Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Trela Farm
Camelford, Cornwall
OS grid ref: (centred on) 212100, 86650

Report: 130415
Ross Dean BSc MSc MA MIfA
23rd April 2013

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1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: 8 April 2013
Area surveyed: 1.2ha
Lead surveyor: Ross Dean BSc MSc MA MIfA

Client
South West Archaeology Ltd, The Old Dairy, Hacche Lane Business Park, Pathfields Business Park, South Molton, Devon EX36 3LH

Location

Site:	Land at Trela Farm
Town and Parish:	Camelford
County:	Cornwall
NGR:	SX121866
NG coordinates:	212100, 86650
Application number:	PA12/09058
OASIS number:	substrat1-148715
Survey archive:	the archive will be held by Substrata

Summary
This report was commissioned by South West Archaeology Ltd on behalf of clients and was produced by Substrata in preparation for submission of a forthcoming planning application

The magnetic contrast across the survey areas was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. A total of four magnetic anomaly groups were identified as pertaining to potential archaeology and all are typical of archaeological linear features such as former field boundaries or other enclosure boundaries.

Survey aims
1. Define and characterise and detectable archaeological remains on the site.
2. Inform any future archaeological investigation of the area.

Survey Objectives
1. Complete a gradiometer survey across agreed parts of the survey area.
2. Identify any magnetic anomalies that may be related to archaeological deposits, structures or artefacts.
3. Within the limits of the techniques and dataset, archaeologically characterise any such anomalies or patterns of anomalies.
4. Accurately record the location of the identified anomalies.
5. Produce a report based on the survey that is sufficiently detailed to inform any subsequent development on the site about the location and possible archaeological character of the recorded anomalies.

Standards
The standards used to complete this survey are defined by the Institute for Archaeologists (2011). The codes of approved practice that were followed are those of the Institute for Archaeologists (2008 and 2009) and Archaeology Data Service/Digital Antiquity Guides (undated). The document text was written using the house style of the Institute for Archaeologists (Institute for Archaeologists, undated).

2 Site description

Landscape

The survey area comprises part of one relatively flat field bounded by Cornish banks and at a height of between 265m and 270m O.D. as shown in figure 3.

Land use at the time of the survey

Grass pasture.

Geology and soils

The site is located on a solid geology of Devonian (Famennian Age) Tredorn Slate Formation. These rocks comprise greenish grey quartz-chlorite-mica slate, locally interbedded with thinly bedded, commonly lenticular bioclastic limestone and dolomite beds, up to 0.15m thick, and with sandstone, siltstone and rare tuff beds (British Geological Survey, undated 1; undated 2).

The soils are defined as fine loamy typical brown earths of the Denbigh2 association (Soil Survey of England and Wales, 1983) which passes to slate or very stony layers within a moderate depth of typically 0.7m to 1m (Findley et al, 1983: 148).

Known archaeological sites in the survey area

There are no Historical Environment Record within the survey area.

Historical Environment Records for adjacent sites:

HER 2255: Cairn recorded on the OS map of 1962 and visible on Aerial photographs. Location: SX 1229 8645 (approximately 276m to the southeast).

HER 57063: Two parallel field boundaries of medieval or earlier date and visible on aerial photographs. Location: SX 1194 8666 (approximately 160m to the west in an adjacent field).

HER 57064: A 252m linear ditch, possibly of post-medieval origin visible as cropmarks on aerial photographs. Location SX 1241 8686 (approximately 374m to the northeast)

Previous fieldwork within the survey area

The Cornwall Landscape assessment was carried out over this land in 1994. No other formal archaeological work has been undertaken on the survey site.

Historic Landscape Characterisation

Anciently enclosed land of medieval or earlier origin (Cornwall Landscape Assessment, 1994).

3. Results, discussion and conclusions

This survey was designed to record magnetic anomalies. The anomalies themselves cannot be regarded as actual archaeological features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeological features. The analysis presented below attempts to identify and characterise anomalies and anomaly groups that may pertain to archaeological deposits and structures.

The reader is referred to section 4.

3.1 Results

Figure 1 shows the interpretation of the survey and table 1 is an extract from a detailed analysis of the survey data provided in the attribute tables of the GIS project on the accompanying CD-ROM.

Figures 1 and table 1 comprise the analysis and interpretation of the survey data.

The processed gradiometer data is presented in figure 2, appendix 1.

Survey data analysis

Site: An archaeological gradiometer survey
Land at Tela Farm, Camelford, Cornwall
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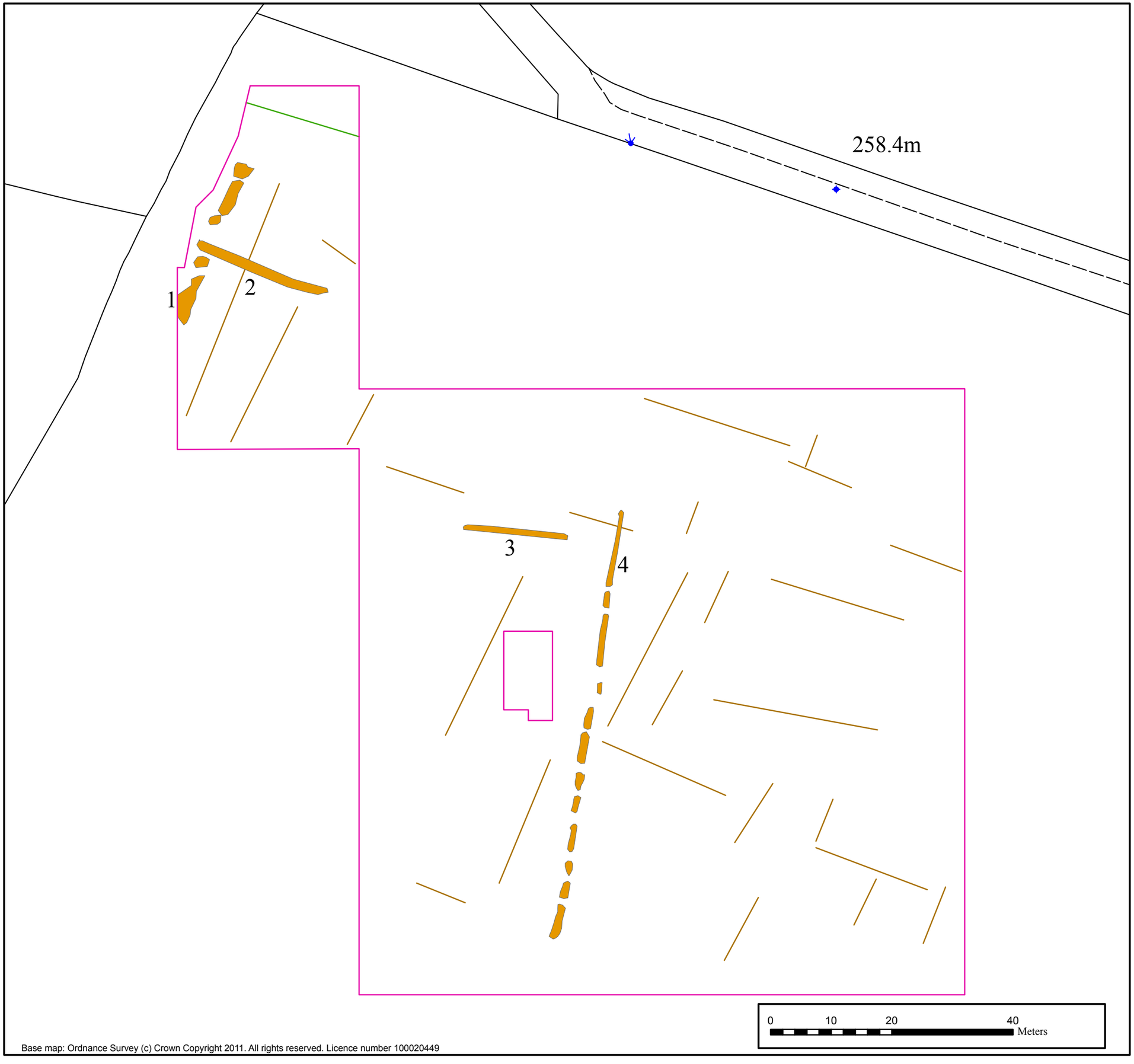
anomaly group	characterisation certainty	anomaly class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	possible	positive	linear			
2	possible	positive	linear			
3	possible	positive	linear			
4	possible	positive	linear			

Table 1: data analysis



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N

Legend

gradiometer survey area

potential archaeology

possible archaeology, positive anomaly

possible archaeology, ciltivation traces (2)

gradiometer possible services

possible service, ferrous drain, pipe or cable

Notes:

1. All interpretations are provisional and represent potential archaeological deposits.
2. Representative of trends; only anomalies relevant to potential archaeology are recorded.
3. Anomalies likely to represent very recent ground disturbance are not highlighted.
4. Anomalies designated "likely archaeology" have supporting evidence e.g. historicasl maps and/or visible earthworks.

While accurate, this figure is intended for use as a reference in the accompanying report and not as a source of positional information.

It is recommended that accurate positional information be obtained from the georeferenced GIS project or AutoCAD plan of the survey interpretation found on the accompanying CD-ROM.

Figure 1: survey interpretation

3.2 Discussion

Refer to figures 1 and 2

Not all anomalies or anomaly groups identified in the survey dataset are discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM. Those anomaly groups possibly representing archaeological deposits are included in data analysis table 1.

Data related to historical maps
None of the anomalies relating to potential archaeological deposits or features could be associated with features recorded on historical Ordnance Survey maps.

Data with no previous provenance
Anomaly groups **1 to 4** are more likely to represent archaeological linear features than natural features. The anomalies may relate to field boundaries or other enclosures of more than one phase of past land management.

3.3 Conclusions

The magnetic contrast across the survey areas was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. A total of four magnetic anomaly groups were identified as pertaining to potential archaeology and all are typical of archaeological linear features such as former field boundaries or other enclosure boundaries.

4 Disclaimer and copyright

The description and discussion of the results presented in this report are the authors, based on his interpretation of the survey data. Every effort has been made to provide accurate descriptions and interpretations of the geophysical data set. The nature of archaeological geophysical surveying is such that interpretations based on geophysical data, while informative, can only be provisional. Geophysical surveys are a cost-effective early step in the multi-phase process that is archaeology.

The evaluation programme of which this survey is part may also be informed by other archaeological assessment work and analysis. It must be presumed that more archaeological features will be evaluated than those specified in this report.

5 Acknowledgements

Substrata would like to thank Colin Humphreys of Southwest Archaeology Ltd for commissioning us to complete this survey.

6 References

Archaeology Data Service/Digital Antiquity Guides to Good Practice (undated): *Geophysical Data in Archaeology* [Online], Available: http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc [April 2013]

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British Geological Survey (undated 2) *The British Geological Survey Lexicon of Named Rock Units [Online], Available:* http://www.bgs.ac.uk/lexicon/home.html [April 2013]

Clark, A. (2000) *Seeing Beneath the Soil, Prospecting methods in archaeology*, London: Routledge

Dean, R. (2013) *A gradiometer survey project design: Land at Trela Farm, Camelford, Cornwall,* Unpublished Substrata document

Findlay, D.C., Colborne, G.J.N., Cope, D.W., Harrod, T.R., Hogan, D.V. and Staines, S.J. (1984) *Soil survey of England and Wales bulletin 14 Soils and their use in south west England*, Harpenden: The Soil Survey of England and Wales

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Appendix 1 Supporting plots

General Guidance

The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

A rough rule for interpreting magnetic anomalies is that the width of an anomaly at half its maximum reading is equal to the width of the buried feature, or its depth if this is greater (Clark, 2000: 83). Caution must be applied when using this rule as it depends on the anomalies being clearly identifiable and distinct from adjacent anomalies. In northern latitudes the position of the maximum of a magnetic anomaly will be displaced slightly to the south of any associated physical feature.

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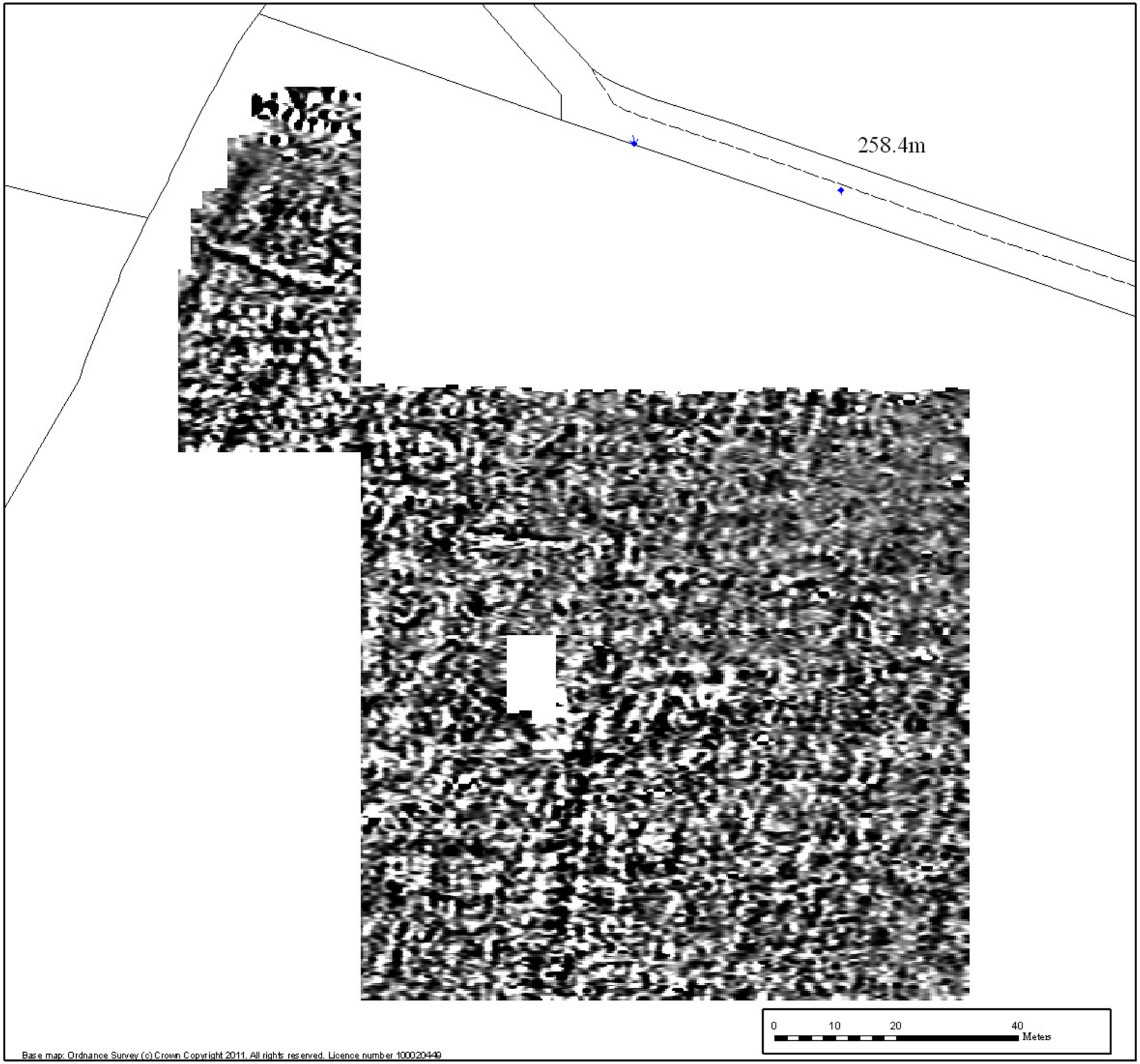
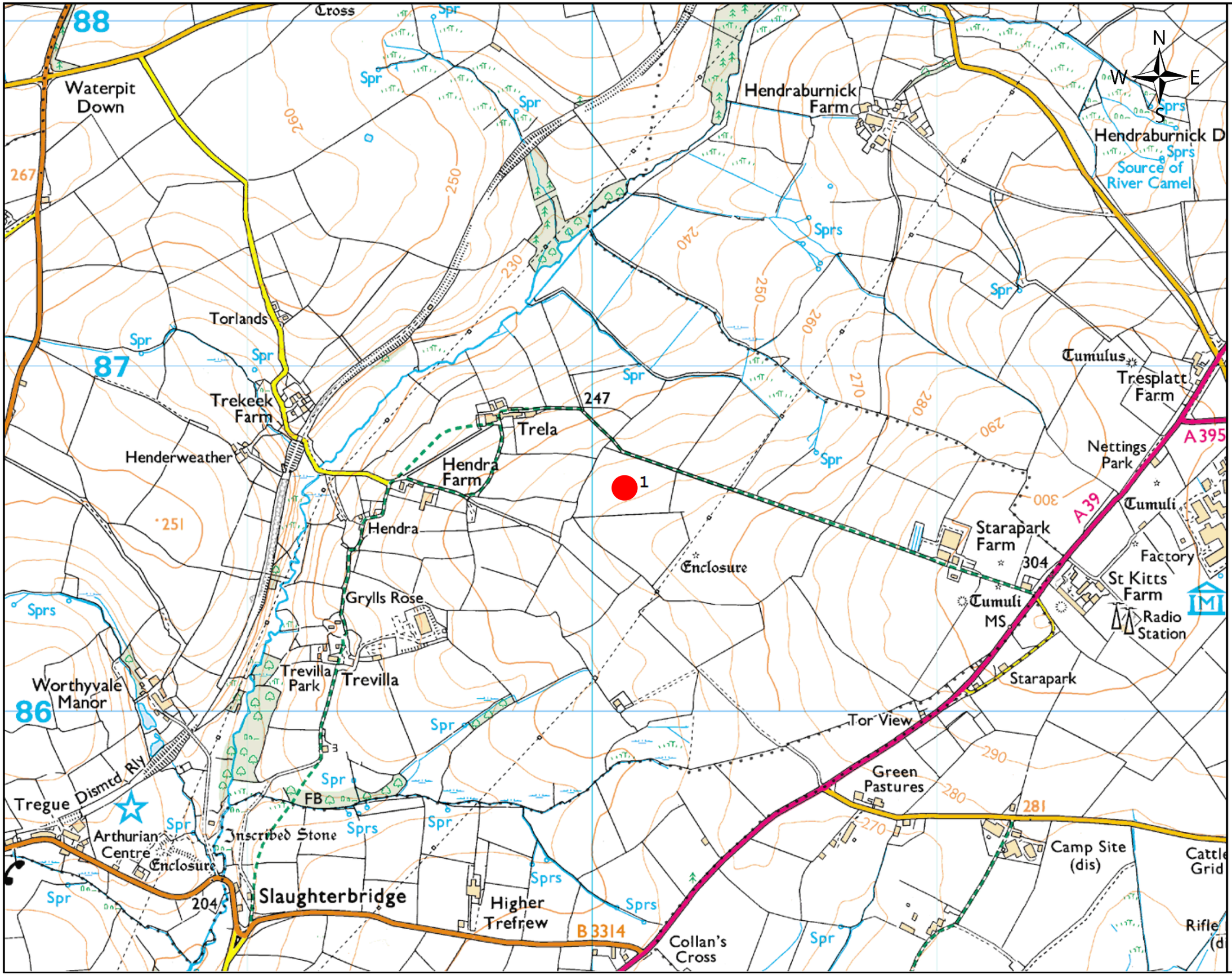


While accurate, this figure is intended for use as a reference in the accompanying report and not as a source of positional information.

It is recommended that accurate positional information be obtained from the georeferenced GIS project or AutoCAD plan of the survey interpretation found on the accompanying CD-ROM.

Figure 2: shade plot of processed data



DRAWING TITLE

Trela Farm
Turbine location

NOTES

Turbine location

Map scale:
1:10,000 when printed at A3

cleanearth

Cleanearth Energy
10B Palmers Way
Trenant Industrial Estate
PL27 6HB

01208 455028

CE NUMBER	CE101109
DATE	24/10/12
SHEET	1 of 1
SCALE	1:10,000
DRAWING	CE101109_SC_TL
CLIENT	Mr Sanders

INSTALLATION ADDRESS

Trela Farm,
Camelford,
Cornwall,
PL32 9UB

DRAWN BY	JM	DATE 24/10/12
CHECKED BY	VB	DATE 24/10/12
APPROVED BY	VB	DATE 24/10/12

Appendix 2 Methodology

<table>
<tr><th colspan="2">Table 2: methodology</th></tr>
<tr><td colspan="2">Documents
Project design: Dean (2013)</td></tr>
<tr><td colspan="2">Methodology
1. The work was undertaken in accordance with the project design. The geophysical (gradiometer) survey was undertaken with reference to standard guidance provided by the Institute for Archaeologists (2011) and Archaeology Data Service/Digital Antiquity Guides (undated).
2. The survey grid location information and grid plan was recorded as part of the project in a suitable GIS system.
3. Data processing was undertaken using appropriate software, with all anomalies being digitised and geo-referenced. The final report included a graphical and textual account of the techniques undertaken, the data obtained and an archaeological interpretation of that data and conclusions about any likely archaeology.</td></tr>
<tr><td colspan="2">Grid
Method of Fixing: DGPS set-out using pre-planned survey grids and Ordnance Survey coordinates.
Composition: 30m by 30m grids
Recording: Geo-referenced and recorded using digital map tiles.</td></tr>
<tr><td>Equipment
Instrument: Bartington Instruments grad601-2
Firmware: version 6.1</td><td>Data Capture
Sample Interval: 0.25-metres
Traverse Interval: 1 metre
Traverse Method: zigzag
Traverse Orientation: GN</td></tr>
<tr><td colspan="2">Data Processing, Analysis and Presentation Software
DW Consulting TerraSurveyor3
ArcGIS 9.3
Microsoft Corp. Office Publisher 2003.</td></tr>
</table>

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
Software: DW Consulting TerraSurveyor v 3.0.19.16

Stats

Max:	149.96
Min:	-149.17
Std Dev:	4.81
Mean:	0.15
Median:	0.00
Surveyed Area:	1.2 ha

Processes: 4

1 Base Layer
2 Clip at 4.00 SD
3 De Stagger: Grids: All Mode: Both By: -2 intervals
4 DeStripe Median Sensors: All

Note: interpolation match x & y doubled is completed during export from TerraSurveyor to georeferenced ERSI format

Appendix 4 Geophysical surveying techniques

1 Introduction

Substrata offers magnetometer and earth resistance surveying. We also provide other archaeology-specific geophysical surveys such as ground penetrating radar and resistivity. The particular method or combination of methods used depends on local soil conditions and the survey requirements. These methods are capable of delivering fast and accurate assessments of the archaeology of both large and small sites.

Further details can be found on our website at www.substrata.co.uk

2 Magnetometer surveying

Standard magnetometer surveys are the workhorse of archaeological surveying when speed and cost-effectiveness are important. Identifiable archaeological features include areas of occupation, hearths, kilns, furnaces, ditches, pits, post-holes, ridge-and-furrow, timber structures, wall footings, roads, tracks and similar buried features.

Magnetometer surveying is used to detect and map small changes in the earth's magnetic field caused by concentrations of ferrous-based minerals within the soil and subsoil, and by magnetised materials buried beneath the surface. While most of these changes are too small to affect a compass needle, they can be detected and mapped by sensitive field equipment. During surveys the different magnetic properties of top-soils, sub-soils, rock formations and archaeological features are recorded as variations against a background value. Subsequently magnetic anomalies resulting from potential archaeology can be identified and interpreted.

Bartington grad601-2 gradiometers

A gradiometer is a type of magnetometer and is sensitive to relatively small changes in the earth's magnetic field. Our primary surveying instruments are Bartington Grad601-2 (dual sensor) fluxgate gradiometers with automatic data loggers. They are specifically designed for field use by archaeologists. The Bartington gradiometers provide proven technology in archaeological magnetic surveying and offer fast, accurate set-up and survey rates. They are sensitive to depths of between 0 and 1.5m below ground level, with optimum sensitivity at depths of 1m or less.

Multiple sensor arrays

A technique relatively new to commercial archaeological surveying but well understood in academic circles involves the use of multiple magnetometer sensors towed behind a quad bike or similar vehicle. With multiple sensors and the use of on-board GPS units, it is possible to achieve faster survey rates at competitive commercial rates when compared to the use of multiple instruments and the techniques discussed above provided the ground is suitable for the vehicle and array. Substrata is pleased to announce that we now offer this service on suitable larger sites

3 Earth resistance surveying

Earth resistance surveying is an excellent tool for detecting buried archaeology. Its relatively slow rate of survey compared to magnetometer surveys means that it usually employed in commercial surveys when a detailed understanding of buried building remains is required. This technique measures changes in the electrical resistance of the ground being surveyed. In practice, the recording of differences in the electrical resistance of near-surface deposits and structures allows the detection and interpretation of masonry and brick foundations, paving and floors, drains and other cavities, large pits, building platforms, robber trenches, ditches, graves and similar buried features.

Resistance to electrical current flow in the ground depends on the moisture content and

structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

For earth resistance surveying Substrata uses the Geoscan Research RM15 series multi-probe resistance meters and purpose-built automatic data-loggers. The Geoscan MPX15 multiplexer is an integral part to the instrument configuration and facilitates multi-probe arrays which speed up survey area coverage rates and, if required, facilitate simultaneous multiple-depth data collection.