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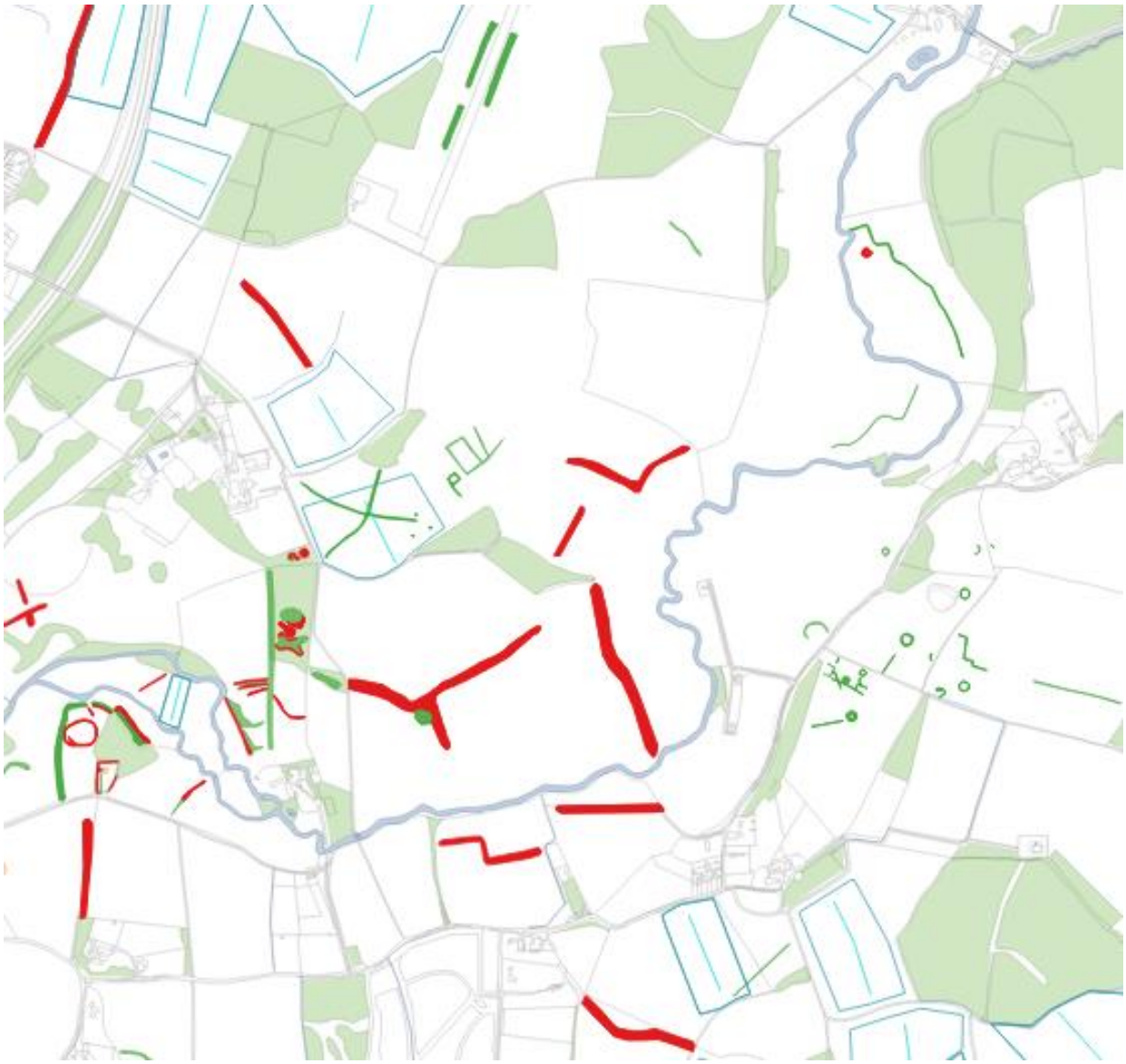
Research Report Series 85/2024

A10 / A120 Corridor, Herts

Aerial Investigation and Mapping

Cara Pearce



Volume 1 of 1

A10 / A120 Corridor, Herts

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Cara Pearce

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Summary

The A10/A120 Corridor Project sought to map and record archaeological features from aerial sources across an area of approximately 90sq km. Features from the prehistoric period to 20th century were mapped and 474 records were either added or extensively edited in the Hertfordshire Historic Environment Record (HHER); 383 records were newly created (MHT39927-40305, MHT40314-19) and 92 records were amended. Highlights include the identification of a length of Roman road partially visible as an earthwork which is recommended for assessment for scheduling and the identification of the level of earthwork preservation, in certain locations, in a landscape thought to be extensively ploughed and devoid of upstanding remains.

The project area has been previously assessed as part of a National Mapping Programme (NMP) pilot project in the 1990s. This report identifies that the outputs of the original pilot project are not suitable for modern heritage protection needs. The project identifies that there are a range of contributions a ‘remapping’ project might make to the archaeological record: in particular the wide scope of current guidance for Aerial Investigation and Mapping (AI&M) projects; the contributions of newer source types (orthophotography and lidar); the metric / measurable nature of the resultant mapping and the systematic system of specialist recording to enhance the Historic Environment Record (HER). Of note is the contribution of the Cambridge University Collection of Aerial Photography (CUCAP) archive to the original pilot project and how lack of access to this archive has impacted the project results.

Contributors

Digital mapping, interpretation, transcription and reporting was undertaken by Cara Pearce of MOLA. Additional contributions were made by Kit Ackland, John Layt, Rebecca Oksman-Sword and Alice Short, all of MOLA. Training opportunities were provided to Hugo Kesterton and Tremaine Edmonds through the life of the project. Figures and illustrations were produced by Rebecca Oksman-Sword.

The Project Assurance Officer was Sally Evans, Aerial Survey Manager and quality assurance for the initial phase of mapping and recording was provided by Fiona Small, both of Historic England.

Acknowledgements

The author would like to thank individuals and organisations who have provided assistance in the undertaking of this project: The Historic England Archive who provided the aerial photographic resources; Damian Grady, Historic England Aerial Reconnaissance Manager who provided specialist aerial advice and knowledge of the project area; Alison Tinniswood, Archaeological Advisor at Hertfordshire County Council who provided regional archaeological knowledge and advice on future development in the project area; and Mark Landon and Rebekah Hart, Historic Environment Record Officers at Hertfordshire County Council for technical support with recording.

Front cover image: Sample of project mapping centred on the manorial site of Thundridgebury. [].

Archive location

Historic England Archive, The Engine House, Fire Fly Avenue, Swindon, Wiltshire, SN2 2EH

archive@historicengland.org.uk

Hertfordshire HER - All reporting recorded under the project coded EHT8943

Date of survey/research/investigation

The mapping was carried out between August 2021 and May 2023. The report was completed in November 2024.

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Introduction

The *A10 / A120 Corridor Aerial Investigation and Mapping (AI&M)* project was carried out by in-house specialists at MOLA Stansted (formerly L – P : Archaeology) and was grant funded by Historic England's Heritage Protection Commissions Programme.

The project covers an area of 90sq km located within East Hertfordshire (Fig. 1) and was selected as an area which may be subject to relatively intensive development pressure over the next five to ten years due to residential and infrastructure expansion. The project area has been the subject of a detailed aerial assessment, the *Crop Marks in Hertfordshire Project* (Fenner 1992), undertaken by the Royal Commission on the Historic Monuments of England (RCHME), which was a pilot/precursor study to the National Mapping Programme (NMP).

The aims of the *A10 / A120 Corridor AI&M* project were two-fold. Firstly, it aimed to enhance the known archaeological record of the project area to promote a better understanding of the historic landscape, which would support robust heritage protection decisions related to proposed development and countryside stewardship. Secondly, to assess how suitable the original mapping might potentially be for informing planning advice, which is reliant on accuracy and sufficient information to assess archaeological potential. This would identify the contribution that changes in methodology, scope and available resources for aerial investigation and mapping surveys, between the pilot project and the current AI&M projects, have made to the resultant data sets.

This report presents the archaeological baseline as understood from the transcription of the available aerial resources, identifying any highlights or contributions to the known archaeological resource discovered through the project. It then moves to look at the differences between the results of the *Crop Marks in Hertfordshire* project and the *A10 / A120 Corridor AI&M* project noting the contributions of each project to the archaeological resource focusing on scope, technology, available resources, recording and accessibility of the record and provides an indication as to the value of potentially 'remapping' earlier projects.

For ease of reference, the *Crop Marks in Hertfordshire Project* is referred to as *CiH,* and this project is referred to as *A10/A120 Corridor* throughout the report.

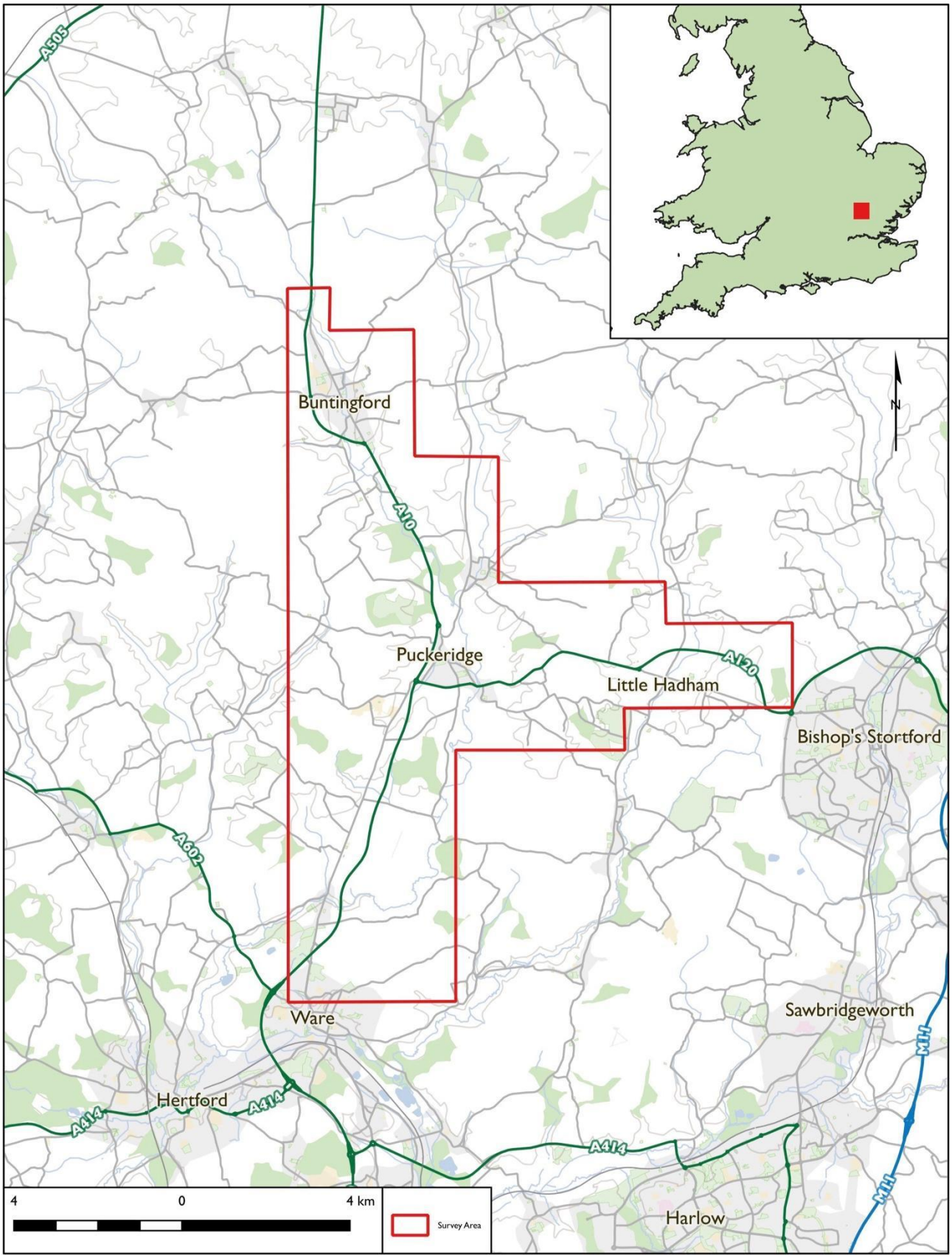

Figure 1: Project Area concentrated along the A10 (broadly north to south) and A120 (east from the A10 towards Bishop's Stortford). [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Project Area

The project area is situated in East Hertfordshire and located along the A10, running from Ware in the south to Buntingford in the north with a spur following the A120 east-west between Puckeridge and Bishop's Stortford (Fig. 2). This project covers an area of some 90sq km and is predominately located on chalks with the eastern limit reaching towards the heavier clays around Bishop's Stortford. The project area was split into two Blocks (1 and 2) to enable efficient data collection and management throughout all stages of the project.

At the project design stage for the *A10 / A120 Corridor* project, extensive development to the north and west of Bishop's Stortford was underway (just beyond the eastern project boundary), the A120 bypass scheme was due to commence archaeological works, and large residential development described as 'land north of Ware' (partially within the southern boundary) was in the earliest of planning stage, as well as a residential development at the construction phase in Buntingford. During the completion of this project, commercial archaeological works for all these areas have been undertaken and any initial reporting available from these works have been included, where appropriate, to inform the archaeological baseline.

Current land allocations, as defined by East Herts District Council (EHDC 2018), are predominately located within the settlements along the northern bank of the River Stort, with Bishop's Stortford rapidly expanding. Following these developments and considering the barrier to expansion provided by the Stort, it is possible that the next phase of development will involve Green Belt roll back towards Much Hadham in one direction and will be located along the A10 in the other. There is also potential for acceleration north from Ware and/or south from Buntingford, with expansion of Standon and Puckeridge. This would provide access to the M11/M25 infrastructure (and by association Stansted airport) and is the only major north south route from the M25 which is not protected by Green Belt. The A120 bypass has created pockets of land which are likely to be subject to rapid infill.

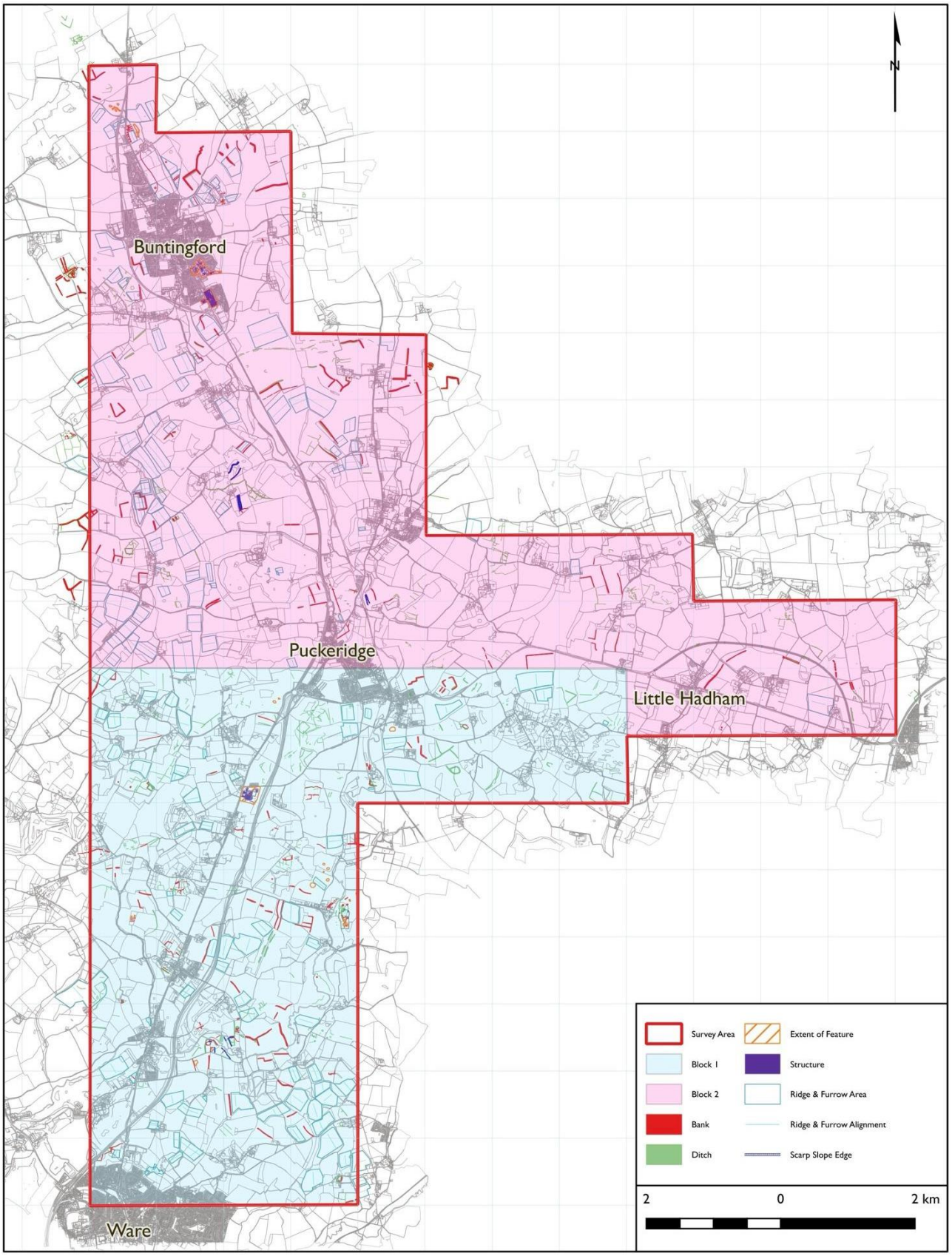

Figure 2: Project Area - detail. Block 1 data collection comprised broadly the southern part of the project area whilst Block 2 data collection was undertaken across the northern and eastern parts of the project area. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Landscape character, geology and topography.

The landscape of East Hertfordshire is undulating, with low hills and numerous river valleys (Fig. 3). The two major river valleys in the district – the Lea and the Stort – lie just outside the project area to the south and east. Three tributaries of the Lea; the River Rib, the River Quin and the River Ash, are within the project area, both running broadly north - south, and their presence has impacted the topography and geology of the area.

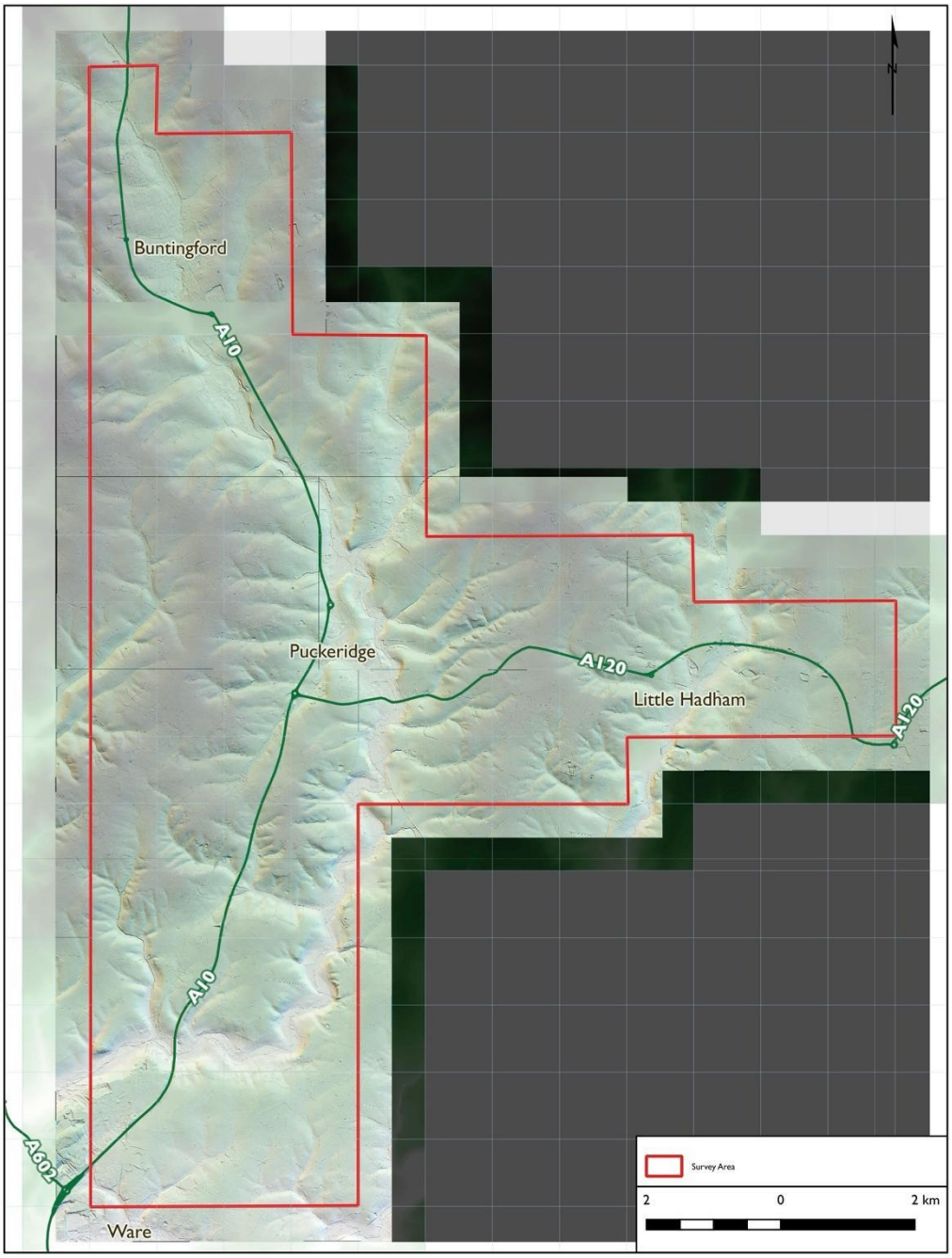

Figure 3: Project Area - Digital Terrain Model (DTM). A major landscape feature of the project area is the valley of the River Rib, which runs broadly north to south in the west of the project area through Buntingford, Puckeridge and Ware. The valley of the River Ash runs through Little Hadham in the east of the project area. [Map produced by MOLA. Lidar Data © Environment Agency].

The land use of the project area is primarily arable agriculture, with no large urban areas, the largest settlements being the small market town of Buntingford and the clustered villages of Standon, Puckeridge and Braughing. The project area is classed as grade 2 (very good quality) or 3 (good to moderate quality) agricultural land by Natural England and fields are enclosed with substantial hedgerows (Natural England 2010). These grades reflect the moderate to minor limitations which affect crop yield, cultivation and harvesting across the land. Arable farming in the area is primarily cereal cultivation which provides favourable soils for cropmark development. The area is also punctuated by small managed areas of woodland, which further provides a protected environment for the upstanding remains of earthworks which have largely and repeatedly been ploughed out across much of the agricultural landscape across the project area. As a result, the project area has often been considered fairly poor for earthwork survival.

The bedrock geology in the northern part of the project area is mainly the Lewes Nodular Chalk Formation and Seaford Chalk Formation, formed during the Cretaceous period, with superficial deposits of glacial till – Lowestoft Formation – Diamicton (Fig. 4) (BGS 2024). The bedrock geology changes to the Thanet Formation clay, sand and silt in the southern part of the study area to the south of Standon and the west of Much Hadham, with areas of London Clay around Little Hadham. The main variation in the superficial geology is in the river valleys, with deposits of alluvium in the valleys of the Rib, Quin and Ash, along with larger areas of head deposits (gravel, sand, silt and clay) spread more widely within those valleys. Glaciofluvial deposits of sand and gravel are also present, primarily within the valleys of the Rib and Quin.

The general undulating nature of the topography in addition to the underlying geological deposits have impacted cropmark and earthwork survival across the project area. A large proportion of the cropmarks recorded as part of the project were more clearly visible on the higher elevations located upon the glacial tills, which are typically not favoured for cropmark production due to poor soil drainage and higher moisture retention, and are only conducive to cropmark formation following severe warm and dry seasons. Cropmarks were less often recorded, though not entirely absent, on the alluvial and head deposits within the river valleys, whereby thicker overlying hillwash and higher moisture retaining deposits are less likely to provide the conditions favoured for producing distinct cropmarks, in that archaeological deposits were buried deeper beneath the ground surface and did not affect shallower plant root growth.

Intensive arable agriculture has had a major impact on the archaeology of the area, with the only recent landscape history of Hertfordshire identifying the impact of agriculture, particularly in the more fertile river valleys, as a major threat to the buried archaeological resource (Rowe & Williamson 2013, 84).

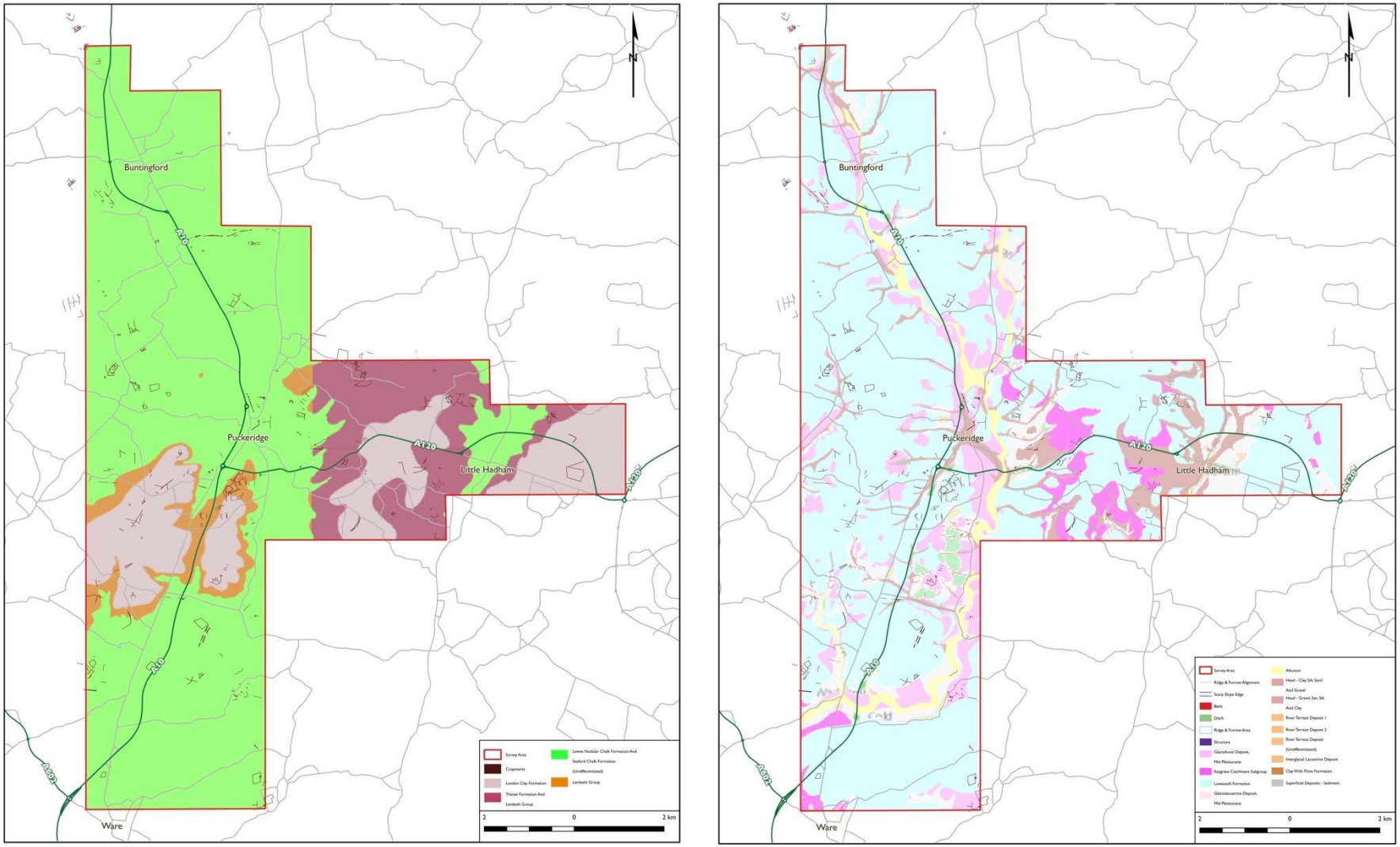

Figure 4: Geological deposits underlying the project area depicting bedrock (left) and superficial deposits (right), showing the distribution of cropmark features identified during the A10/A120 Corridor project. [Map produced by MOLA. © Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Archaeological Background

The known archaeological resource of the project area has an emphasis towards the Late Iron Age/Roman and medieval periods, with a notable dearth of records in Hertfordshire's Historic Environment Record (HHER) of monuments (MHT) dating to the Middle Bronze Age, Middle Iron Age, and Early to Middle Saxon periods. It is important to note that the project area has not, until the last five years, been subject to intensive development requiring archaeological investigation and reporting.

A major concentration of Bronze Age barrows was identified by the *Crop Marks in Hertfordshire* (CiH*)* Project and mapped on Burleigh Common (MHT 2179;7517;7518;7520;7521;7522;7523;7524), directly east of Thundridge. Beyond this there are no known significant concentrations of prehistoric funerary monuments in the project area and its immediate environs. Known Bronze Age settlement activity within the district is primarily well outside the project area, and almost exclusively late, such as at Foxholes Farm (Partridge 1989) and Mangrove Road, Hertford (Boyer 2005; Short 2022) or just outside at Thorley (Last & McDonald 2004) and Hazel End, Bishop's Stortford (Bush 2017), and this generally takes the form of unenclosed settlement defined primarily by pits and postholes. An exception is a recently excavated post-built roundhouse to the south of Bishop's Stortford (Headifen 2021) that is surrounded by a curvilinear enclosure, and there is some evidence to suggest that enclosure was more prevalent on the boulder clays (e.g. also at Hazel End) than gravel sites such as those in the Hertford area. An exceptional enclosed Middle to Late Bronze Age enclosed settlement is known from the wider region on clay at Stansted airport (Cooke *et al* 2008). A preference for high ground, specifically overlooking river valleys, can be noted for settlement archaeology of this period in east Hertfordshire, although the sample size is low.

Recent excavations at Park Farm Industrial Estate, Buntingford revealed an unenclosed Early Iron Age farmstead (Jones 2016), and a Middle Iron Age enclosure, while another enclosed settlement of Middle Iron Age date was present at Hare Street Road, also in Buntingford (MHT31116) (Clarke 2015). Middle to Late Iron Age settlement has been identified through excavation to the north-west of Bishop's Stortford (MHT31670) (Keir 2014) and along the new A120 Little Hadham bypass (MHT31708) (MHT30394) (Streatfeild-James 2016). There is broadly a transition towards enclosure in this region between the Early to Middle Iron Age, and what Middle Iron Age settlements are present in the known record tend to consist of enclosures surrounding single or a couple of ring-gully defined houses, with a less obvious correlation with landscape prominence. The example on the A120 bypass fits this model, as does the enclosure at Bishop's Stortford. Most Early to Middle Iron Age settlement sites in this part of Hertfordshire have been discovered since 2015, concentrated around urban development activity at Bishop's Stortford (MHT31668) (MHT31374) (MHT31622) (31670) (MHT39813) and Buntingford (MHT31116)

(MHT31164) (MHT31671) as a result of development-led commercial archaeology. While settlement size remains small, the landscape is likely to have been populated, at least sparsely with farmsteads at this time, in contrast to a long-held theory that the Middle Iron Age is 'missing' in Hertfordshire (see Thompson 2015, 117–164 for a discussion and a refutation of this). There is certainly a notable lack of known hillforts or large defended settlements in east Hertfordshire, with the closest example being just over the border in Essex at Wallbury Camp.

The project area follows two major Roman roads, with Ermine Street (now mainly followed by the route of the A10) running north–south and Stane Street (now mainly followed by the route of the A120) running east–west. The two do not directly intersect, but broadly meet in the Puckeridge/Braughing area, where the largest and most significant area of known archaeological remains in the project area is located. It is the site of a major Late Iron Age settlement, often considered to be an *oppidum* (Partridge 1981, 354), and a Roman roadside settlement/small town, with much of the area between Puckeridge and Braughing designated as a scheduled monument (NHLE1005249). Major inhumation and cremation cemeteries have been excavated at Mentley Lane and Skeleton Green (Anderson *et al* 2014), indicating the presence of a large population. The quality and diversity of material culture has led to the interpretation of Braughing as a trading centre in the Late Iron Age and Roman periods, with the River Rib used for transport of goods (e.g. Bryant 2007, 62–80). Thus, the project area is traversed by multiple likely important routeways active during this period.

Late Iron Age settlement, of considerably larger scale than the preceding Middle Iron Age farmsteads, is also present both north and south of Bishop's Stortford (Cox 2022; Headifen 2021). Both Ware and Bishop's Stortford (the southern and eastern extents of the project area) were also major Roman centres, with recent excavations at Grange Paddocks Leisure Centre in Bishop's Stortford revealing perhaps more significant settlement along Stane Street than originally expected, including cellared or sunken featured buildings and a large inhumation cemetery (Greef 2021). Further Roman settlement and industrial activity to the north of Stane Street was discovered during the A120 bypass excavations.

The known archaeology from the Late Iron Age and Roman periods in and around the project area dwarfs that of preceding periods, and this is not limited to settlement, with field systems uncovered at Buntingford (Clarke 2016; Jones 2015) and south of Bishop's Stortford (Headifen 2021; Short 2023). One definite Roman villa is known from the project area that is recorded in the HHER (Mentley Farm, Braughing (MHT4222)), with a further site of a possible high status Roman building recording to the east of Layston Church at Buntingford (MHT30366), in addition to Roman buildings recorded at the settlement at Braughing. Hadham Ware pottery is widely distributed regionally, and the Hadham kilns are within the project area, e.g. at Bromley Hall Farm, Much Hadham.

Ware and Bishop's Stortford were both Saxon settlements, and several villages (and parish churches) were Late Saxon foundations, but beyond that there is very little known Anglo-Saxon archaeology within the project area, and a particular absence of Early to Middle Saxon remains. It should be noted that Hertfordshire is not mentioned at all in the Middle to Late Anglo Saxon Resource Assessment for the recently published East of England Research Framework (Hoggett & Davies 2021). Documentary evidence shows that Braughing was a Late Saxon minster, serving a probable royal estate, and excavated evidence from Pentlows Farm revealed pits and postholes containing pottery and other finds spanning the 5th to 12th centuries AD, an unusual and exceptional find for the area (Powell 2013).

Both Ware and Bishop's Stortford, along with Buntingford, were medieval market towns of some importance, with many of the villages and parish churches throughout the project area also having medieval or Late Saxon origins (e.g. Westmill, Braughing, Standon, Little Hadham). Moated sites are widespread, mainly talking the shape of the classic rectilinear/square homestead moat, many of which survive as earthworks. Ridge and furrow is present throughout the landscape, often mapped as wider 'areas' in the HER, though preservation of earthworks is generally quite poor—a legacy of widespread ploughing (see e.g. the levelling of earthworks by 20th-century ploughing at Plashes Farm, Standon; Cox 1999). Below ground settlement archaeology of the period is generally within current urban areas and villages. Conjecture and/or documentary evidence suggests the presence of several deserted medieval villages, such as at Alswick and Corney Bury (Wyddial), but there is little archaeological evidence to support their existence. An exception may be Nobles Farm, Nasty, where earthwork enclosures and possible house platforms have been identified.

Evidence suggests that a settlement pattern emerged centring on river valleys and major routeways during the late Saxon and medieval periods. The boulder clay plateau is considered likely to have been uncultivated with settlements densely packed into the valleys with their well-drained soils and access to water sources (Rowe & Williamson 2013). Much of the clay uplands was still woodland at this time, with numerous deer parks, such as at Little Munden, Albury, Lodge Farm and Hadham Hall (both Little Hadham), and Standon Park. A process of 'colonisation' of the uplands occurred post-Norman conquest and continued throughout the medieval period, due at least in part of population pressures (*ibid*). Both enclosed and open field systems were utilised throughout the medieval period, with small fields prevalent in the river valleys. These small fields were eventually amalgamated with boundaries straightened in the 19th century to form the broad landscape pattern that is evident today.

Previous Aerial Survey

Hertfordshire was one of the first counties to be systematically assessed for archaeological features through aerial resources as part of the *Crop Marks in Hertfordshire* project. The work, initially undertaken in 1989 and completed in 1990–2, was a pilot of what was to become the National Mapping Programme (NMP), now Aerial Mapping and Investigation (AI&M) standards. Its scope was to identify archaeological features dating from the Neolithic to post-medieval period which were visible as cropmarks on aerial photographs. Archaeological features were identified primarily from specialist oblique photography (i.e. photography captured for archaeological purposes) and were sketch plotted at a scale of 1:10,000 (Fig. 5) (Fenner 1992, 23).

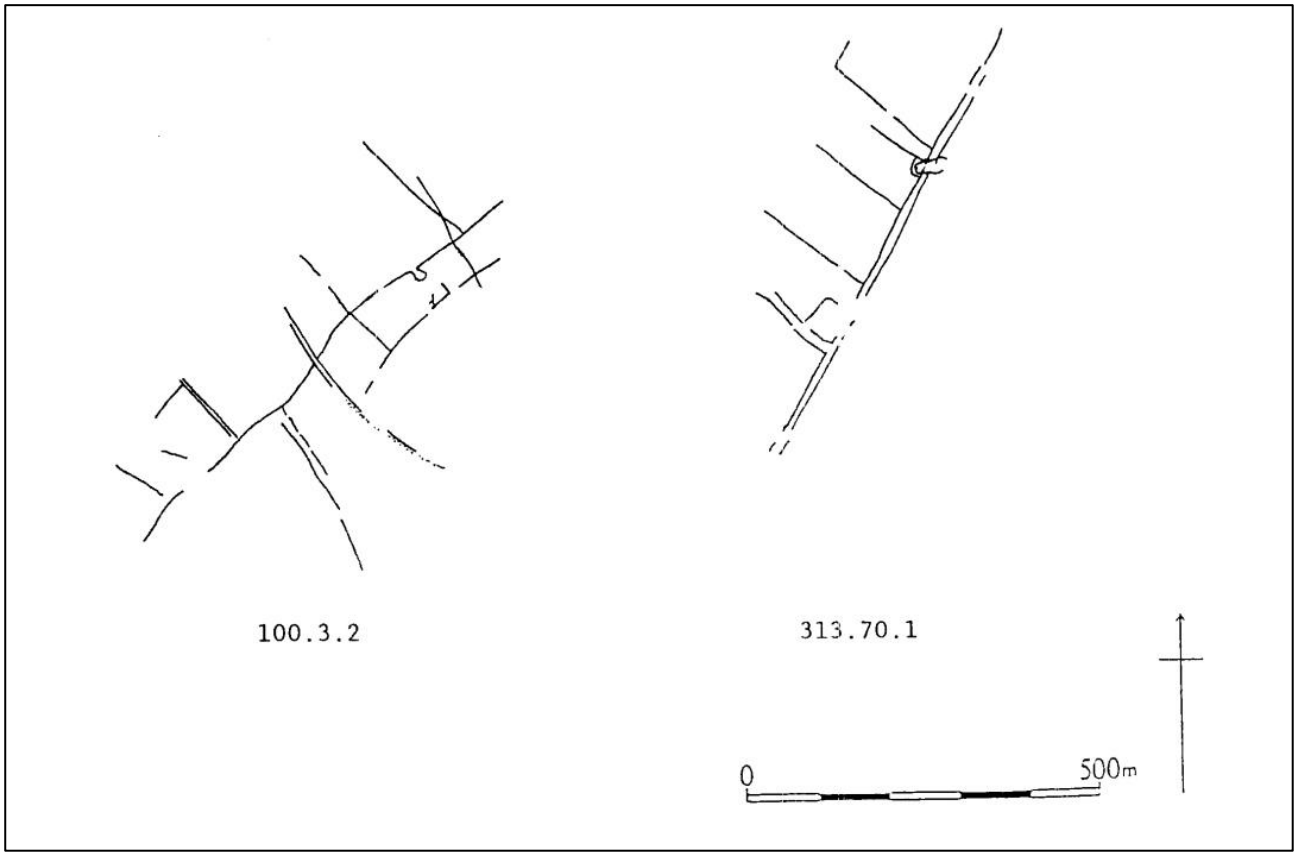

Figure 5: Example of the CiH sketchplot mapping – example mapping of field systems (fig 15) taken directly from report. [© Historic England]

The outputs from the *CiH project* are available on Historic England's Aerial Archaeology Mapping Explorer; these include the report and the vectorised hand-drawn mapping. The recording of archaeological features was undertaken within an early computerised database system, MORPH / MORPH2 which allowed for interrogation of the data based on categories such as morphology, date and certainty of interpretation. The *CiH project* also noted the factor of controlled airspace restrictions of two major airports; Luton and Stansted on the ability to carry out reconnaissance across the county. In particular the A10/A120 project area is still subject to various and complex restrictions, resulting in the

area undoubtedly being subjected to a lower level of reconnaissance than if the restrictions were not in place.

The HHER uses the data from the *CiH project* to inform the knowledge of the archaeological landscape of the region and has the paper mapping scanned and georeferenced as a raster layer within their GIS management system. Monument records have been created for a large proportion of the features identified in the original project, although this has been undertaken in a piecemeal fashion and the majority of the records are brief, unless added to or amended on the basis of research within the HHER or further archaeological work being undertaken at a site.

Hertfordshire County Council (HCC) has commissioned several high-level assessments (either monument recording or monument recording alongside basic single line transcription) from aerial specialists between 2000 and 2015 based on HCC supplied resources, such as aerial imagery from Bluesky Mapping and (later) Environment Agency lidar data and APGB orthophotography. The data gathered from these projects and records generated are considered considerably more reliable with the advantage of inherent spatial accuracy due to mapping from orthophotography and lidar sources.

Research Objectives

A series of aims and objectives for the project were set out using the East of England Regional Research Agendas (ALGAO East of England 2021), the Historic England Research Agenda (Historic England 2017) and the Historic England Research Strategy (Historic England 2016), and were based on the strategic needs with regards to archaeological planning.

The broad aims identified were as follows:

- To identify the nature of the archaeological landscape from the north of Ware to Buntingford and extending eastwards along the A120. There is a particular focus on the development of settlement patterns starting in the Roman period along Ermine Street and Stane Street.
- To provide an enhanced data set for the HHER in the recording of archaeological features identified through cropmarks, soilmarks, parchmarks, earthworks and structures. This will allow for better heritage protection through the active use of the data by Local Authority planning archaeologists.
- To provide a landscape narrative of the region which is inclusive of current intrusive research in order to bring together the wide range of archaeological data available for the region.

The above aims were based on current strategic needs of data within the HHER in order to assist curators in making complex planning decisions, and enable management of the archaeological resource through countryside stewardship. The current nature of the record, as produced through the *CiH project*, does not meet those needs as the data is based on a limited range of photography, is considered to be spatially less accurate than required, and does not hold additional data, such as the last date a feature is seen on photography, all of which negatively impact the ability to inform better planning decisions.

The project was proposed under the 2011 East of England Research Framework, which has since been revised and republished. However, much of the same themes were identified in the present, updated framework. It is worth noting that Hertfordshire is referenced at a lower rate to other eastern counties in the framework, which is partially representative of a comparative lack of large-scale development in Hertfordshire in the last 20 years, including a lack of big infrastructure projects, and the resulting dearth of major publications. Themes identified within the East of England Research Framework include:

- Establishment of projects working at a landscape scale rather than at the individual site level which would allow for ‘the chronological and spatial development of complex areas of palimpsest cropmarks to be analysed’.

- Continuation of NMP [now AI&M] projects as it is recognised that aerial photographs are a significant resource in the intensively arable region of the East of England.
- As the proposed project is situated in a landscape already assessed through aerial photography, it would be of value to further AI&M projects to identify the impact of methodological changes and quantify the impact of a wider range of resources to our understanding of the archaeological landscape.
- Assessing the contribution of lidar, Google Earth and other sources not previously assessed to a previously mapped landscape. The other sources may include photography held by HHER or additions to the HE Archive after the original mapping. This contribution will be assessed by the number of new features recorded from the above sources.
- Assessing how well-suited raster mapping with records created by non specialists is to heritage protection. This will be represented by the changes in locations of mapped features based on the more accurate rectification method available and the number of existing records amended.
- Aim to comment on the impact of post war agriculture on potential earthwork sites, which were unrecorded as part of the original NMP project.

Archaeological Scope and Methodology

Scope

The project scope covered the identification, transcription and recording of all features dating from the Neolithic to 20th-century military remains as identified through a range of aerial sources. This included features identified as cropmarks, soilmarks, parchmarks, earthworks and structures.

It was determined at the outset of the project, due to the project aim to compare the mapping to that of the *CiH Project*, that all features of archaeological origin would be mapped in detail. Not all features which were visible on 1st Edition Ordnance Survey (OS) mapping (or later) were transcribed, such as field boundaries. Certain classes of features that fall within AI&M scope were recorded, such as some types of industrial features or archaeological earthworks, or where features were visible as part of a wider complex of features not previously recorded on historic mapping sources. The one exception to this was to map the munitions factory at Barwick, which produced an updated archaeological description of the site and comment on its preservation as an earthwork.

The mapping of extractive pits was scoped out of the project as the landscape is not known to be industrial in nature and such features were considered to be of low priority for this particular AI&M project and are not currently recorded in the HHER.

Sources

Sources assessed by the project comprised all readily available sources of physical aerial photography including the HEA, HHER and Hertfordshire Archives and Local Studies Library. Digital photography held by HEA and the HHER was also assessed alongside sources of photography such as orthophotography supplied to HE through Aerial Photography for Great Britain (APGB) agreement by Next Perspectives, Google Earth imagery and Bing Map imagery.

All physical imagery available to the project was viewed in person, under magnification and stereoscopically, to aid in the identification of possible earthworks. Any frames where archaeology was identified were scanned at a resolution of 600dpi for mapping purposes.

Digital borne imagery was viewed in GIMP (GNU Image Manipulation Program), which allowed for changes in levels and saturation of colour bands in imagery to visually enhance features for mapping.

Historic England Archive

A total of 1,835 photographs across the area were identified from the Historic England archive, inclusive of vertical, oblique and digital imagery.

Hertfordshire County Council

HCC had 166 photographs identified across the project area, of which 79 were accessible to the project, owing to restrictions in place as a result of the Covid-19 pandemic. The HHER holds a series of orthophotos in its HER GIS environment. Mapping shapefiles produced by the project were added to the HHER GIS at the end of the mapping stage and any transcribed features were amended on the basis of further information provided by the available orthophotography,

Cambridge University Collection of Aerial Photography

The CUCAP archive is currently closed and not able to loan material for the project. The online catalogue reveals that a total of 136 photos covering the project area are held by the archive. Of this 16 were available to view as low resolution thumbnails via the website and none were available for mapping purposes.

Lidar

Lidar tiles of 1m spatial resolutions were obtained from the Environment Agency (part of DEFRA) for the whole site and for 50cm across the majority but not all of the site. These were merged into manageable data parcels in QGIS v3.22 and then processed using the Relief Visualisation Toolbox plugin directly in QGIS. The primary visualisation used for this project was 16-direction hill-shade supplemented with sky-view factor images and open-positive visualisations (Zakšek, Oštir and Kokalj 2011; Kokalj and Somrak 2019). The combination of multiple visualisations enables better differentiation between the identification of archaeological and topographical or geological features within the dataset.

Methodology

Rectification

Images identified for transcription were scanned at a high resolution and rectified using Aerial v5.36, with 1:1,250 OS MasterMap vector background mapping and 5m terrain model (ASCII) for accuracy. The acceptable tolerance for rectification of aerial photographs identified within the AI&M guidance is normally within ±2m of the source used for control. No rectification used in this project has a greater error tolerance of ±1m. The only examples where the accuracy was not possible to assess were in locations where the use of height data was inappropriate, for example against road embankments or similar large features post-dating the imagery to be rectified.

Images which were solely for the purpose of identifying the location and orientation of field of ridge and furrow when visible as cropmarks were georeferenced directly in QGIS, using the georeferencer tool, using a Helmert transformation to geolocate the imagery rather than georeference. The same methodology was used for imagery taken from Google Earth or similarly web derived sources of orthophotography. These images were downloaded at the highest possible resolution for use in the project. They have already been processed

and rectified, therefore only requiring a creation of coordinates. Testing of accuracy against the same images rectified in aerial showed minimal difference and was deemed appropriate in these conditions only.

Mapping / Transcription

Transcription of archaeological features was undertaken using QGIS v3.22 which allowed for background mapping sources (including historic mapping), processed lidar tiles, orthophotography and the rectified imagery all to be held in the same mapping environment.

Three shapefile layers were created for the transcriptions, one for mapping polygons, which comprises the majority of the features, a second for line features and a third for the monument polygons defining the extent of individual monument records (Fig. 6). Each shapefile layer had an attribute table created to record monument types, monument descriptions and mapping sources. This attribute data conforms to AI&M standards, and examples of mapping files and attribute data are provided in APPENDIX 1. Monument polygons were used to define the extent of a feature for recording purposes and had attached HER/NHLE number.

All features were mapped in accordance with Historic England Aerial Investigation and Mapping Standards and Guidelines (Historic England 2019a) and technical specification (Historic England 2019b).

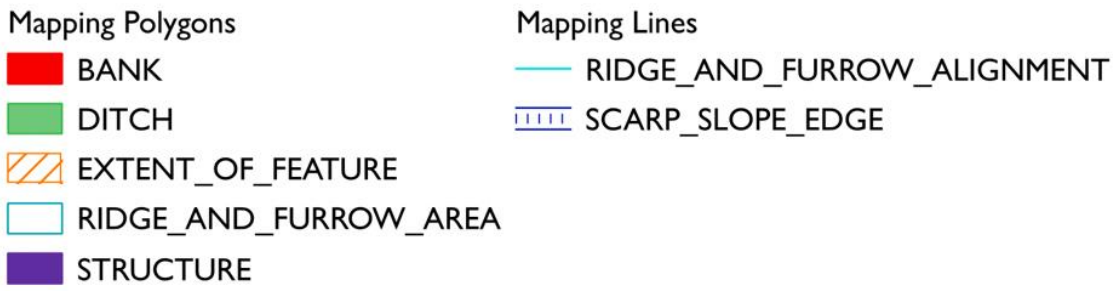

Figure 6: Mapping conventions used in the A10/A120 Corridor, Herts project

Recording

The project recorded archaeological sites and features identified in the mapping directly in the HHER, using HBSMR, an access derived database connected to ArcGIS. The mapping shapefiles produced by the project exists in the HHER GIS as two separate layers which sit alongside other aerial mapping layers produced by other mapping projects in Hertfordshire. The monument polygons are replicated within HBSMR tying the textual record to its geospatial location. The exception to this approach is where for large areas of ridge and furrow, the monument polygon has been created for HE purposes to create a consistent data set with other AI&M projects. This is not in line with HHER recording and

mapping standards and so a multipoint identifying the centre point of each field of ridge and furrow within a monument polygon was used.

Archiving

An event record was created for the digital transcription of the project's mapping within Hertfordshire Historic Record's Historic Buildings, Sites and Monuments Record (HBSMR) database; EHT8943, A10/A120 Corridor, Herts Aerial Investigation and Mapping Project. This is linked to all the relevant monument records.

These monument records will be available to view via Hertfordshire County Council's Historic Environment Record Viewer (https://www.hertfordshire.gov.uk/services/recycling-waste-and-environment/historic-environment-archaeology/hertfordshire-historic-environment-record.aspx) and also via the online Heritage Gateway Service (https://www.heritagegateway.org.uk/gateway/advanced_search.aspx).

Digital mapping will be made available to view via Historic England's Open Data Hub online resource, via the Aerial Archaeology Mapping Explorer (https://historicengland.org.uk/research/results/aerial-archaeology-mapping-explorer/) and this report will be accessible via Historic England's Research Reports search page (https://historicengland.org.uk/research/results/reports/).

The project will be uploaded to the Online Access to the Index of Investigations (OASIS V) reporting resource (https://oasis.ac.uk/) and the OASIS ID for the project is molastan1-527527. Through OASIS the report will be made available for public viewing in the Archaeology Data Service (ADS) library (https://archaeologydataservice.ac.uk/library/).

Chronological Summary of Results

Prehistoric

A general lack of prehistoric features was noted but a small number of Bronze Age round barrows have been identified and mapped as part of this project. One of the main contributing sources for the identification of new features during the *A10/A120 Corridor* project was the Environment Agency lidar, and no earthwork features of this period were identified. This is likely due to the lack of ancient woodland in the region which in other areas of Hertfordshire serve to protect earthwork features, while the rich arable history from the medieval period onwards may also have truncated and possibly levelled above ground features.

Mapped round barrows were typically situated on the higher ridges overlooking the river valleys, and were identifiable as complete or partial ring ditches which on average measured between 12m and 15m in diameter and c.1m in width. The majority of these features were isolated with the exceptions being the Burleigh Common grouping and a small linear arrangement of barrows to the west of Westmill. All examples identified during the project were visible as cropmarks on aerial photography with the exception of two which were visible as earthworks on lidar and two examples as excavated evidence.

As a general recording rule within the HHER, the majority of round barrows within the study area were recorded as ‘ring ditch’ with the interpretation of round barrow described in text. The same monument type was used to record roundhouses, again with the in-text description identifying features as roundhouses. This recording rule has been followed in order that the character of these monuments is not assigned in a definitive nature in the absence of ground-truthing such features. However, the A10/A120 Corridor project sought to separate out the two monument classes where identified as part of the project, in order to aid in the identification of patterns of activity and separate funerary and settlement activity classes.

Late Iron Age–Romano British

The project area is characterised by Ermine Street (MHT9271) and Stane Street (MHT4680) which appear to broadly meet at Puckeridge and formed the spine of the project area. The project aimed to identify any settlement patterns or roadside activity associated with these routeways.

The main Late Iron Age settlement within the project area is the large unenclosed settlement between Braughing and Puckeridge which later became a Roman town (MHT1099) (MHT30708). The project identified smaller isolated areas of likely Iron Age activity which predominantly consisted of single enclosed roundhouses, such as that to the north of Wellpond Green (MHT39999) or short stretches of sinuous ditches, likely

representing later prehistoric tracks. One example of a substantial trackway, interpreted as being Iron Age in date, was identified in the north of the project area running east–west between Dassels and Westmill (MHT224), although a note of caution is raised as the route leads directly to the road at Westmill. There is known sporadic Roman settlement, identified through excavations, along the A120 between the Roman towns at Bishop's Stortford (outside the project area to the east) and at Puckeridge. There is no known Roman settlement activity alongside Ermine Street barring the major settlements at Ware and Puckeridge, although this may be in part to the development of the later small villages and hamlets along the routeway truncating and Roman or earlier remains.

Very little evidence of the known settlements is visible through aerial sources, likely due to the nature of the geological deposits in these areas. Reporting from excavations, alongside geology mapping, shows the superficial deposits in these locations to be Head or alluvial in nature and in some places substantial depths of colluvium were recorded masking archaeological features. APBG photography taken pre-harvesting of the crop shows the excavations underway as part of the A120 bypass, and demonstrates how the continuation of, in some cases, substantial archaeological features are not visible beyond the limits of excavation (Fig. 7).

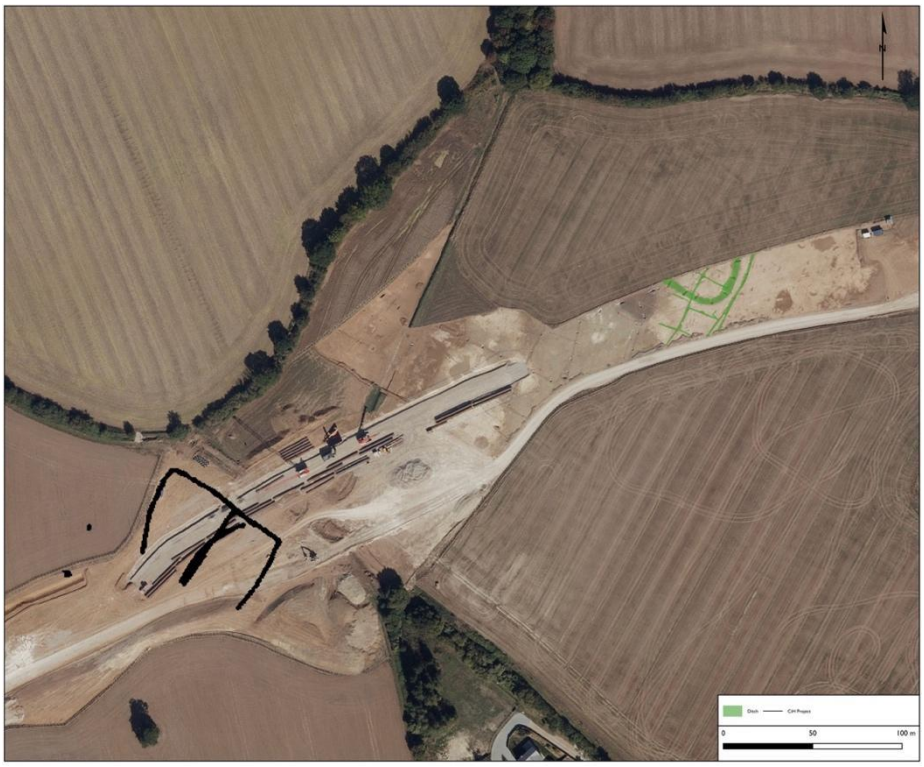

Figure 7: Area of intensive Roman activity (ditches) mapped from imagery of excavations at A120 bypass (green). Ditches mapped by the CiH project are recorded to the southwest (black). Note excavated features not clearly discernible in imagery were not mapped, including part of a cemetery and a Roman corn dryer. [Imagery © Next Perspectives APGB Imagery 14-SEP-2019].

Roads

Short stretches of Roman roads are visible as either cropmarks, soilmarks or in some cases earthworks in the centre of the project area. These in combination with field boundaries and roads have preserved the network of major Roman Roads in the area.

The majority of the route of Ermine Street is fossilised in the north–south roads to the west of the A10 along Hare Street, taking in the villages of Thundridge, Wadesmill and High Cross among others and therefore not visible as a Roman feature in and of itself. The only exception to this is a junction at Ermine Street visible as a cropmark continuously on all photographic sources to the east of Puckeridge (MHT2595) (Fig. 8).

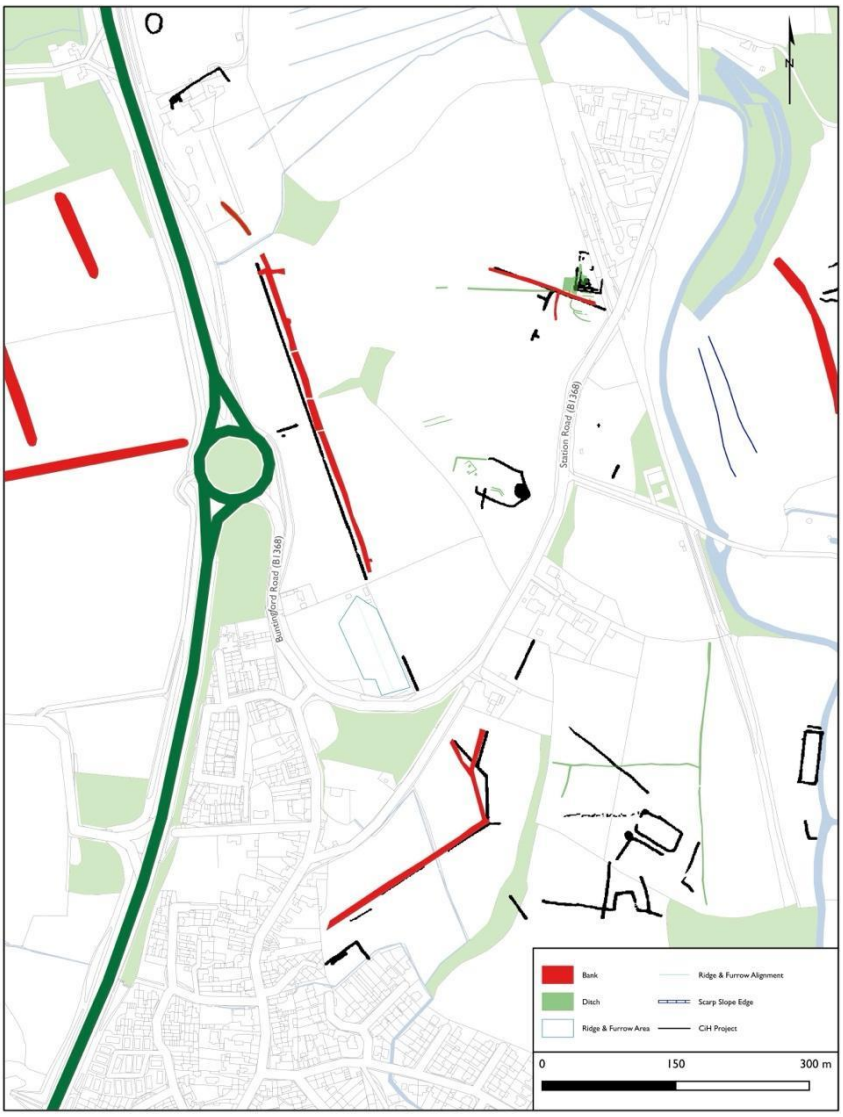

Figure 8: Ermine Street at Puckeridge and junction with Braughing to Great Chesterford road (Margary RR21b). Project mapping of ditches (green) and banks (red), and CiH mapping (black). Note that the junction with Stane Street (RR32) was not identified during the A10/A120 Corridor project. [Base mapping © Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

This section of Ermine Street (MHT9271) can be seen as a broad cropmark running north–west to south–east (Fig. 8). Gaps in the agger identified in the mapping are likely due to archaeological trenches excavated across the feature. In some photography there are possible indications of roadside ditches and possible quarry pits visible as dark positive cropmarks compared to the lighter negative cropmarks created by the road surface itself. These were not mapped as it was considered possible that they were an artefact of the ground conditions or representative of previous excavations at the site. It is interesting to note that whilst the projected routes of Ermine Street and Stane Street (MHT4680) are assumed to intersect at Puckeridge, there is little evidence, either excavated or through the aerial imagery, to suggest that this is the case (MHT2595).

A length of Roman road visible in part as a cropmark and partially as an earthwork was recorded to the southwest of Ermine Street (MHT4615) (MHT40012) (Fig. 9). It follows the route of a projected Roman road to Verulamium (St Albans) (Margary RR21a) and can be traced as a direct route through existing roads and field boundaries from Braughing to Watton-at-Stone to the west of the project area before continuing to St Albans. A short stretch of the road, immediately north-east of the feature mapped, measuring approximately 620m in length is scheduled (NHLE1017473). No features associated with this were discerned on aerial derived sources and so has not been mapped as part of this project. It is suggested that this feature may be a candidate for the revision of the scheduling to include the earthwork portion of the route identified.

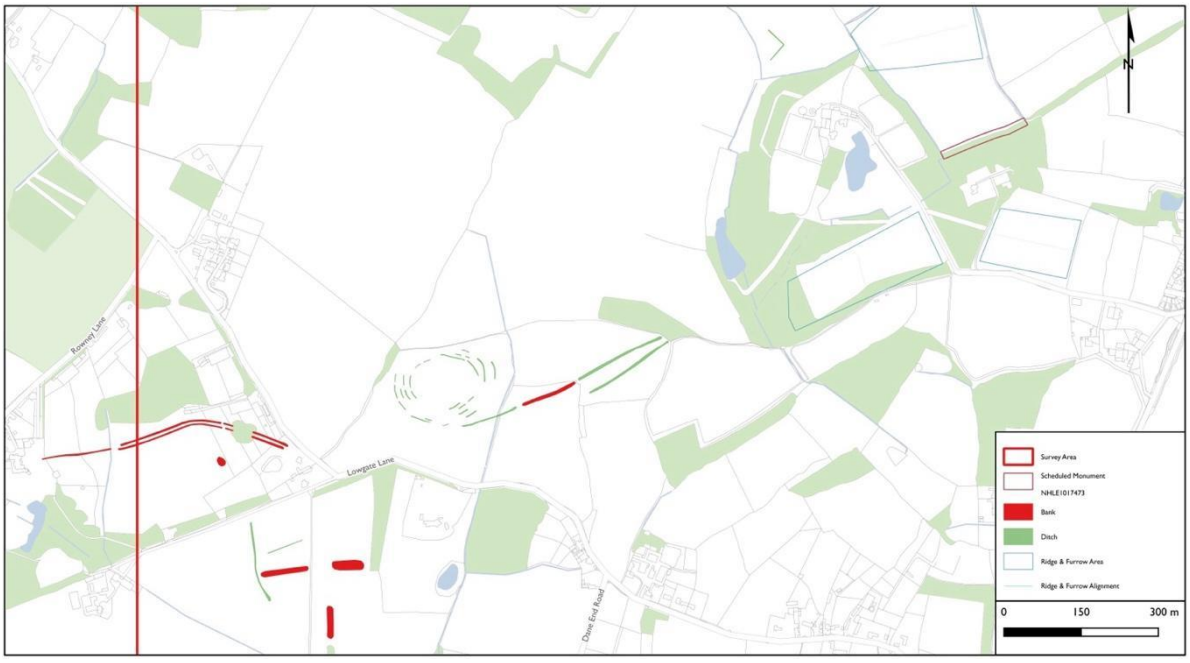

Figure 9: Length of Roman road (MHT4615) (MHT40012) south-west of Puckeridge and west of Colliers End and Ermine Street, between Rigery Lane (scheduled) and Lowgate Lane, showing ditches (green) and a bank section (red) mapped during the project. [Mapping © Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Stretches of a second Roman road running from Braughing to Harlow have been identified through the project area. The route, partially identified by Margary (RR329) can be seen as a broad cropmark, representing the agger and a slight earthwork immediately south of Stane Street (MHT10217). It is then traced following the main street through Wellpond Green before being identified as a subtle earthwork bank to the south of the village. It is considered likely that this southern extent was banked and used as a field boundary in the medieval period and this has enabled the preservation of the route.

Field Systems

Areas of field systems or isolated enclosures have been recorded mainly surrounding Stane Street and are representative of the agricultural hinterland beyond the main settlements. Such examples of this are immediately south of the junction between the modern A10/A120, where complex groupings of field boundaries and associated enclosures are considered to be Late Iron Age to Roman in date (MHT16798) (MHT39980). Other locations include similar field systems at Walnut Tree Green (MHT7549) and at Albury (MHT16757) in the east of the project area. These areas of field systems appear to show enclosures and field boundaries on different alignments, suggestive of multiple phases of activity.

Medieval

The main contribution of the project to the record of the medieval period was based on the enhancement of the detail and understanding of known sites recorded in the HHER. In particular it was possible to identify the extant remains of moated sites and settlements which were recorded as conjectural from documentary evidence (often referred to as deserted medieval villages). There is minimal recording of ridge and furrow, plough headlands and field boundary banks in the HHER; however, this project recorded localised areas where medieval to post-medieval field boundaries and elements of ridge and furrow survive as earthworks, contributing to an understanding of landscape pattern and character in the medieval period. During the project, 129 areas of ridge and furrow were recorded, ten of which were recorded as cropmarks and the remainder were identified as earthworks through lidar.

One site of particular interest sits north of the project boundary, north of Burhill Wood, Buckland (MHT1938) (Fig. 10). The HHER records a stirrup-shaped moat; however, an OS inspection record states that there was no evidence visible of any earthwork. The moated feature, likely representative of a small moated manor, can be seen on lidar as a highly denuded earthwork. Additional features have been mapped from aerial photographs indicating that a small hamlet type settlement developed around the moated structure with a central hollow way running east–west, with a series of plots either side of the road being identifiable. A similar likely pattern of development can be seen to the east of Aspenden Hall where a moated site (MHT225) and associated ponds are recorded as earthworks.

Again, supplementary features were identified through aerial resources indicating the presence of a hollow way and possible plot boundaries running perpendicular to the routeway.

Figure 10: Moated site north of Burhill Wood showing ditches (green) as cropmarks, suggestive of a small moated manor around which a small settlement developed along a central hollow way. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041] [Imagery © Next Perspectives APGB Imagery 14-SEP-2019].

The Thundridgebury Manorial site of a moated enclosure and associated remains (NHLE1012268) (MHT1022) can be seen as a substantial D-shaped moat with partial banks (Fig. 11). The ruins of St Mary's and All Saints Church (MHT2977) and the remains of Thundridgebury House (MHT2982) are also visible as demolished structures within the enclosed area. There has been extensive modification on the north-eastern corner of the bank and ditch where evidence suggests that there were multiple phases of recutting. A previously unrecorded banked curvilinear enclosure has been identified as an earthwork from lidar within the moat, which likely represents some form of post-medieval wood bank.

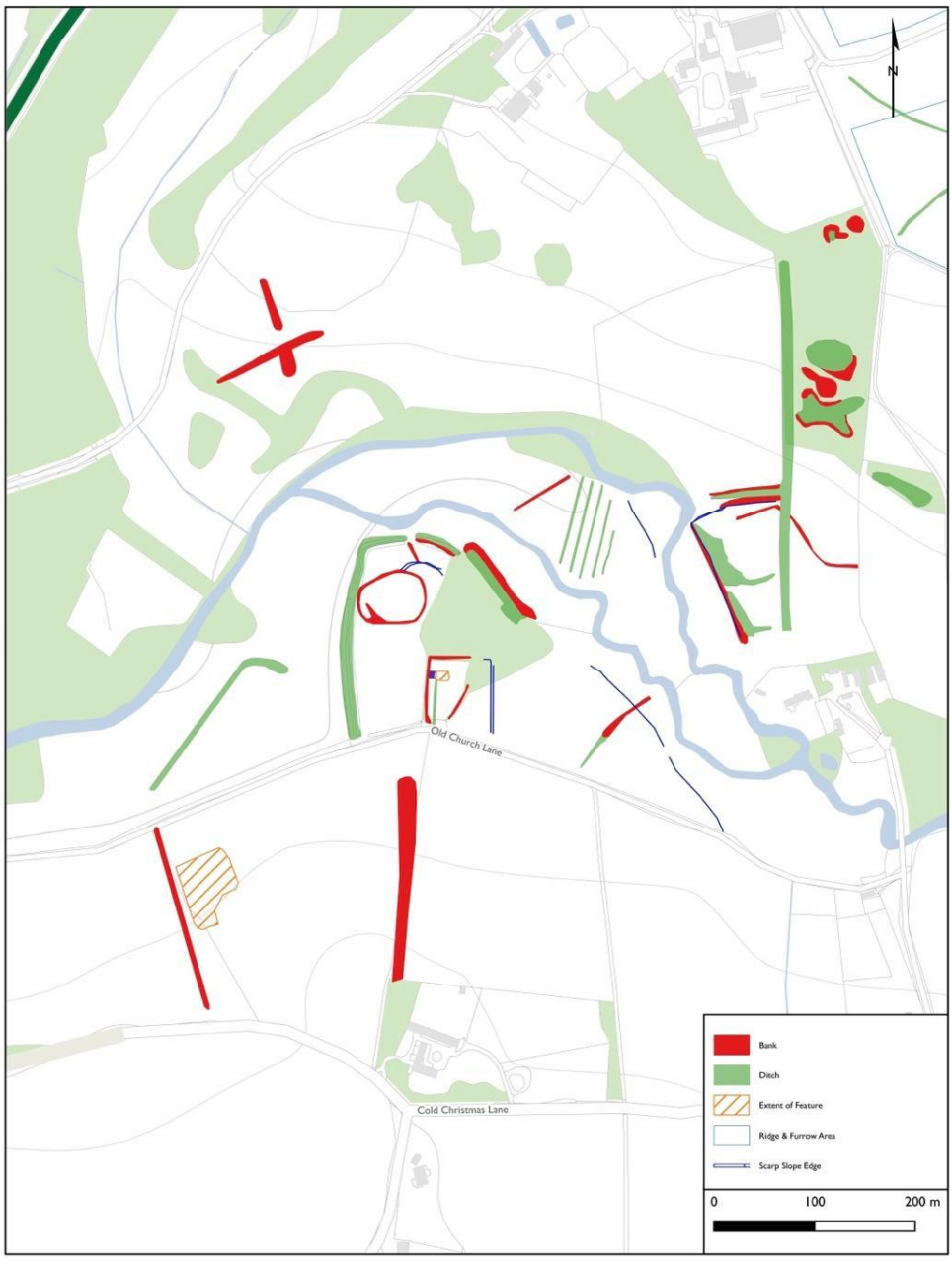

Figure 11: Manorial site at Thundridge (MHT1022) (within the Youngsbury Estate) showing the D-shaped moat (green) with partial surrounding banks (red) and a further internal banked enclosure and divisions (MHT2983), surrounding the ruins of St Mary's and All Saints Church (MHT2977). [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

There has been much speculation as to the origins of the earthworks at Gatesbury Wood, originally identified as an Iron Age hillfort and considered a possible precursor to the enclosed Late Iron Age settlement at Puckeridge (MHT110) (Fig. 12). This interpretation has been questioned and more recent interpretations suggest that the feature may be some form of medieval deer park or woodland management. The site is formed of a single bank on the northern side, with multiple banks and ditches visible on the southern and south-east corner.

The earthworks are clearly visible on lidar and the southern banks are much more clearly defined than the northern bank and are highly likely to have been cleared and recut in the past. The majority of the site has been preserved from plough damage as the site is under tree cover; however, the north-east corner of the site is under arable field and the double ditches can be seen as a cropmark on Google Earth. There are shallow and denuded earthwork banks in the area, all of which are considered likely to be contemporary with the earthwork enclosure, supporting the interpretation of a medieval date for the feature.

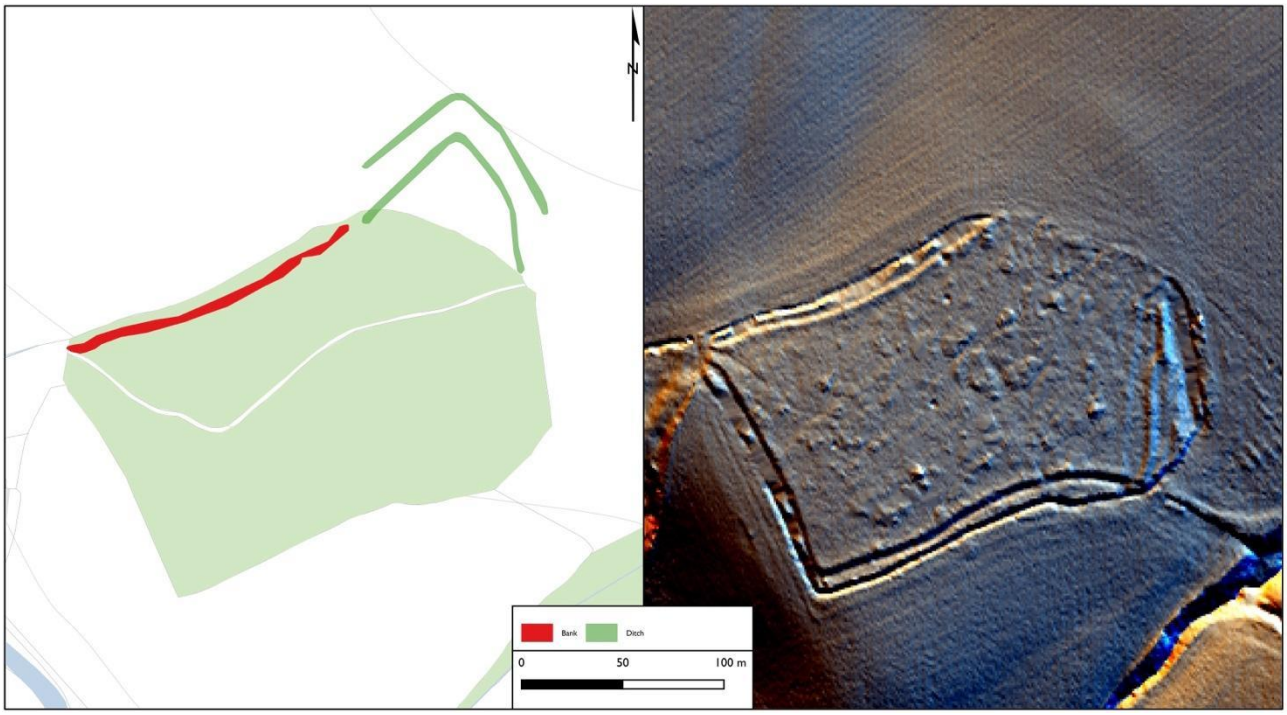

Figure 12: Earthworks (red) and cropmarks (green) at Gatesbury Wood (MHT110) mapped as part of the A10/A120 Corridor project (left) visible on lidar (right). The earthworks along the southern and western edge are much more clearly defined, likely a result of being protected from plough damage by the area of woodland under which the site is covered. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041]. [LIDAR Environment Agency DTM 1M-TL32SE-2017 © MOLA, source Environment Agency].

Post-medieval

The majority of post-medieval features mapped as part of the project related to the remains of ridge and furrow and field boundary banks. Other sites mapped include elements of parkland or designed landscapes identifiable from aerial sources, some of which were located on sites which had been previously abandoned settlements, such as at Knights Hill (MHT2588), Westmill (MHT40224) or located adjacent to medieval settlement, such as the estate of Youngsbury, Ware (MHT2982) (MHT13268) which was designed by Capability Brown and included elements such as the modification of the Rib to create an artificial lake and various garden ornament type features.

Case Study: Medieval to Post-medieval Landscape, Nasty, Greater Munden

This case study looks at the medieval to post-medieval record at Nasty as recorded in the HHER and supplemented through the mapping of archaeological features, primarily field boundaries and ridge and furrow (Fig. 13).

The existing hamlet of Nasty comprises a small number of houses and farms adjacent to the Dane End tributary, which runs broadly north–south where it joins the River Beane east of Watton-at-Stone. The settlement is thought to be post-medieval in date, developed in association with Nobles Farm. The existing farmstead (MHT11141) has a late 16th–early 17th-century core and has been much extended. Nobles Farm is thought to have had a medieval predecessor as the place name refers to the family name of Simon Nobely, documented in 1354.

The HHER records a possible moated site at the farm (MHT6397); however, it is noted that this is supposition broadly based on place name evidence and a mapped pond on the 1841 Tithe. South of Nobles Farm a series of highly denuded earthworks is recorded in the HHER as a possible DMV (MHT2332). Lidar evidence shows a series of earthwork hollows which are extensively ploughed and are not of any clearly identifiable morphology. Aerial photography dating to 2010 shows the site as a series of rectilinear enclosures appended to a curvilinear enclosure, which may represent the medieval activity supposed above. The main manorial site for the area, Mundensbury, is recorded as south of Nasty at Great Munden, although only documentary evidence survives (MHT1014).

The agricultural landscape to the east and north of Nasty is visible through subtle earthworks of field boundaries, plough headlands, and ridge and furrow. West of the site a likely post-mill is mapped as a cropmark from aerial photography and lidar indicates that it was surrounded by a banked enclosure (MHT16520). Much of this landscape appears to be post-medieval in date based on the width of the ridges, taking in to account spread of features from modern ploughing. However, the stepped nature of the boundary banks and subtle suggestions of possible cross ploughing are indicative of the earlier agricultural landscape.

South of the village the earthwork preservation is lower and plough headlands and boundary banks are not visible. However, traces of broad ridge and furrow can be identified on the opposing banks of the Dane End Tributary valley with post-medieval ridge and furrow mapped on the plateau overlooking the valley (MHT40240) (MHT40246) (MHT40249) (MHT40250) (MHT40255) (MHT40256) (MHT40263). The mapping of the visible field systems demonstrates the expansion of the settlements which survived the shrinkage in the population prior to the 14th century.

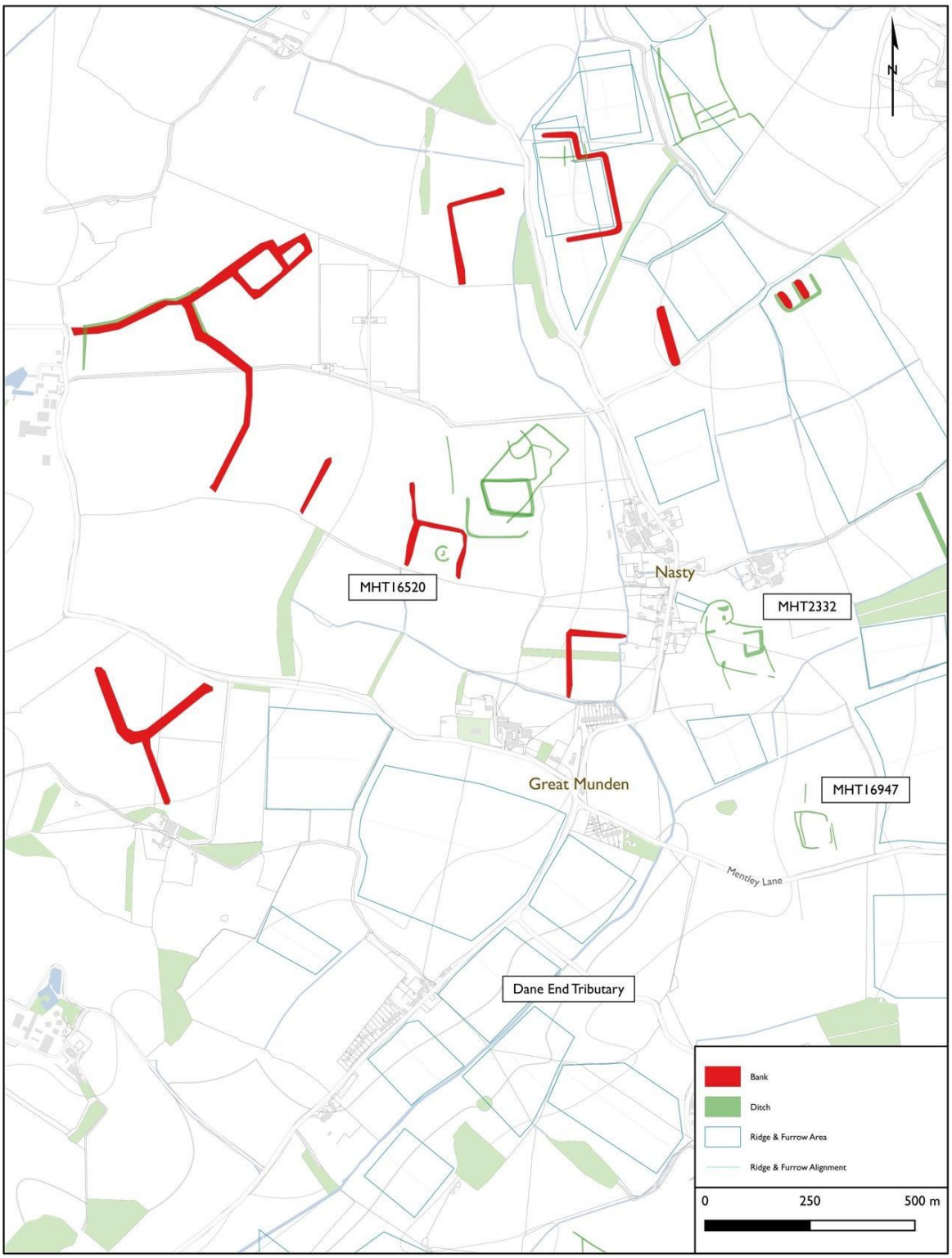

Figure 13: Case Study: Nasty. A number of field boundary banks (red) are visible in the fields radiating from the village centre towards the north-east, and a large number of ridge and furrow areas (blue) were visible to the north and south, extending along the banks of the Dane End Tributary. Two areas of rectilinear ditched enclosures were visible as cropmarks (green) to the northwest and southeast of the village. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

20th Century

The scope of AI&M projects is to identify and record remains up to and including any dating to the 20th century. Any already recorded in detail on the HHER and those which were clearly mapped on 1st Edition, or later, OS mapping were not recorded as part of the A10/A120 project. These included small, local extractive sites, upstanding buildings and structures, and field boundaries. One exception was made for the munitions factory at Barwick (MHT5712) where it was felt that, as an earthwork site clearly visible on lidar, there would be a contribution to the understanding of the condition of the site and therefore highlight any preservation issues by fully mapping and enhancing the record on the HHER. The project worked closely with the team at HCC to identify any such sites which may benefit from an addition to the HHER or enhancement to the existing monument record based on sources available to the project.

Prior to the project there were no military sites recorded in the project area within the HHER. Two military bases were identified. The first was a small Second World War American base at Collier's End (MHT39974) (Fig. 14), Ware which is thought to have continued in use post-war until the late 1950s and is visible as a series of unlabelled buildings on the 1946 revision (published in 1950) OS mapping. On the basis of historic photographs of the site in use, the camp served SCARWAF engineers (Special Category Army Redesign with Air Force). The nearest major Second World War airfield used by the US Airforce was at Stansted Mountfitchet to the east. Elements of the layout and structure of the base are visible on Google Earth.

Figure 14: Post WW2 American base at Collier's End on the southeast side of the junction at Ermine Street and Dowsetts Lane. RAF_58_42 5014 19-MAY-48 Historic England RAF photography. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

A second, larger military camp (MHT40166) was identified in Buntingford to the south of an ordnance factory (MHT7445), to the east of the A10. Whilst this appears to be a more substantial base, there is no readily available information about the site to indicate who was stationed at the site and it was not possible through the scope of the project to research further.

Comparison of projects

The *Crop Marks in Hertfordshire (CiH)* project and *A10/A120 Corridor* project have been assessed together to identify differences in the resultant mapping and records, assess how this is in line with other archaeological data and outputs and highlight areas where this impacts upon heritage protection.

Broadening of scope

The archaeological results above highlight that the main contribution to the archaeological record for the project area is the identification and detail added to the medieval and post-medieval record, particularly identifying the presence of ridge and furrow as earthworks in a landscape which has traditionally been considered to have low earthwork preservation due to extensive ploughing.

The scope of the *CiH* project was exclusively to map cropmarks features as the range of resources available/assessed by the project did not lend itself to the identification of earthworks, with the main source of photography being the specialist oblique imagery.

The *A10/A120 Corridor* project sought to map all archaeological features, from the Neolithic to the 20th century, which could be identified from aerial based sources available. The earthwork features identified by the project were all dated from the Roman period to the 20th century. They predominantly comprised agricultural features, field boundaries and ridge and furrow earthworks with concentrations particularly visible north of Ware and west of Puckeridge (Fig. 15). The earthwork of a bank was identified as a section of Roman road (Margary RR21a) to the southwest of Puckeridge/west of Colliers End, southwest of a section already scheduled at Rigery Lane. The majority of the features were identified from lidar rather than vertical photographic resources. The other feature classes which were identified and mapped from the project were moated sites and aspects of deserted medieval villages.

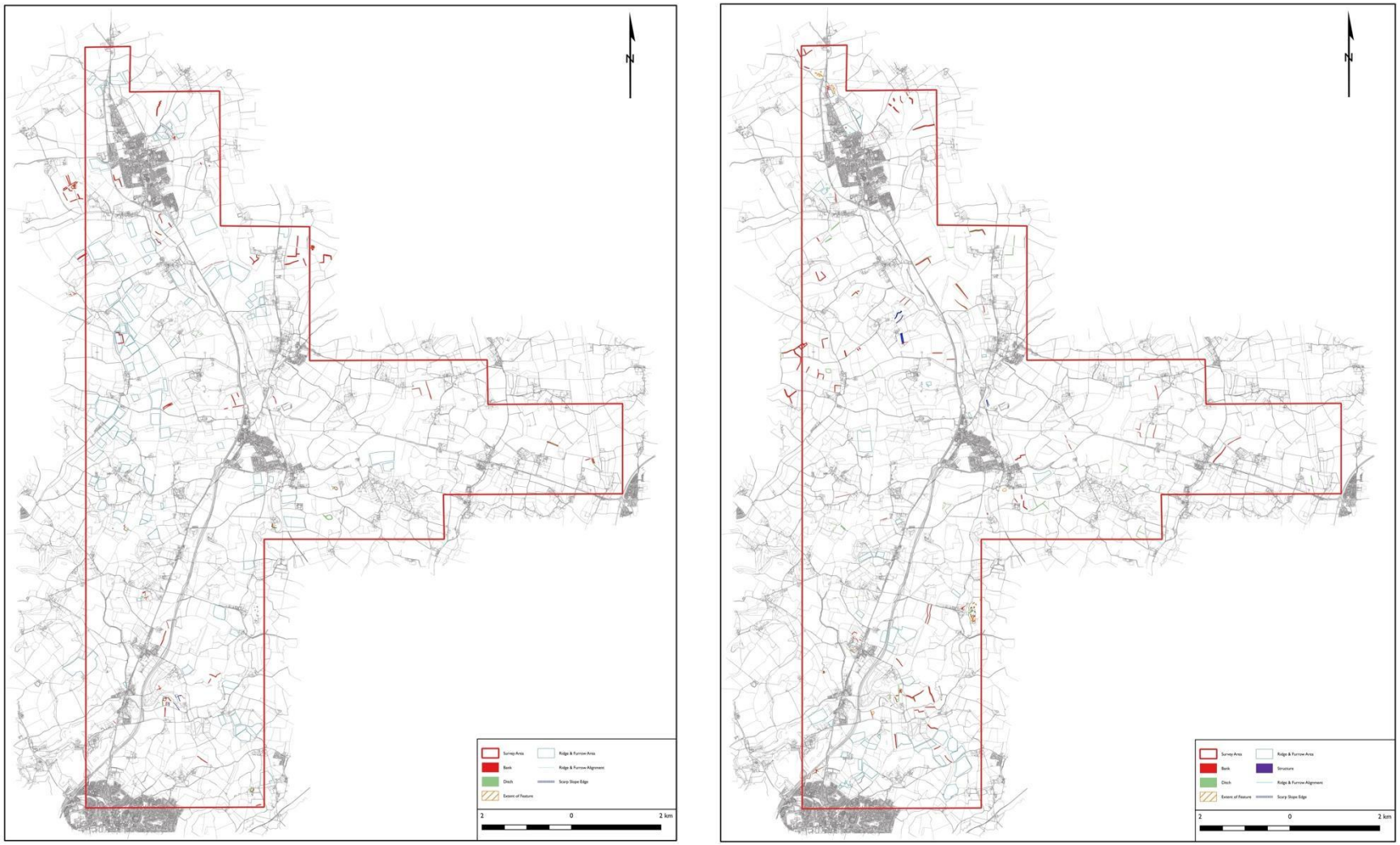

Figure 15: Distribution of features identified as earthworks across the project area dated to the medieval (left) and post-medieval (right) periods. Note a large number of areas of ridge and furrow dating to the medieval period were identified in the west of the project area, west of the A10, and a large number of post medieval banks and areas of ridge and furrow were identified around the Youngsbury Estate, east of the A10 and northeast of Ware in the south of the project area. [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Range of Resources

CiH exclusively used specialist oblique imagery held by the National Library of Air Photos (NLAP, now the HEA) and CUCAP to identify and map archaeological features from aerial photos. Vertical sources were used as supplementary evidence, where necessary, and a limited number were available or assessed as part of the project. Since the completion of the *CiH project*, the HEA has continued to acquire aerial photography from a range of sources alongside targeted imagery captured by Historic England as part of their long running reconnaissance programme.

The increased volume of vertical sources held at the HEA, and available to the *A10/120 Corridor* project, covers a wide range of dates typically ranging from the 1940s RAF imagery to the 1990s OS imagery. This not only offers a time depth to the available archive—allowing for the project area to be seen in different seasons, over different years when crops and vegetation may be subject to a range of stressors and therefore present differentially as cropmarks—but also affords the opportunity to assess much of the photography stereoscopically, aiding the interpretation of earthwork features. The combination of the time depth to the available photography and the ability to view imagery with a sense of 3D perspective allows for areas where earthworks have been levelled to be identified. This can provide valuable information regarding the impact of previous site activity, such as ploughing, and can be an indicator of the likely truncation of archaeological deposits in an area, which is useful for heritage protection purposes.

The *A10 / A120 Corridor* project benefited from a wider range of resources due to the accessibility of resources such as Google Earth, Bing Maps and commercially available photomapping resources. The regularity of photomapping capture, particularly the Google Earth time slider function allowing the viewer to look at the same site over multiple years adds to this sense of time depth.

During the course of the project, full lidar coverage was available at 1m spatial resolution for the entire study area, but only a limited coverage of above 1m resolution (at 50cm) was available, though this resource contributed significantly to the project. The project area is considered as an agricultural landscape that seen as broadly devoid of earthwork features. It is evident from the results of the project that this is not the case, with widespread areas of ridge and furrow cultivation, including plough headlands, and medieval to post-medieval field boundaries noted particularly to the north-east of Ware. Since project completion, the Environmental Agency has made further lidar coverage available at 50cm resolution elsewhere with the hope that this will soon be made available across the remaining project areas in which it is currently unavailable, which will increase the potential for future identification of further earthworks and enhancement of detail to known earthworks across the project landscape.

Table 1 lists the individual features and site recorded from each source to assess the contribution of different resources. The number of individual features indicates how many were identified from different sources, and accounts for where multiple different sources were used to transcribe individual features. Likewise, the number of sites identified by different sources takes into account where an individual site may have been identified as a group of features which were transcribed from multiple sources. This is based on the source used for transcription and does not necessarily indicate the feature was not also visible on other sources.

Table 1: Individual features and number of sites mapped per source

Source	Number of features	Overall percentage of features mapped	Number of sites identified (MHTs)	Overall percentage of sites mapped
HEA	605	36%	133	27.8%
APGB	292	17.4%	105	22%
Google Earth	148	8.8%	32	6.7%
Lidar	928	55.3%	314	65.7%
HCC imagery	7	0.4%	3	0.6%
HCC Photomap	30	1.8%	4	0.8%
Historic mapping	-	-	8	1.7%

The source Google Earth refers exclusively to the orthophotography (including all those available through the time slider feature) held on the platform, and not the 1940s RAF aerial photography that is available for some areas. This type of aerial photography was not available as part of the time slider feature for the project area.

The majority of the cropmark features identified from imagery held by the HEA were from vertical sources, which were either not available or not assessed as part of the *CiH project*. These features were typically small, isolated enclosures, round barrows or field boundaries which are less likely to be identified across the project area likely as a result of the reduced opportunities for reconnaissance due to airspace restrictions in this part of the county. A further factor in considering the visibility of cropmarks recorded on oblique photos in this area is the clay soils and geological deposits which make up the project area. Cropmarks are only likely to develop following severe hot and dry seasons, and then require the opportunity to undertake aerial survey to be taken advantage of which may have previously often been overlooked. Table 2 details the number of features visible as different types of evidence recorded throughout the project, and considers where features may be visible as multiple evidence types.

Table 2: Individual features mapped per evidence type

Evidence type	Number of features
Cropmark	658
Earthwork	917
Demolished building	97
Demolished structure	8
Excavated evidence	15
Extant building	18
Extant structure	1
Structure	5

Whilst the *A10/A120 Corridor* project has identified a significant number of new features, or added detail to existing records or mapping, there are obvious areas where there are missing sites when compared to the *CiH* project (Fig. 16). Six cropmark sites, mapped in the *CiH* project, were not identified as part of *A10/A120 Corridor* project. A further ten features or sites are partially identified through this project whilst being mapped more extensively in the original project. All of the sites identified were field systems or settlement archaeology of Iron Age to Roman date.

This extensive gap in what is a relatively small project area, is attributed to the lack of access to the CUCAP archive which predominantly comprises specialist aerial photography. 136 photographs are identifiable on the online catalogue within the study area, of which only 16 were viewable as low resolution thumbnails on the CUCAP website. None are available to map from due to copyright reasons. Other considerations for the lack of visibility of these sites in the available photography would include the truncation of archaeological features to an extent where they do not exist on later photography and the location of the majority of these sites being located on the alluvial soils which are less likely to produce cropmarks unless under higher stress.

During the course of the project, it became apparent that there was limited overlap between the sources used for the *CiH project* and the *A10/A120 Corridor* project, making a comparison of the accuracy of the mapping difficult. It however highlights the significant contribution of the specialist photography held by the CUCAP archive.

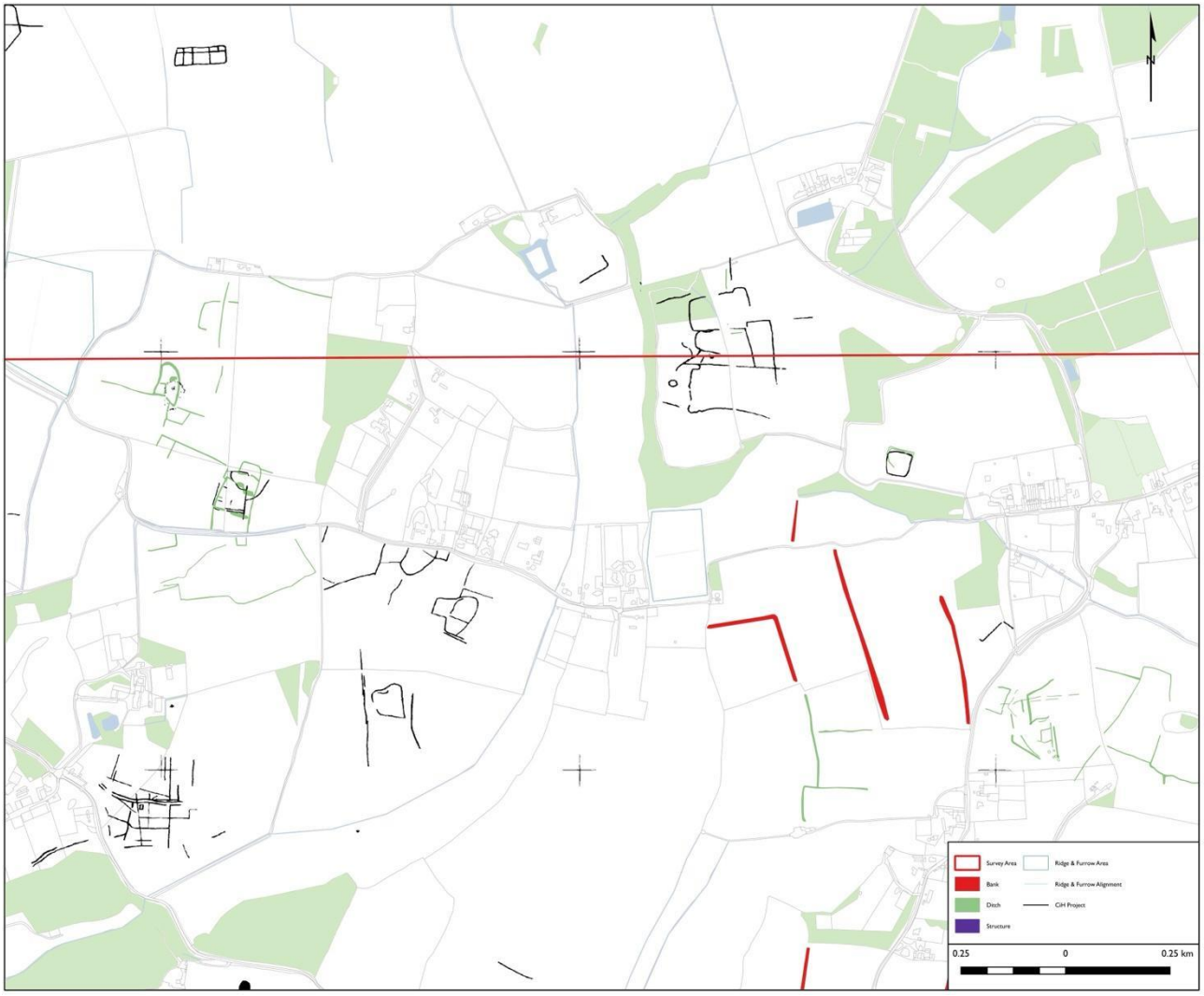

Figure 16: Example area in mapping block 2_4 centred on Horse Cross showing difference in features identified in the CiH project (black) and not seen in A10/A120 Corridor project (red, green, blue). [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

Rectification

The *CiH Project* was undertaken between 1990 and 1992 in the early stages of computing and therefore did not use aerial/digital rectification. Instead, the project used 1:10,000 base mapping as a control source for manual computerised rectification. The rectification methodology did not include the use of height data at this time and features were sketch plotted over OS quarter sheets.

Sketch plotting involved hand-drawing features onto overlays on an OS basemap, using landmark features and field boundaries to plot locations as accurately as possible. This accuracy therefore depended on the quality of the OS mapping available at the time and the skill of the transcriber, and the scale of the base map used for *CiH* at 1:10,000 had relatively low spatial accuracy regardless of the quality of the rectification. Once plotted,

the sites were recorded on a computerised database (MORPH) which enabled descriptions to be entered and analysis of the data to be undertaken.

Digital rectification was undertaken for the A10/A120 project and the methodology used 1:2,500 base mapping and 5m DEM data (where appropriate) to provide as accurate rectification as possible. AERIAL v.536 software was used to georeference historic aerial photographs to the basemap and archaeological features were then plotted off this. The incorporation of height data into digital rectification enabled the process to remove distortions caused by topographic variation in the landscape. All features mapped from photographic sources were deemed to have an accuracy of under 1m in relation to true ground position, with a higher degree of accuracy for features mapped from vertical orthophotographs and lidar.

Whilst in some of the flatter locations, the updated rectification methodology made very little difference to the mapped result between the two projects, in some areas there were significant differences, either in the position or orientation of the features (Fig. 17). This may be due to not only the sources of mapping data available in the *CiH project*, but may also be linked to the predominant reliance on specialist photography in the earlier project where the available ground control might be limited.

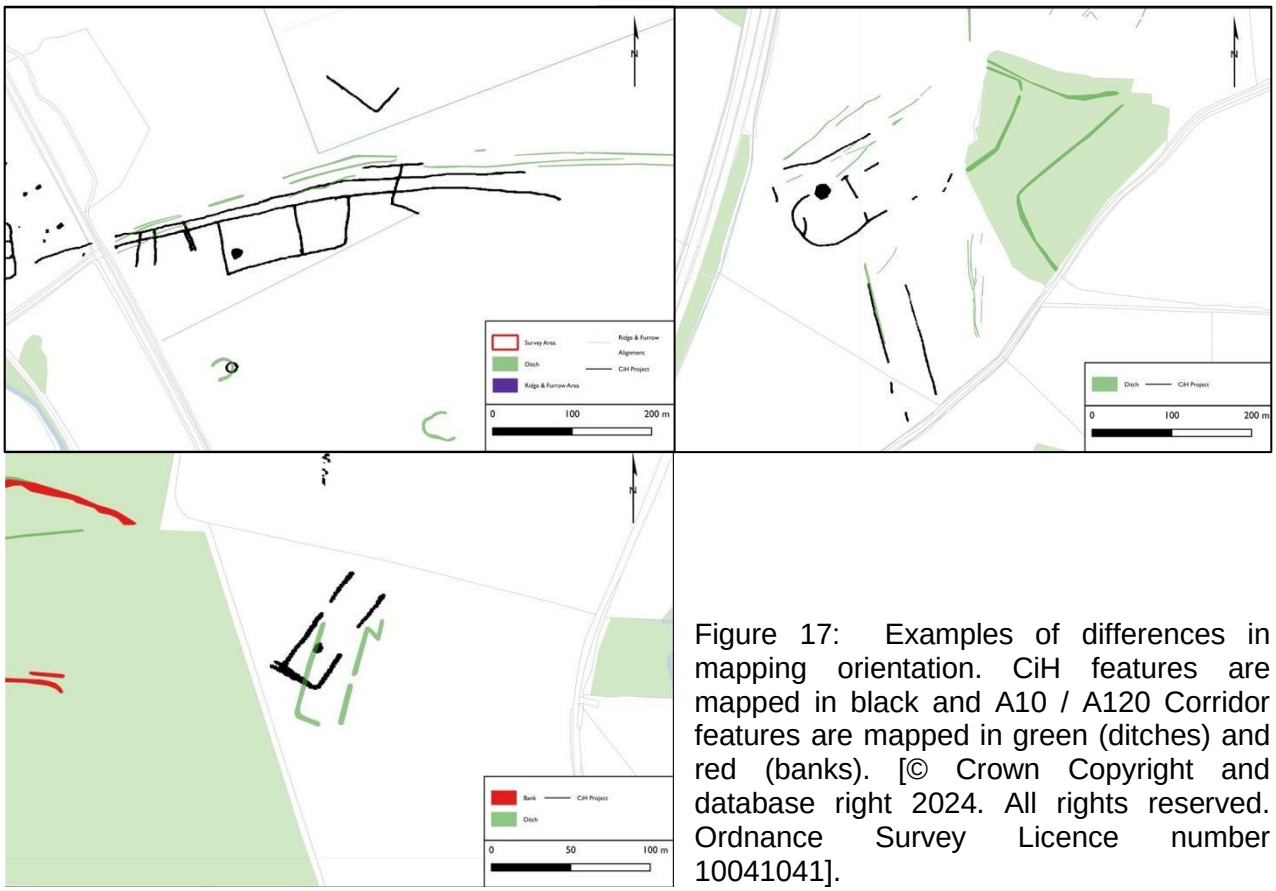

Figure 17: Examples of differences in mapping orientation. CiH features are mapped in black and A10 / A120 Corridor features are mapped in green (ditches) and red (banks). [© Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 10041041].

The lack of accuracy statement and the difference between some mapped features and their visible location on orthophotography held by the HHER has led to a lower level of confidence in the mapping from the *CiH project*.

In terms of the data produced from an AI&M project, the ability to have an accuracy statement on the transcription of an archaeological feature brings the evidence in line with other remote sensed data, such as geophysical survey where data is live collated against GPS data. All archaeological work undertaken in Hertfordshire is surveyed within measured tolerances, for example standards for on-site GPS survey, geophysical survey and earthwork survey are required in all reporting of archaeological investigations.

Transcription

CiH mapping was transcribed from the photography and sketch plotted on to OS quartersheets using 1:10,000 mapping and inked on to transparent overlays. The final mapping was reduced in scale to 1: 25,000 for dissemination. The transcription was standalone from the recording and reporting, in that the spatial and text data was not linked in the same way as digital data is. The technology at the time did not allow for digital spatial recording or data associated with the mapping.

Transcription for the *A10/A120 Corridor* project was undertaken in GIS, a spatial mapping tool which integrates spatial information of a range of data types with descriptive data attached to each feature mapped. This means that the mapping is digitally borne and therefore it can be assessed, visualised, and analysed in a spatial environment as it is created and viewed directly over other data sources.

GIS is an industry standard tool for the presenting of archaeological data and forms half of the HER (see Recording below). The *CiH* mapping has been scanned and rectified to be viewed in the HER GIS. It is possible that some of the orientation issues identified in the mapping comparisons are related to issues with the georeferencing of the paper mapping, which was georeferenced as 66 individual sheets across the county.

Recording

The *CiH Project* was recorded in MORPH2, a specially designed database to record the identified features and be able to undertake descriptive analysis. The data was provided to HCC, and paper HER records were generated using a grid reference from the mapping. The early 1990s saw the development of the use of technology in archaeological recording which lent itself to the categorisation of features, morphologies and types.

There are several issues identified with the use of the records derived from the *CiH Project*:

- The georeferenced raster layer itself is not accurate. This is a legacy of it not originally being digital in nature, and not intended for use in a GIS. The HER itself was paper/card based at the time of the project with no integrated GIS.
- The level of interpretive detail supplied by the project was not sufficient to create detailed records in line with the type of records currently produced in the HER.
- Monument records/record texts were not created by aerial specialists able to provide either a level of confidence in the interpretation or indicate areas of question. As this was a pilot project the use of aerial photographs for systematic identification of archaeological features across a large landscape was in its infancy.
- Subsequent smaller scale mapping by aerial specialists using modern techniques has shown that the accuracy of the pilot project is in question in some locations, and ultimately there is a lack of confidence in both the raster layer and the records based on it for planning purposes.

Recording for the *A10/A120 Corridor* project was undertaken directly in the HHER database. It is important to note that the HHER does not record certain monument classes in the same way as the HE guidance for the AI&M projects. As a result, a disproportionate number of records (for the size of the project) have been recorded or amended as the project has tried to create a dataset that is comparable with both AI&M standards and the current practice at the HHER. Such monument classes include ridge and furrow, unless well preserved as a substantial earthwork, and features that were identified as cropmarks but with a low level of confidence in the identification.

Discussion

In undertaking a project which concentrates on ‘remapping’ a previously assessed area, the predominant issue is whether the outcome of the project is of greater value than the resources spent working in a region where there is already a dataset derived from aerial based sources. In the archaeological climate of today the idea of ‘value’ is multifaceted and not simply tied to cost of resources:

- Is it suitable for heritage protection purposes?
- Is there confidence in the methodological approach?
- Is the data measurable in line with other digital data standards and types produced from archaeological outputs?
- Is the data accessible to a range of archaeological audiences?
- Does the data help to identify significance and heritage protection opportunities (designation, stewardship, planning)?

The *CiH Project,* as part of a series of four prototype projects, was highly successful in terms of providing a starting point for the NMP and later AI&M projects in the infancy of using computerised databases to interrogate archaeological data. This established an approach for broad landscape scale assessment and the AI&M projects continue to be one of the only regularly funded archaeological projects covering this scale and scope.

One of the primary focuses of *CiH* was to identify archaeological features at a site-based level, categorising features based on morphology, and ascribe a likely date to the identified archaeology with an associated level of confidence. The work was produced as hand plotted mapping and an associated database, which allowed for basic interrogation of the data.

The *CiH* project was undertaken and published during a time of rapid change in terms of developer led archaeology, where heritage protection had become a major planning concern and legislation such as Planning Policy Guidance 16 (PPG16) saw a rapid expansion in the commercial archaeology sector and archaeology being undertaken in general at a larger scale.

The data produced from the pilot project was, at the time of production, suitable for heritage protection purposes, identifying a significant number of previously unrecorded archaeological features. However, the management of heritage data and the role that such data plays in heritage protection and curatorial archaeological has changed significantly.

Development and infrastructure in England, particularly in the East of England, is rapidly growing in terms of both scale and number of developments. As a result, field-based

archaeology is no longer being undertaken at a site-based level but rather at a landscape scale, with linear infrastructure schemes running sometimes hundreds of kilometres and green infrastructure projects (e.g. solar farms) covering up to 100ha. There is now a need for invasive archaeology to move beyond the individual site-based approach and interpretations are being undertaken at a landscape scale. Having a reliable source of background data, in which to contextualise this work then becomes vital, particularly considering the general lack of landscape scale publication in the region.

The development of technology in survey methods and approaches across the sector has led to greater precision in data collection, for example, the use of RTK GPS in archaeological excavations and geophysical survey. Aerial based survey, through the use of drones, has become a standard part of field-based recording and there is a desire for data derived from aerial survey of all origins to be comparable and measurable.

The technology to the *CiH Project* did not allow for the creation of accurate mapping within the parameters expected of modern archaeology and therefore no longer appropriate for heritage protection needs, with the data seen as more of a guide rather than an assured identification of archaeological features.

In identifying that the data is not appropriate for modern needs, the question is raised in being able to identify if ‘remapping’ a project is of value in terms of resources spent will depend wholly on the resources and technology available to that project area originally and the type of project output (e.g. whether digital in origin or hand mapped).

The impact of having access to a wide range of sources has been clearly underlined through this project and the contribution of specialist photography cannot be understated. Whilst the largest contribution to the mapping has been through lidar and Google Earth, the inability of the *A10/A120 Corridor* project to map sites which have clearly been identified as cropmark features in the past, highlights the negative impact upon AI&M projects caused by the closure of the CUCAP archive. As a large proportion of the cropmarks identified previously were mapped from aerial photographs that were not available to the current project, it is difficult to assess if there are any other contributing factors to the lack of visibility of such cropmarks in the sources that were available to the project.

More recent projects using AERIAL and a wide range of resources may only need updating on the availability of new sources (e.g. introduction of lidar, assessment of orthophoto imagery). NMP and later projects also benefit from detailed standards and guidance, digital mapping and HER recording. Later projects also have the advantage of the discipline having developed as a specialism over the past 30 years and a familiarity of the resultant data by a broad spectrum of heritage professionals.

Further Work

On the results of the *A10/A120 Corridor* project, it is evident that Hertfordshire would benefit from a ‘remapping’ of the aerial resource. The existing data is not appropriate for modern heritage protection needs and an update to the mapping in line with AI&M standards would generate a dataset which would be a well-used resource.

Assessment of the photographs held in the CUCAP archive and integrating results into the project would contribute further to the accuracy of the results, should the archive reopen or digital access to the full archive become available. New releases of satellite images will also undoubtedly reveal further results which will contribute to the number and detail of sites which can be added to the record. The increased potential for the discovery of cropmarks which develop after particularly hot, dry seasons has often been overlooked in the past by aerial archaeologists, and this is currently being reconsidered by the HE Aerial Reconnaissance team. Any changes to the restrictions on controlled airspace across the project area may similarly provide more opportunities to carry out reconnaissance in the area.

The future availability of lidar coverage at 50cm spatial resolution by DEFRA across the entire project area will also enable further identification of new monuments or enhancements to the records of existing monuments. Several sites would also benefit from further desk-based research and ground-based survey including fieldwalking, metal detecting, geophysical survey or intrusive archaeological investigations, particularly complex sites of intercutting features of possible multi-phase activity, which could further refine the character and dating of such sites beyond that identified from the aerial investigation.

Though not designated, integration of the sites recorded by the project into the HHER will ensure they are afforded better-informed consideration during consultations for future development proposals or land management decisions across the project area.

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