Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Globe Hill, Woodbury, East Devon

Ordnance Survey (E/N): 300700,87010 (point)

Report: 141127

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26 November 2014

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Accompanying CD-ROM

1 Survey description and summary

1.1 Survey

Type:	twin-sensor fluxgate gradiometer
Date:	8 November 2014
Area:	1ha
Lead surveyor:	Ross Dean BSc MSc MA MIfA

1.2 Client

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

1.3 Location

Site:	Land at Globe Hill
Village & Civil parish:	Woodbury
District:	East Devon
County:	Devon
Nearest Postcode:	EX5 1LG
NGR:	SY 007 870
Ordnance Survey E/N:	300700,87010 (point)

1.4 Archive

OASIS number:	substrat1-196483
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

1.5 Introduction

This report was commissioned by AC Archaeology Ltd on behalf of clients. It has been prepared as part of a programme of work in support of a forthcoming planning application at the above site. The location of the proposed development area is shown in Figure 4.

1.6 Summary

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Not all of the application area was suitable for a magnetometer survey given the proximity of highly magnetic materials bordering the site (Figures 1 to 3). Eight magnetic anomaly groups were identified as relating to possible archaeological deposits or features. Of these, five are most likely to relate to field boundaries or other enclosures of more than one phase of previous land management. Two groups are clusters of anomalies either representing postholes or natural deposits. One group denotes either a pit or a natural deposit.

2 Survey aims and objectives

2.1 Aims

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

2.2 Objectives

1. Complete a gradiometer survey across agreed parts of the application 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

4.1 Landscape and land use

The application area (Figure 4) comprises a field and some additional small parcels of land on the western edge of the village of Woodbury. It is bounded to the west and north by fields and to the east and south by residential infrastructure. A stream, channelled to create flood defences, runs through the southern part of the application area and survey area. At the time of the survey the land was under grass.

4.2 Geology

The application area is located on a solid geology of mudstones of the Triassic Exmouth Mudstone And Sandstone Formation. These are typically reddish brown silty mudstones with intercalated reddish brown lenticular sandstone beds, exceptionally to 30m thick, but mostly 5 to 10m thick. The superficial geology is Quaternary alluvium. This is normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present (British Geological Survey, undated).

5 Archaeological background

The following is a short summary of information obtained from the Devon and Dartmoor Historic Environment Record (HER) within 250m of the survey area and deemed relevant to the understanding of the gradiometer survey. Except where specifically stated, this information was obtained using the Heritage Gateway (English Heritage, undated).

The reader is advised that this summary should not be used outside the context of this report and is referred to the Devon Historical Environment Record (DHER) for informed provision of the record.

5.1 Historical Landscape Characterisation

Barton fields: these relatively large, regular enclosures seem likely to have been laid out between the15th and 18th centuries with some curving boundaries possibly following earlier divisions in the pre-existing medieval fields (Devon County Council, undated).

5.2 Heritage Assets within the Application Area

There are no heritage assets within the application area.

5.3 Heritage Assets within 250m of the Application Area

'Woodbury' is recorded as 'Wodeberia' in 1086. Village is of Saxon origin perhaps dating to the late seventh century (DHER entry MDV66826) and had a market and fair granted in 1286. It was named as a Borough in 1288 (MDV21833). A watermill at Woodbury is recorded in the Domesday Book and it may have been in the vicinity of Gilbrook House or on the other side of the road to the south of the application area (MDV19351). Gilbrook Cottages, situated at the eastern edge of site, are a row of three cottages dating from at least the 16th century with later alterations (MDV79882). To the south of the site an 18th century Tannery operated from the seventeenth century until it closed in 1913 (MDV2024). Within the village are a number of buildings recorded as heritage assets dating from the fifteenth century through to the Modern period. Two finds have been recorded near to the application area. A Neolithic greenstone axe, possibly an axe hammer of Trewen picrate, is recorded without a specific location (MDV14972). Two tanged iron arrowheads, presumably Medieval, were found in a garden at Woodbury in 1971 (MDV14396).

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 identifies and characterises anomalies and anomaly groups that may relate to archaeological deposits and structures.

The reader is referred to section 7.

6.1 Results

Figure 1 shows the interpretation of the survey data. It includes the anomaly groups identified as relating 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 along with Table 1 comprises the analysis of the survey data. Plots of the processed data are provided in Figures 2 and 3.

6.2 Discussion

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM.

<u>General points</u>

Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment, drains, cables and other services were only mapped where they comprised significant magnetic responses across the dataset that needed clarification. If mapped, they are listed in Table 1 but are not discussed below.

Not all of the application area was suitable for a magnetometer survey given the proximity of highly magnetic materials bordering the site (Figures 1 to 3).

Data collection along the field edges was restricted as shown in Figures 1 to 3 due to the presence of magnetic materials in and adjacent to the field boundaries. Strong magnetic responses mapped close to the field boundaries are likely to relate to these materials except where indicated otherwise in Figure 1. This is particularly so in the southern survey area section between flood defences and houses where the data was dominated by strong magnetic responses from garden boundaries, river defence fencing and underground services.

<u>Data relating to historical maps and other records</u>

No recorded magnetic anomaly groups coincide with features recorded on historical Ordnance Survey maps.

<u>Data with no previous archaeological provenance</u>

Groups **1** to **4** and **7** are linear magnetic anomaly groups with characteristics typical of anomalies reflecting former field and other enclosure boundaries although group 4 may simply be the result of land subsoil disturbance from land drainage or past cultivation. Groups **5** and **6** may represent either natural deposits or possibly postholes. Group **8** may represent a pit or natural deposit such as that left by a tree bole. The actual nature of groups 5, 6 and 8 would require further archaeological investigations to establish.

6.3 Conclusions

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Eight magnetic anomaly groups were identified as relating to possible archaeological deposits or features. Of these, five are most likely to relate to field boundaries or other enclosures of more than one phase of previous land management. Two groups are clusters of anomalies either representing postholes or natural deposits. One group denotes either a pit or a natural deposit.

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 Analysis table and 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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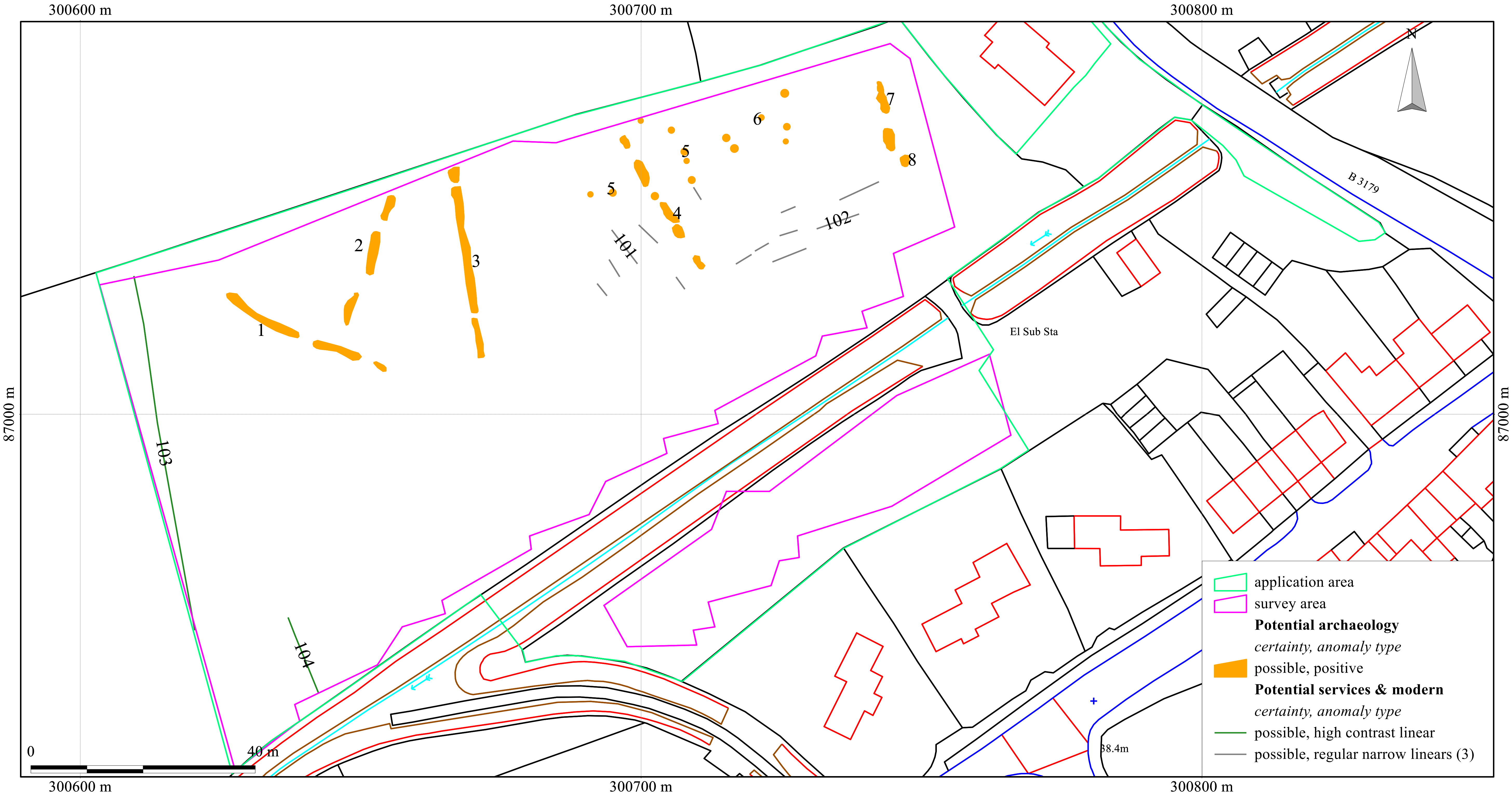
anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments
1	possible, positive	disrupted linear		
2	possible, positive	disrupted linear		
3	possible, positive	disrupted linear		
4	possible, positive	disrupted linear		anomaly group may represent an archaeological deposit, field drainage or sub-soil disturbance due to ploughing or other cultivation practice
5	possible, positive	ovals	postholes or natural deposits	anomaly groups are distinct and may represent either postholes or natural deposits
6	possible, positive	ovals	postholes or natural deposits	anomaly groups are distinct and may represent either postholes or natural deposits
7	possible, positive	disrupted linear		
8	possible, positive	oval	pit or natural deposit	
101	possible, regular narrow linears	field drains or cultivation disturbance		
102	possible, regular narrow linears	sub-soil disturbance		anomalies represent sub-soil disturbance from the passage of livestock, vehicles or recent cultivation
103	possible, high contrast linear	steel or iron cable, pipe or drain		
104	possible, high contrast linear	steel or iron cable, pipe or drain		

Table 1: data analysis



British Grid
centre X: 300720.70 m, centre Y: 87002.68 m

Scale: 1:700 @ 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

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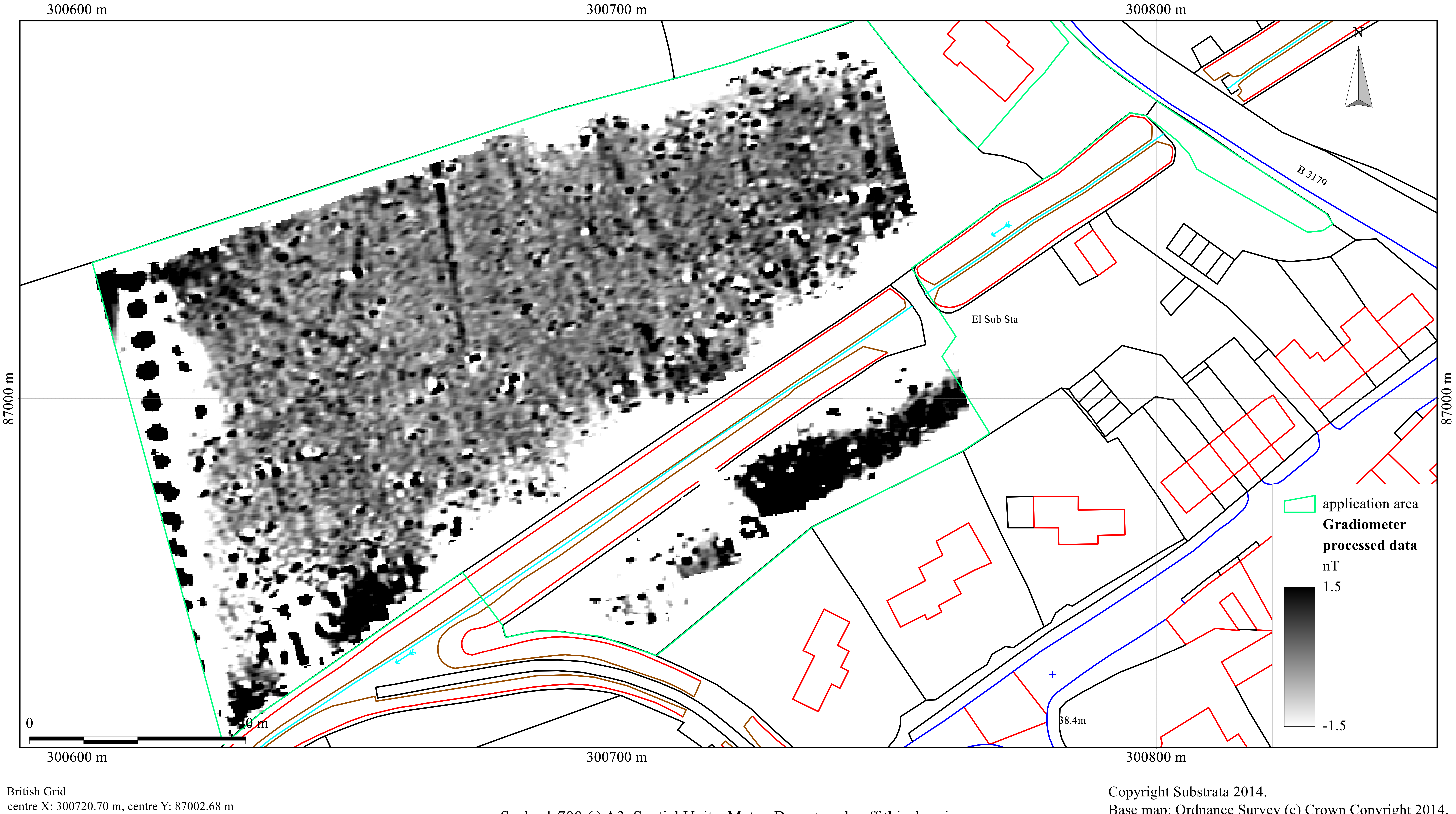

Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 2: shade plot of processed data

Substrata
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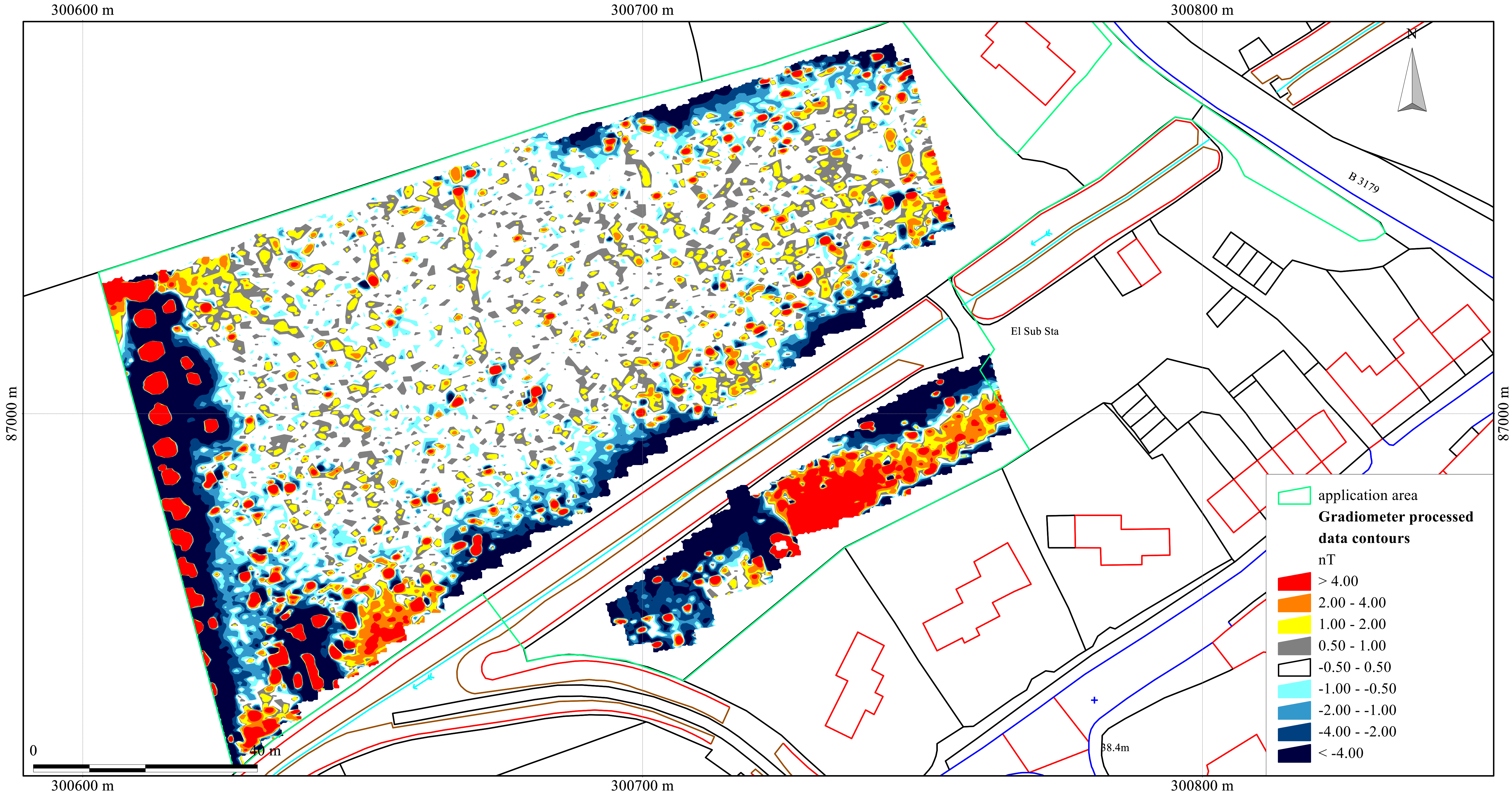

British Grid
centre X: 300720.70 m, centre Y: 87002.68 m

Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 3: contour plot of processed data

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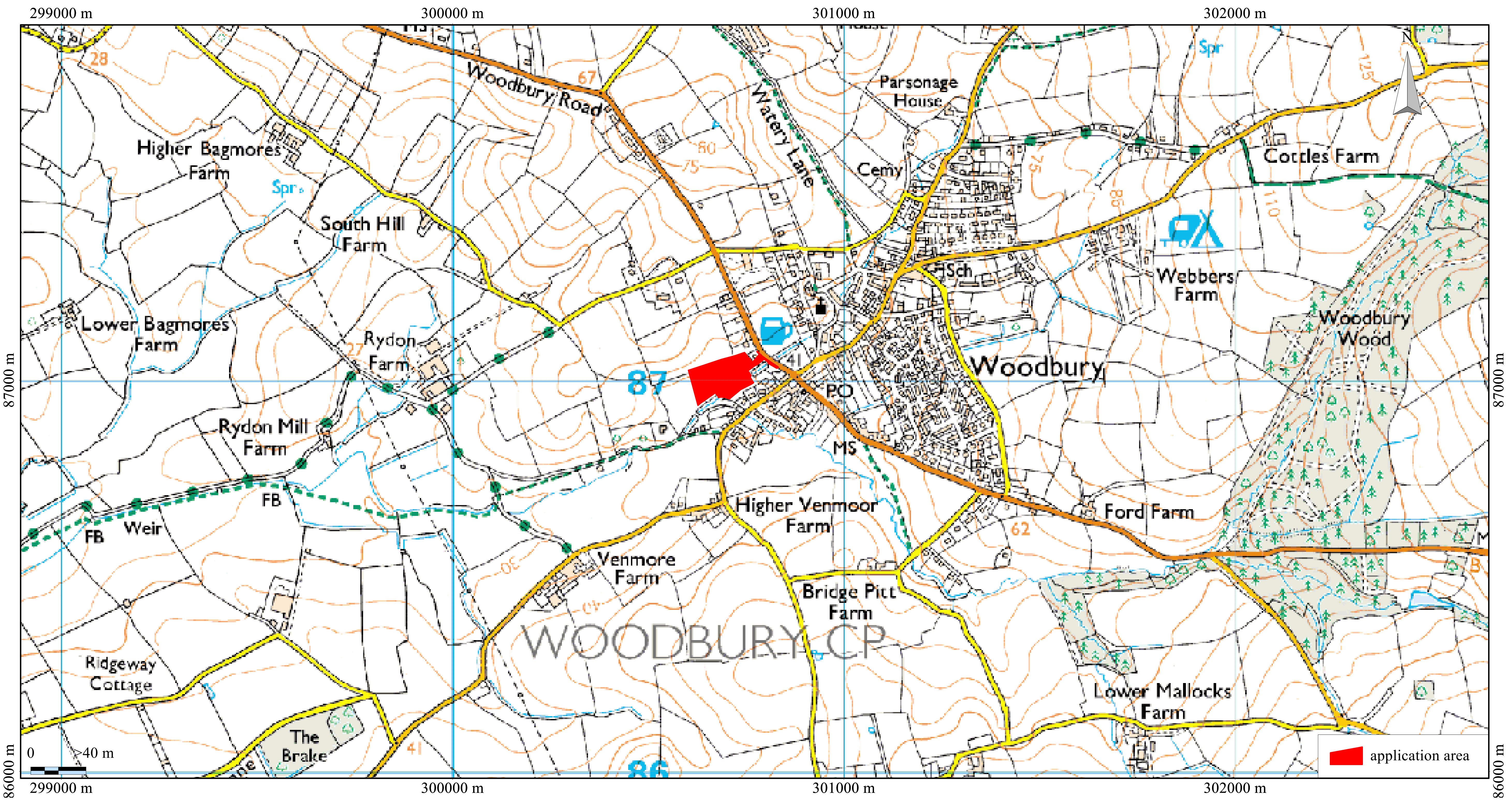

British Grid
centre X: 300772.08 m, centre Y: 86945.38 m

Scale: 1:10000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 4: location map

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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:* GN345
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: 3.0.25.1
Stats Max: 31.45 Min: -34.43 Std Dev: 6.74 Mean: -1.05 Median: -0.11 Surveyed Area: 1.0591 ha Processes: 9 1 Base Layer 2 Clip at 2.00 SD 3 De Stagger: Grids: All Mode: Both By: -1 intervals 4 DeStripe Median Sensors: w3.xgd w6.xgd w9.xgd w12.xgd w13.xgd w4.xgd w5.xgd w10.xgd w11.xgd w14.xgd 5 DeStripe Median Sensors: w1.xgd w2.xgd w7.xgd 6 DeStripe Median Sensors: w17.xgd w18.xgd 7 Edge Match (Area: Top 0, Left 240, Bottom 29, Right 359) to Bottom edge 8 Edge Match (Area: Top 0, Left 120, Bottom 29, Right 239) to Bottom edge 9 Edge Match (Area: Top 0, Left 120, Bottom 29, Right 239) to Right edge Note: converting the gradiometer data into ESRI GIS files imposed an x=y interpolation on the entire dataset

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.