RPS Planning, Transport and Environment

INDEX DATA	RPS INFORMATION
Scheme Title A1 Dishforth to North of Leeming ~~Healam Bridge~~	Details Rep :- Geophysical survey Healam Bridge
Road Number A1	Date 1993
Contractor ~~Anthony [illegible] Partners~~ GSB	
County N. Yorks.	
OS Reference SE 38	
Single sided ✓ Double sided A3 14 Colour 1 (A3)	

3.1

REPORT ON GEOPHYSICAL SURVEY

HEALAM BRIDGE

Report number 93/121

Work commissioned by :

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SITE SUMMARY SHEET
93/121 A1 Trunk Road - Healam Bridge
(Dishforth to North of Leeming)

NGR: SE322837

Location, topography and geology

Five areas were surveyed near to Healam Bridge, North Yorkshire. The survey blocks lie adjacent to the present A1 road, near to both the north and south bound carriageways. The topography varies from area to area and will be commented upon in the main part of the text. The solid geology is Triassic and Permian sandstones. The drift geology is glacial sands and gravels.

Archaeology #

Information collated by **Anthony Walker and Partners** (AWP), in the form of a desktop survey, has indicated that the general area around Healam Bridge is of considerable archaeological interest. The present A1 is known to lie over the Roman road of Dere Street, and it is suggested that there is some evidence for a road side settlement of the same date. It is also thought that a Roman fort may also have been positioned in the near vicinity of Healam Bridge.

Recent fieldwalking initiated by AWP, and forming part of a larger assessment of the upgrading of the present A1, of which the geophysical component is part, has found considerable quantities of Romano-British pottery.

Aims of Survey

The aims of the survey, as set out in the specification are:-
1. to provide a detailed plot of any below-ground archaeological features and deposits;
2. to provide information about the nature and possible interpretation of anomalies revealed by the survey;
3. to identify, as far as possible, any areas which are not responsive to geophysical techniques.

Summary of Results *

In all of the five areas that were surveyed as part of this project it is possible to identify anomalies that are likely to be of archaeological interest. Indeed, three of the areas (C1, C2 and C4) have considerable concentrations of archaeological responses. The interpretation of the anomalies is consistent with the suggestion that both settlement and military occupation is present within the proposed road corridor. It is thought that the remains are relatively intact.

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

Information from Anthony Walker and Partners 'A1 Dishforth to North of Leeming Improvements, North Yorkshire. Contract and Specification for Geophysical Survey'.

SURVEY RESULTS
93/121 A1 Trunk Road - Healam Bridge
(Dishforth to North of Leeming)

1. Survey Areas (Figure 1)

1.1 Five survey areas, C1-5, were surveyed for this project. They ranged in size from 0.16 ha to more than 3 ha. The blocks were sub-divided into 20 x 20m grids and the corners of the grids were set out by AWP using an EDM total station optical instrument. Where appropriate the grid followed the surface collection grid previously positioned by AWP.

1.2 The position of the five survey areas can be seen in Figure 1.

2. Display

2.1 The results are displayed as dot density plots, X-Y traces, grey scale images. These display formats are discussed in the *Technical Information* section, at the end of the report.

2.2 Plots showing the complete data sets, together with summary interpretation diagrams, are produced at a scale of 1:2500.

2.3 The data are also displayed at a scale of 1:1000 in the archive section. 1:500 maps have been supplied to AWP.

2.4 Letters in the text in parenthesis refer to anomalies on the 1:1000 interpretations.

3. General Considerations - Complicating factors

3.1 Conditions were generally good at the site. Ground cover was variable and one of the areas, C2, was relatively heavily ploughed.

3.2 A gas pipeline that obliquely crosses Areas C2 and C4 has produced massive magnetic anomalies, obliterating all other responses for some 25m on either side of the pipe. It is certain that if archaeological remains are within this band then they will not be detected magnetically.

4. Results

4.1 Gradiometer Survey Area C1 (Figures C1.1 to C1.2)

4.1.1 This survey block is situated on the eastern side of the present road, and covers some 1.1ha in extent (see Figure 1). The northern part of the survey area contained a young crop, while the other half was bare earth.

4.1.2 The results are particularly convincing in this survey area. There is evidence for a complex of ditches, pits and presumed habitation debris throughout the length of the corridor.

4.1.3 The results are entirely consistent with the interpretation of previous ribbon settlement adjoining the former Dere Street. Of some interest is the fact that although there are anomalies that extend beyond the north eastern edge of the survey, the settlement type anomalies are concentrated near to the present A1. It is likely that the non-settlement anomalies represent field divisions possibly associated with the settlement area.

4.1.4 The settlement responses are largely contained by a large 'boundary' ditch (A) apparently running the whole length of the survey. There is some suggestion that this may terminate before the limits of the survey area. However, this may be misleading: it is possible that the apparent discontinuity of the main ditch may be the product of the strong habitation responses in the central portion of the survey. The reduction in response may be due to less magnetic fills away from the core settlement area.

4.1.5 The results suggest that there is a considerable quantity of archaeological remains present within this survey area. It is further suggested that a focus of the settlement type responses may lie in the central portion of the survey area. A few of the anomalies indicate that the ditches may have particularly enhanced soils, either suggesting considerable occupation in the area or possible 'industrial' activity (B). The fact that these anomalies lie near an edge of the core settlement area may be important.

4.2 Gradiometer Survey Area C2 (Figures C2.1 to C2.7)

4.2.1 This is the largest survey area (3.12ha) within the project and lies on the western side of the A1, opposite Area C1 (see Figure 1). The ground slopes down rather steeply to the west and south and had been ploughed. Recent fieldwalking undertaken by AWP found a considerable quantity of Romano-British pottery in this field.

4.2.2 The results can be neatly divided into three areas; two of these, at either end of the survey can be regarded as containing many archaeological type anomalies, while the results in the central portion of the survey are dominated by the presence of a ferrous pipe.

4.2.3 In the southern part of the survey it is likely that the responses indicate ditches of both settlement and associated field boundaries. The results are entirely consistent with those in Area C1. Again, there are some ditches at the southern edge of the survey that give considerably stronger responses (C and D) than those seen elsewhere in the area (however, c.f. Section 4.1.5).

4.2.4 Turning to the central portion of the survey we find that there is considerable magnetic disturbance due to the presence of a ferrous pipe. Linear anomalies of archaeological type can be seen running into the disturbed region where they are no longer identifiable. It should be stressed that the archaeological features will only have been damaged if they have been cut by the gas pipe.

4.2.5 To the north of the central zone strong evidence has been identified for the presence of a fortified site. The surveyed area of the 'fort' within Area C2 is some 140 x 50m in extent. However, the north eastern side of the fort lies outside the survey and part of the site is presumably destroyed by the present A1. It is anticipated that the ditch may be some 5m in width.

4.2.6 There are a number of regular linear anomalies within, and apparently contained by, the fort ditch. It is presumed that these must be contemporary with at least part of the fort's use. It is interesting to note that internal to the fort ditch is a discrete area that is magnetically quiet (E). It is likely that this signifies the former position of the bank.

4.2.7 Some of the anomalies at the western corner of the fort are unusual as they are on a different alignment to the other internal anomalies. Some of these (e.g. F) extend beyond the fort ditch and this presumably indicates use during a different period.

4.2.8 There are a series of anomalies exterior to the fort. While some of the linears (e.g G and H) may be part of the defences, the interpretation of others is more problematic. Those anomalies at (I) are particularly strong and may represent 'industrial' features.

4.3 Gradiometer Survey Area C3 (Figures C3.1 to C3.3)

4.3.1 This area, 1.56ha in size, lies to the north of Area C2, and is separated from it by Healam Beck. The surface of the earth was bare, being recently drilled.

4.3.2 The results in this area differ significantly in character from those in the previous two survey blocks. The data are very quiet with occasional ferrous peaks throughout. There is a series of weak linear anomalies (J), aligned approximately north-south, that could be due to modern drains.

4.3.3 Despite the general reduction in noise there are some likely archaeological anomalies. These can be divided into two zones: one zone lies near to the present A1, while the second is close to the Beck.

4.3.4 It is thought that the archaeological type anomalies (K) near the present road may represent settlement along the Roman road. However, the survey area containing these anomalies is very small and interpretation is therefore difficult.

4.3.5 There is a series of relatively strong anomalies next to the Beck. Although it is possible that at least some of these are archaeological, it is equally possible that the curved anomaly (L) may be the product of a former course of the Beck. If the latter is true then it is possible that the former course may be of archaeological interest.

4.4 Gradiometer Survey Area C4 (Figures C4.1 to C4.2)

4.4.1 This area lies adjacent to the south bound carriageway of the A1, to the north west of Area C1. At present the land is covered by stubble. Although the original brief for this area was to investigate a corridor 40m wide, it was in part extended to 60m. A total of 1.08ha was surveyed by gradiometry and, within that, 0.84ha was investigated using the resistance technique (see Section 4.6 below).

4.4.2 The most obvious response that can be seen in this data is the massive distortion due to the ferrous pipe.

4.4.3 However, in the area to the north west of the pipe can be seen clear archaeological type anomalies. Two broad linear anomalies, apparently at right angles to one another, can be identified in the data and are thought to be part of the Roman fortifications. There is a clear decrease in the noise between the 'interior' and the 'exterior' of the fort, which supports this argument.

4.4.4 The pipeline referred to above (Section 4.4.2) has confused the results at the supposed eastern corner of the fort.

4.4.5 Of some concern is the lack of evidence for the northern corner of the fort. While there is no obvious reason for this, it seems logical that the limit of the site (M) should lie as indicated on the interpretation diagram.

4.5 Gradiometer Survey Area C5 (Figure C5.1)

4.5.1 An area of 0.16ha was surveyed, adjacent to Healam Bridge and directly to the northwest of Area C4.

4.5.2 There is significant disturbance within this block due to ferrous material and the presence of a track.

4.5.3 Despite the noise levels at least two possible lengths of ditch can be seen in the data.

4.6 Resistance Survey Area C4 (Figures C4.3 to C4.4)

4.6.1 After consideration of the magnetic data, the main part of Area C4 (approximately 0.9ha) was re-surveyed using the resistance technique. This work had three aims: *1)* to confirm the existence of the main fort ditch and in particular the northeastern corner - feature (M) noted in Section 4.4.5 above; *2)* to identify, if possible, any archaeological anomalies within the area of magnetic disturbance caused by the pipe, and *3)* to try and locate any evidence of structural detail within the fort.

4.6.2 The resistance survey has been of only limited success. The range of values obtained was broad and this has made it difficult to identify archaeological anomalies with any great degree of certainty.

4.6.3 Nonetheless, two low resistance anomalies (N and O) are interpreted as lengths of the main fort ditch. Anomaly (N) is more clearly defined and would seem to confirm the projected northeastern limit of the fort. Anomaly (O) is more ephemeral, but its position matches fairly closely with that of the corresponding magnetic anomaly and this supports its interpretation as a ditch.

4.6.4 The pipe itself is visible as a faint low resistance response but no anomalies of archaeological interest are noted in the immediate vicinity.

4.6.5 A few high resistance anomalies are visible in the data. Those at (P) lie within the fort and may, therefore, represent building rubble. However, they lack any coherent pattern and are similar in strength and form to an anomaly *outside* the fort in the southeastern corner of the survey. Thus it seems possible that all the high resistance responses reflect localised variations in ground moisture and have a non-archaeological origin.

5. Conclusions

5.1 Gradiometry has identified potential archaeology in all five areas. Although the areas are divided by fencelines and the present A1 carriageway, it is thought that many of the magnetic anomalies can be regarded as part of the same complex. The interpretation of the anomalies is consistent with the hypothesis that the area of interest contains a roadside settlement and a fort, both dated to the Romano-British period.

5.2 Several anomalies suggest that there may be areas of industrial activity within the survey blocks.

5.3 Although it is not possible to date the geophysical anomalies, the fact that anomalies are found in different alignments suggest that several phases of activity are likely to be present.

5.4 The resistance survey has confirmed the existence of the main fort ditch but has provided little additional information about possible structures within the fort.

Project Co-ordinator: Dr C Gaffney
Project Assistants: J Gater, N Nemcek, C Stephens and A Shields

16th November 1993
Geophysical Surveys of Bradford

TECHNICAL INFORMATION

The following is a description of the equipment and display formats used in **GEOPHYSICAL SURVEYS OF BRADFORD** 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 **GEOPHYSICAL SURVEYS OF BRADFORD**.

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.

Magnetic readings are logged at 0.5m intervals along one axis in 1m traverses giving 800 readings per 20m x 20m grid, unless otherwise stated. Resistance readings are logged at 1m intervals giving 400 readings per 20m x 20m grid. The data are then transferred to portable computers and stored on 3.5" floppy discs. Field plots are produced on a portable Hewlett Packard Thinkjet. Further processing is carried out back at base on computers linked to appropriate printers and plotters.

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.

(b) Resistance Meter - Geoscan RM4 or RM15

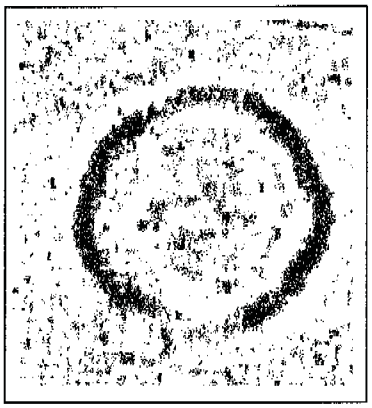
This measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. 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".

(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. The instrument employed for measuring this phenomenon is either a field coil or a laboratory based susceptibility bridge. For the latter 50g soil samples are collected in the field.

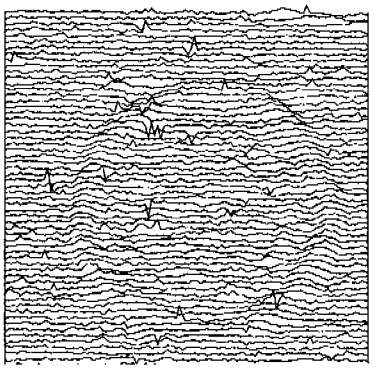
Display Options

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

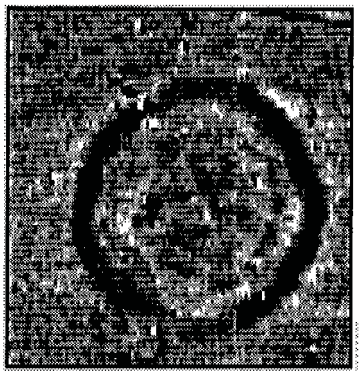
In this display, minimum and maximum cut-off levels are chosen. Any value that is below the minimum cut-off value will appear white, whilst any value above the maximum cut-off value will appear black. Any value that lies between these two cut-off levels will have a specified number of dots depending on the relative position between the two levels. The focus of the display may be changed using different levels and a contrast factor (C.F.). Usually the C.F. = 1, producing a linear scale between the cut-off levels. Assessing a lower than normal reading involves the use of an inverse plot, This plot simply 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. This display is much favoured for producing plans of sites, where positioning of the anomalies and features is important.



(b) X-Y 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. 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 indiviual anomalies. Results are produced on a flatbed plotter.

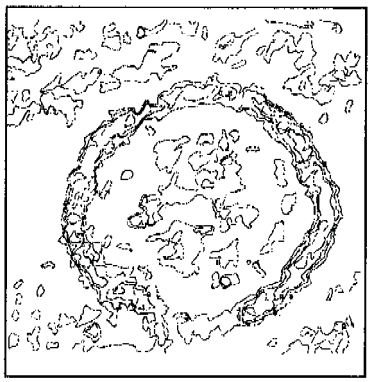
Display Options cont'd



(c) Grey-Scale

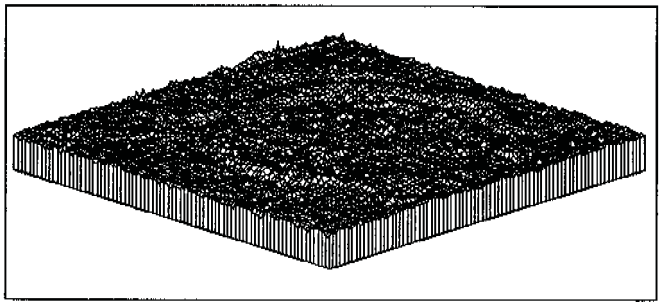
This format divides a given range of readings into a set number of classes. These classes have a predefined arrangement of dots or shade of grey, the intensity increasing with value. This gives an appearance of a toned or grey scale.

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, grey-scales tend to be more informative.



(d) Contour

This display format is commonly used in cartographic displays. Data points of equal value are joined by a contour line. Closely packed contours indicate a sharp gradient. The contours therefore highlight an anomalous region. The range of contours and contour interval are selected manually and the display is then generated on the computer screen or plotted directly on a flat bed plotter / inkjet printer.



(e) 3-D Mesh

This display joins the data values in both the X and Y axis. The display may be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white. A hidden line option is occasionally used (see (b) above).

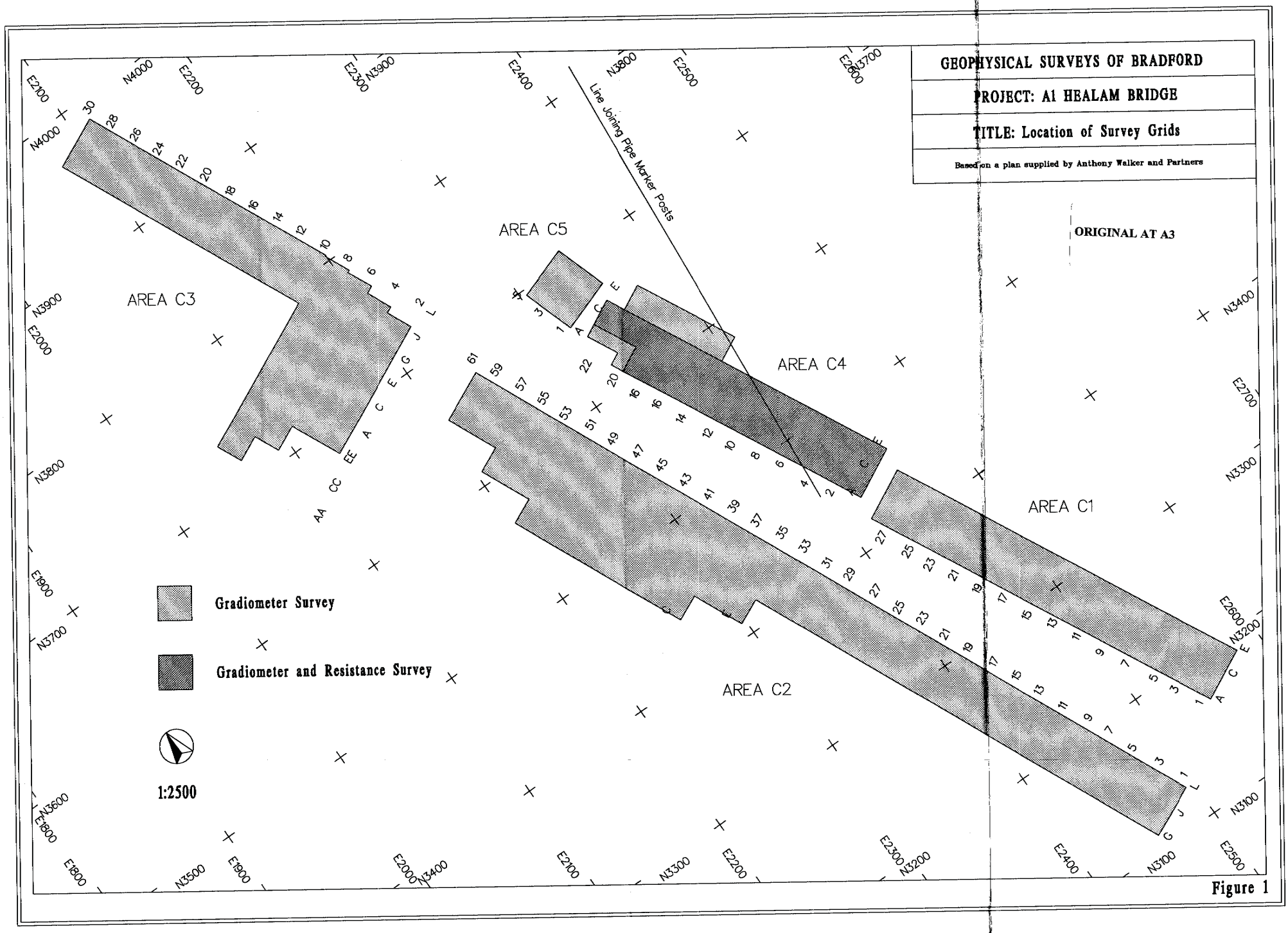

GEOPHYSICAL SURVEYS OF BRADFORD
PROJECT: A1 HEALAM BRIDGE
TITLE: Location of Survey Grids
Based on a plan supplied by Anthony Walker and Partners
ORIGINAL AT A3
Line Joining Pipe Marker Posts
AREA C1
AREA C2
AREA C3
AREA C4
AREA C5
Gradiometer Survey
Gradiometer and Resistance Survey
1:2500

Figure 1

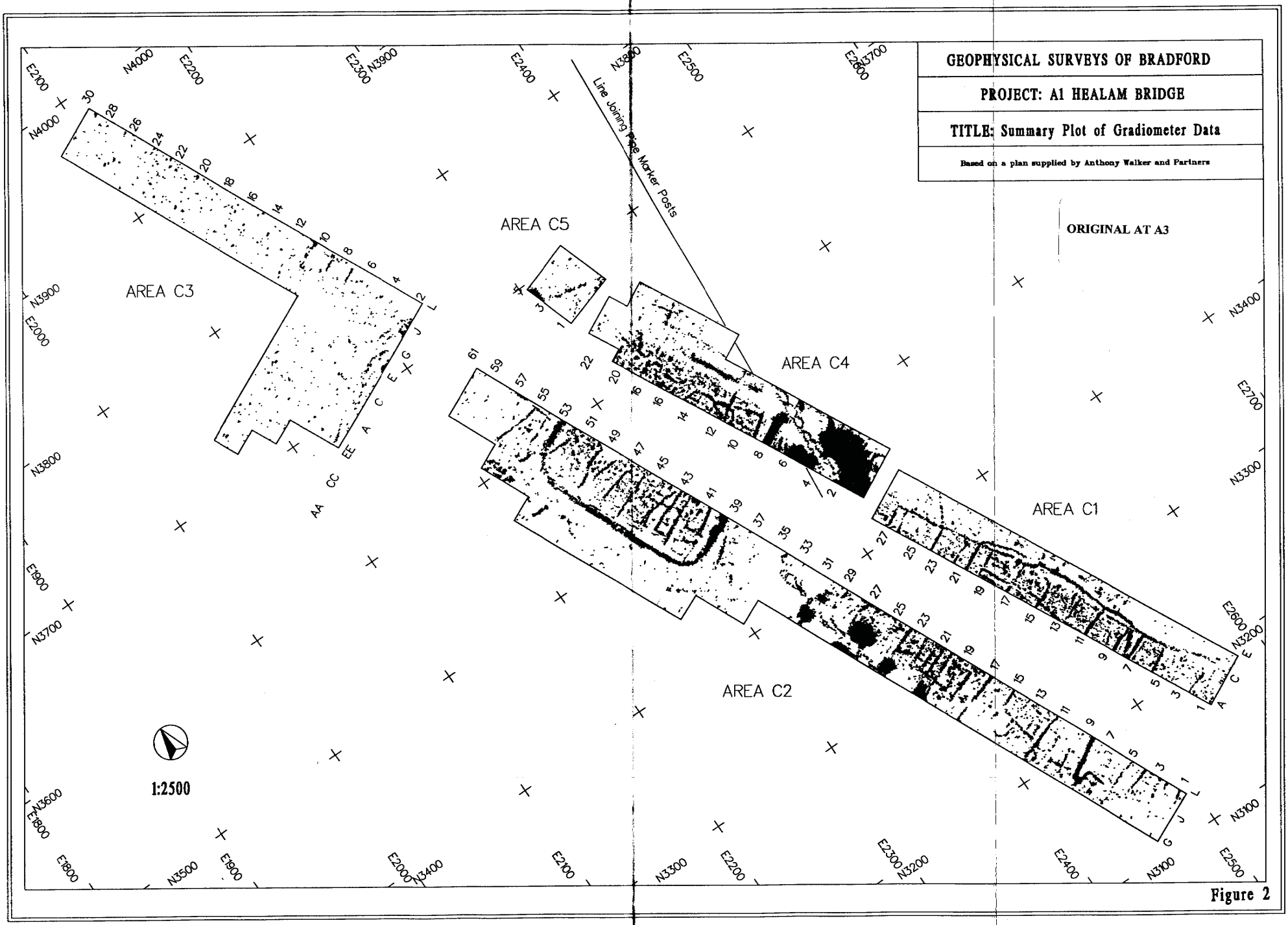
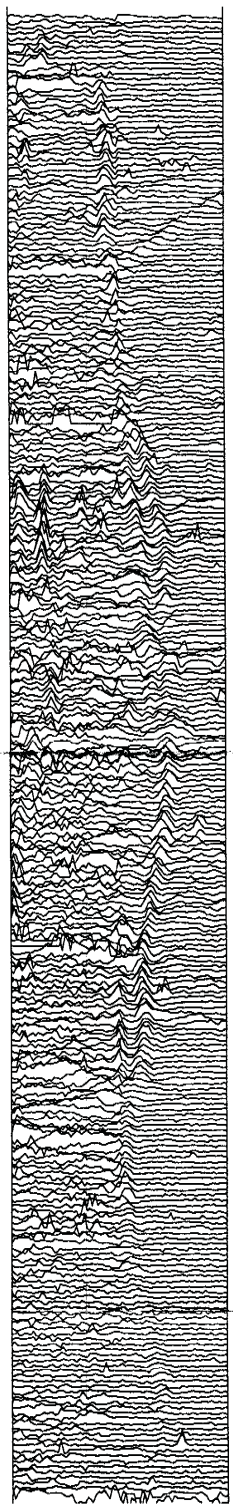

GEOPHYSICAL SURVEYS OF BRADFORD
PROJECT: A1 HEALAM BRIDGE
TITLE: Summary Plot of Gradiometer Data
Based on a plan supplied by Anthony Walker and Partners
ORIGINAL AT A3
AREA C1
AREA C2
AREA C3
AREA C4
AREA C5
Line Joining Pipe Marker Posts
1:2500

Figure 2

A1
HEALAM BRIDGE
Area C1



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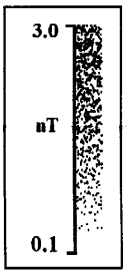


0 m 40

ORIGINAL AT A3

Figure C1.1

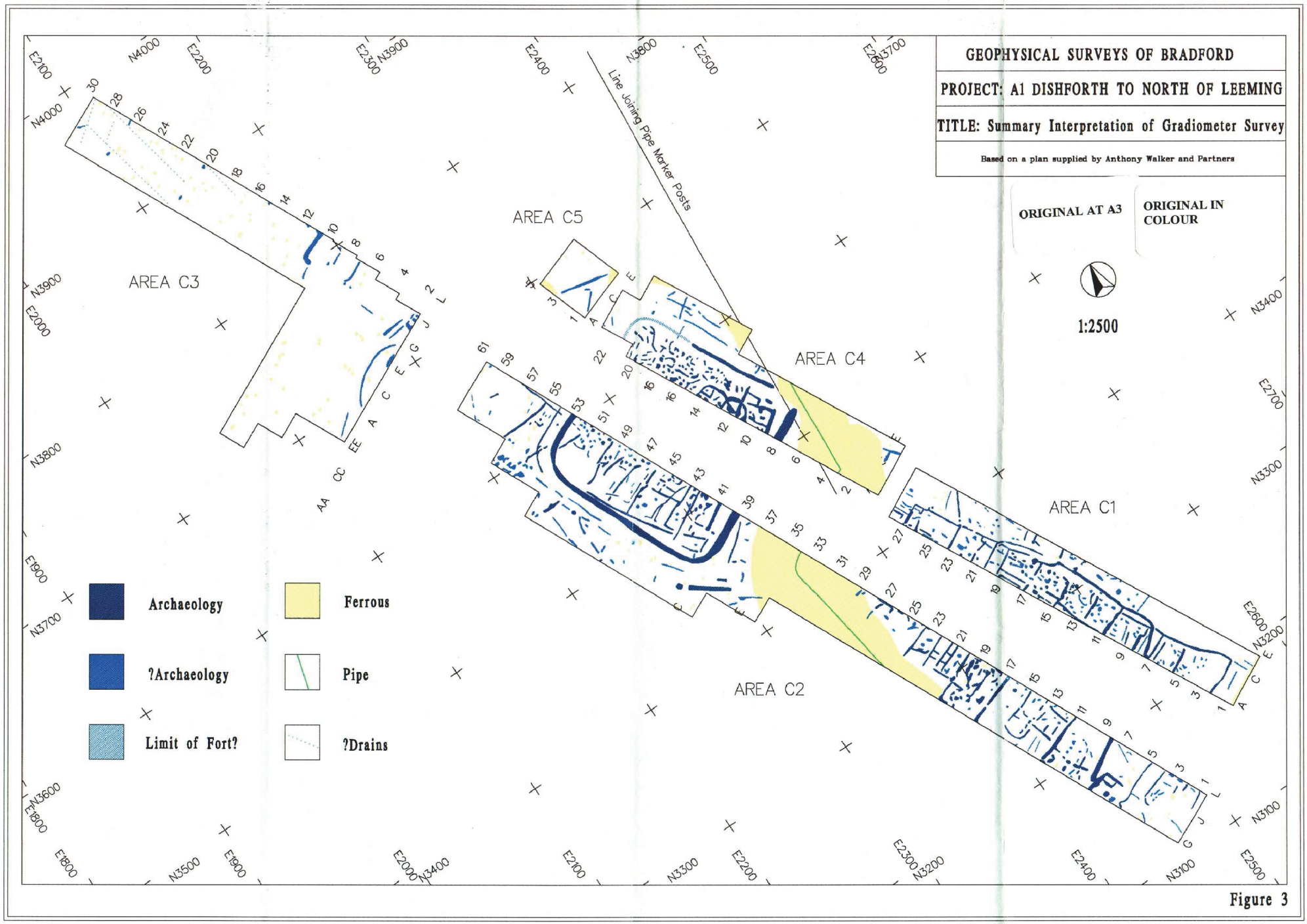
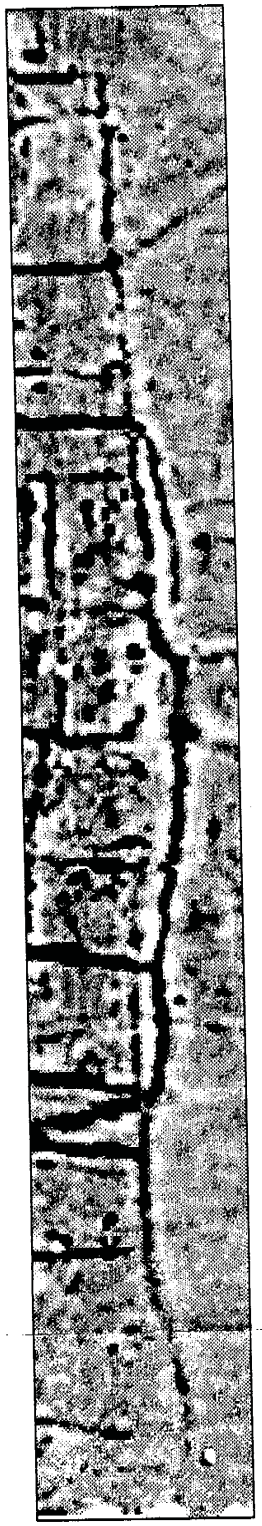
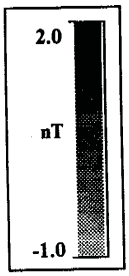

GEOPHYSICAL SURVEYS OF BRADFORD
PROJECT: A1 DISHFORTH TO NORTH OF LEEMING
TITLE: Summary Interpretation of Gradiometer Survey
Based on a plan supplied by Anthony Walker and Partners
ORIGINAL AT A3
ORIGINAL IN COLOUR
1:2500
AREA C1
AREA C2
AREA C3
AREA C4
AREA C5
Line Joining Pipe Marker Posts
Archaeology
?Archaeology
Limit of Fort?
Ferrous
Pipe
?Drains

Figure 3

A1
HEALAM BRIDGE
Area C1





Archaeology

?Archaeology

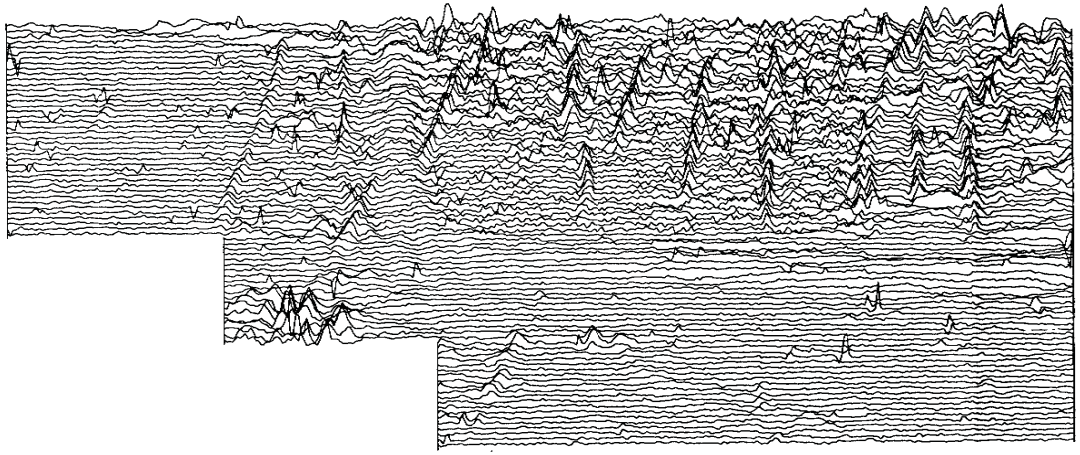
Ferrous

0 m 40

ORIGINAL AT A3

Figure C1.2

A1
HEALAM BRIDGE
Area C2(A)



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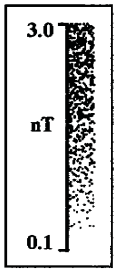
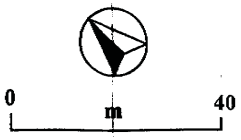
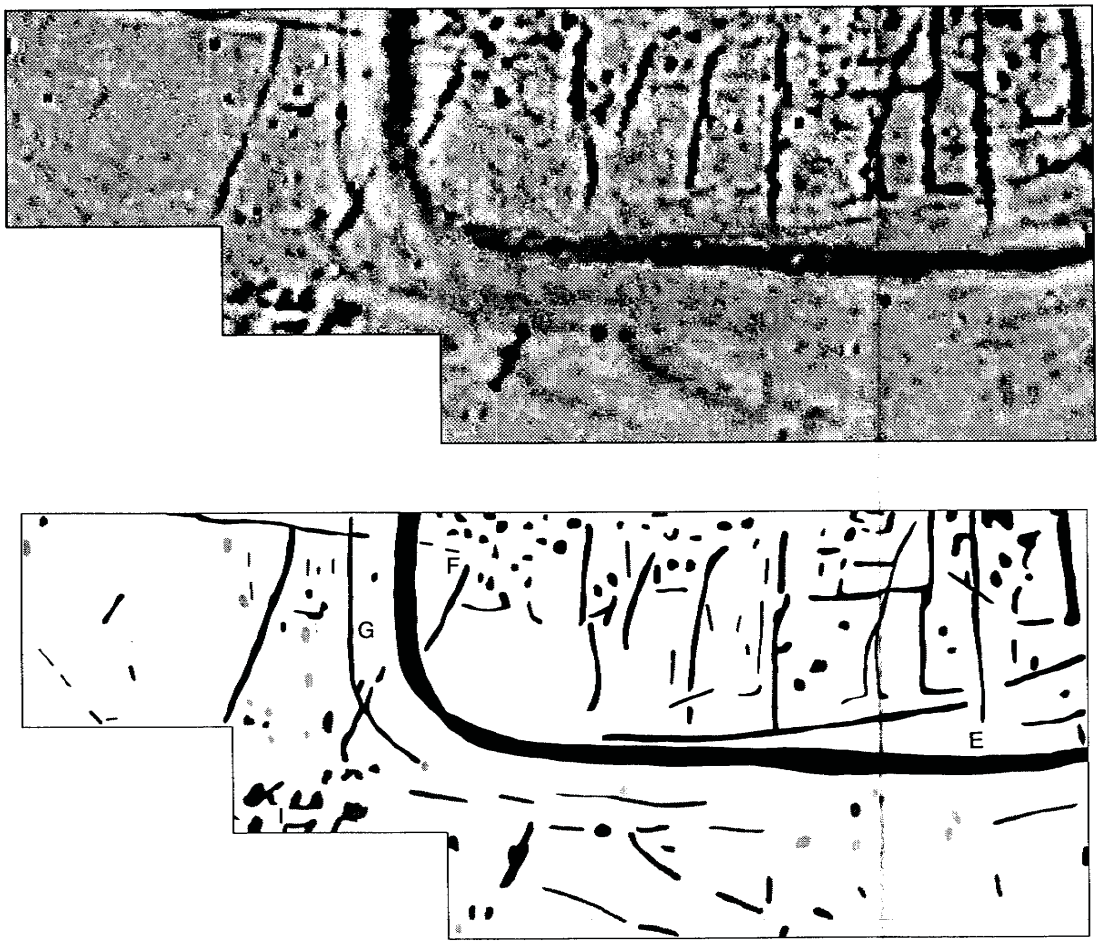


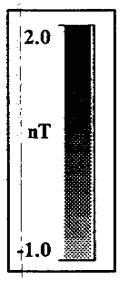


ORIGINAL AT A3

Figure C2.1

A1
HEALAM BRIDGE
Area C2(A)

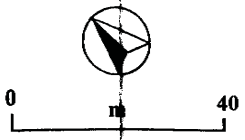




Archaeology

?Archaeology

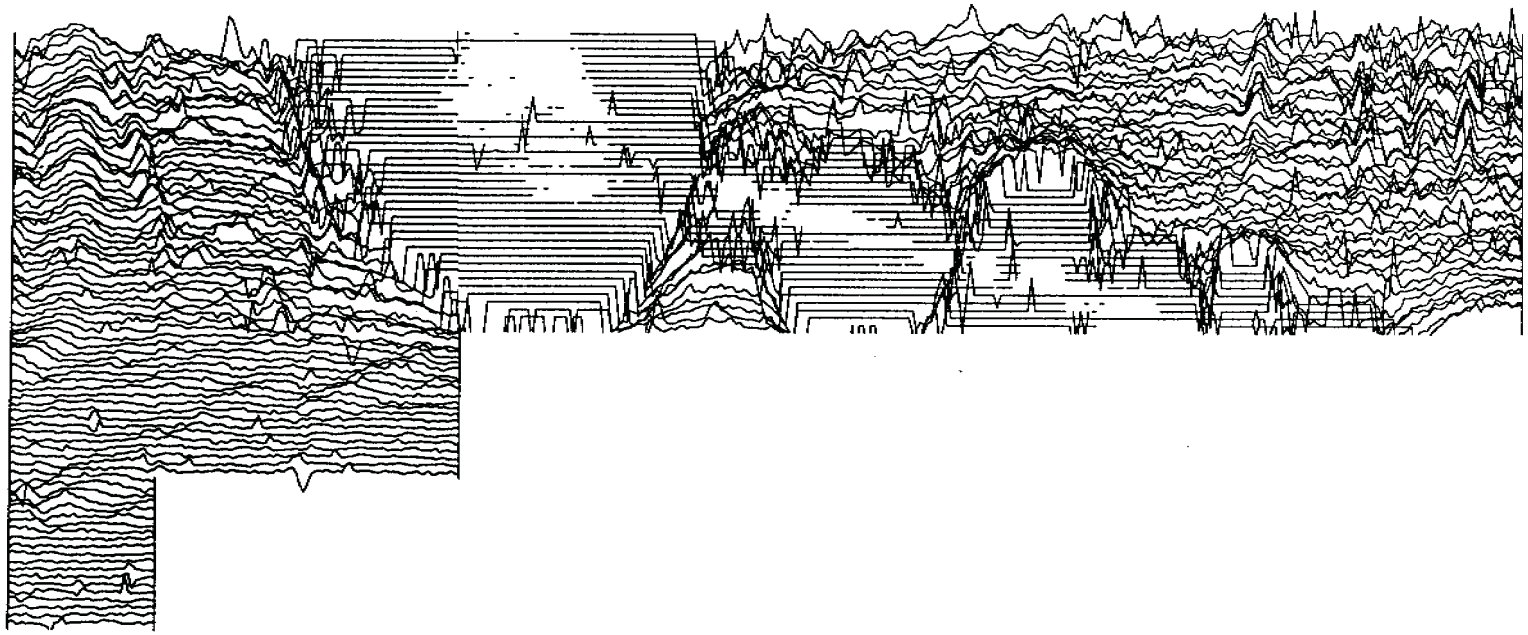
Ferrous



ORIGINAL AT A3

Figure C2.2

A1
HEALAM BRIDGE
Area C2(B)

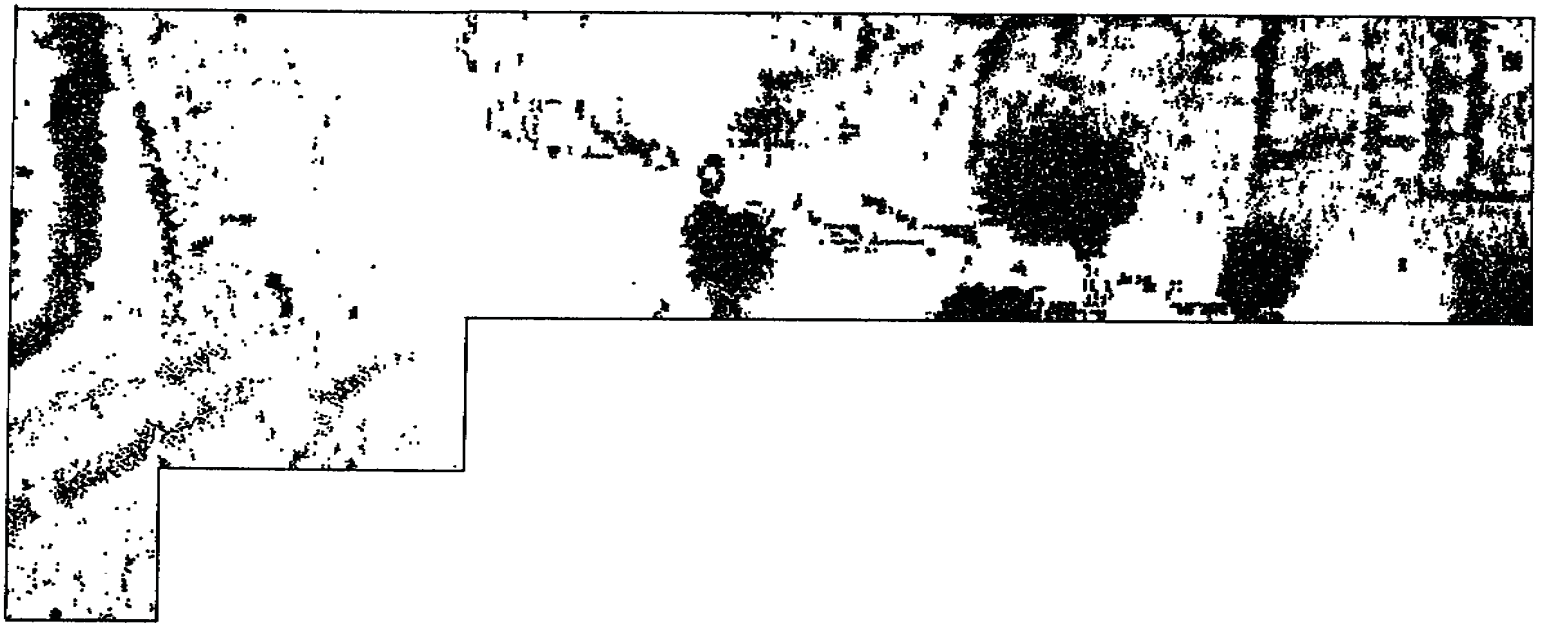


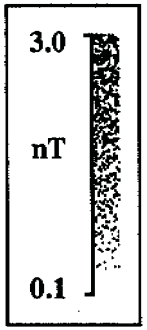
30 nT

0 m 40

Figure C2.3

A1
HEALAM BRIDGE
Area C2(B)





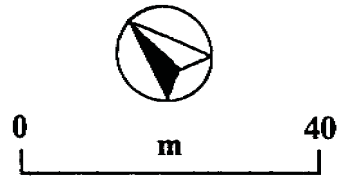
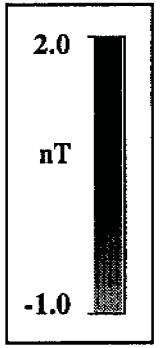


Figure C2.4

A1
HEALAM BRIDGE
Area C2(B)



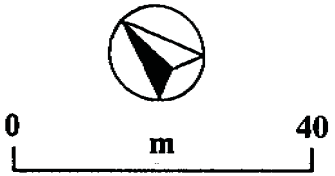
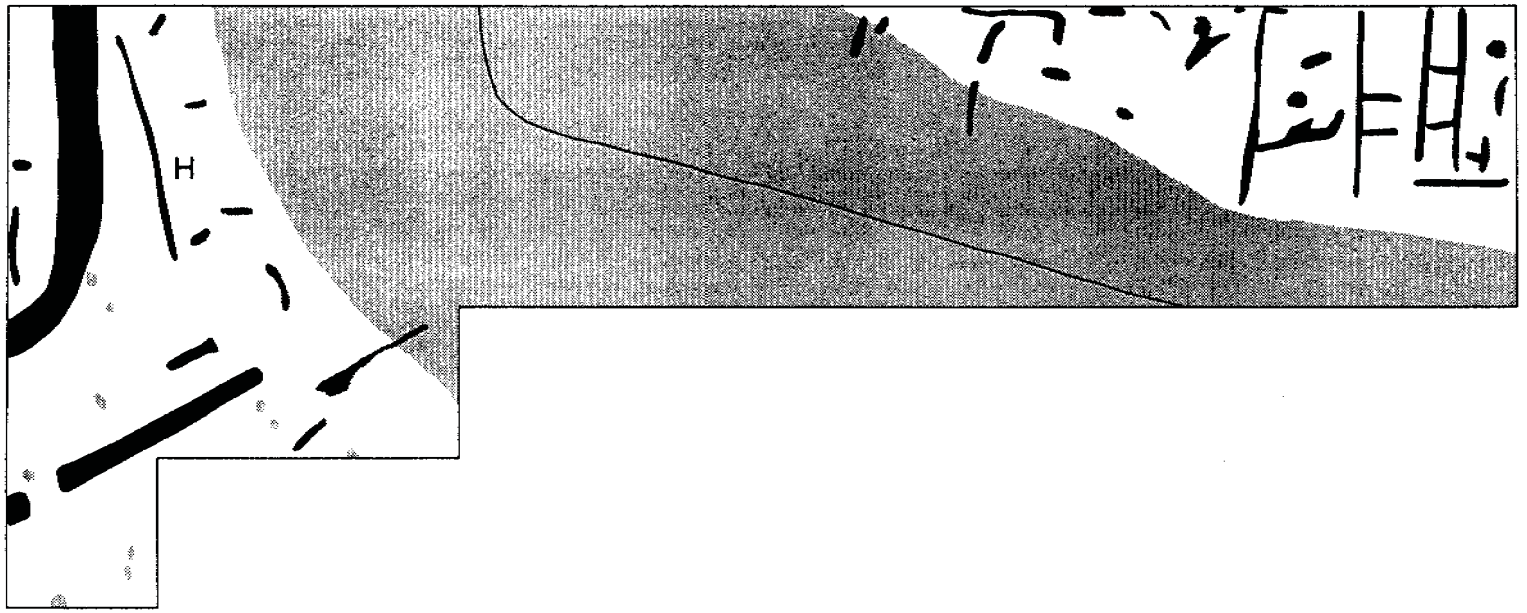


Figure C2.5

A1
HEALAM BRIDGE
Area C2(B)



Archaeology

?Archaeology

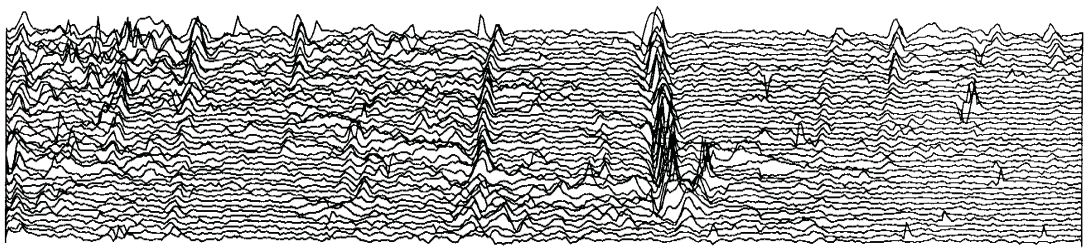
Ferrous

Pipe

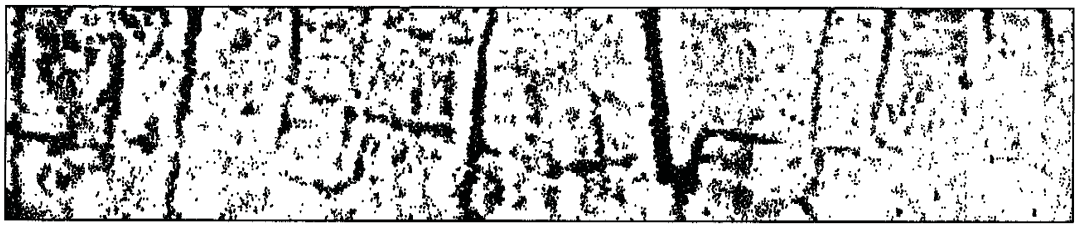
0 m 40

Figure C2.6

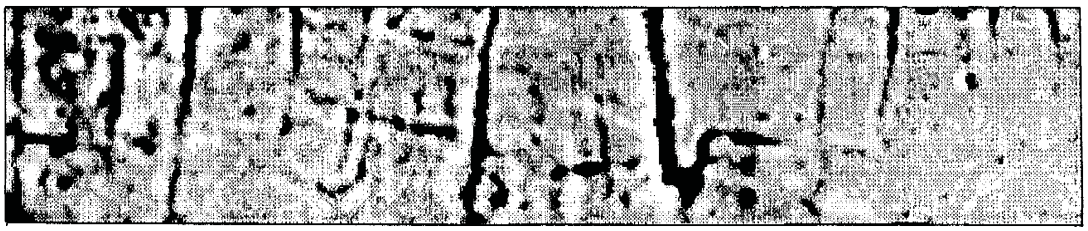
A1
HEALAM BRIDGE
Area C2(C)



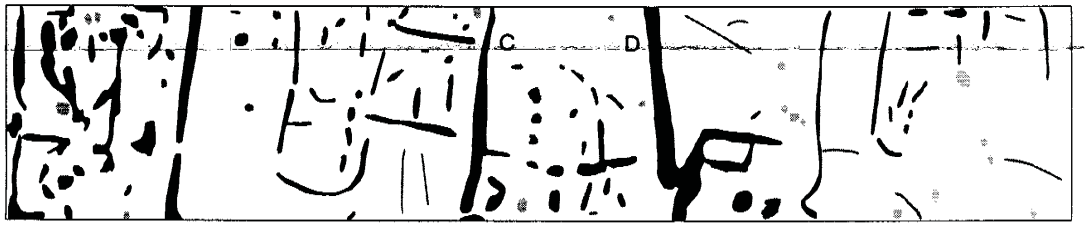
30 nT



3.0
nT
0.1



2.0
nT
-1.0



Archaeology

?Archaeology

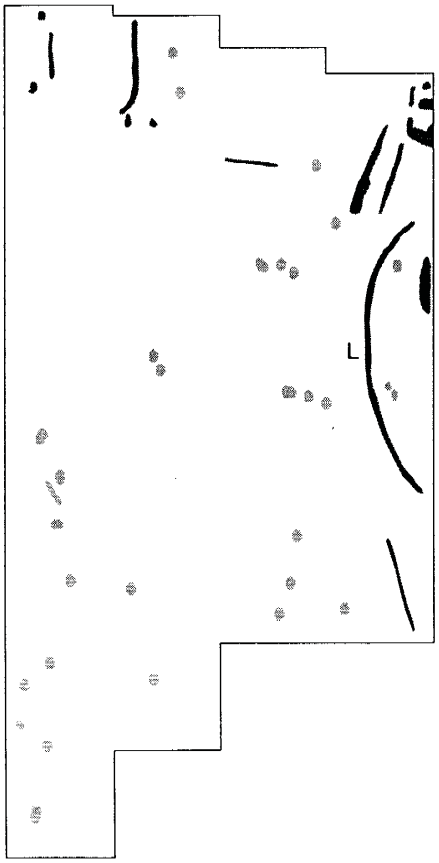
Ferrous

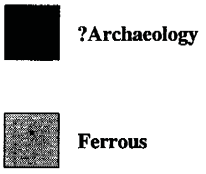
0 m 40

ORIGINAL AT A3

Figure C2.7

A1
HEALAM BRIDGE
Area C3(B)





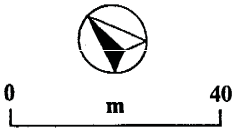
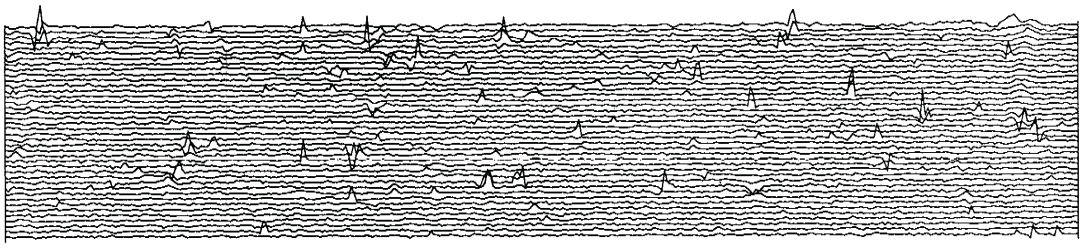
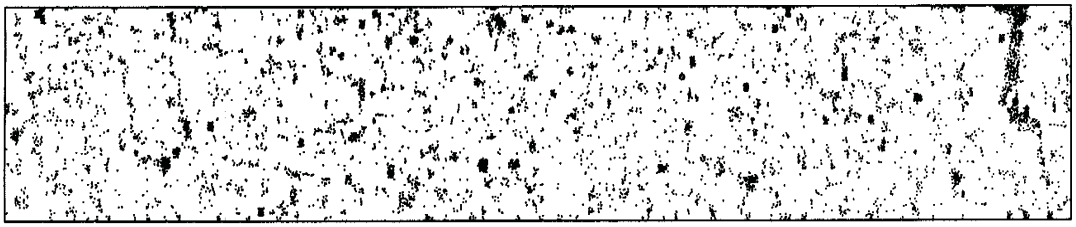


Figure C3.3

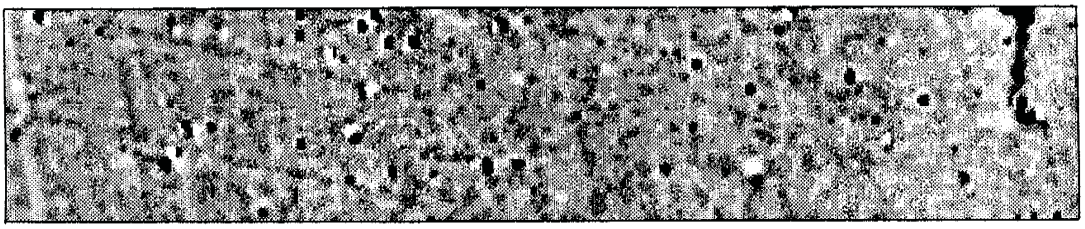
A1
HEALAM BRIDGE
Area C3(A)



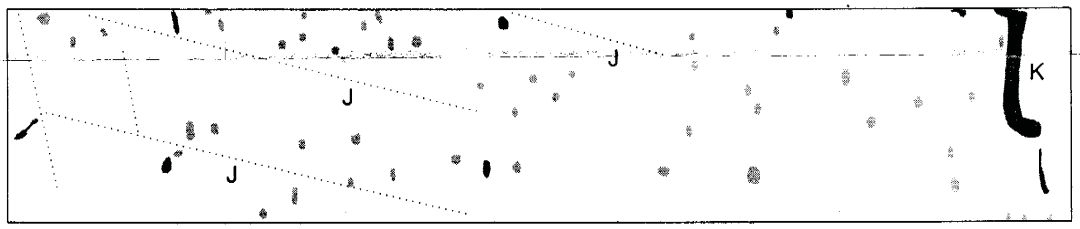
30 nT



3.0
nT
0.1



2.0
nT
-1.0



?Archaeology

Ferrous

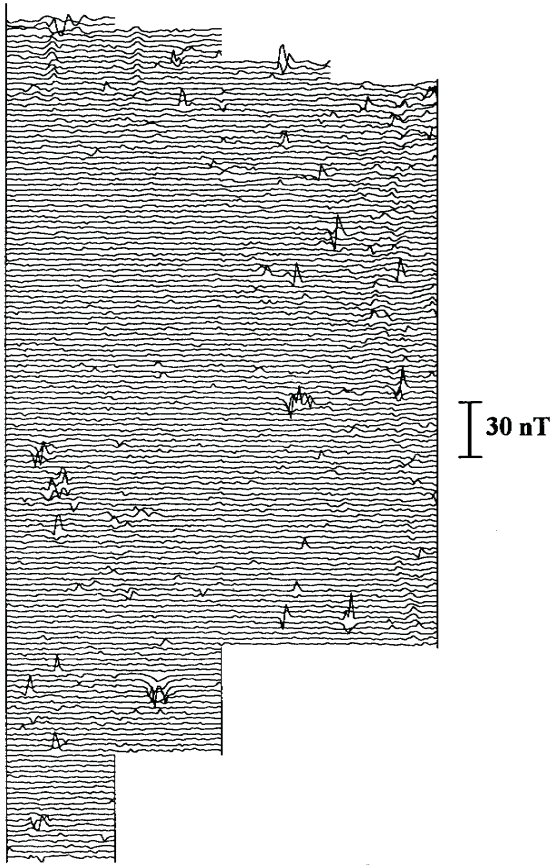
Drains

0 m 40

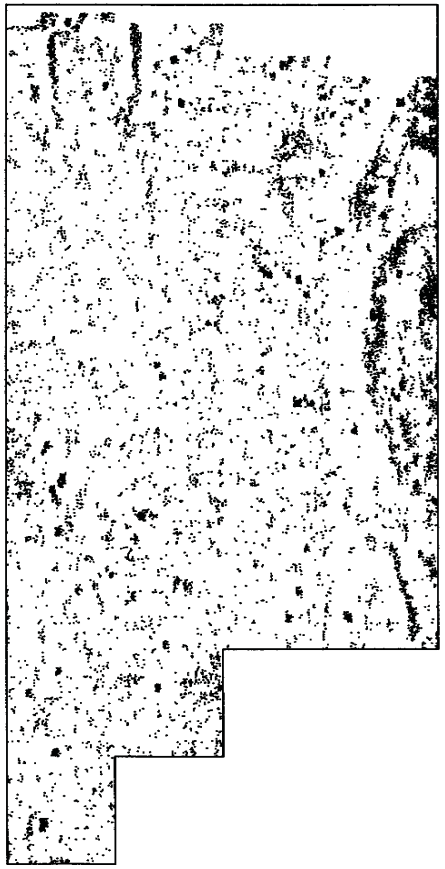
ORIGINAL AT A3

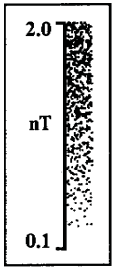
Figure C3.1

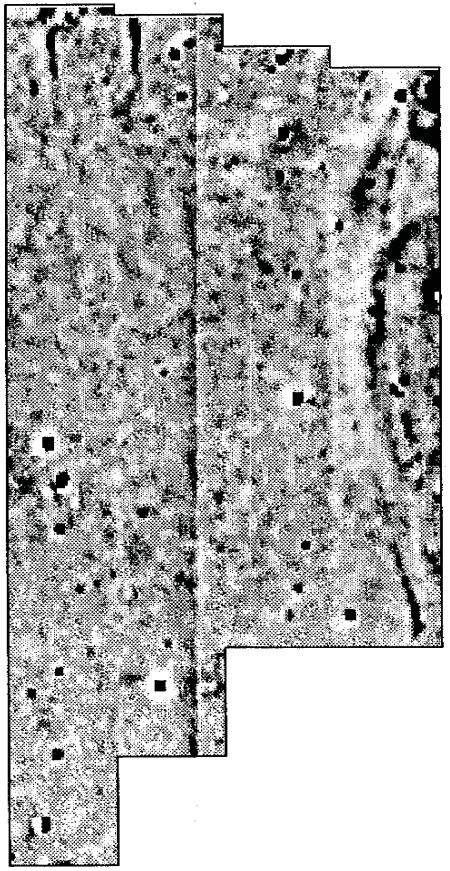
A1
HEALAM BRIDGE
Area C3(B)

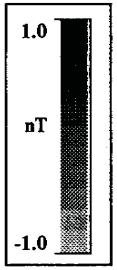


30 nT







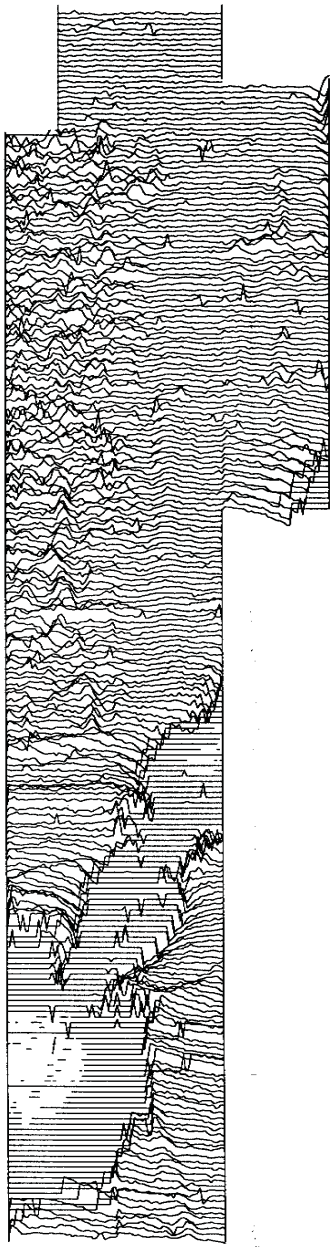


0 m 40

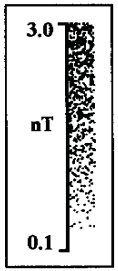
ORIGINAL AT A3

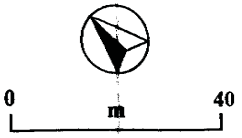
Figure C3.2

A1
HEALAM BRIDGE
Area C4



45 nT

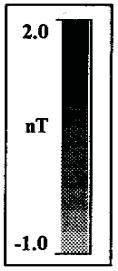




ORIGINAL AT A3

Figure C4.1

A1
HEALAM BRIDGE
Area C4



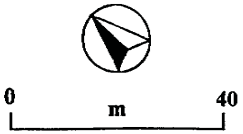
Archaeology

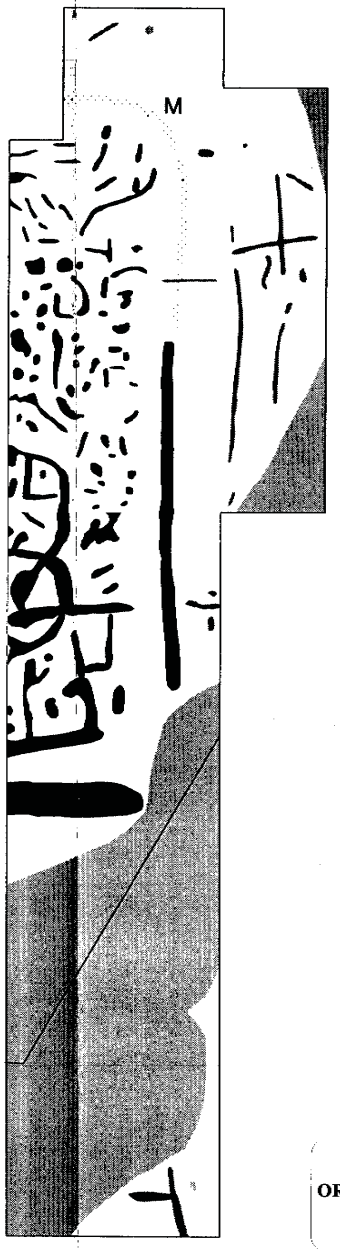
?Archaeology

Ferrous

?Limit of Fort

Pipe



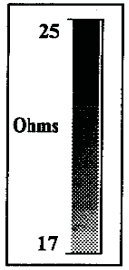


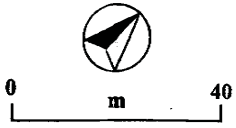
ORIGINAL AT A3

Figure C4.2

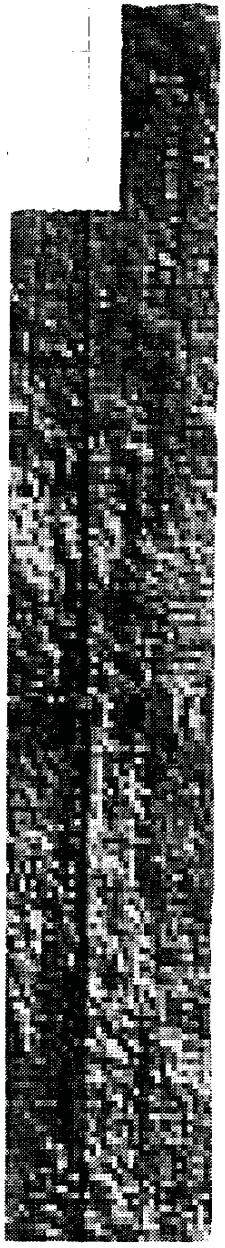
A1
HEALAM BRIDGE
Area C4
Resistance Data

Raw Data





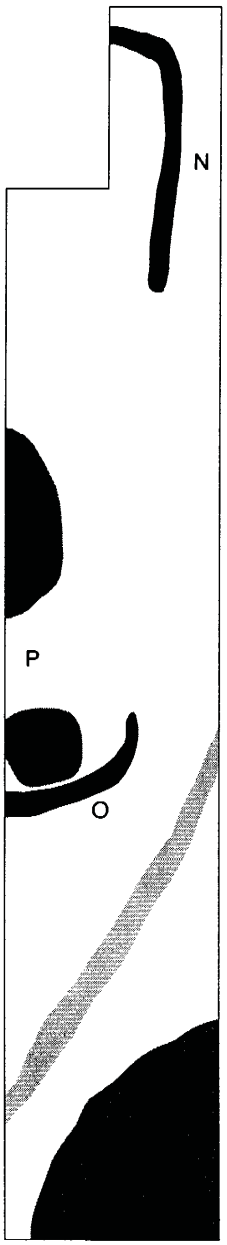
Shade Plot



ORIGINAL AT A3

Figure C4.3

A1
HEALAM BRIDGE
Area C4
Resistance Data



Low Resistance - ?ditch

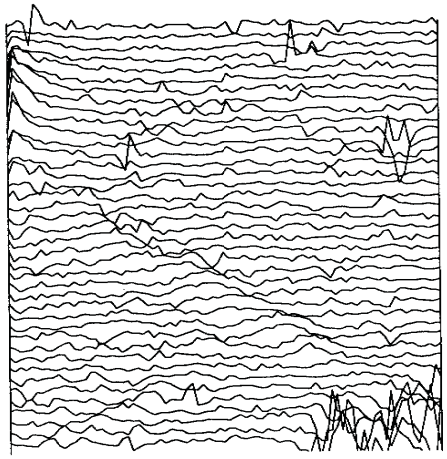
High Resistance

?Pipe

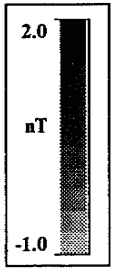
0 m 40

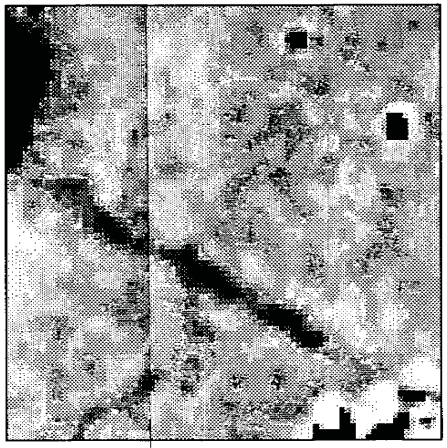
Figure C4.4

A1
HEALAM BRIDGE
Area C5
Resistance Data

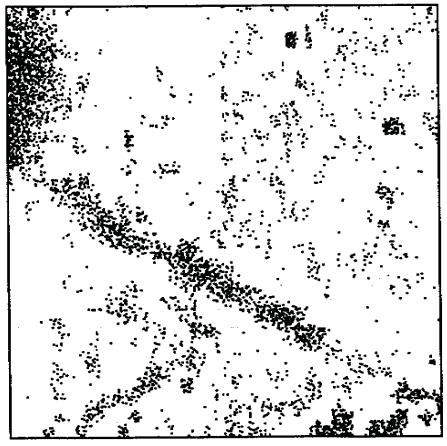


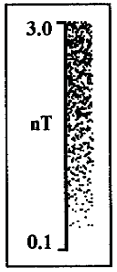
15 nT





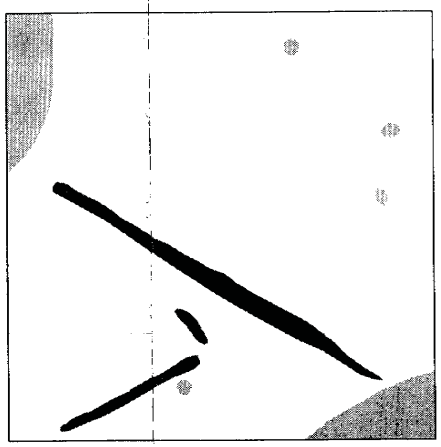
ORIGINAL AT A3





?Archaeology

Ferrous



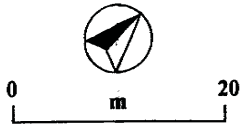


Figure C5.1