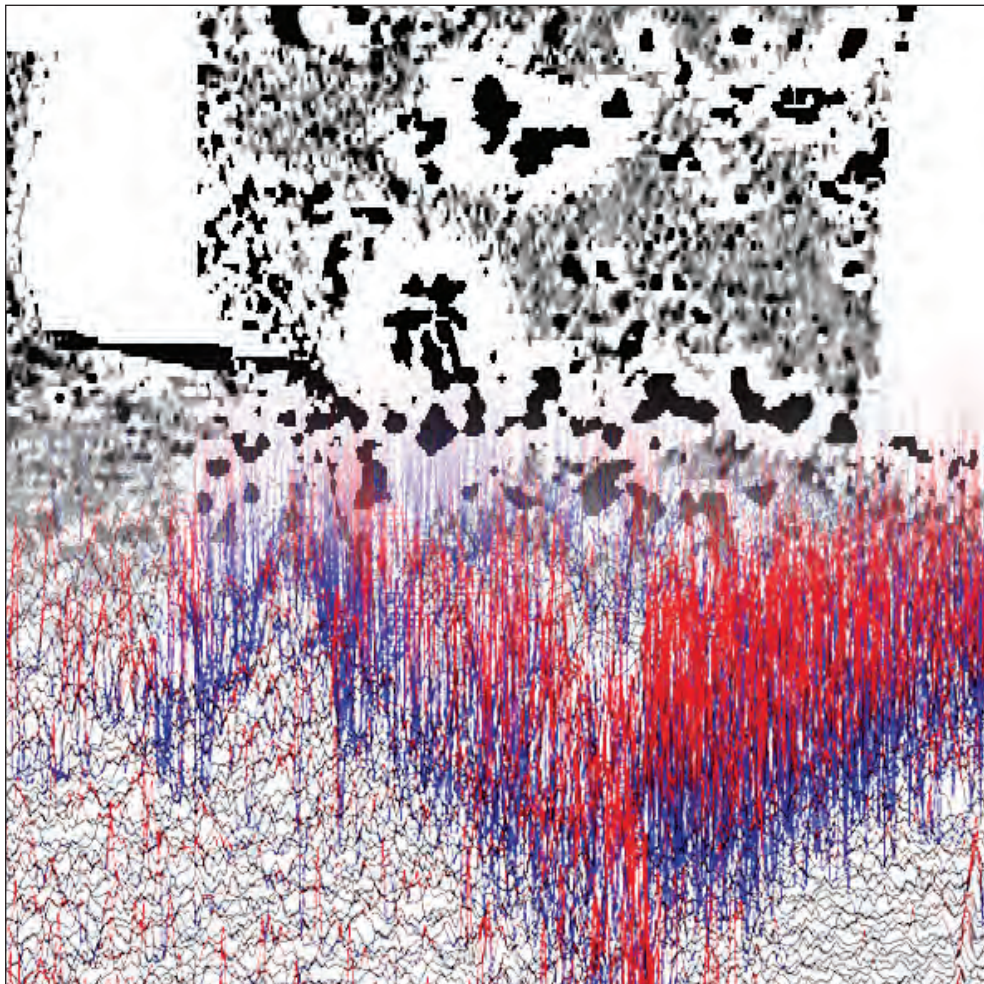




making sense of heritage

Five Towns Park, Castleford, West Yorkshire

Detailed Gradiometer Survey Report



Ref: 107110.01
December 2014



**Five Towns Park, Castleford,
West Yorkshire**

Detailed Gradiometer Survey Report

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December 2014

Report Ref. 107110.02



Quality Assurance

Project Code	107110	Accession Code		Client Ref.	107110.02
Planning Application Ref.		Ordnance Survey (OS) national grid reference (NGR)	444700, 424100		

Vers ion *	Status	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	AS	RDL		15/12/14
File:	X:\PROJECTS\107110_Reports\107110_Geophysics_Report_RDL_20141215.Docx				
v02	E	AS	RDL		23/12/2014
File:	X:\PROJECTS\107110_Reports\107110_Geophysics_Report_RDL_20141223.docx				

* I = Internal Draft; E = External Draft; F = Final

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Five Towns Park, Castleford, West Yorkshire

Detailed Gradiometer Survey Report

Summary

Wessex Archaeology was commissioned by CgMs Consulting to undertake a detailed gradiometer survey of land north of Junction 32 on the M62, West Yorkshire (centred on NGR 444964, 424215). 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 2.2km south-east of the centre of Castleford and 2.6km north-north-west of Pontefract. The Site comprises arable fields located to the north of the M62 and forms the south-facing slope of a shallowly inclined hill.

Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 17.6ha, and has demonstrated the presence of anomalies of likely, probable and possible archaeological significance along with several spreads of increased magnetic response, ploughing trends and at least one former field boundary. The main concentration of archaeological features was located in the western survey area where a number of possible ditches, enclosures, and ridge and furrow were detected.

The survey was undertaken between 24th and 28th November 2014.



Five Towns Park, Castleford, West Yorkshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting and Wessex Archaeology is grateful to Dr Robert Smith in this regard.

The fieldwork was carried out by Chris Hirst, Philipp Maier, Hannah Holbrook and Matthew Tooke. The geophysical data was processed and interpreted by Alistair Salisbury who also wrote this report. The geophysical work was quality controlled by Ross Lefort. Illustrations were prepared by Ross Lefort and Karen Nichols. The project was managed on behalf of Wessex Archaeology by Richard O'Neill.



Five Towns Park, Castleford, West Yorkshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a programme of geophysical survey over land to the north of junction 32 of the M62, West Yorkshire (**Figure 1**) hereafter “the Site” (centred on NGR 444964, 424215).

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

- *to identify the location, extent and character of archaeological remains in the Site; and*
- *to provide information that will enable an assessment of the impact of the development on any potential archaeological remains identified.*

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 a large area of arable land to the north of the M62 (**Figure 1**). The survey area is located just over 2.2km to the south-east of the centre of Castleford and 2.5km north-north-west of the centre of Pontefract. The limits of the geophysical survey are defined by a 40% sample area of the Site as defined in the WSI (CgMs 2014a).

1.2.2 The survey area lies on a shallowly inclined south facing slope of a gentle valley. A raised spur of land lies within the Site and the top of this spur is wooded at a height of over 70m above Ordnance Datum (aOD). The land lies adjacent to Holywell Farm and the height falls from just over 50m aOD at the northern extent to less than 25m aOD at the lowest point in the south. The nearest watercourse is Fryston Beck that flows to the east into the River Aire.

1.3 Soils and geology

1.3.1 The bedrock geology beneath the Site is composed of three separate lithologies: brown and grey micaceous sandstone from the Glass Houghton Rock formation (Carboniferous), a broad expanse of interbedded grey mudstone, siltstone, pale grey sandstone and coal seams from the Pennine Middle Coal measures (Carboniferous) and uncemented or weakly cemented medium – fine grained sand or sandstone from the Yellow Sands formation (Permian) (BGS). No superficial deposits are recorded although alluvial deposits relating to Fryston Beck are recorded nearby (BGS).

1.3.2 The soils underlying the Site comprise pelo-stagnogley soils of the 712a (Dale) formation. These soils are slowly permeable, seasonally waterlogged, clayey, fine loamy over clayey and fine silty soils on soft rock from the Carboniferous (SSEW 1983).



1.4 Archaeological background

- 1.4.1 An Archaeological Desk-Based Assessment (DBA) was carried out by CgMs Consulting (2014b). This assessment concluded there is a low potential for archaeological finds and features of Saxon/medieval origin and later. The assessment also revealed the potential for Iron Age/Romano-British settlement within the south-west of the area, where cropmarks of a double ditched enclosure were observed (CgMs 2014b). The results of this assessment will be referred to, where relevant, during the interpretation of the geophysical data.

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 24th and 28th November 2014. Field conditions at the time of the survey were mixed, with the southern field being ploughed and soft from wet weather, and the northwestern field being used as a recreation ground.

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 ($\pm 5nT$ 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 function was used to account for errors in the ZMT function and to remove grid edge discontinuities. These three 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 numerous anomalies of archaeological interest; these anomalies include a complex of strongly magnetised ditches in the western survey block, along with ridge and furrow. Results are presented as a series of greyscale plots, XY trace plots, and archaeological interpretations, at a scale of 1:2000 (**Figures 2 to 8**).



The data are displayed at -2nT (white) to +3nT (black) for the greyscales and ± 25 nT at 25nT per cm for the XY traces.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figures 3, 5, 7 and 8**). 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 although many may relate to the twentieth century military occupation in the area.

3.2 Gradiometer survey results and interpretation

3.2.1 The most noticeable features in the western survey block (**Figures 2 and 3**) form a field system radiating from a concentrated area of enclosure ditches around **4000 to 4002**. This field system is aligned north-west to south-east, parallel to the contours in the area, and is divided into rectangular parcels of land by single ditches such as **4003 and 4004**. Some of these ditches (**4005**) have an intermittent form where the ridge and furrow, visible across this area, appears to cut through them. If the ridge and furrow is cutting them, then this would indicate an earlier date for the field system.

3.2.2 There are, however, some field boundaries on the same alignment as these enclosures visible on mapping from the 1822 Glasshoughton and Castleford enclosure plan up to the 1965-1969 edition Ordnance Survey (OS) (CgMs 2014b). The service at **4015** follows the line of an old boundary but the other ditch positions do not appear to match up with these mapped boundaries exactly. It is considered that the enclosures identified from the data, the ridge and furrow and the recent boundaries all share an alignment due to the local topography rather than them being roughly contemporary.

3.2.3 The enclosures at **4000 to 4002** show signs of internal features such as ditches and pit-like anomalies. There are some arcing ditches north of **4006** that may possibly relate to a ring ditch. The enclosures appear to be linked by narrow ditch lined corridors that measure between 2m and 4m wide. It is possible the large number of ditches in this area demonstrate more than one phase of occupation. The enclosure ditches and pits have been interpreted as either likely, probable or possible archaeology, depending on their magnetic strength and regularity in plan.

3.2.4 Some isolated ditch-like anomalies are visible at the far north of the survey area around **4007**; they are aligned roughly north-south and have diffuse edges. The function of these ditches is unclear and both have been interpreted as possible archaeology.

3.2.5 Another group of ditches is visible at **4008 to 4010**; these are on a slightly different alignment to the field system further north and have weaker magnetic values. The enclosures formed by these ditches also have a slightly different patterning with curved edges and irregular forms. It is not possible to examine the relationship between these two field systems as there is a large spread of ferrous responses separating them.

3.2.6 The southern group of enclosures have much weaker magnetic values on the whole, typical values are around +1.5nT compared to values in excess of +3nT for ditches further north. The interiors of these enclosures also show few signs of internal features compared to those further north. The enclosures do appear to be linked by corridors like the one around **4009**, but this is much wider at over 8m. The ditches have mostly been classed as probable archaeology, with stronger and weaker ditches classed as archaeology and possible archaeology, respectively.

3.2.7 A former field boundary is recorded nearby at **4011** that is marked on the 1852 OS map as a "Parliamentary Boundary" (CgMs 2014b). It remains marked on OS maps as a track up until recent editions. Anomaly **4012** is visible above ground as a track and features on the 1894 edition OS map; it has been classed as a former field boundary (CgMs 2014b).



- 3.2.8 A concentrated area of ferrous, less than 20m south-west of **4004**, corresponds to a feature marked on OS mapping from 1894 up to the 1965-1969 edition (CgMs 2014b). This feature looks to be a pit backfilled with ferrous material and may correspond to the position of a quarry pit.
- 3.2.9 Modern services can be seen at **4013** to **4015**; these will be discussed in more detail in the next section of the report.
- 3.2.10 The central survey block (**Figures 4** and **5**) shows a much lower concentration of archaeological features. A pair of ditches at **4016** and **4017** may link up with each other and other isolated ditches in the area to form a field system but appear fragmented in the data, possibly due to plough damage. These ditches have been interpreted as either probable or possible archaeology, depending on their magnetic values.
- 3.2.11 A number of arcing ditches interpreted as possible archaeology and trends have been identified in this area at **4018** to **4020**. It is unclear whether these are coincidental patterns in the data or represent the faded impression of more significant features such as ring ditches.
- 3.2.12 The continuation of the track at **4012** can be seen in this block at **4021** (**Figure 8**); this stretch of the track was not entirely visible above ground. It appears on the same mapping as **4012** and has been interpreted as a former field boundary. A curving feature can be seen crossing this track at **4022**; this marks the edge of former woodland that extended this far south up until recent years. This former woodland area is dominated by a high concentration of ferrous responses that can be seen at **4023** and **4024**; the origin of this material is unclear.
- 3.2.13 The eastern survey block (**Figures 6** and **7**) contains the lowest concentration of archaeological features. A weak positive ditch at **4025** is on a similar alignment to those observed at **4016** and **4017**, and may form part of this extended field system. It has been interpreted as possible archaeology due to its weak magnetic values. Another ditch of possible archaeological interest can be seen at **4026** on a different alignment.
- 3.2.14 Some strong linear features can be seen at **4027** and **4028**; they run parallel to the direction of ploughing and are considered to be agricultural.
- 3.2.15 Two modern services are visible at **4029** and **4030**; these will be discussed in more detail in the next section of the report.

3.3 Gradiometer survey results and interpretation: modern services

- 3.3.1 A number of modern services have been identified in the geophysical data at **4013** to **4015** in the western survey block, and **4029** and **4030** in the eastern survey block. The services at **4013** and **4029** most likely link up. All the observed services appear to represent pipes with **4013** and **4029** looking to represent a major service.
- 3.3.2 A number of 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 DISCUSSION

4.1 Summary

- 4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of likely and probable archaeological interest, in addition to ridge and furrow, areas of increased



magnetic response and at least one former field boundary. The anomalies of archaeological interest are concentrated in the western survey block.

- 4.1.2 In the western survey block, the geophysical data has revealed a complex of strongly magnetised ditches at **4000** to **4006** forming a field system of rectangular enclosures aligned north-west to south-east; they also contain internal features such as pits and arcing ditches, possibly indicating a ring ditch. The most complex area of ditches at **4000** to **4002** and **4006** coincides with an area of increased magnetic response and could suggest a density of archaeological features or a core for settlement activity.
- 4.1.3 In the same location and orientation is an area of ridge and furrow. Intermittent gaps in the ditch anomalies suggest that the ridge and furrow might be cutting the ditches of the field system, and therefore indicating an earlier date for them. The common alignment of the field system and ridge and furrow is thought to be due to the topography of the Site, as other more recent field boundaries and modern services at **4012** and **4015** also follow this alignment.
- 4.1.4 Anomalies at **4007** and **4008** to **4010**, interpreted as probable and possible archaeology, may represent further possible enclosures, but they are on a different alignment to the main field system identified between **4000** and **4006**, and have a much weaker magnetic response. The relationship between these three areas of enclosures cannot be established from the geophysical data as they are separated by a former field boundary (**4012**) and a modern service surrounded by a large area of ferrous (**4013**).
- 4.1.5 Former field boundaries located at **4011** and **4012** have been identified on OS maps, and the anomaly **4012** probably continues in the central survey block as anomaly **4021**. A concentration of ferrous less than 20m south-west of **4004** corresponds to a feature, possibly a quarry pit, also identified on OS maps. It is probably backfilled with ferrous material and debris.
- 4.1.6 The central and eastern survey blocks contain only a few anomalies of archaeological interest with several single linear ditches of weak magnetic response across these areas such as at **4017** and **4025**. They are possibly the remains of former field systems, but agricultural and ploughing trends are visible across these areas possibly indicating extensive plough damage.
- 4.1.7 The curvilinear feature at **4022** marks the edge of former woodland, with the area within the former woodland around **4023** and **4024** dominated by ferrous, areas of increased magnetic response and some ploughing trends. Whilst some trends of uncertain origin have been identified which could be of archaeological origin, no anomalies of archaeological or possible archaeological interest have been identified in this area.
- 4.1.8 Five modern services have been identified at **4013** to **4015** and at **4029** to **4030**.
- 4.1.9 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

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CgMs Consulting, 2014a. *Five Towns Park, Castleford: Archaeological Written Scheme of Investigation for Geophysical Survey*. Unpublished client report. CgMs ref. RM/16535.



CgMs Consulting, 2014b. *Five Towns Park: Archaeological Desk-Based Assessment*. Unpublished client report. CgMs ref. RM/16535.

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

5.2 Cartographic sources

British Geological Survey

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

Soil Survey of England and Wales (SSEW), 1983: *Sheet 3, Soils of Midland and Western 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;
- Despiking – 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:

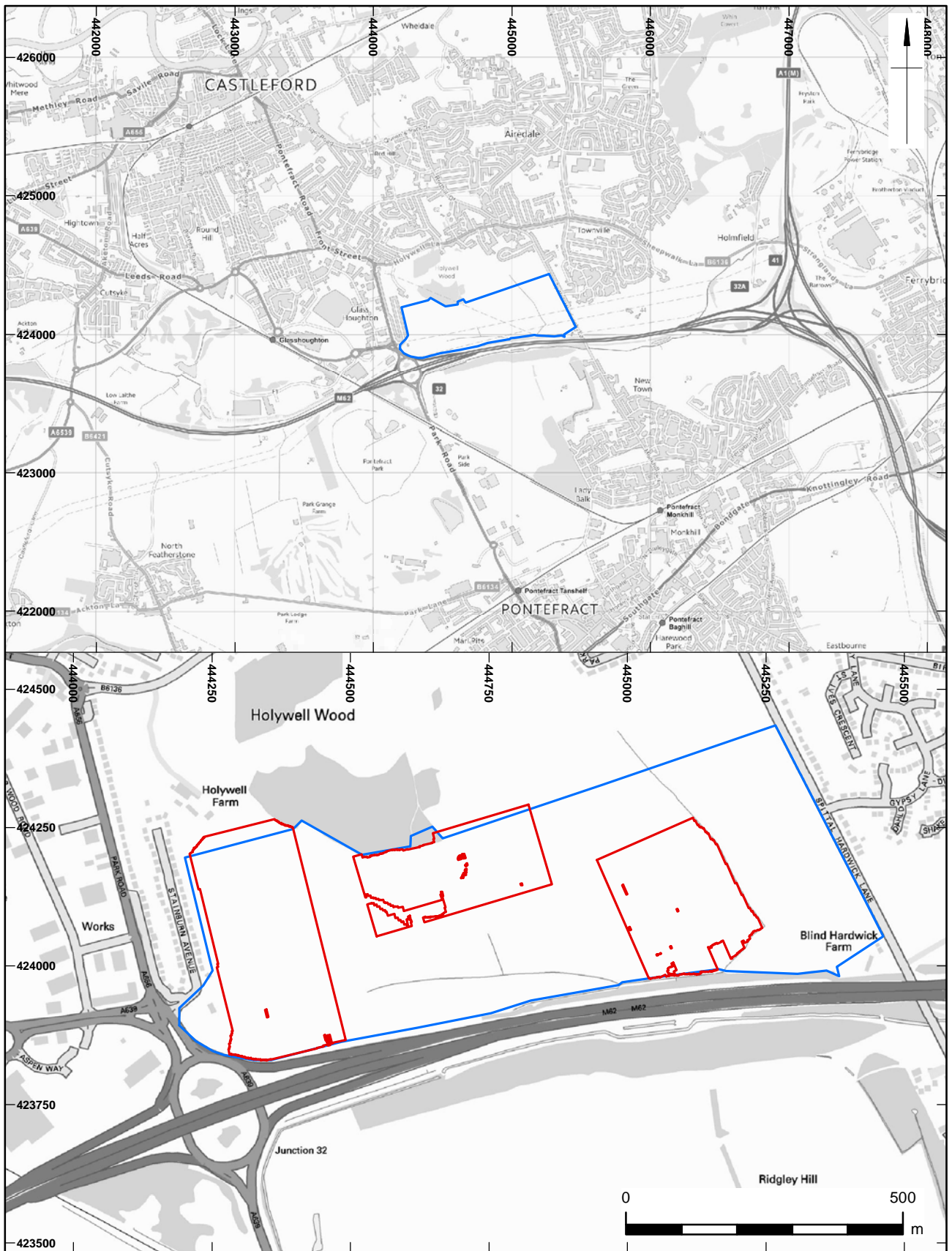
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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

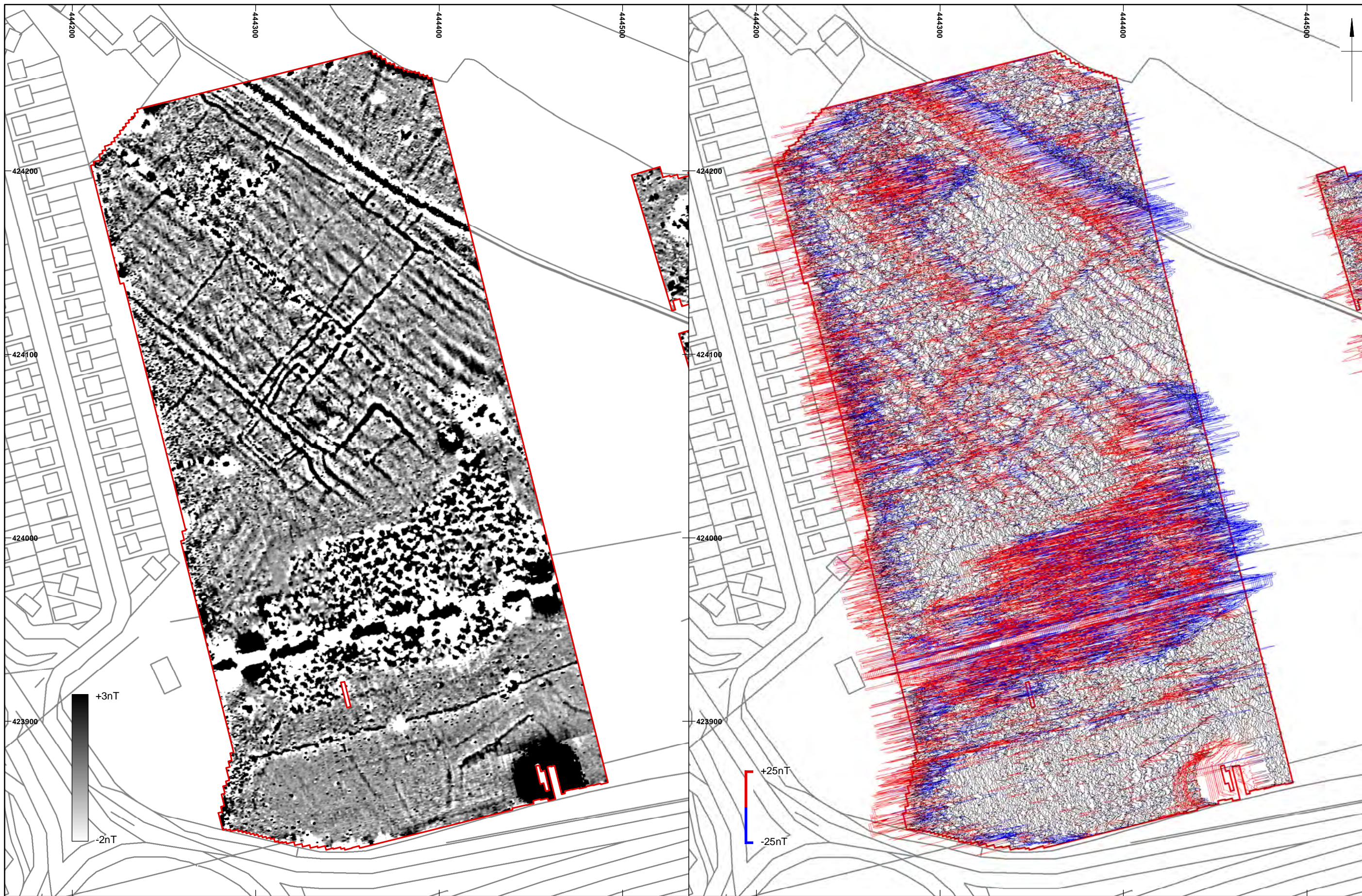
- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They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





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Site location and detailed survey extents

Figure 1




 Detailed Survey Extents

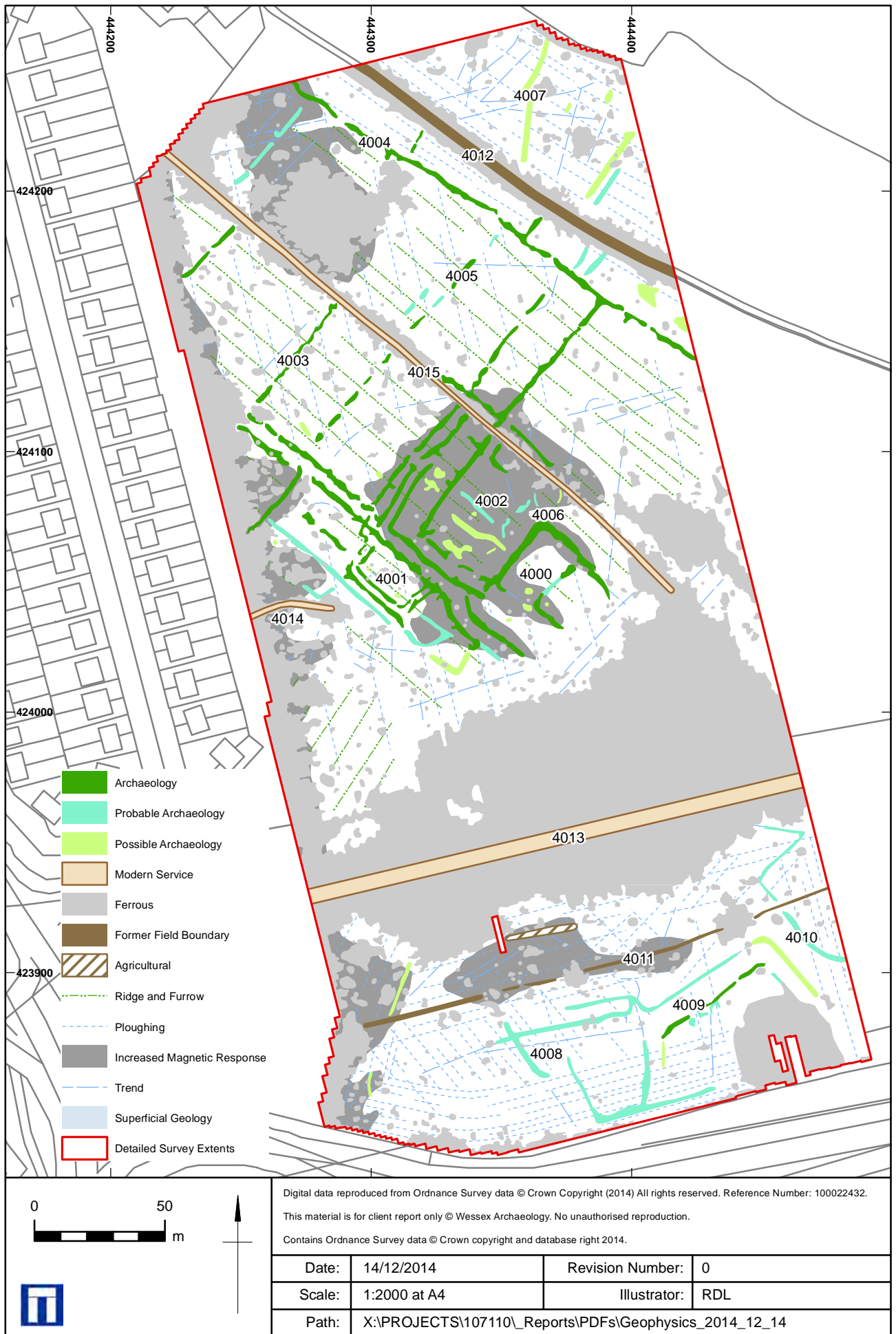


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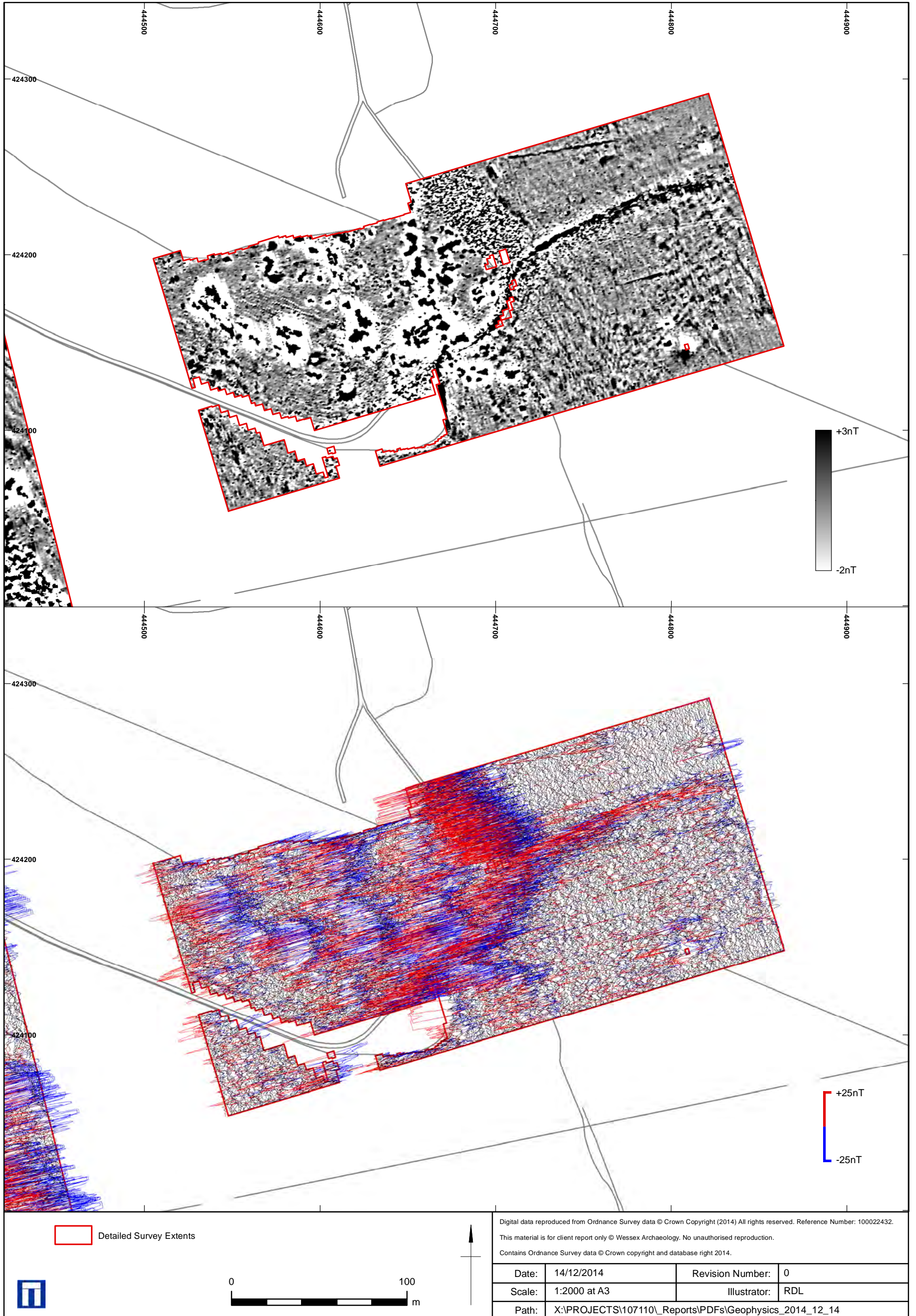
Greyscale and XY trace plot, western survey block

Figure 2



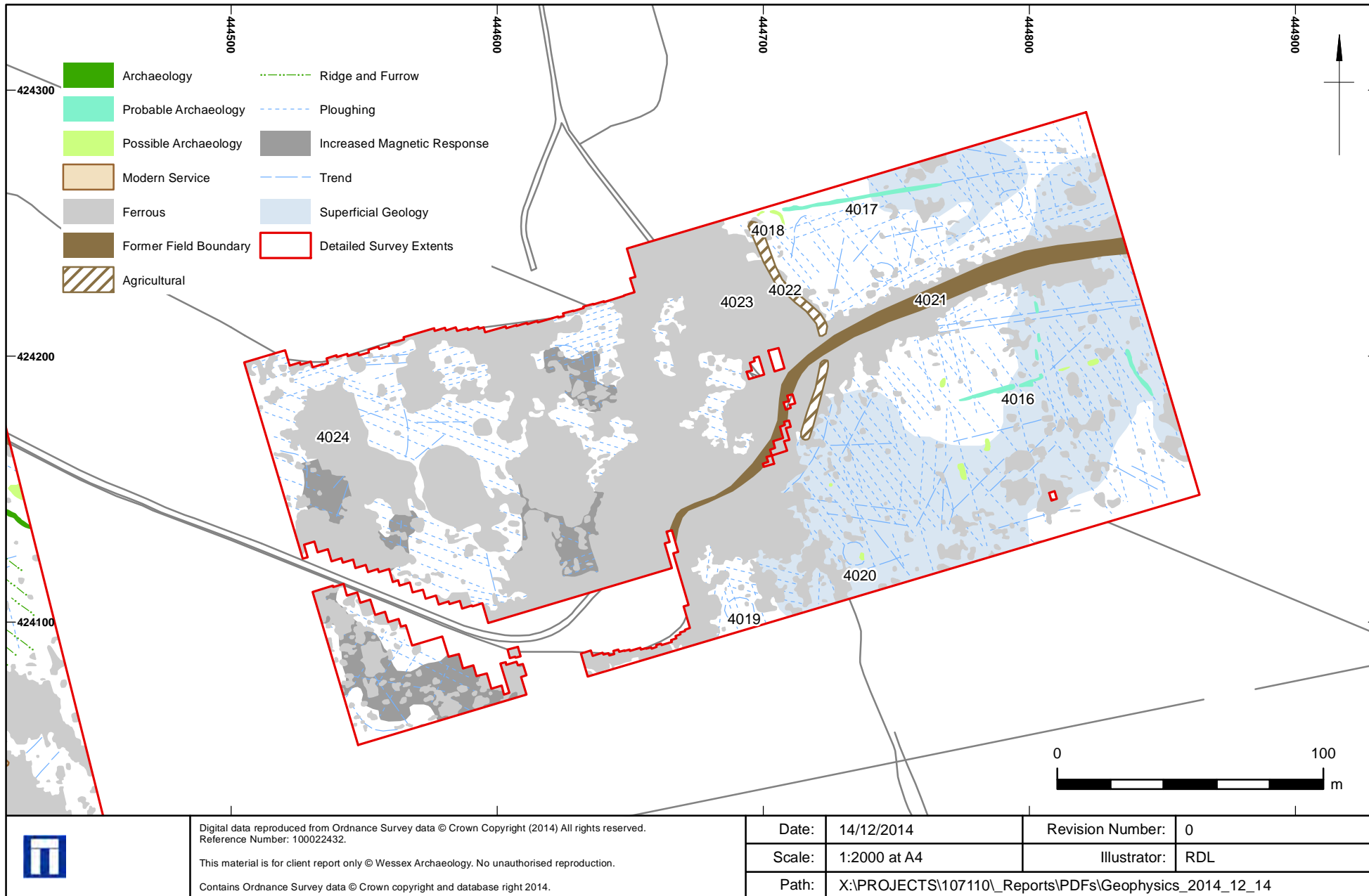
Interpretation, western survey block

Figure 3



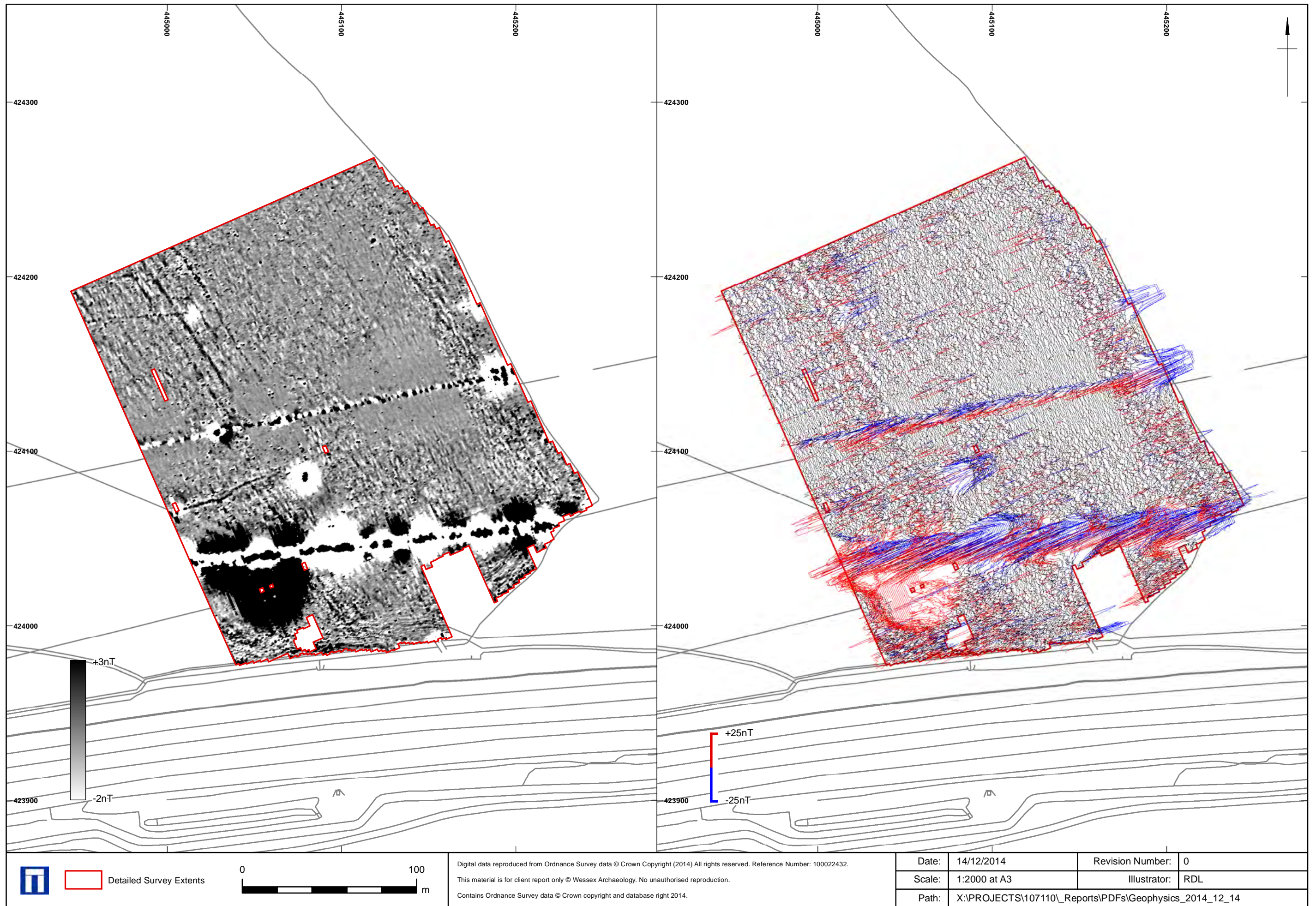
Greyscale and XY trace plot, central survey block

Figure 4



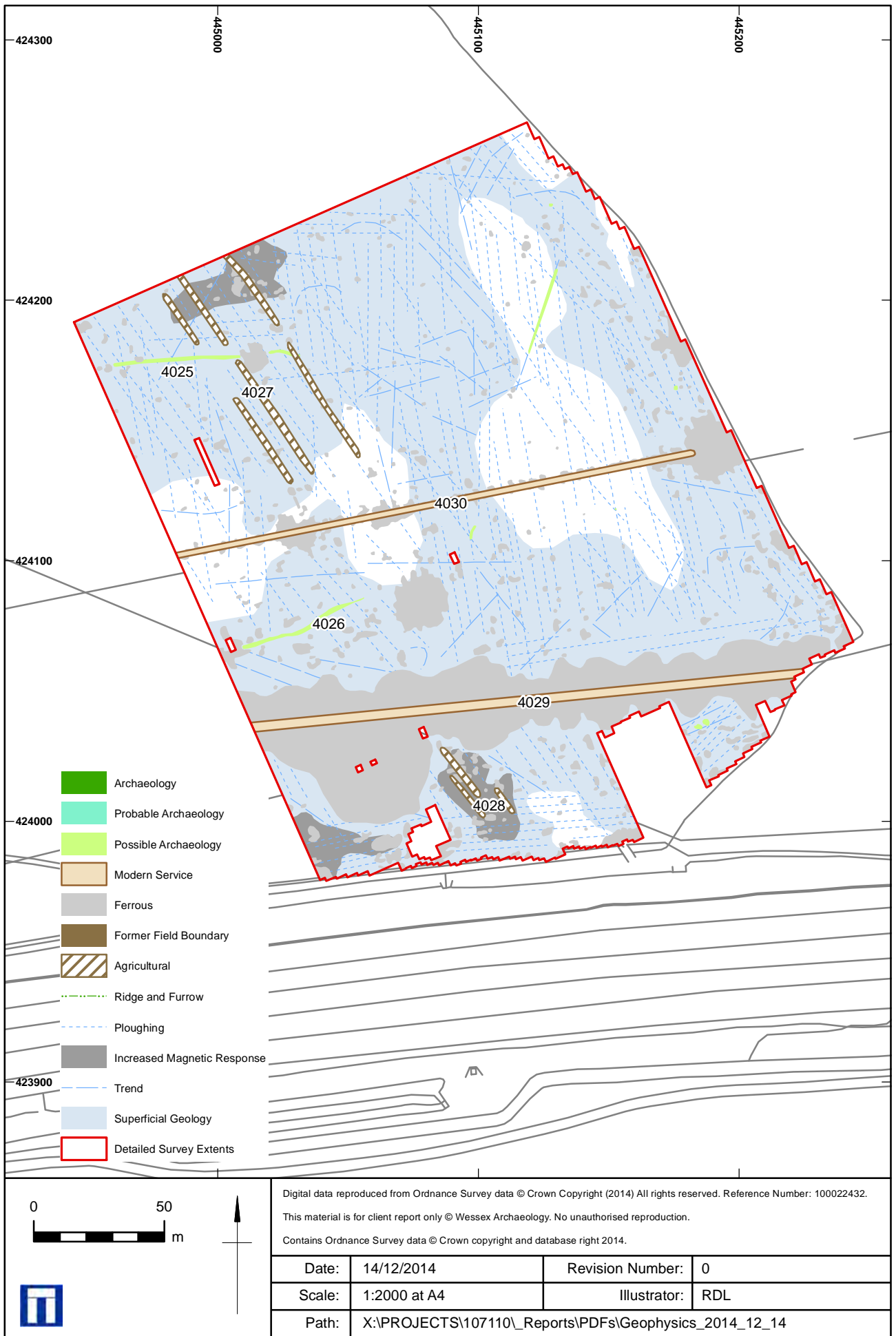
Interpretation, central survey block

Figure 5



Greyscale and XY trace plot, eastern survey block

Figure 6



Interpretation, eastern survey block

Figure 7



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Overall interpretation

Figure 8



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