

Substrata

Archaeological Geophysical Surveyors

An archaeological magnetometer survey

**Land at Harford Cross
A361, Devon**

Centred on NGR: 265600,129590

Report: 1806HAR-R-1

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1 Introduction

This report presents the results of an archaeological geophysical survey at the site listed in Section 4 and shown in Figure 1, hereafter referred to as the 'Survey Area'. It was commissioned by Devon County Council in support of a proposed development. The commissioning of this report was in keeping with the National Planning Policy Framework, Chapter 16, Paragraph 189 (Ministry of Housing, Communities & Local Government, 2018).

The survey and report were completed in compliance with a Survey Method Statement (Dean, 2018).

2 Client

Devon County Council, Matford Offices, County Hall, Topsham Road, Exeter EX2 4QD

3 Copyright

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4 Survey type and location

4.1 Survey

Method:	shallow depth magnetometer survey
Instrument:	twin-sensor fluxgate gradiometer
Date:	18 July 2018
Area:	0.47ha

4.2 Location

Location:	Land at Harford Cross, A361
Civil Parish:	Landkey
District:	North Devon
County:	Devon
Nearest postcode:	EX32 0LG
Survey centre NGR:	SS 60462 31500
Survey centre NGR (E/N):	260462,131500
Historic environment designation:	None
OASIS ID:	substrat1-326746

5 Summary

A magnetometer survey was selected to provide a relatively fast and cost-effective evaluation of any buried archaeology across the Survey Area (see Section 14). The magnetic anomaly groups pertaining to potential buried archaeology were georeferenced to the Ordnance Survey National Grid, mapped, characterised and assigned with an appropriate degree of certainty in conformance with the survey aims and objectives set out in Section 6.

The differences in magnetic responses across the Survey Area were sufficient to be able to differentiate between anomalies representing possible buried archaeology and background magnetic responses.

No magnetic anomaly groups represent potential archaeological deposits. Two groups are likely to represent modern deposits or ground disturbance; an area ferrous material mixed with

stonely deposits and an area of ferrous material possibly associated with a service. One group is likely to represent a ferrous service cable, pipe or drain.

6 Aims and objectives

6.1 Aims

1. Within the framework set out in Chartered Institute for Archaeologists (2014a), complete an archaeological geophysical survey and report which will, as far as possible, establish the presence or absence, extent and character of any buried archaeology within the Survey Area.
2. Provide sufficient information on the nature of any archaeological remains to facilitate the assessment of their interest and any implications for the proposed development.

6.2 Objectives

1. Complete a magnetometer survey across the Survey Area.
2. Identify any magnetic anomalies that may be related to buried archaeology.
3. Within the limits of the technique 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.

7 Standards

The standards used to complete this survey are defined by the Chartered Institute for Archaeologists (2014a) and Historic England (2008). The codes of approved practice that were followed are those of the Chartered Institute for Archaeologists (2014b) and Archaeology Data Service (undated).

8 Methodology

The magnetometer survey was undertaken in accordance a Survey Method Statement (Dean, 2018) to achieve the aims and objectives set out in Section 6 using the standards and guidance specified in Section 7. The survey method was selected to provide a relatively fast and cost-effective evaluation of any buried archaeology across the Survey Area (see Section 14).

Data processing was undertaken using appropriate software (Table 2), 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. The survey and report conform to the Chartered Institute for Archaeologists standard for geophysical survey (CIfA, 2014a).

9 Survey Area

9.1 Location and description

The Survey Area comprises two adjoining paddocks to the north of the A361 at Harford Cross to the northeast of the village of Landkey (Figure 1). The paddocks are bounded by wire fencing.

Both paddocks were being used as horse paddocks at the time of the survey.

9.2 Geology

The bedrock across the Survey Area is mudstone of the Carboniferous and Devonian Pilton Mudstone Formation. Generically, these rocks are grey mudstones and siltstones with thin- to thick-bedded, locally calcareous sandstones and beds and lenses of limestone. Sandstones are thickest and predominate in the lower half of the formation, whereas mudstones predominate in the upper half. The superficial geology comprises gravel, sand and silt of the Quaternary Taw River Terrace Deposits, 3 Member (British Geological Survey, undated).

Two geotechnical logs of near-surface deposits to the south of the Survey Area and in the same

geological environment are provided in Table 5 (ibid).

9.3 Soils

The topsoil comprises ‘Slowly permeable seasonally wet acid loamy and clayey soils’ with (LandIS, undated).

10 Archaeological background

10.1 Historic landscape characterisation

‘Medieval enclosures based on strip fields’

This area was probably first enclosed with hedge-banks during the later middle ages. The curving form of the hedge-banks suggests that earlier it may have been farmed as open strip-fields (Devon County Council, undated).

10.2 Statement of research

The Devon County Council Historic Environment Record 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. Whilst providing a useful context for the data analysis, this source is not comprehensive and detailed publication of the information in commercial reports is not permitted.

11 Results

11.1 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 variations in the magnetic properties of the underlying solid geology, superficial geology and other near-surface deposits including those altered and created by past human activities. Near-surface artefacts can also create magnetic anomalies.

The dimensions of magnetic anomalies mapped as representing potential buried archaeology do not represent the dimensions of any associated archaeology.

The analysis presented below identifies and characterises anomalies and anomaly groups that may relate to buried archaeology.

11.2 Analysis

Figure 2 shows the interpretation of the survey data and includes the anomaly groups identified as possibly relating to archaeological deposits along with their identifying numbers. Table 1 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 and Table 1 comprise the analysis of the survey data.

Figures 3 and 4 are plots of the processed data as specified in Table 3. Figure 5 is a plot of minimally processed data as specified in Table 4. Figure 6 shows the location of the survey grid and grid data files.

12 Discussion

12.1 General points

Scope

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project held in the survey archive.

Data collection

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 and elsewhere in the Survey Area are likely to relate to these materials except where otherwise indicated in Figure 2 and Table 1.

Anomaly characterisation

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 are mapped as potential archaeology when they are associated with other significant anomaly groups or otherwise formed recognisable patterns as listed in Table 1.

Anomalies thought to relate to natural features and recent man-made objects such as manholes, water management equipment, drains, cables and other services are only mapped where they comprise significant magnetic responses across the dataset that need clarification.

Numerous dipole magnetic anomalies are present within the dataset. 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.

12.2 Data characterisation

No magnetic anomaly groups were characterised as representing potential archaeological deposits.

Referring to Figure 2 and Table 1, groups **301** and **303** are likely to represent relatively recent deposits and/or ground disturbance. Group **302** is likely to represent a ferrous service such as a steel or iron pipe, cable or drain.

13 Conclusions

The differences in magnetic responses across the Survey Area were sufficient to be able to differentiate between anomalies representing possible buried archaeology and background magnetic responses.

No magnetic anomaly groups represent potential archaeological deposits. Two groups are likely to represent modern deposits or ground disturbance; an area ferrous material mixed with stony deposits (301) and an area of ferrous material possibly associated with a service (303). One group is likely to represent a ferrous service cable, pipe or drain (302).

14 Disclaimer

The description and discussion of the results presented in this report are the authors', based on their 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.

15 Archive

15.1 Online Access to the Index of archaeological investigationS (OASIS)

OASIS ID: substrat1-326746

The OASIS entry has been completed and the boundary file and report uploaded with six months delay in publication.

15.2 Substrata Limited archive

A full archive of this survey will be held by Substrata Limited on cloud and local hard drive storage as specified in Appendix 3.

15.3 Archaeological Data Service (ADS)

Depending on local authority policy, an archive may be deposited with the ADS as specified in Appendix 3.

15.4 Historic Environment Record (HER)

Subject to any contractual requirements on confidentiality, a PDF or printed copy of the report will be submitted to the appropriate HER within six months of completion.

16 Acknowledgements

Substrata would like to thank Stephen Reed, Senior Historic Environment Officer, Devon County Council, for commissioning us to complete this survey.

17 Bibliography

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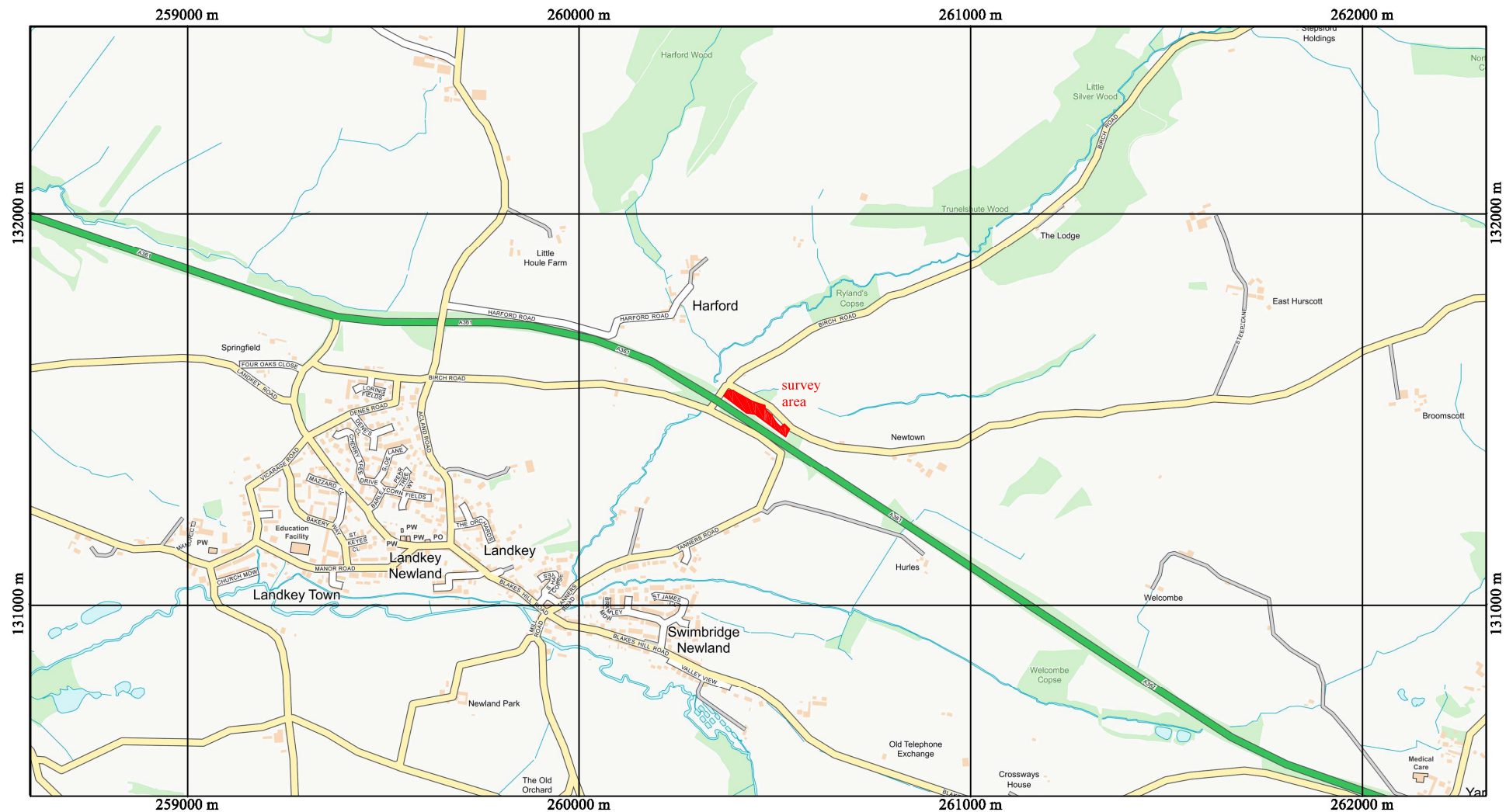
Ministry of Housing, Communities & Local Government (2018). *National Planning Policy Framework* [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf [Accessed 13 Aug. 2018]

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: 260457.11 m, centre Y: 131494.86 m

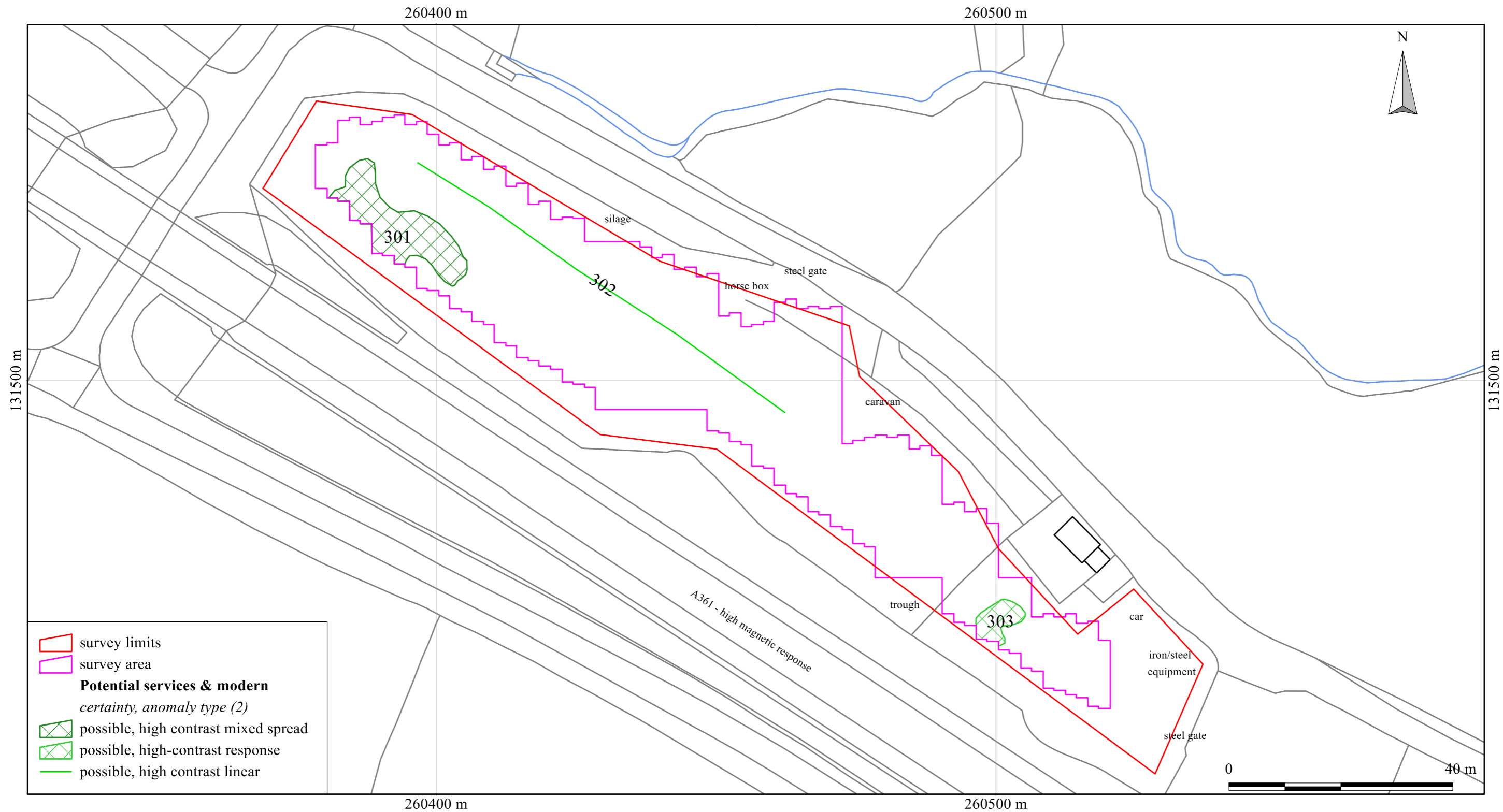
Scale: 1:10000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Geophysical survey: Copyright Substrata Limited.
Base map: Contains Ordnance Survey data
© Crown copyright and database right 2017

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Figure 1: location map

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British Grid
 centre X: 260457.11 m, centre Y: 131494.86 m

Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
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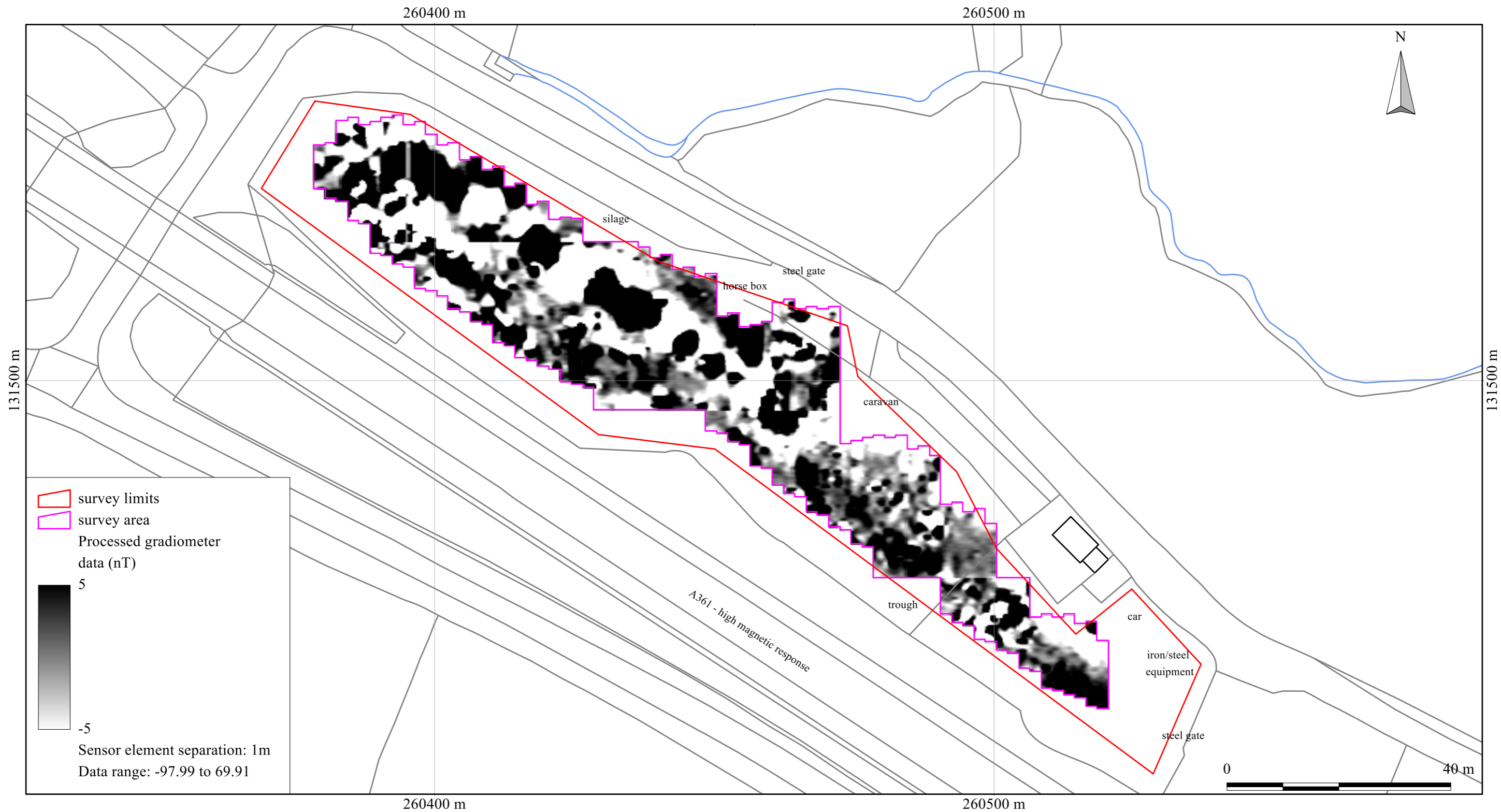
Notes: Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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 recent deposits or ground disturbance, or geological and other natural deposits are not mapped unless relevant to potential buried archaeology.

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Figure 2: survey interpretation

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British Grid
 centre X: 260457.11 m, centre Y: 131494.86 m

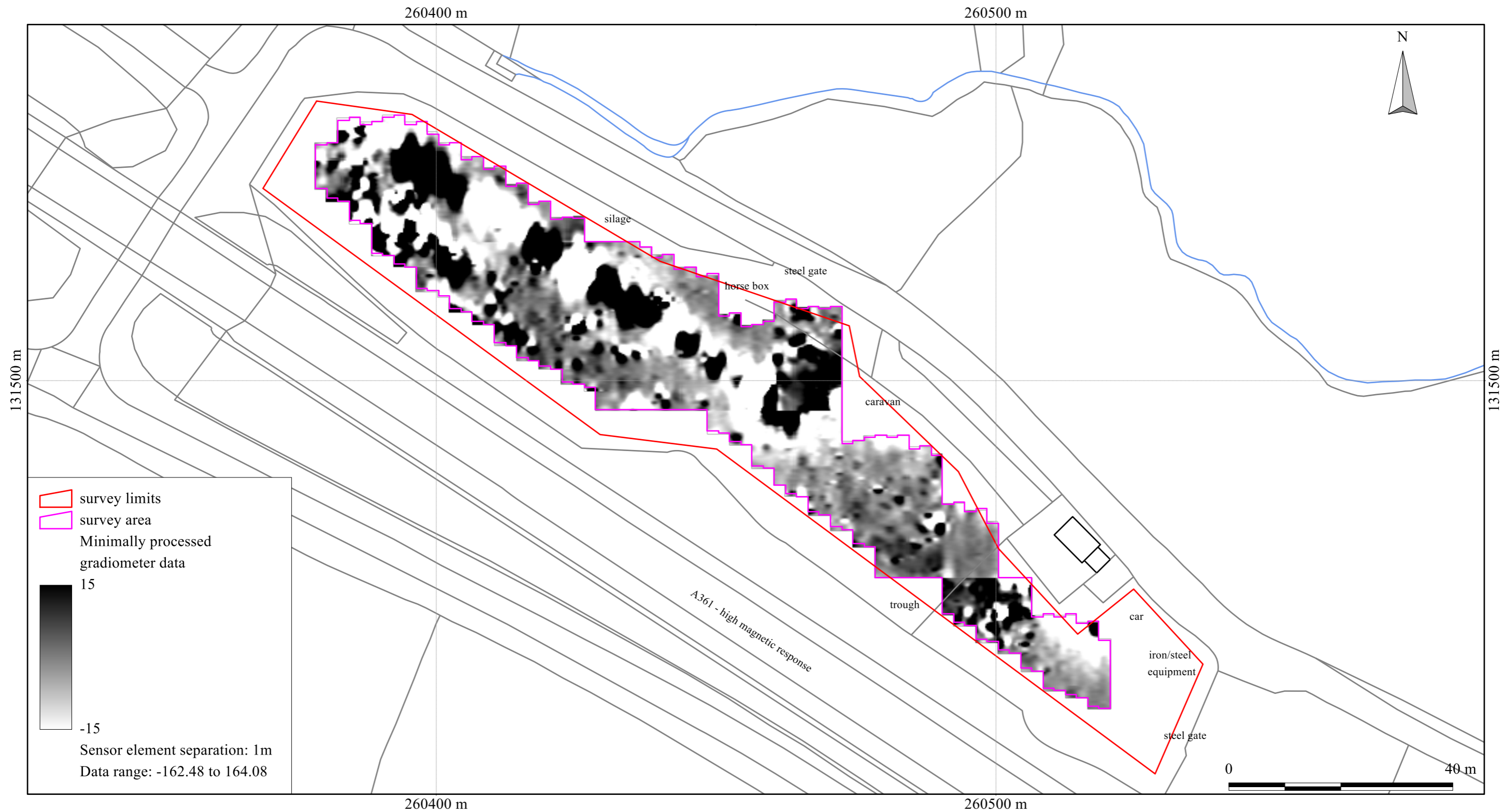
Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
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Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 3: shade plot of processed data

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British Grid
 centre X: 260457.11 m, centre Y: 131494.86 m

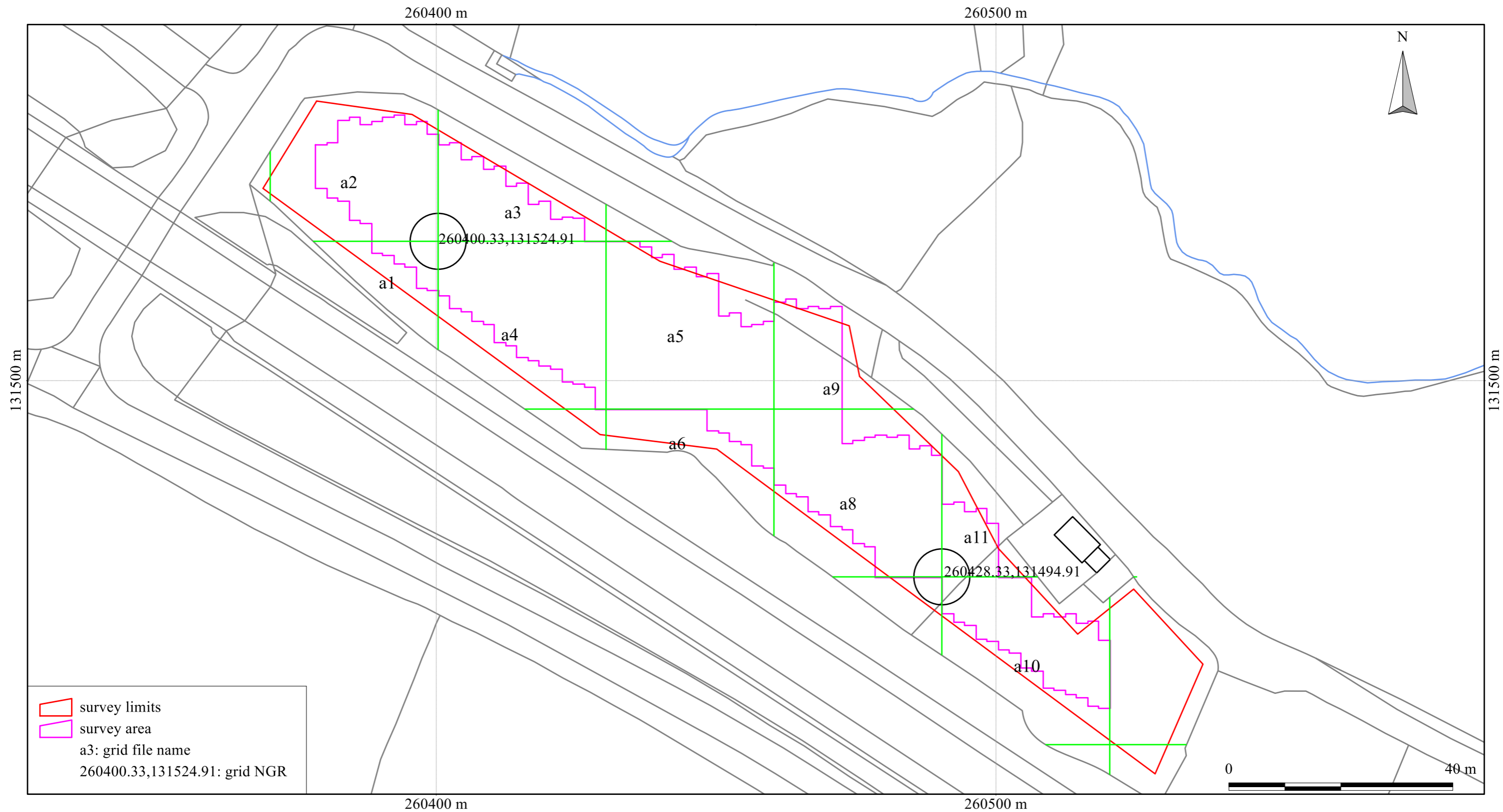
Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
 All rights reserved. Licence number 100022432

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

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 Land at Harford Cross, A361, Devon
 Centred on NGR: 260462,131500
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Figure 5: shade plot of minimally processed data

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British Grid
 centre X: 260457.11 m, centre Y: 131494.86 m

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

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Figure 6: survey grid plan and location

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Appendix 2 Tables

Site: Land at Harford Cross, A361, Devon
Centred on NGR: 260462,131500

anomaly group	anomaly characterisation certainty & class	additional archaeological characterisation
301	possible, high contrast mixed spread	ferrous and stony material
302	possible, high contrast linear	ferrous cable , pipe or drain
303	possible, high-contrast response	ferrous material, associated with service?

Table 1: data analysis

<p>Grid <i>Method of Fixing:</i> DGPS 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. <i>DGPS used:</i> Spectra Precision PM5V2 GPS with external antenna and survey pole and DigiTerra Explorer 7 as the survey control program.</p>	
<p>Equipment <i>Instrument:</i> Bartington Instruments grad601-2 <i>Firmware:</i> version 6.1</p>	<p>Data Capture <i>Sample Interval:</i> 0.25m <i>Traverse Interval:</i> 1 metre <i>Traverse Method:</i> zigzag <i>Traverse Orientation:</i> GN</p>
<p>Data Processing, Analysis and Presentation Software IntelliCAD 8.4 DW Consulting TerraSurveyor3 Manifold System 8 GIS Microsoft Corp. Office 365: Excel, Publisher, Word Adobe Systems Inc Adobe Acrobat 9 Pro Extended</p>	

Table 2: 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, each with 1m separation
Dummy Value:	32702
Program	
Name:	TerraSurveyor
Version:	3.0.33.6
<u>Statistics</u>	<u>Processing</u>
Max:	69.91
Min:	-97.99
Std Dev:	22.19
Mean:	0.22
Median:	0.00
	1 Base Layer
	2 Clip at 1.00 SD
	3 Clip at 1.00 SD
	4 Clip at 1.00 SD
	5 De Stagger: Grids: All By: 0 intervals, 50.00cm
	6 DeStripe Median Traverse: Grids: All
	Interpolate match x & y double is imposed on export to the GIS

Table 3: processed data metadata

Instrument	
Type:	Bartington Grad-601 gradiometer
Units:	nT
Direction of 1st Traverse:	see below
Collection Method:	ZigZag
Sensors:	2 @ 1.00 m spacing, each with 1m separation
Dummy Value:	32702
Program	
Name:	TerraSurveyor
Version:	3.0.33.6
<u>Statistics</u>	<u>Processing</u>
Max:	164.08
Min:	-162.48
Std Dev:	48.99
Mean:	-1.18
Median:	-2.40
	1 Base Layer
	2 Clip at 1.00 SD
	3 Clip at 1.00 SD
	Interpolate match x & y double is imposed on export to the GIS

Table 4: minimally processed data metadata

Site: Land at Harford Cross, A361, Devon
 Centred on NGR: 260462,131500

BGS ID	BGS reference	NGR (E/N)	method	strata	depth (m)	level (m aOD)	thickness (m)
650999	SS63SW63	260390,131470	mechanical excavator	Brown TOPSOIL			0.50
				Firm to stiff yellow-brown silty CLAY with some fine to coarse shale gravel	0.50 to 1.30	42.90 to 42.10	0.80
				Angular fine to coarse shale GRAVEL in a firm to stiff brown very silty CLAY matrix	1.30 to 2.65	42.10 to 41.75	1.35
				Grey, extremely closely spaced bedding discontinuities, highly weathered silty SHALE, weak. Bedding 213/86	2.65 to 3.10	41.75 to 40.30	?
				end of trial pit	3.10		
651003	SS63SW67	260320,131520	mechanical excavator	Brown clayey TOPSOIL			0.20
				Soft grey-brown and orange-brown silty CLAY with occasional sandstone gravel and pottery (!)	0.20 to 0.70	37.80 to 37.30	0.50
				Angular fine to coarse sandstone GRAVEL in a grey-brown and orange-brown silty CLAY matrix	0.70 to 0.90	37.30 to 37.10	0.20
				Grey-blue with orange staining extremely closely spaced bedding discontinuities highly weathered SHALE, weak. Bedding 180/62	0.90 to 1.65	37.10 to 36.35	?
				end of trial pit	1.65		

Table 5: example geological test pit logs avoiding former railway line south of the Survey Area in the same solid and superficial geology as the site (British Geological Survey, undated).

Appendix 3 Project archive contents

A3.1 Substrata Limited archive

A full archive of this survey will be held by Substrata Limited on cloud and local hard drive storage as follows:

Report:	Adobe PDF (.pdf), Microsoft Publisher (.pub)
Raw grid data files:	DW Consulting TerraSurveyor 3 (.xgd) and XYZ (.dat)
Minimally processed data composite files:	DW Consulting TerraSurveyor 3 (.xgd) and ESRI ASCII (.asc)
Final data processing composite files:	DW Consulting TerraSurveyor 3 (.xgd) and ESRI ASCII (.asc)
GIS project:	GIS project Manifold 8 (.map)
Survey interpretation:	ESRI shape files
AutoCAD version of the survey interpretation: (if generated)	AutoCAD (.dwg)
All project working files:	IntelliCAD 8.4 Microsoft Corp. Office 365: Excel, Publisher, Word Adobe Systems Inc Adobe Acrobat 9 Pro Extended

A3.2 Online Access to the Index of archaeological investigationS (OASIS)

Metadata:	online form
Georeferenced survey boundary file:	ESRI shape file
Report:	Adobe PDF (.pdf)

A3.3 Archaeological Data Service

Depending on local authority policy, an archive may be deposited with the ADS as follows:

Raw data composite file:	XYZ file
Processed data plot:	rendered images in TIFF format
Survey grid plot:	image in TIFF format
Details of data processing:	image in TIFF format
Interpretation plot:	rendered images in TIFF format
Metadata:	Microsoft Excel format

A3.4 Historic Environment Record (HER)

Subject to any contractual requirements on confidentiality, a PDF copy of the report will be submitted to the appropriate HER within 6 months of the completion of this report via the OASIS process or by other means, depending on the relevant HER process.