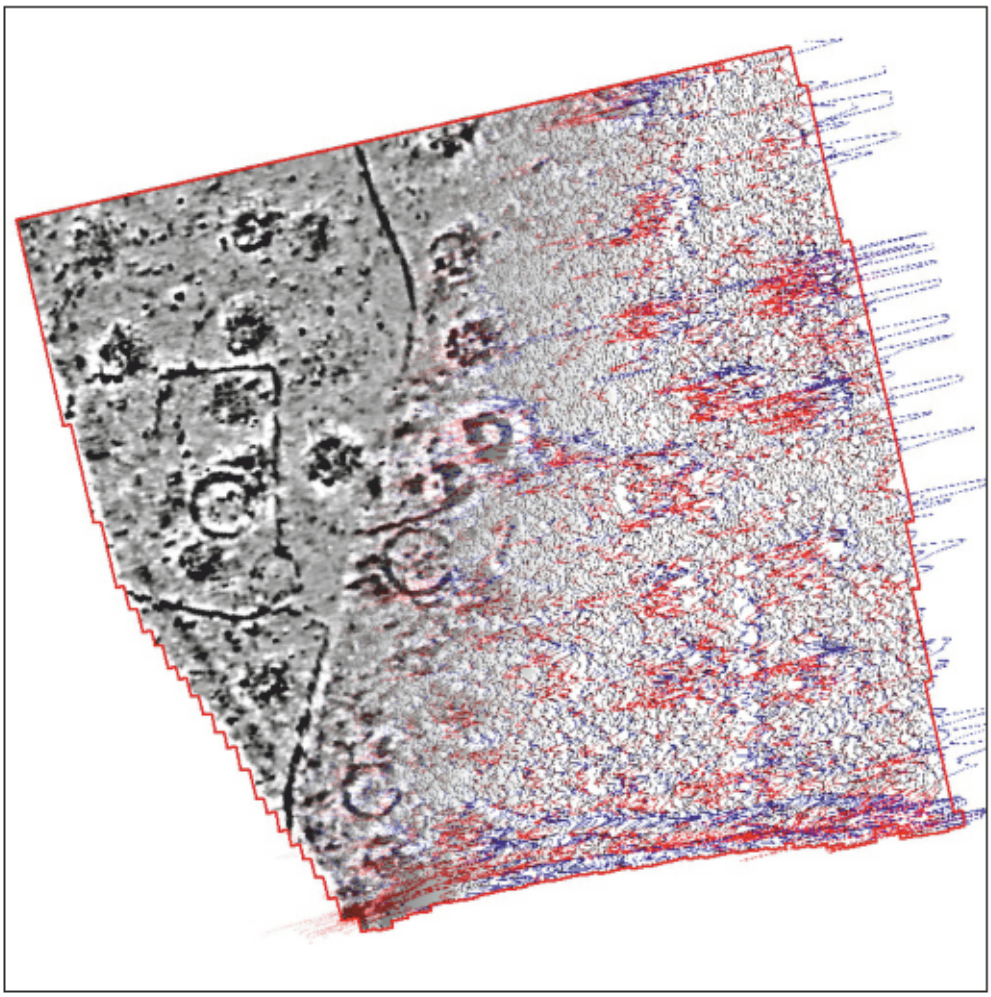
making sense of heritage

Treveale Farm
Ladock, Cornwall

Detailed Gradiometer Survey Report



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geoservices

Treveale Farm, Ladock, Cornwall

Detailed Gradiometer Survey Report

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Treveale Farm, Ladock, Cornwall

Detailed Gradiometer Survey Report

Summary

Wessex Archaeology was commissioned by Montagu Town Planning on behalf of Mr and Mrs Morrow to undertake a detailed gradiometer survey of land at Treveale Farm, Ladock, Cornwall (centred on NGR 187410 052138). The aim of the work was to establish the presence, or otherwise, and nature of detectable archaeological features on the site and inform a planning application for the construction of a milking parlour, to be submitted to Cornwall Council.

The Site is located in Cornwall approximately 8km to the north-east of Truro and around 2km to the north-west of the village of Ladock. Treveale Farm lies around 250m to the south of the Site (**Figure 1**). The Site comprises a sub-rectangular area of land that is currently under pasture. It is bounded to the east by an unnamed road, to the west and south by agricultural boundaries with the northern survey extent defined by the limit of the proposed development.

Detailed Gradiometer survey was undertaken over all accessible parts of the site, a total of *c.3.*5ha, and has demonstrated the presence of anomalies of definite, probable and possible archaeological interest within the survey area, along with anomalies of increased magnetic response.

The archaeological features detected include probable Roman/Iron Age settlement features including several roundhouses and associated enclosure ditches. In addition to these settlement features are a number of enigmatic sub-circular clusters of increased magnetic response that are of possible archaeological interest. These features may be associated with relatively recent woodland management such as charcoal burning or may be related to the clearance of this woodland during the latter half of the twentieth century. The central area of the Site appears slightly disturbed with more fragmentary features and a highly magnetic sub-circular feature; it is possible this feature relates to a Second World War bomb crater noted in this field.

The geophysical survey was undertaken between 1st December and 3rd December 2014.

Treveale Farm, Ladock, Cornwall

Detailed Gradiometer Survey Report

Acknowledgements

This project was commissioned by Montagu Town Planning on behalf of Mr and Mrs Morrow and Wessex Archaeology is grateful to Chris Montagu in this regard.

The fieldwork was carried out by Laura Andrews and Jennifer Smith. The geophysical data was processed and interpreted by Laura Andrews and Lizzie Richley. This report was written by Lizzie Richley. The geophysical work was quality controlled by Dr. Paul Baggaley and Ross Lefort. Illustrations were prepared by Lizzie Richley, and Karen Nichols. The project was managed on behalf of Wessex Archaeology by Andy Crockett

Treveale Farm, Ladock, Cornwall

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by Montagu Town Planning, to undertake a detailed gradiometer survey of land at Treveale Farm, Ladock, Cornwall (hereafter 'the Site', **Figure 1**), centred on National Grid Reference (NGR) 187410 052138.

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 Site Location and Topography

1.2.1 The Site is located in Cornwall and is situated approximately 8km to the north-east of Truro and around 2km to the north-west of the village of Ladock. Around 250m to the south of the Site lies Treveale Farm (**Figure 1**).

1.2.2 The Site comprises a sub-rectangular area of land. It is bounded to the east by an unnamed road and to the north, west and south by agricultural fields. The field is currently under pasture. Hedgerows and occasional trees lie along the boundaries of the Site.

1.2.3 The topography generally slopes down to the north-west, from an elevation of approximately 106m above Ordnance Datum (aOD) to around 91m aOD.

1.3 Soils and Geology

1.3.1 The underlying geology is mapped as the Grampound Formation with sandstone specifically mapped in the northern part of Site and siltstone and mudstone in the southern part of Site (British Geological Survey). No superficial geology is recorded.

1.3.2 The soils underlying the Site are divided between typical brown, loamy/silty soils of 611c (Manod) association and 541K (Denbigh 2) (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

1.4 Archaeological Background

1.4.1 A Desk-based Assessment has been prepared by Wessex Archaeology to determine, as far as is possible from existing information, the nature, extent and significance of the historic environment (WA 2014). The results of this assessment will be referred to, where relevant, in the discussion of the geophysical results.

2 METHODOLOGY

2.1 Introduction

2.1.1 The detailed magnetometer survey was conducted using Bartington Grad601-2 dual fluxgate gradiometer systems. The survey was conducted in accordance with English Heritage guidelines (2008).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 1st and 3rd December 2014. Field conditions at the time of the survey were good, with firm conditions under foot. In total the geophysical survey covered 3.5ha.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).

2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.

2.2.3 Data from the survey were subject to minimal data correction processes. These comprise a Zero Mean Traverse (ZMT) function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. The deslope and add functions were used to account for errors in the ZMT function and to remove grid edge discontinuities. These four steps were applied to all survey areas, with no interpolation applied.

2.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The gradiometer survey has identified anomalies of definite, probable and possible archaeological interest; these anomalies include at least four probable roundhouses with associated enclosure ditches and numerous sub-circular clusters of anomalies of increased magnetic response. Results are presented as a series of greyscale plots, XY trace plots, and archaeological interpretations at a scale of 1:1250 (**Figures 2** to **5**). The data are displayed at -4nT (white) to +6nT (black) for the greyscales and ±25nT at 25nT per cm and ±50nT at 50nT per cm for the XY traces.

3.1.2 The interpretation of the datasets highlights the presence of definite, probable and possible potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 5**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.2 Detailed Gradiometer Survey Results and Interpretation

3.2.1 There are four distinct sub-circular anomalies at the site; **4000**, **4001**, **4002** and **4003** with openings facing east. These have been interpreted as archaeology and are thought to correspond to the footprint of Iron Age/Roman settlement structures. Possibly associated with these are a series of ditches and fragmented ditches across the Site. Ditches **4004** and **4005** divide off **4001** with **4006** potentially representing an earlier round house structure or perhaps a gateway into the area of **4001**. Within **4000** there are numerous small positive anomalies that may present post holes or features associated with the round house.

3.2.2 Across the Site are numerous fragments of ditch features. At **4007** a ditch runs SSW to NNE, it is unclear if this represents a continuation of ditch feature **4005** and/or whether it once continued and joined on to the ditch segment at **4008**. Between **4007** and **4008** there is an area of increased magnetic response, **4009**, this anomaly shares a similar alignment to the two ditch fragments and is potentially related.

3.2.3 A further ditch fragment, **4010**; does not appear to be related to any of the previously discussed sections. The west end of this ditch stops at **4008** continuing on the same alignment though are five sub-circular positive anomalies which have been interpreted as possible archaeology and may be related.

3.2.4 On the west side of the Site, a ditch, **4011** extends from southern edge of the Site for *c.*70m and ends abruptly. It is not clear whether this feature may have extended further or not, nor is it clear whether it is related or contemporary with the other ditch features seen at the Site.

3.2.5 Within the north-eastern part of the Site **4012** ditch curves from the north to the south west. It is possible that this represents a continuation of the ditch highlighted at **4010**; however the relationship is unclear due to the activity in the central area of the Site. Within this central area is a segment of ditch, **4013**, that extends to the northwest from the NNW of **4003** with a further section immediately to the north of the possible dwelling feature at **4003**. The last ditch fragment that has been highlighted in this survey is **4014** which has no clear alignment with any of the other features.

3.2.6 The central area of the Site is dominated by **4015**, a highly magnetic sub circular feature with opening on the south west and is unlike **4000** to **4003** which are larger with openings on the east. This has been interpreted as possible archaeology as it is also distinct from the other sub-circular features that are present across the site. The origin of this feature is unclear but given that it is highly magnetised suggests it could relate to a bomb that is recorded as being dropped on this field during the Second World War.

3.2.7 Historic mapping presented in the DBA (Wessex Archaeology 2014) shows a track way that follows the southern extent of the Site and then curves north. It is likely that **4016** relates to the track way.

3.2.8 The most enigmatic anomalies that have been highlighted in the detailed gradiometer survey are the clusters increased magnetic response; such as at **4017**, **4018** and **4019**. Some of these anomalies have distinct semi-circular edges, i.e. **4017** and **4019** but others, such as **4018** are only clusters of amorphous anomalies. As such aspects of these have been interpreted as possible archaeology due to their distinct form. It is considered that these features relate to this area formerly being covered by woodland. These magnetic anomalies could represent areas of burning associated with woodland clearance or are related to woodland management, such as charcoal production. Burning would best explain the spikey readings in the XY trace plots (**Figures 3** and **4**). The production of charcoal involves platforms on which the wood is burnt.

3.2.9 There are several linear trends present across the Site many of which have no discernible origin. **4020** shows a linear trend that crosses the site from east to west which may represent an old boundary whereas. **4021** and **4022** have distinct rectilinear forms that may be weakly contrasting archaeological features.

3.2.10 There are numerous small positive anomalies in the geophysical data, most form no significant patterns. These are considered to possibly represent small cut features such as small pits or postholes.

3.3 Detailed Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 No modern services have been identified in the geophysical data however it should be noted that gradiometer survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of definite, probable and possible archaeological interest within the Site, in addition to regions of increased magnetic response.

4.1.2 A great concentration of archaeological features has been detected in the geophysical data that suggest this ridge was quite densely populated. Four distinct roundhouse features can be identified with land divisions and enclosure ditches. The origin of the numerous ditches is unclear but is likely that some are contemporary or at least related to the round house features.

4.1.3 Much of the central area of the Site is disturbed and the relationship between the ditches is very confused. The circular, highly magnetised feature in the centre of the Site could potentially relate to a bomb dropped in the field during the Second World War.

4.1.4 The clusters of increased magnetic response that are visible across the Site are enigmatic but are potentially related to woodland management and clearance. Historic mapping (WA 2014) shows the Site has being part of Treveale Wood; it is possible these features are contemporary with the felling of the trees and may be relatively recent in date.

4.1.5 It is considered highly likely that the archaeology detected through this geophysical survey continues in nearly all directions. With the ditch features extending further north, west and south.

4.1.6 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey.

5 REFERENCES

5.1 Bibliography

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline* No 1, 2nd edition.

Wessex Archaeology, 2014. *Treveale Farm, Ladock, Cornwall: Archaeological Desk-Based Assessment*. Report reference 104430.01

5.2 Cartographic Sources

British Geological Survey
http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html

Ordnance Survey, 1957. *Sheet 2, Geological Map of Great Britain: England and Wales*. Ordnance Survey: Chessington.

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APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m Site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

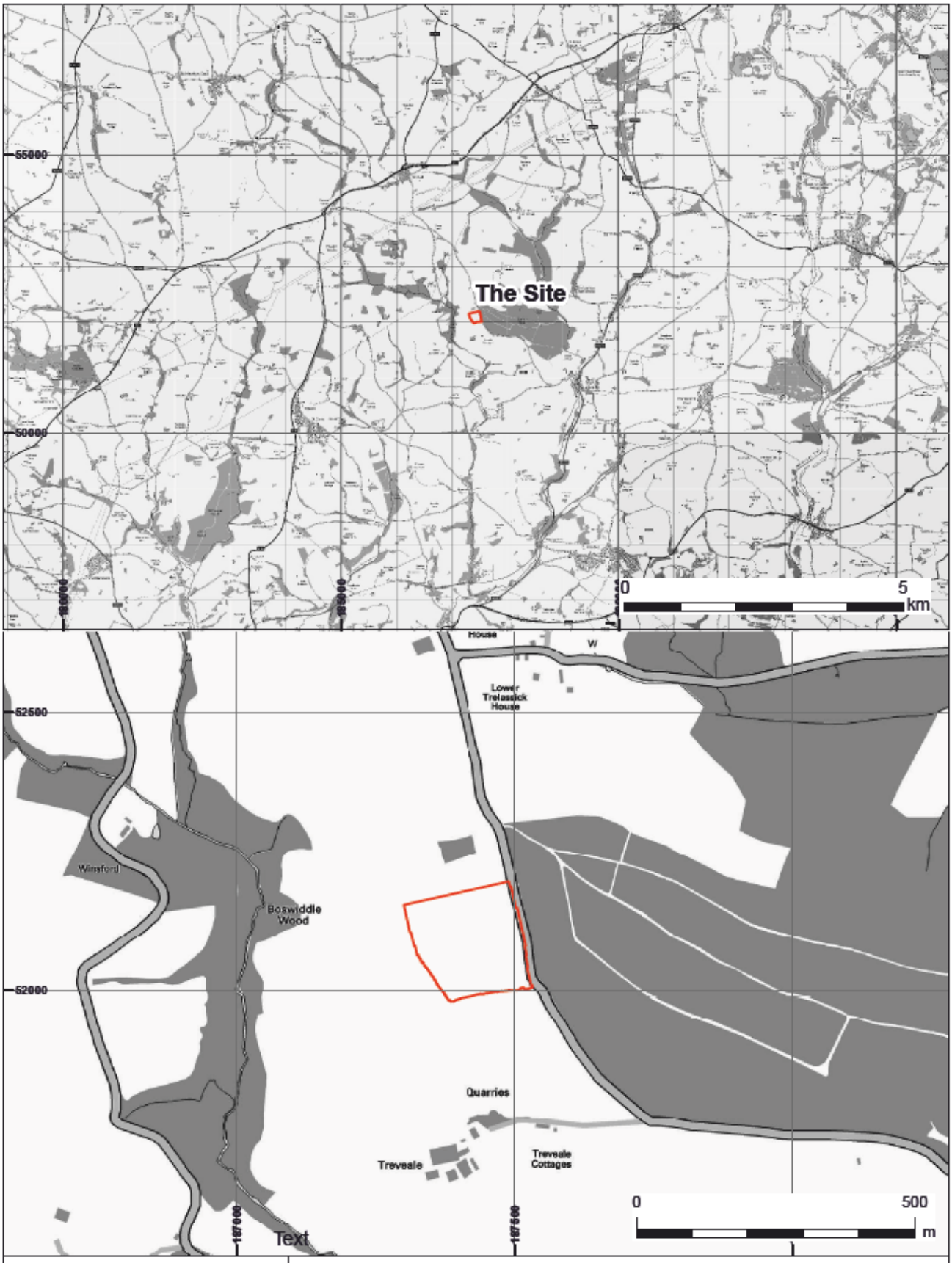
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Agricultural ditches – used for ditch sections that are aligned parallel to existing boundaries and former field boundaries that are not considered to be of archaeological significance.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



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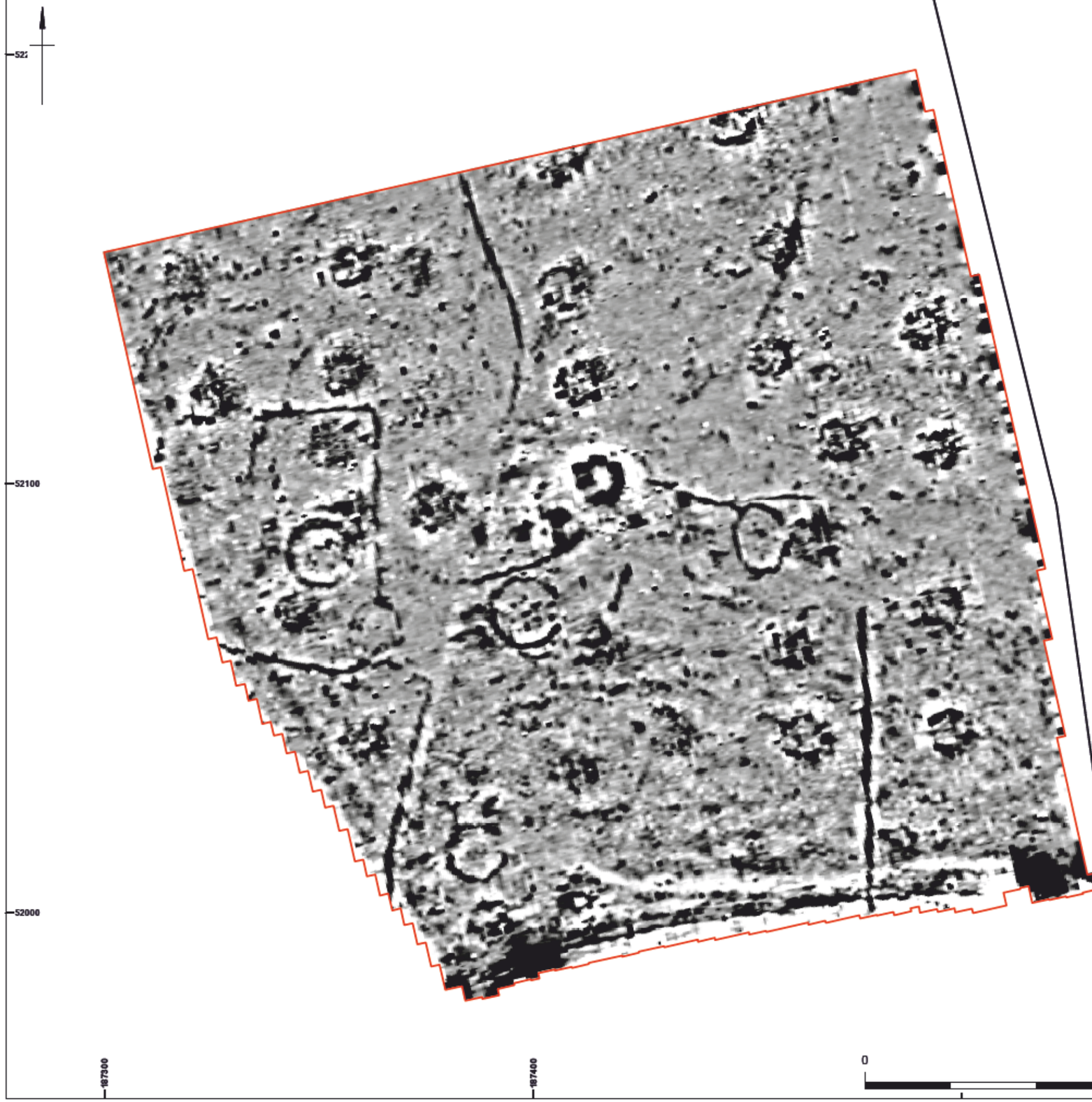
Site Location and Survey Extent

Figure 1



Gradiometer Survey Extents

6 nT

-4 nT

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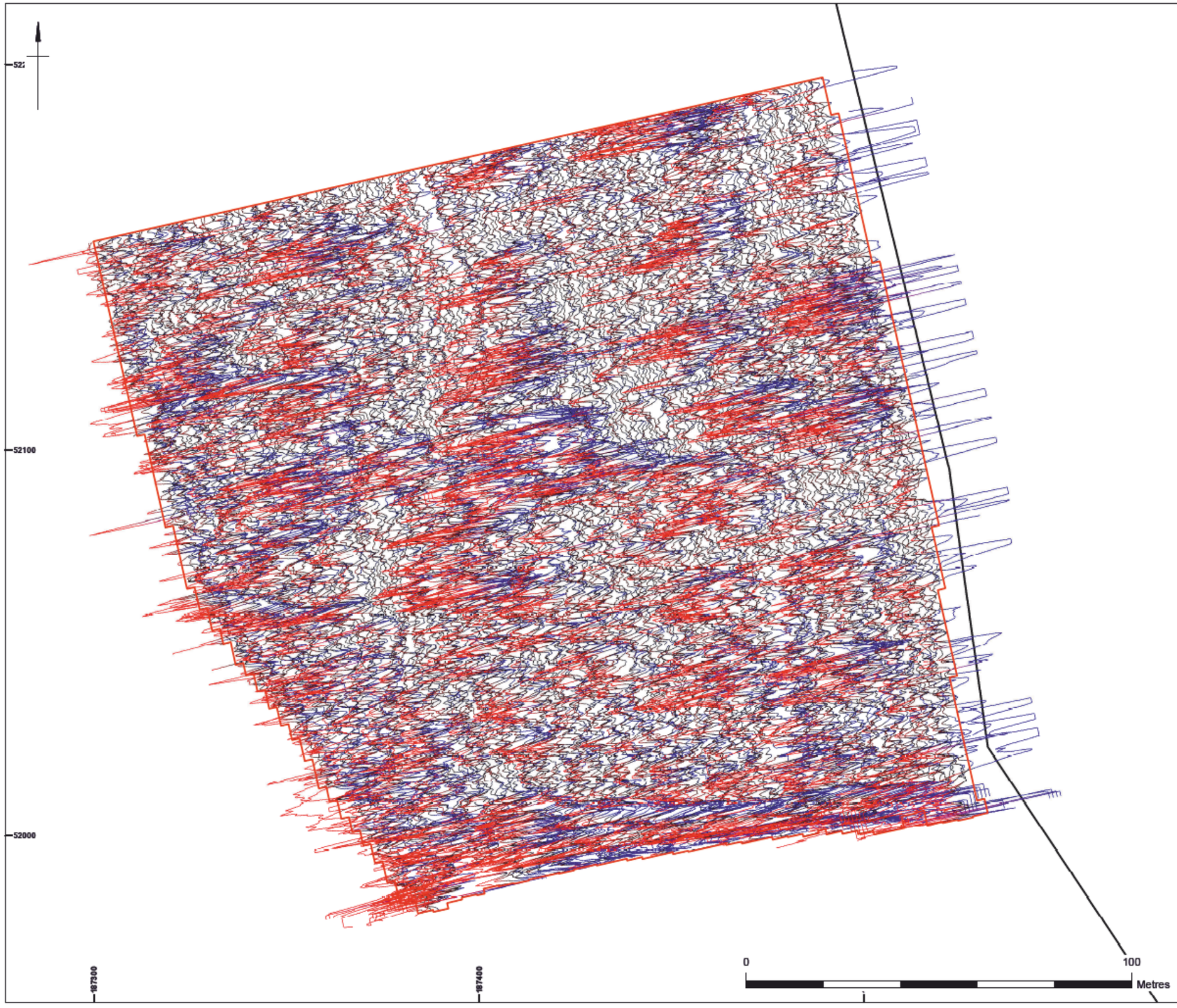
Detailed Gradiometer Results - Greyscale

Figure 2



Gradiometer Survey Extents

25 nT

-25 nT

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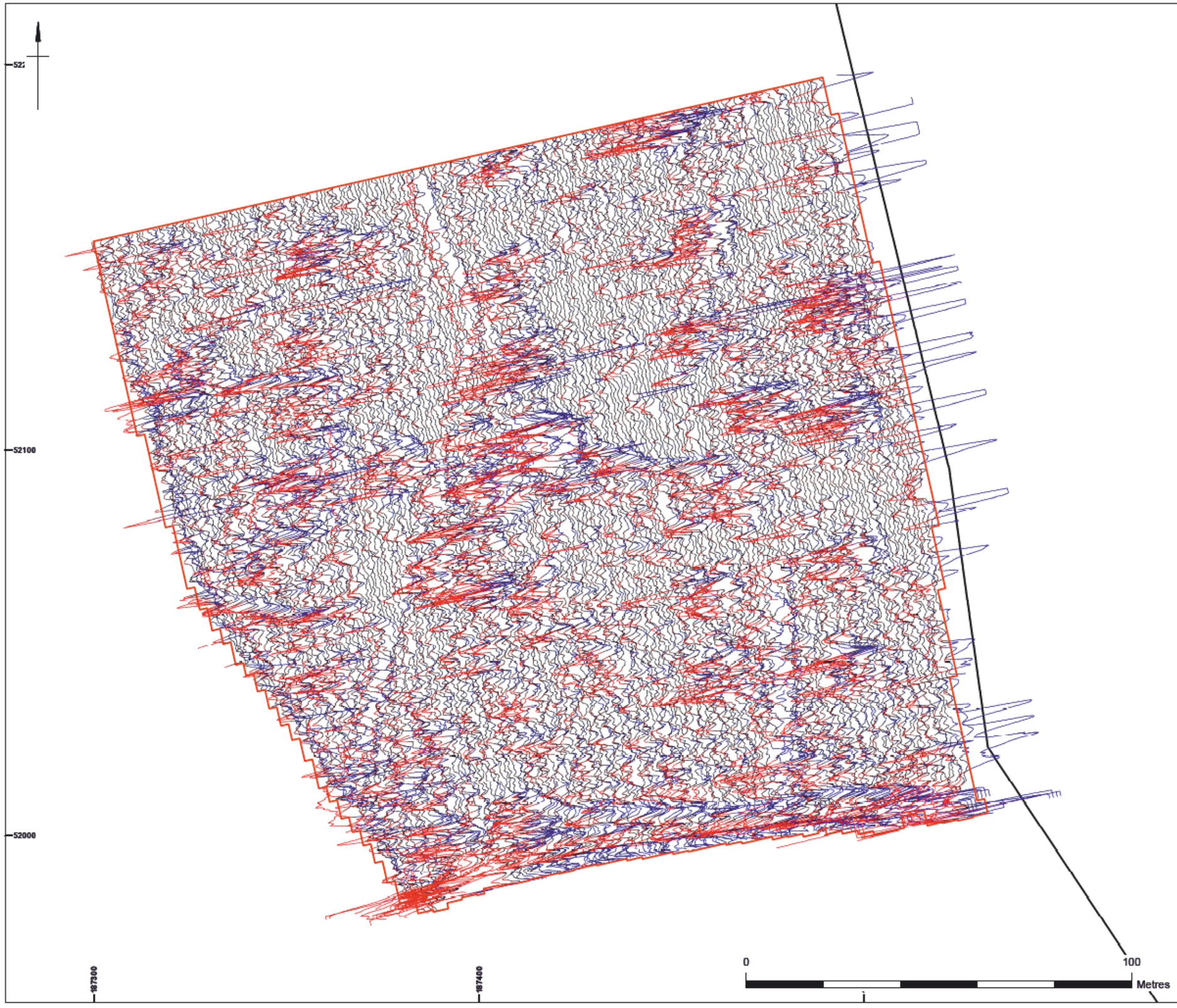
Detailed Gradiometer Results - XY Plot 1

Figure 3



Gradiometer Survey Extents

50 nT

-50 nT

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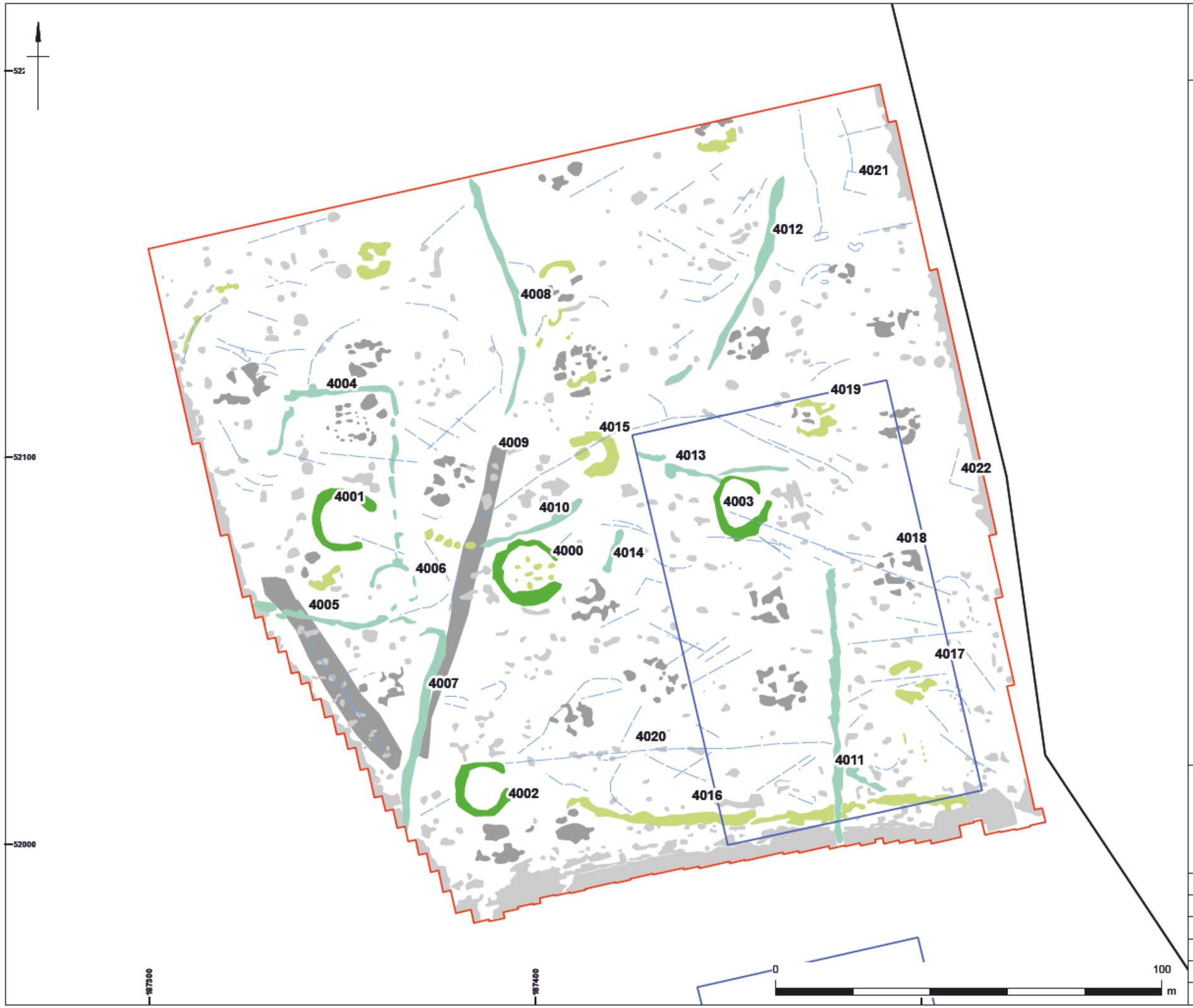
Detailed Gradiometer Results - XY Plot 2

Figure 4



Gradiometer Survey Extents
Trend
Archaeology
Probable Archaeology
Possible Archaeology
Ferrous
Increased Magnetic Response
Development Footprint

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Revision Number:	0
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Detailed Gradiometer Results - Interpretation

Figure 5

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