STRATASCAN

Geophysical Survey Report

Glenda Spooner Farm, Kingsdon, Somerset

for

John Moore Heritage Services

June 2008

J2491

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Document Title:	**Geophysical Survey Report** **Glenda Spooner Farm, Kingsdon, Somerset**
Client:	**John Moore Heritage Services**
Stratascan Job No:	**J2491**
Techniques:	**Detailed magnetic survey (gradiometry)**
National Grid Ref:	**ST 511 257**

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LIST OF FIGURES

1 SUMMARY OF RESULTS

The geophysical survey undertaken over 2.2ha of land at Glenda Spooner Farm, Somerset has located a number of anomalies of a possible archaeological origin. Positive linear and area anomalies indicate the presence of cut features; negative anomalies may represent former earthworks or buried masonry and discrete positive anomalies have been interpreted as possible pits.

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 John Moore Heritage Services.

2.2 Site location

The site is located within Glenda Spooner Farm near Kingsdon, Somerset at OS ref. ST 511 257.

2.3 Description of site

The survey area consists of approximately 2.2ha of land currently used as paddocks.

2.4 Geology and soils

The underlying geology is Lower Lias (British Geological Survey South Sheet, Fourth Edition Solid, 2001).

The overlying soils are known as Evesham 1 which are typical calcareous pelosols. These consist of slowly permeable calcareous clayey soils associated with shallow well drained brashy soils over limestone (Soil Survey of England and Wales, Sheet 5, South Wes0074 England).

2.5 Site history and archaeological potential

The projected line of a Roman Road runs diagonally through the survey area suggesting that there is potential for anomalies of an archaeological origin within the gradiometer data.

2.6 Survey objectives

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

2.7 Survey methods

Detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over two days from 5th June 2008. Weather conditions during the survey were dry and sunny.

3.2 Grid locations

The location of the survey grids is based on the Ordnance Survey National Grid, see Figure 2. The referencing and alignment of grids was achieved using a Leica DGPS System 500.

A DGPS (differential 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. Calculations to correct for these errors are performed at an accurately located base station. The base station then transmits the corrections which are received by DGPS consoles giving sub metre accuracy averaging around 0.5m error.

3.3 Survey equipment

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (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.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 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.

3.4.2 Depth of scan and resolution

The Grad 601 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. The collection of data at 0.5m centres provides an optimum methodology for the task balancing cost and time with resolution.

3.4.3 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 job, data is transferred to the office for processing and presentation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Processing is performed using specialist software known as *Geoplot 3.* 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. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found

on agricultural land. 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 processed gradiometer data used in this report:

1. *Despike* (useful for display and allows further processing functions to be carried out more effectively by removing extreme data values)

   Geoplot parameters:
   X radius = 1, y radius = 1, threshold = 3 std. dev.
   Spike replacement = mean

2. *Zero mean grid* (sets the background mean of each grid to zero and is useful for removing grid edge discontinuities)

   Geoplot parameters:
   Threshold = 0.25 std. dev.

3. *Zero mean traverse* (sets the background mean of each traverse within a grid to zero and is useful for removing striping effects)

   Geoplot parameters:
   Least mean square fit = off

3.5.2 Presentation of results and interpretation

The presentation of the data for each site involves a print-out of the raw data both as greyscale (Figure 3) and trace plots (Figures 4 and 5), together with a greyscale plot of the processed data (Figure 6). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 7).

4 RESULTS

The gradiometer survey undertaken over approximately 2.2ha of paddock at Glenda Spooner Farm, near Kingsdon, Somerset has located a number of anomalies of a possible archaeological origin.

A positive linear anomaly is evident running approximately northwest to southeast through the survey area. This cut feature seems to be parallel to the projected line of the Roman Road. However, the anomaly turns southwest in the southern limits of the survey area instead of continuing in a straight line as would be expected if it was related to the road. It may be that this feature relates to an old field boundary, the orientation of which has been dictated by the presence of the former road.

A positive trend can be noted in the southern limits of the survey area. The orientation and location of this anomaly provides weak evidence for the presence of the Roman Road.

Other positive anomalies indicating cut features, such as ditches of a possible archaeological origin, can be noted across the survey area. Discrete positive anomalies interpreted as pits are also evident within the survey area.

A number of negative linear and area anomalies can be noted within the survey area. These anomalies have been interpreted as being related to former earthworks of a possible archaeological origin. The large negative area anomaly in the southern region of the site has a similar orientation as the Roman Road which may suggest that it could relate to this feature.

Magnetic disturbance is present across the survey area. This disturbance is related to ferrous objects such as fences and a pipeline in the south east of the survey area.

5 CONCLUSION

The gradiometer survey undertaken at Glenda Spooner Farm, Somerset has located a number of anomalies of a possible archaeological origin. No anomalies have been identified that can be confidently assigned to the Roman Road. However a negative area anomaly and a positive trend in the southern limits of the site with the same orientation may represent features related to the road.

6 REFERENCES

British Geological Survey, 2001. *Geological Survey Ten Mile Map, South Sheet, Fourth Edition (Solid)*. British Geological Society.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 Southwest England*.

APPENDIX A – 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 *thermoremnant* 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.

Thermoremnance 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. Thermoremnant archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

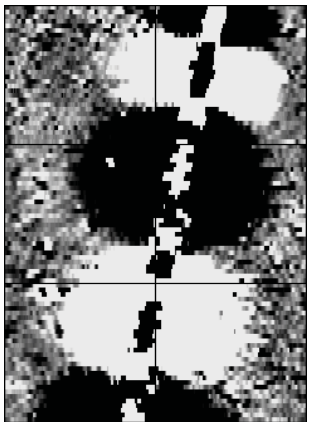
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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 either 0.5 or 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.

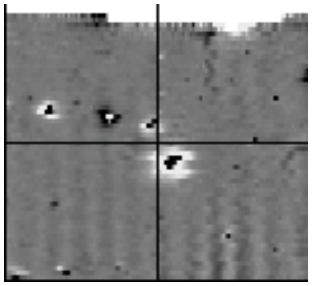
APPENDIX B – Glossary of magnetic anomalies

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

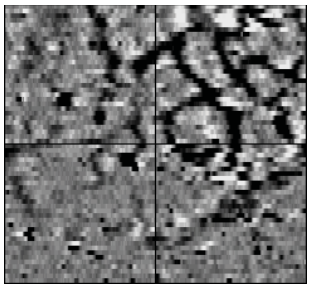


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very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

Positive anomaly with associated negative response

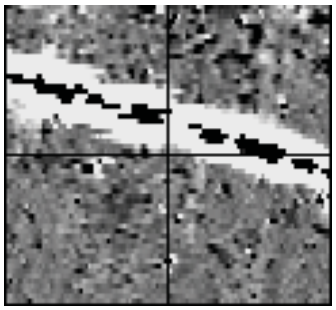
See bipolar and dipolar.

Positive linear



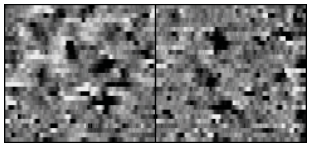
A linear response which is entirely positive in polarity. These are usually related to infilled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity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

Positive linear anomaly with associated negative response



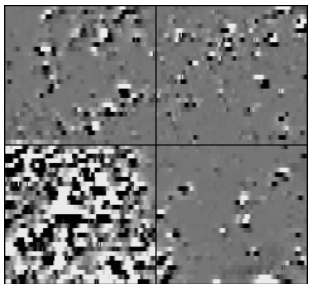
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field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

Positive point/area



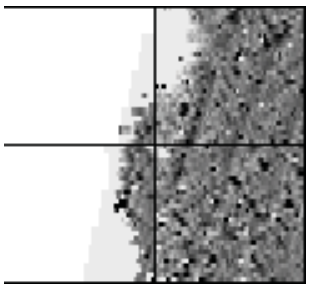
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by infilled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally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

Magnetic debris



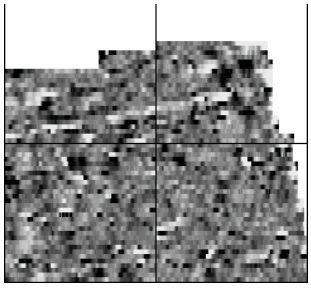
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly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

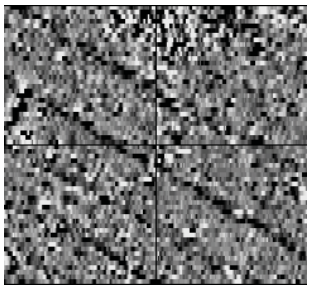


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

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).

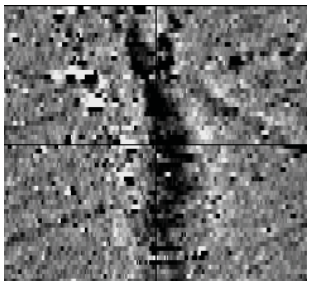
Strength of response

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. Trace plots are used to show the amplitude of response.

Thermoremnant response

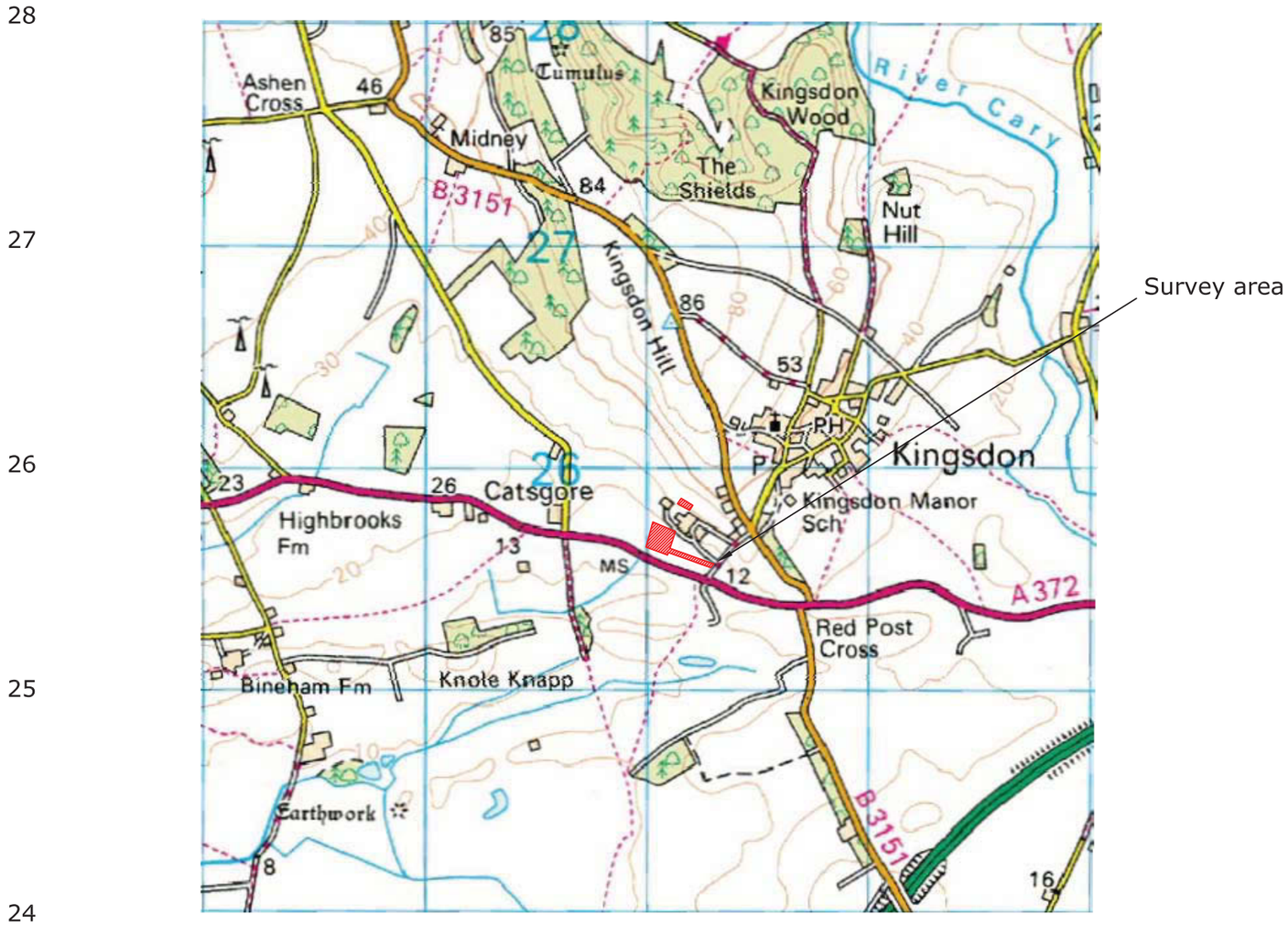
A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred insitu (e.g. a kiln) then 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.

OS 100km square = ST



Amendments

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Site centred on NGR ST 511 257

Client
JOHN MOORE HERITAGE SERVICES

Project Title
GEOPHYSICAL SURVEY - GLENDA SPOONER FARM, KINGSDON, SOMERSET

Job No. 2491

Subject
LOCATION PLAN OF SURVEY AREA

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Survey date	Drawn by	Figure No.
JUNE 08	RAJS	01

Amendments		
Issue No.	Date	Description
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351156.28 125594.97	OS Grid reference
	Survey grid
	Area surveyed within grid

Client

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GEOPHYSICAL SURVEY - GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

LOCATION AND REFERENCING OF SURVEY GRIDS

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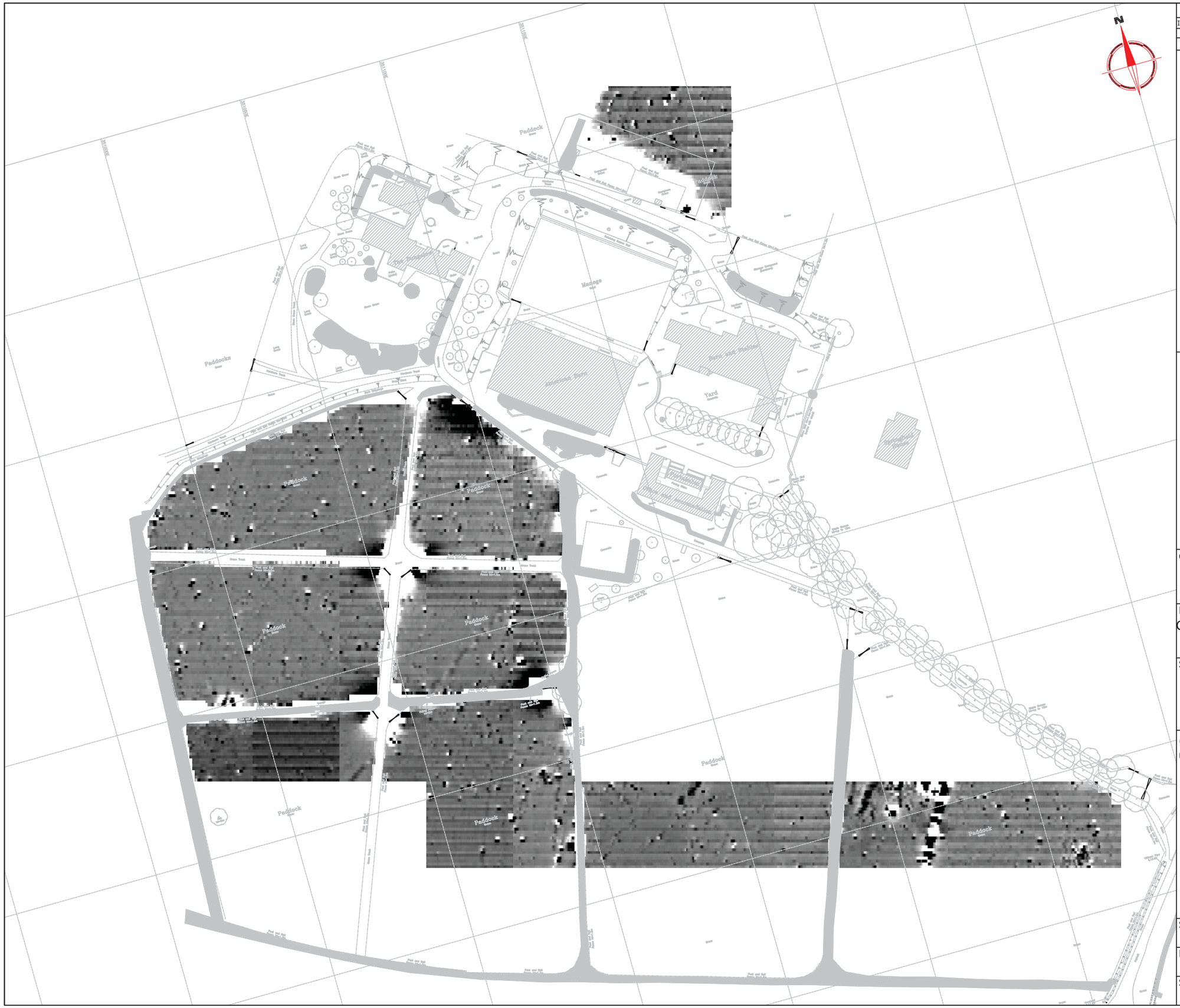

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Plotting parameters

Maximum +5nT (black)
Minimum -5nT (white)

-3SD +3SD

+5nT

-5nT

Client

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GEOPHYSICAL SURVEY -GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

PLOT OF RAW GRADIOMETER DATA

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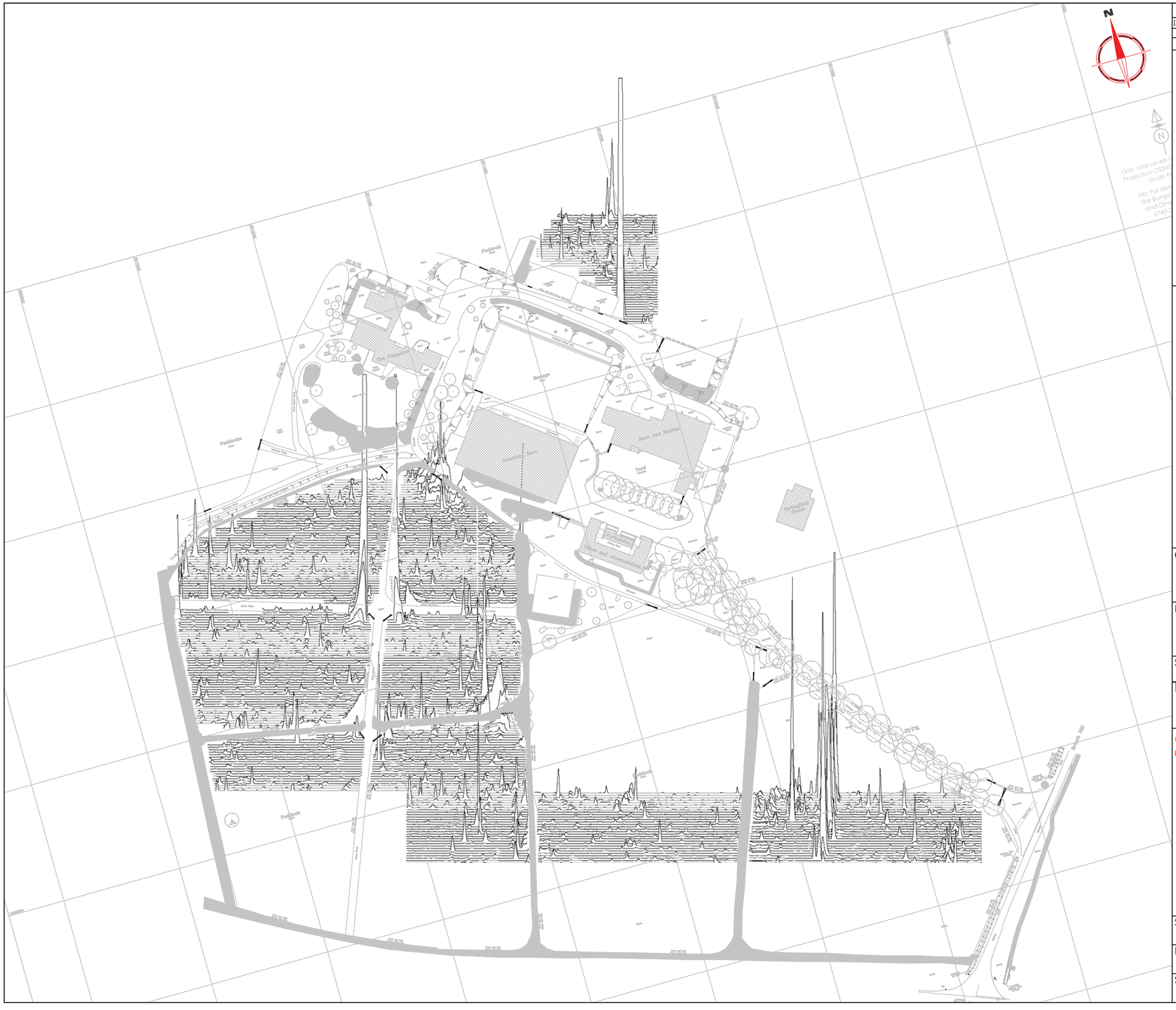

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Plotting parameters

+40nT

(*Positive values displace above the trace line. Hidden values have not been plotted*)

200nT
100nT
0nT

Client

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GEOPHYSICAL SURVEY -GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

TRACE PLOT OF GRADIOMETER DATA SHOWING POSITIVE VALUES

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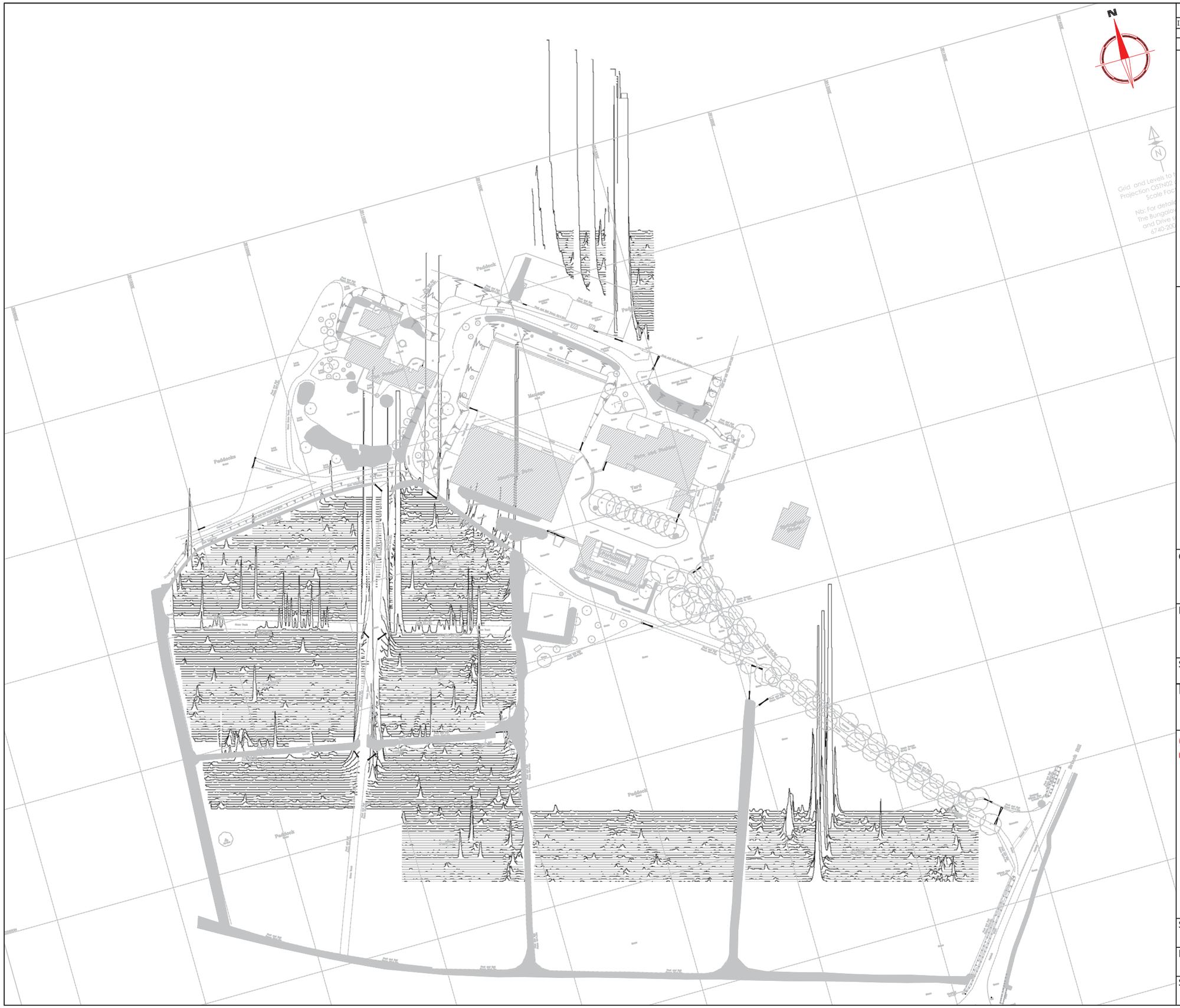

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Plotting parameters

-40nT

(*Negative values displace above the trace line. Hidden values have not been plotted*)

200nT
100nT
0nT

Client

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GEOPHYSICAL SURVEY -GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

TRACE PLOT OF GRADIOMETER DATA SHOWING NEGATIVE VALUES

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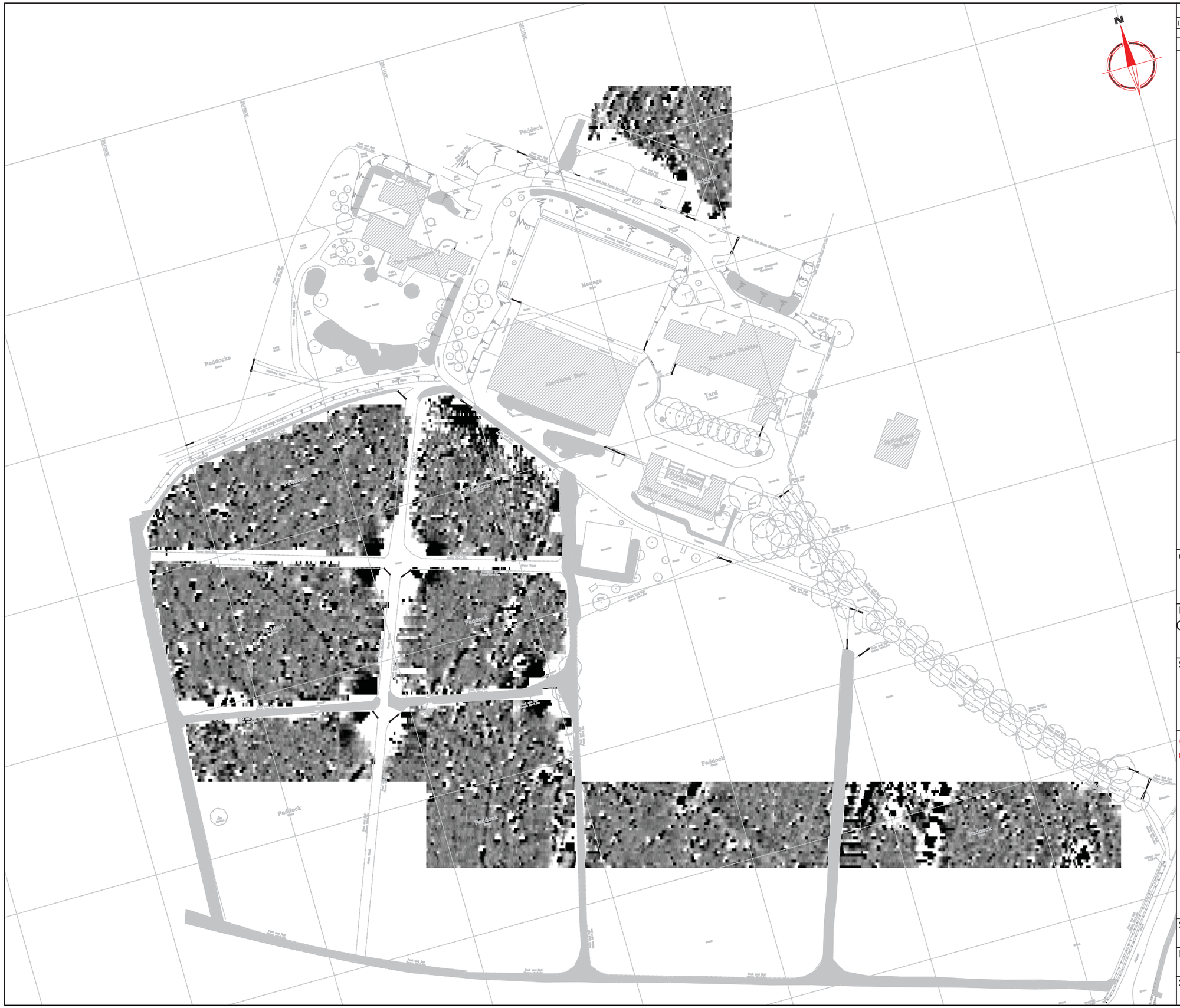

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Plotting parameters

Maximum +1nT (black)
Minimum -1nT (white)

-3SD +3SD

+1nT

-1nT

Client

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GEOPHYSICAL SURVEY -GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

PLOT OF PROCESSED GRADIOMETER DATA

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A3	PPB	01
Survey date	Drawn by	Figure No.
JUNE 08	RAJS	06

Amendments

Issue No.	Date	Description
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-	-	-

KEY

- Discrete positive anomaly - possible pit
- Positive anomaly with associated negative response - ferrous object
- Projected line of Roman Road
- Magnetic disturbance - associated with pipe/cable
- Positive linear anomaly - cut feature of possible archaeological origin
- Negative linear anomaly- possible former earthwork or bank
- Positive area anomaly - cut feature of possible archaeological origin
- Negative area anomaly- possible former earthwork or bank
- Positive trend anomaly- weak evidence of cut feature
- Area of magnetic disturbance- related to ferrous object such as a fence
- Area of magnetic debris- evidence of ground disturbance

Client

JOHN MOORE HERITAGE SERVICES

Project Title Job No. 2491

GEOPHYSICAL SURVEY -GLENDA SPOONER FARM, KINGSDON, SOMERSET

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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REGISTERED ORGANISATION IFA

Scale 1:1250 — 0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
JUNE 08	RAJS	07