ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Stainton Quarry Ltd

# Gayles Quarry
# North Yorkshire

# geophysical survey

report 5177
October 2019

Durham University

## Contents



## Figures





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# 1. Summary


## The project

1.1 This report presents the results of a geophysical survey conducted in advance of proposed development at Gayles Quarry, near Richmond in North Yorkshire. The works comprised approximately 3ha of magnetometer survey.

1.2 The works were commissioned by Stainton Quarry Ltd and conducted by Archaeological Services Durham University.

## Results

1.3 Probable post-medieval ridge and furrow cultivation has been detected.

1.4 Former field boundaries have been identified, as shown on historic Ordnance Survey maps.

1.5 The remains of possible soil-filled features have been identified.

## 2. Project background

**Location** (Figure 1)

2.1 The proposed development area (PDA) was located at Gayles Quarry, Gayles, approximately 7km north of Richmond in North Yorkshire (NGR centre: NZ 1270 0661). It was irregular in plan and covered an area of approximately 6.7 ha. The PDA is surrounded by agricultural land, with an unnamed road to the east and a plantation to the west.

2.2 Surveys totalling approximately 3ha were conducted across all practicable parts of the PDA, comprising pasture land to the east, south and west of the former quarry.

**Development proposal**

2.3 It is proposed to re-open the quarry for the extraction of sandstone and the crushing of sandstone waste to produce aggregate.

**Objective**

2.4 The aim of the survey was to assess the nature and extent of any sub-surface features of potential archaeological significance within the survey 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.

2.5 The *Yorkshire Archaeological Research Framework: research agenda* (Roskams & Whyman 2007) contains an agenda for archaeological research in the region, which is incorporated into regional planning policy implementation. In this instance, the scheme of works was designed to address research priorities for the later prehistoric, Roman and post-medieval periods.

**Methods statement**

2.6 The surveys have been undertaken in accordance with instructions from the client and national standards and guidance (see para. 5.1 below).

**Dates**

2.7 Fieldwork was undertaken on 24th September 2019. This report was prepared for October 2019.

**Personnel**

2.8 Fieldwork was conducted by Mark Woolston-Houshold and Richie Villis. Geophysical data processing and report preparation was by Richie Villis, with illustrations by Janine Watson. This report was edited by Duncan Hale, the Project Manager.

**Archive/OASIS**

2.9 The site code is **GAQ19**, for **GA**yles **Q**uarry 20**19**. The survey archive will be retained at Archaeological Services Durham University and a copy 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 **archaeol3-370080**.

**Acknowledgements**

2.10 Archaeological Services Durham University is grateful for the assistance of the landowners in facilitating this scheme of works.

## 3. Historical and archaeological background

3.1 A detailed archaeological desk-based assessment has been conducted for the proposed development (Archaeological Services 2019); the results of that assessment are summarised here.

3.2 There is no direct evidence for prehistoric or Roman activity within the PDA, but the presence of activity in the vicinity indicates that an as yet unidentified resource has the potential to exist within the PDA.

3.3 The PDA would have been part of Gayles Common in the medieval period and may have been used for farming. It is unlikely that any remains relating to medieval settlement are present within the site. It is possible that evidence for medieval ploughing survives below-ground. Any such evidence would be of limited significance.

3.4 The PDA was enclosed in the 18th century and the land was used for cultivation. The remains of slight ridge and furrow earthworks relating to this use are apparent across part of the site. There are also earthwork remains of field boundaries and stone gateposts/boundary markers which are likely to date from this period.

3.5 A quarry was established on the site by the later 18th century and was operational until the early 20th century. The extraction area and spoilheaps survive as earthworks. A stone bridge for a footpath leading into the quarry also survives. No archaeological resource from previous periods will survive in the extraction area.

## 4. Landuse, topography and geology

4.1 At the time of survey the PDA comprised a former quarry and pasture land. Geophysical survey was conducted across all practicable land not subjected to previous quarrying activity, which comprised several small areas of pasture land to the east, south and west of the former quarry with broken hedgelines, gorse bushes and tumbled down former drystone walls. Many parts of the area proved unsuitable for survey due to dense gorse bushes or other thick vegetation.

4.2 The PDA sloped downwards from 269m OD in the south-west to 246m OD in the north-east. The ground levels across the former quarry vary between 253m OD and 246m OD. The site is within Natural England’s National Character Area 21: Yorkshire Dales. This area is in the Pennine uplands with exposed moorland and sheltered valleys or dales. In the dales the environment is sheltered with walled fields, containing meadow grasses and wild flowers. Small villages and farmsteads, built from local stone are often surrounded by clumps of trees. There are stone field barns scattered across the area with sparse woodlands and occasional open rock scree (Natural England 2013).

4.3 The underlying solid geology of the area comprises Carboniferous sandstone of the Alston Formation, which is overlain by Devensian till.

# 5. Geophysical survey

## Standards

5.1 The surveys and reporting were conducted in accordance with Historic England guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Chartered Institute for Archaeologists (CIfA) *Standard and Guidance for archaeological geophysical survey* (2014); the CIfA 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 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 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 Magnetic gradient measurements were determined using a Sensys Magneto MX V3 multi-sensor magnetometer survey system towed by a quad-bike. Eight FGM650/3 fluxgate gradiometer sensors were mounted at 0.5m intervals, logging data at less than 0.08m intervals along traverses, providing high density data collection.

5.6 Data collection point locations were recorded in relation to the Ordnance Survey (OS) National Grid using an integrated global navigation satellite system (GNSS) with real-time kinematic (RTK) correction typically providing 5-10mm accuracy.

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 Sensys MonMX, DLMGPS and MagnetoARCH software were used to record and display gradient and positional data and to create a matrix of gridded values at 0.2m by 0.2m intervals. TerraSurveyor software was then used to produce a continuous tone greyscale image and a trace plot of the raw (minimally processed) data and to produce a continuous tone greyscale image of filtered data. The greyscale images and trace plot are presented in Figures 2-4; the interpretations are presented in Figures 5-6. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla.

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

| | |
|---|---|
| *clip* | clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic |
| *de-spike* | locates and suppresses iron spikes in gradiometer data |
| *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 0.1m x 0.1m intervals |

5.10 The following filter has been applied to the magnetic data (Figure 3):

| | |
|---|---|
| *low pass filter* | (applied with Gaussian weighting) to remove high frequency, small-scale spatial detail; for enhancing larger weak features and smoothing data |

**Interpretation: anomaly types**

5.11 A colour-coded geophysical interpretation plan is provided. Three types of magnetic 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 |
| *negative magnetic* | regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids |
| *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**

5.12 A colour-coded archaeological interpretation plan is provided. For ease of reference, anomaly numbers shown bold in the text below (eg **a**, **b**, etc) are also shown on the archaeological interpretation plan.

5.13 Series of parallel, relatively closely spaced, alternate positive and negative magnetic anomalies have been detected across the survey area on a broadly north-east/south-west alignment. These correspond to features noted on Google Earth aerial photographs and almost certainly reflect the remains of post-medieval ridge and furrow cultivation.

5.14 A former field boundary is recorded on OS maps in the south-eastern part of the survey area (**a**), with the same orientation as the ridge and furrow. A narrow positive magnetic anomaly detected there probably reflects the former boundary rather than the former ridge and furrow cultivation. A second former field boundary has been identified in the north-west of the survey (**b**).

5.15 Several weak and diffuse linear and curvilinear positive magnetic anomalies have been detected in the northern part of the survey area (**c**). These could reflect the remains of sub-surface soil-filled ditches. However, Google Earth aerial photographs show some gorse bushes and probable animal tracks here, which also broadly correspond to these anomalies.

5.16 A strong positive magnetic anomaly has been detected in the north-western corner of the survey area (**d**). This could reflect part of a soil-filled ditch, just clipping the surveyable area.

5.17 Very narrow, linear, positive and negative magnetic anomalies detected in the eastern part of the survey area correspond to earthwork gullies noted on the ground.

5.18 Small, discrete dipolar magnetic anomalies have been detected across the survey area. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plan, however, they have been omitted from the archaeological interpretation plan.

5.19 Larger and stronger dipolar magnetic anomalies probably reflect larger pieces of ferrous waste. Google Earth aerial photographs show recent temporary enclosures or animal pens in the vicinity of one such anomaly. A second large dipolar magnetic anomaly detected in the centre of the area could reflect an infilled hollow or exploratory hole. A chain of dipolar magnetic anomalies has been detected to the south of the former quarry; this almost certainly reflects a service.

## 6. Conclusions

6.1 Approximately 3ha of magnetometer survey was undertaken at Gayles Quarry, North Yorkshire, prior to the proposed re-opening of the sandstone quarry.

6.2 Probable post-medieval ridge and furrow cultivation has been detected.

6.3 Former field boundaries have been identified, as shown on historic Ordnance Survey maps.

6.4 The remains of possible soil-filled features have been identified.

# 7. Sources


Archaeological Services 2019 *Gayles Quarry, North Yorkshire: archaeological desk-based assessment and heritage statement*. Unpublished report **5108**, Archaeological Services Durham University

CIfA 2014 *Standard and Guidance for archaeological geophysical survey*. Chartered Institute for Archaeologists

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

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

Natural England, 2013 *National Character Area 21. Yorkshire Dales*

Roskams, S, & Whyman, M, 2007 *Yorkshire Archaeological Research Framework: research agenda*. RFRA **2936**

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

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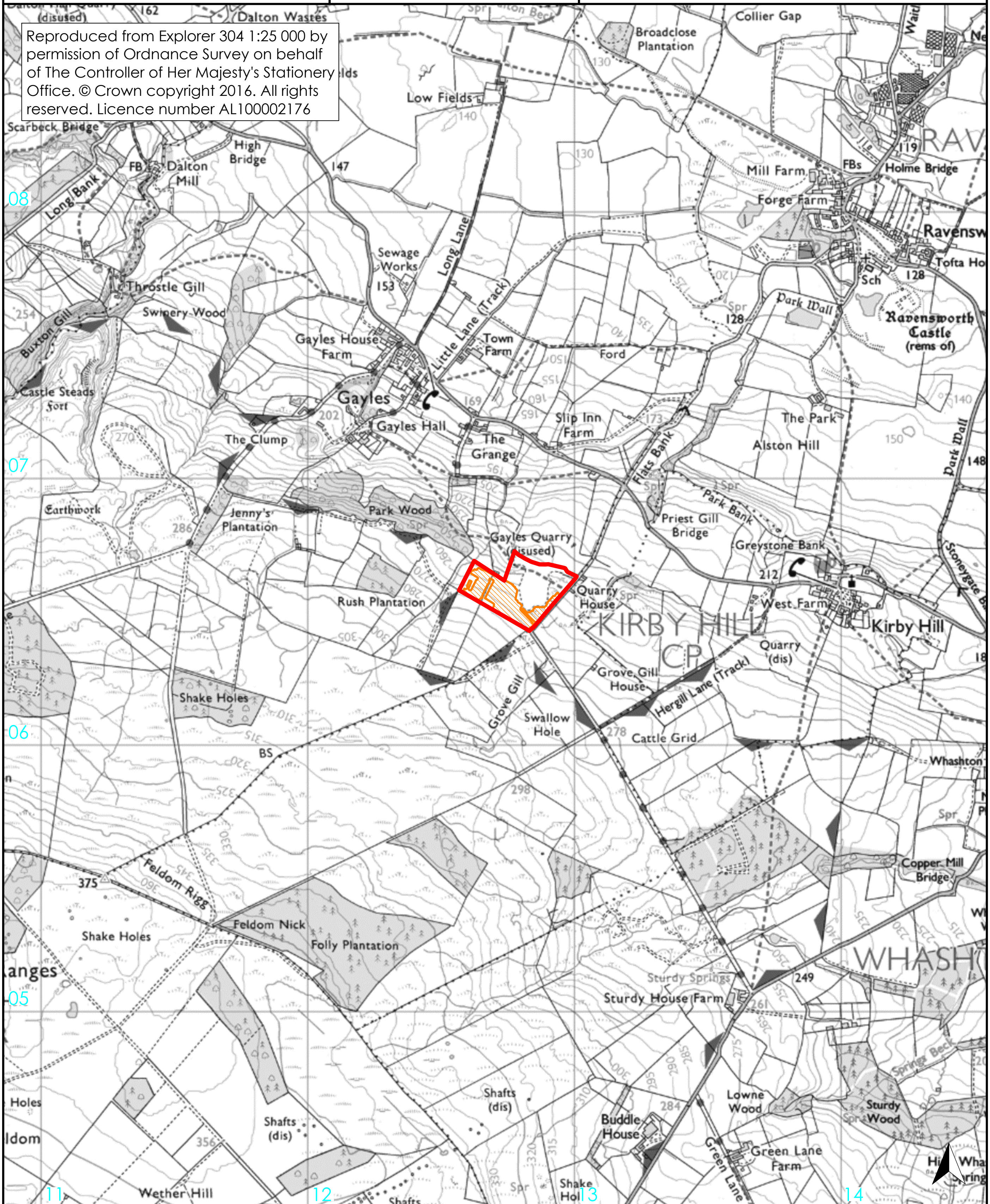
Figure 1: Site location






site location

magnetometer survey

0 — 1km
scale 1:20 000 for A4 plot

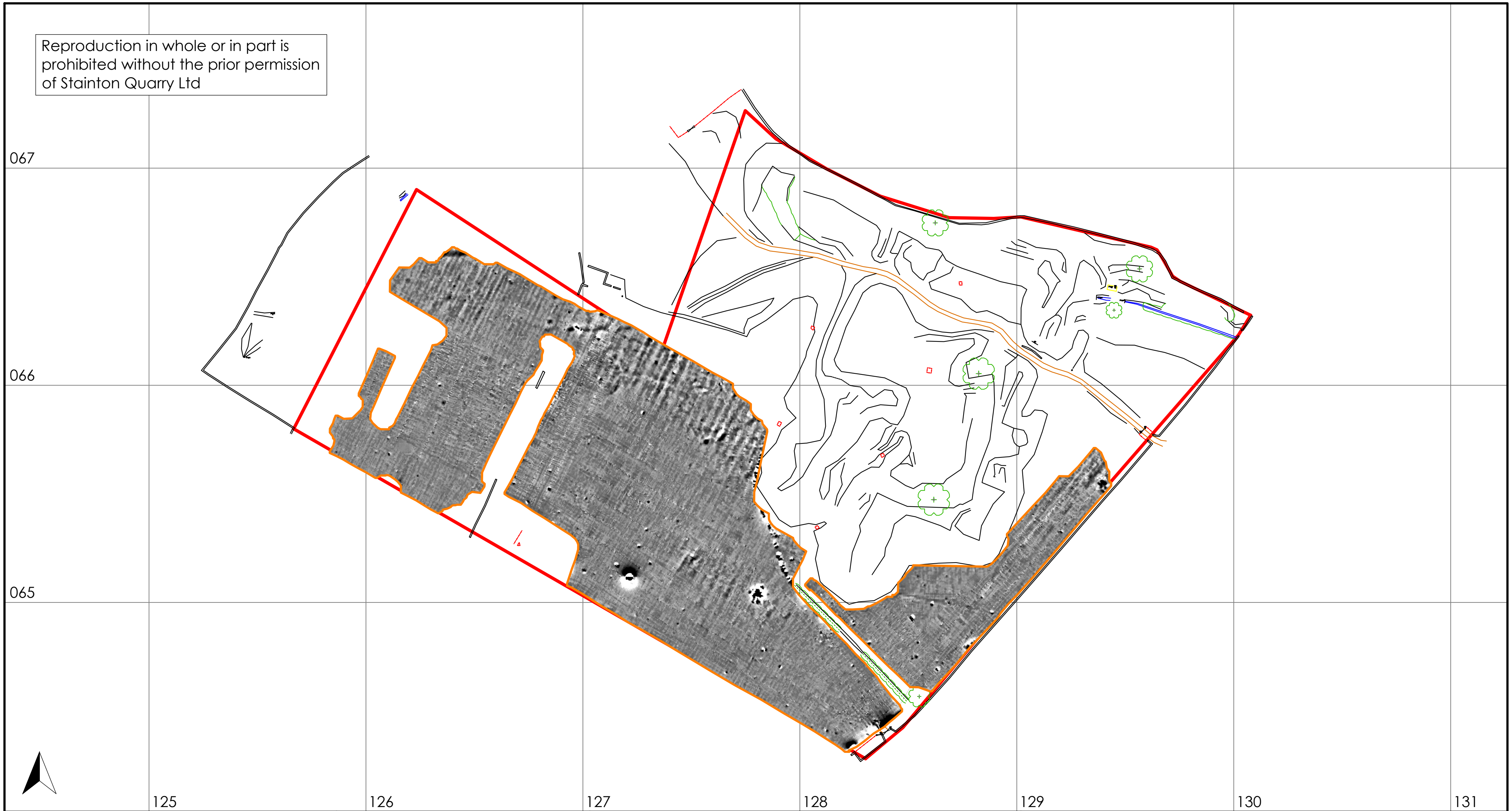



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Figure 2: Magnetometer overview

site boundary

magnetic survey

-4 nT 6

0 100m

scale 1:2500 for A4 plot

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Figure 3: Magnetometer survey (filtered data)

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40.00nT/cm

0 50m
scale 1:1250 for A3 plot

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Figure 4: Trace plot of magnetometer data

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- site boundary
- magnetic survey
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly

0 — 50m
scale 1:1250 for A3 plot

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Figure 5: Geophysical interpretation

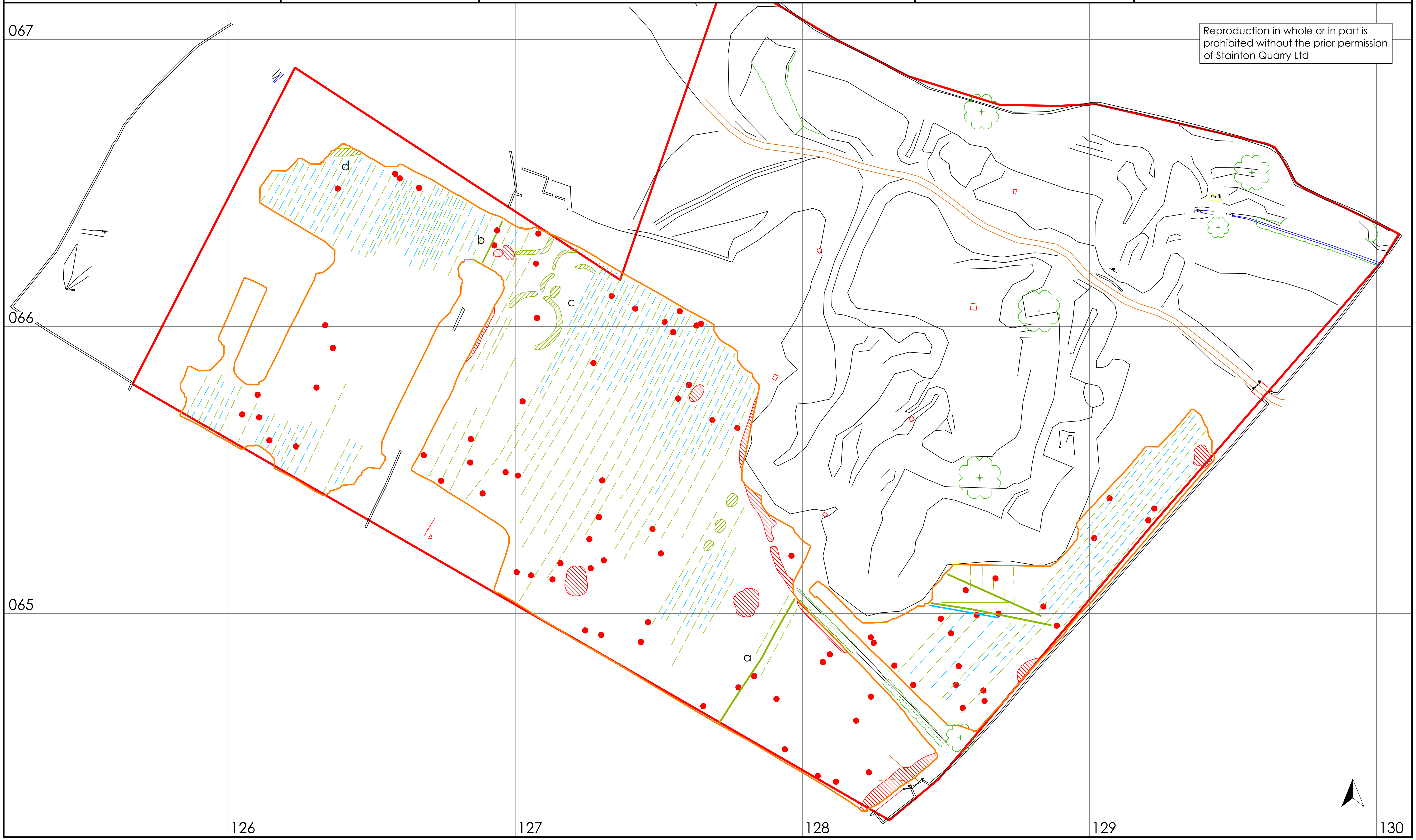

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Figure 6: Archaeological interpretation