8018 parish
Rec 14/4/03

NYCC HER	
SNY	9788
ENY	2974
CNY	5056
Parish	8018
Rec'd	14/04/2003

GEOPHYSICAL SURVEY OF A PROPOSED CLAY EXTRACTION AREA AT HEMINGBROUGH, SELBY, NORTH YORKSHIRE

A programme of research carried out on behalf of

Humber Field Archaeology

by

GeoQuest Associates

1 INTRODUCTION

1 1 This report describes the methodology and results of geophysical surveys on land to the NE of Hemingbrough village near Selby in North Yorkshire (NGR SE 6720 3125 Figure 1) The purpose of the surveys was to test for subsoil archaeological features which may be affected by proposed clay extraction from land currently used for agriculture The proposal site extends to about 18 5ha over 3 fields and the project design called for an initial scan of the entire area using a fluxgate magnetometer followed by detailed gridded survey of areas of potential up to a maximum of 7 4ha (40% of total area)

1 2 The research was carried out by GeoQuest Associates on behalf of Humber Field Archaeology (HFA) and in accordance with a Project Design prepared by Ken Steedman of HFA for M J Carter Associates Technical Advisers on Environmental Issues for the agency proposing clay extraction Geophysical survey is one component of the archaeological appraisal which follows directly from a desk based Cultural Heritage Assessment compiled by HFA (Hall 2003) A further stage of field evaluation may comprise a trial trenching programme whose objectives will be partly determined by results of the geophysical survey

1 3 The geophysical survey was carried out by GeoQuest Associates between 22nd and 24th March 2003

2 SITE DESCRIPTION

2 1 Clay extraction is proposed on an area of land located S of the Hull-Selby railway line and N of houses a scrap yard and water tower adjoining Hull Road (the A63) which passes through Hemingbrough (Figure 1) Although undivided by fences or hedges the study area is traversed by 2 farm tracks which are raised above the surrounding fields on foundations of brick rubble (J Harrison *pers* comm) Land to the W of the main track is presently cultivated for oil seed rape while land to the E for barley Both crops stood 5 20cm tall at the time of survey In addition a small paddock of rough pasture is located in the NE corner of the proposal area N of a drain and E of that part of the main track which leads to a level crossing

2 2 The desk based archaeological assessment identified a total of 81 sites of cultural heritage significance within an area which includes the immediate surroundings of the proposed clay extraction site These range from a possible prehistoric burial mound to post medieval agricultural features and listed buildings reflecting a rich and diverse archaeological environment encompassing the planned extraction site Of particular interest is the presence within the proposal area of a cropmark suggesting the ring ditch of a prehistoric barrow and the presence of Roman settlement remains to the E which probably extend into the study area

2 3 The site is at about 7m AOD on level ground N of the floodplain of the River Ouse about 1km SW During the medieval period the Ouse occupied a more northerly channel (along the present day Oldways Lane) and Hemingbrough village then functioned as a riverside settlement

2 4 Soils within the proposal area comprise stoneless loamy soils of the Sessay Series which are underlain by a succession of glaciolacustrine and glaciofluvial drifts and clays The

solid geology compnses Permian and Tnassic New Red Sandstone (Hall 2003) In this area clay is selectively extracted from one of the drift honzons and fired to create low density pellets used in the manufacture of concrete blocks (Harnson per. comm)

2 5 It is understood that the proposal area has been extensively drained by insertion of tile and plastic land drains Both dram types have been used in the northern part of the site while only tile drains have been used in the southern part (Harnson pers comm)

3 GEOPHYSICAL SURVEY STRATEGY

3 1 Most of the prehistonc Roman and medieval features which may exist in the study area are likely to occur as pits ditches and post holes infilled with topsoil having an enhanced magnetic susceptibility compared to the enclosing subsoil In contrast any *in situ* wall footings roadways and yards will be manifest as volumes with a reduced magnetic susceptibility particularly in this instance where the local solid geology is sandstone These observations suggest that geomagnetic survey (using a fluxgate gradiometer) is likely to be the most sensitive and efficient technique for archaeological prospection in this instance The magnetometer will also be particularly suited to the detection of thermoremanent magnetisation within fired structures such as hearths and kilns

3 2 A rapid geophysical scan was initially performed over the entire proposal area in an effort to identify magnetic anomalies of potential archaeological interest The investigation used a Geoscan FM36 fluxgate gradiometer which was carried along linear transects spaced a maximum of 10m apart Colour coded flags were used to mark on the ground the positions of significant positive and negative magnetic anomalies plus any zones of noisy geophysical terrain Some additional magnetometer searching was carried out to the sides of the 10m traverse lines in an effort to more fully charactense and delineate significant anomalies The coordinates of each flag were then transferred as appropnate symbols onto a scale site plan

3 3 Geophysical scanning revealed that the mean amplitude of most geomagnetic anomalies was near or below the single point detection threshold of the fluxgate gradiometer (typically ±1 0nT/m) As expected the strongest magnetic field anomalies were encountered along field tracks and adjacent to drains and gateways (due to ferrous and brick litter) As a consequence the preliminary scan was judged unlikely to have been effective in recovenng geomagnetic anomalies of archaeological interest Tests were therefore carried out of detailed gridded survey in which data were logged at 1 0x0 5m resolution within a sample block measunng 100x100m in Area 1 These results were processed and examined in the field revealing a number of significant anomalies below 0 5nT/m and it was therefore decided to continue the investigation by expanding the detailed survey in this area particularly since cropmarks of archaeological interest are recorded in this vicinity The remainder of the site was then sampled by a further 3 geophysical survey blocks located in the NE NW and SW quadrants (Figure 1)

3 4 For the detailed surveys measurements of vertical geomagnetic field gradient were again recorded using a Geoscan FM36 fluxgate gradiometer A zig zag traverse scheme was employed and data were logged in grid units of 20x20m and 100x20m at 1 0x0 5m intervals

4 DATA PROCESSING

4 1 Data 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

4 2 The GeoQuest InSite® software was used to process the geophysical data and thus convert the field readings into continuous tone grey scale images In Figure 2 a convention has been used that shows positive magnetic anomalies as dark grey and negative magnetic anomalies as light grey Technical details of the data processing algorithms are given in Appendix A

4 3 An archaeological interpretation of the geophysical survey is presented in Figures 3 and 4 A key defines the colours and fill styles used in these drawings while feature codes f1 f2 etc are included in Figure 4 for reference in the discussion below

5 INTERPRETATION

General

5 1 In Figure 2 it can be seen that geomagnetic anomalies within each of the sample areas are extremely weak with the strongest field gradients being recorded along the edges of tracks (Areas 1 & 2) near pylons (Area 1) and around a bird scarer (western part of Area 3) However a low density of small scale magnetic dipoles is present (f1) facilitating the detection of subtle anomalies of possible archaeological interest

5 2 In Figure 2 it can be seen that the geophysical image from Area 1 contains a N S oriented texture of weak lineaments which probably represents a dense network of tile land drains close to the surface One of these drains is seen to issue in the ditch about 10m E of the gate on Haw Lane at the entrance to the barley field

Area 1

5 3 f2 f3 & f4 Extraction and interpretation of geophysical features in this area is complicated by the land drainage texture descnbed above and by the very low amplitude anomalies charactenstic of the proposal area Nevertheless several weak and diffuse anomalies may be present in the form of linear and curvilinear components these may be consistent with soil filled ditches (Figures 3 & 4) The pattern of ditches may suggest a trackway oriented N S with a number of associated field enclosure ditches Nevertheless the amplitude and style of these anomalies are such that only a low confidence level can be assigned to the archaeological interpretation presented here

Area 2

5 4 f5 If geomagnetic field anomalies ansing from buned archaeology exist in this area then most are below the detection limit of the magnetometer employed since the geomagnetic field was found to be remarkably uniform Several weak and discontinuous linear features

have been detected within a radius 25m E of the track although these may be associated with an area of recent soil disturbance and wheel ruts It is also worthwhile noting that no significant geophysical anomalies have been mapped in the eastern part of this block where there is an area of marshy ground

Area 3

5 5 A small steel framed bird scarer is the source of the intense magnetic dipole in the western half of this block A very low density of magnetic dipoles (due to iron or brick litter) is recorded elsewhere in Area 3

5 6 f6 **f7** & **f8** A very thorough examination of the grey scale image has been carried out using a range of contrast settings and filters and the geomagnetic field in this area has again been found to be remarkably featureless This suggests that subsoil features if present are associated with very low (or zero) contrasts in magnetic susceptibility compared to the enclosing subsoil Several extremely weak positive magnetic lineations may be present (close to the detection limit) and these have been extracted as ditch features in Figures 3 and 4 Clearly a more detailed charactensation of these targets will require a programme of further site investigation for example via trial trenching

Area 4

5 7 No geophysical anomalies of archaeological interest have been detected in Area 4

6 SUMMARY AND CONCLUSIONS

6 1 Geophysical surveys have been carried out within 4 sample areas on land north of Hemingbrough village near Selby in North Yorkshire where a clay extraction scheme has been proposed The research was carried out on behalf of Humber Field Archaeology in accordance with their Working Scheme of Investigation 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

6 2 The geophysical survey took the form of a preliminary geophysical scan followed by detailed gridded survey of sample blocks with emphasis on the SE quadrant where cropmark evidence for archaeological features existed Geomagnetic anomalies were found to be extremely weak throughout the study area reflecting a very low contrast in magnetic susceptibility between materials infilling cut features and the natural undisturbed subsoil Most anomalies were therefore below the detection limit of simple scanning survey only becoming visible by imaging detailed gridded data sets However it remains possible that a number of archaeological features such as ditches and post holes may have escaped detection owing to the low magnetic susceptibility contrasts which are a feature of this terrain

6 3 Tentative evidence has been found for the survival of a number of soil filled ditches in sample Areas 1 2 and 3 The survey provides no evidence to suggest that medieval ridge and furrow once existed on the site nor burnt features such as kilns or hearths However a dense network of tile land drains beneath Area 1 (SE corner) has produced

geomagnetic anomalies of sufficient intensity to mask more subtle field anomalies of possible archaeological interest

6 4 Further charactensation of subsoil targets identified by the survey will require a programme of direct investigation for example by tnal trenching Moreover such excavation will establish whether areas apparently devoid of features in the geophysical data are indeed stenle archaeologically

7 CONFIDENCE LIMITS

7 1 The following are the levels of confidence which we assign to features inferred from the geophysical data

f1	Ferrous/bnck debns	90%
f2	Soil filled ditch or drain	30%
f3	Soil filled ditch or drain	30%
f4	Soil filled ditch or drain	30%
f5	Soil filled ditch or drain	20%
f6	Soil filled ditch or drain	30%
f7	Soil filled ditch or drain	30%
f8	Soil filled ditch or drain	30%

8 REFERENCE

Hall N 2003 *Land at Hemingbrough Setby North Yorkshire Assessment of Archaeological Potential* Humber Archaeology Report No 118 January 2003

9 CREDITS

Sunvey & Report M J Noel PhD FRAS
Date 9th Apnl 2003

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Chantry Field

318

Drain

Oldmill Field Drain

Oldmill Field

AREA 4: SETTING OUT
Origin of baseline is 20m NNW from N electricity pole. Exact bearing of baseline is defined by a parallax of this pole with St Mary's church spire, about 0.5 mile to the SSE.

N

AREAS 2 & 3: SETTING OUT
Baseline is approximately parallel to the E side of the track. Origin is 56m from yellow 'phone box, with exact bearing defined by parallax of this 'phone and a 2-pole pylon about 0.5 mile to the NNW.

AREA 4

AREA 3

EP

20 m

Track

AREA 1

60 m

60 m

56 m

Track

Yellow 'phone box

Disturbed Ground

Level Crossing

Water Tower

Drain

Gate

BH

3 m

100 m

EP

2 m

AREA 2

Railway Line

Pond

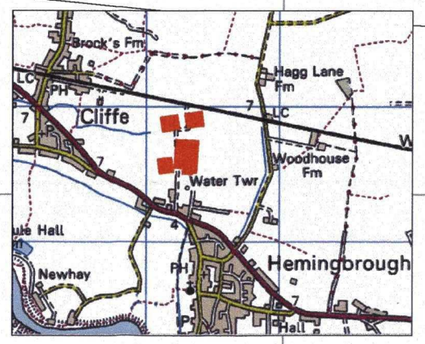
HAW LANE

Track

BH

AREA 1: SETTING OUT
Baseline origin is 3m from W face of S electricity pole, at right angles to field boundary. Bearing is then defined by a point 2m from a peg in the field boundary, 100m along.

Haw Closes



GENERAL LOCATION

LAND AT HEMINGBROUGH, NORTH YORKSHIRE
Location of Geophysical Survey Areas

0 1:1750 80m

SURVEY BY GeoQuest

FOR Humber Field Archaeology

FIGURE 1

673

Chantry Field

Oldmill Field Drain

Oldmill Field

318

Drain

AREA 4

N

AREA 3

EP

Track

AREA 1

Level Crossing

Track

AREA 2

Water Tower

Drain

Gate

Railway Line

EP

Pond

HAW LANE

Track

Haw Closes

ANOMALIES, nT/m

-12.4 -1.4 0.0 1.4 12.4

LAND AT HEMINGBROUGH, NORTH YORKSHIRE

Results of Geophysical Surveys

0 1:1750 80m

SURVEY BY GeoQuest GEOSCIENCES

FOR Humber Field Archaeology

FIGURE 2

673

Chantry Field

318

Drain

Oldmill Field Drain

Oldmill Field

AREA 4

N

AREA 3

EP

Track

AREA 1

Level Crossing

Track

AREA 2

Water Tower

Drain

Gate

Railway Line

EP

Pond

HAW LANE

Track

Haw Closes

KEY

Iron & brick debris

Ditch or tile drain

ANOMALIES, nT/m

-12.4 -1.4 0.0 1.4 12.4

LAND AT HEMINGBROUGH, NORTH YORKSHIRE

Archaeological Interpretation

0 1:1750 80m

SURVEY BY GeoQuest ASSOCIATES

FOR Humber Field Archaeology

FIGURE 3

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Chantry Field

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Drain

Oldmill Field Drain

Oldmill Field

AREA 4

N

AREA 3

f1

f8

f6

f7

EP

Track

f1

f3

f2

f4

f1

Level Crossing

Track

Water Tower

f1

f1

f5

AREA 2

AREA 1

Railway Line

Drain

Gate

BH

EP

f1

f1

Pond

HAW LANE

BH

Track

KEY

Iron & brick debris

Ditch or tile drain

Haw Closes

LAND AT HEMINGBROUGH, NORTH YORKSHIRE

Archaeological Interpretation

0 1:1750 80m

SURVEY BY GeoQuest Associates

FOR Humber Field Archaeology

FIGURE 4

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

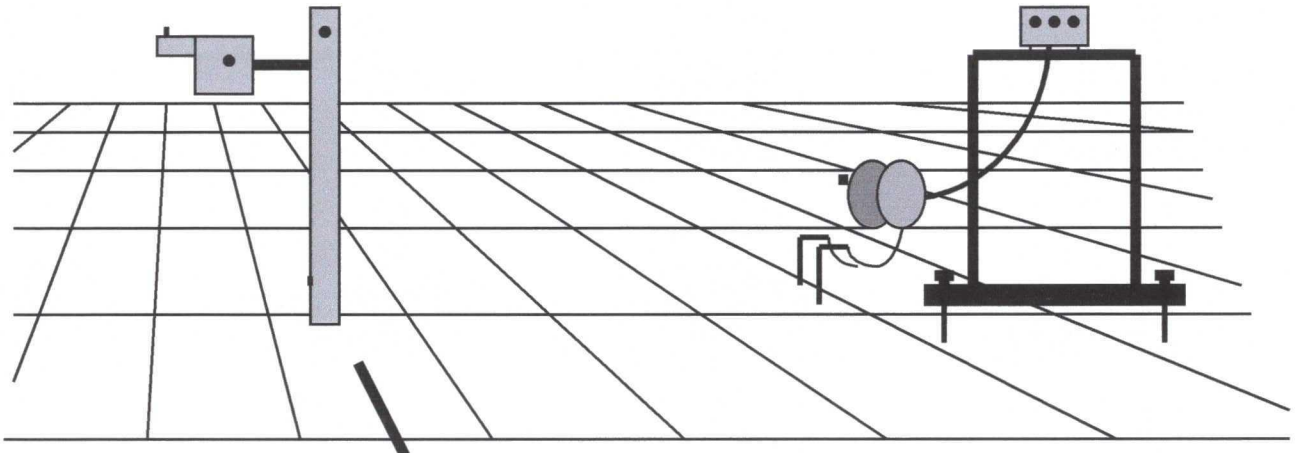
This filter is equivalent to illuminating the data from one direction to produce a pseudo-relief image. Directional filtering is usually employed to aid the identification of subtle anomalies in resistivity data. This filter highlights features trending at right angles to the direction of illumination.

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.

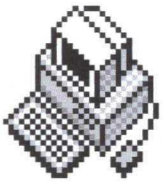
InSite

APPENDIX A
DATA PROCESSING



FIELD PC

LAB PC



QC

DATA ARCHIVE

IMAGE RAW GRID DATA

REMOVE STRIPING

REMOVE SPIKES

REPORT FIGURE 2

INTERPOLATE AND COMBINE

ADJUST GRID MEAN LEVELS

CORRECT FOR METER DRIFT

REDUCE SHEAR

PROJECT: Hemingbrough

SITE: Clay extraction area