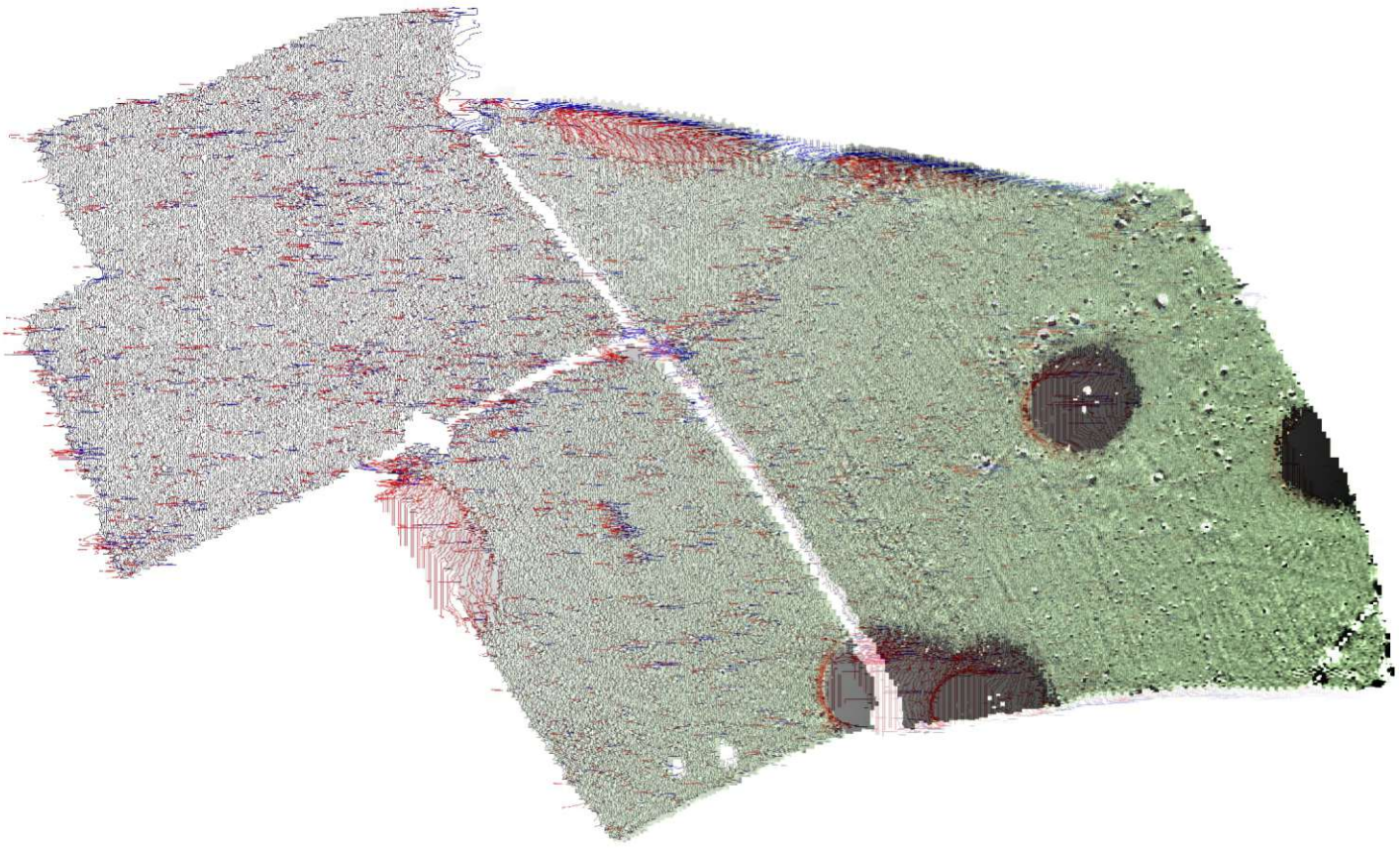
Wessex Archaeology

Land at Saundercroft Farm Whimple, Devon

Detailed Gradiometer Survey Report



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December 2012

LAND AT SAUNDERCROFT FARM
WHIMPLE
DEVON

Detailed Gradiometer Survey Report

Prepared for:

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DISCLAIMER

QUALITY ASSURANCE

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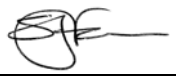
02	**E**	**PAB**	**SF**		**11/12/12**	X:\PROJECTS\87780\GEOPHYSICS\REPORT\87780_GEOPHYSICS_REPORTV2.DOC

I= Internal Draft E= External Draft F= Final

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Detailed Gradiometer Survey Report

Summary

Wessex Archaeology was commissioned by Solar Power Generation Ltd to undertake a detailed gradiometer survey over land west of Saundercroft Farm, Whimple, Devon centred on National Grid Reference 300900, 097075. The project was commissioned with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed solar farm.

The site comprises three pasture fields (Fields A-C) some 3.5km west of Whimple and lies on the north facing slope of a gently sloping valley, aligned approximately east to west. The gradiometer survey covered approximately 14.7ha and has detected a limited number of small anomalies of probable archaeological interest along with several anomalies of possible archaeological interest, areas of increased magnetic response and linear trends.

There is very little clear archaeology visible in the data set. Two small pit-like anomalies were identified in the north-east corners of Fields A and B and are of probable archaeological interest. A former field boundary was noted in Field A and map regression has indicated it is likely to have been removed in the last 50 years. There are a number of trends present running throughout the data set, the majority of which are clearly ploughing trends given their alignment with the modern field boundaries, although several others not aligned with the current ploughing trends may be archaeological in origin. A number of spreads with increased magnetic responses and large ferrous anomalies that mask the bases of pylons were also noted.

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Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Solar Power Generation Ltd and Wessex Archaeology is grateful to Rachel Humphreys and Mark Cullen in this regard.

The fieldwork was directed by Ben Urmston and assisted by Laura Andrews, Alistair Black and Ross Lefort. Ben Urmston processed the geophysical data and Ross Lefort interpreted the data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Sue Farr.

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Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Solar Power Generation Ltd to carry out a geophysical survey of land near Whimple, Devon (**Figure 1**), hereafter 'the Site' centred on National Grid Reference (NGR) 300900, 097075.

1.1.2 The survey was requested by the Archaeologist at Devon County Council to assess the impact of the proposed solar farm on any archaeological remains which may be present within the Site and to determine if further archaeological mitigation would be required ahead of the proposed development.

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 The Site

1.2.1 The survey area comprises three pasture fields (**Fields A**-**C**) located south of an electrical substation, approximately 3.5km west of Whimple, Devon (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site within one area, totalling 14.7ha.

1.2.2 The Site occupies the north facing slope of a gently sloping east-west aligned valley of a stream that is a tributary of the River Clyst; the wider area is characterised by similar gently sloping valleys of a number of other small tributaries. The land slopes from 45m above Ordnance Datum (aOD) at the south-eastern corner of the Site to 25m aOD at the north-western corner of the survey area. The survey area lies north of Saundercroft Road and to the west of Saundercroft Farm; the survey extents are defined by field boundaries.

1.2.3 The soils underlying the Site are likely to be stagnogleyic argillic brown earths of the 572f (Whimple 3) association (SSEW 1983). The bedrock geology is composed of the Aylesbeare mudstone group (Triassic); no superficial deposits are recorded (British Geological Survey). 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 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 19th and 22nd November 2012. Field conditions at

the time of the survey were variable with some waterlogging that made survey a little more difficult. These issues did not have a significant effect upon data quality.

2.2 Method

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

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 was collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (*ibid.*). Data were collected in the zigzag manner.

2.2.3 Data from the survey were subject to minimal data correction processes. These comprise a zero mean traverse 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. These two steps were applied to all survey areas, with no filtering or 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 many ploughing trends and areas of increased magnetic response. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1250 (**Figures 2** to **5**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT 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 (**Figures 6** and **7**). 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

Field A

3.2.1 There is only one anomaly of probable archaeological interest (**4000**) in **Field A** positioned in the north-east corner of the field. Anomaly **4000** is a sub-oval positive anomaly measuring 2.9m x 1.6m with magnetic values of around 5.5nT. This anomaly may represent a cut feature such as a pit.

3.2.2 There are many trends present running through the data; some are clearly ploughing trends given their alignment with the modern field boundary but others are not clearly related to ploughing. There are two parallel trends aligned WNW-ESE at **4001** in the south-east of the field and are broad with diffuse edges and have magnetic values around 1.0nT. It is unclear whether

these anomalies are archaeological or are the faint remains of an earlier agricultural feature. Other trends have better defined edges such as those at **4002** that have magnetic values ranging from 1.0nT to 1.5nT and are aligned NNW-SSE; another trend to the south of **4002** is aligned northeast to southwest and is associated with a negative shadow measuring -1.5nT. These trends are not aligned with the ploughing so may prove to be archaeological. The ploughing trends present throughout the field are either positive or negative and are aligned northwest to southeast.

3.2.3 There are several irregular shaped spreads of small bipolar anomalies (black and white) at **4002** and around **4003**. These spreads have magnetic values typically between -1.5nT and +1.5nT and are either spreads of magnetically enhanced anthropogenic debris such as ceramic sherds or are anomalies created by geological processes. These spreads may prove to be archaeological.

3.2.4 A positive linear anomaly with an associated negative shadow is present at **4004**; this corresponds to a former field boundary marked on maps produced before the construction of the electrical substation to the north. This boundary is associated with a concentration of ferrous and was most likely removed when the substation was constructed. The area northwest of this boundary (**4005**) has far fewer ploughing trends than the area southeast of it, indicative of different land use within the two fields. There are a few other trends that may be archaeological close by and they have magnetic values around 0.5nT.

3.2.5 There are a great many small positive anomalies scattered evenly throughout the field. The majority measure less than 2.5m in length and they have magnetic values ranging from 0.5nT up to 5nT. These anomalies do not form significant patterns in their distribution and as they are so numerous are considered to be of possible archaeological interest only and may equally be variations in the natural geology.

3.2.6 The remaining anomalies are large ferrous anomalies that mark the bases of pylons such as at **4006**. These anomalies have large, strong positive shadows and these will obscure any weaker archaeological features that may be located in the immediate vicinity.

Field B

3.2.7 There is only one anomaly of probable archaeological interest in **Field B** at **4007**; this is a sub-oval positive anomaly measuring 3.7m x 2.7m with maximum magnetic values of around 12.9nT. This anomaly may represent a cut feature such as a pit.

3.2.8 There are more spreads of increased magnetic response at **4008** that are similar in shape and strength to those around **4003**. There are numerous trends present and some, such as at **4009**, are similar to the broad examples observed at **4001** in Field A. They have magnetic values around 1.5nT and are aligned roughly east-west with some weaker examples further south (near **4008**) aligned WNW-ESE. These trends and others in the field may prove to be archaeological. The remaining anomalies comprise a large number of small positive anomalies classed as possible archaeology as they do not form any clear anthropogenic patterns in their distribution. The ploughing trends are aligned northwest to southeast and appear to be stronger towards the west of the field.

3.2.9 There is an elongated spread of ferrous anomalies aligned northwest to southeast at **4010** which is likely to be relatively modern given its alignment with the ploughing trends. There are more ferrous shadows created by pylons located along the northwest and southeast edges of this field and these anomalies will obscure any archaeological features that may be present.

Field C

3.2.10 **Field C** contains no anomalies of definite or probable archaeological interest (**Figure 7**). There are numerous trends visible as is the case in the other fields but this one shows far fewer visible ploughing trends. The most interesting anomaly in the field is a linear trend at **4011** that is associated with a high concentration of small ferrous anomalies. It has magnetic values around 0.5nT and is aligned northeast to southwest, at an angle perpendicular to the direction of ploughing. The remaining anomalies are a large number of small positive anomalies that are classed as possible archaeology as they do not form any clear anthropogenic patterns in their distribution.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of probable and possible archaeological interest within the Site.

4.1.2 There are no anomalies of definite archaeological interest within the survey area, and only two of probable archaeological interest, both of which are consistent with pit-like features. Anomalies of possible archaeological interest were also detected in addition to areas of increased magnetic response along with numerous trends.

4.1.3 The ferrous shadows created by the numerous pylons will have obscured any potential archaeological features present in these areas, although overall the data set shows no evidence of dense settlement activity and the linear trends are indicative of a continual agrarian use of the Site.

4.1.4 The presence of a former field boundary was identified at **4004** but map regression indicates this was removed within the last 50 years.

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 particularly in areas of widespread ferrous anomalies.

5 REFERENCES

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

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

Soil Survey of England and Wales, 1983. *Sheet 5, 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 ±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 two main categories: archaeological and unidentified responses.

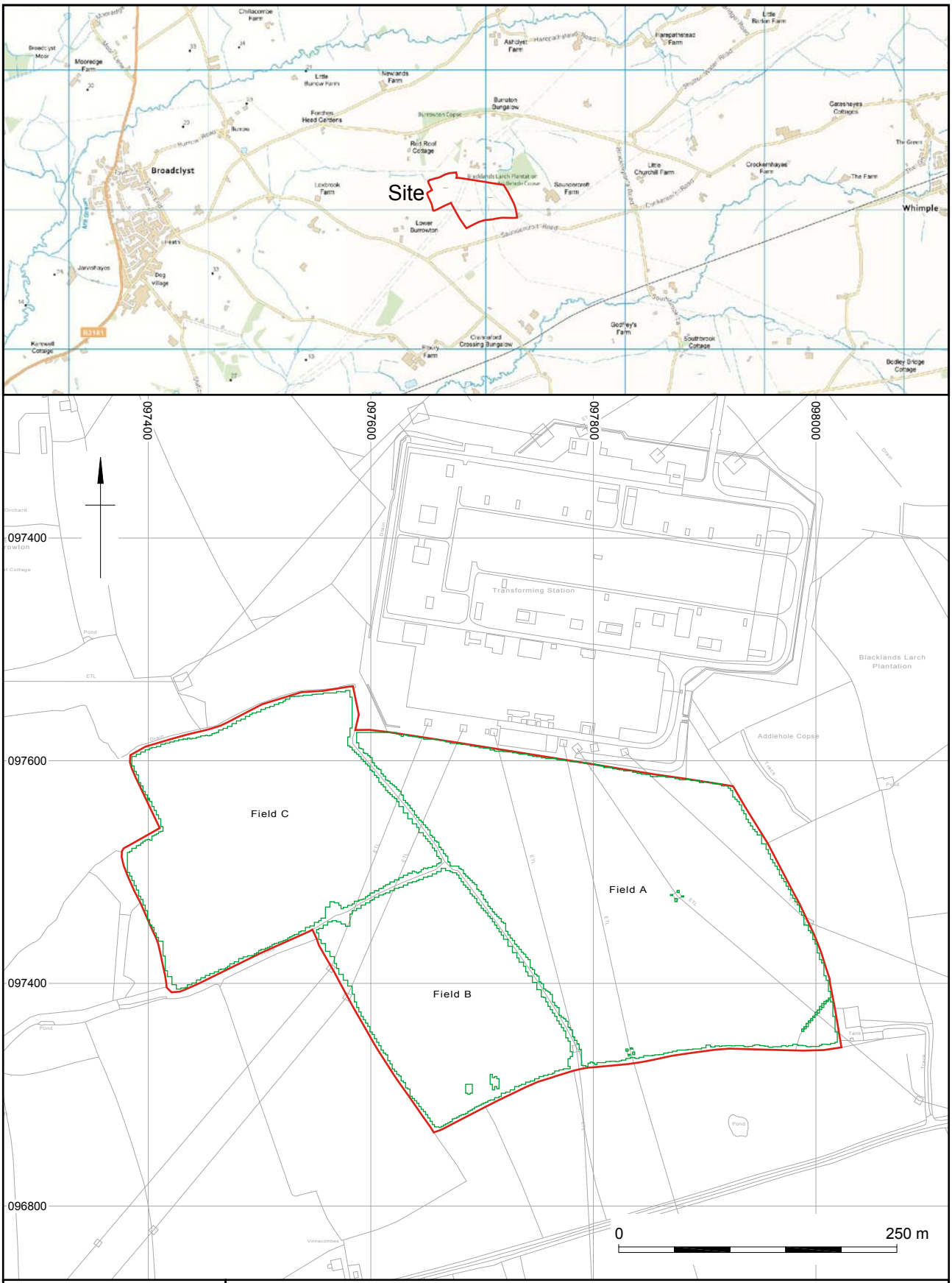
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Site boundary
Geophysical survey area

Wessex Archaeology

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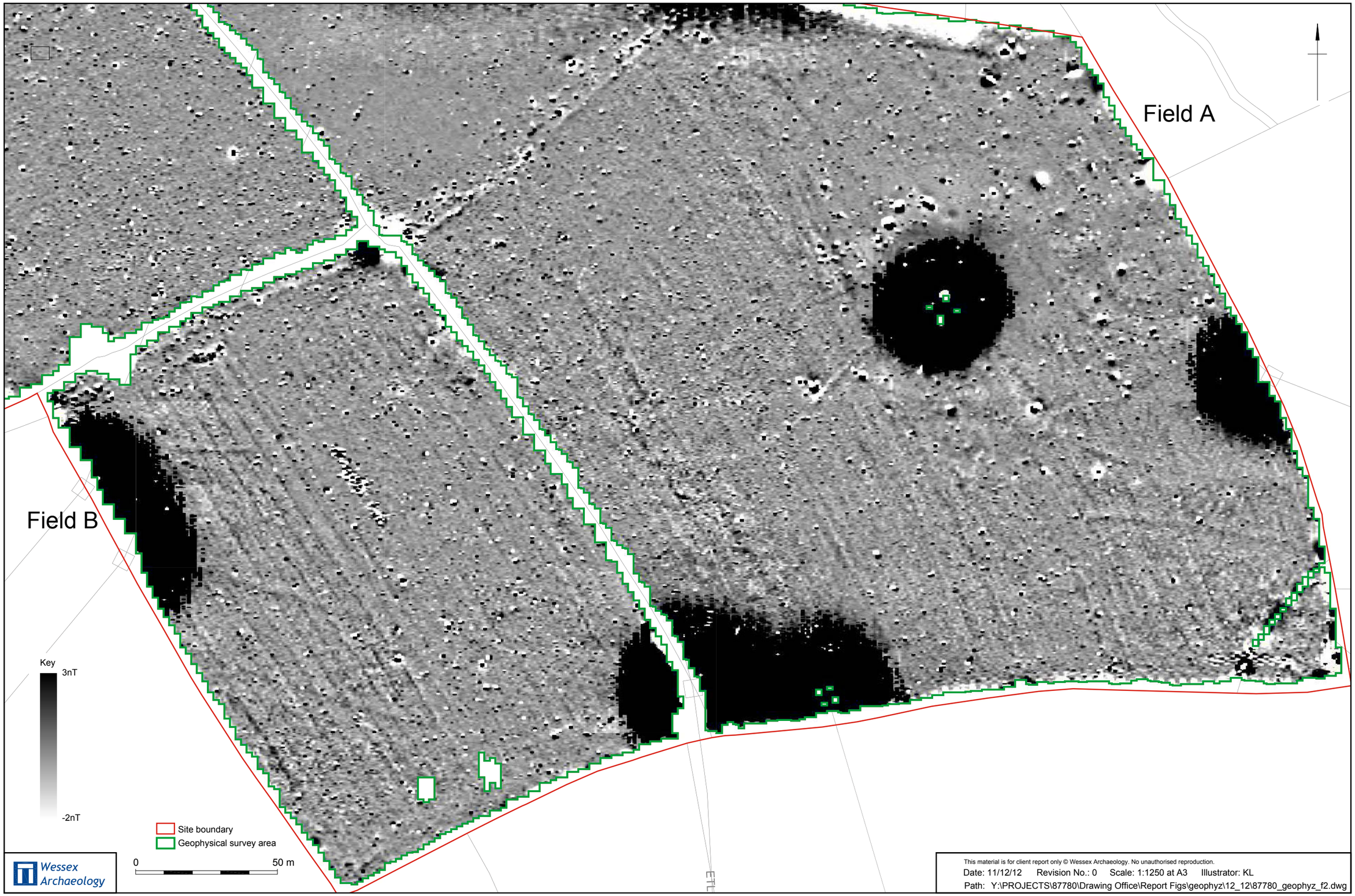
Site location plan

Figure 1



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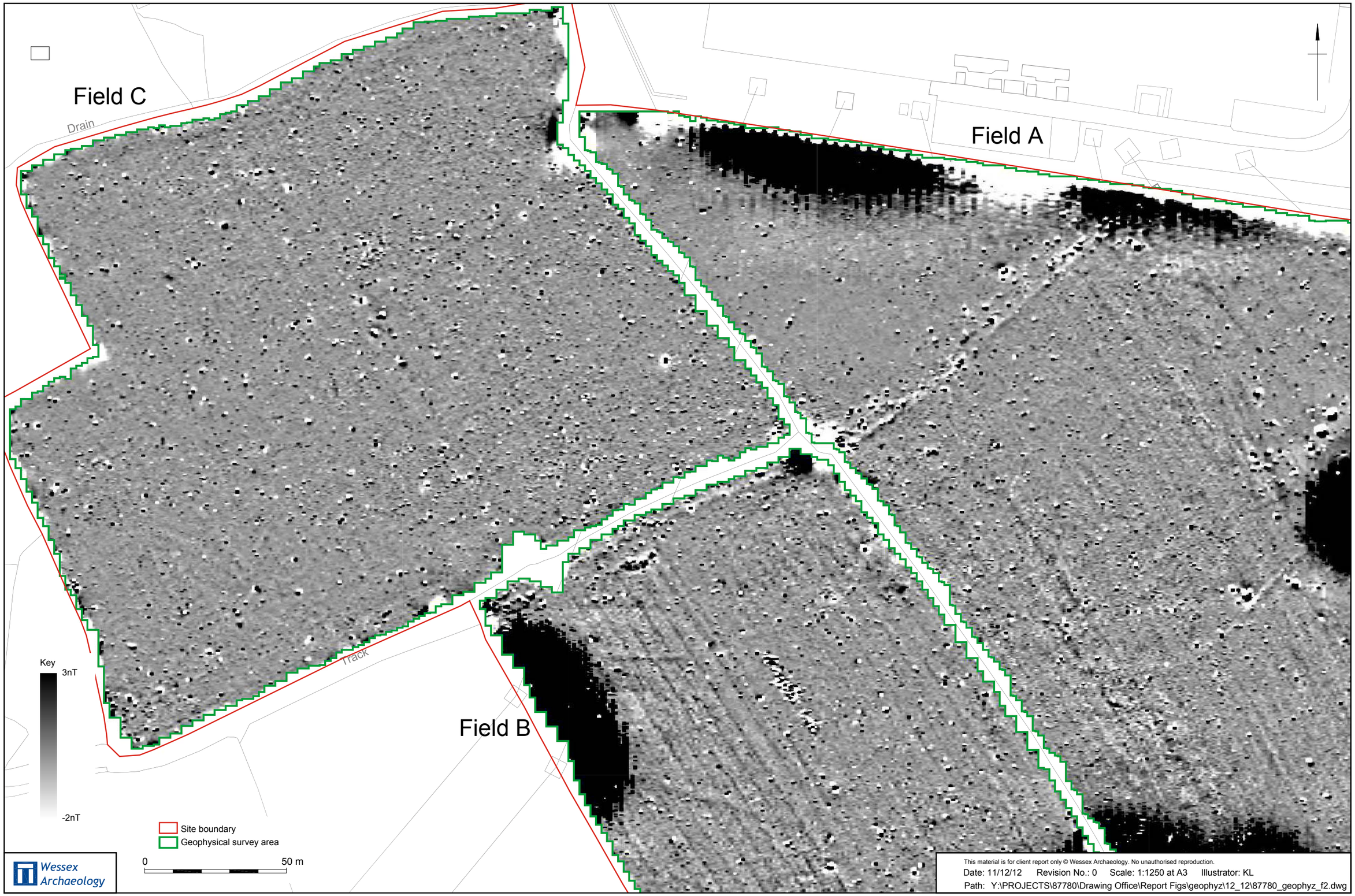
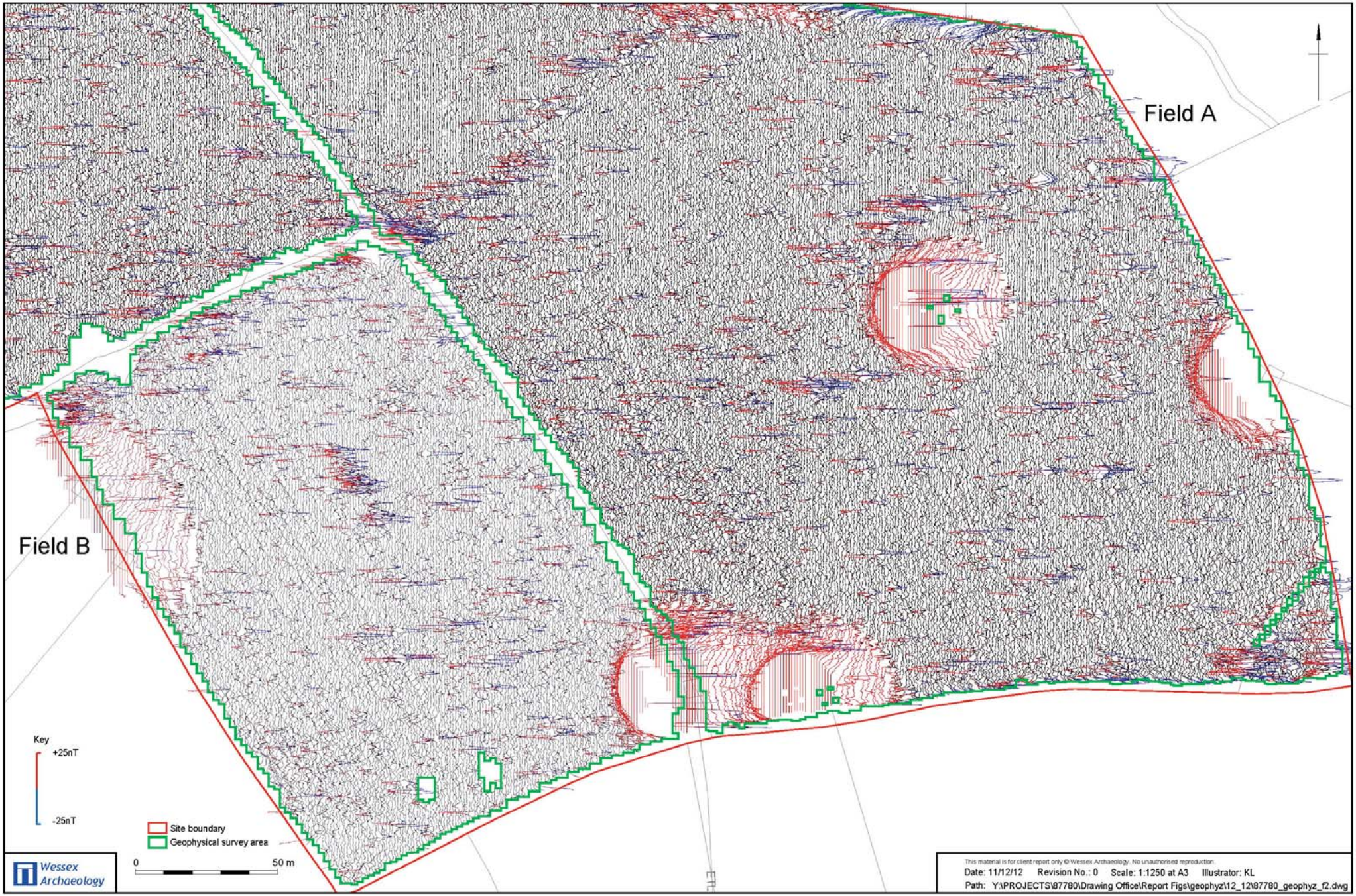
Greyscale plot south

Figure 2



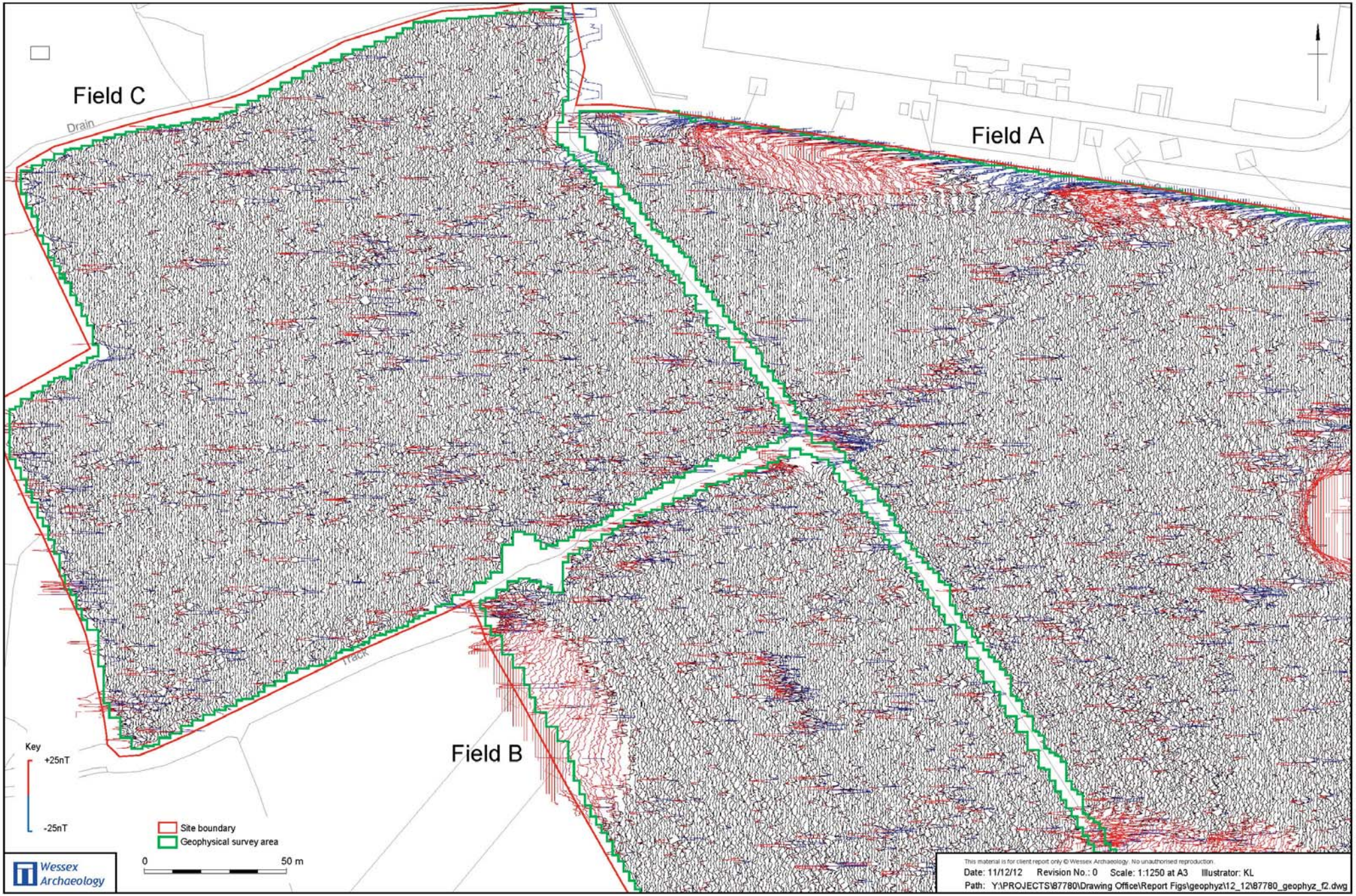
Greyscale plot north

Figure 3



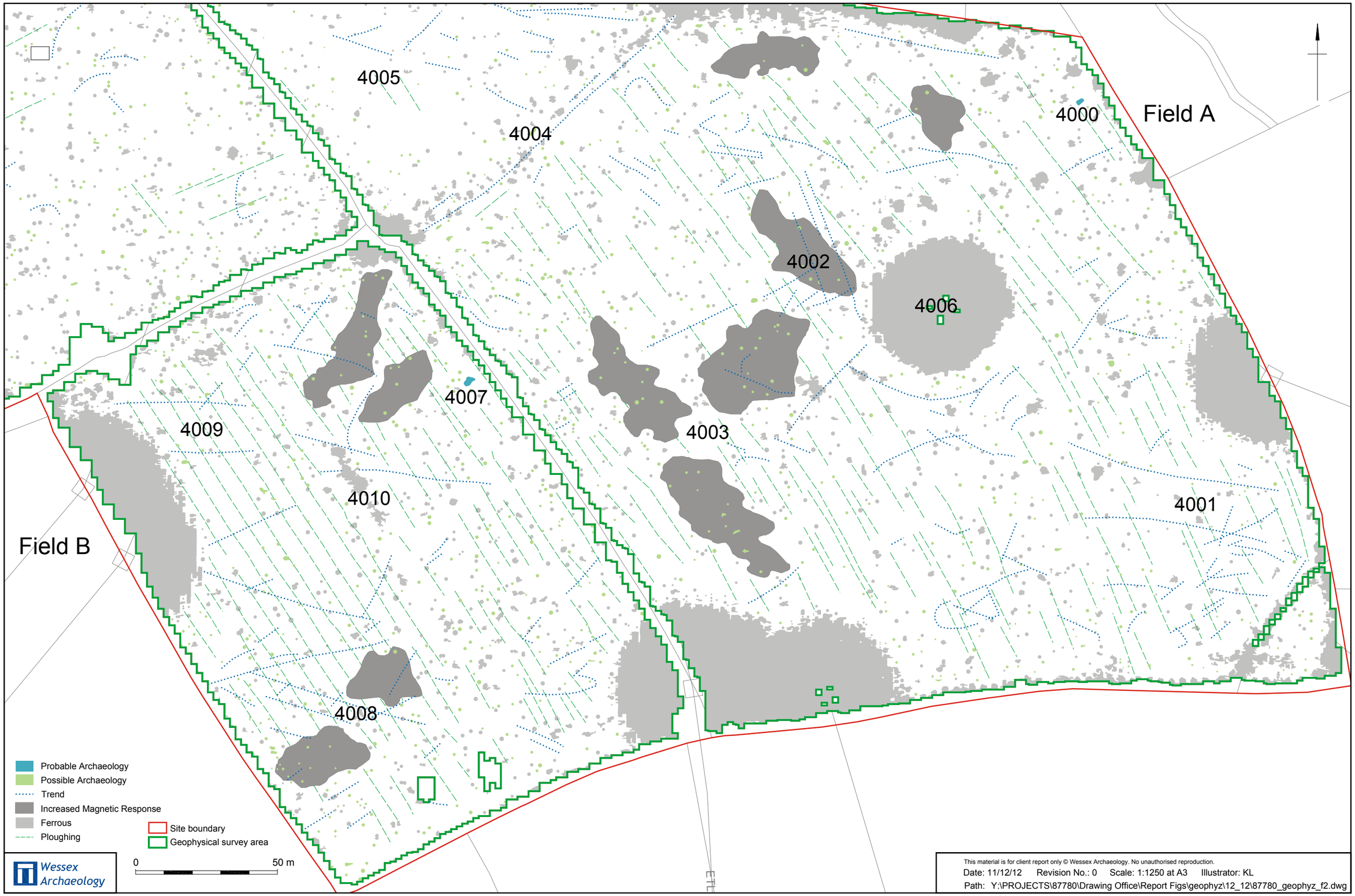
XY trace south

Figure 4



XY trace north

Figure 5



Interpretation south

Figure 6

Field C

Drain

Field A

4011

4005

4004

4002

4007

4003

4009

4010

Track

Field B

Probable Archaeology
Possible Archaeology
Trend
Increased Magnetic Response
Ferrous
Ploughing

Site boundary
Geophysical survey area

0 50 m

Wessex Archaeology

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Interpretation north

Figure 7

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