Rec 10-2-4

3144 parish

NYCC HER	
SNY	8546
ENY	2127
CNY	2946
Parish	3144
Rec'd	10/2/04

NYE 2127
NYC 2946
03/00507/OUT
NYS8546

GEOPHYSICAL SURVEY ON AN AREA OF PROPOSED DEVELOPMENT IN FIELD 0006, MAIN STREET, WEAVERTHORPE, NORTH YORKSHIRE

A programme of research carried out on behalf of

Simon Ward

by

GeoQuest Associates

GeoQuest ASSOCIATES

1 INTRODUCTION

1.1 An archaeological geophysical survey has been carried out on an area of arable land N of Main Street in the village of Weaverthorpe, North Yorkshire (OS Field 0006; Figure 1). At the time of survey the field was sown for barley which was about 10cm tall, with a direction of ploughing oriented N-S parallel to the long axis of the study area.

1.2 The research was carried out by GeoQuest Associates on behalf of Simon Ward, Chartered Surveyor and Town Planner who is acting as consultant to the landowner Mr Mason. The survey was carried out in accordance with a Specification drafted by Gail Falkingham of the Heritage Unit, North Yorkshire County Council.

1.3 The study area is situated on the lower part of a S-facing slope, bounded on the W, S and E sides by fencing. Although development is only proposed for the southern half of the area, the geophysical survey was extended upslope to improve the context for archaeological and geotechnical interpretation. According to the Specification, earthwork remains of the medieval settlement of Weaverthorpe exist to the SE and W of the site, and may extend into the proposal area. In addition, prehistoric banks and trackways are seen in air photographs of fields to the SE, while a low, linear earthwork (suggesting a former field boundary) exists along the northern edge of the area investigated (hachures, Figure 1). Hence, on the basis of available evidence, potential exists for the development to uncover remains associated with prehistoric and later settlement activity. Most of these features are likely to exist as pits, ditches and robbed wall footings, cut into the subsoil and now infilled with topsoil material that has an enhanced magnetic susceptibility. The technique of geomagnetic survey, using a portable fluxgate magnetometer, is therefore appropriate in this instance: this technique will also detect the intense thermoremanent magnetisation within *in situ* fired structures, such as kilns and hearths.

1.4 Geophysical survey of the site was carried out on 1st February 2004. SE 9694 7087

2 THE GEOPHYSICAL SURVEY

2.1 A baseline for the geophysical survey was established parallel to the fence bordering The Beeches, with a 1.0m offset to reduce the influence of iron fixing nails and wire in the fence. Figure 1 provides a definition, together with backup measurements to enable relocation of the baseline in the event that further site works are required to characterise geophysical anomalies. Coordinates of features detected by the survey can be determined relative to the baseline or OS detail by extraction from the associated CAD file.

2.2 Measurements of vertical geomagnetic field gradient were recorded using a Geoscan FM36 fluxgate gradiometer recording at 0.05nT/m resolution. A zig-zag traverse scheme was employed and data were logged in grid units of 20x20m at 1.0x0.5m intervals, thus providing 800 measurements per grid.

2.3 Data obtained from the survey were downloaded on-site into a portable graphics computer for quality checks and initial processing. These data were subsequently transferred to a laboratory computer for final processing, interpretation and archiving.

2.4 The GeoQuest InSite® software was used to process the gridded geophysical data and thus convert the field readings into a continuous tone grey-scale image. In Figure 2 a convention has been used that shows positive magnetic anomalies as dark grey and negative magnetic anomalies as light grey. In Figure 3 the data are presented as a series of profiles, spaced 1.0m apart, with positive anomaly peaks filled. Further details of the data processing procedures are given in Appendix A.

2.5 An archaeological interpretation of the geophysical survey is presented in Figures 4 and 5. A key defines the colours and fill styles used in these drawings, while feature codes **f1**, **f2**, etc, are included in Figure 5 for reference in the discussion below.

3 INTERPRETATION

General

3.1 Geomagnetic field anomalies within the study area were found to be moderate to intense (most in the range ±4.0nT/m), reflecting significant magnetic susceptibility variation in the topsoil and deeper subsoil layers. The data reveal a very low density of iron litter in the topsoil, as shown by the paucity of small-scale magnetic dipoles. The results do not suggest any extensive network of ceramic land drains or iron pipes beneath the area investigated.

Archaeological Features

3.2 **f1**: Immediately S of the linear earthwork feature the survey has detected a positive magnetic lineation which traverses the upper part of the site in a WSW-ENE direction. This anomaly provides good evidence for a soil-filled ditch or ploughed-out earthen bank which may be modified into a double-bank or ditch towards the western end. A strong, compact positive magnetic anomaly 5m S of the mid-point of the ditch suggests that a large pit may exist in this position.

3.3 **f2**: A second, more substantial magnetic lineation has been mapped about 40m S of feature **f1**, effectively bisecting the study area. The character of this geophysical anomaly is consistent with a substantial soil-filled ditch, or possibly an earthen bank which has been levelled by ploughing. It is interesting to note that the geophysical terrain between **f1** and **f2** is relatively featureless, with a weak N-S oriented texture which presumably reflects soil sorting and ridging by modern ploughing.

3.4 **f3**: In contrast, the geophysical image S of **f2** is characterised by a strong pattern of rectilinear positive magnetic anomalies, with the main components measuring up to 15m in length. The structure of the anomaly pattern suggests an array of linear ditches, robbed-out wall footings and drainage gullies which may relate to the former medieval village of Weaverthorpe (buff shading, Figure 5).

3.5 **f4**, **f5** & **f6**: Within the complex pattern described above it is possible to identify several more distinct anomalies which may define a number of individual structures. The largest example is a set of positive lineations forming 3 sides of a rectangle (**f4**), suggesting a structure measuring about 15m x 7m (minimum). This feature may continue W beneath the unmarked path, into the adjacent paddock.

3.6 No further geophysical anomalies of archaeological or geotechnical interest have been detected in the study area.

4 SUMMARY AND CONCLUSIONS

4.1 An archaeological geophysical survey has been carried out over an area of proposed residential development in the SW part of arable field 0006 at Weaverthorpe, North Yorkshire. The research was carried out by GeoQuest Associates on behalf of Simon Ward who is acting as consultant planner to the development scheme. The purpose of the survey was to inform a programme of archaeological investigation aimed at mitigating the effects of groundworks on the heritage resource of the area.

4.2 The survey employed a fluxgate magnetometer, logging data at 1.0x0.5m gridded resolution. The results of the study show that magnetic susceptibility variation in the local topsoil is significant, providing a good basis for the detection of geophysical anomalies arising from archaeological and geotechnical features.

4.3 The geophysical survey data provide evidence for a pair of parallel linear ditches which traverse the centre and upper parts of the site in an E-W direction. The geophysical terrain between these ditches is relatively featureless, suggesting a relative absence of subsoil archaeological remains in this part of the site. In contrast, a complex pattern of rectilinear anomalies has been detected in the southern half of the site, consistent with silted foundation trenches, ditches or gullies in this position. No iron pipes or ceramic land drains have been detected beneath the area investigated.

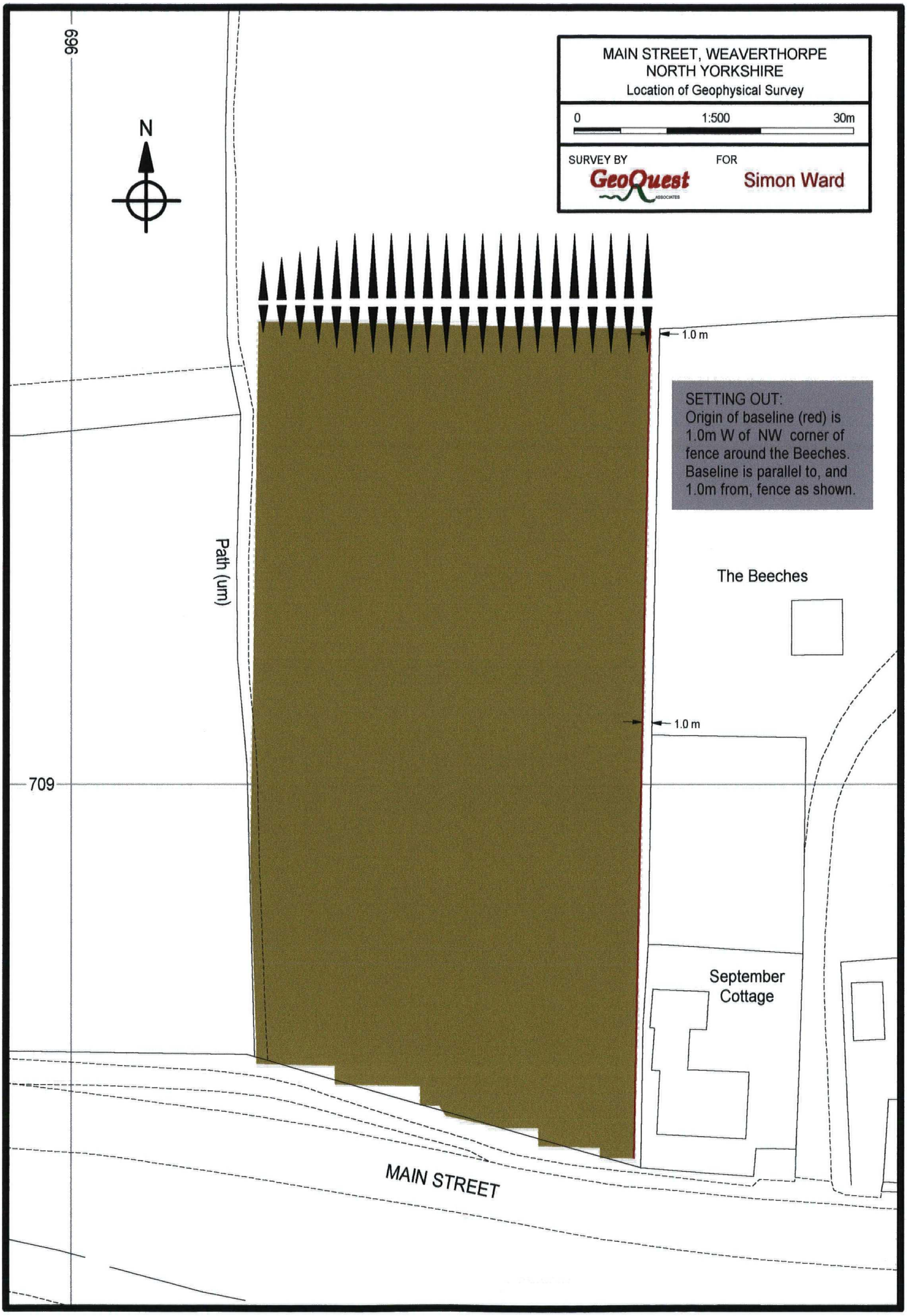
5 CONFIDENCE LIMITS

5.1 The following are the levels of confidence which we assign to features inferred from the geophysical data:

FEATURE	INTERPRETATION	CONFIDENCE LEVEL, %									
		10	20	30	40	50	60	70	80	90	100
f1	Ditch or bank	■	■	■	■	■	■				
f2	Ditch or bank	■	■	■	■	■	■	■			
f3	Former buildings	■	■	■	■						
f4	Ditches/foundations	■	■	■	■	■					
f5	Ditches/foundations	■	■	■	■						
f6	Ditches/foundations	■	■	■	■						

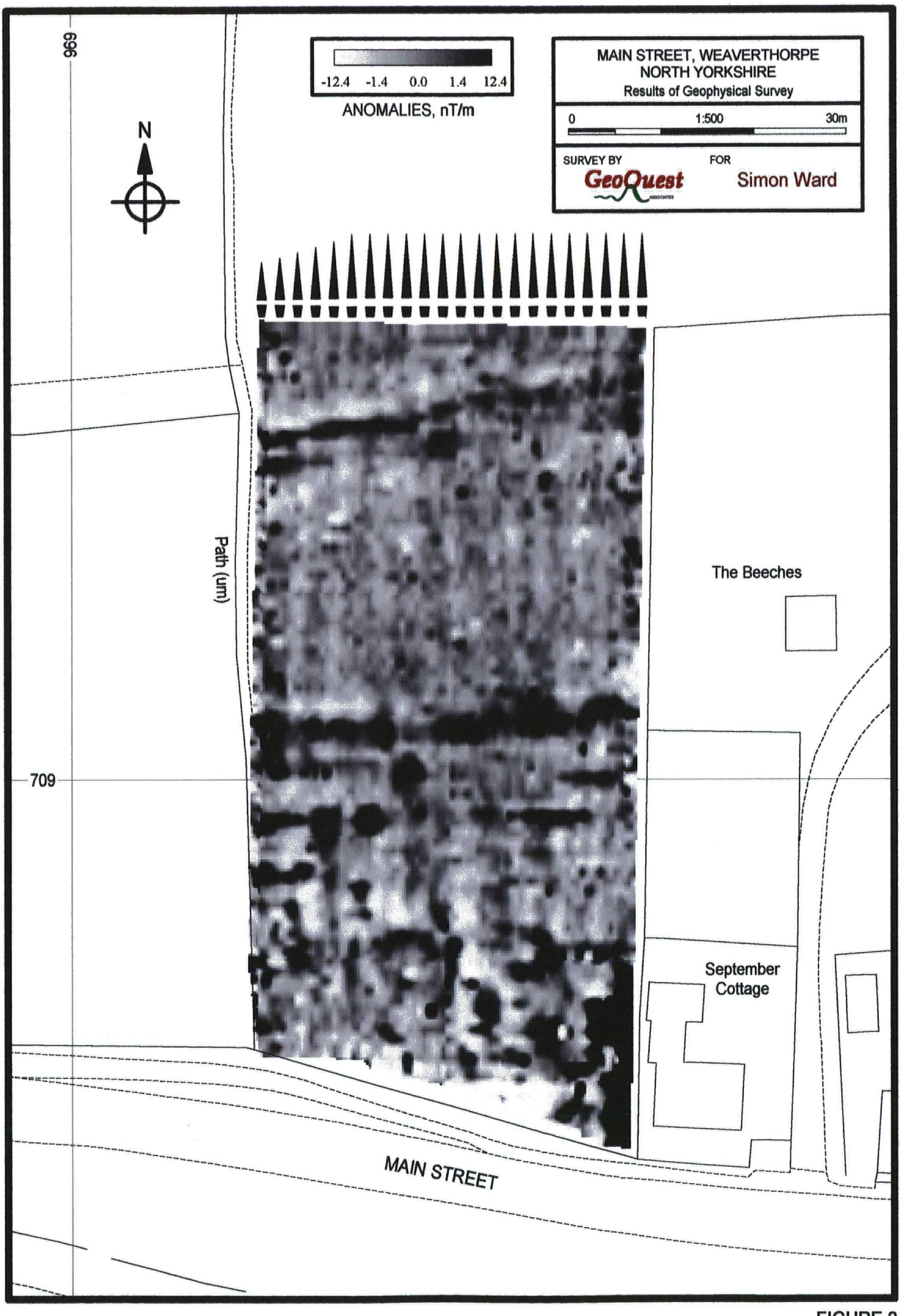
6 CREDITS

Survey & Report: M. J. Noel PhD, FRAS Date: 2nd February 2004



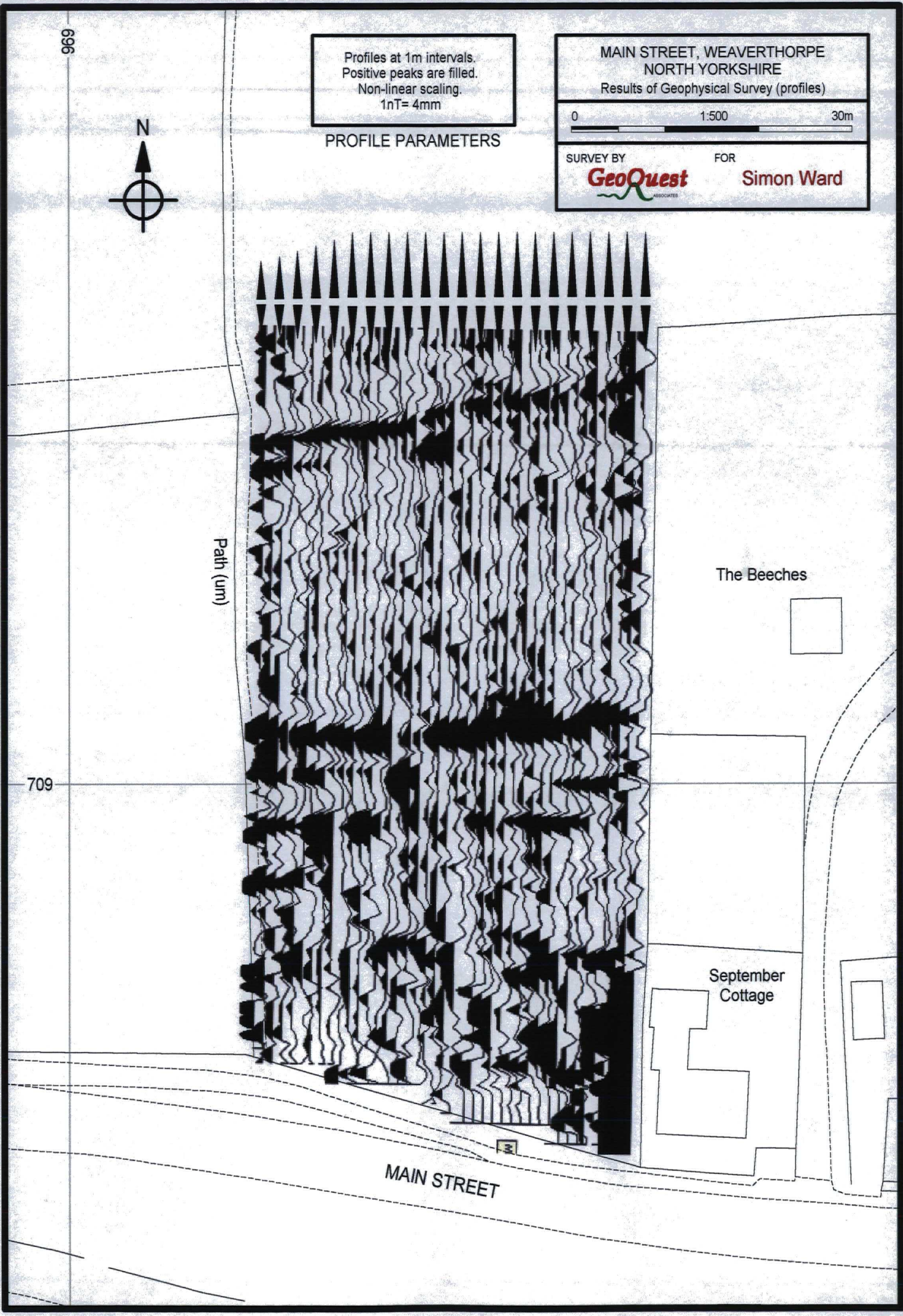
MAIN STREET, WEAVERTHORPE
NORTH YORKSHIRE
Location of Geophysical Survey
0
1:500
30m
SURVEY BY
GeoQuest
ASSOCIATES
FOR
Simon Ward
N
969
709
1.0 m
1.0 m
SETTING OUT:
Origin of baseline (red) is 1.0m W of NW corner of fence around the Beeches. Baseline is parallel to, and 1.0m from, fence as shown.
Path (um)
The Beeches
September Cottage
MAIN STREET

FIGURE 1



969
-12.4 -1.4 0.0 1.4 12.4
ANOMALIES, nT/m
MAIN STREET, WEAVERTHORPE
NORTH YORKSHIRE
Results of Geophysical Survey
0
1:500
30m
SURVEY BY
GeoQuest
FOR
Simon Ward
N
Path (um)
The Beeches
709
September
Cottage
MAIN STREET

FIGURE 2



969
709
Profiles at 1m intervals.
Positive peaks are filled.
Non-linear scaling.
1nT= 4mm
PROFILE PARAMETERS
MAIN STREET, WEAVERTHORPE
NORTH YORKSHIRE
Results of Geophysical Survey (profiles)
0
1:500
30m
SURVEY BY
GeoQuest
FOR
Simon Ward
N
Path (um)
The Beeches
September
Cottage
MAIN STREET

FIGURE 3

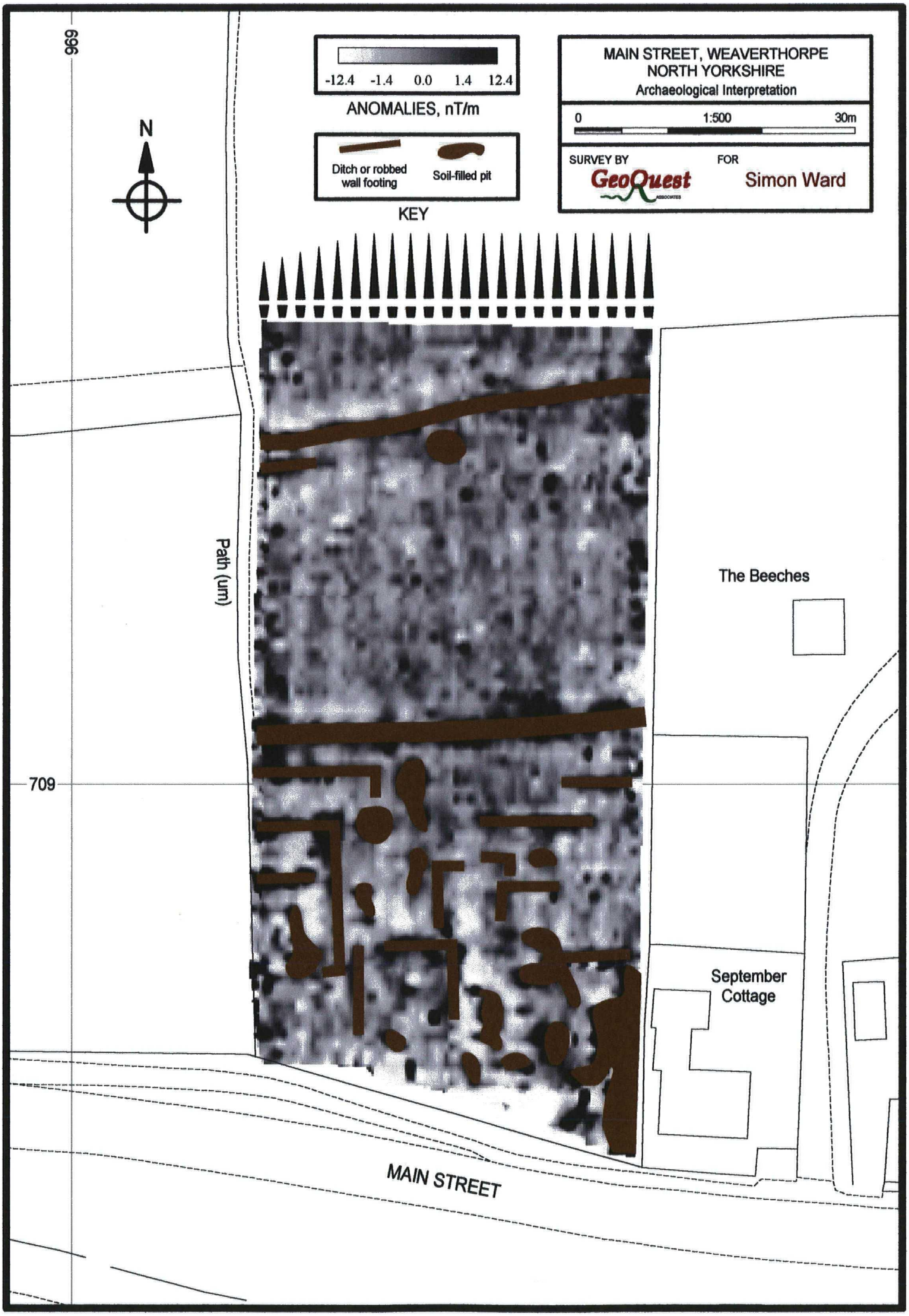

969
N
-12.4 -1.4 0.0 1.4 12.4
ANOMALIES, nT/m
Ditch or robbed wall footing
Soil-filled pit
KEY
MAIN STREET, WEAVERTHORPE
NORTH YORKSHIRE
Archaeological Interpretation
0
1:500
30m
SURVEY BY
GeoQuest
FOR
Simon Ward
Path (um)
The Beeches
709
September Cottage
MAIN STREET

FIGURE 4

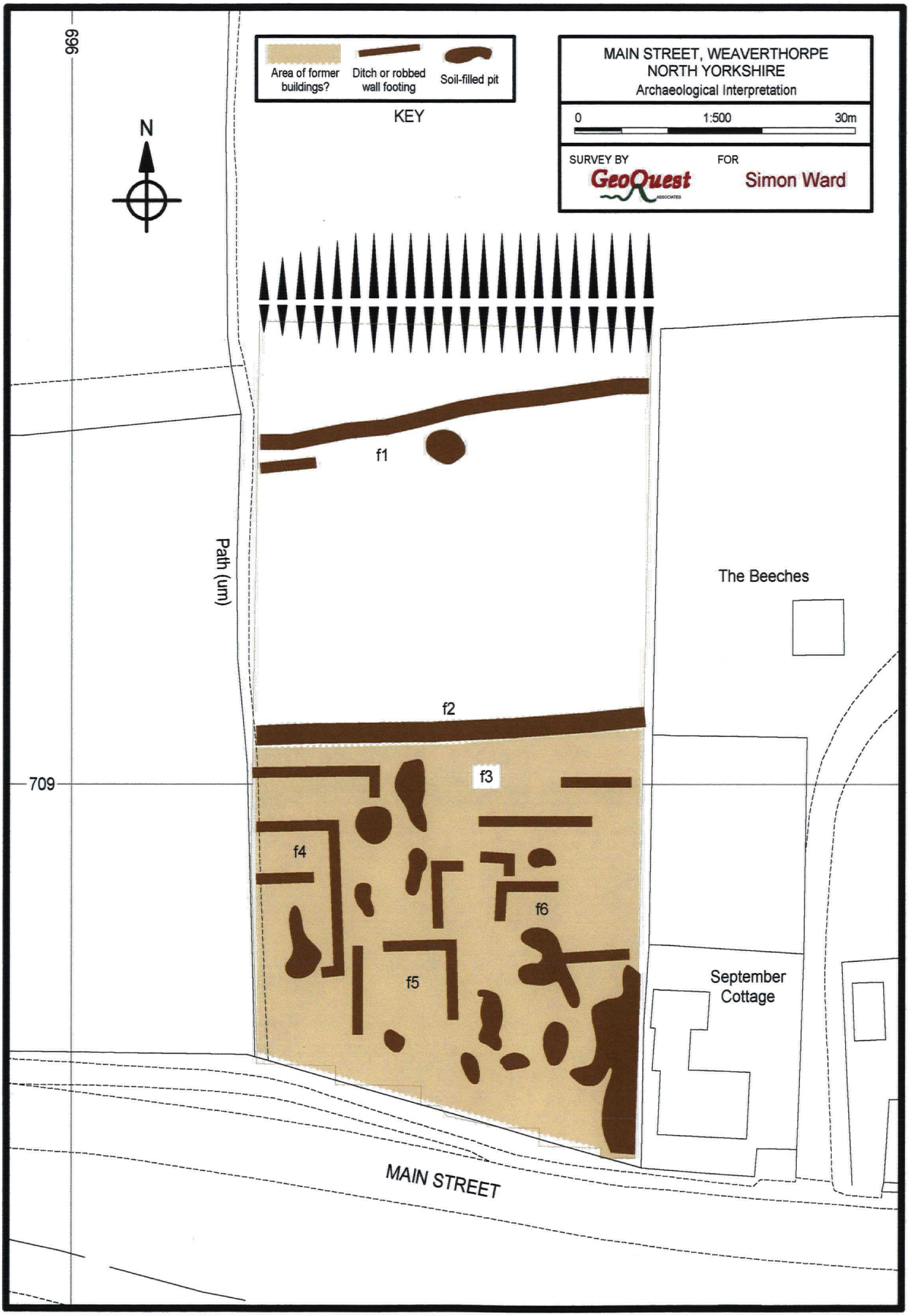

969
Area of former buildings?
Ditch or robbed wall footing
Soil-filled pit
KEY
MAIN STREET, WEAVERTHORPE
NORTH YORKSHIRE
Archaeological Interpretation
0
1:500
30m
SURVEY BY
GeoQuest
FOR
Simon Ward
N
f1
Path (um)
The Beeches
f2
709
f3
f4
f6
f5
September Cottage
MAIN STREET

FIGURE 5

APPENDIX A

DATA PROCESSING

PROCESSING THE SURVEY DATA

The geophysical images contained in this report were prepared within Microsoft Windows® using the InSite® program published by GeoQuest Associates. Geophysical images were then placed onto a map which was digitised from the Ordnance Survey, edited and then plotted using a computer aided drafting (CAD) system and colour inkjet printer.

Data were downloaded from the meter to a portable computer in the field for storage, visualisation and quality control (QC) assessment. These data were then transferred to a laboratory computer for final processing, printing and archiving.

A number of process steps have been applied to the geophysical data obtained during the survey and those which have been used are linked to the main flow path by arrows. Steps were applied in the order shown and are designed to reduce artifacts in the data and enhance geophysical features of archaeological interest. The following sections describe each step in more detail.

REMOVE STRIPING

Reduces a data artifact comprising alternating changes in level in readings logged along zig-zag traverses. This artifact is common in fluxgate magnetometer data. InSite uses a proprietary algorithm to reduce this error.

INFILL SMALL BLANK AREAS

Fills isolated blank data cells with the mean of near-neighbours or a suitable approximation entered manually. Small blank areas will have been logged if it was not possible to obtain a geophysical reading over, for example, a manhole cover in the case of a resistivity survey.

REMOVE SPIKES

Replaces isolated, anomalously high or low values with the mean of near neighbours or a suitable approximation entered manually. 'Spike' readings are commonly associated with ferrous litter or poor electrical contact in the case of geomagnetic and resistivity data, respectively.

REDUCE WALK HARMONICS

Reduces a regular oscillation in traverse data caused by walking movements of the operator during a geomagnetic survey. InSite employs a fast Fourier transform to determine the optimum amplitude and phase of the walk-induced harmonic which is then subtracted from each traverse.

REDUCE SHEAR ARTIFACTS

Corrects for apparent shear in geomagnetic anomalies surveyed by zig-zag traversing in a geomagnetic survey. The shearing effect arises from the interaction of the operator+magnetometer with the geomagnetic field and also from the lag in the instrument response to changes in the field. InSite uses a proprietary algorithm to reduce this error.

CORRECT FOR METER DRIFT

Corrects for a linear drift in the meter calibration with time. Such drift is a common problem with fluxgate magnetometers, particularly during periods of rapid air temperature change. InSite uses least-squares regression on the mean of data along each traverse to estimate the change in calibration level across each grid. This gradient is then removed from the data.

ADJUST GRID MEAN LEVELS

Adjusts for differences in the mean level in data grids due to changes in instrument calibration (fluxgate magnetometer survey) or alteration in remote electrode spacing (resistivity survey).

INTERPOLATE AND COMBINE

Combines grids to form an array of regularly-spaced data on a square mesh. InSite uses bilinear interpolation to accomplish this.

LOW PASS FILTER

If this process task is indicated then a 3x3 or 5x5 boxcar filter has been used to smooth the data and reduce noise or 'speckle' seen in the original image.

HIGH PASS FILTER

If this process task is indicated then a 3x3 or 5x5 filter, with appropriate coefficients, has been used to pass short-wavelength information into the resulting image.

EDGE DETECT FILTER

Signifies that a Sobel, Laplace or other specialised filter has been applied to enhance significant lateral transitions in the geophysical image.

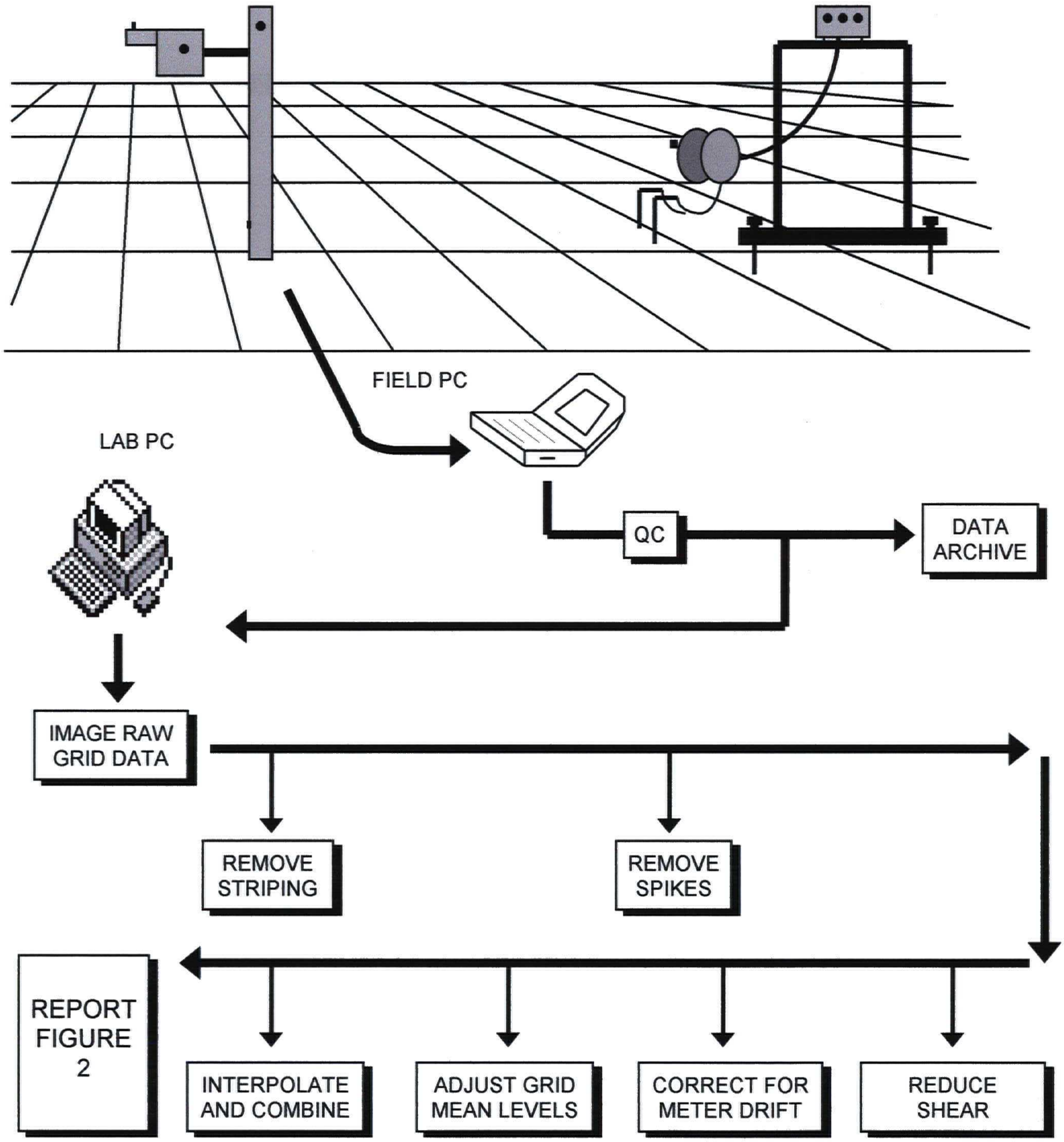
DIRECTIONAL FILTER

This filter is equivalent to illuminating the data from one direction to produce a pseudo-relief image. Directional filtering is usually employed to aid the identification of subtle anomalies in resistivity data. This filter highlights features trending at right angles to the direction of illumination.

NOTE

GeoQuest Associates can supply the geophysical images presented in this report in a variety of digital formats for visualisation on microcomputers running Microsoft Windows. These formats include the TIF, BMP and PCX standards. Please complete the request form at the rear of this report if you would like to receive such image files.

APPENDIX A
DATA PROCESSING



PROJECT: Weaverthorpe

SITE: Field 0006