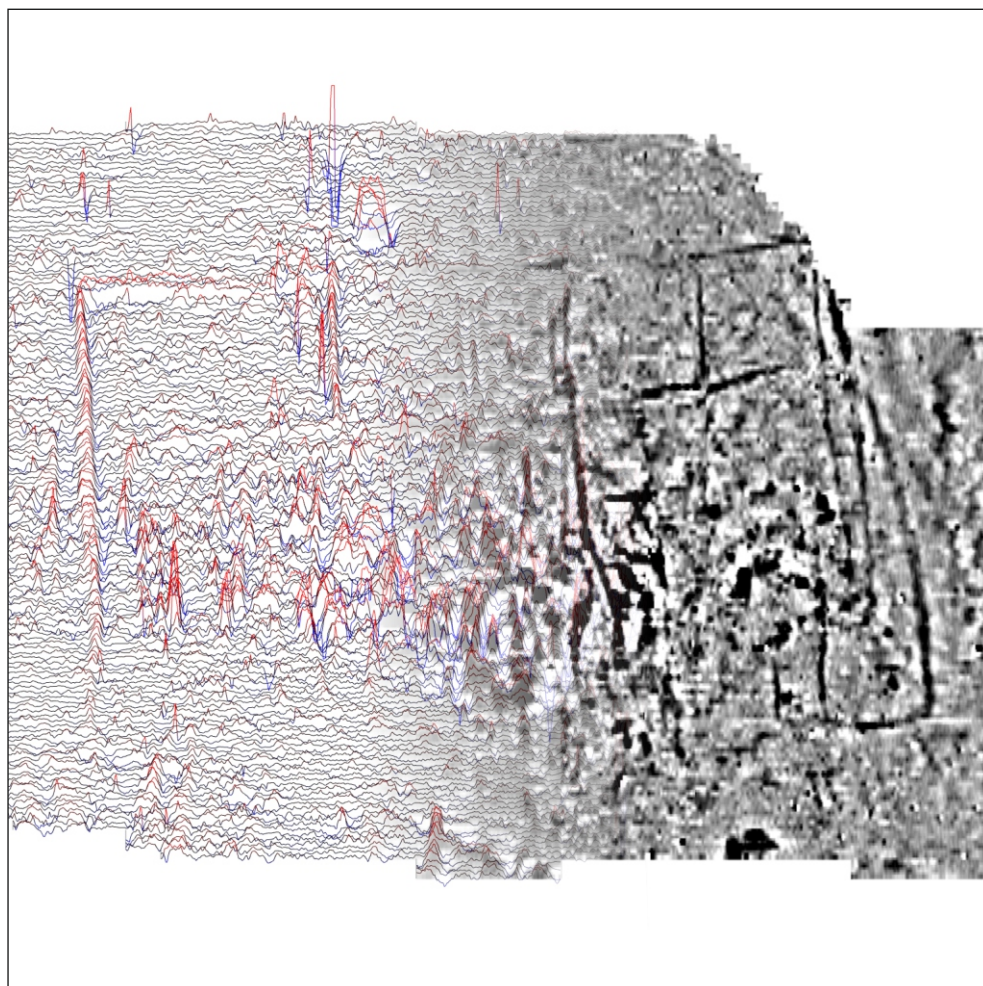




making sense of heritage

Land at High Field House Grantham, Lincolnshire

Detailed Gradiometer Survey Report



Ref: 104420.01
June 2014



Land at High Field House Grantham, Lincolnshire

Detailed Gradiometer Survey Report

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Land at High Field House Grantham, Lincolnshire

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Summary

Wessex Archaeology was commissioned by Rapid Technology Transfer Group on behalf of their client Sonnet Energy Ltd. to undertake a detailed gradiometer survey of land south of High Field House, near Grantham, Lincolnshire (centred on NGR 496050, 342875 and 495850, 342250). The aim of the work was to establish the presence, or otherwise, and nature of detectable archaeological features on the site as part of a programme of archaeological works ahead of proposed development at the Site.

The site is located approximately 7.85km northeast of the centre of Grantham and 2.6km southwest of Ancaster. The site comprises one arable field located to the south of High Field House within a valley that forms the beginning of the main tributary of the River Slea.

Detailed gradiometer survey was undertaken over all accessible parts of the site, a total of 13.1ha, and has demonstrated the presence of anomalies of likely, probable and possible archaeological significance along with several spreads of increased magnetic response and at least one former field boundary. The main concentration of archaeological features was located in the southern survey area where a sub-rectangular enclosure was detected. A track and associated field system was identified in the northern survey area.

The survey was undertaken between 15th and 19th May 2014.



Land at High Field House Grantham, Lincolnshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Rapid Technology Transfer Group on behalf of their client Sonnet Energy Ltd.

The fieldwork was carried out by Phil Roberts, Philipp Maier, Laurence Savage, Martyn Cooper and David Loeb. The geophysical data was processed and interpreted by Ross Lefort and Alistair Salisbury. This report was written by Ross Lefort and Ash Tuck. The geophysical work was quality controlled by Dr. Paul Baggaley and Ben Urmston. Illustrations were prepared by Ross Lefort and Rob Goller. The project was managed on behalf of Wessex Archaeology by Christopher Swales.



Land at High Field House Grantham, Lincolnshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by Rapid Technology Transfer Group on behalf of their client Sonnet Energy Ltd. to carry out a programme of geophysical survey over land to the south of High Field House, near Grantham, Lincolnshire (**Figure 1**) hereafter “the Site” (centred on NGR 496050, 342875 and 495850, 342250). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

1.1.2 A Written Scheme of Investigation (WSI) has been prepared by Wessex Archaeology that sets out the methodology and the aims of the geophysical survey (Wessex Archaeology 2014). The aims of the geophysical survey were:

- *to conduct a detailed magnetometer survey that covers as much of the specified area as possible, allowing for artificial obstructions;*
- *to clarify the presence/absence and extent of any buried archaeological remains within the Site;*
- *to clarify the general nature of the remains present, and;*
- *to produce a report that will present the results of the geophysical survey in sufficient detail, to support an informed decision to be made concerning the Site’s archaeological potential.*

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 comprises two separate survey areas within an arable field to the south of High Field House, some 7.85km northeast of the centre of Grantham and 2.6km southwest of Ancaster in Lincolnshire (**Figure 1**). The survey area is located less than 2km to the west of the Roman road named Ermine Street (B6403). The survey area is bounded by field boundaries to the west and east with the northern extents defined by the limits of the proposed development.

1.2.2 The survey area lies on the east facing slope of a stream valley aligned roughly north-south. The height of the land falls from just over 100m above Ordnance Datum (aOD) at the southern end of the Site to under 90m aOD at the northern end of the Site. The main tributary of the River Sleas flows along the eastern edge of the Site and flows towards Ancaster before it flows into a larger watercourse by Sleacombe further east. The River Witham flows a few kilometres to the west of the Site.

1.3 Soils and Geology

1.3.1 The bedrock geology under the Site is composed of a mix of limestone and mudstone deposits including Lower Lincolnshire limestone member limestone and lime-mudstone



and deposits of Whitby mudstone formation. All of these deposits date to the Jurassic. There are few superficial deposits recorded with only some head deposits (clay, silt, sand and gravel) and Belton sand and gravel recorded at the base of this valley that date to the Quaternary (BGS).

- 1.3.2 The soils underlying the Site are mostly recorded as brown rendzinas of the 343a (Elmton 1) association. There are some deposits of typical stagnogley soils of the 711f (Wickham 2) association and typical sandy gley soils of the 821b (Blackwood) association towards the northern end of the Site (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.

2 ARCHAEOLOGICAL BACKGROUND

- 2.1.1 The following information is summarized from information available online at Heritage Gateway. Two recorded findspots lie within the boundaries of the Site: Romano-British pot and roof tile in the southern portion of the Site, and a possible medieval net-weight in the northern part.

2.2 Prehistoric and Roman

- 2.2.1 Prehistoric and Roman records include a Mesolithic arrowhead and a Bronze Age arrowhead that were both recovered from the beck which forms the eastern boundary of the Site. On the far side of the beck, Mesolithic and Bronze Age flints, Iron Age/Romano-British pottery, Roman roof tile and a Roman bracelet have been found on a number of separate occasions. It has been suggested that there may be a ritual site associated with the source of the River Slea. Neolithic or Bronze Age flints were found at Willoughby Heath, approximately 1km east of the Site.
- 2.2.2 Honington Camp is located a few hundred metres west of the Site, and consists of earthwork remains of an Iron Age multivallate plateau hillfort. Finds include “bits of spears, bridles and swords” and a Roman coin hoard recovered in the late 17th century and partially obtained by William Stukeley in 1728. Finds of Roman coins continue up to the 1990s. Field investigations were undertaken at the hillfort in 1976 that identified the entrance in the southeast angle. Three probable Bronze Age ring ditches are present immediately west of Honington Camp, with Iron Age and Romano-British pottery recovered from this location.
- 2.2.3 Probable prehistoric enclosures are visible as cropmarks north, west and south of Honington Camp, with a pit and a trackway identified south-east of the camp. Many finds have been recovered all around Honington Camp, including Neolithic flints, possible beaker pottery, Bronze Age flints and pottery, a Bronze Age or Iron Age saddle quern, Iron Age pottery and slag, and Roman and Romano-British pottery and glass including an intaglio of green glass with two figures holding barley on one side and the letters AW on the other.
- 2.2.4 Three sherds of Romano-British pottery and one fragment of Roman tile were found within the southern survey area of the Site. No concentration of material was visible to indicate the site of a building.
- 2.2.5 South of West Willoughby and east of High Field House, on land belonging to Hall Farm, a Roman Villa was excavated in 1954/5 by the Lincoln Archaeological Research Committee. Roof and flue tiles, pottery, plaster, coins of Constantine and scraps of bronze were recovered. The site has been damaged by deep ploughing. In the same field, a possible Bronze Age barrow with a fingered urn was identified in 1955. Undated prehistoric flints and a possible antler pick have also been recovered separately, also in the same field.



Immediately east of the villa, Romano-British pottery, building debris and coins of Constantine were also recovered.

- 2.2.6 During the 1960s, road improvements to the A153 near Honington House northwest of the Site uncovered Romano-British pot, flints and a rough wall.
- 2.2.7 Further to the northeast is the town of Ancaster that is the site of a Roman town built over a preceding fort and an Iron Age settlement. The town is located on Ermine Street that runs past the east of the Site. The 3rd century defences that surround the site enclose a 3.5ha area but the settlement and cemeteries associated with it extend beyond this boundary. This settlement and its Iron Age forerunner most likely served as a significant focal point for trade for the surrounding countryside.

2.3 Medieval and post-medieval

- 2.3.1 A possible medieval net weight was recovered from the northern part of the Site. The village of West Willoughby is recorded in the Domesday Book and in later taxations. Earthworks representing a medieval farmyard are visible and a number of medieval artefacts have been discovered in the village. An “old stone pit” is recorded on the 1905 Ordnance Survey (OS) map to the north of Honington Camp.

3 METHODOLOGY

3.1 Introduction

- 3.1.1 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).
- 3.1.2 The geophysical survey was undertaken by Wessex Archaeology’s in-house geophysics team between 15th and 19th May 2014. Field conditions at the time of the survey were good, with firm conditions under foot. In total the geophysical survey covered 13.1ha.

3.2 Method

- 3.2.1 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).
- 3.2.2 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.
- 3.2.3 Data from the survey were subject to minimal data correction processes. These comprise a Zero Mean Traverse (ZMT) function ($\pm 5\text{nT}$ 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.
- 3.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.



4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

- 4.1.1 The gradiometer survey has identified numerous anomalies of archaeological interest; these anomalies include a probable settlement enclosure and a track and associated field system. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**Figures 2 to 6**). The data are displayed at -2nT (white) to +3nT (black) for the greyscales and $\pm 25\text{nT}$ at 25nT per cm for the XY traces.
- 4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figures 4 and 7**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**. The archaeology and probable archaeology interpretation categories have an additional weak response counterpart; these additional categories were added due to the greater variation in strength of magnetic response across this Site.
- 4.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance although many may relate to the twentieth century military occupation in the area.

4.2 Gradiometer Survey Results and Interpretation

- 4.2.1 The most noticeable feature in the southern survey area is a sub-rectangular enclosure defined by ditches at **4000 to 4003**; the eastern side of the enclosure is less well-defined with only a few isolated weak ditch sections such as **4004** that may define this eastern side. The enclosure ditches have variable magnetic values across their lengths with the strongest areas measuring over +2.5nT with the weaker regions measuring around +1nT. The enclosure measures approximately 170m x 90m and is aligned NNE-SSW. The enclosure ditches are mostly defined as archaeology with some isolated ditch sections classed as probable archaeology.
- 4.2.2 The enclosure interior is sub-divided into smaller areas with several clear sub-enclosures running up the western side at **4005 to 4009** with a possible track defined by weak ditches at **4010** that appears to link them. The eastern side of the enclosure has some ditches that may also serve as sub-divisions but are not as clear as those observed along the west. Instead the eastern side is dominated by strong positive sub-oval and elongated anomalies in a concentrated spread running from **4011 to 4012**; these anomalies are considered to represent pits and short ditch sections. A ditch appears to run through this spread at **4013** that may sub-divide this area. An intermittent oval alignment around **4014** may prove to be of significance. All of these anomalies have magnetic values over +3nT and have been classed as either archaeology, probable archaeology or possible archaeology depending on their size, shape and patterns of distribution.
- 4.2.3 There are a number of other weak ditches running across the enclosure interior at differing alignments such as a cross-shaped arrangement south of **4012**. The function of these ditches is unclear and it is unknown if they are contemporary with the enclosure.
- 4.2.4 There are a number of ditches outside the rectangular enclosure at **4015 to 4017** that may be representative of continuations to these enclosed areas or may represent a field system radiating from this enclosure.
- 4.2.5 Two large pits are visible outside of this enclosure; one at **4018** is sub-oval in shape, measures 6.5m and has magnetic values over +5nT whereas the other at **4019** is elongated and more irregular in shape with a length of 10m and magnetic values over 3nT. Both features are surrounded by a negative halo, defined by increased magnetic response, with values around -2nT. The regular shaped pit at **4018** is classed as archaeology whereas the irregular pit at **4019** is classed as probable archaeology.



- 4.2.6 A very weak positive linear runs past the northern side of the enclosure at **4020**; this anomaly has magnetic values around +0.5nT with diffuse edges and is set on an ENE-WSW alignment. This anomaly has been classed as possible archaeology as unclear whether this represents a weak ditch or a geological feature such as a palaeochannel.
- 4.2.7 There are numerous broad spreads of dipolar and bipolar anomalies (black and white) across this survey area. Some such as those within the enclosure are likely to relate to concentrations of archaeological material but others such as the spreads north of the enclosure may prove to be geological. The remaining anomalies include weak linear trends of uncertain origin and small positive anomalies of possible archaeological significance; these small anomalies could represent small pits or postholes but could equally represent natural features.
- 4.2.8 The next survey area further north possesses a far lower concentration of archaeological features with a single track forming the most noticeable feature. This track runs north-south through the survey area at **4021** to **4023** and appears to fade out by **4023**. This track is defined by parallel ditches spaced 6m apart with magnetic values ranging from less than +0.5nT to over +2nT. Other ditches and another track appears to extend off of this main track at **4022** and **4023** with other possible related ditches noted at **4024** and **4025**. These ditches and tracks appear to define a field system that cannot be linked with any recent scheme of agricultural division. The ditches have been classed as either archaeology, probable archaeology or possible archaeology based on their form in plan.
- 4.2.9 Another pit with clear negative halo is present at **4026** that is similar to the example noted at **4019**. This pit is elongated with a length of 12m and magnetic values of +2nT for the pit and less than -1nT for the halo. This pit has been interpreted as probable archaeology.
- 4.2.10 A group of parallel ditches are visible at **4027**; these ditches do not fit with the pattern formed by the tracks and ditches discussed above and the 1889 OS map shows it to be a former field boundary that is mapped until 1956.
- 4.2.11 There are more spreads of increased magnetic response in this field although they cover a smaller area. Some of the isolated spreads in the interior of the field may prove to be of archaeological significance but the spread running along the eastern field boundary at **4028** almost certainly defines a modern track that runs along this area. The remaining anomalies include weak linear trends of uncertain origin and small positive anomalies of possible archaeological interest.
- 4.3 Gradiometer Survey Results and Interpretation: Modern Services**
- 4.3.1 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.



5 DISCUSSION

5.1 Summary

- 5.1.1 The detailed gradiometer survey has been successful in detecting anomalies of likely, probable and possible archaeological interest, in addition to spreads of increased magnetic response and at least one former field boundary.
- 5.1.2 The geophysical data has revealed a large sub-divided enclosure that shows some evidence of division into areas of specialised activity with small enclosed areas along the western side and pits, possibly related to storage along the eastern side. This enclosure lies close to the findspot of Roman material and given the regular shape of this enclosure may be contemporary. This enclosure lies in a valley that runs towards the Roman town at Ancaster and Ermine Street and, if proven to be Romano-British in date, may have been closely linked to the settlement at Ancaster.
- 5.1.3 The tracks detected in the northern survey areas are similar to tracks observed from cropmarks further southwest around Honington Camp. It is possible that such tracks are a common feature of this agricultural landscape although their date of use is unclear.
- 5.1.4 As was mentioned in the archaeological background this area is considered a possible location for a shrine associated with the source of the River Slea. There is no evidence within the layout of the enclosure detected to suggest it represents any more than a settlement site.
- 5.1.5 A large proportion of the features detected relate to relatively recent use of this area for agriculture with numerous ploughing scars, a modern track and one former field boundary detected.
- 5.1.6 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.



6 REFERENCES

6.1 Bibliography

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

Wessex Archaeology, 2014. *Land at High Field House, Grantham, Lincolnshire: Written Scheme of Investigation for Geophysical Survey*. Report T18734.01

6.2 Cartographic Sources

British Geological Survey

<http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html>

Ordnance Survey, 1956. *Lincolnshire*, 1:10,560.

Ordnance Survey, 1889. *Lincolnshire*, 1:2,500.

Soil Survey of England and Wales (SSEW), 1983: *Sheet 5, Soils of South West England*.
Ordnance Survey: Southampton.



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 ± 100 nT 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:

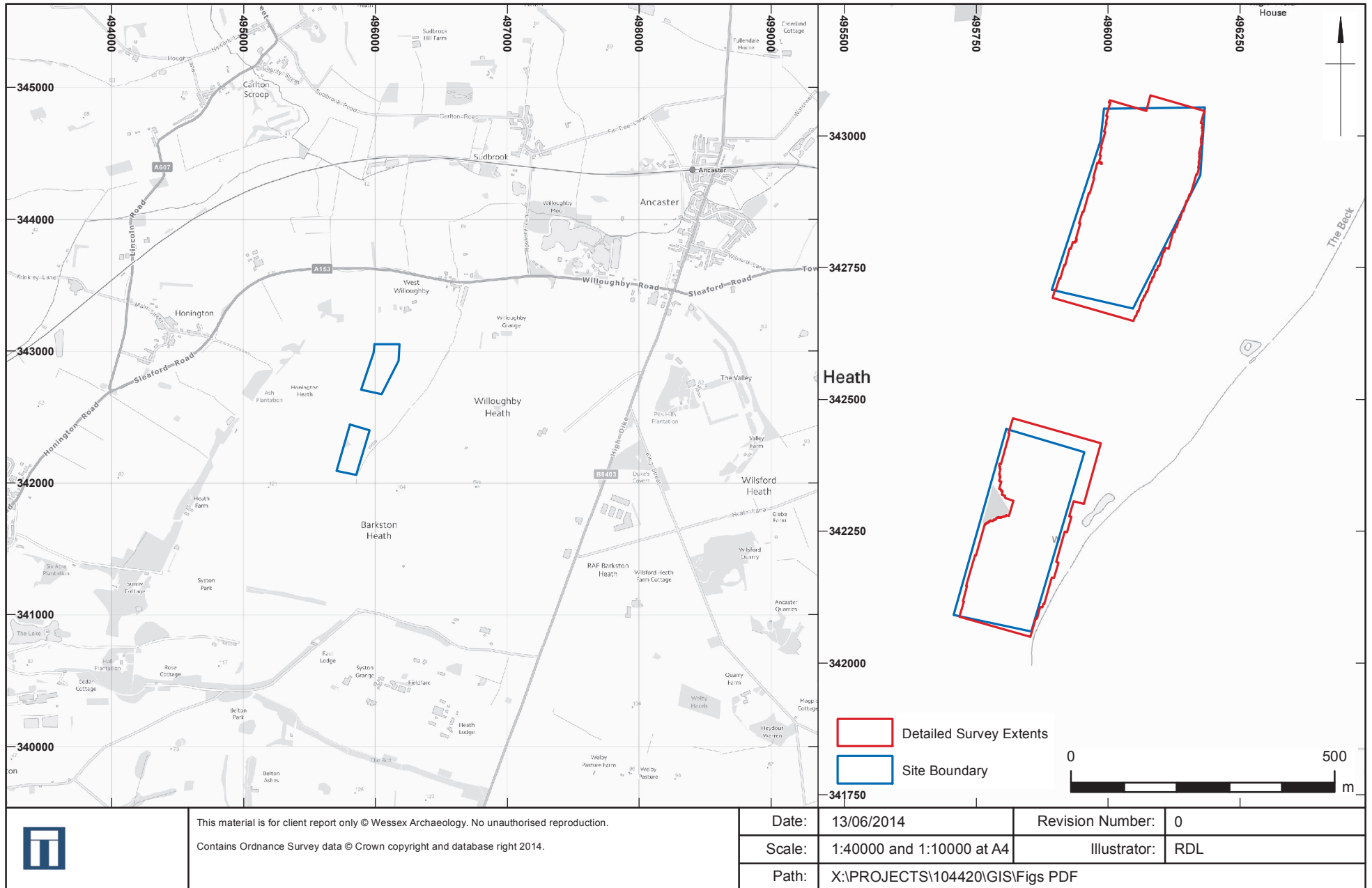
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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

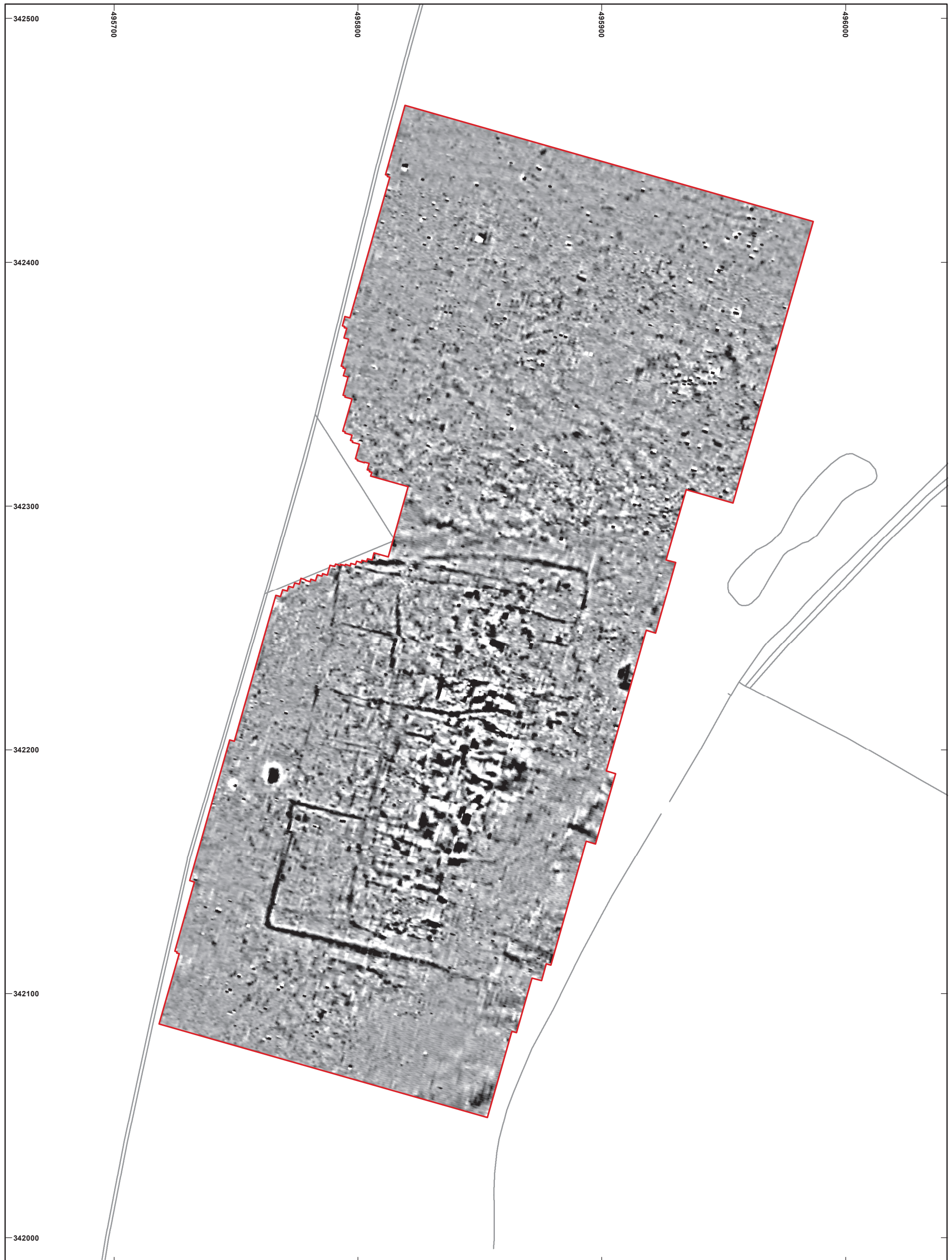
The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- 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.



Site location map and detailed survey extents

Figure 1



+3nT

-2nT

Detailed Survey Extents

0

100

m

↑

↓

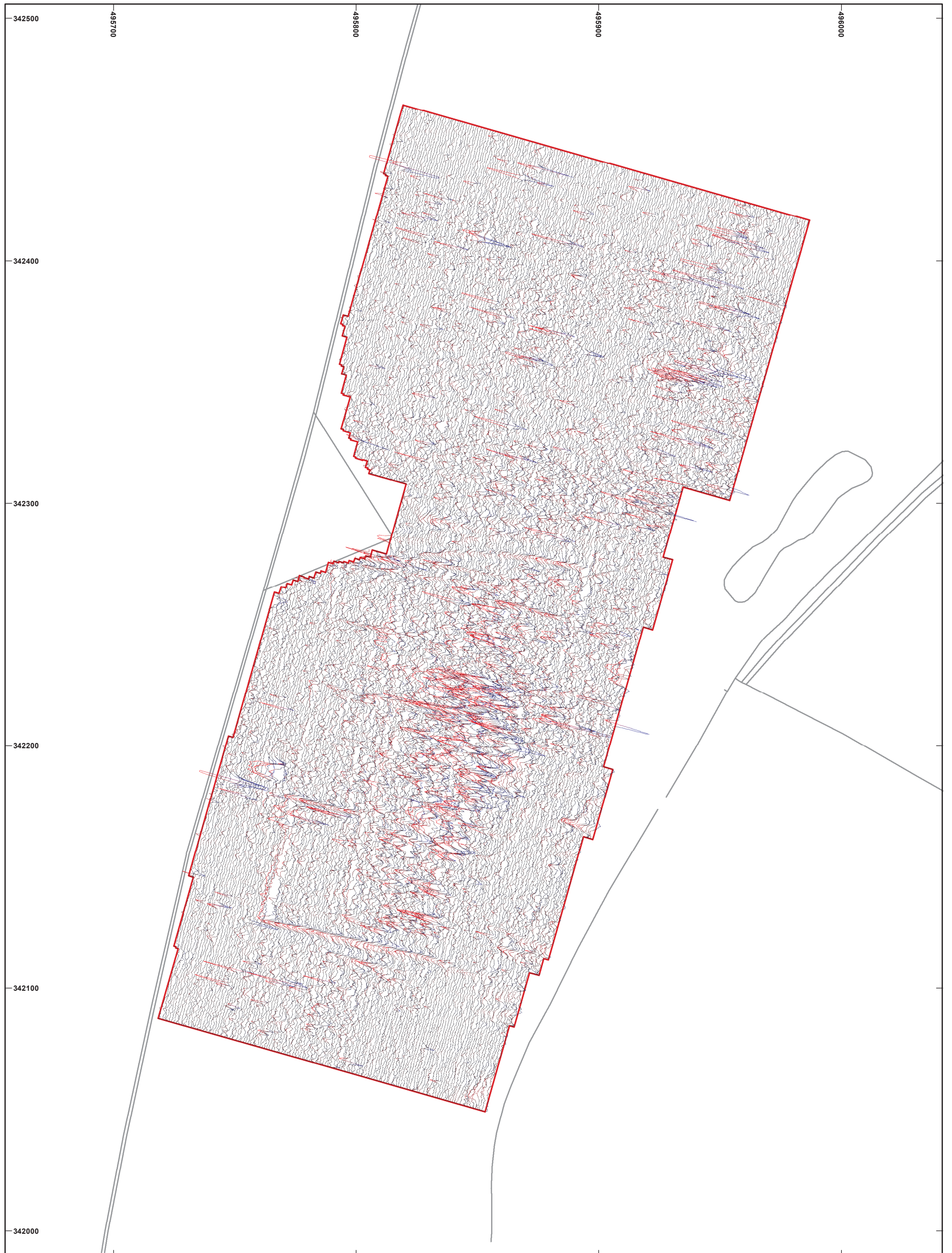
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Greyscale plot, south

Figure 2



+25nT

-25nT

Detailed Survey Extents

0

100

m

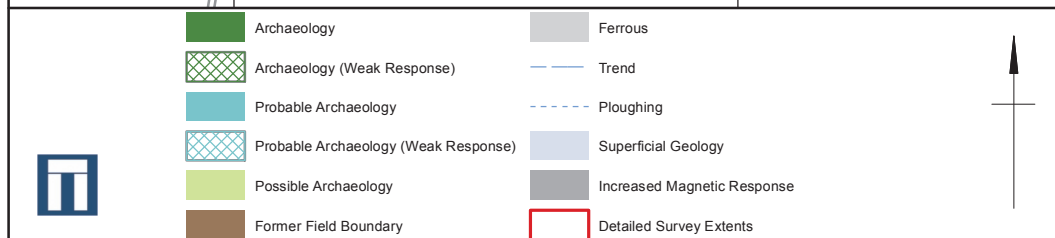
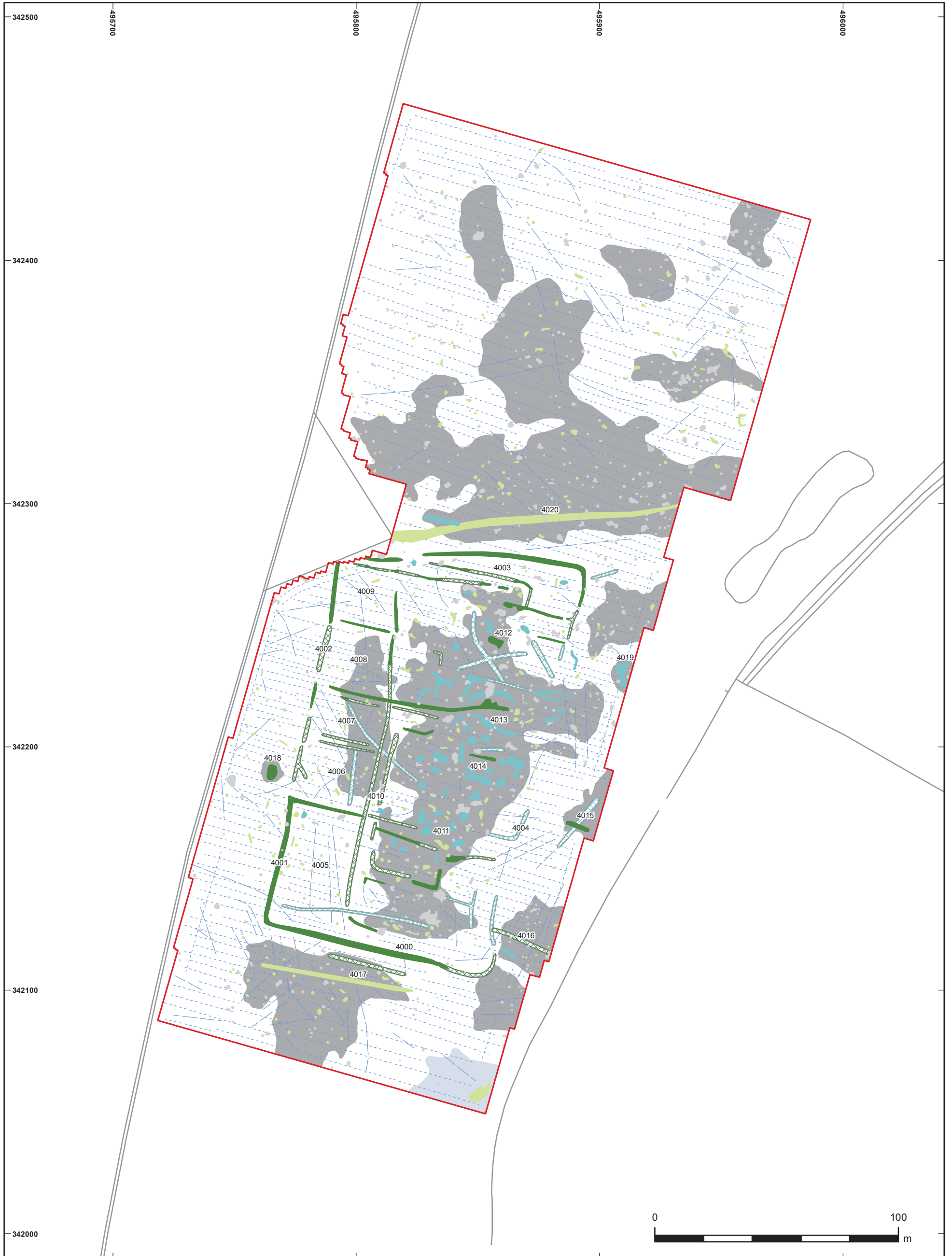
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XY trace plot, south

Figure 3



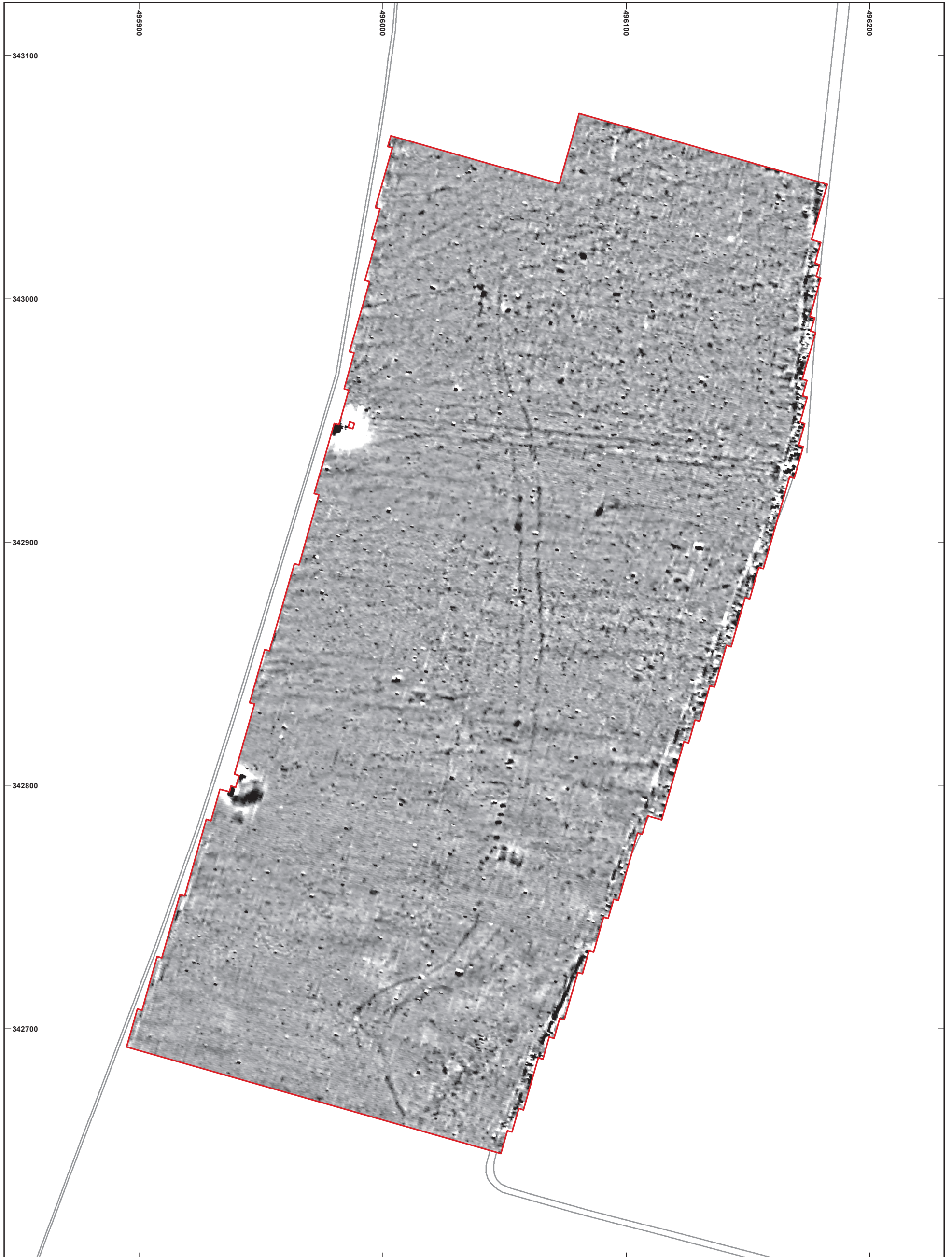
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Path:	X:\PROJECTS\104420\GIS\Figs PDF		

Interpretation, south

Figure 4



+3nT

-2nT

Detailed Survey Extents

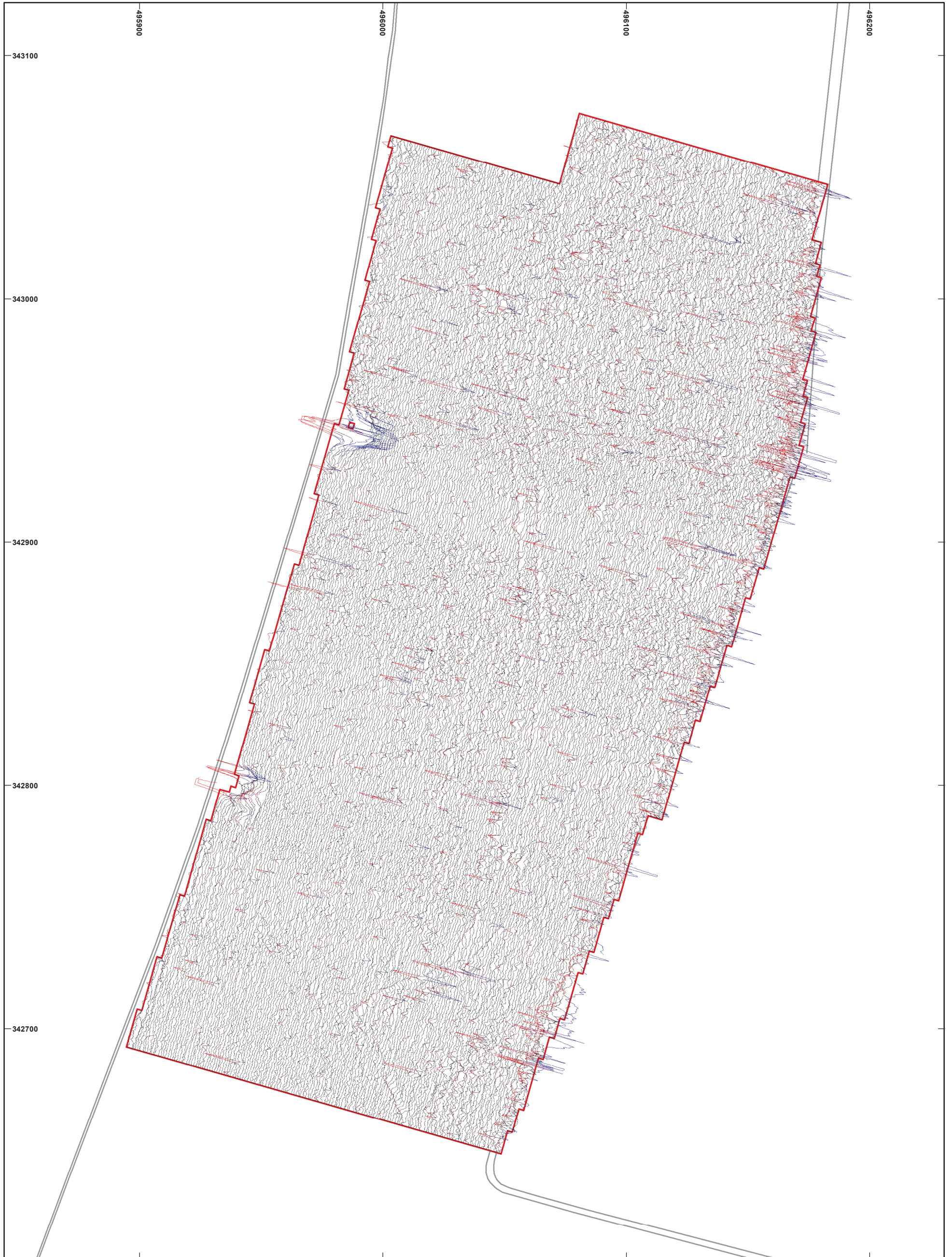
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Greyscale plot, north

Figure 5



+25nT

-25nT

Detailed Survey Extents

0 100 m

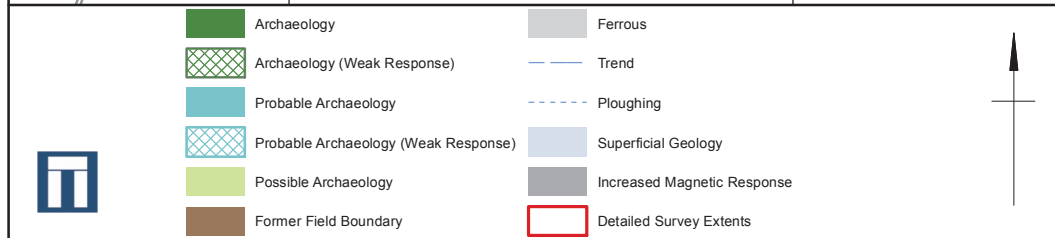
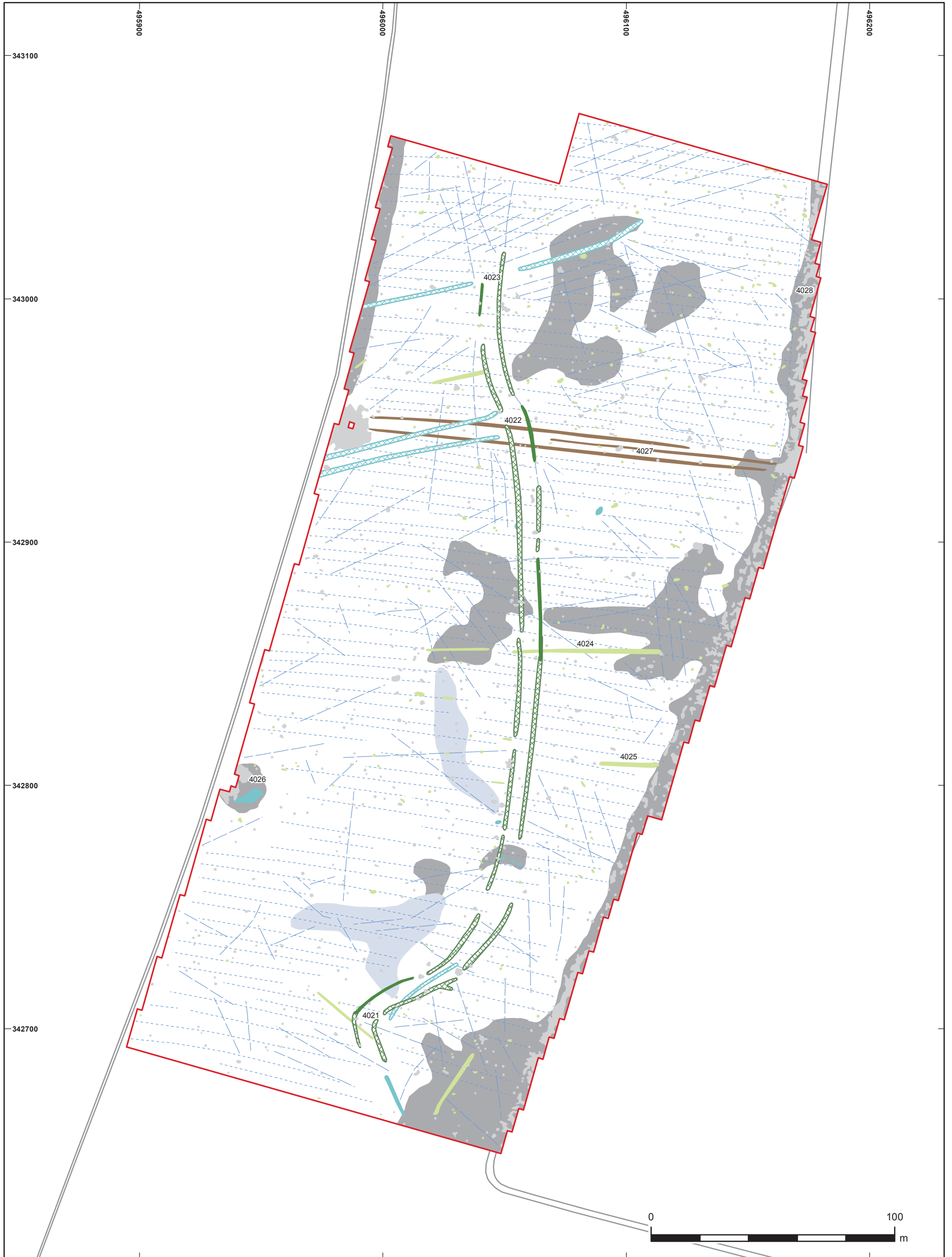
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XY trace plot, north

Figure 6



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Interpretation, north

Figure 7



salisbury rochester sheffield edinburgh



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