GEOPHYSICAL SURVEY REPORT

Lower End Farm, Great Comberton, Pershore, Worcestershire

Client

Rhys Kate Collingwood

Survey Report

05945

OASIS Ref. No.

sumogeop1-504585

Planning Application

21/02258/FUL

Date

14 February 2022

Survey Report 05945: Lower End Farm, Great Comberton

Survey dates	27 January 2022
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Field Team	Liz Williams
Report Date	14 February 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 site.

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 2 hectares of land on the northern outskirts of Great Comberton was carried to investigate the archaeological potential at the site in connection with the Planning Application No: 21/02258/FUL - the excavation of three ponds, a flood retention area and a ditch meander. The results identified a large (60m x 45m) double ditched enclosure with a small, subdivided area, a possible round house and pit-like features. In addition, there may be other ditches. The remains are thought to be associated with known archaeological features recorded south of the survey area. Other responses recorded in the magnetic data include a few uncertain anomalies, geological effects and a small pipeline. The archaeological features are concentrated in the southern quarter of the site away from the location of the Application Areas.

5 INTRODUCTION

5.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey in advance of proposed works at the site. This survey forms part of an archaeological planning requirement being undertaken for the clients **Rhys Kate Collingwood**.

5.2 Site Details

NGR / Postcode	SO 9599 4258 / WR10 3DU
Location	The site under investigation lies approximately 8km west of Evesham between the villages of Great and Little Comberton and comprises two fields north of Mongcroft Road. The survey area is surrounded by agricultural fields; an open drain follows the western boundary of the site.
HER	Worcestershire
OASIS Ref. No.	sumogeop1-504585
District	Wychavon DC
Parish	Great Comberton CP
Topography	Sloping from 41m aOD in south to 34m aOD in north
Land Use	Pasture
Geology (BGS 2022)	Bedrock: Charmouth Mudstone Formation - mudstone Superficial: Head - clay, silt, sand and gravel
Soils (CU 2022)	Soilscape 5: freely draining lime-rich loamy soils
Archaeology	There are no scheduled sites or other known heritage assets within the application area, however the WDC Archaeologist references two archaeological entries in the Historic Environment Record (HER) for Worcestershire: WSM31634 and WSM56936. The Heritage Gateway also records two sites in fields to the south of the survey site: • MWR1973 / WSM0575 Trackway and enclosures, Mongcroft Road, Great Comberton, of unknown date recorded on aerial photographs. • MWR3258 / WSM10567 Enclosures, north east of Great Comberton, of unknown date seen as slight cropmarks.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	2 ha

5.3 ***Aims and Objectives***

5.3.1 To locate and characterise any anomalies of possible archaeological interest within the survey site.

6 RESULTS

6.1 *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 Strong magnetic anomalies are visible in the southern quarter of the site. They comprise a double-ditched rectilinear enclosure with rounded corners [1] whose eastern limit appears to extend into the adjacent field. The enclosure measures conceivably 70m east-west and 45m north-south from the outer ditch; the centre of the latter is approximately 6m apart from the middle of the inner ditch. There is an entrance [2] at the western end and an inner subdivision [3] in the north-west corner which measures approximately 10m square. A possible ring ditch [4] measures 6m in diameter with an entrance on the south. Pit-like responses are visible within the enclosure. The responses are of clear archaeological interest and presumably they are associated with the features visible on aerial photographs in fields to the south of the site.

6.2.2 To the north of the above enclosure are two weaker linear magnetic anomalies [5] and [6] are just discernible in the data; they probably reflect ditches or gullies possibly associated with the archaeological features.

6.3 ***Uncertain***

6.3.1 There are a few isolated anomalies which have been classified as having an uncertain origin; they could be pits in which case an archaeological origin cannot be ruled out, but it is perhaps more likely that agricultural practices or modern activity will be the cause of the anomalies.

6.4 ***Former Field Boundary – Corroborated***

6.4.1 A tentative line of ferrous anomalies [7] indicates the route of a former field boundary that is visible on historic mapping (see Figure 04).

6.5 ***Natural / Geological***

6.5.1 A small area of amorphous magnetic responses [8] reflects localised variations in the superficial geological deposits.

6.6 ***Pipe / Ferrous***

6.6.1 A linear chain of dipole anomalies close to the existing boundary that divides the survey area into two marks the course of a small ferrous pipe.

6.6.2 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 clear anomalies of archaeological interest; as a consequence the technique is deemed to have worked successfully.

8 CONCLUSION

8.1 The magnetometer survey has recorded a double ditched enclosure with internal features which are indicative of habitation. The enclosure is presumed to be associated with enclosures and a trackway recorded in the HER in fields immediately to the south. On the basis of the geophysical results, the archaeological features appear to be confined to the southern quarter of the survey area. Elsewhere scattered responses of uncertain origin have been mapped, along with geological effects, a former field boundary and a small ferrous pipe.

9 REFERENCES

BGS 2022 British Geological Survey, Geology of Britain viewer [accessed 01/02/2022] *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps)

CIfA 2014* *Standard and Guidance for Archaeological Geophysical Survey.* *Amended 2020. CIfA Guidance note. Chartered Institute for Archaeologists, Reading http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf

CU 2022 The Soils Guide. Available: www.landis.org.uk. Cranfield University, UK. [accessed 01/02/2022] *website: http://mapapps2.bgs.ac.uk/ukso/home.html*

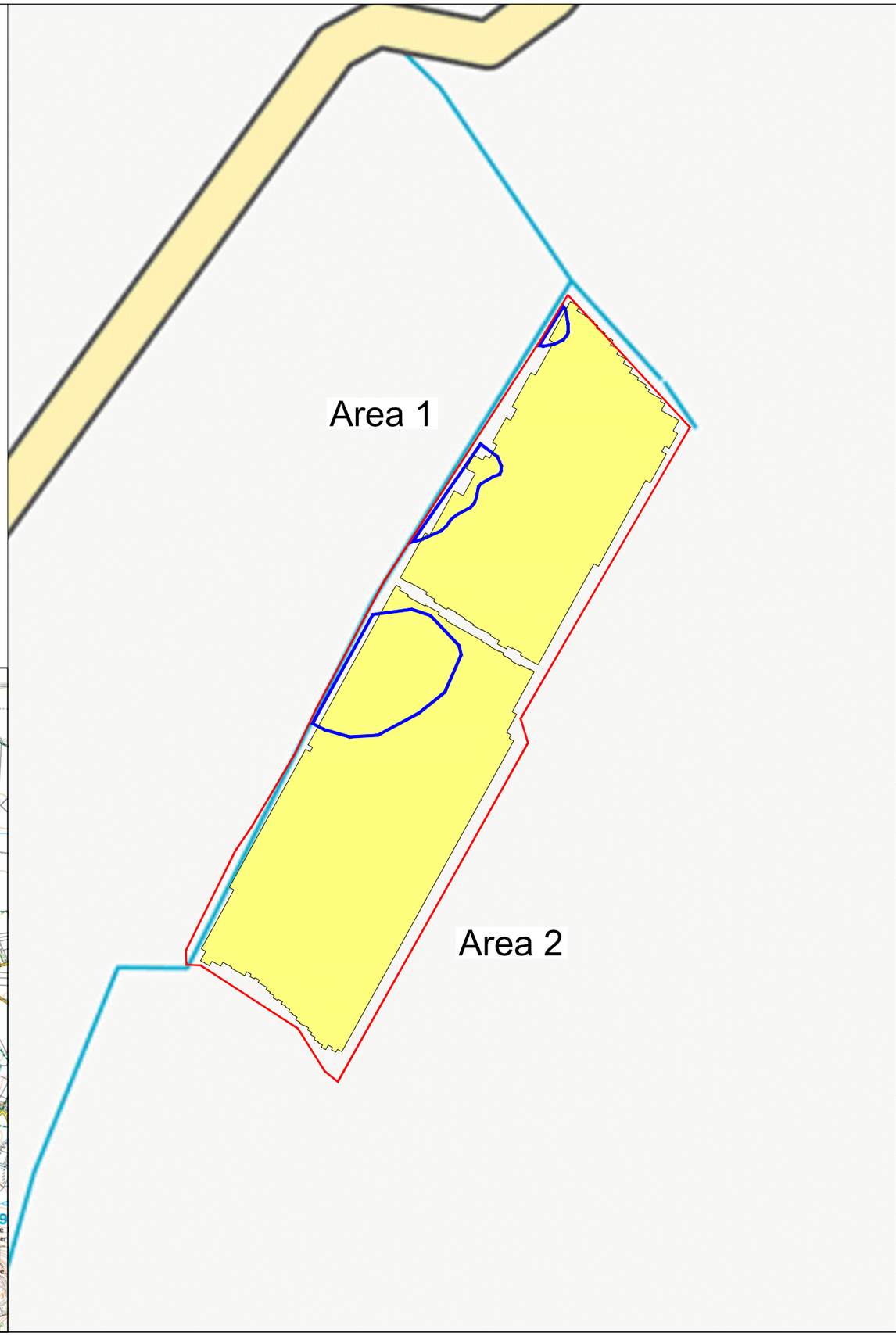
EAC 2016 *EAC Guidelines for the Use of Geophysics in Archaeology,* European Archaeological Council, Guidelines 2.

EH 2008 *Geophysical Survey in Archaeological Field Evaluation.* English Heritage, Swindon https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/ (now withdrawn)

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 Midland's 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



Survey Areas	N
Application Areas	

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

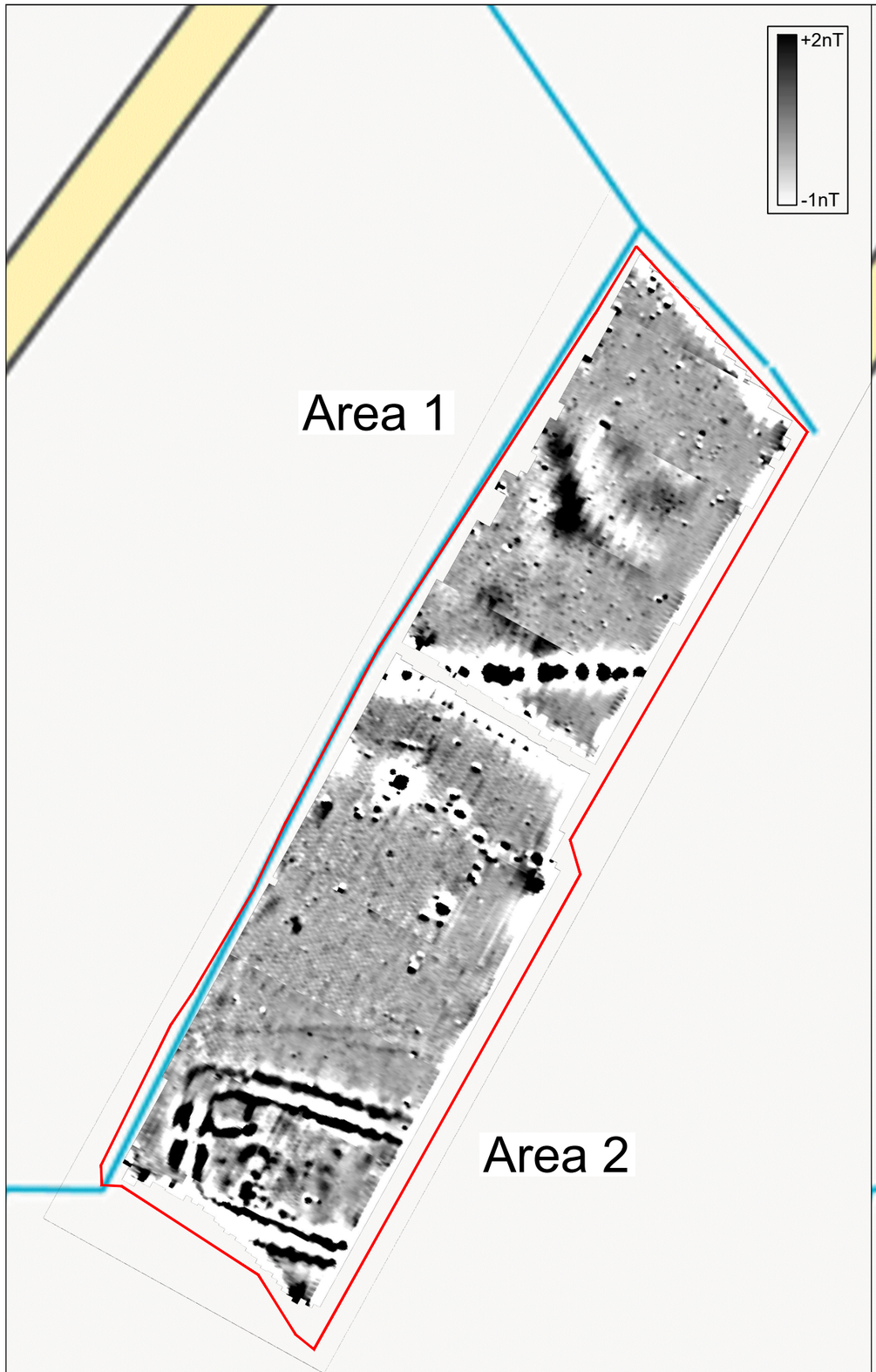
Title:
Site Location

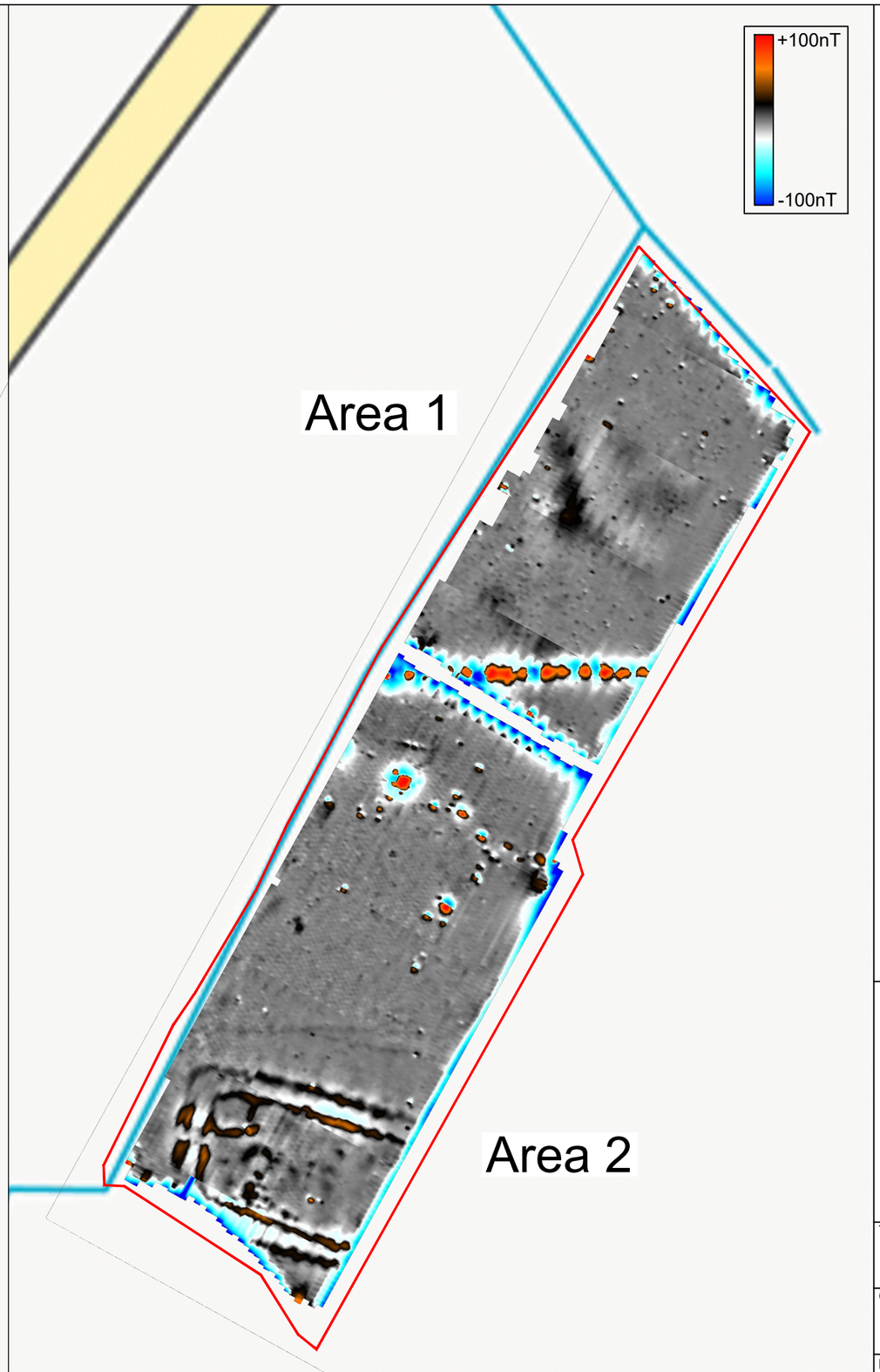
Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
NOT TO SCALE

Fig No:
01





N

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

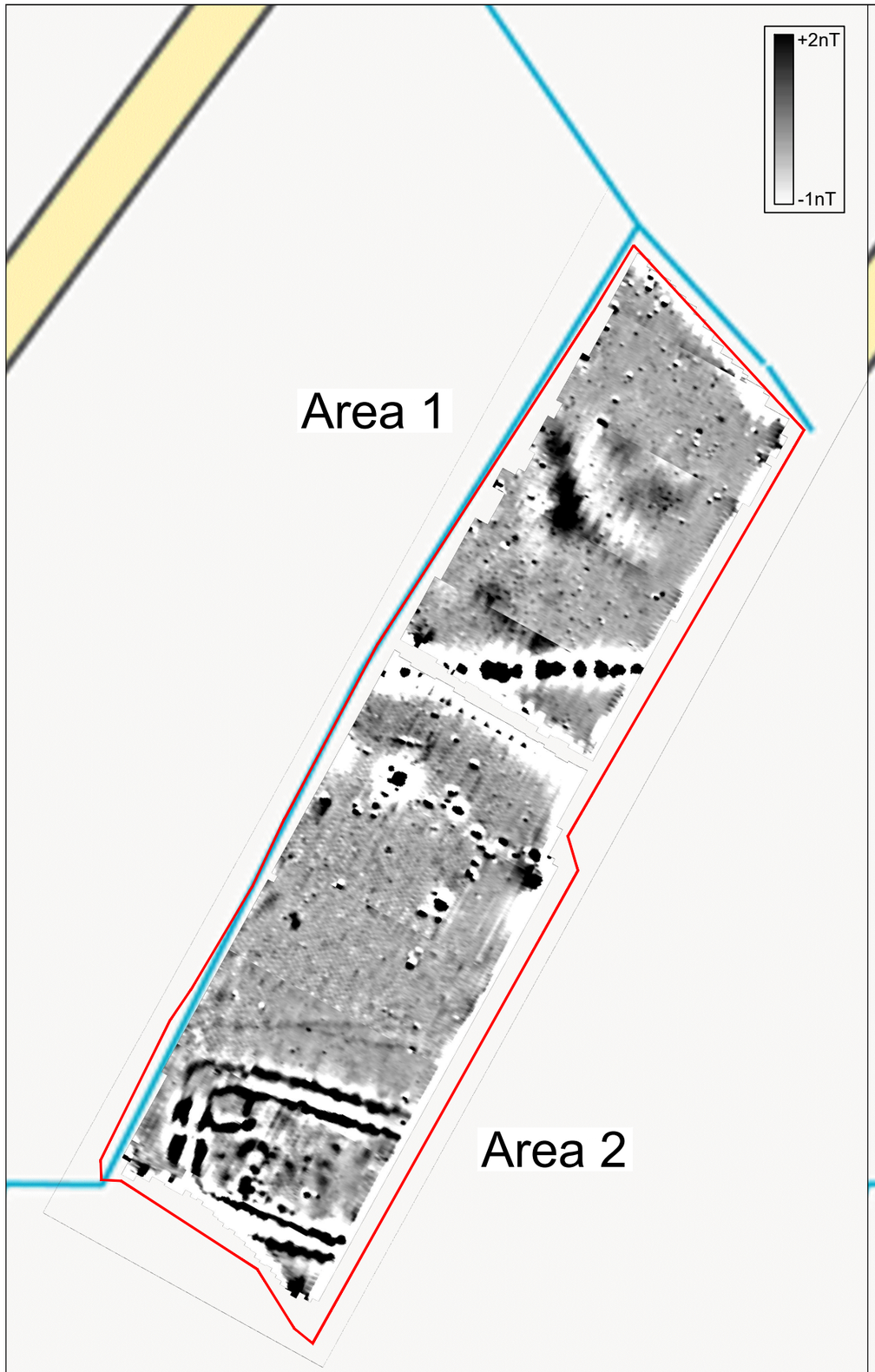
Title:
Magnetometer Survey - Greyscale and Colour Plot

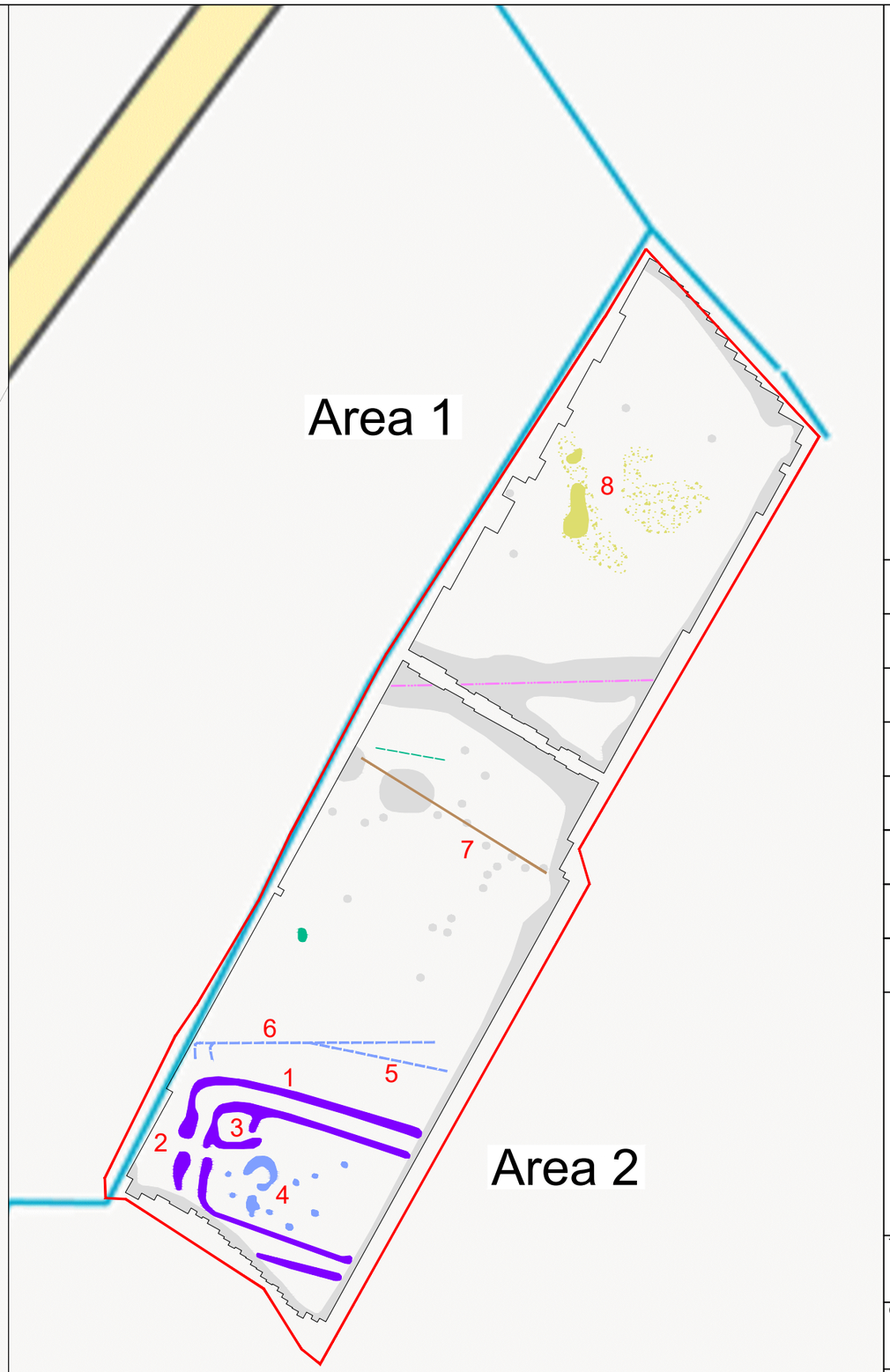
Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
0 metres 75
1:1500 @ A3

Fig No:
02





N

KEY

	Probable archaeology (discrete anomaly)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Natural (e.g. geological / pedological)
	Service
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

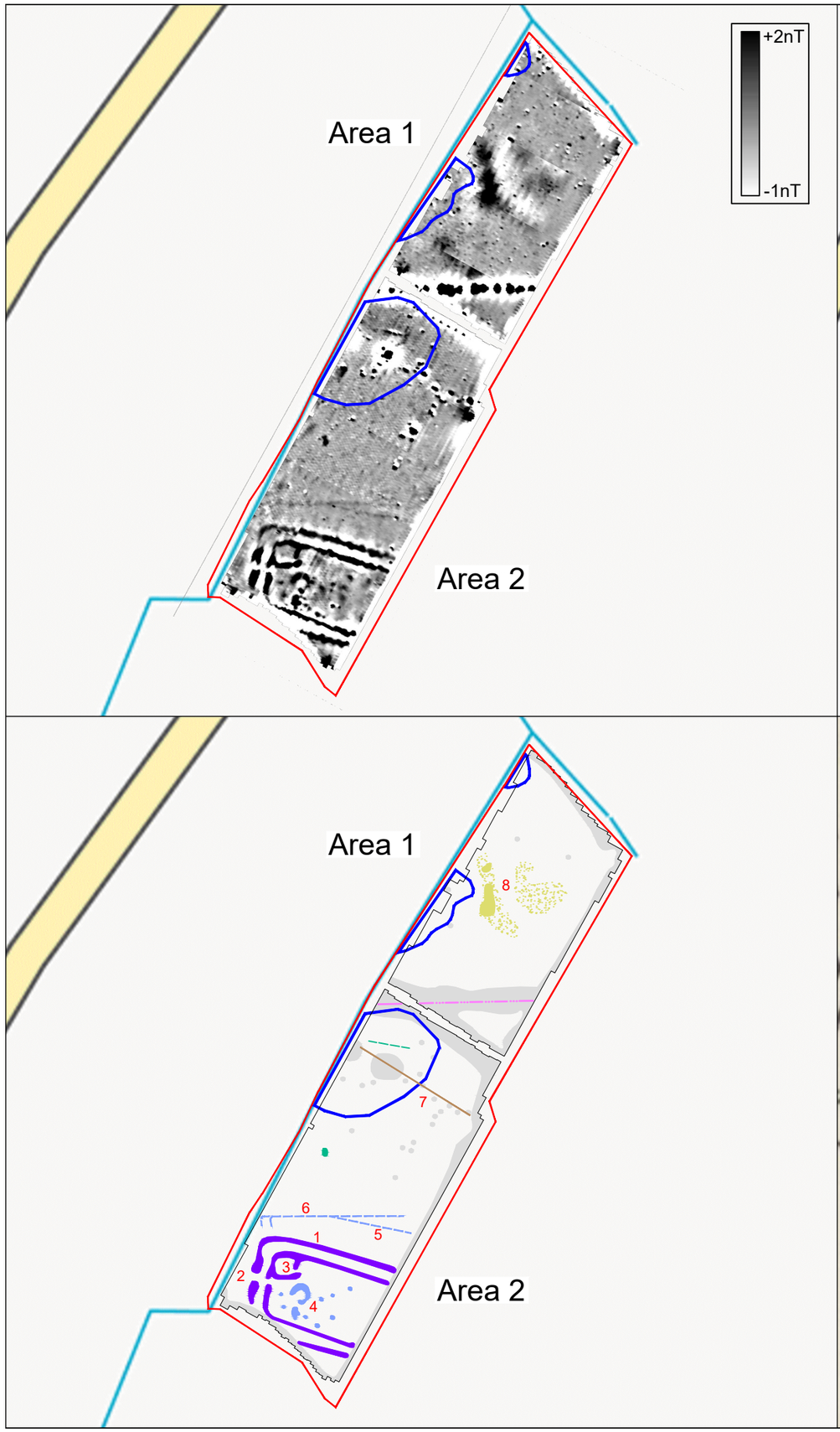
Title:
Magnetometer Survey - Greyscale Plot / Interpretation

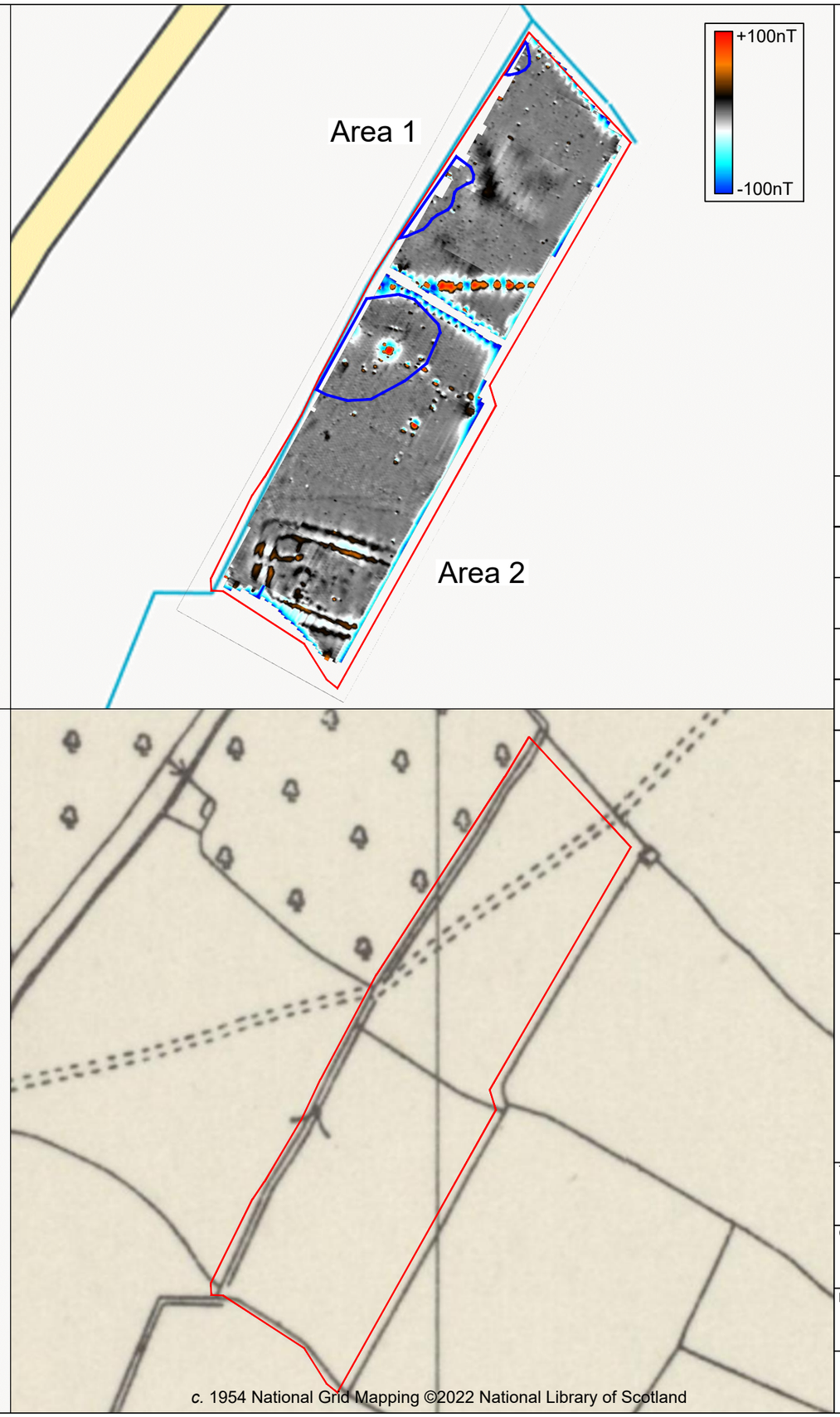
Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
0 metres 75
1:1500 @ A3

Fig No:
03





c. 1954 National Grid Mapping ©2022 National Library of Scotland

N

KEY

	Probable archaeology (discrete anomaly)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Natural (e.g. geological / pedological)
	Service
	Ferrous
	Application Areas

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Greyscale and Colour Plots / Interpretation / 1954 National Grid Mapping

Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
NOT TO SCALE

Fig No:
04

N

+10nT

-10nT

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

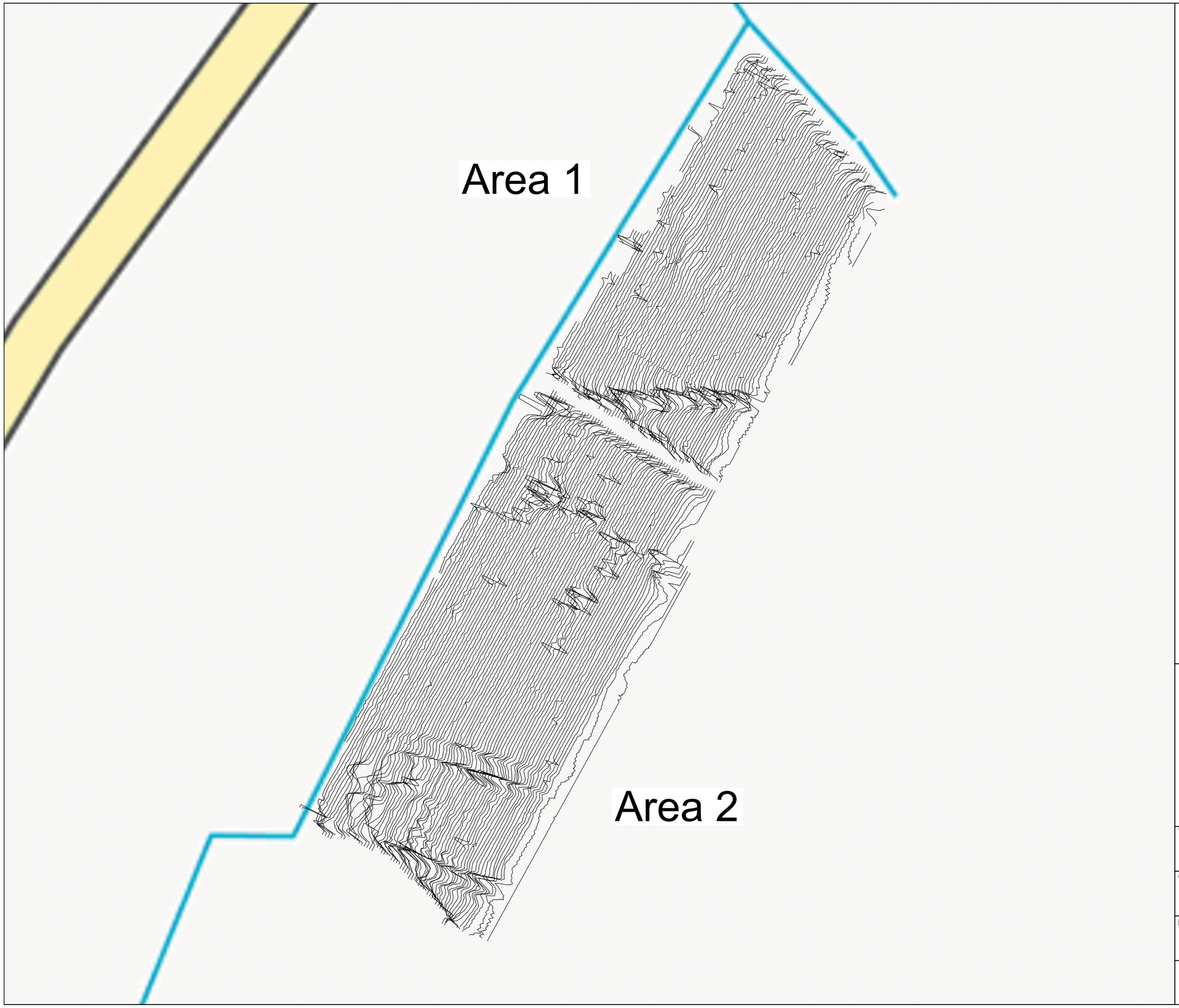
Title:
Minimally Processed Data - Greyscale Plots

Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
0 metres 60
1:1200 @ A3

Fig No:
05



N

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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

Client:
Rhys Kate Collingwood

Project:
05945 - Lower End Farm, Great Comberton, Worcestershire

Scale:
0 metres 60
1:1200 @ A3

Fig No:
06

Appendix A - Technical Information: Magnetometer Survey Method, Processing and Presentation

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 Traverse	This process sets the background mean of each traverse within each grid to zero. 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.

Archaeology / Probable Archaeology	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.
Possible Archaeology	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.
Industrial / Burnt-Fired	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.
Former Field Boundary (probable & possible)	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.
Ridge & Furrow	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.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	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.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
Service	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.
Ferrous	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.
Uncertain Origin	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 *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; 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.

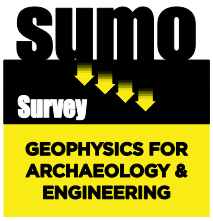
Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same 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 sumogeop1-504585

OASIS ID (UID)	sumogeop1-504585
Project Name	Geophysical Survey at Lower End Farm, Great Comberton, Pershore, Worcestershire
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	05945
Planning Id	21/02258/FUL
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	27-Jan-2022 - 27-Jan-2022
Location	Lower End Farm, Great Comberton, Pershore, Worcestershire NGR : SO 95992 42568 LL : 52.0814497636165, -2.05989368740316 12 Fig : 395992,242568
Administrative Areas	Country : England County : Worcestershire District : Wychavon Parish : Great Comberton
Project Methodology	A temporary grid system was established over the site and marked out using canes. The location of the grid will be set out using an RTK GPS system theoretically accurate to some 0.01m and referenced to OS co-ordinates. Hand Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors (see below) 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	A magnetometer survey of 2 hectares of land on the northern outskirts of Great Comberton was carried to investigate the archaeological potential at the site in connection with the Planning Application No: 21/02258/FUL - the excavation of three ponds, a flood retention area and a ditch meander. The results identified a large (60m x 45m) double ditched enclosure with a small, subdivided area, a possible round house and pit-like features. In addition, there may be other ditches. The remains are thought to be associated with known archaeological features recorded south of the survey area. Other responses recorded in the magnetic data include a few uncertain anomalies, geological effects and a small pipeline. The archaeological features are concentrated in the southern quarter of the site away from the location of the Application Areas.

Keywords	Field Boundary - POST MEDIEVAL - FISH Thesaurus of Monument Types Pipeline - 20TH CENTURY - FISH Thesaurus of Monument Types Pit - UNCERTAIN - FISH Thesaurus of Monument Types Ring Ditch - UNCERTAIN - FISH Thesaurus of Monument Types Double Ditched Enclosure - UNCERTAIN - FISH Thesaurus of Monument Types Ditch - UNCERTAIN - FISH Thesaurus of Monument Types
HER	Worcestershire HER - unRev - STANDARD
HER Identifiers	
Archives	



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

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