STRATASCAN

Geophysical Survey Report

Stamford, Lincolnshire

for

Archaeological Project Services

November 2006

J2252

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Document Title:	**Geophysical Survey Report Stamford, Lincolnshire**
Client:	**Archaeological Project Services**
Stratascan Job No:	**J2252**
Techniques:	**Magnetic Susceptibility, Detailed Magnetometry**
National Grid Ref:	**TF 043 080**

Field Team:	**Richard Fleming, Mark Styles IMI**
Project Manager:	**Simon Stowe BSc (Hons)**
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1 SUMMARY OF RESULTS

The geophysical survey undertaken over approximately 7.5ha of agricultural land near Stamford has located a number of features of possible archaeological origin. These features include positive linear and area anomalies, indicating cut features; negative linear anomalies representing former earthworks and discrete positive anomalies which have been interpreted as possible pits.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Archaeological Project Services to undertake a geophysical survey of an area outlined for development.

2.2 Site location

The site is located near Stamford, Lincolnshire at OS ref. TF 043 080.

2.3 Description of site

The survey area is consists of approximately 7.5ha of agricultural land near Stamford, Lincolnshire. The underlying geology is inferior oolite (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are known as Sherborne soils which are a type of brown rendzina. These consist of shallow well drained brashy calcareous clayey soils over limestone, associated with slowly permeable calcareous clayey soils (Soil Survey of England and Wales, Sheet 4 Eastern England).

2.4 Site history and archaeological potential

No specific details were available to Stratascan.

2.5 Survey objectives

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

2.6 Survey methods

The reconnaissance technique of magnetic susceptibility was employed over the whole of the survey area. From these results areas of enhancement were targeted with detailed magnetometer survey. More information regarding these techniques is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 2 days from the 1st November 2006 to 2nd November 2006 when the weather was fine.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 3.

3.3 Description of techniques and equipment configurations

3.3.1 Magnetic Susceptibility

Alteration of iron minerals in topsoil through biological activity and burning can enhance the magnetic susceptibility (MS) of that soil. Measuring the MS of a soil can therefore give a measure of past human activity and can be used to target the more intensive and higher resolution techniques of Magnetometry and Resistivity. Measurements of MS were carried out using a field coil which provides a rapid scan and has the benefit of allowing "insitu" readings to be taken.

The equipment used on this contract was an MS2 Magnetic Susceptibility meter manufactured by Bartington Instruments Ltd. A field coil known as an MS2D was used to take field readings. This assessed the top 200mm or so of topsoil. To overcome the problem of ground contact all readings were taken 4 or 5 times and an average taken. All obvious localised "spikes" were ignored.

3.3.2 Magnetometer

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.

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

3.4.1 Sampling interval

Magnetic susceptibility
The magnetic susceptibility survey was carried out on a 20 m grid with readings being taken at the node points.

Magnetometer
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 sensor has a 1m separation between the sensing elements giving a strong response to deep anomalies.

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

Magnetic Susceptibility
The MS2D coil assesses the average MS of the soil within a hemisphere of radius 200mm. This equates to a volume of some 0.016m^3 and maximum depth of 200mm. As readings are only at 20m centres this results in a very coarse resolution but adequate to pick up trends in MS variations.

Magnetometer
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 0.5m centres provides an appropriate methodology balancing cost and time with resolution.

3.4.3 Data capture

Magnetic susceptibility
The readings are logged manually on site, and then transferred to the office where they are entered into a computer and grey scale plots are produced.

Magnetometer
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

Magnetic susceptibility
No processing of the data has been undertaken.

Magnetometer
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 magnetometer data used in this report:

Zero mean grid	*Threshold = 0.25 std. dev.*
Zero mean traverse	*Last mean square fit = off*
Despike	*X radius = 1 Y radius = 1*
	Threshold = 3 std. dev.
	Spike replacement = mean

3.5.2 Presentation of results and interpretation

Magnetic susceptibility
The presentation of the data for this site involves a colour scale plot of the field measurements overlain onto a site plan (see Figure 2).

Magnetometer
The presentation of the data for each site involves a print-out of the raw data both as grey scale (Figure 4) and trace plots (Figure 5 and 6), together with a grey scale plot of the processed data (Figure 7). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 8).

4 RESULTS

4.1 Magnetic susceptibility

The magnetic susceptibility survey undertaken over approximately 7.5ha of land at Stamford, Lincolnshire has highlighted a number of areas of enhanced susceptibility in the central and northern regions of the survey area. These areas of enhancement were subsequently targeted with detailed magnetometry.

4.2 Detailed magnetometry

4.2.1 Area 1

Positive linear anomalies, indicating cut features, are evident in the northern and western limits of this survey area. These anomalies may represent ditches of an archaeological origin. Other positive linear anomalies in this area seem to indicate agricultural activity on site.

Positive area anomalies evident in the central regions of Area 1 represent cut features and may be of an archaeological origin.

A negative linear anomaly can be noted running approximately east to west across the southern limits of this survey area. This anomaly may represent a possible former earthwork or bank.

4.2.2 Area 2

A number of positive linear anomalies are evident in the western limits of this survey area. These anomalies seem to enclose part of this area and may be of an archaeological origin. Other positive linear anomalies in this area seem to be related to agricultural activity. The different alignment of these plough marks may suggest different phases of agricultural activity. A large positive linear anomaly indicating a possible former field boundary runs approximately north to south through this area and into Area 3. Two positive area anomalies indicate the presence of cut features of a possible archaeological origin.

A number of discrete positive anomalies can be noted in the northern limits of this survey area. These anomalies have been interpreted as pits of a possible archaeological origin.

4.2.3 Area 3

Positive linear anomalies of an agricultural origin are evident within this survey area. A large positive linear anomaly continues from Area 2 through this survey area. A large positive area anomaly in the eastern limits and two smaller anomalies in the southern limit may indicate cut features of an archaeological origin.

A negative linear anomaly running approximately north to south across this survey area may indicate the presence of a former earthwork or bank.

An area of magnetic debris, indicating some form of ground disturbance can be noted in the southern limits of this survey area.

5 CONCLUSION

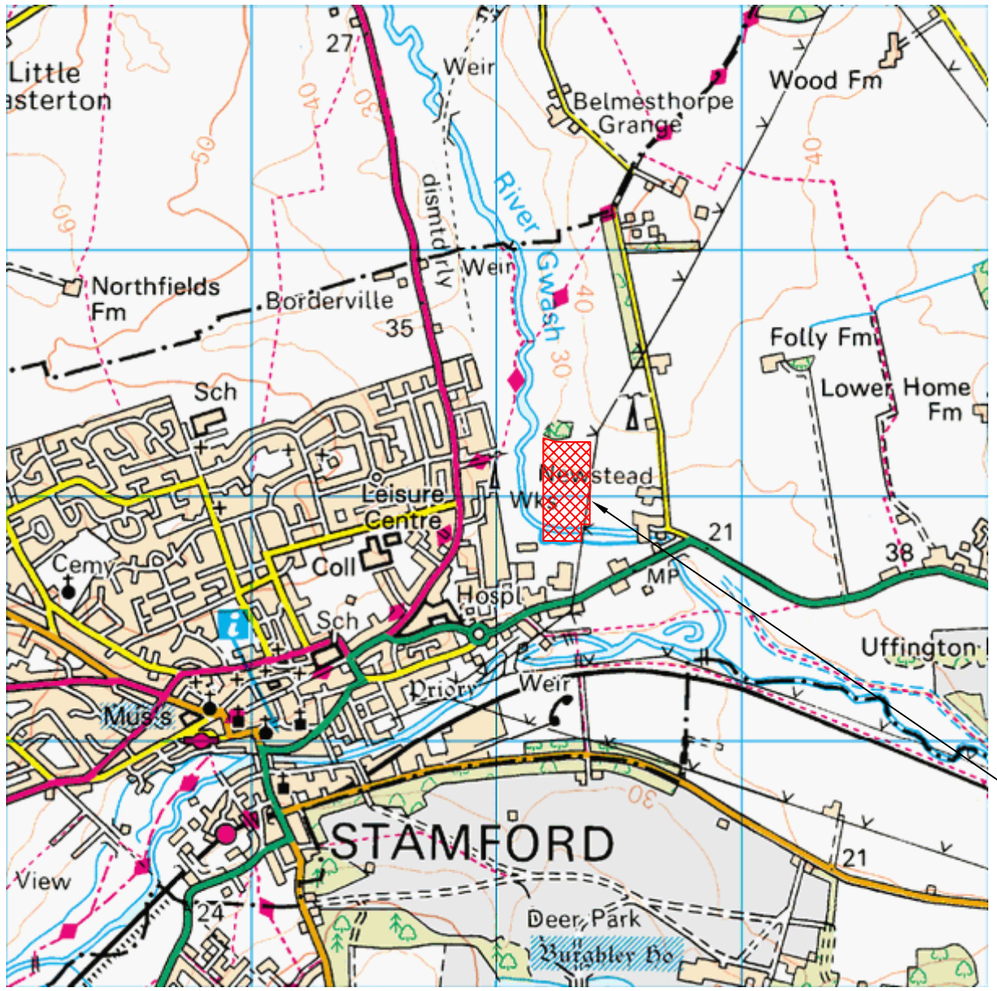
Positive area anomalies are evident across the survey area. These anomalies indicate the presence of cut features of a possible archaeological origin. Positive linear anomalies, also representing cut features of a possible archaeological origin, are evident in Areas 1 and 2.

Discrete positive anomalies representing possible pits are evident in the northern limits of Area 2.

Further investigation would be required in order to ascertain whether or not these features are contemporary with one another.

OS 100km square = TF

10
09
08
07
06



02 03 04 05 06

TRUE N

Amendments

Issue No.	Date	Description
-	-	
		-

Site centred on NGR TF 043 080

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

Subject
LOCATION PLAN OF SURVEY AREA

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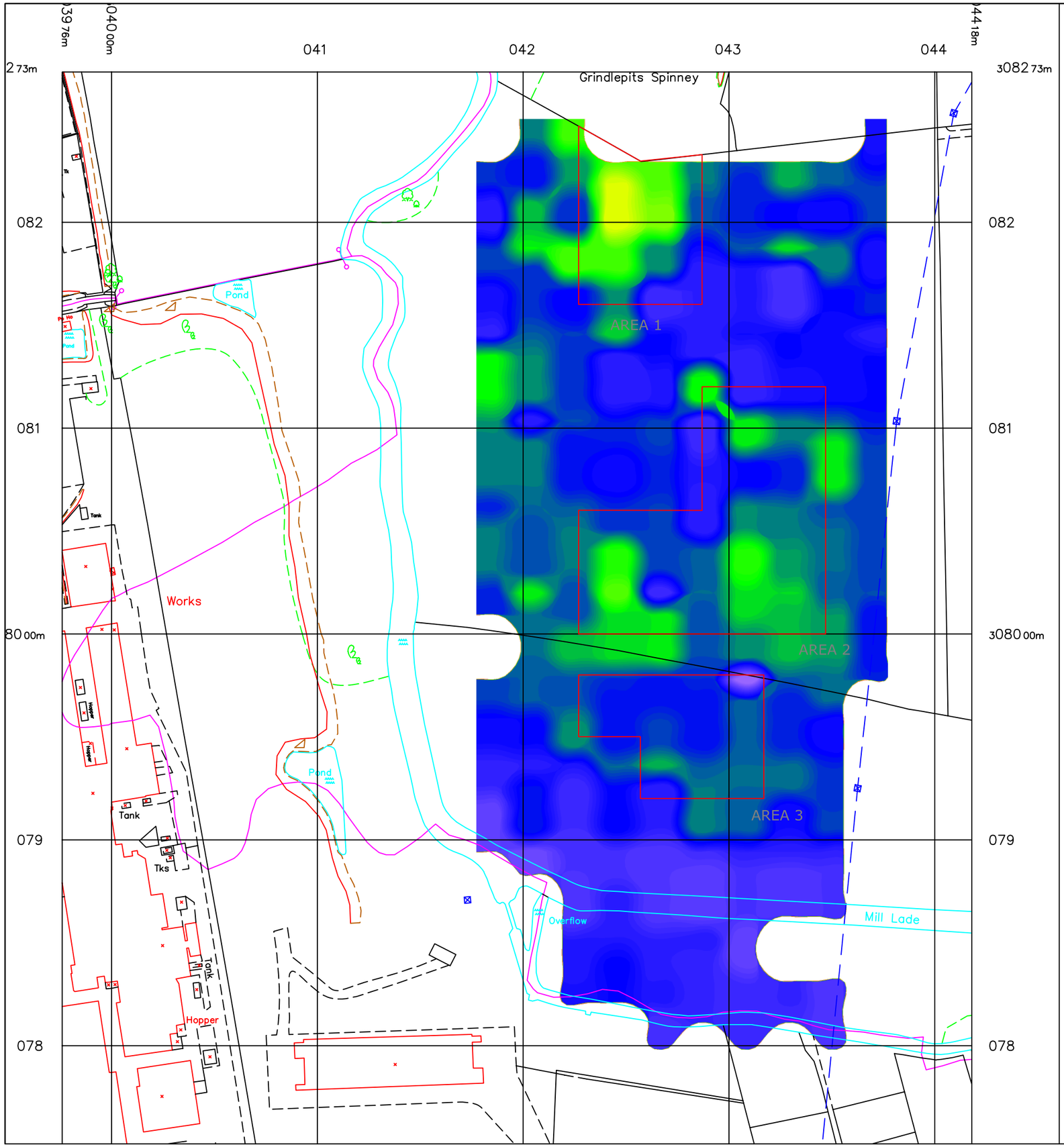
Scale 1:25 000 (0m 500 1000m)

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



Amendments		
Issue No.	Date	Description
-	-	
		-

Areas targeted with detailed gradiometry

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title — Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

Subject
MAGNETIC SUSCEPTIBILITY DATA

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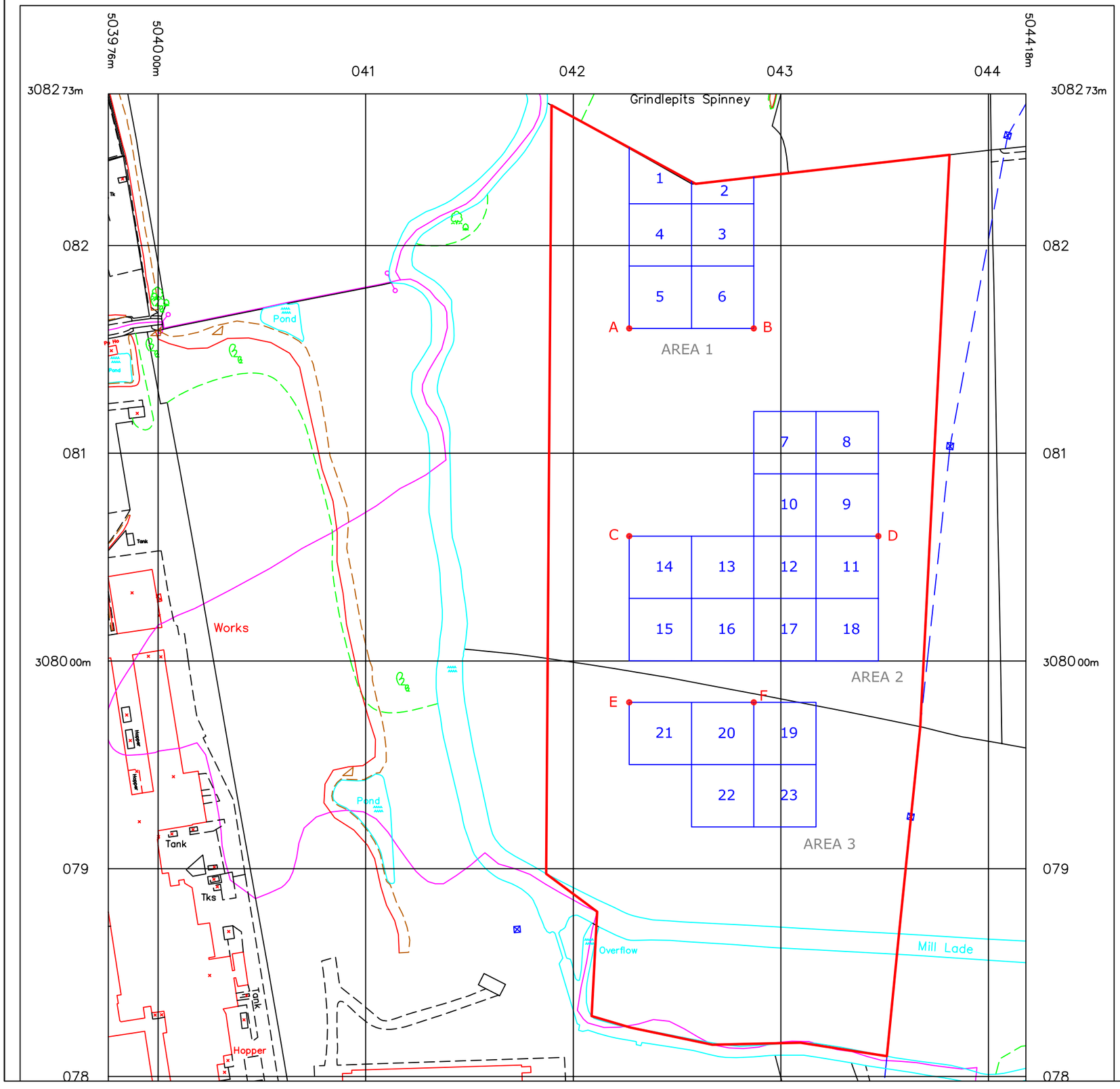
Survey date	Drawn by	Figure No.
NOV 06	RAJS	02

Superplan Data®



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Amendments		
Issue No.	Date	Description
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		-

OS GRID REFERENCES	
A	504227,308160
B	504287,308160
C	504227,308060
D	504347,308060
E	504227,307980
F	504287,307980

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title — Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

Subject
LOCATION AND REFERENCING OF SURVEY GRIDS

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Survey date	Drawn by	Figure No.
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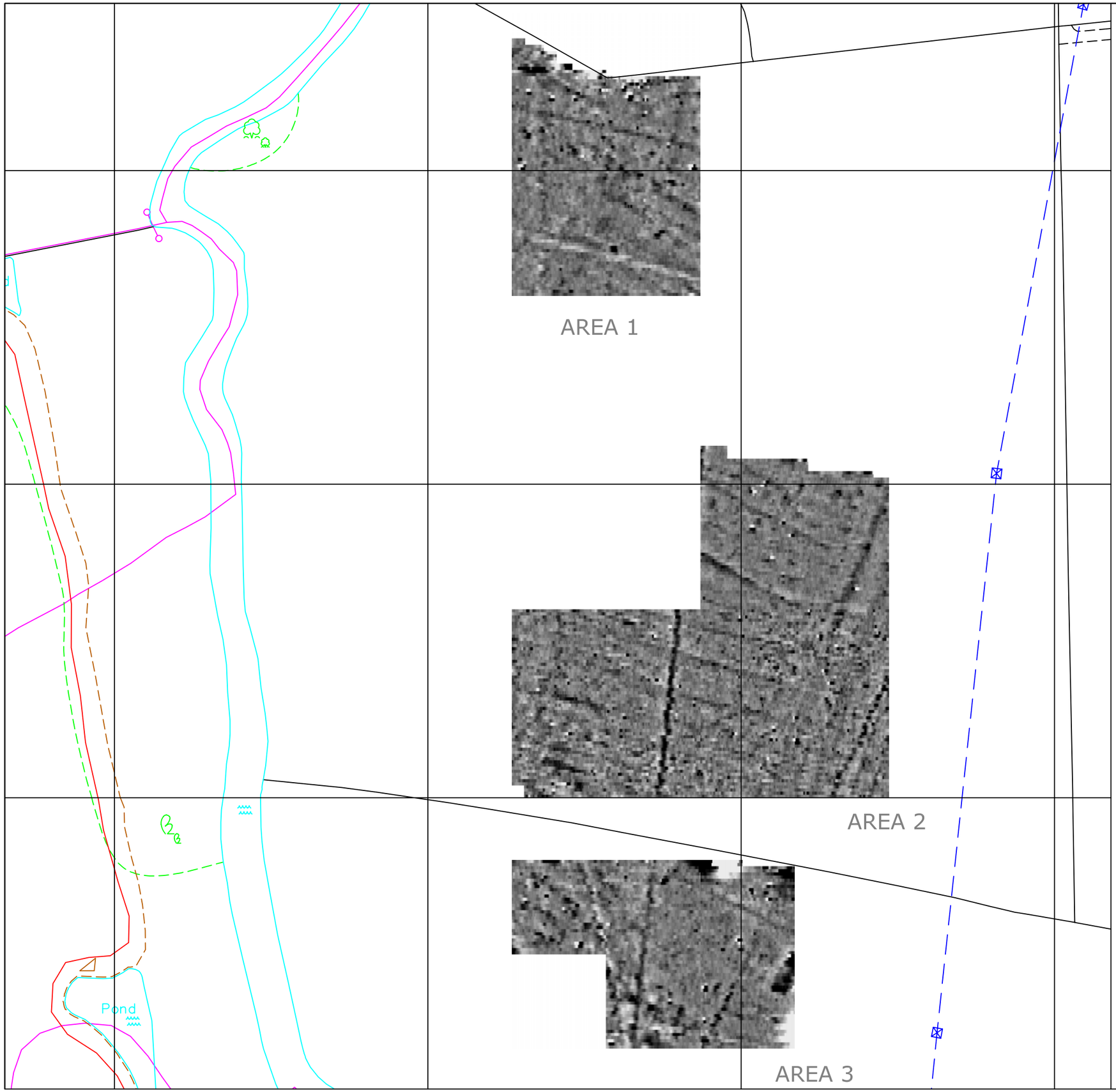

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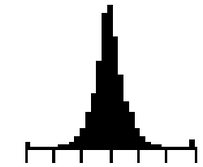
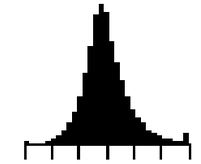


Plotting parameters
Area 1
Maximum +3nT (black)
Minimum -3nT (white)

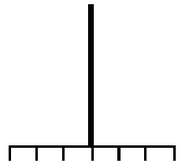
-3SD +3SD



Plotting parameters
Area 2
Maximum +3nT (black)
Minimum -3nT (white)

-3SD +3SD

Plotting parameters
Area 3
Maximum +3nT (black)
Minimum -3nT (white)



-3SD +3SD

+3nT

-3nT

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

Subject
PLOT OF RAW GRADIOMETER DATA

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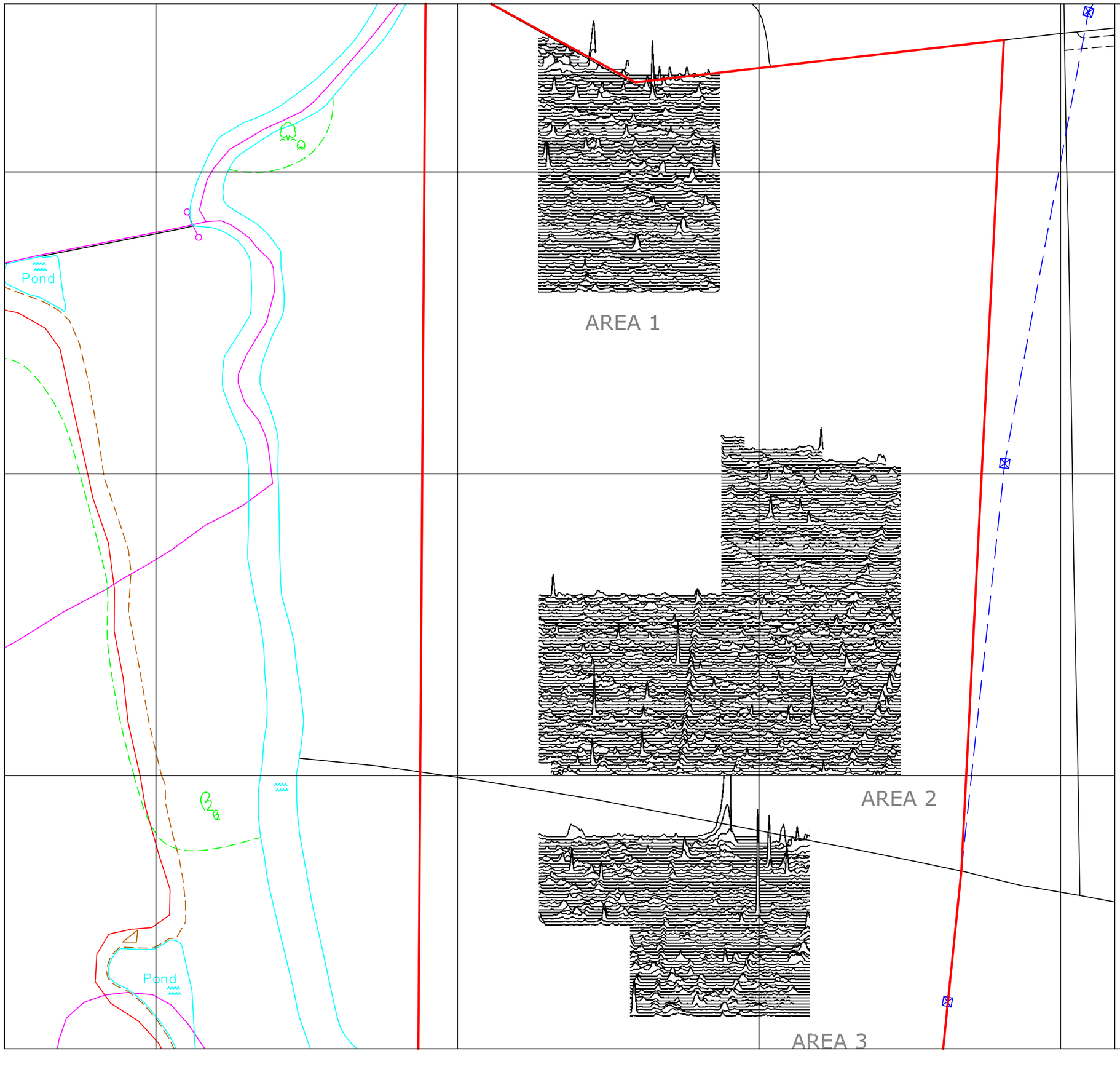
A3	SAS	01
Survey date	Drawn by	Figure No.
NOV 06	RAJS	04



Amendments		
Issue No.	Date	Description
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Plotting parameters

+40nT

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

200nT
160nT
120nT
80nT
40nT
0nT

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title — Job No. 2252
GEOPHYSICAL SURVEY -STAMFORD, LINCS

Subject
TRACE PLOT OF GRADIOMETER DATA SHOWING POSITIVE VALUES

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Scale 1:1250 — 0m 10 20 30 40 50m

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

AREA 1

AREA 2

AREA 3

Pond

082

081

3080 00m

N

Amendments		
Issue No.	Date	Description
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Plotting parameters

-40nT

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

-200nT
-160nT
-120nT
-80nT
-40nT
0nT

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title — Job No. 2252
GEOPHYSICAL SURVEY -STAMFORD LINCS

Subject
TRACE PLOT OF GRADIOMETER DATA SHOWING NEGATIVE VALUES

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Survey date	Drawn by	Figure No.
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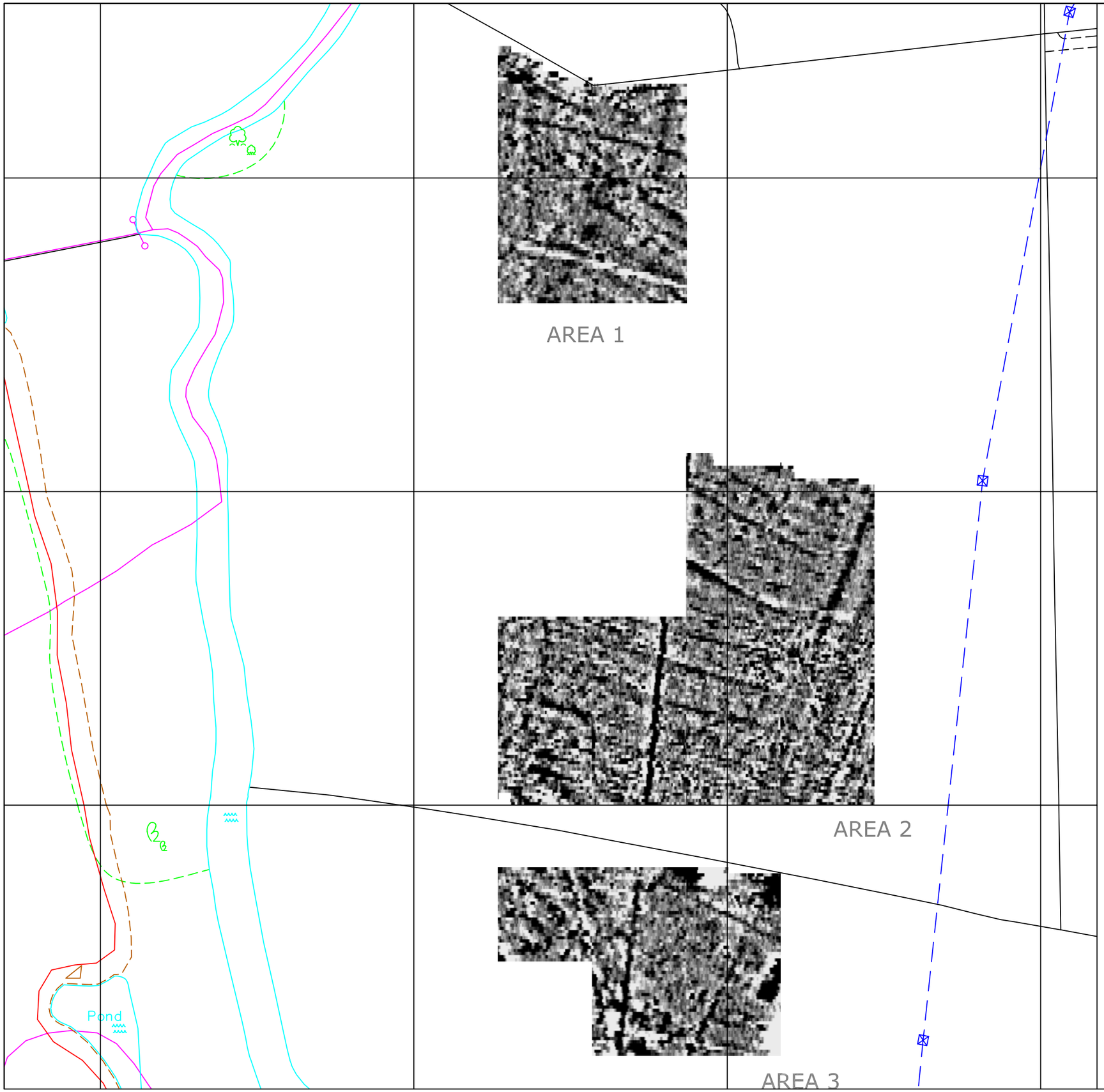

Amendments		
Issue No.	Date	Description
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		-

Plotting parameters
Area 1
Maximum +1nT (black)
Minimum -1nT (white)

-3SD +3SD

Plotting parameters
Area 2
Maximum +1nT (black)
Minimum -1nT (white)

-3SD +3SD

Plotting parameters
Area 3
Maximum +1nT (black)
Minimum -1nT (white)

-3SD +3SD

+1nT

-1nT

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

Subject
PLOT OF PROCESSED GRADIOMETER DATA

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Scale 1:1250 0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	SAS	01
Survey date	Drawn by	Figure No.
NOV 06	RAJS	07

Pond

AREA 1

AREA 2

AREA 3

Pond

082

081

3080

N

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
	Positive linear anomaly- former field boundary
	Agricultural mark
	Positive area anomaly- cut feature of possible archaeological origin
	Area of magnetic debris - evidence of ground disturbance
	Area of magnetic disturbance from proximity to ferrous objects

Client
ARCHAEOLOGICAL PROJECT SERVICES

Project Title — Job No. 2252
GEOPHYSICAL SURVEY - STAMFORD, LINCS

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	SAS	01
Survey date	Drawn by	Figure No.
NOV 06	RAJS	08