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**FLUXGATE GRADIOMETER SURVEY:
SECTIONS ALONG THE PROPOSED
BOURNE TO GUTHRAM WATER MAIN, LINCOLNSHIRE**

NGR: 510998 321856 - 511237 322068 & 515708 322499 - 516220 32261



Report Prepared For
Lindsey Archaeological Services
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Highways & Planning
Directorate

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Table 1: Summary of survey parameters

Front cover: 1st Edition O.S map (1889-92)

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Summary

- A fluxgate gradiometer survey was undertaken along two sections of a proposed water pipeline that will extend between Bourne Water Treatment Works and Guthram Booster Station, Lincolnshire.
- In Area 1, the survey identified an arrangement of inter-connecting ditch-like anomalies; possibly small sub-enclosures. A low number of discrete anomalies may be a reflection of prehistoric salt production.
- There is minimal geophysical evidence of archaeological remains in Area 2, with the possible exception of a curvilinear ditch-like anomaly.
- Magnetic traces of existing services were recorded in both areas. In Area 2, the survey detected traces of known former boundaries and possible demolition debris associated with post-medieval buildings.

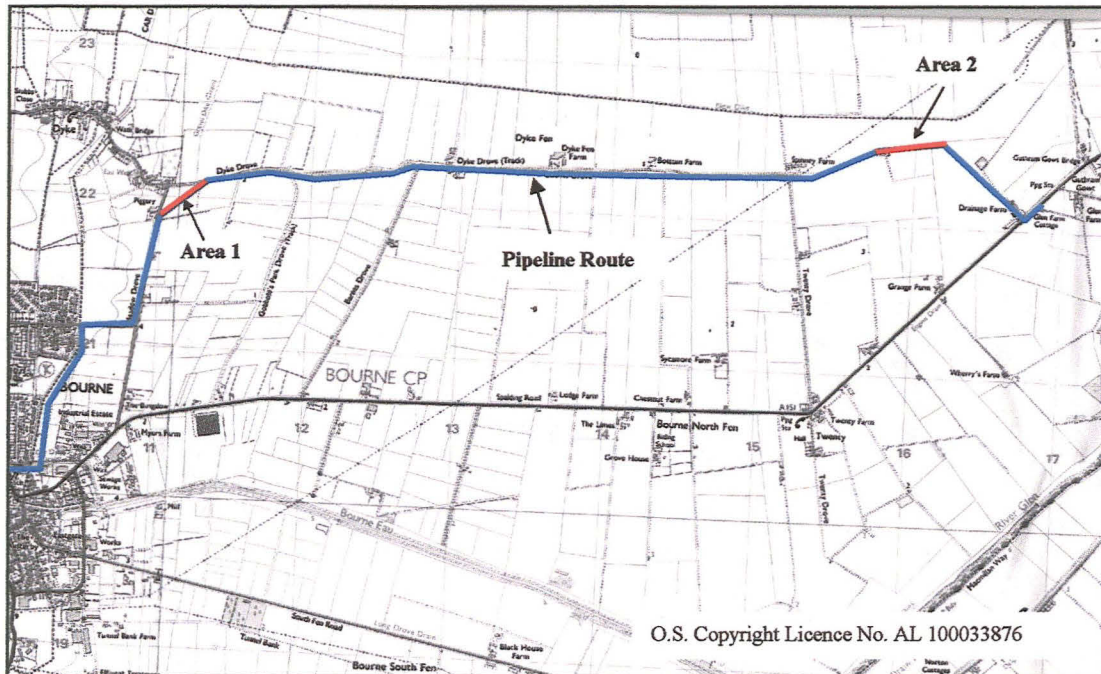


Fig. 1: General location of survey areas 1: 50000

1.0 Introduction

Lindsey Archaeological Services, acting on behalf of Anglian Water Services Ltd., commissioned Pre-Construct Geophysics to undertake a fluxgate gradiometer survey on two sections of the proposed pipeline from Bourne Water Treatment Works to Guthram Booster Station, Lincolnshire.

2.0 Location and description (Figs. 1-3)

This section includes information contained within an archaeological desk-based assessment of the proposed route (Tann, 2006).

The town of Bourne is situated in the South Lincolnshire Fens. The c. 10.5km pipeline will extend northwards from Bourne Water Treatment Works, Manning Road, Bourne (TF 1001 2020) along the eastern bank of Car Dyke. It will continue northwards alongside of Meadow Drove before turning east to follow the course of Dyke Drove. Beyond the eastern end of Dyke Drove, the route veers slightly to the north before, turning southeast toward the A151 and Guthram Gowt pumping station (TF 1700 2230).

An archaeological potential in two areas of the pipeline route informed a request for a limited geophysical survey (Areas 1 – 2).

A substantial part of the route is confined to road verges on disturbed ground. Elsewhere, it extends across green fields.

2.1. Survey Area 1 (Figs. 1-2)

2.1.1 Location and geology

This 360m x 20m section extends across a single arable field that lies to the south of Dyke Drove and to the immediate east of Meadow Drove.

The drift geology is recorded as Peat, overlying solid deposits of Kellaways Clays (grey mudstones) (BGS, 1992). The response of fluxgate gradiometer survey to archaeological features over peat is typically poor to average (Clark, 1990), although the peat has been largely eroded (Tann, 2006).

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2.1.2 Archaeological Context

The Fenland Survey recorded a scatter of Iron Age pottery and *briquetage* from salt processing in this field. There is also cropmark evidence of possible Iron Age and Romano-British settlement remains, including enclosure features.

This part of the route lies close to two major Roman landscapes features: King Street (that passes through Bourne town centre) and the Car Dyke, which lies to the east of the town.

2.2 Survey Area 2 (Figs. 1, 3)

2.2.1 Location and geology

This comprises a c.1km x 20m strip of arable land that extends from the eastern end of Dyke Drove to the mid point of a field that lies to the north of the A151.

Drift geology consists of Sands and Gravel, which overlies Oxford Clays (BGS, 1992). The response of fluxgate gradiometer survey to archaeological features over sands and gravels is typically poor to average (Clark, 1990).

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2.2.2 Archaeological Context

An extensive settlement with field systems and trackways has been identified beyond the eastern end of Dyke Drove, where the underlying ground formed an island in the fen. Two previous water mains cross the site, and a skeleton was recorded during installation of an earlier pipeline.

3.0 Methodology

The survey methodology was based on guidelines set out by English Heritage (David, 1995).

Gradiometry is a non-intrusive scientific prospecting technique that is used to determine the presence/absence of some classes of sub-surface archaeological remains (e.g. pits, ditches, kilns, and occasionally stone walls). By scanning the soil surface, geophysicists identify areas of varying magnetic susceptibility and can interpret such variation by presenting data in various graphical formats and identifying images that share morphological affinities with diagnostic archaeological remains.

The area survey was conducted using a Bartington Grad 601 dual fluxgate gradiometer with a DL601 data logger set to take 4 readings per metre (a sample interval of 0.25m). The zigzag traverse method of survey was used, along 1m wide traverses. The sensitivity of the machine was set to detect magnetic variation in the order of 0.1 nanoTesla.

The data was processed using *ArcheoSurveyor 1.3.2.7*. It was clipped to reduce the distorting effect of extremely high or low readings caused by discrete pieces of ferrous metal on the site. The results are plotted as trace, colourscale, greyscale and interpretive images (Figs. 4-15).

The survey location was recorded using a Leica GPS instrument (indicated on Fig. 2 & 3).

It is essential that the GPS coordinates are used to relocate the survey.

Instrument	Bartington Grad-601
Sample interval	0.25
Traverse interval	1.0m
Traverse method	Zigzag
Sensitivity	0.1nT
Processing software	<i>ArcheoSurveyor 1.3.2.7</i>
Weather conditions	Fine
Area surveyed	c.1.35km x 20m
Date of survey	16-02-07 & 23-02-07
Survey personnel	Neil Jefferson

Table 1: Summary of survey parameters

4.0 Results (Figs. 4 -15)

The gradiometer survey detected isolated and magnetically strong dipolar anomalies in both areas (Figs.4 - 15: examples circled in pink). These typically reflect ferrous-rich objects within the topsoil (e.g. plough shares, horseshoes, and brick/tile fragments).

4.1 Area 1 (Figs. 2, 4 – 7)

The survey detected a group of linear anomalies at the north-eastern end of the field (Fig. 7: red lines). For the most part, these are aligned either east-west or north-south; this perpendicular arrangement suggests a shared origin, possibly as enclosure ditches. The east-west examples are parallel to the northern boundary of the field.

The survey recorded a number of strong and predominately positive magnetic anomalies, which may evidence some form of intense and prolonged burning (Fig. 7: boxed in red). There is evidence of prehistoric salt making in this area and it is possible that these features reflect traces of this activity. Other, magnetically weaker, anomalies may have archaeological significance as pits or small deposits

of burnt material (Fig. 7: examples circled in red). However, it is also possible that some of this weak variation reflects residual pockets of peat.

A zone of strong magnetic readings at the southern and northern ends of the survey (Fig. 7: boxed in pink) almost certainly reflect an existing service that extends along the southern and eastern boundaries of the field (G Tann, *pers. comm.*).

4.2 Area 2 (Figs. 3, 8 – 15)

In Area 2A, the survey corridor lies to the immediate north of an existing track and, perhaps significantly, to the north of the former site of a small group of buildings (depicted on the 1st Edition O.S. map of 1889-92). It seems likely that the bulk of the recorded variation relates to these features (as miscellaneous rubble, possibly dragged into the field by cultivation (Fig. 11: zone boxed in pink). An extremely weak linear anomaly, probably a cultivation feature, was detected in the eastern part of Area 2a (Fig. 11: orange line).

The track turns south at the mid point of Area 2A. The 1st Edition O.S. map records an eastwards continuation, since removed. Evidence of this was recorded in the western half of Area 2B (Fig. 15: zone boxed in pink - probable widespread demolition rubble). An existing service, that has not produced a discrete signature, crosses the route at this point (Tann, 06).

A magnetically weak linear anomaly in the western half of 2B occurs in isolation (Fig. 15: orange line). This is parallel to the western field boundary and perpendicular to the former track, suggesting a relatively recent origin, possibly evidencing cultivation.

A ditch-like curvilinear anomaly was detected in the mid part of Area 2B (Fig. 15: red line). To the east of this, other linear features are evident (Fig. 15: orange lines), probably reflecting cultivation. These features share an alignment with a former boundary (Fig. 15: yellow line) that is depicted on the 1st O.S. map dated 1889-92.

The survey registered an existing water main that lies south of the route (Fig. 15: blue line).

5.0 Conclusions

The Fenland Survey has recorded artefactual evidence of salt production to the east and south of Meadow Drove and Dyke Drove respectively. Survey Area 1 extends across this area and it suggested that the discrete zones of strong magnetic variation could relate to this activity.

A series of potential ditches have been detected in the northern part of survey Area 1. These may evidence enclosures or sub-enclosures, reflecting former occupation of this area.

The results are limited for Area 2, with the possible exception of one curved anomaly, probably a ditch.

Elsewhere, much of the magnetic variation would appear to reflect modern/recent activity: existing services, former boundaries, and miscellaneous ferrous objects in the plough soil. A widespread zone of anomalies at the western end of Area 2 may indicate the demolition debris of former buildings.

In Area 1, some of the more erratic variation could indicate residual pockets of peat.

6.0 Acknowledgements

Pre-Construct Geophysics would like to thank Lindsey Archaeological Services for this commission.

7.0 References

BGS. 1992. *Spalding, Sheet 144*, Solid and Drift Edition, 1:50000 Series. Keyworth, British Geological Survey

Clark, A. J. 1990. *Seeing beneath the soil*. London, Batsford.

David, A. 1995. Research & Professional Services Guidelines No 1: *Geophysical Survey in Archaeological Field Evaluation*. London.

Tann, G. 2006. *Bourne – Guthram Water Main (Bourne Water Treatment Works to Guthram Booster)*. Archaeological Desk-Based Assessment. Lindsey Archaeological Services (Report No. 933).

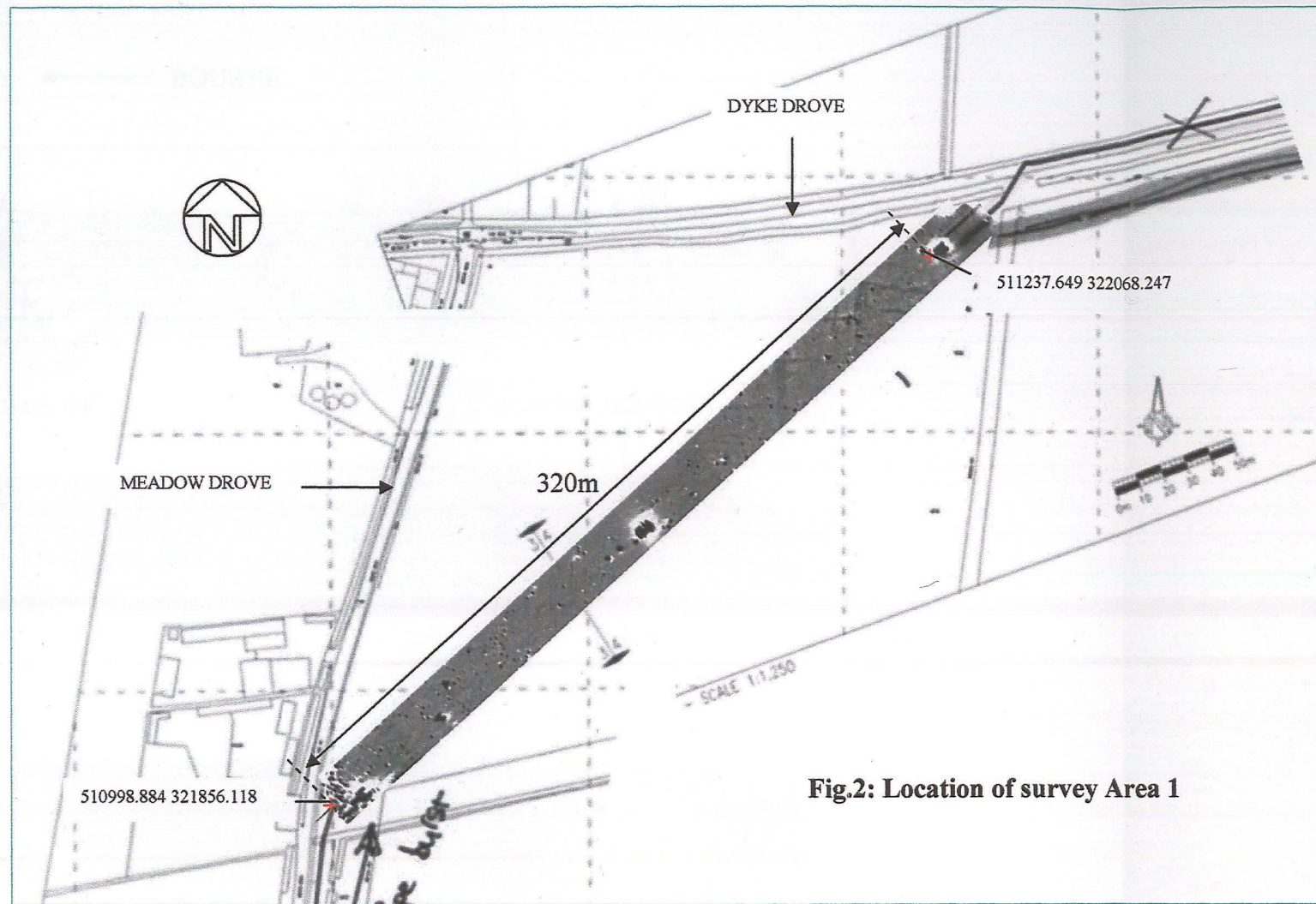


Fig.2: Location of survey Area 1

**DO NOT SCALE
TO RELOCATE SURVEY, USE O.S COORDINATES ONLY**

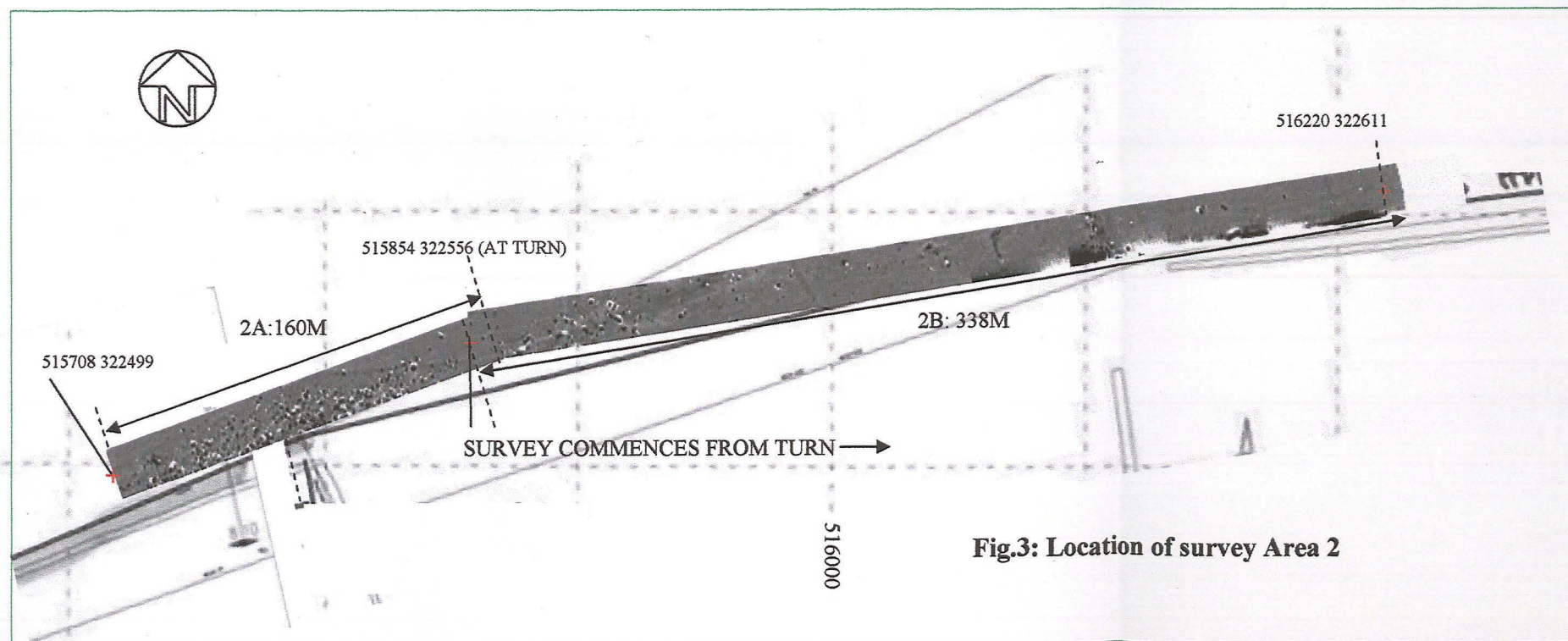


Fig.3: Location of survey Area 2

← BOURNE



Area 1

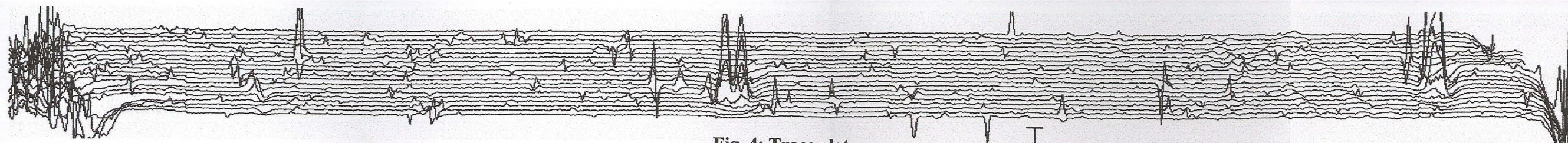


Fig. 4; Trace plot (data clipped to +/-100nT)

30nT

510998.884 321856.118

511237.649 322068.247

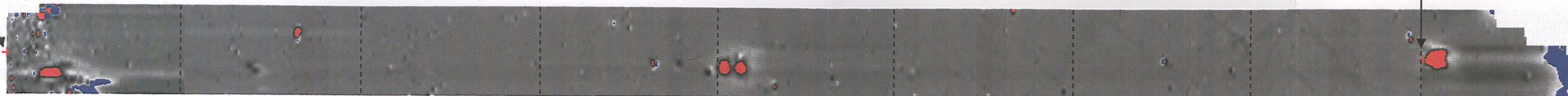


Fig. 5: Colourscale image (data clipped to +/-100nT)

-100 nT 100

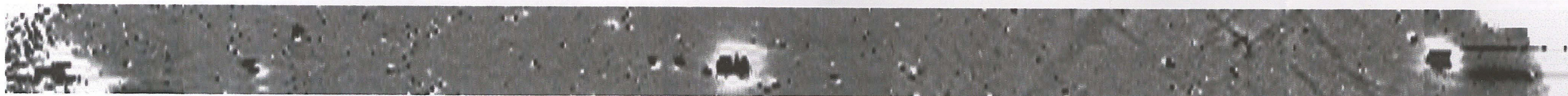


Fig. 6: Greyscale image (data clipped to +/-5nT)

-5 nT 5

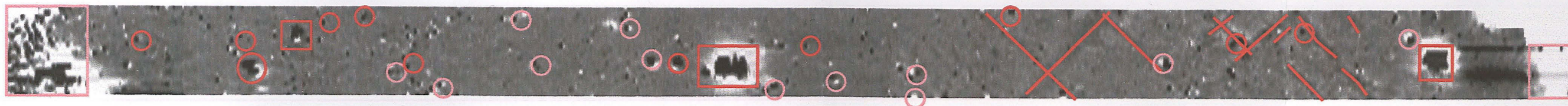


Fig. 7: Interpretive image



50m

Scale 1:1000

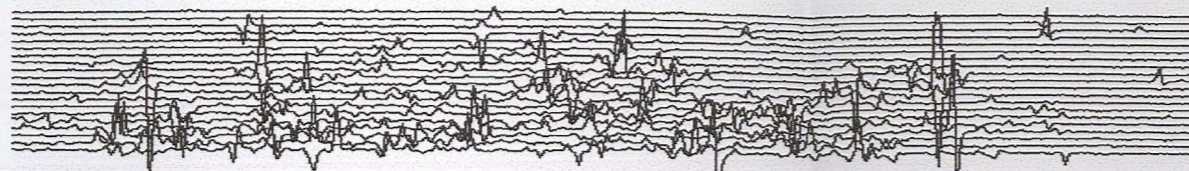
- Potential ditch
- Pit-like (examples)
- Potential saltern
- Discrete ferrous (examples)
- Zone of strong magnetic variation
- Service

GUTHRAM →

← BOURNE

Area 2A

Fig. 8: Trace plot
(data clipped to +/-100nT)



30nT



Fig. 9: Colourscale image
(data clipped to +/-100nT)

515708 322499



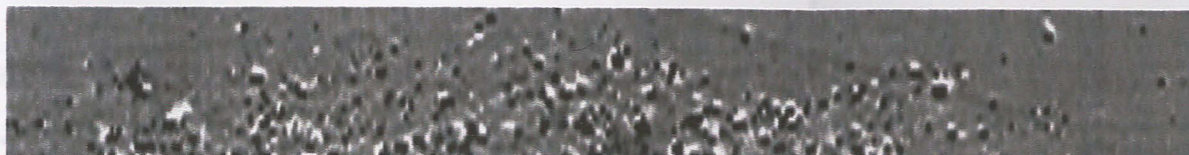
-100 nT 100



50m



Fig. 10: Greyscale image
(data clipped to +/-5nT)

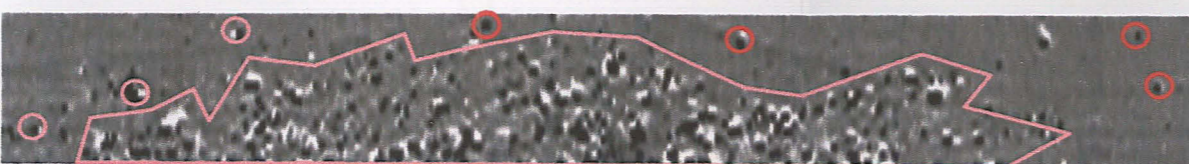








-5 nT 5



Scale 1:1000

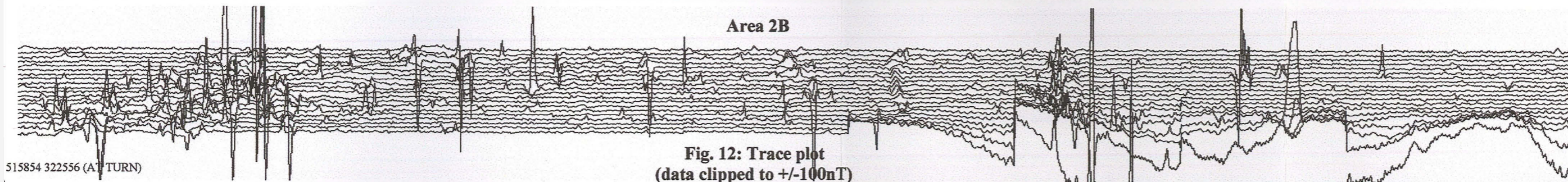
Fig. 11: Interpretive image



-  Possible ditch
-  Pit-like (examples)
-  Ferrous (examples)
-  Zones of strong magnetic variation
-  Service
-  Field boundary

Area 2B

Fig. 12: Trace plot
(data clipped to +/-100nT)



515854 322556 (AT TURN)



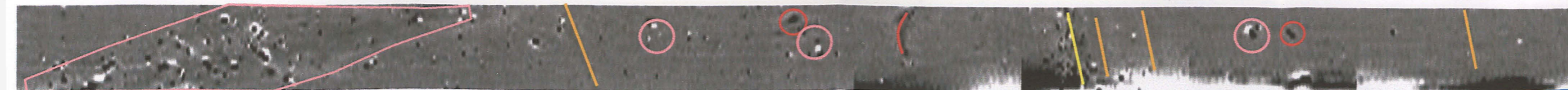
Fig. 13: Colourscale image
(data clipped to +/-100nT)



Fig. 14: Greyscale image
(data clipped to +/-5nT)



Fig. 15: Interpretive image



GUTHRAM →