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North West Rapid Coastal Zone Assessment Survey

Air Survey Mapping Report

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1 SUMMARY

This aerial survey mapping project forms part of the North West Rapid Coastal Zone Assessment Survey (NW RCZAS), funded by English Heritage (EH) through the Historic Environment Enabling Programme (HEEP) (4548 MAIN) and undertaken by Archaeological Research Services Ltd (ARS Ltd) in partnership with EH. The aerial survey mapping component of the project was undertaken by ARS Ltd Investigators based with EH's Aerial Survey & Investigation team in York.

The NW RCZAS survey area consisted of complete 1km squares which covered a strip of land from the lowest astronomical tide level to within 1km inland, along the coast between the Anglo-Welsh border on the Dee and the Anglo-Scottish border on the Solway. To the north of Flimby the project area overlapped with that previously mapped in recent years by the Hadrian's Wall World Heritage Site NMP Project (Event No.1360986) and was therefore not remapped. Digital maps at a nominal scale of 1:10,000 and supporting records were produced to National Mapping Programme (NMP) standards for an area of 1601km² (125 part OS 1:10,000 quarter sheets) of which only 673km² covers exposed land, the remainder fell within the inter-tidal zone. In only mapping a narrow corridor along the coast this project deviated from the normal NMP practice of mapping whole 1:10,000 map quarter sheets. Mapping started on 26th November 2007 and was completed by 22nd May 2009.

The project mapped and recorded archaeological sites varying in date and type from prehistoric enclosures to twentieth century military remains. Records for 1163 new sites, with a further 203 enhancements to existing records, were input to the National Monuments Record (NMR) database AMIE.

The project was also carried out in collaboration with Cambridge University's Unit for Landscape Modelling, their contribution being the loan of aerial photographs from their library (CUCAP). Other project partners included Cheshire County Council, the Metropolitan Authorities of Merseyside (Knowlesly, Liverpool, Sefton, St Helens and the Wirral), Lancashire County Council, Cumbria County Council and the Lake District National Park Authority; their contribution being the loan of material from their air photo collections when accessible, provision of Historic Environment Records (HER) data and repositories for the project's GIS.

2 INTRODUCTION

This air photo mapping project is one element of the NW RCZAS. This is a desk-based survey that aims to improve the archaeological record of the coastal zone within the various local authority HERs and to assist the formulation of long-term strategies for the management of that resource, especially in light of the current Shoreline Management Plans (DEFRA 2001).

The standards adopted are those of the NMP which are intended to produce a comprehensive record of the archaeology of England, from prehistory to modern times, through the interpretation, mapping and recording of all archaeological features visible as earthworks, cropmarks, parchmarks, soilmarks and structures on aerial photographs.

This interim report provides a brief overview of the results of the aerial survey mapping element of the project. A more detailed and comprehensive archaeological report will be produced by Ben Johnson (ARS Ltd) for the NW RCZAS.

3 PROJECT MANAGEMENT

The project was funded by English Heritage and undertaken by Archaeological Research Services Ltd. Drs Clive Waddington & Richard Chatterton were the Project Managers and Ben Johnson was the Project Officer for ARS Ltd. The other members of the Project Team were Peter Murphy (EH) as the Project Assurance Officer and Sue Stallibrass (EH) as the Scientific Adviser. Dave Macleod (EH) was the NMP Project Assurance Officer.

Dr Cinzia Bacilieri, in her role as Air Photo Team Leader, provided quality assurance for the AP mapping phase of the project. Cinzia Bacilieri, David Knight (November 2007 – May 2009), Melanie Partlett (November 2007 – April 2008), Sally Radford (Jun 2008 – Jan 2009) and Shona Williams (February 2009 – May 2009) carried out the air photo mapping and recording, working alongside EH's Aerial Survey team in York, supervised by Dave MacLeod (EH). Yvonne Boutwood and Matt Oakey (EH) provided training and support, offering advice on matters of interpretation, mapping, recording and NMP standards. They also carried out final NMP quality assurance checking to ensure that the work was carried out to NMP standards: approximately 5% of the work of each ARS Ltd team member was checked. At the beginning of the project they also helped with one-to-one training of new team members in all aspects of air photo interpretation, closely monitoring them until they achieved NMP standards.

The project ran for 18 months and started on 26th November 2007 and mapping and recording was completed by 22nd May 2009.

4 SCOPE OF THE SURVEY

4.1 Geographical Scope

The aim of the aerial survey mapping element of the project was to produce accurate mapping and a record of all archaeological features from all periods that could be identified within the study area.

The project area extended across the following authorities (from south to north): Cheshire County Council, the Metropolitan Authorities of Merseyside (Knowlesly, Liverpool, Sefton, St Helens and the Wirral), Lancashire County Council, Cumbria County Council and the Lake District National Park Authority.

The aerial photographic interpretation and mapping focused on the strip of land from the lowest astronomical tide to a width of 1km in-land from the high tide level and extending in length from the Anglo-Scottish border on the Solway southwards to the Anglo-Welsh border on the Dee (Fig. 1). The survey included all estuaries, to their tidal limit or first bridging point. To the north of Flimby (area shown shaded green, Fig. 1), the project area overlapped with that previously mapped in recent years by the Hadrian's Wall World Heritage Site NMP Project (Event No.1360986). These twenty two quarter sheets were already mapped to NMP specifications and were therefore not remapped for this project. The project area fell over 125 1:10 000 scale map quarter sheets (Appendix 1), which maintained full 1km squares within the maps. This met the requirement of English Heritage's National Mapping Programme (NMP), using the same methodology and scope as the NMP. In June 2008 an additional 303km² were added to the initial project area of 1298km² as defined by the Project Design, totalling 1601km²; it was felt that the project area would have benefited from extra coverage of the inter-tidal zones, in particular those of Morecambe Bay, the Ribble and the Mersey estuaries. This variation increased the original project area to include 16 further quarter sheet maps from the original 109 outlined in the Project Design (Fig. 1). The project amounted to an area of 1601km² but only c.673km² covered exposed land, and the remainder fell within the inter-tidal zone.

The project area was divided into 8 blocks to assist management of the photographic loans from the NMR photo library (Fig. 2).

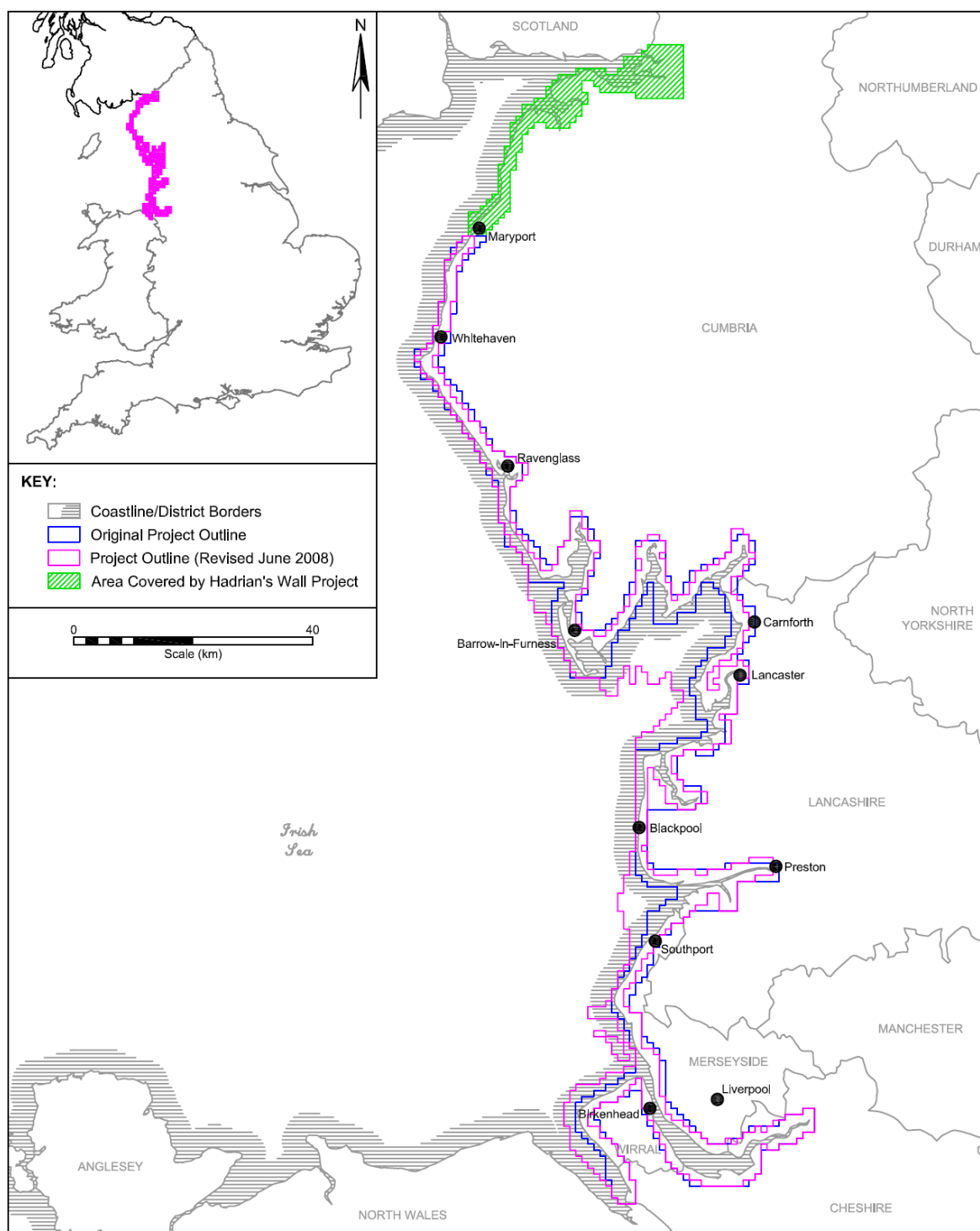
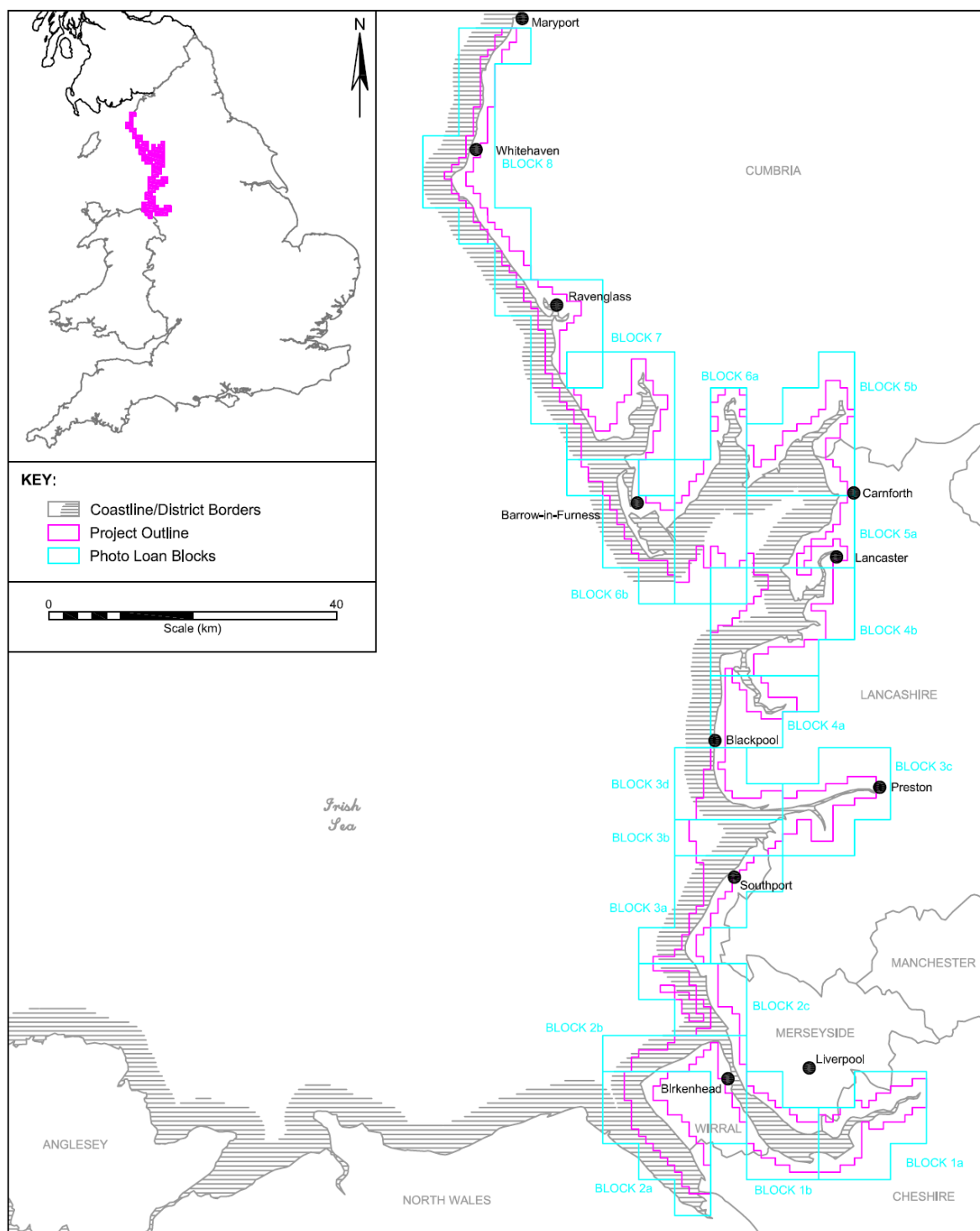


Fig. 1. NW RCZAS Aerial Survey Project Area



4.2 Geology

The north-west English coastline comprises a complex mix of geology and landforms giving rise to distinctive landscapes that range from the gently undulating lowland plains and mudflats of Cheshire, Lancashire and the Solway Firth to the dramatic coastline of West Cumbria where the mountains of the Lake District meet the sea.

The low coastal plains of Lancashire and Cheshire were formed during the last Ice Age (Devensian) when the solid rocks of Triassic and Carboniferous periods were covered by a thick deposit of till producing the gentle landscape features that exist today (Johnson 1985; Tooley 1982). In Cheshire and Lancashire the gently undulating plains are occasionally broken by low sandstone ridges of Triassic age. Within the extensive boulder clay deposits are occasional, superficial deposits of windblown sand again created from deposits left by the retreating Devensian ice Sheet. Within hollows and low-lying plains in these coastal regions deposits of Post-Glacial peat have formed in-filling such features (Tooley 1978, Innes 1980; Cowell 1993). A similar process created the Solway Plain to the north of Cumbria (Tooley 1982) with the solid geology again consisting of Triassic sandstones and Carboniferous rocks such as the coal measures (Dixon et al. 1926). The dramatic mountains of the lake District which rise from the sea leaving only a narrow coastal plain in this area are formed from much older igneous rocks of Ordovician, Silurian and Carboniferous age (BGS 2002).

The coastal area of North-West England has, of course, not always been a coastal landscape. The land bridge between the Isle of Man and mainland Britain was only breached around 9270 uncal. BP (9270 +/- 200bp) (Tooley 1980, 83) and the narrow isthmus of glacial moraine that connected South-West Scotland with Ireland was breached in the early Post Glacial c.12000 uncal. BP (Smith 1992). A relatively rapid sea level rise then followed between 9000 uncal. BP and 7000 uncal. BP when the coastline reached the approximate position of today's shoreline. The sea level in the North-West has not remained static since then though, with numerous major oscillations having been recorded by Tooley (1978). Tooley identified ten distinct marine transgressions in the North-West during the Post-Glacial period leaving significant deposits of silts and sands in areas such as Lytham and Morecambe Bay.

The sea level rise in the North-West has left submerged forests offshore and in the inter-tidal zone which are revealed at low tide, especially following storm events. These have been identified off the north Wirral coast and fresh discoveries are still being made, as has recently occurred off the coast of Bootle in Cumbria.

4.3 Archaeological Scope

The project adhered to the archaeological scope adopted for the NMP, which aims to increase our understanding of the historic environment. All probable and possible archaeological features visible on air photographs as cropmarks, soilmarks, parchmarks, earthworks and structures were identified, interpreted, mapped and

recorded. The NMP Sphere of Interest draft report (RCHME 1997, English Heritage 2005) documents the scope of the NMP; the main aspects relevant to this project are summarised below. Minor differences in depiction are observable in those maps that form part of Hadrian Wall's World Heritage Site NMP that fall within the project area. A summary report for the latter project is currently being produced by EH Aerial Survey Team and will be released as part of EH Research Department Report Series (Oakey 2009).

4.3.1 Earthwork archaeology

All extant earthworks identified as archaeological in origin were mapped. When available RCHME /EH ground survey plans were used to assist and enhance the air photograph interpretation and mapping. If the quality of photography was not sufficient to depict individual earthwork features these were mapped as an extent of area.

4.3.2 Levelled archaeology

All cropmarks, soilmarks and parchmarks identified as archaeological in origin were mapped.

4.3.3 Post medieval and modern field boundaries

Field boundaries that have been removed (upstanding or levelled), but are depicted on first edition Ordnance Survey or later edition maps, were generally not mapped. However, where they occurred with newly identified field boundaries, which were not depicted by the Ordnance Survey, then some were mapped to provide a wider context for the field systems.

4.3.4 Medieval and post medieval ridge and furrow

Ridge and furrow was mapped, using a simple graphical depiction, delineating the extent of area and direction of the furrows. The difference between levelled and earthwork ridge and furrow was distinguished. The state of preservation of the latter was evaluated from the latest photography, which in the case of this project was mainly from vertical photographs.

4.3.5 Industrial features and extraction

Widespread and common small-scale (less than 2 hectares) extraction of stone resources was generally not mapped unless it directly impinged on archaeological features. Large-scale quarries (greater than 2 hectares) and coal mining were mapped and recorded, irrespective of whether they were depicted on any Ordnance Survey map. Large collieries or open cast mining complexes were mapped generally as an extent of area. Associated features, such as tramways, within the monument perimeter were generally not mapped or depicted as an extent of area.

4.3.6 Post Medieval and 20th Century military features

Former Post Medieval, First and Second World War military sites and installations were mapped. Extensive military complexes and sites were outlined as an extent of area as

were anti-landing obstacles and tank traps. Installations such as pill boxes and coastal gun/searchlight batteries were mapped. As many sites of this period and function were by nature short lived and transitory emphasis was placed on the identification and general extent of activity when appropriate, rather than the accurate depiction of single features such as barbed wire fences and local trackways. Significant features within outlined areas were mapped either “as seen” or schematically, according to the quality of the available photography. Where the only source was oblique imagery with poor control, coastal defence sites in the inter-tidal zone such as pillboxes, tank traps, barbed wire fences and beach scaffolding, were sketch plotted (A sentence was added to the record stating that ‘the monument was sketched because it was not possible to locate the feature due to lack of control points on the source photograph’).

4.3.7 Buildings

The foundations of buildings visible as cropmarks, soilmarks, parchmarks, earthworks, or ruined stonework were mapped, except when they were depicted on first edition Ordnance Survey or later edition maps. Standing roofed or unroofed buildings or structures were generally not recorded unless they had a particular association in the context of industrial or military remains. Medieval castles and monastic sites previously recorded and extensively surveyed and mapped by the Ordnance Survey were generally mapped as an extent of area.

4.3.8 Geomorphological features or natural deposits

Geomorphological features, natural deposits, organic sediments and paleochannel fills were not mapped. This is in line with normal NMP methodology.

4.3.9 Parkland, landscaped parks, gardens and country houses

Earthwork and levelled landscape and garden features associated with this category were mapped.

4.3.10 Maritime Features

Ship wrecks and fish traps visible in the inter-tidal zones were mapped. If it was not possible to position these features accurately due to a lack of reference points on the source photograph, only a circle on the extent of area layer with a diameter of 100m, 500m or 1km (the radius depending on the control points on the source photograph) was drawn. The centre of this was the grid reference obtained from the source photograph. Following the same methodology adopted for the North East Rapid Coastal Zone Assessment Survey (NE RCZAS), wrecks mapped in Block 1-3 were recorded as features of uncertain date (Bacilieri, Knight and Radford 2008). This methodology was revised in October 2008, on the basis that few would be likely to pre-date the medieval period, the wrecks were subsequently recorded as post medieval in date for the remaining part of the project.

4.4 Air Photographs

All readily available air photographs were consulted and were contained in five main collections. The National Monuments Record (NMR) was the prime source. A search for photographs identified 5,910 specialist obliques and 24,055 vertical prints for the project area. The vertical photographs held by the NMR comprised mainly of RAF and Ordnance Survey sorties, with some Meridian Airmaps Ltd photographs, which together ranged in date from 1940 to 1999. The specialist oblique photographs ranged in date from 1940 to 2006; these included specialist military photographs and those from recent reconnaissance.

For the purposes of mapping, the area was divided into eight blocks to facilitate photo loans from and to the NMR library. It was noticed from the outset that a considerable number of photographs covered only a small part of the coast at a time. This, and the restriction enforced by the NMR that limited their loans to a maximum of 2000 prints each time, increased the frequency of loan requests necessary for work-flow. Despite their best efforts, the NMR staff were unable of keeping up with the continuous requests, and recurring delays in delivery occurred. As a result the project was left on hold on several occasions (4th - 14th January 2008, 21st July - 6th August 2008, 15th - 26th August 2008, 24th - 29th September 2008), for a total of 34 days without photographs. To solve the problem, the NMR agreed to send the photography for Blocks 4-8 all at once on 30th September 2008. The difficulty of managing the photograph loans to keep in line with the project timetable is clearly a recurring issue of RCZAS projects (Bacilieri, Knight and Radford 2008), and it is therefore recommended that this is identified as high risk in future RCZAS Project Design Risk Logs.

Additionally, 1202 specialist oblique and 3161 vertical prints were consulted from the Photograph Library of Cambridge University Collection of Air Photographs (CUCAP), administered by the Unit for Landscape Modelling (ULM). AP Collections of Cheshire County Council, Lancashire County Council (M.A.R.I.O online Air Photo catalogue <http://mario.lancashire.gov.uk>) and Cumbria County Council were also consulted but only a handful of these latter photographs were used for the project.

The CUCAP collection holdings for this project were quantified using the online catalogue (www-arcis.geog.cam.ac.uk). The ULM then kindly loaned the relevant photographs on a quarter sheet by quarter sheet basis. Yvonne Boutwood (EH) and David Knight (ARS Ltd) administered the loan liaison between the project and ULM.

Other forms of remote sensing imagery (e.g. Lidar) were not used during the mapping phase of the project. Lidar data tiles were provided for the whole NMP project area in JPEG format, but after an evaluation it was decided not to use them for the mapping side of the project. As for the NE RCZAS (Bacilieri, Knight, Radford 2008; Tolan-Smith 2008), a review of a sample area suggested that because a proportion of the data was collected at high tide Lidar was of limited use in identifying features in the inter-tidal zone. Where the tide was low the resolution was too low to show small discrete features like wrecks but showed major features. Consequently it was felt that these

RCZAS projects were not the most appropriate projects in which to test the potential of this data to its fullest. This is not to say that Lidar data does or will not make a contribution to future coastal or inland archaeological surveys.

4.5 Monument data

The National Monuments Record database AMIE was consulted as was the relevant HER data for each quarter sheet during the course of transcription and recording. This process was assisted by the output from EH's GIS Data which facilitated graphic representation of the records with attached summary data. Where possible, concordance between HER datasets and AMIE was made. There are several scheduled monuments in the project area.

4.6 Previous Survey Work and Research

The North-West Regional Research Framework (NWRRF) has recently asserted that the north-west region remains under-researched for most archaeological periods with a corresponding low level of data compared to most other regions in the country. However, when investigated the area has proved rich in archaeological and palaeoenvironmental deposits demonstrating the need for further research.

The Devensian ice sheet would have melted approximately 14,500 radiocarbon years ago (Tooley 1982, 10) which would have provided conditions suitable for human habitation to re-commence. As has been seen above, the lowland areas which are now coastal would not have been so in the Late Upper Palaeolithic and remains of this period in such areas are likely to have been buried beneath marine deposits from the marine transgressions identified by Tooley (1978). However, Late Upper Palaeolithic material has been identified from deposits in the limestone caves around Morecambe Bay, such as Kirkhead Cave (Ashmead et al. 1974). The presence of hunter gatherers in the region in the Late Upper Palaeolithic is also confirmed by the discovery of the remains of an elk with barbed points made from antler preserved in peat at Poulton le Fylde (Hallam et al. 1973).

Programmes of fieldwalking in the region since the 1980s have produced evidence for Mesolithic activity along the north-west Coast. In the Merseyside region the National Museums and Galleries on Merseyside undertook a systematic fieldwork programme which has discovered numerous sites of the period (Cowell 1992). This includes evidence for Early Mesolithic activity, supported by excavation, on the Wirral at Greasby. Further Early Mesolithic flintwork has been recovered from Heysham Head (Salisbury and Sheppard 1994). Further north archaeologists have discovered evidence for Mesolithic activity on the Cumbrian coast including at Eskmeals (Bonsall 1981; Bonsall et al. 1986). The work of the north-west wetlands project also identified numerous sites of Mesolithic date (Cowell & Innes 1994) concentrated in coastal and estuarine areas. Mesolithic sites within the region are predominantly identified from surface flint scatters. Few sites have been excavated and those that have been

excavated produced no evidence of faunal, pollen or botanical remains except at Eskmeals which remains largely unpublished. The vast majority of Mesolithic sites within the study area date, by typology, from the Late Mesolithic period. The similarity in flintworking in the Early Neolithic may indicate that many of these scatters date from the later period. More enigmatic evidence of the Mesolithic period has been revealed by the fossilised footprints on the coast at Formby which have been dated by the dating of sediments above and below these features (Roberts et al. 1996).

Aerial photographic research in the region began with the work of Professor J.K. St Joseph in 1949 in the Solway Plain area of Cumbria, work that was continued by G.D.B. Jones and N.J. Higham in the 1970's. Bewley undertook a large scale analysis of aerial photographs of the Solway Plain as part of his doctoral research in the early 1980's. This identified many ditched enclosures to which Bewley attributed a Romano-British date. The benefits of combining fieldwork with aerial photographic analysis was revealed when one of these sites, at Plasketlands, was excavated revealing a circle of large post holes in addition to the ditch (Bewley 1993). A radiocarbon date obtained from one of these postholes revealed that the timber post circle dated to the Early Neolithic period.

The North West Wetlands Survey deduced from palaeoenvironmental analysis that the lowlands of North-West England were characterised in the Neolithic, Bronze Age and Iron Age periods as a predominantly forested landscape with small scale clearances and settlement and small scale cereal cultivation (Cowell and Innes 1994). Furthermore, it has been suggested that some areas of the North-West lowlands were abandoned during the Bronze Age and Iron Age periods. However, evidence of later prehistoric activity has been identified in the region with excavations revealing evidence of Neolithic settlement at Ehenside Tarn, West Cumbria. Bronze Age pit circles, ring ditches and a burnt mound have been excavated in and around Carlisle (McCarthy 2002). Bronze Age inhumations and a cremation cemetery were excavated at Ewanrigg, Maryport on the Cumbrian coast (Bewley et al. 1992). Evidence of Iron Age activity in the study area is sparse, but hillforts are present on some of the sandstone ridges of Cheshire such as those at Helsby overlooking the coast. Iron Age farmsteads have been excavated at Brook House Farm which was identified from aerial photographs, and at Latham, West Lancashire and Irby on the Wirral, identified as a result of development. McCarthy has also suggested that some of the ditched enclosures identified by Bewley (1993) date to the Iron Age period (2002). An Iron Age burial was also discovered by chance during Bellhouse's excavations of the Roman milecastle at Maryport (Bellhouse 1981).

The Roman period in the North-West of England has been well researched from the antiquarian period through to the present day. This is especially the case in Cumbria where Hadrian's Wall comes to an end at Bowness on Solway, but a series of forts, coastal defences and earthworks proceed down the Cumbrian coast as far as Ravenglass. A series of scholars have surveyed and excavated sites along this particular stretch of coastline (Collingwood 1923; 1933; Birley 1949; 1969; Bellhouse 1969; 1981; Potter 1979; Higham & Jones 1975). Most recently the Hadrian's Wall

World Heritage Site NMP project has mapped the aerial photographs for the area to NMP standards. Excavations in the region have tended to concentrate on the military sites. However the Lanes Project in Carlisle 1978-82 revealed substantial areas of the Roman townscape (McCarthy 2000) and an industrial site at Wilderspool on the Mersey in Lancashire has also been excavated (Hinchcliffe and Williams 1992). The work of Bewley (1993) on the Solway Plain examining Romano-British ditched enclosures on the Solway Plain has already been referred to.

The post-Roman period has been investigated in the coastal area of north-west England at Carlisle (McCarthy 1993) and at Lancaster (Howard Davies et al. forthcoming). The continuing activity on the sites of Roman forts has been noted at Lancaster, Carlisle, Ravenglass and Muncaster. However, settlement sites in the Early Medieval period are extremely rare (Newman and Brennand 2007) due, at least in part, to the settlements being of wooden posthole construction and the prevalence of pastureland masking such sites. However, the relative lack of research on the Early Medieval period has, undoubtedly, accentuated this lack of evidence. Excavation of a headland site at Heysham in Lancashire has revealed evidence of an 8th Century chapel and church which suggest that the site may well have been Monastic (Potter & Andrews 1994). The importance of headland sites is also suggested from similar sites at Workington, Cumbria and possibly at Moresby, Cumbria (Newman & Brennand 2007). Griffiths (Oxford University), Philpott (Liverpool Museums) and Egan (Museum of London) are working towards the publication of material collected from Meols, an Early Medieval trading port on the north coast of the Wirral. Meols was uncovered by coastal erosion of sand dunes in the second half of the 19th Century. This revealed evidence for an important port which traded with the classical world and Africa from the 7th Century through to the medieval period. A vast number of artefacts were collected from the coast by antiquarian collectors which are now housed in the various museums. Meols appears to have been a Scandinavian trading port in contrast to the Mercian port of Chester which is supported by the large number of Scandinavian place names on the Wirral.

The medieval period in the coastal zone of north-west of England is again generally lacking in research activity. White records that 'we have not yet defined archaeologically a single burgage plot or a single medieval house site in any Lancashire Town' (1996, 125). The coastal towns of Lytham, Blackpool, Fleetwood and Morecambe developed in the Victorian period and were fishing hamlets in the medieval period (Bagley 1967). However, 'a survey of the Medieval and post medieval fishing industry in England did not mention a single site from the north-west' (Newman & McNeil 2007, 119). Excavations of medieval towns have taken place in Lancaster (White 1996, 132) and Carlisle (McCarthy 1993). The Lancashire Historic Towns Survey has upgraded the HER in relation to coastal towns such as Lancaster but much still remains to be done. Evidence of industry in the medieval period has been ascertained from the region. The monastery at St Bees in Cumbria was extracting coal and the monks at Furness were working iron in the 13th Century (Bowden 2000).

Despite the north-west being at the vanguard of the process of industrialisation, and that the coastal regions were crucial in this development, the NWRRF records that 'Little attention has been paid in the north-west to coastal, estuarine or marine archaeology' (Newman and Mcneil 2007, 141). Several projects have recently been established or proposed, such as the Liverpool Bay Seascapes project, funded by EH. An identification survey of the salt industry along the Solway and Cumbrian coast has been proposed (Newman and Mcneil 2007). However, as the NWRRF records there is an urgent need to record the remains of Post Medieval ports along the coast and to record the remains of coastal industries which are abundant in the inter-tidal zone. The same need applies to the remains of boat wrecks in the inter-tidal zone. An extensive database of military installations along the coastline has been collated by the Defence of Britain Project, the findings of which are now presented online via the Archaeology Data Service. There are, in addition, several projects which will run concurrently with this project which will both inform, and be informed by, this project such as the Historic Seascapes Project in Liverpool Bay.

5 METHODOLOGY AND RECORDING

5.1 Mapping Methods

Mapping methods were in accordance with practices developed for the National Mapping Programme (NMP). All air photographs were examined under magnification and stereoscopically where possible. Oblique and vertical photographs were scanned at a suitable resolution, normally between 350-400dpi, and rectified using appropriate software (AERIAL 5.29). Ordnance Survey 1:2,500 digital maps were used for control and as a base for mapping in AutoDesk Map 2004 and AutoDesk Map 3D 2007. Where appropriate, topographic information was derived from Ordnance Survey Land-Form PROFILE (5m vertical interval, scale 1:10,000) and the height data used to create Digital Terrain Models to improve the accuracy of the photo rectification.

Accuracy for the Ordnance Survey map is in the range of $\pm 2.8\text{m}$ and rectification of photographs is normally within $\pm 2\text{m}$. The latter mismatch may increase up to $\pm 4\text{m}$ in the inter-tidal areas where the lack of control points on the available source photograph makes a more accurate rectification impossible. When it was not possible to position maritime features accurately due to a lack of reference points on the source photograph, only a circle on the extent of area layer with a diameter of 100m, 500m or 1km (the radius depending on the control points on the source photograph) was drawn. The centre of this was the grid reference obtained from the source photograph.

Rectified images were output from AERIAL in uncompressed TIF format at a resolution of 300dpi and a scale of 1:10,000. A World file (.TFW) was created alongside each TIFF file and the control information was retained in the AERIAL RDA file (RDA). Mapping conventions and the layer structure used in the AutoDesk Map drawing files is summarised in Appendix 2. Within the AutoDesk Map drawing files the interpretation of the features was recorded in an attached data table (see Appendix 3).

The Ordnance Survey First Edition and later mapping was routinely consulted as an aid to the interpretation and mapping. Reports of previous archaeological investigations in the project area were consulted, where they were published and readily available.

5.2 Recording Practice

All mapped features were recorded in the English Heritage NMR database, AMIE. The monument types and evidence terms used for this project are listed in appendices 4 and 5. This was routinely consulted and data from EH's GIS was downloaded for use in the AutoDesk Map environment. New records were created (1163), or existing monument records were amended (203), following NMR Heritage Datasets: Monument Recording Guidelines.

5.3 Copyright

Copyright of the aerial survey mapping and associated AMIE records produced by the project resides with EH. Licence to use the data has been extended to ARS Ltd and the project partners.

5.4 Project Archive

This project produced 125 AutoDesk Map drawing files, one for each part 1:10,000 quarter sheets (see Appendix 1).

The parent collection number is EHC01/114 and collection numbers for each map are listed in Appendix 5. Copies of the digital drawing files are deposited in the archive of the NMR. Aerial Survey York and Swindon also retain copies of the digital files, for day to day access. This report will be deposited in the NMR archive.

The newly created and amended text records form part of the national monuments database AMIE, which are downloaded into the English Heritage webGIS.

5.5 Project Dissemination

Copies of the AutoDesk Map drawing files have been supplied to ARS Ltd. These will be incorporated within the wider RCZA project results and shared with HERs and project partners. The final product of the NW RCZAS, which includes the aerial survey mapping, will have a wider distribution to the local authority project partners.

All AMIE records have been supplied to ARS Ltd in Portable Document Format (.pdf). This project also used Oracle Discoverer Plus Version 9.0.4.45.04 to output the AMIE record data in EXCEL spreadsheet format. A copy of this aerial survey mapping report has been deposited within the NMR archive in Swindon.

6 SUMMARY OF PROJECT RESULTS

The following is intended to provide a brief overview of the project's results. Taking into account the nature of the NW RCZAS and considering that the area examined was only a narrow corridor 1km wide, a comprehensive analysis of the monuments in a broad archaeological landscape context has not been attempted here. A more detailed and comprehensive archaeological report will be produced by Ben Johnson (ARS Ltd) for the NW RCZAS.

For the aerial survey mapping project a total of 1163 new records were created and amendments were made to 203 records in the AMIE database. In other words, 85% of the records for this project were new to the NMR. This summary provides an overview of the archaeology of the area as evidenced by the aerial survey record. Sites discussed in this report are referenced by their AMIE monument unique identifier number.

The predominant forms of evidence in the survey area were structures, earthworks and cropmarks, including parching. Soilmarks are not explicitly differentiated from cropmarked sites in the record but it was noted that very few were encountered, probably because the area was rarely flown at the times of the year when the soils were bare.

Dating of monuments recorded from aerial photographs relied on recognising morphologically characteristic forms. Other sources of archaeological and historical data have been consulted to complement the aerial survey evidence and aid interpretation. The data is evaluated chronologically to provide 'period' overviews, spanning the millennia from early prehistory to the twentieth century. In the text sites are referred to by their NMR Unique Identifier Number (UID), which is used in the attached data tables in the AutoDesk Map drawings (Appendix 3). The monument types recorded by this project, in AMIE and the AutoDesk Map drawing attached data tables, are in accordance with EH's AMIE thesaurus and are listed in Appendix 4 and 5.

Considering that the area examined was only a narrow corridor 1km wide, throughout the project sites were occasionally interpreted and recorded more as individual features than as cohesive elements forming part of a wider historical landscape.

6.1 Prehistoric

6.1.1 Bronze Age

The survey area produced surprisingly little dateable evidence to pre-date the Iron Age and Roman periods. Only four sites visible from the air were documented, all of which were previously known. These features all appeared to date to the Bronze Age and were defined as stone circles and funerary round barrows.

The sites were spread throughout the northern half of the survey area, three of which clustered around the region of Morecambe Bay. One of the barrows was located in the Parish of Beetham (1002554), had a diameter of approximately 10m and measured 0.6m in height. To the south, in the Parish of Morecambe itself was Torrisholme Barrow (41141).

The largest of the stone circles was the Druids Circle in the Parish of Urswick, Cumbria (38039). This site consists of two non-concentric circles, of which the outer one is only partially visible on air photographs due to vegetation cover. The other site was Grey Croft Stone Circle at Seascale (8753). All of these features were extant at the time of the latest photography.



Plate 1. Druids Circle, Parish of Urswick, Cumbria (38039)
NMR SD 2973/1 (13440/07) 07-FEB-1979 © English Heritage. NMR

6.1.2 Iron Age / Roman

The majority of the Iron Age/Roman activity was located along the Cumbrian coastline, towards the lowland slopes of the more upland environment of the Lake District. All of this activity was visible as cropmarks, and although other features defined as 'uncertain' in date may be from this period, the only sites we categorised as Iron Age /Roman were the more distinct field systems and enclosures particular to this period.

The two southernmost enclosures lay either side of the Duddon Estuary. The western feature (1491102), located at Millom, was a curvilinear enclosure with an incomplete

circuit measuring approximately 62m in diameter and had associated field boundaries running on a north-west to south-east alignment.

The remaining Iron Age/Roman features were generally concentrated further to the north between Seascale and Egremont. The most pronounced of these was a previously unrecorded rectilinear enclosure (1493117), close to Egremont, with a ditch over 5m in width and containing a probable internal round house and other undefined features. The enclosure had an intermittently visible circuit with an entrance visible on the east side and measured 76m x 77m. A curvilinear ditched enclosure and a series of linear ditches lay external to this feature.



Plate 2. *Iron Age/Romano-British enclosure west of Egremont (1493117)*
RAF (F22) 58/2202 39 20-JUN-1957 English Heritage (NMR) RAF Photography

In the fields east of Harrington/Workington was an Iron Age/Roman doubled-ditched defended enclosure, with no apparent associated external field boundaries (8582). The feature was irregular in plan, with maximum dimensions of 85m x 89m, and displayed an undefined internal cropmark. This feature was reminiscent of similar defended sites found on the north east coast.

6.2 Roman

There has been much suggestion of Roman activity, in the form of findspots and suggested fortlets and roads throughout a large extent of the Cumbrian area of study, but aerial photography only revealed two previously well-studied forts. The furthest south of these was the fort at Moresby, thought to be that of *Gabrosentum* (8593),

lying largely within a graveyard and measuring approximately 140m x 100m. Some way to the north in the Parish of Seaton were the earthwork remains of Burrow Walls Fort, thought to be *Magis* (9041). This site was only partly visible on air photographs, displaying two large earthwork banks with maximum dimensions of 95m x 35m.



Plate 3. Gabrosentum Roman Fort, Moresby (8593)
NMR NX 9821/6 (13552/27) 01-SEP-1976 © English Heritage. NMR

6.3 Medieval and Medieval/Post Medieval

The predominant use of the landscape during the medieval period appears to have been for agricultural purposes. A number of examples of cultivation terraces and lynchets were discovered in varying locations, but primarily around the mouth of the River Kent in Morecambe Bay (e.g. 1002473 and 1487331). Another example lay immediately to the east of a possible associated long-house and banked enclosure at Arnside (1002528). The most common form of medieval feature encountered during the project was undoubtedly ridge and furrow. The two main concentrations were visible in the districts of South Ribble (1481644) and Barrow in Furness (1488302). A rapid assessment of the condition of these remains suggested that approximately 48% survived as earthworks on the most recent photography available, whilst the remainder had been levelled. In many instances the latest photography only dated to the 1970s and 1980s therefore more of the features are presumed to have been levelled since.

Evidence for medieval settlement along the coastal hinterland and inter-tidal zone was primarily in the form of castles and religious foci rather than the typical nucleated

settlements. The clearest evidence for the more typical settlements were the possible remains of the deserted medieval village of Upper Rawcliffe (40967). The site consisted of a platform and ditched field boundaries with associated ridge and furrow and banks visible as cropmarks and earthworks. It is possible that elements may represent more recent land division or drainage.



Plate 4. *Possible remains of the deserted medieval village of Upper Rawcliffe (40967)*
NMR SD 4141/1 (9210/946) 02-NOV-1978 © English Heritage. NMR

The majority of sites were visible as earthworks or structural remains, though a small number can be seen as cropmarks, such as a possible moat in the Parish of Cuerdley (1462453). A number of structural fortifications were visible on air photographs, but these features were not recorded in detail unless they displayed distinct earthworks, such as Millom Castle (37299) where part of the moat can be seen, or north of Lancaster Castle (41218) where medieval ramparts and associated hollow way and mounds (1485180) were visible. A further two castles were seen and mapped through the assessment survey: Halton Castle in Runcorn (71756) and Piel Castle (37706).



Plate 5. Coastal erosion at Piel Castle, Piel Island (37706)

NMR 20774/001 13-MAY-2008 © English Heritage. NMR

Differing forms of fortifications were visible in the form of two Tower Houses: Hazelslack Tower (41496) and Arnside Tower (41500), the latter of which was in use until the 17th century. Both towers stand in close proximity to one-another south of the River Kent.

A number of ecclesiastical sites were mapped during the project, the most prominent of which was Cockersand Premonstratensian Abbey (41089). Although the quality of the photography for this site was particularly poor, a recent detailed English Heritage field survey was used to aid interpretation and mapping. Also recorded were Stanlow Cistercian Monastery (69550) in Ellesmere Port, Birkenhead Priory (67268) and Norton Priory (71788) in the Parish of Runcorn. With the exception of Cockersand, which survived predominantly as earthworks, the other sites displayed surprisingly little evidence of external activity. This may be partly due to an urban build-up of the area pre-photography.

A total of 26 fish trap records were created during the survey, of which three may have been associated with St. Bees Priory and therefore medieval in date (1493459, 1493094 and 1493112). One of these appeared to be quite a substantial feature built of stone, whereas the more common post medieval variations were less regular in shape and probably constructed of timber uprights.



Plate 6. *Fish trap of probable post medieval date, Ravenglass (1157584)*

NMR SD 0895/12 (17168/07) 18-AUG-1998 © English Heritage. NMR

Several other types of site possibly originated during the medieval period and were continually utilised afterwards. Evidence of post medieval ridge and furrow respecting earlier boundaries could be evidence of this. One such example was a series of ditches, banks and enclosures near Glasson Dock (1484749) which were probably medieval in formation, but displayed post medieval ridge and furrow abutting them showing probable re-use. Another example of multi-phased activity was seen in an extensive field system of banks, ditches and lynchets at Dallam Park, Beetham (1002729).

For the post medieval period the most dominant archaeology was again ridge and furrow. This form of archaeology was visible throughout the entire survey area with the exception of the built-up regions. Later ridge and furrow was particular in form and can be differentiated from the earlier forms in most cases. There are many areas of post medieval re-use of earlier ridge and furrow, but the majority was clearly later in form. Approximately 24% of the post medieval ridge and furrow was made up of a narrow form, which is the latest in date and suggestive of steam ploughing.



Plate 11. *Medieval/post medieval ridge and furrow, South Ribble (1481644, 1481649)*
RAF 540/1492 110 07-DEC-1954 English Heritage (NMR) RAF Photography

6.4 Post medieval and Twentieth Century

6.4.1 Industry

The most prevalent mapped industrial features were quarries, most of which cannot be attributed to any particular form of quarrying. A total of 49 quarrying sites were mapped as part of the survey, ranging from Post Medieval to 20th century in date.

Ten of these quarries were identified as limestone extraction, primarily through Ordnance Survey map regression, and others through their proximity to lime kilns, for example a cluster of quarries east of Scales (1487797, 1487791 and 1487822) with a number of associated kilns (1489491, 1487791 and 1389992), all of which were at least partially extant on the latest photography. A further fifteen lime kilns were identified during the project.



Plate 7. *Limestone quarry and associated lime kiln, Scales (1487797, 1489491)*
 NMR SD 2872/5 (17190/25) 24-AUG-1998 © English Heritage. NMR

The only other type-identified quarry was that of Ghyll Scaur on the edge of Millom Park which is still used for granite extraction (1491070). As well as large-scale quarrying a large quantity of extraction pits were also identified on air photographs; for sand (e.g. 1490032), clay (e.g. 1479934) and gravel (e.g. 1485139).

A high concentration of collieries and coal workings were visible from St. Bees Head and to the north, which ranged from post medieval to the 20th century in date. One of the most illustrative mid-19th century examples was Jane Pit in Workington, where the engine house had been preserved and scheduled (8578).



Plate 8. Colliery at Siddick, Cumbria (1495488)
NMR NX 9930/6 (30381/PO-0025) 14-AUG-1948 © English Heritage. NMR

The Duddon Estuary proved to be a unique area for its extensive ironstone workings. These sites were extensive but have been mostly reclaimed now. The largest site lay on the north of the estuary and encompassed a small estate of mines, tracks, spoil-heaps and workers accommodation (1490540). This site encompassed an area of nearly 180ha.



Plate 9. Remnants of Ironstone Workings, Roanhead, Askam and Ireleth (1127051)
RAF 106G/UK/1205 4010 07-MAR-1946 English Heritage (NMR) RAF Photography

Other forms of industrial activity concentrated more around various works, including brickworks (1487838), chemical works (1487658) and a gunpowder works (1025660); all of which were located along the mouth of the River Leven entering Morecambe Bay.

6.4.2 Maritime Features

Fish traps: Examples of these were found throughout Morecambe Bay, the Duddon Estuary and on the River Esk at Ravenglass (1157584).

Also visible in the inter-tidal zones were 70 wrecks mostly dating from the post-medieval to 20th century (N.B. wrecks visible from the Wirral to the River Ribble were initially recorded as uncertain in date). Although recorded as wrecks many of these features, especially along the Mersey Estuary, were simply abandoned vessels deserted along the shoreline. One such example was a cluster of 12 vessels by Garston docks, with several wrecks simply piled on top others (892680).



Plate 10. *Abandoned Vessels at Garston Docks (892680)*
NMR SJ 4083/14 (17758/3) 02-SEP-2002 © English Heritage. NMR

6.5 Military Features

6.5.1 Post Medieval Coastal Defences

In order to examine the Second World War sites it is important to view all the military activity dating back to the Post Medieval period. In the case of the north-west coast this history only stretches back as far as the 19th century. Perhaps the earliest official defensive feature is Fort Perch Rock on the northern apex of New Brighton, at the mouth of the Mersey (1429176). Constructed in the early 19th century this fort became a coastal battery at the end of the century and was also re-commissioned during the Second World War.



Plate 12. *Fort Perch Rock, New Brighton (1429176)*
NMR 20752/023 18-MAR-2008 © English Heritage. NMR

Further Victorian military archaeology was viewed on air photographs in the form of firing ranges; one at Barrow-in-Furness (1490031) and two others at Fleetwood in Lancashire (1483550). These ranges appear to have been constructed in the late 19th century, and utilised right through to the Second World War and afterwards.

These firing ranges illustrate the main use for military activity in the north-west. Once you leave the defended dock areas and the distinct areas of defence, such as Fort Crosby, then it becomes clear that much of the north-west coast, especially north of Morecambe Bay, focussed on war production, testing and military training. The reason for this concentration was probably due to the increasing distance for enemy aircraft and potential invasion forces to penetrate.

6.5.2 World War I

The First World War has left very little evidence on the north-west coast. With the advent of the First World War military training was on the increase, but our survey found very little evidence for the practice trench systems we would usually expect. This may be due to reuse of sites during the Second World War which removed any traces of previous activity. However a good example of Great War practice trenches was seen as cropmarks in Blackpool (1480790). These trenches displayed the usual size and shape layout of box-trench formation.



Plate 13. *Cropmarks of First World War practice trenches, Blackpool (1480790)*
NMR SD 3133/001 (9224/2170) 25-JUL-1984 © English Heritage. NMR

The First World War saw the large-scale introduction of factories for wartime production. By the period of the earliest photography referred to in our survey (1940s)

the evidence for these had largely but not completely disappeared. In Lancaster a filling factory was visible in the Parish of Heaton with Oxcliffe (1485081) where shells and explosive components were assembled.

6.5.3 World War II

The greatest proportion of the NW RCZAS recorded sites date to this period. Photographs taken by the RAF during the conflict and in the post war era have captured a snapshot of Britain during that time. This is particularly important as many features associated with the Second World War were quickly removed in the years following the end of the war (Small 2006, 125). For this project area the study of the RAF photography has revealed a considerable number of World War II sites, the majority of them previously unrecorded.

A total of twelve production factories were identified on aerial photographs, dating to various periods of the 20th century. Many of these sites were civilian factories switched to the production of ordnance and military equipment. Some of these factories were defended such as the Moss Bay Works in Workington (1413049). Perhaps one the most illustrative was the Rootes Securities Shadow Factory, which adjoined RAF Speke (now Liverpool John Lennon Airport) to the east (1416049). This factory had immediate access to the runway of the military airfield and was heavily defended by numerous pillboxes, anti-aircraft batteries and various trenches. Vertical photography dating to October 1940 displayed the heavily camouflaged rooftops of the factory surrounded by many earthwork air-raid shelters.

Centring around the region of Ravenglass were a number of Royal Ordnance Factories, of which the most well known was gradually redeveloped after 1947 for the Nuclear Weapons Programme; now known as Sellafield (1075104). Much of this ordnance manufacturing appears to have been related to the weapons testing facility at Bootle, which is still in use today (1491643) and covers a huge area of over 222ha.



Plate 14. *Royal Ordnance Factory, Drigg (1075121)*
RAF/CPE/1940/4003 (1075121) English Heritage (NMR) RAF Photography

Non-military wartime activity appeared to have been centred towards the populated areas, primarily docklands. Air defence precautions were obviously highly necessary in these areas as they were prime targets for bombers during the Second World War. These precautions consisted primarily of air-raid shelters and emergency water supplies. In each instance they were spread throughout the more densely populated and industrially important cities and towns. These features were recorded mostly in Liverpool, Blackpool and Barrow-in-Furness. A total of 4,489 air-raid shelters were mapped during the project, which of course only covered the immediate coastal regions of the great cities. These shelters were predominantly communal in nature, rather than smaller types such as Anderson shelters, and therefore displayed only a small percentage of the total number along this stretch of the coast.

The distribution and density of such shelters in Barrow-in-Furness and on Walney Island reflected the wartime importance of this district. The heart of the region lay in the submarine docks of Barrow itself, which were surrounded by a very tight network of barrage balloons, of which twenty-three sites were seen and mapped through aerial photography. Walney Island, which sheltered the entrance to the docks, consisted of Barrow Airfield (1383764), two coastal batteries (1489733 and 1429214), and four anti-aircraft batteries (1471349, 1471337, 1489524 and 1471334). The remainder of the island was littered with military camps, buildings, pillboxes, weapons pits and barbed wire obstructions. The landward side of the channel the docks and the immediate coastline of Barrow were covered by an enormous number of pillboxes, of which thirty-eight were recorded in just over 10km² (this does not even include the

sixteen others on Walney Island itself). This is the highest density of pillboxes recorded anywhere on the north-west.



***Plate 15.** Barrage balloon strewn skies above Wallasey*
NMR SJ 3094/2 (31242/PO-02) 16-AUG-1941 © English Heritage. NMR



Plate 16. Barrage balloon on the shore of Crosby, Merseyside
NMR SJ 3197/1 (31246/PO-51) 17-AUG-1941© English Heritage. NMR

A total of seven airfields were mapped as part of the NWRCAS, some of which saw continued use after the Second World War. RAF Speke (now Liverpool John Lennon Airport) (1410957), Blackpool Airport (1411199), Walney Aerodrome (1383764) and Warton Airfield (1431202) are still in use today. The others sites no longer in use were Hooton Park (1397920), RAF Millom (1107992) and RAF Cark (1381510).







<p>RAF Hooton Park (1397920) 1917-1957</p> 	<p>RAF Speke (Liverpool John Lennon Airport) (1410957) 1930-Present</p> 
<p>RAF 13A/UK755 10 31-MAR-1941 English Heritage (NMR) RAF Photography</p>	<p>RAF 106G/UK/626 3207 10-AUG-1945 English Heritage (NMR) RAF Photography</p>
<p>RAF Warton (Warton Airport) (1431202) 1942-Present</p> 	<p>RAF Cark (1381510) 1941-1945</p> 
<p>RAF 106G/UK/623 4160 10-AUG-1945 English Heritage (NMR) RAF Photography</p>	<p>RAF 106G/UK/1536 4031 23-MAY-1946 English Heritage (NMR) RAF Photography</p>
<p>RAF Barrow (1383764) 1941-1946</p> 	<p>RAF Millom (1107992) 1939-1945</p> 
<p>RAF 106G/UK/1334 5366 29-MAR-1946 English Heritage (NMR) RAF Photography</p>	<p>RAF 106G/UK/652 3256 13-AUG-1945 English Heritage (NMR) RAF Photography</p>

Fig. 3. Military Airfields

As has already emphasised much of the north-west military areas appear to have been laid aside for training purposes, including airfields. Associated with some of these were air-gunnery firing ranges at RAF Millom (1490637) and Walney (1488708). A number of standard infantry firing ranges were also scattered along the full length of the survey area. Situated within the Duddon Estuary and Morecambe Bay were a number of Second World War bombing range markers, consisting of concrete arrow-shaped surfaces pointing towards bombing markers in the sand and mudflats. One such example could be seen in the Parish of Preesall (1484030), which pointed towards an enclosed bombing range on Preesall Sands (1484034). This bombing range encompassed an area measuring nearly twenty four hectares.

Although a number of decoy sites were known to have existed in the survey area, only 9 were identified on aerial photography. Quite a lot of evidence for German bombing was discovered in the form of bomb craters, especially heavily concentrated around Liverpool and Wallasey. Other regions showed areas of clear building removal due to bomb damage, but the mapping/recording of this unfortunately did not form a part of our specification.



Plate 17. Bomb damage in Poulton, Wirral
RAF 13H/UK789 110 11-JUN-1941 English Heritage (NMR) RAF Photography

In one instance a 'Starfish' bombing decoy site on Burton Marsh (1467648) appeared to have proved successful in decoying enemy bombers from their targets in Liverpool, as the decoy was surrounded by two dozen bomb craters in linear formation (1467612).

However the greater part of military activity on the north-west coast, stretching the full length of the survey area from the Wirral to Maryport in Cumbria emphasises coastal defence. Other than the previously mentioned coastal batteries at Perch Rock and Walney, a further four were seen on air photographs. The southernmost of these formed the centre of a large defensive complex known as Fort Crosby (1476752). This extensive site covered a stretch of coast over 3km in length protecting the northern approaches to Merseyside. The complex consisted of a dense concentration of barbed wire obstructions, anti-tank obstacles (1476748), pillboxes, trenches and minefields surrounding the Crosby Point Coastal Battery (1425941), an anti-aircraft battery (1476726), a searchlight battery (1476739), and associated camps and buildings.

Another primary source of defence common to the northwest were the anti-glider obstacles, sometimes in the form of linear ditches mounted by large intermittent banks. However the more common form of aircraft obstructions were upright poles set into the flat sands, such as at Morecambe Bay (1483577, 1485449) and Birkdale Sands (1479220). These poles could be set out in regular grids or placed randomly to prevent enemy aircraft from landing. A total of 103km² of anti-glider poles were mapped as part of the project, but many more almost certainly lay beyond the limits of the photography.



Plate 18. *Anti-glider obstacles, Crossens Marsh, Southport (1480280)*
RAF 106G/UK/623 4090 10-AUG-1945 English Heritage (NMR) RAF Photography

The most dominant form of air-defence were however the anti-aircraft batteries, of which 22 were drawn throughout the project. As with most features these centred primarily around the large towns, cities and ports. Many of these appear to have been associated with searchlight batteries, of which 18 were identified.

If an enemy attack and landing were to have been successful the defence would have fallen towards the landward features, the most prominent being pillboxes, of which 217 were recorded including a number of possibilities. This number does not include those structures in, around and associated with larger sites such as airfields and camps etc. Two exceptional surviving examples can be seen flanking the A41 New Chester Road in Port Sunlight (1421779 and 1420650).



Plate 19. Pillboxes on the A41 (1421779, 1420650)
NMR 20754/49 18-MAR-2008 © English Heritage. NMR

The north-west appears to have played an important role during the Second World War for construction, defensive and training purposes. The emphasis was clearly placed around the built-up regions, but the entire coastline shows evidence of activity during the conflict.

6.6 Features of Uncertain date

A number of sites were identified as of uncertain date due to either poor aerial photographic quality, their poor preservation, or simply that the features were not characteristic of any one particular period of function.

As previously stated many of these records related to wrecks, which are now considered to be post medieval in date. Otherwise the majority of the remaining sites were visible as cropmarks and appeared to be ditches and field boundaries of various natures. Some of these sites, especially those in the northern 20km of the survey area lay in areas of known Iron Age and Roman activity, but no physical or typological relationships could be discerned, therefore a date could not be given (e.g. 1494290 and 1494300).

6.7 Discussion

Throughout this research, evidence for human activity has been discovered ranging from prehistory to the present day. The nature of sites discovered varies from the funerary monuments of prehistory, through to the settlement features of the Iron Age/Roman and medieval periods. Of a more recent, but no less archaeological valuable nature is the wealth of military activity located along the north east coastline.

The varied nature and type of site mapped as part of the project inevitably means that there is a varying degree of preservation of the heritage assets identified. The majority of the mapped structural features date from the Second World War although many were removed in the immediate aftermath of the War. Earthwork sites, with occasional structural components form the majority of the mapped sites from the early post-medieval and medieval periods. The record is dominated by ridge-and-furrow earthworks, but other site types, including motte-and bailey and castle sites have been recorded. The Roman and Iron Age periods are almost wholly represented by cropmarks. Such sites are at threat from different forms of erosion, including ploughing or development activity, as well as coastal erosion processes.

This loss and potential loss of sites and features varies from region to region throughout the north-west. Although the threat from coastal erosion has always been present, it is particularly quarrying, extraction and mining that have led to the most dramatic changes visible on the aerial photographic record for the north-west coast. The distribution of industrial sites in the region follows rich zones of natural ore, in particular collieries are especially prevalent in the very north of the study area around Workington, whereas ironstone workings are located around the river mouths forming Morecambe Bay. These latter forms of industrial activity left great swathes of quarried land, now reclaimed as lakes and ponds.

This is however not to say that coastal erosion does not play its part in the potential threat to the archaeological remains along the north-west coast. Several areas stand out as the most susceptible, such as Walney Island, exposed to the currents of the Irish Sea. Figure 4 illustrates photography dating from several periods of a heavy anti-aircraft battery at the south of the island, which over a period of less than forty years lost nearly 80m of its shoreline. The sheltered side of the island however shows increased deposition of the eroded deposits from the seaward side.

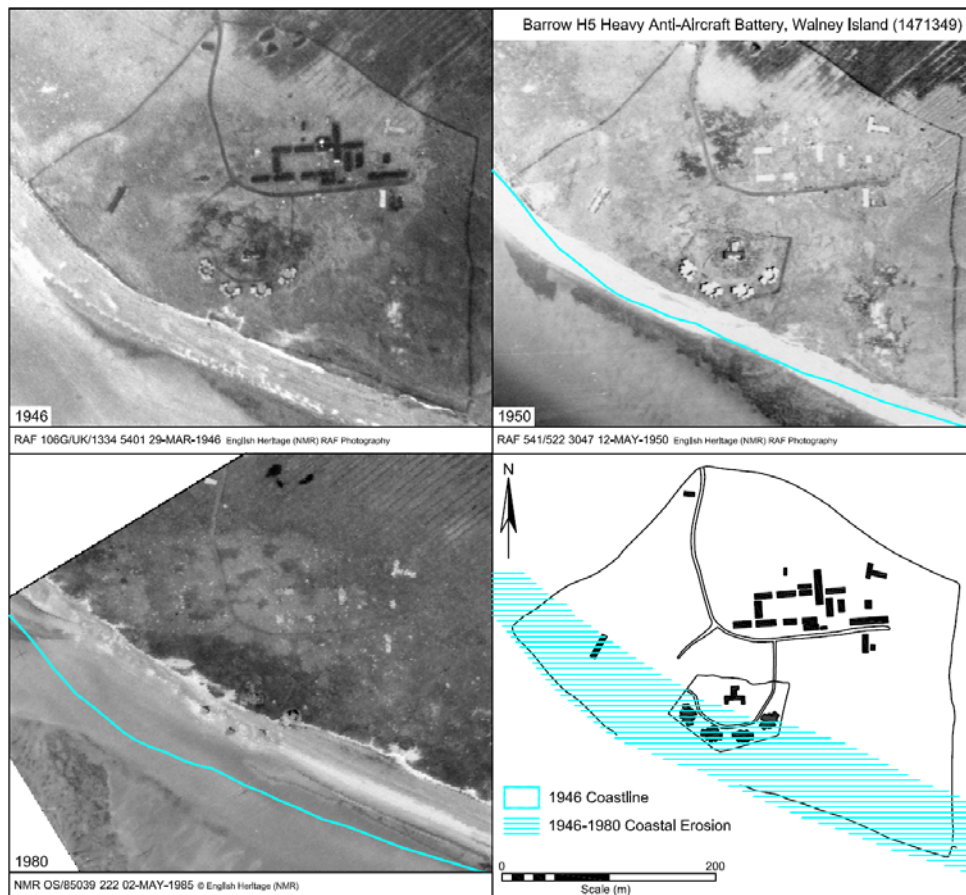


Fig. 4. Coastal Erosion on Walney Island

Although much less of a threat, deposition and reclamation of the inter-tidal zone must be taken into consideration. The migration of sands and mudflats can increasingly be seen to almost block estuaries. Many of these movements were caused by human intervention seeking to prevent erosion in other areas. This of course could lead to a burying of important archaeological sites.

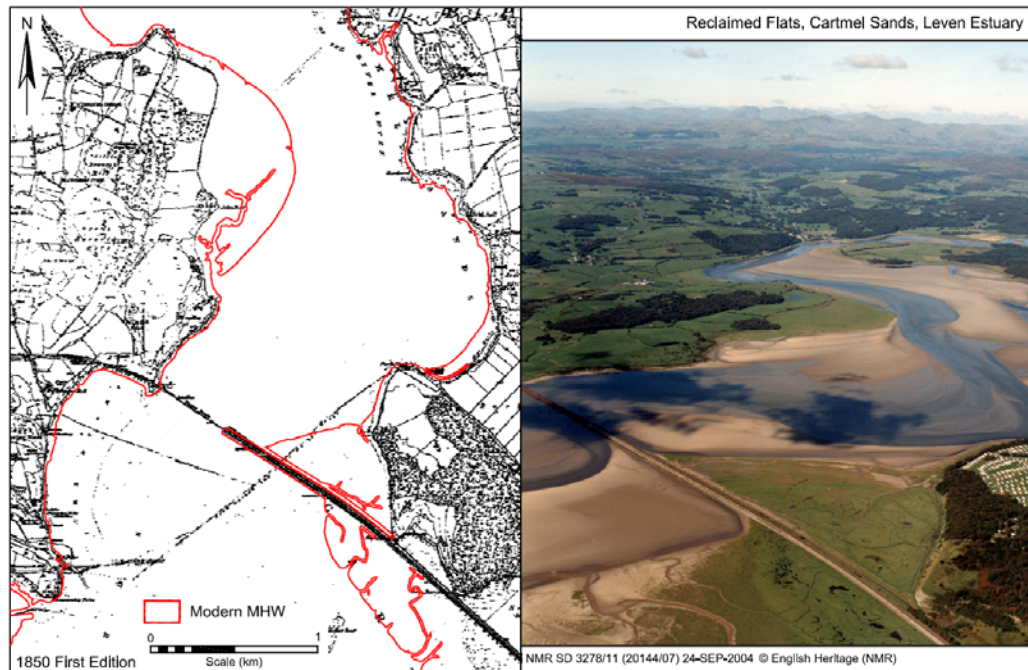


Fig. 5. Coastal Deposition in the Leven Estuary

The quality of the aerial photograph coverage can have a huge impact on aerial survey. In the case of this north-west coast assessment the vertical and oblique photographic coverage of the project area was particularly extensive; although it should be noted that towards the north of the project area the volume of photography decreased in direct correlation with the decrease of urban areas. This was particularly true of the early RAF photography and perhaps led to a negative bias in the number of Second World War sites mapped in the northern counties, particularly in north Cumbria.

A further issue for the NW RCZAS was the poor quality of the available early M-series RAF vertical photography. The NMR photo library does not hold the negatives to these prints and therefore their loan outside the archive is restricted. In these instances the images were supplied as laser scans rather than the original prints and the inevitable reduction in quality was also compounded by the scanning and rectification process. Much more could be made of this important resource if the original prints were scanned at a high resolution and supplied digitally. On the other hand, good quality coverage of an area can also have an impact. Where a high quality run of photography was available, a potential bias can be seen in the sites recorded. This appears to be the case for the identification of a concentration of Iron Age/Roman cropmarks in the area between Seascale and Egremont. RAF vertical coverage from June 1957 was the only source for these sites and, as the coverage was limited only to this immediate area, further sites beyond this may exist but remain undiscovered.

Remarkably, only four pre-Iron Age/Roman sites were identified. This could lead to questioning of the process of dating features using morphology and whether some features dating from earlier periods have fallen within the 'uncertain' date category.

However, this lack of evidence may be the result of poor photographic coverage of the more northerly regions of the project area, or due to the large scale urbanisation of the more southern regions. Curiously, there were no earthwork remains identified of features such as hillforts and only one site recorded is reminiscent of the multivallate forts of the north east coast. This absence is probably potentially due to the topography rather than photographic factors.

The north-west coast was known to have Roman occupation yet only two Roman forts were mapped. Existing SMR and EH AMIE data highlighted the known and supposed locations of several others but there was no photographic evidence for the sites to facilitate transcription. It is feasible that some of these forts may have been subsumed by the later settlement that developed around them but others have most probably been lost over time to either the plough or the sea. In other circumstances, such as at Ravenglass, the photography simply did not provide any visibility of a fort which is known to be evident on the ground.

Evidence for typical nucleated medieval settlements along the coastal hinterland appeared to be lacking, despite ridge and furrow probably being the most common form of medieval feature encountered in the project. It is anticipated that the settlements, whilst not immediately obvious, would have been situated beyond the agricultural zone and the 1km area of the survey, hence their apparent absence. Furthermore, the lack of more recent photography led to a positive bias in the amount of ridge and furrow recorded as extant to the north of Barrow-in-Furness, the majority of which may have been destroyed or ploughed since the latest photography (often dating back to the 1980s).

Several examples of early mottes, sometimes with associated baileys, were recorded throughout the survey, but as with most earthwork sites their survival and appearance is often reduced. For example plate 20 illustrates the motte at Aldingham, now greatly diminished in size due to erosion.



Plate 20. *Medieval Motte and Bailey suffering from coastal erosion, Aldingham (38085, 37622, 37622)*

NMR SD 2769/3 (17190/34) 24-AUG-1998 © English Heritage. NMR

With the exception of Cockersand Abbey which survives predominantly as earthworks, the other religious sites displayed surprisingly little evidence of external activity. This may be partly due to an urban build-up of the area, pre-photography, but this is an example of where further investigations would be valuable. Associated with some of these monastic sites were a number of fish traps; the earlier examples of these features appear to be quite substantial structures built of stone, whereas the more common post-medieval variations are less regular in shape and probably constructed of timber uprights. The reason for the change in construction material is unclear, given that the stone features would have been substantial and more resistant to natural destruction by the sea and tide. One can only assume that the wooden features were easier to construct and to clear of silt and other marine deposits.

The centre of activity along the north-west coast gradually changed throughout the latter half of the 19th century towards military activity, reaching a peak during the Second World War. Once the survey moved beyond the defended docks areas it becomes apparent that much of the wartime activity centred on production, testing and training. There were some areas that were extremely well defended, such as Fort Crosby, protecting the northern approaches to Merseyside, and the intense concentration of anti-aircraft and invasion devices installed around Barrow-in-Furness to prevent damage to the vastly important submarine docks. The remainder of the coastline however simply consisted of limited defences with huge concentrations of training facilities, such as firing ranges, airfields, ordnance factories and weapons testing sites. The reason for this concentration was that the north-west was a long

distance target for enemy aircraft and potential invasion forces to penetrate, allowing it to be a more secure area for such activities.

In addition to the mapping, another aspect of the air photo side of the RCZA is to identify threats to monuments. Although this is not the primary aim of the NMP, by looking at recent photography we can help our colleagues understand changes in the landscape and monitor and assess current monument conditions.

An example is Cockersand Abbey, mentioned above, where coastal erosion has been shown to be causing damage to the western side of the monument's precinct, as shown in this aerial photograph from 1984, in which the white line of the sea defences in the lower part of the photograph can be seen to have been overwhelmed during storm events and erosion to the archaeological deposits subsequently occurred.

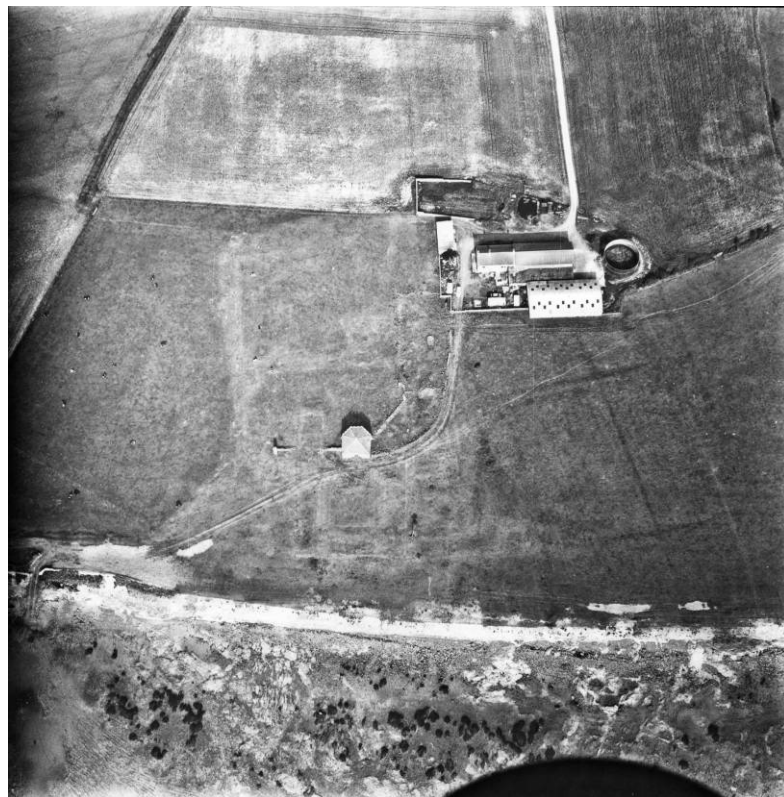


Plate 21. Cockersand Abbey

NMR SD 4253/17 (2539/43) 01-JAN-1984 © English Heritage. NMR

A number of sites seem worthy of further study: monuments of uncertain date, features affected by coastal erosion and the majority of the prehistoric sites mapped by the project.

Recommendations for future research:

- Additional aerial reconnaissance (particularly in the areas north of Barrow-in-Furness).
- Further investigation for significant features (as discussed).

- Mitigation measures at sites under imminent threat from coastal erosion.

The technique of aerial survey has shown to be successful in the north-west coastal region. It is therefore reasonable to suggest further aerial photographic mapping in this region be undertaken in order to place these archaeological features in their wider landscape context.

6.8 A Moment in Time

It is intended to look in this section at several examples, where the detail contained on some of the aerial photographs provides an invaluable insight into the past.

Plate 22 shows a 1941 image of Hooton Park Airfield: built in the First World War, it was reused as a civilian airport between 1918 and 1939 and utilised again for military purposes in WWII. The airfield was originally built on parkland.



On this AP, the distinct open airfield, hangars and associated buildings can be identified but an attempt to camouflage the aerodrome by imitating field boundaries and trees can also be seen. There are also rectilinear structures, known to represent bomb storage and also barbed wire fences in one corner most likely surrounding a pillbox.

Plate 22. Hooton Park, 1941

RAF/13A/UK755 10 31-MAR-1941© English Heritage (NMR)
RAF Photography

By the end of 1944 the airfield perimeter had been expanded and furnished with two intersecting tarmac landing surfaces (seen here as it appeared in 1957).



Plate 23. Hooton Park, 1957

RAF/RRF/953 21 19-JUN-1957© English Heritage (NMR)
RAF Photography

Particular use of the airfield can also be visualised. Photography from 1946 showed



the northern end of the airfield being utilised as a scrap yard for obsolete aircraft. The photograph shows the breaking up of either Lancaster or Halifax bombers in the immediate aftermath of the war. The stripes that can be seen on close inspection of the dismantled wings are Invasion Stripes introduced for the D-Day Offensive to enable easier aircraft recognition.

Plate 24. *Hooton Park, 1946*

RAF 3G/TUD/UK/17 5088 12-JAN-1946 © English Heritage (NMR)
RAF Photography



Plate 25. Hooton Park, 1946

RAF 3G/TUD/UK/17 5088 12-JAN-1946 © English Heritage (NMR) RAF Photography

It is also possible to see the direct result of the war on the people of the north-west. These pre-fabricated buildings were erected for the homeless victims of German bombing in Birkenhead. Some of these structures survived for many years after the war.



Plate 26. *Pre-Fabricated Housing, Birkenhead*
RAF CPE/UK/2111 5055 28-MAY-1947 © English Heritage (NMR) RAF Photography

Barrow-in-Furness, although being much smaller than Liverpool and containing fewer docks, contained some of the highest densities of anti-aircraft and anti-invasion sites found throughout the survey. This was due to the presence of Vickers shipyard, where warships were constructed, primarily submarines. Plates 27 and 28 show a group of 1940s and modern submarines using the same site.

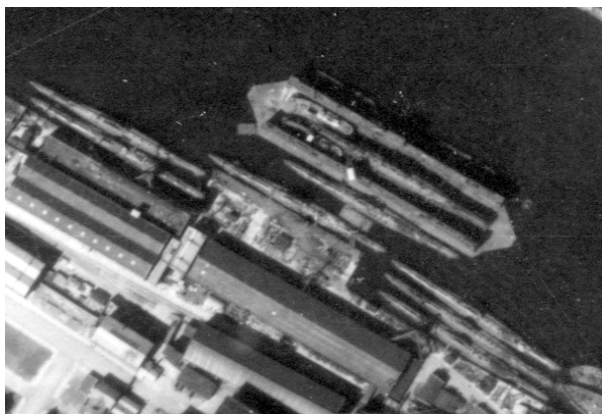


Plate 27. *Barrow-in-Furness Docks, 1946*
RAF 106G/UK/1487 4070 09-MAY-1946 © English Heritage (NMR) RAF Photography



Plate 28. *Barrow-in-Furness Docks, 1992*

NMR SD 1968/17 (12248/97) 26-MAY-1992 © English Heritage
(NMR) RAF Photography

Plate 29 shows the method of how the early Second World War low-level oblique photography was obtained. The distinct outline of a Spitfire can be seen, from which the photography was taken from a remotely controlled camera, mounted in a small holding at the back of the cockpit.



Plate 29. *Reconnaissance Aircraft near Crosby*

NMR SD 2903/10 (31246/PO-39) 17-AUG-1941© English Heritage
(NMR) RAF Photography

Plate 30 illustrates the human involvement in archaeology in-progress, not often seen on air photographs. These workers on the shore near Sellafield have been captured waving at the passing plane.

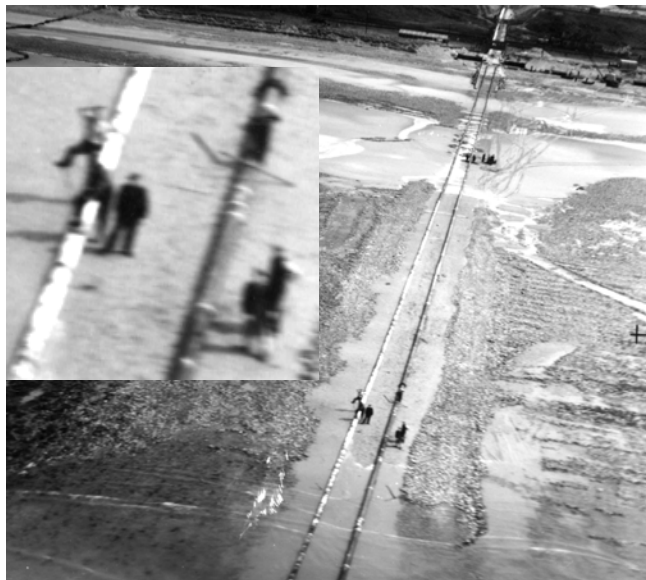


Plate 30. *Workers at Sellafield*

NMR NY 0103/13
(30343/PSFO-0025) 20-JUN-1950 © English Heritage
(NMR) RAF Photography

It is clear from this small number of photographs that more than just archaeological sites can be gleaned from air photos as an historic resource. While much of the information in this section is not directly relevant to RCZA surveys, the detail available from a social history perspective is invaluable and should not be underestimated.

7 BIBLIOGRAPHY

- Ashmead, R.M.A., P. & Wood, R.H. 1974. Second report on the archaeological excavations at Kirkhead Cavern. *North West Speleology* 2(1): 24-33.
- Aitkenhead, N., Barclay, W.J, Brandon, A, Chadwick, R.A, Chisholm, J.I, Cooper, A.H & Johnson, E.W. 2002. The Pennines and adjacent areas. Nottingham, British Geological Survey.
- Bacilieri, C., Knight, D., Radford, S. 2008. North East Coast Rapid Coastal Zone Assessment Survey - Air Survey Mapping NMP Interim Report. Unpublished
- Bagley, J. 1976. *The History of Lancashire*. Chichester and London.
- Beaches, Fields, Streets, Hills 2006. The anti-invasion landscapes of England, 1940, William Foot, English Heritage. CBA Research Report 144.
- Bellhouse, R.L. 1969. Roman site in the Cumberland coast 1966-7. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 69: 54-101.
- Bellhouse, R.L. 1981. Hadrian's Wall: the Limiting ditches in the Cardurnock Peninsular. *Britannia* 12: 135-142.
- Bewley, R.H. 1992. Excavations on two crop-mark sites in the Solway Plain, Cumbria. Ewanrigg settlement and Swarthy Hill 1986- 1988. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 92: 23-47.
- Bewley, R.H. 1993. Survey and excavation at a crop-mark enclosure, Plasketlands, Cumbria. *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society* 93: 1-18.
- Birley, E. 1949. *The Centenary Pilgrimage of Hadrian's Wall*. Society of Antiquity of Newcastle.
- Birley, E. 1961. *Research on Hadrian's Wall*. Titus Wilson Son. Kendal.
- Bonsall, C., Sunderland, D, Tipping, R, and Cherry, J. 1986. The Eskmeals Project 1981-5: an interim report. *Northern Archaeoll*, 7 (1): 1-30.
- Bonsall, C. 1981. The coastal factor in the Mesolithic settlement of North-west England. In B. Gramsch (ed.) *Mesolithikum in Europa*. 2. Internationales Symposium Postdam, 3 bis 8 April 1978 Bericht. (Veroffentlichungen des Museums fur Urund Frugeschichte Postdam. 14/15) Berlin, Deutscher Verlag der Wissenschaften: 451-472.
- Boutwood, Y. 2005. Hadrian's Wall NMP Project: Bowness and Solway to Carlisle, Cumbria. English Heritage internal report AER/03/2005.

- Bowden, M. 2000. Furness iron: the physical remains of the iron industry and related woodland industries of Furness and southern Lakeland. Swindon: English Heritage.
- Brennand, M. (ed.) 2007. Research and Archaeology in North West England. An Archaeological Research Framework for North West England: Volume 2 Research Agenda and Strategy. Archaeology North West 9 (Issue 19 for 2007).
- Butler, C. 2007. East Sussex Under Attack. Anti-invasion sites 1500-1990.
- Chatterton, R. and Waddington, C. 2007. North East Coast Rapid Coastal Zone Assessment - Project Design for HEEP funding. Archaeological Research Services Ltd
- Cherry, J.C., P.J. 1983. Mesolithic Habitation Sites at St. Bees, Cumberland. Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society 73: 47-62.
- Collingwood, R.G. 1923. An inventory of Ancient Monuments of Cumberland. Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society 23: 206.
- Collingwood, W.G. 1933. An introduction to the prehistory of Cumberland and Westmorland and Lancashire north of the Sands. Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society 33: 111-136.
- Council for British Archaeology. 1996. 20th Century Defences in Britain. An Introductory Guide. Practical Handbooks in Archaeology 12.
- Cowell, R.W. 1992. Prehistoric survey in North Cheshire. Cheshire Past 1: 6-7.
- Cowell, R.W, A. Milles & G. Roberts. 1993. Prehistoric footprints on Formby Point beach, Merseyside. In R. Middleton (ed.) North West Wetlands Survey Annual Report 1993. 43-48.
- Cowell, R.W. & Innes. J.B. 1994. The Wetlands of Merseyside. In (ed.) North West Wetlands Survey, Vol. 1. Lancaster Imprints 2, Lancaster.
- Department for Environment, Food and Rural Affairs (DEFRA), 2001. Shoreline Management Plans. A guide for coastal defence authorities. London: DEFRA.
- English Heritage & RCHME, 1996. England's Coastal Heritage: a statement on the management of coastal archaeology. London: English Heritage.
- English Heritage, 2005. The National Mapping Programme - Manual. Unpublished.
- English Heritage, 2005. A Brief for Rapid Coastal Zone Assessment Surveys. Version 4. London: English Heritage.
- Fulford, M., Campion, T., and Long, A. (eds.), 1997. England's Coastal Heritage: A Survey for English Heritage and the RCHME, English Heritage Archaeological Report 15, English Heritage and RCHME, London.

- Hallam, J.S.E., B.J.N Barnes, B. & Stuart, A.J. 1973. The remains of late glacial elk associated with barbed points, from High Furlong, near Blackpool, Lancashire. *Proceedings of the Prehistoric Society* 39: 100-128.
- Hegarty, C., Newsome, S. 2007. *Suffolk's Defended Shore. Coastal Fortification from the Air*. English Heritage
- Higham, N.J. & Jones, G.D.B. 1975. Frontier, forts and farmers: Cumbria aerial survey 1974-5. *Archaeological Journal* 132: 16-53.
- Hinchcliffe, J.W. & Williams, J.H. (Eds.). 1992. *Roman Warrington*. Manchester.
- Howard-Davis, C. 'The glass'. In R.L. Newman, R.H. (ed.) *Dacre: an early Christian monastery?* Forthcoming
- Johnson, B. 2009. *North West Rapid Coastal Zone Assessment (NWRCA)*. Archaeological Research Services Ltd Forthcoming
- Macarthy, M.R. 1991. The Roman waterlogged remains and later features at Castle Street, Carlisle: excavations 1981-2. Kendal.
- Macarthy, M.R. 1993. *Carlisle: history and guide*. Stroud.
- Macarthy, M.R. 2000. *Roman and medieval Carlisle: the Southern Lanes*. Carlisle: Department of Archaeological Sciences, University of Bradford Research Report 1.
- Macarthy, M.R. 2002. *Roman Carlisle and the lands of the Solway*. Stroud: Tempus.
- Newman, R.M.B. 2007. The Prehistoric Period Research Agenda. In M. Brennan (ed.) *Research and Archaeology in North West England*. Council for British Archaeology North West:
- Newman, R.M., R. 2007. The Industrial and Modern Period Research Agenda. In M. Brennan (ed.) *research and archaeology in North West England*. Council for British Archaeology North West
- Oakey, M. 2009. *Hadrian's Wall World Heritage Site National Mapping Programme Project – Summary Report*. Forthcoming
- ODHAMS. circa 1946. *Britain's Modern Army Illustrated*. An authoritative account of the daily life of a modern soldier and of the work, weapons and machines of the Army.
- Payne-Gallwey, Sir R. 1886. *The Book of Duck Decoys. Their construction, management, and history*.
- Potter, T.W. 1979. *Romans in the north west of England: excavations at the Roman forts of Ravenglass, Watercrook and Bownesson Solway*. Kendal.
- Potter, T.W.A., R.D. 1994. Excavation and survey at St. Patrick's Chapel and St. Peter's Church, Heysham, Lancashire, 1977-8. *Antiquity* 74: 55-134
- RCHME 1997. *The National Mapping Programme – Sphere of Interest*. Unpublished.

- Roberts, B.K. 1996. *Landscapes of Settlement. Prehistory to the Present*. London, Routledge.
- Salisbury, C.R.S., D. 1994. The Mesolithic occupation of Heysham Head, Lancashire. *Trans Lancashire Cheshire Antiquity Society* 87: 141-149.
- Small, F. 2006. *Military Features Gloucestershire, Forest of Dean NMP Research Department Report Series 28/2006 English Heritage*
- Smith, C. 1992. *Late Stone Age Hunters of the British Isles*. London, Routledge.
- Tolan-Smith, C. 2008. *North East Rapid Coastal Zone Assessment (NERCZA)*. Archaeological Research Services Ltd
- Tooley, M.J. 1978. *Sea- level changes: the coast of north-west England during the Flandrian Stage*. Oxford.
- Tooley, M.J. 1982. Sea-Level changes in northern England. *Proceedings of the Geological Society* 93 (2): 43-51.
- Waddington, C., D.G. Passmore. 2006. *Planning for the Future. Historic Environment Planning Guidance for the Till-Tweed Valleys, Northumberland, UK*. London, English Heritage.
- White, A. 1996. 'Medieval towns'. In R. Newman (ed.) *The Archaeology of Lancaster*. University of Lancaster: 125-138.

APPENDIX 1 1:10,000 MAP SHEETS

MAP	BLOCK	AUTHOR	DATE OF COMPLETION	Collection No EHC01/114 AF00243
SJ 47 NE	1A	David Knight	25/01/2007	MD002229
SJ 48 SE	1A	Cinzia Bacilieri	18/12/2007	MD002227
SJ 57 NW	1A	David Knight	08/01/2007	MD002234
SJ 58 NE	1A	David Knight	14/08/2008	MD002232
SJ 58 NW	1A	Melanie Partlett	24/01/2008	MD002230
SJ 58 SE	1A	David Knight	22/01/2008	MD002233
SJ 58 SW	1A	Melanie Partlett	01/02/2008	MD002231
SJ 37 NE	1B	Cinzia Bacilieri	25/03/2008	MD002225
SJ 38 NE	1B	Melanie Partlett	17/03/2008	MD002223
SJ 38 SE	1B	David Knight	06/03/2007	MD002224
SJ 47 NW	1B	Melanie Partlett	18/02/2008	MD002228
SJ 48 SW	1B	David Knight	12/02/2007	MD002226
SJ 18 NE	2A	David Knight	16/04/2008	MD002325
SJ 18 SE	2A	David Knight	19/03/2008	MD002324
SJ 27 NE	2A	David Knight	27/03/2008	MD002332
SJ 27 SE	2A	David Knight	26/03/2008	MD002331
SJ 28 NW	2A	David Knight	10/04/2008	MD002329
SJ 28 SE	2A	David Knight	27/03/2008	MD002333
SJ 28 SW	2A	David Knight	03/04/2008	MD002328
SJ 19 SE	2B	Sally Radford	04/06/2008	MD002326
SJ 29 SE	2B	Cinzia Bacilieri	28/08/2008	MD002334
SJ 29 SW	2B	Sally Radford	06/06/2008	MD002330
SJ 38 NW	2B	David Knight	27/06/2007	MD002337
SJ 38 SW	2B	David Knight	26/06/2007	MD002336
SJ 39 SW	2B	Sally Radford	08/07/2008	MD002338
SD 20 SE	2C	David Knight	21/06/2008	MD002341
SD 30 SW	2C	David Knight	18/06/2008	MD002342
SJ 39 NW	2C	Sally Radford	18/07/2008	MD002339
SD 20 NE	3A	David Knight	14/08/2008	MD002381
SD 21 SE	3A	Sally Radford	13/08/2008	MD002378
SD 31 NE	3A	Sally Radford	15/08/2008	MD002377
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SD 31 SW	3A	Sally Radford	13/08/2008	MD002379
SD 32 SE	3B	Sally Radford	02/09/2008	MD002372
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SD 42 NW	3C	David Knight	10/09/2008	MD002369
SD 42 SE	3C	David Knight	25/09/2008	MD002370
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SD 53 SW	3C	Sally Radford	23/09/2008	MD002366
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SD 32 NW	3D	Cinzia Bacilieri	16/09/2008	MD002363
SD 33 SW	3D	Sally Radford	11/09/2008	MD002361
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MAP	BLOCK	AUTHOR	DATE OF COMPLETION	Collection No EHC01/114 AF00243
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SD 28 SW	7	Cinzia Bacilieri	27/02/2009	MD002533
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NX 91 NE	8	Cinzia Bacilieri	20/04/2009	MD002615
NX 91 SE	8	Shona Williams	30/03/2009	MD002613
NX 91 SW	8	Shona Williams	01/04/2009	MD002614
NX 92 NE	8	David Knight	21/04/2009	MD002618
NX 92 SE	8	Shona Williams	23/04/2009	MD002617
NX 93 SE	8	Shona Williams	24/04/2009	MD002619
NY 00 NW	8	David Knight	08/04/2009	MD002611
NY 00 SW	8	Cinzia Bacilieri	23/03/2009	MD002610
NY 03 SW	8	Cinzia Bacilieri	29/04/2009	MD002620

No archaeological features were mapped and recorded in quarter sheets:

MAP	BLOCK
SJ 27 NW	2A
SD 20 SW	2C
SJ 29 NE	2C
SD 20 NW	3A
SD 21 NE	3A
SD 22 SE	3B
SD 32 SW	3B
SD 22 NE	3D
SD 23 SE	3D
SD 35 NE	4
SD 17 SW	6
SD 25 NE	6
SD 25 NW	6
SD 36 NW	6
SD 36 SW	6
NX 91 NW	8

Additional 22 quarter sheets mapped as part of Hadrian's Wall World Heritage Site NMP Project (Event No.1360986):

MAP	BLOCK	AUTHOR	DATE OF COMPLETION
NY 15 NE	1A	Yvonne Boutwood	09/02/2008
NY 16 SE	1A	Antonia Kershaw	07/01/2003
NY 25 NE	1A	Yvonne Boutwood	19/12/2006
NY 25 NW	1A	Antonia Kershaw	12/09/2002
NY 26 SE	1A	Antonia Kershaw	13/12/2002
NY 26 SW	1A	Ann Carter	11/03/2003
NY 35 NE	1B	Jane Stone	28/08/2003
NY 35 NW	1B	Yvonne Boutwood	14/07/2008

MAP	BLOCK	AUTHOR	DATE OF COMPLETION
NY 36 NW	1B	Antonia Kershaw	26/03/2003
NY 36 SE	1B	Yvonne Boutwood	23/05/2003
NY 36 SW	1B	Antonia Kershaw	30/04/2003
NY 04 NE	6A	Ann Carter	14/07/2008
NY 05 SE	6A	Ann Carter	15/07/2008
NY 14 NW	6A	Jane Stone	05/06/2008
NY 15 NW	6A	Matthew Oakey	18/04/2008
NY 15 SE	6A	Matthew Oakey	19/05/2008
NY 15 SW	6A	Ann Carter	21/05/2008
NY 03 NE	6B	Matthew Oakey	10/03/2008
NY 03 NW	6B	Jane Stone	20/02/2008
NY 04 SE	6B	Matthew Oakey	08/02/2008
NY 13 NW	6B	Ann Carter	18/02/2008
NY 14 SW	6B	Ann Carter	17/12/2007

APPENDIX 2 AUTODESK MAP LAYERS AND DRAWING CONVENTIONS

Layer Name	Layer content	Attached data tables	Layer colour	Line type
0	None (AutoDesk 2007 requirement)	none	7 (white)	CONTINUOUS
BANK	Closed polygons for features such as banks, platforms, mounds and spoil heaps	MONUMENT	1 (red)	CONTINUOUS
BANKFILL	Solid fill for BANK layer polygons	MONUMENT	1 (red)	
DITCH	Closed polygons for cut features such as ditches, ponds, pits or hollow-ways	MONUMENT	3 (green)	CONTINUOUS
DITCHFILL	Solid fill for DITCH layer polygons	MONUMENT	3 (green)	
EXTENT_OF_AREA	Closed polygons outlining complex or extensive remains such as mining or military installations	MONUMENT	8 (grey)	DASHEDX2
GRID	grid lines at 1km intervals	NONE	7 (white)	CONTINUOUS
MONUMENT_POLYGON	Closed polygons encircling all the features recorded within a single AMIE record	MONUMENT	7 (white)	CONTINUOUS
RIGARREWK	Polyline showing the direction of ploughing in outlines of extant ridge and furrow	MONUMENT	4 (cyan)	CONTINUOUS
RIGARRLEVEL	Polyline showing the direction of ploughing in outlines of levelled or crop mark ridge and furrow	MONUMENT	6 (magenta)	ACAD_ISO03W100
RIGDOTSEWK	Closed polygon defining the furlongs or extent of area of extant ridge and furrow	MONUMENT	4 (cyan)	DOTX2
RIGDOTSLEVEL	Closed polygon defining the furlongs or extent of area of levelled or cropmark ridge and furrow	MONUMENT	6 (magenta)	DOTX2
STRUCTURE	Closed polygons for built features including concrete, metal and timber constructions such as military installations	MONUMENT	9 (grey)	CONTINUOUS
STRUCTUREFILL	Solid fill for STRUCTURE layer polygons	MONUMENT	9 (grey)	
THACHURE	Polyline T-hachure convention to schematize sloped features indicating the top of slope and direction of slope	MONUMENT	5 (blue)	CONTINUOUS

APPENDIX 3 AUTODESK MAP DATA TABLES

MONUMENT DATA TABLE

The Monument Data table consists of five fields that were input directly through AutoDesk Map 2007. The content of these fields follows those that are entered in the National Monuments Record Database AMIE.

FIELD NAME	FIELD CONTENT	Sample data
MONARCH	AMIE Unique Identifier (UID)	1495736
PERIOD	Date of features (EH Thesaurus)	SECOND WORLD WAR
TYPE	Monument type (EH Thesaurus)	MINEFIELD
EVIDENCE	Form of remains (EH Thesaurus)	EARTHWORK
PHOTO	NMR or other reference for the photograph from which the feature was mapped and the date of photography	RAF 58/B/44 5237 19-MAY-1948

Minor differences in methodology are also observable in those maps part of Hadrian Wall's World Heritage Site NMP that fall within the project area. These maps have also an additional data table called Monarch (the former name of AMIE database). This comprises just one field that records the AMIE Monument UID.

APPENDIX 4 MONUMENT TYPES USED IN THE PROJECT

ABBEY
AIR RAID SHELTER
AIRCRAFT OBSTRUCTION
ANTI AIRCRAFT BATTERY
BANK (EARTHWORK)
BARBED WIRE OBSTRUCTION
BARRAGE BALLOON SITE
BARROW
BEACH DEFENCE
BLAST SHELTER
BLAST WALL
BOMB CRATER
BOMB STORE
BOMBING DECOY
BOMBING RANGE
BOMBING RANGE MARKER
BOUNDARY BANK
BOUNDARY DITCH
BRICKWORKS
BUILDING
BUILDING PLATFORM
CASTLE
CHAIN HOME STATION
CHAPEL
CHEMICAL WORKS
CIRCULAR ENCLOSURE
CLAY PIT
COAL WORKINGS
COAST ARTILLERY SEARCHLIGHT
COASTAL BATTERY
COLLIERY
COLLIERY/BRICKWORKS
CURVILINEAR ENCLOSURE
DECOY POND
DITCH
DITCH/ BANK (EARTHWORK)
DRILL HALL
EMERGENCY WATER SUPPLY
ENCLOSURE
EXTRACTIVE PIT
FIELD BOUNDARY
FILLING FACTORY
FIRING RANGE
FISH TRAP
FISH TRAP
FISHPOND
FLOOD DEFENCES
FORT
GARDEN FEATURE
GARDEN PATH

GRANITE QUARRY
GRAVEL PIT
GUN EMPLACEMENT
GUNPOST
GUNPOWDER WORKS
HEAVY ANTI AIRCRAFT BATTERY
HOLLOW WAY
IRON WORKS
IRONSTONE WORKINGS
LIME KILN
LIMESTONE QUARRY
LYNCHET
LYNCHET
MACULA
MILITARY AIRFIELD
MILITARY BUILDING
MILITARY CAMP
MILITARY OBSERVATION SITE
MILITARY ROAD
MILITARY TRAINING SITE
MILL RACE
MILL RACE
MINEFIELD
MOAT
MONASTERY
MOTTE
MOTTE AND BAILEY
MOUND
MUNITION HOUSE
NARROW RIDGE AND FURROW
NISSSEN HUT
OBSERVATION POST
OIL REFINERY
ORDNANCE FACTORY
OYSTER BEDS
PILLBOX
PIT
PLATFORM
PLOUGH HEADLAND
PRACTICE TRENCH
PRIORY
QUARRY
RADAR STATION
RAILBLOCK
RAMPART
RECTILINEAR ENCLOSURE
RIDGE AND FURROW
ROAD BLOCK
ROUND BARROW
ROUND CAIRN

ROUND HOUSE (DOMESTIC)
ROYAL OBSERVER CORPS SITE
RUINED BUILDING
SALT WORKS
SAND PIT
SEARCHLIGHT BATTERY
SLAG HEAP
SPIGOT MORTAR EMPLACEMENT
SPOIL HEAP
STONE CIRCLE
STRUCTURE
TANK TRAP

TOWER HOUSE
TRACKWAY
TREE AVENUE
TRENCH
WAR PRODUCTION FACTORY
WATER STORAGE SITE
WATER TANK
WEAPONS PIT
WEAPONS TESTING SITE
WRECK

APPENDIX 5 EVIDENCE TERMS USED IN THE PROJECT

EVIDENCE Term	EXPLANATION
EARTHWORK	Monument existing as an upstanding earthwork
CROPMARK	Monument visible as a mark in standing crops, parchmarks or soilmarks Cropmark monument that was visible as cropmarks but has been built over
LEVELLED EARTHWORK	Earthwork has been levelled Earthwork monument that has been built over
STRUCTURE	Structure or building still extant Structure or building no longer in situ due to coastal erosion (e.g. a pillbox that is now at the bottom of a cliff) Structure or building may have been covered by sand Structure has been demolished but some remains are visible Structure or building has been demolished and no surface features are visible
DEMOLISHED BUILDING, RUINED BUILDING	Building is demolished but foundations and ground plan are visible
DESTROYED MONUMENT	Monument has been quarried away Earthwork or cropmark monument lost due to coastal erosion
MOVED STRUCTURE*	Structure or building has been moved from a position where it was originally recorded

* New AMIE term introduced for RCZAS: it relates to features recorded prior to this project from ground inspection but moved from their original position due to coastal erosion or human activities.

APPENDIX 6 FIGURES

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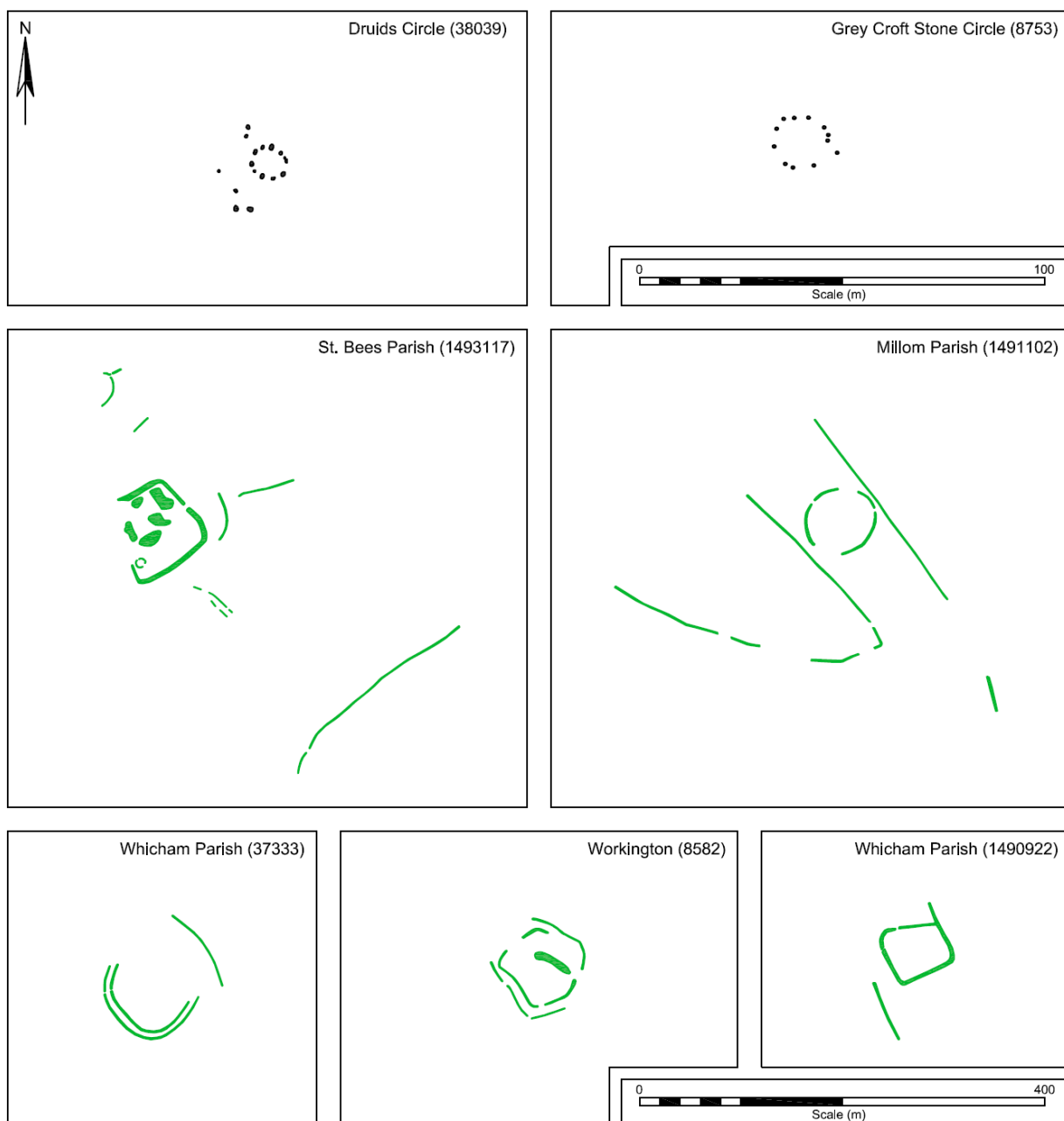


Fig. 6. Prehistoric, Iron Age/Roman Sites: Stone Circles and Enclosures

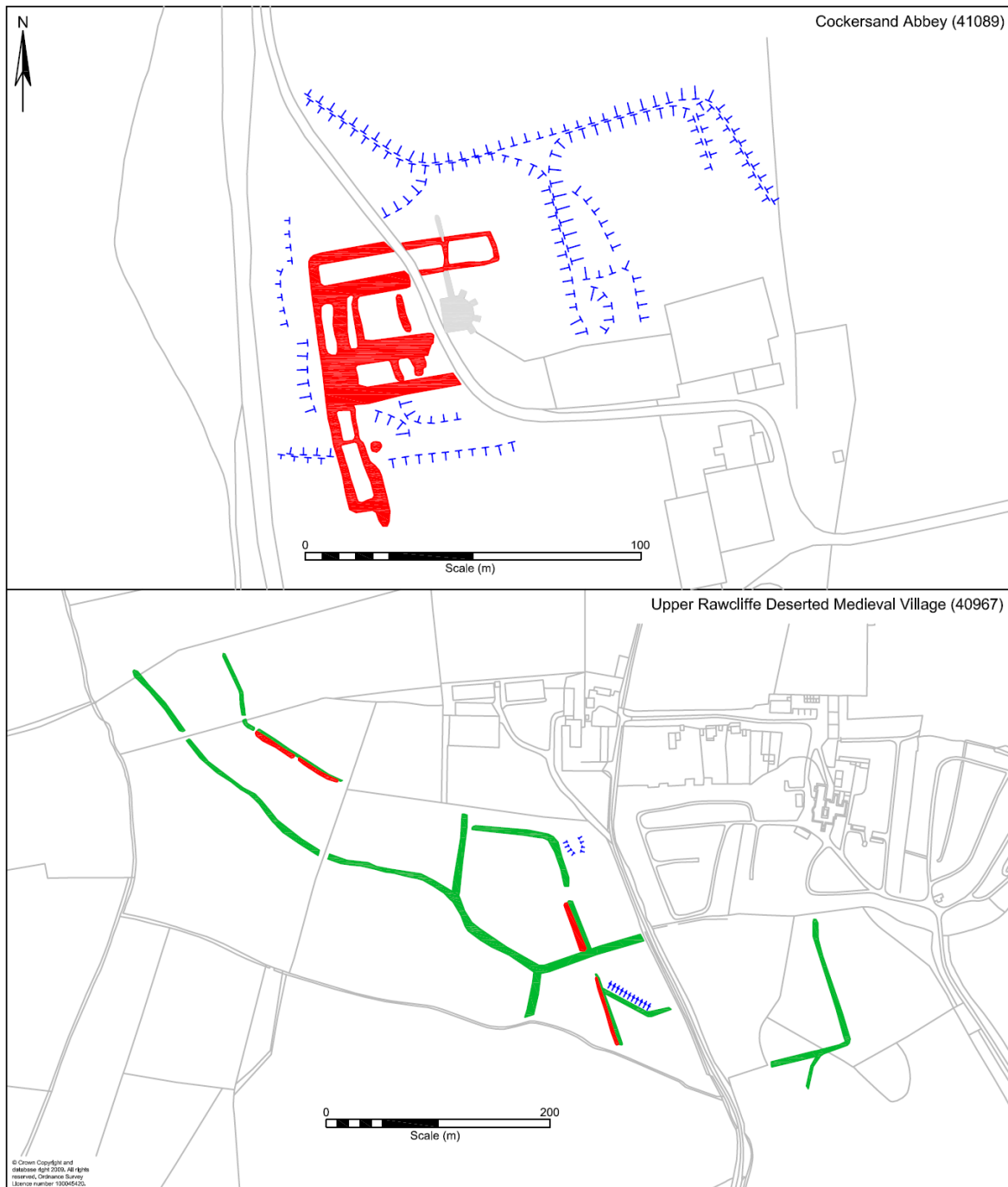


Fig. 7. Medieval Sites

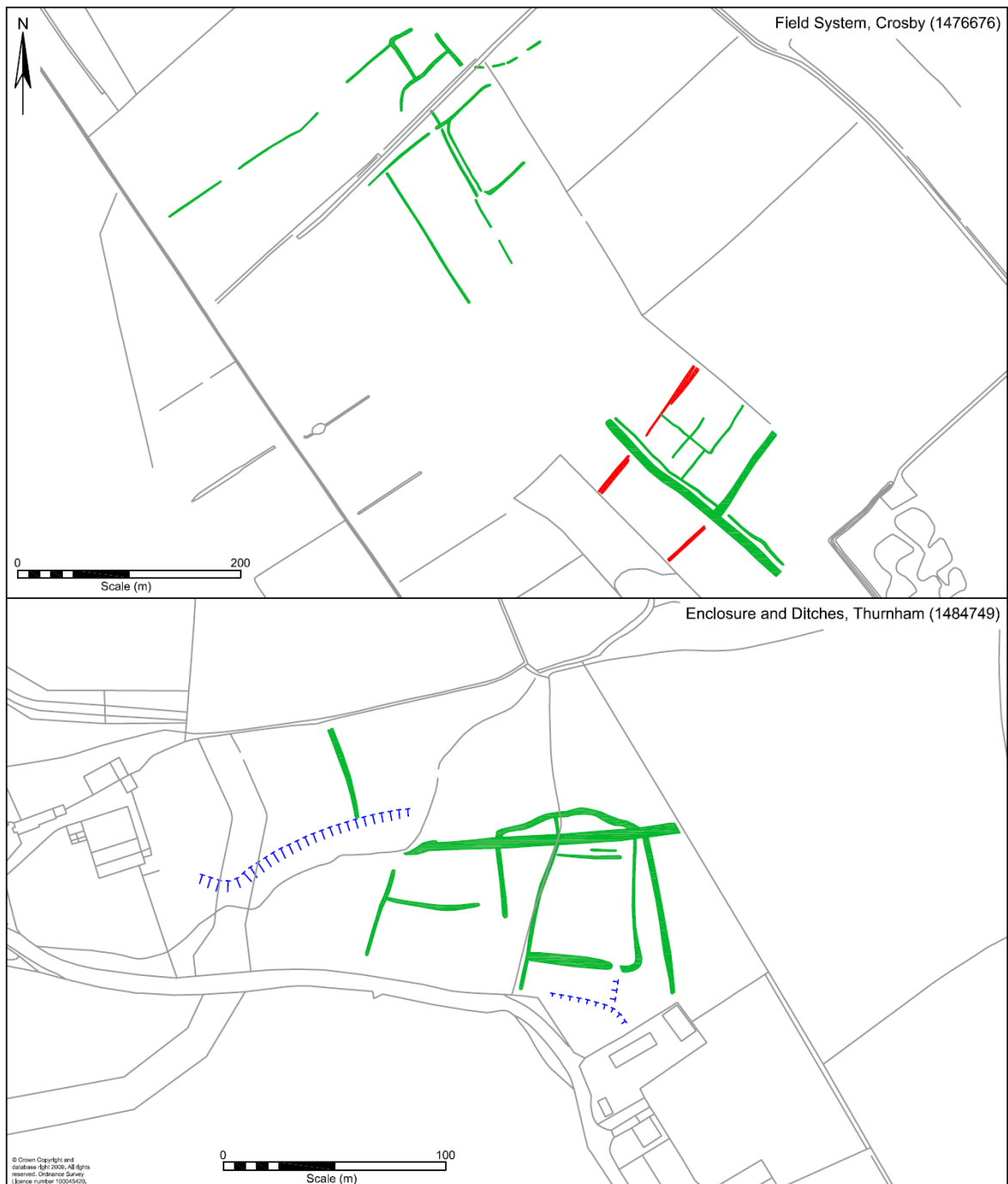


Fig. 8. Medieval/Post Medieval Sites

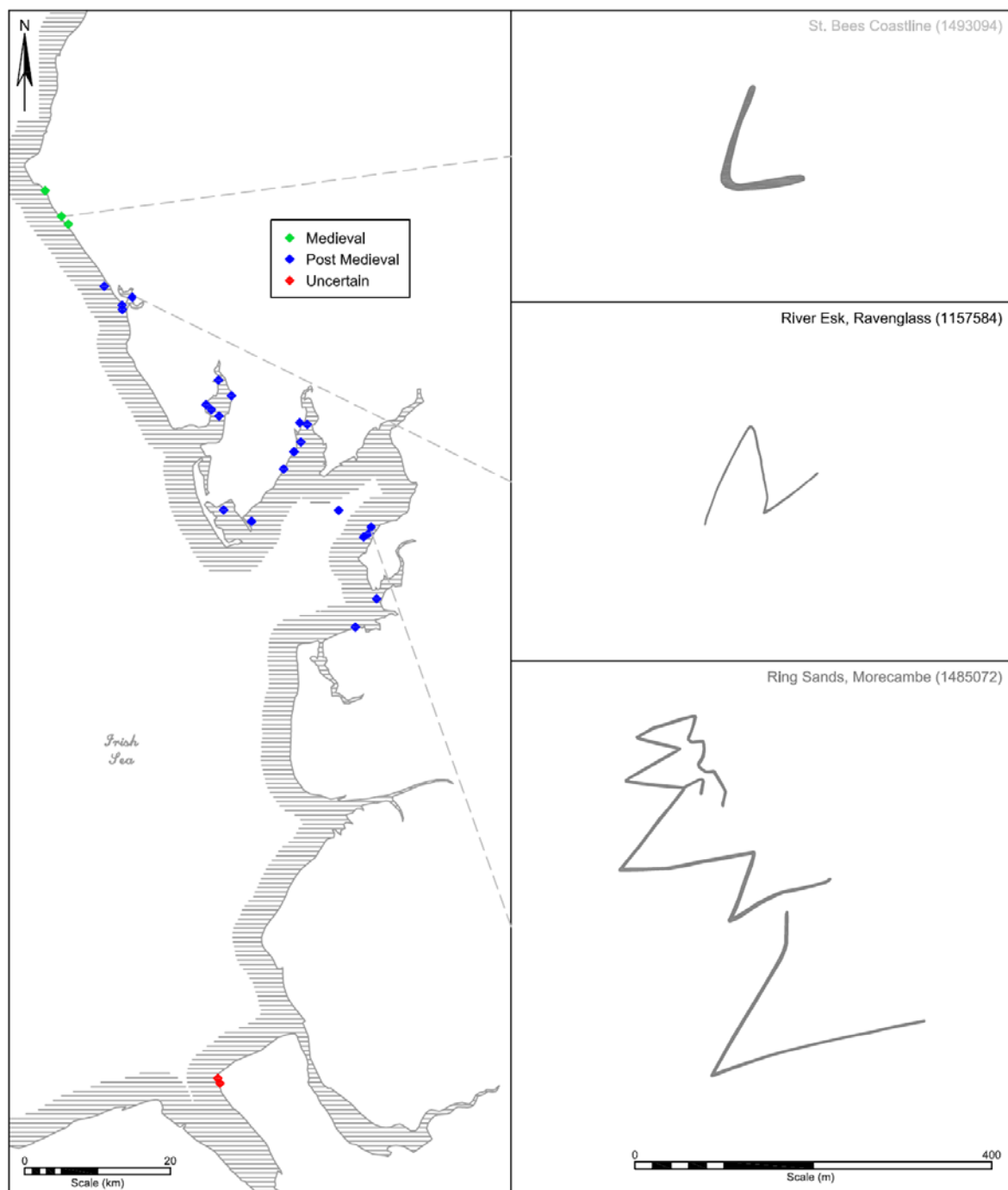


Fig. 9. Medieval/Post Medieval Sites: Fish Traps

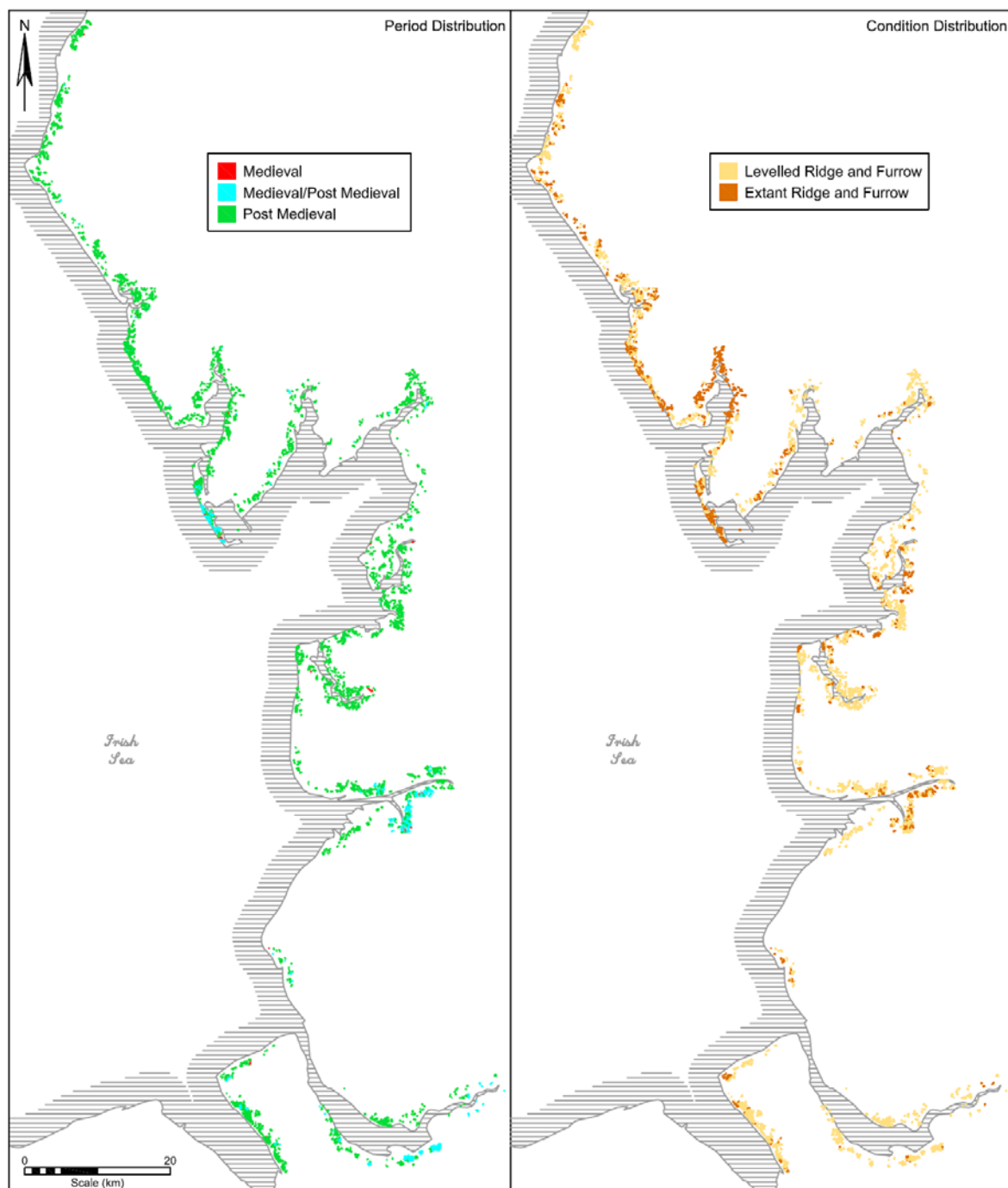


Fig. 10. Medieval/Post Medieval Sites: Ridge and Furrow

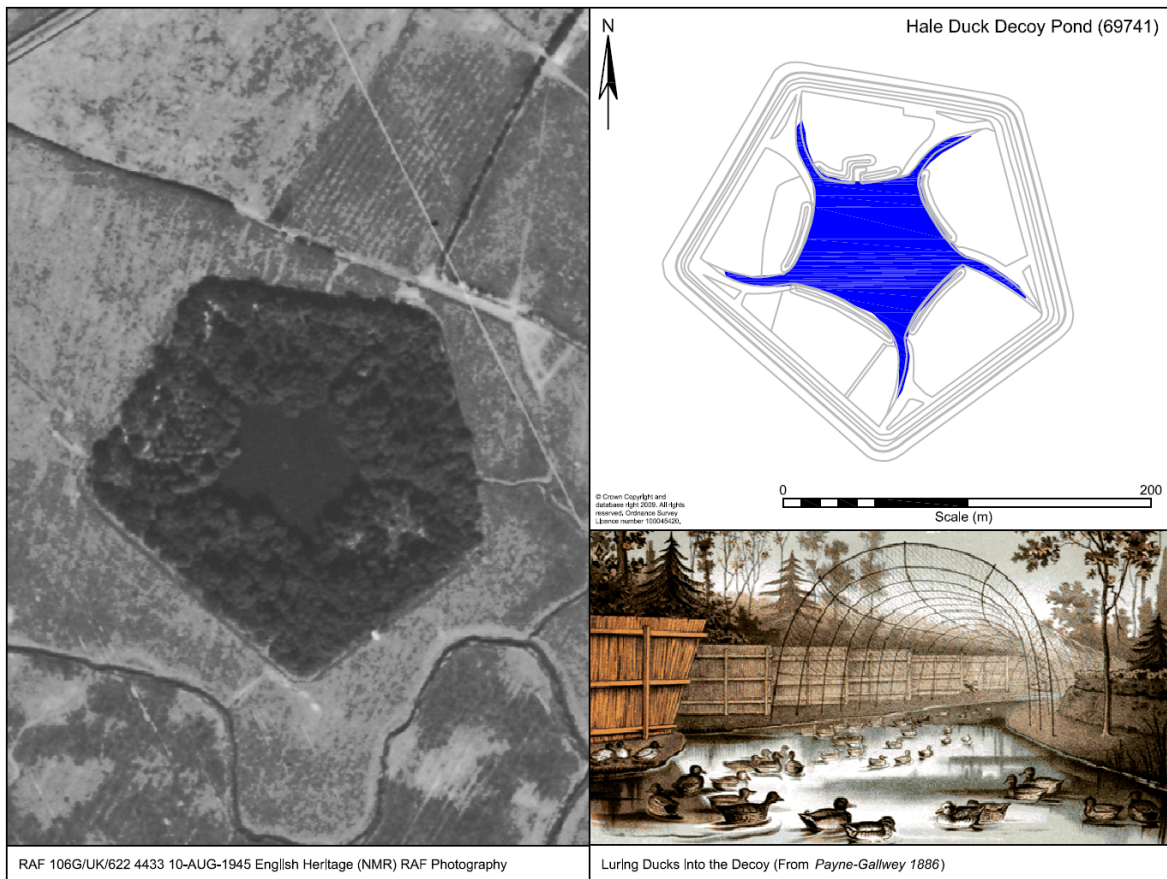


Fig. 11. *Post Medieval Sites: Duck Decoy*

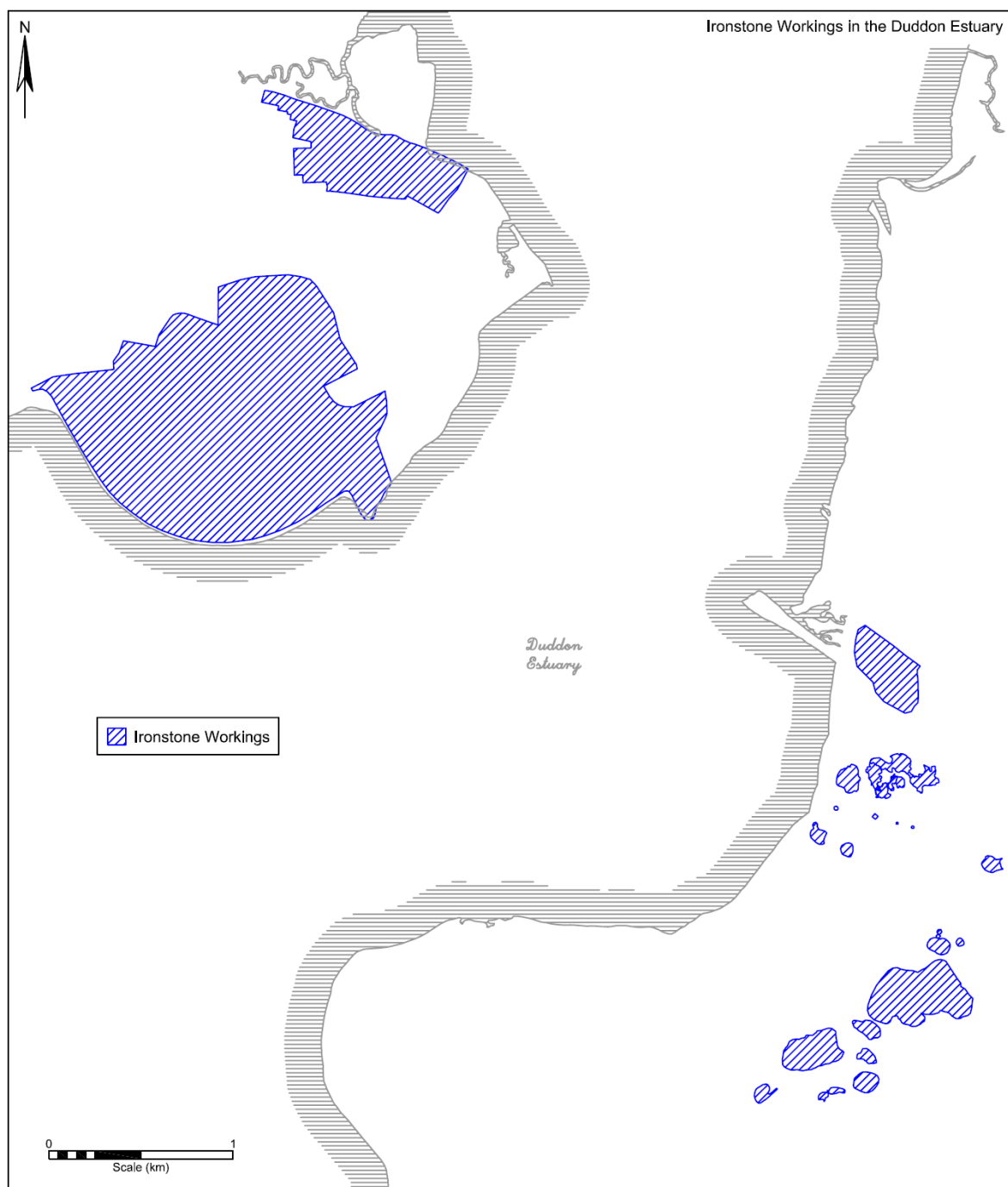


Fig. 12. *Post Medieval/20th Century Sites: Industrial*



Fig. 13. Military Sites: First World War

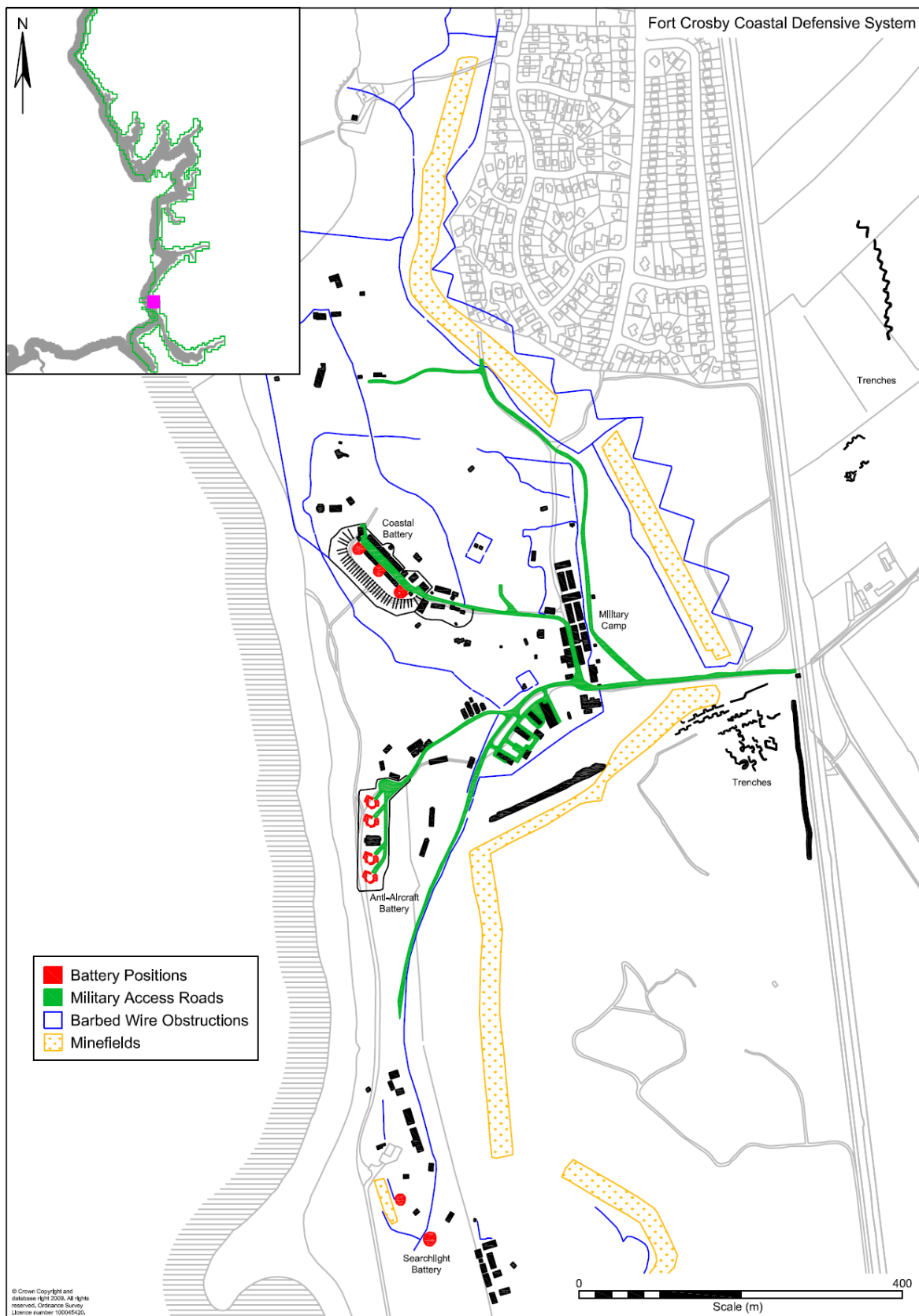


Fig. 14. Military Sites: Coastal Defence



Fig. 15. Second World War: War Production Factories

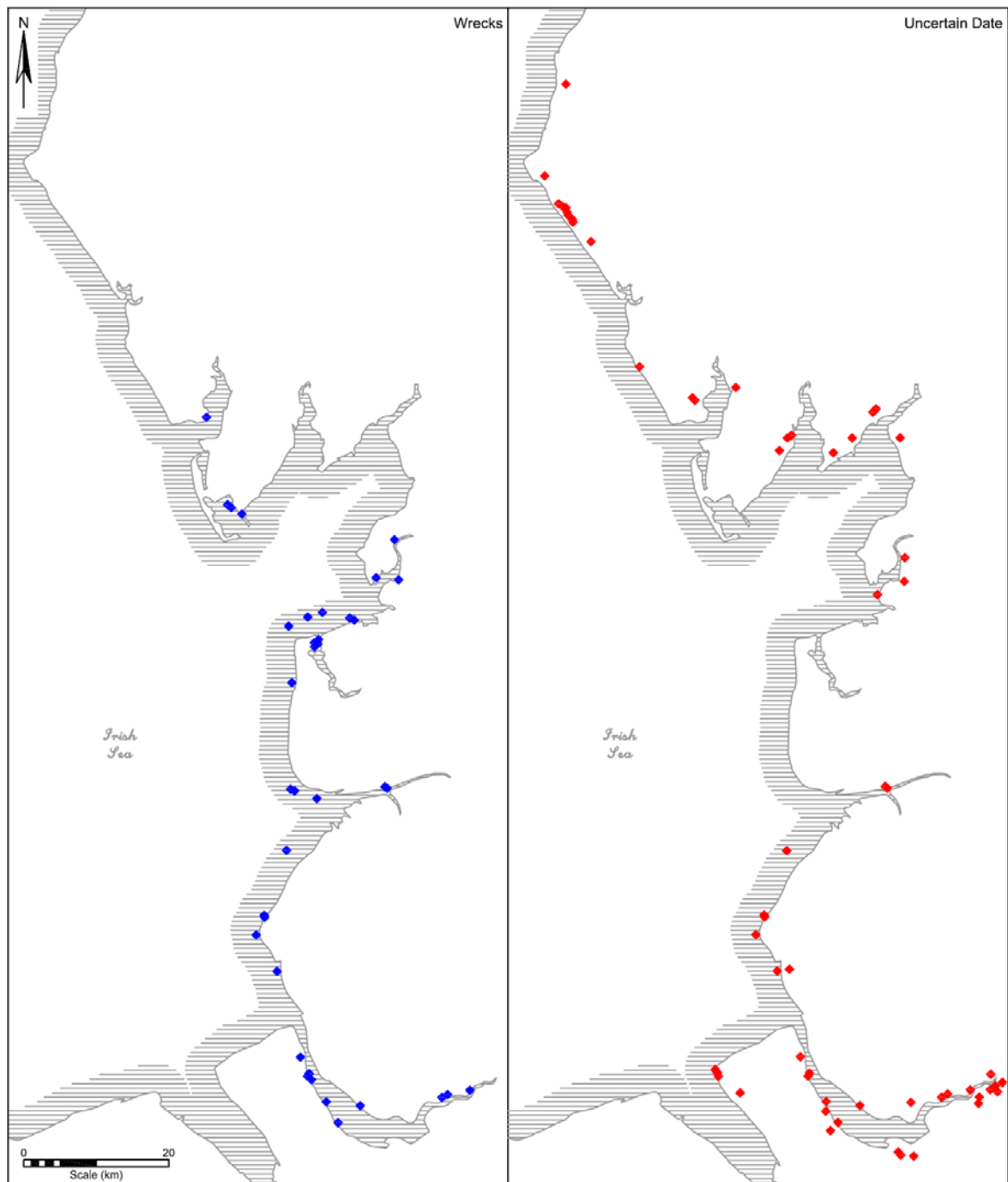


Fig. 16. Wrecks and Sites of Uncertain Date