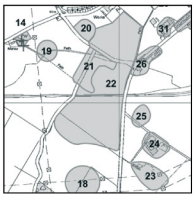
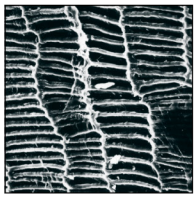
HCQC19










HIGH CLOSE QUARRY, ASPATRIA,CUMBRIA

GEOPHYSICAL SURVEY REPORT

PLANNING REF. 2/19/9010 & 2/19/9011

commissioned by Stephenson Halliday
on behalf of Thomas Armstrong (Aggregates) Ltd

January 2020

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

HIGH CLOSE QUARRY, ASPATRIA,CUMBRIA

GEOPHYSICAL SURVEY REPORT

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January 2020

This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **HCQC19** / NGR **NY 1472 3811** / Parish **Plumbland** / Local Authority **Cumbria County Council** / OASIS Ref. **headland5-380017**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **David Harrison** / Fieldwork **Glyn Sheldrick, Richard McGregor Edwards** / Graphics **Beata Wieczorek-Oleksy, Sam Harrison**

Approved by **Sam Harrison** .....

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HEADLAND ARCHAEOLOGY

part of the RSK Group

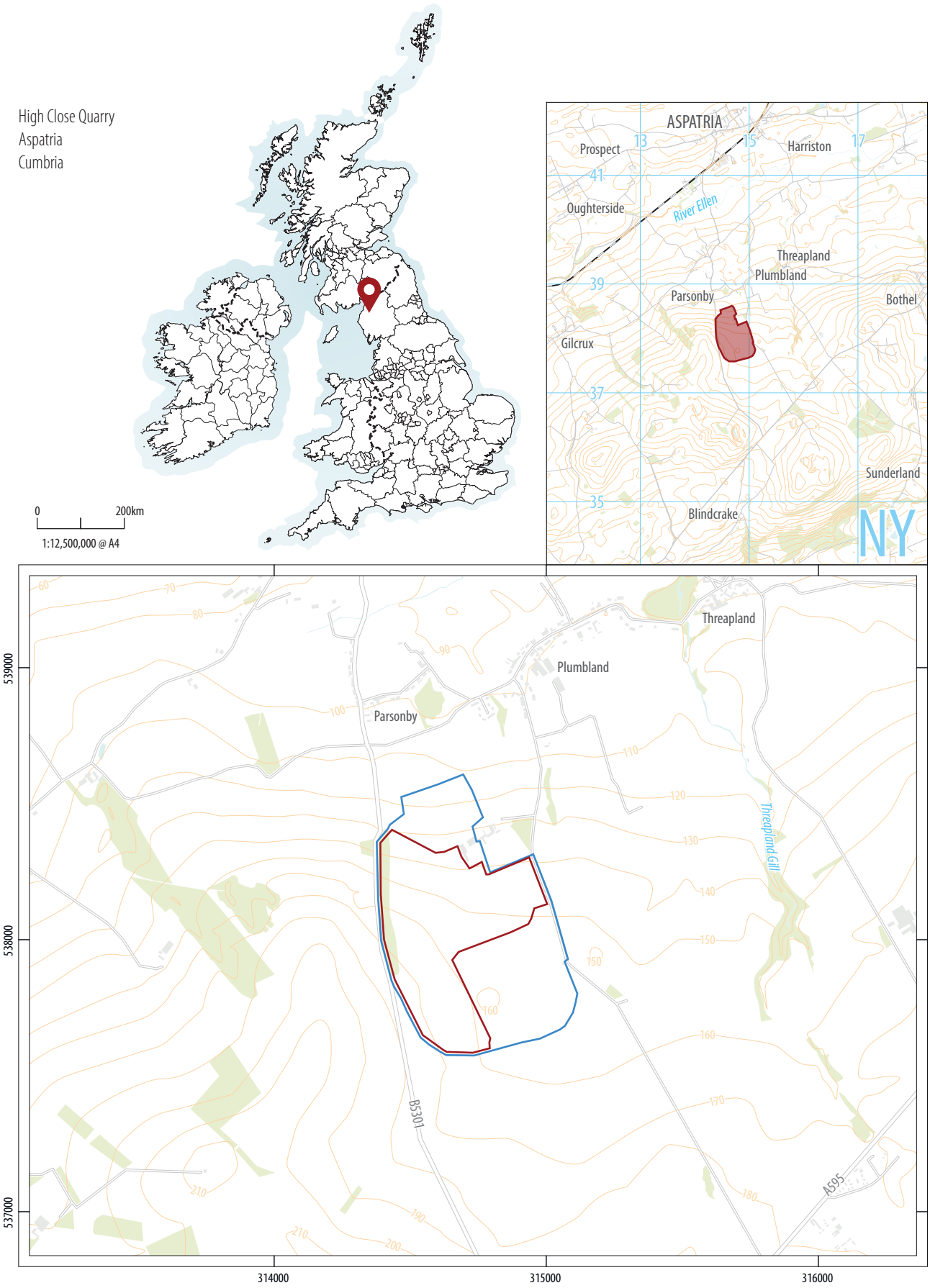
REGISTERED ORGANISATION CIfA

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 25 hectares on land at High Close Farm, near Aspatria, Cumbria, to inform planning for the reopening of a dormant limestone quarry (Planning Application Ref 2/19/9010 & 2/19/9011). The survey has identified a clear area of archaeological potential in the south of the application area comprising a sub-oval enclosure. The enclosure is located close to a cropmark of prehistoric or Romano-British origin which is recorded on the Cumbria Historic Environment Record (CHER Ref 3722) and is assessed as of high archaeological potential. Isolated high magnitude anomalies in the vicinity of the enclosure may be due to pits and are assessed as of moderate archaeological potential, whilst two particularly broad and high magnitude anomalies may indicate burning, although a modern origin cannot be discounted. An extensive area of magnetic disturbance in the north of the site clearly locates the extents of the former, infilled limestone quarry which is also recorded on the HER (Ref 10861). Elsewhere, anomalies have been identified which reflect the post medieval agricultural landscape in the form of ploughing and field drains. Therefore, on the basis of the geophysical survey, the majority of the application area is assessed as of low archaeological potential and locally high in the vicinity of the enclosure.

CONTENTS

LIST OF ILLUSTRATIONS



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ILLUS 1 Site location

HIGH CLOSE QUARRY, ASPATRIA,CUMBRIA

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Stephenson Halliday (the Agent), on behalf of Thomas Armstrong (Aggregates) Ltd (the Client) to undertake a geophysical survey on land at High Close Farm, near Aspatria, Cumbria, to inform planning for the reopening of a dormant limestone quarry (Planning Application Ref 2/19/9010 & 2/19/9011). The results of the survey will inform future archaeological strategy at the site.

The survey was undertaken in order to assess the impact of the proposed development on the historic environment and was undertaken in accordance with an Archaeological Written Scheme of Investigation (WSI) (Harrison 2019) which was submitted to, and approved by, Jeremy Parsons, Historic Environment Officer at Cumbria County Council, with guidance within the National Planning Policy Framework (MHCLG 2019) and in line with current best practice (Chartered Institute for Archaeologists 2014, Europae Archaeologia Consilium 2016).

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Application Area (AA) extends north and south of High Close Farm, 500m south-west of Plumbland, centred on NY 1471 3811 (Illus 1). It comprises an irregularly-shaped block of land over 42 hectares and is bound to the west by the B5301 (Parsonby Brow) and to the east by a minor road between Plumbland and the A595. The Geophysical Survey Area (GSA) covers only those fields (F1–F6) where extraction is proposed. Survey was restricted along the west of F1/F4 by a strip of trees and within F2 by overgrown vegetation (Illus 2).

Generally, the topography falls from the south and west being at 177m Above Ordnance Datum (AOD) in the south of F6 and at 130m AOD at High Close Farm. At the time of the survey the GSA was mostly under improved pasture.

The survey was carried out between the 10th and 13th December 2019.

1.2 GEOLOGY AND SOILS

The bedrock geology mostly comprises Fifth Limestone and includes a narrow band of sandstone running north/south through the east of the AA and a north/south band of Fourth Shale Member (sandstone, siltstone and mudstone) along the western site boundary (NERC 2019). Glacial till is recorded over the east of the AA with no superficial deposits recorded over F1, F2 or F4.

The soils are classified in the Soilscape 17 Association, characterised as slowly permeable, seasonally wet loams and clays (Cranfield University 2019).

2 ARCHAEOLOGICAL BACKGROUND

An Archaeological Desk-Based Assessment (Fox 2017) identified three heritage assets within the AA comprising a cropmark enclosure of prehistoric or Romano-British date (CHER 3722), a quarry and lime kilns dating from the early nineteenth century or earlier (CHER 10861), and areas of ridge and furrow cultivation (Illus 5).

ILLUS 2 F2, looking north

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide enough information to establish the presence/absence, character and extent of any archaeological remains within the GSA. This will therefore enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the likely presence/absence and extent of any buried archaeological features; and
- to produce a comprehensive site archive and report.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc) software was used to collect and export the data. Terrasurveyor V3.0.35.1 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:20,000. Illus 2–4 are site condition photographs. Illus 5 is a 1:4,000 survey location plan showing the direction of survey as GPS swaths. The data is presented in greyscale and XY trace formats, at a scale of 1:2,500, in Illus 6 and Illus 7. Illus 8 is an interpretation plot of the data also at a scale of 1:2,500.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

ILLUS 3 F3, looking west

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Harrison 2019), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (ClfA 2014). All illustrations from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

Ground conditions were good throughout the GSA and have contributed to a high standard of data throughout. A variable magnetic background has been detected across the survey area which is due to the magnetic susceptibility of the soils and the limestone bedrock from which they derive. Against this background several anomalies have been identified and cross-referenced to specific examples on the interpretation figure (Illus 8).

4.1 FERROUS ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being present as a result of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

Localised areas of magnetic disturbance in the south of F4 are caused by animal feeders/troughs.

Two high magnitude dipolar linear anomalies, SP1 and SP2, aligned north-west/south-east in the east of F3 locate buried service pipes. The larger dipolar linear anomaly, SP3, aligned north-east/south-west across the centre of the site locates a gas main.

Magnetic disturbance along the field edges is due to the presence of ferrous material within and adjacent to the field boundaries and is of no archaeological interest.

4.2 QUARRYING ANOMALIES

Magnetic disturbance dominates the survey data throughout F2. This is caused by the material used to infill the former limestone quarry.

4.3 AGRICULTURAL ANOMALIES

Series of faint parallel linear trends are identified throughout the GSA on various alignments. These are mostly aligned parallel with the existing field boundaries and are caused by post medieval and/or modern ploughing. Series of parallel trends throughout F3 are aligned oblique to the field boundaries and are indicative of modern land drainage.

A fragmented linear anomaly (FB1, Illus 8) can be seen north/south in F1 and F4 over 600m. The anomaly is aligned roughly parallel

ILLUS 4 F6, looking east

with Parsonby Brow which borders the AA to the west, and is thought to be due to a former field boundary pre-dating the first edition Ordnance Survey map (1866). The anomaly is caused by the soil-fill of a ditch.

4.4 GEOLOGICAL ANOMALIES

As previously mentioned, a variable magnetic background has been detected throughout the GSA. This manifests in the data as both frequent discrete areas of magnetic enhancement and as series of long, low magnitude sinuous trends. The latter are mostly aligned north/south in the western half of the GSA and follow the same alignment as the narrow bands of sandstone, siltstone and mudstone which are recorded by the British Geological Survey (NERC 2019).

4.5 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

A clear sub-oval enclosure, E1, has been identified in the east of F6 close to a cropmark of prehistoric or Romano-British origin which is recorded on the CHER (Ref 3722). The enclosure (centred on NY 1471 3772) measures 110m north/south and 43m east/west and is assessed as of high archaeological potential. Several discrete anomalies are identified in the interior of the enclosure which may be archaeological in origin. However, against the variable magnetic background it is difficult to confidently discriminate between discrete anomalies which may be due to archaeological activity, such as pits, and those that are probably due to localised geological variation. For this reason, most of the anomalies within E1 are ascribed a possible archaeological origin and those outside, except where the responses are particularly broad or high in magnitude (eg P1–P3), interpreted as of non-archaeological origin.

West of E1, isolated anomalies of particularly high magnitude (BU1 and BU2) may be caused by burning activity, perhaps kilns. However, no coherent pattern is discernible from the data and the anomalies could be caused by modern industrial activity. These anomalies are assessed as of moderate archaeological potential.

In the centre of F4 a clear rectilinear anomaly (D1) does not conform to the prevailing pattern of agricultural anomalies and therefore an archaeological cause should be considered. The anomaly is due to a soil-filled ditch and may be archaeological in origin.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey area and has identified a clear area of archaeological potential in the south of the site comprising a sub-oval enclosure. The enclosure is located close to a cropmark of prehistoric or Romano-British origin which is recorded on the Cumbria Historic Environment Record (CHER Ref 3722) and is assessed as of high archaeological potential. Isolated high magnitude anomalies in the vicinity of the enclosure may be due to pits and are assessed as of moderate archaeological potential, whilst two particularly broad and high magnitude anomalies may indicate burning, although a modern origin cannot be discounted. An extensive area of magnetic disturbance in the north of the site clearly locates the extents of the former, infilled limestone quarry which is also recorded on the HER (Ref 10861). Elsewhere, anomalies have been identified which reflect the post medieval agricultural landscape in the form of ploughing and field drains. Therefore, on the basis of the geophysical survey, the majority of the application area is assessed as of low archaeological potential and locally high in the vicinity of the enclosure.

6 REFERENCES

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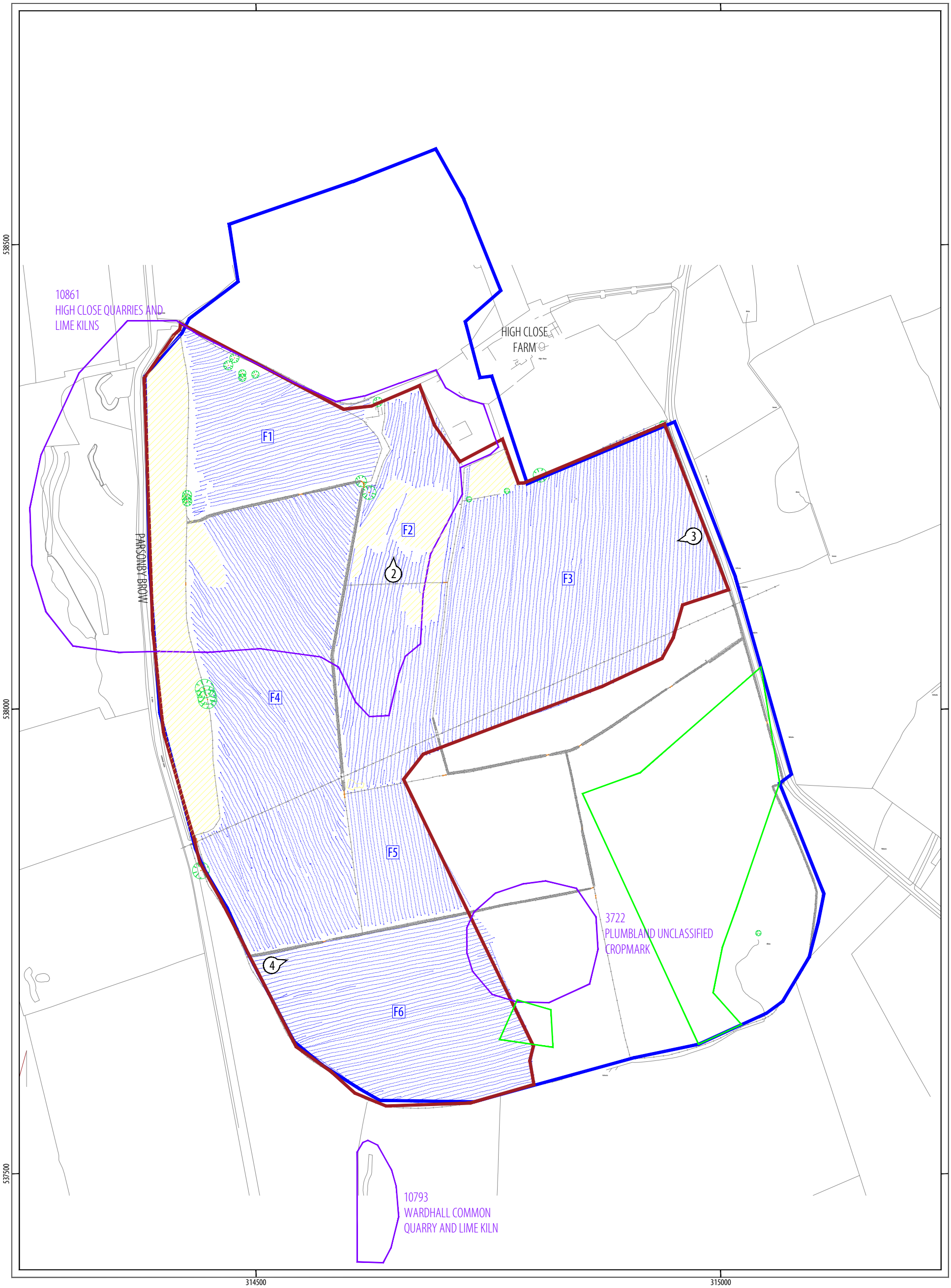

application area
geophysical survey area
GPS swaths
area unsuitable for survey
Cumbria HER data
ridge and furrow identified in DBA
location and direction of ILLUS 2–4

ILLUS 5 Survey location showing GPS swaths

0 100m
1:4,000 @ A3

PROJECT HCQC19
High Close Quarry
Aspatria
Cumbria

CLIENT Thomas Armstrong
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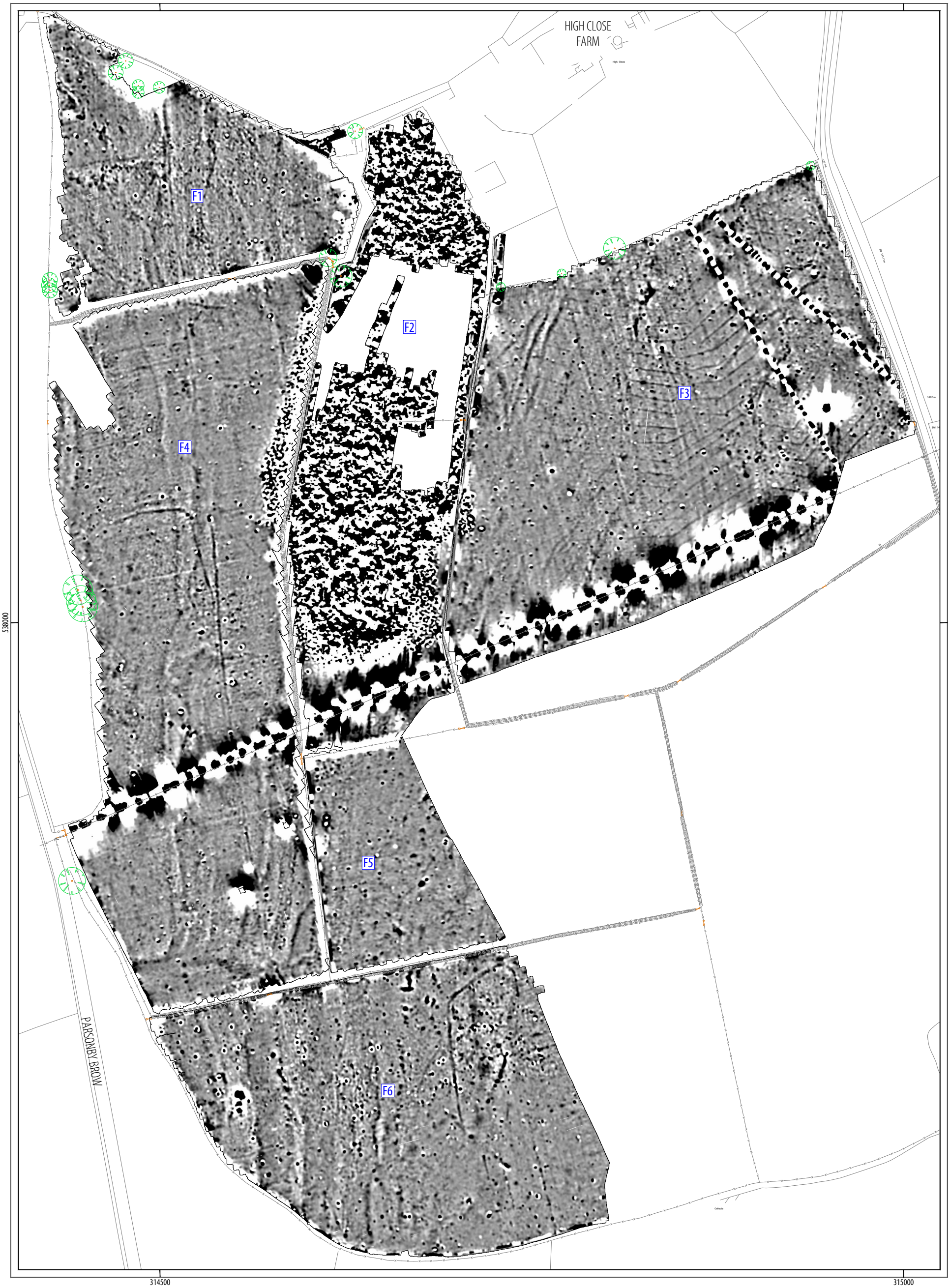

nT
-2.0 3.0

0 50m
1:2,500 @ A3

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Cumbria

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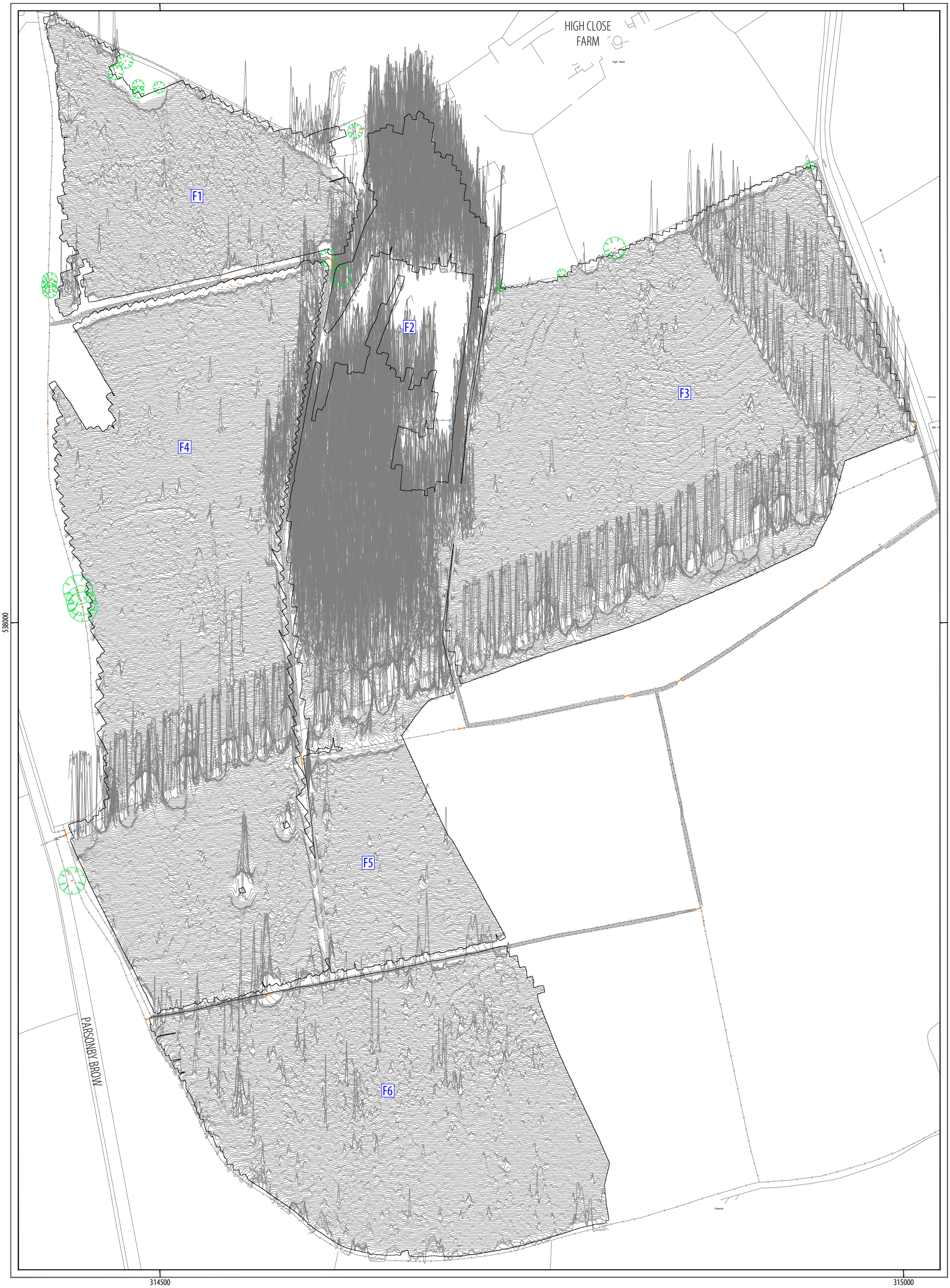
ILLUS 6 Processed greyscale magnetometer data



79.0nT/cm

0 50m

1:2,500 @ A3

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ILLUS 7 XY trace plot of minimally processed magnetometer data

HIGH CLOSE FARM

FB1
F1
F2
F3
F4
F5
F6
SP1
SP2
SP3
D1
P1
P2
P3
BU1
BU2
E1

PARSONBY BROW

538000

314500

315000

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
magnetic disturbance	quarrying
linear trend	agricultural
linear trend	field drain

TYPE OF ANOMALY	INTERPRETATION
linear	former field boundary?
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	kiln/burning
magnetic enhancement	archaeology

ABBREVIATIONS	
BU	burning?
D	ditch
E	enclosure
FB	former boundary
P	pit
SP	service pipe

0 50m
1:2,500 @ A3

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Cumbria

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ILLUS 8 Interpretation of magnetometer data

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes) These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Lightning-induced remnant magnetisation (LIRM) LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical currents associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

Linear trend This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-380017

PROJECT DETAILS	
Project name	High Close Quarry, Aspatria
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 25 hectares on land at High Close Farm, near Aspatria, Cumbria, to inform planning for the reopening of a dormant limestone quarry (Planning Application Ref 2/19/9010 and 2/19/9011). The survey has identified a clear area of archaeological potential in the south of the application area comprising a sub-oval enclosure. The enclosure is located close to a cropmark of prehistoric or Romano-British origin which is recorded on the Cumbria Historic Environment Record (CHER Ref 3722) and is assessed as of high archaeological potential. Isolated high magnitude anomalies in the vicinity of the enclosure may be due to pits and are assessed as of moderate archaeological potential, whilst two particularly broad and high magnitude anomalies may indicate burning, although a modern origin cannot be discounted. An extensive area of magnetic disturbance in the north of the site clearly locates the extents of the former, infilled limestone quarry which is also recorded on the HER (Ref 10861). Elsewhere, anomalies have been identified which reflect the post medieval agricultural landscape in the form of ploughing and field drains. Therefore, on the basis of the geophysical survey, the majority of the application area is assessed as of low archaeological potential and locally high in the vicinity of the enclosure.
Project dates	Start: 10-12-2019 End: 13-12-2019
Previous/future work	Not known / Not known
Any associated project reference codes	HCQC19 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 5 - Character undetermined
Monument type	None
Monument type	None
Significant Finds	None
Significant Finds	None
Methods & techniques	"Geophysical Survey"
Development type	Mineral extraction (eg sand, gravel, stone, coal, ore, etc)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Fifth Limestone and includes a narrow band of sandstone running north/south through the east of the AA and a north/south band of Fourth Shale Member (sandstone, siltstone and mudstone) along the western site boundary
Drift geology	Glacial sand and gravel
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	Cumbria allerdale plumbland High Close Quarry, Aspatria, Cumbria
Study area	25 Hectares
Site coordinates	NY 1472 3811 54.730621377481 -3.324465526267 54 43 50 N 003 19 28 W Polygon

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Headland Archaeology

Project design originator	Headland Archaeology
Project director/manager	Harrison, S
Project supervisor	McGregor Edwards, R.
Type of sponsor/funding body	Developer

PROJECT ARCHIVES

Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	'other'
Digital Media available	'Geophysics','Images raster / digital photography','Images vector'
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1

Publication type	Grey literature (unpublished document/manuscript)
Title	High Close Quarry, Aspatria, Cumbria
Author(s)/Editor(s)	Harrison, D.
Other bibliographic details	HCQC19
Date	2020
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 Glue bound report and PDF/A

Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	9 January 2020

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