

Geophysical Survey Report

Wrawby, North Lincolnshire

for

Archaeological Project Services

November 2006

J2240

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Document Title: **Geophysical Survey Report
Wrawby, N. Lincolnshire**

Client: **Archaeological Project Services**

Stratascan Job No: **J2240**

Techniques: **Detailed magnetic survey (gradiometry)**

National Grid Ref: **TA 028 078**



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1 SUMMARY OF RESULTS

The geophysical survey undertaken over approximately 9ha of agricultural land near Wrawby has located evidence of Roman and prehistoric activity on the site. On the northern side of the field boundary areas of magnetic disturbance and rectilinear enclosures suggest the presence of Roman industrial activity. On the south side of the field boundary positive curvilinear anomalies indicate the presence of a prehistoric enclosure, possibly dating to the Iron Age.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Archaeological Project Services to undertake a geophysical survey of an area of archaeological interest. This survey forms part of an archaeological investigation being undertaken by the Wrawby Local History Group.

2.2 Site location

The site is located near Wrawby, North Lincolnshire at OS ref. TA 028 078.

2.3 Description of site

The survey area consists of approximately 9ha of relatively flat arable land to the southwest of Wrawby.

2.4 Geology and soils

The underlying geology is Ampthill Clay (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are known as Whickam 2 soils which are typically stagnogley soils. These consist of slowly permeable seasonally waterlogged fine loamy over clayey, fine silty over clayey and clayey soils (Soil Survey of England and Wales, Sheet 4 Eastern England).

2.5 Site history and archaeological potential

The northern half of the site has yielded quantities of Roman pottery and tile and the farmer has removed stonework over the years. Cropmarks are also evident including an apparent curvilinear enclosure (Steve Malone, pers comm.).

2.6 Survey objectives

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

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 six days from 25th October 2006. Weather conditions during the survey were variable.

3.2 Grid locations

The location of survey grids was based upon and has a similar orientation to the Ordnance Survey National Grid, see Figure 2. The referencing and alignment of grids was achieved using a Sokia Set5E Total Station in conjunction with a Leica SR50 DGPS system.

3.3 Survey equipment

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each sensor has a 1m separation between the sensing elements increasing the sensitivity to small changes in the Earth's magnetic field.

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 Grad601-2 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 0.25m centres provides an appropriate methodology 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 downloaded 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 (Figures 3 and 4) and trace plots (Figures 5 and 6), together with a greyscale plot of the processed data (Figures 7, 8 and 11). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figures 9, 10 and 12).

4 RESULTS

4.1 North

A number of positive linear anomalies (1) are evident within this survey area. These anomalies indicate cut features, such as ditches and are likely to be of an archaeological origin. Many of these ditches have a northwest - southeast orientation and seem to have been used to divide the land into a number of areas. A positive curvilinear feature (2) is evident within the central region of this northern area and a rectilinear feature (3) can be noted annexed onto one of the large cut features (7). Positive area anomalies (4), indicating the presence of cut features, are evident in the central and western limits of this area.

Three negative linear anomalies (5) can be seen in the northern limits of this area. These anomalies may be related to former earthworks or banks of an archaeological origin.

Areas of magnetic disturbance (6) can be noted within this area, all of which seem to be restricted to the central area within the ditches of anomalies (7 and 8). This disturbance may be related to industrial activity taking place on site. It is interesting to note that one of these areas is enclosed within the rectilinear anomaly (3).

4.2 South

A series of positive curvilinear anomalies indicates the presence of a prehistoric settlement in the central region of this survey area. Five circular or semi-circular features (8) provide evidence for the presence of roundhouses surrounded by a bank and

ditch system (**9** and **11**). Positive and negative linear anomalies to the south of the survey area (**10** and **21**) suggest a further, outer system of banks and ditches. Positive area anomaly **14** and negative area anomalies **15** may also be related to this defence system.

A number of discrete positive anomalies (**12**) can be noted in close proximity to the prehistoric settlement. These features have been interpreted as pits of a possible archaeological origin. A possible pit has also been identified within one of the roundhouses (**13**). Further investigation would be required in order to ascertain whether this pit is contemporaneous with the roundhouse.

Positive linear anomalies are evident to the north of the prehistoric settlement. These anomalies (**16**) seem to correlate with those noted on the northern side of the field boundary and therefore may be related to industrial activity.

Areas of magnetic disturbance (**17**) similar to those to the north of the field boundary are also evident within this part of the survey area. These anomalies may be related to industrial activity. An area of magnetic debris within the magnetometer data (**18**) correlates with an area of slag at surface level. This provides further evidence for industrial activity having taken place on site.

Modern activity on site is represented by a field drain (**20**) in the eastern limits of the southern survey area. A number of parallel bipolar linear features are evident within the survey area with a particular focus in the southern area. The origin of these anomalies is unknown. The fact that they do not correspond with the survey grid suggests that they are not related to an equipment fault. It is possible that these features relate to drainage or former trenches.

5 CONCLUSION

The northern half of the survey area has produced positive linear anomalies laid out in regular arrangements. Within these divisions areas of magnetic disturbance are evident. It is possible that these areas of disturbance are related to industrial activity taking place in the past. The regular arrangement of the ditches and the discovery of Roman pottery in this area would suggest that these anomalies are Roman in origin.

A prehistoric settlement, possibly dating to the Iron Age, is evident on the southern side of the field boundary. This settlement seems to have approximately 5 roundhouses located within two sets of defensive banks and ditches. A number of possible pits have been identified in close proximity to the settlement, one of which lies within a roundhouse.

The Roman activity is, of course, of a later date than the Iron Age settlement. However, there seems to be no evidence of the Roman industrial buildings overlapping the prehistoric settlement which may suggest a period of co-habitation of the site.

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.

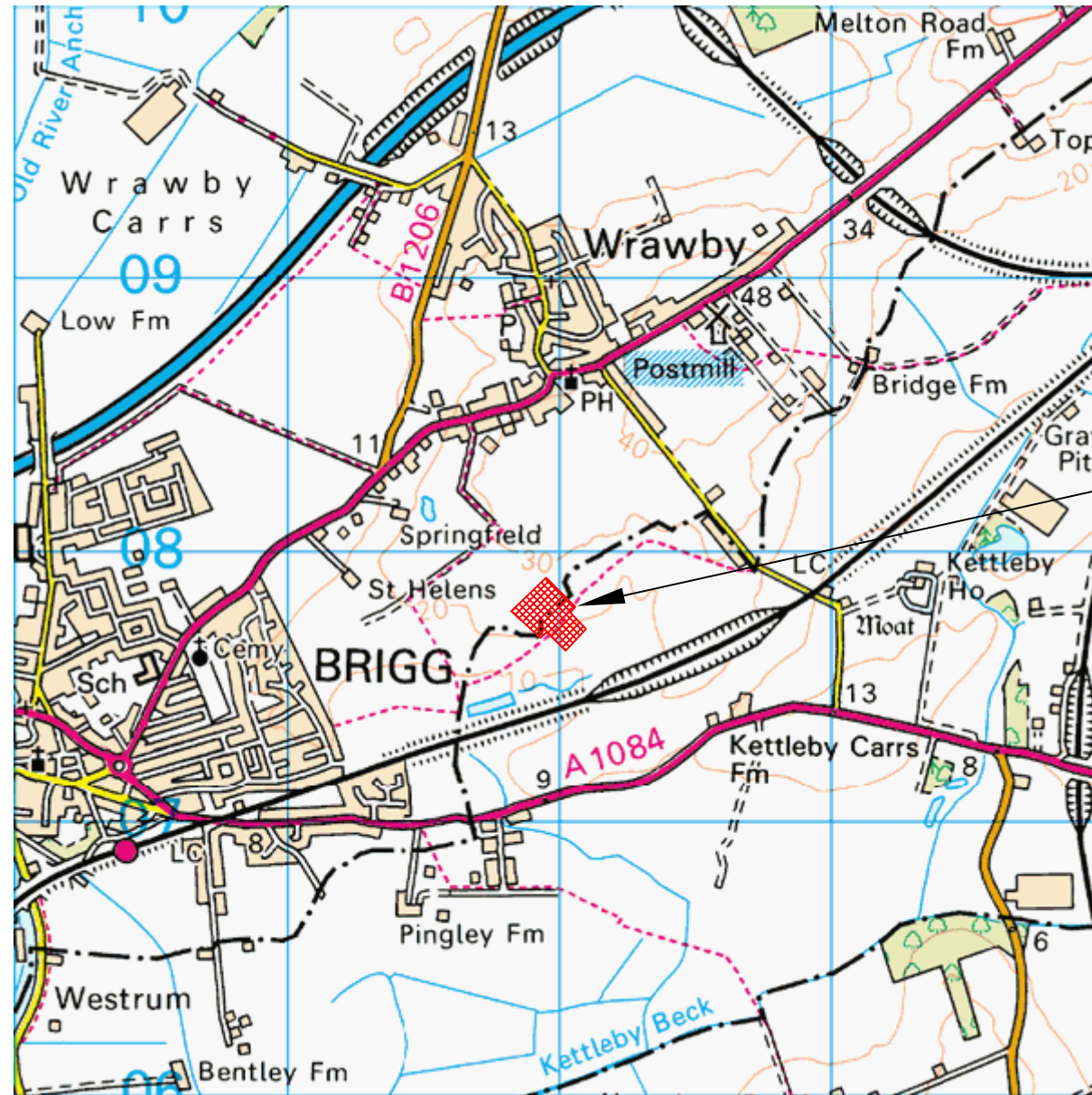
Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically either 0.5 or 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures 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.

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 Upton Upon Severn
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 OS 100km square = TA



10
09
08
07
06



Survey Area

01 02 03 04 05

Amendments		
Issue No.	Date	Description
-	-	-

Site centred on NGR TA 028 078

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title
GEOPHYSICAL SURVEY - WRABY, NORTH LINCOLNSHIRE

Job No. 2240

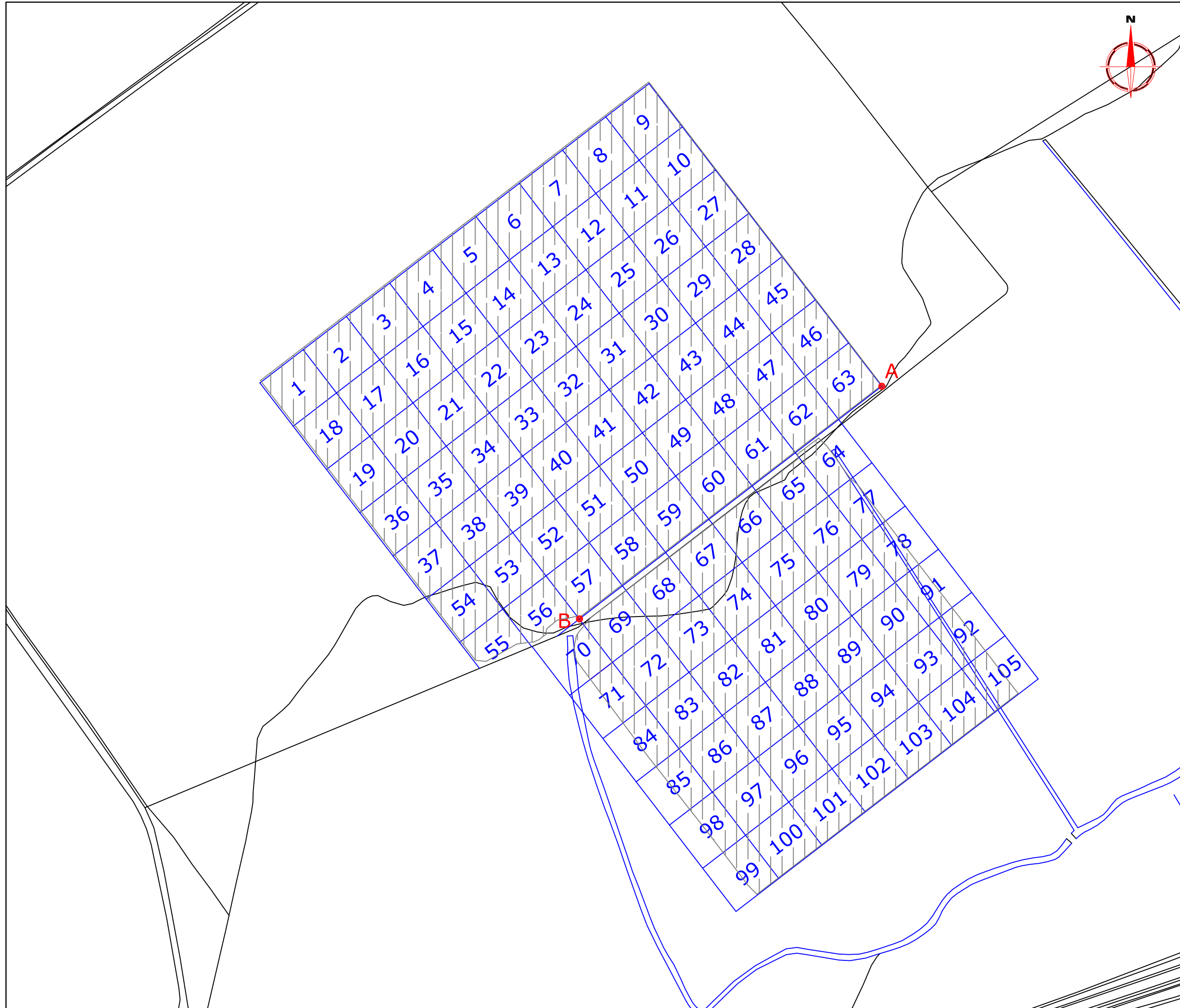
Subject
LOCATION PLAN OF SURVEY AREA

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REGISTERED ORGANISATION IFA

Scale
1:25 000
 0m 500m 1000m

Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by RAJS	Figure No. 01



Amendments		
Issue No.	Date	Description
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KEY	
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B	501857.2 , 407681.2
	Area surveyed within grid
2	Grid number


Client
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Project Title Job No. 2240
GEOPHYSICAL SURVEY - WRABBY, N. Lincs

Subject
SITE PLAN SHOWING LOCATION OF SURVEY GRIDS

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Scale 1:2000 

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Survey date OCT 06	Drawn by RAJS	Figure No. 02

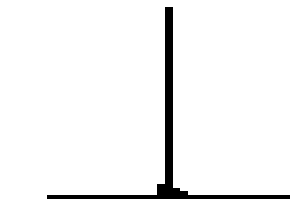


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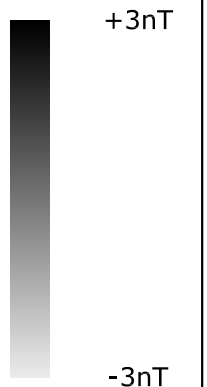
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Minimum -3nT (white)



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Client

APS

Project Title Job No. XXXX

GEOPHYSICAL SURVEY -
WRAWBY NORTH LINCOLNSHIRE

Subject

PLOT OF RAW GRADIOMETER DATA
NORTH

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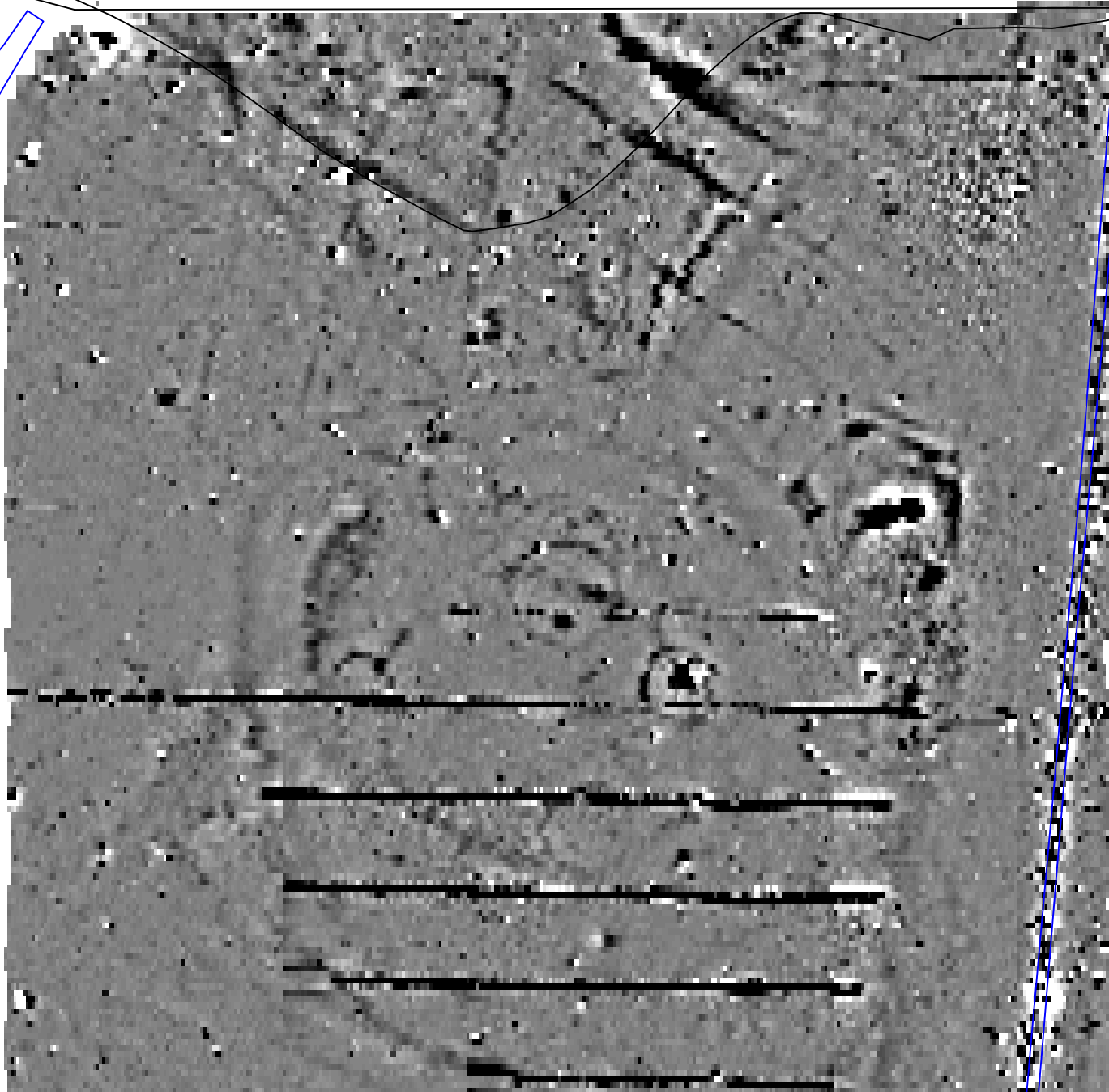
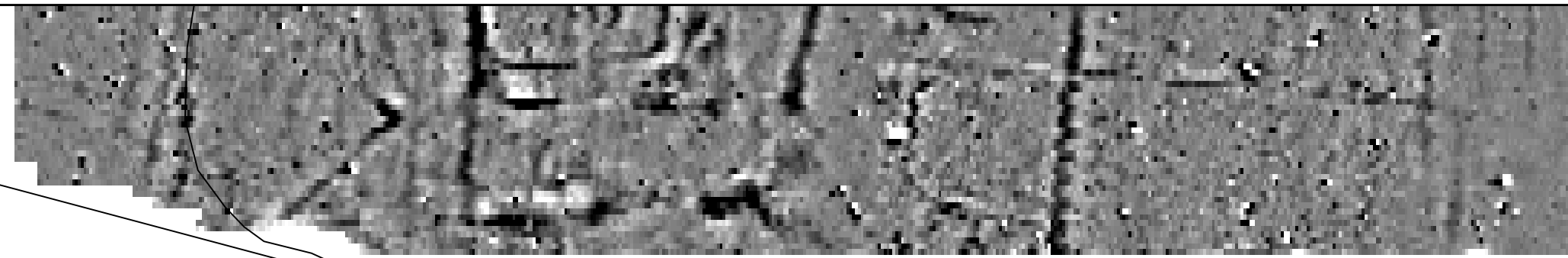
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Scale 1:1000 0m 10 20 30 40 50

Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by LB	Figure No. 03



Amendments		
Issue No.	Date	Description
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Plotting parameters

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Minimum -3nT (white)

Client
APS

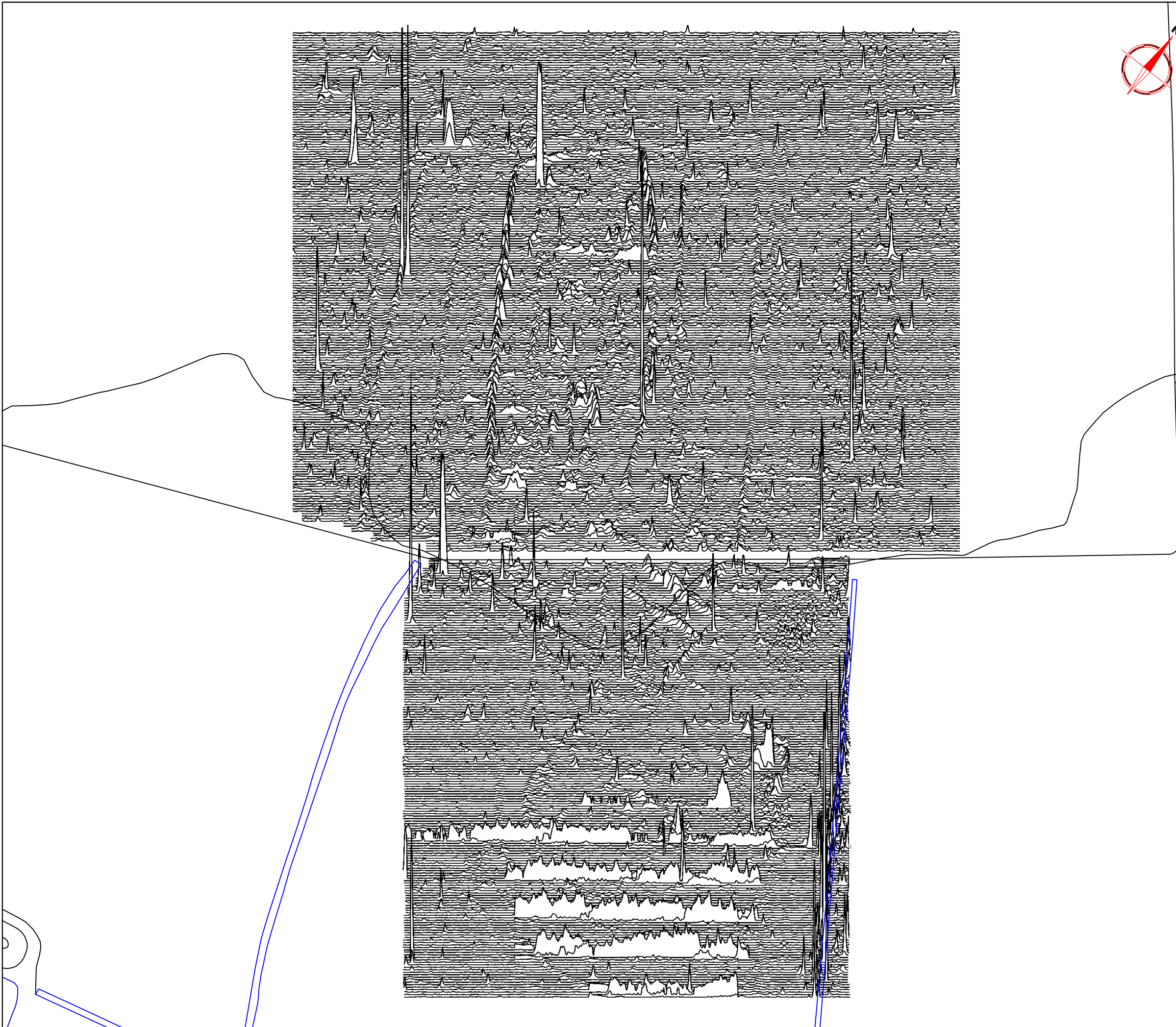
Project Title **GEOPHYSICAL SURVEY - WRAWBY NORTH LINCOLNSHIRE** Job No. 2240

Subject
PLOT OF RAW GRADIOMETER DATA SOUTH

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Survey date OCT 06	Drawn by LB	Figure No. 04



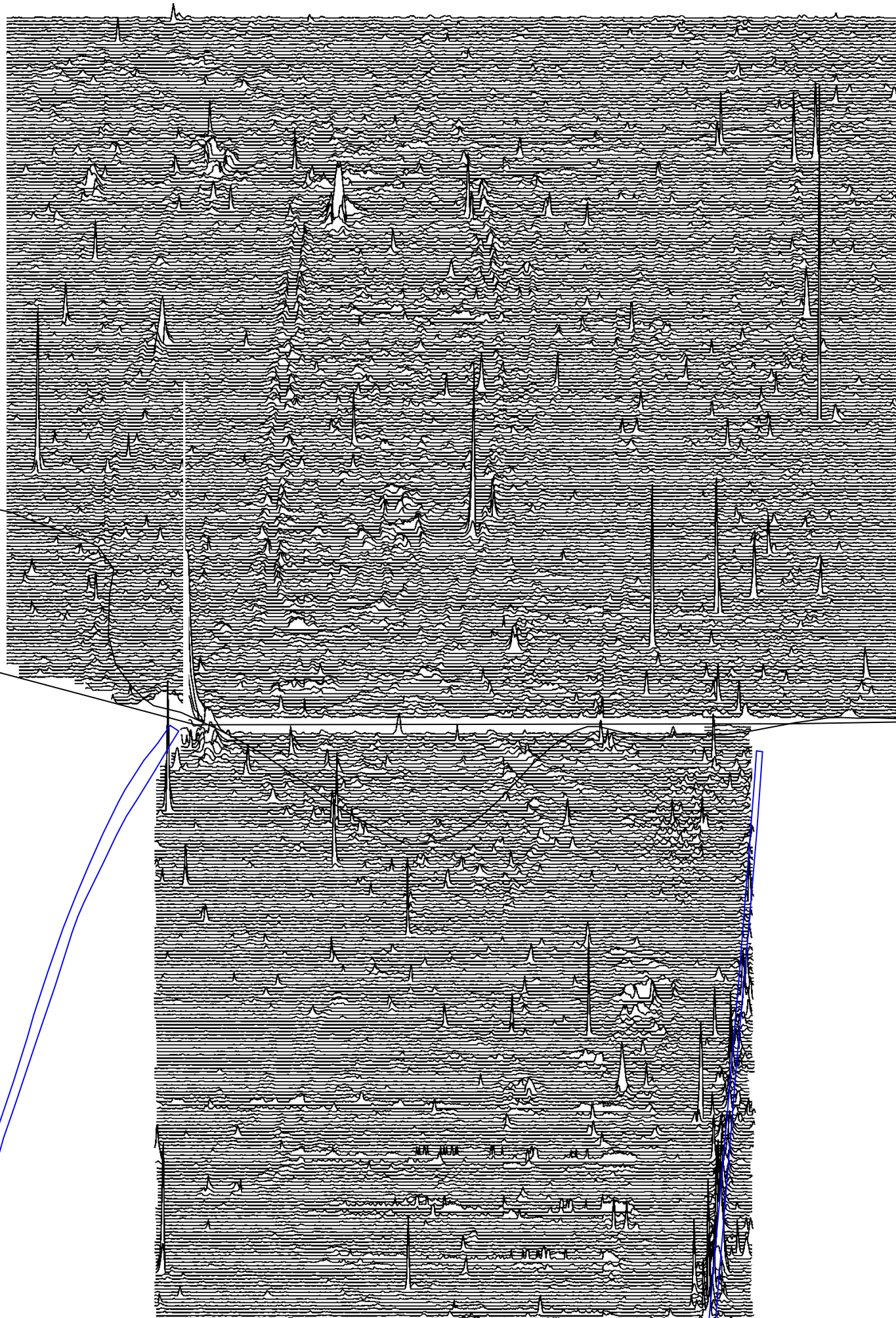
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	80nT
	40nT
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Client	ARCHAEOLOGICAL PROJECT SERVICES
Project Title	Job No. 2240 GEOPHYSICAL SURVEY - WRAWBY NORTH LINCOLNSHIRE
Subject	TRACE PLOT OF GRADIOMETER DATA SHOWING POSITIVE VALUES

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Plot	Checked by	Issue No.
A3	SAS	01
Survey date	Drawn by	Figure No.
OCT 06	RAJS	05



Amendments		
Issue No.	Date	Description
-	-	-

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(Negative values displace above the trace line. Hidden values have not been plotted)	-120nT
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Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title
GEOPHYSICAL SURVEY -
WRABY NORTH LINCOLNSHIRE

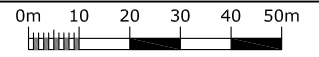
Job No. 2240

Subject
TRACE PLOT OF GRADIOMETER DATA
SHOWING NEGATIVE VALUES

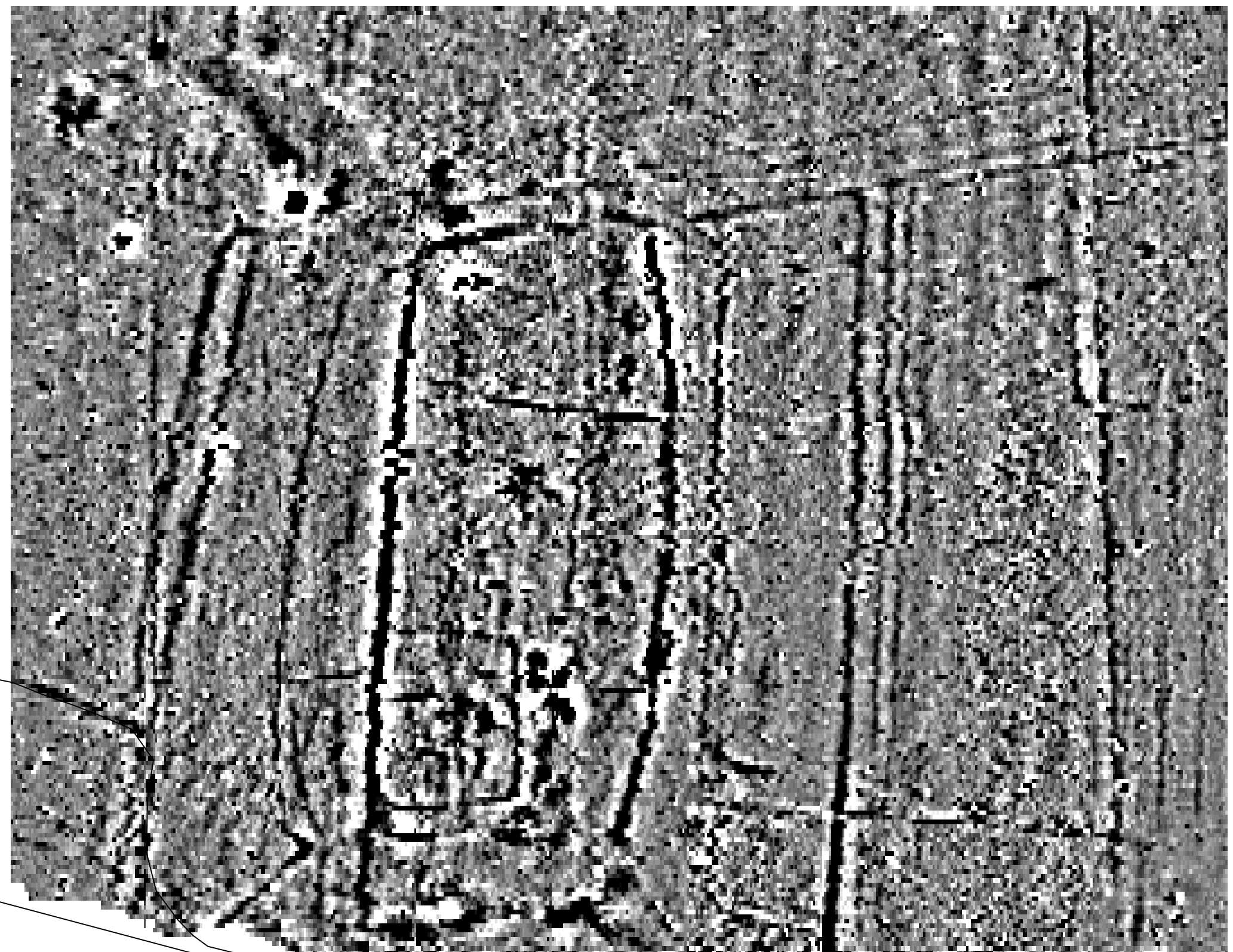
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Scale
1:1500



Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by RAJS	Figure No. 06



Amendments		
Issue No.	Date	Description
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Plotting parameters

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Minimum -1nT (white)

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Client
APS

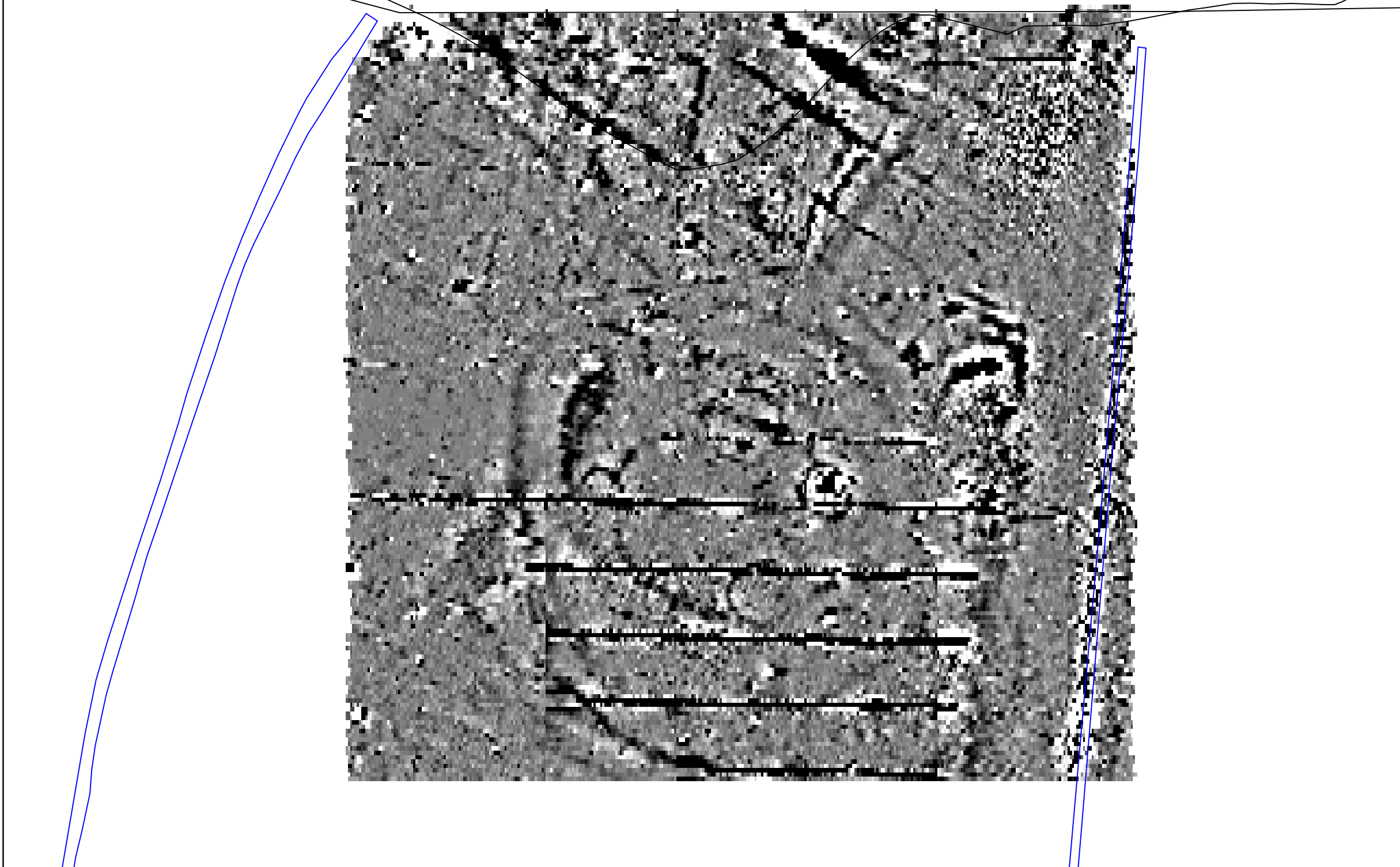
Project Title Job No. 2240
**GEOPHYSICAL SURVEY -
WRAWBY NORTH LINCOLNSHIRE**

Subject
**PLOT OF PROCESSED
GRADIOMETER DATA NORTH**

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Scale 0m 10 20 30 40 50
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Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by LB	Figure No. 07



Amendments		
Issue No.	Date	Description
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-	-	-

Plotting parameters

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

-3SD +3SD

Client
APS

Project Title Job No. XXXX
**GEOPHYSICAL SURVEY -
WRAWBY NORTH LINCOLNSHIRE**

Subject
**PLOT OF PROCESSED
GRADIOMETER DATA SOUTH**

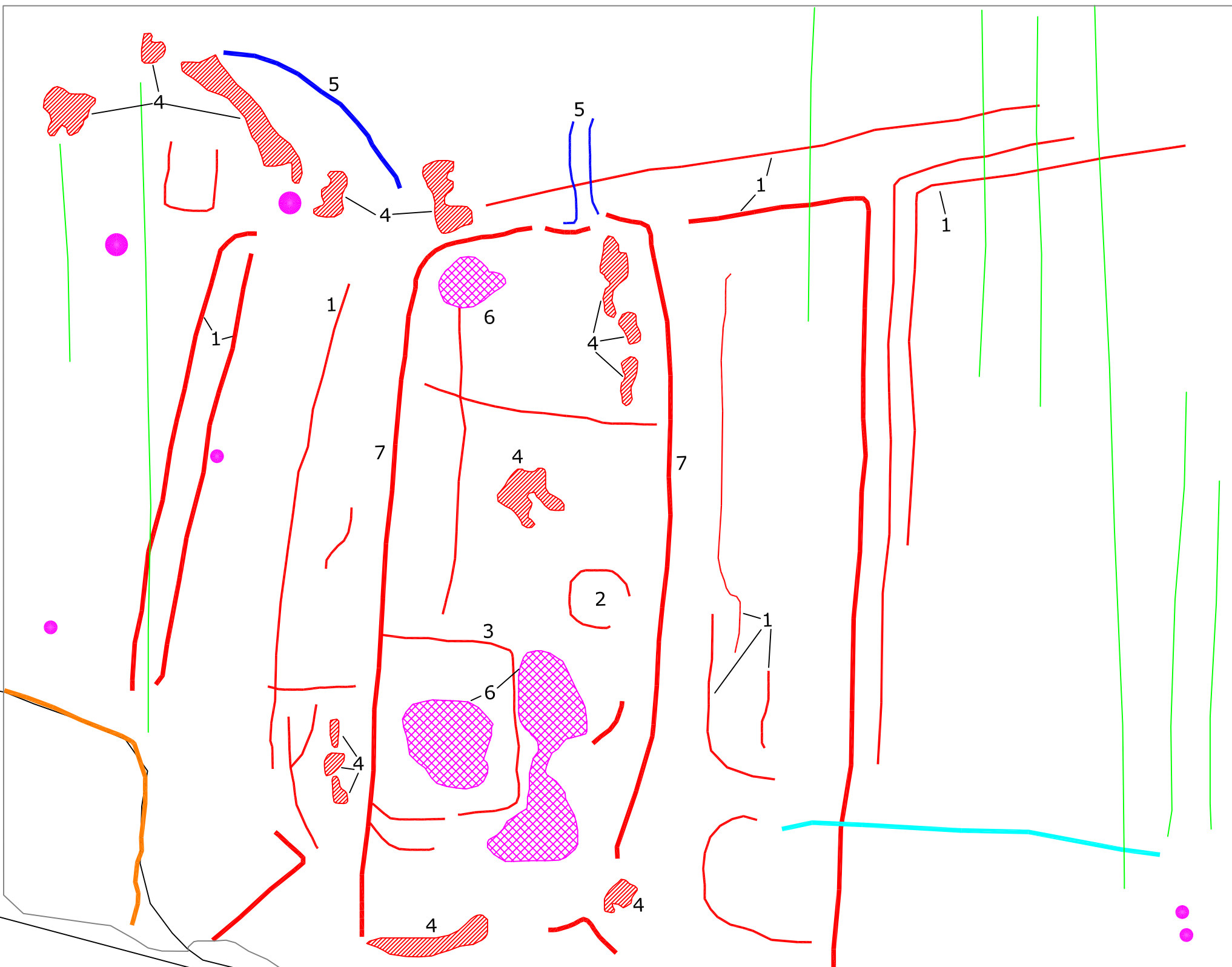
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Scale **1:1000**

Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by LB	Figure No. 08



Amendments		
Issue No.	Date	Description
-	-	-
-	-	-



KEY	
	Positive anomaly with associated negative response - ferrous object
	Positive linear anomaly - agricultural mark
	Positive linear anomaly - cut feature of possible archaeological origin
	Negative linear anomaly- possible former earthwork or bank
	Linear anomaly - possibly related to land drains
	Positive area anomaly- cut feature of possible archaeological origin
	Area of magnetic disturbance- possibly related to industrial activity
1	Anomaly identification number

Client
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Project Title Job No. 2240
GEOPHYSICAL SURVEY -WRAWBY, N.LINCS

Subject
ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES- NORTH

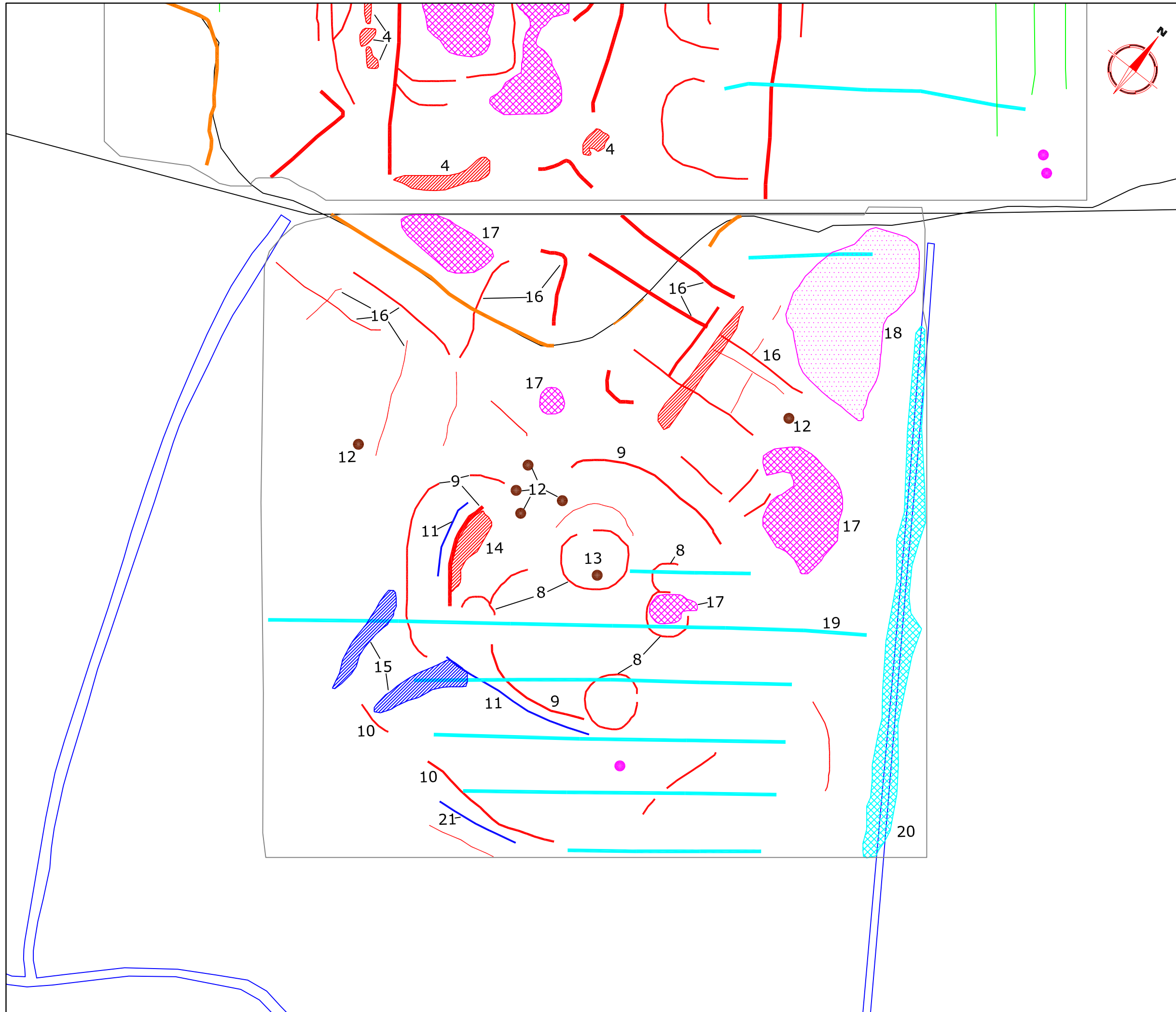
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Scale **1:1000**
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Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by RAJS	Figure No. 09





Amendments		
Issue No.	Date	Description
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-	-	-
KEY		
	Discrete positive anomaly - possible pit	
	Positive anomaly with associated negative response - ferrous object	
	Positive linear anomaly - cut feature of possible archaeological origin	
	Negative linear anomaly- possible former earthwork or bank	
	Linear anomaly - possibly related to land drains	
	Positive linear anomaly- former field boundary	
	Positive area anomaly- cut feature of possible archaeological origin	
	Negative area anomaly- possible former earthwork or bank	
	Area of magnetic disturbance- possibly related to industrial activity	
	Area of magnetic debris- related to surface slag	
	Linear area of bipolar response- related to field drain	
1	Anomaly identification number	
Client		
ARCHAEOLOGICAL PROJECT SERVICES		
Project Title		Job No. 2240
GEOPHYSICAL SURVEY -WRAWBY, N.LINCS		
Subject		
ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES- SOUTH		
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Scale		
1:1000		
Plot	Checked by	Issue No.
A3	SAS	01
Survey date	Drawn by	Figure No.
OCT 06	RAJS	10



Amendments		
Issue No.	Date	Description
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-	-	-

Plotting parameters

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

-3SD +3SD

Client
ARCHAEOLOGICAL PROJECT SERVICES

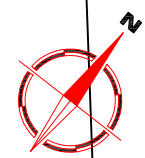
Project Title Job No. 2240
GEOPHYSICAL SURVEY -WRAWBY, N. LINCS

Subject
PLOT OF PROCESSED GRADIOMETER DATA

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Scale **1:1500**
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Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by RAJS	Figure No. 11



Amendments		
Issue No.	Date	Description
-	-	-
-	-	-
KEY		
	Discrete positive anomaly - possible pit	
	Positive anomaly with associated negative response - ferrous object	
	Positive linear anomaly - cut feature of possible archaeological origin	
	Negative linear anomaly- possible former earthwork or bank	
	Linear anomaly - possibly related to land drains	
	Positive linear anomaly- agricultural mark	
	Positive linear anomaly- former field boundary	
	Positive area anomaly- cut feature of possible archaeological origin	
	Negative area anomaly- possible former earthwork or bank	
	Area of magnetic disturbance- possibly related to industrial activity	
	Area of magnetic debris- related to surface slag	
	Linear area of bipolar response- related to field drain	
1	Anomaly identification number	
Client ARCHAEOLOGICAL PROJECT SERVICES		
Project Title GEOPHYSICAL SURVEY -WRAWBY, N.LINCS		Job No. 2240
Subject ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES		
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Scale 1:1500		
Plot A3	Checked by SAS	Issue No. 01
Survey date OCT 06	Drawn by RAJS	Figure No. 12