GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:
Cotswold Farm Park

Client:
CgMs Consulting

Job ref:
J10135

October 2016

GEOPHYSICAL SURVEY REPORT

Project name: **Cotswold Farm Park** Client: **CgMs Consulting**	Job ref: **J10135**
Survey date: **11th July, 30th August & 21st September 2016**	Report date: **October 2016**
Field team: **Robert Knight BA** **Stephen Weston BA** **Thomas Hynd BSc**	Project Manager: **Simon Haddrell** BEng(Hons) AMBCS PCIfA
Report written by: **Dr John Gater** MCIfA FSA **Rebecca Davies** BSc	Report approved by: **David Elks** MSc ACIfA
CAD illustrations by: **Jon Tanner** BSc MSc PCIfA **Rebecca Davies** BSc	Site Director: **Peter Barker** CEng MICE MCIWEM MCIfA FCInstCES
Version number and issue date:	Amendments:
V2 10/10/2016	New area surveyed (Area 3)

STRATASCAN LTD
Vineyard House Upper Hook Road Upton upon Severn
Worcestershire WR8 0SA United Kingdom

T: 01684 592266 F: 01684 594142
info@stratascansumo.com www.stratascan.co.uk

SUMO Survey Services
SUMO Group Member

TABLE OF CONTENTS

LIST OF FIGURES

1 SUMMARY OF RESULTS

Although there are no anomalies falling into the category *probable* archaeology, there is a ditch-like response and a couple of pit-like anomalies which have been classified as *possible archaeology*. The responses could be the result of the natural limestone bedrock. The tentative archaeological interpretation is based largely on the presence of the nearby barrow cemetery. Other responses reflect magnetic disturbance associated with the existing farm, a pipe, a possible drain and past ploughing, including ridge and furrow cultivation.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for an extension to an existing farm park. This survey forms part of an archaeological investigation being undertaken by CgMs Consulting.

2.2 Site Details

NGR / Postcode	SP 112 265 / GL54 5UG
Location	Approximately 20kms east of Cheltenham and 2kms east of Kineton village. Fields to the south, west and east of the existing caravan park.
HER/SMR	Gloucestershire
Planning Authority / Ref	Cotswold District
District	Bourton Vale
Parish	Temple Guiting CP
Topography	Generally level
Current Land Use	Pasture (plus a very small area of hardstanding – unsuitable for survey).
Weather Conditions	Overcast / rain
Soils	The overlying soils are from the Sherborne Association, which are shallow well-drained brashy calcareous clayey soils (Soil Survey of England and Wales, Sheet 5, South West England).
Geology	The underlying geology is Eyford Member Limestone – sedimentary. No recorded drift geology (British Geological Survey website).
Archaeology	A Bronze Age Round Barrow Cemetery lies approximately 100m to the south of the survey area. See *Heritage Assessment, Cotswold Farm Park*, CgMs Consulting, MD 20495 (unpublished report).
Survey Methods	Magnetometer survey (fluxgate gradiometry)

Study Area	3.75 ha – approximately 0.1 hectares could not be surveyed due to an area of hardstanding. Approximately 0.25 hectares was not accessible.

2.3 Aims and objectives

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

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

Magnetometer survey has been successfully employed in the vicinity of Guiting Power to identify and map features of archaeological interest. Given the nature of the possible buried archaeology (cut features like ditches and pits) detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in Appendix A.

3.3 Processing

The following schedule shows the basic processing carried out on the data used in this report:

1. *De-stripe*
2. *De-stagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

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 very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, 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".

4 RESULTS

The detailed magnetic gradiometer survey conducted at Cotswold Park Farm has identified a handful of anomalies which have been characterised as being of a *possible* archaeological origin. The following list of numbered anomalies refers to numerical labels on the interpretation plots.

4.1 Probable Archaeology

No probable archaeology has been identified within the survey area.

4.2 Possible Archaeology

A linear magnetic anomaly **[1]** has the characteristics of a buried (silted-up) ditch, following a west-east alignment, with a possible break at one point and perhaps with a number of pits to the north. There are no recorded field boundaries visible on the available old mapping and as such the anomalies have the potential for being of archaeological interest, despite the fact the 'ditch' does not appear to continue into the other survey areas to the west. Given the known Bronze Age barrows only 100m to the south, it is possible that the feature represents a prehistoric land division, but this interpretation has to be tentative. Limestone geologies can result in fractured linear and pit-like magnetic anomalies, so without a clearer wider archaeological context, a natural origin is also possible.

4.3 Medieval/Post-Medieval Agriculture

Parallel and widely spaced anomalies in the data **[2]** are indicative of former ridge and furrow cultivation; the responses to the west of the existing caravans are clearer than those to the east. More closely spaced anomalies **[3]** are associated with more recent ploughing.

4.4 Other Anomalies

Two straight linear anomalies **[4]** could be associated with old field boundaries. The western-most of the two is parallel to an existing field division further to the west (off the map) and is visible on aerial photographs dating to 1945. The magnetic responses are perhaps more typical of a land drain or small service trench / pipe. A definite service pipe is visible in the data at **[5]**. Areas of magnetic disturbance **[6]** are the result of substantial nearby ferrous metal objects such as fences, caravans and cars. It is uncertain of the cause of the responses **[7]** but in the context of the site they are not thought to be of any great antiquity. Areas of magnetic disturbance in Area 3 are likely associated with the campsite, and are indicative of areas of made ground. A number of magnetic 'spikes' (typically, single pole positive or negative peaks, or bipolar anomalies) indicate ferrous like objects which are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Eyford Limestone is classified as generally providing a good response for magnetic survey and the results of the present survey confirm this fact. Limestones can produce anomalies which appear pit-like (due to natural pitting) and hence they can be difficult to interpret. In this instance, a natural response is the most likely explanation as there is no wider archaeological context for the observed anomalies.

6 CONCLUSION

One linear anomaly has been identified which could be either an archaeological ditch or a natural fissure in the limestone. If archaeological, some of the pit-like responses could be of interest, but a natural origin is equally likely. There are no responses indicative of barrow ditches or other definite archaeological features.

7 REFERENCES

British Geological Survey, n.d., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 21/07/2016]

Chartered Institute for Archaeologists. *Standard and Guidance for Archaeological Geophysical Survey. (*http://www.archaeologists.net/sites/default/files/CIfAS&GGeophysics_1.pdf)

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation.*

IfA 2002. The Use of Geophysical Techniques in Archaeological Evaluations, IFA Paper No 6, C. Gaffney, J. Gater and S. Ovenden. Institute for Archaeology, Reading

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

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	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 (Destagger)	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.

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 response 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 will often lead and empty into larger diameter pipes and 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. They are presumed to be modern.
Service	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
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* and *Possible Natural* or (in the case of linear responses) *Possible Archaeology* and *Possible 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 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, 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.

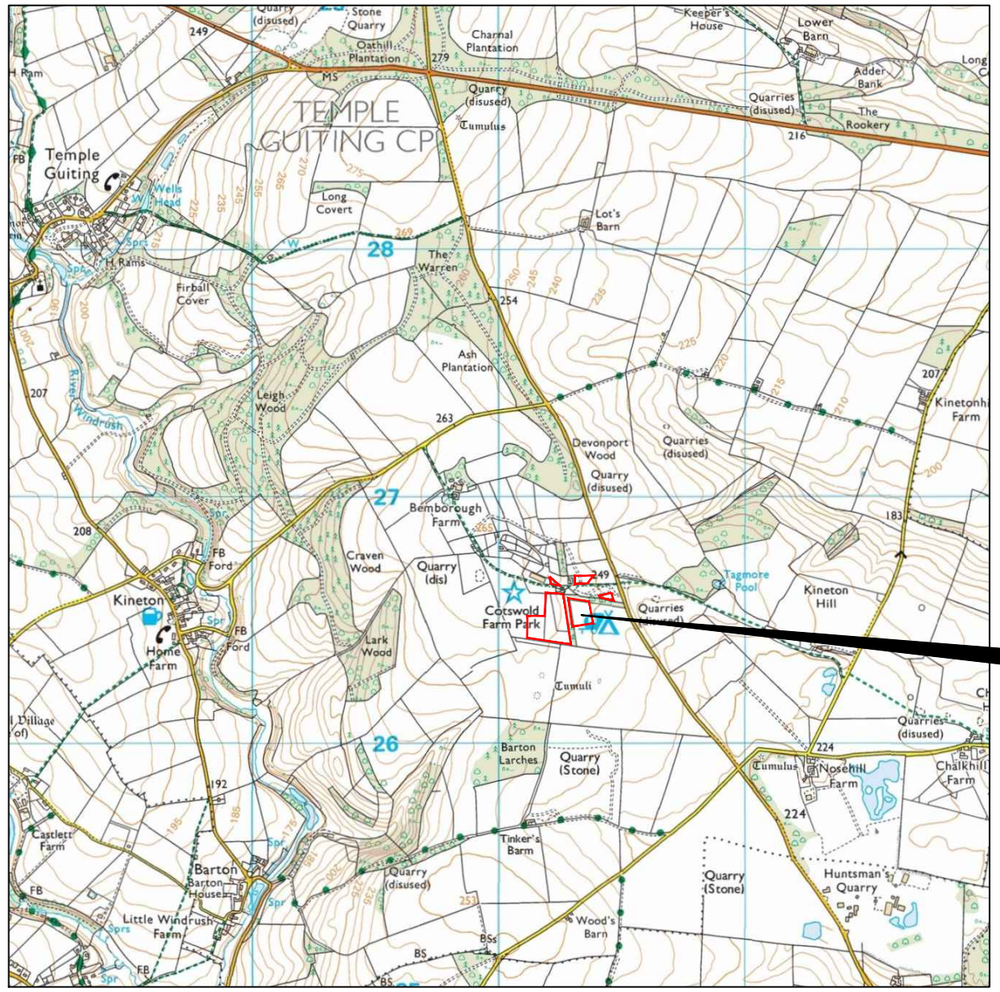
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological 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 and 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 field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried 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, disturbance from modern services etc.



N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR: SP 113 265

Client: CgMs CONSULTING

Project Title: GEOPHYSICAL SURVEY - COTSWOLD FARM PARK, GLOUCESTERSHIRE

Job No. 10135

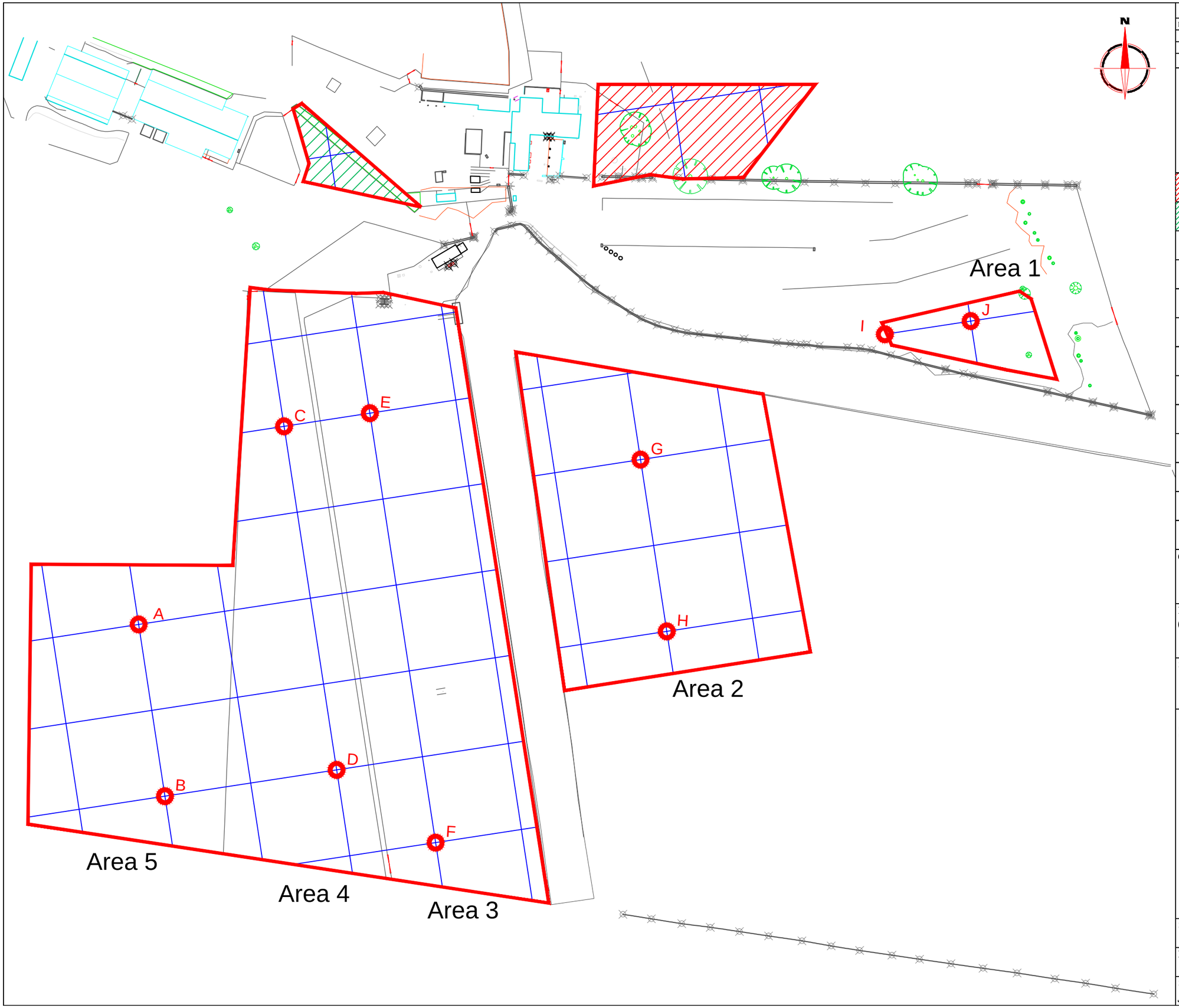
Subject: LOCATION PLAN OF SURVEY AREA

STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk

SUMO GROUP MEMBER

Scale: 1:25000 (0m 500 1000m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUL-SEP 16	RD	01



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

No access

Area unsurveyable due to hardstanding

OS GRID REFERENCES

A	411152.84, 226491.07
B	411161.92, 226431.76
C	411203.06, 226559.46
D	411221.23, 226440.85
E	411232.72, 226564.01
F	411255.43, 226415.74
G	411326.22, 226547.98
H	411335.31, 226488.67
I	411410.64, 226591.26
J	411440.29, 226595.81

Client
CgMs CONSULTING

Project Title
GEOPHYSICAL SURVEY - COTSWOLD FARM PARK, GLOUCESTERSHIRE

Job No. 10135

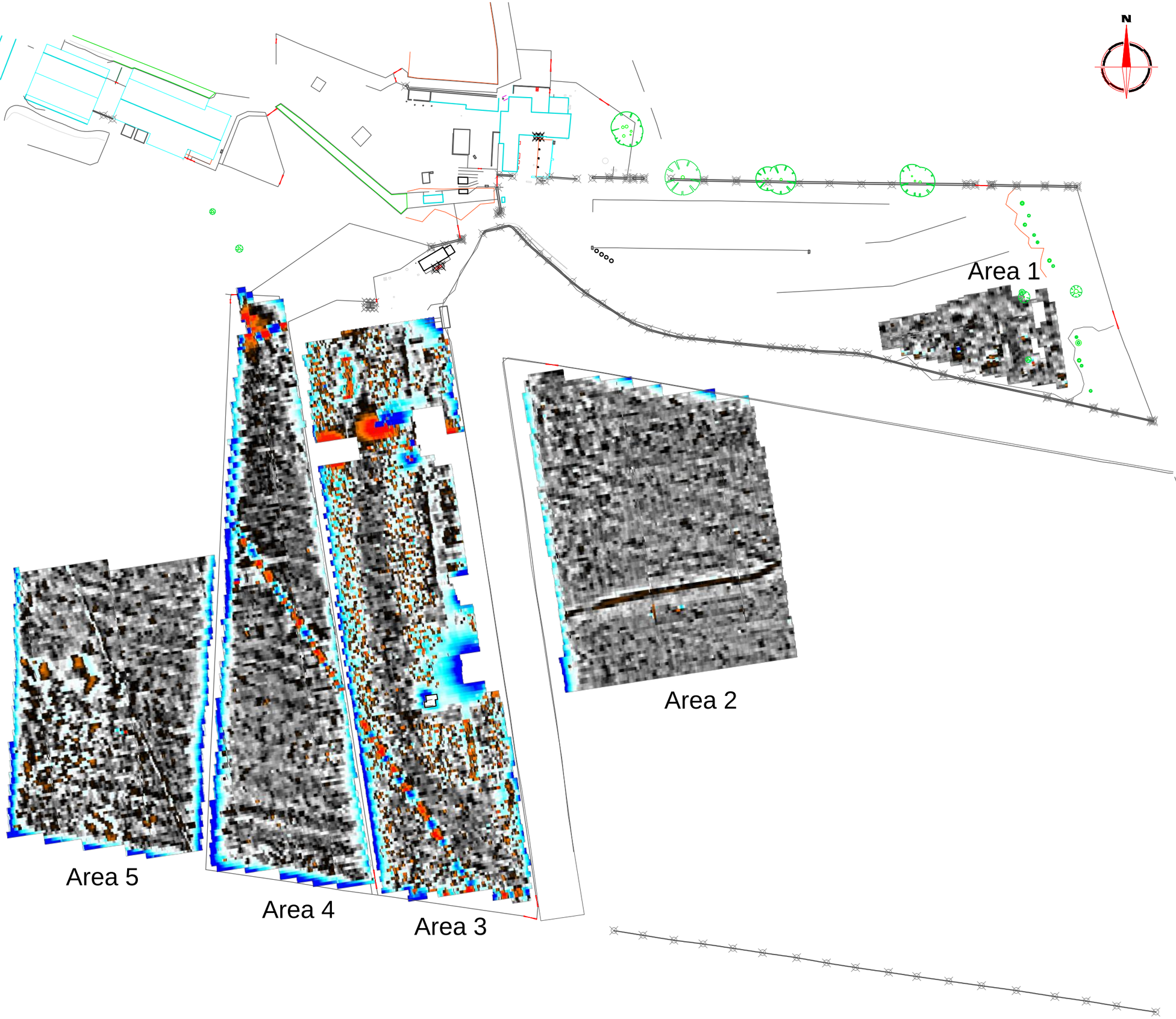
Subject
LOCATION OF SURVEY GRIDS AND REFERENCING

STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk

SUMO GROUP MEMBER

Scale 1:1250 (0m 10 20 30 40 50m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUL-SEP 16	RD	02



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

Client
CgMs CONSULTING

Project Title
GEOPHYSICAL SURVEY - COTSWOLD FARM PARK, GLOUCESTERSHIRE

Job No. 10135

Subject
COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES

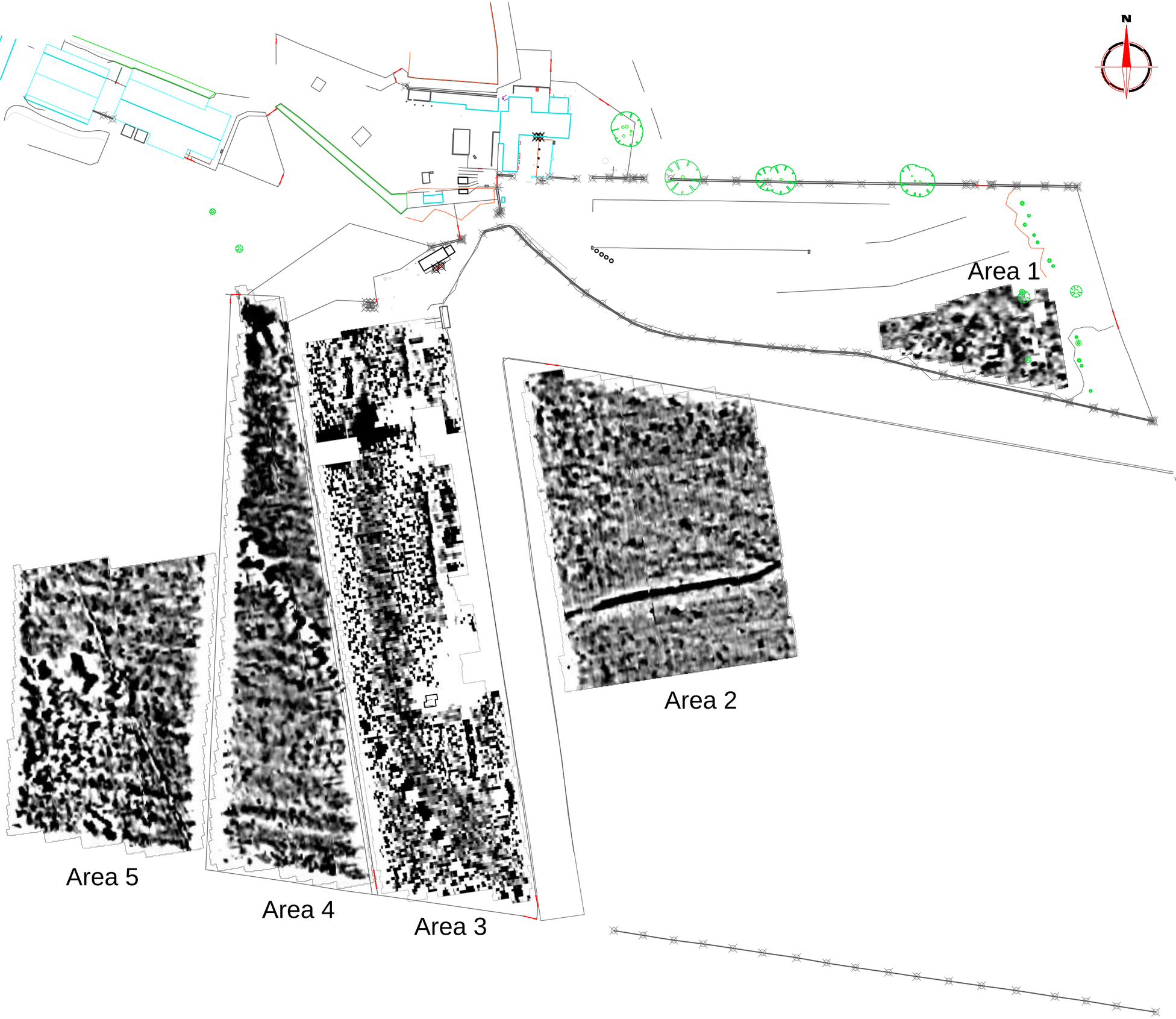
STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk

SUMO GROUP MEMBER

Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUL-SEP 16	RD	03

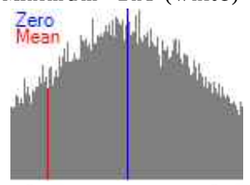


Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +2nT (black)
Minimum -2nT (white)



Client
CgMs CONSULTING

Project Title
GEOPHYSICAL SURVEY - COTSWOLD FARM PARK, GLOUCESTERSHIRE

Job No. 10135

Subject
PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA

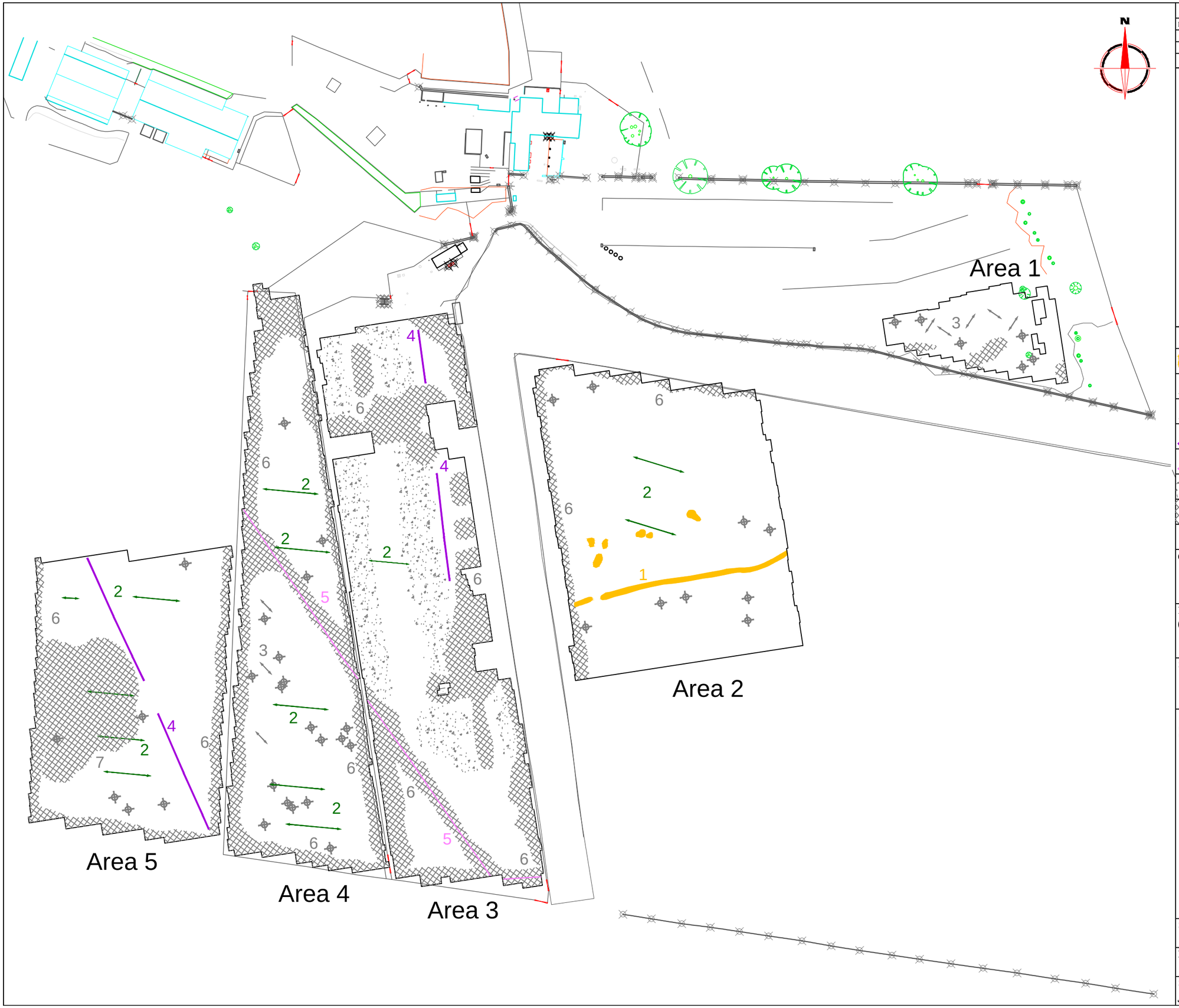
STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk

SUMO GROUP MEMBER

Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUL-SEP 16	JT	04



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Linear anomaly - possibly related to land drain
- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - probably related to a former field boundary or drain visible on aerial photography
- Linear anomaly - probably related to pipe, cable or other modern service
- Magnetic debris associated with campsite/caravan park
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Magnetic spike - probable ferrous object

Client

CgMs CONSULTING

Project Title — Job No. 10135

GEOPHYSICAL SURVEY - COTSWOLD FARM PARK, GLOUCESTERSHIRE

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
VINEYARD HOUSE
UPTON UPON SEVERN
WR8 0SA
T: 01684 592266
E: info@stratascan.co.uk
www.stratascan.co.uk

SUMO GROUP MEMBER

Scale 1:1250 (0m 10 20 30 40 50m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
JUL-SEP 16	JT	05

Your Survey Partner

For a complete and complementary range of survey services

Survey services you can rely on

Archaeological
As Built Records
BIM Ready 3D Models
Boundary Disputes
CCTV
Geophysical
Laser Scanning
Measured Building
Pipeline Routes
Railway
Retrofit
Setting Out
Statutory Plan Collation
Topographic
Utility Mapping
UXO Detection
Void Detection

STRATASCAN LTD
Vineyard House Upper Hook Road Upton upon Severn
Worcestershire WR8 0SA United Kingdom

T:01684 592266 F: 01684 594142
info@stratascan.co.uk www.stratascan.co.uk

STRATASCAN