



An archaeological magnetometer and resistance survey

**A bowl barrow 260m northwest of Putson Cross  
Tiverton, Devon**

Centred on NGR (E/N) 298617,113989

Report 1710TIV-R-1

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21 January 2018

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## Project archive

Report .....	Adobe PDF format
Copies of report figures .....	Adobe PDF format
Raw and processed grid & composite files.....	DW Consulting TerraSurveyor 3 formats
Minimal processing data plots and metadata .....	DW Consulting TerraSurveyor 3 formats
Final data processing data plots and metadata.....	DW Consulting TerraSurveyor 3 formats
GIS project, shape files and classification schema	
GIS project.....	Manifold 8 ‘.map’ file
GIS shape files .....	ESRI standard
GIS classification schema .....	Adobe PDF format
AutoCAD version of the survey interpretation.....	AutoCAD DXF

*Website: [substrata.co.uk](http://substrata.co.uk)*

*For an overview of Substrata, our archaeological geophysical surveying techniques and the results we obtain.*

## 1 Survey description and summary

### 1.1 Survey

Type: magnetometer; twin-sensor fluxgate gradiometer  
twin-probe resistance  
Dates: magnetometer survey: 9 October 2017  
resistance survey: 16 October May 2017  
Area: magnetometer survey: 0.9ha  
resistance survey: 0.58ha  
Lead surveyor: Mark Edwards  
Author: Ross Dean

### 1.2 Client

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

### 1.3 Site information

Site: A bowl barrow 260m northwest of Putson Cross  
Civil Parish: Tiverton  
District: Mid Devon  
County: Devon  
NGR: SS 98617 13989 (point)  
NGR E/N: 298617,113989 (point)  
Post code: EX35 6JJ  
Historic Environment Entry: MDV12370  
Scheduled Monument Number: 1017132

### 1.4 Archive

OASIS number: substrat1-299073  
Archive: At the time of writing, the archive of this survey will be held by Substrata. Depending on local authority policy, an archive of the unprocessed data may be deposited with the Archaeological Data Service

### 1.5 Introduction

This work comprises part of a larger survey completed by AC Archaeology Ltd at the above site and documented in report ACD1579/2/0.

### 1.6 Summary

*The magnetic and resistance responses were sufficient to be able to differentiate anomalies representing possible archaeological features.*

*A total of six magnetic anomaly groups and six resistance anomaly groups were mapped as representing potential archaeological deposits and features. Of these one magnetic group and one resistance group coincide and are likely to represent the remains of a ring ditch associated with the barrow. One magnetic anomaly group may represent deposits within the confines of the barrow that appear to have been disrupted by possible ridge-and-furrow ploughing although no relationship between these deposits and the barrow could be ascertained. Three magnetic groups represent either archaeological deposits such as small pits or postholes or natural deposits. Two resistance groups also lie within the barrow area but these may represent relatively recent ploughing.*

*The remaining magnetic and resistance anomalies are linear and may be associated with former field or enclosure boundaries of unknown date although they may represent field drains or natural deposits.*

## 2 Survey aims and objectives

### 2.1 Aims

To establish the presence or absence, extent and character of any archaeological features and

deposits within the survey area.

## 2.2 Objectives

1. To identify any below ground archaeological feature (such as ditches, pits, burning activity, walling etc).
2. To ascertain the nature of the circular feature.
3. To identify any related archaeological features or potential features.
4. To build on the knowledge of surveying sites of this type on Exmoor.
5. To use modern remote sensing techniques including gradiometry and earth resistance.

## 3 Methodology

The work was undertaken in accordance with the survey methodology statement (Dean, 2017).

The survey grid location information and grid plan were recorded as part of the project in a suitable GIS system (Table 3).

Data processing was undertaken using appropriate software (Table 3), with all anomalies being digitised and geo-referenced. The final report (this document) includes 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.

## 4 Standards

The standards used to complete this survey are defined by the Chartered Institute for Archaeologists (2014a) and Historic England (2010). The codes of approved practice that were followed are those of the Chartered Institute for Archaeologists (2014b) and Archaeology Data Service/Digital Antiquity Guides (undated).

## 5 Site description

### 5.1 Landscape and land use

The survey area comprised part of a large, relatively flat agricultural field that had been recently harrowed at the time of the survey. Details of the barrow setting and related information are provided in AC Archaeology report ACD1579/2/0.

### 5.2 Geology

The solid geology across the survey area is sandstone of the Permian Tidcombe Sand Member. The superficial geology is alluvium. Additional layers of silt, sand, peat, basal gravel and a stronger, desiccated surface zone may be present (British Geological Society undated).

## 6 Archaeological background

The archaeology of the site is described in AC Archaeology report ACD1579/2/0.



## 7 Methodology, results, discussion and conclusions

### 7.1 Scope and definitions

The two surveys were designed to record magnetic anomalies and resistance anomalies. The analysis of the data sets was designed to highlight anomalies and reflection patterns judged indicative of archaeological deposits, structures, features or other signs of past human activity.

The terms ‘archaeological deposit’, ‘structure’ and ‘feature’ refer to any artefacts, material deposits or disturbance of natural deposits thought to be the result of human activity, excluding recent land maintenance and farming.

The reader is referred to section 8.

#### 7.1.1 Magnetometer survey

A magnetic anomaly is a local variation in the Earth's magnetic field. Such variations can result from differences in the magnetism of underlying solid geology, superficial geology and other near-surface deposits including those altered and created by past human activities. Near-surface and surface artefacts can also create magnetic anomalies.

#### 7.1.2 Resistance survey

A resistance anomaly is a local variation in the electrical resistance of a soil and is related to its porosity, permeability, saturation, and chemical nature of entrapped fluids (Heimmer and De Vore, 1995:30), all of which can be altered by past human activities. Higher concentrations of ions allow electrical current to pass more easily through the soil, creating a lower electrical resistance.

### 7.2 Results

The interpretations of the magnetometer and resistance surveys are summarised together in Figure 2 and individually in Figures 3 and 4. All three figures include the designations of the anomaly groups identified as possibly relating to archaeological and other deposits. Tables 1 and 2 are extracts of the detailed analysis of the magnetometer and resistance survey data sourced from the attribute tables of the GIS project provided in the project archive.

Figures 2 to 4 and Tables 1 and 2 comprise the analysis of the survey data.

Various plots of the processed data as specified in Tables 4 and 5 are provided in Figures 5 to 8.

Figures 9 and 10 are plots of the unprocessed magnetometer data and the unprocessed resistance data respectively.

### 7.3 Discussion

#### 7.3.1 General points

##### Discussion scope

Not all magnetic and resistance anomaly groups or radar reflection patterns identified in the figures and tables specified in Section 7.2 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project held the survey archive.

##### Data collection

Data collection during the magnetometer survey was restricted as shown in the relevant figures due to the presence of relatively modern magnetic materials along boundaries and elsewhere within the survey area. Strong magnetic responses are likely to relate to these materials except where otherwise indicated in Figures 2 and 3.

#### Anomaly characterisation and mapping

There are a number of magnetic and resistance anomaly groups that could be interpreted as relating to large postholes or pits although most will have natural origins. Anomalies of this sort are only mapped as potential archaeology if they are clustered in groups or otherwise form recognisable patterns.

Anomalies thought to relate to natural features and recent man-made objects were only mapped where they comprised significant magnetic responses across the dataset that needed clarification.

Numerous dipole magnetic anomalies are scattered across the magnetometer data set. These are likely to represent recent ferrous objects. They are only mapped if they could influence the analysis of anomaly groups thought to have an archaeological origin.

A gas main and the remains of another ferrous service pipe or cable crosses the survey area. The magnetic response from the gas main was large enough to interfere with the data processing and was masked out to allow the processing to be undertaken (compare Figures 5 and 9).

#### Data trends

A number of data trends were recorded in both the magnetometer and resistance data. It is likely that group r102 (Figure 4) reflects relatively recent ploughing whereas groups g101 g102 g103 (Figure 3) and r101 (Figure 4) may relate to historical ridge-and-furrow cultivation.

#### 7.3.2 Anomaly groups

Refer to Figures 2 to 6 and Tables 1 and 2.

Magnetic anomaly group g1 and resistance anomaly group r1 have the same trend and lie adjacent to each other which implies that they represent the same deposit or structure. The groups may represent archaeological linear deposits, natural deposits or field drains with r1 more likely to have a relatively stony composition and g1 more earthen.

Magnetic group g2 and resistance group r3 coincide and are likely to represent the remains of a ring ditch associated with the barrow.

Magnetic group g3 appears to be disrupted by possible ridge-and-furrow ploughing (Figure 3) and so could represent a deposit or structure that pre-dates at least the latest phase of any ridge-and-furrow ploughing. Group g3 also coincides with resistance groups r4 and r5 although these could reflect relatively recent ploughing disturbance.

Magnetic groups g4, g5 and g6 may represent natural deposits or archaeological deposits such as small pits or post holes. Similar anomaly groups were recorded in the dataset outside the barrow but these do not display any particular grouping or other pattern and so have not been mapped as potential archaeological deposits.

Groups r2 and r6 may represent linear, relatively stony archaeological deposits, natural features or field drains.

#### 7.4 Conclusions

The magnetic and resistance responses were sufficient to be able to differentiate anomalies representing possible archaeological features.

A total of six magnetic anomaly groups and six resistance anomaly groups were mapped as representing potential archaeological deposits and features. Of these one magnetic group (g2) and one resistance group (r3) coincide and are likely to represent the remains of a ring ditch associated with the barrow. One magnetic anomaly group (g3) may represent deposits within the confines of the barrow that appear to have been disrupted by possible ridge-and-

furrow ploughing although no relationship between these deposits and the barrow could be ascertained. Three magnetic groups (g4 to g6) represent either archaeological deposits such as small pits or postholes or natural deposits. Two resistance groups (r4 and r5) also lie within the barrow area but these may represent relatively recent ploughing.

The remaining magnetic and resistance anomalies (g1, r1, r2 and r6) are linear and may be associated with former field or enclosure boundaries of unknown date although they may represent field drains or natural deposits.

## 8 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.

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## 9 Acknowledgements

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

## 10 Bibliography

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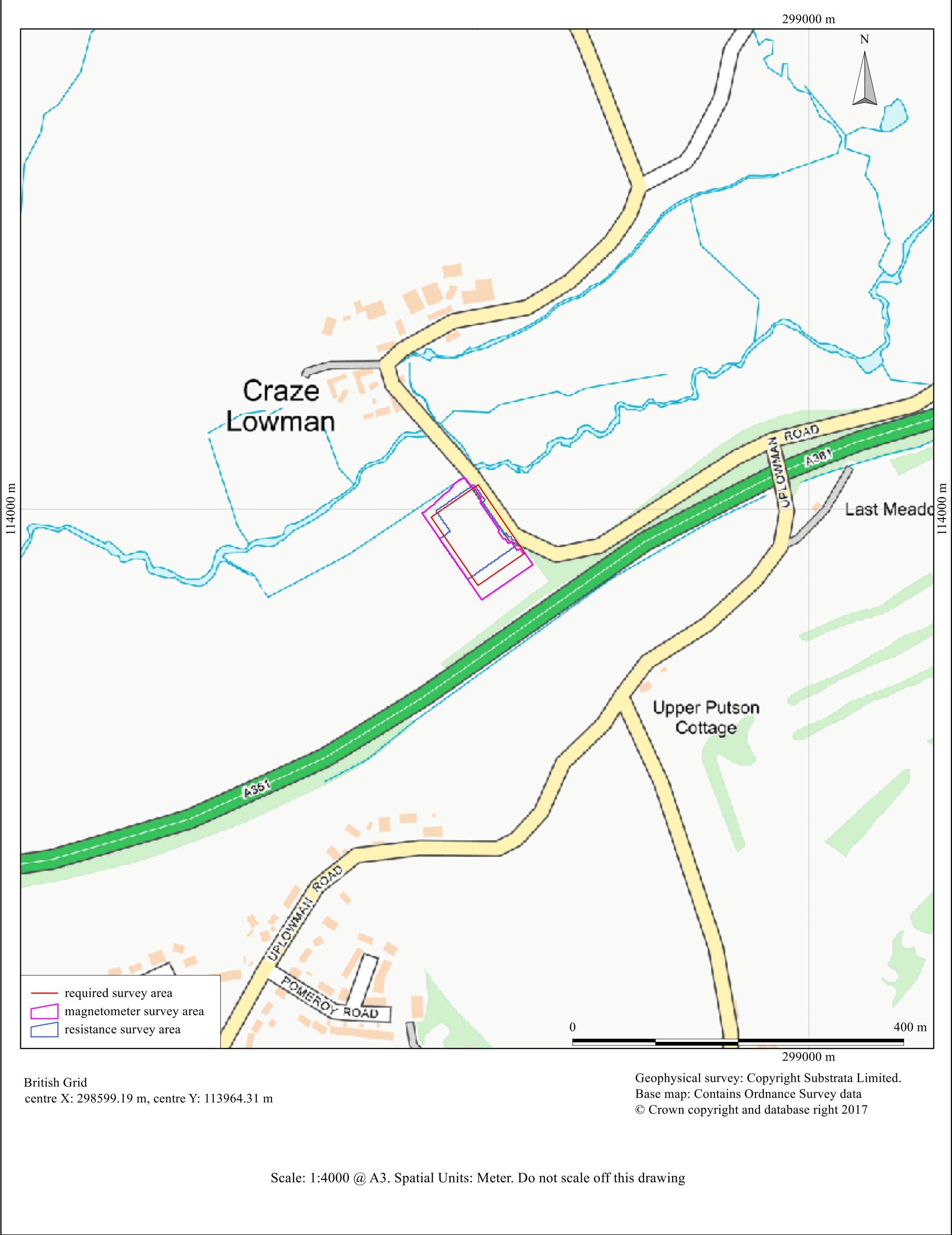
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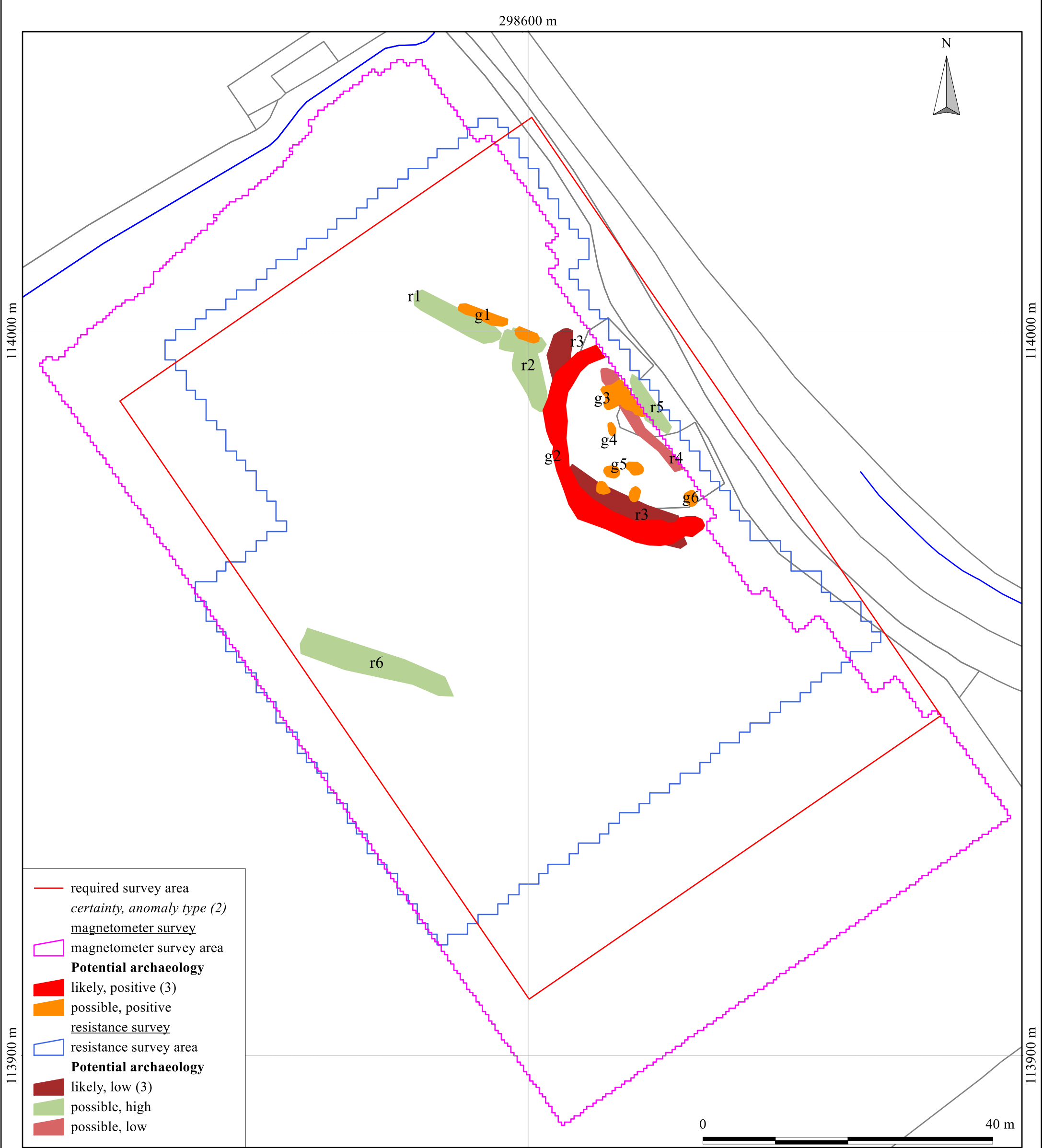
## Appendix 1      Figures



An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
Centred on NGR (E/N) 298617,113989  
Report 1710TIV-R-1

Figure 1: location map

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British Grid  
centre X: 298599.19 m, centre Y: 113964.31 m

Geophysical survey: Copyright Substrata Limited.  
Base map: Ordnance Survey (c) Crown Copyright 2017.  
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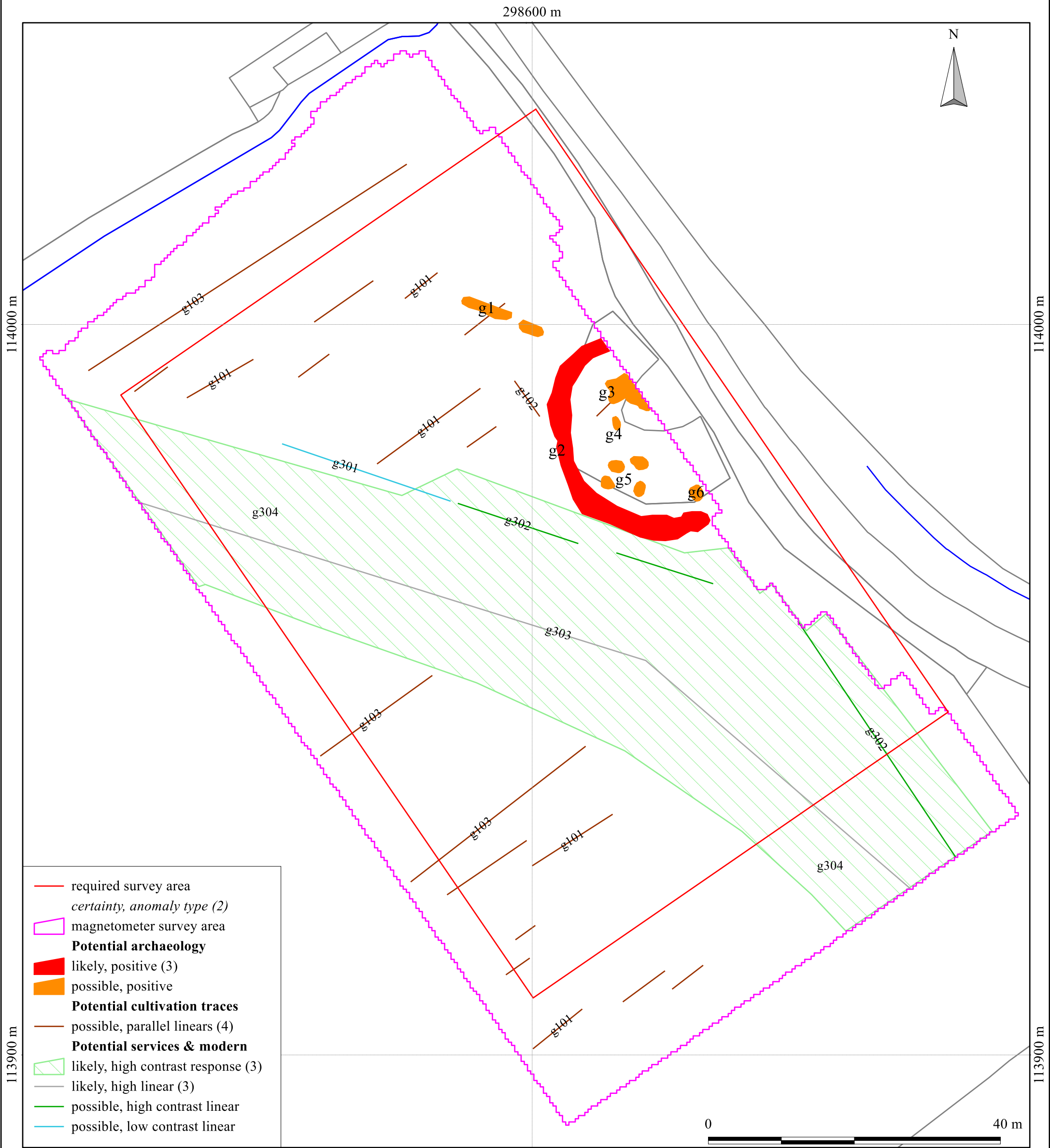
Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

- Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
  2. 'Anomaly type' is a description of the magnetic anomaly. See the report text or GIS for an archaeological characterisation.
  3. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
  4. Not all instances are mapped.
  5. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposits.

An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
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Figure 2: magnetometer and resistance survey interpretation,  
whole survey area, archaeology only

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British Grid  
centre X: 298599.19 m, centre Y: 113964.31 m

Geophysical survey: Copyright Substrata Limited.  
Base map: Ordnance Survey (c) Crown Copyright 2017.  
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Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

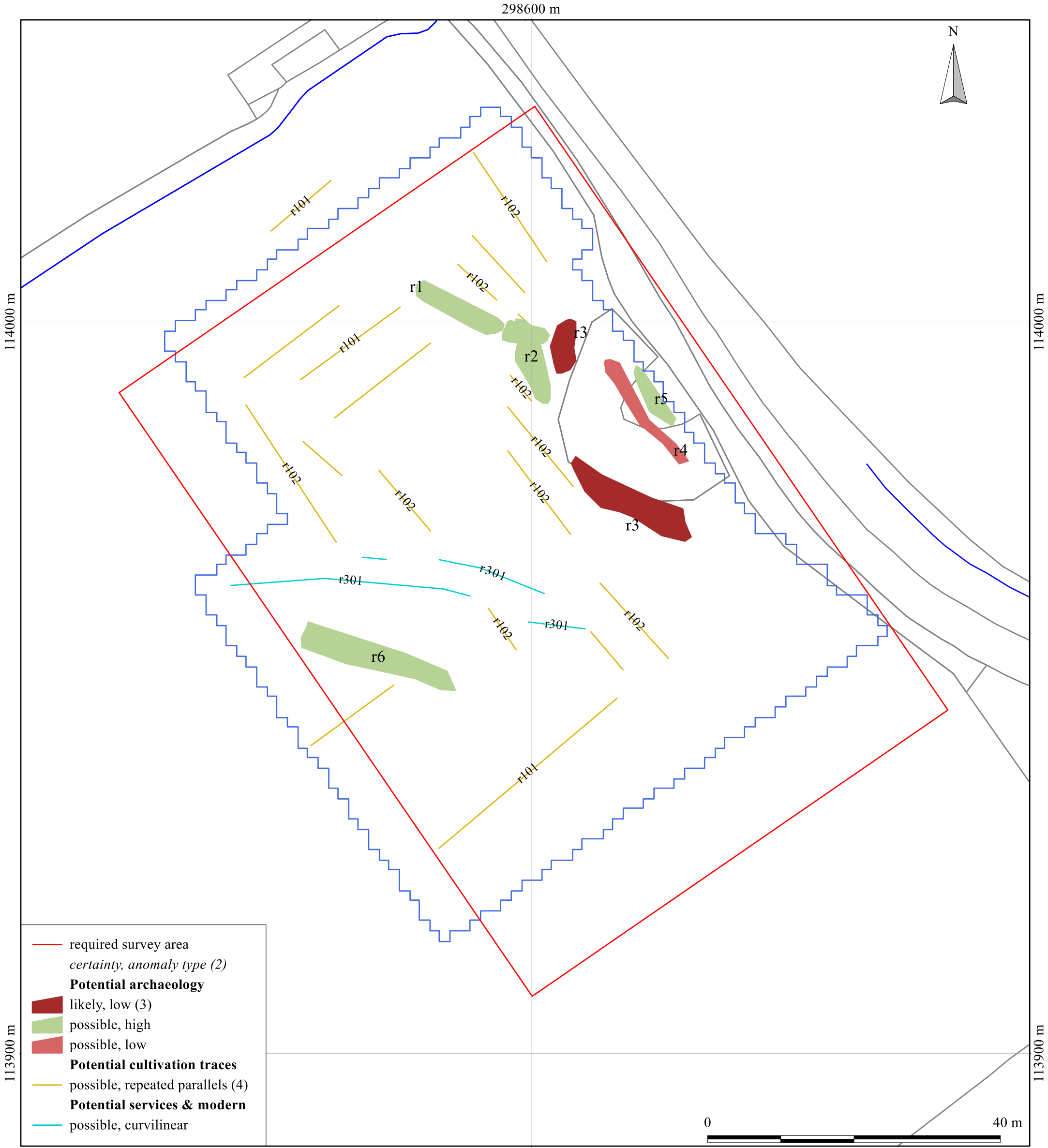
- Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
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An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
Centred on NGR (E/N) 298617,113989  
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Figure 3: magnetometer survey interpretation

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centre X: 298599.19 m, centre Y: 113964.31 m

Geophysical survey: Copyright Substrata Limited.  
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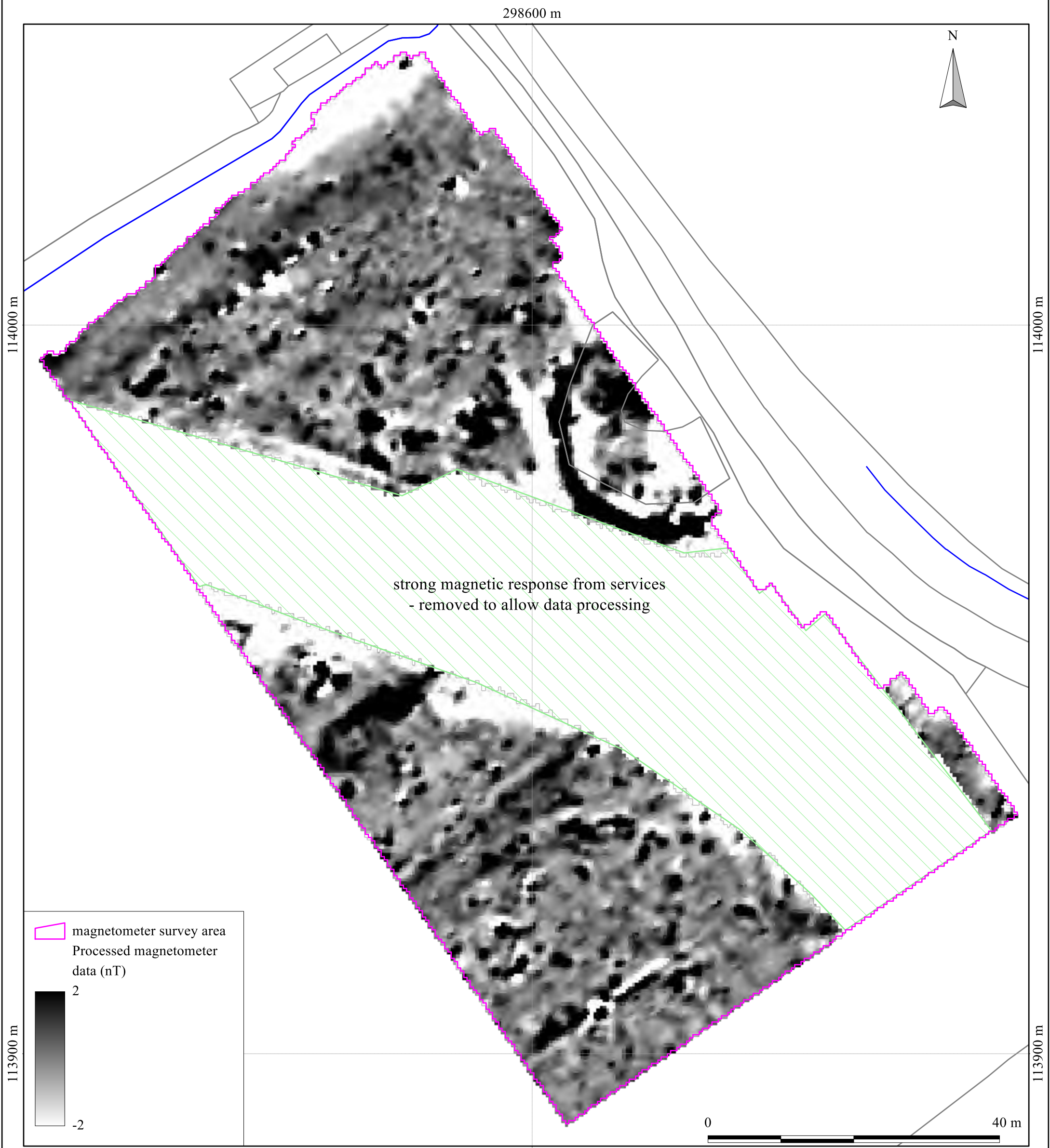
Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

- Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
  2. 'Anomaly type' is a description of the magnetic anomaly. See the report text or GIS for an archaeological characterisation.
  3. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
  4. Not all instances are mapped.
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An archaeological magnetometer and resistance survey  
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Figure 4: resistance survey interpretation

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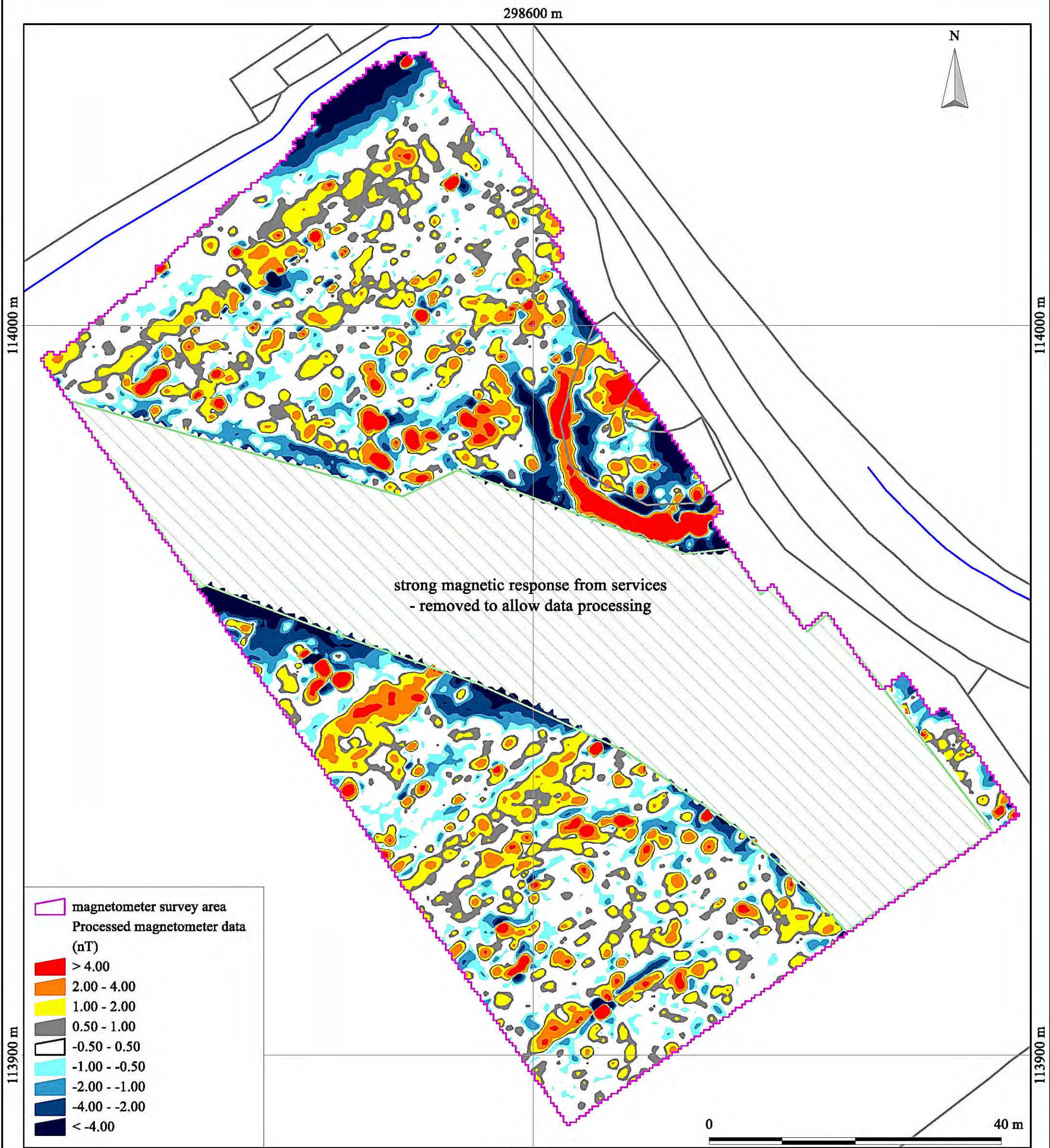
British Grid  
centre X: 298599.19 m, centre Y: 113964.31 m

Geophysical survey: Copyright Substrata Limited.  
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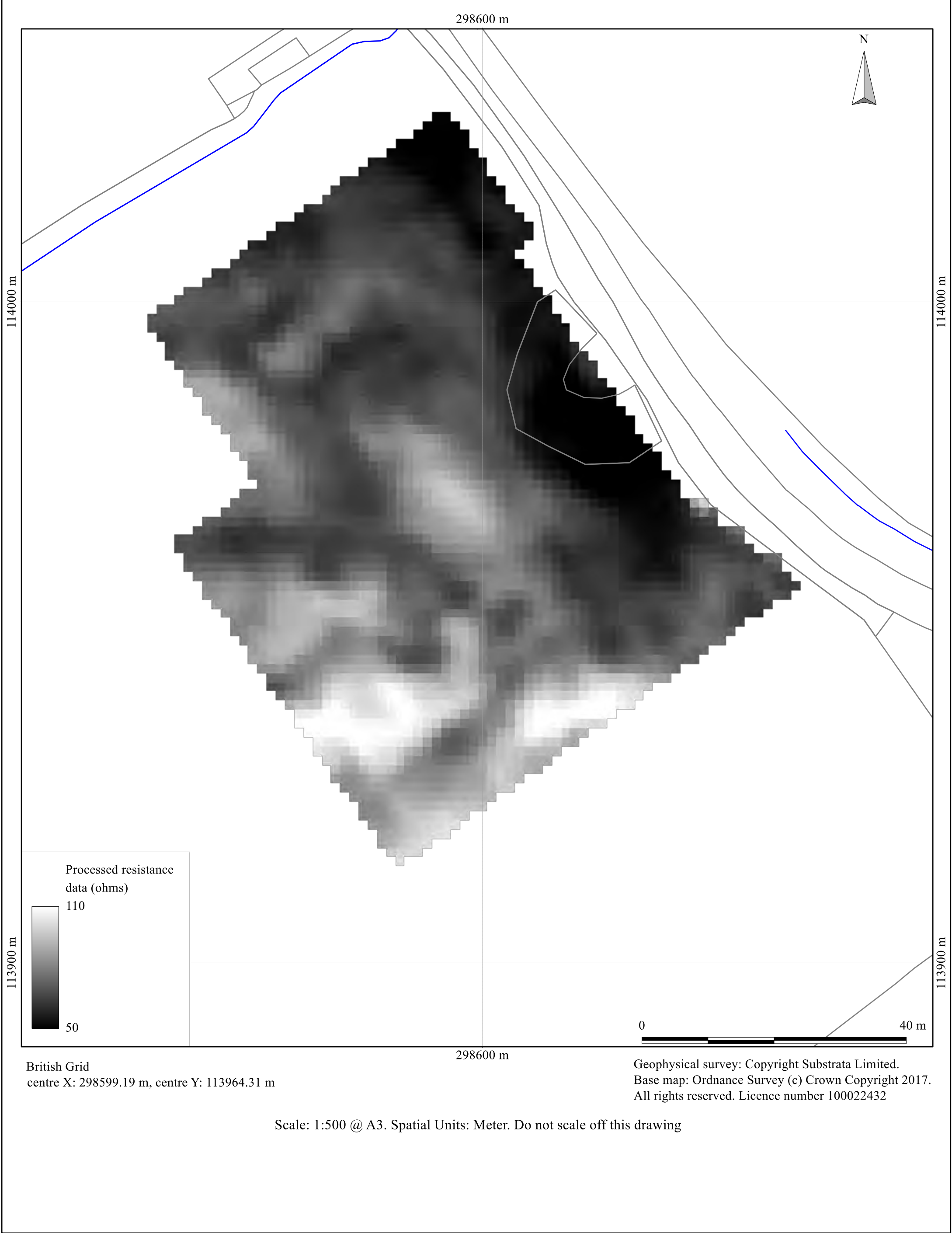
Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Figure 5: shade plot of processed magnetometer data





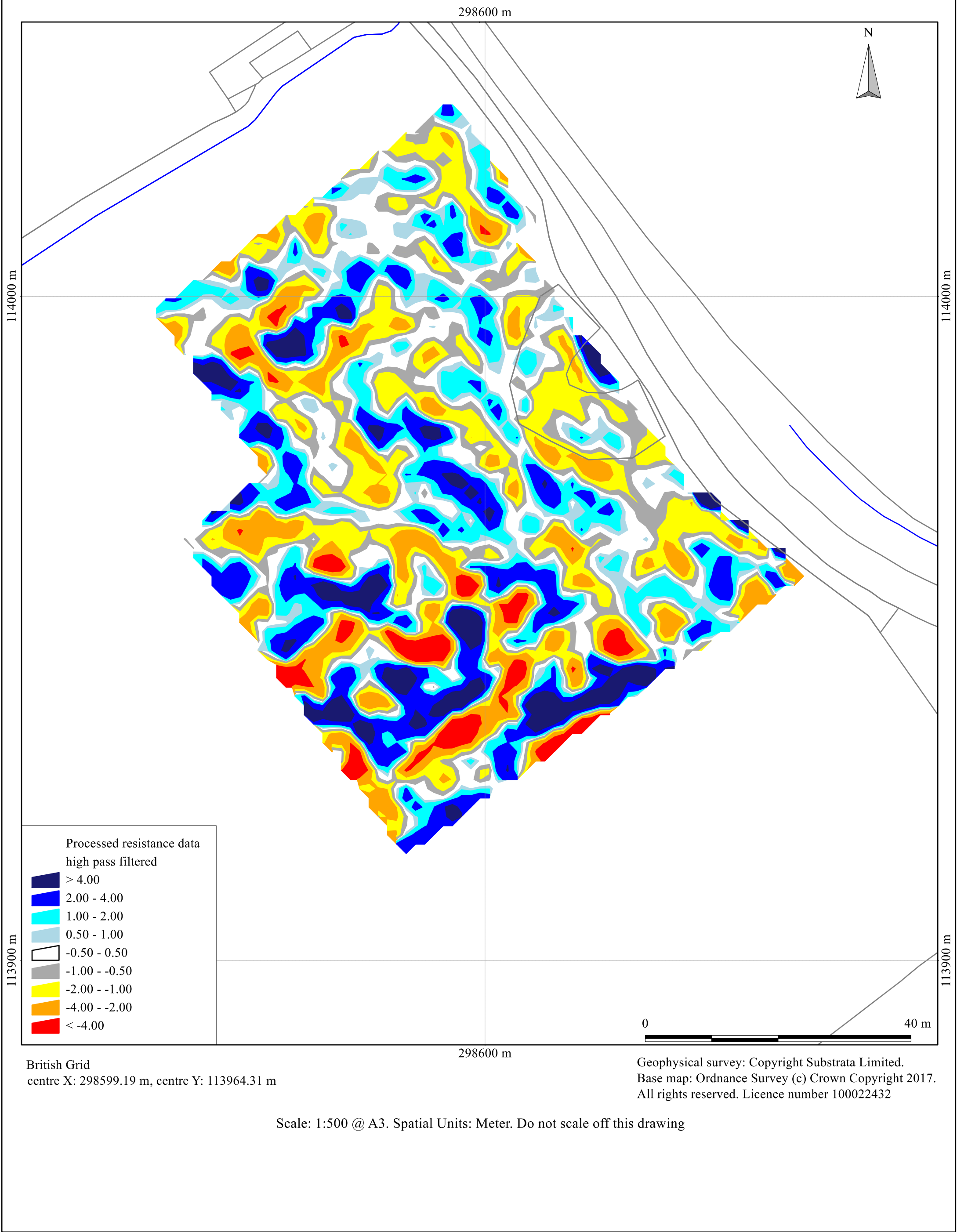




An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
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Figure 7: shade plot of processed resistance data

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An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
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Figure 8: contour plot of processed resistance data

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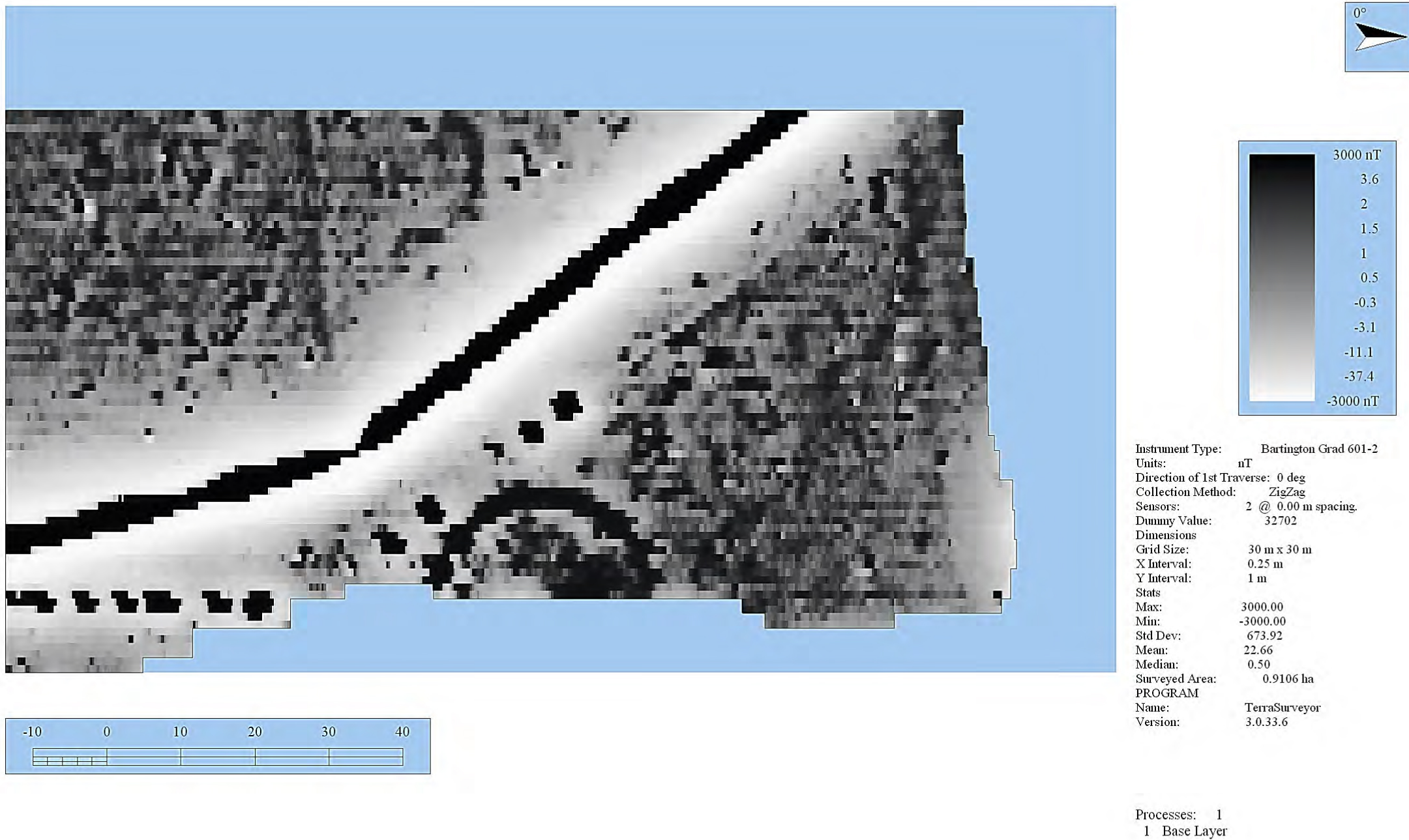
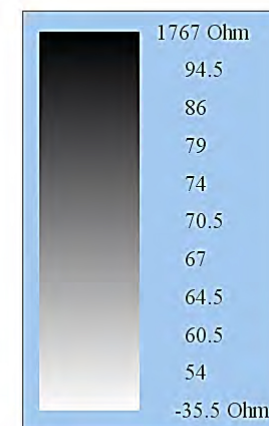
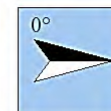
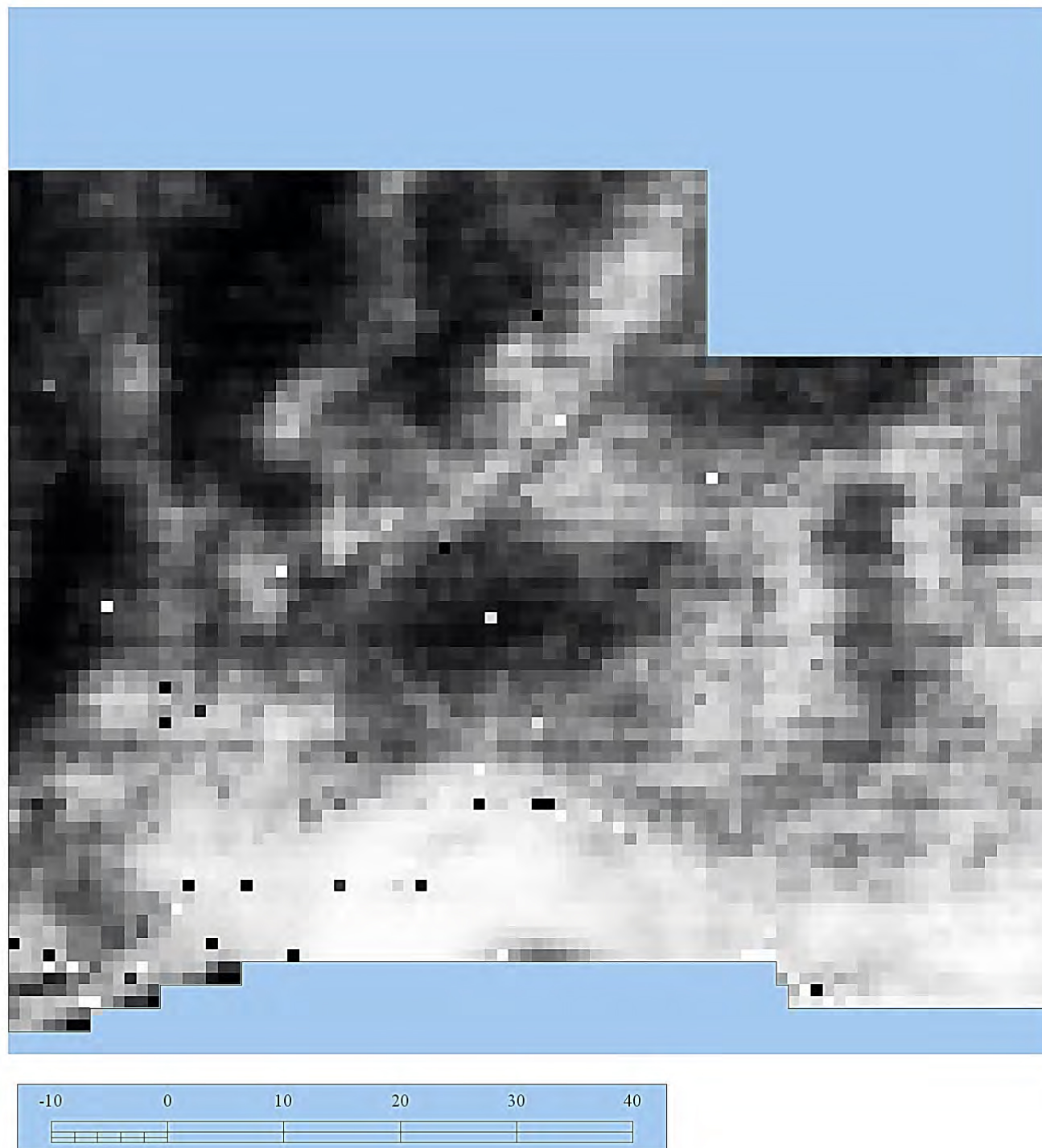


Figure 9: shade plot of unprocessed magnetometer data





Instrument Type:	GeoScan (Resistance)
Units:	Ohm
Direction of 1st Traverse:	0 deg
Collection Method:	ZigZag
Sensors:	1
Dummy Value:	2047.5
Dimensions	
Grid Size:	30 m x 30 m
X Interval:	1 m
Y Interval:	1 m
Stats	
Max:	1767.00
Min:	-35.50
Std Dev:	32.86
Mean:	73.82
Median:	70.50
PROGRAM	
Name:	TerraSurveyor
Version:	3.0.31.0

Processes: 1  
1 Base Layer

Figure 10: shade plot of unprocessed resistance data

## Appendix 2      Tables



Site: An archaeological magnetometer and resistance survey  
A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
Centred on NGR (E/N) 298617,113989  
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anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
g1	r1	possible, positive	disrupted linear			
g2	r3	likely, positive	semi-circular	bowl barrow ring ditch	anomaly group coincides with an extant Scheduled bowl barrow and likely represents part of an associated ring ditch	Monument number 1017132, HER entry MDV12370
g3	r4	possible, positive	irregular	potential archaeological deposit apparently disrupted by historical (ridge-and-furrow?) ploughing		
g4		possible, positive	oval	small pit, posthole or natural deposit		
g5		possible, positive	group of ovals	group of small pits, postholes or natural deposits		
g6		possible, positive	oval	small pit, posthole or natural deposit		
g101		possible, parallel linears		cultivation traces - possible ridge-and-furrow		
g102		possible, parallel linears		cultivation traces - possible ridge-and-furrow?		
g103		possible, parallel linears		cultivation traces - possible ridge-and-furrow?	anomaly group is more pronounced suggesting that the groups may represent more substantial deposits such as ditches but the equivalent resistance anomalies do not exhibit any differences to similar anomalies on the site - on balance, these anomaly groups represent cultivation traces and not ditches	
g301		possible, low contrast linear		service trench		
g302		possible, high contrast linear	disrupted multi-linear	ferrous drain, pipe or cable		
g303	g304	likely, high linear	multilinear	gas main		field owner personal communication
g304	g303 g302	likely, high contrast response			strong magnetic signal associated with services	

Table 1: magnetometer survey data analysis

Site:       An archaeological magnetometer and resistance survey  
          A bowl barrow 260m northwest of Putson Cross, Tiverton, Devon  
          Centred on NGR (E/N) 298617,113989  
          Report 1710TIV-R-1

anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
r1	g1	possible, high	linear			
r2		possible, high	linear			
r3	g2	likely, low	disrupted curvilinear	bowl barrow ring ditch	anomaly group coincides with an extant Scheduled bowl barrow and likely represents part of an associated ring ditch	Monument number 1017132, HER entry MDV12370
r4	r5 g3	possible, low	linear	either archaeological deposits or ploughing disturbance		
r5	r4	possible, high	linear	either archaeological deposits or ploughing disturbance		
r6		possible, high	linear			
r101		possible, repeated parallels		cultivation traces - possible ridge-and-furrow		
r102		possible, repeated parallels		cultivation traces		
r301		possible, curvilinear		ground disturbance associated with services		

Table 2: resistance survey data analysis

<b>Grid</b> <i>Method of Fixing:</i> DGPS and RTK set-out using pre-planned survey grids and Ordnance Survey coordinates. <i>Composition:</i> 30m by 30m grids <i>Recording:</i> Geo-referenced and recorded using digital map tiles.	
<b>Magnetometer Equipment</b> <i>Instrument:</i> Bartington Instruments grad601-2 <i>Firmware:</i> version 6.1	<b>Magnetometer Data Capture</b> <i>Sample Interval:</i> 0.25-metres <i>Traverse Interval:</i> 1 metre <i>Data capture:</i> automatic data logger <i>Traverse Method:</i> zigzag <i>Traverse Orientation:</i> GN324
<b>Resistance Equipment</b> <i>Instrument:</i> Geoscan Research RM15 multi-probe resistance meter <i>Configuration:</i> twin probe <i>Mobile probe spacing:</i> 0.5-metres	<b>Resistance Data Capture</b> <i>Sample Interval:</i> 1 metre <i>Traverse Interval:</i> 1 metre <i>Data capture:</i> automatic data logger <i>Traverse Method:</i> zigzag <i>Traverse Orientation:</i> GN326
<b>Data Processing, Analysis and Presentation Software</b> QCAD Professional 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	

Table 3: methodology information

<b>Instrument</b>	
Type:	Bartington Grad 601
Units:	nT
Direction of 1st Traverse:	0 deg
Collection Method:	ZigZag
Sensors:	2 @ 1.00 m spacing.
Dummy Value:	32702
<b>Program</b>	
Name:	TerraSurveyor
Version:	3.0.31.0
<u>Figures 5 and 6</u>	
<b>Statistics</b>	Processes: 8
Max: 11.59	1 Base Layer
Min: -11.10	2 Mask for All layers (services)
Std Dev: 1.49	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean: -0.15	4 Clip at 1.00 SD
Median: -0.07	5 Clip at 1.00 SD
Surveyed Area: 0.9ha	6 DeStripe Median Traverse: Grids: All
	7 Periphery Match ALL grids in the survey.
	8 Interpolate: Match X & Y Doubled.

Table 4: magnetometer survey - processed data metadata

<b>Instrument</b> Type: Geoscan Research RM15 Units: resistance data (ohms) normalised about a near-zero mean Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702  <b>PROGRAM</b> Name: TerraSurveyor Version: 3.0.31.0	
<u>Figure 7</u> <b>Statistics</b> Max: 118.23 Min: 43.30 Std Dev: 14.93 Mean: 72.84 Median: 70.05 Surveyed Area: 0.58ha	<b>Processes</b> 1 Base Layer 2 Despike Threshold: 1 Window size: 3x3 3 Despike Threshold: 1 Window size: 3x3 4 Despike Threshold: 1 Window size: 3x3 5 Low pass Gaussian filter: Window: 3 x 3
<u>Figure 8</u> <b>Statistics</b> Max: 39.12 Min: -11.82 Std Dev: 2.72 Mean: 0.04 Median: -0.06 Surveyed Area: 0.58ha	<b>Processes</b> 1 Base Layer 2 Despike Threshold: 1 Window size: 3x3 3 Despike Threshold: 1 Window size: 3x3 4 Despike Threshold: 1 Window size: 3x3 5 High pass Gaussian filter: Window: 10 x 10 6 Low pass Gaussian filter: Window: 3 x 3

Table 5: resistance survey - processed data metadata