Substrata
Archaeological Geophysical Surveyors

An archaeological magnetometer survey

Single Wind Turbine at land west of Little Lansenwith, Trethaegue Stithians, Cornwall

Centred on NGR (E/N): 171960,035770

Report: 1705STI-R-1

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25 March 2017

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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:	3 May 2017
Area:	1.9ha
Lead surveyor:	Mark Edwards BA
Author:	Ross Dean BSc MSc MA MIfA

1.2 Clients

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

1.3 Location

Site:	Single Wind Turbine at land west of Little Lansenwith, Trethaegue
Civil Parish:	Stithians
County:	Cornwall
Nearest Postcode:	TR16 6PF
NGR:	SW 71960 35770 (point)
NGR (E/N):	171960,035770 (point)

1.4 Archive

OASIS number:	substrat1-285937
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 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 AC Archaeology Ltd on behalf of clients. 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.

Four magnetic anomaly groups were mapped as representing potential archaeological deposits or features and one as possible ridge-and-furrow ploughing. One of the groups is likely to represent a track, or possibly a field wall, recorded on the 1842 Stithians tithe map and later historical Ordnance Survey maps up to and including at least 1972-77. Another represents a track on the same set of maps. One group is likely to represent a field or enclosure boundary recorded on the tithe map only. The fourth anomaly group coincides with, and likely represents, a section of a pre-medieval enclosure recorded in the Cornwall Historical Environment Record (MCO35472). This enclosure was partially recorded on the tithe map as an earthwork or track and continued to be recorded on Ordnance Survey maps in a reduced form up to and including 1962-63.

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 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).

4 Site description

4.1 Landscape and land use

The survey area is located to the east of Stithians Reservoir, within the parish of Stithians, as shown in Figure 1. The survey area included the proposed turbine area and part of a proposed access track (Figure 2). The turbine area is sited within a larger field at approximately 185m AOD. The section of the proposed access track lies in an adjacent field to the west.

4.2 Geology

The bedrock across the site is microgranite of the Permian and Carboniferous Carnmenellis Intrusion. The superficial deposits for the site are not recorded in the source used (British Geological Survey, undated).

5 Archaeological background

5.1 Historic landscape characterisation (Cornwall Council, undated).

Turbine Area

'Modern Enclosed Land'

Mainly Anciently Enclosed Land or Post-Medieval Enclosed Land whose field systems have been substantially altered by large-scale hedge removal in the 20th century. It also includes, however, 20th century intakes from rough ground, woodland and marsh.

Access Track

'Farmland: Medieval'

Summary : 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.

5.2 Summary of archaeological background

An Historical Environment Impact Assessment was produced by AC Archaeology for the same programme of work between August 2016 and March 2017 (Costen and Pink, 2017). This report contains a detailed analysis of the historic environment of the site.

The following is an extract of that report.

An enclosure of unknown, but likely prehistoric to medieval date, is recorded in the area where the proposed wind turbine is to be positioned. Additional non-designated heritage assets have been recorded in the vicinity and include a field system of likely medieval or earlier date, identified from aerial photographic evidence (ibid: 1).

6 Results, discussion and conclusions

6.1 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 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 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.

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 7.

6.2 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 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 processed data as specified in Table 3. Figures 5 and 6 are plots of unprocessed data with accompanying metadata.

6.3 Discussion

6.3.1 General points

Discussion 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 the survey archive.

Data collection

Data collection along the survey area edges and within the survey area was restricted as shown in the figures due to the presence of magnetic materials. Un-mapped strong magnetic responses shown in Figures 3 to 6 are likely to relate to these materials except where otherwise indicated in Figure 2 and Table 1.

Anomaly characterisation and mapping

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 1.

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.

6.3.2 Data relating to historic maps and other records

Magnetic anomaly group **1** coincides with, and likely represents, a field boundary or possibly a track recorded on various historical maps between 1842 and at least 1974-77. Group **2** coincides with a track recorded on the same set of historical maps.

Group **3** coincides with part of a pre-medieval, polygonal banked enclosure recorded as cropmarks on aerial photographs (Costen and Pink, 2016: Figure 1 and Appendix 1, after) Cornwall Historic Environment Record MCO35472). It also coincides with a track or earthwork recorded on the 1842 Stithians tithe map in this field only; the rest of the polygonal enclosure is not recorded on the tithe map. Part of the feature represented by the anomaly group continues to be mapped as a remnant of this track or earthwork on historic Ordnance Survey maps up to and including 1962-63.

Group **4** coincides with a field or enclosure boundary on the 1842 Stithians tithe map but not on later Ordnance Survey maps.

6.3.3 Data with no previous archaeological provenance

Group **101** may represent traces of ridge-and-furrow ploughing. No other anomaly groups were considered to represent potential archaeological deposits or features.

6.4 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.

Four magnetic anomaly groups (1 to 4) were mapped as representing potential archaeological deposits or features and one (101) as possible ridge-and-furrow ploughing. One of the groups (1) is likely to represent a track, or possibly a field wall, recorded on the 1842 Stithians tithe map and later historical Ordnance Survey maps up to and including at least 1972-77. Another (2) represents a track on the same set of maps. One group (4) is likely to represent a field or enclosure boundary recorded on the tithe map only. The fourth anomaly group (3) coincides with, and likely represents, a section of a pre-medieval enclosure recorded in the Cornwall Historical Environment Record (MCO35472). This enclosure was partially recorded on the tithe map as an earthwork or track and continued to be recorded on Ordnance Survey maps in a reduced form up to and including 1962-63.

7 Disclaimer and copyright

The description and discussion of the results presented in this report are the authors, based on his interpretation of the survey data. Every effort has been made to provide accurate descriptions and interpretations of the geophysical data set. The nature of archaeological geophysical surveying is such that interpretations based on geophysical data, while informative, can only be provisional. Geophysical surveys are a cost-effective early step in the multi-phase process that is archaeology. The evaluation programme of which this survey is part may also be informed by other archaeological assessment work and analysis. It must be presumed that more archaeological features will be evaluated than those specified in this report.

8 Acknowledgements

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

9 Bibliography

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Costen, D. and Pink, F. (2017) *Single Wind Turbine at land west of Little Lansenwith, Trethaegue, Stithians (Centred on NGR SW 71960 35770), Historic Environment Impact Assessment*, AC Archaeology Ltd unpublished report ACD1407/1/1

Dean, R. (2017) *A survey method statement for a detailed magnetometer survey over land near Stithians, Cornwall.* Substrata Ltd unpublished document 1705STI-M-1

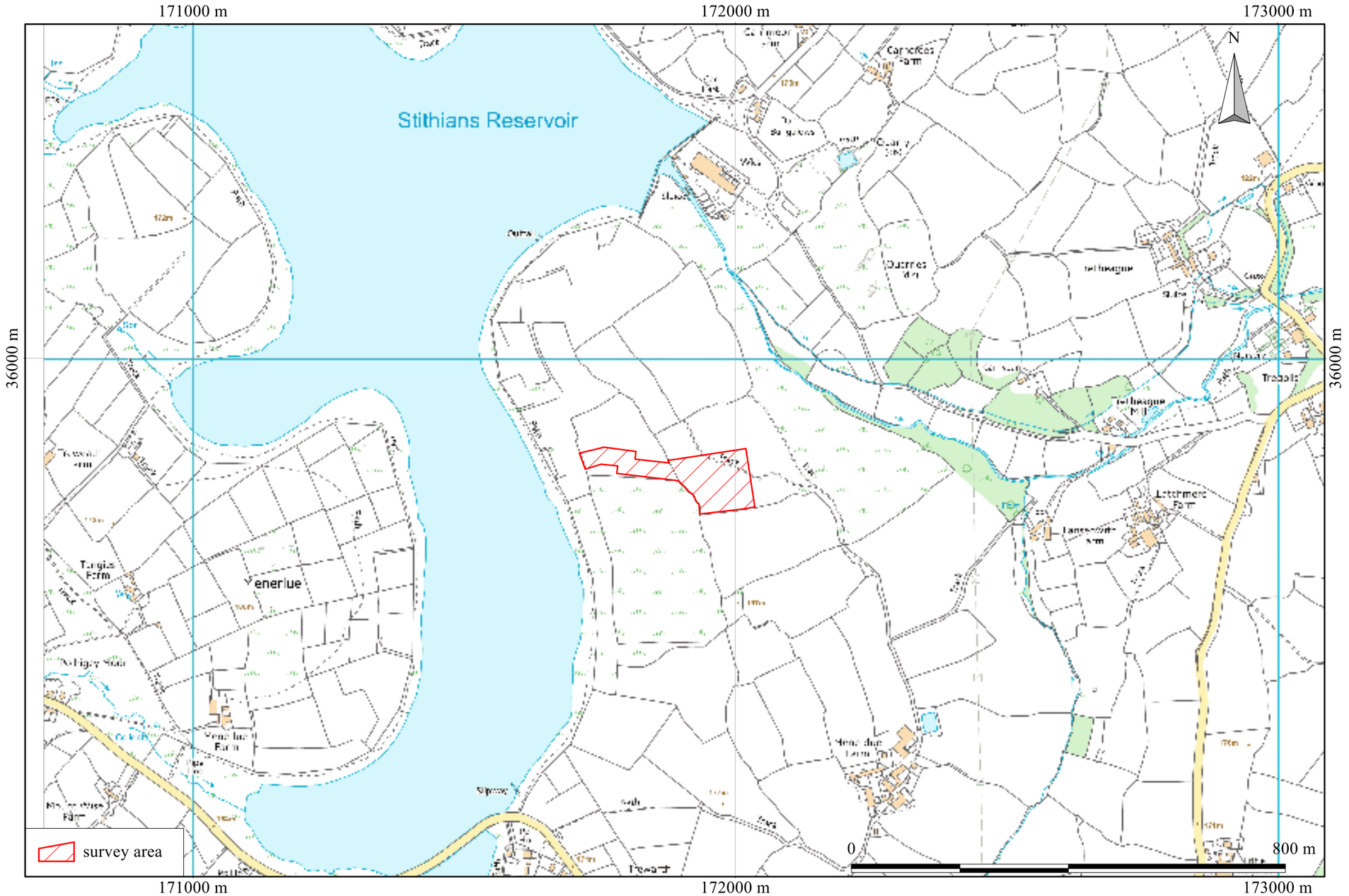
Historic England (2010) *Geophysical Survey in Archaeological Field Evaluation* [Online], Available: https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/ [April 2017]

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 (see Section 6.1).

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: 171888.57 m, centre Y: 35829.99 m

Scale: 1:8000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
Single Wind Turbine at land west of Little Lansenwith
Trethaegue, Stithians, Cornwall
Centred on NGR (E/N): 171960,035770
Report: 1705STI-R-1

Figure 1: location map

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171700 m 171800 m 171900 m 172000 m

35800 m

35700 m

N

Access Track

Turbine Area

101 101 301

302 201 303 304 305 306

1 2 3 4

steel gates

surface rock - quarrying?

uneven ground

deep tractor tracks

survey limits
magnetometer survey area
certainty, anomaly type (2)
Potential archaeology
likely, positive (3)
likely, negative (3)
Potential natural
possible, weak broad response (4)
Potential cultivation traces
possible, repeated parallels (4)
Potential services & modern
possible, high contrast (4)
possible, high contrast linear
possible, linear (4)

0 80 m

British Grid
centre X: 171872.96 m, centre Y: 35782.37 m

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 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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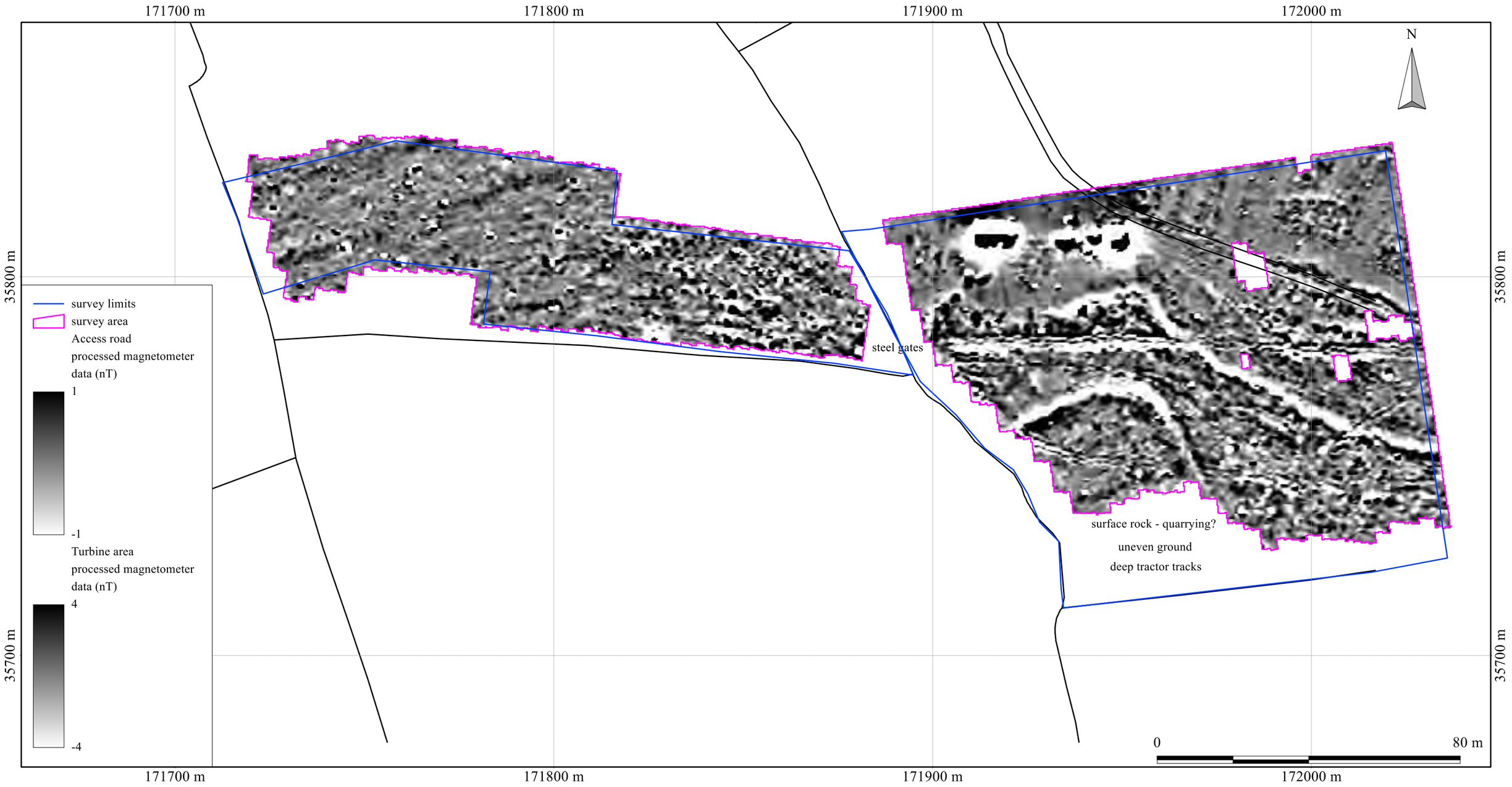

British Grid
centre X: 171853.38 m, centre Y: 35768.87 m

Scale: 1:1000 @ 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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171700 m | 171800 m | 171900 m | 172000 m

35800 m

35700 m

N

steel gates

surface rock - quarrying?

uneven ground

deep tractor tracks

survey limits
survey area
Access road processed magnetometer data (nT)
> 4.00
2.00 - 4.00
1.00 - 2.00
0.50 - 1.00
-0.50 - 0.50
-1.00 - -0.50
-2.00 - -1.00
-4.00 - -2.00
< -4.00
Turbine area processed magnetometer data (nT)
> 8.00
4.00 - 8.00
2.00 - 4.00
1.00 - 2.00
-1.00 - 1.00
-2.00 - -1.00
-4.00 - -2.00
-8.00 - -4.00
< -8.00

0 80 m

British Grid
centre X: 171853.38 m, centre Y: 35768.87 m

Scale: 1:1000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
Single Wind Turbine at land west of Little Lansenwith
Trethaegue, Stithians, Cornwall
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Figure 4: contour plot of processed data

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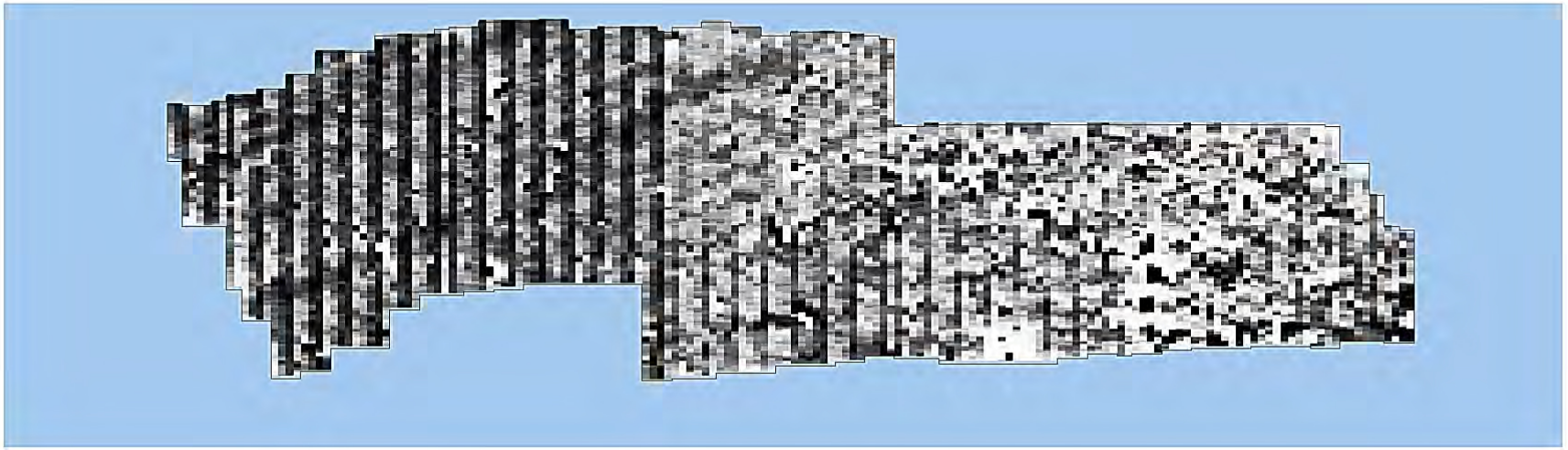
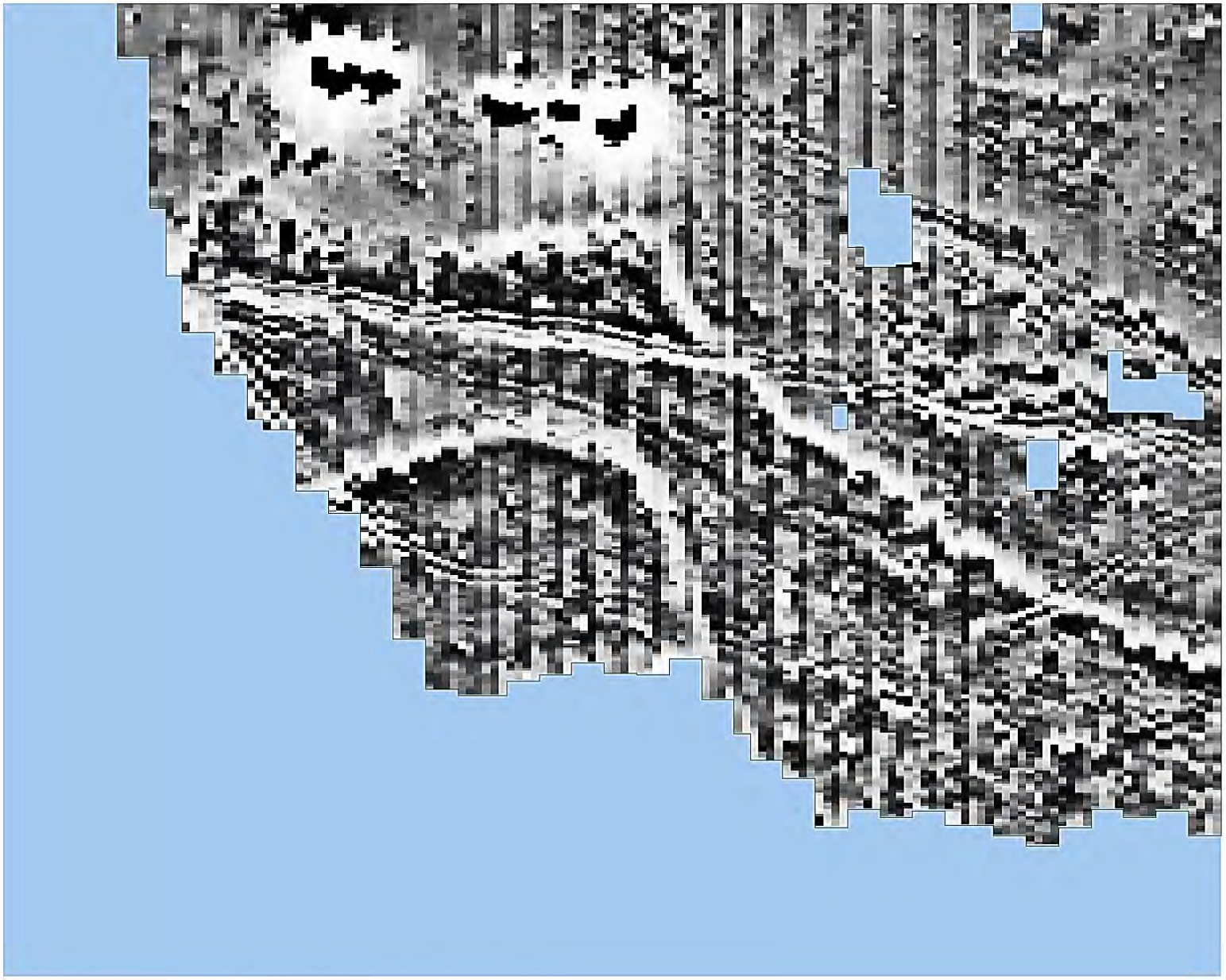
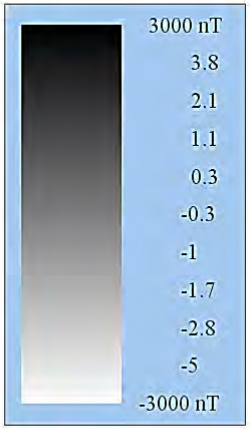


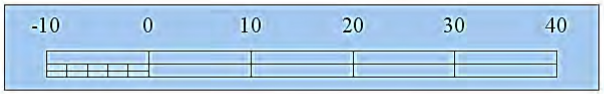
Instrument type: Bartington grad601-2
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 0.00 m spacing.
Dummy Value: 2047.5
Dimensions
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m
Stats
Max: 3000.00
Min: -3000.00
Std Dev: 55.41
Mean: 0.72
Median: 0.10
Surveyed Area: 0.5761 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.31.0

Processes: 1
1 Base Layer

Figure 5: shade plot of unprocessed magnetometer data, Access Track







Instrument type: Bartington grad601-2
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 0.00 m spacing.
Dummy Value: 2047.5
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: 193.97
Mean: -1.70
Median: -0.30
Surveyed Area: 1.0846 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.31.0

Processes: 1
1 Base Layer

Figure 6: shade plot of unprocessed magnetometer data, Turbine Area

Appendix 2 Tables

Site: An archaeological magnetometer survey
Single Wind Turbine at land west of Little Lansenwith
Trethaegue, Stithians, Cornwall
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area	anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
Turbine Area	1	likely, negative	curvilinear	field wall recorded on historic maps - may be a track	anomaly group approximately coincides with a field wall or track recorded on historic maps up to at least 1974-77	1842 Stithians tithe map, OS maps 1878-80 1:2500 to1974-77 1:10000
	2	likely, negative	curvilinear	track recorded on historic maps	anomaly group approximately coincides with a track recorded on historic maps up to at least 1974-77	1842 Stithians tithe map, OS maps 1878-80 1:2500 to1974-77 1:10000
	3	likely, negative	curvilinear	enclosure & track or earthwork	anomaly group approximately coincides with a pre-medieval enclosure recorded as cropmarks on aerial photographs; it also coincides with a track or earthwork recorded on the tithe map in this field only and as a remnant of this track or earthwork on historic OS maps up to 1962-63	Cornwall HER MCO35472, 1842 Stithians tithe map, OS maps 1878-80 1:2500 to1962-63 1:10560
	4	likely, positive	disrupted linear	enclosure boundary	anomaly group approximately coincides with a boundary recorded on the 1842 tithe map	1842 Stithians tithe map
	201	possible, weak broad response		spring or wet area		
	302	possible, high contrast		recent ferrous rich deposits		
	303	possible, high contrast		recent ferrous rich deposits		
	304	possible, high contrast		recent ferrous rich deposits		
	305	possible, linear		modern extant track		
	306	possible, linear		recent ground disturbance	anomaly group results from tractor and other vehicle disturbance	observed by surveyors
Access Track	101	possible, repeated parallels		cultivation traces - possible ridge-and-furrow	ridge-and-furrow traces recorded in the Cornwall National Mapping Programme in southern adjacent field with a different orientation	Cornwall HER MCO35473
	301	possible, high contrast linear		ferrous pipe, cable or drain		

Table 1: data analysis

Notes:
Cornwall HER : Cornwall Historic Environment Record

Documents
Survey methodology statement: Dean (2017)

Methodology

1. The work was undertaken in accordance with the survey methodology statement. The geophysical (magnetometer) survey was undertaken with reference to standard guidance provided by the Chartered Institute for Archaeologists (2014) and Archaeology Data Service (undated).
2. The survey grid location information and grid plan was recorded as part of the project in a suitable GIS system.
3. Data processing was undertaken using appropriate software, with all anomalies being digitised and geo-referenced. The final report included a graphical and textual account of the techniques undertaken, the data obtained and an archaeological interpretation of that data and conclusions about any likely archaeology.

Grid
Method of Fixing: DGPS set-out using pre-planned survey grids and Ordnance Survey coordinates.
Composition: 30m by 30m grids
Recording: Geo-referenced and recorded using digital map tiles.
DGPS used: Spectra Precision PM5V2 GPS with external antenna and survey pole and DigiTerra Explorer 7 as the survey control program.

Equipment	**Data Capture**
Instrument: Bartington Instruments grad601-2 *Firmware:* version 6.1	*Sample Interval:* 0.25m *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN351 turbine Area, GN5 access Track

Data Processing, Analysis and Presentation Software
IntelliCAD Technology Consortium IntelliCAD 8.0
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 2: methodology summary

SITE
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: 3.0.31.0

Turbine Area Stats Max: 26.25 Min: -26.61 Std Dev: 4.98 Mean: -0.19 Median: 0.01 Surveyed Area: 1.08ha	Processes: 11 1 Base Layer 2 Clip at 1.00 SD 3 Clip at 2.00 SD 4 DeStripe Median Traverse: Grids: All 5 De Stagger: Grids: All Mode: Both By: -2 intervals 6 De Stagger: Grids: a24.xgd Mode: Both By: 1 intervals 7 De Stagger: Grids: a25.xgd Mode: Both By: 1 intervals 8 De Stagger: Grids: a22.xgd Mode: Both By: 1 intervals 9 De Stagger: Grids: a21.xgd Mode: Both By: 1 intervals 10 Interpolate: Match X & Y Doubled. 11 Clip at 5.00 SD
Access Track Stats Max: 23.99 Min: -24.85 Std Dev: 1.32 Mean: 0.05 Median: 0.00 Surveyed Area: 0.57ha	Processes: 7 1 Base Layer 2 Clip at 1.00 SD 3 Clip at 5.00 SD 4 DeStripe Median Traverse: Grids: All 5 De Stagger: Grids: a4.xgd a5.xgd a8.xgd a2.xgd a3.xgd a6.xgd a7.xgd Mode: Both By: -2 intervals 6 De Stagger: Grids: a9.xgd a12.xgd a13.xgd a10.xgd a11.xgd a14.xgd Mode: Both By: -1 intervals 7 Interpolate: Match X & Y Doubled.

Table 3: processed data metadata