GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:

Land at Otherton Farm, Cotheridge, Worcestershire

Client:

OST Environment Ltd

October 2015

Job ref:
J8826

Report author:
Rebecca Davies BSc (Hons)

GEOPHYSICAL SURVEY REPORT

Project name:
Land at Otherton Farm, Cotheridge, Worcestershire
Client:
OST Environment Ltd

Job ref:
J8826

Techniques:
Detailed magnetic survey – Gradiometry

Survey date:
17th - 18th September 2015

Site centred at:
SO 807 538

Post code:
WR6 5LS

Field team:
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TABLE OF CONTENTS

LIST OF FIGURES 2
1 SUMMARY OF RESULTS 3
2 INTRODUCTION 3
2.1 Background synopsis 3
2.2 Site location 3
2.3 Description of site 3
2.4 Geology and soils 3
2.5 Site history and archaeological potential 4
2.6 Survey objectives 4
2.7 Survey methods 5
2.8 Processing, presentation and interpretation of results 5
2.8.1 Processing 5
2.8.2 Presentation of results and interpretation 5
3 RESULTS 5
3.1 Probable Archaeology 6
3.2 Possible Archaeology 6
3.3 Medieval/Post-Medieval Agriculture 6
3.4 Other Anomalies 6
4 DATA APPRAISAL & CONFIDENCE ASSESSMENT 6
5 CONCLUSION 7
6 REFERENCES 8
APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT 9
APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY 10
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES 11

LIST OF FIGURES

Figure 01	1:25 000	Location plan of survey area
Figure 02	1:2000	Location of survey grids and referencing
Figure 03	1:2000	Colour plot of gradiometer data showing extreme values - overview
Figure 04	1:1250	Colour plot of gradiometer data showing extreme values - north
Figure 05	1:1250	Colour plot of gradiometer data showing extreme values - south
Figure 06	1:2000	Plot of minimally processed gradiometer data - overview
Figure 07	1:1250	Plot of minimally processed gradiometer data - north
Figure 08	1:1250	Plot of minimally processed gradiometer data - south
Figure 09	1:2000	Abstraction and interpretation of gradiometer anomalies - overview
Figure 10	1:1250	Abstraction and interpretation of gradiometer anomalies - north
Figure 11	1:1250	Abstraction and interpretation of gradiometer anomalies - south

1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 8.6 hectares of arable farmland. No features of probable or possible archaeological origin have been identified. The features identified include an area of natural magnetic variation, evidence of modern ploughing, disturbance from nearby ferrous metal objects, and magnetic spikes which are likely to be modern rubbish.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by OST Environment Ltd.

2.2 Site location

The site is located at Otherton Farm, to the west of Worcester at OS ref. SO 807 538. The site is bound to the east and west by agricultural land, to the north by a reservoir and to the south by Otherton Lane.

2.3 Description of site

The survey area is approximately 8.6 hectares of flat, agricultural land. A number of telegraph poles and hay bales across the site were the only obstructions, but have not significantly reduced the survey area.

2.4 Geology and soils

The underlying geology across the north of the site is recorded as mudstone of Sidmouth Mudstone Formation, while the geology across the south comprises siltstone of Sidmouth Mudstone Formation (British Geological Survey website). Drift geology of Holt Heath Sand and Gravel Member – sand and gravel is recorded across the northern half of the site with no drift geology recorded across the south (British Geological Survey website).

The overlying soils are known as Newnham, which are typical brown earths. These consist of well drained reddish coarse and fine loamy soils over gravel (Soil Survey of England and Wales, Sheet 3 Midland and Western England).

2.5 *Site history and archaeological potential*

Extract from "Otherton Farm, Otherton Lane, Nr Worcester – Desk-Based Archaeological Assessment" (Wyvern Heritage, 2015):

"There is no evidence for activity of Prehistoric date within 1km of the development site. The site is however within an area of Palaeolithic potential on the Holt Heath Sand and Gravel Member (WSM56937). There is also an undated curvilinear enclosure 250m to the north east of the site which may have prehistoric origins (WSM34650). Additionally, stratified flint scrapers have been recovered from a number of sites throughout the parish of Rushwick. There, therefore is, based on available information, a medium archaeological potential for buried archaeology relating to this period.

There is no evidence for activity of Roman archaeology within 1km of the development site, although there has been several Roman finds recorded within the Portable Antiquaries Scheme. There, therefore is, based on available information, a low archaeological potential for buried archaeology relating to this period.

The HER records no evidence relating to post-Roman or Anglo-Saxon activity within 1km of the development site. There therefore is, based on available information, a low archaeological potential for buried archaeology relating to this period.

There are no medieval archaeological sites or finds within the site recorded in the HER. However the area around Otherton Farm has considerable Medieval influence including an area of ridge and furrow adjacent to the north east of the site and on the eastern side of the ponds 450 m east of the house (WSM34227); and a Deserted Medieval Village on the western side of Otherton Lane (WSM00993). Aymestrey School (WSM17318), 480 m to the northeast of the site is a manor house with late 11th century origins which became a post medieval country house. There is also a Holloway on the eastern side of the A4103 (WSM05548). Several Medieval finds have been recorded in the Portable Antiquities scheme within 1km of the site (WSM65596; WSM65740; WSM65741). There, therefore, is a medium to high archaeological potential for buried archaeology relating to the medieval period within the site, as known sensitive locations lie just beyond its boundaries."

2.6 *Survey objectives*

The objective of the survey was to locate any features of possible archaeological origin in order that they may be assessed prior to development.

2.7 *Survey methods*

This report and all fieldwork have been conducted in accordance with both the English Heritage guidelines outlined in the document: *Geophysical Survey in Archaeological Field Evaluation, 2008* and with the Chartered Institute for Archaeologists document *Standard and Guidance for Archaeological Geophysical Survey.*

Due to the moderate potential for prehistoric remains and the moderate-high potential for medieval remains, detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in Appendix A.

2.8 *Processing, presentation and interpretation of results*

2.8.1 *Processing*

Processing is performed using specialist software. This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all minimally processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)
2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

2.8.2 *Presentation of results and interpretation*

The presentation of the data for each site involves a print-out of the minimally processed data both as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site.

3 RESULTS

The detailed magnetic gradiometer survey conducted at Otherton Farm, Cotheridge has not identified any anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin.

The following list of numbered anomalies refers to numerical labels on the interpretation plots.

3.1 *Probable Archaeology*

No probable archaeology has been identified within the survey area.

3.2 *Possible Archaeology*

No possible archaeology has been identified within the survey area.

3.3 *Medieval/Post-Medieval Agriculture*

1 A number of closely spaced parallel linear anomalies across the site. These are related to modern agricultural activity, such as ploughing.

3.4 *Other Anomalies*

2 An area of amorphous magnetic variation in the south-east of the site. This is likely to be natural, i.e. geological in origin.

3 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies, but on this site have not affected a significant proportion of the area.

4 A number of magnetic 'spikes' (strong focussed values with associated antipolar response) indicate ferrous metal objects. These are likely to be modern rubbish.

4 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Both mudstone and siltstone geologies can give variable results for gradiometer survey, as can superficial deposits of sand and gravel. No features of archaeological origin have been identified on the site, despite the potential for prehistoric and medieval remains. Given the fact that no archaeological features have been discovered, along with the generally low contrast between responses across the site, it could be determined that the underlying geology and superficial deposits have lessened the effectiveness of the survey.

5 CONCLUSION

The survey at Otherton Farm has not identified any features of archaeological origin, despite the potential for prehistoric and medieval remains. The features identified include an area of amorphous magnetic variation, which is likely to be natural in origin, evidence of modern ploughing, and disturbance from nearby ferrous metal objects.

6 REFERENCES

British Geological Survey South Sheet, 1977. *Geological Survey Ten Mile Map, South Sheet First Edition (Quaternary).* Institute of Geological Sciences.

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APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT

Grid locations

The location of the survey grids has been plotted together with the referencing information. Grids were set out using a Leica 705auto Total Station and referenced to suitable topographic features around the perimeter of the site or a Leica Smart Rover RTK GPS.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

Survey equipment and gradiometer configuration

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

Sampling interval

Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

Depth of scan and resolution

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

Data capture

The readings are logged consecutively into the data logger which in turn is daily down- loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

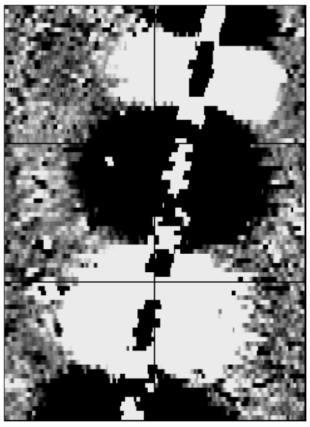
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

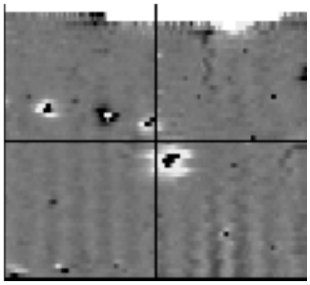
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES

Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

Dipolar

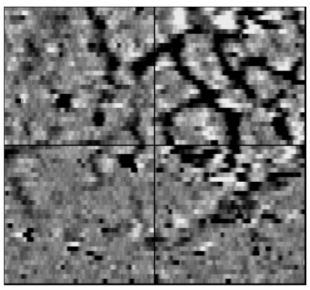


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

Positive anomaly with associated negative response

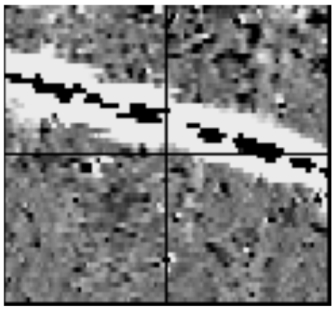
See bipolar and dipolar.

Positive linear



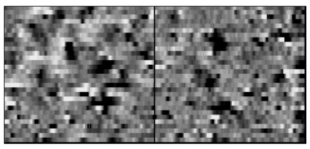
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

Positive linear anomaly with associated negative response



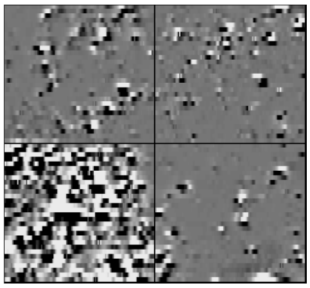
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

Positive point/area



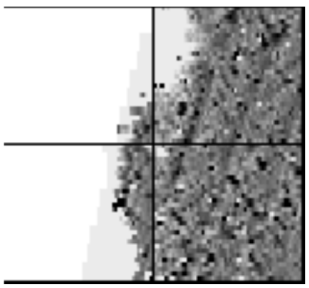
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

Magnetic debris



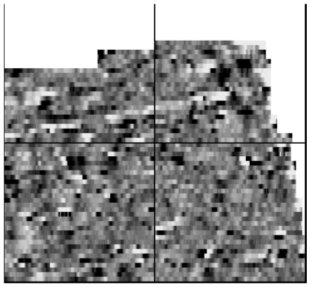
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly (+/-250nT) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

Negative linear

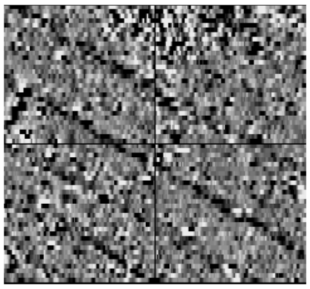


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative to the background top soil is built up. See also ploughing activity.

Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing. Clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

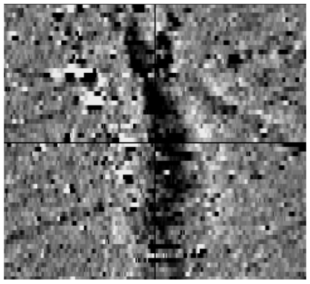
Strength of response

The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a 10m^2 area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.

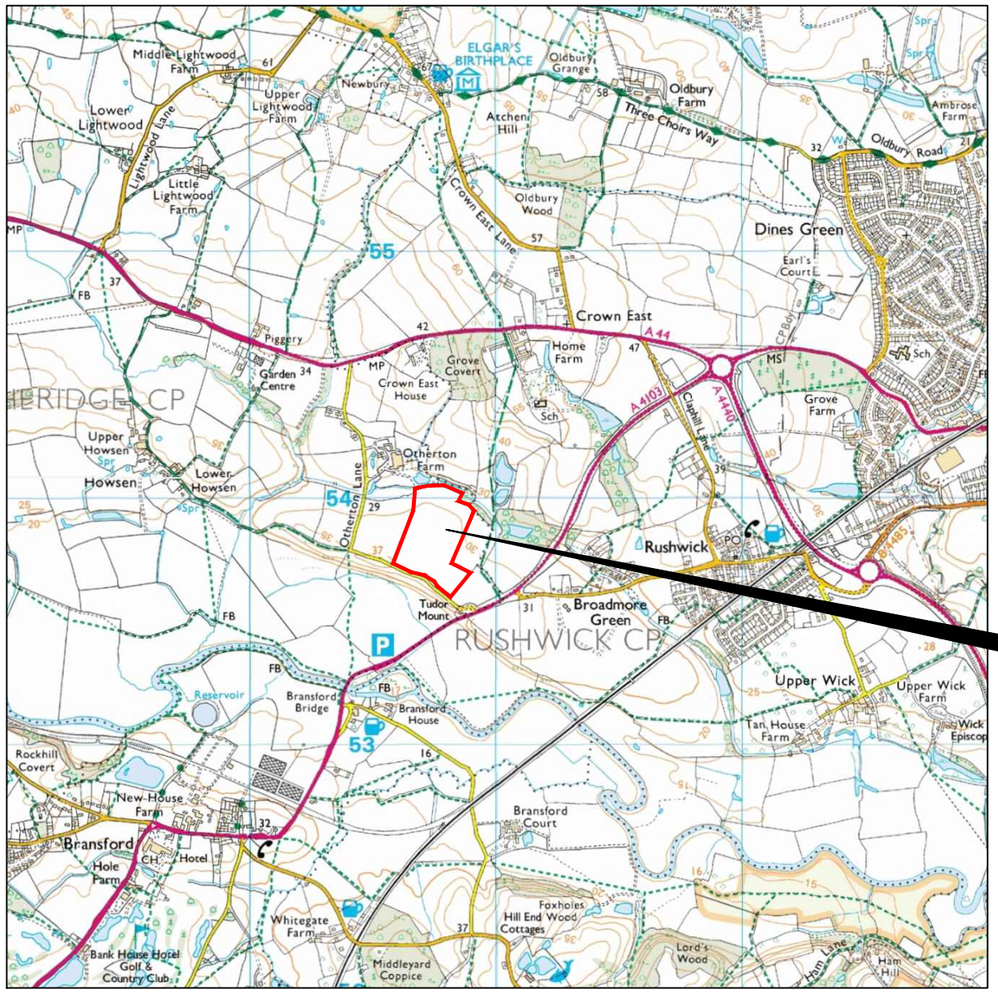
Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR: SO 807 538

Client: OST ENVIRONMENT LTD

Project Title: LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Job No. J8826

Subject: LOCATION PLAN OF SURVEY AREA

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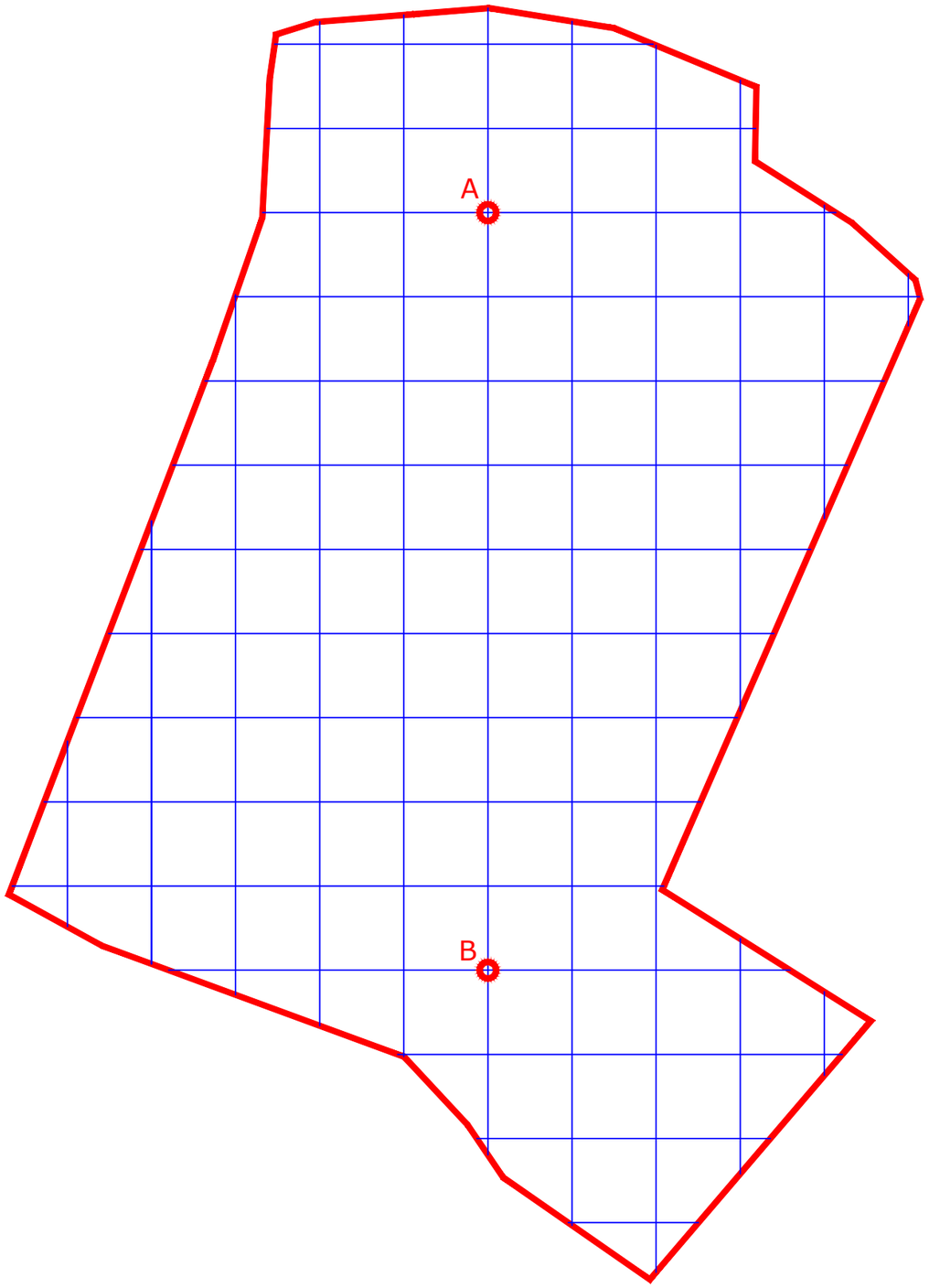
SUMO GROUP MEMBER

Scale: 1:25000 (0m 500 1000m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	RD	01



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

OS GRID REFERENCES

A	380762.87, 253972.16
B	380762.87, 253702.16

Client
OST ENVIRONMENT LTD

Project Title
LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Job No. J8826

Subject
LOCATION OF SURVEY GRIDS AND REFERENCING

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Scale 1:2000 (0m 20 40 60 80 100m)

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Survey date	Drawn by	Figure No.
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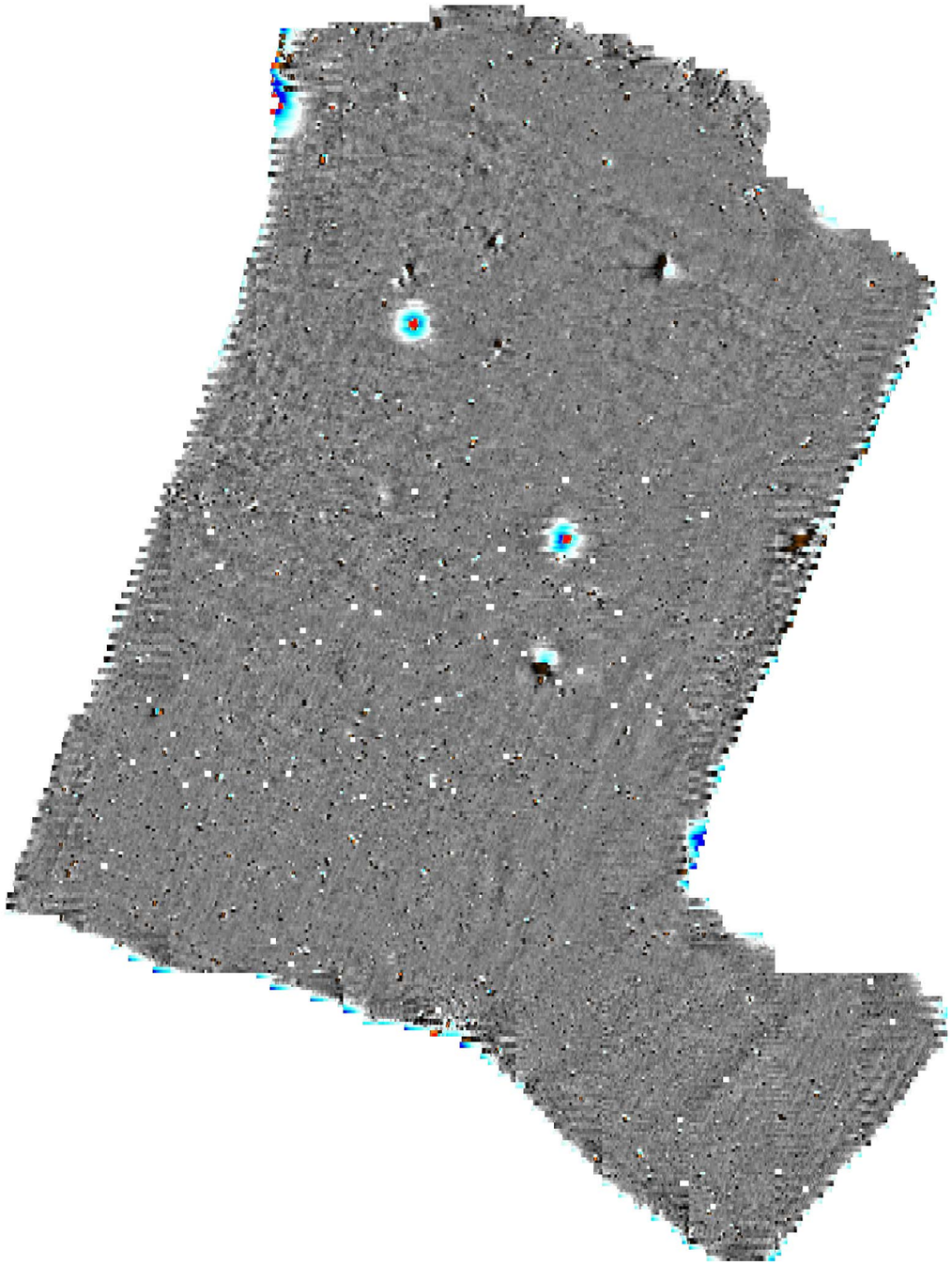

N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

Client

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Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES - OVERVIEW

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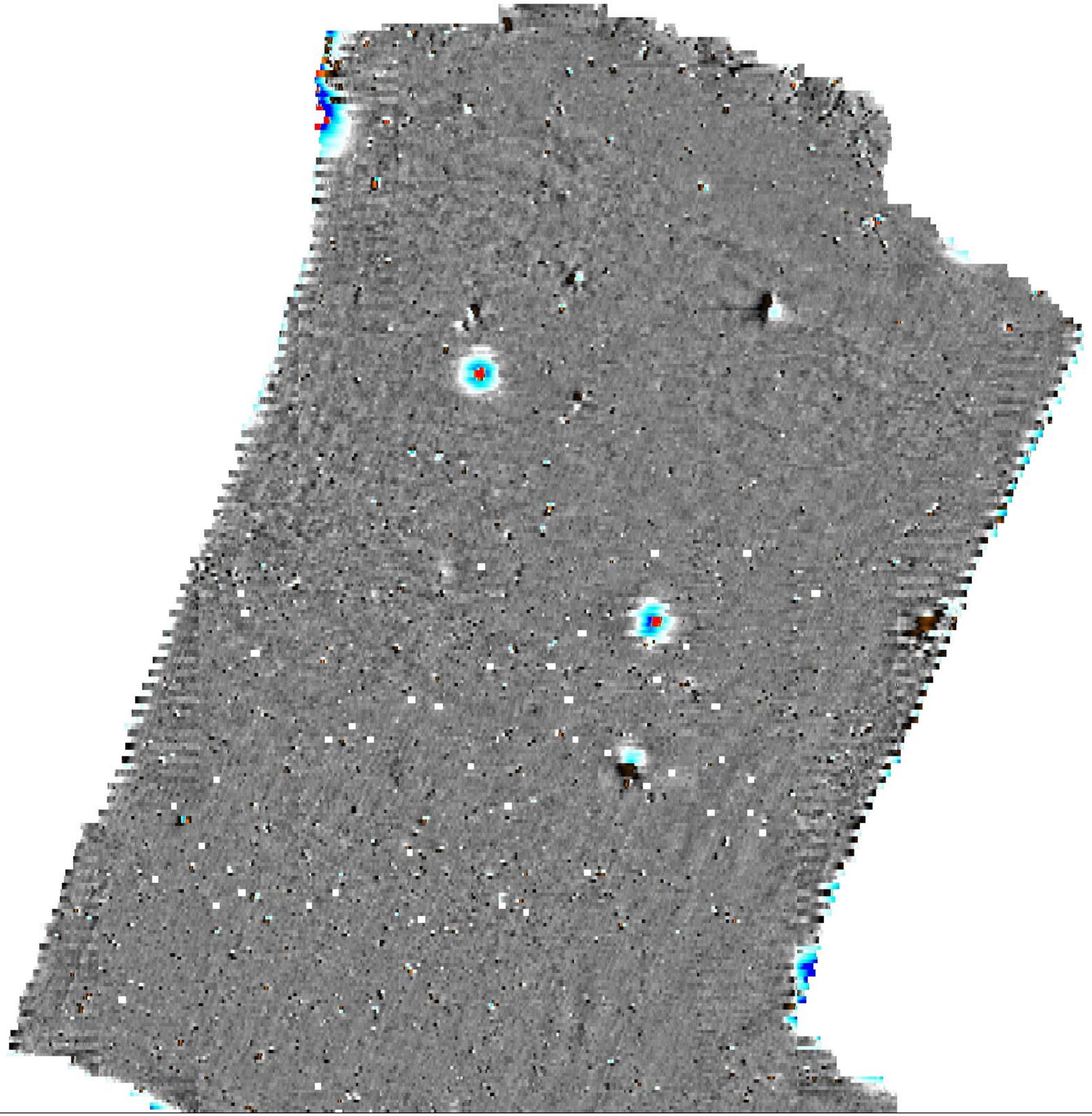
Scale 1:2000 (0m 20 40 60 80 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	03



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES - NORTH

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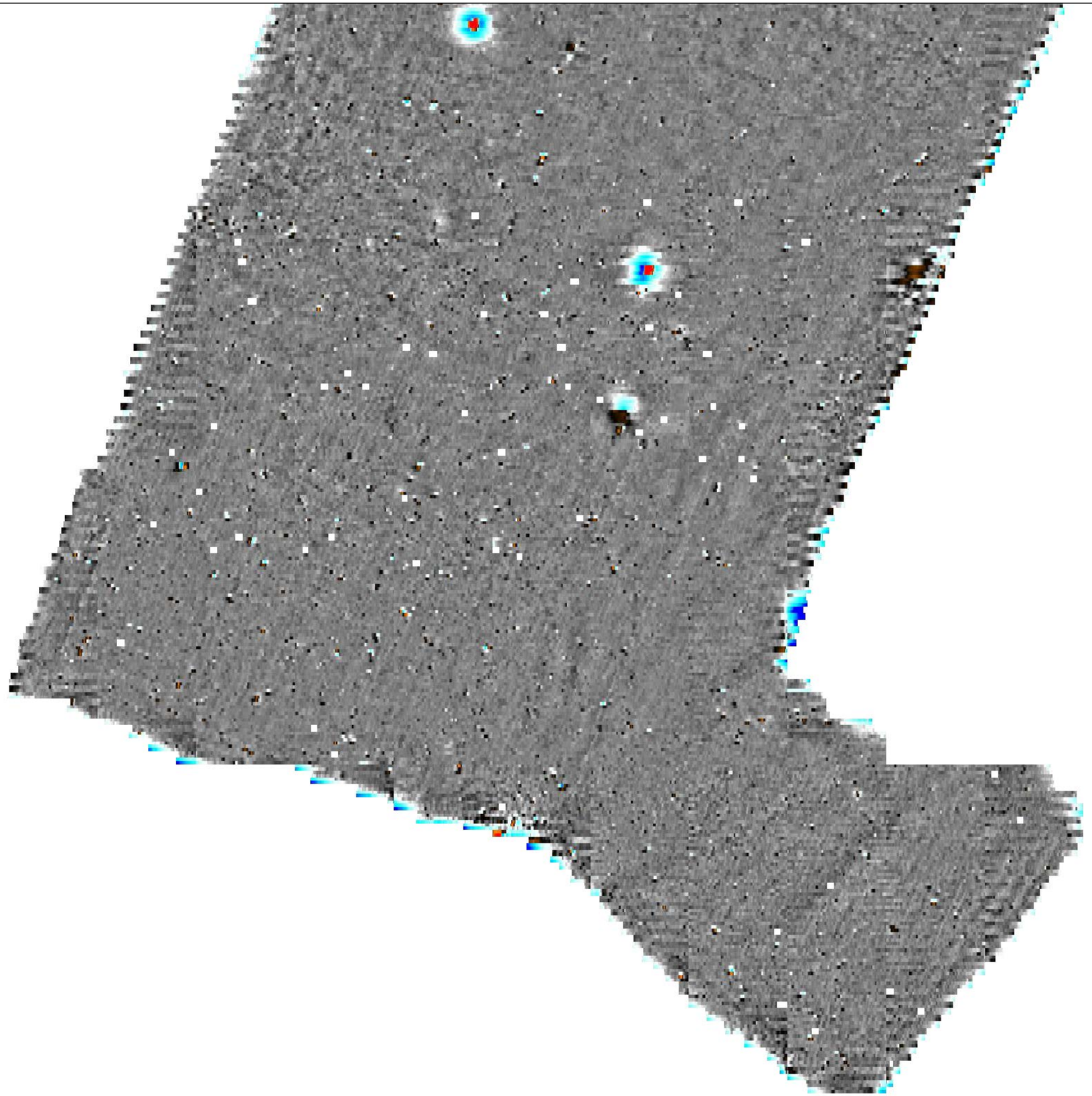
SUMO GROUP MEMBER

Scale		
1:1250	0m 10 20 30 40 50m	
Plot: A3	Checked by: DGE	Issue No.: 01
Survey date: SEP 15	Drawn by: TR	Figure No.: 04



N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES - SOUTH

STRATASCAN™
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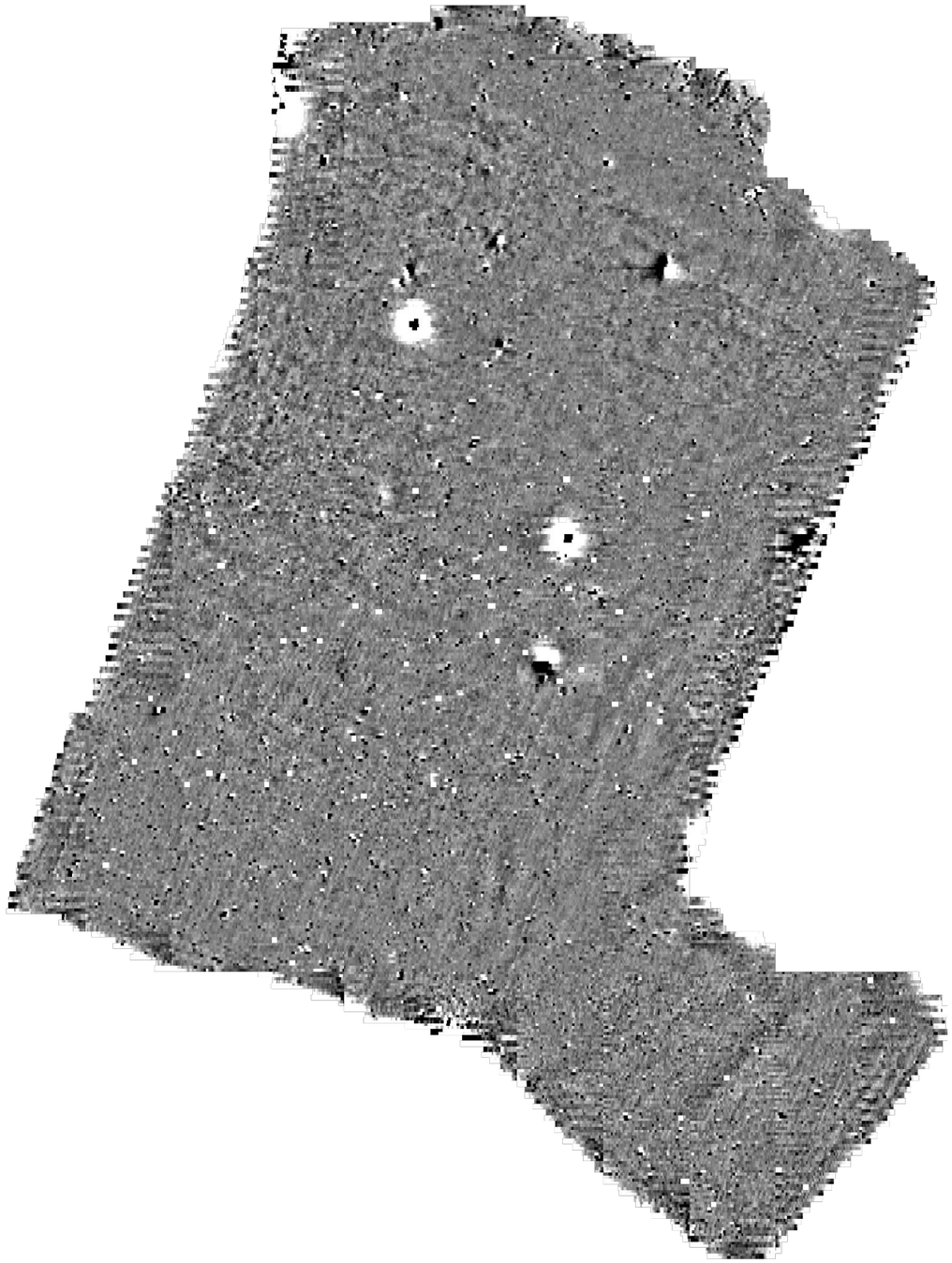
SUMO GROUP MEMBER

Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	05



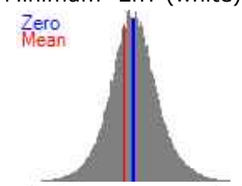
N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +2nT (black)
Minimum -2nT (white)



Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA - OVERVIEW

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EUROPEAN GPR ASSOCIATION

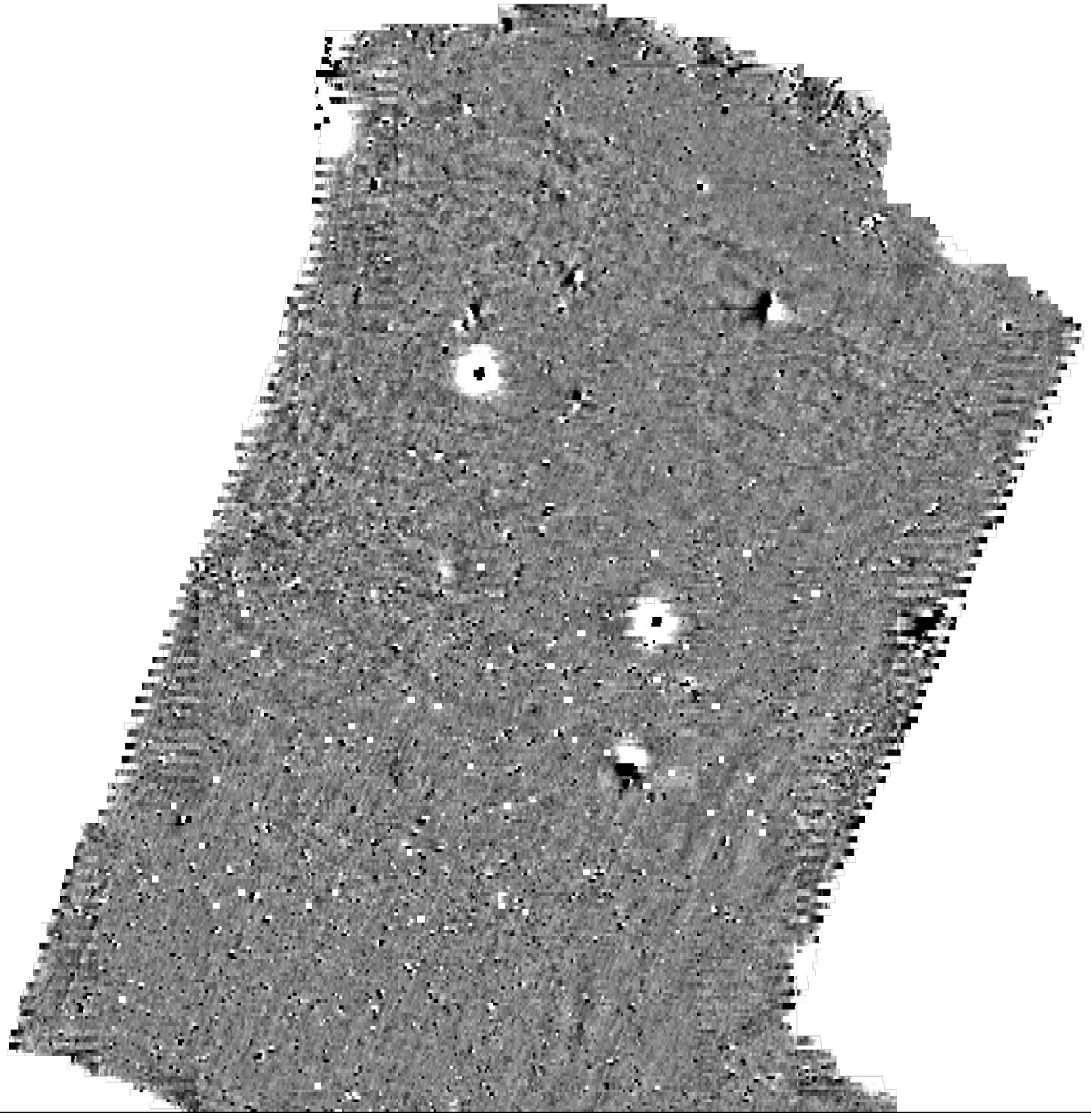
SUMO GROUP MEMBER

ISO 9001 certified

ISO 14001 certified

Scale 1:2000 — 0m 20 40 60 80 100m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	06

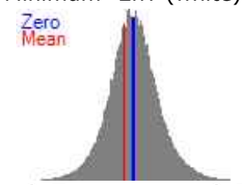


Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +2nT (black)
Minimum -2nT (white)



Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA - NORTH

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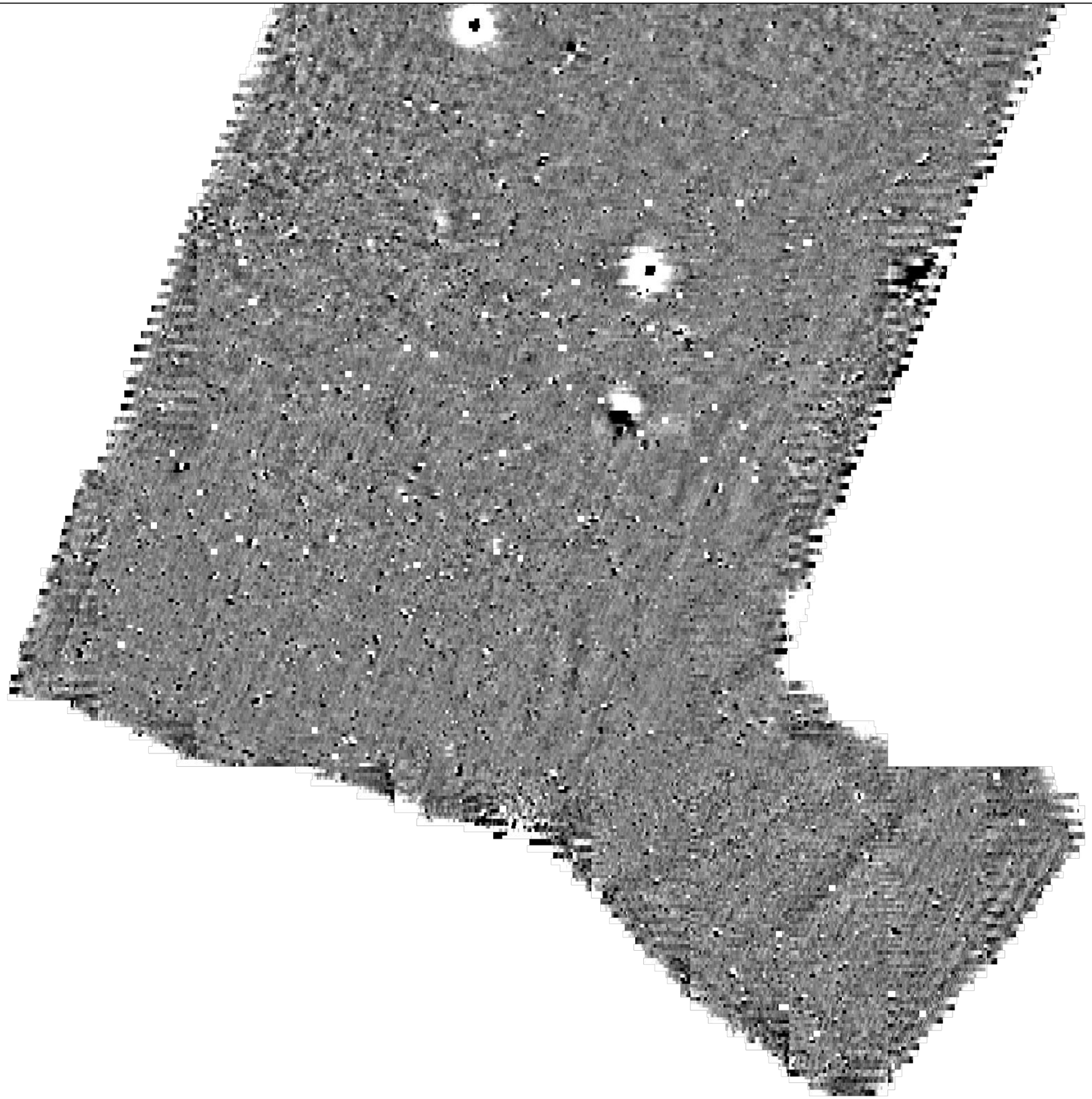
SUMO GROUP MEMBER

Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	07

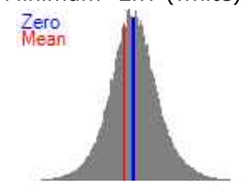


Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +2nT (black)
Minimum -2nT (white)



Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA - SOUTH

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Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	08

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin

POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin

MEDIEVAL/POST-MEDIEVAL AGRICULTURE

- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow
- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - probably related to a former field boundary not present on available mapping
- Linear anomaly - related to a former field boundary present on available mapping

OTHER ANOMALIES

- Linear anomaly - probably related to pipe, cable or other modern service
- Linear anomaly - possibly related to land drain
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Strong magnetic debris - possible disturbed or made ground
- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin
- Magnetic spike - probable ferrous object

Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES - OVERVIEW

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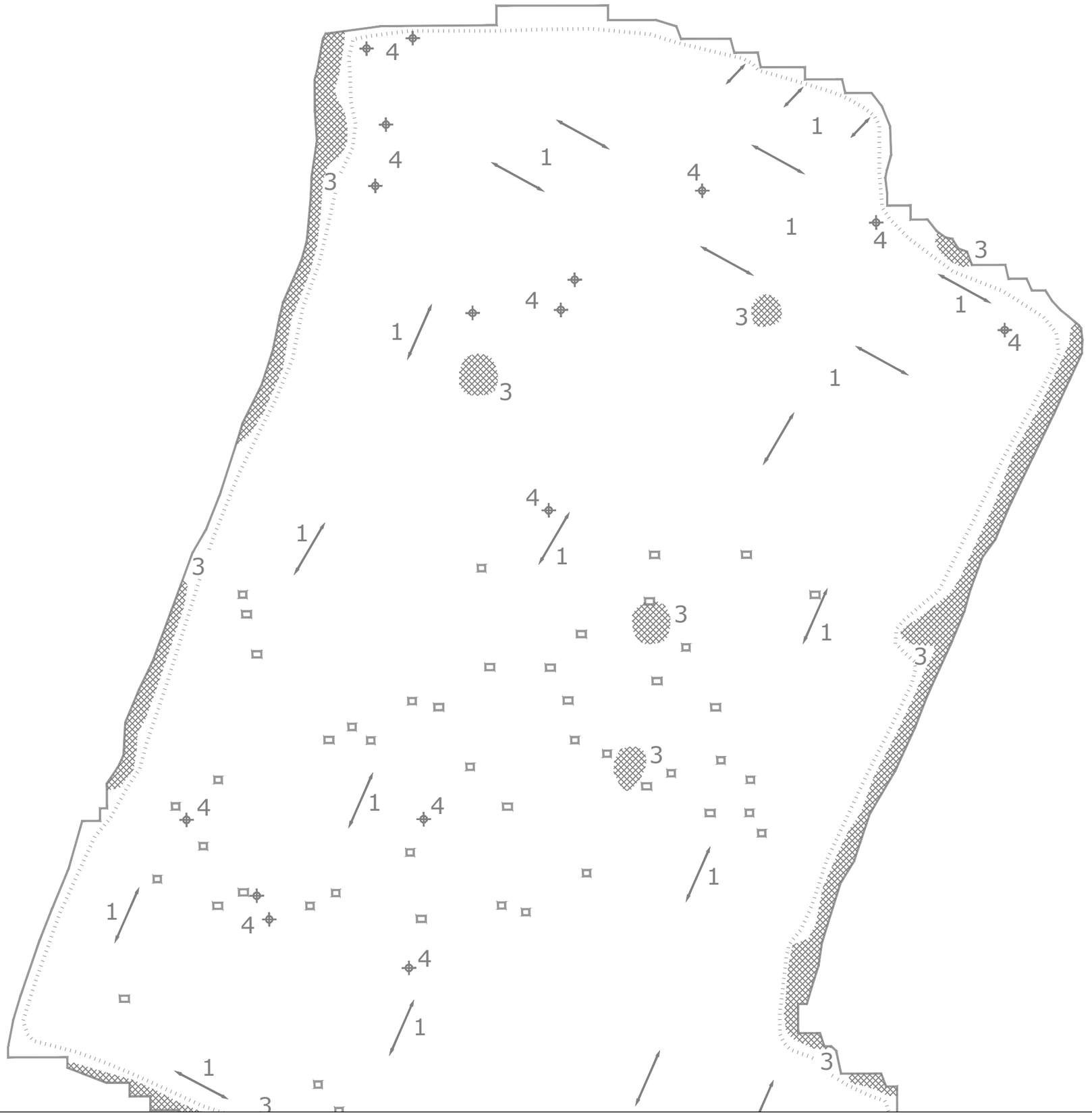
Scale 1:2000 (0m 20 40 60 80 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	09



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

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- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin
- Magnetic spike - probable ferrous object

Client

OST ENVIRONMENT LTD

Project Title — Job No. J8826

LAND AT OTHERTON FARM, COTHERIDGE, WORCESTERSHIRE

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES - NORTH

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Scale 1:2000 (0m 20 40 60 80 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	10

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

PROBABLE ARCHAEOLOGY

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Subject

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Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
SEP 15	TR	11

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