M2/6

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GEOPHYSICAL SURVEY REPORT 2002/13

WARDENTREE LANE
Pinchbeck
Lincolnshire

Client:

JSAC JOHN SAMUELS ARCHAEOLOGICAL CONSULTANTS

SITE SUMMARY SHEET

2002 / 13 Wardentree Lane, Pinchbeck, Lincolnshire

NGR: TF 250 251 (approximate centre)

Location, topography and geology

The area of interest covers 7ha and occupies a field approximately 1km south-east of Pinchbeck, Lincolnshire. The field is bounded to the south by Wardentree Lane, to the east by a factory, to the north by a ditch and to the west by a field boundary and a house. At the time of survey, the field was under emergent cereal crop; the topography is flat. The soils are alluvial gleys comprising deep silty loams formed from a parent of marine and river alluvium (SSEW, 1983).

Archaeology

No known archaeological sites, monuments or finds are lie within the field itself. However, features associated with Roman and medieval saltmaking (SMR nos. 23592 & 23591), a medieval moated site (SMR no. 20144) and undated cropmarks (SMR no. 23584) all exist within a 1km radius of the survey area (JSAC, 2001).

Aims of Survey

Magnetic susceptibility mapping was undertaken over the entire field. Gradiometer survey sampled 1.5ha and was positioned on the basis of the susceptibility data. The aim was to locate any detectable anomalies of archaeological potential. This work forms part of a wider investigation by **John Samuels Archaeological Consultants (JSAC)**.

Summary of Results *

The magnetic susceptibility data show a concentration of elevated values in the south-western corner of the field and along the eastern margin which are attributed to modern topsoil contamination. Two linear anomalies and an ill-defined zone of slightly increased susceptibilities were detected and noted for detailed gradiometry.

Three areas of detailed survey were deployed: one sampled the two linear anomalies; another examined the zone of increased susceptibilities, and the third area sampled a part of the field which magnetic susceptibility survey suggested was archaeologically 'blank'. The gradiometer data contain several ditch-type responses which, when viewed as a whole, suggest former field boundaries. One ditch anomaly has a sinuous form and a more muted magnetic signal and may represent a section of palaeochannel. The data also contain numerous trends, most of which are characteristic of ploughing. Those remaining may be archaeological but their origin is debatable.

*** It is essential that this summary is read in conjunction with the detailed results of the survey.**

SURVEY RESULTS

2002 / 13 Wardentree Lane, Pinchbeck, Lincolnshire

1. Survey Areas

1.1 The entire field, covering 7ha, was subject to volume-specific magnetic susceptibility (vMS) survey using a Bartington field coil. Subsequently, 1.5ha of gradiometer survey in three areas (Areas A, B and C) was undertaken. The location of survey is shown in Figure 1 at a scale of 1:2500.

1.2 The survey grids were set out and tied in by **GSB Prospection** using an EDM system and tapes. Stakes and canes have been left *in situ* to facilitate the re-establishment of the grid.

2. Display

2.1 Figure 2 presents the susceptibility data as two greyscales, showing raw and interpolated data, at the scale of 1:2000. This is accompanied by an interpretation at the same scale (Figure 3).

2.2 Figure 4 is a summary greyscale of the gradiometer data for Areas A, B and C at a scale of 1:1000, with an interpretation (Figure 5) at the same scale.

2.3 Figures 6 to11 present the gradiometer data as XY traces and dot density plots with interpretations at the scale of 1:500.

2.4 Numbers in parentheses in the text refer to specific anomalies noted on the interpretation diagrams.

2.5 The display formats and the interpretation categories employed are discussed in the *Technical Information* section at the end of the report.

3. General Considerations - Complicating Factors

3.1 Conditions for survey were good with the ground being flat and free from obstructions.

3.2 Several isolated ferrous type responses are apparent in the gradiometer datasets. These are presumed to reflect modern debris in the topsoil. Only the most prominent of these are highlighted on the interpretation diagram and are not referred to in the text unless considered relevant.

4. Results of Magnetic Susceptibility Survey

4.1 The susceptibility survey noted a few zones of elevated readings which may be of possible interest. The mean value is 12SI and the standard deviation is 13SI. The values range from 7SI to 196SI. However, once the high values in the south-west corner of the field are excluded, the mean and mode are 11SI and the standard deviation is 1.25.

4.2 A concentration of high susceptibilities is evident in the south-western corner of the survey area. This lies next to a house and coincides with a surface spread of modern debris and is, therefore, discounted as modern.

4.3 Two linear anomalies of increased susceptibilities (1) and (2), orientated approximately north-south, have been recorded and were noted for detailed gradiometer survey (Area B).

4.4 A more amorphous zone of increased topsoil susceptibility (3) has been recorded in the northern half of the study area. This was also targeted by gradiometry (Area A).

4.5 The remainder of the data was almost unvarying, with readings being at or close to the modal value of 11SI. A third block of detailed gradiometry (Area C) was positioned to sample this apparently 'blank' area.

5. Results of Gradiometer Survey

Area A

5.1 This area was positioned to investigate an ill-defined zone of slightly elevated topsoil susceptibilities (3).

5.2 Gradiometry has recorded two ditch-type responses which abut at right angles. These probably represent part of a former field boundary and whilst they may be of archaeological interest, a more recent origin is also credible.

5.3 The data also contain an amorphous response, which is thought to be natural, and several trends. These are at the limits of detection and any interpretation would be conjecture.

Area B

5.4 This area was positioned to cover two strips of elevated readings (1) and (2) in the susceptibility data.

5.5 Gradiometry detected several short ditch-type responses (4), these appear to join perpendicularly with a less pronounced linear anomaly (5). A slightly sinuous response (6) has also been recorded and, on the basis of its form and magnetic signal, is thought to be natural, perhaps a palaeochannel. Whilst anomalies (4) and (5) may be archaeological, the interpretation of (4) in particular is complicated by (6). The putative natural response (6) may grade into anomalies (4), although there is the faint suggestion that (6) continues south-eastwards but quickly fades away. The implication is that some or all of the short ditch-type anomalies that comprise (4) may be related to (6) and, therefore, be natural.

5.6 Numerous parallel trends can also be discerned in the data and are characteristic of ploughing; they do not coincide with the present direction of ploughing. These add an additional complication to the interpretation of (4) because the latter is aligned with the ploughing trends. It is possible, therefore, that the anomalies (4) represent, partly or wholly, features or deposits which have been disturbed by ploughing.

Area C

5.7 This area sampled a region of uniformly low topsoil susceptibilities.

5.8 The data contain several linear and short ditch-type anomalies which appear to represent former field boundaries. One arm of these responses (7) may continue and join with anomalies (4).

5.9 Several trends have been noted, some of which share a common orientation with the ploughing trend in Area B. Any trends on a differing alignment may be archaeological but this is speculation.

5.10 When one views all three areas of gradiometer survey together, the linear and ditch-type anomalies suggest a system of former field boundaries. It is not clear, however, if or how these responses relate to one another.

6. Conclusions

6.1 The mapping of topsoil susceptibility over the whole study area recorded two linear anomalies and an ill-defined zone of slightly enhanced susceptibility. These were targeted by detailed gradiometry. Other areas of topsoil enhancement are attributed to modern contamination.

6.2 Gradiometer survey was conducted in three areas: two over the magnetic susceptibility anomalies and a third sampled an apparently 'blank' area. In all three areas linear and ditch-type responses have been recorded. Viewed as a whole, these have the appearance of former field boundaries. These may be of archaeological interest but it is impossible to be precise. One slightly sinuous anomaly has been detected and is thought to be natural in origin.

6.3 The gradiometer data also contain numerous trends. Most of these are parallel and are attributed to ploughing, any trends on independent orientations may be of interest but any interpretation would be conjecture.

Project Co-ordinator: Dr D Weston
Project Assistants: I Dewar & J Leigh

Date of Survey: 5th and 6th February, 2002
Date of Report: 1st March, 2002

References:

JSAC, 2001 *An Archaeological Desk-Based Assessment of Land at Wardentree Lane, Pinchbeck, Lincolnshire.* JSAC 861/01/01.

SSEW, 1983. *Soils of England and Wales. Sheet 4, Eastern England.* Soil Survey of England & Wales.

TECHNICAL INFORMATION

The following is a description of the equipment and display formats used in **GSB Prospection (GSB)** reports. It should be emphasised that whilst all of the display options are regularly used, the diagrams produced in the final reports are the most suitable to illustrate the data from each site. The choice of diagrams results from the experience and knowledge of the staff of **GSB.**

All survey reports are prepared and submitted on the basis that whilst they are based on a thorough survey of the site, no responsibility is accepted for any errors or omissions.

Instrumentation

(a) Fluxgate Gradiometer - Geoscan FM36

This instrument comprises of two fluxgates mounted vertically apart, at a distance of 500mm. The gradiometer is carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is conventionally measured in nanoTesla (nT), or gamma. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally features up to one metre deep may be detected by this method. Readings are normally logged at 0.5m intervals along traverses 1.0m apart.

(b) Resistance Meter - Geoscan RM15

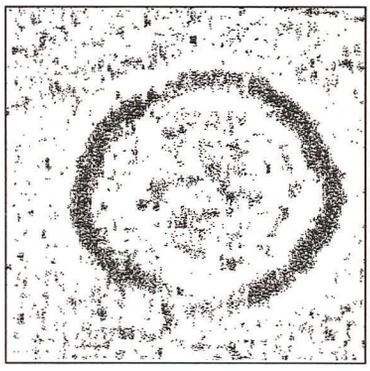
This measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The "Twin Probe" arrangement involves the paring of electrodes (one current and one potential) with one pair remaining in a fixed position, whilst the other measures the resistance variations across a fixed grid. The resistance is measured in Ohms and the calculated resistivity is in Ohm-metres. The resistance method as used for area survey has a depth resolution of approximately 0.75m, although the nature of the overburden and underlying geology will cause variations in this generality. The technique can be adapted to sample greater depths of earth and can therefore be used to produce vertical "pseudo sections". In area survey readings are typically logged at 1.0m x 1.0m intervals.

(c) Magnetic Susceptibility

Variations in the magnetic susceptibility of subsoils and topsoils occur naturally, but greater enhanced susceptibility can also be a product of increased human/anthropogenic activity. This phenomenon of susceptibility enhancement can therefore be used to provide information about the "level of archaeological activity" associated with a site. It can also be used in a predictive manner to ascertain the suitability of a site for a magnetic survey. Sampling intervals vary widely but are often at the 10m or 20m level. The instrument employed for measuring this phenomenon is either a field coil or a laboratory based susceptibility bridge. The field coil measures the susceptibility of a volume of soil. The laboratory procedure determines the susceptibility of a specific mass of soil. For the latter 50g soil samples are collected in the field. These are then air-dried, ground down and sieved to exclude the coarse earth (>2mm) fraction. Readings are made using an AC-coil and susceptibility bridge, with results being expressed either as SI/kg x 10^{-8} or m^3/kg.

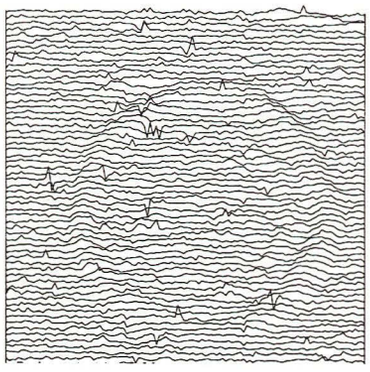
Display Options

The following is a description of the display options used. Unless specifically mentioned in the text, it may be assumed that no filtering or smoothing has been used to enhance the data. For any particular report a limited number of display modes may be used.



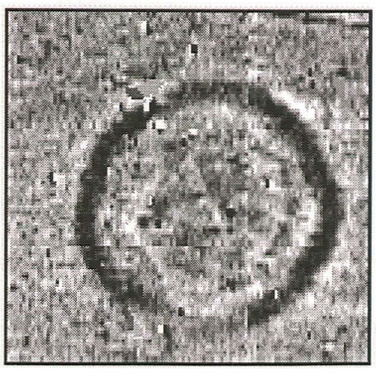
(a) Dot Density

In this display minimum and maximum cut-off levels are chosen. Any value that is below the minimum will appear white, whilst any value above the maximum will be black. Values that lie between these two cut-off levels are depicted with a specified number of dots depending on their relative position between the two levels. Assessing a lower than normal reading involves the use of an inverse plot that reverses the minimum and maximum values, resulting in the lower values being presented by more dots. In either representation, each reading is allocated a unique area dependent on its position on the survey grid, within which numbers of dots are randomly placed. The main limitation of this display method is that multiple plots have to be produced in order to view the whole range of the data. It is also difficult to gauge the true strength of any anomaly without looking at the raw data values. However, this display is favoured for producing plans of sites, where positioning of the anomalies and features is important.



(b) XY Plot

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.



(c) Greyscale

This format divides a given range of readings into a set number of classes. These classes have a predefined arrangement of dots or shade of grey, the intensity increasing with value. This gives an appearance of a toned or grey-scale. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. While colour plots can look impressive and can be used to highlight certain anomalies, greyscales tend to be more informative.

Terms commonly used in the graphical interpretation of gradiometer data

Ditch / Pit
This category is used only when other evidence is available that supports a clear archaeological interpretation e.g. cropmarks or excavation.

Archaeology
This term is used when the form, nature and pattern of the response is clearly or very probably archaeological but where no supporting evidence exists. These anomalies, whilst considered anthropogenic, could be of any age. If a more precise archaeological interpretation is possible then it will be indicated in the accompanying text.

? Archaeology
The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.

Areas of Increased Magnetic Response
These responses show no visual indications on the ground surface and are considered to have some archaeological potential.

Industrial
Strong magnetic anomalies, that due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.

Natural
These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.

? Natural
These are anomalies that are likely to be natural in origin i.e geological or pedological.

Ridge and Furrow
These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.

Ploughing Trend
These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.

Trend
This is usually an ill-defined, weak or isolated linear anomaly of unknown cause or date.

Areas of Magnetic Disturbance
These responses are commonly found in places where modern ferrous or fired materials are present e.g. brick rubble. They are presumed to be modern.

Ferrous Response
This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes or above ground features such as fencelines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

NB This is by no means an exhaustive list and other categories may be used as necesssary.

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GSB PROSPECTION

PROJECT: 2002/13 Wardentree Lane, Pinchbeck

TITLE: Location Diagram

Sketch Map based on a plan supplied by the client

Detailed Gradiometer Survey

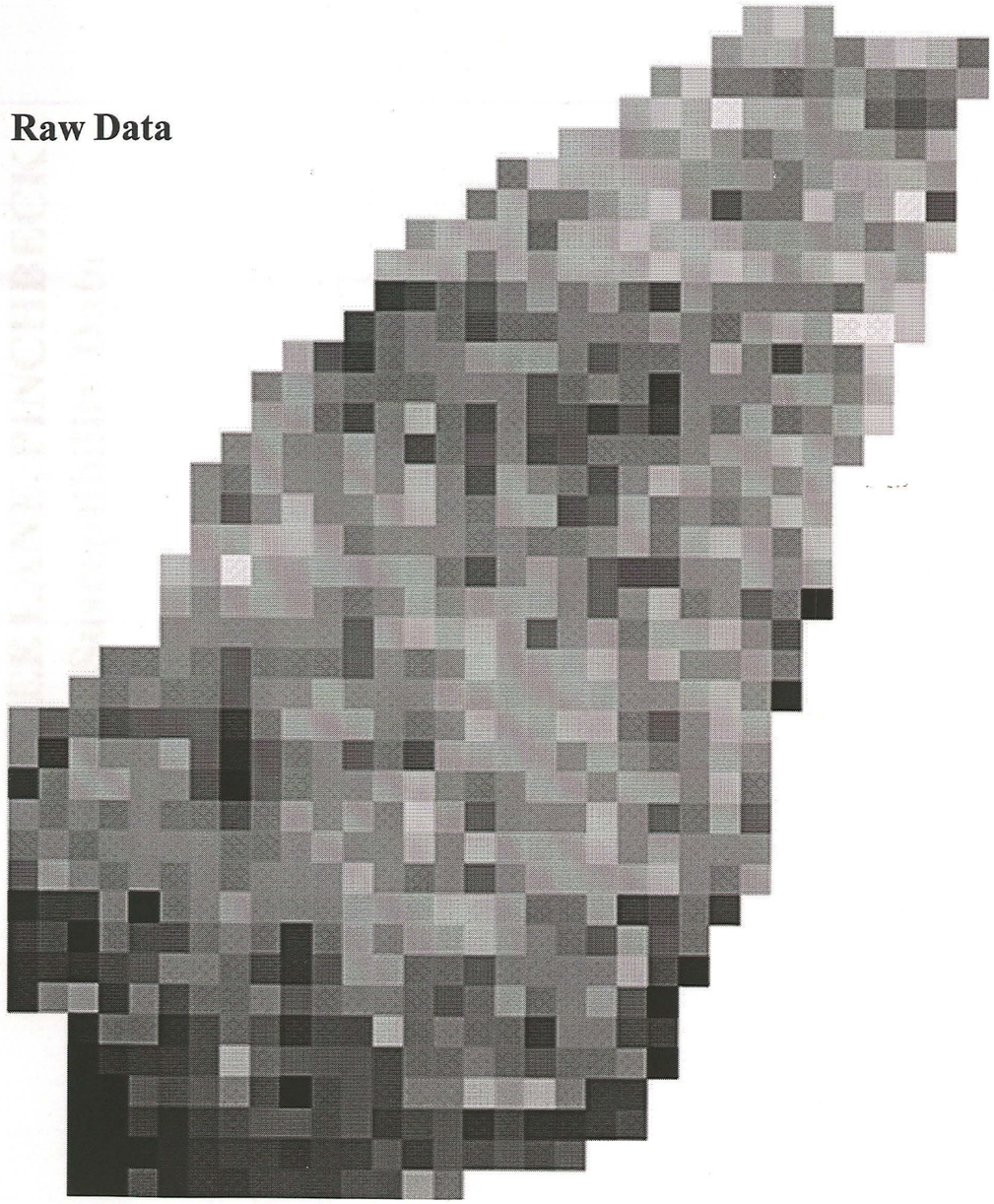
Magnetic Susceptibility Survey

0 metres 100

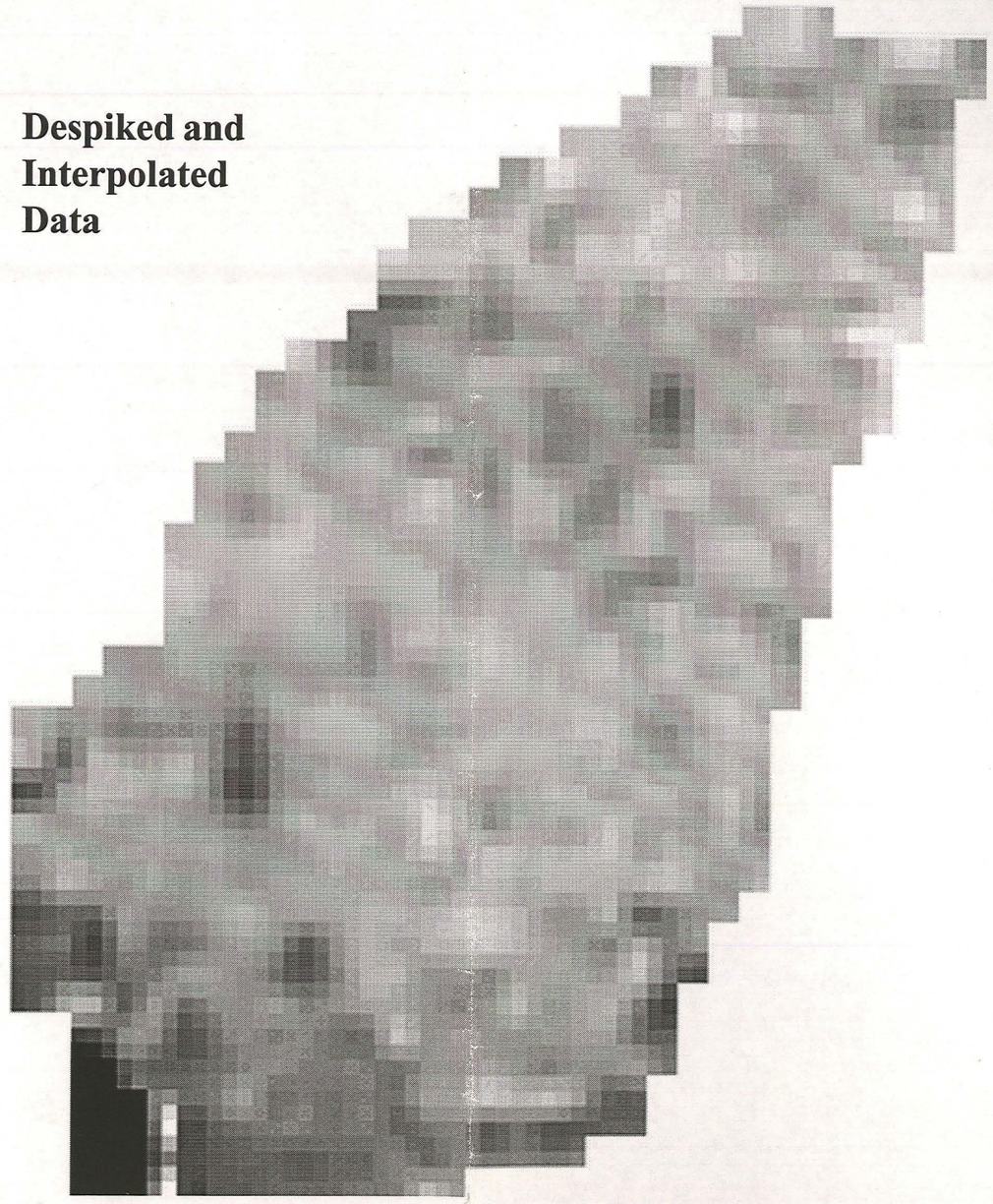
Figure 1

WARDENTREE LANE, PINCHBECK
Magnetic Susceptibility Data

Raw Data



Despiked and Interpolated Data



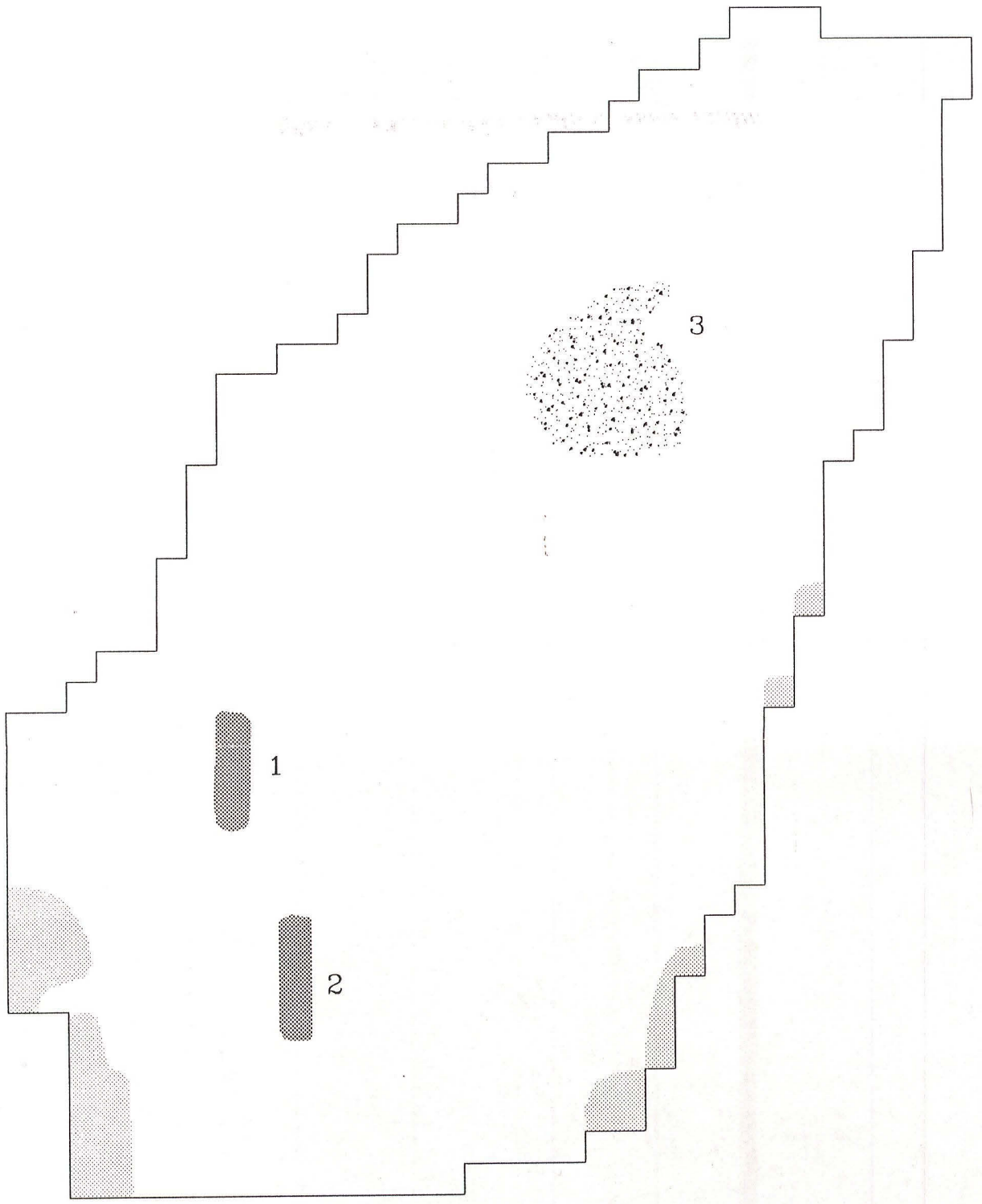
0 80

m

GSB Prospection 2002/13

Figure 2

WARDENTREE LANE, PINCHBECK
Magnetic Susceptibility Data



Elevated Magnetic Susceptibility:
?Archaeology

Elevated Magnetic Susceptibility:
?Modern

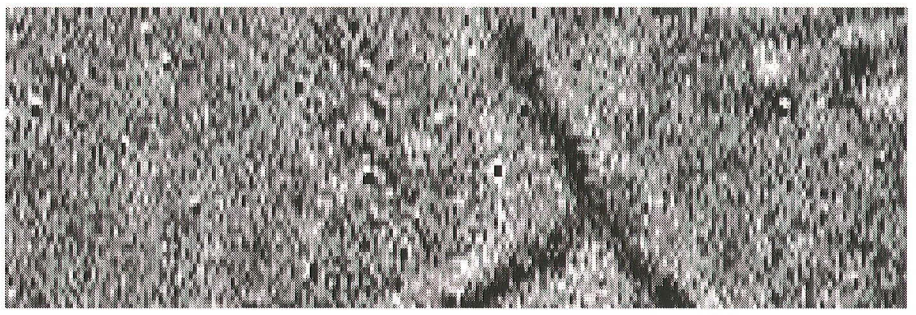
0 80
m

GSB Prospection 2002/13

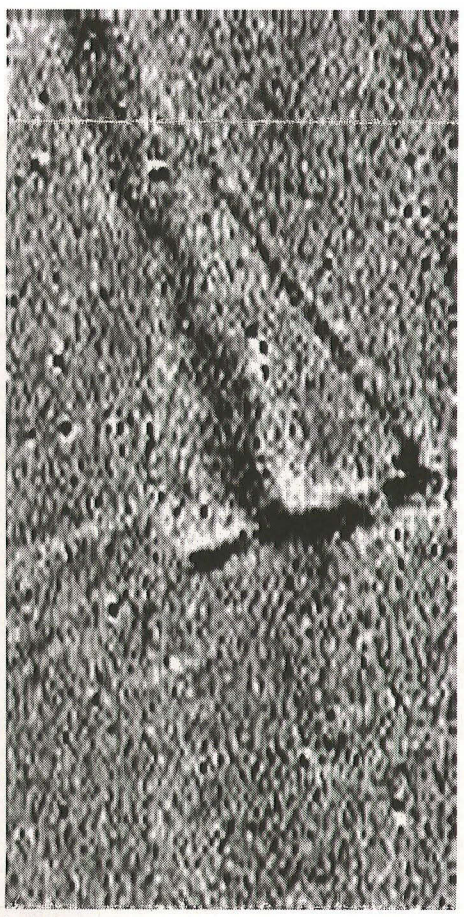
Figure 3

WARDENTREE LANE, PINCHBECK
Gradiometer Data

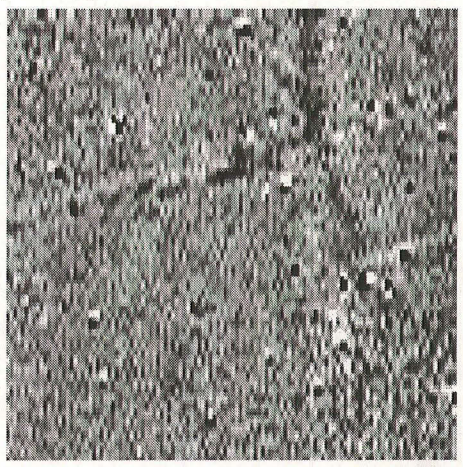
Area A

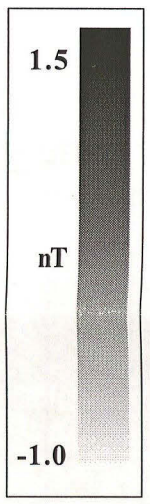


Area B



Area C



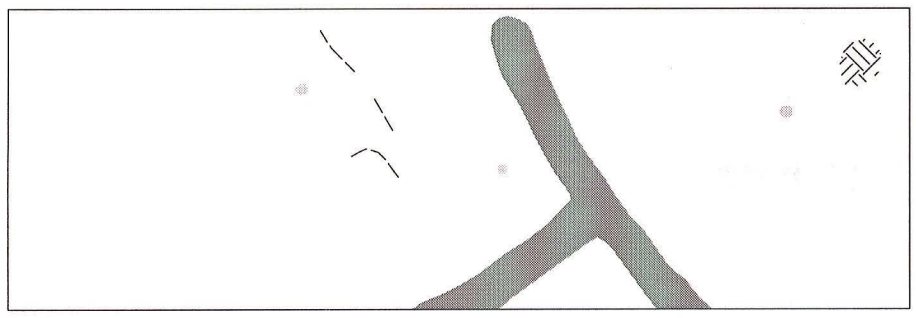


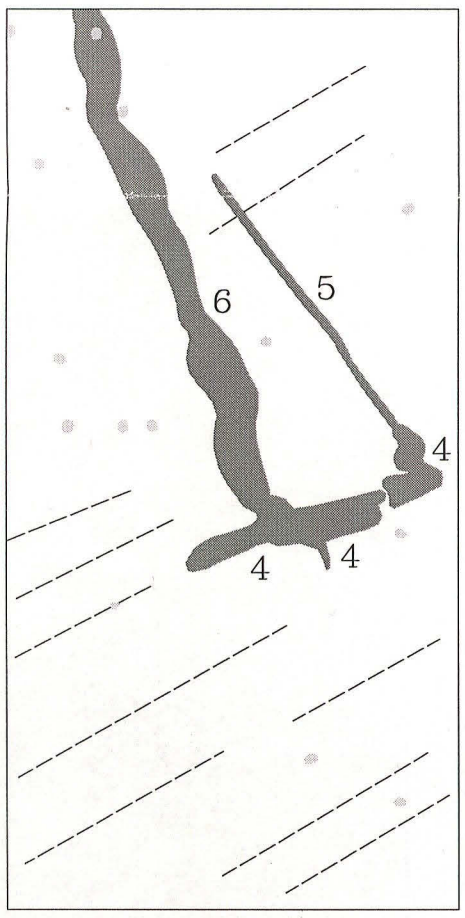
0 40
m

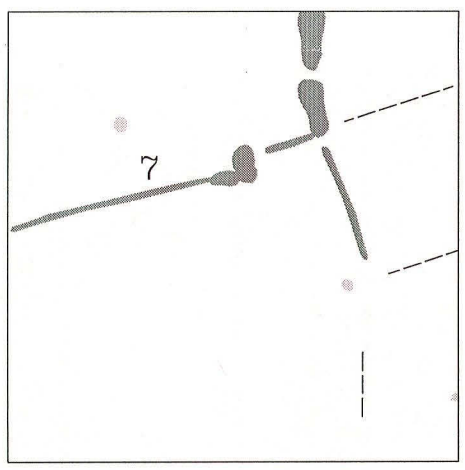
GSB Prospection 2002/13

Figure 4

WARDENTREE LANE, PINCHBECK
Gradiometer Summary Interpretation







?Archaeology

Trend

?Natural

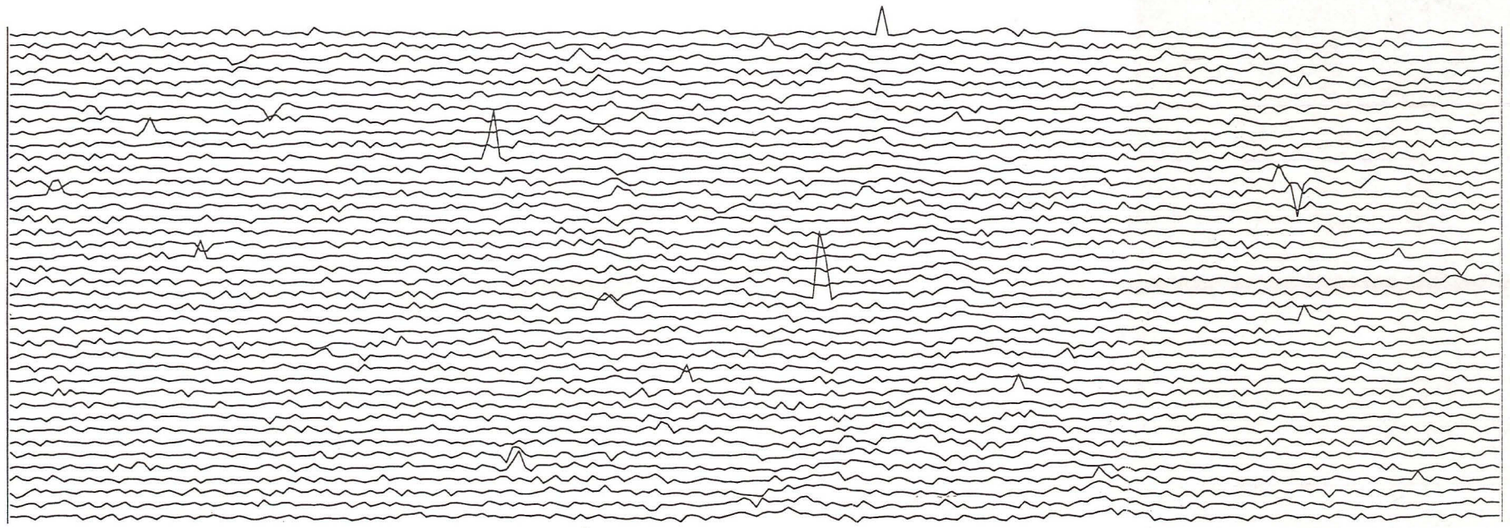
Ferrous

0 m 40

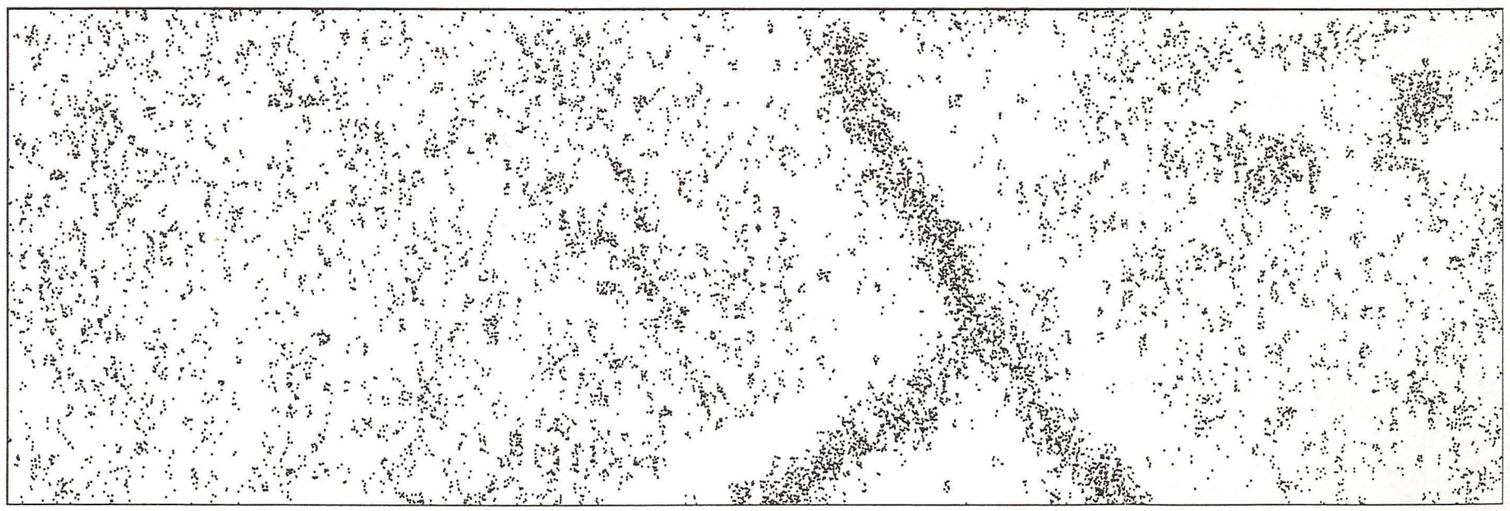
GSB Prospection 2002/13

Figure 5

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area A



15 nT



1.0
nT
0.1

0 m 20

Figure 6

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area A

?Archaeology

?Natural

Trend

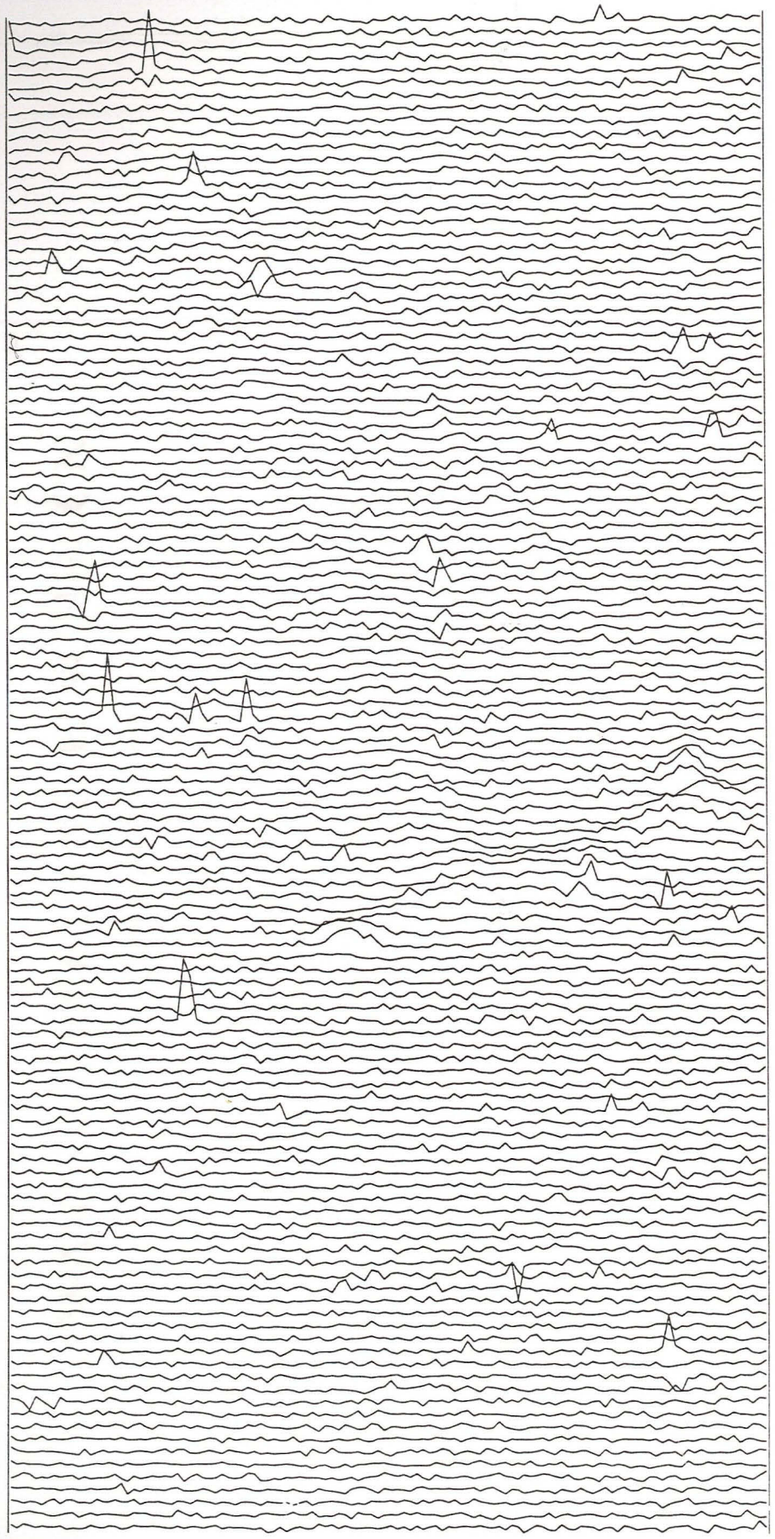
Ferrous Response

0 m 20

GSB Prospection 2002/13

Figure 7

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area B



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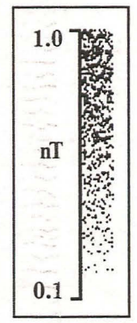

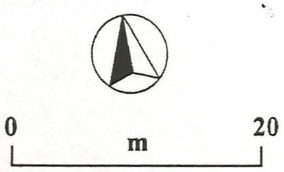

Figure 8

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area B

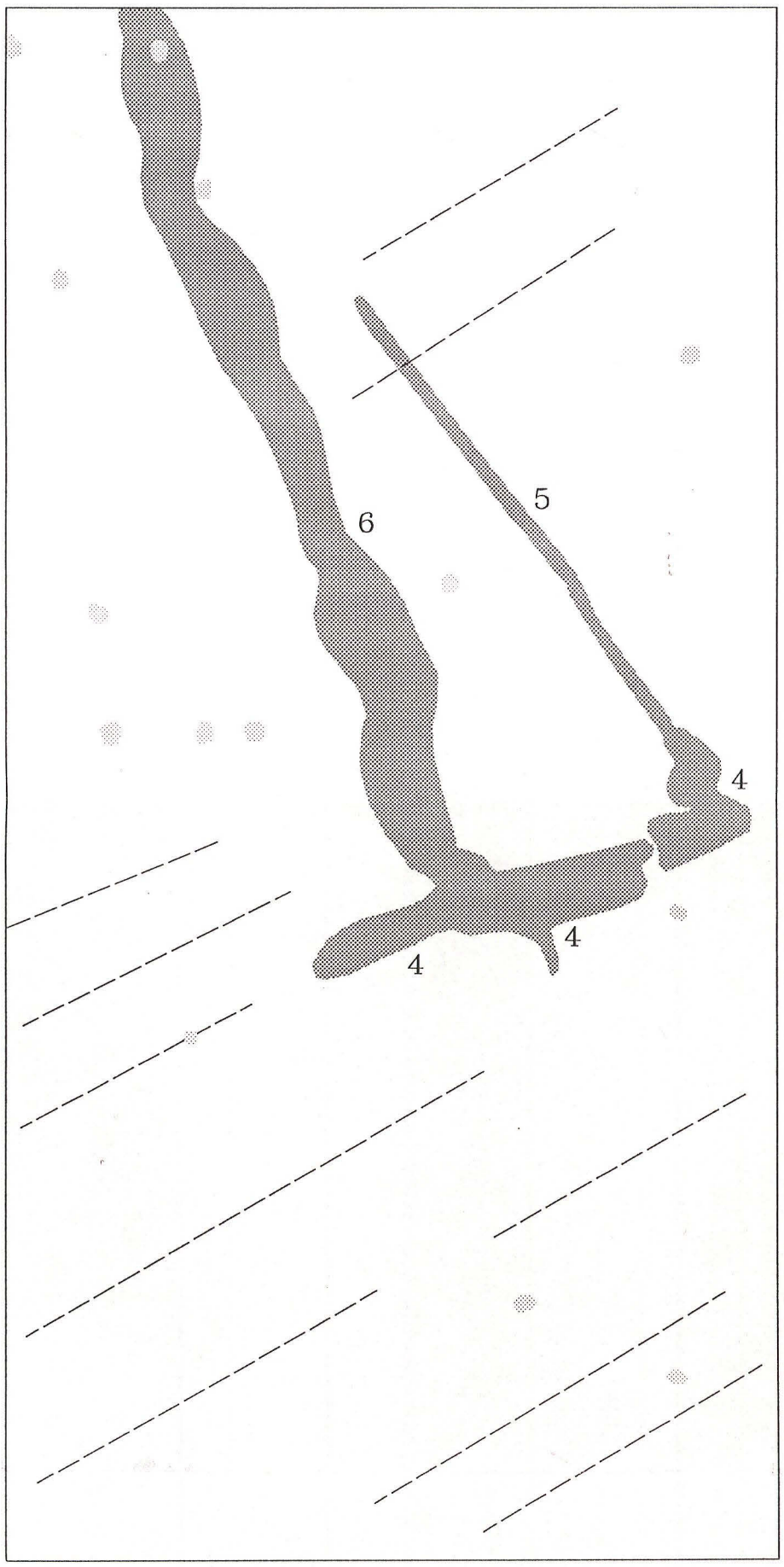

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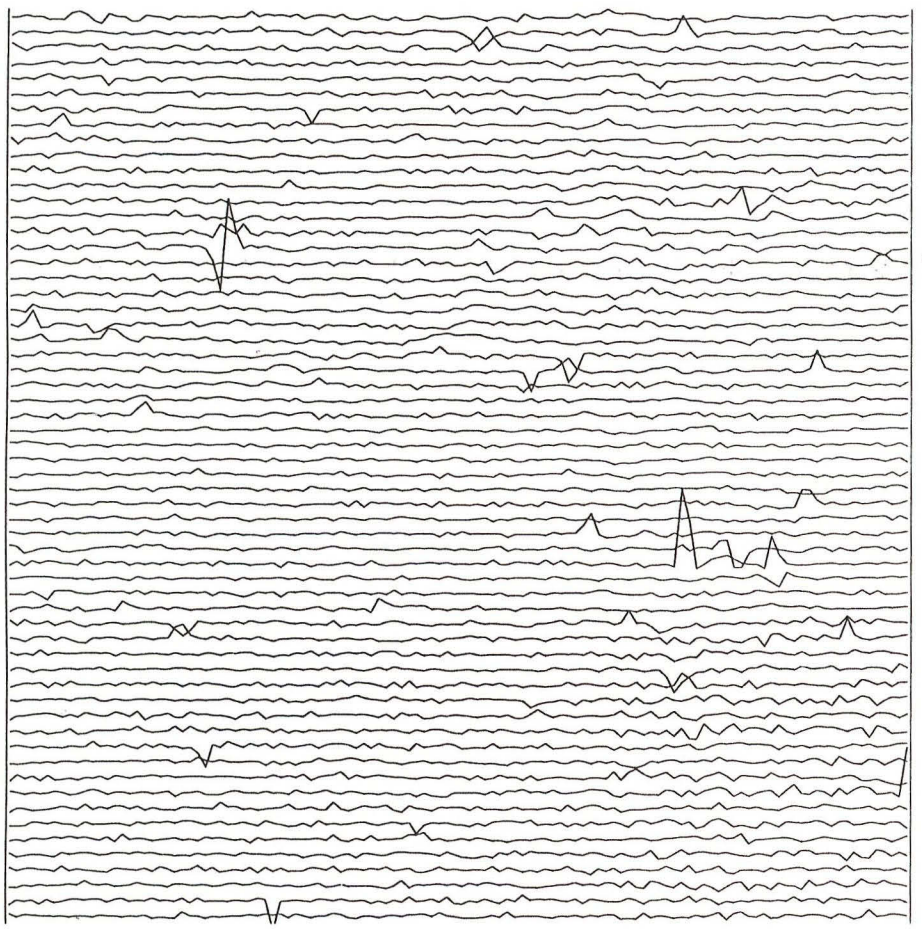
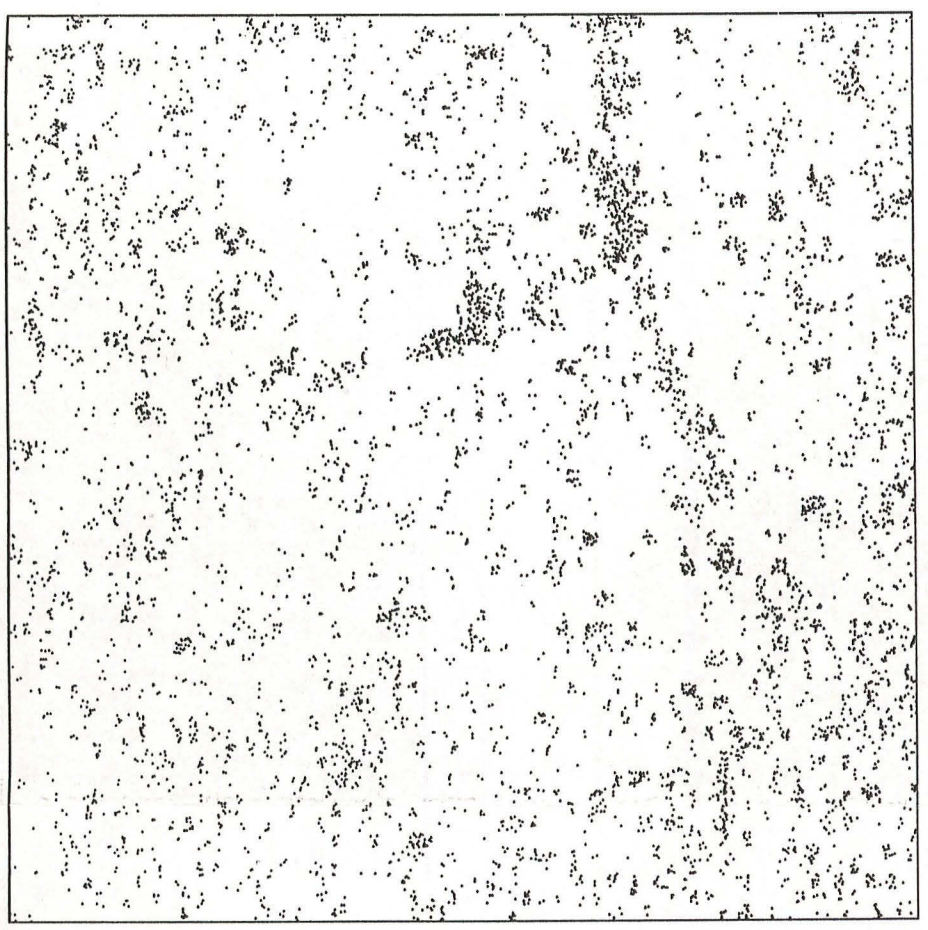
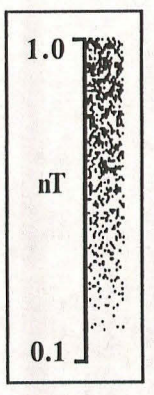
Figure 9

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area C



15 nT



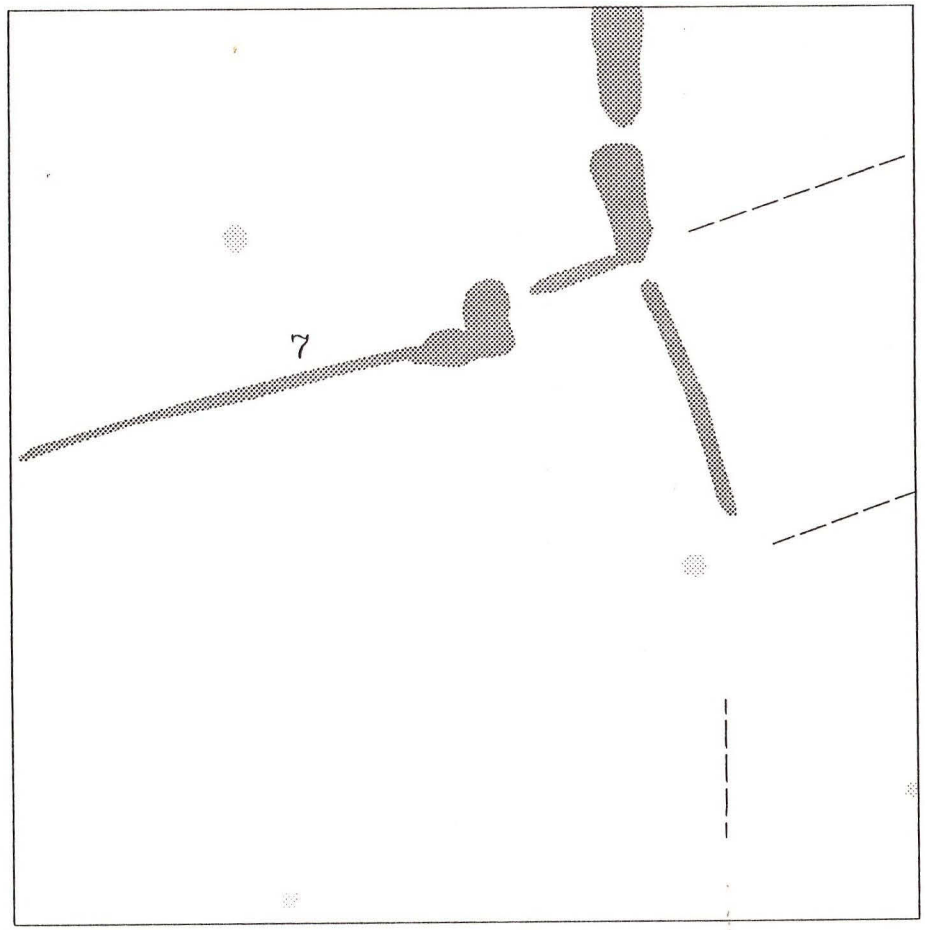


0 m 20

GSB Prospection 2002/13

Figure 10

WARDENTREE LANE, PINCHBECK
Gradiometer Data
Area C



?Archaeology

Trend

Ferrous Response

0 m 20

GSB Prospection 2002/13

Figure 11