

Substrata

Archaeological Geophysical Surveyors

An archaeological magnetometer survey

Land at Quenchwell Road, Carnon Downs, Cornwall
(NGR 180070,40750)

Document 1908QUN-R-1

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1 Introduction

This report presents the results of an archaeological magnetometer survey at the proposed development site listed in Section 4.

The survey was commissioned by Cotswold Archaeology on behalf of clients in advance of a planning application. The commissioning of this report was in keeping with the National Planning Policy Framework, Chapter 16, Paragraph 189 (Ministry of Housing, Communities & Local Government, 2019). The survey and report were completed in compliance with a Survey Method Statement (Substrata Ltd, 2019).

The total proposed survey areas comprise c.2.5 hectares of pasture land adjacent to the premier inn at Quenchwell Road, Carnon Downs, Cornwall. The application area (see Fig 1) comprised 0.7 hectares.

2 Client

Cotswold Archaeology Ltd, No. 1 Clyst Units, Cofton Road, Marsh Barton Exeter, EX2 8QW

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:	March 2020
Area:	2.5 ha
Investigation level:	Level 2 (prospection and delineation)
Survey resolution:	1m by 0.25m

4.2 Location

Location:	Land at Quenchwell Road
Town and Civil Parish:	Carnon Downs, Feock
District:	Carrick
County:	Cornwall
Nearest Postcode:	TR3 6JP
NGR:	SW 180070 40750
NGR (E/N):	180070,40750(point)
Historic environment designation:	None
Oasis ID:	substrat1-389416

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 7.

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.

One anomaly group was characterised as representing possibly buried archaeology, with a further 11 as representing historical field boundaries, 4 as representing modern field drainage networks/ agricultural plough, 3 as representing modern plough patterns and 2 as representing modern services.

6 Standards

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

7 Survey aims and objectives

7.1 Aims

1. Within the framework set out in Chartered Institute for Archaeologists (2014b) and Europae Archaeologiae Consilium (undated), 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 prior to the determination of the planning application.

7.2 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.

8 Methodology

The magnetometer survey was undertaken in accordance a Survey Method Statement (Substrata Ltd, 2019) using the standards specified in Section 6 to achieve the aims and objectives set out 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 (Chartered Institute for Archaeologists, 2014b) and Europae Archaeologiae Consilium (undated).

9 Survey Area

9.1 Location and description

The Survey Area is an irregularly-shaped field, on the north-eastern periphery of the town of Carnon Downs in central Cornwall (see Figure 1). To the east of the Survey Area is a Premier Inn motel, housing to the south and west, and open fields across the road to the north. The Survey Area slopes from c. 97 m (AoD) in the east to c. 75m (AoD) in the west. The site was under grass pasture at the time of survey. The application area (see Fig 1) is an area of 0.7 hectares within the field, bordering the road in the south western corner and extending to the north.

9.2 Geology and sub-surface deposits

The proposed development site lies upon a bedrock geology of the Mylor Slate Formation - Slate And Siltstone. Sedimentary Bedrock formed approximately 359 to 383 million years ago in the Devonian Period. Local environment previously dominated by open seas with pelagite deposits. (British Geological Survey, undated)

9.3 Soils

The soils within the survey area are Freely draining slightly acid loamy soils. (www.landis.org.uk, undated)

10 Archaeological background

10.1 Historic landscape characterisation

Land enclosed in the 17th, 18th and 19th centuries, usually from land that was previously Upland Rough Ground and often medieval commons. Generally in relatively high, exposed or poorly-drained parts of the county. (Cornwall County Council, undated)

10.2 Summary of the archaeological background

This section summarises heritage assets that are thought relevant to the survey data analysis and is not designed to be a comprehensive description of the archaeological background.

There are no designated heritage assets within the site boundary.

There are no designated heritage assets within the site boundary. Cornwall Council's Historic Environment Planning team have commented that site lies within land recorded on the Cornwall and Scilly Historic Environment Record as Post-medieval Enclosed Land; that is Land enclosed in the 17th, 18th and 19th centuries, usually from land that was previously Upland Rough Ground and often medieval commons. There are a number of extant and demolished Bronze Age barrows to the south west, south and south east of the proposal site.

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 differences 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 buried archaeology 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.

Figure 3 is a plot of the processed data as specified in Table 3. Figure 4 is a plot of minimally processed data as specified in Table 4. Figure 5 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 magnetic materials within and adjacent to the plot boundaries. Strong magnetic responses mapped close to the boundaries are likely to relate to the magnetic materials except where otherwise indicated in Figure 2 and Table 1.

Anomaly characterisation

A number of anomaly groups that could be interpreted as relating to large postholes or pits will be visible on most magnetometer surveys, although most will have natural origins. Anomalies of this sort are mapped as potential archaeology when they are well defined in the data, 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.

Data trends

12.2 Data relating to historic maps and other records

Anomaly Groups 1, 2, 3, 4, 5, 6, 9 and 10 are likely to be former field boundaries (Cornish Hedges) as they match the field pattern depicted in the local tithe mapping of c. 1840. These field boundaries appear in the geophysical plot as adjacent strands of positive-negative-positive response, suggesting a substantial hedge bank with flanking ditches, c.4m across.

Anomaly Group 7 is likely to be a remodelling of the field boundary in this position. The tithe map depicts a kink in the alignment of the bank in this point.

12.3 Data with no previous archaeological provenance

Anomaly Group 8 has the geophysical signature of a Cornish hedge bank with flanking ditches, however this anomaly does not appear on historical mapping. A known water / sewer service associated with anomaly group 13 correlates exactly with group 8 this indicates that parts/ most of this anomaly will be the service, although due to amount of disturbance in this area it is impossible to accurately map the service itself.

Anomaly Group 12 is a narrow positive linear anomaly of uncertain interpretation. It possibly forms the eastern side of a former north-south field boundary to the west, possibly the eastern ditch. It may be archaeological.

Anomaly Group 11 is a long, sinuous positive anomaly, c. 2m across, of uncertain interpretation. It is of a different geophysical signature to the surrounding 19th century field pattern, however it is on a similar alignment. It may represent a boundary from an earlier field system, alternatively it may represent a ditch of uncertain, possibly prehistoric date.

Anomaly Group 13 is a linear negative anomaly c. -30nT likely modern origins. The regular linearity and direction from the motel to the modern housing suggest modern services.

Anomaly Group 14 is a set of parallel positive linear responses in the northeast corner of the Survey Area. They appear to run into a perpendicular channel at the fields edge, Anomaly Group 15, and a curving anomaly, Group 16. These are interpreted as a grip-style field drainage system. The curving morphology of Group 16, following the perimeter of the motel suggests it is 20th century in date.

Anomaly Group 17 is a series of roughly parallel positive curvilinear anomalies in the southeast corner of the Survey Area. These are interpreted as field drains of a similar dating to Group 14/15/16 discussed above, i.e. 20th century.

Anomaly Groups 100, 101 and 102 are groups of narrow parallel linears of both magnetic polarities occurring across the Survey Area. These are interpreted as a modern ploughing trend, and this directionality is attested in aerial photography from the last 20 years visible

13 Conclusions

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

The survey detected 20 geophysical anomaly groups, with the majority considered to represent post-medieval and modern agricultural practices in the form of relic field systems, modern drainage regimes and plough patterning. One anomaly group, Anomaly Group 11, may be an element of historic field pattern on a similar alignment, but may equally be a ditch of uncertain, possibly much earlier date.

Across the Survey Area can be seen patches of raised magnetic response. The organic pattern of these and their distribution across a wide area suggests they are the background response of the natural underlying geology.

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) substrat1-353341

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 Zoe Arkley of Cotswold Archaeology for commissioning us to complete this survey.

17 Bibliography

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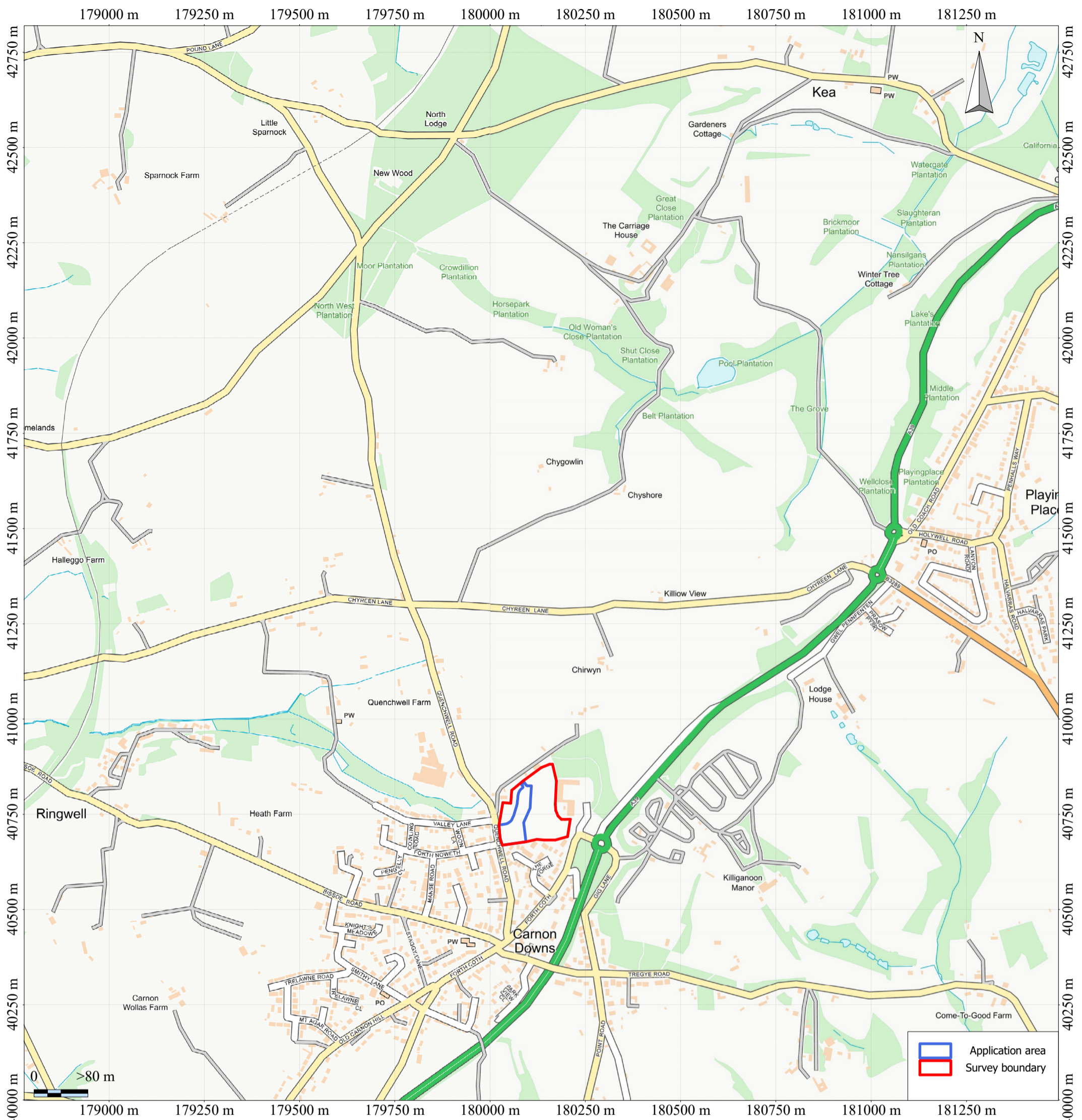
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Appendix 1 Figures

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: 180134.50 m, centre Y: 41409.36 m

Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
 All rights reserved. Licence number 100053143

Scale: 1:10000 @ 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 recent deposits or ground disturbance, or geological and other natural deposits are not mapped unless relevant to potential buried archaeology.

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 Centred on NGR 180070,40750
 Report: 1908QUN-W-1

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Figure 1: Location plan



British Grid
 centre X: 180117.55 m, centre Y: 40777.09 m

Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
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Scale: 1:1000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 2: Survey interpretation



British Grid
centre X: 180117.55 m, centre Y: 40777.09 m

Geophysical survey: Copyright Substrata Limited.
Base map: Ordnance Survey (c) Crown Copyright 2018.
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Scale: 1:1000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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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.
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Figure 3: Processed magnetometer data



British Grid
centre X: 180117.55 m, centre Y: 40777.09 m

Geophysical survey: Copyright Substrata Limited.
Base map: Ordnance Survey (c) Crown Copyright 2018.
All rights reserved. Licence number 100053143

Scale: 1:1000 @ 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 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 4: Unprocessed magnetometer data



British Grid
 centre X: 180117.55 m, centre Y: 40777.09 m

Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2018.
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Scale: 1:1000 @ 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 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 5: Control points and grid plan

Appendix 2 Tables

Site: Land at Quenchwell Road, Carnon Downs, Cornwall
 Centred on NGR: 180070,40750

plot	anomaly group	associated anomaly groups	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
	1		likely, pos-neg-pos lines	rectilinear	former field boundary?	visible on tithe map c.1840	tithe c 1840
	2		likely, pos-neg-pos lines	curvilinear	former field boundary?	visible on tithe map	tithe map c 1840
	3		likely, pos-neg-pos lines	linear	former field boundary	oriented similar to nearby boundaries seen on tithe map	
	4		likely, pos-neg-pos lines	curvilinear	former field boundary?	visible on tithe map	tithe map c 1840
	5		likely, pos-neg-pos lines				
	6		likely, pos-neg-pos lines	curvilinear	former field boundary?	visible on tithe map	tithe map c. 1840
	7	6?	likely, pos-neg-pos lines	linear	former field boundary?	visible on tithe map. kink in direction of boundary here. remodelled? is this a later section?	tithe map c 1840
	8	13	likely, pos-neg-pos lines	linear	modern sewer service	Modern water pipe/ Sewer, has similar response to a cornish hedgebank. Although this could relate to the modern sewer	
	9		likely, pos-neg-pos lines	linear	former field boundary?	visible on tithe map	tithe map c 1840
	10		likely, pos-neg-pos lines	curvilinear	former field boundary?	visible on tithe map	tithe map c.1840
	11		possible, positive	curvilinear	Uncertain. Ditch?	probably not the E-W field boundary roughly in this position on the tithe map, which in reality is probably further south	
	12		possible, positive	curvilinear	former field boundary? ditch?	possibly the field boundary depicted here on the tithe map, or some element of it i.e. ditch	
	13	8	possible, negative	curvilinear	modern sewer service	Modern water pipe/ Sewer	
	14		possible, positive	various	field drainage lateral channel?	grip style?	
	15		possible, positive	various	field drainage main channel?	grip style?	
	16		possible, positive	various	field drainage main channel?	grip style?	
	17		possible, positive	various	field drainage?		
	100		likely, parallel linears	parallel linear	plough trend?		
	101		likely, parallel linears	linears	plough trend?		
	102		likely, parallel linears	linears	plough trend?		

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

Description:	
Instrument Type:	Grad 601 (Magnetometer)
Units:	nT
Direction of 1st Traverse:	0 deg
Collection Method:	ZigZag
Sensors:	2 @ 1.00 m spacing.
Dummy Value:	32702
Dimensions	
Composite Size (readings):	1680 x 360
Survey Size (meters):	210 m x 180 m
Grid Size:	30 m x 30 m
X Interval:	0.125 m (surveyed @ 0.25 m)
Y Interval:	0.5 m (surveyed @ 1 m)
Stats	
Max:	74.97
Min:	-85.55
Std Dev:	8.89
Mean:	0.58
Median:	0.04
PROGRAM	
Name:	TerraSurveyor
Version:	3.0.34.10
Processes:	10
1	Base Layer
2	Clip at 2.00 SD
3	DeStripe Median Traverse: Grids: All
4	De Stagger: Grids: All Mode: Both By: -2 intervals
5	De Stagger: Grids: a28.xgd Mode: Both By: 2 intervals
6	De Stagger: Grids: a20.xgd Mode: Both By: -2 intervals
7	De Stagger: Grids: a25.xgd Mode: Both By: 1 intervals
8	De Stagger: Grids: a18.xgd Mode: Both By: -1 intervals
9	De Stagger: Grids: a05.xgd a06.xgd Mode: Both By: -2 intervals
10	Interpolate: X & Y Doubled.
Note: Input to the GIS results in slight changes to the stats shown above. The data stored in the archives (Appendix 3) will have the above metadata and the values quoted in the report figures will be those quoted in this metadata table.	

Table 3: processed data metadata

Description:	
Instrument Type:	Grad 601 (Magnetometer)
Units:	nT
Direction of 1st Traverse:	0 deg
Collection Method:	ZigZag
Sensors:	2 @ 1.00 m spacing.
Dummy Value:	32702
Dimensions	
Composite Size (readings):	840 x 180
Survey Size (meters):	210 m x 180 m
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:	33.12
Mean:	2.29
Median:	1.60
Processes: 1	
1 Base Layer	
Note: Input to the GIS results in slight changes to the stats shown above. The data stored in the archives (Appendix 3) will have the above metadata and the values quoted in the report figures will be those quoted in this metadata table.	

Table 4: minimally processed data metadata

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 CSV (.xyz)
Raw data composite files:	CSV (.xyz)
Minimally processed data composite files:	DW Consulting TerraSurveyor 3 (.xgd) and CSV (.xyz)
Final data processing composite files:	DW Consulting TerraSurveyor 3 (.xgd) and CSV (.xyz)
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:	CSV (xyz)
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.