Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Farleigh Meadows Tiverton, Devon

Ordnance Survey (E/N): 294645,113591 (point)

Report: 141003

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AutoCAD version of the survey interpretation ..... AutoCAD DXF

1 Survey description and summary

Type of survey:	twin-sensor fluxgate gradiometer
Date of survey:	February 2014
Area surveyed:	8ha (10ha were surveyed but 2ha was deemed to be unnecessary for the purposes of this programme of work)
Lead surveyor:	Ross Dean BSc MSc MA MIfA

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

Location

Site:	Land at Farleigh Meadows
Parish:	Tiverton
District:	Mid Devon
County:	Devon
Nearest Postcode:	EX16 5AF
NGR:	SS 946 135
Ordnance Survey E/N:	294645,113591 (point)

Archive

OASIS number:	substrat1-192861
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

Summary
This report was commissioned by AC Archaeology Ltd on behalf of clients and has been prepared as part of a programme of work in support of a forthcoming planning application. The location of the proposed development area is shown in Figure 1.

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Fifteen magnetic anomaly groups were identified as relating to archaeological deposits or structures. Of these, six groups are likely to represent former field boundaries mapped on historical Ordnance Survey maps. Five anomaly groups have patterns typical of anomalies representing former field or enclosure boundaries of unknown date and archaeological provenance. One group may represent a former ditched or otherwise bound track. Three anomaly groups may represent either deposits of rubble or natural, near-surface geological features.

2 Survey aims and objectives

Survey aims
1. Define and characterise and detectable archaeological remains on the site.
2. Inform any future archaeological investigation of the area.

Survey Objectives
1. Complete a gradiometer 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 site about the location and possible archaeological character of the recorded anomalies.

3 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).

4 Site description

Landscape and land use

The survey area (Figure 1) is located on upland, rising sharply from the River Exe which is located directly to the east. The survey area lies under a mixture of arable and pasture farmland but the proposed development will also extend into two small areas currently occupied by residential housing. It is bounded to the south-west and north-west by residential properties and a minor road, to the north by housing and the A361 and to the east by the river and mill leat of the Exe (Wessex Archaeology, 2008)

Geology

The site is located on a solid geology of breccias of the Permian Halberton Breccia Formation. The superficial geology is Quaternary Diamicton Colluvium which comprises poorly-sorted sediment with a wide clast size range. The clasts make up over 50% of the volume and are derived from pre-existing siliceous rocks (British Geological Survey, undated).

5 Archaeological background

A comprehensive description of the heritage assets within a *Study Area* measuring 350m from the site boundaries can be found in the Wessex Archaeology Ltd Archaeological Desk-based Assessment for this programme of work (Wessex Archaeology, 2008). The following is a short interpretation of information obtained from the Assessment relevant to the immediate *Survey Area*. The reader is advised that this summary should not be used outside the context of this report and is referred to the Devon Historical Environment Record (HER) for informed provision of the record.

General Background

There is no archaeological evidence for human activity dating to the prehistoric periods within the Study Area, although the Exe Valley Way footpath, which crosses the Survey Area on a north-south alignment, has been suggested as the route of a former prehistoric ridgeway. Despite the absence of data from the Study Area, the evidence from the wider landscape indicates a general level of human activity during prehistoric times. Although the Devon HER contains no entries of Romano-British date for the Study Area, Tiverton was the site of a Roman encampment. The Roman Fort of Bolham Hill (SM No. 10502) is located approximately 500m north of the Study Area, reflecting at the very least, Roman military interest in the region. Tiverton is believed to have originated as a Saxon settlement in the 7th century and possibly formed part of a royal estate centre. There is substantial archaeological evidence dating to the post-medieval and modern periods within the Study Area.

Historical Landscape Characterisation

Modern enclosures replacing post-medieval water meadows.
Water meadows were once common in Devon but are now very rarely used (Devon County Council, undated).

Heritage Assets within the survey area

There are no heritage assets recorded within the survey area.

Previous Studies

There are no known intrusive archaeological investigations that have been conducted upon the Site or Study Area. Study of the archaeology within the Study Area has been limited to field observation and mapping.

6 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 7.

6.1 Results

Figure 1 shows the interpretation of the survey data. It includes the anomaly groups identified as pertaining to archaeological deposits along with their numbers. 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.

Figure 1 along with table 1 comprises the analysis of the survey data.

A plot of the processed data is provided in Figure 2.

6.2 Discussion

Refer to Figures 1 and 2. Not all anomalies or anomaly groups identified in the survey dataset are necessarily 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 the data analysis (Table 1).

General points
Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment or drains have not been mapped except where they comprise significant magnetic responses across the dataset.

Data collection along the field edges was restricted as shown in Figures 1 and 2 due to the presence of magnetic materials in and adjacent to the field boundaries. Strong magnetic responses mapped close to the field boundaries are likely to relate to these items except where indicated otherwise in Figure 1.

Data relating to historical maps and other records
There are four magnetic anomaly groups (**7, 8, 9 and 14**) that coincide with three former field boundaries recorded on the 1890 Ordnance Survey first edition 1:2500 map for the area but not on subsequent maps. One group (**6**) coincides with part of one of these field boundaries that survived into the later part of the twentieth century and was mapped by the Ordnance Survey between 1890 and 1993. Anomaly group **11** may be an extension of the field boundary represented by anomalies 6 and 7.

Data with no previous provenance
There are five linear and curvilinear anomaly groups (**1 to 5**) which are distinct in the data set and are likely to relate to archaeological features such as field or enclosure boundaries of unknown date.

One parallel set of two linear anomalies (group **10**) may represent to a former ditched or otherwise edged track.

Three anomaly groups (**12, 13 and 15**) may represent either deposits of rubble or natural, near-surface geological features.

6.3 Conclusions

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Fifteen magnetic anomaly groups were identified as relating to archaeological deposits or structures. Of these, six groups are likely to represent former field boundaries mapped on historical Ordnance Survey maps. Five anomaly groups have patterns typical of anomalies representing former field or enclosure boundaries of unknown date and archaeological provenance. One group may represent a former ditched or otherwise bound track. Three anomaly groups may represent either deposits of rubble or natural, near-surface geological features.

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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Institute for Archaeologists (2008) *Code of approved practice for the regulation of contractual arrangements in archaeology*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_code_practice.pdf [October 2014]

Wessex Archaeology (2008) *Land at Farleigh Meadows, Tiverton, Devon, Archaeological Desk-based Assessment*, Wessex Archaeology unpublished report 68580.01, March 2008

Appendix 1 Analysis table and 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.

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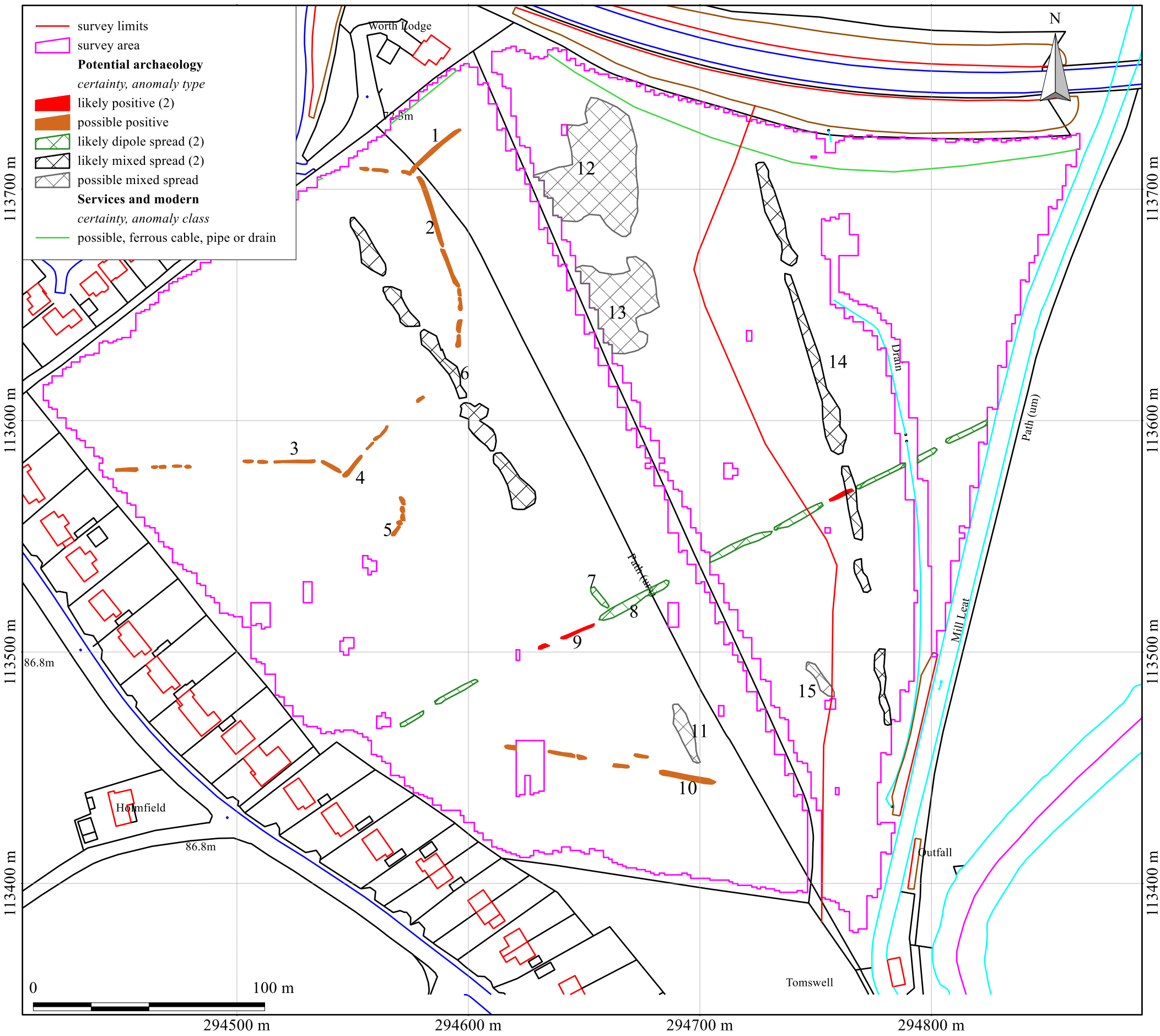
anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible positive	disrupted linear			
2		possible positive	disrupted linear			
3		possible positive	disrupted linear			
4		possible positive	disrupted linear			
5		possible positive	disrupted linear			
6	7 11	likely mixed spread	linear	field boundary	anomaly groups coincide with a former field boundary mapped between 1890 and 1993	Ordnance Survey maps 1890 to 1993
7	6 11	likely dipole spread	linear	ferrous material associated with field boundary	anomaly groups coincide with a former field boundary mapped in 1890 but not on subsequent Ordnance Survey maps	Ordnance Survey map 1890 1:2500 1st edition
8	9	likely dipole spread	linear	ferrous material associated with field boundary	anomaly groups coincide with a former field boundary mapped in 1890 but not on subsequent Ordnance Survey maps	Ordnance Survey map 1890 1:2500 1st edition
9	8	likely positive	linear	field boundary	anomaly groups coincide with a former field boundary mapped in 1890 but not on subsequent Ordnance Survey maps	Ordnance Survey map 1890 1:2500 1st edition
10		possible positive	disrupted parallel linear			
11	6 7	possible mixed spread	linear	rubble		
12		possible mixed spread	irregular	rubble		
13		possible mixed spread	irregular	rubble		
14		likely mixed spread	linear	field boundary	northern half of anomaly groups coincide with a former field boundary mapped in 1890 but not on subsequent Ordnance Survey maps	Ordnance Survey map 1890 1:2500 1st edition
15		possible mixed spread	linear	rubble		

Table 1: data analysis



Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

British Grid
centre X: 294649.17 m, centre Y: 113561.34 m

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. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeolo

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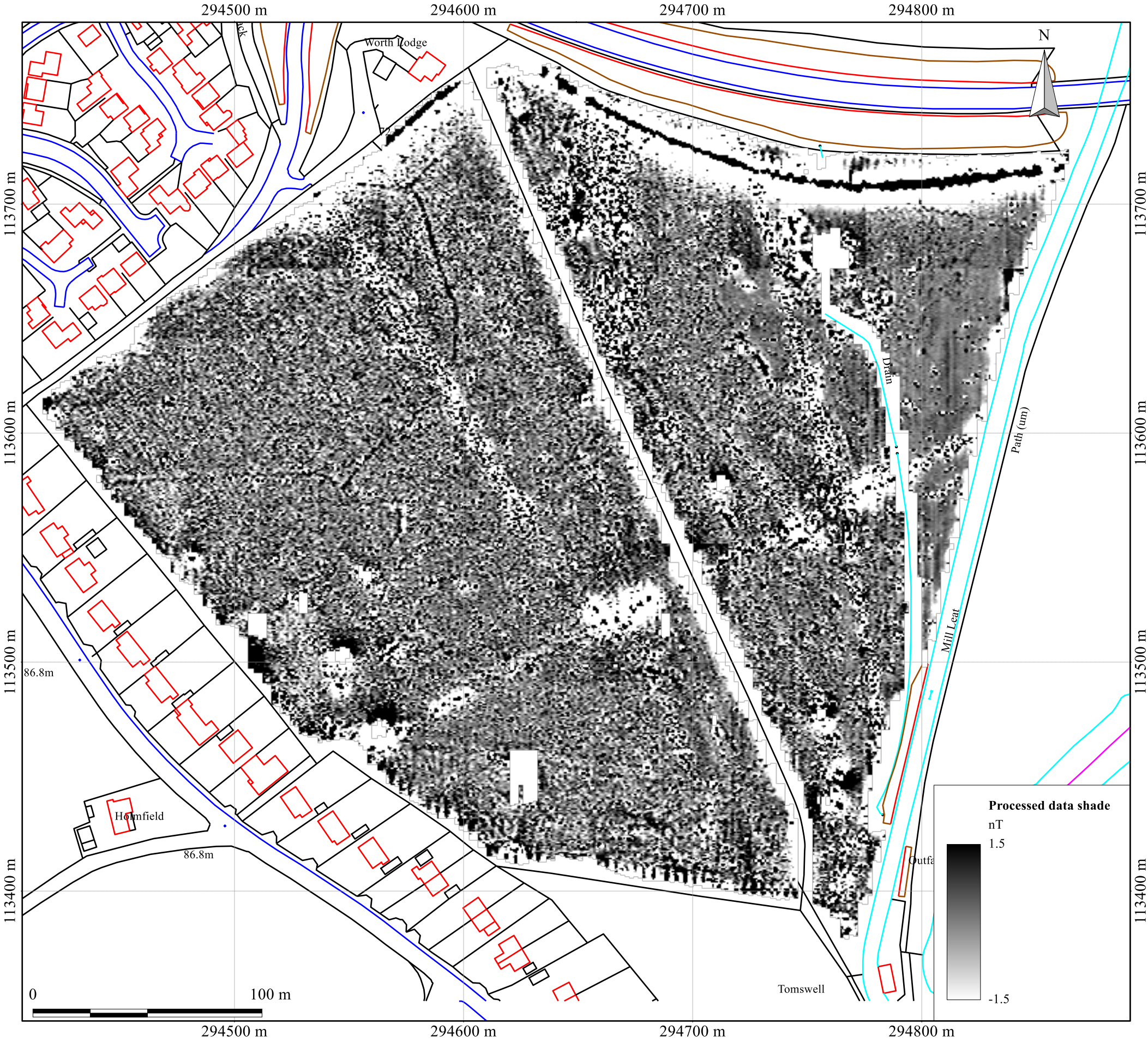
Figure 1: survey interpretation



Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

British Grid
centre X: 294649.17 m, centre Y: 113561.34 m

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Figure 2: shade plot of processed gradiometer data

Appendix 2 Methodology Summary

<table>
<tr><th colspan="2">Table 2: methodology summary</th></tr>
<tr><td colspan="2">Documents
Survey methodology statement: Dean (2014)</td></tr>
<tr><td colspan="2">Methodology
1. The work was undertaken in accordance with the survey methodology statement. The geophysical (gradiometer) survey was undertaken with reference to standard guidance provided by the Institute for Archaeologists (2011) and Archaeology Data Service/Digital Antiquity Guides (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.</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td>Equipment
Instrument: Bartington Instruments grad601-2
Firmware: version 6.1</td><td>Data Capture
Sample Interval: 0.25-metres
Traverse Interval: 1 metre
Traverse Method: zigzag
Traverse Orientation: GN</td></tr>
<tr><td colspan="2">Data Processing, Analysis and Presentation Software
IntelliCAD Technology Consortium IntelliCAD 7.2
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</td></tr>
</table>

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
SITE Instrument Type: Bartington Grad 610 Units: nT Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 PROGRAM Name: TerraSurveyor Version: 3.0.25.1
Stats Max: 359.81 Min: -344.96 Std Dev: 22.33 Mean: -0.60 Median: -0.10 Surveyed Area: 9.9303 ha Processes: 6 1 Base Layer 2 Clip from -236.72 to 236.93 nT 3 De Stagger: Grids: All Mode: Both By: -2 intervals 4 De Stagger: Grids: flc20.xgd Mode: Both By: -1 intervals 5 DeStripe Median Sensors: flba15.xgd flba16.xgd flca6.xgd fld4.xgd flb6.xgd flb28.xgd flba1.xgd flba14.xgd flba17.xgd flca7.xgd fld3.xgd flab1.xgd flb5.xgd flb7.xgd flb27.xgd flba2.xgd flba13.xgd flca5+flba18.xgd flca8.xgd fld2.xgd fla24.xgd flab2.xgd flb4.xgd flb8.xgd flb25.xgd flba3.xgd flba12.xgd flca4+flba19.xgd flca9.xgd fld1.xgd fla9.xgd fla23.xgd flab3.xgd flb3.xgd flb9.xgd flb24.xgd flba4.xgd flc13+flba11.xgd flca3+flba20.xgd flca10.xgd fld5+flca26.xgd fla8.xgd fla10.xgd fla22.xgd flab4.xgd flb2.xgd flb10.xgd flb23.xgd flba5.xgd flc14+flba10.xgd flca2.xgd flca11.xgd fld6+flca25.xgd fld16.xgd fla1.xgd fla7.xgd fla11.xgd fla21.xgd flab5.xgd flb1.xgd flb11.xgd flb22.xgd flc13+flba6.xgd flc15.xgd flca1.xgd flca12.xgd fld7+flca24.xgd fld15.xgd fla2.xgd fla6.xgd fla12.xgd fla20.xgd flab6.xgd flab16.xgd flb12.xgd flb21.xgd flc12+flba7.xgd flc16.xgd flc26.xgd flca13.xgd fld8+flca23.xgd fld14.xgd fla3.xgd fla4.xgd fla13.xgd fla19.xgd flab7.xgd flab15.xgd flb13.xgd flb20.xgd flc11+flba8.xgd flc17.xgd flc25.xgd flca14.xgd fld9+flca22.xgd fld13.xgd fla5.xgd fla14.xgd fla18.xgd flab8.xgd flab14.xgd flb14.xgd flc3+flb19.xgd flc10.xgd flc18.xgd flc24.xgd flca16+flca15.xgd flca21.xgd fld12.xgd fld17.xgd fla15.xgd fla16.xgd flab9.xgd flab13.xgd flb15.xgd flc4+flb18.xgd flc9.xgd flc19.xgd flc23.xgd flca17.xgd flca20.xgd fld11.xgd fld18.xgd 6 DeStripe Median Sensors: flc2+flb16.xgd flc5.xgd Note: converting the gradiometer data into ESRI GIS files imposed an x=y interpolation on the entire dataset

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 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.

Bartington grad601-2 gradiometers

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.

Multiple sensor arrays

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.