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FLUXGATE GRADIOMETER AND RESISTIVITY SURVEYS: CAISTOR GRAMMAR SCHOOL PLAYING FIELD, CAISTOR, LINCOLNSHIRE

TA 1105 0110

Report prepared for Caistor Grammar School
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Illustrations

Summary

- *Detailed fluxgate gradiometer and resistivity surveys were undertaken on behalf of Caistor Grammar School, on the Caistor Grammar School Playing Field, Lincolnshire.*
- *Resistivity survey results revealed an underlying land drainage system, possible walls, and areas of geological banding.*
- *Fluxgate gradiometer survey results identified linear anomalies running diagonally across the site, denoting possible land drains or ridge and furrow cultivation remains. Other magnetic anomalies are considered to be of modern origin.*
- *No substantial archaeological remains were detected, even though the site is close to the Roman town of Caistor, and a series of medieval fish ponds.*

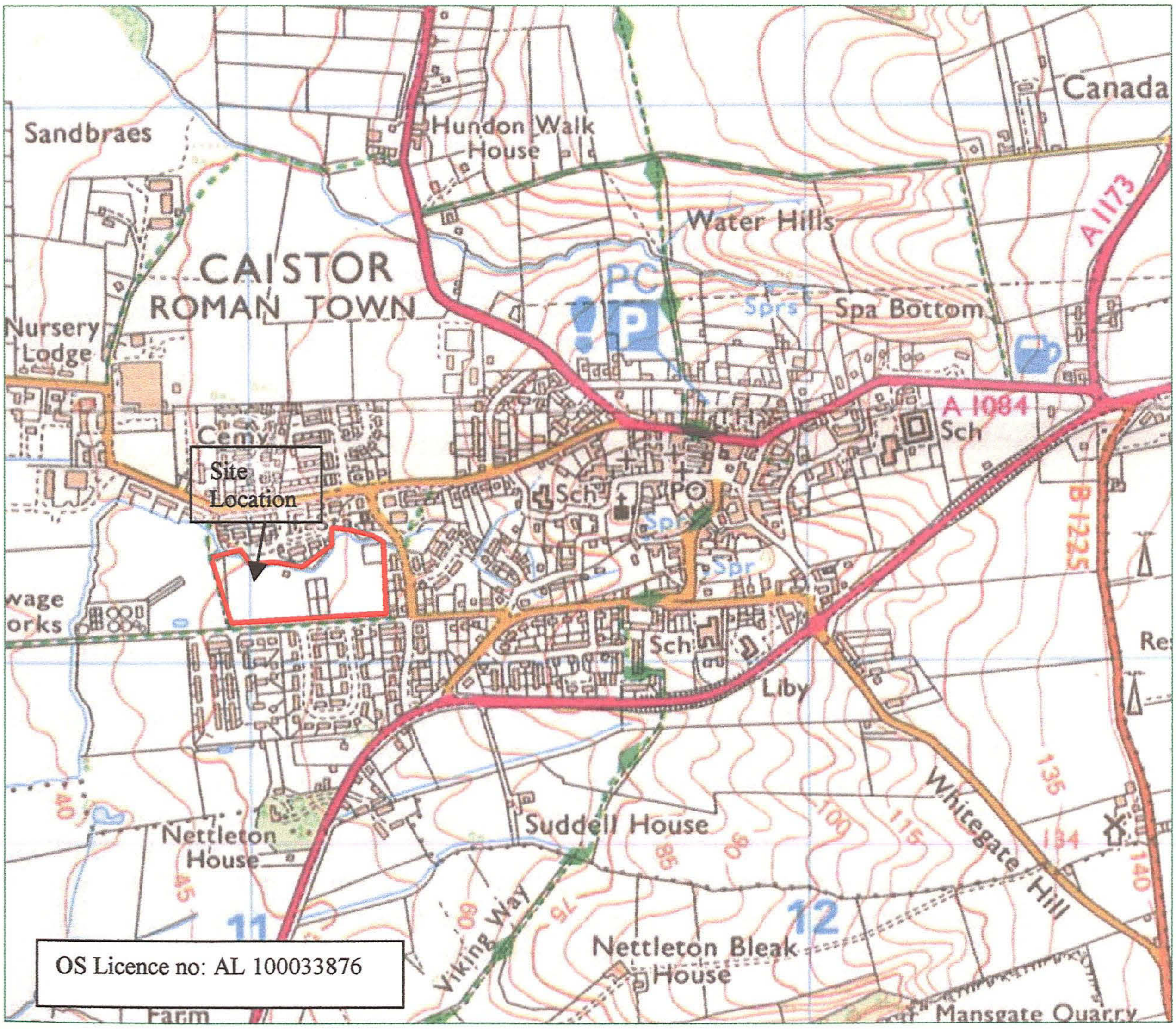


Fig. 1 Location of site **Scale = 1:12,500**

1.0 Introduction

Pre-Construct Geophysics was commissioned to carry out both gradiometer and resistivity surveys on the Caistor Grammar School Playing Field, Caistor, (NGR TA 1105 0110; Fig.1). The work was undertaken on 21 March 2003 on behalf of Caistor Grammar School, and it was carried out to comply with the English Heritage document *Geophysical Survey in Archaeological Field Evaluation,* 1995, and in accordance with the recommendations of Lincolnshire County Council.

The surveys were undertaken on approximately 0.7 hectares of land, where planning consent is sought for a new sports pavilion and agro-turfing surface.

The purpose of the surveys was to detect any sub-surface archaeological remains relating to the nearby Roman town of Caistor, without the use of intrusive techniques.

2.0 Location and description

Caistor is in the administrative district of West Lindsey, approximately 12.5km south-east of Brigg and 12.5km north of Market Rasen. The proposed development site is on the west side of the town, approximately 400m west of the parish church. It comprises an area of approximately 0.7ha, situated on the west side of the current playing field (Fig. 2).

The site is situated between the 50m and 60m contours, and the underlying geology of the area is characterised as windblown sand (drift) over Elsham Sandstone (solid) of the Late Jurassic period. (BGS 1982). An outcrop of the Elsham sandstone has been mapped on the south-west edge of the survey area. It lies towards the base of the west-facing slope of the Lincolnshire Wolds, and consequently the ground undulates and gently slopes from east to west. Hedges bound the playing field to the east, west and south sides, and a brook defines its northern boundary.

3.0 Archaeological background

Roman Caistor was a small fortified town (the name Caistor derives from the Latin *castra*, a military fort). Little is known about the Roman town, as it is not specifically referenced in literary sources (Burnham and Wacher 1990, 240). The proposed development site is approximately 100m to the west of the Roman town defenses, and activities, which would normally have taken place outside the town walls, may be anticipated in this area. Two pottery kilns are known; one directly to the south-west of the site, and one on the edge of the town boundary, approximately 125m to the north (SMR refs. 50869 and 52684). Both kilns were producing grey utilitarian vessels in the 3^{rd} - 4^{th} centuries AD. A hearth in the vicinity of the site (SMR ref. 50876) may have been associated with Roman industrial processes, but no associated dating evidence has been recovered.

Roman tesserae (mosaic fragments) were found in 1950 to the west of the survey area (SMR ref 52641), but little evidence has been found to support the existence of Roman buildings.

Four burials were found in the 1960s on the north side of Navigation Lane, close to the east end of the playing field (SMR ref. 50585). No grave goods or associated artefacts were recovered, but their location, on the edge of the Roman town boundary, suggests that the burials may have been part of a contemporary cemetery, as Roman law forbade burial within the walls of a town.

There is very little evidence of activity in this area during the Anglo-Saxon and Viking periods, although agricultural regimes, at least, must have continued. The Domesday Survey of 1086 valued Earl Morcar's manorial lands in Caistor, with a church, a priest and four mills, at a prosperous £50. The Sites and Monuments Record refers to a pre-Norman inscribed stone found within Caistor, approximately 200m to the north-east of the proposed development site (SMR ref. 52681).

Traces of medieval ploughing can be seen as 'ridge and furrow' in fields outside of Caistor, to the north-west of the site (SMR ref. 52718). A series of artificial fishponds, connected by leats and dams, exist to the north of Navigation Lane (adjacent to the survey area), and these are believed to be of medieval origin.

A recent archaeological evaluation, which comprised of two trial trenches, was carried out to the south-east of the site and south of Navigation Lane. This did not reveal any significant archaeological remains (Savage 2003).

4.0 Methodology

Detailed area survey using a fluxgate gradiometer is a non-intrusive method of evaluating the archaeological potential of a site. The gradiometer detects magnetic anomalies created by areas of high or low magnetic susceptibility. These variations are caused by changes in the composition of the subsoil or the underlying geology. Archaeological features result from man-made alterations to the soil and they may also incorporate intrusive materials such as brick and stone. These features can create detectable magnetic anomalies. In addition, activities that involve heating and burning can generate magnetic anomalies, as will the presence of ferrous metal objects.

The anomalies detected by a fluxgate gradiometer survey can often be resolved into entities sharing morphological similarities with features of known archaeological provenance. This enables the formulation of an informed, but subjective, interpretation.

Resistivity survey measures the electrical resistance of the earth's soil moisture content. A twin probe configuration is normally carried out, which involves the pairing of electrodes (one current and one potential), with one pair remaining in a fixed position (remote probes), whilst the mobile probes measure resistivity variations across the survey grids. Resistance is measured in ohms, and this method generally detects to a depth of 1m.

Features such as wall foundations are usually identified as high resistance anomalies, as well as rubble spreads, made surfaces (ie yards and paths) and metalled roads and trackways. In contrast, low resistance values are normally associated with water-retentive features such as large pits, ditches, drains and gulleys.

The Gradiometer survey was undertaken using a Bartington Grad-01 Dual Fluxgate Gradiometer. The resistivity survey was carried out using a Geoscan RM15 Resistance Meter with an MPX15 Multiplexer, configured as a two-twin Parallel electrode probe array configuration in mobile probe spacing of 0.5m.

The zigzag traverse method of survey was used, with 1.0m wide traverses across 30m x 30m grids.

Data from the surveys was analysed using Geoplot v.3.0 (Geoscan 2000). In the resultant plots, low magnetism/resistance is shown as white and high magnetism/resistance as black. The plots are shown as raw and enhanced data.

The gradiometer survey data has been processed using zero mean functions to correct the unevenness of the plots in order to give a smoother graphical appearance. The data was also processed using algorithm to remove magnetic spikes, thereby reducing extreme readings sometimes caused by stray iron fragments and spurious effects due to the inherent magnetism of soils.

The resistivity survey data has been processed using high and low pass filters in order to reduce anomalies caused by variation in geology and depth of topsoil. This also gives the plots a smoother graphical appearance.

The results are presented as greyscale and traceplot images, along with an interpretative plan (Figures 3-4).

Instruments	Bartington Grad – 01 – 1000 fluxgate gradiometer with DL601 data logger and RM15 Resistance Meter with MPX15 multiplexer and twin probe array
Grid size	30m x 30m
Sample interval	0.25m and 1m (RM15)
Traverse interval	1.0m
Traverse method	Zigzag
Sensitivity	0.1nT and ohms
Processing Software	Geoplot (v.3.0)
Weather conditions	Sunny
Area Surveyed	0.7ha
Date of survey	21st March 2003
Survey personnel	Peter Masters and Peter Heykoop
National Grid Reference	TA 01105 0110

Table 1: Summary of survey parameters

5.0 Analysis and Interpretation of Results

The site survey area contained two goal posts at either end of the football pitch and a pile of cleared vegetation. These areas were not surveyed, and are shown as blank areas on figures 3 and 4.

<u>Resistance Survey</u> (Fig 3)

With resistivity surveying, there is a large variation in the background resistance of both large and small scale surveys. This is due to a combination of varying subsoil geology, variation in topsoil depth, and change in relief. The resultant raw data plot shows broad high resistance readings to the south-west and north-east (1), which is almost certainly caused by near-surface geology.

Faint positive linear anomalies (2) aligned north-south indicate the positions of land drains. Areas of individual high resistance readings are due to spikes caused by poor electrical contact, or where probes have made contact with underlying stones.

A short linear high resistance anomaly (3) towards the north-west of the area could well be part of the broad band of geology, because its graphical appearance does not resemble a wall alignment.

In order to create the same localised background resistance over the whole site, a high-pass filter has been passed over the data. It is important to note that the method of filtering used can, under some circumstances, create anomalies or mislead interpretation, especially at the join between grids or where geological changes are of the same width as the filter.

Upon filtering the data, a high resistance anomaly (4) was identified, running parallel to the hedge line along Navigation Lane. This possibly indicates the line of a wall foundation, but is more likely to represent a feature created from the processing of the data.

<u>Gradiometer Survey</u> (fig 4)

A series of regular, narrow linear anomalies, orientated south-east to north-west, were detected over a wide area (dashed green lines). These anomalies could reflect buried land drains, or possibly the remains of medieval ridge and furrow (where the survey has identified the bases of truncated furrows).

Along the south edge of the survey, running parallel to the southern hedge boundary is a strong magnetic anomaly, which almost certainly results from ferrous noise created by a wire fence or from rubbish that has been discarded in the vicinity of the hedge.

Immediately to the north, a curvilinear positive magnetic anomaly was detected denoting a possible ditch.

Randomly scattered across the survey (examples shown as red stars) are magnetic spikes caused by stray ferrous objects.

No other significant anomalies were detected.

6.0 Conclusions

Both resistivity and gradiometer techniques revealed few significant archaeological anomalies. The resistivity survey results identified what appear to be near-surface geological variations and land drains. In contrast, results from the gradiometer survey have identified what appear to be furrows from the pre-enclosure field system and also confirms the geological changes detected by resistivity.

The overall results suggest that, if extra-mural settlement remains associated with the Roman town exist, then these are more likely to occur elsewhere outside of the walled enclosure.

7.0 Aknowledgements

Pre-Construct Geophysics would like to thank Eddie Cook, Deputy Head, Caistor Grammar School for this commission.

8.0 References

Abbreviations

BGS = British Geological Survey
EH = English Heritage

BGS 1982, *Brigg, Sheet 89, Drift Edition, 1:50 000 Series.* (Keyworth, Nottingham: British Geological Survey).

Burnham, C & Wacher, J 1990 *The Small Towns of Roman Britain*, Batsford London

Clark, A 1990 *Seeing Beneath the Soil*, Batsford London

EH 1995 *Geophysical Survey in Archaeological Field Evaluation, Research and Professional Services Guideline No.1*

Savage, S 2003 *Navigation Lane, Caistor, Archaeological Evaluation Report*, Pre-Construct Archaeology (Lincoln)

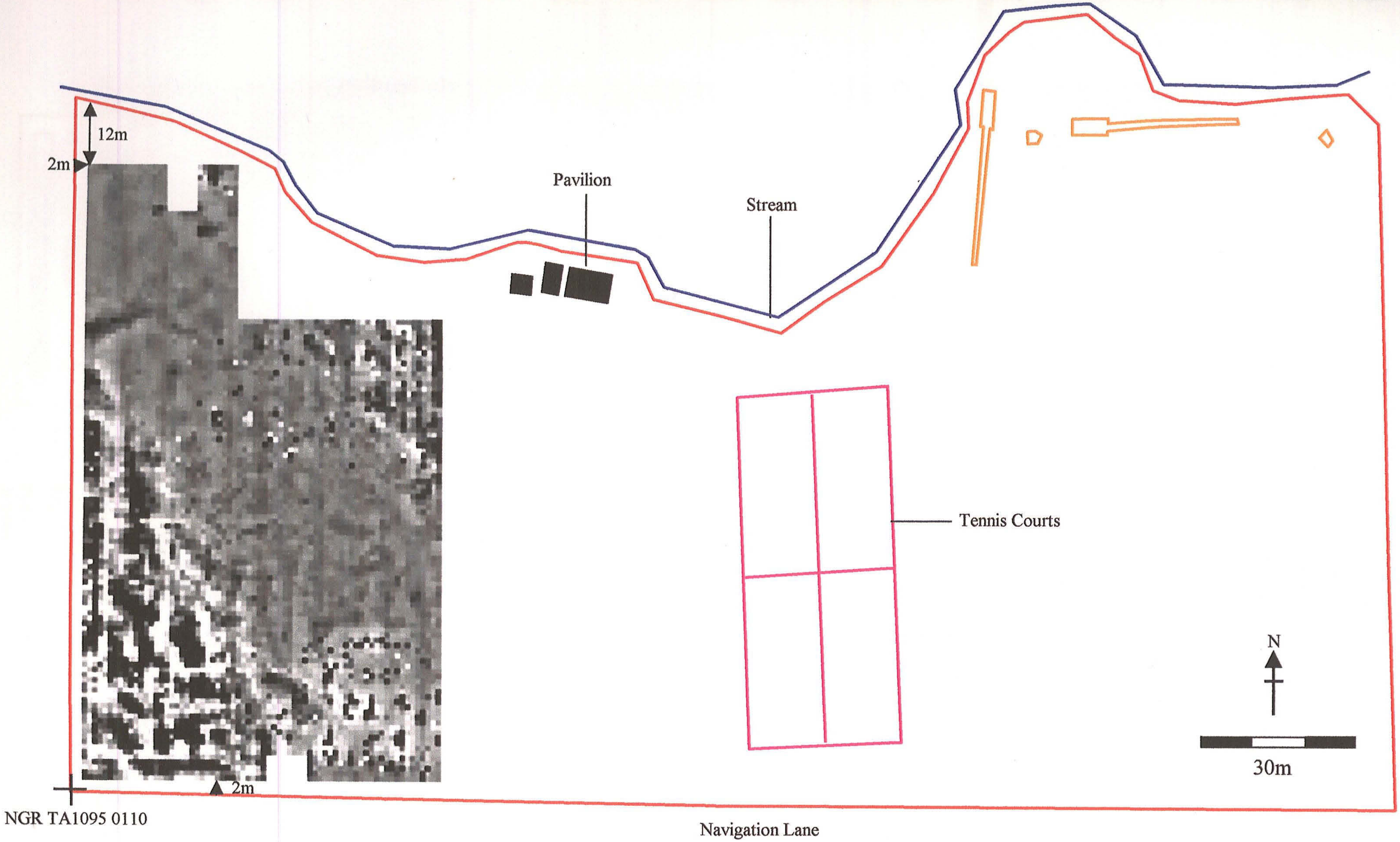
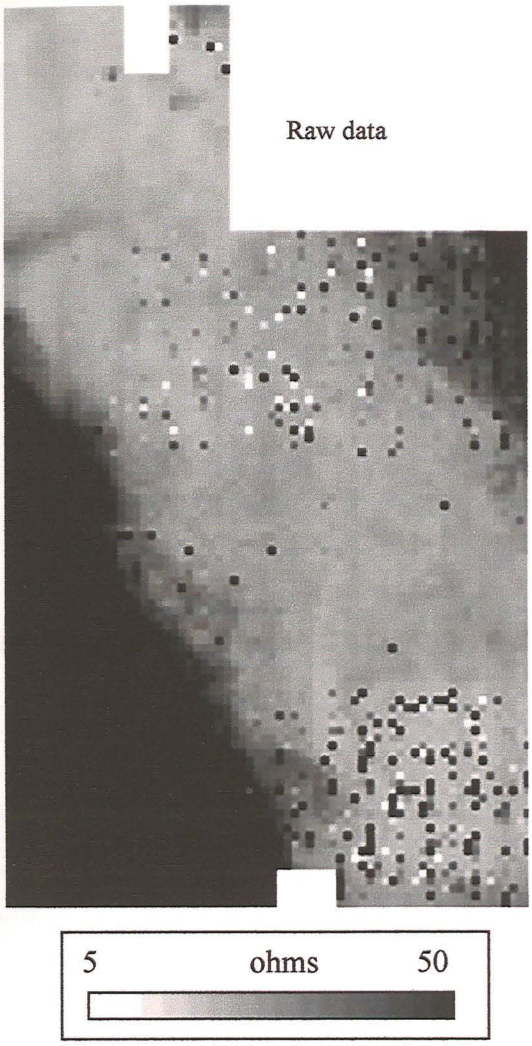
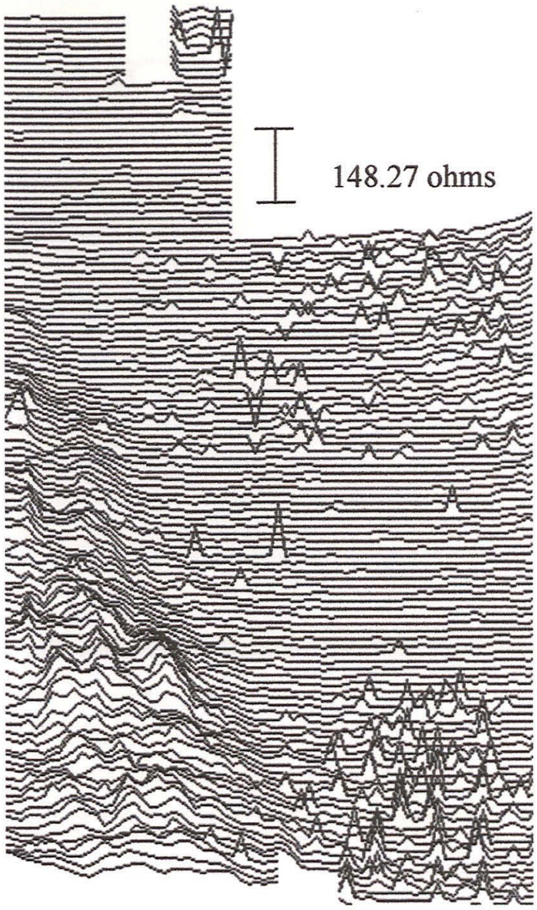
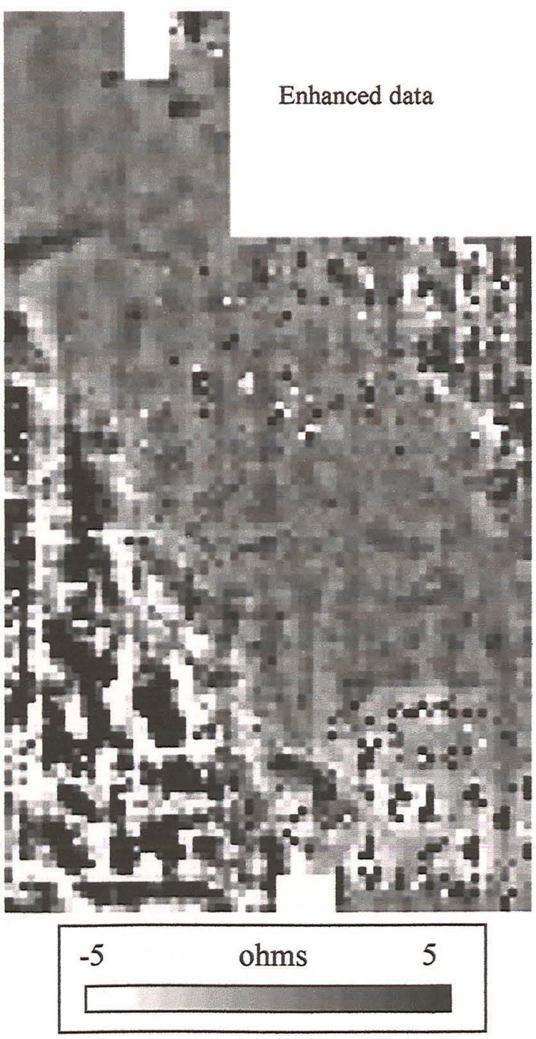


Fig. 2 Location of survey, scale 1:1000







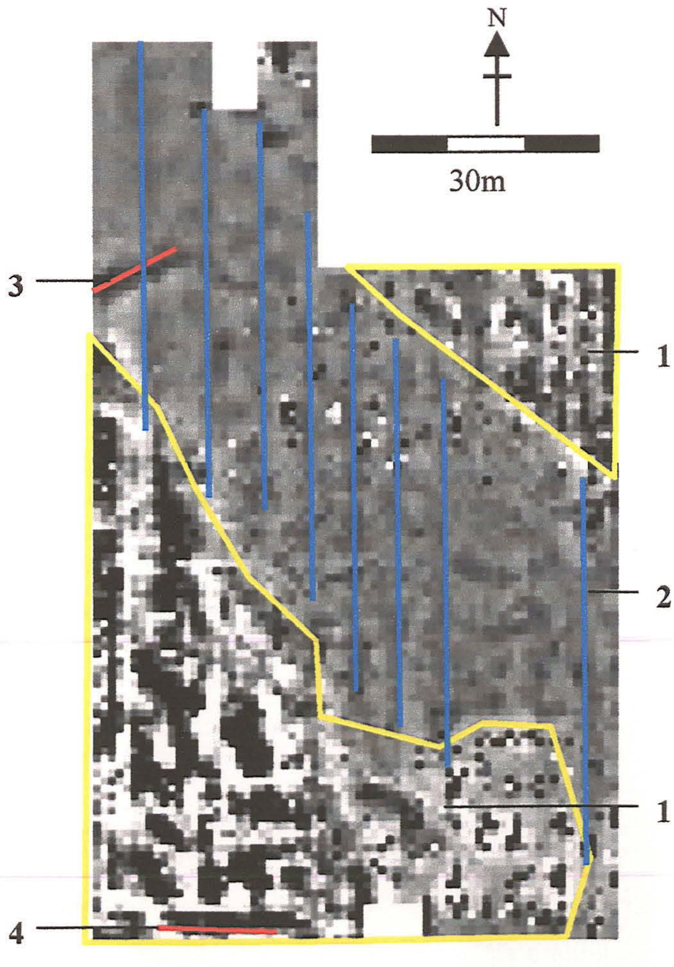


Fig.3 Resistivity survey results shown as Grey scale and trace plots with interpretation, scale 1:1000

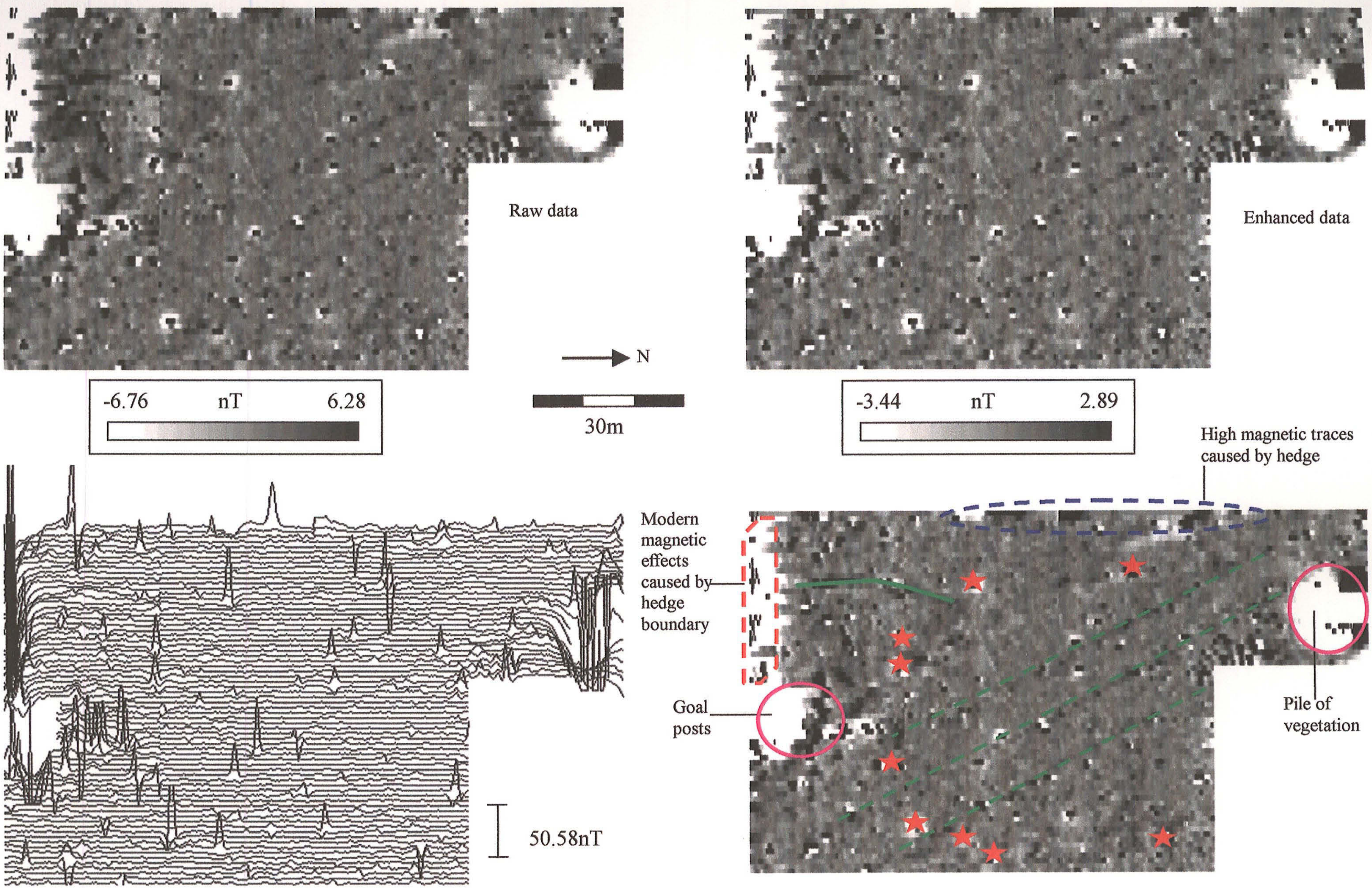


Fig. 4 Gradiometer survey results shown as Grey scale and trace plots with interpretation, scale 1:1000