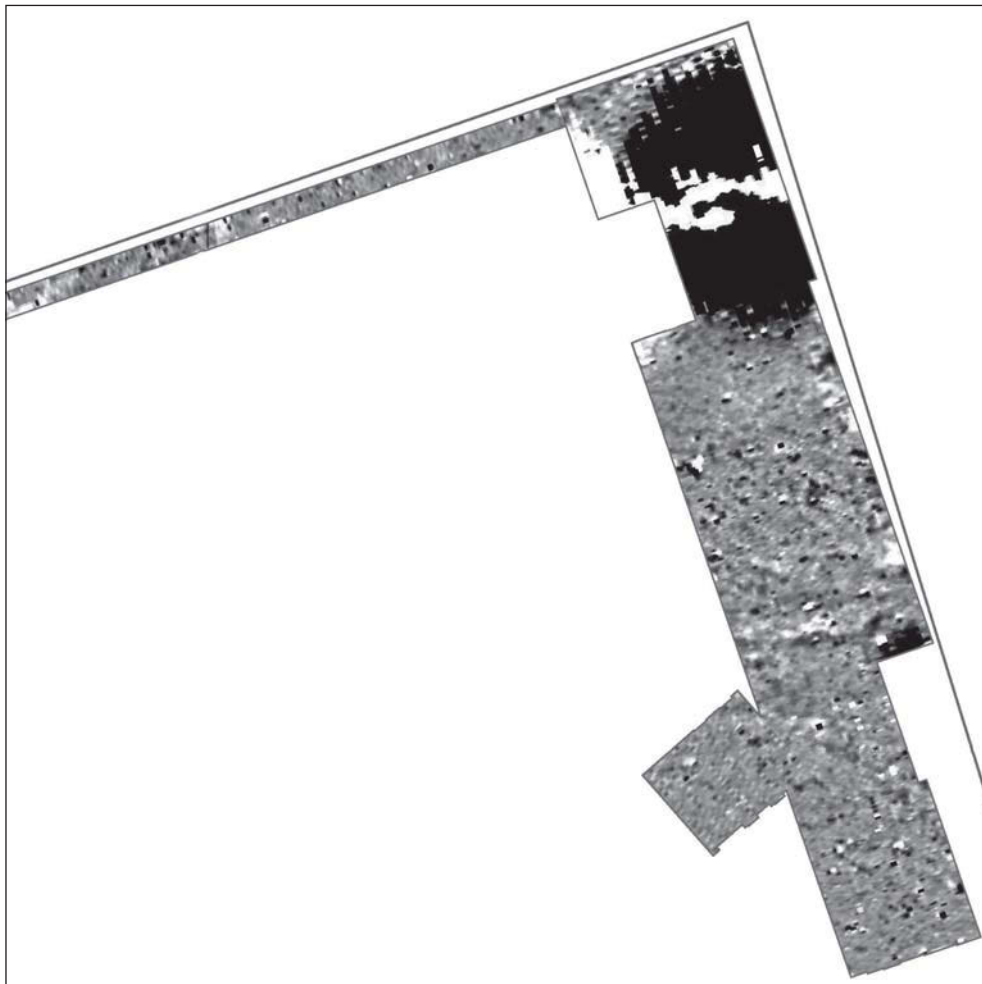




making sense of heritage

Samples Farm, Walkington East Riding of Yorkshire

Detailed Gradiometer Survey Report



Ref: 103520.06
October 2014



**Samples Farm, Walkington,
East Riding of Yorkshire**

Detailed Gradiometer Survey Report

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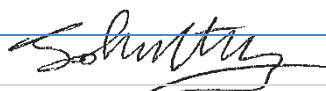
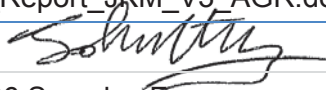
October 2014

WA Ref. 103250.06



Quality Assurance

Project Code	103520.06	Accession Code		Client Ref.	n/a
Planning Application Ref.	DC/12/04892/STPLF/STRAT	Ordnance Survey (OS) national grid reference (NGR)	497913E, 435490N		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
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V02	F	RM	JKM		04/11/2014
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* I = Internal Draft; E = External Draft; F = Final

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Samples Farm, Walkington, East Riding of Yorkshire

Detailed Gradiometer Survey Report

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Samples Farm, Walkington, East Riding of Yorkshire

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land at Samples Farm, Walkington, East Riding of Yorkshire (centred on 497913, 435490). The project was commissioned by AGR Renewables Ltd. with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed single wind turbine and associated infrastructure development.

The site comprises arable fields located to the south of Samples Farm covering an area of approximately 2.5 hectares. Due to heavy crop coverage the surveyable area was reduced to approximately 1.1ha. The geophysical survey was undertaken on 26th June 2014.

The gradiometer survey has demonstrated the presence of a number of anomalies of possible archaeological interest. These are located largely in the southeastern part of the site, and comprise short lengths of ditch-like anomalies and pit-like responses. The limited area available for survey has made the interpretation less conclusive and these anomalies are consistent with several possible origins, including from archaeological, geological and agricultural sources. They have therefore been interpreted as being of possible archaeological interest as this cannot be excluded entirely. This survey was undertaken to inform a subsequent Watching Brief and Strip, Map and Sample (WA ref 103520.05).

A band of geological responses has been identified across the centre of the site, although it is not clear whether this is a change in soil morphology or a more tangible geological feature.

A modern service has been identified near the northeastern extent of the survey and is associated with a gas main seen on aerial photography. Strong magnetic disturbance can be seen in association with it, which has prevented accurate location of the centreline of the service.



Samples Farm, Walkington, East Riding of Yorkshire

Detailed Gradiometer Survey Report

Acknowledgements

Wessex Archaeology would like to thank David Smith and AGR Renewables Ltd. for commissioning the geophysical survey.

The fieldwork was undertaken by Philip Roberts, David Loeb and Natasha Brett. Garreth Davey processed and interpreted the geophysical data with the report being written by Philip Roberts and Garreth Davey. The geophysical work was quality controlled by Dr. Paul Baggaley and Ben Urmston. Illustrations were prepared by Chris Breeden. The project was managed on behalf of Wessex Archaeology by John McCarthy.



Samples Farm, Walkington, East Riding of Yorkshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by AGR Renewables Ltd to carry out a geophysical survey of land at Samples Farm, Walkington, East Riding of Yorkshire (hereafter “the Site”, centred on NGR 47913, 4354930) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of a proposed wind turbine and associated infrastructure development at the Site. This programme has been undertaken in consultation with Humber Archaeological Partnership and English Heritage’s Science Advisor (correspondence dated 19th June 2014 to 22nd July 2014).
- 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.
- 1.1.4 Both an archaeological Desk-Based Assessment (Garland 2013) and a Written Scheme of Investigation (Wessex Archaeology 2014a) were carried out for the Site and are referred to in relation to the interpretation of the geophysical results.

1.2 Site Location and Topography

- 1.2.1 The Site occupies a mostly level expanse of ground, encompassing an arable field. At the time of the survey the majority of the field was under heavy crop, however to the eastern end the field was open and free of obstruction. The proposed development involves the erection of a single wind turbine measuring 62 m to blade tip. The construction will require excavation for the turbine base, development of access tracks approximately 500m in length, the construction of a crane pad measuring approximately 20m by 22m, and the development of other related infrastructure including the extension of existing farm access tracks and the export cable route.

1.3 Soils and Geology

- 1.3.1 The solid geology comprises Burnham Chalk Formation (Garland 2013). Though no superficial geological deposits were identified across the application site, Devensian till deposits are located approximately 1km to the east.
- 1.3.2 The soils underlying the Site are likely to comprise the typical brown calcareous earths of the 511c (Panholes) association (SSEW 1983). Soils in such geological backgrounds have been demonstrated to produce magnetic contrasts suitable for gradiometer survey.



1.4 Archaeological Background

- 1.4.1 The background of the Site has been presented in an archaeological desk-based assessment (DBA) (Garland 2013), a summary of which is presented below. There are no designated assets (Scheduled Monuments, Listed Buildings, Registered Parks and Gardens, Registered Buildings or Conservation Areas) within the Site development boundary; however there are 107 entries in the SMR located within a 2.5km radius of the centre of the Site.
- 1.4.2 There are a number of Bronze Age barrows located to the north, north-west, and west of the application site including Ling Howe long barrow. Further evidence of Bronze Age settlement is illustrated by the presence of linear earthworks interpreted as territorial markers. A large section of multiple earthwork dykes spans the study area. A section of this feature was excavated approximately 500m to the west of the application site and identified three prehistoric ditches with multi-occupational fill. In addition, a series of earthworks tentatively dated to the late Bronze Age or early Iron Age were identified across the study area, the closest being immediately to the south of the proposed turbine location. Similar evidence exists from the Iron Age in the form of cropmarks illustrating potential fieldworks, enclosures, trackways and two possible barrows. There is no recorded archaeological evidence of Roman activity within the study area or the wider area as covered by the DBA.
- 1.4.3 There is no recorded archaeological evidence of Saxon date within the survey area though there are Saxon era sites identified to the north of the application area (Garland 2013). By the medieval period, the nearby village of Walkington was established to the north east of the area. The majority of evidence for medieval occupation is centred at Walkington though the scheduled site 'Cellar Heads' (1015302) is located 2km to the east. Consequently the potential for archaeological material related to these periods has been identified as low to moderate.
- 1.4.4 The map regression exercise indicated that the site area has been in use as arable fields with static field boundaries from at least the 19th century to present. The DBA identifies that the development of the turbine at the application site will likely encounter 19th and 20th century evidence of agricultural practices with an additional potential to encounter earlier archaeological deposits.



2 METHODOLOGY

2.1 Introduction

- 2.1.1 The detailed magnetometer survey was conducted using a Bartington Grad 601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (English Heritage 2008).
- 2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 26th June 2014. Field conditions at the time of the survey were variable, although conditions were firm under foot. Due to the presence of mature crop in the field, the proposed 2.5ha survey area was reduced and 1.1ha was surveyed.

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 gradiometer 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 was subject to minimal data correction processes. These comprise a zero mean traverse function (± 5 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. These two 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 been successful in identifying anomalies of probable and possible archaeological interest across the Site, along with areas of increased magnetic response and a large amount of ferrous material. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**Figures 2 and 3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ± 25 nT at 25nT per cm for the XY trace plots.
- 3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**). 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 Gradiometer Survey Results and Interpretation

- 3.2.1 At the southernmost extent of the survey, rectilinear anomalies **4000** and **4001** are of possible archaeological interest. They are not clearly defined from the general magnetic background but are consistent with short lengths of ditch. However, no overall pattern can be seen within their distribution and it is possible that they relate to agricultural activity. Several isolated pit-like responses can be seen nearby, although it is possible that these are natural in origin.
- 3.2.2 Near the centre of the survey area, a band of geological responses is visible. Immediately north of this, a series of pit-like anomalies **4002** can be seen in a rough arc. Further similar anomalies can be seen to the northwest, to the west of **4003**; these anomalies have been interpreted as being of possible archaeological interest given their response, although it is possible that they are the result of geological or agricultural activity.
- 3.2.3 Linear anomalies **4003** are consistent with short lengths of ditch, although they are not particularly extensive. It is considered that they are anthropogenic in origin, although their date is uncertain and it is possible that they relate to agricultural activity.
- 3.2.4 Along the western arm of the survey, pit-like anomalies **4005** and **4006** are of possible archaeological interest. The limited extent of the survey area here makes interpretation much less confident, however, and it is possible that these responses are associated with modern debris or agricultural activity.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

- 3.3.1 Modern service **4004**, aligned WSW-ENE has been identified in the data at the northeasternmost corner of the Site. The extensive magnetic disturbance associated with the service would have masked any weaker archaeological anomalies.
- 3.3.2 The dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, based upon the materials used and backfill area of the service trenches. The physical dimensions of the services may differ from their magnetic extents in plan. It should be noted that the limited extents of the survey area prevented and the location of the service should be taken as indicative only.



4 CONCLUSION

- 4.1.1 The detailed gradiometer survey has identified anomalies of possible archaeological interest as well as regions of increased magnetic response across the Site and is considered to have fulfilled the aims of the survey.
- 4.1.2 The majority of anomalies detected by the survey lie towards the southeastern extent and take the form of short ditch-like anomalies and pit-like responses. The limited survey extents make conclusive interpretation difficult and these anomalies are consistent with a number of possible origins, including archaeological features. None is well defined from the magnetic background, suggesting that the originating feature is relatively ephemeral or that its fill is not enhanced magnetically; ploughing trends seen throughout the survey area indicate that there is some impact on the subsurface deposits.
- 4.1.3 A band of geological responses can be seen across the centre of the Site, although it is not clear whether this is a change in soil type or if it relates to a feature such as a former channel.
- 4.1.4 The modern service relates to a gas main, the course of which is identifiable on aerial photography. It should be noted that the survey did not identify accurately the centreline of the service due to the limited surveyable extents through the mature crop in the field; whilst mapping of services is beyond the remit of this report, it is reiterated that the interpretation should be taken as being indicative only and other methods will be used to establish the location of the service more accurately before any intrusive work is undertaken in the vicinity of the pipeline.
- 4.1.5 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.
- 4.1.6 An archaeological watching brief and strip, map and sample was undertaken subsequent to the geophysical survey to test some of the features identified and full results are outlined in a separate report (Wessex Archaeology, 2014b).

5 STORAGE AND CURATION

5.1 Archive

- 5.1.1 It is recommended that the project archive resulting from the excavation be deposited with the East Riding Archives and Local Studies Service at the East Riding Treasure House. The Office has agreed in principle to accept the project archive on completion of the project **103521.02**.
- 5.1.2 The complete site archive comprising printed report, photographic records, graphics, and digital data, will be prepared following nationally recommended guidelines (IfA 2009; Brown 2011; ADS 2013).
- 5.1.3 All archive elements will be marked with the site/accession code and a full index will be prepared. The physical archive comprises the following:
- *Printed technical report with figures and plates;*
 - *Digital copies of the report, site photographs and GIS datasets.*



- 5.1.4 An OASIS entry (see **Appendix 3**) has been completed for the project, and grey literature reported uploaded.

5.2 Copyright

- 5.2.1 This report, and the archive generally, may contain material that is non-Wessex Archaeology copyright (e.g. Ordnance Survey, British Geological Survey, Crown Copyright), or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferrable by Wessex Archaeology. Users remain bound by the conditions of the Copyright, Designs and Patents Act 1988 with regard to multiple copying and electronic dissemination of the report.

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5.3 Security Copy

- 5.3.1 In line with current best practice (Brown 2011), on completion of the project a security copy of the written records will be prepared, in the form of a digital PDF/A file. PDF/A is an ISO-standardised version of the Portable Document Format (PDF) designed for the digital preservation of electronic documents through omission of features ill-suited to long-term archiving.



6 REFERENCES

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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 ± 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 two main categories: archaeological and unidentified responses.

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 unidentified 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.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.



APPENDIX 3: OASIS FORM

6.1 OASIS ID: wagherita1-193208

Project details

Project name	Samples Farm, Walkington, East Riding of Yorkshire Detailed Gradiometer Survey Report
Short description of the project	A detailed gradiometer survey was conducted over land at Samples Farm, Walkington, East Riding of Yorkshire. The project was commissioned by AGR Renewables Ltd. with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed single wind turbine and associated infrastructure development. The gradiometer survey has demonstrated the presence of a number of anomalies of possible archaeological interest. These are located largely in the southeastern part of the site, and comprise short lengths of ditch-like anomalies and pit-like responses.
Project dates	Start: 26-06-2014 End: 26-06-2014
Previous/future work	Yes / Yes
Any associated project reference codes	103250.06 - Contracting Unit No.
Any associated project reference codes	DC/12/04892/STPLF/STRAT - Planning Application No.
Type of project	Recording project
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	NONE Uncertain
Significant Finds	NONE None
Investigation type	"Geophysical Survey"
Prompt	Planning agreement (Section 106 or 52)
Solid geology	CHALK (INCLUDING RED CHALK)
Solid geology (other)	Burnham Chalk Formation
Drift geology	BOULDER CLAY AND MORAINIC DRIFT
Techniques	Magnetometry

Project location

Country	England
Site location	EAST RIDING OF YORKSHIRE EAST RIDING OF YORKSHIRE WALKINGTON Samples Farm, Walkington



Postcode	HU17 8SZ
Study area	4.00 Hectares
Site coordinates	SE 979 354 53.8054491054 -0.513201901292 53 48 19 N 000 30 47 W Point
Height OD / Depth	Min: 0.20m Max: 0.20m

Project creators

Name of Organisation	WA Heritage
Project brief originator	AGR Renewables Limited
Project design originator	John McCarthy
Project director/manager	John McCarthy
Project supervisor	Dr Andrew Bicket
Type of sponsor/funding body	Developer
Name of sponsor/funding body	AGR Ltd

Project archives

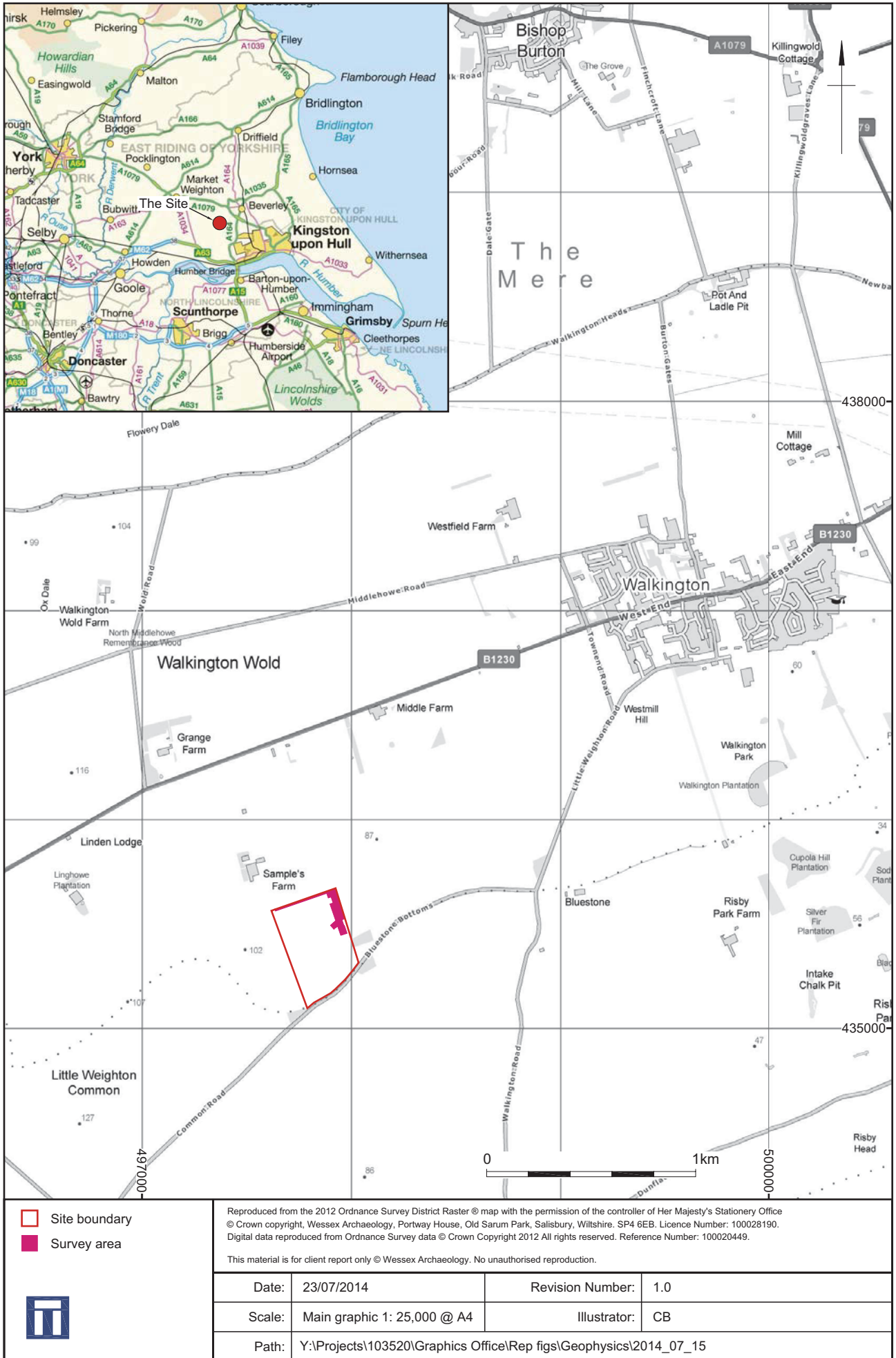
Physical Archive Exists?	No
Digital Archive recipient	East Riding Archives and Local Studies Service
Digital Archive ID	103520.06
Digital Contents	"none"
Digital Media available	"Survey"
Paper Archive recipient	East Riding Archives and Local Studies Service
Paper Archive ID	103520.06
Paper Contents	"none"
Paper Media available	"Report"

Project



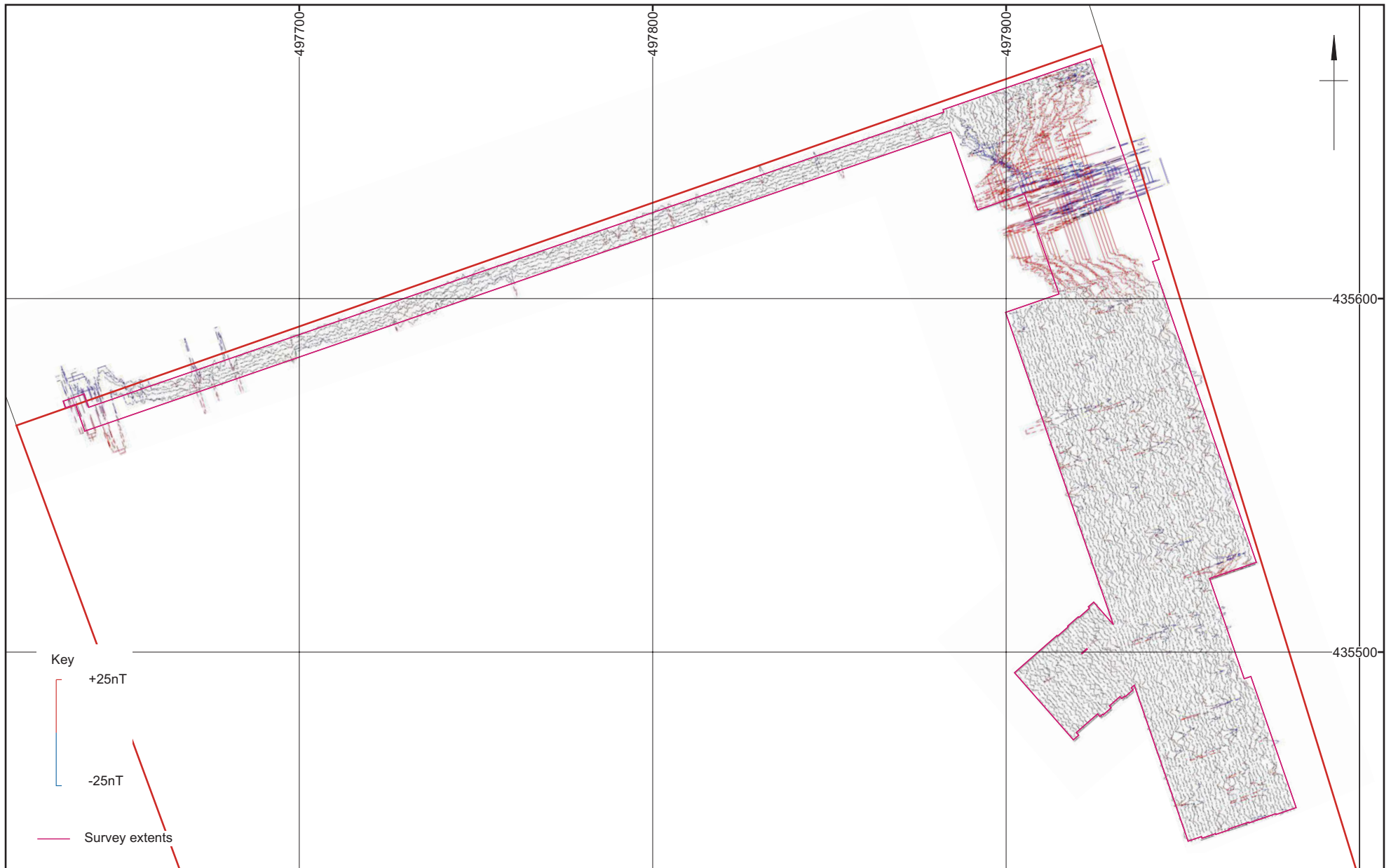
bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Samples Farm, Walkington, East Riding of Yorkshire Detailed Gradiometer Survey Report
Author(s)/Editor(s)	Roberts, P. and Davey, G.
Other bibliographic details	103520.06
Date	2014
Issuer or publisher	WA Heritage
Place of issue or publication	Edinburgh
Description	Brief bound paper report



Site location

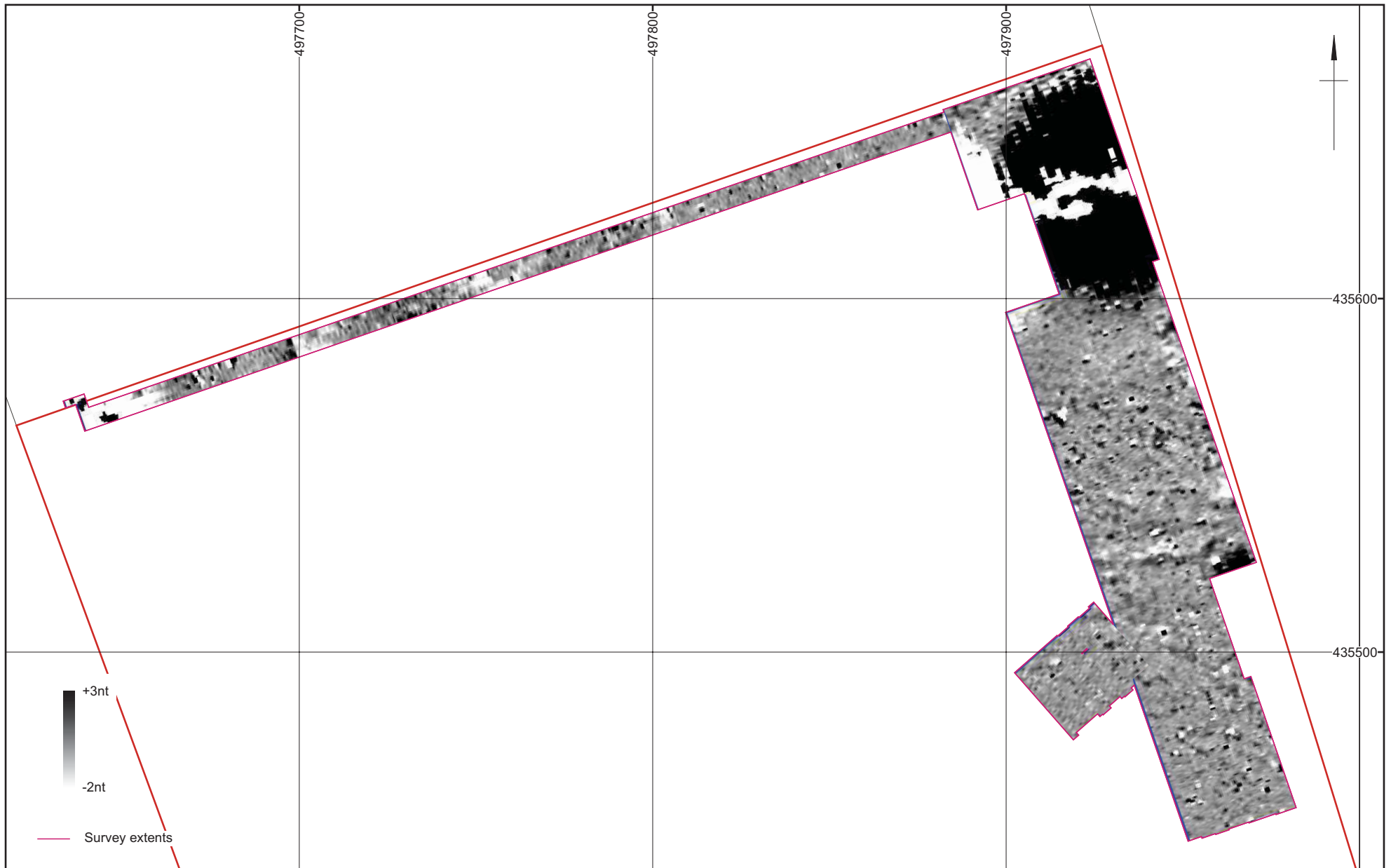
Figure 1



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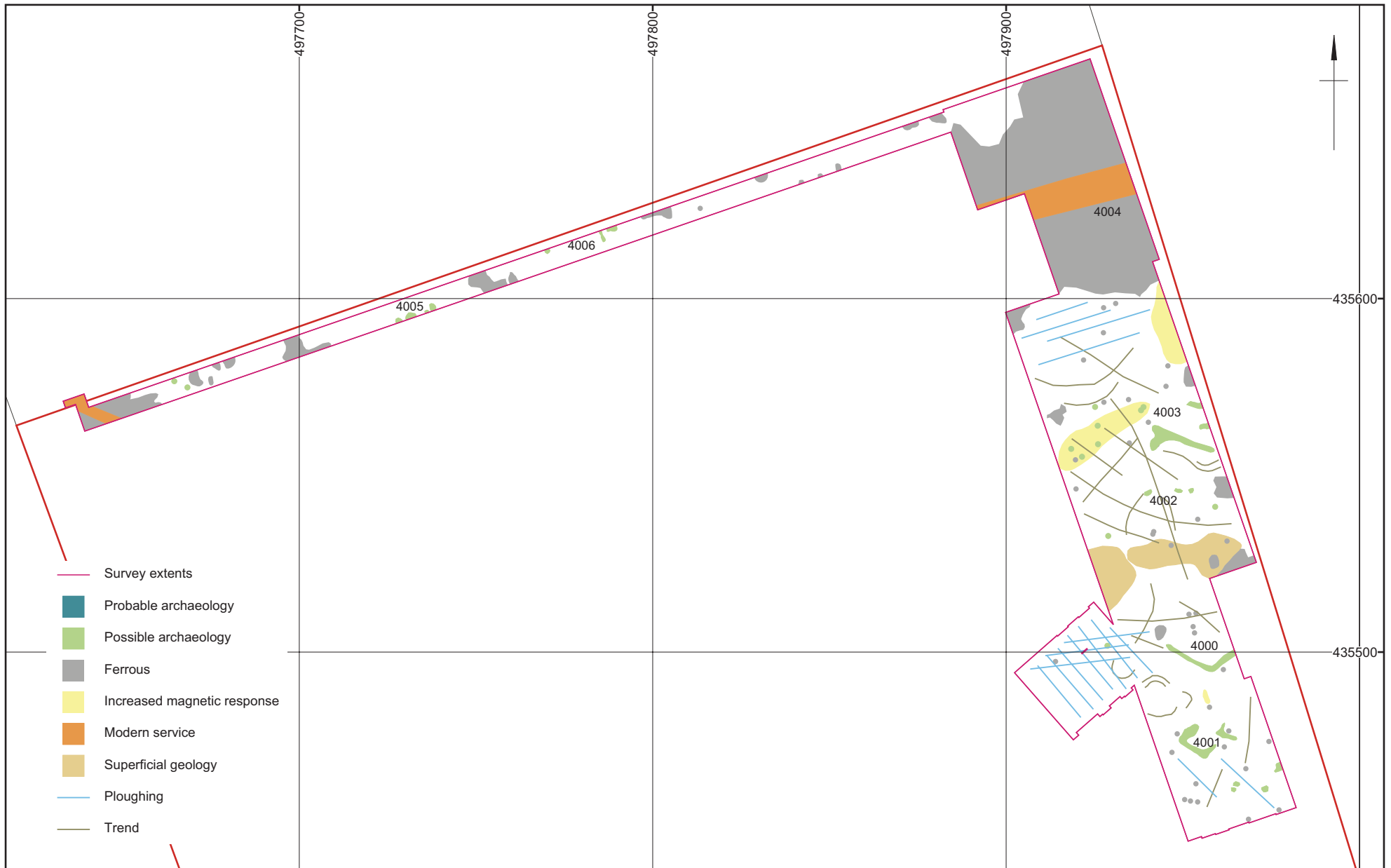
XY trace

Figure 2



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- Survey extents
- Probable archaeology
- Possible archaeology
- Ferrous
- Increased magnetic response
- Modern service
- Superficial geology
- Ploughing
- Trend



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