Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Salters Farmhouse, Whiterocks Park, St Anns Chapel Gunnislake, Cornwall

Ordnance Survey E/N: 318840 88210 (point)

Report: 130713

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11 July 2013

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1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: 17 June 2013
Area surveyed: 2ha.
Lead surveyor: Ross Dean BSc MSc MA MIfA

Client
South West Archaeology Ltd, The Old Dairy, Hacche Lane Business Park, Pathfields Business Park, South Molton, Devon EX36 3LH

Location

Site:	Land at Salters Farmhouse, Whiterocks Park St Anns Chapel, Gunnislake
District:	Caradon
Civil Parish:	Calstock
County:	Cornwall
NGR:	SX 413 713 (point)
OS E/N:	241380 71300 (point)
Planning Application:	PA12/02414
HE Planning Advice Officer:	Phil Copleston, Historic Environment Service, Cornwall Council , Luxstowe House, Liskeard
Planning Authority Officer:	Jonathan Luker, Planning & Regeneration, Cornwall Council, Luxstowe House, Liskeard
OASIS number:	substrat1-154879
Archive:	The archive of this survey will be held by Substrata.

Summary
This report was commissioned by South West Archaeology Ltd on behalf of clients to comply with recommendations made by the Cornwall Council Historic Environment Service with regard to the above planning application for the erection of an Endurance 3120 50kw wind turbine.

The work was undertaken in accordance with a Written Scheme of Investigation produced by South West Archaeology (Walls, 2013) in response to requirements for a geophysical survey specified in a Brief from the Cornwall County Council Historic Environment Service (Copleston, 2012). The Brief set out the minimum requirements for an archaeological desk-based assessment, geophysical survey and a landscape and visual impact assessment at the above site. The purpose of this work was to inform the developer and the Planning Authority of the archaeological potential of the development site and the visual impacts upon the settings of other nearby heritage assets, and to suggest mitigation where appropriate. The desk-based assessment and landscape and visual impact assessment were completed by South West Archaeology Ltd. (report forthcoming).

The magnetic contrast across the survey areas was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. A total of 10 magnetic anomaly groups were identified as pertaining to potential archaeology and one of these denotes a former field boundary mapped in 1883 but not later. One anomaly group is associated with extant earthworks, appears to be respected by a former mapped field boundary and is on the same orientation as former earthworks mapped in 1883. One sub-circular structure and one possible pit were identified in the data set. Four possible former field boundaries, enclosures or similar archaeological features were identified, one of which may be a double ditch. Further points are made in section 3.3 Conclusions.

Survey aims
The site specific aims are to:

- Draw together the historical and archaeological information about the site
- Undertake an archaeological magnetometer survey
- Produce a report containing the geophysical data and the data in interpreted form
- Inform whether an archaeological evaluation or further archaeological recording of any potential buried remains or other mitigation is required

The geophysical survey area specified was a one hectare area centred on the location of the turbine base and a 30m wide strip along the line of both the access trackway and the cable grid connection.

At the client's request, the survey area around the survey base was extended to the western boundary of the field concerned (figure 1).

Standards
The standards used to complete this survey are defined by the Institute for Archaeologists (2011). The codes of approved practice that were followed are those of the Institute for Archaeologists (2008 and 2009) and Archaeology Data Service/Digital Antiquity Guides (undated). The document text was written using the house style of the Institute for Archaeologists (Institute for Archaeologists, undated).

2 Site description

Site location and description
The site of the proposed wind turbine is located within farmland to the north of the A390 Callington to Gunnislake road, centred on Ordnance Survey grid reference SX 41375 71290, with an proposed access track to the west and a cable grid connection to the southwest.

Geology and soils
The site is located on a solid geology of Upper Devonian Upper-Middle Famennian Kate Brook Slate Formation comprising greenish grey slate. The disused quarry on the north-west corner of the site extracted Carboniferous microgranite and Carboniferous granites are found approximately 500m to the north-east of the survey area (British Geological Survey, 1993).

The soils comprise cambic stagnogley soils of the Sportsmans Association which are compact stony subsoils overlain by approximately 0.2m of more permeable loamy material (Soil Survey of England and Wales, 1983; Findlay et al, 1984: 285-6)

Archaeological background
The development area has been recorded on the Cornwall and Scilly Historic Environment Record (HER) as located within the inscribed area of the UNESCO Cornish Mining World Heritage Site (WHS). The site is also near to the linear alignment of a group of prehistoric Bronze Age barrows, two within 200m of the proposed wind turbine, and three Grade II Listed buildings, all within 400m of the turbine site. The presence of the nearby barrows suggests a potential for the survival of further buried archaeological remains at the location of the development. Further wider views of historic landscapes, Scheduled landscapes at Chilsworthy, Harrowbarrow and Cleave, the Conservation Area at Calstock, and the Tamar Valley Mining District (A10i) of the WHS, may also be affected by this development.

As far as is known, no previous archaeological investigation has specifically investigated this site.

3. Results, discussion and conclusions

This survey was designed to record magnetic anomalies. The anomalies themselves cannot be regarded as actual archaeological features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeological features. The analysis presented below attempts to identify and characterise anomalies and anomaly groups that may pertain to archaeological deposits and structures.

The reader is referred to section 4.

3.1 Results

Figure 1 shows the interpretation of the survey and table 1 is an extract from a detailed analysis of the survey data provided in the attribute tables of the GIS project on the accompanying CD-ROM.

Figures 1 and table 1 comprise the analysis and interpretation of the survey data.

The processed gradiometer data and the survey interpretation over the relevant Ordnance Survey 1st Edition map are presented in appendix 1.

Site: An archaeological gradiometer survey
Land at Salters Farmhouse, Whiterocks Park
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Ordnance Survey E/N: 241380 71300 (point)
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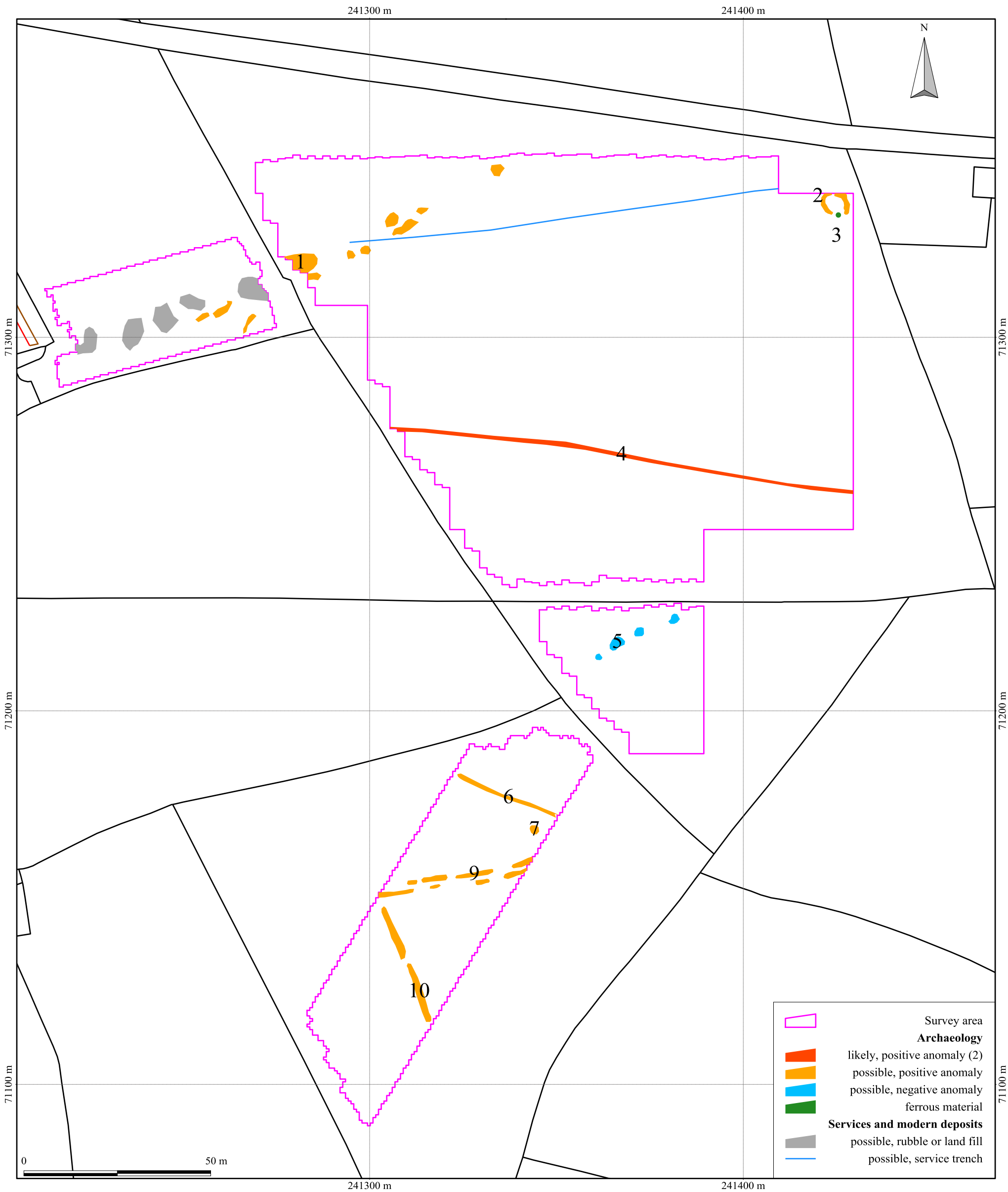
group	characterisation certainty	form	further archaeological characterisation	comments	supporting evidence
1	possible	disrupted linear	field boundary	anomaly group may represent deposits within an extant earthwork partially on the line of a former field boundary shown on OS 1st edition and on OS 1883 1:10560 but not on 1906 1:2500 and subsequent maps	Ordnance Survey maps 1883-1900 1:2500, 1889-1891 1:10560, 1906 1:2500
2	possible	subcircular		anomaly group may represent archaeological deposits but could equally be a fortuitous alignment of anomalies actually representing ploughing traces and disrupted by a strong ferrous signal	
3	possible		ferrous material	highlighted to show influence of anomaly on group 2	
4	likely	linear	field boundary	anomaly group probably represent a former field boundary shown on OS 1st edition and on OS 1883 1:10560 but not on 1906 1:2500 and subsequent maps	Ordnance Survey maps 1883-1900 1:2500, 1889-1891 1:10560, 1906 1:2500
5	possible				
6	possible	linear			
7	possible	oval	pit		
9	possible	double linear			
10	possible	linear			

table 1: survey data analysis



British Grid
centre X: 241336.50 m, centre Y: 71230.00 m

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

Produced 11/7/2013

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Anomalies likely to represent geological or other natural deposits are not mapped.

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Figure 1: survey interpretation

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3.2 Discussion

Refer to figures 1, 2 and 3.

Not all anomalies or anomaly groups identified in the survey dataset are discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM. Those anomaly groups possibly representing archaeological deposits are included in data analysis tables 1 and 2.

General observations

While sufficient to allow distinctions between potential archaeological and natural deposits, the site had a low magnetic contrast. In addition to the anomaly groups discussed below, there was a distinct north-north-west to south-south-east trend in the data resulting from relatively recent ploughing (figure 2).

Data related to historical maps and other records

Anomaly group **4** is likely to reflect a field boundary a former field boundary shown on Ordnance Survey 1st edition and 1883 1:10560 map (figure 3) but not on the 1906 1:2500 map and subsequent maps.

Data with no previous provenance

Anomaly group **1** follows part of the course of a former field boundary shown on Ordnance Survey 1st edition and 1883—1900 1:10560 maps but not on the 1906 1:2500 map and subsequent maps. Referring to figure 3, group 1 continues away from the former boundary to the north-east. The former field boundary appears to respect the deposits represented by group 1. A number of earthworks in the form of linear banks were noted in this area of the field by the survey team and the anomaly group aligns with earthworks to the south-west recorded on all Ordnance Survey maps until 1953.

Anomaly group **2** may represent sub-circular archaeological deposits but could equally be a fortuitous alignment of anomalies actually representing ploughing traces and disrupted by a strong anomaly from ferrous material in the subsoil (group **3**).

Group **5** has a distinct pattern and approximately aligns with an extant field boundary. Its archaeological character is difficult to determine but, while it cannot be ruled out, a natural origin is less likely.

Groups **6** and **10** are linear patterns of anomalies that typically relate to archaeological features such as field boundaries and other enclosures.

Group **7** may relate to a pit and the nearby group **9** to a linear deposit that appears to be a highly disrupted double ditch.

3.3 Conclusions

Summary

The magnetic contrast across the survey areas was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. A total of 10 magnetic anomaly groups were identified as pertaining to potential archaeology and one of these denotes a former field boundary mapped in 1883 but not later. One anomaly group is associated with extant earthworks, appears to be respected by a former mapped field boundary and is on the same orientation as former earthworks mapped in 1883. One sub-circular structure and one

possible pit were identified in the data set. Four possible former field boundaries, enclosures or similar archaeological features were identified, one of which may be a double ditch.

Points of note in the data set

Anomaly group 1 appears to be respected by former field boundary and is associated with visible earthworks as well as earthworks mapped until 1953 (figure 3). Only further archaeological investigations will clarify the relationship between group 1, the extant earthworks, the former earthworks and field boundary mapped in 1883.

Anomaly group 2 may represent a sub-circular archaeological feature although this is not clear. Given the proximity of the survey area to known barrows (section 2 and figure 3), this anomaly group may represent such a feature.

Anomaly group 9 is unusual in the data set in that, while highly disrupted, it may represent a double ditch.

4 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.

5 Acknowledgements

Substrata would like to thank Colin Humphreys of South West Archaeology Ltd for commissioning us to complete this survey.

6 References

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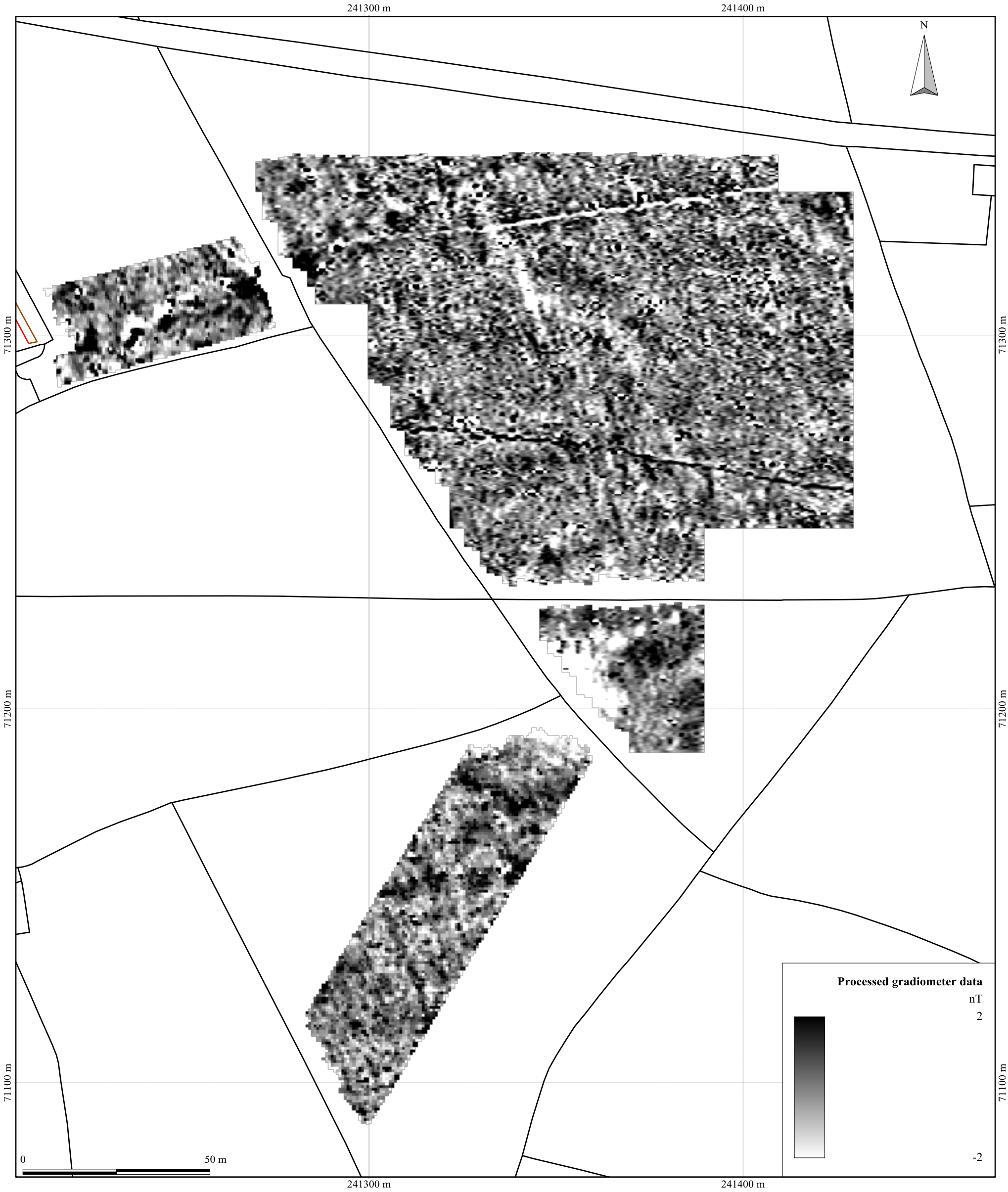
Appendix 1 Supporting plots

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: 241336.50 m, centre Y: 71230.00 m

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

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Figure 2: processed data

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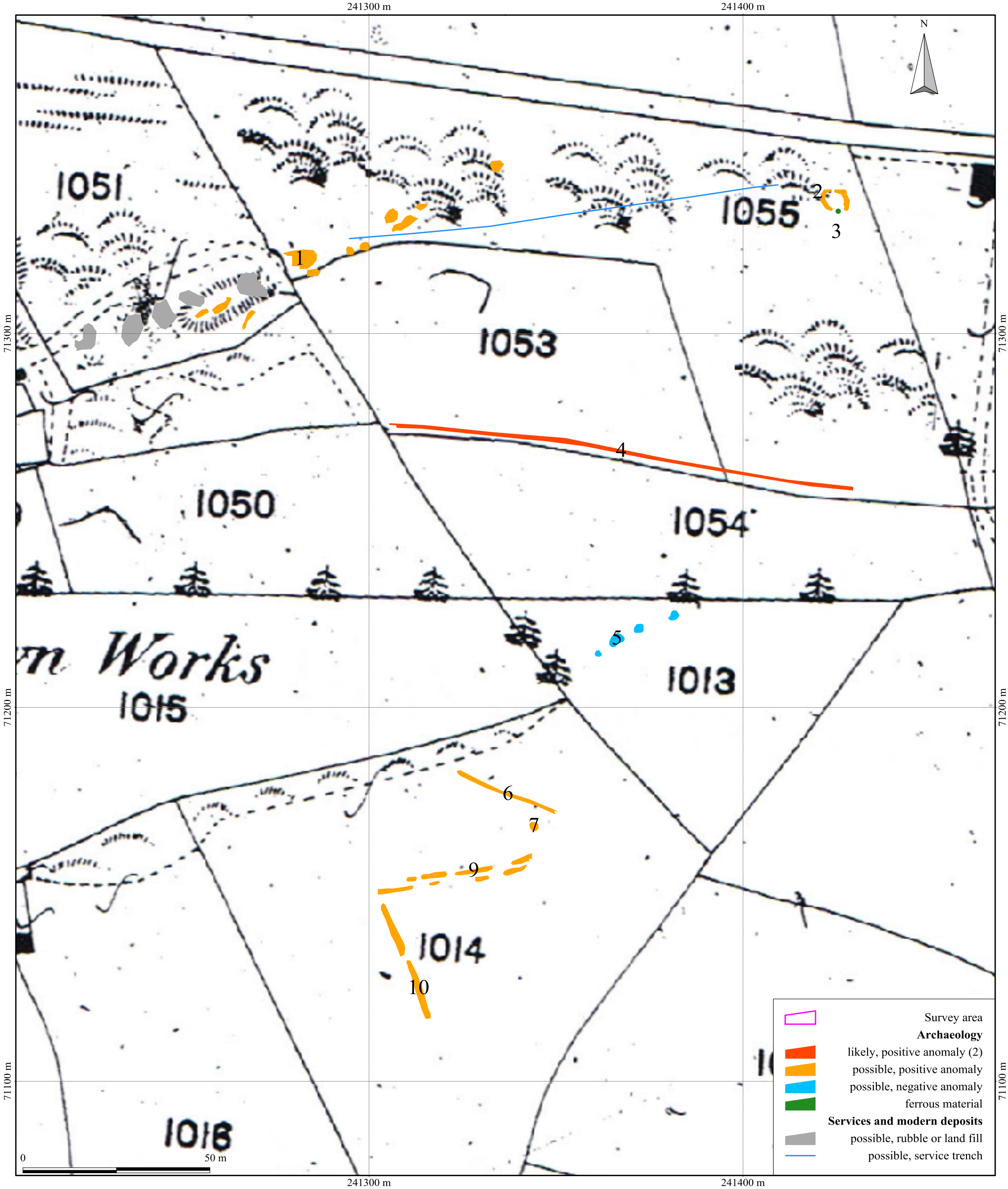

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Figure 3: survey interpretation over Ordnance Survey
1883 - 1900 Calstock 1st Edition map

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Appendix 2 Methodology

Table 2: methodology
Documents Brief: Copleston (2012) Written Scheme of Investigation (WSI): Walls (2013)
Methodology 1. The work was undertaken in accordance with the WSI. The geophysical (gradiometer) survey was undertaken with reference to standard guidance provided by the Institute for Archaeologists (2011), the Archaeology Data Service/Digital Antiquity Guides (undated) and as outlined in the Section 42 licence. 2. The temporary 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.
Data Processing, Analysis and Presentation Software DW Consulting TerraSurveyor3 Manifold System 8.0 Universal Edition Microsoft Corp. Office Publisher 2003.

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
SITE Land at Salters Farmhouse, Whiterocks Park, St Anns Chapel, Gunnislake, Cornwall Ordnance Survey E/N: 318840 88210 (point) Report: 130713
COMPOSITE Instrument Type: Bartington Grad 610 Units: nT Surveyed by: on 17/06/2013 Assembled by: on 10/07/2013 Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 Dimensions Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m Stats Max: 8.63 Min: -8.08 Std Dev: 1.47 Mean: 0.06 Median: 0.00 Composite Area: 3.29 ha Surveyed Area: 1.99 ha
Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 De Stagger: Grids: All Mode: Both By: -3 intervals 4 DeStripe Median Sensors: All Note: interpolation match x & y doubled is completed automatically during export from TerraSurveyor to ERSI format for the GIS

Appendix 4 Geophysical surveying techniques

1 Introduction

Substrata offers magnetometer and earth resistance surveying. We also provide other archaeology-specific geophysical surveys such as ground penetrating radar and resistivity. The particular method or combination of methods used depends on local soil conditions and the survey requirements. These methods are capable of delivering fast and accurate assessments of the archaeology of both large and small sites.

Further details can be found on our website at www.substrata.co.uk

2 Magnetometer surveying

Standard magnetometer surveys are the workhorse of archaeological surveying when speed and cost-effectiveness are important. Identifiable archaeological features include areas of occupation, hearths, kilns, furnaces, ditches, pits, post-holes, ridge-and-furrow, timber structures, wall footings, roads, tracks and similar buried features.

Magnetometer surveying is used to detect and map small changes in the earth's magnetic field caused by concentrations of ferrous-based minerals within the soil and subsoil, and by magnetised materials buried beneath the surface. While most of these changes are too small to affect a compass needle, they can be detected and mapped by sensitive field equipment. During surveys the different magnetic properties of top-soils, sub-soils, rock formations and archaeological features are recorded as variations against a background value. Subsequently magnetic anomalies resulting from potential archaeology can be identified and interpreted.

<u>Bartington grad601-2 gradiometers</u>

A gradiometer is a type of magnetometer and is sensitive to relatively small changes in the earth's magnetic field. Our primary surveying instruments are Bartington Grad601-2 (dual sensor) fluxgate gradiometers with automatic data loggers. They are specifically designed for field use by archaeologists. The Bartington gradiometers provide proven technology in archaeological magnetic surveying and offer fast, accurate set-up and survey rates. They are sensitive to depths of between 0 and 1.5m below ground level, with optimum sensitivity at depths of 1m or less.

<u>Multiple sensor arrays</u>

A technique relatively new to commercial archaeological surveying but well understood in academic circles involves the use of multiple magnetometer sensors towed behind a quad bike or similar vehicle. With multiple sensors and the use of on-board GPS units, it is possible to achieve faster survey rates at competitive commercial rates when compared to the use of multiple instruments and the techniques discussed above provided the ground is suitable for the vehicle and array. Substrata is pleased to announce that we now offer this service on suitable larger sites

3 Earth resistance surveying

Earth resistance surveying is an excellent tool for detecting buried archaeology. Its relatively slow rate of survey compared to magnetometer surveys means that it usually employed in commercial surveys when a detailed understanding of buried building remains is required. This technique measures changes in the electrical resistance of the ground being surveyed. In practice, the recording of differences in the electrical resistance of near-surface deposits and structures allows the detection and interpretation of masonry and brick foundations, paving and floors, drains and other cavities, large pits, building platforms, robber trenches, ditches, graves and similar buried features.

Resistance to electrical current flow in the ground depends on the moisture content and

structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

For earth resistance surveying Substrata uses the Geoscan Research RM15 series multi-probe resistance meters and purpose-built automatic data-loggers. The Geoscan MPX15 multiplexer is an integral part to the instrument configuration and facilitates multi-probe arrays which speed up survey area coverage rates and, if required, facilitate simultaneous multiple-depth data collection.