Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Tregrill Farm Menheniot, Cornwall

Ordnance Survey E/N: 227811,63746
and 227980,63140 (points)

Report: 131025
Ross Dean BSc MSc MA MIfA
20 November 2013

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1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: 30 September and 1 October 2013
Area surveyed: 2.7ha.
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 Tregrill Farm
Civil Parish:	Menheniot
County:	Cornwall
Nearest Postcode:	PL14 3PQ
NGR:	SX278637 (point)
Ordnance Survey E/N:	227811,63746 and 227980, 63140 (point)
OASIS number:	substrata1-164853
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 was produced by Substrata in preparation for submission of a forthcoming planning application for a single wind turbine with access route.

The magnetic contrast across the survey area was relatively good and was sufficient to distinguish between anomalies representing potential archaeology and natural deposits.

Thirty-five magnetic anomaly groups were identified as representing potential archaeological deposits. Twenty-eight of these groups may represent large filled pits or similar deposits and stand out clearly in the data set. With this type of anomaly it is difficult to distinguish archaeological deposits from natural deposits unless there is some clear distribution. Their distribution does imply that they may be associated with mining or quarrying but other past activities cannot be ruled out. Only further archaeological investigations will clarify whether the anomalies represent archaeological features, natural features or a combination of both.

The remaining anomalies characterised as potential archaeology represent one spread of possible archaeological material, five linear deposits and one curvilinear deposit. Of the five linears, two are clearly former Cornish bank field boundaries and one of these was recorded on Ordnance Survey maps between 1882 and 1978. The other linear groups and curvilinear groups cannot be characterised further archaeologically except to say that such groups often represent features such as ditches or banks.

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

Landscape
The survey area comprised 4 areas within 4 fields situated on an northwest-southeast ridge of land as shown in figure 11 (appendix 1). The turbine base (area 1, figure 11) lies at approximately 120m to 130m O.D. The access route partially comprises an existing track which did not require surveying and otherwise follows field boundaries over the brow of a hill to the west of Tregrill (areas 2 to 4). Here the land descends north to south from approximately123m to 95m O.D. with a relatively steep gradient (areas 3 and 4).

Land use at the time of the survey
Grass pasture.

Geology
The site is located on a solid geology of the Emsian (Early Devonian) to Tournaisian (Lower Carboniferous) Saltash Formation. The rocks are dark grey and grey silty mudstone with variable but very subordinate amounts of laminae and thin beds of siltstone and sandstone. There are scattered units of thin- to thick-bedded limestone (eg: Marble Cliff Limestone Member), thin- to thick-bedded sandstone (eg: Wearde Sandstone Member), basaltic lava (spilite), massive and bedded hyclastite, and bedded tuff (eg: St Germans Tuff Member). There are un-named microgabbro igneous intrusions mapped in the area but not close to the survey area (British Geological Survey, undated).

The superficial geology was not mapped in the source used.

Known archaeological sites within 1000m of NGR SX278637
Please refer to figure 11 for the location of the entries listed below.

The following are summaries of entries of the Cornwall and Scilly Historic Environment Record (HER) (Cornwall Council, undated). They were collated using the Heritage Gateway which provides access to local and national records on the historic environment and is managed by English Heritage in partnership with the Association of Local Government Archaeological Officers (ALGAO) and the Institute of Historic Building Conservation (IHBC).

The information provided through the Heritage Gateway is updated four times a year. The summaries below are provided as an indication of the archaeological potential of the survey area and as points of discussion when referring to the geophysical survey data. The summaries below should not be used as a definitive guide to the HER for the site. Readers are directed to the Cornwall and Scilly Historic Environment Service for a complete set of entries.

In addition to those records summarised below, there are a number of entries in the HER referring to Post-Medieval monuments and Post-Medieval activities such as mining and quarrying. Most of these are not listed below unless are judged to be a potential influence on survey data and/or contribute to the archaeological potential of the survey area.

Relevant entries within the survey field:

There were no entries within the survey areas or fields.

Relevant entries in adjacent locations:

HER 10353: TREGRILL - Early Medieval settlement, Medieval manor, Medieval settlement. The settlement of Tregrill is first recorded in the Domesday survey of 1086. The name is Cornish and contains the elements tre meaning 'estate, farmstead' and possibly cryn meaning 'dry, withered' and the meaning 'place'. SX 2823 6314.

HER 71655: TREGRILL - Early Medieval field boundary visible in aerial photographs. SX 2833 6287

HER 165389: TREGRILL VEAN - Romano British findspot, Early Medieval findspot, Medieval settlement, Post Medieval settlement. Tregrill Vean, near Menheniot, is a medieval hall house. A large collection of pottery has accumulated mainly from service trenches and from cultivating the garden. Finds include: Roman pottery, including Samian wares and 'Exeter Fortress wares'; early-medieval Bar-Lug sherds; medieval sherds, including Lostwithiel and St Germans wares, as well as N Devon imports, and a number of continental imports. The finds list suggests that the site was first occupied as early as the 1st century AD, and that it has enjoyed a history of continuous (or perhaps discontinuous) occupation for almost 2000 years. SX 2821 6310

Relevant entries within 1000m of the survey area:

HER 10341: BODGARA MILL - Early Medieval settlement, Medieval settlement. The settlement of Bodgara is first recorded in 1328. The name is Cornish and contains the element bod 'dwelling' with an unknown element. Records for the corn mill (HER 10382) predate 1275 the first recording of the settlement. SX 2685 6455.

HER 10382: BODGARA MILL - Medieval corn mill, Post Medieval corn mill. Bodgara Mill was the town mill for Liskeard. SX 2685 6458

HER 71646: CRIFT - Early Medieval field system, Medieval field system visible on aerial photographs. SX 2829 6473

HER 10346: MENHENIOT - Medieval settlement. The settlement of Menheniot is first recorded in 1260. The name is Cornish and contains the element ma 'place or plain open county' and a personal name. SX 2882 6286.

HER 10349: ROSELAND - Medieval settlement. The settlement of Roseland is first recorded in 1399 and the name is English. SX 2738 6331.

HER 71650: ROSELAND - Early Medieval field system, Medieval lynchet. The remains of closely spaced banks and ditches are visible on air photos. SX 2745 6350

HER 71653: ROSELAND - Early Medieval field system, Medieval lynchet. The remains of closely spaced banks and ditches are visible on air photos. SX 2746 6308

HER 71647: TREVARTHA - Early Medieval field system, Medieval lynchet. The remains of closely spaced banks and ditches are visible on air photos. SX 2799 6404.

HER 10370: TREVARTHA - Early Medieval settlement, Medieval settlement. The settlement of Trevartha is first recorded in 1342. The name is Cornish and contains the element tre 'estate, farmstead' and an Old English personal name. There are three settlements with the name Trevartha: 'Lower, Higher and Trevartha Cottages'. Trevartha Cottage appears on the 2nd Edition 1:2500 OS map c1907, while the Listed farmhouse at Higher Trevartha is C17 suggesting that this might be the site of the original settlement although this is speculative. SX 2799 6442.

HER 42655: WEST MARY ANN - Post Medieval mine. West Mary Ann mine (silver and lead) is shown on the OS map of 1882. It is shown as disused on the OS edition of 1963. An area of spoil and rough ground at the site of the mine, is visible on air photos. SX 275 636.

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 5 (appendix 1) is a summary plot of the survey interpretation across the entire survey area and shows the location of survey areas 1 to 4.

Figures 1 to 4 (this section) show the interpretation of the survey across survey areas 1 to 4 respectively 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 to 4 and table 1 comprise the analysis and interpretation of the survey data.

Plots of the processed data is provided in figures 6 to 10 (appendix 1).

Figure 11 (appendix 1) shows the survey areas and the HER records summarised in section 2 and the topology of the area.

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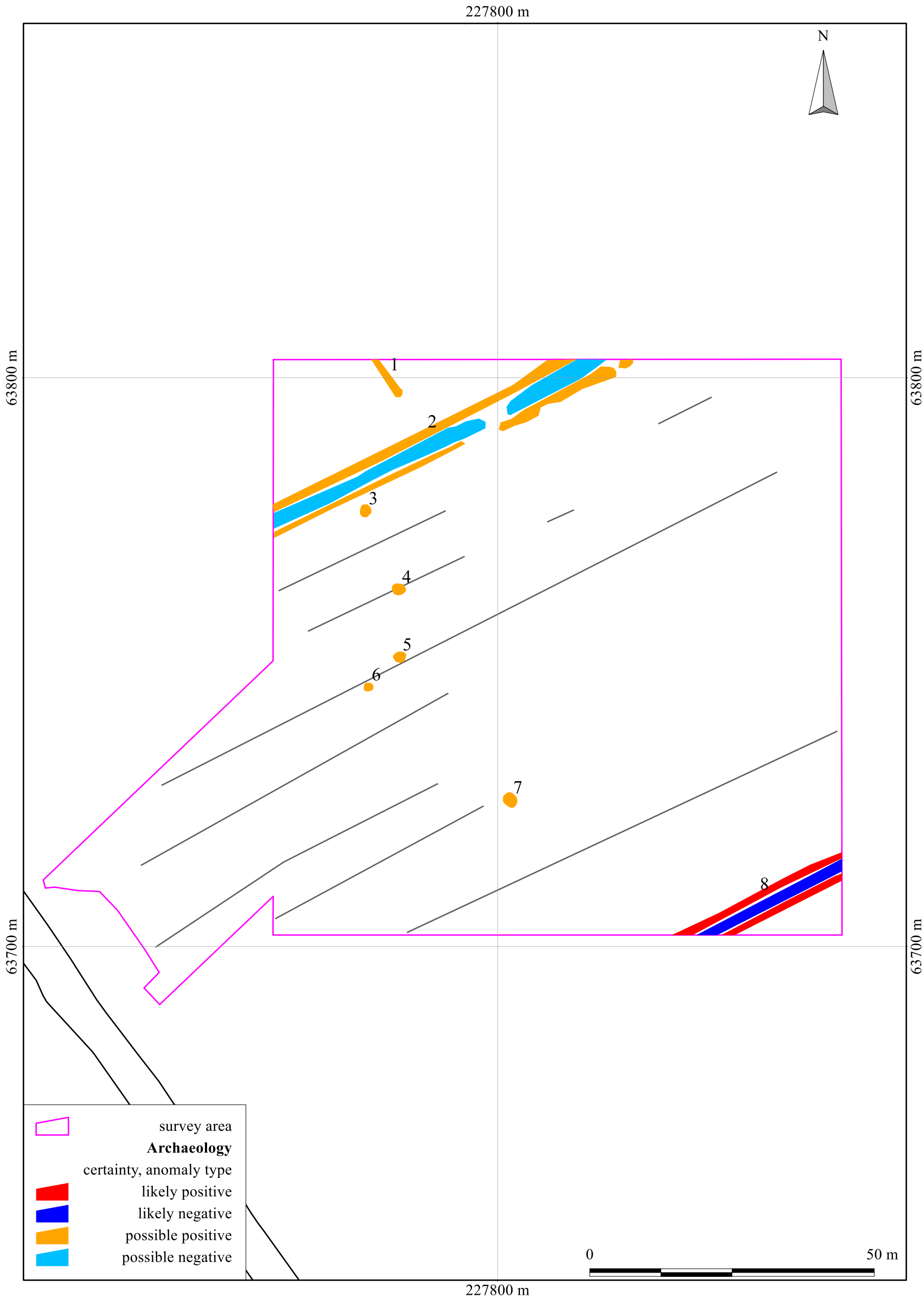
field number	anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	1	possible positive	linear		anomaly group represents either an archaeological deposit or relatively recent ploughing	
1	2	possible pos/neg/pos	linear	Cornish bank	anomaly group pattern is typical of the Cornish bank type field wall. No such wall was recorded on the OS1882 or later maps	Ordnance Survey Cornwall & Isles of Scilly 1882 1:2,500
1	3	possible positive	oval	large pit or similar deposits	see note 1	
1	4	possible positive	oval	large pit or similar deposits	see note 1	
1	5	possible positive	oval	large pit or similar deposits	see note 1	
1	6	possible positive	oval	large pit or similar deposits	see note 1	
1	7	possible positive	oval	large pit or similar deposits	see note 1	
1	8	likely pos/neg/pos	linear	Cornish bank	anomaly group pattern is likely to represent a field wall mapped on OS maps between 1882 & 1978 but not later	Ordnance Survey Cornwall & Isles of Scilly 1882 1:2,500 to 1978 1:10,560 but not 1:2,500
2	9	possible positive	irregular			
2	10	possible positive	oval	line of large pits or disrupted linear	see note 1	
2	11	possible positive	oval	large pit or similar deposits	see note 1	
2	12	possible positive	oval	large pit or similar deposits	see note 1	
2	13	possible positive	oval	large pit or similar deposits	see note 1	
2	14	possible positive	oval	large pit or similar deposits	see note 1	
2	15	possible positive	oval	large pit or similar deposits	see note 1	
2	16	possible positive	oval	large pit or similar deposits	see note 1	
2	17	possible positive	oval	large pit or similar deposits	see note 1	
2	18	possible positive	oval	large pit or similar deposits	see note 1	
2	19	possible positive	oval	large pit or similar deposits	see note 1	
2	20	possible positive	oval	large pit or similar deposits	see note 1	
2	21	possible positive	oval	large pit or similar deposits	see note 1	
2	22	possible positive	oval	large pit or similar deposits	see note 1	
2	23	possible positive	oval	large pit or similar deposits	see note 1	
2	24	possible positive	oval	large pit or similar deposits	see note 1	
2	25	possible positive	oval	large pit or similar deposits	see note 1	
3	26	possible positive	oval	large pit or similar deposits	see note 1	
3	27	possible positive	oval	large pit or similar deposits	see note 1	
3	28	possible positive	oval	large pit or similar deposits	see note 1	
3	29	possible positive	oval	line of large pits or disrupted linear	see note 1	
3	30	possible positive	oval	line of large pits or disrupted linear	see note 1	
3	31	possible positive	oval	large pit or similar deposits	see note 1	
4	32	possible positive	disrupted curvilinear			
4	33	possible positive	linear			
4	34	possible positive	oval	large pit or similar deposits	see note 1	
4	35	possible positive	linear			

Notes:

1 With such anomalies it is always difficult to distinguish archaeological deposits from natural deposits in the data set and so further archaeological investigations would be necessary to define the anomaly group

Table 1: data analysis



British Grid
centre X: 227794.23 m, centre Y: (

Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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, area 1

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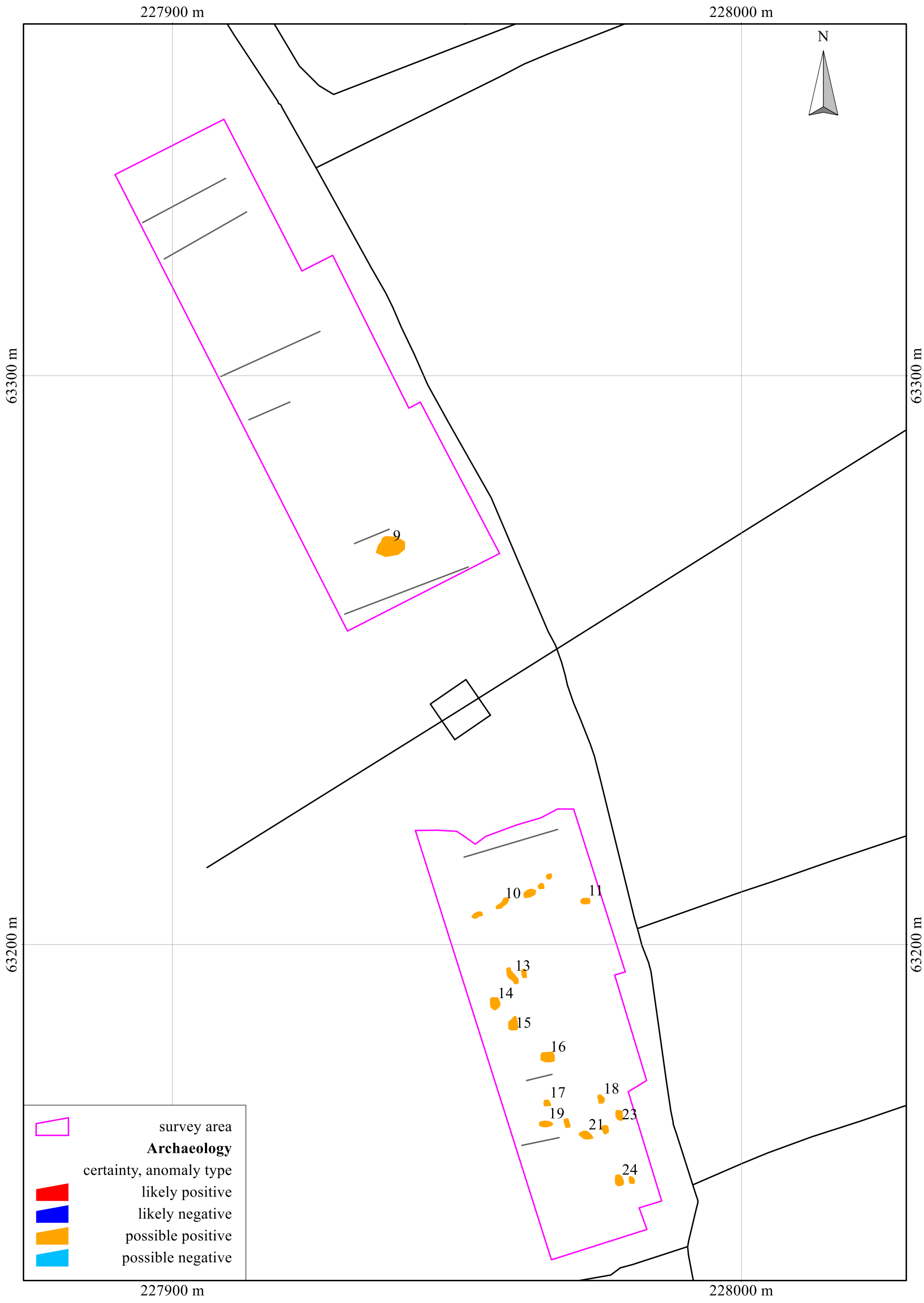

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Figure 2: survey interpretation, area 2

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British Grid
centre X: 228002.20 m, centre Y: (

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4. Anomalies likely to represent geological or other natural deposits are not mapped.

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Figure 3: survey interpretation, area 3

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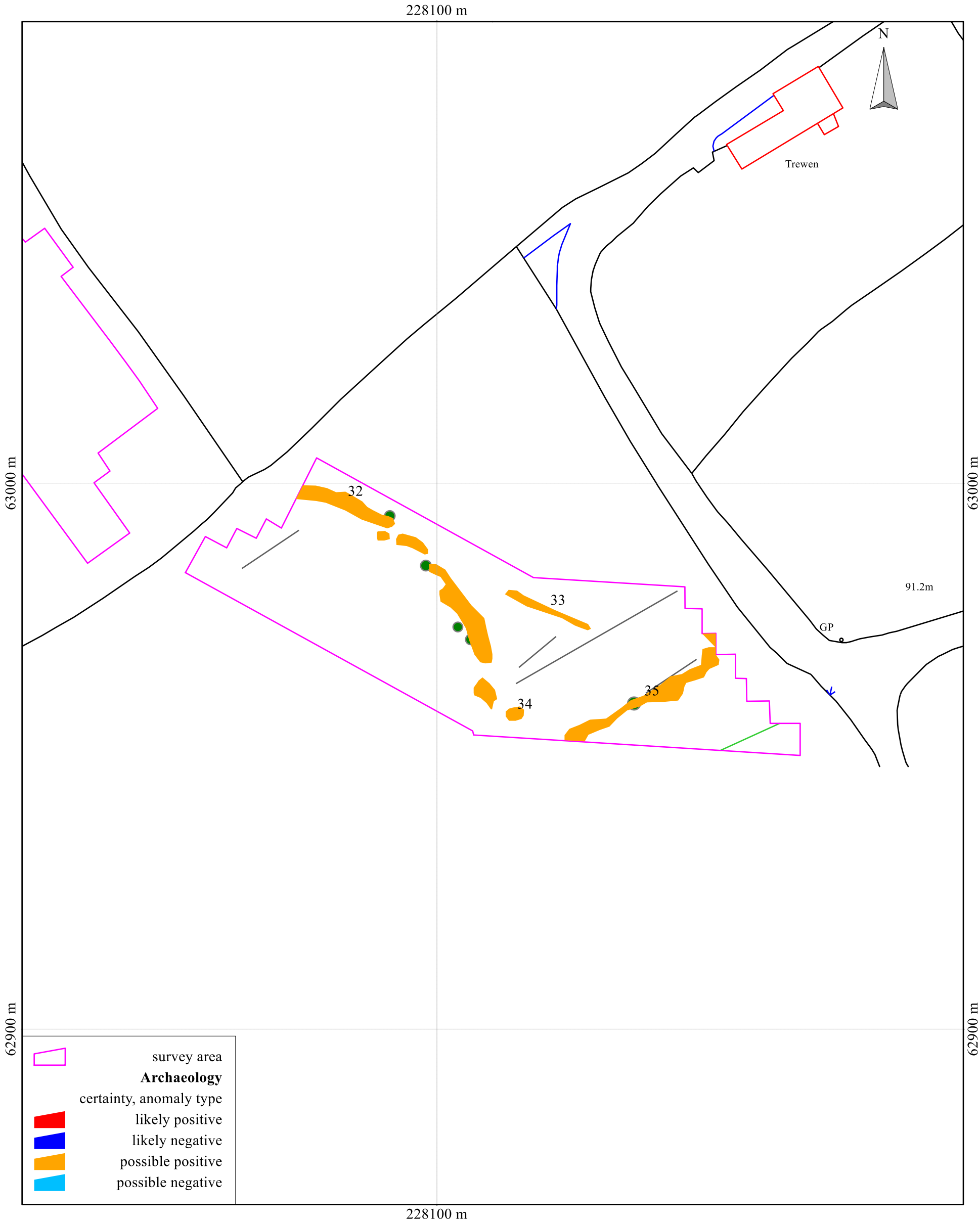

British Grid
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Scale: 1:700 @ A3. Spatial Units: Meter. Do not scale off this drawing

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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 4: survey interpretation, area 4

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3.2 Discussion

Refer to figures 1 to 4 (this section) for the interpretive plots of each area and figure 5 (appendix 1) for a summary interpretative plot of all the survey areas. Figures 6 to 10 (appendix 1) show the processed survey data. Figure 11 (appendix 1) provides an overview of the areas in relation to the topology and to the HER entries discussed in section 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 table 1.

In addition to the anomaly groups numbered in figures 1 to 4, sequences of parallel linear groups trending approximately east-north-east to west-south-west across the plots are likely to represent relatively recent ploughing and/or land drainage.

Area 1 (figures 1 and 6)
Group **1** may represent a linear archaeological deposit.

Group **2** probably represents an unmapped former field boundary. The anomaly patterns of group 2 are typical of Cornish banks which comprise an earthen bank with stone outer edges and a ditch on either side.

Group **8** is likely to represent a former field boundary recorded on OS maps between 1882 and1978 but not later. The anomaly patterns of group 8 are typical of Cornish banks as discussed above (group 2).

Groups **3 to 7** stand out clearly in the data set (figure 6, appendix 1) and may represent large filled pits or similar deposits. As noted in table 1, with this type of anomaly it is difficult to distinguish archaeological deposits from natural deposits in the data set unless there is some clear pattern in their distribution. Only further archaeological investigations will clarify their nature but an archaeological origin cannot be ruled out.

Area 2 (figures 2 and 7)
Area 2 lies on the relatively flat top of a hill (figure 11).

Group **9** is an area of positive magnetic anomalies which often represent filled hollows or an earthen spread.

Groups **9 to 24** may represent large pits or similar deposits with the same caveat discussed above. Their distribution suggests possible mining or quarrying but other past activities cannot be ruled out.

Area 3 (figures 3 and 8)
Area 3 lies on the relatively steep side of a hill (figure 11).

Groups **26 to 31** may represent large filled pits or similar deposits with the same caveat discussed above. As with similar groups in area 2, their distribution suggests possible mining or quarrying but other past activities cannot be ruled out.

Area 4 (figures 4 and 9)
Area 4 lies at the base of a hill and incorporates the head of a dry valley descending east towards a stream (figure 11).

Group **32** represents a possible curvilinear feature such as a curving ditch or similar deposit near the base of the hill and at the head of the valley.

Group **33** is a possible linear deposit while **34** is a possible large filled pit although a natural origin for 34 cannot be ruled out.

Group **35** represents a linear deposit which lies along the base of the east-west trending.

3.3 Conclusions

The magnetic contrast across the survey area was relatively good and was sufficient to distinguish between anomalies representing potential archaeology and natural deposits.

Thirty-five magnetic anomaly groups were identified as representing potential archaeological deposits. Twenty-eight of these groups may represent large filled pits or similar deposits and stand out clearly in the data set. With this type of anomaly it is difficult to distinguish archaeological deposits from natural deposits unless there is some clear distribution. Their distribution does imply that they may be associated with mining or quarrying but other past activities cannot be ruled out. Only further archaeological investigations will clarify whether the anomalies represent archaeological features, natural features or a combination of both.

The remaining anomalies characterised as potential archaeology represent one spread of possible archaeological material, five linear deposits and one curvilinear deposit. Of the five linears, two are clearly former Cornish bank field boundaries and one of these was recorded on Ordnance Survey maps between 1882 and 1978. The other linear groups and curvilinear groups cannot be characterised further archaeologically except to say that such groups often represent features such as ditches or banks.

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 Dr Paula Lutescu-Jones of AC Archaeology Ltd for commissioning us to complete this survey.

6 References

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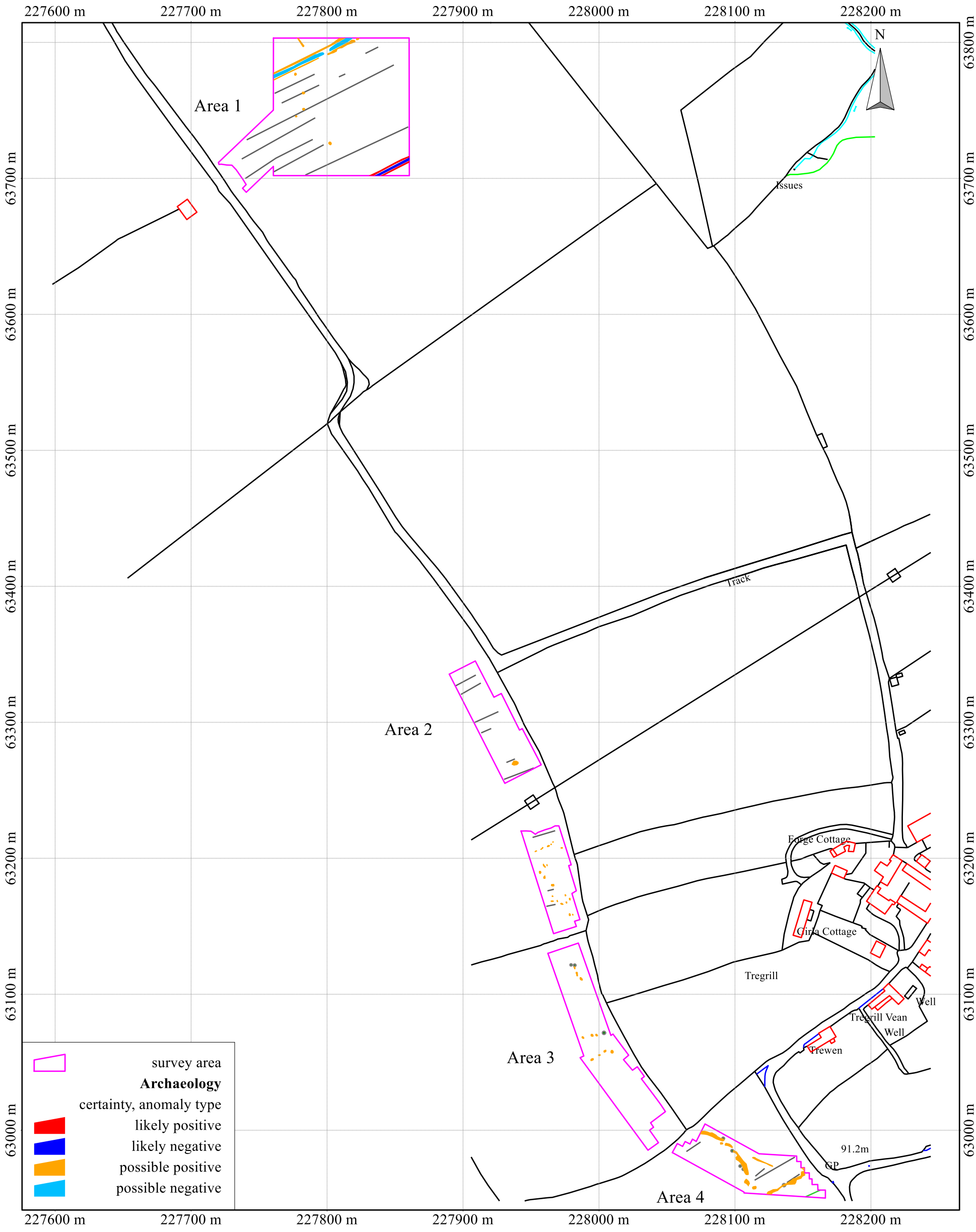
Appendix 1 Supporting plots

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.



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Scale: 1:2800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 5: survey interpretation, all areas

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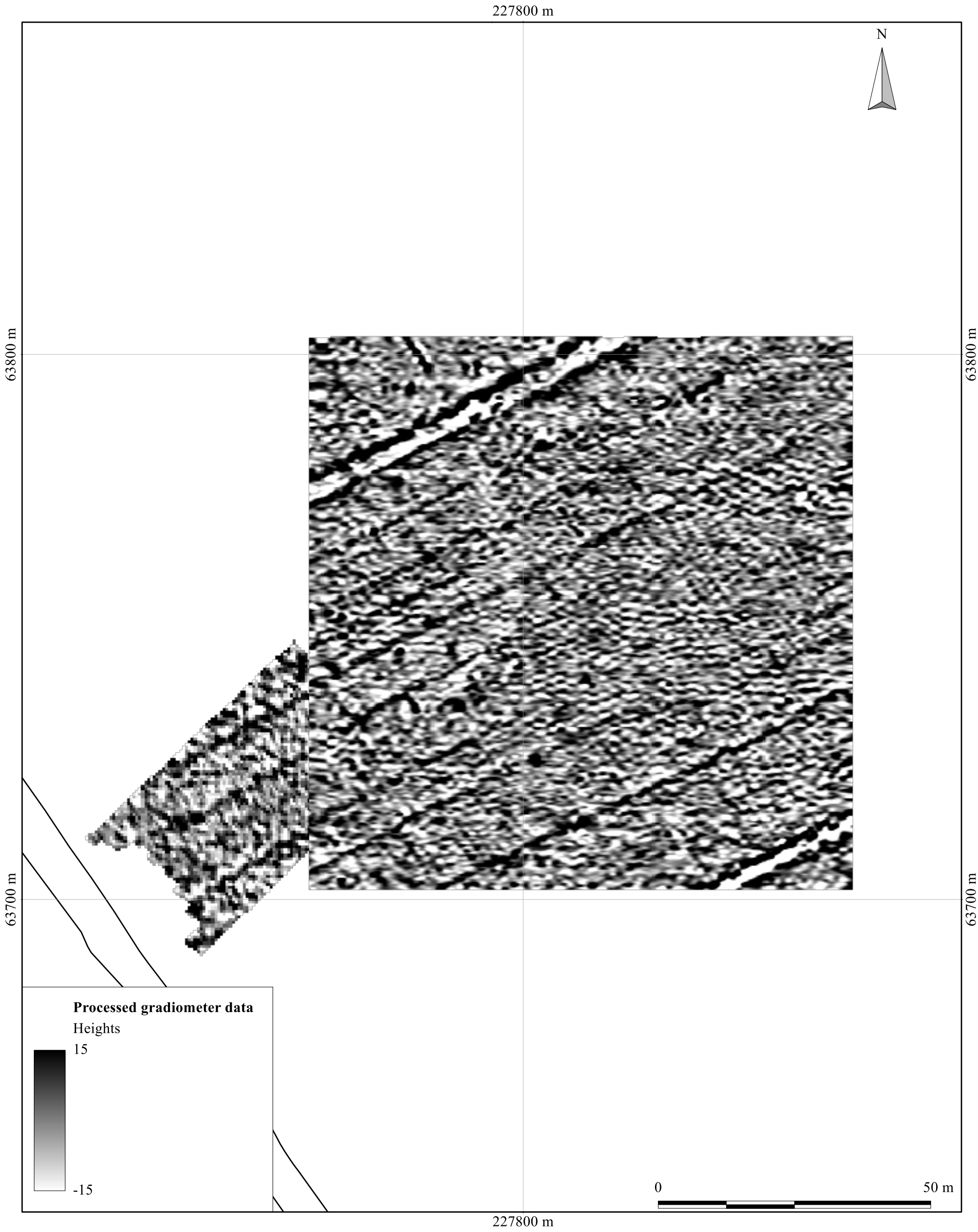

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Figure 6: processed survey data, area 1

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Figure 7: processed survey data, area 2

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Figure 8: processed survey data, area 3

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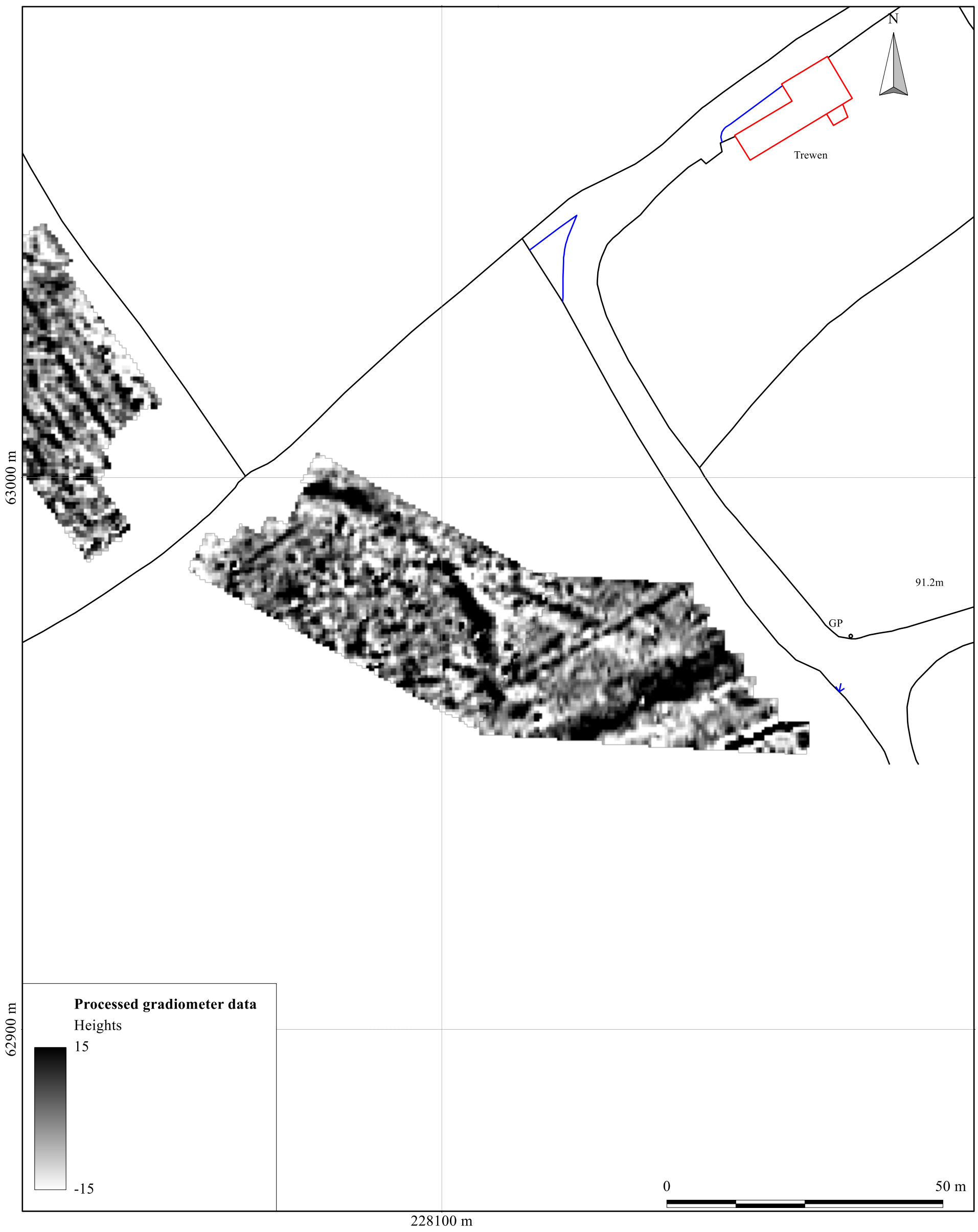

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Figure 9: processed survey data, area 4

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An archaeological gradiometer survey
Land at Tregrill Farm, Menheniot, Liskeard
Ordnance Survey E/N: 227811,63746 and 2
Report 131025

Figure 10: processed survey data, all areas

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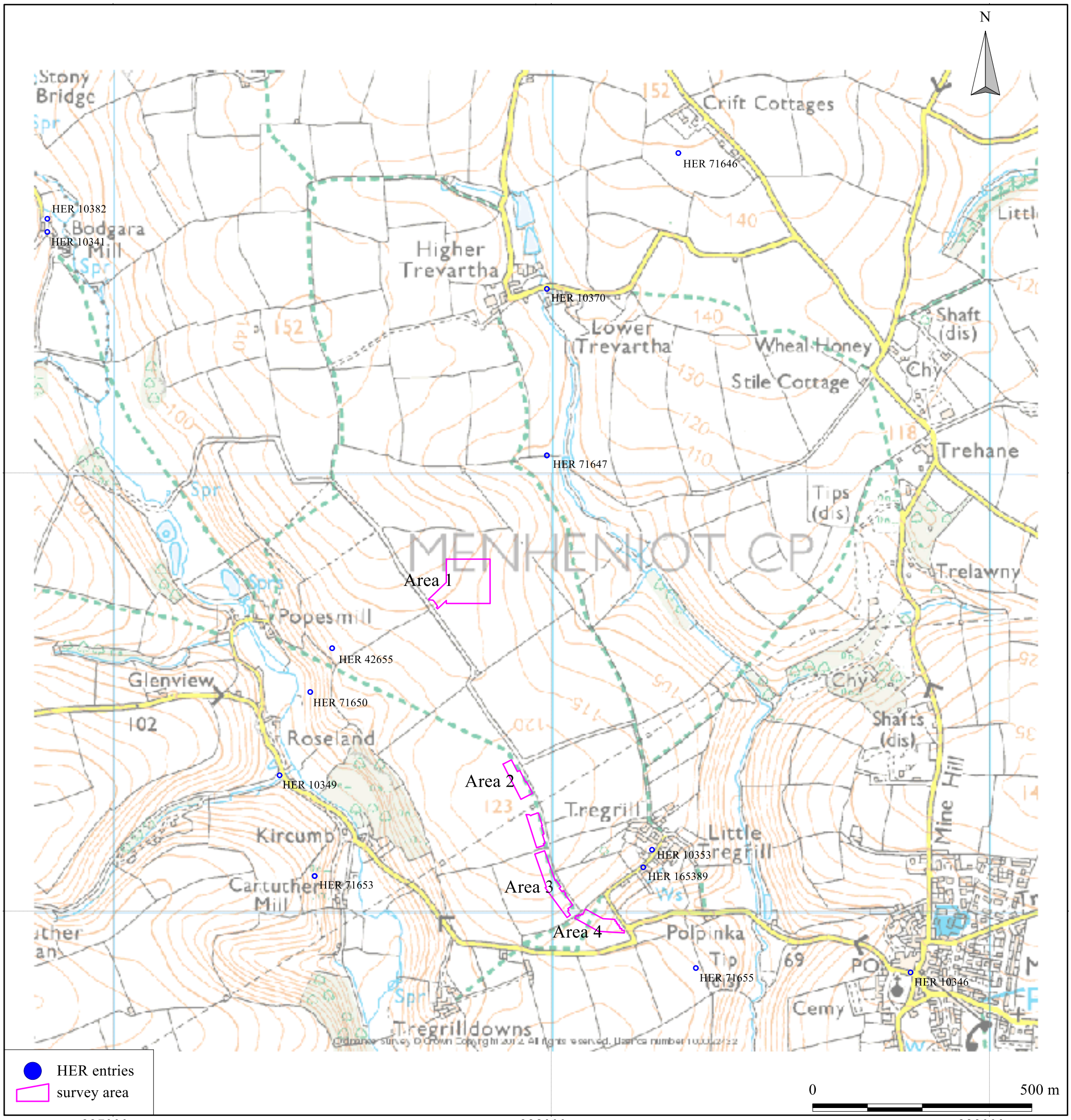

British Grid
centre X: 227964.81 m, centre Y: 6

Scale: 1:9000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 11: Historical Environment Record (HER) entries within 1000m of Ordnance Survey E/N 22780,63700

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Appendix 2 Methodology

Table 2: methodology	
Documents 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) 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.	
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.	
Equipment *Instrument:* Bartington Instruments grad601-2 *Firmware:* version 6.1	**Data Capture** *Sample Interval:* 0.25-metres *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN over turbine areas and along the line of the access track
Data Processing, Analysis and Presentation Software DW Consulting TerraSurveyor3 Manifold System 8 Microsoft Corp. Office Publisher 2013.	

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 (turbine area) & along line of access track sections Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 PROGRAM Name: TerraSurveyor, 3.0.22.1			
Area	Dimensions	Stats.	Processes
1N	Composite Size (readings): 480 x 120 Survey Size (meters): 120 m x 120 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Stats Max: 58.30 Min: -54.32 Std Dev: 13.36 Mean: 0.36 Median: 0.00 Composite Area: 1.44 ha Surveyed Area: 1.0146 ha	Processes: 3 1 Base Layer 2 Clip at 4.00 SD 3 DeStripe Median Sensors: All
1SW	Composite Size (readings): 240 x 30 Survey Size (meters): 60 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 49.80 Min: -55.56 Std Dev: 14.15 Mean: 0.23 Median: 0.00 Composite Area: 0.18 ha Surveyed Area: 0.1454 ha	Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 DeStripe Median Sensors: All 4 De Stagger: Grids: All Mode: Both By: -2 intervals
2NW	Composite Size (readings): 360 x 30 Survey Size (meters): 90 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 60.18 Min: -56.62 Std Dev: 13.28 Mean: 0.99 Median: 0.00 Composite Area: 0.27 ha Surveyed Area: 0.24 ha	Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 De Stagger: Grids: All Mode: Both By: -2 intervals 4 DeStripe Median Sensors: All
2SE	Composite Size (readings): 480 x 30 Survey Size (meters): 120 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 51.84 Min: -51.99 Std Dev: 11.05 Mean: 0.55 Median: 0.00 Composite Area: 0.36 ha Surveyed Area: 0.1931 ha	Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 De Stagger: Grids: All Mode: Both By: -2 intervals 4 DeStripe Median Sensors: All
3NW	Composite Size (readings): 360 x 30 Survey Size (meters): 90 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 39.53 Min: -37.86 Std Dev: 8.01 Mean: 0.26 Median: 0.00 Composite Area: 0.27 ha Surveyed Area: 0.2046 ha	Processes: 5 1 Base Layer 2 Clip at 4.00 SD 3 Clip at 4.00 SD 4 De Stagger: Grids: All Mode: Both By: -2 intervals 5 DeStripe Median Sensors: All
3SE	Composite Size (readings): 360 x 30 Survey Size (meters): 90 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 130.55 Min: -80.40 Std Dev: 9.12 Mean: 0.31 Median: 0.00 Composite Area: 0.27 ha Surveyed Area: 0.2132 ha	Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 De Stagger: Grids: All Mode: Both By: -2 intervals 4 DeStripe Median Sensors: All
4W	Composite Size (readings): 240 x 30 Survey Size (meters): 60 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 34.77 Min: -34.67 Std Dev: 6.48 Mean: 0.47 Median: 0.00 Composite Area: 0.18 ha Surveyed Area: 0.1593 ha	Processes: 3 1 Base Layer 2 Clip at 4.00 SD 3 DeStripe Median Sensors: All
4E	Composite Size (readings): 240 x 30 Survey Size (meters): 60 m x 30 m Grid Size: 30 m x 30 m X Interval: 0.25 m Y Interval: 1 m	Max: 92.02 Min: -88.76 Std Dev: 12.00 Mean: 0.87 Median: 0.00 Composite Area: 0.18 ha Surveyed Area: 0.1451 ha	Processes: 4 1 Base Layer 2 Clip at 4.00 SD 3 Clip at 4.00 SD 4 DeStripe Median Sensors: All

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.