

Longfield Solar Scheme, near Terling: Aerial Investigation and Mapping Report

Client: Aecom

Date: December 2020



PLACE
SERVICES



Essex County Council

	Name	Signed	Date
Title	Longfield Solar Scheme, near Terling: Aerial Investigation and Mapping Final Report		
Author	Helen Saunders		17 December 2020
Derivation	Project Tender		
Origination Date:	November 2020		
Reviser(s)	Richard Havis		18 December 2020
Date of last revision:	18 December 2020		
Version:	1.2		
Status:	Final		
Summary of Changes:	N/A		
Circulation:	Loic Boscher, Aecom		
Required Action:			
File Name/Location:			
Approved			

Copyright

This report may contain material that is non-Place Services copyright (e.g. Ordnance Survey, British Geological Survey, Historic England), or the intellectual property of third parties, which Place Services is able to provide for limited reproduction under the terms of our own copyright licences or permissions, but for which copyright itself is not transferable by Place Services. Users of this report remain bound by the conditions of the Copyright, Designs and Patents Act 1988 with regard to multiple copying and electronic dissemination of the report.

Contents

Contents	3
1. Introduction and Background	5
2. Project Aims	6
3. Aerial Photography and Lidar Sources	7
4. Previous Work	8
5. Challenges	10
6. Results	11
7. Conclusions	14
8. Figures	16
References	24
Appendix 1: Methodology for Mapping	25

List of Figures

Figure 1 - Project area Red Line Boundary	16
Figure 2 - All archaeological features mapped within the project area.....	17
Figure 3 – Areas of identified archaeological features and Site Numbers	18
Figure 4 – Cropmarks of two incomplete sub-circular enclosures and field boundaries digitally mapped and the location of an enclosure originally mapped for the NMP but was not visible on the available aerial photographs (Site 2)	19
Figure 5 – Cropmarks of possible Bronze Age barrow cemetery, enclosures, field boundaries and pits (Site 4)	20
Figure 6 - Cropmarks of WWI practice trenches and field boundaries (Site 5).....	21
Figure 7 - Cropmarks of a former field system with an enclosure and annex (Site 6)	22
Figure 8 - Possible prehistoric enclosure (Site 8)	23

List of Plates

Plate 1 - Aerial Photograph of a round barrow and enclosures at Toppinghoe Hall (Site 5) (EX17/02/001 © Essex County Council).....	6
Plate 2 - Extract from a 2010 ECC vertical photograph showing the RLB of the project area. The RLB excluded many areas of woodland (© Essex County Council).....	7
Plate 3 - Archaeological and geological cropmarks (Site 5) located adjacent to Toppinghoe Woods (EX13/05/042 © Essex County Council).....	8
Plate 4 - The archaeological cropmarks identified during the NMP at Mill House Farm, Chadwell St. Mary	9
Plate 5 - Excavation plan of all features identified at Mill House Farm, Chadwell St. Mary (© Archaeological Solutions 2017, Figure 3).....	9
Plate 6 – Rectified aerial photo showing Site 5 (EX13/05/039 © Essex County Council)....	10
Plate 7 - Cropmarks of a medieval field system and enclosure (Site 6), (CP/08/27/06) © Essex County Council).....	15

1. Introduction and Background

This is the report to accompany the Aerial Investigation and Mapping (AIM) assessment of a proposed large-scale solar scheme to the west of Terling, Braintree. The proposed solar scheme covers a largely rural landscape with numerous non-designated archaeological cropmarks recorded in the vicinity (Figure 1).

The study area covers 578 hectares and a GIS shape file of the Red Line Boundary was supplied by the client.

For large development schemes in rural areas it is essential to understand the potential for unknown heritage assets (buried or near surface) and the risks involved in the scheme encountering them. AIM is a quick, efficient and cost-effective method of determining the location and quantity of below-ground archaeological features within a landscape that is conducive to the formation of cropmark. Once the AIM work has been completed the extent of potential impacts to the non-designated buried archaeological resource will be determined during the detailed assessment and evaluation programme.

This project has used AIM techniques to ensure the systematic examination of all the readily available aerial photographs and other remote sensing data such as lidar and then to record and map all visible archaeological features accurately. The information gathered through this survey will contribute to a better understanding of the historic environment that will be impacted by the solar development and its significance. This includes below-ground archaeological features and landscapes showing as earthworks, soilmarks and cropmarks dating from the later prehistoric period through to the twentieth century.

Preserved settlements, cemeteries, farming, drainage and industry from late prehistory to the post-Medieval period may lie in the application area and these below-ground

archaeological features will potentially be adversely affected by the development. The predominant geology within the project area is London Clay, with outcrops of sands and gravels, brickearth and alluvium. Cropmark formation on clay geology can be infrequent, with very specific climatic conditions needed for the cropmarks to form. However, frequent aerial reconnaissance of the clay geologies in the county has shown that there are extensive archaeological remains in areas where it was previously thought that there was little activity. To research such remains, aerial reconnaissance has been employed in Essex since 1974. Annual reconnaissance surveys have been undertaken, which has led to the compilation of a large archive of oblique aerial photographs. More recent photography from 2013 and 2019 have been particularly important for this study.

The assessment has been undertaken in accordance with the guidelines set out in Historic England guidance on *Aerial Investigation and Mapping (Historic England 2019)*. Following the systematic assessment of available aerial photographs held by ECC and the Essex Historic Environment Record (EHER), all visible archaeological features have been transcribed and the results will be used in the Cultural Heritage assessment and to facilitate a programme of targeted trial trenching as part of the overall Environmental assessment of the scheme. A full methodology can be found in Appendix 1 and a full list of aerial photographic sources consulted for the project can be found in the Aerial Photographic Catalogue.

2. Project Aims

The overall aim of this project was to complete aerial investigation and mapping work within the project area and to identify and interpret the archaeological features (both upstanding and below-ground) visible on aerial photographs and remote sensed data such as Lidar.

The principle aims of this project were:

1. To examine all easily accessible aerial photographs and lidar data within the site boundary, plus a buffer study area, to identify archaeological features, both known and hitherto unknown. This study included those photographs already used in previous National Mapping Programme (NMP) or AIM surveys.
2. To accurately rectify relevant aerial photographs and georeference them;
3. To transcribe archaeological features from rectified and/or georeferenced aerial sources to HE standards, and reproduce them in ArcGIS format;
4. To provide detailed accurate information to facilitate the placement of archaeological trial trenches to maximise the quality of information recovered:



Plate 1 - Aerial Photograph of a round barrow and enclosures at Toppinghoe Hall (Site 4) (EX17/02/001 © Essex County Council)

3. Aerial Photography and Lidar Sources

The sources of aerial photographs for this project included the Essex Historic Environment Record (HER), Essex County Council Vertical Collection, Aerial Photography Great Britain (APGB) digital photography from 2016 and 2019 and Google Earth. A full list of all the images viewed within the project area can be found in the Aerial Photographic Catalogue.

AIM work on a scheme of this size would normally include a full assessment of the Historic England Archive (HEA) collections. However, due to the current Covid-19 restrictions the Historic England Archive and other remote archives are currently closed and have not been consulted and only Essex County Council archives and online sources have been used for this work.

All the photographic prints held within the HER were assessed in conjunction with the digital images (both oblique and verticals) held (Plate 1 is an example of a digital oblique images held within the HER). The Essex County Council vertical collection is entirely digital, with scanned prints from 1960 to 1990 and digital ortho-rectified images from 2000, 2010 and 2014. The HER holds a limited number of prints from the Cambridge University Collection of Aerial Photographs (CUCAP) and these were assessed along with the other prints; however, the HER only holds approximately 18% of the prints that are actually within the CUCAP collection.

Images from Google Earth were assessed onscreen and images of visible archaeological features were saved and used for digitising. 8-10 sets of photographs were available, although there was not complete coverage of the project area for each set.

Additional ortho-rectified vertical photography from 2016 and 2019 were supplied by APGB and these were also assessed.

Lidar data was downloaded from the Environment Agency (EA). Lidar data was downloaded directly from their webpage (<https://environment.maps.arcgis.com/>) as ASCII data and Tiff's. The composite 1m DTM and 1m DSM data was used (as downloaded in November 2020). An overall mosaic of the lidar data was created and multiple visualisations were produced using Relief Visualisation Toolbox (RVT) version 2.2.1 Various visualisations (including hill shade, Slope Gradient, Simple Local Relief Model, Analytical hill shading and positive and negative openness) were then viewed in ArcGIS. Archaeological features visible as earthworks on the lidar were digitised from the visualisations created in RVT using standard mapping conventions.



Plate 2 - Extract from a 2010 ECC vertical photograph showing the RLB of the project area. The RLB excluded many areas of woodland (© Essex County Council)

4. Previous Work

Historic England's (formerly English Heritage) sponsored National Mapping Programme (NMP) has been completed in Essex, with work carried out between 1993 and 2003 and produced 1:10,000 scale hand-drawn maps. The work included both upstanding archaeological features (visible in the form of earthworks) and those below-ground archaeological features visible only as cropmarks and soil marks but did not make use of any lidar data. The results of the Essex mapping were incorporated into the Essex HER at the time of the project, but little work has been carried out since the completion of the project in 2003.

Essex County Council has undertaken specialist archaeological aerial reconnaissance since the 1970's and has commissioned vertical photography of the county since the 1960's. All these aerial photographs have the potential to contain information of currently unknown above and below-ground archaeological features. While the area covered by the proposed solar scheme was part of Essex NMP, the work was completed in 1996 and no overall photographic assessments have been completed on the ever-growing aerial photographic collections since. Cropmarks, such as those within Site 5 (Plate 3) have been recorded within the HER but no mapping has taken place.

In addition, modern aerial investigation and mapping standards have been implemented which ensure increased accuracy and use a wider spectrum of sources, such as Lidar, as standard. The features recorded during the original NMP were mapped using manual rectification practices at a scale of 1:10,000. The accuracy of the transcription of each site is unknown and there were limited records of the photographs used for mapping. It should also be noted that while the original NMP data can be viewed in a GIS the source data was not created in a digital format, but was hand drawn on 1:10,000 film sheets that have been subsequently scanned and geo-referenced; a process that can exacerbate inaccuracies.

A number of the features mapped for the original NMP could not be located on the aerial photographs assessed for this project and have not been digitally recorded (but are

visible on the scans of the original NMP). These features should not be dismissed although they have not been remapped. These features are likely to be on photographs that could not be accessed for this project, such as the HEA and CUCAP collections that are currently unavailable (other than those images held within the HER).

The original NMP emphasized the extensive number of below-ground archaeological features that could only be seen from the air. However, recent excavations have demonstrated that while archaeological cropmarks are crucial to the identification of sites, they rarely give a true indication of the number of archaeological features on a site. The archaeological cropmarks of a circular enclosure approximately 40m in diameter, some field boundaries and a possible incomplete sub-circular enclosure were identified and recorded during the Essex NMP at Mill House Farm, Chadwell St. Mary (Plate 4). However, Plate 5 shows the excavation plan following work carried out ahead of gravel extraction (Archaeological Solutions 2017). This excavation identified an extensive archaeological landscape comprising in excess of 1000 features.



Plate 3 - Archaeological and geological cropmarks (Site 5) located adjacent to Toppinghoe Woods (EX13/05/042 © Essex County Council)



Plate 4 - The archaeological cropmarks identified during the NMP at Mill House Farm, Chadwell St. Mary

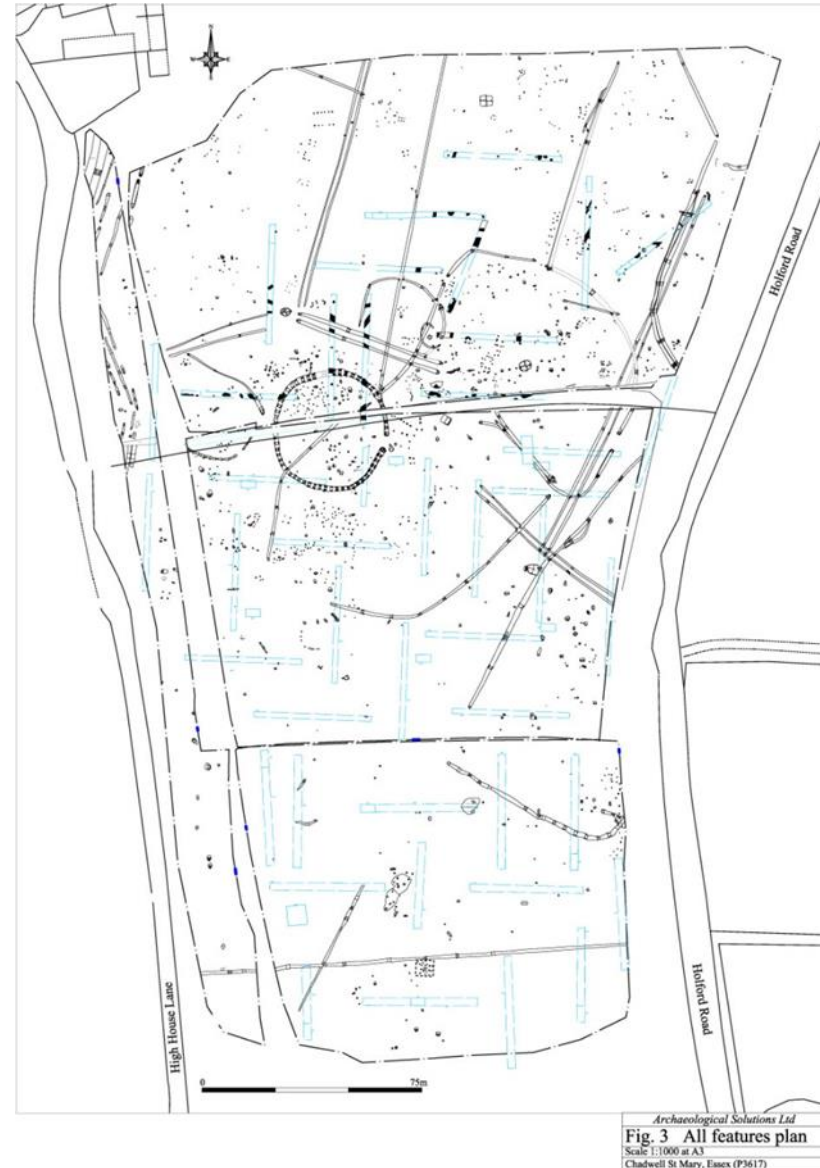


Plate 5 - Excavation plan of all features identified at Mill House Farm, Chadwell St. Mary (© Archaeological Solutions 2017, Figure 3)

5. Challenges

Several challenges were faced during the aerial investigation and mapping carried out throughout this project. The aerial photography assessed for the project ranged in date from 1960 to 2018. While the landscape has remained largely rural, a large number of field boundaries have been removed and property boundaries have changed. This caused some issues with the identification of suitable control points on some of the older oblique aerial photographs. However, this should not have caused a significant problem with the accuracy of the rectification of the aerial photographs used for this project.

The aerial photographs that have been assessed for this project have been a combination of hard copy prints held in the Essex HER and digital images. None of the vertical images could be viewed as stereo pairs or under magnification. This means that surviving earthworks could not be detected on the vertical photography, this is particularly significant when using the photography from the 1960s and 1970s where extant earthworks that have since been ploughed out may have survived. An assessment of the available lidar data has been completed, which would have enabled low-level extant earthworks to be detected, if the features survived, and would compensate, in part, for the loss of stereo assessment.

As the HEA collections were not assessed there were some issues with a reduced number of photographs of sites. It is common for archaeological features to be recorded on multiple photographs, often taken over a number of years and this frequently means different features showing on different photographs. However, in a few cases there was only a single photograph of a feature or site which may mean some of the finer details have not been recorded or mapped.

For most of the sites that were mapped the underlying geology did not create geological cropmarks that masked the archaeological features. The only exception to this was Site 5 (Plate 3 and Plate 6), which is located on sands and gravels that did produce some geological cropmarks that may mask archaeology.



Plate 6 – Rectified aerial photo showing Site 5 (EX13/05/039 © Essex County Council)

6. Results

Archaeological features were recorded within the project area and a plan of the overall project results can be seen in Figure 2. There were a few features that were recorded on the original NMP that were not recorded during this current project and these have been identified on the detailed figures. This could be because access to the photographs was limited and they were not visible on the assessed images or because of the interpretation of the visible features. Below is a table of the results from this AIM work. Each site area has a summary description of the features recorded and where possible a suggested date and function. A guide to the archaeological potential and archaeological significance of each site has been given as Low, Medium, High or Very High. The location of each site can be seen in Figure 3

Site Number	HER Number	Description of site and features mapped	Potential	Significance
1	9856	Cropmarks of former field boundaries and a wood boundary forming part of a field system, many of these features are visible on the 1st edition OS mapping of the 1880s but may have much earlier origins.	Low	Low
2	8972	Cropmarks of possibly 2 incomplete curvilinear enclosures of an unknown date and function, one of which may have been truncated by more recent woodland planting (Figure 4). Other cropmarks in the vicinity include of former field boundaries many of which are visible on the 1 st edition OS mapping of the 1880s but may have earlier origins. The original NMP also recorded a further curvilinear enclosure of an unknown date located in the vicinity, however, this larger enclosure was not observed on the available photography and could not be digitally mapped.	Medium	Low
3	8956	Cropmarks of a ring-ditch which may represent a ploughed-out Bronze Age round barrow. The ring-ditch is 9m in diameter with a small internal off-set pit. While the ring-ditch is isolated, with no other visible barrows in the vicinity, there are extensive linear boundaries/ditches located to the north. In addition, 160m to the south of the ring ditch is a possible trackway and further ditches and field boundaries. Trial trenching in the area found a prehistoric pit (Early Iron Age) and an undated ditch.	Medium	Medium

Site Number	HER Number	Description of site and features mapped	Potential	Significance
4	6117 20576	<p>Cropmarks of a multi-period site (Figure 5). Four complete ring-ditches and a further possible incomplete ring ditch were recorded probably representing a small Bronze Age barrow cemetery. The round barrows are located to the east of Toppinghoe Hall. Other features recorded include a large rectangular enclosure, with a possible incomplete internal enclosure, which, given the proximity to the Chelmsford to Colchester Roman road, could represent a Roman settlement site. Further incomplete enclosures were recorded for the first time closer to the road and are possible prehistoric enclosures.</p> <p>Closer to the hall are a complex series of linear ditches, possible incomplete enclosures and pits, while some of these features are probably associated with landscape and parkland features surrounding the hall some could have much earlier origins. Toppinghoe was Topingo in 1194 and documented regularly throughout the 13th and 14th centuries. Toppinghoe means ‘the ridge of the people of Topp (Topp being a personal name) with the <i>ing</i> (people) element of the name suggests Saxon origins (Reaney, 1935)</p> <p>A small rectangular enclosure (8m by 20m) of an unknown date was recorded for the first time adjacent to the largest ring-ditch. A further possible elongated enclosure was recorded 25m to the north-west. This enclosure was only visible on a limited number of photographs and was masked by geology.</p> <p>The area was also the location of a WWII ‘Prison Pen’ that was surrounded by barbed wire entanglements, although the size is unknown. It is possible that some of the cropmarks could be associated with this WWII activity</p> <p>The geological cropmarks in the field could be masking further additional archaeological features.</p>	High	Medium
5	48299	<p>Cropmarks of extensive practice trenches and field boundaries (Figure 6) probably dating to the First World War (based on form and examples from elsewhere, such as those shown in Brown, 2017). These trenches were not recorded on aerial photographs until 2015 so it is unlikely they were visible on RAF vertical photography from the 1940s which was used during the original NMP work (though currently this cannot be checked), so this would imply the trenches are from WWI. The practice trenches are spread out across the site and it is likely that there are further trenches that are masked by geology in the area. Examples of practice trenches are rare in Essex and these cropmarks are a very good example. The group of trenches located at TL 767 122 are a mix of crenelated and wavy ditches with a single square island traverse forming a cohesive interconnected group, while the examples elsewhere in the field form single crenelated lines.</p>	Medium	High

Site Number	HER Number	Description of site and features mapped	Potential	Significance
6	46668	Cropmarks of extensive former field boundaries forming a cohesive field system, the majority of these field boundaries are visible on the 1 st edition OS mapping (Figure 7). Part of the field system forms an enclosure with a possible annex. Two darker areas within the enclosure could show large pits or disturbance. This enclosure and annex is not visible on the early cartographic evidence and may represent a former farm or settlement site of medieval date. Essex has many abandoned settlement sites of the 12 th and 13 th centuries.	Medium	Low
7	NEW	Cropmarks of former field boundaries marked on the 1 st edition OS mapping though they may have much earlier origins	Low	Low
8	49051	Cropmarks of an irregular curvilinear enclosure 95m in diameter of a possible prehistoric date (Figure 8). The enclosure has no visible entrances, but a large pit or cut feature is located against the southern boundary. The south-east corner of the enclosure was extremely faint on the available photography. While this feature is being interpreted as a possible prehistoric enclosure it is also conceivable that it represents a former extraction site/pond as there are similar extant features in the vicinity, although this one would be larger.	Medium	Medium
9	NEW	Cropmarks of extensive former field boundaries forming a cohesive field system, the majority of these field boundaries are visible on the 1 st edition OS mapping. Some of the field boundaries form trackways	Low	Low
10	NEW	Cropmarks of former field boundaries marked on the 1 st edition OS mapping, though they may have much earlier origins	Low	Low
11	13971	Cropmarks of a series of field boundaries (not visible on 1 st edition OS mapping) and extraction pits of an unknown date	Medium	Low
12	NEW	Cropmarks of former field boundaries, not visible on 1 st Edition OS mapping	Low	Low
13	NEW	Cropmarks of former field boundaries, some are visible on 1 st Edition OS mapping, and some are located outside the project boundary. A possible incomplete enclosure and pit of an unknown date and origin was also recorded	Low	Low
14	14006	Cropmarks of former field boundaries marked on the 1 st edition OS mapping though they may have much earlier origins	Low	Low

7. Conclusions

The results of the aerial investigation and mapping provides an accurate location for the known below-ground archaeological features visible as cropmarks and will facilitate the positioning of trial trenches for the field assessment.

This work allowed several sites to be accurately mapped for the first time allowing a better understanding of the landscape to be developed. In addition, several new features were recorded for the first time, including the excellent example of WWI practice trenches near Toppinghoe Wood (Figure 6 and Plate 3). New features were recorded on Site 4 (Figure 5), with a possible curvilinear enclosure with an annex and a possible elongated enclosure. Both these features are within a cropmark complex which had been mapped by the previous NMP work.

Several areas of former field boundaries were identified across the project area and many of these boundaries are likely to be medieval in origin. Around much of the project area there is clear evidence that the medieval field patterns are still in use and while there has been some field boundary loss it has not be as extensive as elsewhere in the county.

The pattern of cropmarks within this project area is typical within the local area, with pockets of archaeological features identified and large gaps in the cropmark record in between. It is likely that these gaps in the cropmark record are due to the underlying geology. The predominant geology in the project area is clay which often results in waterlogged soils during periods of wet weather and dry hard soils in times of draught. This is not conducive to cropmark development so features are not visible as regularly as they are on sands and gravels. However, as aerial reconnaissance in 2011 showed, given the right combination of climatic conditions cropmarks are visible on clay soils as several new features were recorded in the vicinity.

There were limited cropmarks at the northern part of the project area, but given the extensive multi-period cropmarks located less than 1km to the east around Terling and 500m to the west around Lyons Hall Cottages it is likely that there will be further below-ground archaeological remains in the project area.

No surviving earthworks were identified through the analysis of the available Lidar data within the project area. This area has a long history of ploughing it is likely that any extant earthworks that may have been visible on the early photography (pre-1960s) have since been ploughed level.

While every effort has been made to access the widest variety of photographic sources, evidence for all the features previously mapped in the area of Site 2 could not be identified, however, this does not mean these features should be dismissed or ignored and the areas still have potential for the survival of below ground archaeology, even if it has not been recorded from the available aerial photographs.

There are pockets of cropmarks within this project area, but it should be noted that even where cropmarks are known, they may only represent a fraction of the archaeological features actually present. Furthermore, the absence of cropmarks is by no means likely to be an indication of a lack of archaeological features but rather a result of either the soil-types or the agricultural regime not being conducive to cropmark formation (Ingle and Saunders, 2011, 81).

The aerial survey has therefore provided an indication of the extent and complexity of the archaeological landscape within the project area and this combined with the other evaluation techniques will support the evaluation phase of the archaeological assessment.



Plate 7 - Cropmarks of a medieval field system and enclosure (Site 6), (CP/08/27/06) © Essex County Council

8. Figures

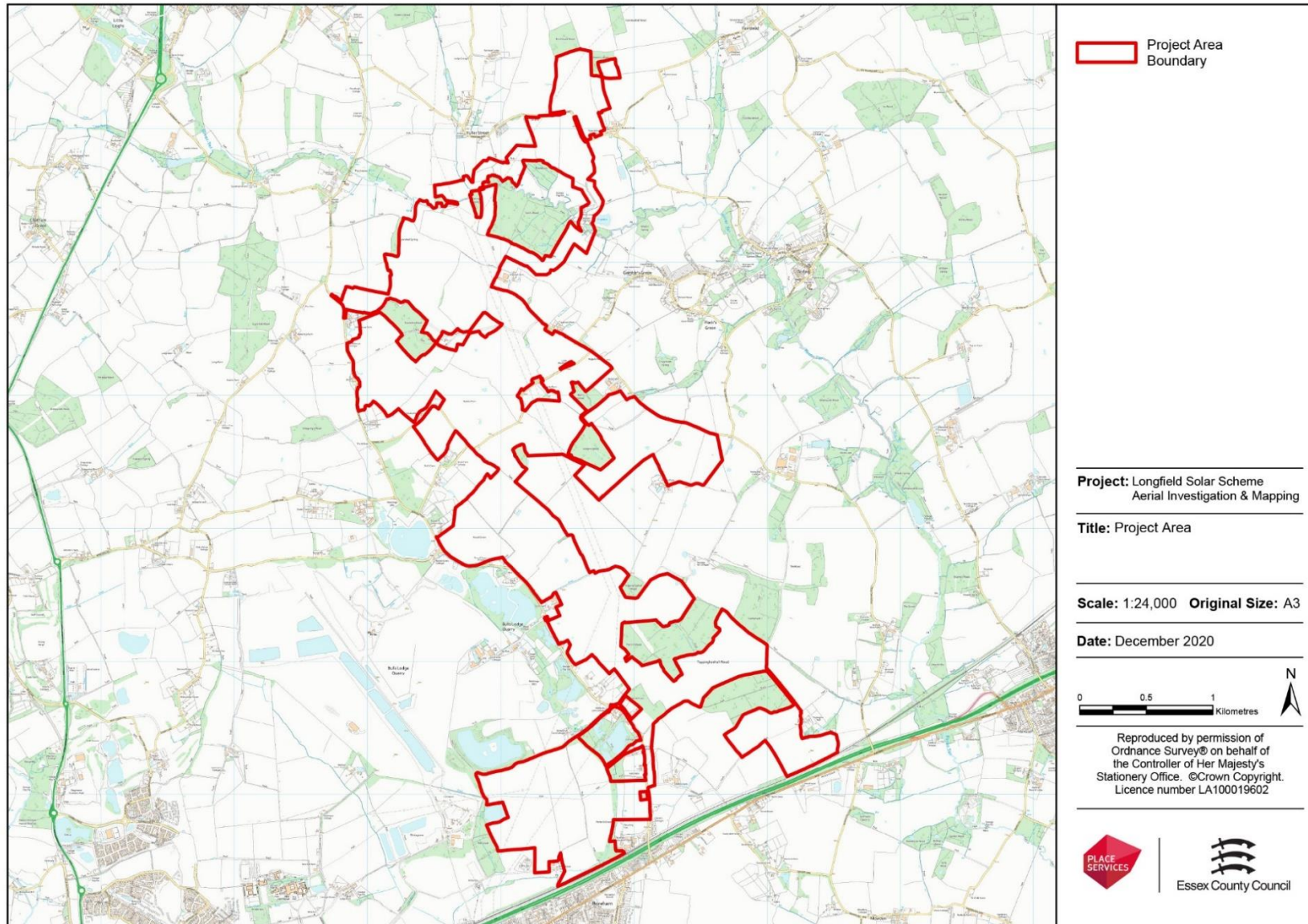


Figure 1 - Project area Red Line Boundary

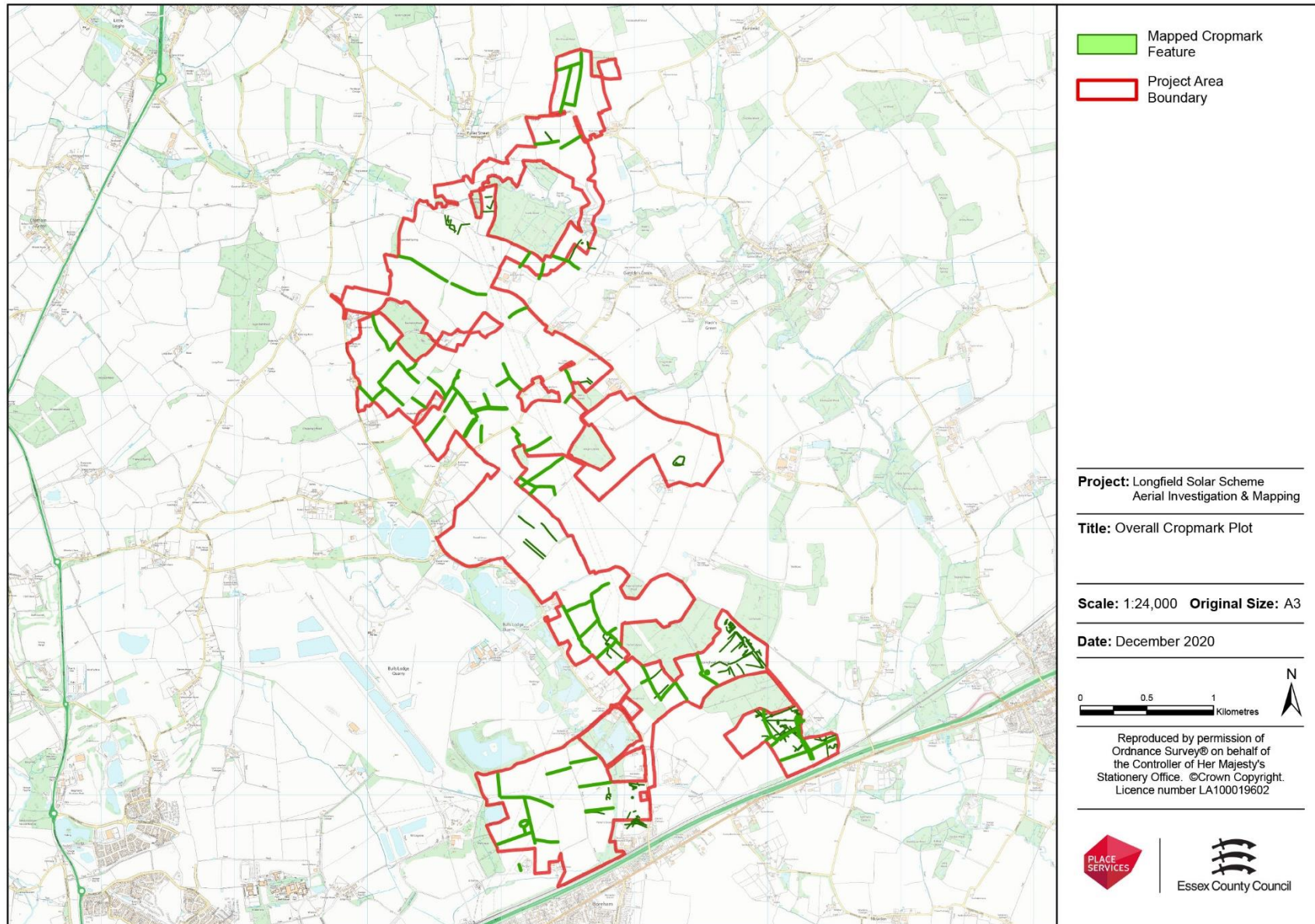


Figure 2 - All archaeological features mapped within the project area

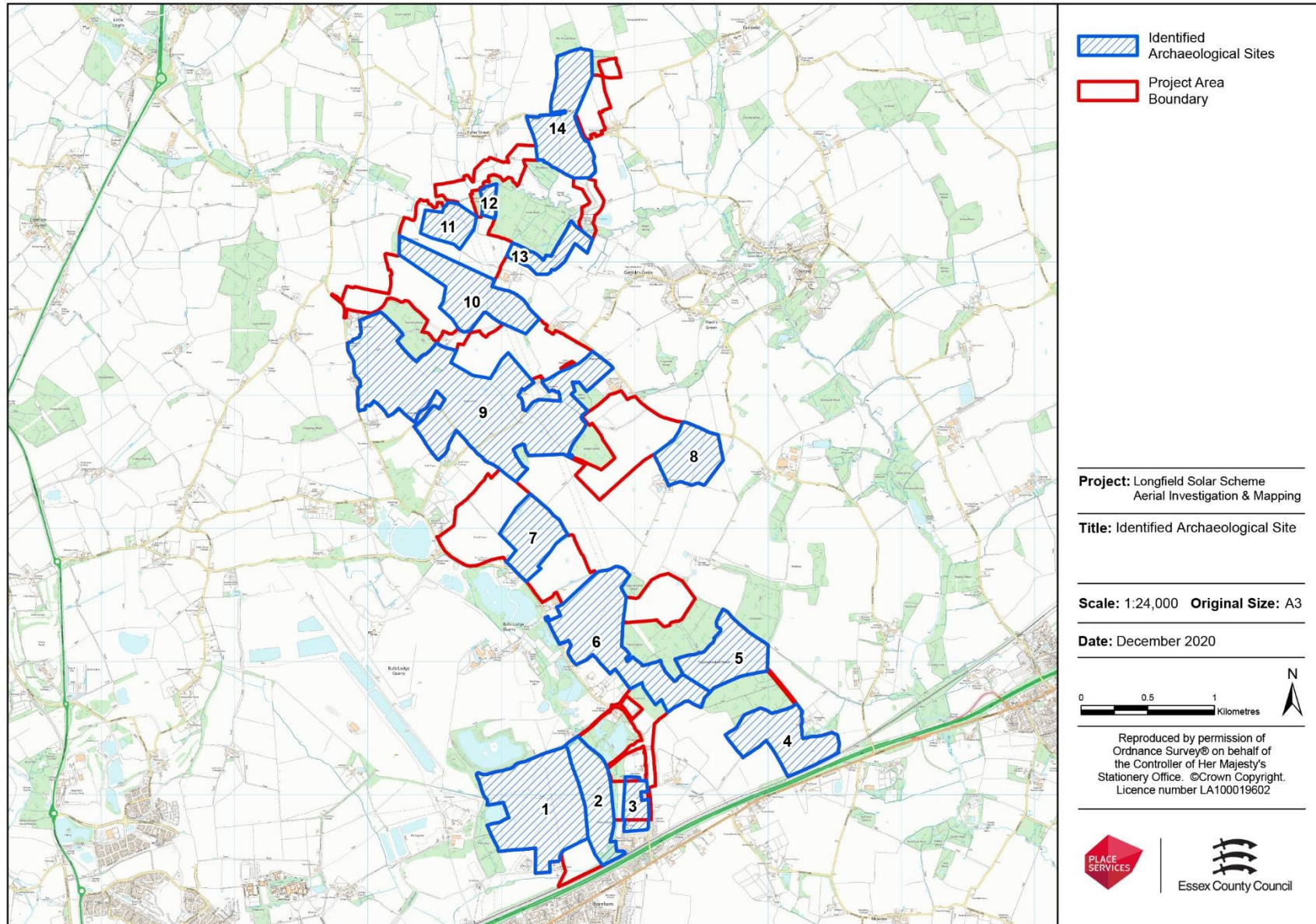


Figure 3 – Areas of identified archaeological features and Site Numbers

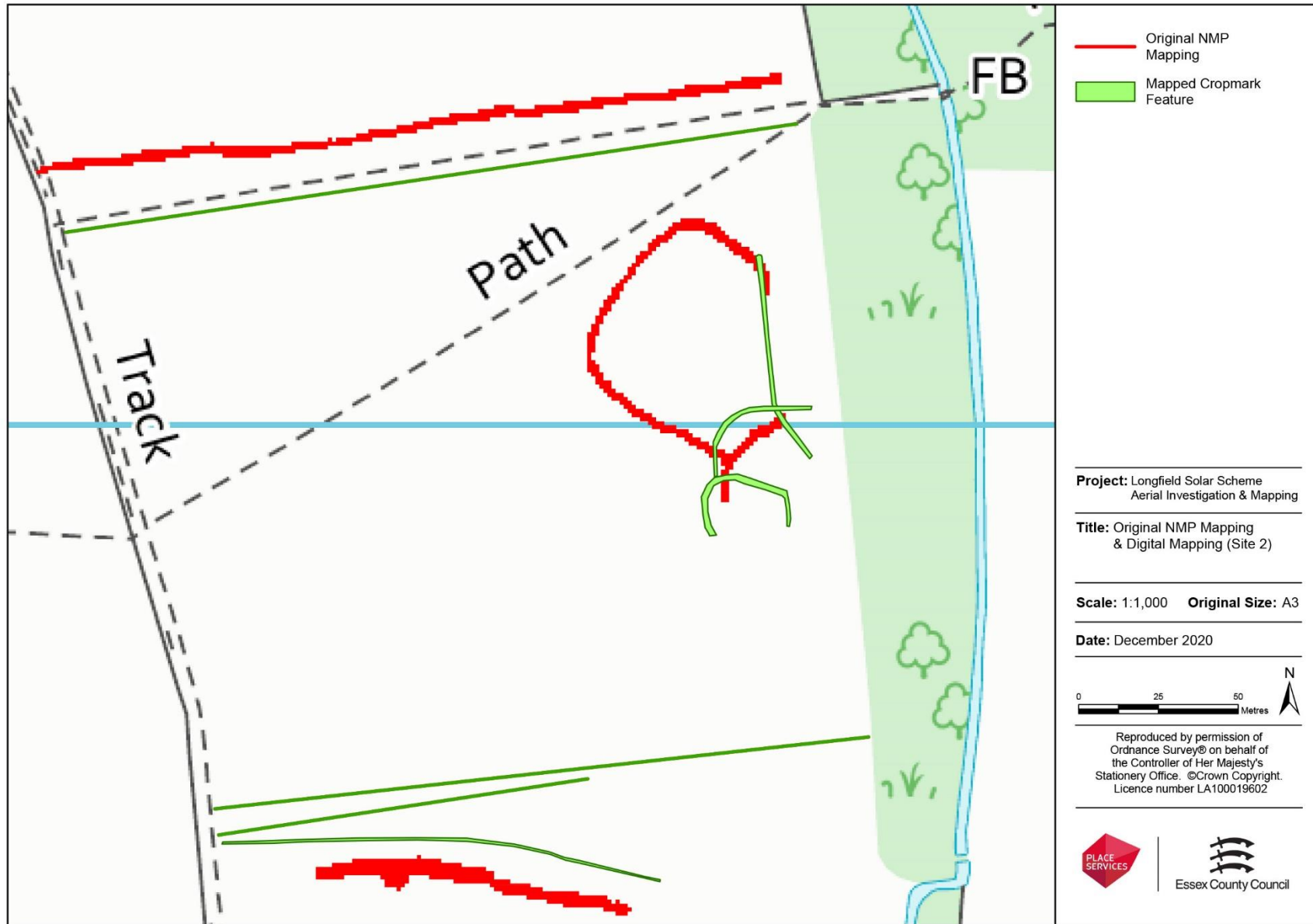


Figure 4 – Cropmarks of two incomplete sub-circular enclosures and field boundaries digitally mapped and the location of an enclosure originally mapped for the NMP but was not visible on the available aerial photographs (Site 2)

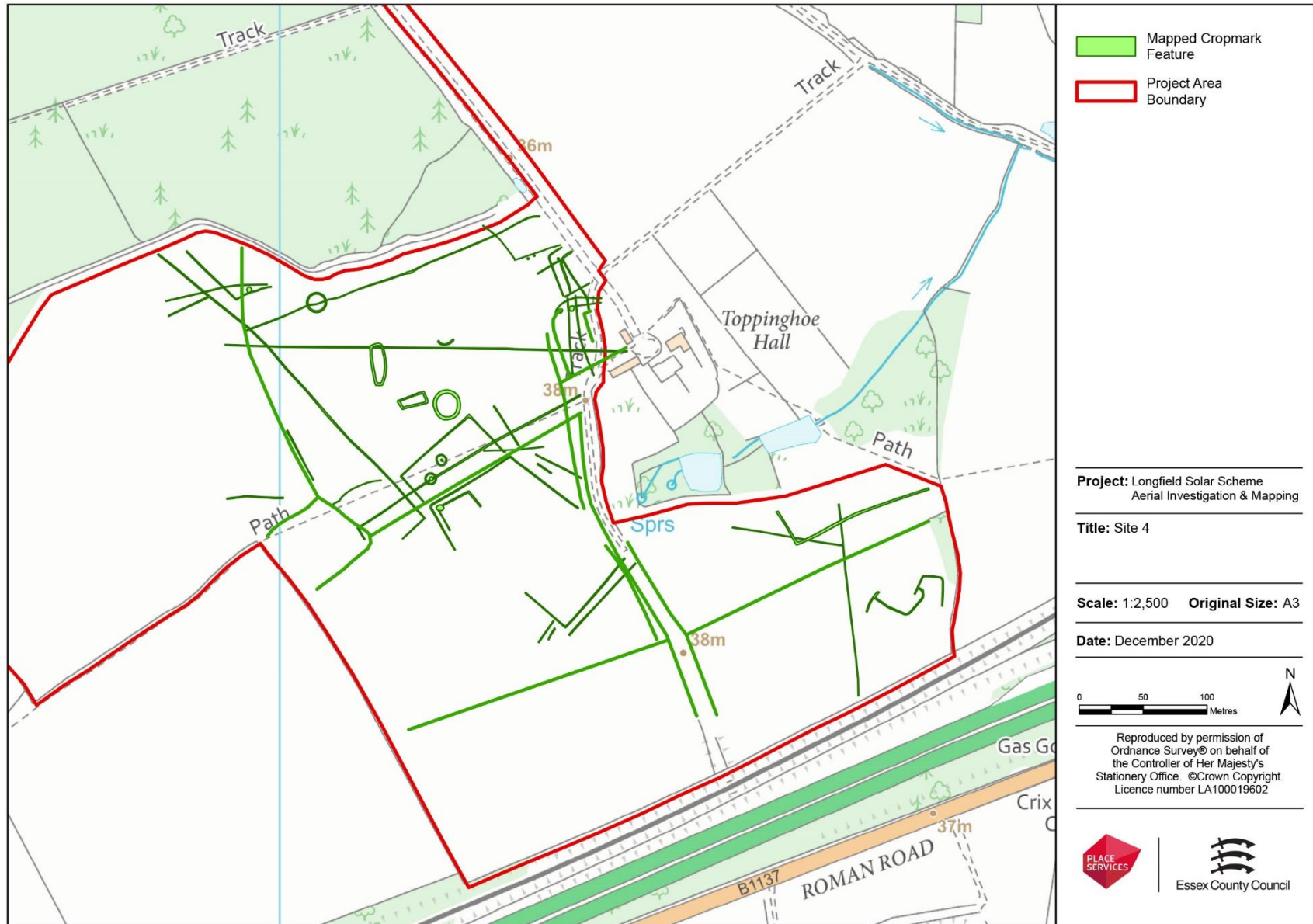


Figure 5 – Cropmarks of possible Bronze Age barrow cemetery, enclosures, field boundaries and pits (Site 4)

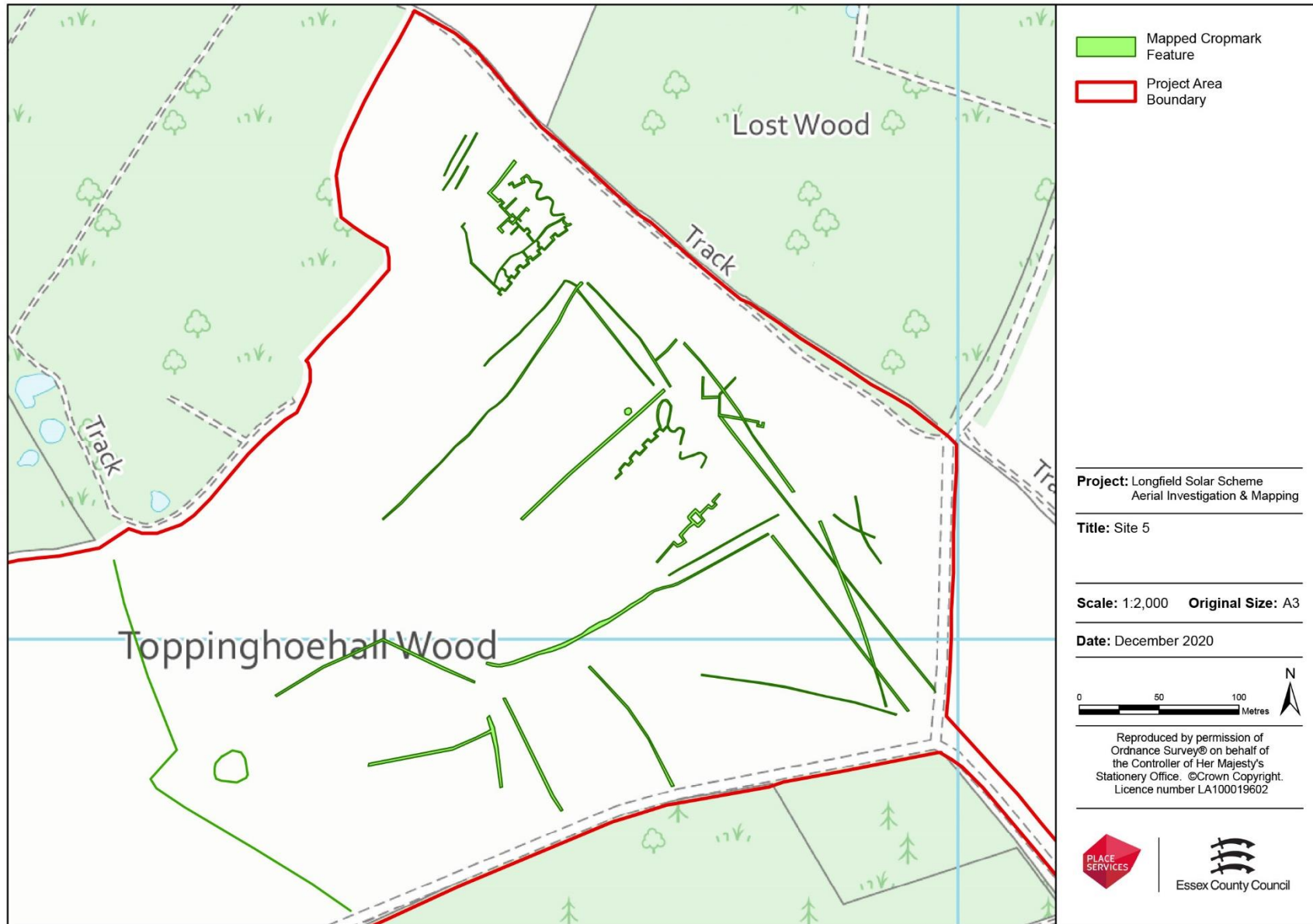


Figure 6 - Cropmarks of WWI practice trenches and field boundaries (Site 5)

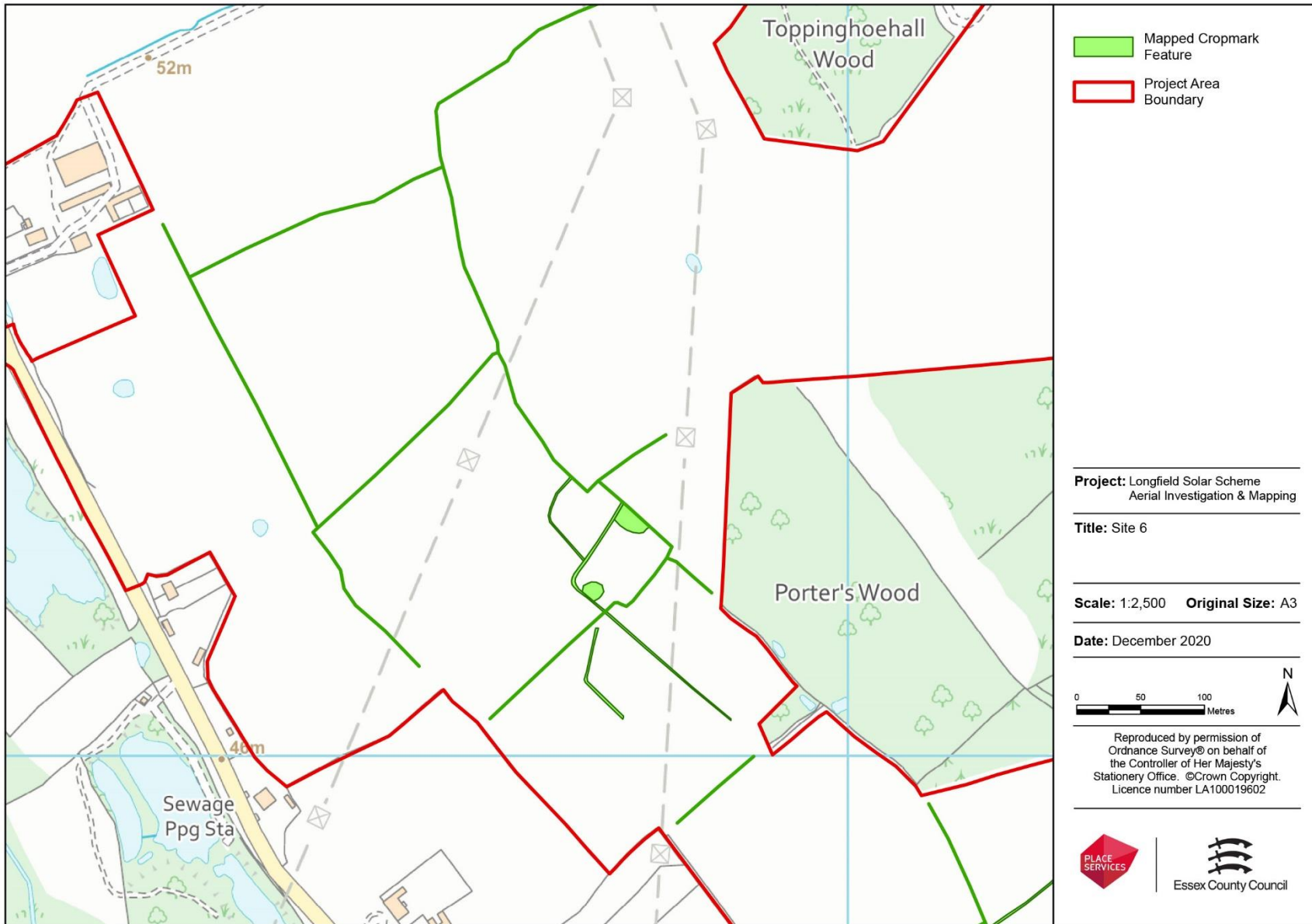


Figure 7 - Cropmarks of a former field system with an enclosure and annex (Site 6)

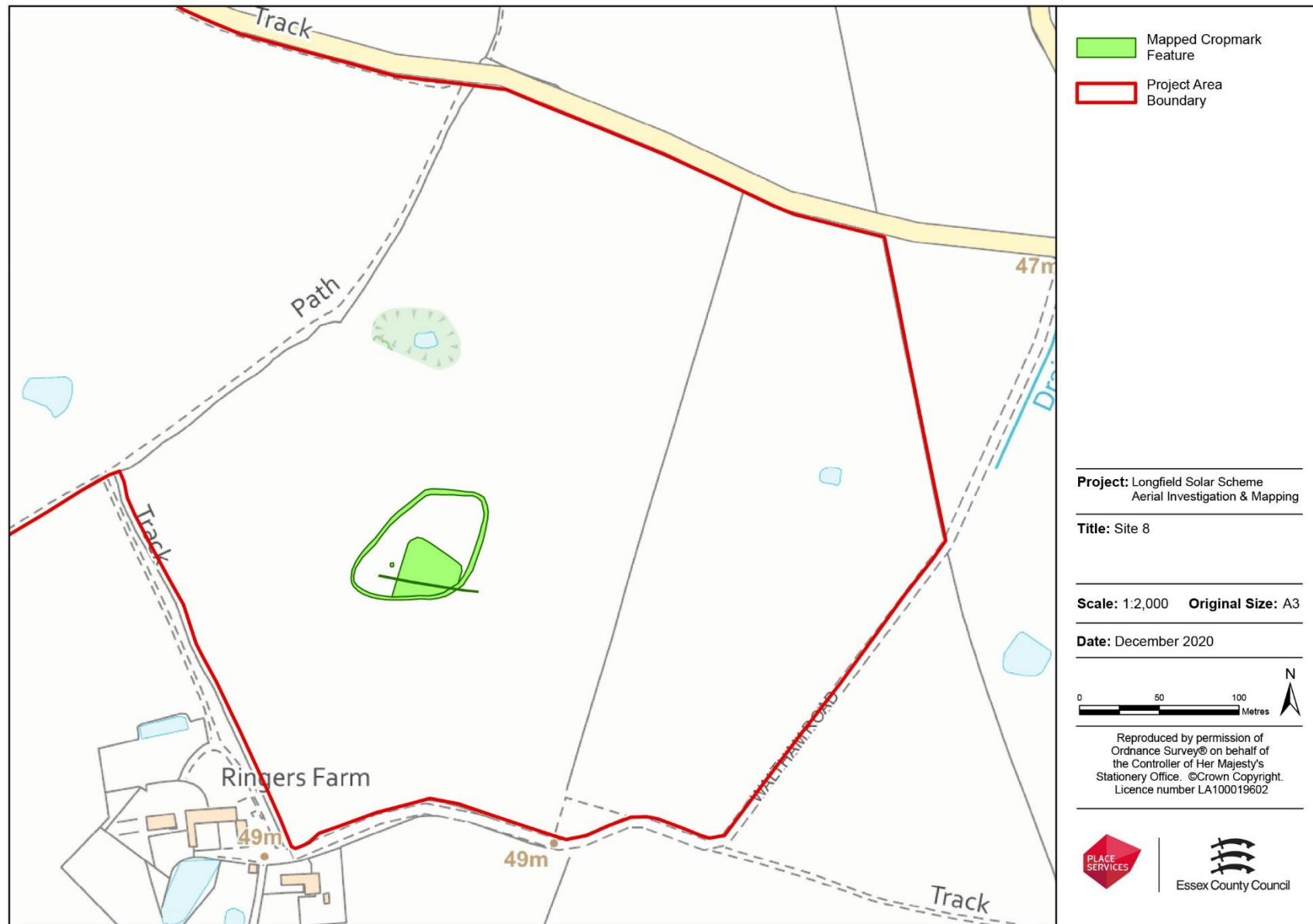


Figure 8 - Possible prehistoric enclosure (Site 8)

References

- ASE, 2013, *Archaeological Investigations at Lowley's Farm, Great Leighs, Essex*, ASE Report No 2013242
- Archaeological Solutions 2017, *Mill House Farm, Chadwell St Mary, Essex, archaeological assessment and updated project design* unpublished report
- Brown, M., 2017, *First World War Fieldworks in England*, Historic England Research Report Series 61/2017, Historic England
- Historic England, 2019, *Historic England Aerial Investigation & Mapping (formerly National Mapping Programme) Standards Technical Review*, Research Report Series 46/2019
- Ingle, C. and Saunders, H. 2011, *Aerial Archaeology in Essex: the role of the National Mapping Programme in interpreting the landscape* E. Anglian Archaeol. 136
- Reaney, P.H., 1935, *The Place names of Essex*, Cambridge University Press

Appendix 1: Methodology for Mapping

The following sections identify the archaeological scope of the project, the aerial photographic sources consulted and the methodology used for transcription. Aerial investigation and mapping typically records all archaeological features visible on aerial photographs and other airborne remotely sensed data such as Lidar dating from the Neolithic up to the 20th Century. The following lists the classes of monuments that were within the scope of this project, though not all feature types were recorded:

Archaeological Scope

Plough-levelled features and earthworks: All cropmarks and soilmarks that represent below-ground features of archaeological origin have been recorded. All earthwork sites visible on aerial photographs and Lidar were recorded. Earthworks that were no longer extant on the most recent photography were mapped and recorded as 'levelled earthworks' in the GIS attributes (see Section A1.3 below for further information regarding GIS attributes).

Post-medieval field boundaries: Former field boundaries and field systems that were marked on the 1st edition OS mapping (c. 1880s) were mapped where they were visible in conjunction with other archaeological features (and these field boundaries were mapped in a different GIS layer) to ensure the former field boundaries were identified correctly and not misinterpreted (e.g. in areas with complex archaeological features). Where former field boundaries that were on the 1st Edition OS mapping were visible in isolation (with no other archaeological features to be mapped) they were not mapped. All other field boundaries and field systems not marked on the OS mapping were recorded.

Twentieth-century Military remains: Military buildings and structures were recorded and mapped according to their form (e.g. military buildings or pillboxes were recorded as structures; airfields were recorded as extent of feature). Military features and structures mapped included anti-glider ditches and anti-aircraft batteries.

Ridge and Furrow: All remains of medieval and post-medieval ridge and furrow were recorded using a standard convention to indicate the extent of area covered by the ridge and furrow, with arrows to indicate the direction of the furrows.

Buildings and structures: Foundations of buildings and structures which appeared as ruined stonework, earthworks, cropmarks, soilmarks or parchmarks were recorded. Only buildings relating to military or industrial sites were mapped as 'structures' or defined by an 'extent of area' as appropriate, other standing buildings (e.g. with roofs) and structures were not plotted.

Parks and Gardens: Earthworks and levelled landscape features associated with historic parks and gardens were recorded but features associated with 20th-century parks and gardens were not included.

Water meadows and drainage: Areas of water meadow were mapped using bank and ditch mapping conventions. While extensive areas of drainage were not routinely mapped, drainage channels were included where the features were associated with other identified archaeological features (such as moats or water meadows).

Natural Features: Geological and geomorphological features were not mapped, although these natural features were noted in the record and within the attributes of

other mapped features where their presence would help to define the limits of archaeological features or if they could be misinterpreted.

Transport: Transport features such as canals or railways were not mapped as these features are adequately recorded elsewhere such as on historic OS mapping. Smaller features such as trackways and pathways were assessed and mapped if appropriate (for example, some historic pathways were visible on the aerial photographs were identified on the 1st edition OS mapping and these features were mapped when they were visible with other archaeological features, in a similar way to the post-medieval field boundaries).

Sources of Aerial photographs

All readily available aerial photographs were consulted during the project. Table A1 shows the main sources for the photographs that were reviewed for the project.

Source	Type of photography
Essex County Council HER	Oblique and vertical
Cambridge University Collection of Aerial Photographs (CUCAP)	Oblique and vertical images that are held within the HER or HEA. The CUCAP library is currently not accessible, therefore not all images could be viewed
Google Earth	Verticals (from up to 8 different years)

Table A1 - Sources and types of aerial photography consulted for this project

Vertical Photography

The main vertical collection for this project came from the d ECC vertical collections (Table A1). Essex County Council holds a vertical collection which ranged in date from 1960 to 2014. The ECC verticals from 2000, 2010 and 2014 were available as digital ortho-photographs with the pre-2000 photographs available as high quality scanned images (not georeferenced).

Vertical photography from Google Earth and Bing Maps was assessed; both these sources of photography are high resolution, with good clarity, are accessible and easy to assess. Up to eight sets of photographs of the project area were available on Google Earth. The available photography on Google Earth ranges in date from 2000 to 2017.

Oblique Photography

The main source of oblique aerial photography was the Essex HER. Oblique photography from the Essex HER consisted of hard copy prints of some of the HEA photography, along with hardcopy ECC photography and digital images taken between 2009 and 2018.

The CUCAP library in Cambridge was not consulted as it is currently closed, however, the Essex HER contained CUCAP images, which were assessed.

Lidar

Lidar data was downloaded directly from the Environment Agency as ASCII data. The composite 1m DTM data was used (as downloaded in November 2020). In addition, lidar was supplied by Jacobs which covered the majority of the development corridor. An overall mosaic of the lidar data was created (split into north and south sections to make the data size more manageable and easier to process).

A hill shade image was created in ArcMap. This hill shade composite image was assessed and examined alongside the available aerial photography. Where features of interest were found or additional investigation was needed multiple visualisations were produced using Relief Visualisation Toolbox (RVT) version 2.1. Various visualisations (including Slope Gradient, Simple Local Relief Model, Analytical hill shading and positive and negative openness) were then viewed in ArcGIS. Archaeological features visible as earthworks on the lidar were digitised from the visualisations created in RVT using standard mapping conventions.

Transcription and GIS

The results of the mapping were produced entirely in a digital format. ESRI's ArcMap 10.4 was used. As all the aerial photographs were assessed and archaeological features were identified a GIS polygon was created to identify the extent of the visible features and each area was given a site number (information such as description of features visible, existing HER number (if applicable) and photograph reference number were recorded in the attribute table). This system of numbered polygons allowed hardcopy and digital images of the same site to be collated, while mapping was tracked and suitable images of each site were recorded.

The oblique and vertical photographs to be used for transcription were either scanned (if the original was a hard copy held within the HER) or the digital image identified. The images were rectified using Aerial (a programme for the rectification of perspective distortion in aerial photographs, enabling archaeological features to be directly mapped from the rectified image). Control information (points such as the corner of a building or field boundary identifiable on the OS maps and the aerial photograph) was derived from OS MasterMap or the digital ortho-photography available and a digital terrain model (created from digital contour data) was used to compensate for distortion due to slope and terrain. The rectified aerial

photographs were imported into the GIS and could be viewed in conjunction with other geographic information such as geology, soil information and historic OS mapping (see Section A1.1.1 for other available layers).

Archaeological features were digitally transcribed in ArcMap using conventions and guidance from the 'Standards for National Mapping Programme projects on transcription (English Heritage, 2012, 22-23) in a compatible format of the existing digital Essex NMP. The transcription was carried out using two GIS layers (polygons and polylines) within an ESRI Personal Geodatabase. The geodatabase made use of 'domains' (the attribute domain is the set of values permitted in the attribute); this allowed rules on the editing of data to be imposed. These rules allowed 'coded values' or set text to be used that ensured consistent categories of attributes could be recorded through a pick-list system throughout the project (for example, for the attribute 'Feature Type' either – DITCH, BANK, EXTENT OF AREA, STRUCTURE, RIDGE AND FURROW and LARGE CUT FEATURE could be chosen from a list to best describe the feature that had been mapped).

The majority of the features identified during the project were digitised as polygons, while former field boundaries marked on the 1st edition OS mapping were digitised in a polyline layer (for further information regarding the mapping of field boundaries please see Archaeological Scope). The mapping conventions used for the project (and in the illustrations throughout this report, unless otherwise stated) are shown in Table A2.

Feature Type	Layer Format	Colour	Description
DITCH	Polygon and Polyline	Green	Used for all negative features seen as cropmarks and earthworks, e.g. ditches or pits. Only features digitised in the polyline layer were field boundaries marked on the 1 st Edition OS mapping
BANK	Polygon	Red	Used for upstanding earthwork, earthworks that were visible on earlier photographs that had since been levelled or compacted surfaces such as roads/trackways
EXTENT OF AREA	Polygon	Dashed outer line, no fill	Used to depict the extent of large areas features such as airfields or searchlight emplacements
STRUCTURE	Polygon	Grey	Used to outline structures such as pillboxes, Nissen huts or military tents
RIDGE AND FURROW	Polygon	Purple with purple arrow	Used to depict the area of ridge and furrow with an arrow showing direction of furrows
LARGE CUT FEATURES	Polygon		Used to depict large areas of quarrying

Table A2 - Mapping conventions used in the GIS for this project

A1.1.1 Other data

During the assessment and transcription of photographs several other digital sources were also consulted (Table A3).

Data type	Source	Format
HER monuments	ECC	GIS shape files
HER Event	ECC	GIS shape files
Essex HER	ECC	HBSMR database
Scheduled Monuments	HE	GIS Shape file
Previous/surrounding NMP data	ECC	Georeferenced TIFF images
Quarry data showing disused, existing and proposed quarry & mineral extraction areas	ECC	GIS Shape files
Geology/Soil maps	ECC/BGS/Cranford University	GIS Shape files and data from www.bgs.ac.uk/ www.landis.org.uk/soilscapes
Historic Mapping (OS 1 st – 4 th Edition 25 Inch)	ECC	Georeferenced Tiff's

Table A3 – Sources of other digital data consulted during the project

Place Services

County Hall, Essex CM1 1QH

T: +44 (0)3330 136 844

E: enquiries@placeservices.co.uk

www.placeservices.co.uk

 [@PlaceServices](https://twitter.com/PlaceServices)



Essex County Council