



AIR PHOTO MAPPING,
INTERPRETATION AND
ANALYSIS FOR ALL
ARCHAEOLOGICAL APPLICATIONS
www.alisondeegan.co.uk

Cumbria Terrestrial Mineral Resource
Air Photo and Lidar
Mapping and Interpretation

EH Project No. 6490

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Alison Deegan BSc MIFA

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Produced on behalf of
Oxford Archaeology North and English Heritage

SUMMARY

The Cumbrian Terrestrial Minerals Resource Assessment has undertaken air photo and lidar mapping and interpretation as part of English Heritage's National Mapping Programme. The CTMR is operated by Oxford Archaeology North, funded by the Historic Environment Enablement Project and this work was undertaken by Alison Deegan.

The air photo and lidar mapping covers 102km² of land in the county of Cumbria, divided into 11 discrete areas. This work was undertaken to English Heritage's National Mapping Programme standards using existing air photographs and lidar data. The main outputs of this project are digital maps, supporting records and this summary report.

New monument records were created for 500 monuments or monument groups and a further 29 existing monument records were amended or enhanced.

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1 INTRODUCTION

This report concerns the air photo and lidar mapping and interpretation element of a wider project titled Cumbria Terrestrial Mineral Resource (CTMR) - Assessing the Impact of Aggregate Extraction on the Historic Environment.

The CTMR is funded by English Heritage and operated by Oxford Archaeology North. The air photo and lidar mapping and interpretation element was undertaken by Alison Deegan between January 2013 and October 2013. The air photo and lidar element also contributes to English Heritage's ongoing National Mapping Programme (NMP).

The NMP is generating a comprehensive record of the archaeology that is visible on air photographs for the whole of England. It is an ongoing programme and had covered over 46% of the country as of September 2013.

2 BACKGROUND TO THE SURVEY AREAS

Stage 1 of the Cumbria Terrestrial Mineral Resource had defined 11 Study Areas where "the potential for the destruction of the archaeological resource was deemed to be greatest as a result of future aggregate extraction." (Quartermaine and Deegan 2013, 7). The methodology and rationale for the selection of the 11 Study Areas is given in 4. STAGE 1 RESULTS of the project design (Quartermaine and Deegan 2013, 17-18)

To meet the requirements of the NMP the Study Areas had to be extended out to cover full kilometre squares. Parts of some of the extended areas had been dealt with by two earlier NMP-standard projects, namely the Hadrian's Wall Project (NRHE Event UID1360986) and the North-West RCZA (NRHE Event UID1461811) and so these parts were excluded from this new work. As a consequence the areas covered by the air photo and lidar mapping interpretation element are slightly different to the CTMR Study Areas, they are referred to hereon as the AP&L Survey Areas (see Figure 1).

Overall the AP&L Survey Areas covered 102km² of land. The mineral and aggregate-producing foci of each of the 11 Study Areas lie outside the Lake District National Park but some of the AP&L Survey Areas clip the park boundary.

3 ARCHAEOLOGICAL SCOPE

The scope of this project broadly mirrors the NMP Sphere of Interest (Winton 2012, Section 5). The main aspects that are pertinent to this particular project and any divergence from it are summarised in Appendix 1.

4 SOURCES CONSULTED

4.1 Air Photographs

Three collections of air photographs were consulted for this project. Contact details for these collections are provided in Appendix 2.

English Heritage Archive (EHA) (formerly National Monuments Record).

The vertical, specialist oblique and military oblique air photographs held by the EHA were made available to this project in a series of loans. The prompt and efficient servicing of photo loans by the Archives team, and in particular Luke Griffin, ensured that this project was able to progress smoothly. A small proportion of photographs could not be loaned and laser copies were supplied in lieu. Some recent digital photography was supplied as digital files because no physical prints have been produced. Unfortunately there is, as yet, no mechanism for the stereoscopic examination of digital photographs for the NMP, which may have been useful in some cases. The EHA loan reference numbers are given in Appendix 2 these refer to the lists of the loaned photographs and as such are a record of the EHA images consulted for this project.

Cambridge University Committee for Aerial Photography (CUCAP) collection

This project was carried out in collaboration with CUCAP (briefly known as Cambridge University's Unit for Landscape Modelling): its contribution being the loan of air photographs to EH's Aerial Survey and Investigation (York). Loans were limited to 100 photographs at a time.

A list of the photographs in this collection that were examined for this project is contained in the file CTMR_6490_CUCAP.xls.

Cumbria County Council (CCC)

CCC holds a collection of oblique and vertical air photographs at its offices in Kendal. The vertical air photographs were flown by the RAF, the Ordnance Survey, Fairey Surveys Ltd and Hunting Surveys Ltd. The vertical coverage is inconsistent and not complete and many of the vertical photographs are duplicates of those held in the EHA. The oblique air photographs are attributed

to a variety of organisations and individuals, including CUCAP, Manchester University, T. Gates and R. H. Bewley.

To facilitate completion of each Survey Area in turn, the available air photographs in this collection were scanned in advance and the scan copies were used for interpretation and mapping during the course of the project. Permission to scan the T. Gates photographs solely for the purposes of mapping and interpretation was sought and granted. Small scale verticals photographs and those duplicated in the EHA were not scanned. Duplicates of CUCAP photographs were not scanned because these would become available via that collection (see above).

A list of the photographs in this collection that were examined for this project is contained in the file CTMR_6490_CCC.xls.

Table 1. Air photo collections and summary of material consulted (includes duplicates between collections)

Collection Name	Quantity consulted	
	<i>oblique air photos</i>	<i>vertical air photos</i>
EHA	363 specialist + 5 military obliques	2482
CUCAP	35	21
CCC	127	21
Total	803	2524

4.2 Digital air photos supplied through the Pan Governmental Agreement

Geo-referenced 0.25m resolution colour digital air photos produced by GeoPerspectives were made available to this project through the Pan Governmental Agreement (PGA). These were supplied as 1km² tiles and were taken on various dates between May 2008 and September 2010. This imagery is a digital only-product (no prints) so it was viewed on screen during the course of mapping from the other photographs and again towards the end of the mapping process for each quarter sheet to inform the monument condition assessment.

4.3 Online digital air photographs

Digital air photographs delivered online by Google Earth were examined and they were captured and rectified where necessary. The imagery delivered by Bing was consulted on an ad hoc basis as and when information from all other sources was ambiguous.

4.4 Light Detection and Ranging (lidar)

Environment Agency lidar data was available for approximately 55% of the overall project areas. At the outset of this project this was limited to low resolution, georeferenced, colour raster images (jpegs) with fixed parameters (eg lighting, azimuth and vertical exaggeration). However, during the course of the project 1m and 2m resolution ASCII data became available and was used in preference to the raster images for the remaining AP&L Survey Areas. The ASCII data was processed either as 16 direction hill-shade models or as a series single-lit views, depending on the resources available. Digital surface models were examined in preference to digital terrain models except in areas of extensive tree cover. Figure 2 shows the relative coverage of raster and ASCII lidar data as used by this project.

4.5 Existing records

The textual and spatial monument and event records in the National Record of the Historic Environment (NRHE) were routinely consulted during the course of this project. Existing NRHE monument records were updated with new information from the air photos and mapping. Where there was no existing monument record pertaining to the archaeological features mapped from the air photos and/or lidar imagery, then a new record was created.

Cumbria Historic Environment Record (CHER) supplied monument and events data for the AP&L Survey Areas. This informed the mapping and recording and where possible the NRHE records that were created or enhanced by this project were concorded with the CHER records.

4.6 Historic Maps

The historic Ordnance Survey maps delivered through EH's WEBGIS were consulted in tandem with the air photos and lidar imagery. These informed interpretations and where appropriate were identified as a source in the NRHE monument record.

5 METHODOLOGY AND RECORDING

5.1 Mapping Methods

All of the available air photographs from the specified sources were examined under magnification and stereoscopically where possible. Photographs selected for transcription (rectification and mapping) were then scanned at a suitable resolution, this was usually 300 dpi, and output as uncompressed TIFF format images (.TIF).

Scanned images were rectified using the specialist software AERIAL5.33. Control information was mostly derived from the Ordnance Survey Land-Line™ 1:2500 scale vector maps, which

were also used as a base for mapping. Accuracy for the Ordnance Survey raster 1:2500 maps is in the range of $\pm 2\text{m}$ and acceptable tolerance for rectification of photographs is generally $\pm 2.5\text{m}$. Rectified images were output from AERIAL in uncompressed TIFF format at a minimum resolution of 300 dpi and a scale of 1:2500.

Individual digital maps for each AP&L Survey Area were created in MAPINFO Professional 11.5. The rectified images (air photos and lidar) were placed into the relevant map drawing and the archaeological features were then digitised from the images, observing the NMP standards.

5.2 Recording Strategy

There are two strands to the NMP recording strategy and these were both employed for this project. The main strand is the creation of new or the enhancement of existing monument records in the NRHE. The NMP-generated entries or enhancements for each monument or monument group in this database record the location, the monument types present and their dating, the latest condition, a free text description of the monument or monument group, the source of record information (i.e. photograph and any bibliographic or cartographic references) and administrative details such as concordance with SMR/HER records, record authorship, and links to NRHE event records and archives.

To assist in the management and querying of the map data in a GIS or in Autodesk Map® environment select monument data is attached to each individual mapped feature. The content of this data table is listed Appendix 3.

5.3 Quality Assurance

During the lifetime of the project the air photos, mapping and recording for sample areas were examined and checked by EH's own Aerial Investigators to ensure the product met the required standard for the NMP.

6 PROJECT REVIEW

This is a review of the aims defined in the original project design (Quartermaine and Deegan 2013, 9-10).

AIM: To contribute to EH SHAPE sub-programme 32111.110 National Mapping Programme: recording and mapping archaeological landscapes using aerial photographs.

This project has contributed 102km² of mapping to the programme.

AIM: To identify, characterise, and map, using a GIS, Cumbria's historic environment resource (outside the designated landscapes listed in *Section 1.1.1*) in relation to areas of past and potential future extraction of sand and gravel.

Prior to this project the NRHE recorded a total of 158 monuments within the 11 AP&L Survey Areas. A substantial percentage of these pertained to standing buildings or structures, a smaller proportion to small finds, and earthwork or cropmarked archaeological monuments were in the minority. This project has enhanced 29 of those existing monument records entries and generated records for 500 new monuments or monument groups.

The HER had previously recorded 312 monuments within the AP&L Survey Areas, with a higher presentation of archaeological monuments that had been known in the NRHE. Ninety-nine of the new or enhanced NRHE records were concorded with existing HER records suggesting that the mapping and textual information for a further 430 monuments will be new to the HER. An overview of the results for each area is provided in Section 7 and a list of all the period terms and monument types identified by the project is given in Appendices 5 and 6.

The results of this work cover only a parts of the identified CTMR Study Areas, the other parts being covered by previous projects. In order to meet the Research Aims 1-4 identified in the project design there will need to be some consolidation of all the available data. This is beyond the scope of this particular element of the CTMR.

7 PROJECT RESULTS

This section provides a brief overview of the results of this project for each AP&L Survey Area. References to NRHE records are provided in brackets eg (23599).

AP&L Survey Area	Brampton Kames
Area covered (km ²)	13
No. of new NRHE monument records	75
No. of enhanced NRHE monument records	5
No. of records concorded with HER monuments	15

The Brampton Kames AP&L Survey Area is split into two by the Hadrian's Wall NMP Project. The two parts that are quite distinct, with the northern part being dominated by the moorland fringe, small pasture fields and wooded valley and the southern part being characterised by hummocky moraines and larger fields.

No monuments of Neolithic or Bronze Age date were identified by this project in this area. This reflects a general paucity in the NRHE of finds or monuments from these periods in this area.

Although most of the features recorded within these areas are earthworks of medieval or later date the hummocky moraine to the south and east of Tarn Lodge Farm, Castle Carrock has produced cropmarks that may be of earlier origin (UID1029653). Long ditches 600m and more in length cross east to west between the B6413 and the farm with one long and several short sections running north to south across these. A previous assessment of recent aerial reconnaissance indicated that these linears extended beyond the AP&L Survey Area and formed a fairly cohesive field system. A fragment of a possible contemporary enclosure is recorded a little to the north (UID1573368) and another more substantial rectilinear enclosure lies to the west (UID1573369). These features have been identified as being of possible Iron Age or Roman date, although the dating of the latter enclosure is more equivocal.

In the northern area cropmarks near Williamgill Wood suggest the presence of two Iron Age or Roman rectilinear enclosures (UID928546). Cropmarks in this part of the Brampton Kames AP&L Survey Area are otherwise very rare.

Cultivation ridges are fairly extensive in the northern part but appear to absent in the southern strip, but this is likely to reflect differential preservation rather than the real extent of historic cultivation. Most of these ridges are in the form of narrow ridge and furrow and date to the post medieval period. Some of the ridges are broader but only those on the north banks of Coalfell Beck have been identified as being of medieval origin, most are attributed to the medieval and/or post medieval periods because specific dating information is lacking.

The remains of several different post medieval extractive industries are to be found in the northern part of this AP&L Survey Area. In the east the landscape is dominated by Clowhill Limeworks and the associated infrastructure (UID12504). The large quarry and internal features including limekilns, an inclined plane, the bed of a conveyor, and several structures appear to be well preserved. The limeworks were served by the Tindale Fell Waggonway (UID 1569609) and the Blacksike Railway and parts of these survive as earthworks (UIDs 1573284, 1573219 & 1573229).

To the east of Clowhill Limeworks, on the slopes of Coalfell Beck the earthwork remains of a complex history of coal extraction are present (see Figure 3). These include clusters of small extraction pits (eg UID1573193), larger single shafts with substantial rings of spoil (eg UID1573166), adits (eg UID1573180), and the Howard Pit drift mine (UID963436). Intriguingly amongst these, on the north side of the beck, there is a series of tofts and building platforms and fields arranged around several well-defined hollow ways (UID1573191). These may have been a post medieval settlement and/or processing area associated with the coal extraction but an earlier origin for these earthworks cannot be discounted on the present evidence. These remains were not previously recorded in the NRHE.

To the west of Clowhill Limeworks the features that were mapped comprise mainly the medieval and/or post medieval cultivation ridges noted above, small discrete quarries (eg UID963430), some with limekilns (eg UID958433) and some incised trackways (eg UID1573306) of likely post medieval origin.

Of particular note are a small group of earthworks at Moss Pladdow. These comprise walled and ruined walled boundaries of likely post medieval date (UID1573309) but within them lies a small group of mutilated earthworks that appear to represent small embanked or walled enclosures (UID1573311). Whether these are the remains of stock enclosures or hut circles and their date are not known.

AP&L Survey Area	Low Plains
Area covered (km ²)	11
No. of new NRHE monument records	43
No. of enhanced NRHE monument records	16
No. of records concorded with HER monuments	25

The Low Plains AP&L Survey Area is rich in prehistoric and Roman period earthworks and cropmarks (see Figure 4). Just below the ridge near Castlerigg Castle there is a cropmarked ring ditch may be the remains of a Neolithic or Bronze Age burial mound (UID1573713). The ring ditch is slightly oval in plan which may suggest that this monument was more complex than a

single phase round barrow. On the opposite side of the valley, in the field to the north-east of Low Plains farm, is a possible Bronze Age or Iron Age palisaded enclosure (UID1573681). It is visible as a very narrow cropmarked ditch or gully outlining a rectilinear enclosure with bowed sides. The enclosure appears to be cut by a field boundary of possible later Iron Age or Roman date (see below)

Three hill-top enclosures of possible Iron Age or Roman date were recorded in this area. Two lie on local promontories and opposite one another on either side of a small valley (UIDs 1454250 & 1573704). The third sits higher up, on the edge of Blaze Fell (UID11356). The two lower examples appear to be fairly simple ditch-defined enclosures with only slight hints of internal or external features. The third example is defined by a more substantial ditch with hints of an internal counter-scarp and internal divisions. However these differences this may simply be the result of differential survival, the latter is a substantial earthwork whilst the two lower-lying enclosures have been truncated by modern ploughing.

In the low lying fields between the A6 and Blackrack Beck there are traces of four rectilinear enclosures which may also date to these periods (UIDs 1573644, 1573647 & 1573648). Unfortunately the cropmark evidence here is rather ambiguous and they warrant further specialist reconnaissance.

A significant feature in this survey area is the presence of numerous long linear boundaries. These have been recorded on Thiefside Hill and the lower southern slopes of Blaze Fell (eg UIDs 1573628 & 1473670). Most of these features are single-ditched but several of the linears converging towards the A6 on the south-east side of Thiefside Hill are double ditched and may have been trackways (ie UIDs 1573629, 11364 & 1573638). Together the boundaries and trackways appear to comprise a large and slightly irregular system of land division. This may have been associated with the Roman farmstead at Petterilgreen on the north-west side of Thiefside Hill but may have had its origins in the Iron Age.

The Petterilgreen Roman farmstead is a substantial rectilinear enclosure defined by broad rampart with inner and outer ditches (UID11351). It is surrounded by fields defined by ditches and trackways (UID927416). This farmstead 700m to the west of the Roman road that ran between Brougham to Carlisle (UID1031541). In this area the A6 runs along the course of this Roman Road, except at Thiefside Hill where the modern route briefly diverts to the east around the hillside and the remains of the Roman Road are visible as distinct parchmarks on the air photos (UID1573635).

Three of the earthwork enclosures recorded on Lazonby Fell near the southern edge of this area had been identified as being of medieval date by other investigators. No new evidence arose

from this work to contradict this. Two of the enclosures comprise low and indistinct earthworks (UID12466). The larger is irregular in plan and appears to encircle a small knoll, the second appears to be cut by the north-east circuit of the larger. A previous field investigation had concluded that these earthworks were indecipherable. The third enclosure sits slightly upslope and 540m to the east (UID12463). In recent decades it has been under woodland plantation and so has been obscured on most recent air photos. Field investigators concluded that a medieval origin was plausible.

There is very little earthwork or cropmark evidence of other post medieval activity in this AP&L Survey Area. Ridge and furrow of any date is relatively sparse and the large-scale extractions at Low Plains (UID1573671) and near Abbots Moss Farm (UID1573696) did not start until the twentieth century.

Cardewmires

AP&L Survey Area	Cardewmires
Area covered (km ²)	10
No. of new NRHE monument records	35
No. of enhanced NRHE monument records	3
No. of records concurred with HER monuments	6

No monuments of Neolithic or Bronze Age date were identified in the Cardewmires AP&L Survey Area. This reflects a general paucity in NRHE records of finds or monuments of these periods in this area.

Three areas of possible Iron Age or Roman date remains are in evidence on the air photos.

Near Cardew Hall the cropmarked enclosures, trackways and fields that lie on the eastern side of Gill Beck have been scheduled as an undated settlement (UID10507, SM1007206). The visible remains are contained within a single modern field unit but are likely to extend further unseen. The scheduled area only encompasses the two enclosures and not the associated trackway or fields.

In the Cardewlees area there is an extensive network of long single and double ditched linears which appear to be the remains of a system of land division of possible Iron Age or Roman date. (UIDs 10802 & 1574064). The evidence for settlement amongst these boundaries is equivocal. Two circular features north of Barras Brow that are defined by vigorous nettle growth have previously been interpreted as hut circles (UID10802), a more circumspect interpretation of these features as pits has been made by this project. However a small circular enclosure identified on the north side of Dalston has been posited as a possible hut circle (UID1574064).

The latter feature was recorded from the PGA digital air photos and it is clear that this area would benefit from further specialist reconnaissance.

Further west, on the banks of Nealhouse Beck near Wood Farm there are cropmarks indicating a curvilinear enclosure, a trackway and fragments of field boundaries (UIDs 1574035 & 1574033). Again these are likely to be of Iron Age and/or Roman date.

These three groups of cropmarks are all on slowly permeable soils which indicates that there is potential even where the conditions for cropmark formation appear unpromising.

Ridge and furrow is fairly widespread across this area but arranged in relatively small clusters of strip fields, some with medieval ridges but others with later narrow ridge and furrow.

Other post medieval remains in this area are two possible construction camps sited alongside the Maryport and Carlisle railway. They are of similar plan and comprised a large elongated rectilinear terrace or enclosure and several buildings platforms or footings (UIDs 1574048 & 927357) (see Figure 5).

The late post medieval small scale extractions that are common in many of the AP&L Survey Areas are seemingly absent here. The large scale extractions at Cardew Mires are of twentieth century origin (UID 1574036).

AP&L Survey Area	Abbeytown “Ridge”
Area covered (km ²)	3
No. of new NRHE monument records	7
No. of enhanced NRHE monument records	1
No. of records concorded with HER monuments	0

The small Abbeytown “Ridge” AP&L Survey Area lies to the east of and is contiguous with parts of Hadrian’s Wall NMP Project.

This is a small area which yielded no earthworks, a small number of cropmarked ditches and a 20th century structure.

No monuments of Neolithic or Bronze Age date were identified by this project. This reflects a general paucity in of NRHE records of finds or monuments of these periods in this area.

This AP&L Survey Area covers the eastern extents of the extensive Holme Abbey Ridge cropmark complex (Higham and Jones, 1975 fig. 4). This complex indicates a landscape of Iron Age and/or Roman settlements, field boundaries and dyke systems. Within the AP&L Survey Area only a few possible field boundaries are visible (eg UID1574197). Most of the Holme Abbey Ridge cropmarks are located on freely draining sandy soils but they peter out in the AP&L Survey Area and there the cropmarks are formed on slower permeable soils. Again this indicates the

potential for unpromising areas to produce evidence and further reconnaissance may be warranted.

One of a pair of 20th direction finders is visible as a structure on Common Moss (UID1473538). The other was recorded by the Hadrian's Wall NMP Project (UID1469228).

AP&L Survey Area	Moota
Area covered (km ²)	7
No. of new NRHE monument records	49
No. of enhanced NRHE monument records	1
No. of records concorded with HER monuments	3

The Moota AP&L Survey Area is contiguous with Hadrian's Wall NMP Project to the west.

No monuments of Neolithic or Bronze Age date were identified by this project. This reflects a general paucity of NRHE records of finds or monuments of these periods in this area

The Egremont to Carlisle Roman road (UID 1325580) is one of only two monuments previously recorded in this area in the NRHE. Although in the AP&L Survey Area this route is largely followed by the A595, up to three possible sections of the Roman road are visible on the air photos. In the fields south-west of Williamsgate, cropmarks and low earthworks reveal a section of road and possible road side ditches along the projection of the Roman road, where the A595 takes a slightly more southerly route (UID1325580). North-east of Threaplands Gill the A595 again takes a more southerly path and its Roman precursor can be seen as cropmarks running in a more northerly orientation in a neighbouring field (UID 1574426).

At Threaplands Gill itself a hollowed way descends and ascends the banks of the gill on the alignment of the Roman road (UID 1574415). On the post-war air photos the modern road crossed the gill a little further south but this diversion was straightened out in the late 20th century. Part of the hollow way is depicted on the Ordnance Survey map of 1866 where it ran through Threapland Wood (now removed). It was probably in use in the post medieval period, but it may have been part of the original Roman route.

A significant element of this landscape is the pattern of long narrow fields that flank either side of the Roman road near Blindcrake (see Figure 6). Now fossilised by hedges and walls these fields are relics of a medieval strip farming system. This project has identified the presence of medieval ridge and furrow within many of the strip fields and suggests that some ridges may still survive as earthworks. The village of Blindcrake and the fields south of the road are a Conservation Area and the character of the fields is cited as one of the points of special interest that justify its status (UIDs 1574382 & 1574382).

The second pre-existing monument record in this area was for a Prisoner of War camp at Moota Hill (UID1474045). Camp 103 served as a PoW camp during the war and then as a Displaced Person Camp in the immediate post-war period. The early vertical photographs show the layout of the camp and more recent photography indicates that some of the buildings are still in situ.

AP&L Survey Area	Tendley
Area covered (km ²)	10
No. of new NRHE monument records	48
No. of enhanced NRHE monument records	0
No. of records concorded with HER monuments	8

No monuments of prehistoric or Roman date were identified by this project within the Tendley AP&L Survey Area, although a small number of Neolithic and Bronze Age finds have been recorded here (eg UIDs 8851, 8871 and 9032).

The remains of ridge and furrow are present in many of the fields within this area, particularly around the two villages Brigham and Eaglesfield. Some strips of possible medieval ridge and furrow have been recorded (eg UIDs 1574731 & 1574824) although these are far more fragmentary and dispersed than the landscape around Blindcrake, which lies a short distance to the north-east (see Moota above). In common with the other areas, dating for most of the ridge and furrow is ambiguous, it having neither the broad, S-bend character of medieval plough ridges nor the very straight and narrow form of post medieval ploughing.

The air photos did yield some evidence of possible abandoned settlement remains around Eaglesfield (UIDs 1574725, 1574721 & 1574718). These include parchmarks that appear to relate to a group of structures that are depicted on the Ordnance Survey map of 1881 but the other features may be older.

This AP&L Survey Area is dominated by two main industrial complexes: the limeworks at Brigham and the Tendley Hill Quarry. Nineteenth century Ordnance Survey mapping indicates that the complex at Brigham was large and included lime kilns trackways, tramways and a coal depot as well as deep excavations. It is not clear whether the complex was still in use on the earliest air photos but certainly the quarry floors had been colonised by shrubs and trees at that time. This complex is now largely obscured by vegetation and some parts have been re-landscaped so it not clear which historic elements still survive.

By contrast the Tendley Hill Quarry has expanded in recent decades (UID1574742). In doing so it has subsumed a number of quite small individual pits and lime kilns that were depicted on the Ordnance Survey map of 1864 and were still extant on the earliest air photos.

AP&L Survey Area	Eskett and Rowrah
Area covered (km ²)	13
No. of new NRHE monument records	83
No. of enhanced NRHE monument records	0
No. of records concorded with HER monuments	25

The Eskett and Rowrah area is one of the more industrialised landscapes covered by this project. Aside from the trace of possible Roman road at Frizington Parks (UID1576115) and a fragment of possible medieval ridge and furrow near Rowrah Hall Farm (UID1576443) most of the features recorded in this area pertain to the post-medieval period or later.

Two main industries were active in this AP&L Survey Area: ironstone mining and limestone quarrying. Most of the Ironstone mines were active in the 19th century and are depicted in some detail on the Ordnance Survey maps of that time. In many cases it has been possible to reconcile earthwork shafts, spoil heaps and some structures with individual mines that are named on the historic maps (eg UID1576146 Eskett and Eskett Park Iron Ore Mines). This project has also recorded some of the infrastructure that was associated with the mines, namely the tramways and mineral railways (eg UID1576127). Most of the ironstone workings appear to have been abandoned by the date of the earliest air photos.

Limestone extraction is concentrated at five main locations: Yeathouse Quarry (UID1576156), Eskett Quarry (UID1576183), at Rowrah (UID1576183), Stockhowhall Quarry (UID1576234) and Kelton (UID1576251). All of these quarries originate from small 19th century workings. The Yeathouse and Stockhowall works had been abandoned by the 1940s but the others have expanded in recent decades. In between the modern workings and re-landscaping some historic remnants of these industries do survive, particularly at Yeathouse and Stockhowall quarries, and at the north ends of the Rowrah and Kelton complexes.

Regarding the air photo coverage, unusually there is a slight gap between early vertical sorties in the vicinity of kilometre square NY0516. Historic maps show that there were ironstone workings in this area. The problem is compounded because by the 1960s, the date of the next available photographs, the Eskett Quarry had already expanded and subsumed many of those workings. Fortunately the Ordnance Survey historic maps serve as a record of what has been lost.

AP&L Survey Area	Peel Place
Area covered (km ²)	14
No. of new NRHE monument records	50
No. of enhanced NRHE monument records	1
No. of records concorded with HER monuments	3

The Peel Place study area is contiguous with the NW RCZA project to the west. Although this area is relatively rich in Neolithic and Bronze Age finds, notably lithics, no monuments of Neolithic or Bronze Age date were identified by this project.

There is, however, a pair of enclosures of speculative later prehistoric origin on the north side of Drigg (UID1579049). These are in the form of two hedged fields, one oval in plan with an out-turned entrance and the other is of rather irregular shape. A small part of the hedging has been removed and exposes a broad but seemingly shallow ditch. If not of prehistoric origin these features may have their roots in the medieval period.

Most of the other monuments in this area are either ridge and furrow or quarries. A considerable proportion of the ridge and furrow is of the narrow form and of likely post medieval date, the remainder may be of medieval and/or post medieval origin.

There are a few historic quarries in this area including the excavations at Drigg Cross (UID1579029) and near Seascale Hall (UID1579067). The larger workings: the sand pit between Newton Wood and Fleming Hall (UID1579003), and the quarries at Seven Acres (UID1579013) and near Peel Place (UID579019) appear to have started in the mid-20th century or later.

AP&L Survey Area	Ghyll Scaur
Area covered (km ²)	9
No. of new NRHE monument records	47
No. of enhanced NRHE monument records	1
No. of records concorded with HER monuments	6

The Ghyll Scaur AP&L Survey Area is contiguous with the NW RCZA project to the east. This project did not identify any monuments of Neolithic or Bronze Age date in this area, which reflects a general paucity in the NRHE of any finds or monuments of any periods for this area.

This area is generally devoid of any cropmarks so the two locations at which cropmarks were observed have significance for their rarity. Both are located in the north-west, by the side of Whicham Beck. Near Topping Moss Plantation a sub-circular embanked feature is visible as a slight earthwork on earlier air photos and as a cropmark on later (UID1577369). Approximately

1km upstream a group of linear cropmarks and soilmarks appear to suggest enclosures and boundaries (UID1577372). However it is far from certain that any of these features are of archaeological origin.

Cultivation ridges are fairly widespread in this area, except within the bounds of Millom Park. Although today the park is largely under plantation or has been taken by the Ghyll Scaur quarry most of the land surface was visible on air photographs up until at least 1972 and the absence of evidence for ridge and furrow appears to be an accurate reflection of its distribution. Outside of the park very little of the ridge and furrow could be confidently identified as being medieval in origin. Of potential interest though are two low broad banks (UID1577435) near Arnaby that appear to be cut by medieval or post medieval plough furrows (UID1577433). These resemble plough headlands and may indicate an earlier phase of cultivation.

Interestingly around Greenhills (UID1577487) and Crosshouse Hill (UID1577457) the medieval and/or post medieval ploughing continues up to and between the rocky outcrops that characterise this landscape. This might indicate that there were considerable pressures to bring such difficult terrains into cultivation.

Some of the ridge and furrow is divided into fields by low narrow banks or exposed walling. Many of these are depicted on the historic Ordnance Survey map and so in general have not been duplicated for this survey, but where they have not they are recorded (eg UID1577487). Of potential significance are the boundary remains found with the otherwise unenclosed north part of Millom Park (UID1577405)

Quarrying activity in this area is characterised by small post medieval quarries (eg UIDs 1577402, 1577422 & 1577411). Only one such quarry developed into a larger operation and this was the Ghyll Scaur granite quarry in Millom Park which covered an area of approximately 21 hectares in 2010.

AP&L Survey Area	Roosecote
Area covered (km ²)	4
No. of new NRHE monument records	24
No. of enhanced NRHE monument records	1
No. of records concorded with HER monuments	5

The Roosecote AP&L Survey Area is contiguous to the south with the NW RCZA Project. This area contains several intriguing features of possible to likely later prehistoric or Roman date. Perhaps the most significant of these is the spread of cropmarked features recorded in the Catty Crook Lane area (UID1572108). The dominant features are a large rectilinear enclosure which appears to contain an avenue defined by large pits and at least two circular enclosures, though this

relationship may be coincidental. Beyond the enclosure there is a third circular enclosure and a large rectilinear pit which appears to be aligned with the pit avenue. The pit arrangement might suggest a monument of Neolithic or Bronze Age ritual purpose and so the circular enclosure might be the remains of round barrows or related monuments. However the enclosure itself may as readily be of Iron Age or Roman date as earlier origin and in this context the circular enclosure could be the remains of hut circles.

Around the enclosure there are many ditches which appear to be form a system of land division, albeit rather fragmentary (UIDs 1579334, 1579335 & 1579340). These features were identified by recent archaeological reconnaissance and were initially recorded by the EH Aerial Reconnaissance (North): 2010-11 Programme. (Event UID1570057)

By contrast the two possible Neolithic or Bronze Age round barrows identified just to the north of Moor Head Cottage are only recorded on vertical photographs (UIDs 1579508 & 1579512). Similarly the faint cropmarks indicating a small Iron Age or Roman rectilinear enclosure with internal hut circles near Dungeon Lane (UID1579320) are only visible on recent imagery published on Google Earth. From a monument protection viewpoint both sets of features would in the first instance benefit from specialist reconnaissance to establish their validity, or otherwise.

Ridge and furrow is sparsely distributed in this area and is medieval and/or post medieval origin. This area also contains two Second World War features associated with the protection of the strategically important ports and industrial complexes at Barrow in Furness. They are a pillbox near the A5087 near Roose (UID1429744) and on the opposite side of the road the remains of a barrage balloon site (UID1579305).

AP&L Survey Area	Roan Edge
Area covered (km2)	8
No. of new NRHE monument records	39
No. of enhanced NRHE monument records	3
No. of records concorded with HER monuments	3

Prior to this mapping there were no monuments in this AP&L Survey Area in the NRHE. This work has revealed several possible sites of potential later prehistoric date. These are very cautious interpretations because of the nature of the remains and the available evidence.

ASCII lidar data was available for Roan Edge area for manipulation and interrogation. This data appears to show the low earthworks of an embanked oval enclosure (UID1576797) a little to the west of the Roan Edge quarry (UID1576752). It lies on high ground but in an inferior position and close to an area of issues and collects. It measures approximately 45x34m. It is not obviously visible on any of the vertical air photos that cover this area and there is no specialist coverage. This feature is morphologically similar to others in the wider area that are thought to be of later prehistoric date (eg UID1574607) but a medieval origin cannot be discounted, if the feature is indeed of archaeological origin.

This area has produced the only identified examples of later prehistoric cord rig in the whole survey. These characteristically narrow and uneven cultivation ridges are visible on the east side of the M6 on the western slopes of Drybeck Hill (UIDs 1576927 & 1576929). If they can be confirmed as cord rig they might indicate that there was contemporary settlement in the area.

By the side of the more northerly patch of cord rig there is a small earth disturbance which resembles the remains of a scooped hut platform. However, the Ordnance Survey map of 1860 also marks a triangulation station in the same area, which may explain the disturbance. A second possible hut circle is visible further north between Spanishaw Beck and the M6. The oval enclosure, cord rig and 2 hut circles all require ground-based investigation to validate their presence and these interpretations.

Evidence of medieval or post medieval ploughing is relatively sparse on this area.

One significant feature of that was probably in use in the post medieval period but have had earlier origins is the long trackway that ran across New Hutton Common from Latterhowe Bridge towards Drybeck Hill (UIDs 1576749 & 1576741). Some sections have been destroyed by the Roan Edge Quarry (UID 1576752) but beyond this it is defined by some deeply-incised hollow ways.

Until the 1980s quarrying activity in this area was represented by a sparse distribution of small and abandoned post medieval pits (eg UIDs 1576792 & 1576934). However at the end of the

decade one of these pits, the Roan Edge Quarry (UID 1576752), was reopened and extended and now covers over 30 hectares.

8 DATA ARCHIVING AND DISSEMINATION

8.1 Copyright

The copyright of the air photo mapping and associated records produced by this project lies with English Heritage.

8.2 Project Archive

The results of this project's mapping and interpretation are contained within 11 ESRI shape files. These will be deposited with the English Heritage Archive. Aerial Survey and Investigation shall also retain digital copies.

The records resulting from this project are contained within and are integral to the NRHE. They may also be accessed online via Pastscape (www.pastscape.org.uk).

There are no formal arrangements for the archiving of other digital files created during the course of this project: scanned image files (.TIF), rectified image files (.TIF), World files (.TFW), AERIAL rectification files (.RDA) and lists of consulted material (.XLS). Copies of these will be deposited on the English Heritage file server under Aerial Survey. For this project decisions regarding the preservation of these files will be the responsibility of English Heritage but this is an area that needs consideration for future projects.

9 SUMMARY OF SUGGESTED ACTIONS

- Consolidate the results of this survey with the earlier NMP projects for each Study Area
- Target specialist aerial reconnaissance on cropmarked landscapes and features between the A6 and Blackrack Beck (Low Plains); near Dungeon Lane and Moor Head Cottage (Roosecote); north side of Dalston (Cardewmires); Whicham Beck (Gyhll Scaur) and the eastern end of the Holme Abbey Ridge complex (Abbeytown "Ridge")
- Undertake ground truthing of several previously unidentified earthworks in the Road Edge AP&L Survey Area, around Eaglesfield (Tendley) and the Drigg hedged enclosures (Peel Place).
- Undertake detailed field survey of the Coalfell Beck landscapes (Brampton Kames)

- Re-evaluate Schedule Monument status and descriptions of cropmarked settlement on Cardew Hill (UID10507/SM10077206) (Cardewmires), and enclosures on Lazonby Fell (UIDs 12466 & 12463 both SM1007195) (Low Plains).
- Devise protection strategies for the potentially regionally important Catty Crook Lane cropmarked complex.
- Formalisation of archiving procedures for non-core data eg photo lists
- Provision should be made for the archiving and dissemination of a version of the project mapping that contains ALL the original object data (see note below Appendix 3)

REFERENCES

- Higham N J and Jones G D B (1975) Frontier, Forts and Farmers: Cumbrian Aerial Survey 1974-5. The Archaeological Journal Vol. 132 16-53
- Quartermaine, J and Deegan, A. (2012) 'Terrestrial Mineral Resource: Cumbria. Assessing the Impact of Aggregate Extraction on the Historic Environment. Revised National Mapping Programme Project Design' Oxford Archaeology North. December 2012.
- Winton, H 2012 Standards for National Mapping Programme projects 2012. English Heritage. Internal document.

APPENDIX 1 SPHERE OF INTEREST

Summarised from Winton 2012.

Cropmarks, parchmarks, soilmarks

All sub-surface archaeological remains are recorded when visible as cropmarks, parchmarks or soilmarks.

Earthworks

All archaeological earthworks that are visible on aerial photographs or lidar imagery. This includes features visible as earthworks on early photographs but which have subsequently been levelled.

Buildings and Structures

All foundations of buildings visible as cropmarks, soilmarks, parchmarks, earthworks or ruined stonework. Standing roofed or unroofed buildings are usually more appropriately recorded by other methods, so will not normally be mapped. The exceptions are in specific archaeological contexts (e.g. industrial and military complexes and country houses), or when associated with other cropmark and earthwork features. Other non-roofed structures particularly 20th century military structures, sheepfolds and shooting butts can be mapped if considered to be of archaeological significance to the project.

Ridge and Furrow

All medieval and post medieval ridge and furrow and prehistoric cord rig, regardless of preservation, according to NMP conventions.

Post Medieval Field Boundaries

Exclude post medieval field boundaries, whether seen as cropmarks, earthworks, or still extant, with the exception of circumstances when they may be of particular archaeological significance (e.g. when field systems are not mapped by the Ordnance Survey).

Parkland, Landscape Parks, Gardens and Country Houses

This was not particularly relevant to this project but refer to Winton 2012 if required.

Industrial Features and Extraction

Due to this project's focus on past and future aggregates and minerals a more inclusive approach was taken to the recording of extraction sites in particular. Small local use quarries were recorded and all quarries of all dates up to the most recent air photos were depicted.

Transport

The Sphere of Interest suggests that transport features such as canals and railways should not be recorded by NMP if they are depicted on historic Ordnance Survey maps. The approach of

this project was more inclusive and disused mineral railways in particular were depicted where they were integral to the industrial landscape.

Urban areas

This was not particularly relevant to this project but refer to Winton 2012 if required.

20th Century Military Features

All First and Second World War as well as Cold War features

Natural features

All natural features which are geological or geomorphological in origin are excluded. If there is risk of confusion in contexts with other archaeological features, then the natural features should be mentioned in the text record; they should not be mapped.

APPENDIX 2 AIR PHOTO COLLECTION DETAILS

English Heritage Archive (formally the National Monuments Record): English Heritage, National Monuments Record Centre, Great Western Village, Kemble Drive, Swindon SN2 2GZ

Table 4. Summary of EHA loans.

Project blocks	EHA loan ref.	Loaned verticals	Loaned obliques	Loaned military obliques
Block 1a	75178A	476	169	0
Block 1b	75178	691	113	1
Block 2	75446	1315	113	4
Total		2482	363	5

Cumbria County Council: Historic Environment Team, County Offices, Kendal, Cumbria, LA9 4RQ

CUCAP: University of Cambridge, Air Photograph Library, Sir William Hardy Building, Tennis Court Road, Cambridge CB2 1QB

APPENDIX 3 MONUMENT DATA (GIS)**MONUMENT DATA TABLE**

The Monument Data table consists of ten data fields. These are associated with and specific to each graphical element in a monument depiction.

Field name	Field content	Sample data
EHLAYER*	Name of NMP layer to which the object belongs	BANK, DITCH, EXTENT OF FEATURE, RF, MONUMENT POLYGON, STRUCTURE, T HACHURE
MONARCH	NRHE Unique Identifier (UID)	1460426
CHER*	Corresponding monument record in Cumbria HER (where appropriate)	12345
PERIOD	date of features (EH Thesaurus)	LATER PREHISTORIC
TYPE	monument type (EH Thesaurus)	RING DITCH/ROUND HOUSE (DOMESTIC)
EVIDENCE	Form of remains as recorded on the source photograph (EH Thesaurus)	CROPMARK
PHOTO1	NMR or other reference for the photograph from which the feature was plotted and its date of photography	HCC HAP 91/13/7 16-JUL-1991
LATEST CONDITION*	Condition of the monument as suggested by the latest available photos or lidar-derived images (this field may be blank if EVIDENCE was CROPMARK)	LEVELLED EARTHWORK
PHOTO2*	NMR or other reference for the most recent photograph from which LATEST CONDITION was deduced (this field may be blank if the EVIDENCE was cropmark or latest condition relied on the evidence of the lidar-derived images.	EARTH.GOOGLE.COM 01-OCT-2009 ACCESSED 01-JUNE-2010
Lidar*	If the monument could be detected on the lidar-derived images the relevant tile reference was recorded here.	LIDAR SE2896 ENVIRONMENT AGENCY D0057155 20TH-JUL-2006

* these are not core NMP-standard data fields and they may not be retained in the files that are formally archived by the EHA and/or uploaded to the EH GIS. However it is highly desirable that arrangements are made for the archive and dissemination of the full data versions as this information cannot easily be recovered from the NRHE records alone.

APPENDIX 4 EH PERIOD TERMS INDEXED BY THE PROJECT

NEOLITHIC	EARLY 20TH CENTURY
BRONZE AGE	SECOND WORLD WAR
IRON AGE	MID 20TH CENTURY
LATER PREHISTORIC	20TH CENTURY
ROMAN	LATE 20TH CENTURY
MEDIEVAL	21ST CENTURY
POST MEDIEVAL	UNCERTAIN

APPENDIX 5 EH THESAURUS TERMS INDEXED BY THE PROJECT

ADIT	GRAVEL PIT	RAILWAY SIDING
BANK (EARTHWORK)	HILLTOP ENCLOSURE	RAMPART
BOUNDARY	HOLLOW	RECTILINEAR ENCLOSURE
BOUNDARY BANK	HOLLOW WAY	REVTMENT
BOUNDARY DITCH	HUT CIRCLE	RIDGE AND FURROW
BRIDGE	HUT PLATFORM	RING DITCH
BUILDING	INCLINED PLANE	ROAD
BUILDING PLATFORM	IRONSTONE MINE	ROBBER TRENCH
CAMP	IRONSTONE WORKINGS	ROUND BARROW
CAUSEWAY	LIME KILN	SAND AND GRAVEL EXTRACTION SITE
CHIMNEY	LIMESTONE QUARRY	SAND PIT
CIRCULAR ENCLOSURE	LYNCHET	SCARP
COAL DEPOT	MILL DAM	SHAFT
COAL WORKINGS	MILL POND	SHAFT MOUND
CONSTRUCTION CAMP	MILL RACE	SHEEP FOLD
CONVEYOR	MINERAL RAILWAY	SPOIL HEAP
CORD RIG	MOUND	STOCK PEN
CROFT	NARROW RIDGE AND FURROW	TANK
CURVILINEAR ENCLOSURE	OVAL ENCLOSURE	TERRACE
DAM	PADDOCK	TOFT
DIRECTION FINDER	PALISADED ENCLOSURE	TRACKWAY
DITCH	PEAT CUTTING	TRAMWAY
DRAINAGE DITCH	PIT	TREE ENCLOSURE RING
DRIFT MINE	PIT ALIGNMENT	TRIANGULATION STATION
DYKE (DEFENCE)	PLATFORM	WAGONWAY
ENCLOSED SETTLEMENT	PLOUGH HEADLAND	WALL
ENCLOSURE	POND	WATER CHANNEL
EXTRACTIVE PIT	PRISONER OF WAR CAMP	WOOD
FARMSTEAD	QUARRY	WOOD BANK
FIELD	RAILWAY	
FIELD BOUNDARY	RAILWAY CUTTING	
FIRING RANGE	RAILWAY EMBANKMENT	
GRANITE QUARRY		

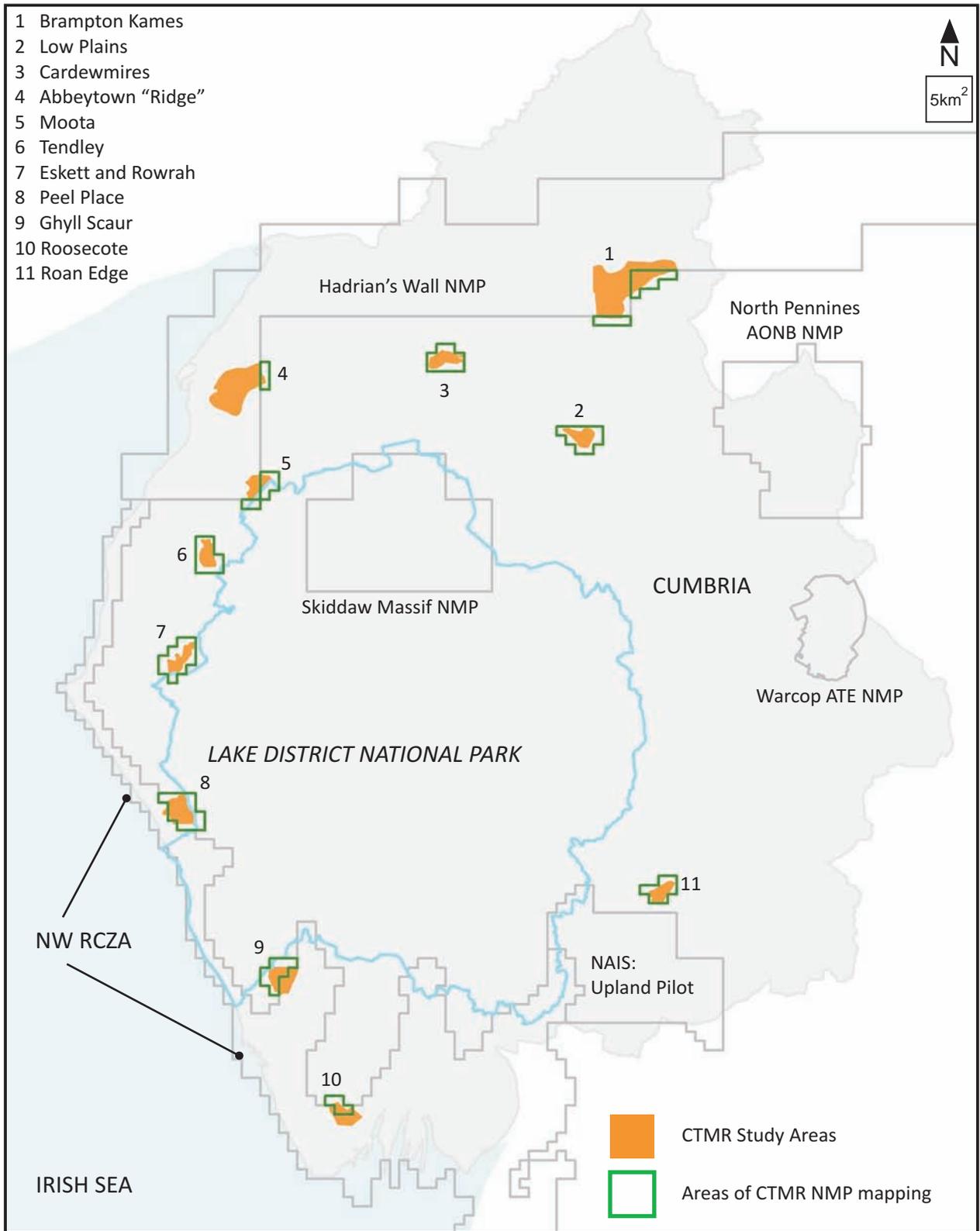


Figure 1. Location plan of the CTMR NMP Survey Areas

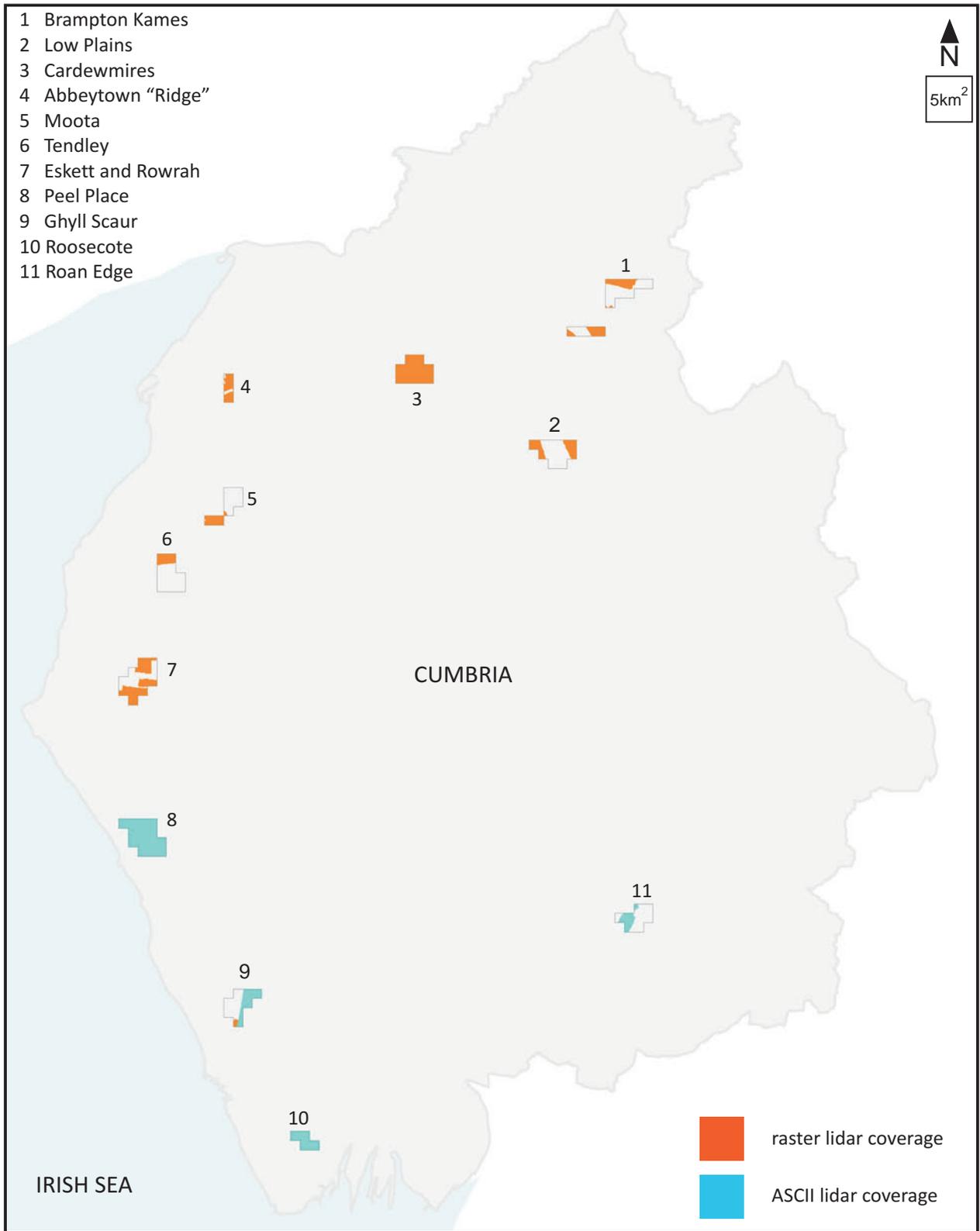


Figure 2. The distribution of ASCII versus raster lidar data across the CTMR NMP Survey Areas



Figure 3. Brampton Kames: mining and farming landscape around Coalfell Beck.

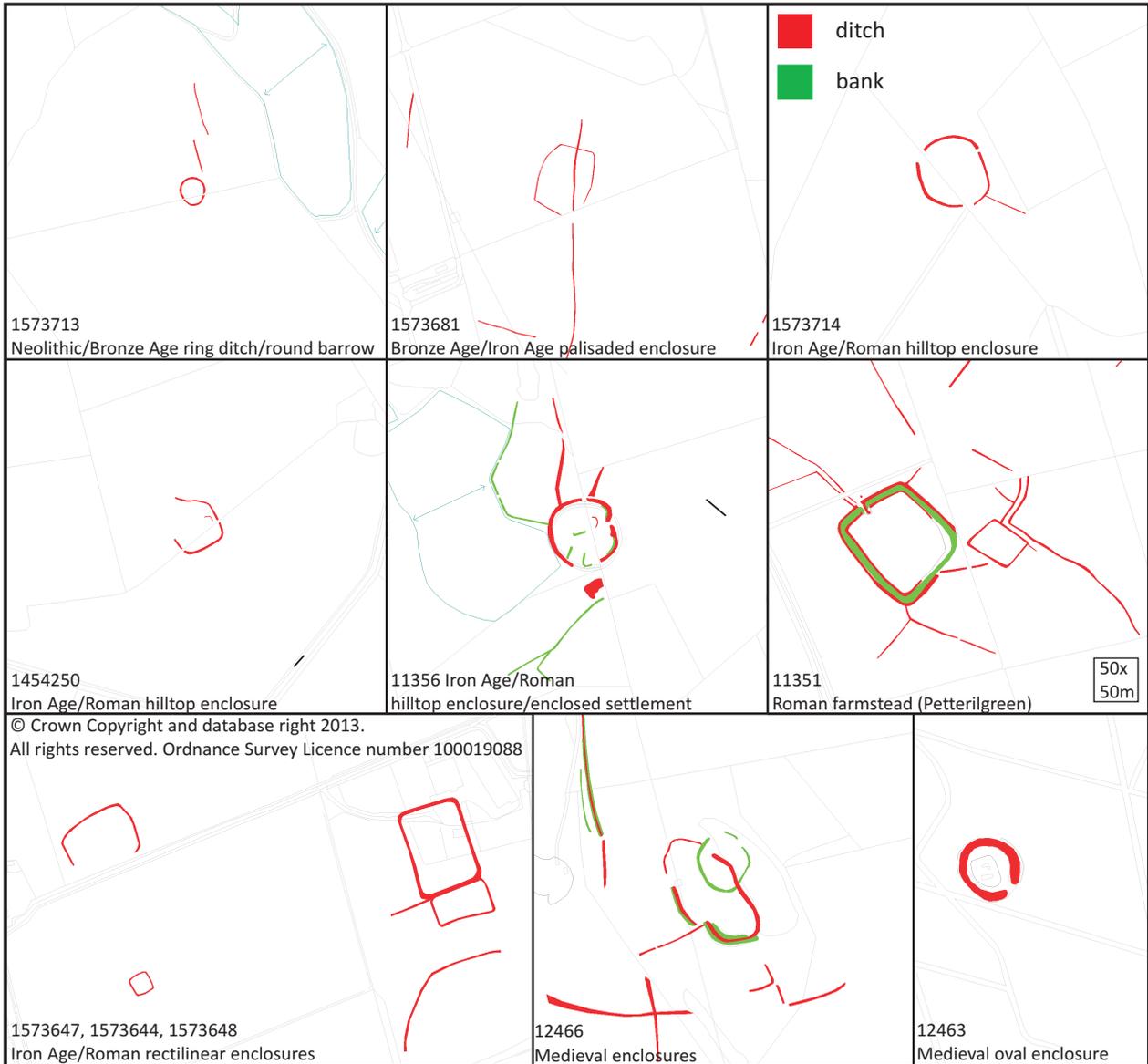


Figure 4. Low Plains: the prehistoric, Roman and medieval enclosures.

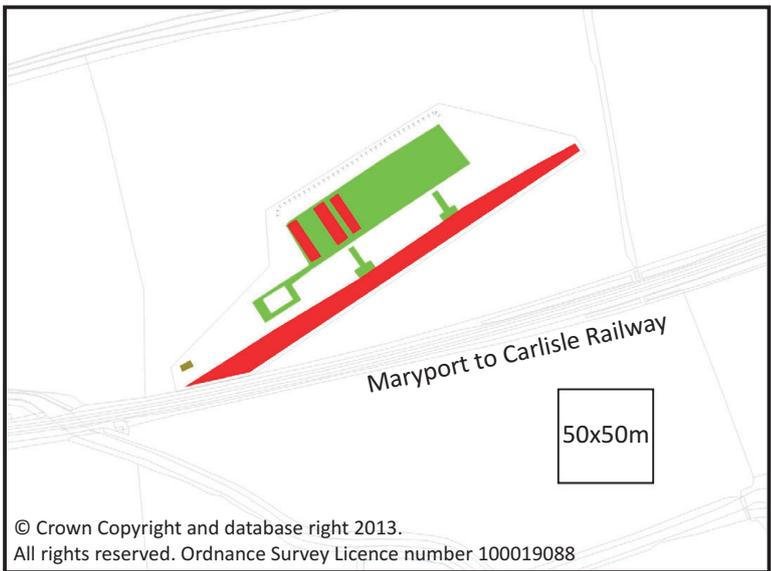
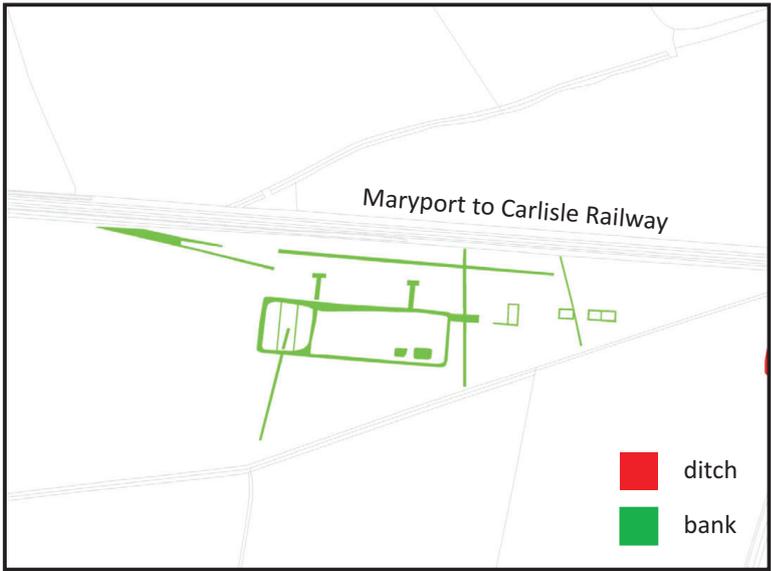


Figure 5. Cardewmires: two possible construction camps adjacent to the Maryport to Carlisle railway line. (top: UID1574048, bottom: UID927357).



Figure 6. Moota: fossilised medieval field system around Blindcrake.
English Heritage RAF Photography RAF/CPE/UK1209 3136



Figure 7. Peel Place: possible early enclosures fossilised by field boundaries. English Heritage RAF Photography RAF/CPE/UK1940 3015.

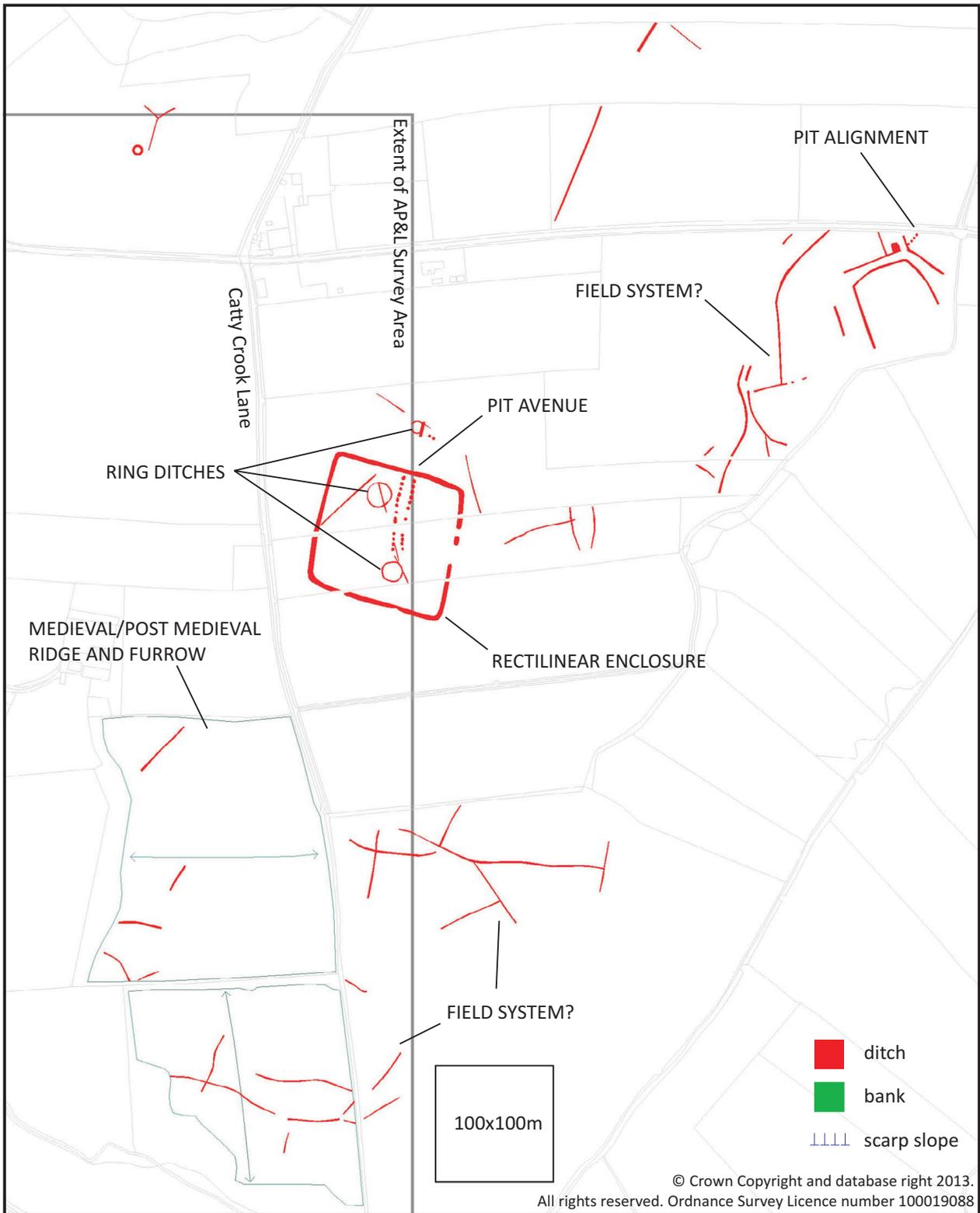


Figure 8. Roosecote: cropmarked landscape around Catty Crook Lane.



Figure 9. Roan Edge: possible oval enclosure revealed by lidar data on New Hutton Common (UID1576797) 16-direction hillshade processed from LIDAR SD57926 Environment Agency DSM.

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Fax: 01793 414926

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