Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Narcrossa Farm
Penryn, Cornwall

Ordnance Survey E/N: 172860,33565 (point)

Report: 140407

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7 April 2014

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1 Survey description and summary

Type of survey:	twin-sensor fluxgate gradiometer
Date of survey:	between 1 and 3 April 2014
Area surveyed:	9 ha
Lead surveyor:	Ross Dean BSc MSc MA MIfA

Client
AC Archaeology Ltd, 4 Halthaies Workshops, Bradninch, Nr Exeter, Devon EX5 4QL

Location

Site:	Land at Narcrossa Farm, Rame
Civil Parish:	Wendron
County:	Cornwall
Nearest Postcode:	TR10 9EE
NGR:	SW 728 335 (point)
Ordnance Survey E/N:	172860,33565 (point)
OASIS number:	substrata1-176578
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

Summary
This report was commissioned by AC Archaeology Ltd on behalf of clients. It was prepared by Substrata as supporting information for a forthcoming planning application relating to a proposed solar farm at the above site. The location of the site is shown in figure 5.

The magnetic contrast across the survey area was low but sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses.

Eighteen magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Of these, two may represent in-situ heated deposits of potential archaeological significance but which would need further archaeological investigations to clarify their nature. One of these lies close to the location of a possible Bronze Age or Post Medieval mound (HER55847). Nine and possibly ten anomaly groups may correspond to filled pits. One probably represents a deposit of rubble. The remaining anomalies are linear and curvilinear anomalies that may relate to former fields or other enclosure boundaries not recorded on historical Ordnance Survey maps.

2 Survey aims and objectives

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.

3 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).

4 Site description

Landscape
The survey area was situated within four fields on the south-eastern side of Rame. The field designations are shown in figure 2. The site is bordered by agricultural fields to the north, west and south. To the east it is bordered by Lestraynes Lane. There is an electricity transformer station to the south of field B. Some residential properties lie to the north of the site (figure 5).

The four fields surround the head of a coombe with the valley and drainage trending north to south and southwest. The land descends from approximately 200m to 195m O.D. to the southwest.

Land use at the time of the survey
Grass pasture.

Geology
The site is located on a solid geology of Permian and Carboniferous Microgranite of the Carnmenellis Intrusion with the local environment previously dominated by intrusions of silica -rich magma. The intrusion comprises (GA) coarse-grained granite with abundant feldspar megacrysts >15mm; (GB) coarse-grained granite with sparse feldspar megacrysts >15mm; (GC) coarse-grained granite with abundant feldspar megacrysts <15mm; (GD) variable medium- to coarse-grained granite with abundant feldspar megacrysts >15mm; (GE) medium- to coarse-grained biotite-muscovite-granite; (GH) fine- to medium-grained, variably megacrystic granite, feldspar megacrysts <10mm (British Geological Survey, undated).

The superficial geology is not recorded in the source used.

5 Archaeological background

What follows is a short summary of information obtained from the Cornwall and Scilly Historic Environment Record (HER) along with interpretations of aerial photographs from the National Mapping Programme (NMP) relevant to the understanding of the gradiometer survey. This information was provided by the Cornwall and Scilly Historic Environment Service to AC Archaeology Ltd on 24 March 2014.

The reader is advised that this summary should not be used outside the context of this report and is referred to the Cornwall and Scilly HER for informed provision of the record.

Historical landscape characterisation
The proposed development site has been classified as:

> ‘Post Medieval Enclosed Land’: land enclosed in the 17th, 18th and 19th centuries, usually from land that was previously ‘Upland Rough Ground’ and often Medieval commons. Generally in relatively high, exposed or poorly-drained parts of the county.

Heritage assets within the survey area
There are no designated heritage assets and two non-designated heritage asset within the survey area:

> HER entry: 55847 (field A, figures 1 and 2)
> Mound? (Bronze Age - 2500 BC to 801 BC) (Post Medieval - 1540 AD to 1900 AD)
> NGR SW 7281 3368
> A possible mound is visible as cropmarks on vertical aerial photographs taken in 1946. It lies 500m to the north-west of the Bronze Age round barrows described in HER entry

18371 (below). Although the possibility of this feature being a barrow cannot be ruled out, the appearance of the cropmark is such that a modern agricultural origin is equally likely.
No evidence for this feature was detected in the survey data although some potential archaeological deposits were recorded close by (group 1, figure 1).

HER entry: 55843 (field D, figure 2)
Mound? (Bronze Age - 2500 BC to 801 BC) (Post Medieval - 1540 AD to 1900 AD)
NGR SW 7300 3332
A possible mound is visible as cropmarks on vertical aerial photographs taken in 1946. It lies 500m to the north-west of the Bronze Age round barrows described in HER entry 18371 (below). Although the possibility of this feature being a barrow cannot be ruled out, the appearance of the cropmark is such that a modern agricultural origin is equally likely.
No evidence for this feature was detected in the survey data.

Heritage assets immediately adjacent to the survey area
There are no designated heritage assets and five non-designated heritage asset immediately adjacent to the survey area:

HER entry: 55844 (figure 2)
Field system (Post Medieval - 1540 AD to 1900 AD)
NGR SW 7277 3350
The field system to the south of Rame is considered to be post medieval in origin. A field boundary which fits into this extant field pattern is visible as cropmarks on vertical aerial photographs.

HER entry: 55845 (figure 2)
Mound? (Bronze Age - 2500 BC to 801 BC) (Post Medieval - 1540 AD to 1900 AD)
NGR SW 7276 3347
Two possible mounds are visible as cropmarks on vertical aerial photographs taken in 1946. They lie 390m to the north-west of the Bronze Age round barrows described in SMR no. 18371. Although the possibility of these features being barrows cannot be ruled out, their appearance is such that a modern agricultural origin is equally likely.

HER entry: 55848 (figure 2)
Extractive pit (Early Medieval to Modern - 410 AD to 2050 AD)
NGR SW 7300 3365
A shallow hollow is visible as a faint earthwork on vertical aerial photographs taken in 1964 in a field to the south-west of Little Lestraynes. The feature is approximately 10m across and is considered likely to be an extractive pit of post medieval or earlier origin.

HER entry: 181371.10 (approx. 100m southeast of the southern boundary of field 2)
Scheduled Monument CO976
Barrow (Bronze Age - 2500 BC to 801 BC)
NGR SW 7302 3319
One of a small cemetery consisting of two barrows (see also 18371.20). This one is marked as a tumulus on the 1962 OS map. Henderson records that this barrow was formerly ploughed over, and that it is separated from the barrow to the north-east by the old 'ridgeway' dividing two parishes . The OS describe this barrow as "a mutilated bowl barrow, 20m diameter by 6.0m high", whilst Sheppard gives the height as approx. 0.3m.

HER entry: 181371.20 (approx. 100m southeast of the southern boundary of field 2)
Scheduled Monument CO976
Barrow (Bronze Age - 2500 BC to 801 BC)
NGR SW 7307 3323
One of a small cemetery consisting of two barrows (see also 18732.10). It is listed Dowson and Henderson records that the site was formerly ploughed, and that it is separated from the barrow to the south-west by the old 'ridgeway' dividing two parishes.

The OS describe this site as "a bowl barrow 24m diameter and 1.1m high". Mercer gives the dimensions as 8.0m by 1.0m.

Archaeological works adjacent to the survey area

The survey area was within the area of the Heath EN Project:

Event ID: ECO2644
Cornwall HER Event Record: 2696
Cornwall HES Project Code: 2005069
Environmental sampling
01/01/2005 to 31/12/2005
NGR SW 6437 3397 (centre point), 53159m by 48328m
English Heritage's in-house contribution to HEATH involved palaeoecological and dating services aimed at tracing the origins, long-term history and development of West Cornwall's heathland and vegetation.

6 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 7.

6.1 Results

Figure 1 (this section) shows the interpretation of the survey and includes the anomaly groups identified as pertaining to archaeological deposits along with their numbers. 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.

Figure 1 and table 1 comprise the analysis of the survey data.

The four fields comprising the survey area were designated fields A to D as shown in figure 2, appendix 1. No anomalies thought to relate to archaeological deposits or features were identified in field D.

Plots of the processed data are provided in figures 3 and 4 (appendix 1).

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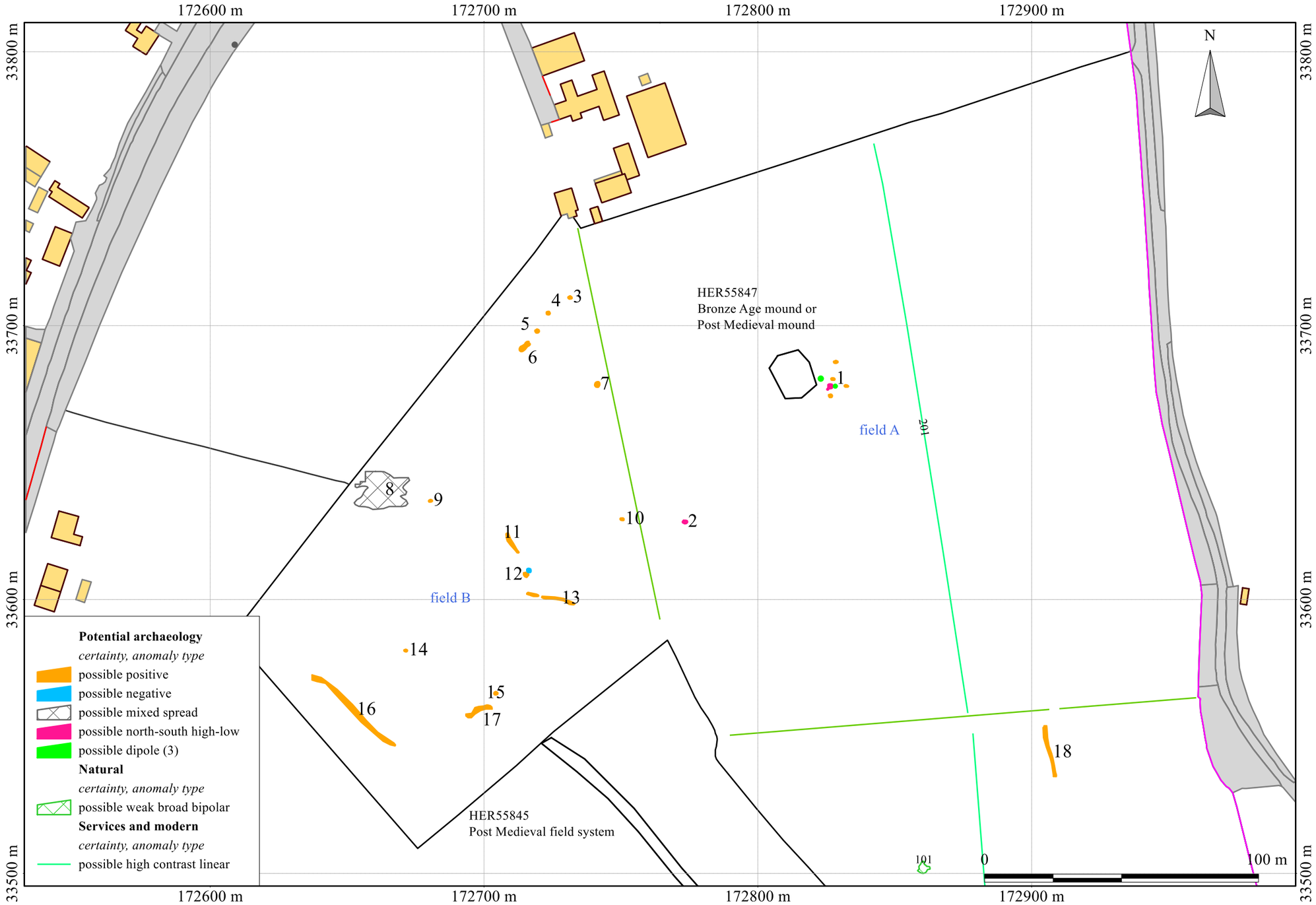
field designation	anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments
A	1	possible north-south high-low		in-situ heated deposits	anomalies either represent in-situ heated deposits or a coincidental interaction of surrounding anomalies resulting from ferrous deposits
		possible dipoles		ferrous deposits	anomalies likely to represent rerrous-rich deposits of unknown age or provenance - included to show interaction with nearby anomalies
		possible positive	oval	pit	
	2	possible north-south high-low		in-situ heated deposits	anomalies either represent in-situ heated deposits or a coincidental interaction of surrounding anomalies resulting from ferrous deposits
B	3	possible positive	oval	pit	
	4	possible positive	oval	pit	
	5	possible positive	oval	pit	
	6	possible positive	linear		
	7	possible positive	oval	pit	
	8	possible mixed spread	irregular	archaeological deposit, recent rubble or near-surface bedrock	
	9	possible positive	oval	pit	
	10	possible positive	oval	pit	
	11	possible positive	linear		
	12	possible positive			anomaly groups either represent possible archaeological deposits or, less likely, a deposit of ferrous material
	13	possible positive	disrupted linear		
	14	possible positive	oval	pit	
	15	possible positive	oval	pit	
	16	possible positive	curvilinear		
	17	possible positive	curvilinear		
C	18	possible positive	linear		
	101	possible weak broad bipolar		spring	springs are natural deposits but can have archaeological significance and so are highlighted in the survey data
A, B, C, D	201	possible high contrast linear		ferrous cable, pipe or drain	

Table 1: data analysis



British Grid
centre X: 172764.25 m, centre Y: 33653.03 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:

1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposits.

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Figure 1: survey interpretation, fields A to C,
with map of HER/NMP records

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6.2 Discussion

Refer to figures 1 (this section), 2, 3 and 4 (appendix 1).

Not all anomalies or anomaly groups identified in the survey dataset are necessarily 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 the data analysis (table 1).

General points

There is a distinct lowering of the magnetic response on the western side of field D as shown in figures 2 and 3. This reflects the leaching and alteration of magnetic minerals as a result of relatively wet conditions in the sub-soils and deeper deposits.

Anomalies though to relate to natural features were not mapped.

Recent man-made objects such as manholes, water management equipment or drains have not been mapped except where they comprise significant magnetic responses across the dataset.

Data collection along the field edges was restricted as shown in figures 2 and 3 due to the presence of magnetic materials and objects in and adjacent to the field boundaries. Strong magnetic responses mapped close to the field boundaries are likely to relate to these items except where indicated otherwise in figure 1.

There a number of distinct trends in the fields that are likely to relate to recent ground disturbance resulting from ploughing or to natural processes. These trends were not mapped.

All the fields had a relatively low magnetic response making the display of small survey errors inevitable. These can be seen as stripes trending north-south across the data set. They do not affect the analysis or interpretation of the survey data.

No anomalies thought to relate to archaeological deposits or features were identified in field D.

Data relating to historical maps and other records

No anomaly groups were identified as relating to mapped or otherwise recorded features although group 1 lies adjacent to one such feature (see below).

Data with no previous provenance

Anomaly group **1** (field A) lies adjacent to the site of a possible mound (HER 55847, section 5). The group contains one possible in-situ heated deposit, four potential pits and a number of ferrous objects, two of which are recorded. In-situ heated deposits can be evidence of , for example, hearths, furnaces, kilns and cremations. In this case, the anomaly group may represent archaeological deposits or may be a coincidental interaction of surrounding anomaly patterns. The ferrous responses are recorded as examples of the numerous responses close to group 1; they are likely to represent relatively recent objects.

Group **2** represents a second possible in-situ heated deposit. As with group 1, the magnetic response is not crisp and the anomaly group may represent archaeological deposits or may be a coincidental interaction of surrounding anomaly patterns.

Groups **3 to 5, 7, 9, 10, 14 and 15** (all in field B) are relatively clearly defined and may represent filled pits.

Group **8** probably represents a deposit of rubble.

Group **12** (field B) is ambiguous so far as an archaeological characterisation is concerned but unlikely to represent natural deposits.

The remaining anomalies identified as potential archaeological deposits are linear and curvilinear anomalies that may relate to former fields or other enclosure boundaries not recorded on historical Ordnance Survey maps.

6.3 Conclusions

The magnetic contrast across the survey area was low but sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses.

Eighteen magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Of these, two may represent in-situ heated deposits of potential archaeological significance but which would need further archaeological investigations to clarify their nature. One of these lies close to the location of a possible Bronze Age or Post Medieval mound (HER55847). Nine and possibly ten anomaly groups may correspond to filled pits. One probably represents a deposit of rubble. The remaining anomalies are linear and curvilinear anomalies that may relate to former fields or other enclosure boundaries not recorded on historical Ordnance Survey maps.

7 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.

8 Acknowledgements

Substrata would like to thank John Valentin of AC Archaeology Ltd for commissioning us to complete this survey.

9 Bibliography

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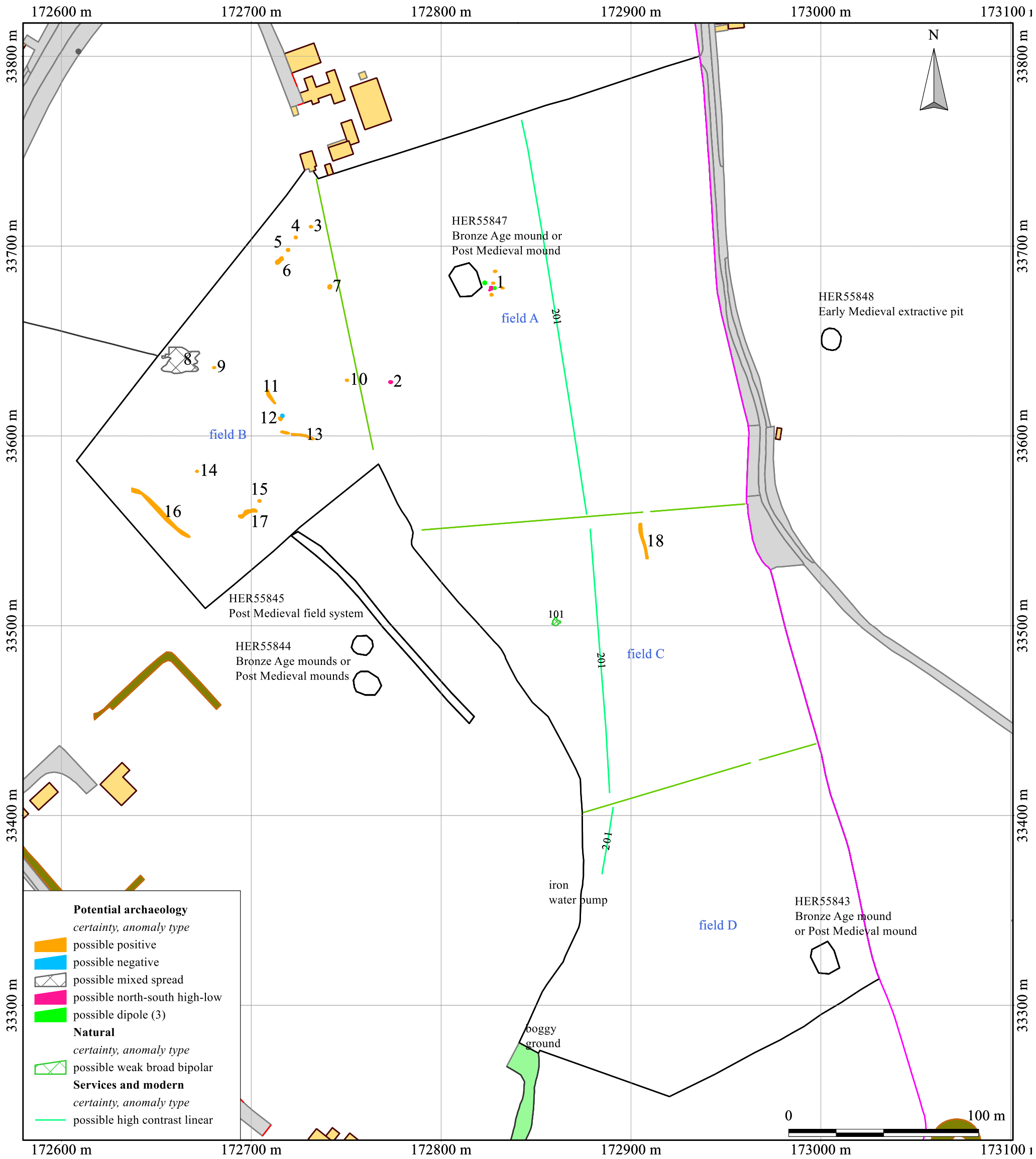
Appendix 1 Supporting plots

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.



British Grid
centre X: 172840.48 m, centre Y: 33523.26 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
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Figure 2: survey interpretation, all fields
with map of HER/NMP records

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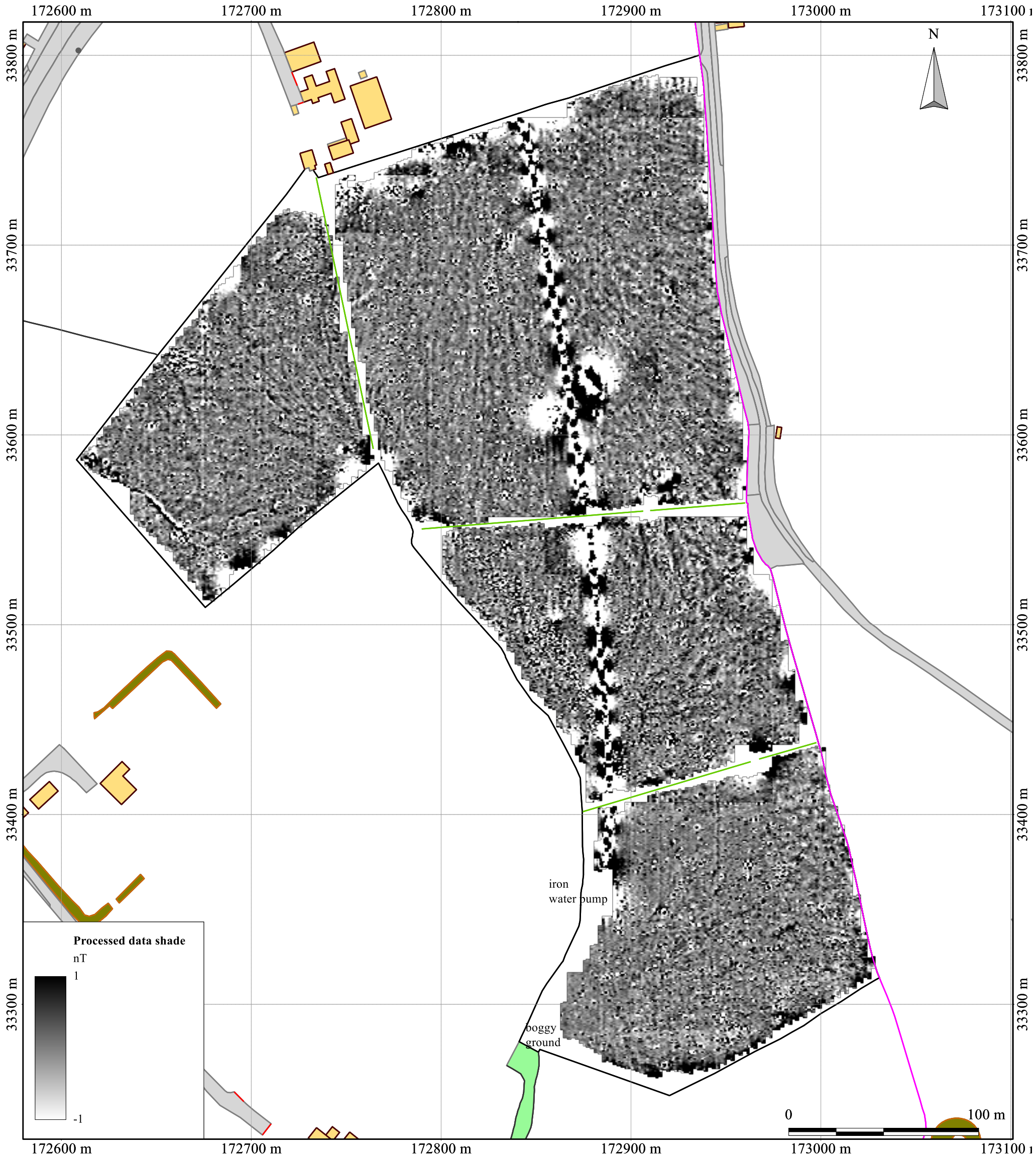

British Grid
centre X: 172840.48 m, centre Y: 33523.26 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 3: shade plot of processed data

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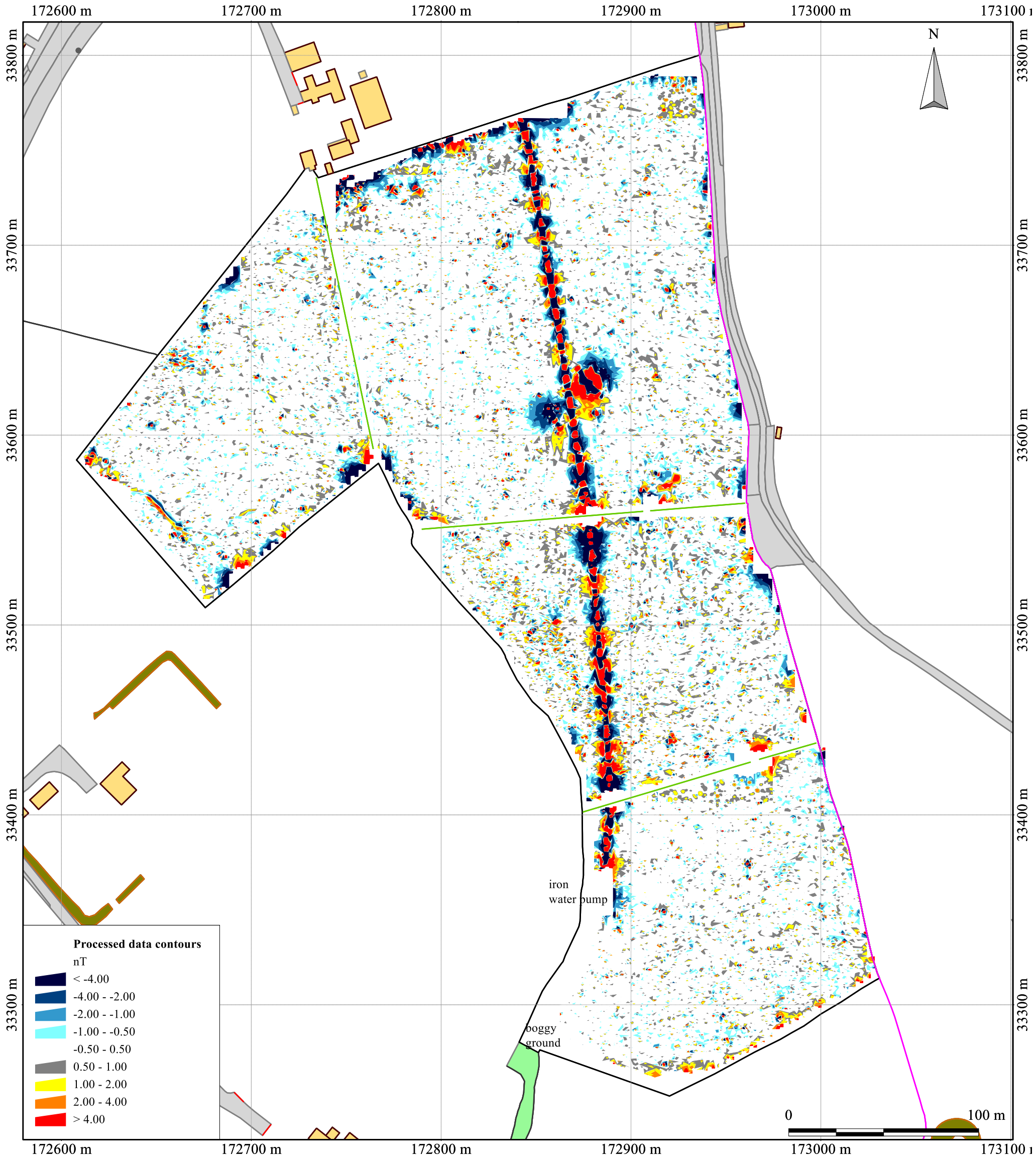

British Grid
centre X: 172840.48 m, centre Y: 33523.26 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 4: contour plot of processed data

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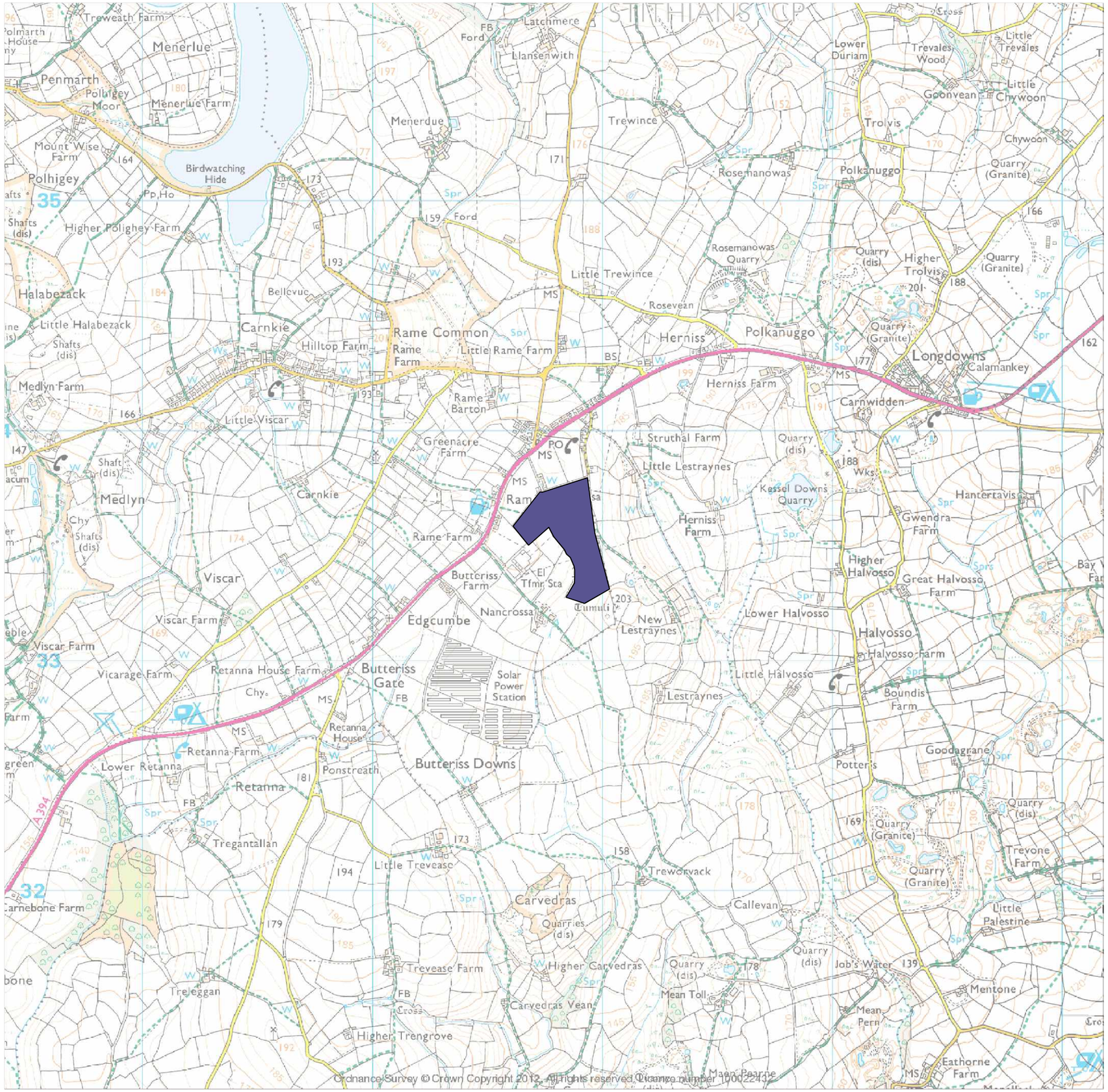

PROJECT

Nancrossa Farm, Penryn, Cornwall

TITLE

Figure 5: Site location

AC archaeology

Appendix 2 Methodology Summary

Table 2: methodology summary	
Documents Survey methodology statement: Dean (2014)	
Methodology 1. The work was undertaken in accordance with the survey methodology statement. 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.	
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. *DGPS used:* Spectra Precision PM5V2 GPS with external antenna and survey pole and DigiTerra Explorer 7 as the survey control program.	
Equipment *Instrument:* Bartington Instruments grad601-2 *Firmware:* version 6.1	**Data Capture** *Sample Interval:* 0.25-metres *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN
Data Processing, Analysis and Presentation Software IntelliCAD Technology Consortium IntelliCAD 7.2 DW Consulting TerraSurveyor3 Manifold System 8 GIS Microsoft Corp. Office Excel 2013 Microsoft Corp. Office Publisher 2013 Adobe Systems Inc Adobe Acrobat 9 Pro Extended	

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
SITE Instrument Type: Bartington Grad 610 Units: nT Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 PROGRAM Name: TerraSurveyor Version: 3.0.22.1
Stats Max: 55.35 Min: -67.02 Std Dev: 4.76 Mean: -0.05 Median: 0.00 Surveyed Area: 9.3966 ha Processes: 5 1 Base Layer 2 Clip at 1.00 SD 3 Clip at 4.00 SD 4 De Stagger: Grids: All Mode: Both By: -3 intervals 5 DeStripe Median Sensors: All Note: exporting the processed data from TerraSurveyor into Manifold GIS for analysis imposes an 'x matches y' interpolation on the data which is reflected in the processed data figures.

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 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.

<u>Bartington grad601-2 gradiometers</u>

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.

<u>Multiple sensor arrays</u>

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.