

Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

**Land at Lodge Trading Estate
Broadclyst, Exeter**

Ordnance Survey (E/N): 299500,95435 (point)

Report: 141024

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24 October 2014

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Accompanying CD-ROM

Report	Adobe PDF format
Copies of report figures	Adobe PDF format
Raw and processed grid & composite files.....	DW Consulting TerraSurveyor 3 formats
Minimal processing data plots and metadata.....	Adobe PDF format
GIS project, shape files and classification schema	
GIS project.....	Manifold 8 '.map' file
GIS shape files	ESRI standard
GIS classification schema.....	Adobe PDF format
AutoCAD version of the survey interpretation	AutoCAD DXF

1 Survey description and summary

1.1 Survey

Type: twin-sensor fluxgate gradiometer
Date: September 2014
Area: 3.92ha
Lead surveyor: Ross Dean BSc MSc MA MifA

1.2 Client

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

1.3 Location

Site: Land at Lodge Trading Estate, Broadclyst
Parish: Broadclyst
District: East Devon
County: Devon
Nearest Postcode: EX5 3DY
NGR: SX 995 954
Ordnance Survey E/N: 299500,95435 (point)

1.4 Archive

OASIS number: substrat1-193466
Archive: At the time of writing, the archive of this survey will be held by Substrata.

1.5 Introduction

This report was commissioned by AC Archaeology Ltd on behalf of clients. It has been prepared as part of a programme of work in support of a forthcoming planning application at the above site. The location of the proposed development area is shown in Figure 4.

1.6 Summary

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Two magnetic anomaly groups were identified as relating to possible archaeological deposits or features. One represents a former mapped field boundary and the other is isolated and could not be characterised further.

2 Survey aims and objectives

2.1 Aims

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

2.2 Objectives

1. Complete a gradiometer survey across agreed parts of the application 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

4.1 Landscape and land use

The application area is a parcel of land lying to the south of the village of Broadclyst and northeast of the village of Cranbrook in the Clyst valley. The site is approximately 3.9ha in extent and lies about 20m O.D. It is bounded to the north, east and west by the Cranny Brook, a stream which flows westwards into the river Clyst. To the south it is bounded by buildings and other infrastructure of the Lodge Trading Estate and a railway line (Figure 4).

At the time of the survey the land was under grass with some thick vegetation.

4.2 Geology

The application area is located on a solid geology of the Permian Dawlish Sandstone Formation which comprises reddish brown sands and sandstones, cross-bedded, with intercalated thin lenses and beds of breccia and mudstone. The superficial geology is Quaternary River Terrace Deposits which are typically composed of sand and gravel, locally with lenses of silt, clay or peat (British Geological Survey, undated).

5 Archaeological background

The following is a short summary of information obtained from the Devon and Dartmoor Historic Environment Record (HER) within 500m of the Survey Area and deemed relevant to the understanding of the gradiometer survey. Except where specifically stated, this information was obtained using the Heritage Gateway (English Heritage, undated). The HER entries cited below are summarised in Appendix 4.

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.

5.1 Historical Landscape Characterisation

Watermeadow: this area was probably watermeadows in the late Medieval and/or Post-medieval periods, and has changed little in the twentieth/twenty-first centuries. (Devon County Council, undated).

5.2 Heritage Assets within the Survey Area

There are no designated or undesignated heritage assets within the survey area.

5.3 Heritage Assets close to the Survey Area

There are a number of heritage assets within 500m of the application area demonstrating activity in the area from Prehistoric times onwards. These include a Neolithic (4000 BC to 2201 BC) axe head (MDV10151), an assemblage of Prehistoric (698000 BC to 42 AD) struck flints probably dating from before late Bronze Age (MDV61349) and, to the east, an oval raised enclosure that may have been an early bank-and-ditch enclosed settlement site dating to sometime from the ninth century AD onwards (MDV65264). A large, almost circular enclosure of unknown date is thought to have been located in the vicinity of the Lodge Trading Estate on the southern boundary of the application site (HER entry MDV10169). A

geophysical survey undertaken in 2006 in fields to the south of the application area (Cook, 2006) recorded various undated potential archaeological deposits and/or structures (Appendix 4). An area of watermeadows with a series of Modern (1751 AD to present) leats and weirs has been recorded to the north of the Cranny Brook on the western boundary of the application area (MDV65268).

5.4 Previous Historical Environment work

EDV4610

Name: Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon.

Source: Cook (2006)

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 identifies and characterises anomalies and anomaly groups that may relate 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 relating 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. Plots of the processed data are provided in Figures 2 and 3.

6.2 Discussion

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM.

General points

Anomalies thought to relate to natural features were not mapped. 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. If mapped, they are listed in Table 1 but are not discussed below.

There are two areas of mixed magnetic signals in the southwest and southeast of the survey area. These are likely to relate to recent ground disturbance, made-up ground and deposits of material from the construction of the trading estate and possibly the railway line to the south.

Data collection along the field edges was restricted as shown in Figures 1 to 3 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 materials except where indicated otherwise in Figure 1. Further restrictions were imposed by two areas of thick vegetation in the east and south of the application area and by some wet ground to the west.

Data relating to historical maps and other records

Group 2 coincides with a former field boundary mapped by the Ordnance Survey between 1889 and 1969.

Data with no previous archaeological provenance

The only other anomaly group that may relate to an archaeological deposit or a structure is located close to the stream at the eastern side of the survey area (group 1). No further archaeological characterisation of this group was possible.

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. Two magnetic anomaly groups were identified as relating to possible archaeological deposits or features. One represents a former mapped field boundary and the other is isolated and could not be characterised further.

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.

Ross Dean, trading as Substrata, will assign copyright to the client upon written request but retains the right to be identified as the author of all project documentation and reports as defined in the Copyright, Designs and Patents Act 1988 (Chapter IV, s.79).

8 Acknowledgements

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

9 Bibliography

Archaeology Data Service/Digital Antiquity Guides to Good Practice (undated): *Geophysical Data in Archaeology* [Online], Available: http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc [July 2014]

British Geological Survey (undated) *Geology of Britain viewer* [Online], Available: http://www.bgs.ac.uk/discovering_Geology/geologyOfBritain/viewer.html [October 2014]

Clark, A. (2000) *Seeing Beneath the Soil, Prospecting methods in archaeology*, London: Routledge

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Dean, R. (2014) *A gradiometer survey method statement, Land at Broadclyst, Devon*, Substrata unpublished document

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Institute for Archaeologists (2009) *Code of conduct*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/code_conduct.pdf [October 2014]

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]

Appendix 1 Analysis table and supporting plots

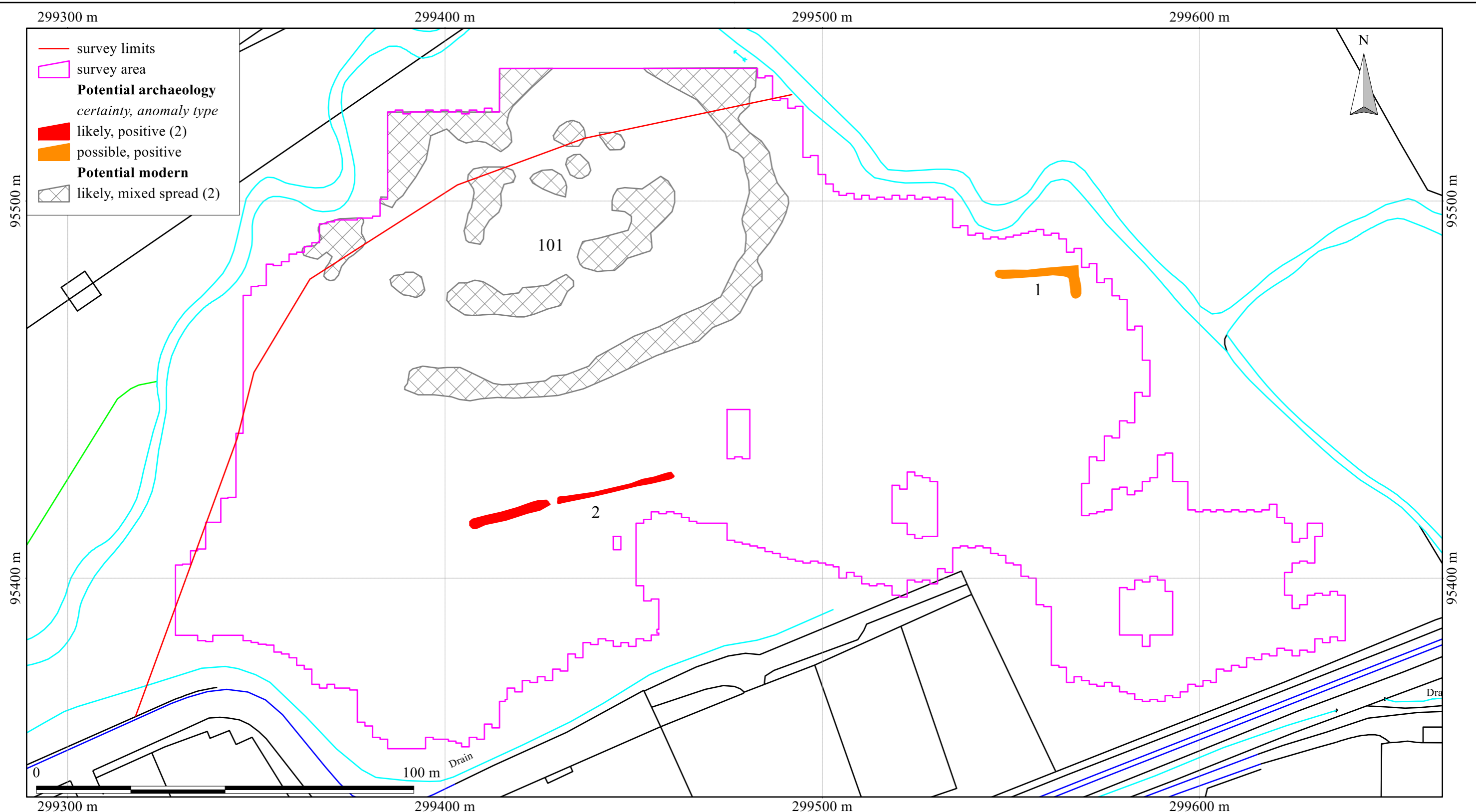
General Guidance

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.

Site: An archaeological gradiometer survey
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 Ordnance Survey (E/N): 299500,95435 (point)
 Report: 141024

anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, positive	rectilinear			
2		likely, positive	disrupted linear	former field boundary	anomaly group coincides with the line of a former field boundary mapped between 1889 and 1969	Ordnance Survey maps 1889 1:2500 to 1962-3 1:2500
101		likely, mixed spread	oval	race track	anomaly groups coincide with a modern 'banger' race track notwithstanding nearby heritage assets including near-circular enclosure just to the south and a large possible raised settlement site to the east	Aerial photograph, MDV10169, MDV65264, owner pers comm



299300 m
 British Grid
 centre X: 299476.72 m, centre Y: 95443.89 m

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

Copyright Substrata 2014.
 Base map: Crown Copyright & Database Right 2014
 All rights reserved. Licence number 100022432

- 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 archaeological events or deposits.

Figure 1: survey analysis

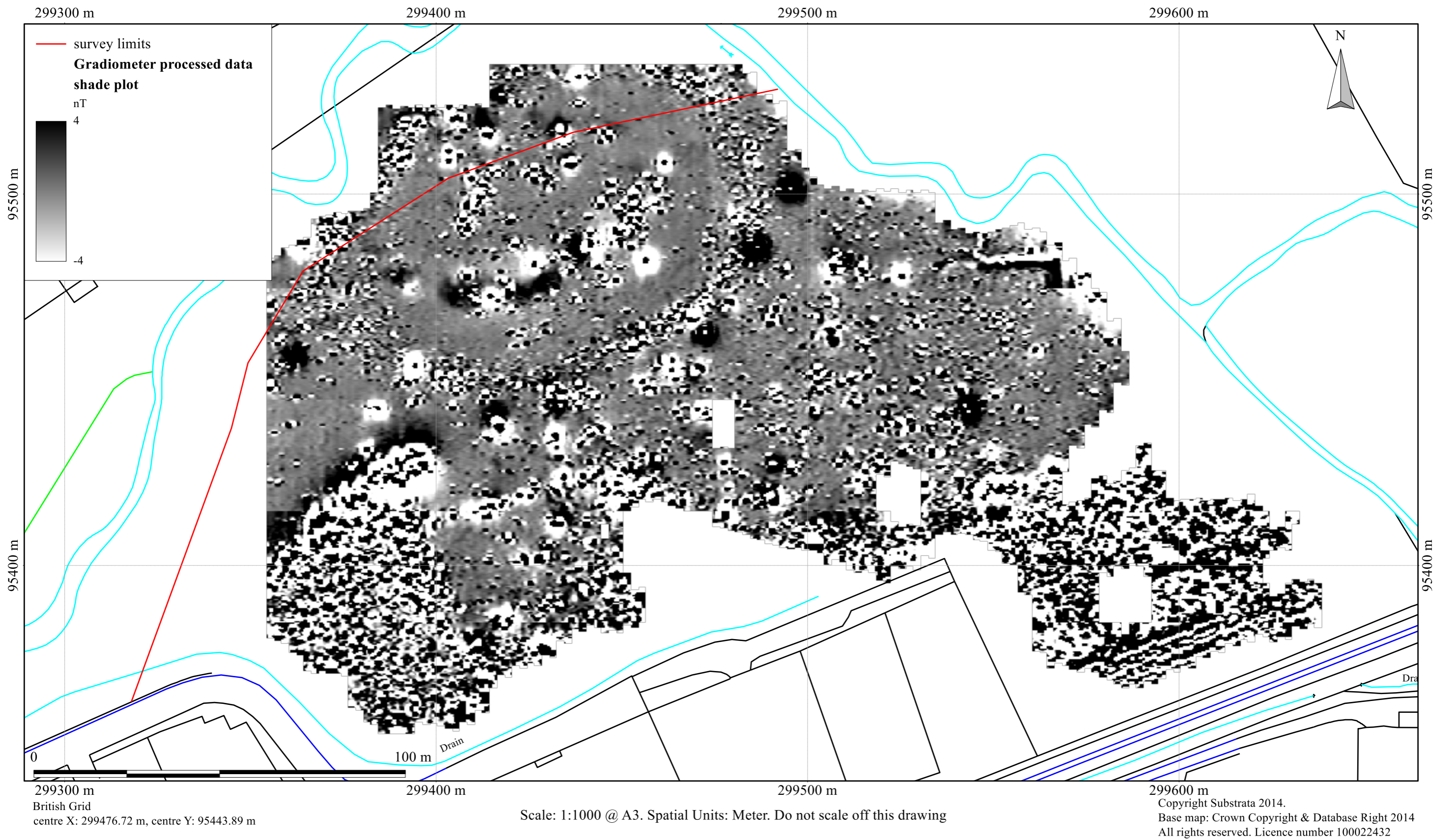
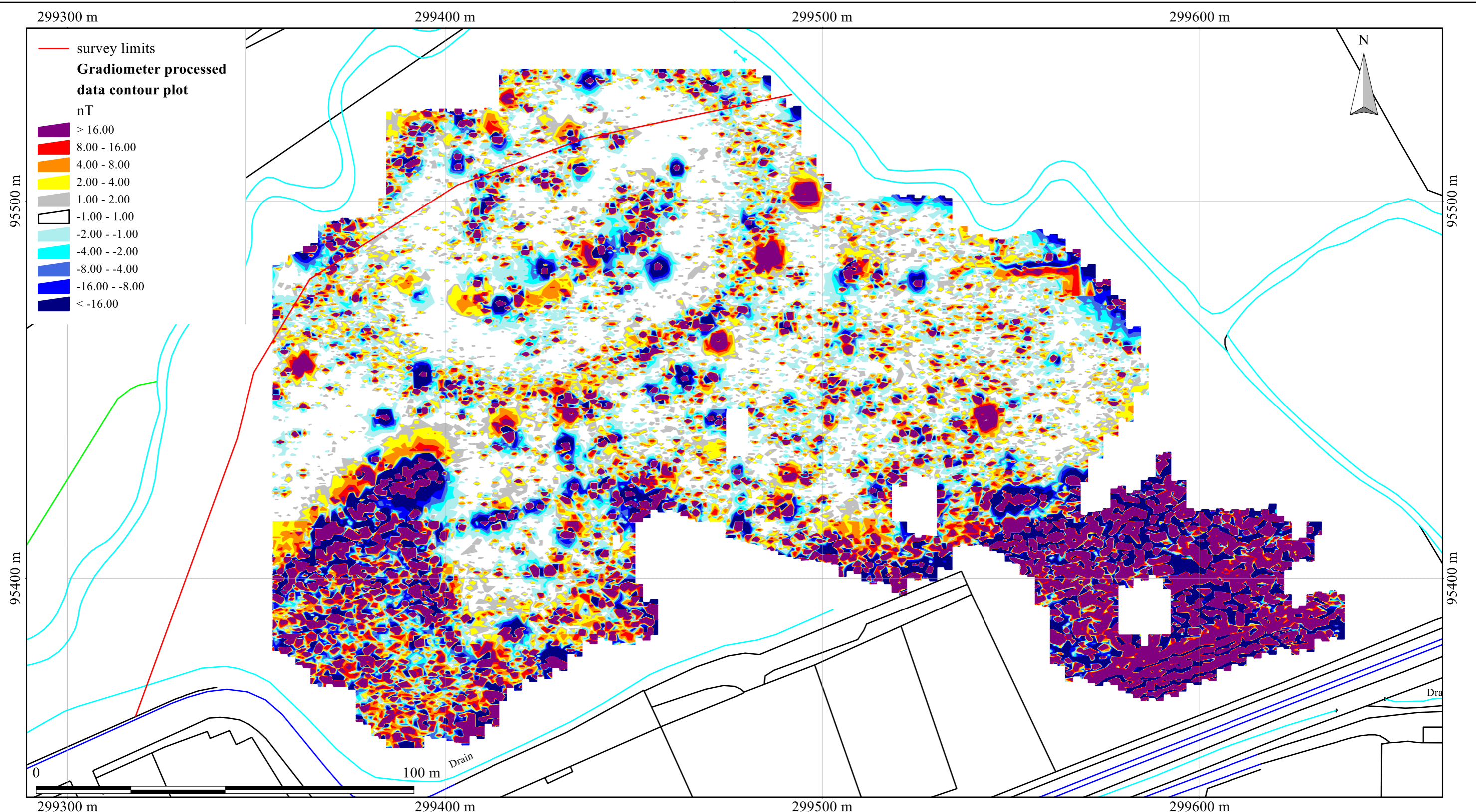


Figure 2: shade plot of processed data



299300 m
British Grid
centre X: 299476.72 m, centre Y: 95443.89 m

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

299600 m
Copyright Substrata 2014.
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Figure 3: contour plot of processed data



British Grid
 centre X: 299474.60 m, centre Y: 95435.28 m

Copyright Substrata 2014.
 Base map: Crown Copyright & Database Right 2014
 All rights reserved.

Scale: 1:4000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
 Land at Lodge Trading Estate, Broadclyst, Exeter
 Ordnance Survey (E/N): 299500,195435 (point)
 Report: 141024

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Figure 4: site location and aerial photograph

Appendix 2 Methodology Summary

Table 2: methodology summary	
<p>Documents Survey methodology statement: Dean (2014)</p>	
<p>Methodology</p> <ol style="list-style-type: none"> 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. 	
<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> 0.25-metres <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 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</p>	

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
Max:	168.07
Min:	-224.39
Std Dev:	31.41
Mean:	-0.16
Median:	0.00
Surveyed Area:	3.1 ha
Processes:	9
1	Base Layer
2	Clip at 1.00 SD
3	Clip at 1.00 SD
4	DeStripe Median Sensors: All
5	De Stagger: Grids: All Mode: Both By: -2 intervals
6	De Stagger: Grids: ba10.xgd ba11.xgd ba22.xgd ba23.xgd ba9.xgd ba12.xgd ba21.xgd ba24.xgd ba8.xgd ba13.xgd ba20.xgd ba25.xgd ba7.xgd ba14.xgd ba19.xgd ba26.xgd ba6.xgd ba15.xgd ba18.xgd bb1.xgd ba16.xgd ba17.xgd bb2.xgd Mode: Both By: -1 intervals
7	De Stagger: Grids: bb3.xgd bb4.xgd bb5.xgd bb6.xgd Mode: Both By: -1 intervals
8	De Stagger: Grids: bb7.xgd bb8.xgd bb9+bb10.xgd bb11.xgd bb12.xgd Mode: Both By: -1 intervals
9	De Stagger: Grids: bb13.xgd bb15+bb14.xgd Mode: Both By: -1 intervals
Note: converting the gradiometer data into ESRI GIS files imposed an x=y interpolation on the entire dataset	

Appendix 4 Summaries of cited Devon and Dartmoor Historical Environment
Record Entries as recorded in the Heritage Gateway
(English Heritage, undated)

HER Number: MDV10151

Name: Axe

Summary:

A greenstone axe was found on the bank of the stream near Broadclyst station after it was cleared by council workmen. The surface is polished for about 20mm back from the cutting edge which is still sharp. The rest of the surface has weathered rough, and the butt is somewhat battered with some pecking in the centre of one side where the haft fitted. The implement petrology survey for the south west reports that it cannot be assigned to any factory or group. Microscopic examination revealed 'green hornblende in large fibrous plates, and small prisms or needles dispersed through completely decomposed felspar. Large grains of ilmenite were largely converted to leucoxene.

Location Grid Reference: SX 991 952

Monument Type(s) and Dates: FINDSPOT (Neolithic - 4000 BC to 2201 BC (Between))

Associated Finds: FDV3432 - AXE HEAD (Early Neolithic to Unknown - 4000 BC)

HER Number: MDV10169

Summary:

Large oval, almost circular, enclosure in the Clyst flood plain. Its northern side is confused by marks produced by the course of a former road. The site is now under buildings and cannot be exactly located.

Location Grid Reference: SX 994 953

Monument Type(s) and Dates: ENCLOSURE (Unknown date)

Sources / Further Reading:

Aerial Photograph, Aph=OS/66/185/360/(-/7/1966)/height 7500 feet/retained at aerial photograph division, ordnance survey, Southampton/copy in SMR

HER Number: MDV61349

Summary:

Seven struck flints recovered from topsoil during machining and pre-machining field walking along a section of pipeline to northeast of Wishford farm. Six were concentrated around point at which pipeline crossed Hellings Park Lane, but may represent material that has migrated during ploughing, or by soil creep from further upslope. Of the seven worked flints, only one, an end scraper, has been retouched. Assemblage probably dates from before late Bronze Age.

Location Grid Reference: SX 990 956

Protected Status: none recorded

Monument Type(s) and Dates: ARTEFACT SCATTER (Prehistoric - 698000 BC to 42 AD (Between))

HER Number: MDV65264

Summary:

An oval or sub-oval enclosure raised approximately 2m above the surrounding area. This may have been an early settlement site. The southern bank has been removed but the ditch remains.

Location Grid Reference: SX 997 958

Monument Type(s) and Dates: ENCLOSURE (XI to Post Medieval - 1066 AD to 1750 AD (Between))

HER Number: MDV65268

Summary:

The permanent pasture along the northern side of the 'cranny brook' has been used as water meadows. One is located at the above the cited NGR with another centred on SX 997 956. A series of leats and weirs controlled the flow of water.

Location Grid Reference: SX 992 954

Monument Type(s) and Dates: WATER MEADOW (Modern - 1751 AD to 2009 AD (Between))

HER Number: MDV76685

Name: Linear Feature East of Sher Moor Farm

Summary:

Linear Feature circa 20 metres east to west, identified by geophysical survey in a field to the east of Sher Moor Farm.

Location Grid Reference: SX 995 950

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76686

Name: Linear Features North-East of Sher Moor Farm

Summary:

Two linear features forming a V-shape were identified by geophysical survey, in a field to the north-east of Sher Moor Farm.

Location Grid Reference: SX 996 951

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76688

Name: Possible Pit North-East of Railway Terrace

Summary:

A possible pit circa 1 metre in diameter was identified by geophysical survey, about 40 metres to the north-east of Railway Terrace.

Location Grid Reference: SX 994 952

Monument Type(s) and Dates: PIT (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76689

Name: Linear Feature North-East of Railway Terrace

Summary:

Small linear feature circa 10 metres long north-east to south-west, identified by geophysical survey in a field to the north-east of Railway Terrace.

Location Grid Reference: SX 994 952

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76692

Name: Two Possible Pits North-West of Shermoor Cottages

Summary:

Two possible pits in field to north-west of Shermoor Cottages, circa 1 metre in diameter and about 4 metres apart, identified by geophysical survey.

Location Grid Reference: SX 992 949

Monument Type(s) and Dates: PIT (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76693

Name: Linear Feature North-West of Shermoor Farm

Summary:

Small linear feature identified by geophysical survey, in the field to the north-west of Shermoor Farm.

Location Grid Reference: SX 992 949

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76694

Name: Linear Feature North-West of Blue Hayes

Summary:

Linear feature circa 22 metres long, identified by geophysical survey in a field to the north-west of Blue Hayes.

Location Grid Reference: SX 997 953

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76695

Name: L-shaped Feature to North-West of Blue Hayes

Summary:

Two linear features forming an L-shape, identified by geophysical survey in a field to the north-west of Blue Hayes.

Location Grid Reference: SX 997 953

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76696

Name: Linear Feature to North of Blue Hayes

Summary:

Linear feature circa 15 metres long north-east to south-west, identified by geophysical survey in the field to the north of Blue Hayes.

Location Grid Reference: SX 999 954

Monument Type(s) and Dates: LINEAR FEATURE (Unknown date)

Full description

Sources / Further Reading

Report:

Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

HER Number: MDV76697

Name: Possible Banks North of Blue Hayes

Summary:

Two roughly parallel lengths of possible bank, circa 60 and 80 metres long, identified by geophysical survey in a field to the north of Blue Hayes.

Location Grid Reference: SX 999 954

Monument Type(s) and Dates: BANK (EARTHWORK) (Unknown date)

Sources / Further Reading:

Report - Geophysical Survey: Cook, J.. 2006. Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon. Stratascan Report. J2262

Associated Events:

EDV4610 - Geophysical Survey for Water/Sewage Treatment Infrastructure Near Exeter Airport, East Devon

Appendix 5 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 is 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.