

Lidar Landscapes North Pennines (East) Project Report

October 2017

Paul Frodsham



Front cover.

Lidar image of a previously unknown late prehistoric or Roman period settlement and extensive field system either side of the Lunedale road at Wemmergill. This remarkably well-preserved complex was discovered using lidar as part of this project. Enclosures and roundhouses can be seen at the centre of the image, surrounded by fields of presumably contemporary date. If subjected to excavation, this complex could tell us a great deal about life in this part of the North Pennines during later prehistory and/or the Roman period.

Lidar Landscapes: North Pennines (East)

Project Report by Paul Frodsham
(Lidar Landscapes Project Officer)

October 2017

Executive summary

This report presents the results of the North Pennines AONB Partnership's *Lidar Landscapes (North Pennines - East)* project. Largely funded by the Heritage Lottery Fund, with a contribution from the Weardale Area Action Partnership, this project ran for a little over a year from July 2016 - August 2017. It trained a total of 175 volunteers in the techniques of archaeological landscape survey using lidar. Each volunteer had the opportunity to attend three workshops with project consultant Professor Stewart Ainsworth and project officer Paul Frodsham. Each volunteer was allocated at least one kilometre square of lidar to survey, with opportunity to make significant discoveries. Several significant discoveries were made; some of these are completely 'new' sites, while others relate to enhancement of knowledge regarding previously known sites. Particularly important discoveries were made regarding settlement and farming in the late prehistoric and Roman landscape, and post-medieval agriculture. Very few 'new' sites from earlier prehistory were recognised, which was not a surprise given the often slight nature of such sites (eg small cairns within Bronze Age cairnfields often not picked up by 1m resolution lidar). Often extensive field systems of apparently medieval date were recorded in many places, as were numerous shafts, mines, quarries and other industrial features of post-medieval origin. The project was very ambitious, being completed within just a single year with a part-time project officer, but this report, together with the project archive, represents a significant contribution to North Pennines studies. Many of the project volunteers are now undertaking lidar-based research elsewhere, and discussions are already underway regarding follow-up projects using the results presented here, so the project legacy is ongoing.

The project archive will be passed to the Durham County Archaeologist so that all the data can be incorporated into the County Durham Historic Environment Record. (A small part of the Derwent project area, north of Derwent Reservoir, falls in Northumberland; the archive for this area will be sent to the Northumberland HER).

As is often the case with this type of research, there is much more that can be done. Due to the great success of the project, future initiatives including completing similar work in areas yet to be covered will be considered by the AONB Partnership.

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Acknowledgements

The project has only been possible due to the commitment and enthusiasm of the Lidar Landscapes volunteers. The Upper Derwent survey involved 28 volunteers and covered 136 km sqs; Weardale involved 60 volunteers in the survey of 173 km sqs; and the Upper Teesdale survey attracted 87 participants to survey a total of 240 km sqs. A total of 175 volunteers have thus participated in the survey of a total area of 549 km sqs (note: this figure does not take into account the fact that a small number of participants contributed to more than one project area). The Lidar landscapes Teams were as follows:

Upper Derwent Valley Lidar landscapes Team

Alan Chatt, Linda Davies, Perry Gardner, Deb Haycock, John Henderson, Joyce Jackson, Pete Jackson, Roy Lawson, John McNulty, Janet Matthews, Robert Matthews, Barbara Metcalfe, Tony Metcalfe, Steve Newcombe, Janice Newcombe, Andy Newton, Sheila Newton, Ray Oughton, Roger Owen, Rob Pearson, Jack Pennie, Chris Powell, Mike Powell, Joan Raine, Raymond Shepherd, Geoff Taylor, Elaine Vallack, Stuart White.

Weardale Lidar landscapes Team

Marc Adams, John Atkinson-Millmoor, Leslie Barnes, Rosamond Barnes, Steve Bentley, Katharine Birdsall, Alan Blackburn, Joan Carrick, Ben Coult, Jon Dimmick, John Dobson, Alison Donaldson, Steve Douglas, Sophie Ebeling, Ian Forbes, Pam Forbes, Martin Green, Colin Hardy, David Heatherington, Kathy Heatherington, Ken Heatherington, John Henderson, Jan Hicks, Jackie Hooley, Andy Hopkirk, Anne Hopkirk, David Humphreys, Liz Hunt, Joyce Jackson, Peter Jackson, Andrew King, Steve Lambert, Philip Lewis, Malcolm McCallum, Kelvin McKivitt, Margaret Manchester, Tony Metcalfe, Alan Newham, Jane Norris, Mike Ogden, Chris Potts, Chris Ruskin, Elaine Ryder, Peter Ryder, Tricia Snaith, Christine Southward, David Stacey, June Stanworth, Valdis Stals, Andy Turnell, Julie Turnell, Cheryl Twigg, Stephen Twigg, William Tyson, Ann Walker-Graham, Keith Walker-Graham, Peter Walters, Andrew Watson, Ann Wilkinson, Helen Wild.

Upper Teesdale Lidar landscapes Team

Karin Adams, Dave Armstrong, Michelle Arthy, Geoff Barber, Billy Barnett, Trina Barrett, Audrey Battersby, Chris Battersby, Steve Bence, Brigid Black, Wendi Blair, Alison Bravington, Ruth Brewis, Robin Brooks, Roger Carpenter, Julie Charlton, H Collingwood, Liz Cook, Neil Diment, Jock Dominie, Keith Duncan, Sue Duncan, Sophie Ebeling, Ian Edmunds, Ken Fairless, Perry Gardner, Jason Garrett, Chris Gibson, Jenny Green, Heather Hardy, Brian Henderson, Peter Hicks, Ian Hodgson, Michael Hodgson, Ian Johnson, Anne Jowett, Steve Keeney, Liz Kerrey, Andrew

King, Timothy Lazenby, Mike Leatherland, Eileen Leatherland, Jenny Lee, Ray Lee, John MacPherson, Margaret Manchester, Malcolm McCallum, Kelvin McKivitt, Jim Merrington, Sophie Metcalfe, Val Metcalfe, Doug Moffatt, Ian Moorhouse, Matt Parker, Carole Parkes, Jan Parkes, David Patrick, Jonathan Peacock, Anne Pickering, Roger Redfern, Catharine Ryan, Phil Ryan, Mark Samuelson, Bruce Shepherd, Dave Shepherd, Louise Shepherd, Anna Smith, Tony Smith, Tricia Snaith, David Stacey, Brian Stirk, Christina Taylor, Chris Thornton, Julie Tomlinson, Lorna Tones, Chris Twigg, Steve Walker, Andrew Walmsley, Ray Waters, Andy Watson, Angus Wheeler, Carol White, Stuart White, Ian Willans, G Williams, Chris Wilson, Thea Worthington.

The project could not have taken place without the enthusiasm and expertise of Prof Stewart Ainsworth of Chester University who acted as Project Consultant throughout. The project was managed by Paul Frodsham, who wrote this report. The project structure was based on an original concept developed by Stewart Ainsworth and Paul Frodsham for the survey of Hexhamshire and the Allen Valleys during the North Pennines AONB Partnership's HLF-funded *Altogether Archaeology* project. Lidar processing for the project was undertaken by Gary Duckers (Chester University), and much essential help regarding GIS and the production of aerial imagery and OS mapping was kindly provided by Alistair Lockett (North Pennines AONB Partnership). Within the AONB Partnership, project management (and editing of this report) was by Simon Wilson, with financial expertise provided by Debbie Johnson and Joy Clark, and administrative support by Aimee Lee.

1. Introduction - aims and scope of the project

This project was designed to address interest from many local people in undertaking archaeological landscape survey throughout three extensive areas of the North Pennines AONB (see Section 3, below). Occasional discoveries demonstrate that people have been present in these areas since Mesolithic times, perhaps 10,000 years ago, but most of the AONB has never been subjected to detailed archaeological survey. The development of lidar technology now makes the survey of these vast upland areas feasible, enabling work like this to be done by local volunteers, after only a brief training session, from the comfort of their own homes.

The project involved 175 volunteers, working under the expert tutelage of Stewart Ainsworth (Visiting Professor of Landscape Archaeology at the University of Chester). Prof Ainsworth (known to millions through his work with Channel 4's Time Team) is an expert on the application of lidar in archaeological survey, having played the lead role in designing and delivering the recent English Heritage 'Miner-Farmer' project on Alston Moor. He has also worked with local Altogether Archaeology volunteers on the recent Allen Valleys and Hexhamshire lidar surveys. The Project Manager was Paul Frodsham, based at the North Pennines AONB office in Stanhope. Paul previously managed the Altogether Archaeology project for the AONB Partnership, and has worked closely with Stewart Ainsworth in the development and delivery of community lidar projects.

ALS data, more commonly referred to as lidar ('Light Detection And Ranging') is a relatively new information source being used by archaeologists to discover, interpret and record archaeological sites. The data for this project, provided free of charge by the Environment Agency, was gathered using sensors mounted on an aircraft. This data can be processed to make a computerised 3D model of the ground and all the features on it at the time of capture and can be precisely referenced to the OS National Grid, in effect producing what is termed a 'lidarmap'. For this project the 3D data collected has been processed to produce 2D 'hillshaded' images which replicate the 3D data; this technique emphasises features on the ground, including surviving earthworks of archaeological sites and allows the data to be used as image files which can be viewed on home computers. Although the images look like aerial photographs they are not - they are computer models of everything on the ground that the laser pulses hit. For the lidar to be used in this project the 3D coordinates of approximately 5 million points were collected in each km square.

The degree of detail revealed about the historic landscape by this technique can be staggering, often far more informative than aerial photography, but it still needs human eyes to spot it and interpret it. This is the role of the project volunteers. Only two skills were required to make a contribution to the project - interest and inquisitiveness (coupled with access to a computer). Involvement in the project not only allowed volunteers to develop new archaeological and recording skills, but also

provided them with opportunities to understand more about the development of the complex archaeological landscapes of the North Pennines.

The project methodology was developed during the recent Altogether Archaeology project survey of the Allen Valleys and Hexhamshire, derived ultimately from that used in the Miner-Farmer project on Alston Moor undertaken by English Heritage. It was designed to enable volunteers with little or no archaeological background to make meaningful contributions to the recording and understanding of the historic landscape, while providing the tantalising prospect of significant, even spectacular, new discoveries. The recording method used software that is either commonly available on most home computers or is freely available on the internet, enabling contributors to work at home at a pace that suits their own circumstances.

The project provided training for volunteers in the process of interpretation and recording using digital lidarmap images on home computers with commonly available programs such as Microsoft Paint and Word. The project was designed to be as paperless as possible and all file exchanges were by email. After participation in this project, the volunteers now have the skills necessary to continue to explore the use of lidar as an aid to landscape analysis, interpretation and recording. The recording system has been structured in such a way that after validation by the Project Manager, the results will be collated into an archive that will be readily incorporated into the County Durham Historic Environment Record (HER). Here, they will be available for anyone planning new research projects, while also making a key contribution to future landscape management.

The landscape throughout the three areas surveyed is varied, containing a range of ancient settlements, industrial complexes and extensive field systems. Some newly-recorded sites are readily identifiable in terms of their original function and date, while in some cases it has not been possible to state the form or age of a site with any degree of certainty. Volunteers were encouraged to try and identify all sites by reference to a standard 'site type' list; in some cases such identifications might be certain, while in others they may be little more than informed guesses. In all cases, sites have been recorded in outline, enabling closer analysis later where appropriate. Many sites were discussed at project workshops, helping volunteers to improve their general knowledge of the types of site that survive throughout the North Pennines.

The project thus had two key objectives. To enable local volunteers to develop skills in archaeological landscape survey using lidar, and to undertake important surveys of three large landscape areas in the eastern half of the North Pennines AONB. Many local people, many of whom had not previously even heard of lidar, have now developed the skills undertake such survey work, and large swathes of the landscape have been surveyed resulting in several important discoveries. While organised field visits were not arranged directly through the project, participants were

encouraged to investigate sites independently and have been sign-posted to other active organisations including the Altogether Archaeology group. It is hoped that a follow-up project will be undertaken to enable the results of the project to be enhanced through work in the field; this is touched on at the end of this report.

3. The project areas

The project was structured as three relatively independent modules, each studying one landscape area with a different team of volunteers. The procedure for each area was identical, with the results being brought together for presentation at the final project conference and within this report. The archive is structured in accordance with these three areas. (Note: the maps of the lidar coverage for the three survey areas shown below are not entirely accurate as some extra areas were also included; for details of individual km sqs actually surveyed, reference should be made to the project archive).

The AONB contains about 1500 km squares of Environment Agency lidar, all of which is potentially available (after processing) for archaeological analysis. Of this area, 383 km squares had already been surveyed prior to this project (Allen Valleys 169, Hexhamshire 118, and Alston Moor 96), leaving about 1100 km squares to be surveyed. This project covers three substantial areas in the eastern half of the North Pennines covering a total area of 549 km sqs (although, as noted elsewhere in this report, many of these km sqs only have partial lidar coverage).

3.1 Upper Derwent Valley

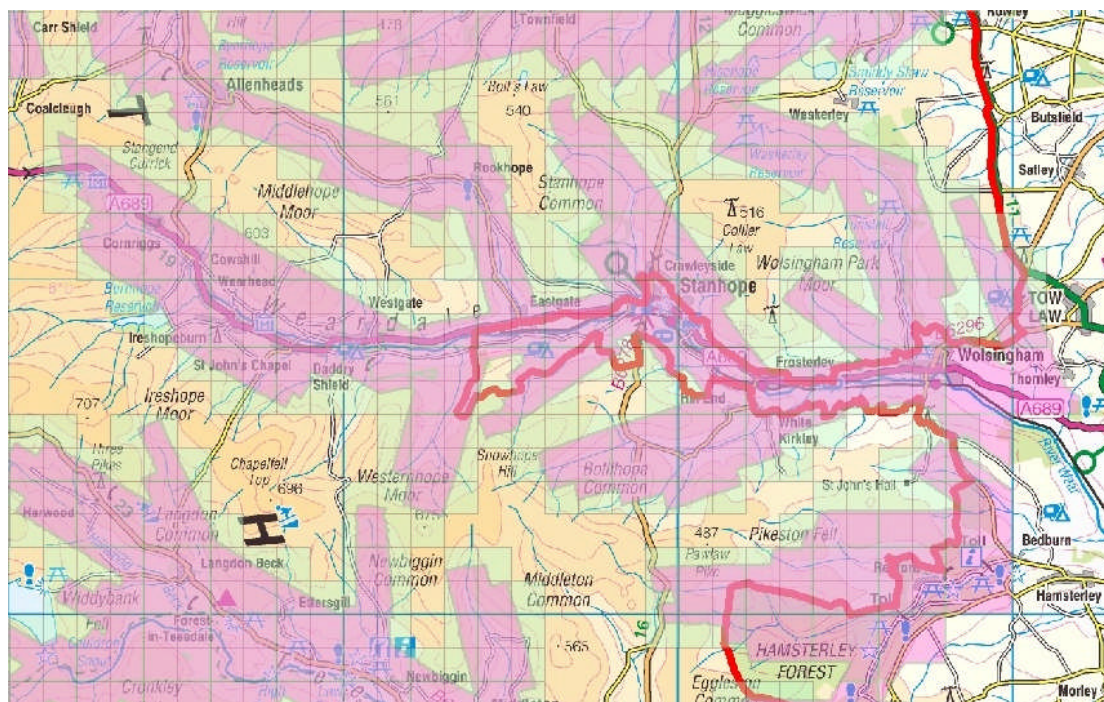
This area covers 136 sq kms. It extends westwards from Castleside on the A68 for some 20kms to Nookton Fell in the west where it merges with areas already surveyed as part of the Altogether Archaeology (Allen Valleys and Hexhamshire) project. It includes the historic village of Edmundbyers at its heart, with Derwent Reservoir just to the north. It extends from Slaley Hall in the north, to Waskerley Park in the south, where it merges with this project's Weardale project area. Much of the area was studied by Sheila Newton in her recent thesis covering the historic parishes of Edmundbyers and Muggleswick (Newton 2014), while the industrial archaeology of the region is discussed in detail by Pirt and Dodds (2002).



3.2 Weardale

This area was initially planned to cover 218 sq kms. Unfortunately lidar was only available at 2m resolution for the main valley above Westgate. After careful consideration it was deemed inappropriate to expect volunteers to undertake survey using 2m lidar, as the images pixelate to such an extent that archaeological features become very difficult if not impossible to identify. The processed 2m lidar is included within the project archive, but has not been surveyed. This is unfortunate, as there is potential for new discoveries above Westgate; however, there is nothing that can be done about it. This means that 45 sq kms were removed from the original project area, leaving a total of 173 sq kms to be surveyed.

The revised project area extends westwards up Weardale from just west of Tow Law as far as Westgate, and includes an extension up the Rookhope Burn to include the important post-medieval industrial landscape here. This area has been studied in detail by Peter Bowes (Bowes 1990), and much of the central area, once occupied by the Bishop of Durham's great deer park, was surveyed by a team of volunteers supervised by Tom Gledhill and Ros Nichol in the first few years of this century (Gledhill and Nichol 2004, 2005, 2006).

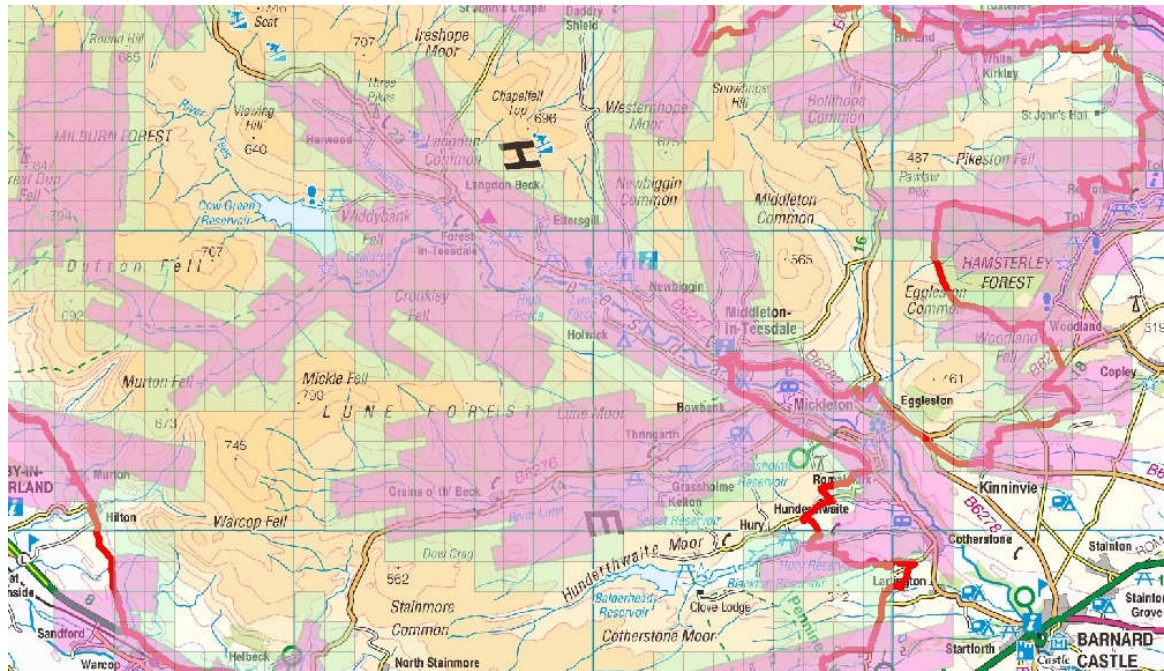


3.3 Upper Teesdale

This is the largest of the project areas - a block of 240 km sqs extending through Upper Teesdale from Cotherstone in the south-east as far as Harwood Common in the north-west. It includes the historic settlements of Middleton-in-Teesdale, Eggleston, Newbiggin, Mickleton and Romalduke. It also includes an extension along Lunedale, taking in Selset and Grassholme Reservoirs, and a smaller extension

along Baldersdale including Hury Reservoir. Much of the high ground between Teesdale and Lunedale is also included. In the north, the area merges with the Weardale project area.

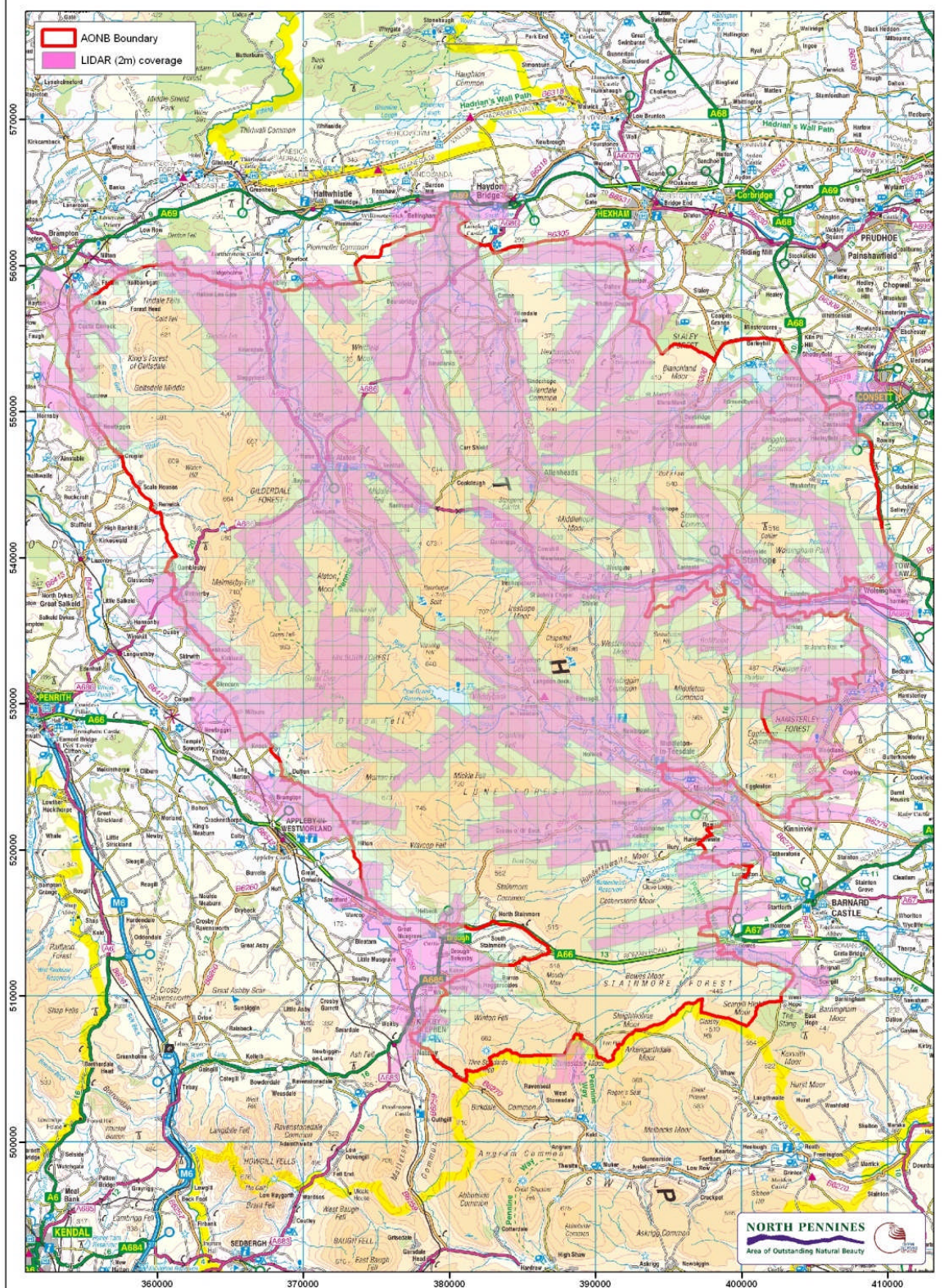
Much of this area has been studied in detail by Dennis Coggins and colleagues (eg Coggins 1986a, 1986b), while the industrial archaeology has been recorded by Fairbairn (2008).



LIDAR (2m) coverage within the North Pennines AONB

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1:227,571



Map showing the extent of 1m and 2m resolution lidar coverage throughout the North Pennines AONB. (This map, and the others above, generated by North Pennines AONB GIS).

4. Project Methodology

4.1 Lidar processing

Processed lidar data for the three project areas was commissioned from an appropriately experienced consultant. The background to the processing methodology is discussed in the Allen Valleys and Hexhamshire project report (Ainsworth 2016) so will not be repeated here. In short, the data was processed to produce Digital Surface Model (DSM - showing all surfaces including trees, buildings, walls etc) and Digital Terrain Model (DTM - with above-ground features such as trees, buildings walls etc removed) tiles for each km sq within the project area. The lidar was processed using Principal Components Analysis (PCA) tools to produce 8-direction hillshade models as single greyscale images that could be easily circulated to volunteers as jpegs. These images provided the basis on which the volunteers undertook their survey work.

4.2 The Project Manual

All volunteers were sent the Project Manual by email. This includes detailed instructions as to how surveys should be completed, along with background information.

4.3 Roles of Project Officer and Project Consultant

The Project Officer undertook all aspects of project management, including maintaining a volunteer database for each project area, circulating lidar data to volunteers, collating results submitted by email, and organising and helping to deliver project workshops. The Project Consultant played the main role in volunteer training at workshops, and in presenting results at the results workshops. The Project Officer and Project Consultant worked together on the assessment and validation of survey results, undertaking detailed surveys of some areas to complement the work of the volunteers.

4.4 Volunteer training

Effective volunteer training was an essential element of the project. Training was essentially limited to the training workshops, which, in addition to an introduction to the methodology and practical training exercises, included ample opportunity for people to ask questions. The Project Officer was always available to answer any questions that volunteers wished to ask by email, but few such questions were received outside of the initial training workshops.

4.5 Data circulation and submission of results

Following attendance at a training workshop, all signed-up contributors were sent a copy of the Recording Manual, together with recording forms, by email. They were also sent the relevant digital data (DTM and DSM lidar, OS map, and recent colour vertical air photograph) for their first kilometre (km) square. The contributors then worked through their allocated km squares using the lidar images and recording forms supplied. The results were then returned to the Lidar Landscapes Project Manager, checked, and entered into the project archive.

4.6 Data Validation

Full validation of all results was not included within the project. All results were inspected as they were submitted and are filed alongside the project archive.

4.7 Results workshops

A results workshop was held for each of the project areas. Several important discoveries were presented at each, and volunteers also had the opportunity to look in detail at their own km sqs and discuss aspects of them with the Project Manager, Project Consultant and fellow volunteers. A final project conference was also held to enable volunteers from each of the three areas to see results from the others, and thus to better appreciate their own results within the wider context of the North Pennines. This event also gave volunteers the opportunity to discuss follow up work that they would like to do, if the necessary resources can be found.

4.8 Project archive

All results have been collated into the project archive. This consists of all the results supplied by volunteers, and a general database summarising all finds. The general databases for each area will be submitted to the relevant County Archaeologist for incorporation into the Historic Environment Record.

4.9 Project report

This report presents a summary of the project methodology and results. The Project Manager and Consultant are considering writing an academic paper for an appropriate journal highlighting some of the results; if such an article is produced then it will be circulated to all project volunteers (whose contribution will be appropriately acknowledged) in due course.

5. Archaeological results

(Note: 5-figure or 6-figure numbers in brackets throughout the following account are site archive numbers).

Introduction

Although the results were in several places spectacular, with numerous important sites (many of which had not previously been recognised) now accurately recorded for the first time through lidar, it is probably fair to say that the general themes were to an extent predictable. As expected no evidence relating to Mesolithic, Neolithic or early Bronze Age settlement was noted. This is because the remains of such settlements are ephemeral at best, and not susceptible to discovery by 1m resolution lidar. Such early settlement must exist at many places in the North Pennines (eg Young 1987, Frodsham in prep), but locating it must rely on other methods, principally the recovery of lithics through field walking, perhaps linked to predictive modelling.

The other great void in terms of results is the early medieval period, between the end of Roman rule in c410 and the Norman conquest of 1066. This void may, in part at least, be a result the way we do archaeology, and certainly should not be taken as evidence of a lack of activity during these six and a half centuries. We have much visible evidence for so-called 'Romano-British' activity, and for 'medieval' settlement and agriculture, but nothing for the centuries in between. It may be that much of the evidence for early medieval settlement and agriculture lies concealed within or beneath (and in part, no doubt, destroyed by) later settlements and field systems, while it also possible that some 'Romano-British' settlements were occupied into post-Roman times. The early medieval 'gap' may, therefore, not actually be as wide as it currently appears. There may also be early medieval sites, perhaps consisting of timber buildings that leave minimal if any surface trace, that remain to be recognised. This is a general research priority that is unlikely to be resolved through lidar survey.

Despite these major 'gaps' in the record, lidar survey has made a significant contribution to other periods, on which the rest of this chapter will concentrate. The following discussion is divided into three sections:

1. Later prehistoric and Roman. Without doubt the most significant period in terms of new sites and clarification of the nature of others. Numerous 'native' settlements and extensive field systems dating from the pre-Roman Iron Age and Roman period.
2. Medieval. Extensive ridge-and-furrow field systems, which show up very well on lidar, recorded in many places, especially in the vicinity of historic villages.
3. Post medieval. Significant results relating to industry and agriculture, though not much new information regarding settlement.

A further important observation regarding the results is their general distribution - a pattern that applies to all three project areas. This is not surprising, but is worth stressing. Above a certain height, about 400m, there is little evidence of anything other than post-medieval industrial activity, principally lead mining. Evidence from elsewhere in northern England, principally the Cheviots, suggests that Bronze Age settlement could survive at such high altitudes, but much of the high ground here is covered in peat, which could hide such features and render them insusceptible to discovery by lidar. In contrast, on the lower slopes towards the bottom of the dales, fields have generally been much improved in post-medieval times, so the ground has been flattened through continual ploughing over two or three centuries. In some places, 'ghosts' of ancient field systems, and occasionally settlements, can be glimpsed in these fields, but in general terms evidence of medieval and earlier sites has been lost. It is worth noting that where medieval fields do survive, these must in many places have destroyed earlier sites, while the later prehistoric fields considered below presumably in some cases overly earlier (Bronze Age) field systems. Similarly, many of today's villages and farmsteads must overlie earlier settlements. Such is progress! Remember too that the lidar coverage is far from seamless; many areas with significant archaeological remains are not covered by lidar, so cannot be considered here. These factors should be born in mind when seeking to interpret the results of lidar surveys; the lidar coverage is only partial, and can only record what is visible on the surface today.

5.1 Prehistoric and Roman

Introduction

A couple of possible later Neolithic henge monuments have been recorded, one in Teesdale and one in Weardale, although both need evaluation in the field before anything can be said for certain about their origins. If these do prove to be henges then, along with the example at Allendale recorded during previous lidar survey (Ainsworth 2015), they represent a significant contribution to Neolithic studies.

The Teesdale site (00191) is just west of Cotherstone, on the south bank of the Tees. It has been damaged in places by medieval and later ploughing, but appears to consist of a central platform surrounded by a substantial circular bank with internal ditch. A large mound (00192), which could be natural (although no similar examples have been noted in the vicinity, suggesting it could be artificial) stands to the east of the possible henge. The Weardale example (05361), which has been almost flattened by ploughing, is at Coves House Farm, south of the Wear about halfway between Frosterley and Wolsingham. It is quite small, only about 45 metres in diameter.

Although both these sites could have alternative origins, the possibility that they could be Neolithic means they should certainly be subjected to careful inspection on the ground.

Bronze Age landscapes

It would appear that the earliest permanent farmsteads in the North Pennines (as opposed to seasonally occupied settlements) date from the middle Bronze Age, from the centuries around 1500BC. The classic such site, and the first in northern England to be excavated and recognised as Bronze Age, is the isolated roundhouse and field system at Bracken Rigg in Upper Teesdale (Coggins & Fairless 1983). Dated by a single radiocarbon date to about 1500BC, the site shows up very clearly on lidar. This would suggest that comparable sites, should they survive, would be visible on lidar. to be excavated in northern England,

A few examples of cairnfields, some of which probably represent middle Bronze Age farming, are known in the North Pennines, a classic example being Crawley Edge, Weardale (Young & Welfare 1992). However, these sites, consisting mostly of small cairns, are not generally susceptible to discovery by lidar; indeed, the Crawley Edge complex is only just visible on the lidar used for this project, even though we know exactly where it is. It is therefore quite possible that similar sites still await discovery, even within areas for which the lidar has been studied. Bronze Age landscapes become more visible when field boundaries are constructed, and these, although still ephemeral in comparison to later prehistoric fields (see below), are more likely to be noted on lidar. In many places such field systems must underlie (or have been destroyed by) later prehistoric fields, but good examples were recorded by this project in two places, one in Weardale and one in Teesdale.

The Weardale example (93373) is at 326m OD, above White Well Crag, east of the Westernhope Burn about a kilometre south of its confluence with the Wear. It is possible that the field system here may have covered a much larger area as it is encroached upon by a very extensive later prehistoric field system to the north-east. However, it is also possible the original site may have been located here to take advantage of natural springs, and that most of it still survives. The fields are very irregular, and still contain quite large cairns - presumably the result of field clearance, though they may contain burials like the excavated example at Crawley Edge. No houses were recorded at this site, but they would have been timber and evidence for them probably will survive below ground amongst the fields.

In Teesdale, about 1km south-west of Middleton-in-Teesdale, an extensive Bronze Age landscape survives on the north-east slopes of Crossthwaite Common (94241). As with White Well Crag, Weardale, discussed above, there are many springs in the immediate area. In this case, the landscape seems to include at least a couple of unenclosed roundhouses (the houses were presumably of timber with either a low stone wall, or completely of timber but surrounded by a ring of field clearance stone; either way, other houses, exclusively of timber, probably also survive here, but with no obvious surface trace). The irregular, stone-walled fields contain many cairns, just as at White Well Crag.

These newly recognised sites, together with other known or suspected Bronze Age settlements (eg Scordale, above Hilton in the upper Eden valley; Crawley Edge, Weardale; Bracken Rigg, Teesdale; Pedham's Oak, Upper Derwent Valley), suggest

that settlement in the North Pennines was rather more widespread than might be thought. While many other sites must have been destroyed through subsequent development, there are now sufficient sites to enable a project to be developed looking at aspects of Bronze Age life in the North Pennines.

Iron Age and Roman settlement and agriculture

Results for this period are undoubtedly the project's most spectacular legacy. Numerous settlements with roundhouses, most set within extensive fieldsystems, have been recorded. Many of these were already known (eg through the work of Tom Gledhill and Ros Nichol in Weardale, and Dennis Coggins and Ken Fairless in Teesdale) but several are new discoveries. For those which were known previously, the lidar imagery provides a new way of looking at them, and in most cases adds to previously recorded detail, especially with regard to the nature and extent of field systems. It should be noted that there is no way of telling with any degree of certainty, from their surface form alone, whether these settlements have origins in the pre-Roman Iron Age, or whether occupation extended into post-Roman times. Each settlement will have its own individual story to tell, but the telling of these stories will not be possible without further fieldwork including a degree of excavation. Preliminary analysis of the distribution of the settlements suggests that, in some parts of Weardale and Teesdale, the farmsteads seem to have been sited approximately a kilometre apart, with the intervening land almost completely covered with fields. This suggests they were occupied contemporaneously, within what must have been busy agricultural landscapes that in many ways resembled those of the dales just a century or so ago.

One of most spectacular discoveries is the settlement and fieldsystem at Wemmergill (90212), along the line of the current road just north of Selset reservoir. This came as a complete surprise as no sites had previously been recorded here and at 370m OD its elevation is rather higher than most such sites. It appears to consist of a settlement complex, containing several round-houses, focussed on a couple of enclosed homesteads, from which a remarkably well-preserved field system extends to the east and the west over a distance of some 2km (the only serious damage seems to be that caused by the construction of the current road, and the large quarry towards the east of the complex, at Scarth Hills). Within this field system, trackways are clearly visible in places; it appears as though at least some of the fields may have been laid out along the line of a main trackway - perhaps a precursor of the current road through this part of Lunedale. No other comparable sites were recorded further down Lunedale to the east, which is perhaps surprising, but the landscape around Thringarth, of small, irregular stone-walled fields, has clearly been quite intensively farmed in post-medieval times so it is quite possible that older settlements here may have been destroyed, or may still lie concealed within the fieldscape.

Although the Wemmergill complex appears isolated in today's landscape, the same is certainly not true of other parts of the Upper Teesdale survey area, where certain and probable IA/RB settlements with often extensive fieldsystems have been recorded in three particular concentrations: south and west of Middleston-in-

Teesdale (11 sites); around High Force waterfall (9 sites); and in the lower reaches of Baldersdale (4 sites). It should be emphasised that these figures only refer to sites recorded on lidar; further sites, for example on Crossthwaite Common, have been recorded by Denis Coggins and colleagues, and any attempt to interpret the lidar sites must pay due regard to other relevant sites and landscapes. The recognition of so many sites within Upper Teesdale demands much speculative interpretation, but only a very basic overview can be provided here.

Of the eleven sites that cluster around Middleton-in-Teesdale, perhaps the most remarkable are the three set within 600 metres of each other, within an apparently contemporary field system, just north of the Middleton to Holwick road, at a height of c250m OD above the south bank of the Tees. The field system extends into Park End Wood to the west, where there may be a further enclosure containing a roundhouse. Unusually, the westernmost of the enclosures, Park End West (92251) has straight sides to the north and east, with curvilinear banks to the south and west. It appears to contain at least a couple of roundhouses. The central site, Park End East (92252), is actually an agglomeration of compounds with one large enclosure that appears to contain a rectangular building. This may be a contender for settlement site extending through into post-Roman times. The easternmost of these enclosures, Middle Crossthwaite (93251), is a sub-rectangular enclosure about 50 by 35 metres, the banks of which are now mostly overlain by drystone walls. It contains internal compounds, though no obvious roundhouses. As noted above, Dennis Coggins (1986a, 1986b) completed much important survey work Crossthwaite Common (for which, unfortunately, there is no lidar coverage) to the immediate south of this area, but there is no record of this area having ever been surveyed, and no mention of it in the Durham HER. Extraordinary as it may seem, this must therefore be regarded as a new discovery. It certainly demands inspection on the ground.

Three probable sites sit at a similar elevation on the opposite (north) bank of the Tees, at Dent Bank (93261), Lane Head (94253) and within the village of Middleton-in-Teesdale (94251). These have all been damaged by later activity, and no certain internal features are visible within them. If they had surrounding field systems then these are now lost within the extensive medieval ridge-and-furrow that surrounds Middleton-in-Teesdale.

The other five sites are a couple of kilometres south and south-east of Middleton village extending from Kirkcarrion in the west to north of Mickleton in the east. All have been damaged by later ploughing, and their identification as late prehistoric settlements is not secure.

Also worthy of mention here is the only potentially Roman military site recorded during the project, although it may be something completely different. This is a rectilinear enclosure approximately 60 metres square, at Cote House (95232) with well-defined double banks to the east which form a very neat curved right-angle, in the classic manner of a Roman camp or fort, at the south-east corner. The northern portion of the site has been lost, apparently the result of landslip. There is no obvious context for a Roman fortlet here, but the site would be a good one for a watchtower

of some sort, with good views up and down Lunedale. This is another site that should be checked on the ground.

The four sites along the Balder, at heights of between 200 and 250m, are all in good locations for farmsteads. All have been damaged by ploughing, but the two examples at West End (99201, 99202) retain some evidence of internal roundhouses and a surrounding field system, albeit now much trashed by rig of apparent post-medieval date. About 1.5km south-east of the Balder's confluence with the Tees, on the east bank of the Tees above Cotherstone, a small hillfort (02191) shows up well on lidar - this has been known about for many years and is depicted on OS maps. Not previously noted, however, is a large, univallate enclosure some 800m to the NW, at Low Shipley (02202). This has a diameter of c120 metres and appears to be a hillfort; despite its ramparts and interior having been much damaged through ploughing, it is certainly worthy of further investigation. A little over a km NW of this, a very well preserved late prehistoric farmstead with two or three internal roundhouses shows up clearly on lidar above Shipley Wood, on the east bank of the Tees (00211).

The nine sites in the vicinity of High Force include the excavated examples at Forcegarth North and Forcegarth South (Fairless & Coggins 1980), now supplemented by a probable third example immediately north of East Forcegarth farmhouse. Although it has been known for a long time that the Forcegarth settlements sit within an extensive contemporary fieldsystem, the extent of this fieldsystem, which survives remarkably intact due to the relatively non-intensive nature of subsequent agriculture here, can now be fully appreciated by reference to the lidar. The excavations suggest that one of the Forcegarth settlements is late Iron Age, while the other is Roman, a conclusion which could not readily be drawn on the basis of surface evidence alone and which reminds us that there is often no way of telling the chronology of these sites without excavation.

To the south of the Tees, immediately opposite the Forcegarth sites, is the intriguing settlement at Bleabeck, while a little further south is a newly recognised probable settlement on White Rigg, at a height of 420m. These settlements would appear to be located here for industrial rather than agricultural reasons, probably linked to the many iron bloomeries recorded in the vicinity. That said, the settlement on White Rigg could have functioned as a seasonal settlement rather like a medieval shieling, while also being linked to iron working.

Four further settlement sites exist about a kilometre east of High Force. One, consisting of what appears to be a single round house within a field system, is south of the river (this was recorded during the Altogether Archaeology Holwick survey). The other three are on the north bank. The northernmost example, at Dirt Pit above the Ettersgill Beck, appears very well preserved, with a fieldsystem and trackway to the south. Similarly, the enclosure east of the High Force Hotel, has a system of compounds and irregular fields extending south-eastwards to the north bank of the Tees. The HER records Roman coins from the vicinity, though whether these are of any relevance to the settlement site is not known. The final example in this group, at

Bridge House above the confluence of the Ettersgill Beck and the Tees, is a rectilinear enclosure containing one apparent roundhouse platform, with suggestions of a surrounding field system to north, west and south.

In Weardale, the distribution of late prehistoric and Roman settlements and fieldsystems is concentrated in an area between Eastgate and Westgate, largely within what later became the medieval Stanhope deerpark. The distribution presumably extended to east and west, but many sites lower down the dale have probably been destroyed by later ploughing, and 1 metre resolution lidar data is unfortunately not available for the dale above Westgate. Most of the settlement sites, and many areas of field systems, were recorded during the Stanhope Park Archaeological Survey (Nichol & Gledhill 2004, 200, 2006), and although only part of the area surveyed by that project is covered by lidar, the lidar data certainly enables this extraordinarily well preserved landscape to be appreciated in a new way. Ten settlements are visible on lidar, nine of them close to the river at heights of 260 - 300 metres OD, six on the south side and three on the north. The tenth site is higher, at 350 metres OD, some 2.5km north of the Wear at North Hanging Wells, above the west bank of the Rookhope Burn. This apparently well-preserved settlement (94401) appears not to have been recorded prior to the current project. It consists of an irregular enclosure containing at least one round house, with suggestions of surrounding fields. It lies adjacent to an ironstone mine of post-medieval date; could the site perhaps have been located here to exploit this ironstone resource in Iron Age or Roman times?

Of the sites south of the river, the most fascinating is the double-banked enclosure at Billingsshield (95381). This appears to be at the heart of an extensive field system, but the field banks overlie the ramparts, suggesting it may be considerably older than the fields. A single large mound, perhaps a burial mound, lies within the interior. The site occupies what could be termed a 'strategic place' in the landscape, on a natural plateau facing towards the confluence of the Rookhope Burn and the Wear. No other site quite like this has been recorded anywhere else, it may well have Bronze Age origins and could have been a very important place for the communities of prehistoric Weardale. It is certainly a site that demands detailed investigation. In the adjacent field to the west of this site what appears to be a more typical late prehistoric settlement 994383, containing at least one roundhouse, surrounded by apparently contemporary fields.

Of the other settlement sites south of the Wear, that at Hag Gate (95382) is a well-preserved example, with at least three roundhouses within an irregular embanked enclosure. The settlement at Horsley High Cottage, on the north bank of the Horsley Burn adjacent to a waterfall, seems to be a courtyard-type settlement with at least a couple of roundhouses. The site is partially overlain by post-medieval ploughing, but seems to be well preserved.

These settlements lie within what was clearly a complex agricultural landscape; the lidar shows extensive field systems, including trackways, extending for several kms

along the south side of the river almost everywhere except where they have been destroyed by later activity such as ploughing or quarrying.

The three sites above the north bank of the Wear include the previously recorded settlements at Old Park House and a previously unknown example at South Eastgate Plantation. The Old Park House complex is remarkable well preserved. The eastern enclosure (92381) contains earthworks which could represent several roundhouses. It is linked to a very clear embanked trackway heading east which is suggestive of pastoral agriculture. The western enclosure (92382) doesn't display any clear evidence of internal structures, but it looks like another probable settlement; its bank is clearly linked into the surrounding field system. East of these two enclosures, partially underlying the modern road up to Heights Quarry, there appears to be another enclosure containing a couple of roundhouses. These sites sit within a complex and extensive field system (92383) careful examination of which may lead to the identification of several phases from later prehistory through to post-medieval times.

The site at South Eastgate Plantation (94381), a rectilinear enclosure containing at least one roundhouse, with suggestions of agricultural terraces to east and west, has been damaged by post-medieval ploughing but still appears to survive quite well. The site overlooks the confluence of the Rookhope Burn and the Wear, being about 1km north-west of the Billingshield site described above.

Roughly midway between the Old Park House and South Eastgate settlements, in fields at Dun Hill which for some reason appear not to have been ploughed as heavily as surrounding areas, an extensive and well-preserved field system of rectilinear plots and terraces (93382) shows up well on lidar. Towards the north-west corner of this is a scooped settlement with at least three house platforms, recorded by the Stanhope Park survey (Nichol & Gledhill 2004), site 76). The lidar shows much more detail of this complex than recorded on the surveys by Nichol & Gledhill, but it is important to note that walkover survey during the Stanhope Park Survey did result in the discovery of further settlements, including isolated house platforms within field complexes, in addition to those visible on lidar. This part of Weardale should without doubt be re-examined in detail using all available sources to produce a new overview.

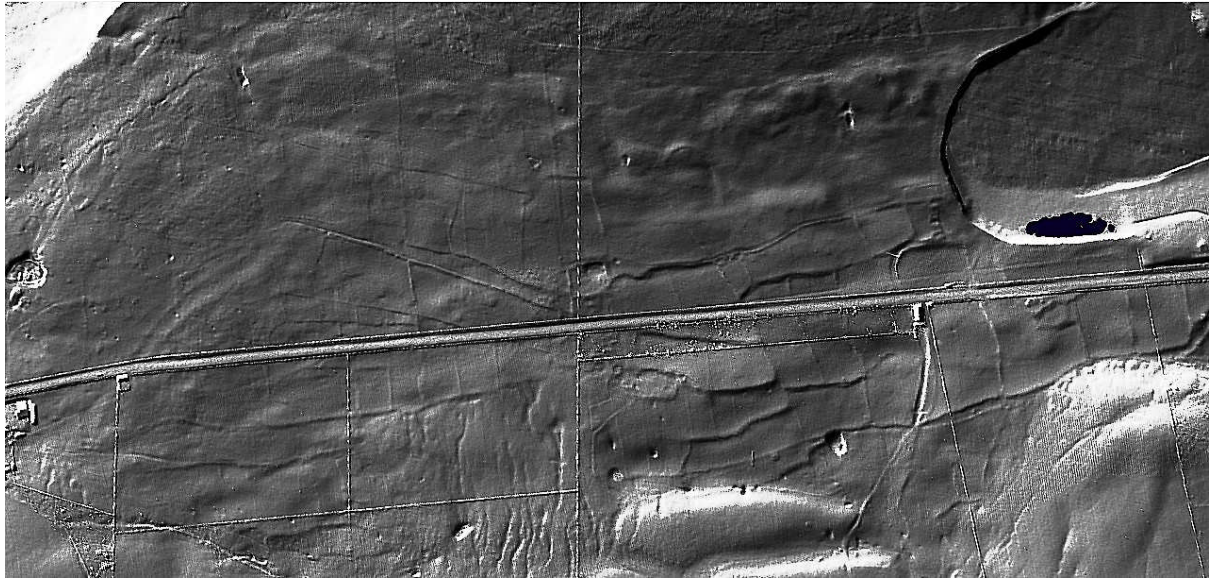
The Derwent valley survey recorded a small number of apparent late prehistoric or Roman settlements, though most are badly damaged by later activity and their designation is far from certain. The one exceptionally well-preserved site is at Nookton, above the north bank of the Nookton Burn, where at least three roundhouses survive in association with a couple of curvilinear enclosures, with a rectilinear enclosure containing at least one roundhouse just to the north. Whether these remains represent the replacement of an older (Iron Age) curvilinear settlement with a later (Roman) rectilinear one, as seems to have happened in some places in the Cheviots for example, or whether the entire site was occupied contemporaneously, cannot be known at present. Suggestions of possibly contemporary field fields survive beneath the later, post-medieval fieldsystem. Other

possible late prehistoric settlements, such as the example just east of Edmundyers and another in the grounds of Minsteracres Monastery, are all badly damaged by medieval and later ploughing and require field inspection to assess their validity.

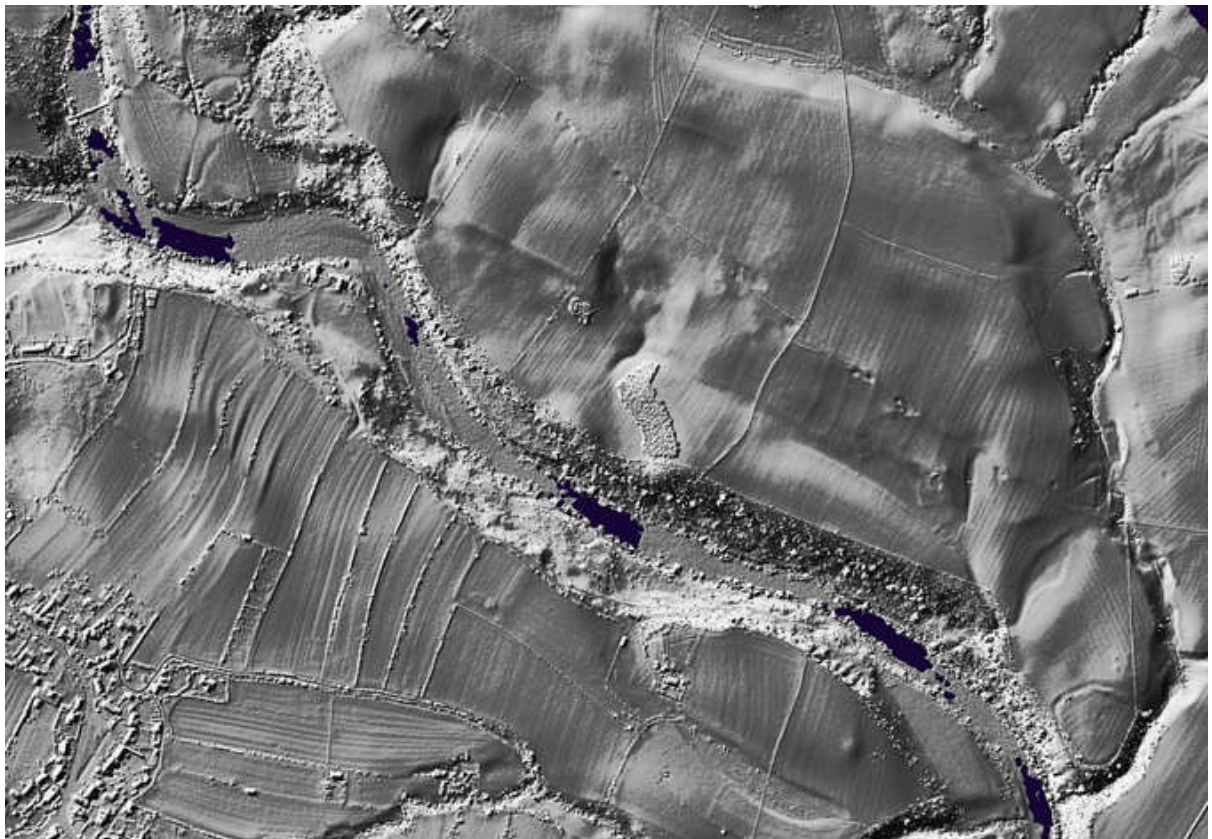
Much further work is needed to better understand the North Pennines in late prehistoric and Roman times. Several dozen settlements have now been recorded from Teesdale, Weardale, the Upper Derwent Valley, Allendale, Hexhamshire, Alston Moor and other places, most of them linked to apparently contemporary and often very extensive field systems. All of the sites recently recorded by lidar would justify detailed survey on the ground, after which some could be subjected to further analysis. At present, the only excavated sites are the settlements at Forcegarth Pasture (North and South), and Gilderdale Burn near Epiacum fort on Alston Moor, which clearly demonstrate the potential for further carefully targeted small-scale excavations at other sites. While most of the recorded settlements are essentially farmsteads, it may well be that some were located in part to exploit mineral reserves - notably iron and (during Roman times) lead and silver. In addition to Epiacum at the heart of the North Pennines, the Roman forts and associated settlements at Bowes and Greta Bridge in Teesdale, and Binchester in Weardale, are not far away, and it is quite possible that the inhabitants of the native settlements discussed here were engaged in the production of industrial and agricultural produce for the 'Roman' market.



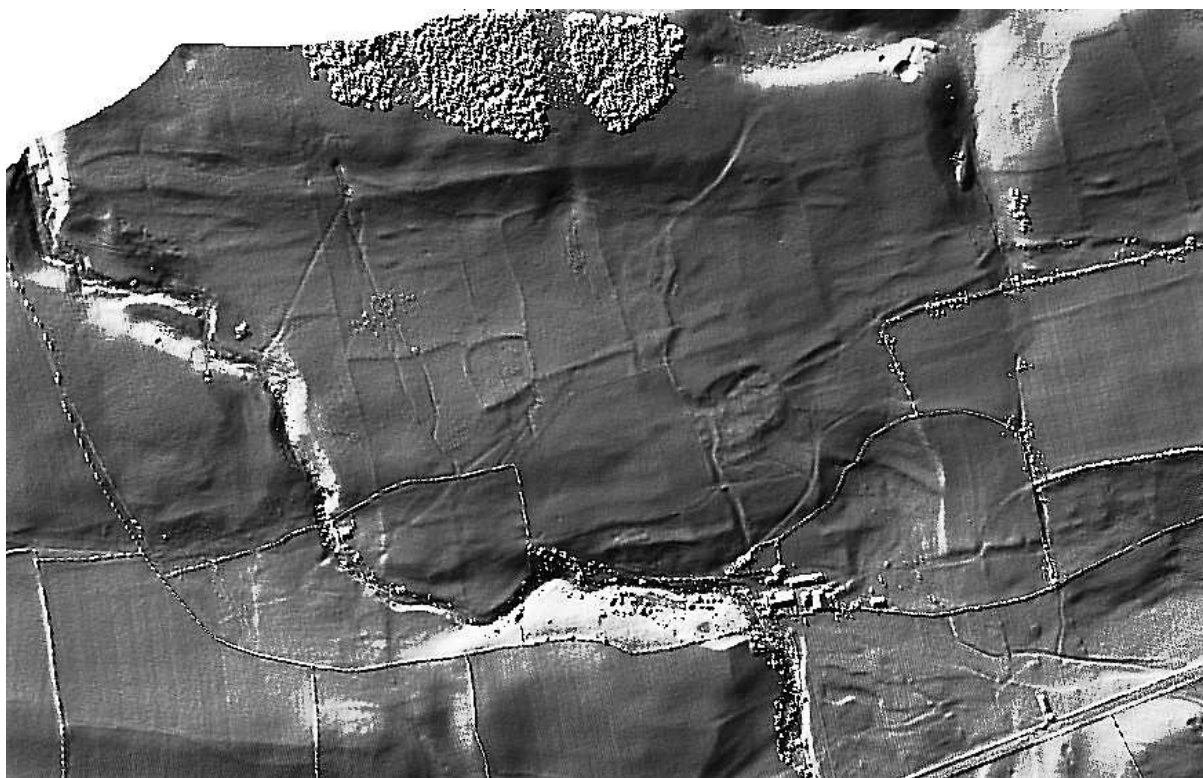
The Tees at Forcegarth. North-east of the huge quarry, the late prehistoric and Roman period settlements of Forcegarth North and South can be seen within a complex contemporary field system. Immediately south of the quarry, on the south side of the river, roundhouses of the Bleabeck homestead, of the same general date as the Forcegarth settlements, have been captured by the lidar and are just visible in this view.



This extraordinary late prehistoric or Roman period settlement complex and field system at Wemmergill is crossed by the modern road, but had not been recorded prior to this project. It hardly shows up at all on available vertical photography, but is clearly visible on this lidar image.



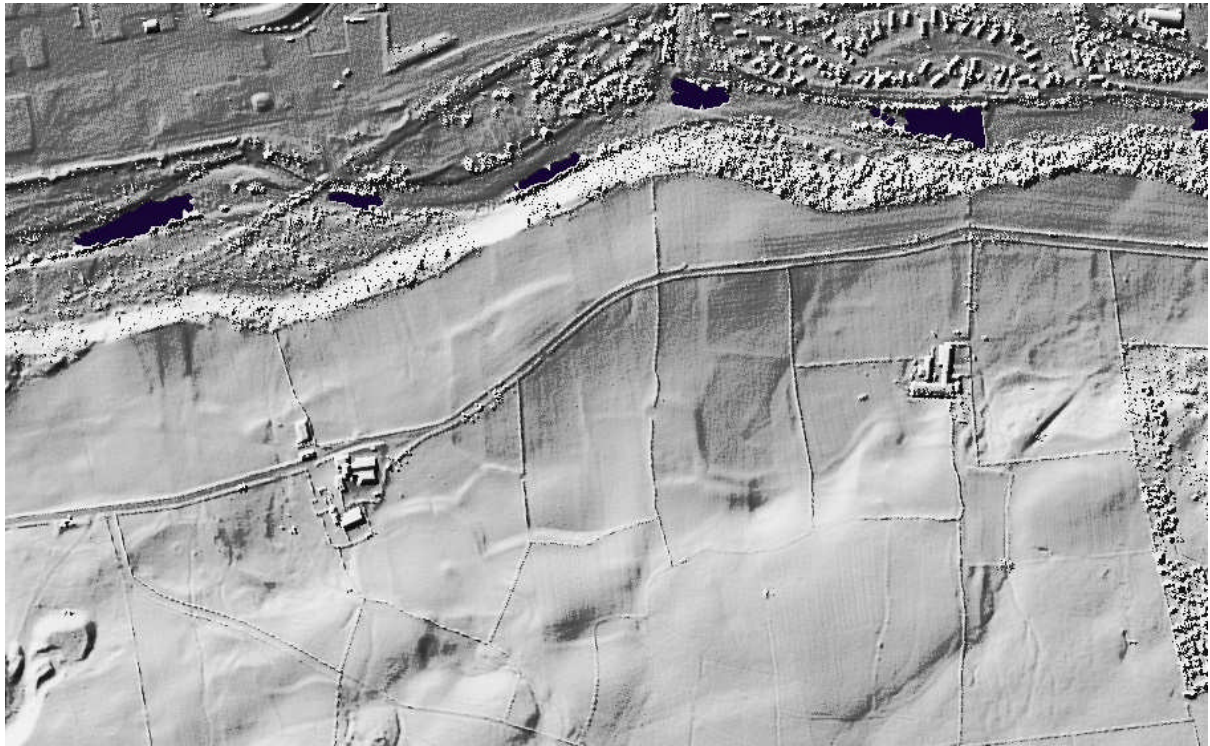
The Tees north-east of Cotherstone. Within a landscape of medieval field systems, a small late prehistoric hillfort can be seen at the bottom-right corner. North of this, towards the top-right corner, a much larger, roughly circular earthwork can be seen. This is probably another late prehistoric enclosure, possibly also a hillfort.



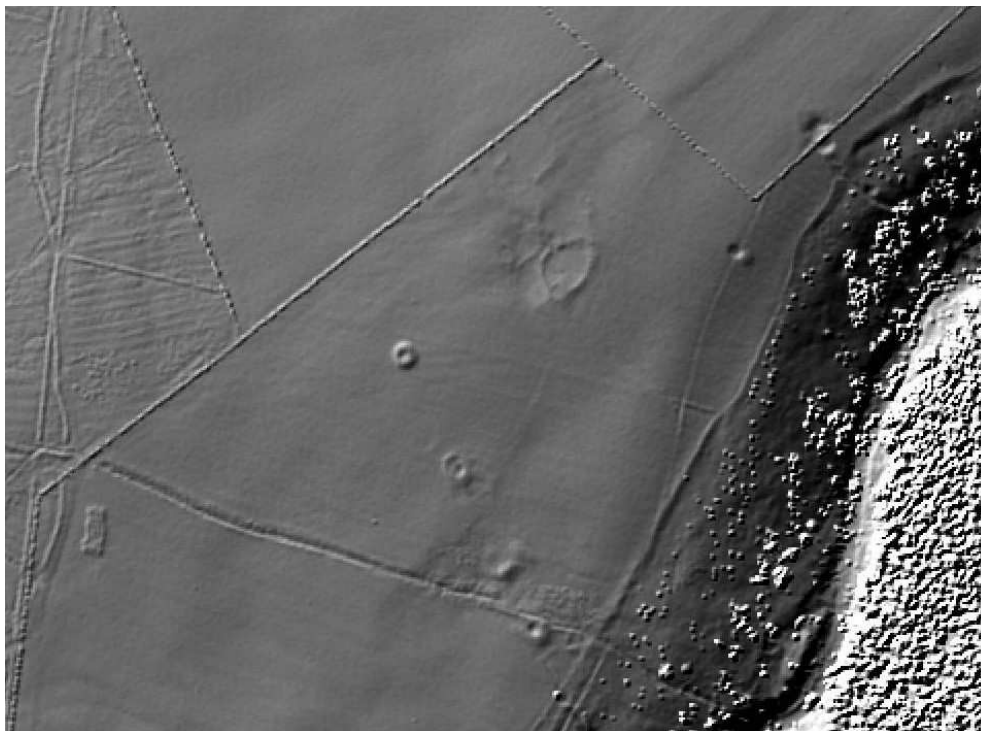
Late prehistoric or Roman period enclosures and field system at Old Park House, Weardale.



Late prehistoric or Roman period field system at Dun Hill, Weardale.



Part of the very well-preserved late prehistoric or Roman period landscape south of the Wear near Eastgate. Two enclosures with roundhouses can be clearly seen (one in the angle formed by the roads towards the south-west corner, the other near the east side of the view at the north-west corner of the plantation). Also visible is a unique double-banked enclosure containing a large 'bump', immediately south-east of the farm buildings in the west half of the view; this could be a Bronze Age enclosure. All these sites sit within a complex ancient field system which can be clearly seen underlying the present-day field boundaries.



Late prehistoric or Roman period settlement above the Nookton Burn in the Upper Derwent Valley. The circular doughnut-like features are post-medieval mineshafts.

5.2 Medieval

Settlement

Several already known medieval hamlets, such as the very well-preserved example at Well Head (90263) behind the Strathmore Arms in Holwick, Teesdale (recently excavated by the Altogether Archaeology group) do show up well on lidar, but perhaps surprisingly, given the size of the areas surveyed, the number of new discoveries that probably date from the medieval period (c1066 - 1600) is surprisingly small. No certain medieval settlements have been newly discovered, although a few isolated structures such as the linear range at Barnley in Teesdale (00221), which could be a grange, may prove to be medieval.

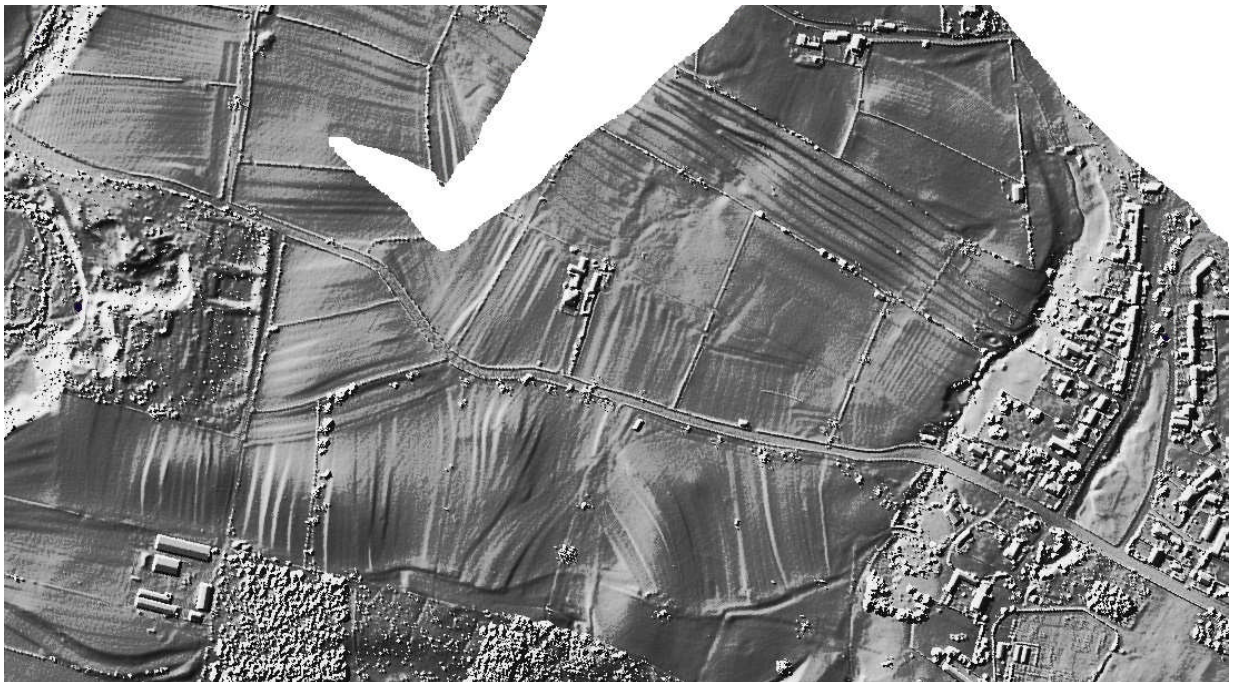
Field systems

The ridge-and-furrow field systems around many historic settlements do show up very clearly on lidar and have been recorded in many places. Some examples are relatively small in scale, presumably relating to isolated medieval farmsteads or hamlets, while elsewhere ridge-and-furrow of apparently medieval date extends continuously over several square kilometres. These field systems have only been recorded in general terms (eg as 'medieval field system surrounding Edmundbyers') but the lidar offers the opportunity of recording them in great detail. There are clearly different types of ploughing in different places, and in some cases detailed analysis may be able to identify changes through time, but such analysis was beyond the scope of the current project. It is worth noting here that some of these field systems may well have pre-medieval origins, and in some cases it would be an interesting exercise to study them in relation to late prehistoric or Roman period field systems that survive in the same places (though such early field systems must have been destroyed by medieval ploughing in many places). In some places, medieval fields have been ploughed flat by more recent ploughing, while in some cases the ridges can still be made out as 'ghosts' within more recent fields. In many places, for example between Frosterley and Wolsingham in Weardale, the present-day field walls fossilise the form of the old medieval fields, even where the interior of these fields has been ploughed completely flat. Occasionally, individual fields have been left unploughed over recent centuries while surrounding areas have been ploughed flat, leaving isolated islands of medieval ridge-and-furrow. A project to accurately record and attempt to establish the chronology of medieval field systems throughout the North Pennines would be a very worthwhile exercise.

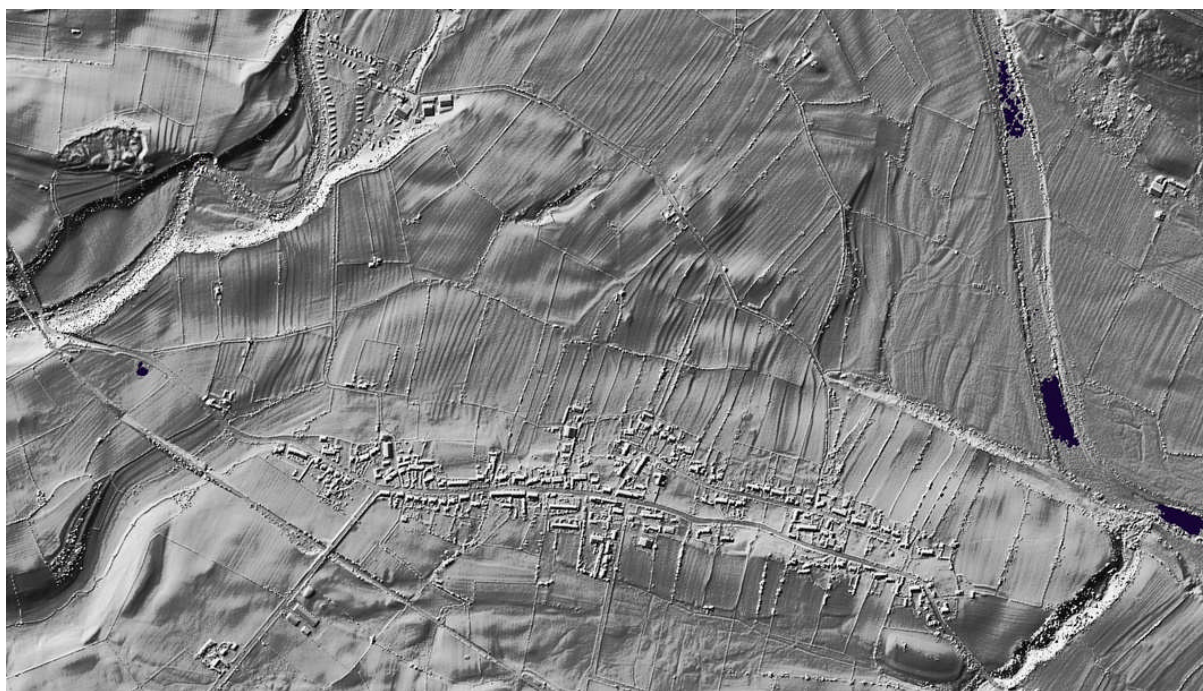
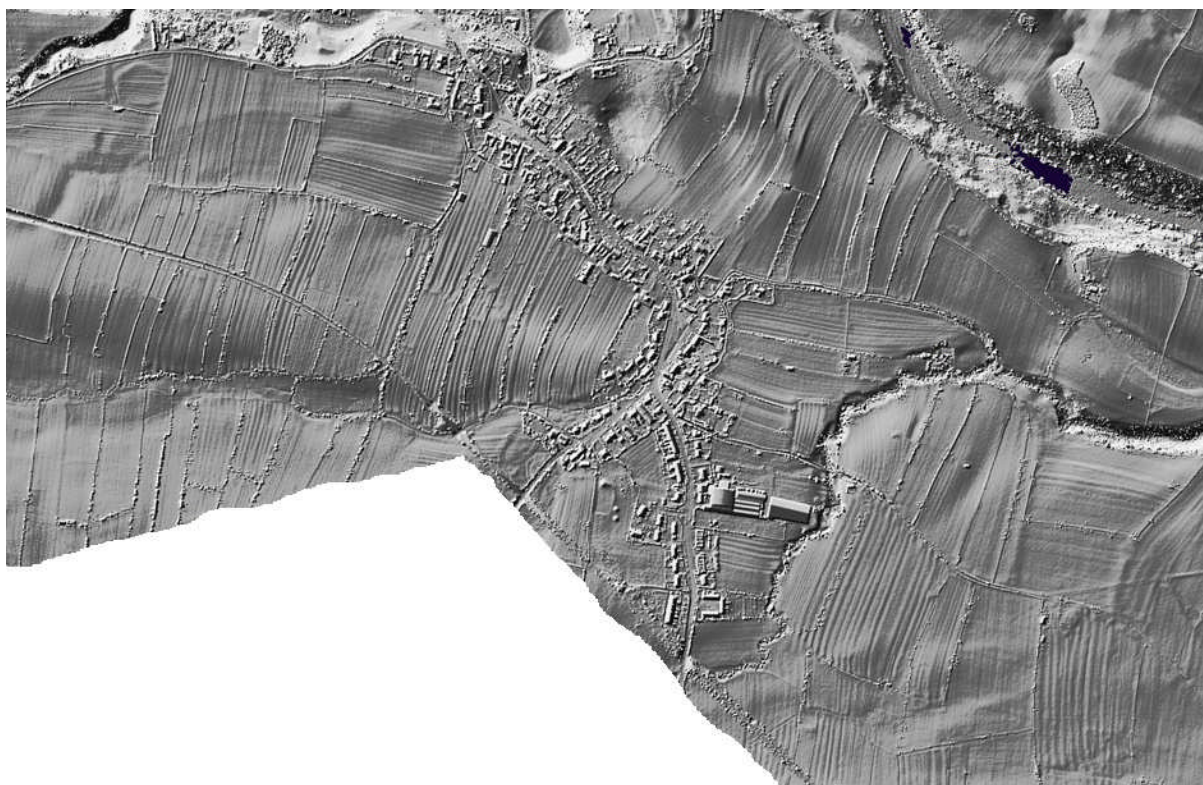
Parks

Linear earthworks that could be park pales (the boundaries around medieval deer parks) have been recorded in a couple of places in the Teesdale survey area, at Thringarth Park in Lunedale (94232) and Corn Park/West Park in Baldersdale (99191), though further work is necessary to record these in detail and establish their

origins for sure. The pale around Stanhope Park in Weardale, the location of which is known through earlier survey work, shows up well on lidar in places, though frustratingly there is no lidar coverage for much of the park. The same is true of Muggleswick Park and Waskerley Park in the Upper Derwent survey area.



Medieval field systems at Edmundbyers (top) and Eggleston (bottom).



Medieval field systems at Cotherstone (top) and Mickleton (bottom).

5.3 Post-medieval

As expected, by far the largest number of sites recorded during the project belong in this category. There was much variation in the level of detail in which these sites were recorded by project volunteers, and results from some areas have yet to be fully validated. Consequently the results summarised here must be regarded only as provisional; they will be updated in the final version of the report. In the final analysis, there will be many hundreds of post-medieval sites, including abandoned farmsteads, field systems, industrial sites ranging from individual mineshafts and small pits to huge mining complexes and massive quarries, as well as transport routes. In the past, much attention has been paid to the post-medieval industrial heritage of the North Pennines, but rather less to other aspects of the post-medieval landscape. Lidar enables all these different features to be appreciated and studied together, thus enabling us to attempt the integrated study of post-medieval times rather than focusing on just the industrial heritage.

Field systems

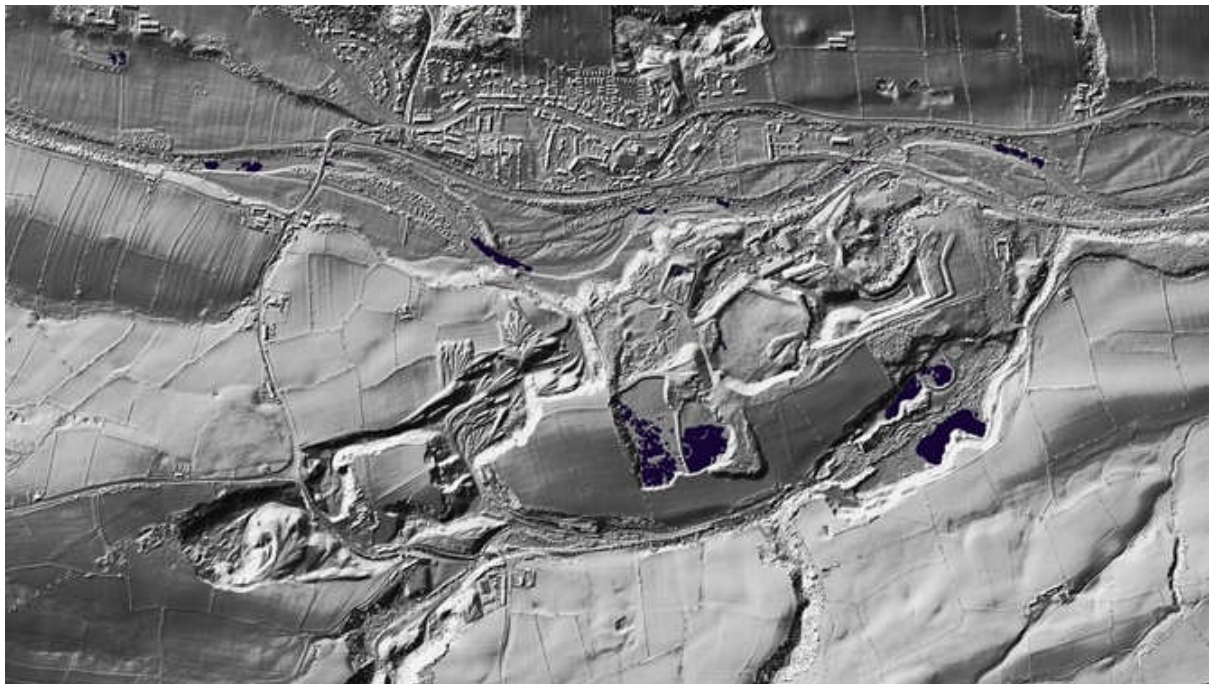
It is clear that in many places, in all three project areas, there are agricultural landscapes intermediate between the great ridge-and-furrow open fields characteristic of medieval times and the rectilinear fields associated with the enclosure movement, which generally date from a few decades either side of 1800. During this project, these were termed 'post-medieval pre-enclosure field systems'. In many cases they consist of large intakes, often containing rigg which was probably more about improving drainage for grazing than to enable arable cultivation. Many of them were probably linked to the 'miner-farmer' communities, and represent attempts to improve the land by families engaged in the mining industry. Some are associated with settlements, while others appear to be isolated and must have been managed by people who lived in nearby settlements.

Routeways

In some places, most notably in the Upper Derwent project area, well-established holloways were recorded. These show up particularly well on lidar. In some places these were single lines while in others there were multiple lines, demonstrating continued usage over a long period of time. They have been classified here as post-medieval, but some of the routes could well have earlier origins. In some cases the general line of the holloways is followed by present-day roads, which have clearly replaced them, while in others there is no corresponding modern road. Holloways can result from agricultural use (the driving of stock) or industry (eg routes from quarries, or between mines and processing plants); in the case of the extensive holloways of the Upper Derwent area, it is tempting to see them as relating in some way to the lead industry. Further work will be needed to check the various routes, relate them to other sites, and attempt to establish their chronology.

Industrial sites

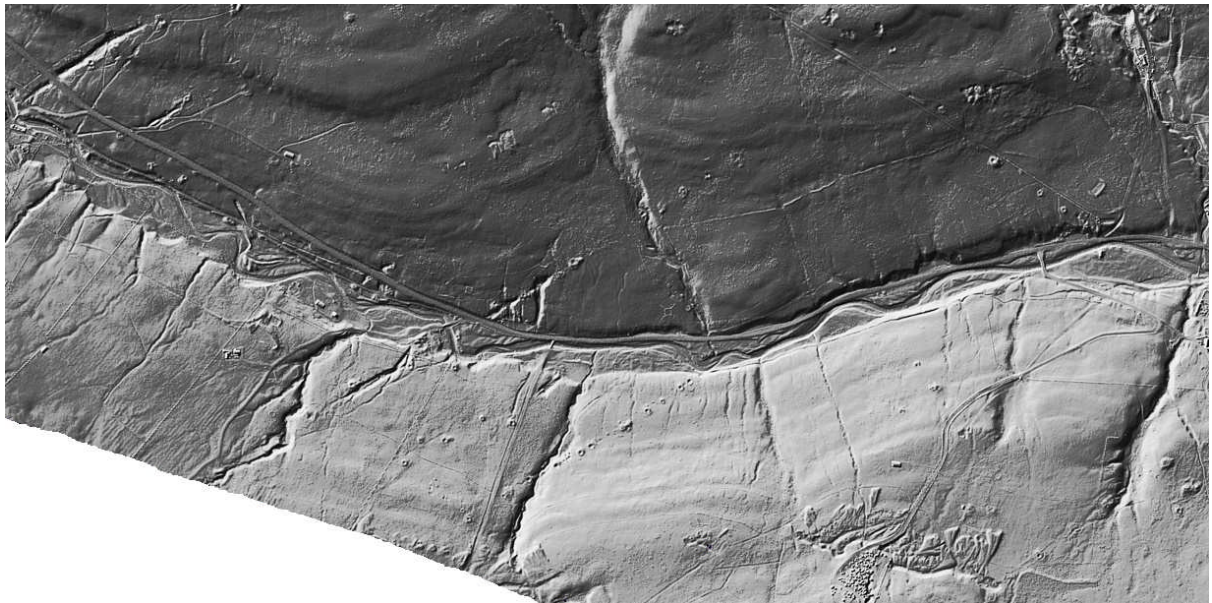
Industrial sites, mostly linked to the lead industry but also including coal mines and numerous quarries, were recorded in many places. The vast majority of these were already recorded on the County Durham Historic Environment Record; indeed many are clearly depicted on 1st and 2nd edition OS maps. However, the value of lidar is that it shows what survives, in often remarkable detail; for example, details of finger dumps at old mine workings and within quarries show up very well on lidar. A glance at the lidar of some areas, such as those illustrated below, demonstrates the complexity of such industrial landscapes. Lines of shafts, areas of quarrying (from huge quarries to small quarry pits), reservoirs and leats are all clearly visible and have been recorded. In general, the larger concentrations have simply been recorded as industrial complexes, as there was not scope within this project to record individual elements of them in any detail. Even recorded only in outline in this way, the existence of lidar for industrial complexes represents a useful addition to the Historic Environment Record, enabling the lidar to be studied alongside aerial photos, historic maps and other sources. There is certainly scope for much more detailed investigation of industrial landscapes using lidar. The lidar also offers the opportunity for such remains to be studied in relation to the agricultural landscapes discussed above, the detail of which has not generally been previously recorded.



South of the village of Frosterley, the historic landscape has been effectively 'wiped clean' of medieval and earlier features through a combination of post-medieval ploughing and quarrying.



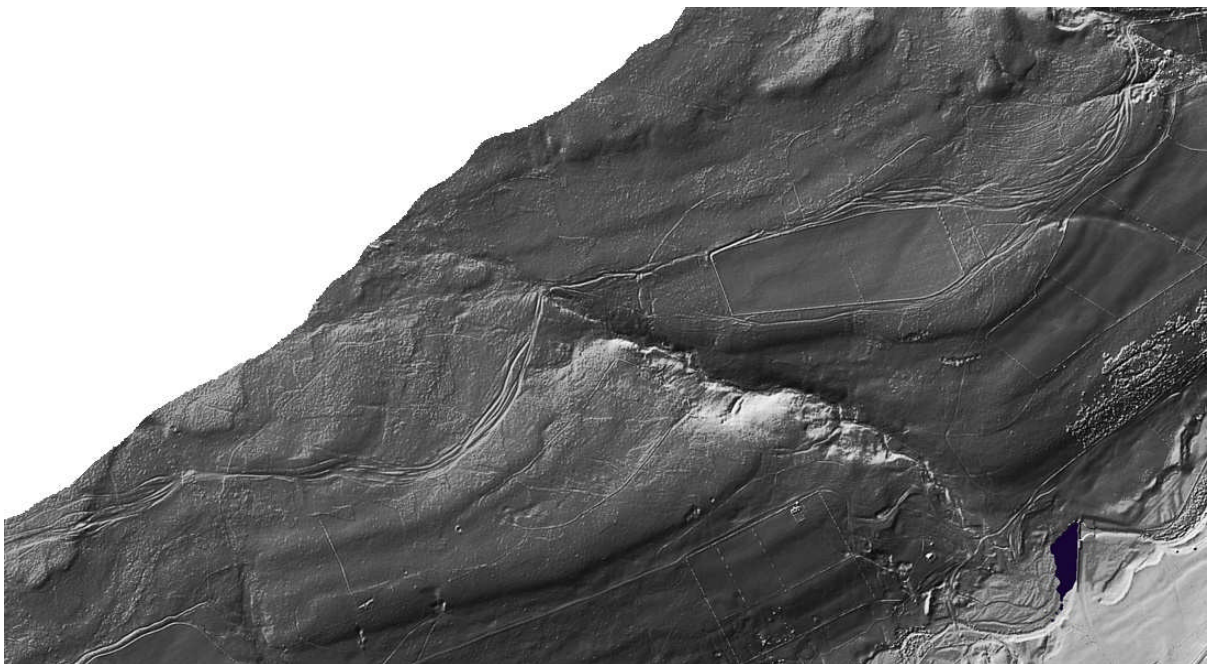
The extraordinary industrial landscape at Hudshope, north of Middleton-in-Teesdale.



Industrial landscape west of Rookhope.



The landscape north of Stanhope displays many scars of its post-medieval industrial heritage.



Holloways running roughly SW - NE, west of Edmundbyers in the Upper Derwent valley.

6. Summary and conclusions

6.1 Archaeology

The above account has demonstrated the usefulness of lidar in archaeological survey, with many important sites having been newly discovered while others have been recorded in more detail than ever before. The sheer quantity of data generated has been astonishing and it could reasonably be argued that this project has done more than any other to expand knowledge of archaeology throughout the eastern North Pennines. Most impressively, it has enabled the archaeology of extensive landscapes to be seen in astonishing detail for the first time, demonstrating how individual later prehistoric and Roman settlements survive within field systems extending over several square kilometres, and the extent to which medieval ridge-and-furrow still surrounds historic settlements, perhaps most notably in parts of Upper Teesdale. The results are also important in demonstrating how what must once have been complex archaeological landscapes have been decimated over the past two or three centuries by agricultural and industrial activity; some parts of the historic landscape have effectively been wiped clean by ploughing or quarrying. That said, there is still an astonishing amount of material for present and future North Pennine communities to study and enjoy. It is important now to work with those responsible for land management throughout the North Pennines to ensure that effective conservation policies are in place so that future communities can continue to enjoy their remarkable historic environment.

Quantification of the nature and numbers of sites recorded must await enhancement of the project archive (see 6.3, below). For now we can say that several hundred sites have been recorded, many for the first time, and that the results will represent a substantial contribution to the County Durham Historic Environment Record. Once the project archive is complete, this section of the report will be expanded to include statistical analysis of the kinds of different sites recorded by area and by period, and appropriate additions and amendments will be made to Section 5, above.

6.2 Methodology

A number of observations will be made here regarding the project methodology. These observations are intended to help with the planning and delivery of comparable projects that may be attempted elsewhere in future. There can be no doubt that the Lidar Landscapes volunteers have made a significant contribution to North Pennines studies through this project; however, it is also the case that much more could have been done with additional time and resources. Whilst the project was ambitious, it was always anticipated that if successful it would pave the way for more involved projects based on the same methodology. It is therefore important to note the observations below when planning future, similar work.

The basic methodology (as described in Section 2) is considered to have been sound, but the scope of the project was ambitious given the available time and should a similar piece of work be attempted in future, it would be prudent to either concentrate on a smaller area with less volunteers or increase the time and co-ordination resource.

All the volunteers attended an initial two-hour 'start-up' workshop, one for each project area, including an introduction to the project methodology and a practical training exercise. These events were very popular and all overran considerably; in retrospect these should have been half-day sessions rather than evening events, with at least three hours allocated to each. There was also a results workshop for each survey area, where provisional results were presented and discussed; these were also well attended and overran their allotted two hours. In addition, a final evening conference allowed volunteers from each of the three project areas to see and discuss the results of all three areas, and to discuss possible follow-up work by which the value of these results could be enhanced.

The volunteers inevitably all had differing degrees of relevant experience, and some were better able to notice and record archaeological features from lidar than others. Consequently the nature of volunteer results is very variable; some recorded post-medieval fields in great detail, while others struggled to identify quite obvious features. None of this is a problem - all were requested to record what they thought they could see, and offer their best interpretations of what they thought different features might be. Ideally, individual feedback with volunteers should be incorporated into future similar projects.

The Project Officer and Project Consultant spent two very intensive days studying the lidar of each project area (6 days in total), and the results of this work form the basis of the project archive. During this work, it was possible to access 3D lidar models which, due to the non-availability of the required software, was not available to the Project Officer. This made it possible to check particularly interesting areas in greater detail than would otherwise have been the case. For any similar work in future, the facility to access 3D lidar should be available to the Project Officer. It has not been possible for the Project Officer to check every km sq in detail, but all areas of reasonable to high potential have been checked. The Teesdale area has been checked in full and the archive is largely complete, but some parts of other areas would benefit from additional scrutiny.

The project archive consist of two parts: a summary of all sites noted by the Project Officer and Project Consultant, and the results (unedited) provided by the volunteers. These two sets of results will be merged into a single enhanced database in the near future; until this is done anyone wishing to use the results for any purpose should really examine both sets of data. The enhanced archive will be incorporated into the HER, and made available to volunteers along with an enhanced version of this report, in due course.

When examining the results, it must be borne in mind that they by no means represent the whole story of the archaeology of the areas in question. In many cases, no lidar is available for potentially significant areas, while in others (most notably

Weardale above Westgate) only low-resolution lidar is available, which is not much use for this type of survey. Consequently, not only should anyone studying these areas go back to the original lidar images as discussed above, but they must also access other appropriate sources such as the HER, aerial photography, historic mapping, and published and unpublished reports.

The project was originally designed to include analysis of processed lidar data for all km sqs for which EA lidar data it was available. Only subsequently was it realised that several km sqs included only a small patch, in some cases only a sliver, of lidar coverage. Such km sqs are not worth allocating to volunteers for survey. For future projects it would be worth doing some preliminary analysis and excluding such areas. A further point to note is that with the exception of a few isolated industrial sites such as shafts and quarries, the highest ground is fairly featureless and very few sites have been recorded from the lidar. Such km sqs were generally not circulated to volunteers and were surveyed by the Project Officer. To a lesser extent, the same is true of lower ground which has been heavily ploughed over recent centuries. Where possible, volunteers were only sent interesting km sqs with reasonably high potential for significant discoveries. For future projects, it would probably be worth doing some preliminary survey to ensure that efforts are concentrated on areas of highest potential.

6.3 Suggestions for further work

The above points, taken together, mean there is still much work to be done to enhance the benefits of the already impressive work undertaken by the project volunteers. Without doubt, there is potential for one or more exciting follow-up projects to build on the excellent work done to date. There are two key tasks, one short-term and one longer-term.

In the short term, there is still work to be done to enhance this report, along with the project archive. The Project Officer, Paul Frodsham, hopes to complete this work on a voluntary basis during 2018, after which a final version of this report will be circulated to all volunteers and passed, along with the final project archive, to the County Durham Historic Environment Record (HER). It is planned to complete this work in consultation with the Project Consultant, Prof Stewart Ainsworth, and a small team of volunteers.

Once the final report is available, it will represent a very important contribution to our understanding of North Pennines Archaeology. But it is important to stress that the report and archive should not be studied in isolation; anyone studying one or more areas covered by the project should study the original lidar data for themselves, as it is quite possible that some sites may have been missed or misinterpreted. The original data, as part of the project archive, will be available for inspection at the North Pennines AONB office in Stanhope; unfortunately, due to the size of the archive, it cannot be made available online.

In the longer term, there is much important work to be done to develop the results of this initial lidar survey. In the first instance, several sites require inspection on the ground to enable provisional interpretations set out in the project archive, and discussed in this report, to be checked. Some of these will almost certainly justify detailed ground survey, which in some cases could include geophysics. In the longer term, a programme of small-scale excavation to establish the chronology of a selection of sites, and details as to their use, would be justified. There is also a need to inform landowners of important sites on their ground, and discuss with them and other appropriate authorities how these should best be managed. The AONB Partnership, Project Officer and Project Consultant intend to liaise with a range of potential partners to establish how this all should best be done. It is hoped that a follow-up project can be undertaken to enable many of the participants involved in this project to develop their important work to date, and thus make further significant contributions to our understanding of North Pennines archaeology.

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