Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Station Hill and Oldway Lane Chudleigh, Newton Abbot, Devon

Ordnance Survey E/N: 285932 78878 (point)

Report: 130713
Ross Dean BSc MSc MA MIfA
26 July 2013

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Client:
Rocklands Development Partnership

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1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: between 17 June and 25th June 2013
Area surveyed: 8.5ha.
Lead surveyor: Ross Dean BSc MSc MA MIfA

Client
Rocklands Development Partnership

Location

Site:	Land at Station Hill and Oldway Lane
Civil Parish & town:	Chudleigh
District:	Teignbridge
County:	Devon
NGR:	SX 859 789 (point)
Ordnance Survey E/N:	285932 78878 (point)
Planning Application:	13/01062/MJA Outline Application
OASIS number:	substrat1-155793
Archive:	The archive of this survey will be held by Substrata.

Summary
This report was commissioned by Rocklands Development Partnership in response to comments received from the Devon County Council Historic Environment Service with regard to the above outline planning application.

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 22 magnetic anomaly groups were identified as pertaining to potential archaeology.

A concentration of potential archaeological deposits were found in the north-eastern part of area 3 (figures 4 and 8). These indicate the possibility of the survival of enclosures that are not contemporary with either the current field system or typical medieval field patterns along with a possible gapped ditch. The remaining magnetic anomalies highlighted as pertaining to potential archaeology elsewhere in the survey area are typical of archaeological features such as field boundaries and other enclosures.

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.

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 survey site lies to the south-west of the town of Chudleigh and comprises 11 fields of grass pasture on land with occasionally steep slopes between approximately 20m and 50m O.D. (figure 9).

Geology and soils

The site is located on a solid geology of Upper Carboniferous Namurian grey shales and sandstones of the Crackington Formation (British Geological Survey, 1976). The drift geology in the local valley bottoms is described as 'clay and undifferentiated' (ibid).

The soils comprise fine loamy typical brown earths of the Denbigh1 Association which pass into solid or shattered rock within 0.8m (Soil Survey of England and Wales, 1983; Findlay et al, 1984: 145)

Archaeological background

The proposed development lies in a landscape that contains evidence of prehistoric activity and where little in the way of formal archaeological investigation has been undertaken. Less than 1km to the east lies Castle Dyke an Iron Age hillfort, while less than 300m to the south-east lie caves at Chudleigh Rocks that have evidence of human occupation dating to around 10,000BC (see the know archaeological sites discussed below). Given the area of the proposed development and the known prehistoric activity in the vicinity, the Devon County Council Historic Environment Service considers it is possible that archaeological deposits may be present within the application area (Reed, 2013).

Historic Landscape Characterisation

The majority of the survey area is classified as 'Post-medieval enclosures' which are fields laid out in the 18 and 19 centuries A.D., with many having dead-straight field boundaries (Devon County Council, undated).

The two large fields comprising the majority of area 1 (figure 1) are classified as 'Modern enclosures adapting medieval fields' which are modern fields created out of probable medieval enclosures with sinuous medieval boundaries surviving in places (ibid).

Known archaeological sites near the survey area

There one Historical Environment Record (HER) entry within the survey area:

MDV8969: Teign Valley Branch railway which ran to the west of the western boundary of the site. It was opened in 1882 and was closed by 1965. Location centred SX 8590 8567 (8594m by 15148m).

Records relating to the Archaeological Background discussed above:

MDV8997: Palaeolithic. Evidence of Palaeolithic activity. Documentary evidence. Location centred SX 8648 7876 (11m by 11m).

MDV9018: Upper Palaeolithic. Artefacts and bones associated with a hearth. Documentary evidence. Pixies' Hole cave, Chudleigh Rocks. Location centred SX 8654 7866 (15m by 21m).

MDV14724:	Eight Lower Palaeolithic to Late Neolithic. Eight worked flints. Cow Cave, Chudleigh Rocks. Documentary evidence. Location SX 8647 7866 (13m by 19m).
MDV14725:	Upper Palaeolithic material including flint blades. Tramp's Cave, Chudleigh Rocks. Documentary evidence. Location centred SX 8667 7860 (11m by 17m)
MDV9008:	Iron Age. Hillfort. Castle Dyke in Ugbrook Park.

Previous fieldwork within the survey area

There are no Event Record entries directly associated with the survey area:

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.

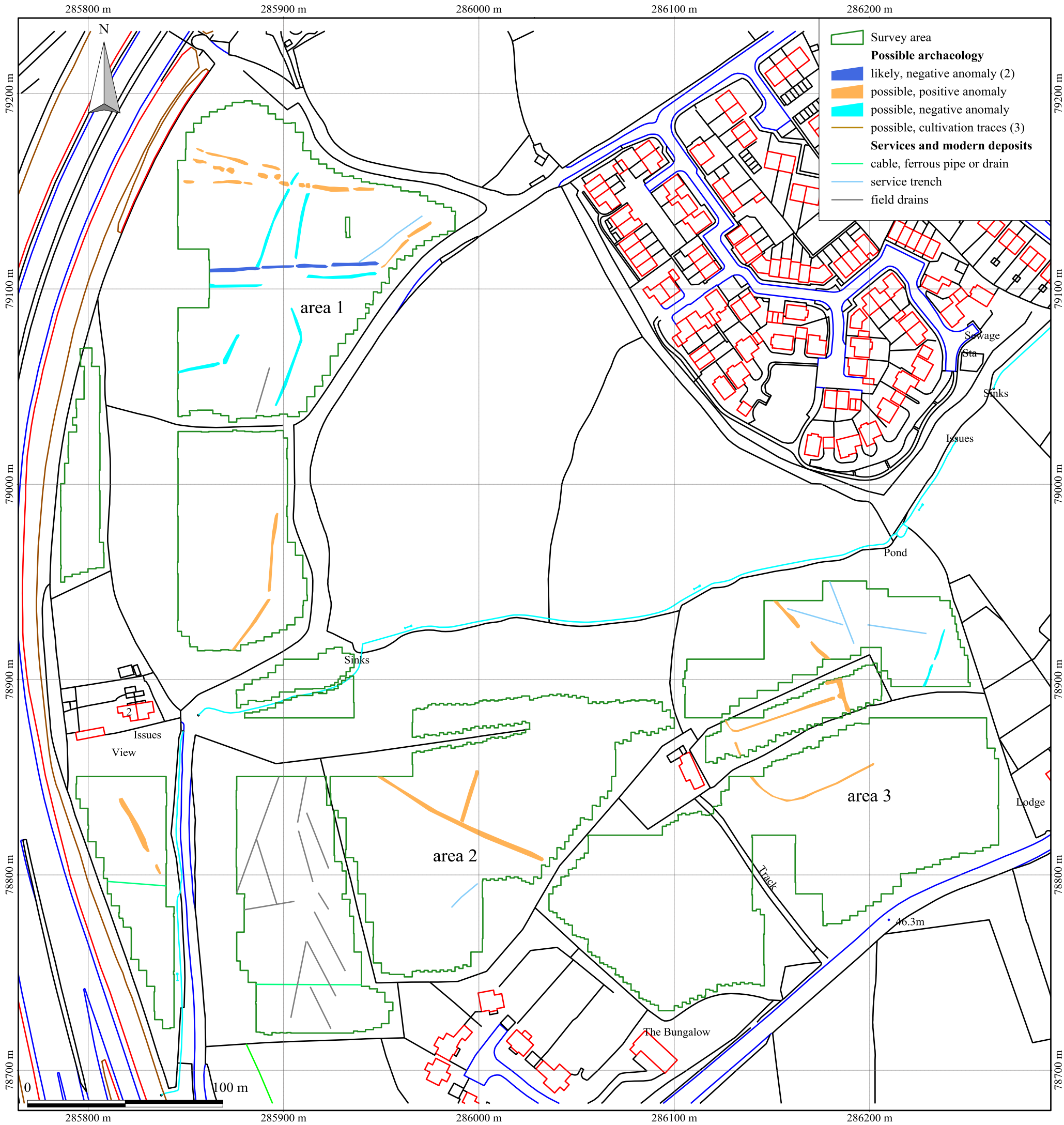
3.1 Results

For ease of discussion, the survey area was divided into three areas as shown in figure 1 (this section) which also shows a summary of the survey interpretation across the entire survey area.

Figures 2, 3 and 4 (this section) show the interpretation of the survey across areas 1 to 4 respectively. The accompanying 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 2 and 3 along with table 1 comprise the analysis and interpretation of the survey data.

The processed gradiometer data is presented in figures 5 to 8, appendix 1.



British Grid
centre X: 286028.47 m, centre Y: 78959.07 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Produced 26/7/2013

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

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Figure 1: survey interpretation, all areas

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Survey data analysis

Site: An archaeological gradiometer survey
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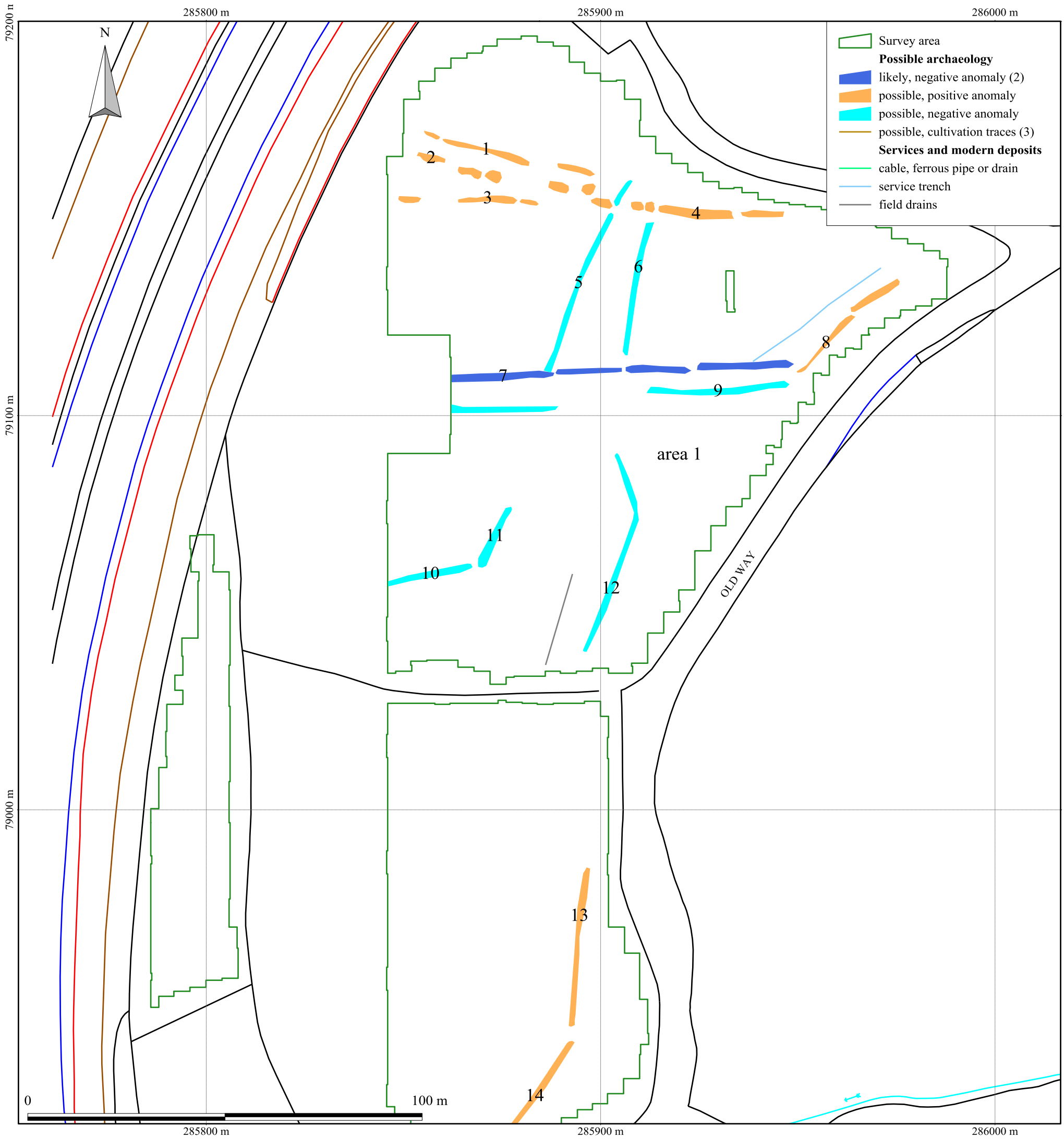
field number	anomaly group	associated anomaly group(s)	anomaly class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	1		possible positive	disrupted linear			
1	2		possible positive	disrupted linear			
1	3		possible positive	disrupted linear			
1	4		possible positive	disrupted linear			
1	5		possible negative	linear		anomaly group may represent archaeology but very likely to be field drains	
1	6		possible negative	linear		anomaly group may represent archaeology but very likely to be field drains	
1	7		likely negative	linear	field boundary	anomaly group on alignment of a field boundary mapped on the OS 1883 1st edition and 1890 maps but not on the 1905 and subsequent maps	Ordnance Survey 1883-89 1:2500, 1890-91 1:10560, 1905 1:2500 & later maps
1	8		possible positive	linear			
1	9		possible negative	linear		anomaly group may represent archaeology but very likely to be field drains	
1	10		possible negative	linear		anomaly group may represent archaeology but very likely to be field drains	
1	11		possible negative	linear		anomaly group may represent archaeology but very likely to be field drains	
1	12		possible negative	multilinear		anomaly group may represent archaeology but very likely to be field drains	
1	13		possible positive	linear			
1	14		possible positive	linear			
2	15		possible positive	linear		anomaly group strongest among a number of similar trends - may be archaeology, natural or cultivation traces	
2	16		possible positive	curvilinear			
2	17		possible positive	linear			
3	18		possible positive	disrupted linear			
3	19		possible negative	disrupted linear			
3	20		possible positive	multilinear			
3	21		possible positive	multilinear			
3	22		possible positive	curvilinear			

Table 1: data analysis



British Grid
centre X: 285884.50 m, centre Y: 79060.19 m

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

Produced 26/7/2013

Notes:
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3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped.

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Figure 2: survey interpretation, area 1

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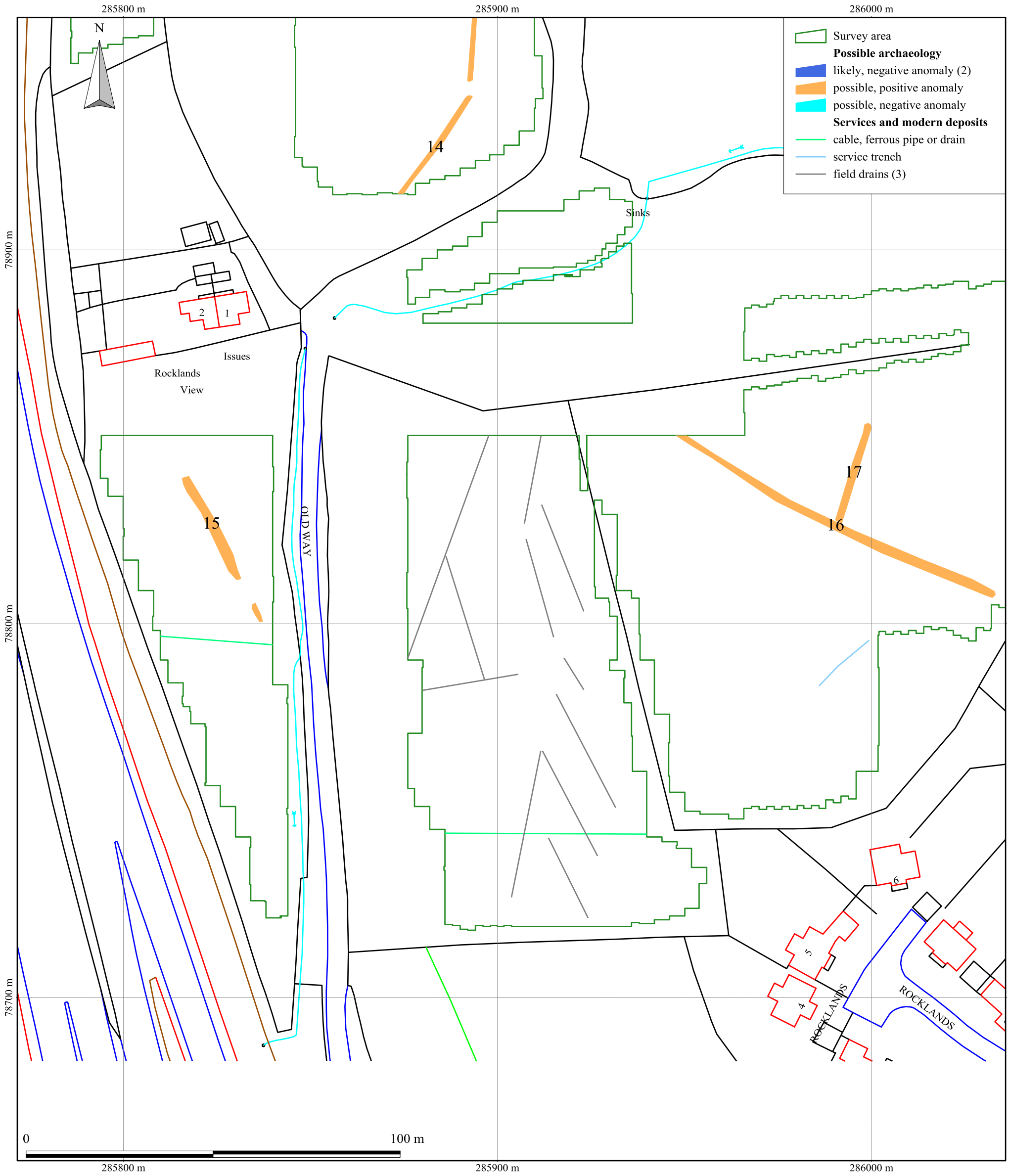

British Grid
centre X: 285903.74 m, centre Y: 78809.28 m

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

Produced 26/7/2013

Notes:
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Figure 3: survey interpretation, area 2

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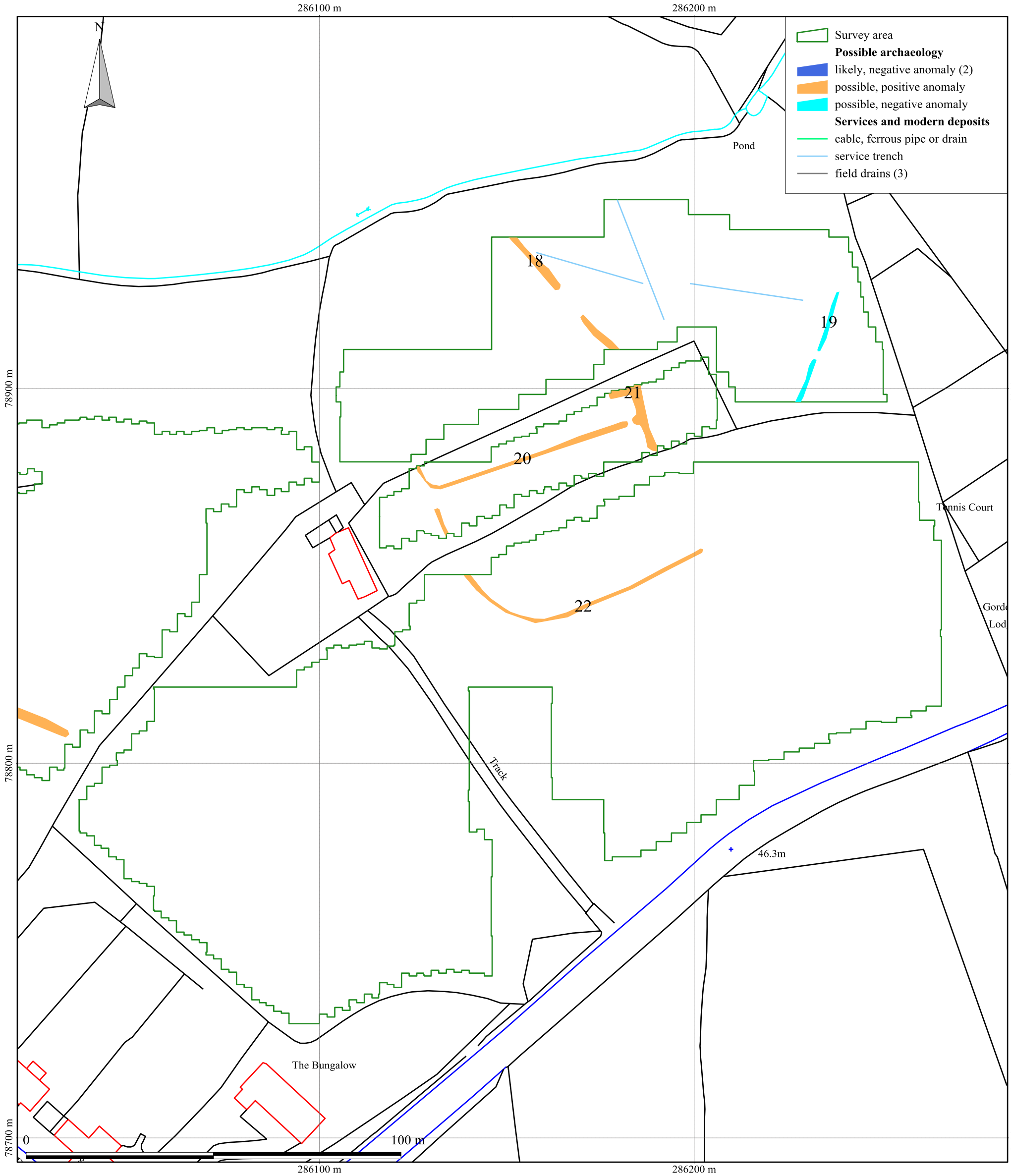

British Grid
centre X: 286151.51 m, centre Y: 78846.44 m

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

Produced 26/7/2013

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
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Figure 4: survey interpretation, area 3

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3.2 Discussion

Refer to figures 1 and 2

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.

Data related to historical maps and other records

Area 1

Anomaly group **7** is likely to represent a field boundary mapped on the Ordnance Survey 1st Edition map of 1883-89 and the subsequent 1890 map but not the 1905 and later maps.

Data with no previous provenance

Area 1

Anomaly groups **1 to 4**, **8**, **13** and **14** are linear patterns of anomalies that typically relate to archaeological features such as field boundaries and other enclosures.

Anomaly groups **5**, **6**, **10**, **11** and **12** may relate to linear archaeological deposits such as field boundaries but are very likely to relate to relatively recent field drains.

Area 2

Groups **15** and **17** may denote linear archaeological features such as a former field boundaries or other enclosures.

Group **16** indicates the presence of a former field boundary or, less likely, a former track.

Area 3

Anomaly group **18** denotes a possible linear feature such as a field boundary or ditch with a gap which could be the result of later disturbance of the ground or reflect an original feature.

Group **19** may be the result of an archaeological deposit or due to a relatively recent service trench.

Anomaly groups **20**, **21** and **22** denote potential archaeological deposits that typically reflect enclosures that are not contemporary with either the current field system or typical medieval field patterns.

3.3 Conclusions

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 22 magnetic anomaly groups were identified as pertaining to potential archaeology.

A concentration of potential archaeological deposits were found in the north-eastern part of area 3 (figures 4 and 8). These indicate the possibility of the survival of enclosures that are not contemporary with either the current field system or typical medieval field patterns along with a possible gapped ditch. The remaining magnetic anomalies

highlighted as pertaining to potential archaeology elsewhere in the survey area are typical of archaeological features such as field boundaries and other enclosures.

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 Cornish of Rocklands Development Partnership for commissioning us to complete this survey.

6 References

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Reed, S. (2013) *Consultation Response Archaeological* **,***Case : 13/01062/MAJ, Development Control, Major Application, IP, Property : Land At NGR 285932 78878 Station Hill, Station Hill, Chudleigh,* Devon County Council Historic Environment Service unpublished email 02 May 2013 reference Arch/DM/TE/20192a

Soil Survey of England and Wales (1983) *Soils of South West England Sheet 5* 1:250 000, Southampton: Ordnance Survey

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: 286028.47 m, centre Y: 78959.07 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 5: processed data, all areas

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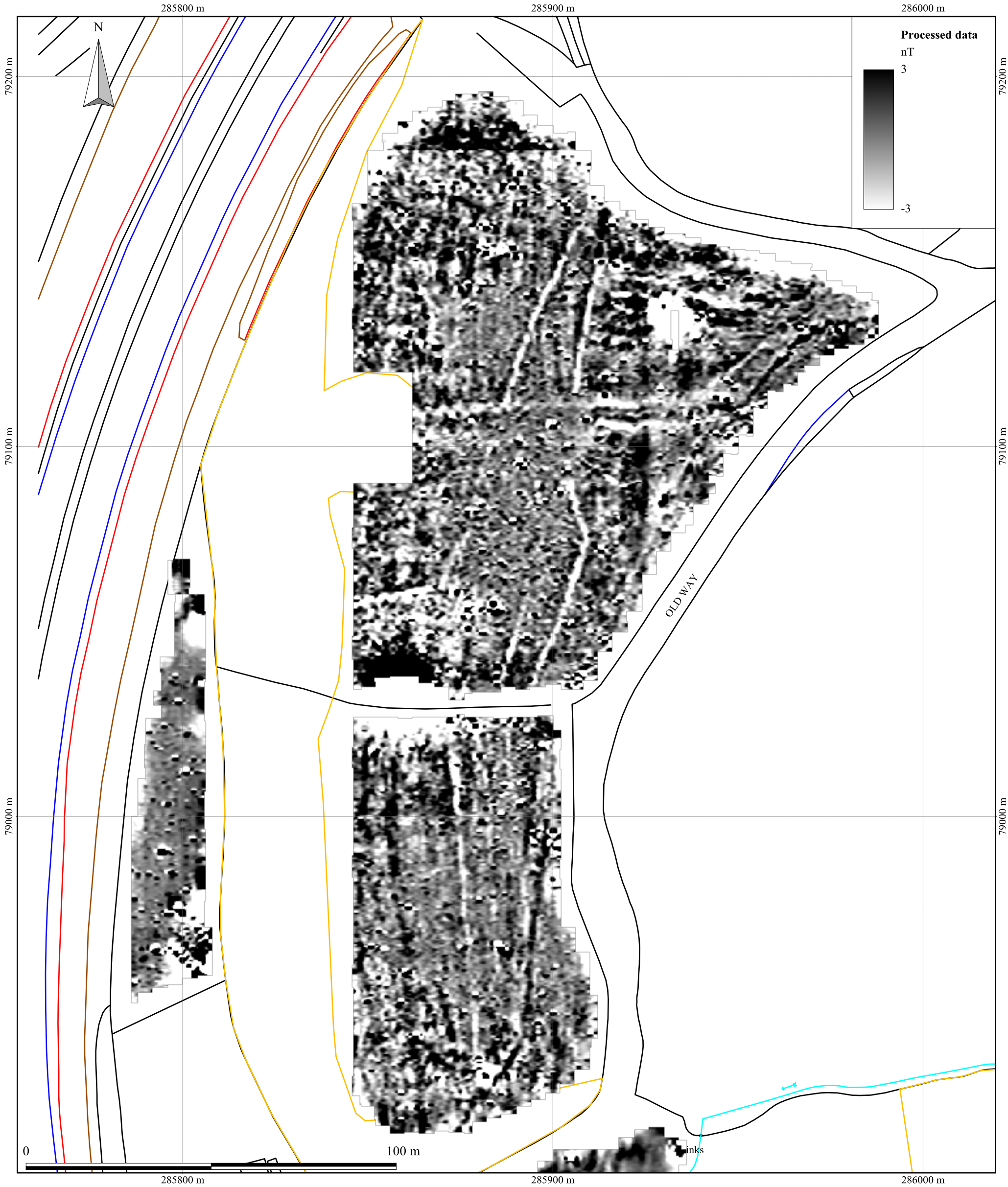

British Grid
centre X: 285887.46 m, centre Y: 79059.94 m

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

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Figure 6: processed data, area 1

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British Grid
centre X: 285946.85 m, centre Y: 78815.06 m

Scale: 1:1200 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 7: processed data, area 2

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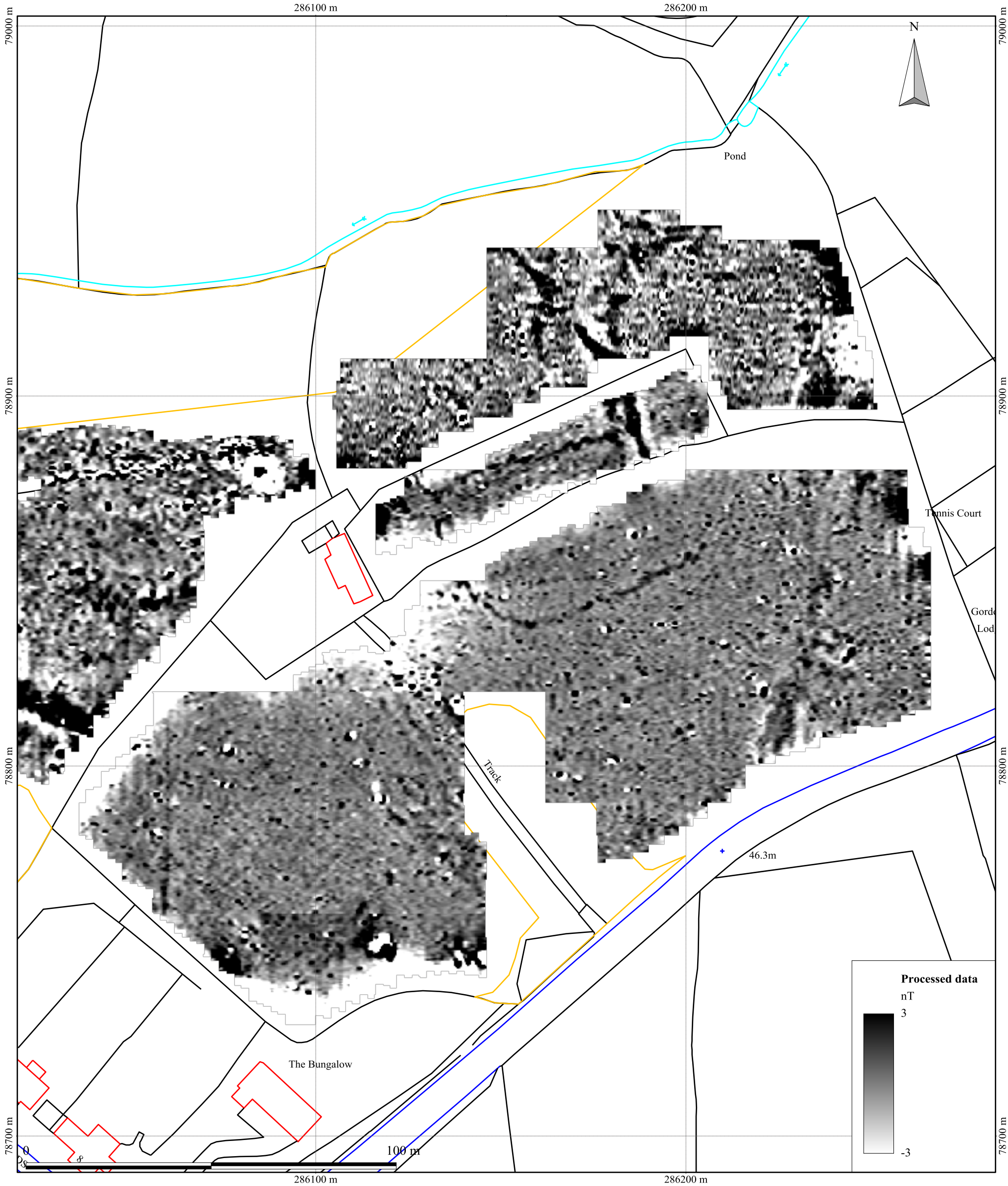

British Grid
centre X: 286151.51 m, centre Y: 78846.44 m

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

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Land At Station Hill And Oldway Lane
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Figure 8: processed data, area 3

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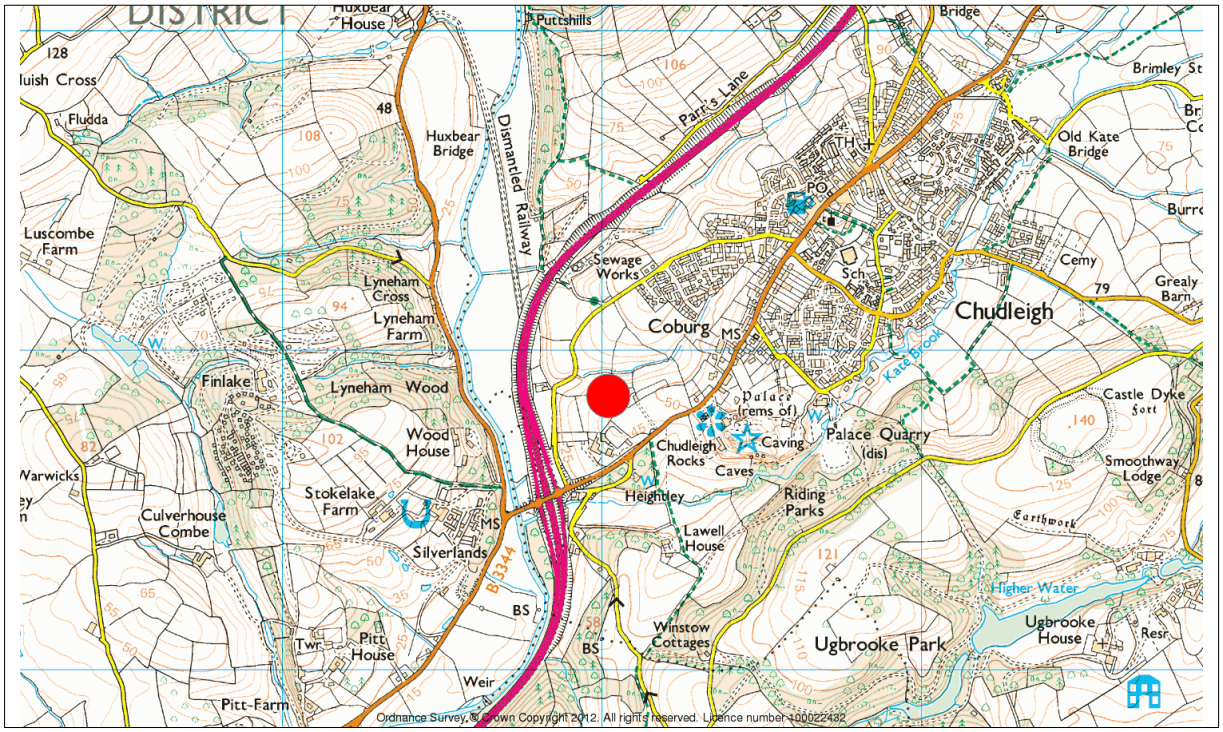

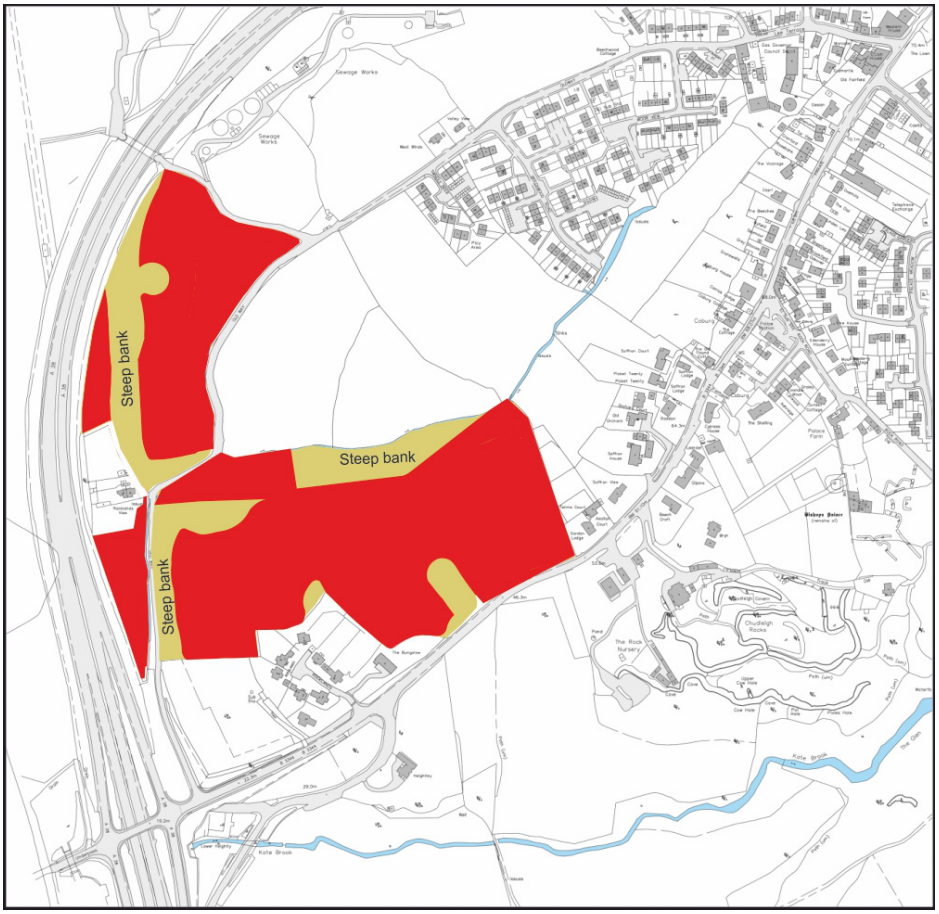

An archaeological gradiometer survey
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Ordnance Survey E/N: 241380 71300 (point)
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Figure 9: location map

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Appendix 2 Methodology

Table 2: methodology
Documents Project requirement: Reed (2013) Project design: Dean (2013)
Methodology 1. The work was undertaken in accordance with the project design. 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). 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 Station Hill and Oldway Lane, Chudleigh, Newton Abbot, Devon Ordnance Survey E/N: 285932 78878 (point) Report: 130712
COMPOSITE Instrument Type: Bartington Grad 610 Units: nT Surveyed by: on 26/06/2013 Assembled by: on 26/06/2013 Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 X Interval: 0.25 m Y Interval: 1 m Stats Max: 182.00 Min: -204.47 Std Dev: 9.35 Mean: -0.34 Median: 0.00
Processes: 20 1 Base Layer 2 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 116, Left 762, Bottom 120, Right 772) 3 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 120, Left 766, Bottom 128, Right 778) 4 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 129, Left 772, Bottom 134, Right 780) 5 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 135, Left 779, Bottom 138, Right 784) 6 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 140, Left 781, Bottom 141, Right 791) 7 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 143, Left 796, Bottom 145, Right 805) 8 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 148, Left 813, Bottom 149, Right 822) 9 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 148, Left 806, Bottom 149, Right 813) 10 Clip at 1.00 SD 11 De Stagger: Grids: clc33.xgd Mode: Both By: -2 intervals 12 De Stagger: Grids: clc38.xgd Mode: Both By: -2 intervals 13 De Stagger: Grids: clc46.xgd Mode: Both By: -1 intervals 14 De Stagger: Grids: clc66.xgd clc107.xgd clc108.xgd clc115.xgd clc65.xgd clc67.xgd clc103.xgd clc106.xgd clc109.xgd clc114.xgd clc64.xgd clc68.xgd clc78+clc104.xgd clc105.xgd clc110.xgd clc113.xgd clc116.xgd clc63.xgd clc69.xgd clc77.xgd clc79.xgd clc111.xgd clc112.xgd clc117.xgd clc71+clc62.xgd clc70+clc74.xgd clc76.xgd clc80.xgd clc83.xgd clc99.xgd clc118+clc100.xgd clc72.xgd clc73.xgd clc75.xgd clc81.xgd clc82.xgd clc101.xgd Mode: Both By: -3 intervals 15 De Stagger: Grids: clc102.xgd Mode: Both By: -3 intervals 16 DeStripe Median Sensors: All 17 Edge Match (Area: Top 300, Left 480, Bottom 359, Right 599) to Left edge 18 DeStripe Median Traverse: Grids: clc58+clc57.xgd 19 DeStripe Median Traverse: Grids: clc46.xgd 20 Edge Match (Area: Top 1200, Left 120, Bottom 479, Right 239) to Right edge 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.