

**GEOPHYSICAL SURVEY  
OF LAND AT  
LOW PLAINS QUARRY,  
LAZONBY,  
PENRITH, CUMBRIA**

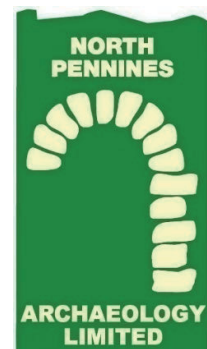
**GEOPHYSICAL SURVEY REPORT**

**CP. No: 947/09**

**11/06/2009**

NORTH PENNINES ARCHAEOLOGY LTD  
NENTHEAD MINES HERITAGE CENTRE,  
NENTHEAD,  
ALSTON,  
CUMBRIA,  
CA9 3PD

TEL/FAX: (01434) 382045/043  
WWW.NPARCHAEOLOGY.CO.UK



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### *Quality Assurance*

This report covers works as outlined in the brief for the above-named project as issued by the relevant authority, and as outlined in the agreed programme of works. Any deviation to the programme of works has been agreed by all parties. The works have been carried out according to the guidelines set out in the Institute for Archaeologists (IfA) Standards, Policy Statements and Codes of Conduct. The report has been prepared in keeping with the guidance set out by North Pennines Archaeology Ltd on the preparation of reports.

<b>REVISION SCHEDULE</b>			
	<b>01</b>	<b>02</b>	<b>03</b>
<b>PREPARED BY:</b>	Angus Clark		
<b>POSITION:</b>	Geophysics Assistant		
<b>DATE:</b>	11/6/2009		
<b>EDITED BY:</b>	Martin Railton		
<b>POSITION:</b>	Project Manager		
<b>DATE:</b>	11/6/2009		
<b>APPROVED BY:</b>	Matthew Town		
<b>POSITION:</b>	Project Manager		
<b>DATE:</b>	11/6/2009		

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FIGURE 3: GEOPHYSICAL SURVEY

FIGURE 4: GEOPHYSICAL INTERPRETATION

FIGURE 5: ARCHAEOLOGICAL INTERPRETATION

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## SUMMARY

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In June 2009, North Pennines Archaeology Ltd, commissioned by Tarmac Limited, undertook geophysical surveys of land adjacent to Low Plains Quarry, Lazonby, Penrith (centred on Ordnance Survey grid reference NY 4997 4166), prior to the extension of the quarry.

It is believed that archaeological remains could survive at the site, including possible prehistoric features. A number of pits and ditches of possible prehistoric date have previously been revealed during topsoil stripping immediately to the south of the present survey area.

The objective of the geophysical survey was to determine the presence/absence, nature and extent of potential archaeological features within the study area, and the presence/absence of any known modern features within the survey area, which may affect the results.

Geomagnetic survey covering c.1.6ha of land was conducted within one pastoral field adjacent to the northern boundary of the Low Plains Quarry site. A wire fence bound the survey area and this was detected as an area of dipolar magnetic anomalies along the southern side of the survey area and a small section to the north.

The geomagnetic surveys detected a small number of positive magnetic anomalies, which have been interpreted as possible soil filled features, and a number of positive and negative magnetic anomalies that are believed to be related to the sites varied topography and local geology.

Given the results of the geophysical surveys no further survey work is recommended. It is expected the site will be monitored during the stripping of topsoil prior to further extraction of sands and gravels from the site.

## ACKNOWLEDGEMENTS

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North Pennines Archaeology Ltd would like to thank Alan Scally, Tarmac Limited, for commissioning the project, and for all assistance throughout the survey.

The geophysical survey was undertaken by Angus Clark and Don O'Meara. The report was written and illustrated by Martin Railton, Project Manager for NPA Ltd and Angus Clark, Geophysics Assistant, NPA Ltd.

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## 1 INTRODUCTION

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### 1.1 CIRCUMSTANCES OF THE PROJECT (FIGURES 1 & 2)

- 1.1.1 In May 2009, North Pennines Archaeology Ltd, undertook a geophysical survey of land at Low Plains Quarry, Lazonby, Penrith, Cumbria at the request of Tarmac Limited. This followed a proposal by the client to extend the extraction area on the north side of the existing gravel quarry. The geophysical survey was undertaken as part of the archaeological evaluation of the site, prior to the proposed development taking place. This was in line with government advice as set out in the DoE Planning Policy Guidance on Archaeology and Planning (PPG 16).
- 1.1.2 The study area comprised of a single field of pasture land to the north of Low Plains Farm, and east of Blackrack Beck, measuring c.1.6ha in total (Figure 2). It was bounded by the existing gravel quarry to the south, Blackrack Beck to the west, and field boundaries to the north and east. (Figure 1). The site is centred on Ordnance Survey grid reference NY 4997 4166.
- 1.1.3 It is believed that archaeological remains could survive at the site, including possible prehistoric features. A number of pits and ditches of possible prehistoric date have previously been revealed during topsoil stripping immediately to the south of the present survey area.
- 1.1.4 The objective of the geophysical surveys was to determine the presence/absence, nature and extent of potential archaeological features within the survey area, and the presence/absence of any known modern features within the survey area, which may affect the results. The results of the project were to be used to inform the need for further archaeological work, or mitigation measures, should potential significant archaeological remains be identified during the project.
- 1.1.5 This report outlines the results of the geophysical surveys undertaken, and includes an interpretation of the geophysical survey results, in light of the archaeological and historical background of the site, with recommendations for further work where necessary.

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## 2 METHODOLOGY

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### 2.1 STANDARDS

2.1.1 The work was consistent with the relevant standards and procedures of the Institute for Archaeologists (IfA 2002), and English Heritage Guidelines (English Heritage 2008).

### 2.2 GEOPHYSICAL SURVEYS

2.2.1 *Technique Selection:* geomagnetic survey was selected as the most appropriate technique, given the non-igneous environment, and the expected presence of cut archaeological features at depths of no more than 1.5m. This technique involves the use of hand-held gradiometers, which measure variations in the vertical component of the earth's magnetic field. These variations can be due to the presence of sub-surface archaeological features. Data were recorded by the instruments and downloaded into a laptop computer for initial data processing in the field using specialist software.

2.2.2 *Field Methods:* the geophysical study area measured c.1.6ha. A 30m grid was established in this area, and tied-in to known Ordnance Survey points using a Trimble 3605DR Geodimeter total station with datalogger.

2.2.3 Geomagnetic measurements were determined using a Bartington Grad601-2 dual gradiometer system, with twin sensors set 1m apart. It was expected that significant archaeological features at a depth of up to 1.5m would be detected using this arrangement. The survey was undertaken using a zig-zag traverse scheme, with data being logged in 30m grid units. A sample interval of 0.25m was used, with a traverse interval of 1m, providing 3600 sample measurements per grid unit. The data were downloaded on site into a laptop computer for processing and storage.

2.2.4 *Data Processing:* geophysical survey data were processed using ArchaeoSurveyor II software, which was used to produce 'grey-scale' images of the raw data. Positive magnetic anomalies are displayed as dark grey, and negative magnetic anomalies are displayed as light grey. A palette bar shows the relationship between the grey shades and geomagnetic values in nT.

2.2.5 Raw data were processed in order to further define and highlight the archaeological features detected. The following basic data processing functions were used:

*Despike:* to locate and suppress random iron spikes in the gradiometer data.



*Clip:* to clip data to specified maximum and minimum values, in order to limit large noise spikes in the geophysical data.

*Destagger:* to reduce the effect of staggered gradiometer data, sometimes caused by difficult working conditions, topography, or operator error.

*Interpolate:* to match the traverse and sample intervals in the geophysical data.

2.2.6 **Interpretation:** three types of geophysical anomaly were detected in the gradiometer data:

*positive magnetic:* regions of anomalously high or positive magnetic data, which may be associated with the presence of high magnetic susceptibility soil-filled features, such as pits or ditches.

*negative magnetic:* regions of anomalously low or negative magnetic data, which may be associated with features of low magnetic susceptibility, such as stone-built features, geological features, land-drains or sub-surface voids.

*dipolar magnetic:* regions of paired positive and negative magnetic anomalies, which typically reflect ferrous or fired materials, including fired/ferrous debris in the topsoil, modern services, metallic structures, or fired structures, such as kilns or hearths.

2.2.7 **Presentation:** the grey-scale images were combined with site survey data and Ordnance Survey data to produce the geophysical survey plan. A colour-coded geophysical interpretation diagram is provided, showing the locations and extent of positive, negative, and dipolar geomagnetic anomalies.

2.2.8 An archaeological interpretation diagram is provided, which is based on the interpretation of the geophysical survey results, in light of the archaeological and historical background of the site.

## 2.3 ARCHIVE

2.3.1 The data archive for the geophysical survey has been created in accordance with the recommendations of the Archaeology Data Service (ADS 2001). This archive is currently held at the company offices at Nenthead, Cumbria.

2.3.2 One copy of the final report will be deposited with the County Historic Environment Record, where viewing will be available on request. The project is also registered with the Online Access to the Index of archaeological investigationS (OASIS), where a digital copy of the report will be made available.

2.3.3 The OASIS reference for this project is **northpen3-60642**

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## 3 BACKGROUND

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### 3.1 LOCATION AND GEOLOGICAL CONTEXT

- 3.1.1 Low Plains Quarry lies approximately 0.5km to the south of Armathwaite and west of Lazonby, within the Eden Valley, east of the Pennines. The area is characterized by a blend of mixed farmland with woodland, mature hedgerows, and drystone walls with distinctive villages constructed of red sandstone or limestone. The valley contains some of the richest agricultural land in Cumbria (Countryside Commission 1998, 38). The site lies at a height of approximately 120m AOD. The area at the southern edge of the proposed extraction area has previously been worked as a gravel quarry.
- 3.1.2 The underlying geology is Permian New Red Sandstone and mudstones, overlain by glacial deposits of boulder clay (British Geological Survey North Sheet, First Edition Quaternary, 1977). The overlying soils are known as Wick 1 soils, which are deep well-drained loamy or sandy soils, locally over gravel (SSEW 1980).

### 3.2 HISTORICAL CONTEXT

- 3.2.1 *Introduction:* this historical background is based on a rapid review of published material and the online consultation of the Cumbria County Council Historic Environment Record (HER). It is intended only as a summary of the known archaeological background of the site.
- 3.2.2 *Prehistoric:* there is good evidence that the surrounding area was occupied in the later prehistoric periods. Neolithic, Bronze Age and Iron Age sites have been identified close to the quarry, including on the nearby Lazonby Fell. A possible Iron Age or Romano-British enclosure on Blaze Fell (HER 728) is located c.1km to the north of the proposed development area. A number of unclassified cropmarks have also been identified on air photographs of the area (LUAU 2000).
- 3.2.3 Prehistoric activity has also been identified at the quarry site. Four Bronze Age cremations were revealed during previous quarrying 500m to the southwest of the survey area (HER 41936). Two possible Bronze Age burnt mounds have also discovered. A number of pits and ditches of possible prehistoric date were also identified during topsoil stripping immediately to the south of the survey area.
- 3.2.4 *Roman:* during the Roman period, there was a heavy military presence in Cumbria, and there is considerable evidence for Roman military activity in the area during this period. The proposed development area lies close to the

route of the A6 Roman road to Carlisle, which runs c.100m to the west of the site.

- 3.2.5 *Medieval*: little is known about medieval activity in the vicinity of the proposed development area, however it is likely that the area was used as agricultural land or for grazing during the medieval period.
- 3.2.6 *Post-medieval and Modern*: the proposed development area has remained agricultural land into the modern period, the most notable development in the area being the nearby gravel quarries.

### **3.3 PREVIOUS ARCHAEOLOGICAL WORK**

- 3.3.1 A number of excavations and investigations have occurred in the immediate area around Low Plains Quarry, including a number of desk-based assessments by the former Lancaster University Archaeological Unit.
- 3.3.2 In 2003, an area 500m to the southeast of the present gravel quarry was stripped under archaeological supervision by Oxford Archaeology North (OAN), however no archaeological features were identified. During quarrying to the north of this area in 2004, four Bronze Age cremations were discovered, and were subject to archaeological excavation. Further monitoring was undertaken during topsoil stripping to the east of the cremations, but no further features were revealed.
- 3.3.3 During monitoring of topsoil stripping immediately to the south of the present survey area in 2007, a number of archaeological features were identified, including two possible Bronze Age burnt mounds. A number of pits and ditches were also identified, which were interpreted as prehistoric (OAN 2007).

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## 4 THE GEOPHYSICAL SURVEYS

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### 4.1 INTRODUCTION (FIGURE 2)

- 4.1.1 The geophysical survey was undertaken on the 9<sup>th</sup> June 2009. Geomagnetic survey was undertaken over the majority of the study area (Figure 2).
- 4.1.2 The survey area was bounded by wire fences that produced strong dipolar magnetic anomalies around the periphery of the survey area, most notably along the northern and southern boundary.
- 4.1.3 Small discrete dipolar magnetic anomalies were detected across the whole of the study area. These are almost certainly caused by fired/ferrous litter in the topsoil, which is typical for modern agricultural land. These anomalies are indicated on the geophysical interpretation drawing, but not referred to again in the subsequent interpretation.
- 4.1.4 The topography of the survey area was very varied, a hill occupied the centre of the survey area. The ground sloped steeply downhill to the east of this before rising again to form a steep-sided valley at the eastern end of the survey area. At the northern corner of the site was a steep slope that could not be surveyed. At the base of the slope was a number of old tyres and large boulders that are believed to be cumulatively responsible for the area of dipolar magnetic anomalies in this part of the survey area.

### 4.2 GEOPHYSICAL SURVEY AREA (FIGURES 3-5)

- 4.2.1 A number of irregular weak positive and negative magnetic anomalies were detected in the centre of the survey area which coincide with the plateau of the hill. These irregular anomalies are probably an effect of the varied topography and geology of the site.
- 4.2.2 A broad linear positive magnetic anomaly was detected to the south east of the survey area running north to south along the bottom of the valley. This was interpreted as a possible soil filled feature, but could also be a result of the varied topography and geology.
- 4.2.3 Three weak linear positive magnetic features were detected to the east of the survey area and are aligned north south. These may be possible soil filled features. A curvilinear positive magnetic anomaly surrounding a weak negative magnetic anomaly was also detected in the south west corner of the survey area. This again is believed to be a possible soil filled feature.

### **4.3 DISCUSSION (FIGURE 5)**

- 4.3.1 A number of weak positive and negative magnetic anomalies were detected in the centre of the survey area and are believed to be the effects of the varied topography and local geology.
- 4.3.2 The three weak linear positive magnetic anomalies detected to the east, aligned north south, a broad linear positive magnetic anomaly to the southeast, and a curvilinear positive magnetic anomaly to the southwest are believed to be possible soil filled features. These soil filled features could be related to the prehistoric features uncovered by previous excavation directly to the south of the survey area. However this will only be confirmed by excavation.

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## 5 CONCLUSIONS AND RECOMMENDATIONS

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### 5.1 CONCLUSIONS

- 5.1.1 Geomagnetic survey covering *c.*1.6ha of land have been conducted within a single pastoral field to the north of Low Plains Quarry, Lazonby, Penrith, covering the proposed location of a quarry extension.
- 5.1.2 A number of crop marks have been identified in the surrounding area and previous archaeological monitoring recorded a number of pits and ditches, believed to be prehistoric, directly to the south of the survey area.
- 5.1.3 The geomagnetic survey detected a number of possible soil filled features which could potentially be related to those uncovered in the previous phase of archaeological work.

### 5.2 RECOMMENDATIONS

- 5.2.1 Given the results of the geophysical surveys no further survey work is recommended, it is expected the site will be monitored during the stripping of topsoil prior to further extraction of sands and gravels from the site.

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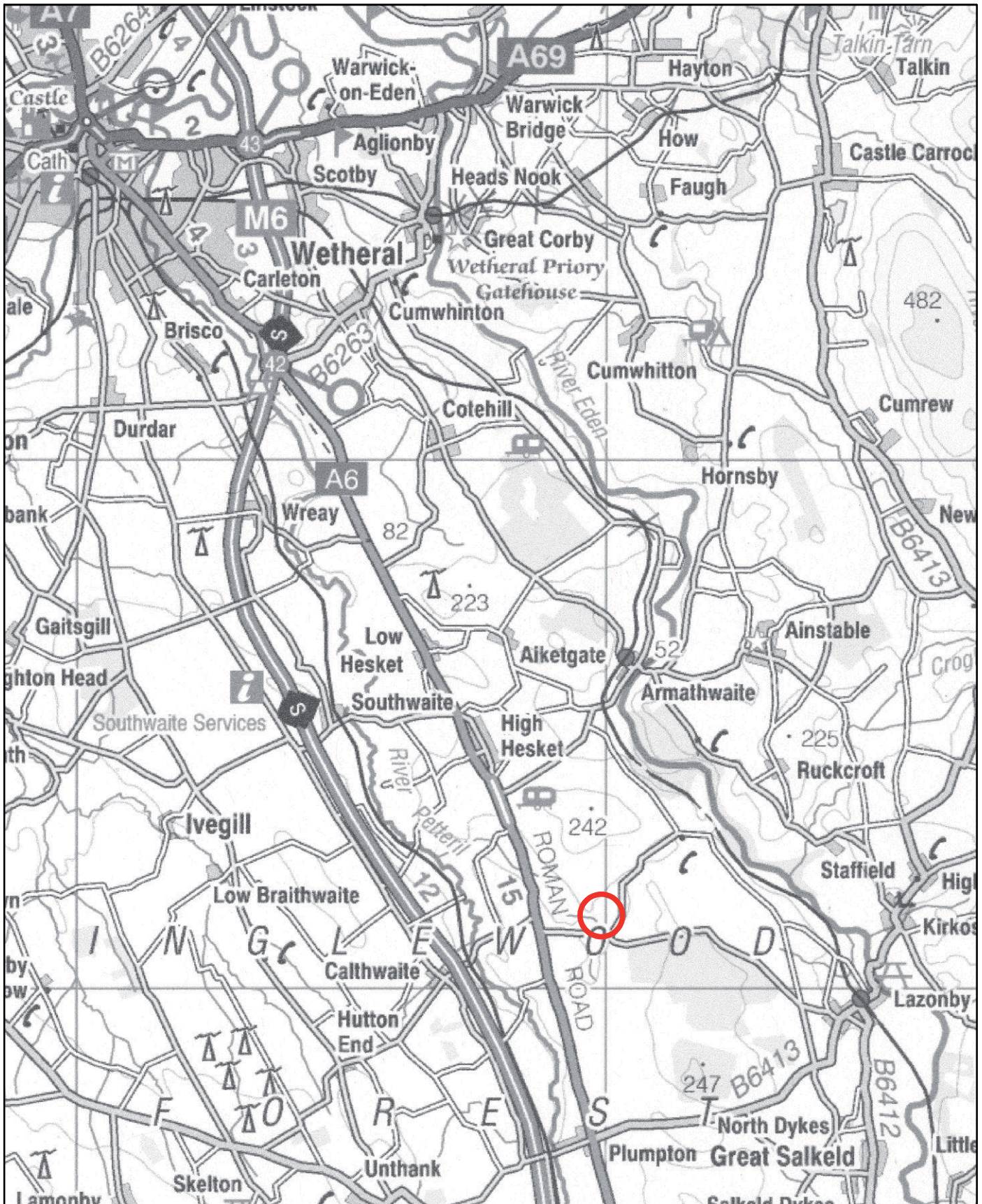
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## APPENDIX 1: FIGURES

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North Pennines Archaeology Ltd  
2009

PROJECT: Low Plains Quarry, Lazony  
 SCALE: 1:10,000 at A4  
 REPORT No: CP 947/09  
 CLIENT: Tarmac Limited  
 DRAWN BY: MDR  
 DATE: May 2009  
 FIGURE No: 1

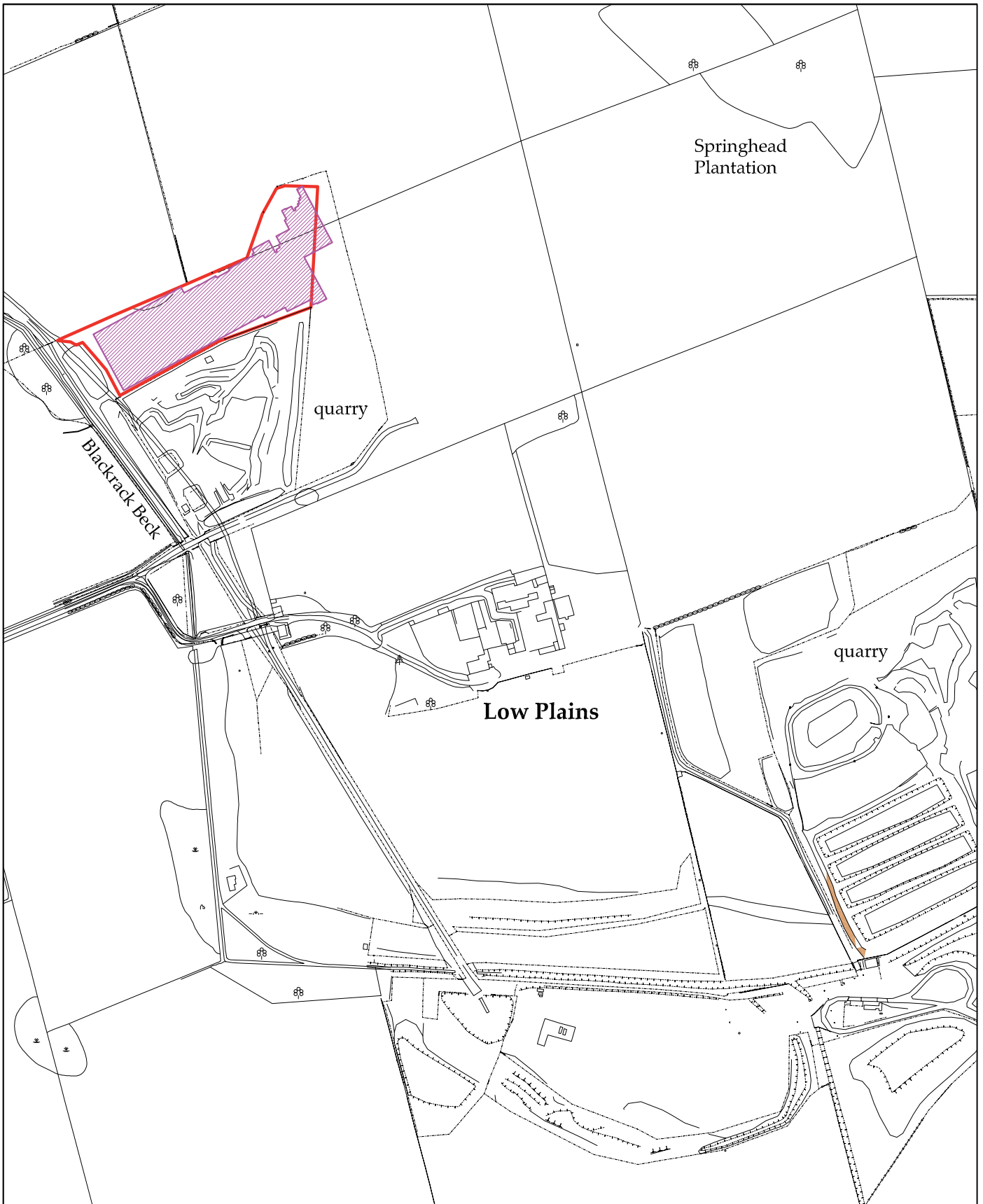
 site location



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Figure 1 : Location map





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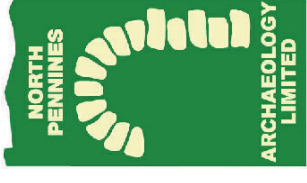
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 SCALE: 1:5,000 at A4  
 REPORT No: CP 947/09  
 CLIENT: Tarmac Limited  
 DRAWN BY: MDR  
 DATE: May 2009  
 FIGURE No: 2

 outline of proposed extraction area  
 Geophysical survey area



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Figure 2 : Location of proposed extraction area



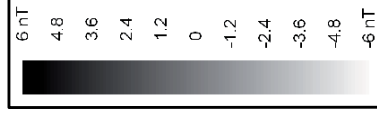
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Low Plains Quarry  
Lazonby  
Cumbria

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Tarmac Limited

SCALE: 1:1000 at A3

DRAWN BY: MDR  
DATE: May 2009

- outline of proposed extraction area
- outline of geophysical survey area

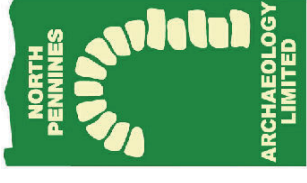


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Figure No: 3



Figure 3 : Geophysical survey








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Cumbria

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DATE: May 2009

-  outline of proposed extraction area
-  outline of geophysical survey area
-  positive magnetic anomaly
-  negative magnetic anomaly
-  dipolar magnetic anomaly

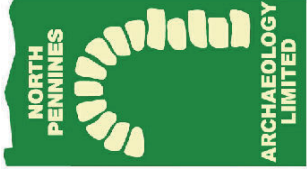


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Figure 4: Geophysical interpretation



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DATE: May 2009

- outline of proposed extraction area
- outline of geophysical survey area
- possible soil filled features
- Possible geological features



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Figure No: 5

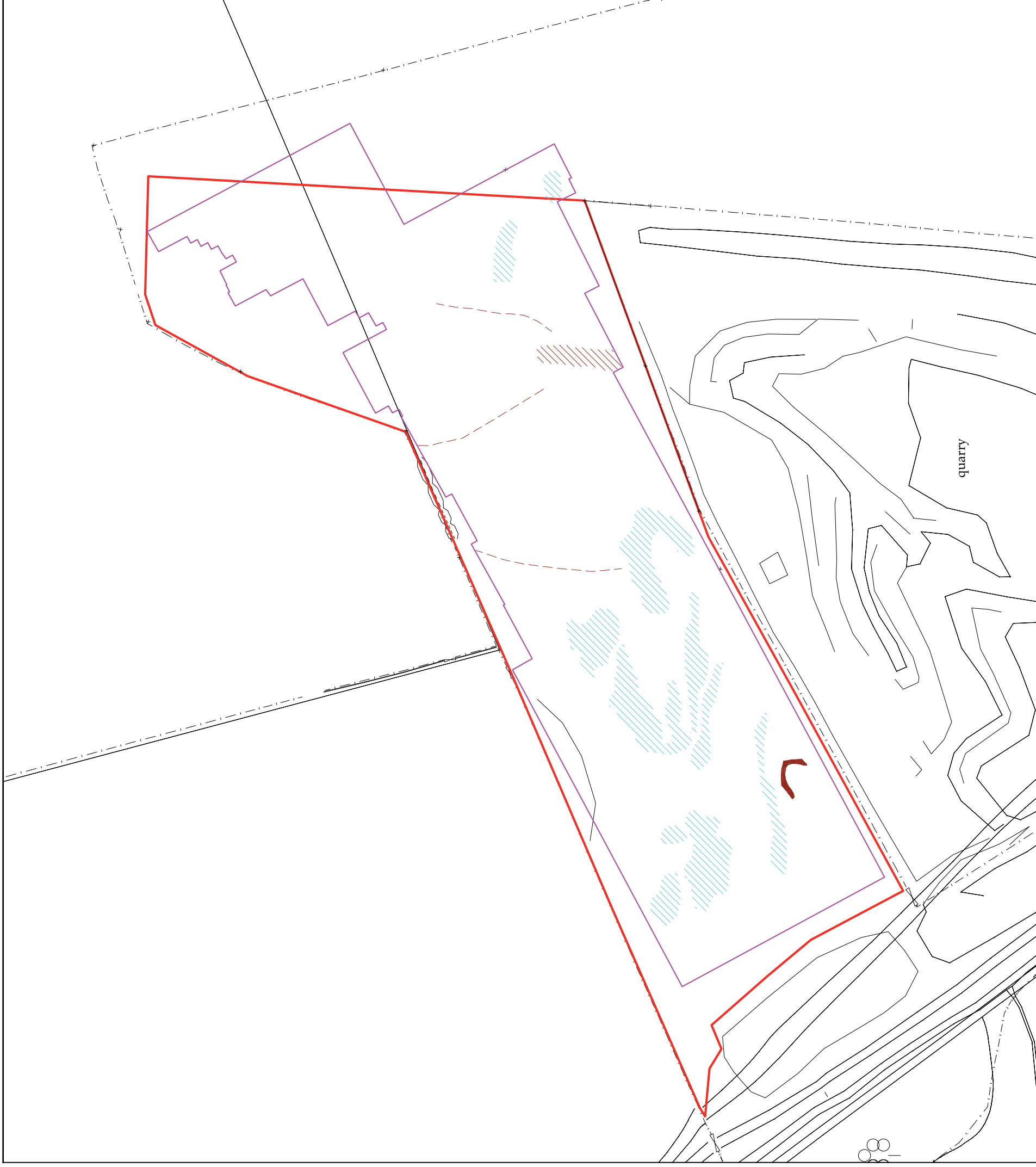


Figure 5: Archaeological interpretation