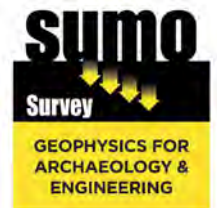


Fig No: 12



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



Title: Magnetometer Survey - Interpretation - Areas 4, 5 and 6

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 125
1:2500 @ A3

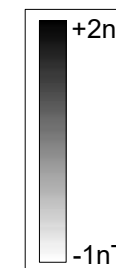
Fig No: 13

Area 5
(west)

Area 6

Area 8

Area 7



Title:
Magnetometer Survey - Greyscale Plots -
Areas 6, 7 and 8

Client:
Pegasus Group

Project:
09575 - Nuneham Courtenay, Oxfordshire

Scale:
0 metres 100
1:2000 @ A3

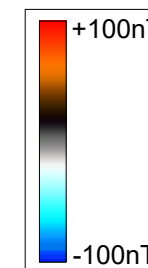
Fig No:
14

Area 5
(west)

Area 6

Area 8

Area 7



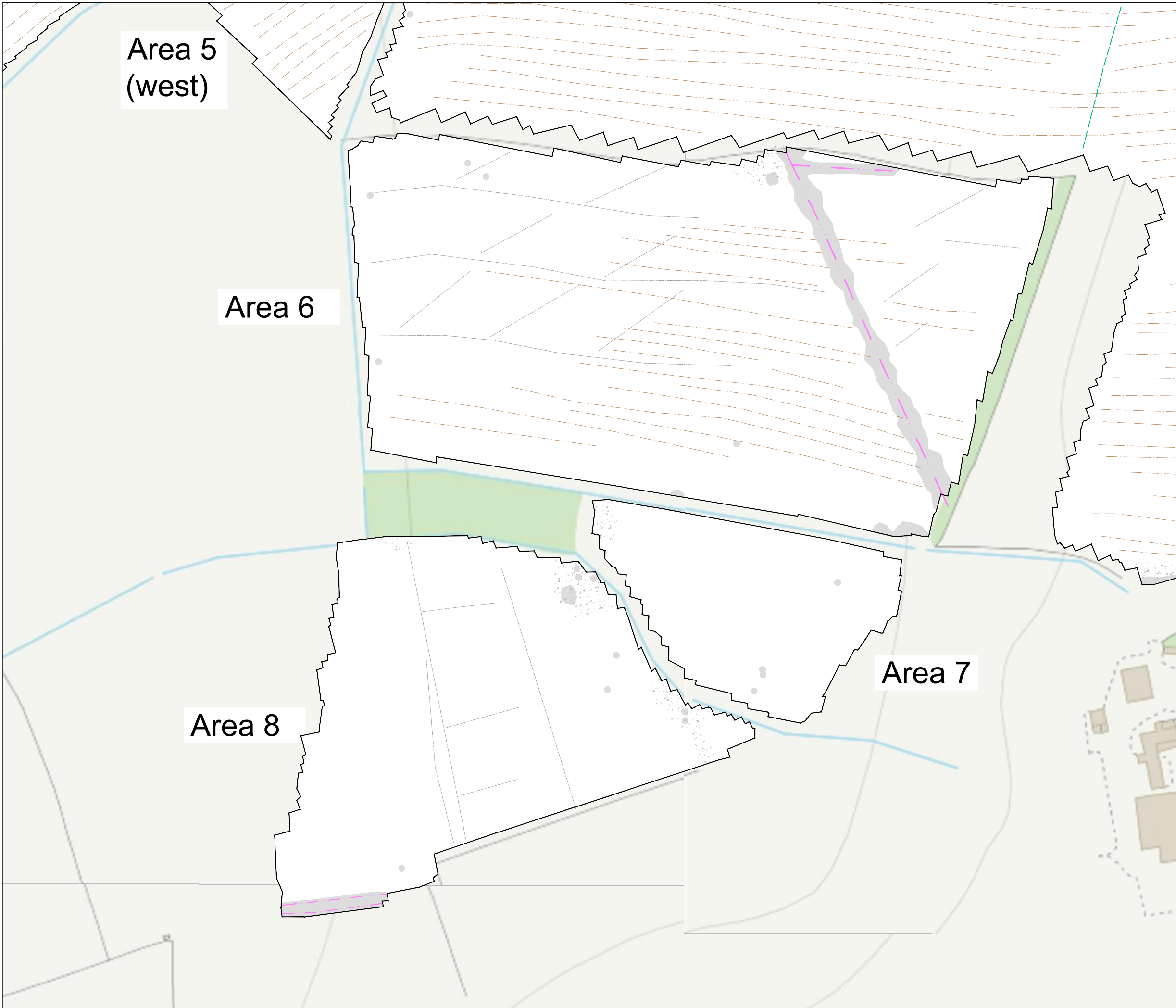
Title: Magnetometer Survey - Colour Plots - Areas 6,7 and 8

Client: Pegasus Group









Project: 09575 - Nuneham Courtenay, Oxfordshire

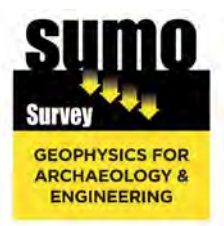
Scale: 0 metres 100
1:2000 @ A3

Fig No: 15



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



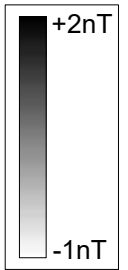
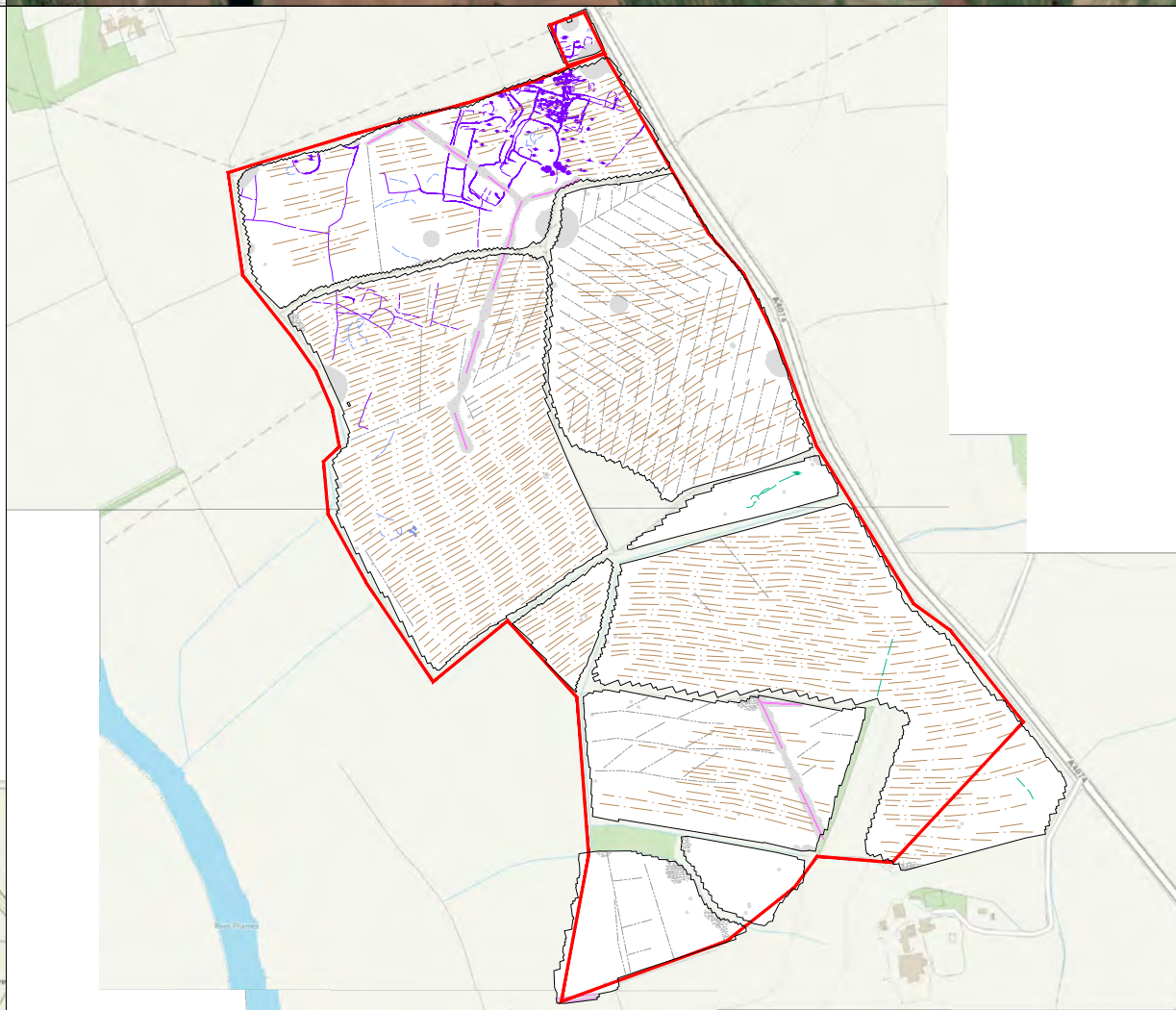
Title: Magnetometer Survey - Interpretation - Areas 6, 7 and 8

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 100
1:2000 @ A3

Fig No: 16



KEY

	Probable archaeology (discrete anomaly / trend / enhanced response)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Agriculture (ridge and furrow)
	Land drain
	Magnetic disturbance
	Service
	Ferrous



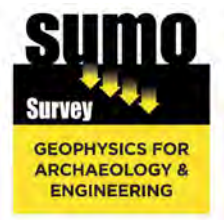
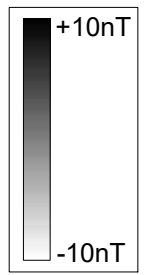
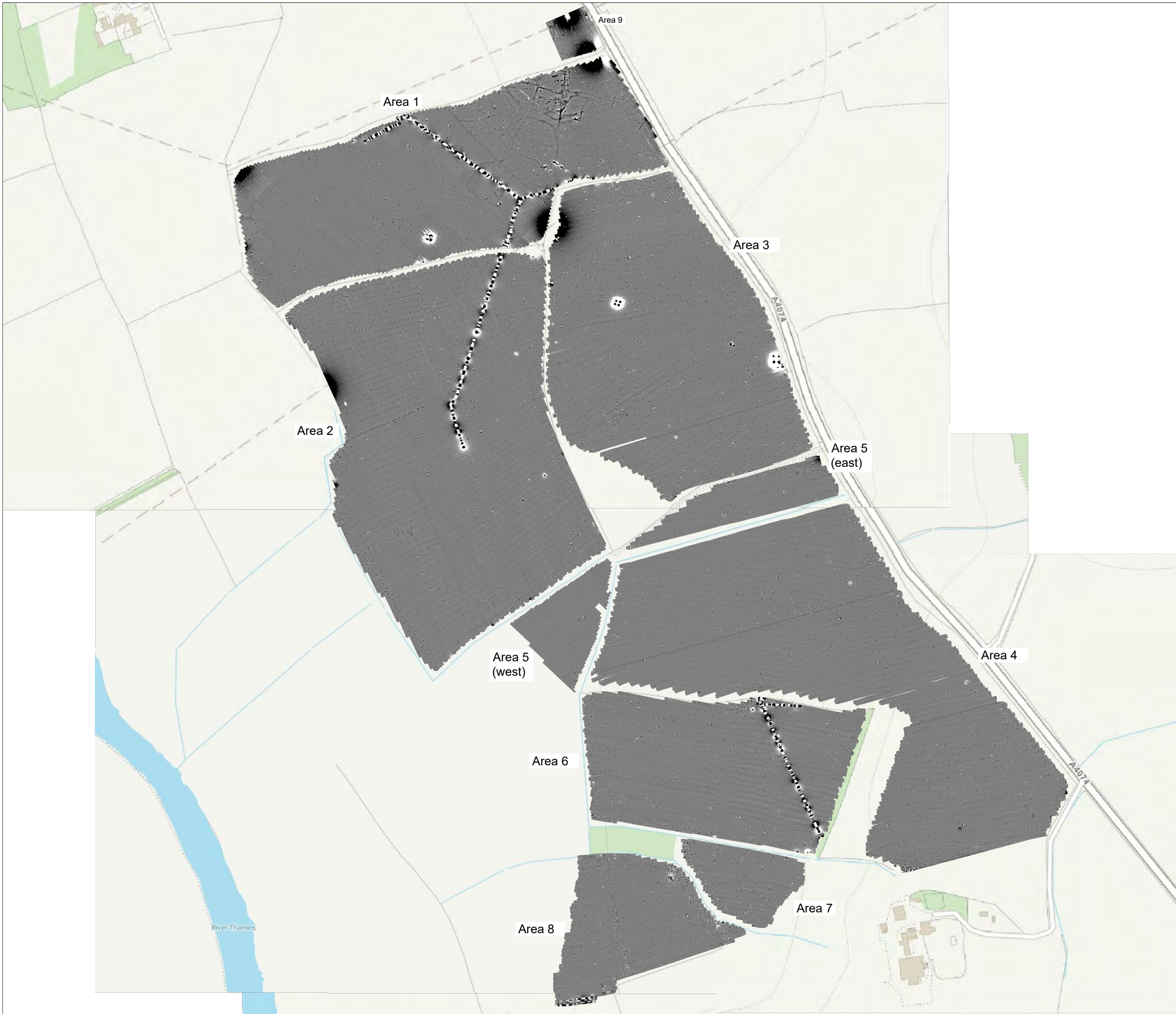
Title:
Greyscale Plots, 2020 Aerial Image, c. 1892-1914
Ordnance Survey Map and Interpretation

Client:
Pegasus Group

Project:
09575 - Nuneham Courtenay, Oxfordshire

Scale:
NOT TO SCALE

Fig No:
17



Title: Minimally Processed Data - Greyscale Plots

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

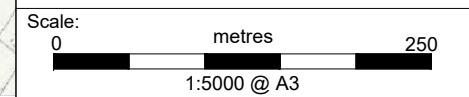
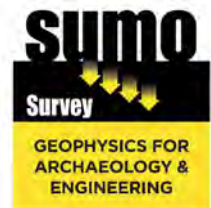


Fig No: 18



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

Client: Pegasus Group

Project: 09575 - Nuneham Courtenay, Oxfordshire

Scale: 0 metres 250
1:5000 @ A3

Fig No: 19

Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

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	1m	0.25m

Instrumentation: **Bartington Grad 601-2**

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, 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. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

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.
--------------------------------	---

Presentation of results and interpretation

The presentation of the results includes a 'minimally processed data' and a 'processed data' greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the 'Interpretation' drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: Abbey Wall or Roman Road. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: Probable, or Possible Archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification Possible.

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.

Appendix C - OASIS Summary Sheet

Summary for sumogeop1-513908

OASIS ID (UID)	sumogeop1-513908
Project Name	Geophysical Survey, Magnetometry Survey at Nuneham Courtenay, Oxfordshire
Sitename	Nuneham Courtenay, Oxfordshire
Activity type	Magnetometry Survey, Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	06575
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	24-Nov-2022 - 28-Feb-2023
Location	Nuneham Courtenay, Oxfordshire NGR : SP 54351 00013 LL : 51.6962400243943, -1.21502106105893 12 Fig : 454351,200013
Administrative Areas	Country : England County : Oxfordshire District : South Oxfordshire Parish : Nuneham Courtenay
Project Methodology	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 site. All survey techniques followed the guidance set out by CIFA (2014, updated 2020), Historic England (2008), and the European Archaeology Council (EAC) (2016).
Project Results	A magnetometer survey conducted over approximately 69 hectares at Nuneham Courtenay has identified an extensive complex of archaeological responses, forming a continuation of the scheduled Romano-British site recorded immediately to the north. The complex comprises rectilinear enclosures, ditches, trackways, pits and possible kilns along with a wider field system. Former ridge and furrow cultivation is evident across much of the site, along with numerous systems of land drains, underground services and areas of magnetic disturbance from nearby ferrous objects.
Keywords	Rectilinear Enclosure - ROMAN - FISH Thesaurus of Monument Types Enclosed Field System - LATER PREHISTORIC - FISH Thesaurus of Monument Types Ridge And Furrow - MEDIEVAL - FISH Thesaurus of Monument Types
Funder	
HER	Oxfordshire HER - unRev - STANDARD
Person Responsible for work	Rebecca, Fradgley
HER Identifiers	
Archives	

Appendix D – Historic England Section 42 Summary Sheet



Historic England Geophysical Survey Summary Questionnaire

Survey Details

Name of Site: **Nuneham**

County: **Oxfordshire**

NGR Grid Reference (Centre of survey to nearest 100m): **SU 5499 3698**

Start Date: **27.02.2023**

End Date: **28.02.2023**

Geology at site (Drift and Solid):

Solid: Amptill Clay Formation and Kimmeridge Clay Formation – mudstone; Amptill Clay Formation – mudstone; Kimmeridge Clay Formation – siltstone and sandstone.

Drift: Head – clay, silt, sand and gravel across northern extent.

Known archaeological Sites/Monuments covered by the survey

(Scheduled Monument No. or National Archaeological Record No. if known)

NHLE 1471867: Romano-British pottery site, prehistoric ring ditches and enclosures, including medieval ridge and furrow, Lower Nuneham Farm, Nuneham Courtenay

Archaeological Sites/Monument types detected by survey

(Type and Period if known. "?" where any doubt).

Surveyor (Organisation, if applicable, otherwise individual responsible for the survey):

SUMO Geophysics

Name of Client, if any:

Pegasus Group



Historic England

Purpose of Survey:

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

Location of:

a) Primary archive, i.e. raw data, electronic archive etc: SUMO Geophysics – Upton upon Severn, Worcestershire

b) Full Report: SUMO Geophysics – Upton upon Severn, Worcestershire



Technical Details

(Please fill out a separate sheet for each survey technique used)

Type of Survey (Use term from attached list or specify other): **Magnetometer**

Area Surveyed, if applicable (In hectares to one decimal place): **67.7**

Traverse Separation, if regular: **1.0**

Reading/Sample Interval: **0.25**

Type, Make and model of Instrumentation: **Bartington Grad 601-2, fluxgate gradiometer**



Historic England

Type of Survey (Use term from attached list or specify other): [Magnetometer](#)

Area Surveyed, if applicable (In hectares to one decimal place): [67.7](#)

Traverse Separation, if regular: [1.0](#)

Reading/Sample Interval: [0.25](#)

Type of Survey (Use term from attached list or specify other): [Magnetometer](#)

Area Surveyed, if applicable (In hectares to one decimal place): [67.7](#)

Traverse Separation, if regular: [1.0](#)
[0.125](#)

Reading/Sample Interval:



Historic England

Land use at the time of the survey (Use term/terms from the attached list or specify other): [Arable](#)

Additional Remarks (Please mention any other technical aspects of the survey that have not been covered by the above questions such as sampling strategy, non standard technique, problems with equipment etc.):



List of terms for Survey Type

Magnetometer (includes gradiometer)

Resistivity

Resistivity Profile

Magnetic Susceptibility

Electro-Magnetic Survey

Ground Penetrating Radar

Other (please specify)

List of terms for Land Use:

Arable

Grassland - Pasture

Grassland - Undifferentiated

Heathland

Moorland

Coastland - Inter-Tidal

Coastland - Above High Water

Allotment

Archaeological Excavation

Garden

Lawn

Orchard

Park

Playing Field

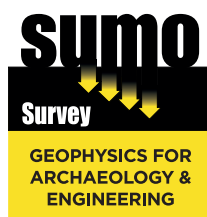
Built-Over

Churchyard

Waste Ground

Woodland

Other (please specify)



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

SUMO Services Ltd, incorporated under the laws of England and Wales,
Company Registration No.4275993.
Registered Office Unit 8 Hayward Business Centre, New Lane, Havant, Hampshire, PO9 2NL