Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land near Cat Copse, Clyst St Mary, Devon

Ordnance Survey (E/N): 299050,91130 (point)

Report: 140529

Ross Dean BSc MSc MA MIfA

30 May 2014

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Accompanying CD-ROM

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Copies of report figures ..... Adobe PDF format
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- GIS project ..... Manifold 8 '.map' file
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- GIS classification schema ..... Adobe PDF format

AutoCAD version of the survey interpretation ..... AutoCAD DXF

1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: May 2014
Area surveyed: 5 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 near Cat Copse, Clyst St Mary
Civil Parish:	Sowton (represented by the Bishop's Clyst Parish Council)
District:	East Devon
County:	Devon
Nearest Postcode:	EX5 1QL
NGR:	SX 990 911 (point)
Ordnance Survey E/N:	299050,91130 (point)
OASIS number:	substrata1-180237
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. The location of the site is shown in figure 8.

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

Twelve magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Of these, six represent deposits and structures mapped as part of a former brick and tile works. One group may relate to former ridge and furrow ploughing. The remaining groups are linear and curvilinear deposits or structures 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 three fields to the west and north of a housing estate on the east side of Clyst St Mary. The field designations are shown in Figure 1 and the location of the site in Figure 8. Field 1 is bordered by Cat Copse woods to the north, the Westpoint County Showground to the west, the housing estate to the east and the A3052 to the south. Field 2 is bordered by Cat Copse woods to the north, field 1 to the west, field 3 to the east and the housing estate to the south. Field 3 is bordered by Cat Copse woods to the north, field 2 to the west, an agricultural field to the east and the housing estate to the south.

The three fields are relatively flat and lie between approximately 20m and 25m O.D. on the northern side of a valley containing the Grindle Brook stream with the northern slopes of the valley rising to the west, north and south within 1000m of the survey area (Figure 8).

Land use at the time of the survey
Grass pasture.

Geology
The site is located on a solid geology of mudstone of the Triassic Exmouth Mudstone and Sandstone Formation which comprises reddish brown silty mudstones with intercalated reddish brown lenticular sandstone beds, exceptionally to 30m thick, but mostly 5 to 10m thick (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 National Heritage List for England and the Devon and Dartmoor Historic Environment Record (HER) within 1000m of the proposed development site and relevant to the understanding of the gradiometer survey. Except where specifically cited, this information was obtained using the Heritage Gateway (English Heritage, undated 1).

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

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

Field 1
Public complex: Represents public buildings and other related complexes including schools, colleges, hospitals, government offices, civic centres and cemeteries.

Field 2
Post-medieval enclosures: Enclosures of post-medieval date. Fields laid out in the C18th and C19th commonly have many surveyed dead-straight field boundaries.

Field 3
Modern enclosures adapting post-medieval fields: Modern enclosures that have been created by adapting earlier fields of probable post-medieval date.

Heritage assets within the survey area
Refer to Figure 7.

HER MDV51325: “Brick and tile works (disused)” marked on OS 6" (1906) map. Kennels on 1972 map (OS). Modern - 1751 AD to 2009 AD (Between). NGR SX 988 909 (point).

Evidence for the debris from this works and its demolition was detected in the survey data as large areas of strong mixed magnetic responses (figures 3 to 6).

HER MDV51326: "Old clay pit" marked on OS 6" (1906) map in Cat Copse. Unlabelled pits on 1972 map (OS). Modern - 1751 AD to 2009 AD (Between). NGR SX 989 911 (point).
No evidence for this feature was detected as the data set in this area was dominated by the brick works debris.

Heritage assets immediately adjacent to the survey area
Refer to Figure 7.

HER MDV18536: Roman road in Farringdon parish. ROAD (Roman - 43 AD to 409 AD (Between). NGR SX 990 908 (point).

HER MDV62984: Medieval ridge and furrow seen on RAF vertical aerial photograph cpe/uk/1974/4456 11/apr/47. Medieval - 1066 AD to 1539 AD (Between). NGR SX 988 908 (point).

Archaeological works within and adjacent to the survey area
No works recorded.

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

The three fields comprising the survey area were designated fields 1 to 3 as shown in figure 1. No anomalies thought to relate to archaeological deposits or features were identified in field 3.

Figures 1 and 3 show the interpretation of the survey across all three fields and across the southern part of field 3 respectively. They include 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.

Figures 1 and 2 along with table 1 comprise the analysis of the survey data.

Plots of the processed data are provided in figures 3 to 6 (appendix 1).

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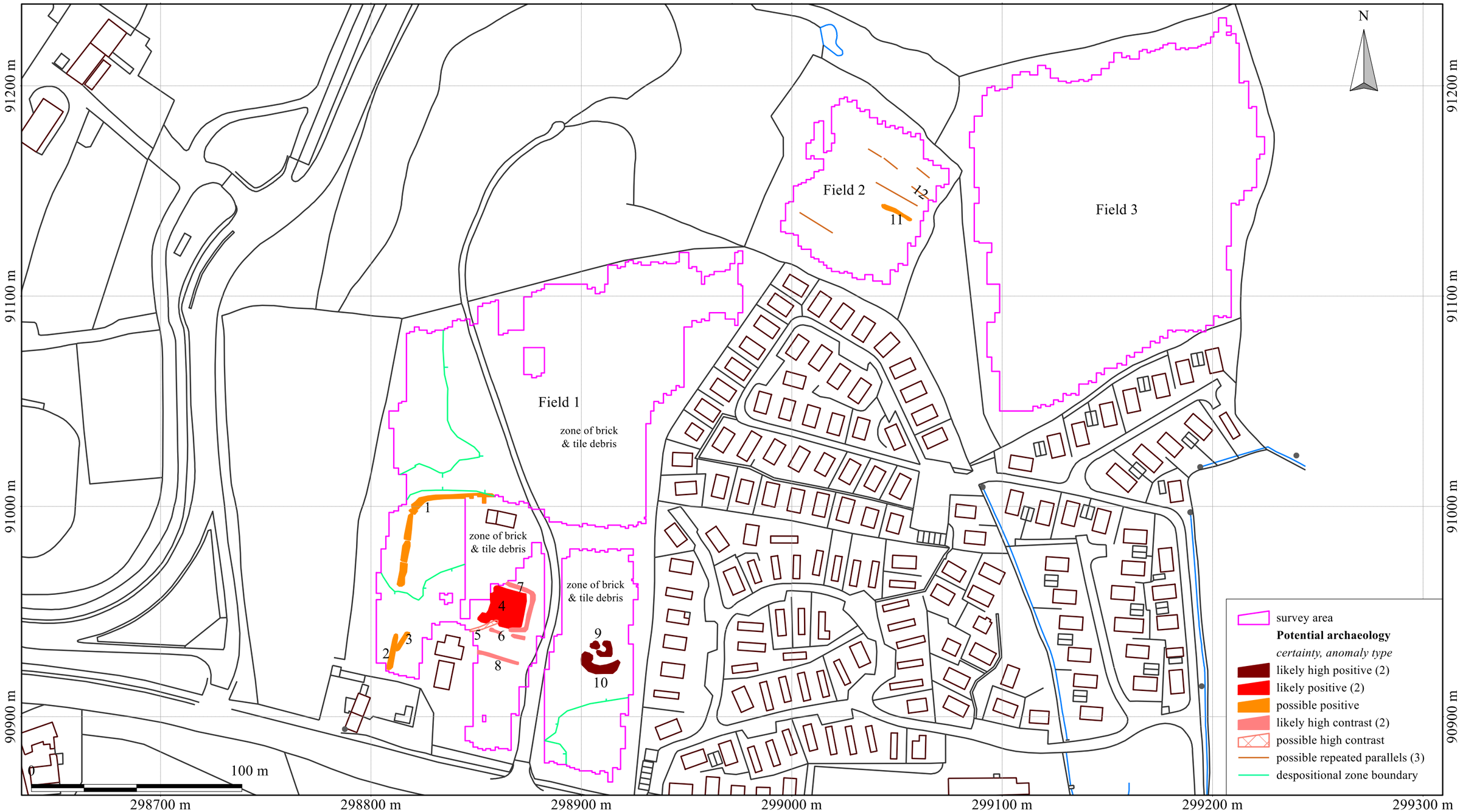
field number	anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	1	2	possible positive	disrupted curvilinear		anomaly group possibly a continuation of 2	
	2	1	possible positive	linear		anomaly group possibly a continuation of 1	
	3		possible positive	linear		anomaly group within area of a former brick works	
	4		likely positive	rectangular		anomaly group within area of a former brick works & coinciding with former yard area	Devon and Dartmoor HER entry MDV51325
	5		possible high contrast	linear		anomaly group within area of a former brick works	Devon and Dartmoor HER entry MDV51325
	6		likely high contrast	disrupted linear		anomaly group indicative of a structure or deposit of highly heated material such as brick within area of a former brick works & coinciding with former buildings	Devon and Dartmoor HER entry MDV51325
	7		likely high contrast	rectilinear		anomaly group indicative of either a structure with regular steel/iron posts or, less likely, a ferrous cable or ferrous pipe within area of a former brick works - coincides with boundary of former yard	Devon and Dartmoor HER entry MDV51325
	8		likely high contrast	linear		anomaly group indicative of a structure or deposit of highly heated material such as brick within area of a former brick works & coinciding with former buildings	
	9		likely high positive	irregular		anomaly group coincides with a pond mapped between 1889 and 1980 (OS); not mapped by 1985-90 (OS) - the strength of magnetic response suggests debris from brick works present in quantity	Ordnance Survey maps 1889 1:2500 to 1985-93 1:10,000
	10		likely high positive	curvilinear		anomaly group coincides with a pond mapped between 1889 and 1980 (OS) and a bund mapped in 1968 only (OS); neither are mapped by 1985-90 (OS) - the strength of magnetic response suggests debris from brick works present in quantity	Ordnance Survey maps 1889 1:2500 to 1985-93 1:10,000
2	11		possible positive	linear		anomaly group may represent a linear archaeological deposit; possibly ridge and furrow or a ditch	
	12		possible repeated parallels		ridge and furrow		

Table 1: data analysis



British Grid
centre X: 298971.64 m, centre Y: 91050.76 m

Scale: 1:1800 @ 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, all fields

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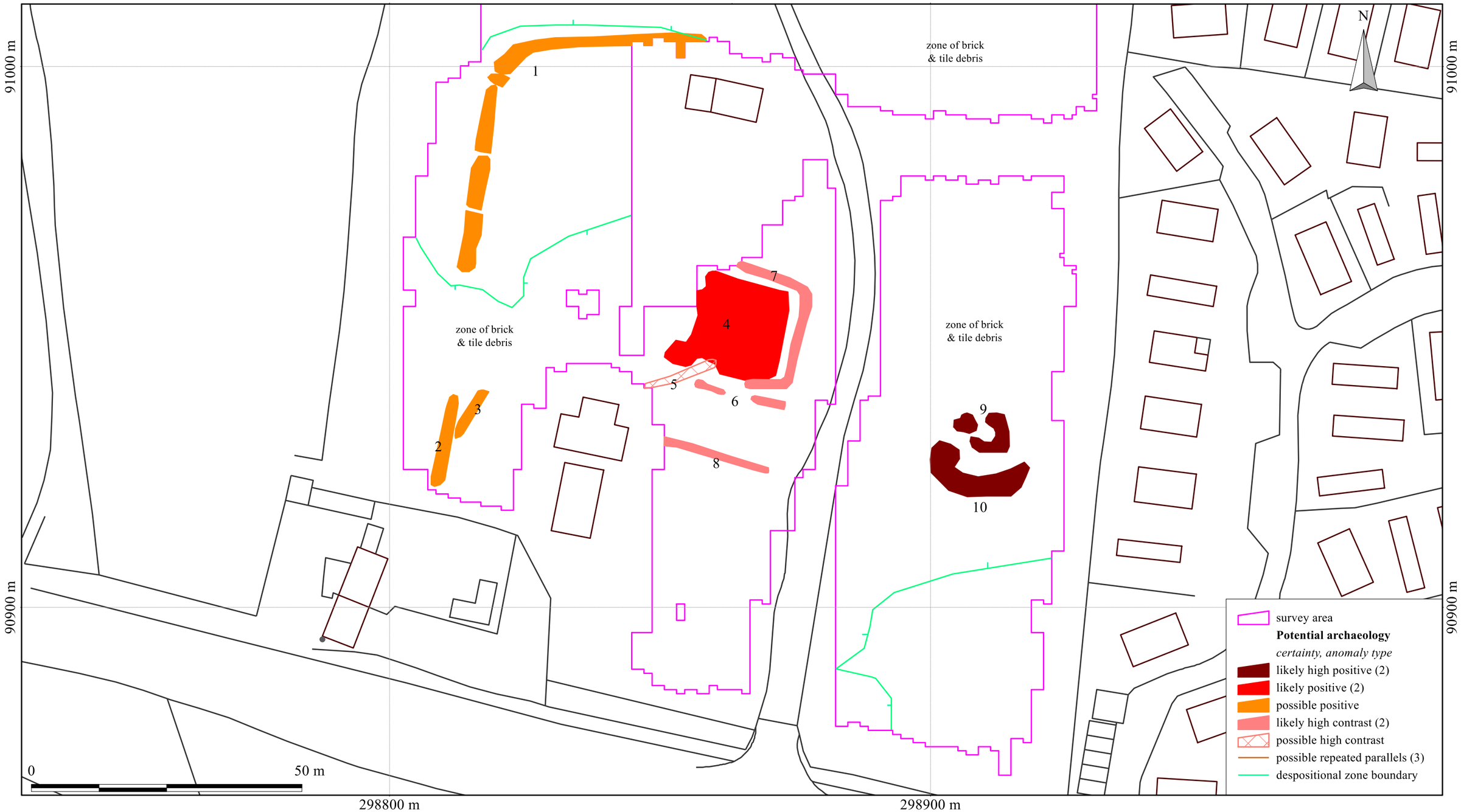

British Grid
centre X: 298863.30 m, centre Y: 90938.41 m

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 2: survey interpretation, field 1, southern area

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6.2 Discussion

Refer to figures 1 and 2 (this section), 3 to 6 (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 are areas of strong mixed magnetic responses in area 1. These relate to brick and tile debris and the demolition debris of a former brick and tile works located in field 1 (Devon and Dartmoor Historic Environment entry HER MDV51325 (section 5)).

There is a distinct lowering of the magnetic response in field 3 as shown in figures 3 and 5. This reflects the ploughing regime undertaken in the field in recent times.

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 3 to 6 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 figures 1 and 2.

No anomalies thought to relate to archaeological deposits or features were identified in field 3.

Data relating to historical maps and other records

Groups **4, 6, 7, 8, 9 and 10** coincide with structures associated with a former brick and tile works (Devon and Dartmoor Historic Environment entry HER MDV51325) mapped between 1889 and 1968 by the Ordnance Survey. Group **4** corresponds to a former yard area and group **7** with the boundary of that area. Group **7** includes magnetic responses that may indicate iron posts (Figures 5 and 6). Groups **9 and 10** represent deposits from a former pond and an associated bund.

Data with no previous provenance

Anomaly groups **1 and 2** probably represent the same deposit or structure not recorded on any historical Ordnance Survey map.

Groups **3 and 11** may relate to former fields or other enclosure boundaries not recorded on historical Ordnance Survey maps.

Group **12** may reflect traces of former ridge-and-furrow.

6.3 Conclusions

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

Twelve magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Of these, six represent deposits and structures mapped as part of a former brick and tile works. One group may relate to former ridge and furrow ploughing. The remaining groups are linear and curvilinear deposits or structures 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: 298971.64 m, centre Y: 91050.76 m

Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 3: shade plot of processed data, all fields

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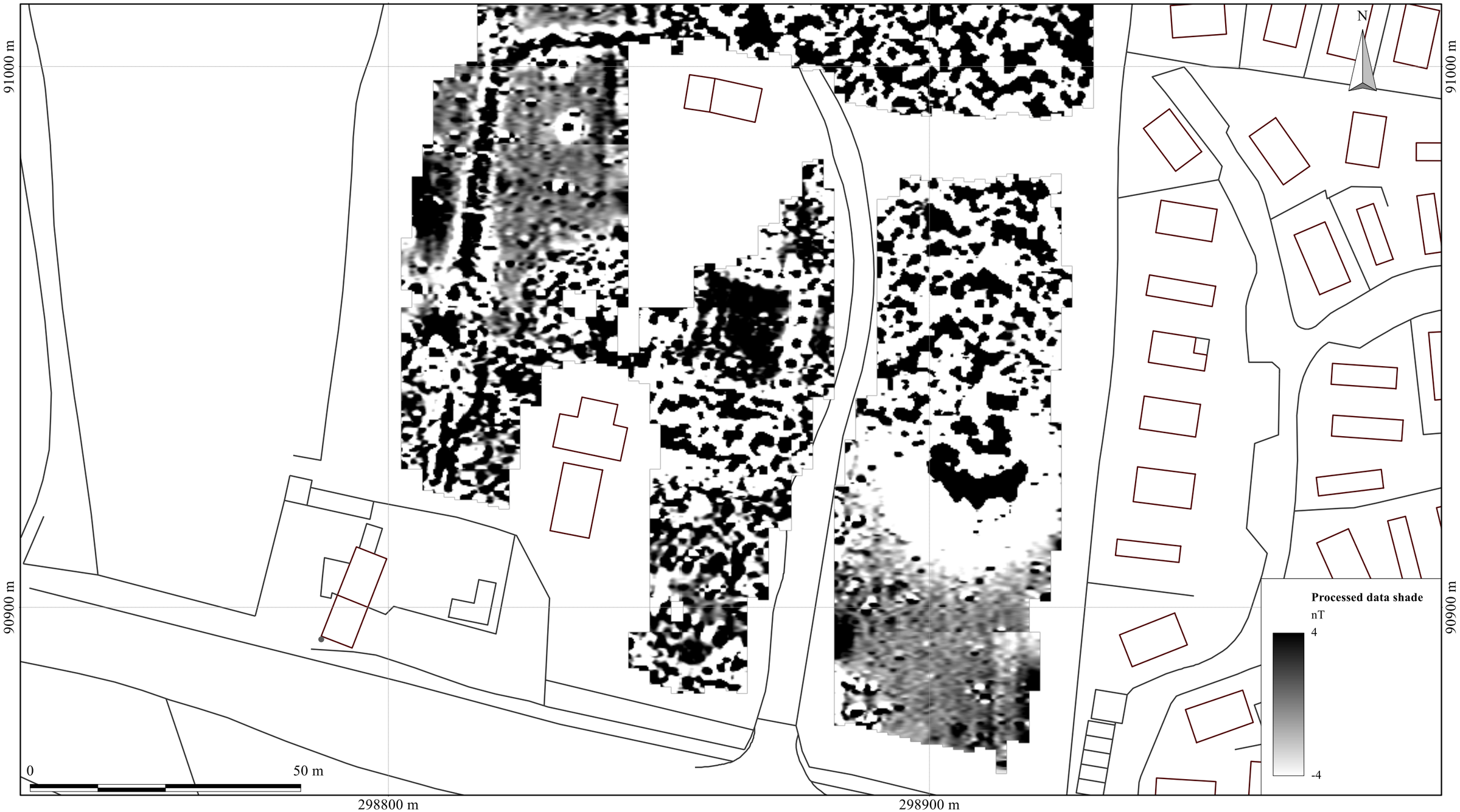

British Grid
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Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 4: shade plot of processed data, field 1, southern area

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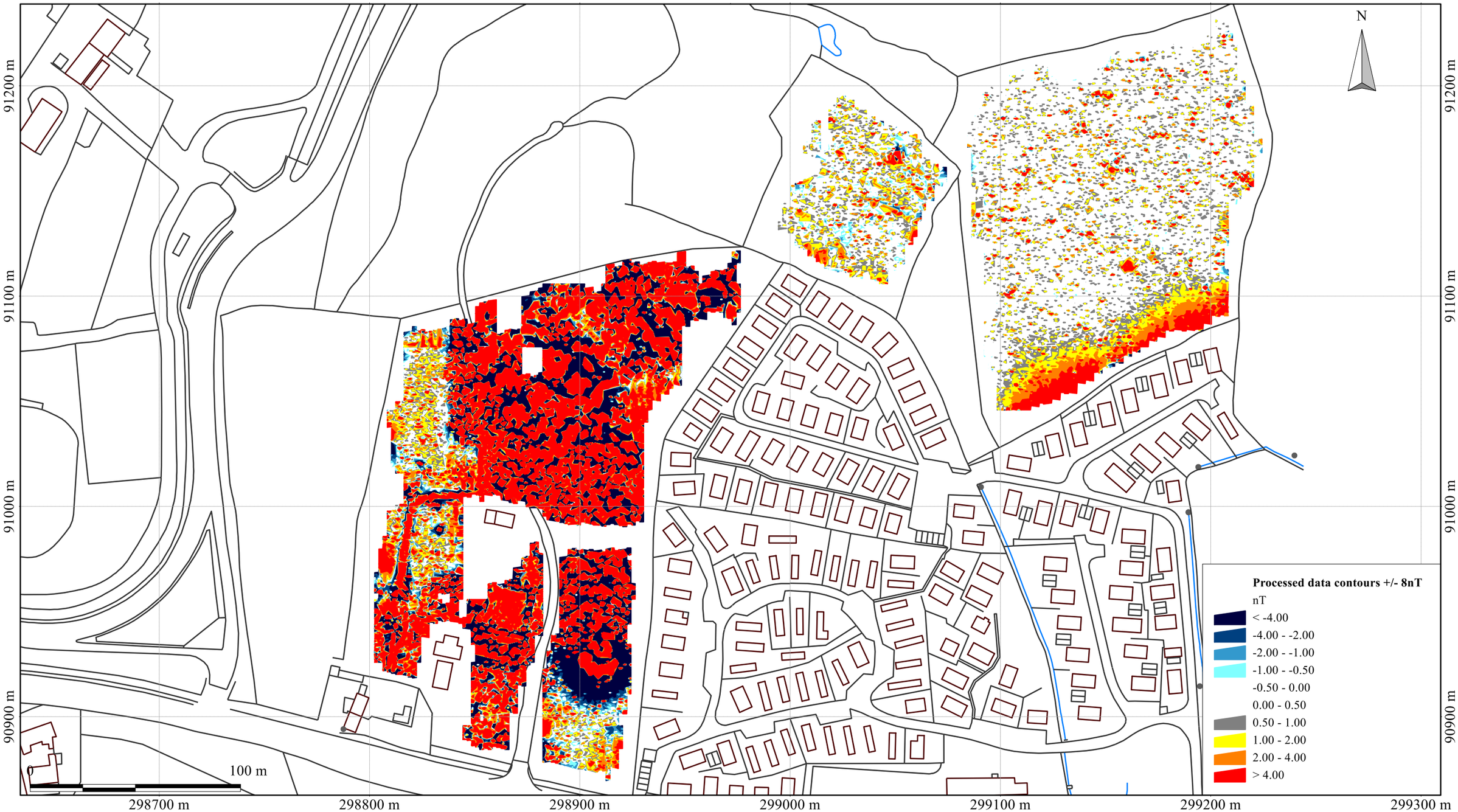

British Grid
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Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 5: contour plot of processed data, all fields

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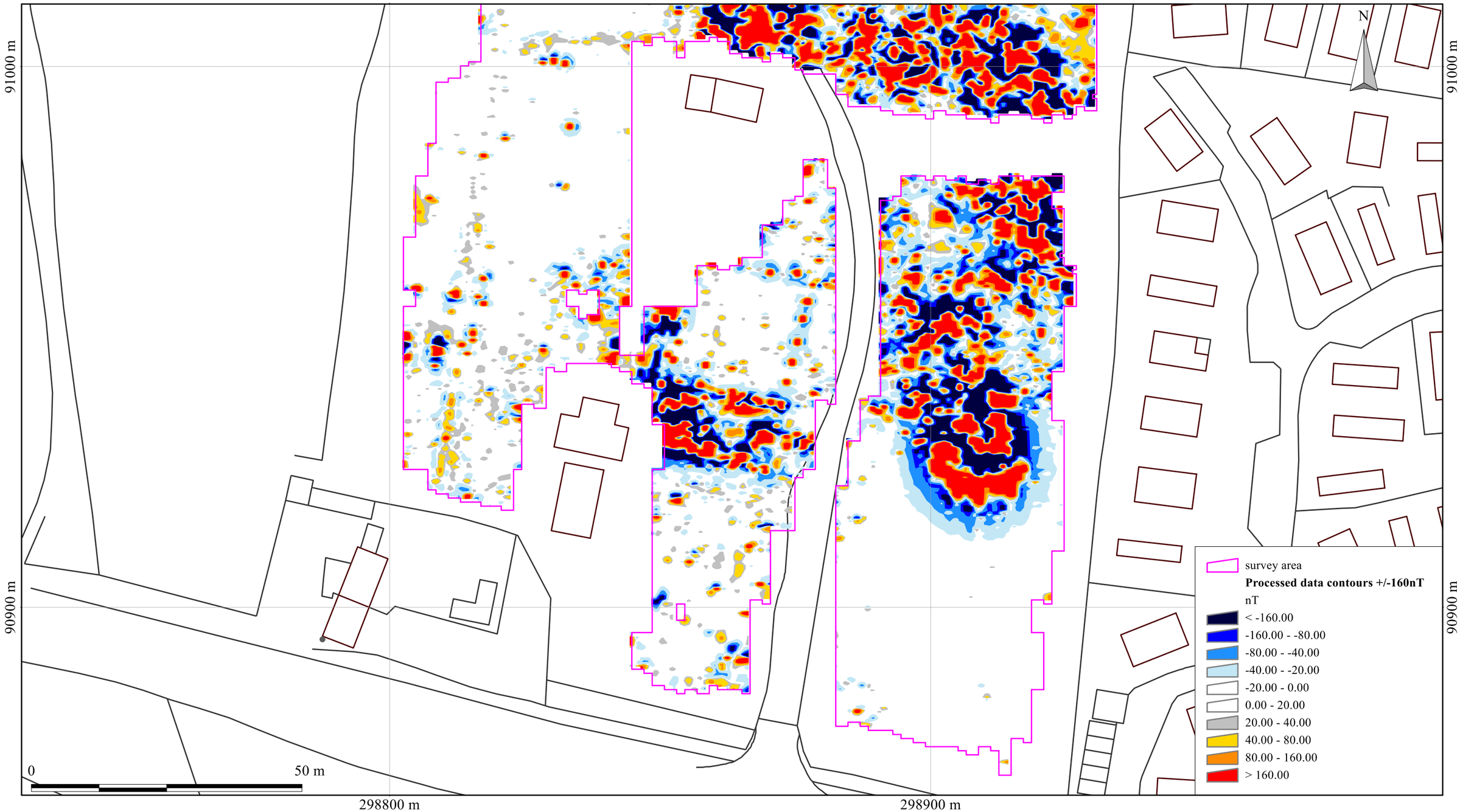

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Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 6: contour plot of processed data, field 1, southern area

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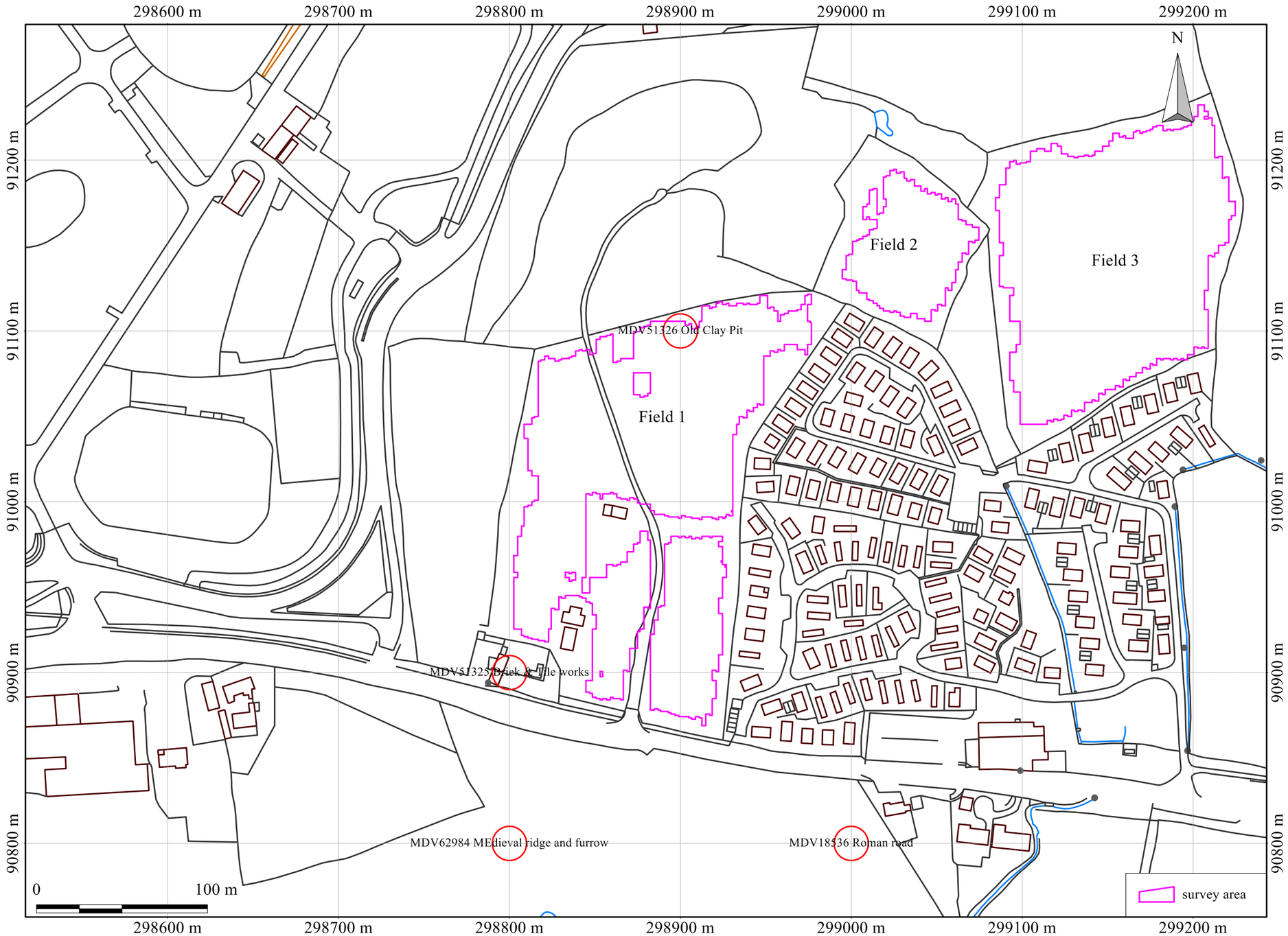

British Grid
centre X: 298879.92 m, centre Y: 91018.15 m

Scale: 1:2500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 7: survey areas and Devon & Dartmoor HER entries

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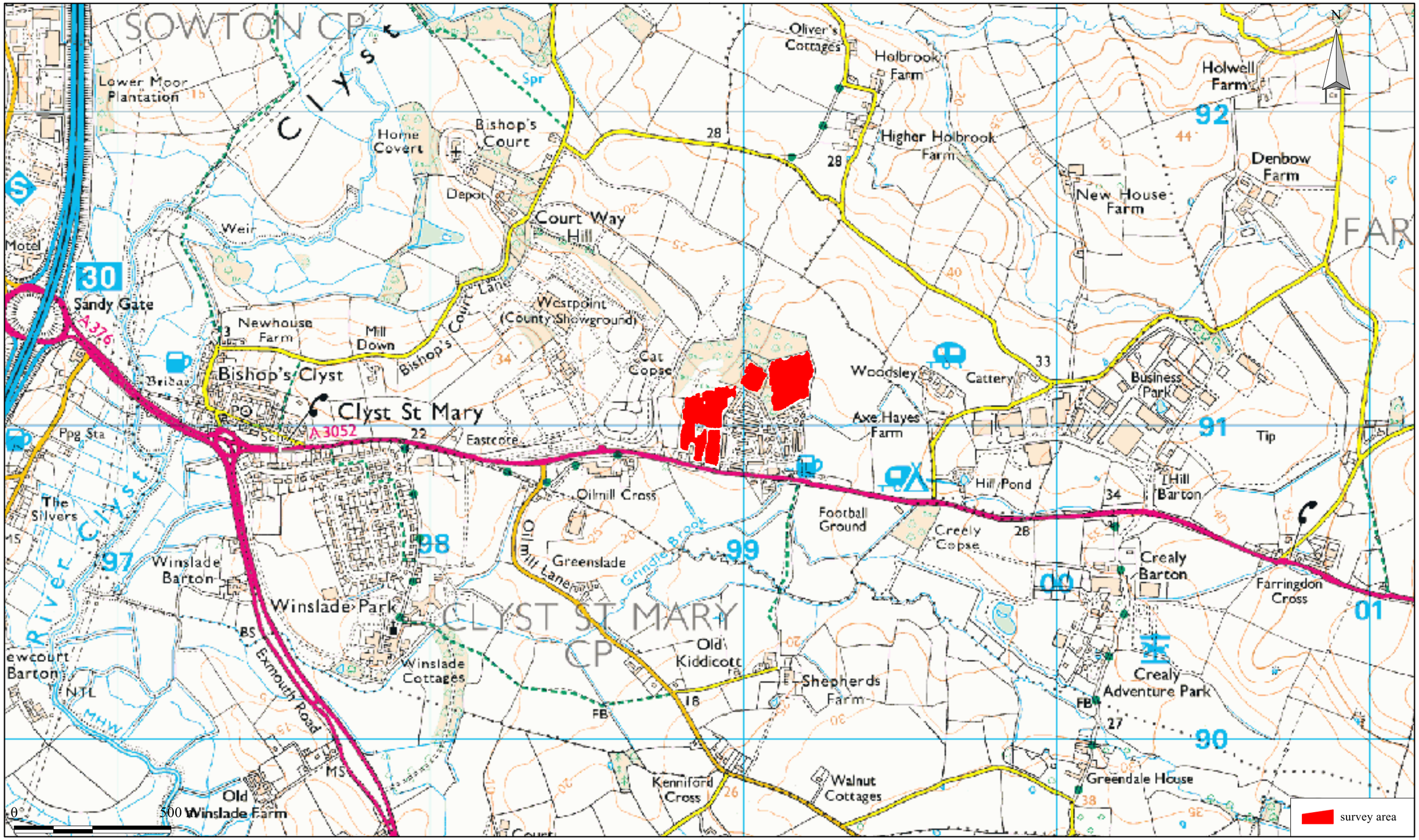

British Grid
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Scale: 1:12000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 8: 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:* 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: 334.69 Min: -397.71 Std Dev: 69.28 Mean: -1.60 Median: 0.00 Processes: 19 1 Base Layer 2 Clip at 1.00 SD 3 Clip at 1.00 SD 4 De Stagger: Grids: All Mode: Both By: -2 intervals 5 De Stagger: Grids: ccb5.xgd ccb6.xgd ccb4.xgd ccb7.xgd ccb3.xgd ccb8.xgd Mode: Both By: -1 intervals 6 DeStripe Median Sensors: ccc15.xgd ccc16.xgd ccc1.xgd ccc14.xgd ccc17.xgd ccc2.xgd ccc13.xgd ccc18.xgd ccc3.xgd ccc12.xgd ccc19.xgd ccc4.xgd ccc11.xgd ccc20.xgd ccc5.xgd ccc10.xgd ccc21.xgd ccc6.xgd ccc9.xgd ccc22.xgd ccc7.xgd ccc8.xgd ccc23.xgd 7 DeStripe Median Sensors: ccc27.xgd ccd8.xgd ccc26.xgd ccd9.xgd ccc25.xgd ccd10.xgd ccd15.xgd ccc24.xgd ccd11.xgd ccd14.xgd ccd12.xgd ccd13.xgd 8 DeStripe Median Sensors: ccd3.xgd ccd4.xgd 9 DeStripe Median Sensors: ccd16.xgd cca8.xgd cca11.xgd cca20.xgd ccb1+ccd17.xgd ccb5.xgd ccb6.xgd cca1.xgd cca7.xgd cca12.xgd cca19.xgd ccb2.xgd ccb4.xgd ccb7.xgd cca2+ccb9.xgd cca6.xgd cca13.xgd cca18.xgd ccb3.xgd ccb8.xgd cca3.xgd cca5.xgd cca14.xgd cca17.xgd cca4.xgd cca15.xgd cca16.xgd 10 DeStripe Median Sensors: cca23.xgd cca24.xgd cca30.xgd cca25.xgd cca29.xgd cca26.xgd cca28.xgd cca27.xgd 11 Edge Match (Area: Top 300, Left 840, Bottom 389, Right 959) to Right edge 12 Edge Match (Area: Top 360, Left 840, Bottom 389, Right 959) to Top edge 13 Edge Match (Area: Top 300, Left 720, Bottom 359, Right 839) to Right edge 14 DeStripe Median Sensors: cca9.xgd 15 DeStripe Median Sensors: cca22.xgd 16 Edge Match (Area: Top 390, Left 840, Bottom 419, Right 959) to Right edge 17 Edge Match (Area: Top 300, Left 720, Bottom 329, Right 839) to Right edge 18 DeStripe Median Traverse: Grids: cca8.xgd cca11.xgd cca7.xgd cca12.xgd cca6.xgd cca13.xgd cca5.xgd cca14.xgd cca4.xgd cca15.xgd 19 DeStripe Median Traverse: Grids: cca19.xgd cca23.xgd cca18.xgd cca24.xgd cca30.xgd cca17.xgd cca25.xgd cca29.xgd cca16.xgd cca26.xgd cca28.xgd cca27.xgd 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.