ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Ms Hazel Kellett

Land south of Etherley Road
Low Etherley
County Durham

geophysical survey

report 3430
May 2014

Durham University

Contents

Figures

Green Lane · Durham · DH1 3LA · tel 0191 334 1121 · fax 0191 334 1126
archaeological.services@durham.ac.uk · www.dur.ac.uk/archaeological.services

1. Summary

The project

1.1 This report presents the results of a geophysical survey conducted in advance of proposed development at Low Etherley, Bishop Auckland. The works comprised 1ha of geomagnetic survey.

1.2 The works were commissioned by Ms Hazel Kellett and conducted by Archaeological Services Durham University.

Results

1.3 Possible structural remains have been identified in south-west of the survey area. A less structured cluster of strong anomalies in the east could reflect further ferrous and fired debris.

1.4 Several positive magnetic anomalies have been detected across the site, which could represent the remains of ditches and pits.

1.5 A potential large pit or bonfire site has been detected in the north-west of the area.

2. Project background

Location (Figure 1)

2.1 The survey area was located at Low Etherley, Bishop Auckland, County Durham (NGR centre: NZ 17062 28841). One survey measuring 1ha was conducted in one land parcel on the east side of the village. The site is bounded to the north by the B6282 Etherley Road with terraced houses to the west and agricultural land to the south.

Development proposal

2.2 The proposal is for a residential development of terraced and detached homes, with associated access and infrastructure.

Objective

2.3 The principal aim of the survey was to assess the nature and extent of any sub-surface features of potential archaeological significance within the proposed development area, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in relation to the development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client, a survey proposal provided by Archaeological Services Durham University and national standards and guidance (see para. 5.1 below).

Dates

2.5 Fieldwork was undertaken on the 9th May 2014. This report was prepared for May 2014.

Personnel

2.6 Fieldwork was conducted by Patricia Edwards (supervisor) and Neil Lythe. The geophysical data were processed by Patricia Edwards. This report was prepared by Patricia Edwards, with illustrations by David Graham, and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **BLE14**, for **B**ishop **L**ow **E**therley 20**14**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-178772**.

3. Historical and archaeological background

3.1 An archaeological desk-based assessment has been undertaken by Archaeological Services Durham University, which provides a detailed account of the archaeological and historic background to the site (Archaeological Services 2014). The following summary information is taken from that report.

3.2 There are no historic or statutorily protected buildings in the vicinity of the site. The route of the former Stockton & Darlington Railway lies less than 150m to the west of the site and is a Scheduled Ancient Monument (HER2600, SAM 41525).

3.3 There is no direct evidence of prehistoric or Roman activity in the proposed development area. There is, however, evidence that the surrounding area was exploited in prehistory, and an as yet unidentified resource relating to this has the potential to survive within the proposed development area.

3.4 The area lies on the edge of the medieval village of Etherley, and it is probable that the area was used in the medieval and post-medieval periods as agricultural land. Evidence relating to this, in the form of ridge and furrow cultivation and field boundaries, may survive. Some earthworks are present on the site, currently undated.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised one field of pasture. It was not possible to collect data in the north-east of the site due to dense vegetation. In the north-west corner of the area was a pigeon cree that extended into the survey area.

4.2 The development site sloped gently down to the north with a mean elevation of approximately 164m OD.

4.3 The underlying solid geology of the area comprises Pennine Lower Coal Measures (mudstones, sandstones and siltstones), which are overlain by glacial till.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service & Digital Antiquity *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2013).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on desktop research, it was considered likely that cut features such as ditches and pits might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.5 A 30m grid was established across the survey area and related to the Ordnance Survey National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.6 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 sample measurements per 30m grid unit.

5.7 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.8 Geoplot v.3 software was used to process the geophysical data and to produce both a continuous tone greyscale image and a trace plot of the raw (minimally processed) data. The greyscale image and interpretations are presented in Figures 2-4; the trace plot is provided in Figure 5. In the greyscale image, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.9 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
de-stagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.10 A colour-coded geophysical interpretation plan is provided. Two types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

5.11 A colour-coded archaeological interpretation plan is provided.

5.12 Strong, rectilinear, dipolar magnetic anomalies have been detected in the south-west and east of the survey. These anomalies are broadly oriented east-west. They almost certainly reflect ferrous and/or fired material and could represent structural remains of buildings. The cluster of anomalies near the southern edge could possibly represent a range of three or four compartments. The anomalies near the eastern edge have a less regular structure but could reflect building debris. There are no structures shown on any OS editions that correspond with these anomalies.

5.13 To the north of the possible structures are several positive magnetic anomalies. These reflect relative increases in high magnetic susceptibility materials and could represent the remains of soil-filled ditches and pits.

5.14 One irregularly shaped strong positive magnetic anomaly measuring 5-6m across in the north-west of the site could reflect a large pit or possibly an area of burning such as a bonfire.

5.15 Occasional positive magnetic anomalies detected elsewhere on the site could also reflect the remains of ditches and pits.

5.16 Strong magnetic anomalies along the edges of the survey reflect the adjacent metal fences.

5.17 In the north-west corner of the survey area a large dipolar magnetic anomaly reflects an adjacent pigeon cree.

5.18 The only other anomalies detected here are small, discrete dipolar magnetic anomalies. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments.

6. Conclusions

6.1 One hectare of geomagnetic survey has been undertaken at Low Etherley, Bishop Auckland, prior to proposed development.

6.2 Possible structural remains have been identified in south-west of the survey area. A less structured cluster of strong anomalies in the east could reflect further ferrous and fired debris.

6.3 Several positive magnetic anomalies have been detected across the site, which could represent the remains of ditches and pits.

6.4 A potential large pit or bonfire site has been detected in the north-west of the area.

7. Sources

Archaeological Services 2014 *Land south of Etherley Road, Low Etherley, County Durham: archaeological desk-based assessment.* Unpublished report **3432**, Archaeological Services Durham University

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, 2013 *Geophysical Data in Archaeology: A Guide to Good Practice*. Archaeology Data Service & Digital Antiquity, Oxbow

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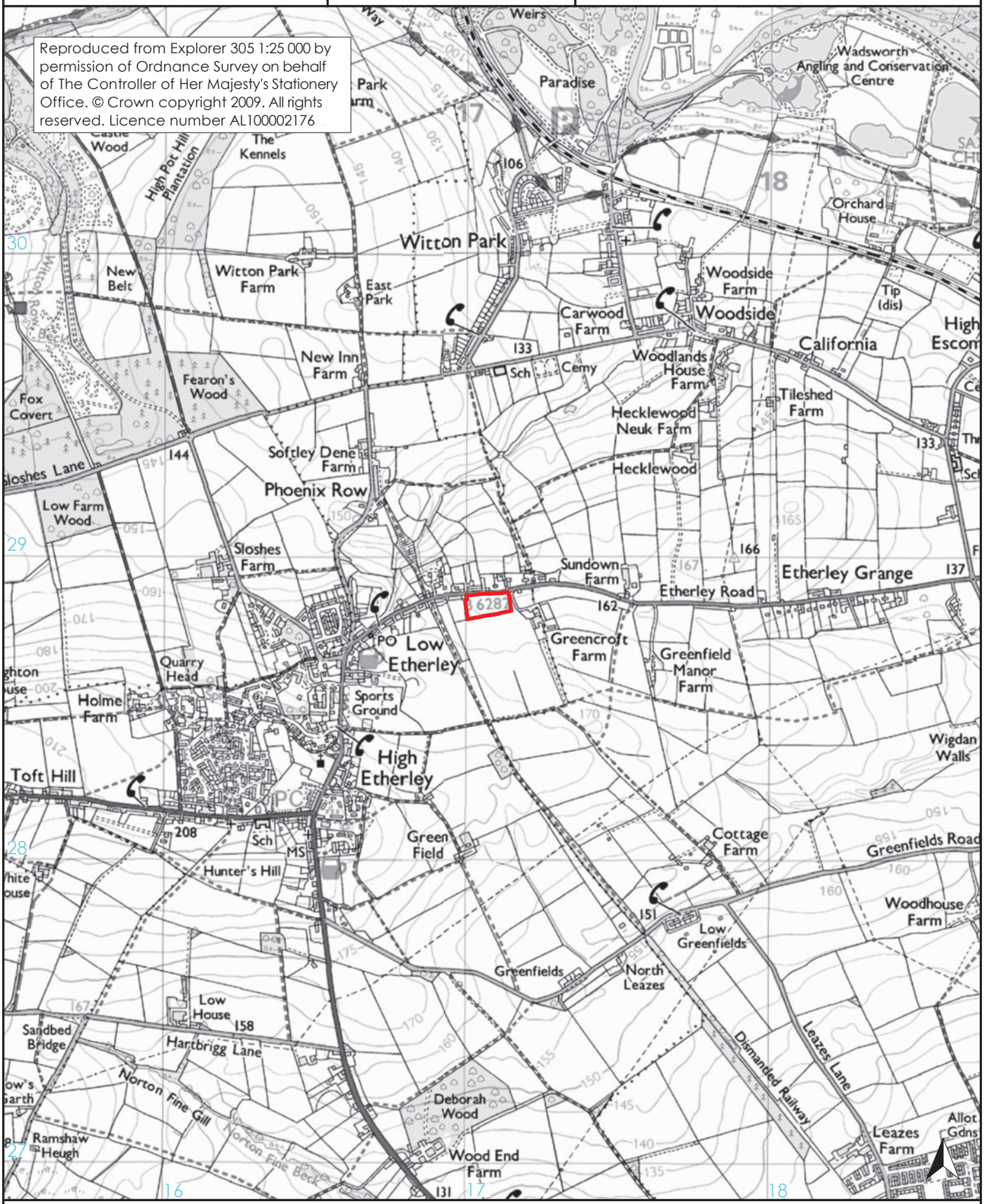
Figure 1: Site location



site location

0 800m
scale 1:17 500 for A4 plot

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Figure 2: Geophysical survey

0 50m
scale 1:1000 for A4 plot

magnetic survey

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Figure 3: Geophysical interpretation

0 50m
scale 1:1000 for A4 plot

magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly

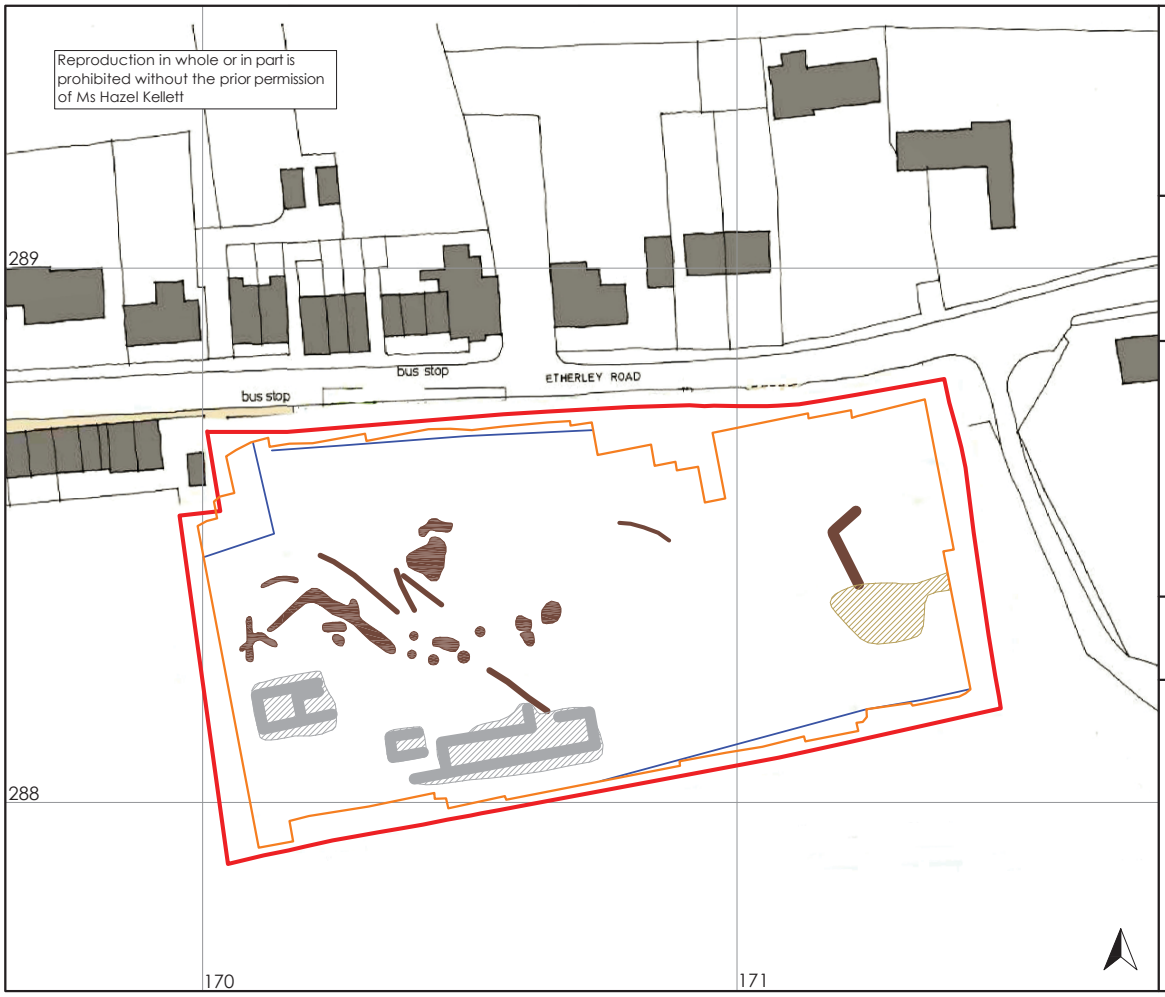

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Figure 4: Archaeological interpretation

0 50m
scale 1:1000 for A4 plot

- magnetic survey
- probable soil-filled features
- possible structural remains
- disturbed area
- fence

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Figure 5: Trace plot of geomagnetic data

0 50m
scale 1:1000 for A4 plot