An archaeological magnetometer survey

Land adjoining Helebridge Road Marhamchurch, Cornwall

Centred on NGR (E/N): 221920,103690

Report: 1712MAR-R-1

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Website: 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:	twin-sensor fluxgate gradiometer
Date:	13 December 2017
Area:	0.52ha
Lead surveyor:	Mark Edwards BA
Author:	Ross Dean BSc MSc MA MIfA

1.2 Clients details

E Trewin & Sons, Higher Northcott Barn, Poughill, Bude, Cornwall, EX23 9EQ

1.3 Location

Site:	Land adjoining Helebridge Road
Civil Parish:	Marhamchurch
District:	North Cornwall
County:	Cornwall
Nearest Postcode:	EX23 0HZ
NGR:	SS 21920 03690 (point)
NGR (E/N):	221920,103690 (point)

1.4 Archive

OASIS number:	substrat1-304967
Archive:	At the time of writing, the archive of this survey will be held by Substrata. Depending on local authority policy, an archive may be deposited with the Archaeological Data Service.

1.5 Introduction

This report presents the results of an archaeological magnetometer survey at the above site, hereafter referred to as the survey area. It has been prepared for E Trewin & Sons (details above). The survey area location is shown in Figure 1.

1.6 Summary

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

Five magnetic anomaly groups were mapped as representing potential archaeological deposits or features. One group represents a deposit of rubble and disturbed ground which, speculatively, could be associated with the Marhamchurch Incline of the Bude Canal that was situated just to the north of the survey area. Three anomaly groups may represent fragments of a linear deposit such as a field boundary or enclosure ditch. One deposit may represent a pit or a natural deposit.

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 Survey objectives

1. Complete a magnetometer 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 survey area about the location and possible

archaeological character of the recorded anomalies.

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 (undated).

5 Site description

5.1 Landscape and land use

The survey area comprises part of one field to the north of Helebridge Road on the western edge of Marhamchurch, North Cornwall (Figure 1). The survey area sloped southeast to northwest from approximately 33m to approximately 20m AOD. The field was bounded by hedges and was under grass pasture at the time of the survey.

5.2 Geology

The bedrock across the site comprises sandstone of the Carboniferous Bude Formation. Generically the Bude Formation consists of grey thick-bedded, somewhat argillaceous and silty sandstones, in laterally discontinuous internally massive beds 1-5m thick and commonly amalgamated into units up to 10m thick. Very thick beds of slumped and destratified strata are also present. Grey mudstones occur as interbeds up to 1m thick but locally packets of darker mudstone up to 20m thick with thin ironstone beds and bundles of thin sandstones are present, especially in the upper part of the Formation (British Geological Survey, undated).

The superficial deposits for the site are unknown (ibid).

6 Archaeological background

6.1 Historic landscape characterisation

‘Farmland: Medieval’. The agricultural heartland, with farming settlements documented before the 17th century AD and whose field patterns are morphologically distinct from the generally straight-sided fields of later enclosure; either medieval or prehistoric origins (Cornwall Council, undated).

6.2 Summary of archaeological background

The Cornwall and Scilly Historic Environment Record (HER) was examined via the Heritage Gateway (Historic England, undated) to gain an appreciation of historic assets pertinent to the geophysical survey data within approximately 500m of the survey area perimeter.

This section is not designed to provide a comprehensive understanding of the historic environment of the surrounding area and should not be used as a source for further work.

Table 1 provides a summary of the HER entries though relevant to the survey.

7 Results, discussion and conclusions

7.1 Scope and definitions

This survey was designed to record magnetic anomalies. A magnetic anomaly is a local variation in the Earth's magnetic field. Such variations can result from changes in the magnetism of the 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.

The terms ‘archaeological deposit’, ‘structure’ and ‘feature’ refer to material deposits, disturbance of natural deposits, constructions or artefacts thought to be the result of past human activity and indicative of potential historic assets.

Magnetic anomalies cannot be regarded as physical archaeological deposits, structures or features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeology.

The analysis presented below identifies and characterises anomalies and anomaly groups that may relate to archaeological deposits, structures and features.

The reader is referred to section 8.

7.2 Results

Figure 2 shows the interpretation of the survey data which includes the anomaly groups identified as possibly relating to archaeological deposits along with their identifying numbers. Table 2 is an extract of the detailed analysis of the survey data sourced from the attribute tables of the GIS project provided in the project archive.

Figure 2 along with Table 2 comprise the analysis of the survey data.

Figures 3 and 4 are plots of processed data as specified in Table 4. Figure 5 is a plot of minimally processed data with its metadata.

7.3 Discussion

7.3.1 General points

<u>Discussion scope</u>

Not all anomalies or anomaly groups identified in Table 2 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project held the survey archive.

<u>Data collection</u>

Data collection along the survey area edges was restricted as shown in the figures due to the presence of magnetic materials within and adjacent to boundaries. Strong magnetic responses mapped close to the boundaries are likely to relate to these materials except where otherwise indicated in Figure 2 and Table 2.

<u>Anomaly characterisation and mapping</u>

There are a number of anomaly groups that could be interpreted as relating to large postholes or pits although most will have natural origins. Anomalies of this sort were mapped as potential archaeology when they were associated with other significant anomaly groups or otherwise formed recognisable patterns as listed in Table 2.

Anomalies thought to relate to natural features and 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.

Numerous dipole magnetic anomalies are scattered across the 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.

7.3.2 Data relating to historic maps and other records (Figure 2 and Table 2)

No magnetic anomaly groups directly related to mapped or otherwise recorded historic assets within the survey area.

7.3.3 Data with no previous archaeological provenance (Figure 2 and Table 2)

Magnetic anomaly group **1** represents part of a deposit of rubble and disturbed ground. Speculatively, this deposit could be associated with the Marhamchurch Incline of the Bude Canal that ran to the north of the survey area (HER entry 97.18 in Table 1).

Groups **2**, **3** and **5** may represent the fragments of a linear archaeological feature such as a field boundary ditch.

Group **4** may represent an archaeological pit or a natural deposit.

Groups 4 and 5 have characteristics typical of wet or water-logged deposits.

7.4 Conclusions

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

Five magnetic anomaly groups were mapped as representing potential archaeological deposits or features. One group (1) represents a deposit of rubble and disturbed ground which, speculatively, could be associated with the Marhamchurch Incline of the Bude Canal that was situated just to the north of the survey area. Three anomaly groups (2, 3 and 5) may represent fragments of a linear deposit such as a field boundary or enclosure ditch. One deposit (4) may represent a pit or a natural deposit.

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.

9 Acknowledgements

Substrata would like to thank E Trewin & Sons for commissioning us to complete this survey.

10 Bibliography

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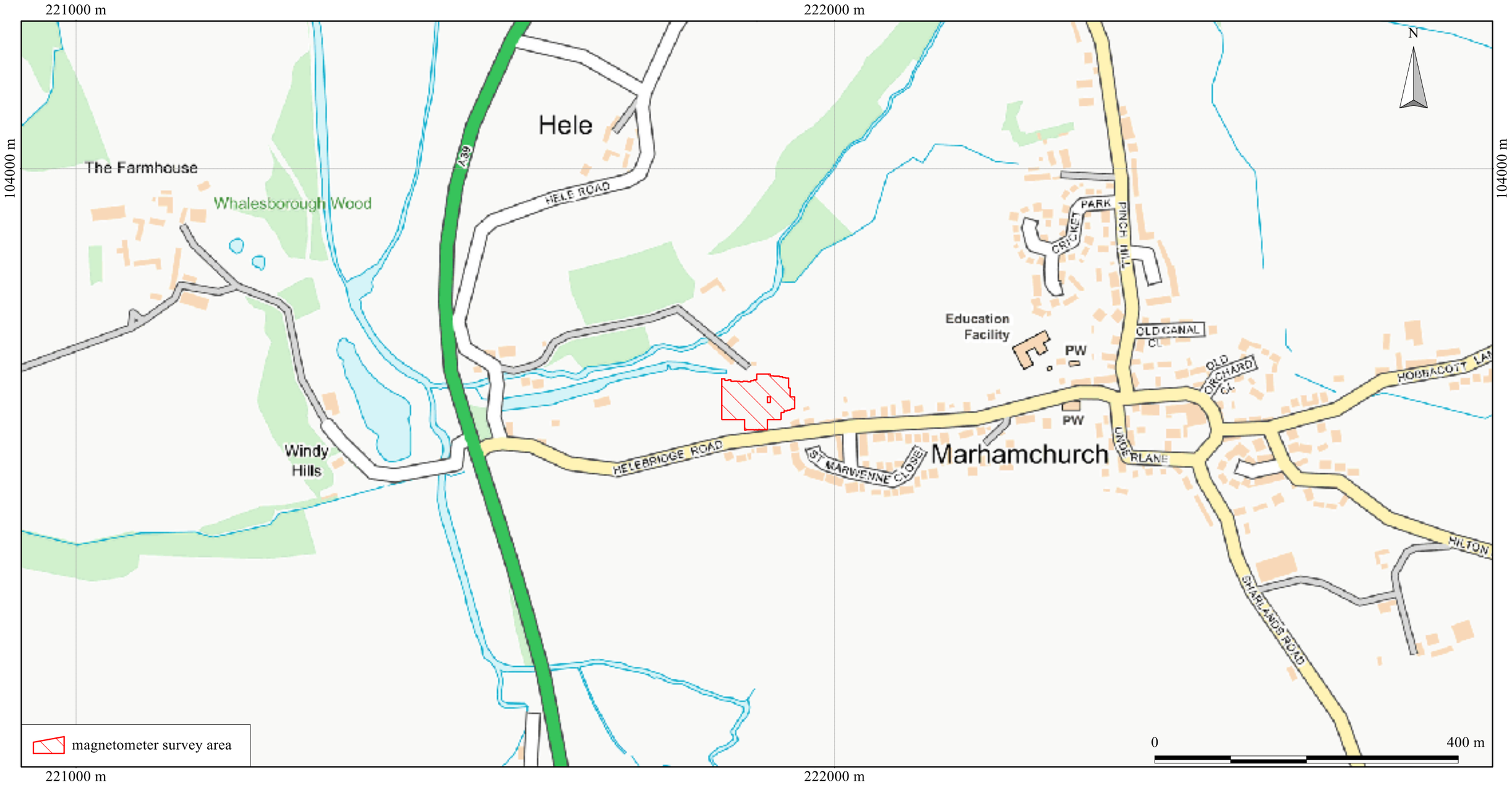
Appendix 1 Figures

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: 221897.57 m, centre Y: 103703.15 m

Scale: 1:5000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
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Figure 1: location map

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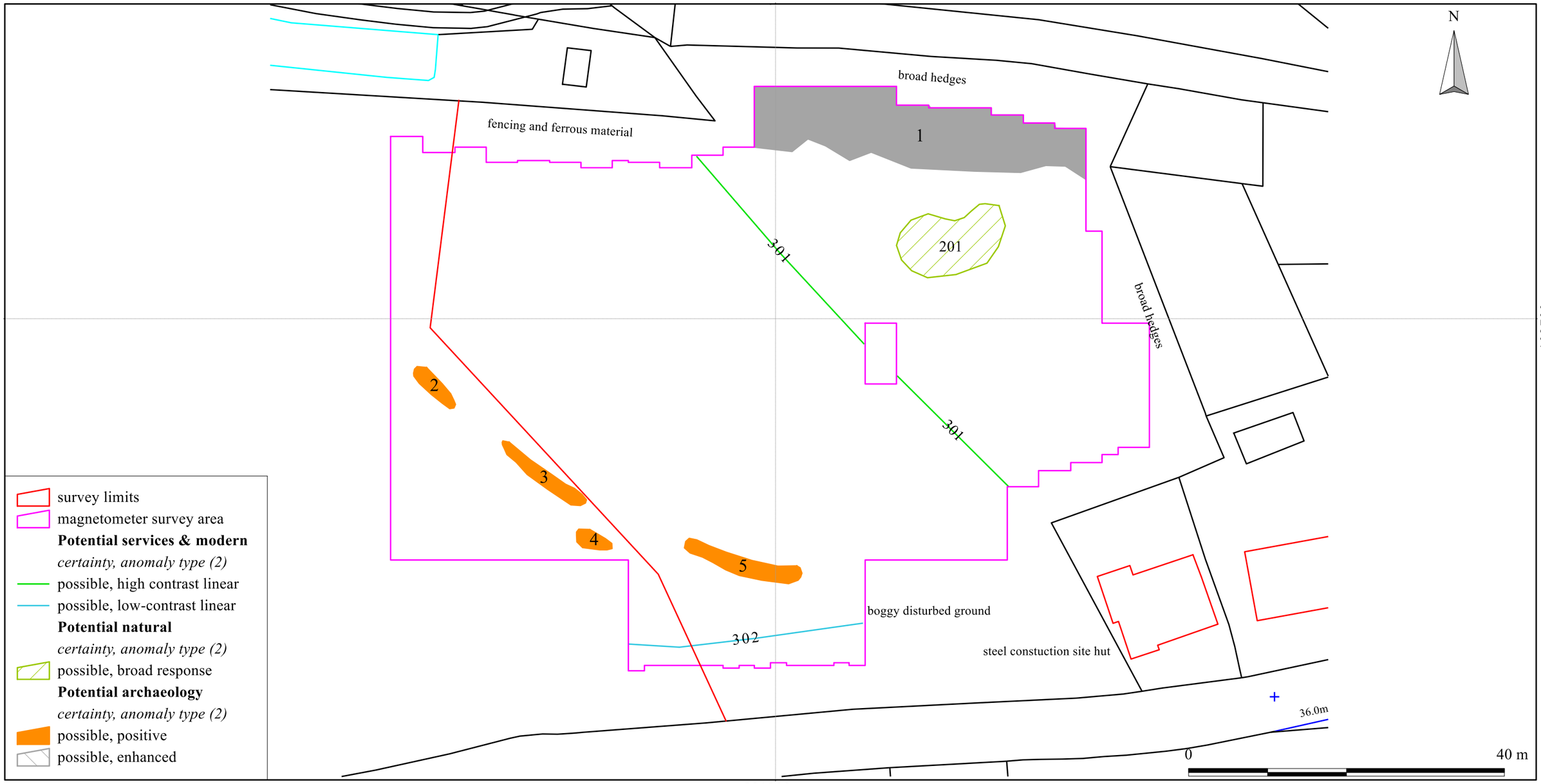

British Grid
centre X: 221899.37 m, centre Y: 103690.72 m

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.

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Figure 2: survey interpretation

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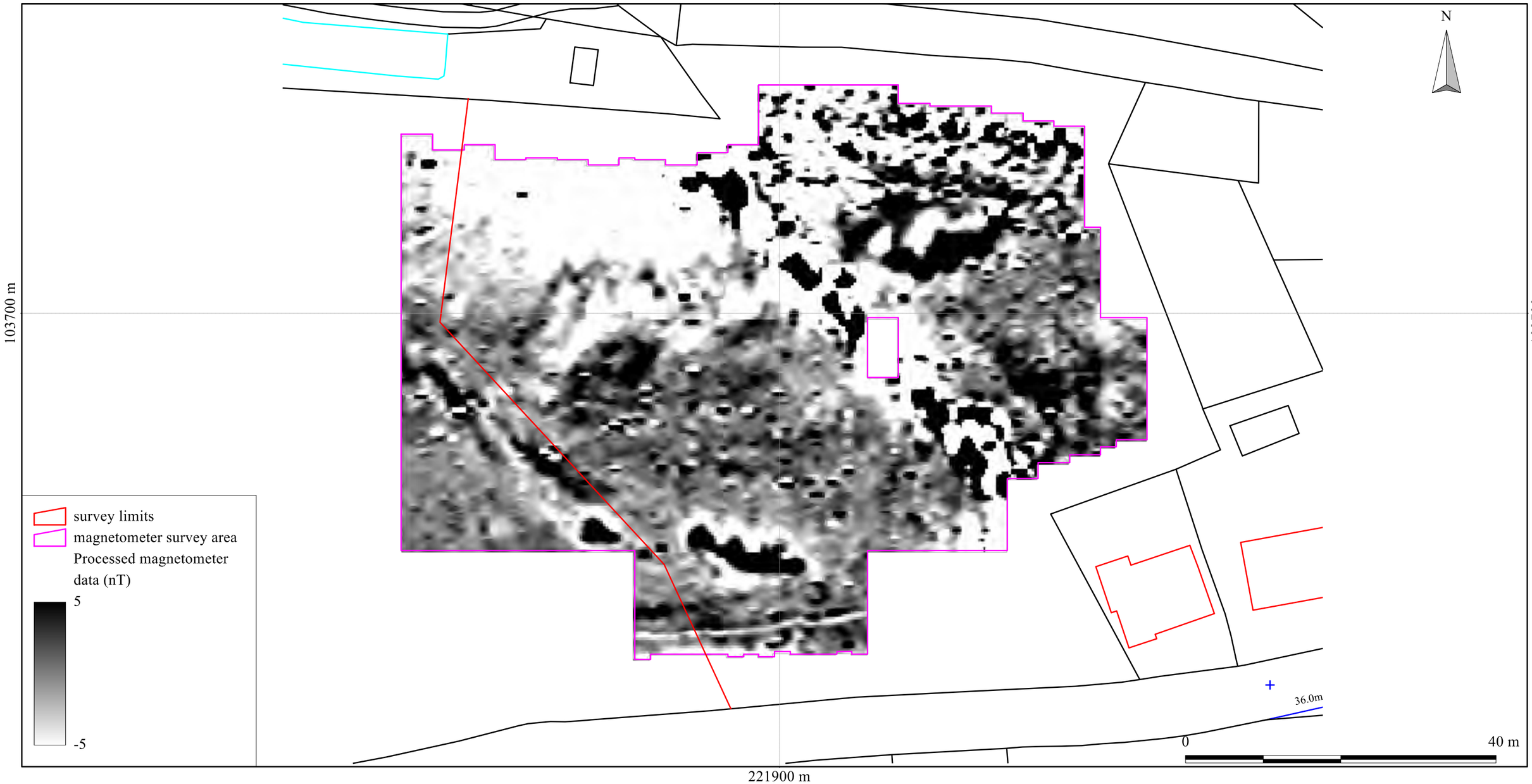

British Grid
centre X: 221899.37 m, centre Y: 103690.72 m

Scale: 1:500 @ 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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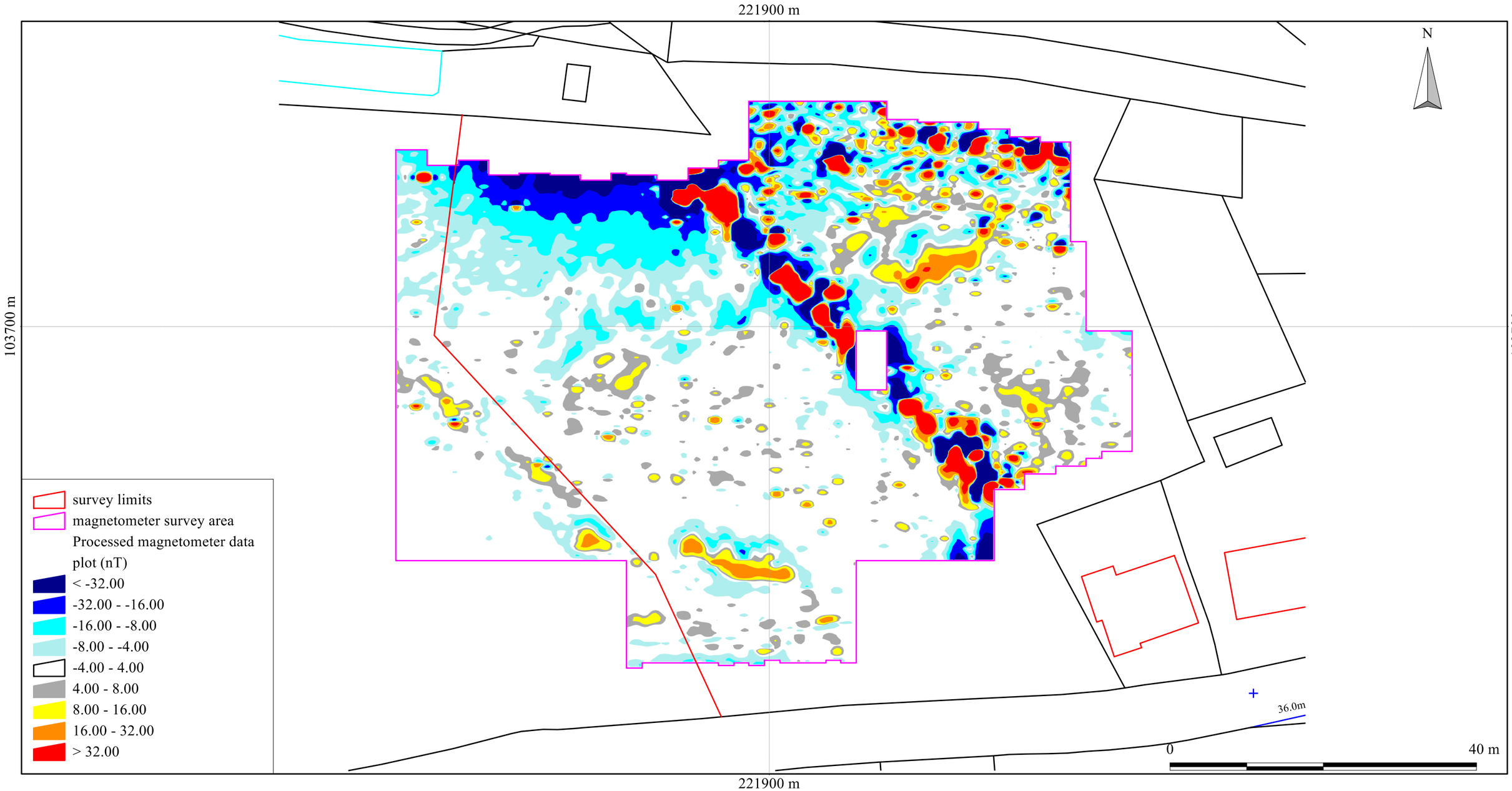

British Grid
centre X: 221899.37 m, centre Y: 103690.72 m

Scale: 1:500 @ 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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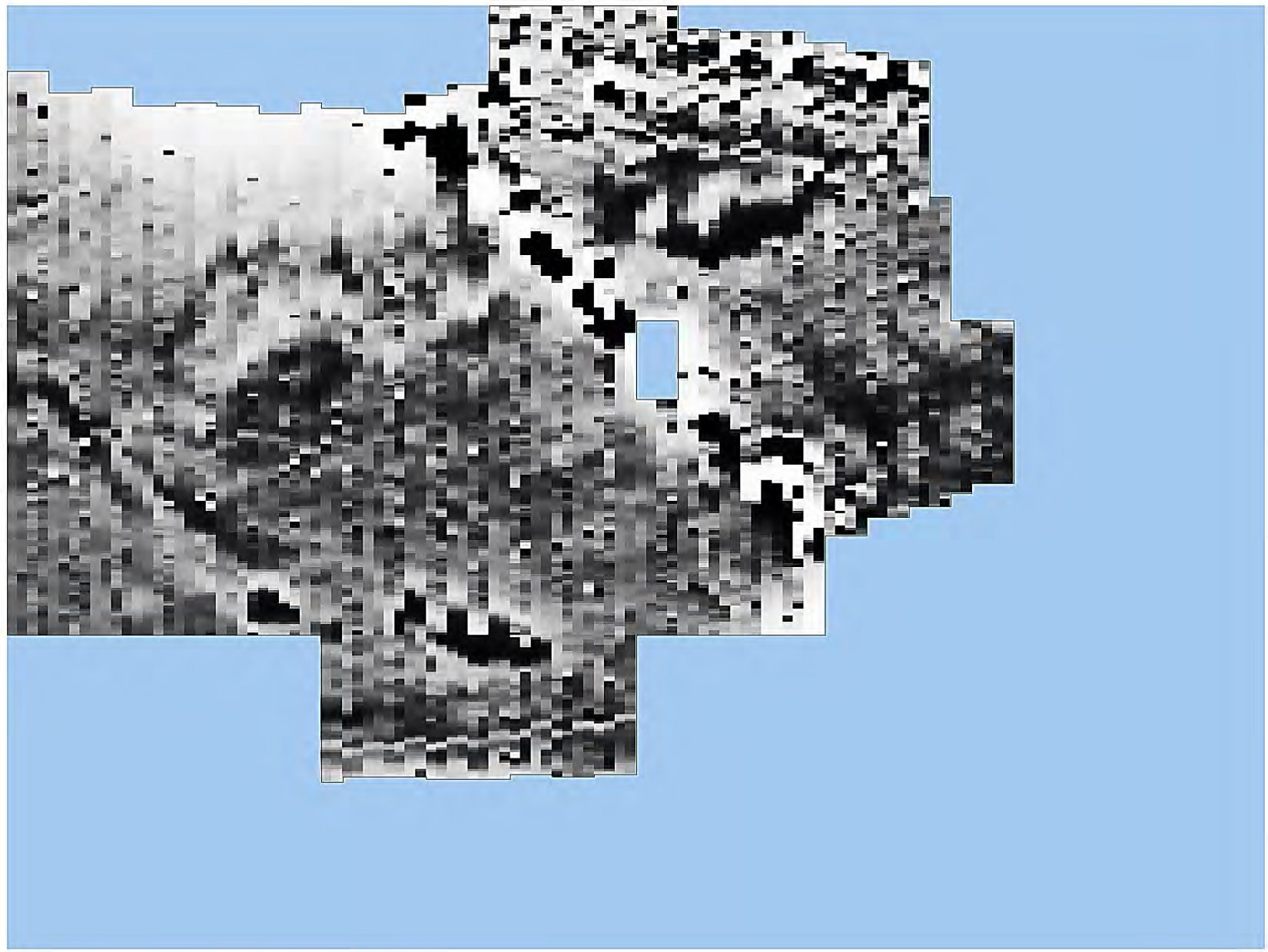

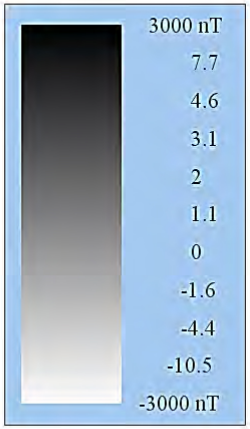

Instrument type: Bartington grad601-2
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 0.00 m spacing.
Dummy Value: 32702
Dimensions
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m
Stats
Max: 3000.00
Min: -3000.00
Std Dev: 363.62
Mean: -1.26
Median: 1.10
Surveyed Area: 0.5215 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.33.6

Processes: 1
1 Base Layer

Figure 5: shade plot of unprocessed data

Appendix 2 Tables

An archaeological magnetometer survey
Hele Road
Marhamchurch, Cornwall
Centred on NGR (E/N) 221920,103690
Report: 1712MAR-R1

County: Cornwall
District: North Cornwall
Parish: Marhamchurch
Source: Heritage Gateway

HER number	grid reference	designations	type	period	description	distance (m) from site centre	bearing (GN) from site centre
97.18	SS 2194 0372		Inclined plane	19th Century - 1801 AD to 1900 AD	Marhamchurch incline was the first inclined plane on the Bude Canal. It had a rise of 120 ft and was 836 ft long, operated by a water wheel. The wheel pit has been partially infilled , and the course of the incline is now obscured by new housing and other encroachment.	36	34
382	SS 2186 0377		Foundry	18th Century - 1701 AD to 1800 AD	This foundry at Hele Bridge, Marhamchurch, was founded in the 1740's by the Box family and continued in operation until 1939 under a succession of owners. It is marked on the OS map of 1883 and parts of it are extant, although now largely converted to domestic use. The foundry produced all the metalwork for the Bude Canal.	100	323
MCO57541 MCO57542 MCO57543	SS 2183 0377	Listed Building (II) 64878	Foundry	19th Century - 1801 AD to 1900 AD	Iron foundry converted into pair of houses and adjoining outbuilding Mid C19. Originally Box's iron foundry which manufactured kitchen ranges. The foundry is adjacent to the Bude Canal and the Marhamchurch incline plane.	120	312
178585	SS 2181 0374		Canal basin	19th Century - 1801 AD to 1900 AD	Dredging works revealed the remains of walling at the base of the Marhamchurch Incline. Two stretches of walling were uncovered, the first running alongside the northern bank, c0.3m wide and c4.0m long, the second being in the middle of the basin, c0.2m wide and c1.5m long. The stump of a timber post was found against the middle wall and is possibly a mooring post. Both exposed sections of walling were of local rubble stone construction and were in poor condition. The position of the walling corresponds with a dividing boat bay shown at the base of the incline on the 188 1,2500 OS map.	121	294
70477	SS 2202 0377		Field System	Medieval - 1066 AD to 1539 AD	The remains of a field system are visible on air photos and were plotted as part of the NMP. The remains are sited within an area of Anciently Enclosed Land and are likely to be medieval in origin.	128	51
97.17	SS 2169 0369		Canal warehouse	19th Century - 1801 AD to 1900 AD	The canal warehouse on Helebridge Wharf. It is a single storey building under a slate roof, and is now home to the Bude Canal Museum	230	270
70479	SS 2169 0363		Field boundary	Medieval - 1066 AD to 1539 AD	A field boundary is visible in air photos and was plotted as part of the NMP	238	255
97.14	SS 2166 0371		Canal basin	19th Century - 1801 AD to 1900 AD	Helebridge Wharf and basin is the western terminus of the barge section of the Bude Canal. It is sited at the foot of the Marhamchurch Incline, which only tub-boats could use	261	274
97.16	SS 2163 0369		Wharf	19th Century - 1801 AD to 1900 AD	Helebridge Wharf was a key transhipment and loading facility on the Bude Canal.	290	270
70478	SS 2168 0345		Drainage system/ Field system	Post Medieval - 1540 AD to 1900 AD	The remains of a field system are visible on air photos and were plotted as part of the NMP	339	225
278	SS 221 035		Strip Field	Medieval - 1066 AD to 1539 AD	To the SW of Marhamchurch and recorded on the 1st Edition 6" OS map of 1888 are the long, thin and curving fields which may represent the enclose strips of a medieval open field system associated with the settlement of Marhamchurch	355	173
70517	SS 2159 0385		Field system	Early Medieval to Modern - 410 AD to 2050 AD	The remains of a field system are visible on air photos and were plotted as part of the NMP	367	296
280	SS 2170 0401		Settlement	Medieval - 1066 AD to 1539 AD	The settlement of Hele is first recorded in the C13. The name may be Cornish and contain the element heyl meaning 'estuary'	388	325
249	SS 2238 0370		Settlement	Early Medieval - 410 AD to 1065 AD	The settlement and manor of Marhamchurch is first recorded in the Domesday survey of 1086.	460	89
70487	SS 2145 0325	Primary Record No. (1985-2009): 70487	Barrow	Bronze Age - 2500 BC to 801 BC	A possible barrow, diameter approx. 20m, is visible as a cropmark on aerial photographs	644	227

Table 1: Historical Environment Entries thought relevant to geophysical survey

Site: An archaeological magnetometer survey
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anomaly group	associated groups	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, enhanced	broad linear	rubble	anomaly group are most likely to represent rubble - either recent or associated with the former canal - stone work associated with the canal was found close to this site	Cornwall Council HER entry 178585
2	3 5	possible, positive	linear	archaeological or natural deposit		
3	2 5	possible, positive	linear	archaeological or natural deposit		
4		possible, positive	ovoid	archaeological pit or natural deposit - wet deposits		
5	2 3	possible, positive	linear	archaeological or natural deposit - wet deposits		
201		possible, broad response	irregular	water-logged area		
301		possible, high contrast linear		ferrous cable, pipe or drain		
302		possible, low-contrast linear		service trench	surveyors observed ground evidence of a recent service trench	

Table 2: data analysis

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:* 0.25m *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN
Data Processing, Analysis and Presentation Software QCAD Professional 3 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

Instrument Type: Bartington Grad-601 gradiometer Units: nT Direction of 1st Traverse: see below Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702	
Program Name: TerraSurveyor Version: 3.0.33.6	
Statistics Max: 357.03 Min: -363.95 Std Dev: 35.36 Mean: -2.40 Median: -0.91 Surveyed Area: 0.52 ha	**Processing** 1 Base Layer 2 Clip at 1.00 SD 3 Clip from -264.88 to 266.06 nT 4 De Stagger: Grids: b18.xgd By: 0 intervals, 75.00cm 5 De Stagger: Grids: b19.xgd By: 0 intervals, 25.00cm 6 DeStripe Median Sensors: Grids: All 7 Edge Match (Area: Top 0, Left 240, Bottom 29, Right 359) to Left edge 8 Edge Match (Area: Top 30, Left 240, Bottom 59, Right 359) to Top edge 9 Interpolate: Match X & Y Doubled.

Table 4: processed data metadata