National Mapping Programme

Essex

Management Report

November 2003

Essex County Council

ENGLISH HERITAGE

ESSEX NMP PROJECT

MANAGEMENT REPORT

By

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November 2003

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SUMMARY

The Essex Mapping Project has been carried out by Essex County Council (ECC) as part of the English Heritage (EH) (formerly RCHME) National Mapping Programme of Archaeological Recording in England.

The project started in 1993 on the well-established foundations of skills and data developed by ECC since the mid-1970s. It is part of the continuing development of a broader Historic Environment Record for the county that includes Historic Landscape Characterisation and other thematic information.

This Management Report sets out the progress, development and methodology of the project's mapping and recording stage, which ended in January 2003. The project covered 190 quarter sheets and has mapped and recorded 10,700 archaeological sites of which 13.2% were new to the Essex Heritage Conservation Record (EHCR) and more than 81% were new to the NMR. This data and the results of research and analysis will be disseminated through formal publication. The data will be available through the EHCR and National Monuments Record Centre.

1 BACKGROUND TO THE PROJECT

1.1 The National Mapping Programme

The aim of the National Mapping Programme (NMP) is "to enhance our understanding about past human settlement, by providing primary information and syntheses for all archaeological sites and landscapes (visible on aerial photographs) from the Neolithic period to the twentieth century" (Bewley, 2001:78). The creation of the NMP, in 1992, builds on earlier geographically restricted approaches to mapping and interpretation from air photographs, including for example areas within the Upper Thames Valley (Benson & Miles 1974; Leech 1977), the Danebury environs (Palmer 1984) and the Yorkshire Wolds (Stoertz 1997).

The full National Mapping Programme has its immediate origin in three pilot cropmark classification projects in 1988 funded by English Heritage for the Monuments Protection Programme (MPP): Kent (Edis and MacLeod 1989), Hertfordshire (Fenner 1992) and Thames Valley (Fenner and Dyer 1994). These projects were aimed at assessing the methodology and resource requirement for mapping and recording sites visible as cropmarks and soilmarks to standard specifications at a scale of 1:10,000. In 1989 a fourth pilot project was initiated to examine the same questions for an upland environment in the Yorkshire Dales.

NMP produces a basic level of data with an actual representation of features in the landscape, rather than just dots on maps, but does so at a speed that allows large areas to be covered in a relatively short period of time. The results and success of these projects led to the creation of a National Mapping Programme (NMP) for England, (Bewley, 1998b) in 1992, aimed at providing an inclusive and standardised approach to mapping archaeological landscapes of all periods over extensive survey areas.

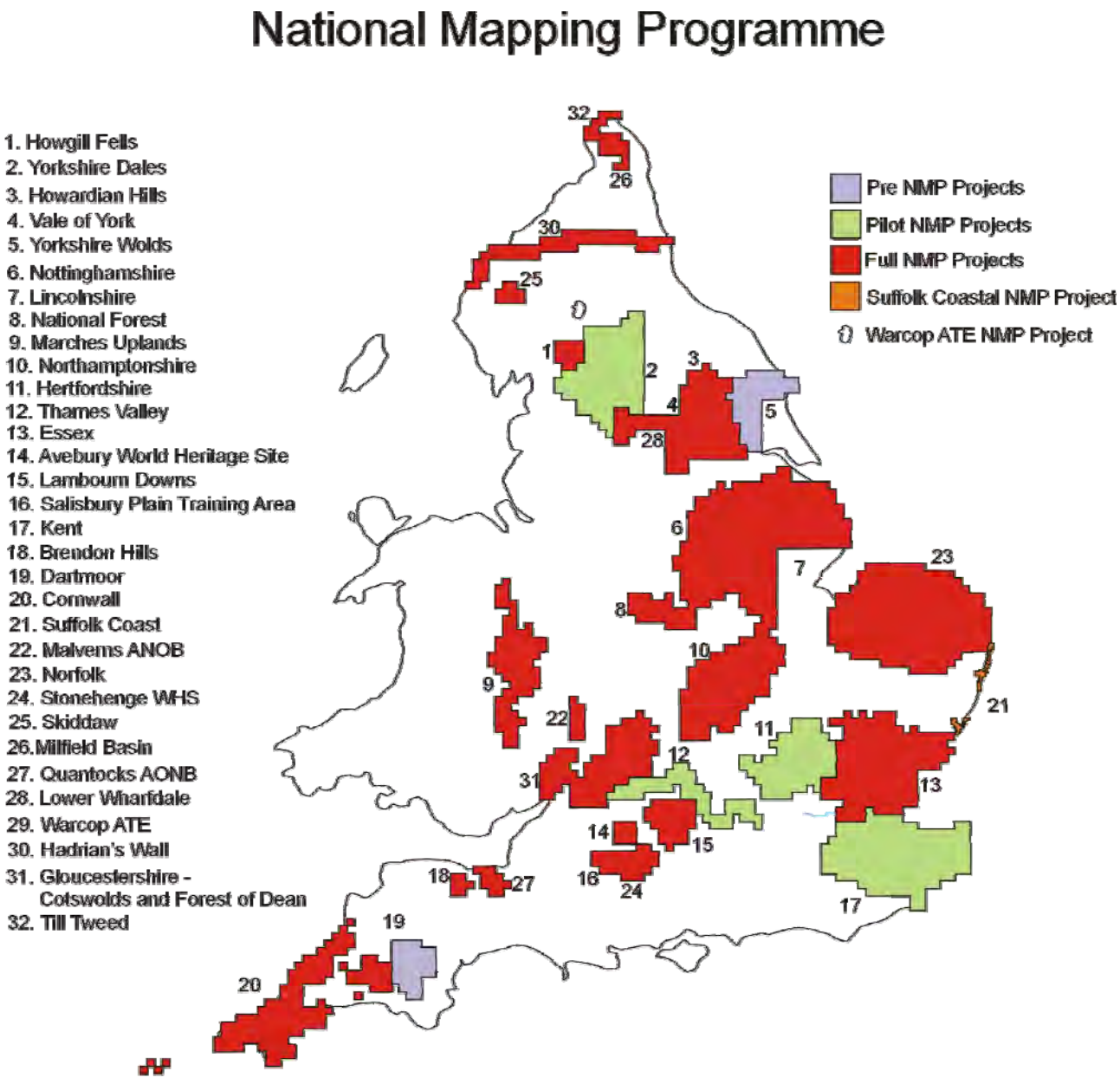


Figure 1 - Map of the National Mapping Programme in 2002

The first full NMP projects were in Lincolnshire, conducted by the Air Photo Unit (APU) of the Royal Commission on the Historic Monuments of England (RCHME), Essex (1993), Nottinghamshire (1993), Cornwall (1994) and Northamptonshire (1994) undertaken by Essex County Council, Air Photo Services, Cornwall County Council and Northamptonshire County Council respectively. The external projects were initially funded by English Heritage (EH) grant-aid through RCHME, then directly by RCHME.

Since 1999, following the merger of EH and RCHME, the Essex project has been funded through English Heritage's Archaeology Commissions Programme as part of the NMP Acceleration Programme.

At the time of writing 22 NMP projects have been completed and 10 are in progress. To date over 30% of England has been mapped by the programme.

Methodology

NMP uses a mapping scale of 1:10,000, with standard recording systems to ensure site descriptions and interpretations are systematically and consistently recorded. The aim of morphological classification is to attempt to understand classes of groups or sites in a landscape and to explore their distributions.

Classification of features is by monument type, date and form, location, size and shape. There is an assumption that sites of similar shape and size in similar locations might have had a similar date and/or function. "It is recognised that information about archaeological sites and landscapes derived from aerial photographs has its limitations: the majority of sites are undated, except by association, some are undateable without further investigation, and the sites we can see are only a small percentage of what may have existed or of what is visible using this technique" (Bewley 2001, 79).

Despite the limitations of aerial evidence noted above, and the fact that as a single source it has biases of discovery and interpretation, it offers the ability to formulate hypotheses about settlements and landscape by the creation of groups of sites based on location, size and shape. Hypotheses generated can be tested by research projects and the information has been used by MPP to determine selection for scheduling.

The reports on NMP projects completed to date demonstrate the success of this type of approach. Not only do they show that a high percentage of sites mapped are new to the record, but they have made significant advances in our understanding of the landscapes investigated.

1.2 The context of the Essex project in the NMP

Essex County Council (ECC) has been conducting aerial reconnaissance survey for archaeological sites since 1974, with funding from the RCHME and EH. This work has included the integration of the survey results into the Essex Heritage Conservation Record (EHCR), formerly the Sites and Monuments Record (SMR). Computer-aided techniques of transcription were adopted in the early 1980s for the plotting of some sites.

Essex, whilst rich in archaeological remains of all periods, has very few visible prehistoric monuments, a consequence of both a long history of cereal growing and a lack of stone to build megalithic structures. Over the past 30 years aerial survey has made a significant contribution to changes in knowledge and perception of prehistoric Essex (and much of eastern England), enabling the identification and recording of extensive cropmark evidence for settlements, field systems and other monument types.

The continued use of aerial photography for the location and recording of archaeological landscapes is particularly important in Essex where intensive agriculture in particular has been a constant threat to the

archaeology, but conversely over much of the county geology and current land use is conducive to cropmark formation. A considerable proportion of archaeological sites in Essex have been (and continue to be) discovered by aerial survey indicating the potential of systematic mapping using the most informative aerial photographic resources available. (Strachan 1998; Brown and Glazebrook 2000).

Given the wealth of cropmark sites a number of previous studies have assessed blocks of landscape, e.g. Blackwater estuary project (Wallis and Waughman 1998), Ardleigh (Brown 2000), South Essex (Wilkinson and Murphy 1988). Others have focused on particular classes of monument, e.g. cropmark enclosures project (Brown 2003). The continued programme of aerial survey, the Essex Mapping Project, programmes of excavation and field survey and other projects have all added considerably to the record of cropmark sites and excavated examples against which these can be compared.

With this history of reconnaissance and mapping and the existing expertise, and given the relatively large proportion of the county's archaeology surviving only as buried features, Essex was selected as one of the first NMP projects in 1993. This was the first attempt in the county to systematically plot all sites in a consistent and accurate manner and to bring together evidence from a wide range of sources into one coherent whole. Furthermore it allowed the reassessment of many of these, as yet undated, features in order to gain some possible interpretation of their date and function, and to guide further more focused research.

2 PROJECT DETAILS

2.1 Project Area.

The Essex NMP project was begun in 1993 and as a result encompasses the county of Essex as defined at that time. It includes the two Unitary Authorities of Thurrock and Southend created by Local Government Reorganisation in 1998. For the purposes of this report 'Essex' is used to define the post 1974 and pre-1998 administrative county. The project consists of 190 whole 0S 1:10, 000 scale quarter sheets totalling 4250 square kilometres, providing complete coverage of Essex. Of these 102 sheets are full sheets covering Essex, 35 are coastal edge sheets and 53 quarter sheets overlap into one or more of the neighbouring 4 counties (Greater London, Hertfordshire, Cambridgeshire and Suffolk) and 2 unitary authorities.

The Hertfordshire NMP project, completed as one of the pilot studies in 1992, immediately adjoins the Essex NMP and there is an overlap of 11 map sheets. Hertfordshire NMP did not use vertical photographs and recorded only cropmark sites so it was felt important to remap the area. To the south across the Thames Kent was also mapped as one of the pilot projects this time using verticals, but again recording only cropmark sites. The project recording in the areas within adjacent counties was not completed to the same specification as the Essex data. Whilst all the NMR and CUCAP photographs for the entire sheet have been consulted, additional material held by the relevant SMR has not been assessed and only sites within the Essex border have been added to the MORPH2 database. However the scope and quality of mapping and interpretation are consistent with the general NMP standards and the maps are available for future NMP projects in these areas.

The Essex NMP project was divided into blocks of contiguous quarter sheets for the management of National Monuments Record (NMR) photo loans and for monitoring purposes. The original organisation of blocks and its numerical sequence was established to reflect the mapping priorities at that time, including the completion of the entire coast during the early stages of the project. As the project progressed, these priorities changed on a number of occasions and the remaining project area was reordered and renumbered.

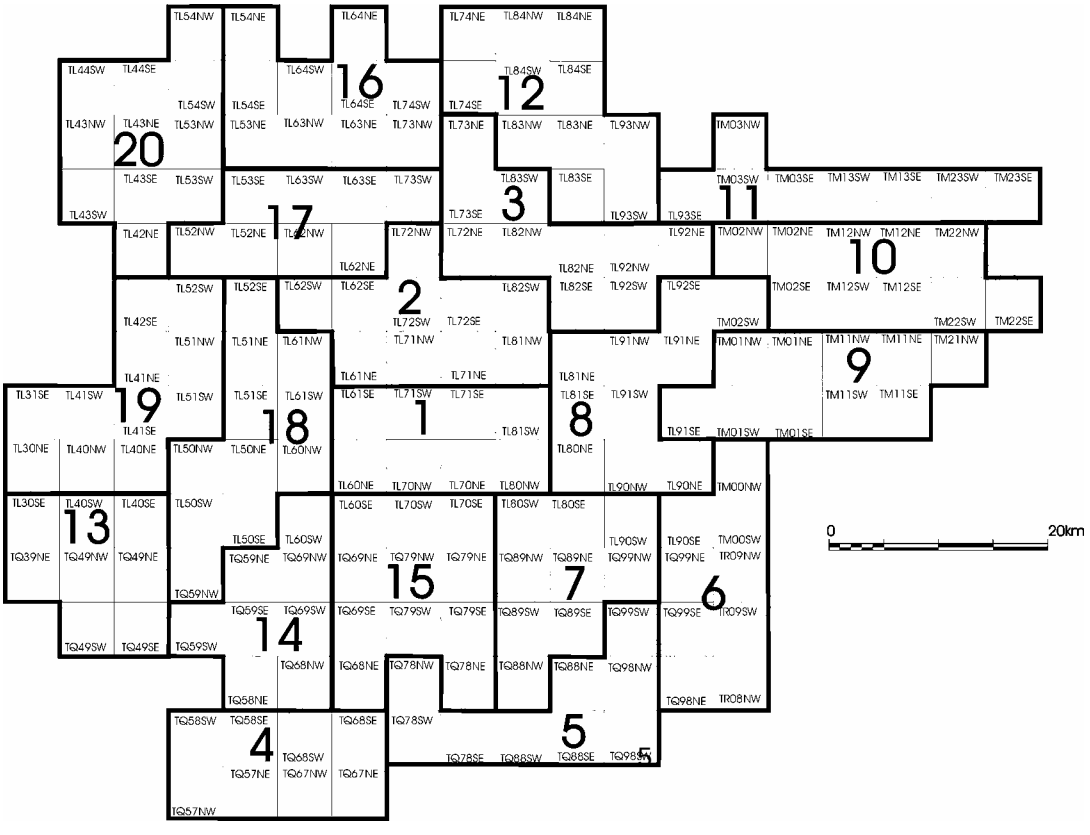


Figure 2 - The Essex NMP Blocks as mapped

2.2 Geology of the county.

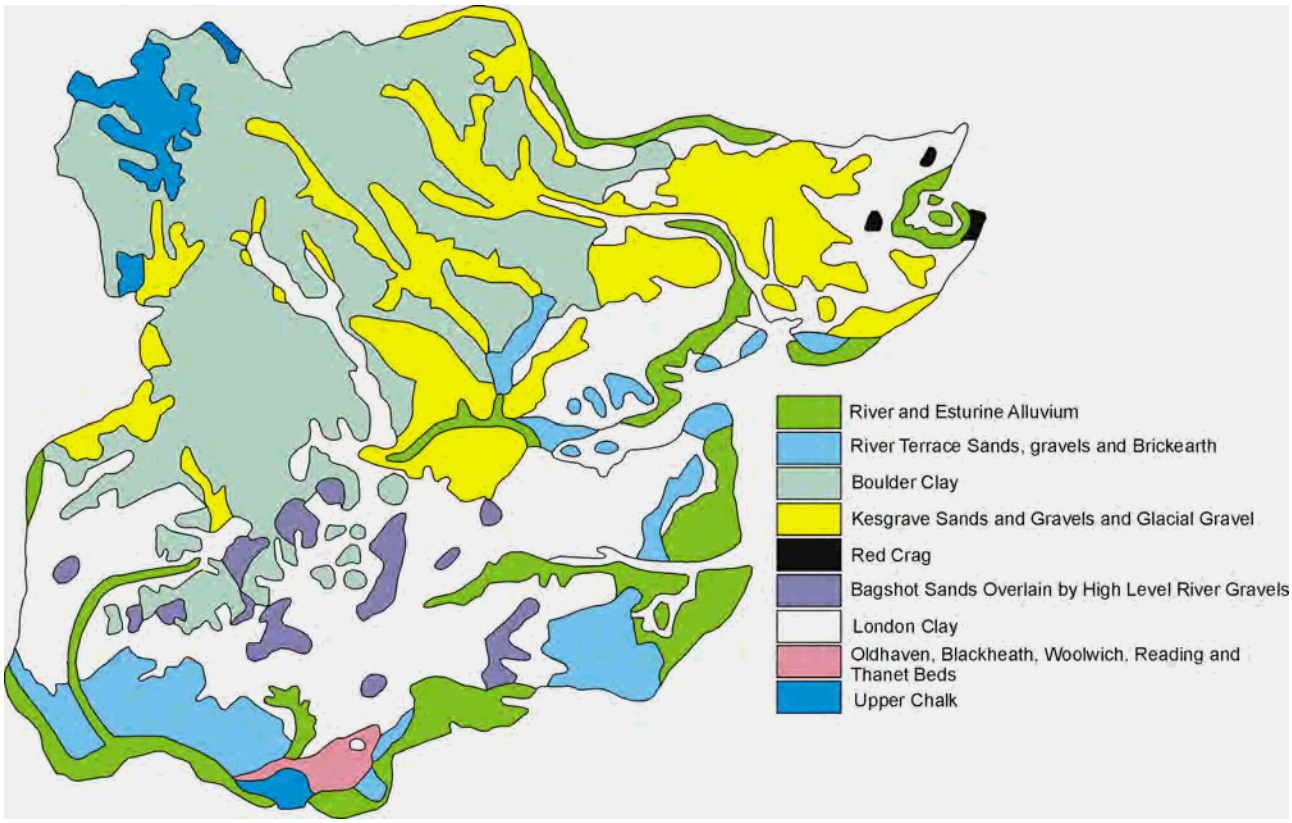


Figure 3 - Solid and Drift Geology in Essex (after BGS)

Quaternary	Recent/Holocene	Flandrian		
	Pleistocene	Devensian	Cold glacial at end of stage	Wind-blown silts – loess and brickearth
		Ipswichian	Temperate	
		Wolstonian	Cold, in part glacial	
		Hoxnian	Temperate	Silts and Clays
		Anglian	Periglacial and Glacial	Chalky Boulder Clay
		Cromerian	Temperate	Clay enriched Sands and Gravels
		Beestonian	Periglacial and Glacial	Sands and Gravels
		Waltonian	Temperate	Crag Deposits
Tertiary	Eocene		Warm climate	London Clay; Claygate and Bagshot Beds, Oldhaven Beds
	Palaeocene		Temperate	Woolwich and Reading Beds
			Temperate	Thanet Beds
Cretaceous				Chalk

Table 1: Solid and drift deposits found in Essex

Structurally Essex occupies a large part of the geological formation known as the London basin, a trough shaped syncline which trends southwest to northeast from London to Harwich. It is bounded and underlain by Chalk and filled with successive later deposits. The solid geology of Essex comprises deposits of Cretaceous and Tertiary Age but over much of the county these are overlain by drift deposits of Quaternary age.

Cretaceous: Chalk

The oldest rocks found in the county is the Cretaceous Chalk which forms the foundations of the London Basin, but now reaches the surface in only two comparatively small areas; in the south of the county in Thurrock, Purfleet and Grays, and in the extreme north west of the county around Saffron Walden. It creates a downland landscape which links south-westwards to the Chiltern Hills and northwards to the Gog Magog Hills of Cambridgeshire. In both areas it was quarried, particularly near the Thames where it was extensively extracted for the Portland cement industry.

Tertiary

Palaeocene

These are thin deposits, laid down between 54 and 65 million years ago, and are generally sandy and silty. The fine grained Thanet Beds (sands with silt and loams) are overlain by the marine and lagoonal Woolwich and Reading Beds comprising sands, clays, pebble beds and loams.

Eocene:

London Clay

The London Clay covers the chalk over much of the county and comprises of stiff dark or bluish-grey clay, which shrinks and cracks in dry weather. It was used as a source for red bricks and tiles.

Claygate and Bagshot Beds

These form a sandy transition at the top of the London Clay, the Claygate Beds consisting of alternate layers of sand and clay, whilst the Bagshot Beds are mainly fine sand. Formerly covering the whole region, erosion has now reduced the outcrops it to isolated patches on hilltops in central Essex.

Quaternary

Three principal geological and climatic processes of the Quaternary had a significant effect in forming the present landform and landscape in Essex:

- Migration of the Thames and Medway rivers.
- Anglian ice sheet with the subsequent deposition of the Lowestoft Till and the formation of the present river drainage system.
- Relatively recent rise in sea level. (Hunter 1999)

Fluvial sands and gravels

The extensive deposits of sands and gravels which overly the solid geology of Essex are derived from the former courses of the rivers Thames and Medway. During the early Ice Age the Thames flowed to the north of London, through north Essex, Suffolk and Norfolk and out across what is now the southern North Sea to become a tributary of the Rhine. The substantial thickness of what is now called Kesgrave Sands and Gravels represents the actual bed of the river. Although much of this deposit has been buried beneath the Lowestoft Till, although post-Anglian glacial erosion by the new rivers Stour, Colne, Blackwater and Chelmer, has exposed the fluvial deposits on their valley sides. During the Quaternary period this proto-Thames appears to have migrated progressively south-eastwards through northern Essex, settling into the mid-Essex Depression through Chelmsford and Colchester before the final diversion by the Anglian ice sheet into its modern course. The terraces, which resulted from this, have survived because the river did not rework its own deposits (Hunter 1999).

Originally during this time the River Medway flowed north across east Essex to join the Thames near Clacton, leaving behind a ribbon of distinctive gravel which can be found between Burnham-on-Crouch and Bradwell-on-Sea. At the same time as the deposition of the Kesgrave Sands and Gravels, the Medway laid down the High-level East Essex Gravels, which survive as degraded gravels at Dawes Heath, Ashingdon and St Lawrence on the Dengie peninsula (Lucy, 1999).

Following its diversion the Thames combined with the Medway in the late stage of the Anglian to carve create a channel from Southend through Asheldham and Cudmore Grove to Clacton. This filled with deposits during the Hoxnian and the channel moved progressively eastwards leaving beds of gravel,known as the Low-level East Essex Gravels , at Southchurch, Rochford, Shoeburyness, Barling and across the Dengie peninsula. These are known as the Low-level East Essex Gravels.

A fourth group of deposits are those of the Lower Thames Terraces laid down following the diversion of the river. These occur at Little Thurrock, Orsett Heath and Mucking. The modern (post-diversion) Thames has numerous bench-like terraces on either side of the valley, the oldest being at the highest elevation. There were also other northward-flowing tributaries of the early Thames, which have left as evidence patches of gravel that are found on the tops of the hills in south Essex, such as the Langdon Hills, Warley and High Beach in Epping Forest (Hunter 1999).

Glacial till

The Anglian glaciation, a severe cold stage about 450,000 years ago, enabled an ice sheet to spread south into the region across the valley of the early Thames, diverting it south to its present position. The ice sheet deposited a substantial thickness of boulder clay, or till, over most of the county north of the A12. This overlies on top of the old Thames gravels and it forms a distinct plateau over the north of Essex, now dissected by modern river valleys. Boulder Clay is the main geological deposit in the northwest of the county and consists of clays, silts and sands with many erratics. The chalk content makes it highly fertile.

At its furthest extent the ice sheet reached the line of hills formed of Bagshot and Claygate Beds, penetrating at points to leave deposits of till and glacial outwash. The southern extent of the Boulder Clay is defined by a line of low hills rising as a ridge south-east of the London-Colchester road as far south as Hornchurch.

Glacial sands and gravels

The region was situated at the southern-most limit of the Anglian ice sheet, where colossal volumes of melt water would have been continually released. In parts of East Anglia, boreholes have revealed deep, steep-sided valleys cut into the chalk bedrock and now completely filled with sand and gravel and hidden by a covering of boulder clay. Known as buried tunnel valleys or buried channels these remarkable natural features were formed beneath the ice sheet and were the main drainage routes for melt water. They include one of the best examples of a buried channel is the Cam-Stort Buried Channel that is present from Great Chesterford south as far as Bishops Stortford. Glacial gravel is present in many other places in Essex, and is recognisable as an unsorted residue of many rock types, mostly flint, laid down under these exceptional conditions (Lucy 1999)

End of glaciation

During the final glacial stage, the Devensian, ice sheets spread no further south than north Norfolk. Essex experienced permafrost conditions for which evidence is seen in the network of ice wedge polygons that are occasionally revealed by crop marks.

The position of the Essex coastline has changed extensively during post-Glacial times. In general sea levels have risen as the Arctic ice has melted and in response to the isostatic sinking of southern England and localised depression of the southern North Sea floor between Essex and Europe (Allen & Sturdy 1999).

2.3 Soils

Details of the soils and their uses are given in table 2 and map in figure 4

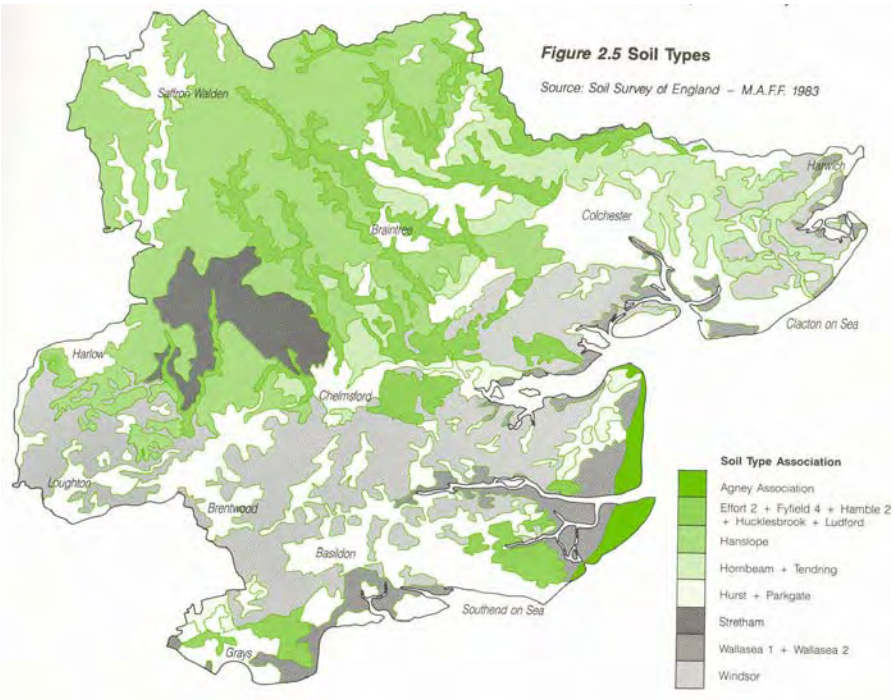


Figure 4 - Soil Types (from The Essex Environment)

Essentially the soils in Essex are derived from the glacial drift deposits, laid down during the Pleistocene and Recent periods. The drift is often thin and is rarely more than 50m thick, and the deposits are of variable nature and include Head, glaciofluvial and river terrace deposits, Aeolian drift, alluvium, lacustrine sediments and peat. The most significant characteristic of Essex soils is their great variety, in texture and composition, both over the county as a whole and within small distance (Scarfe 1942; Hodge et al 1984).

Till was the most widespread and thickest drift deposited by the ice sheets, and is characteristically poorly sorted, often unbedded. Glaciofluvial sands and gravels are partly-sorted, water laid deposits formed within or beyond the ice sheets. Beyond the limits of the ice in the surrounding periglacial zone, thin unsorted Head deposits were formed locally. Silt and sand blown from the relatively bare periglacial zone have been redeposited as Aeolian silt and sand. River terraces, comprising better sorted than glaciofluvial deposits, formed in valleys during periods of river aggradation. Alluvium and peat are widespread in river valleys and along the coast. There are, however, some areas of the county, particularly parts of the London Clay that have not been covered by later drift.

The broad categories of soils therefore reflect the underlying drift and, where appropriate, solid geology:

London Clay: The London Clay where completely free of drift gives a very heavy soil, as the stiff blue clay weathers to a brownish sticky soil, which is difficult to work when wet and which cracks when dry. Extending

across south and east Essex this heavy soil It is very impervious to water and needs careful draining except where slopes are steep.

However, in the north-east of the county the London Clay has erratic and very thin spreads of gravely or loamy drifts (not significant enough to be marked on the geological map) which change the character of the soil. Although the spreads may be little more that a few inches thick they make a great difference to the working of the soil and its productivity, resulting in a medium soil with some stones and a large number of septarian and pyritic nodules (Scarfe 1942).

Bagshot and Reading Beds: Soils developed in the Bagshot Hill Zones are extremely complex. Bagshot and Reading Beds almost always form light soils, which are sometimes sandy, sometimes very stony, and tend to be left as woodland or heath, whilst the finer Reading Beds almost always give well cultivated loams. Epping Forest which covers the summit and flanks of the steep Epping Ridge illustrates the vegetation types that would develop naturally along these hills, with mixed hornbeam/oak woodland on the London Clay while beech predominates on the claygates (Scarfe 1942).

Chalk: The chalk soils of the far north west of Essex are light and a good deal of the adjoining areas which have only thin spreads of very chalky boulder clay tend to develop light or medium solid.

Glacial Drift: The Boulder clay, glacial gravels and loam form soils of varied texture.

Boulder Clay: In the Eastern region as a whole the Chalky Boulder Clay covers some 30% of the region on the dipslope of the chalk but overlapping the London Clay and the chalk. The till surface has flat crests and rounded slopes, the whole landscape falling gently to the east following the general dip of the rocks underneath (Hodge et al 1984)

The chalk content of the till varies, the non-carbonate residue in the upper part of the till is uniformly clay over a wide area. Typically the unweathered clay is grey, calcareous, unstratified and massive. The uppermost two or 3 metres are usually fissured and weathered to grey with yellow brown mottles. It contains abundant pebbles and rounded fragments of white chalk, and also includes angular flints and occasional quartz, limestone, septaria and igneous rock fragments. It differs greatly from the London Clay, works more easily, because of its lime content, and is less impervious. It also contains many kettle holes and ponds useful for cattle.

Glaciofluvial deposits: These are mainly outwash from ice sheets so typically occur at the margins of the till and like river terrace deposits consist of a mixture of sand and siliceous stones. The matrix is brown, yellow-brown, red-brown sand although locally loamy or with loamy laminations or lenses of chalk pebbles. The glaciofluvial drift outcrops from beneath the chalky till on the sides of the many wide valleys which drain the till boulder clay plateau.

Head: During the cold stages of the Pleistocene the ground was seasonally frozen, the freeze-thaw shattering rocks and stones and distorting and heaving the ground. During the summer thaw the upper layers were saturated and the semi-liquid debris moved laterally by solifluction. Head, an unsorted deposit of local material, was laid down as valley trails, fans and spreads on low ground leaving a widespread though thin deposit in the clay lowlands (Hodge et al 1984)

Aeolian drift: This was thinly and widely deposited outside the glacial limits during the Devensian (Hodge et al 1984). Its average grade varies with the location and rarely forms a distinct deposit as it has usually been incorporated into the underlying material by cryoturbation and other processes. It occurs on the high ground between Colchester and Ipswich. Small patches are found in some of the valleys west of Chelmsford and St Albans and there are larger areas near Southend-on-Sea where the loess becomes calcareous at depth.

Large areas of boulder clay afford medium loam or marl while the glacial gravels are usually light. Particularly fertile and noteworthy is the area of medium glacial loam occurring north and north-east of Colchester whose distinctive character gives rise to a separate agricultural region, the rich fertile soil being particularly suited for market gardening. The boulder clays and loams together with brickearth are undoubtedly the richest soils of Essex (Scarfe 1942).

Terrace gravels

River terrace deposits are a similar but generally finer lithology and better sorted than glacial deposits and are widespread throughout the region. The terrace gravels of south west Essex form light soils as do the valley gravels of Burnham and Clacton. River terraces, with well-defined flat surfaces, usually flank the present rivers. The constituent stones reflect the river catchment at the time of deposition.

Alluvium

The soils developed on the coastal alluvium are mainly calcareous, deriving from alluyvium. This was deposited during marine incursions during the postglacial rise in sea level. Large areas flank the rivers Colne, Blackwater, Crouch and Thames in Essex. The marshes of the Crouch are clayey inland and silty towards the sea. In places the seaward parts of the alluvium have been disturbed by an ancient salt making industry.

River alluvium is less extensive than marine alluvium. Strips which are rarely more than a kilometre wide are found on the floodplains of the main rivers. These are of variable thickness and generally clayey. Most catchments are in clayey rocks so most alluvium is clayey. Its thickness varies.

Table 2: The main soil associations in Essex (information from Scarfe 1942; Hodge et al 1984; Essex County Council 1992).

Name	Location	Nature of soil	Comments
Agney Association	These develop in marine alluvium on flat reclaimed land near the coast. The soil is predominantly found on the Dengie peninsula and the seaward side of Foulness and Havengore.	This consists mainly of calcareous alluvial gley soils of the Agney and Wisbech series.	The soils are very porous and easy to cultivate. In Essex arable crops, including cereals, potatoes and some sugar beet are grown. Many areas of Foulness have rough grazing around military installations.
Efford 2 Association	Covering an area around Chelmsford. The soils are generally found on high land, and are formed in glacio-fluvial drift. Formed in glaciofluvial drift, associated deeply weathered drift and the underlying Eocene clay.	A variable soil association with no dominant soil series. It consists of a range of well-drained, mainly fine loam over gravely soils,	At Danbury and Wickham Bishops a prominent dissected ridge is well wooded. Most of the land, however, is arable with a wide range of crops grown. There are pear and apple orchards and around Tiptree soft fruit. The main arable crops are wheat and barley, some beans and oilseed rape and sugarbeet around Tollesbury.
Fyfield 4 Association	They occur on the tertiary formations in Essex, principally on the gentle slopes of south Essex where Thanet, Woolwich, and Blackheath Beds emerge from beneath the Thames terrace gravels.	The main Fyfield soils are coarse, loamy brown earths.	The land is mainly arable with some grassland and mixed farming.
Hamble 2 Association	It is found principally on low-lying land in Essex, such as on the gently sloping river terraces along the Thames and Crouch; where the soils are mostly deep.	This is composed of deep, stoneless, silty soils occurring mainly in silty (mainly Aeolian) drift overlying river terrace or raised beach sands and gravels.. The soil pattern is generally simple with fine silty stoneless soils, and brown earths.	The soils are easily cultivated and a wide range of crops are grown which reflects their versatility. Cereals are the main crops grown, but the soils are also suited to roots and other vegetables including early and main crop potatoes, sugarbeet, vining peas and beans, bulb onions and flower bulb crops.
Hucklesbrook Association	It is found on river terraces adjacent to and slightly above floodplains along the lower Thames valley in Essex.,	This consists of well drained coarse, loamy and sandy soils. The principal soils are developed in loamy or sandy drift over flint gravel. The complex and local distribution of soils in this association reflects the variability of the soil parent materials and is reflected in variable crop growth in dry years	The main soils can be cultivated over long periods in the spring and autumn. Irrigated vegetable and salad crops are grown for local markets. Land is also dug for sand and gravel.

Ludford Association	This soil association occurs predominantly gently to strongly sloping ground in draining valleys which dissect extensive plateaux, such as along the Colne and Chelmer valleys.	The main soils are brown earths which are permeable and well drained.	The association is mainly under arable cropping, largely cereals with some sugar beet, oilseed rape and potatoes. In areas where the land is relatively steep it is grassland or woodland.
Hanslope Association	These are developed in chalky till on low plateau and gently to strongly sloping valley flanks. The Faulkbourne series is particularly common around Braintree and between Chelmsford and Great Dunmow	This association of Hanslope series (calcareous pelosols) and Faulkbourne series (argillic pelosols) consist of soils developed in chalky till.	It provides some of the most extensive cereal growing land in Middle and Eastern England.
Hornbeam 3 Association	It is found on flat and gently sloping land along the southern margins of the chalky till in Essex.	Most of the component soils are loamy, over clayey, with slowly permeable subsoil's; they suffer from some seasonal water logging.	During the autumn months conditions are generally good for land work with an adequate period to establish autumn-sown crops. The main crops grown are cereals with oilseed rape, peas, and beans as subsidiary crops. There are also some orchards.
Hurst Association	In Essex the soils are developed principally in fine loamy drift over river terrace gravels which rest at depth on London Clay. It is extensive near the River Blackwater and Crouch, where most land is low-lying, and level or gently sloping.	The main soils in this association are gravely and are developed principally in low-level river terrace deposits over tertiary strata.	Land use on these soils is varied. Much of the land is drained and arable crops are widespread with cereals being the predominant crop. Sugar beet is also grown and there is some grassland. Irrigated market gardens and orchards are found near Rainham and Southminster.
Park Gate Association	It occurs on flat and gently sloping low lying ground, around Bulphan in Essex on level land a little above the alluvium of the Mar Dyke..	This consists of deep stoneless silty soils. The soils are developed in silty Aeolian drift, mainly over river and marine gravels. The soils are moderately permeable and affected by high winter water tables.	There is sufficient available water for cereal crops. However, grass yields will be limited in dry summers and potatoes need irrigating. For successful arable cropping periodic liming is necessary as the soils are naturally acidic.
Stretham Association	This association occupies an area in north-east Essex where the land is level and gently sloping.	On chalky till this association consists of calcareous, moderately to slowly permeable clay soils. The soils are usually deep and stoneless.	Although claytey the soils are relatively easily worked., The land is intensively farmed and is nearly all arable with little grassland. Winter wheat and barley for malting are the main cereal crops, together with oilseed rape, sugar beet, potatoes peas and maize.
Wallasea 1 Association	This is the main association on the marine alluvium of the coastal marshes of Essex.	The soil pattern is simple, with predominantly clayey soils.	Goldhanger and Old Hall marshes to the north of the Blackwater and other small areas are crossed by deep creeks, and remain under rough grazing or permanent grassland. In other areas the land is level without creek beds or ridges. The land is mainly in arable production,

			mainly winter cereals with oilseed rape and peas. Grassland varies from rough grazing to reseeded long lays.
Wallasea 2 Association	The association is extensive on reclaimed alluvium in the marshes of Essex. The land is generally level with just occasional ridges.	The predominant soils are clayey with greyish brown topsoil.	The land is generally used for winter cereals and lay grassland.
Windsor Association	The Windsor Association occurs in south Essex on both undulating terrain and in wide valleys	The soils are clayey and slowly permeable and occur on Eocene Clays and associated thin drifts.	Cultivation needs to be carefully timed, as the moisture retentive topsoil's when wet are easily damaged and compacted during cultivation and grazing. Winter wheat, barley and winter oilseed are the main crops grown.

2.4 Topography

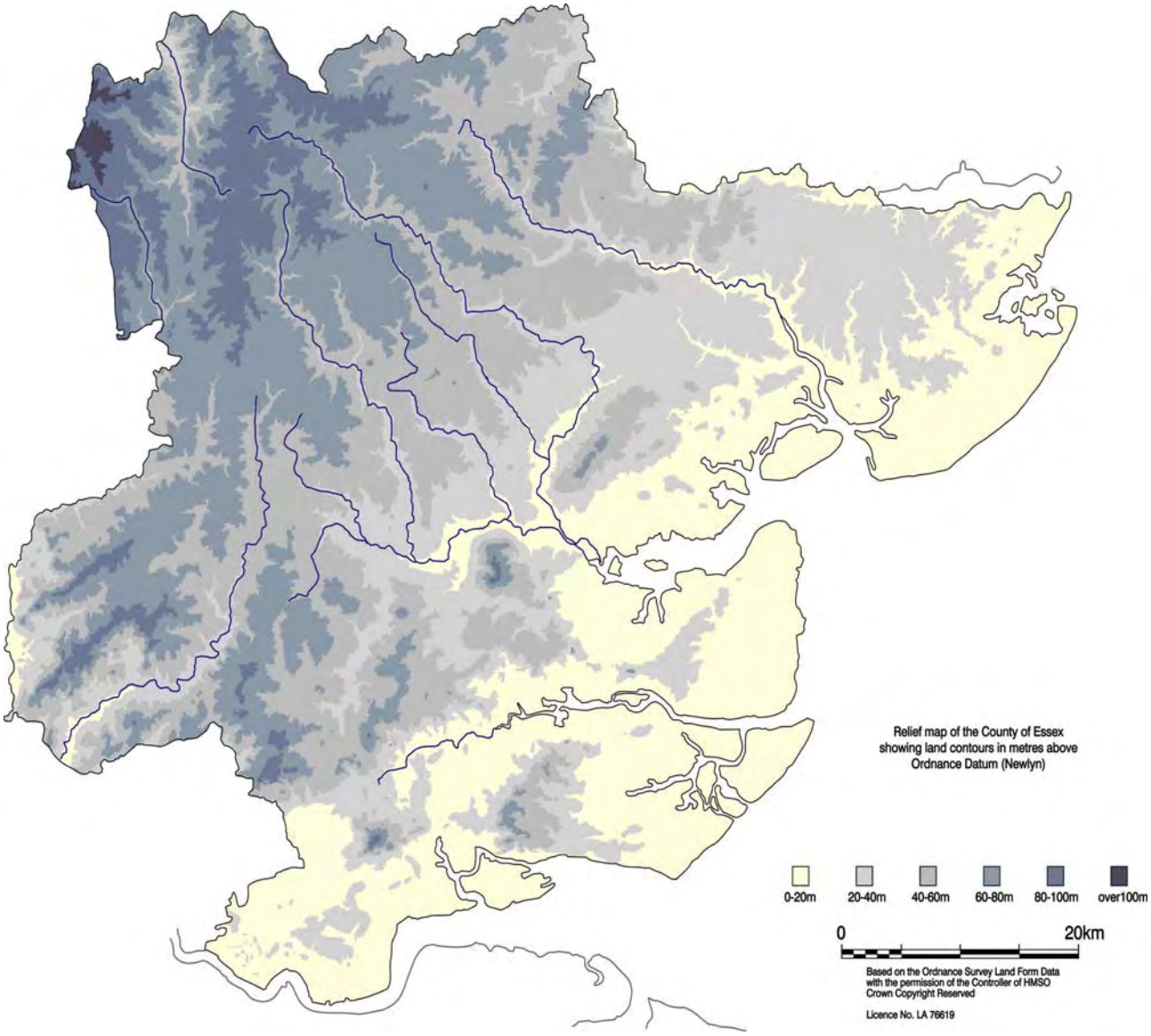


Figure 5 - Simplified relief map of the Essex NMP project area

Essex is situated on one of the major estuarine embayments of southern England, and its deeply indented coastline presents a marked contrast of that of neighbouring Kent and Suffolk.

The geology gives rise to a landscape of low relief and only in the north-west of Essex are there altitudes exceeding 120m above sea level. There is a general rise towards the north-west from sea level to about 30m around Chelmsford, interrupted only by a series of hills and ridges of which the highest is Danbury Hill at 116m. From here the land surface rises gently to a little over 130m west of Saffron Walden, where the subdued north-eastward extension of the chalk escarpment that comprises the Chiltern Hills terminates near the border with Cambridgeshire (Allen and Sturdy 1980). The boulder clay lands in the north-western half of the county mainly lie between 60m and 120m and are intersected by the rivers Stort, Roding, Chelmer, Blackwater, Colne and Stour which all drain in a south-easterly direction to the coast.

Apart from the coast, rivers generally form the county boundary, the Stour to the north, the Lea and Stort to the west, and the Thames to the south. The principal rivers within the county are the Colne, Blackwater, Chelmer, Crouch, Mardyke and Roding. The Colne, Blackwater, Chelmer and their tributaries rise in the plateau area to the north of the county underlain by Boulder Clay, and flow south-eastward to extensive estuaries. The Crouch flows due east across undulating lowland to the south of the Boulder Clay plateau, and is joined by the Roach to form an estuary complex with low-lying Wallasea, Potton and Foulness Islands. The Mardyke and Roding flow south to the Thames. The River Cam in the NW flows northwards from the Henham-Ashdon watershed into Cambridgeshire.

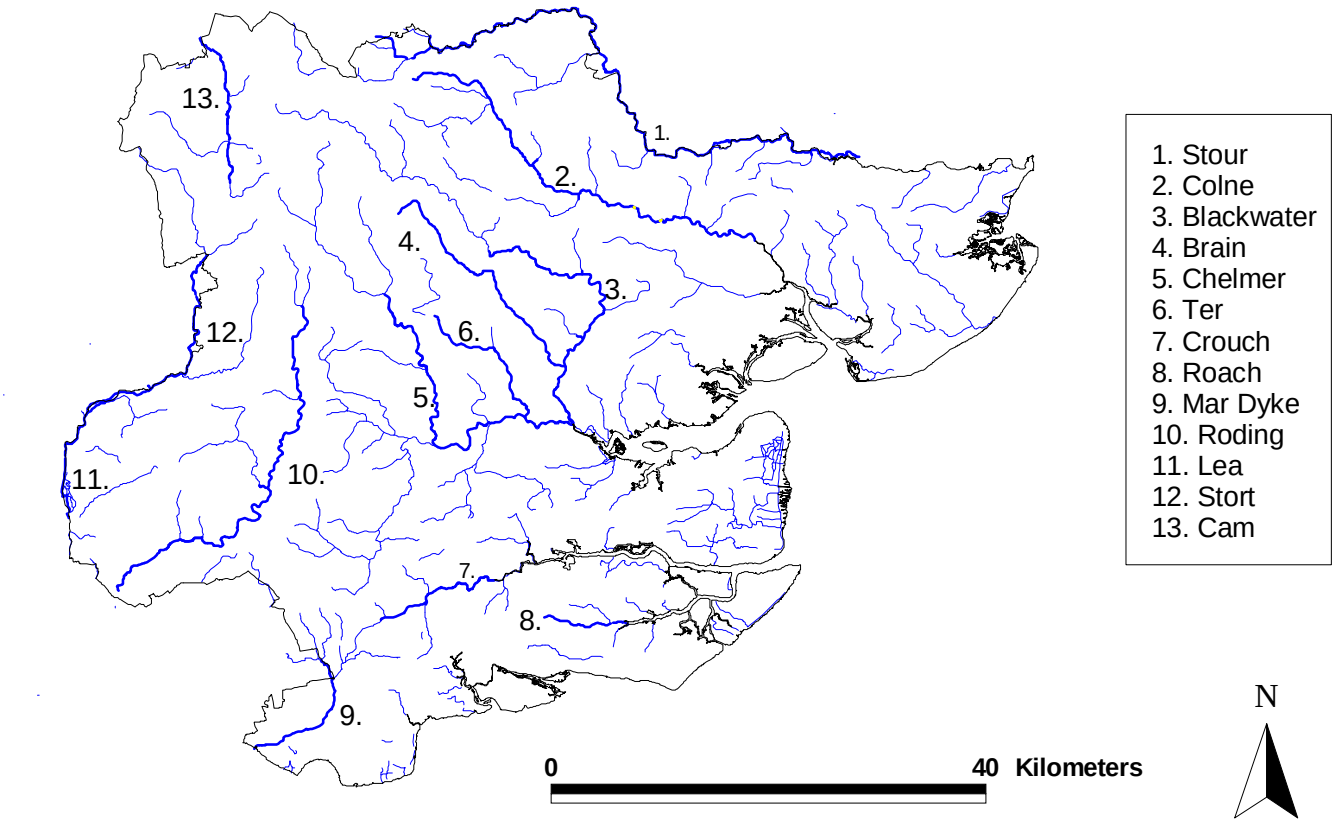


Figure 6 - Major rivers and catchment areas in the Essex NMP project area.

Large areas of coastal Essex are below 30m and essentially consist of extensive marshland areas, some of which have been reclaimed relatively recently. The coastline has a nearly complete fringe of marshland, but between the Colne and Stour estuaries and at Southend there are short stretches of cliff. The Essex coastline is broken by the estuaries of the Colne, Blackwater and the Crouch and shelters many small islands. Inland from the coastal lowlands there are a series of relatively steep-sided hills such as Horndon, Laindon, Brentwood and Danbury rising to over 100m above sea level

2.5 Landscape regions

The County can be divided into six broad landscape regions which relate to the geology, soils and topography but which also to some extent reflect their economic potential, which has in turn influenced their historical development:

1. Coastal marshland
2. River terraces
3. London Clay lowland
4. Bagshot Hills
5. Dissected Boulder Clay plateau
6. Chalk dipslope.

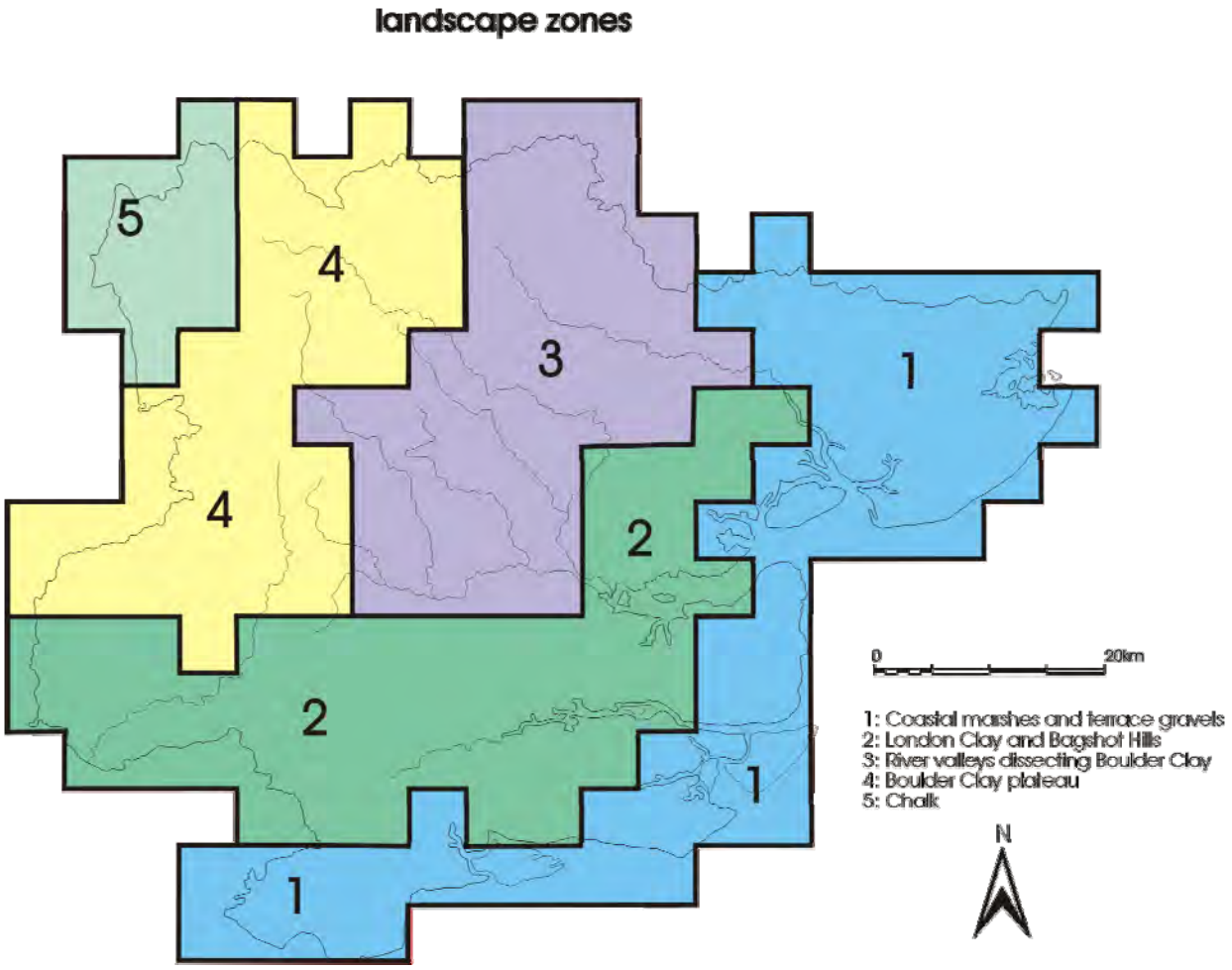


Figure 7 - Landscape Regions as used for Mapping Purposes (with London Clays and Bagshot Clays Combined)

2.5.1 Coastal marshland

Until the end of the 17th century the coastal marshlands were an important element in the rural economy for sheep pasturage. Huge flocks of marshland sheep recorded in Domesday supplied the wool for the cloth industries. Today, the traditional grazing marshes are now mostly arable, with saltmarsh, mudflats and shingle beyond the sea walls. The land was reclaimed progressively by the process of inning and there are now some 300 miles of sea wall to maintain. Reclaimed areas are characterised by heavy soils in clayey alluvium. The area is still at risk from sea flooding and was much more so in the past.

Evidence for earlier occupation, if present, is generally buried at considerable depth below marsh deposits. There is relatively little potential for the development of cropmarks of early sites, although later, post medieval features are occasionally visible, as for example, a decoy pond visible in rape on reclaimed land first recorded near Bradwell in 1992.

2.5.2 River terraces

This zone contains some of the best agricultural land in Essex, and since the soils are easily worked loams the region contains many prime sites used for early occupation and farming. The soils are free draining and have always been attractive to farmers and for quarrying sand and gravel. Despite the lack of visible history in the form of above ground remains the area is rich in archaeology, particularly evident at Mucking where intensive excavation has revealed successive settlement from the Neolithic to the Saxon period (Hunter 1999). The soils include deep soils over brickearth around Southend, and thinner silty loams over gravel in Tendring. It is in this region that cropmarks are apparent in most summers, for example on the Thames terraces in the Grays-Thurrock area, including geological features such as ice polygons. It is also a region in which many archaeological sites have been lost to mineral extraction and urban development, particularly over the past 50 years.

2.5.3 London Clayland

The outcrop of London Clay extends from Thurrock through Rochford to the gently rising topography of the Dengie peninsula and the land northeast of Maldon. It is inherently less fertile than the Boulder Clay and soils developed in this area are mostly heavy clays, although lighter soils occur in some footslope positions. London Clay is heavy but fertile soil with water-logging is a problem on agricultural areas: the soils shrink and crack on drying, and swell on rewetting, and soils are difficult to cultivate. The heavy nature of the soils has made arable farming difficult leading to sparse settlement and an emphasis on pasture. The London Clay appears only to have been occupied from the Late Iron Age and was abandoned at, or near, the end of the Roman period (although rough grazing may have continued) to be reoccupied in the middle or late Saxon period. The field patterns and boundaries of this region display the characteristics of early planned landscapes, with fields in a roughly rectilinear pattern except where crossed by main water courses (Hunter 1999).

To the north, between Maldon and Colchester, the London Clays crop out from beneath Kesgrave layers and with some scattered Thames/Medway deposits, slope down to the north shore of the Blackwater estuary and

Mersea Island. The area is sparsely settled, undulating topography, but the field patterns of this area do not display the planned rectilinear pattern seen on the London Clays to the south (Hunter 1999).

2.5.4 Bagshot Hills

These form a transition zone between the Boulder Clay plateau and the lower levels of London Clay, stretching through several ridges from Epping Forest to Thorndon, Galleywood and Tiptree. They rise above the general level of the London Clay lowland to about 100m, capped in most places by Pebbly Clay Drift over fine sand of the Bagshot Beds. The soils are readily cultivated although of low natural fertility and much of this zone is covered in woodland, some ancient and some secondary on former common land, for example to the south of Brentwood. Although much of this woodland may be secondary and preserve archaeological features within it, aerial reconnaissance is rarely able to advance recognition and recording of earthwork features within this zone. The former heathlands show planned landscape features characteristic of late enclosure, although they are rich in archaeology as evidenced by aerial photography.

In south Essex there are two groups of hills, generally wooded, the larger based on Rayleigh, Hockley and Hadleigh and the smaller, some distance to the west forming the Langdon Hills. Over much of the wooded hills of mid-Essex fields have remained relatively small, and there are many small woods. The varied topography and acid soils were traditionally conducive to woodland and pasture farming and there are indications that the area was once subject to intercommoning. Many commons have survived, including Epping Forest, but many more were lost when parliamentary enclosure was fashionable (Hunter 1999).

Northwards the Wooded Hills merge into an area of low relief with light, often sandy soils which stretches around Colchester to reach the edge of the Stour Valley. It is an area of the county which has seen significant landscape change in recent centuries. The Chapman and Andre map of 1777 shows extensive heaths ringing Colchester and these included Stanway and Lexden to the west, Bergholt, Mile End, Boxted and Dedham in the north, Ardleigh, Crockleford, Whitmore, Wivenhoe, Elmstead and Alresford in the east, and Layer and Donyland to the south of the town. The heaths depicted in 1777 generally followed boundaries that had been established by 1300, although some internal enclosures may have taken place subsequently and at an earlier time the heaths may have been more extensive. The 14th century was a time of pressure to bring more land into cultivation. Farms and smallholdings abutted the edges and in between the former heaths are winding lanes and relicts of the medieval landscape that once linked the tracts of open land. Over the areas once covered by the heaths we see the landscape of late enclosure with straight roads and lanes (Hunter 1999).

2.5.5 Dissected Boulder Clay plateau

This zone covers at least one third of the county, and comprises a thick till of chalky boulder clays over the series of terraces of the earlier courses of the Thames. Two main types of soil are developed: wet clayey soils and drier clayey soils. Both types require underdraining for modern agriculture and it was formerly common to use ridge and furrow as an aid to drainage. Many of the common land sites remaining today are associated with the wetter level sites.

The plateau is dissected by the valleys of the Stort, Chelmer, Ter, Brain, Blackwater, Colne and Stour, the rivers of the drainage system established after the end of the Ice Age. These contain a variety of deposits of glacial origin. Most of these are glacial sands and gravels, brickearth, head and alluvium. The gravels are associated with terraces in the lower reaches of the Chelmer, Blackwater and Stour. The rivers have cut down to expose Kesgrave gravels and sometimes London clay in the valley sides, the valleys in the north being more deeply cut because of the slight southward tilt of the valleys. The topography between valleys is one of dissected plateau with occasional deposits of glacial sands and gravels on the watersheds, sometimes clothed with ancient woodland. The chalk content of the soils renders them fertile and the plateau is sprinkled with spring lines all of which formed the basis for scattered settlement of villages, greens, hamlets and farms. In the Bronze Age the fringes of the Till were being colonised by farmers and by the Roman period the heavy but fertile soils were extensively cultivated. Excavation and survey at Stansted Airport have provided a better understanding of the settlement and landscape history of the Till. Here there was woodland clearance and settlement on the edge of the plateau in the late Bronze Age; Iron Age settlement was recorded well into the plateau and by the Roman period this area was extensively settled and farmed. Villa estates abounded and it remained a prosperous farming area until the agricultural depressions set in towards the end of the last century (Hunter 1999).

The subsequent settlement pattern is scattered and diverse although not sparse. Landscape features such as roads, lanes and field boundaries relate closely to topography and soil type and suggest evolution and slow change over a long period of time. In the second half of the 20th century (following the Agriculture Act 1950) the Boulder Clay region changed from one of mixed farming to an area dominated by arable with the associated removal of hedgerows to enlarge fields (Hunter 1999).

The Boulder Clay is extremely varied geologically with sand and gravel from stratigraphically below the drift exposed on the valley sides and with brickearth overlying the clay surviving on higher ground. A Roman villa at Chignall, located from the air in 1974, is situated on one such area of brickearth and subsequent excavation established it as a focus of an extensive farming estate on the surrounding Boulder Clay. Here the Roman activity was preceded by a substantial Iron Age settlement with evidence for occupation in the Bronze Age, Neolithic and Mesolithic periods.

2.5.6 Chalk dipslope

In the extreme north-west of the county the chalk emerges in the valley of the Cam and its lateral rills valleys and on the escarpment along the boundary with Cambridgeshire. Historically this is the only area of Essex where an open field system resembling that of the Midlands was developed. Large common fields developed here and were enclosed late, in the 18th and 19th centuries, The Tithe Maps of the 1840s still depicted strip farming in some parishes, e.g. Langley. Great Chesterford, is truly on the 'Midland' model, being fully open field until enclosure in 1804; it lies on the county boundary where 'woodland' Essex meets 'champion' south Cambridgeshire. (Hunter 1999).

This landscape was traditionally more open than the Till countryside, but a skim of clays on the higher land developed features more characteristic of Essex than neighbouring south Cambridgeshire. The rolling landscape is predominantly open chalkland fields on the Cam valley floor and ancient enclosed field patterns with species rich hedges where it adjoins the clay plateau. Villages and woodland avoid the true chalk and cling to the better water supply of the patchy drift cover. It retains winding lanes, dispersed hamlets and greens, and ancient woodlands.

Fieldwalking survey in North-West Essex by Tom Williamson found 34 probably Iron Age settlements (Williamson 1986) which tended to cluster near the junction of the heavy plateau soils and the freely draining clay and chalk soils on the valley sides – a pattern that continued. On the plateau evidence was found for fairly evenly dispersed settlement, suggesting that by the end of the Iron Age the area was already extensively deforested, even on the level interfluvial areas. For the Roman period some 35 probable sites were found (not necessarily all occupied at the same time) and as in the Iron Age settlements were most numerous on the margins, and these sites were larger and longer lived, and probably of higher status than those more evenly and sparsely scattered over the heavier clays of the plateau. Williamson concluded that the Roman landscape of north-west Essex was very extensively cleared; it may have carried less woodland than in the 18th and 19th centuries. Evidence for Saxon settlement is sparser and Domesday indicates that this area was less extensively farmed and settled than it had been in the Roman period. In the 12th and 13th

centuries the population rose and land was reclaimed, leading to a dense and varied settlement pattern (Williamson 1986).

2.6 Modern landuse.

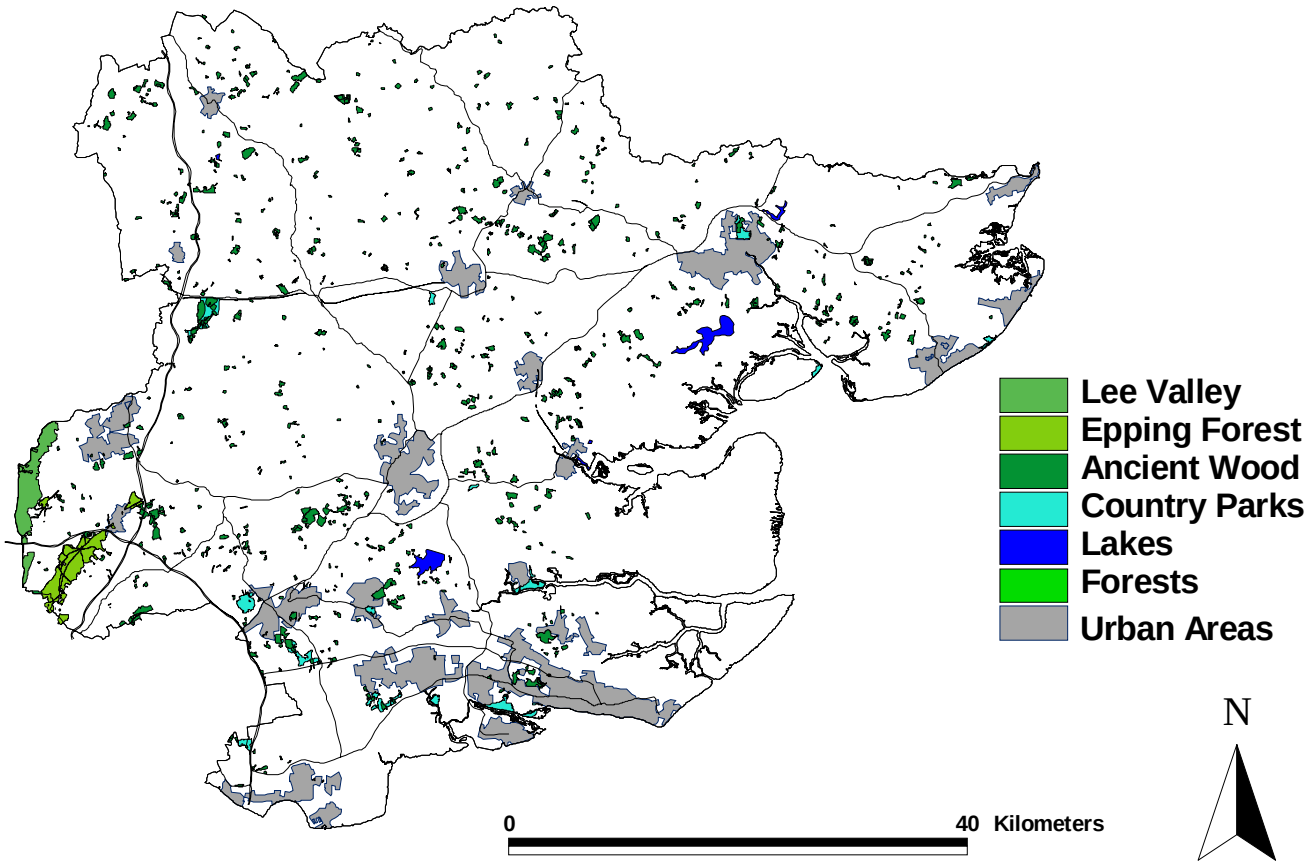


Figure 8 - Urban areas and woodland cover in Essex

The project area is predominantly rural in character. The major urban areas are in the extreme south west on the fringes of greater London, with smaller urban centres around Chelmsford, Southend, Colchester, Harlow and Braintree.

Traditionally, the light glacial gravel soils of north Essex are largely grassland whereas heavy clays and medium loams are mainly arable. The light soils of south Essex are well cultivated because of their physical properties rather than chemical content, although human agents have added greatly to their fertility. The gravels are not very fertile and do not lend themselves as easily to cereal cultivation. In addition they are often on sloping ground on valley sides where the steepness has been accentuated by a hardened layer due to ferruginous or carbonate cementation of the gravel that often occurs at the junction of the boulder clay and glacial gravel. In north Essex nucleated settlement developed mainly on small patches of gravel or light soil, especially where such occurrences form a small spur of higher ground alongside a valley.

In south Essex it is the heavy soils that form the pasture (Scarfe 1942). The London Clay region in the south and east of the mid Essex region is less fertile than the boulder clay region. Its heavy nature has made arable farming difficult leading to small dispersed settlements and an emphasis on pasture.

Toward the north west of the county the land becomes increasingly arable. In south west Essex another zone of concentrated arable land seems to follow the Thames in a wide band from Ilford to Stanford le Hope which coincides with the wide Thames gravel terraces (Scarfe 1942).

Only 5% of Essex is forest and heath. The chief zone of forests is the south Essex hill belt which includes Epping Forest.

2.7 Geology and industry

Essex is not a mining county with extensive coal and iron ore deposits, and in the absence of major building stone there has been limited quarrying apart from chalk and gravel extraction. Chalk extraction has wrought changes in the landscape both as major quarries at Purfleet and Thurrock and minor chalk pits particularly in the north west of the county.

Because of the nature of geological deposits in Essex, the county has held the premier position for many years among English Counties for the supply of sand and gravel with the consequent destruction of archaeological sites. The Essex clays in various parts of the county have been the raw material over the centuries for the brick making industry. Once the suitable clays had been exhausted many of the areas were redeveloped for housing.

3 PREVIOUS AND OTHER TRANSCRIPTION WORK IN THE COUNTY

From its inception in 1972, the enhancement of the EHCR with new information from aerial reconnaissance has been an integral part of the Essex County Council programme.

3.1 EHCR photo archive

One of the first priorities of the Essex County Council Archaeology Section on its establishment in 1972 was the creation of a Sites and Monuments Record, an integral part of which is an aerial photographic record. It soon became apparent that cropmarks formed by far the largest source of unpublished archaeological evidence in Essex. The recording and interpretation of this data became of fundamental importance to any understanding of the landscape and settlement history of the county. Special emphasis has therefore been given to the photographic archives within the EHCR which acts as a resource for a fully integrated policy of survey and research, preservation, conservation and where necessary excavation.

The main corpus of photographic evidence was compiled from the national archives held by the Cambridge University Committee for Aerial Photography (CUCAP) and the Royal Commission on the Historical Monuments of England (RCHME). These collections were checked annually until 1987 and selective prints acquired for the EHCR. There have also been a number of particularly active local fliers in Essex, and the EHCR was supplemented at a local level in particular from the collections of Commander Richard Farrands and Ida McMaster. Both of these collections focus particularly on the north-east of the county. Aerial photographs have also been acquired from other individuals and local societies, including Colchester Archaeological Trust, Brain Valley Archaeological Society, Edward Clack, and Felix Erith. The results of many of the aerial surveys carried out by members of local societies have been published by the relevant local societies.

3.2 Transcriptions

A high proportion of the archaeological sites in the EHCR are cropmarks (approaching 10% of the records on the EHCR when the NMP Project Specification was written). Within the EHCR sites recorded under a single number vary greatly in their complexity i.e. some single numbers will represent individual features like a field boundary whilst others will be cropmark complexes with multiphase elements. A programme of cropmark plotting was implemented intermittently from 1979. Between 1981 and 1983 an Aerial Photographic Plotter funded by the DoE dealt with the backlog of photographs and their plotting, with the objective of the examination, acquisition and incorporation into the EHCR of all available air photographic evidence, and to interpret and make this information available in appropriate form to further all aspects of the Archaeology Section, including development control. From the mid 1980s plotting continued with the aid of grants for post-reconnaissance work from the RCHME.

The plotting of sites from aerial photographs targeted cropmarks because of the particular significance of these sites in the county. This involved the transcribing of cropmark detail to OS 1:10,560 base overlays and both comparative plotting of cropmark types and plotting of individual cropmark complexes at large scale. Detailed large scale plotting by graphical methods was confined to those sites selected for research, preservation or excavation purposes.

Mapping, supported by trial trenching, also allowed the selection of a number of important sites for scheduling, including the causewayed enclosure at Orsett, rectangular enclosures at Woodham Walter, and the Roman villa at Chignall St James. This method appeared to be the only viable method to proceed and enabled general patterns of historic settlement and landscape to be readily identified over much of eastern and southern Essex (Priddy and Buckley 1987: 48). The cropmark plots were updated as necessary when new aerial photographic evidence was acquired.

The use of AERIAL (the Bradford Aerial Rectification System See below 6.2) from the 1980s enabled more accurate large scale plots of individual sites to be produced for specific projects (excavation, scheduling recommendations, mitigation of development impact), but AERIAL was not used for general recording of air photo information for addition to the EHCR.

Other archaeological features identified from aerial photographs (standing monuments, earthworks) were recorded only on the EHCR 1:10,000 (formerly 1:10560) sheets, on which a solid line delimited the extent of the site but no details or component features are plotted.

3.3 Classification/assessment of cropmarks

On the EHCR cropmark sites are classified through the use of descriptive keyword terms for site types according to word lists which adhere to standards in the RCHME/EH thesaurus. (RCHME/EH 1998).

In 1987 Priddy and Buckley published an assessment of excavated enclosures and selected cropmark sites. This aimed to assess the extent to which excavated sites can aid the interpretation of unexcavated cropmarks on the basis of morphology. It concluded that although form is often, though not necessarily, an indicator of date, it is unreliable as a guide to function. Further, it stated that the circular enclosures were the only enclosure that could be readily classified by its size and form. Such a statement is readily contradicted by the results of the Essex Cropmark Enclosures Project (Brown & Germany, 2003) which examined four examples of circular cropmark enclosures interpreted as Neolithic or Bronze Age monuments on the basis of their morphology; two as probable henges, one as a possible hengiform monument, and the fourth as a possible henge of Springfield type monument of Late Bronze Age date. Trial trenching showed two to have been medieval windmills, a third to be a large Bronze Age barrow and only one of the four to have been of Neolithic date.

For other studies analysis of the cropmark evidence has been a key part of the assessment of landscape history. Examination of the air photographic evidence of the Lower Blackwater valley has been used to set the results of excavations at a number of sites into the wider landscape setting.

3.4 Aerial reconnaissance

Since the 1970s the County Council has conducted its own programme of aerial reconnaissance. The present programme was initiated in 1983. During the 1980s flights were primarily targeted at the location of new cropmark sites and the continued reconnaissance of known sites. In 1985, with funding from RCHME and ECC, reconnaissance was aimed at threatened areas in the Chelmer and Blackwater valleys. This region is rich in sand and gravel deposits with a high potential for the development of cropmarks but also

contains areas where archaeology is under threat from mineral extraction, industrial and housing development and road schemes. In the late 1980s survey was focused on the boulder clay of the north-west of the county, a programme initiated as part of the Stansted project. A combination of aerial and terrestrial survey demonstrated a greater concentration of sites on the boulder clay than was previously known. Survey showed cropmarks to be particularly numerous along the course of Stane Street from Rayne to Great Dunmow and along the Chelmer valley.

1989 and 1990 were particularly good years for the development of cropmarks and parchmarks , including clear cropmarks in sugar beet, and many new sites were discovered. Prolonged reconnaissance has continued to identify new sites even in poor years. From 1992 the survey programme was expanded to include reconnaissance of the intertidal and coastal areas of the county following the discovery and recording of timber features, the remains of fish traps, at Collins Creek in the Blackwater estuary. The discovery highlighted the potential for survival of archaeological sites in the more inaccessible parts of the intertidal zone. A number of sites were recorded in 1992, including a kiddle (fish trap) off Mersea Island, several hundred metres long lying c. 1 km off land. Similar features have also been recorded at Bradwell on Sea, West Mersea.

In recent years, pioneering work in Essex has helped to develop the use of aerial photography along the coast, and in particular on the extensive inter-tidal mud-flats. Flying along the coast at low tide, timber fish-weirs, oyster pits and shipwrecks have been recorded. Many of these areas are extremely inaccessible, and aerial photography allows archaeologists to rapidly cover large areas and locate structures that can then be visited on foot (Strachan 1995).

4 ARCHAEOLOGICAL SCOPE OF THE SURVEY

The project was undertaken in accordance with the general aims and objectives of the National Mapping Programme as laid down in the National Mapping Programme Guidelines (RCHME 1994). These are to identify and transcribe "*All probable and possible archaeological features showing as crop marks and soil marks and previously unsurveyed earthworks (with the exception of extensive systems of medieval ridge and furrow ploughing) up to the NMR terminal recording date of 1945*". Some county-specific issues necessitated refinement of the general NMP scope, for example the desire to record the timber post structures in the intertidal zones. The transcription programme was conducted to record primarily features showing as cropmarks, soilmarks, earthworks or stoneworks, although given the value of the photographic archive the opportunity was also taken to note other features for basic addition to the EHCR.

4.1 Cropmarks and Soilmarks

All archaeological features, levelled by subsequent ploughing or some other agency, that appear on the aerial photographs as crop marks, parchmarks or soilmarks were recorded by graphical representation. This included the significant loss of field boundaries in the county, particularly during the past 50 years, as many of these former boundaries are only visible as cropmarks. The project has included evidence for any field boundaries not recorded on the Ordnance Survey First Edition 6" sheets, since the aerial photographs are the main source for systematically identifying these. The First edition sheets are now available digitally and so information is more readily accessible to EHCR users through the GIS.

4.2 Earthwork features

All upstanding archaeological features visible on the aerial photographs were recorded by graphical representation of the observed ditches, banks, pits and/or surfaces. Where earthwork sites that show on aerial photographs have been the subject of ground survey, existing survey plans have been used as the basis for plotting. There are few examples in Essex of ridge and furrow and those examples that were identified were mapped using NMP established conventions.

4.3 Landscape parks and gardens

Areas of parkland and garden landscapes were not mapped however structural elements within them visible as crop marks soilmarks or abandoned earthworks were mapped as seen. Elements of parks and gardens still in use were not recorded by the NMP project but records of these features do form part of the broader historic landscape dataset created by ECC.

4.4 Industrial archaeology

Evidence of historic extraction industries such as quarries was recorded, normally by outlining the visible extents of the activity. This included those of a more marginal nature such as gravel/extraction pits of medieval and post-medieval date. The location of recent quarries was also relevant, and recorded on the Map Note Sheet, as areas where archaeological remains are likely to have been destroyed.

4.5 Military archaeology

In line with the general NMP scope, former military sites and installations up to 1945, such as discrete monuments such and gun emplacements, were recorded where visible as cropmarks, soilmarks stonework or earthworks. Pillboxes were noted for the EHCR as appropriate but were not mapped; in many areas these formed the focus of a separate World War Two Defences Survey. Airfields and associated structures were recorded by a simple outline of the visible extent with the detail of runways and hard standings. This information may have been taken from vertical photographs or derived from a map source, and in general recorded the plan during the mid 1940s, disregarding elements of post-1945 expansion, where it was possible to differentiate these.

4.6 Buildings

Standing buildings were not recorded for this project. The ruined or levelled remains of structures pre-dating 1945 were recorded where they were seen as earthworks (or masonry foundations) or as crop or soil marks. However, buildings of archaeological interest visible on the photographs and not previously recorded on the EHCR (e.g. pillboxes) were noted for addition to the record.

4.7 Coastal and Intertidal archaeology:

A range of features have been identified and plotted in the coastal zones. They have included the fish traps that survive as extensive structures comprising rows of upright posts. Whilst these are strictly outside the format of the project (neither stone, soil, earth nor cropmarks) their nature and location mean that aerial photographs offer one of the best means of plotting their extent.

4.8 Modern features

Where modern features, such as land drains and removed field boundaries that were recorded on 1st Edition maps or later were visible alongside other archaeological features on photographs selected for transcription then those features were noted in the EHCR, but not plotted.

4.9 Geological/geomorphological features

Aerial photographs of many parts of the county record numerous features of glacial origin, including ice polygons, and former river channels. These have not been plotted although their existence has been noted as their presence in some cases will assist with an assessment of the archaeological potential of an area.

5 SOURCES

5.1 Aerial Photographs

The initial quantification assessment, completed in March 1993 (Ingle 1993a) identified a minimum of 27,000 oblique and 113,000 vertical photographs for the county and detailed the key sources of photographs for the county. The three major sources of specialist oblique photography for the county, all used for the project are:

- National Monuments Record
- Cambridge University Committee for Aerial Photography
- Essex Heritage Conservation Record

Each of these includes material taken by a number of local fliers.

Over 100,000 vertical aerial photographs of the county were identified by the quantification assessment. Potential sources included a number of commercial companies, but it was deemed not to be practical or desirable to consult ALL of the available material. The project focused on the following key sources:

- ECC: The main source being the 10-year-high-level county survey, initially four sets (1960, 1970, 1980/81 and 1990) but for the latter stages of the mapping also including the results of the 2000 survey.
- NMR: The index of vertical photography lists over 74,000 for the county.
- CUCAP: The collection includes a relatively small proportion of vertical coverage, comprising c.2000 prints.

Whilst a significant resource is held by ADAS (then part of MAFF) the majority of material is held as negatives only and not available for general consultation.

Source	**Vertical Prints**	**Oblique prints**
NMR	74,080	5835 prints (656 slides)
CUCAP	2217	6648
ECC SMR	364	4427 (+599 slides)
ECC Other	10,127 (High level survey) 2390 (RAF)	7440 (Planning reprographics)
Ordnance Survey	9,475	
ADAS	13,969	
Other	1200	1797 (+1602 slides)
TOTAL	**113,822**	**26,147 (+2857 slides)**

Table 3: Quantification Assessment: oblique and aerial photographs

5.1.1 Essex Heritage Conservation Record (EHCR)

The EHCR maintains records of the air photographic coverage of the county held in its own and other collections. The quantification assessment recorded over 6,000 photos, including copies of NMR and CUCAP prints although a large proportion of photographs in the EHCR photo archive result from many years intensive reconnaissance by ECC. The majority of the archive is of cropmark sites, although with increasing numbers of photographs of the coastal zone. The prints are housed in files within the EHCR organised by EHCR site number and most prints have been examined for the NMP project. Aerial reconnaissance has continued during the course of the project but it has not been possible to revise NMP sheets following photography after completion of individual sheets.

In addition, the EHCR maintains a colour slide collection, which includes aerial photographs but these were not consulted systematically for the Essex project. This is acknowledged as a shortcoming in the project as the potential for these photographs to reveal otherwise unrecorded archaeological features was unknown and untested, although to a large extent these duplicate sites recorded on prints taken at the same time.

The main source of vertical photography within the County Council are the sets of 10-year high level county survey, taken at various scales..Initially the four surveys from 1960, 1970, 1980/81 and 1990 were consulted, but in the later stages of the project the 2000, survey was included.

5.1.2 The National Monuments Record (NMR)

The index provided by the NMR for the quantification assessment listed almost 6,000 specialist oblique prints for the county. Whilst some of these had already been acquired for inclusion in the EHCR, and there is consequently a significant degree of duplication between the NMR and the Essex EHCR collections, the NMR collection had not been systematically checked by EHCR staff for new sites since the mid 1980s. To mitigate against any gaps in the Essex EHCR holdings, all the oblique prints available for loan were borrowed and examined according to the stated methodology.

Most of the photographs in the specialist collection were taken for archaeological purposes. The vertical collection contains photographs at various scales taken for mainly non-archaeological purposes: military and cartographic reconnaissance, civil engineering projects such as road schemes, census recording and environmental monitoring. As such, the volume of this photography is not a valid indicator of the density of visible archaeological features within a given area. All the large to medium scale (1:20,000 minimum) vertical photographs that were accessioned to and available from the NMR at the time of mapping were made available on loan to the ECC project staff and have been consulted for this project. The NMR supplied laser copies of restricted use prints.

5.1.3 Cambridge University Unit for Landscape Modelling (Formerly the Committee for Aerial Photography)

This collection houses oblique and vertical photographs taken since 1945. It includes a permanent loan of photographs taken with RAF support, which are Crown Copyright. The oblique photographs in this collection were often taken for archaeological purposes but also to record geological landscapes, modern townscapes and for environmental monitoring. The photographs are available as contact prints from the large format (70 mm) negatives. Most of the oblique photographs were taken on black and white film.

The prints are organised by film and the films by date of photography but the collection can be searched via the film catalogues, a subject index or National Grid Reference (NGR) (held on card index but now available digitally on (www-arcims.geog.cam.ac.uk), or by parish.

A total of 6648 oblique and colour photographs are catalogued within the collection for Essex. Of these, 3699 are black and white and 35 colour cropmark photographs. Although the EHCR contains copies of over 500 of these photographs to ensure comprehensive coverage the photography was also consulted at CUCAP in Cambridge.

5.1.4 Other Collections

There are several local fliers who have amassed considerable collections (including Ida McMaster and Edward Clack) and others, together with some of the museums and local societies who hold smaller amounts of material (including Colchester Museum, which now holds the collections of the late Richard Farrands, and Southend Museum). These sources are particularly important for the north-east of the county. Many key photos have been copied into the EHCR and were consulted. The project did not separately consult private collections.

5.2 Data sources

5.2.1 Heritage Conservation Record

From 1994 to 1996 information was accessed through an Oracle SMR database and after a brief spell using the Monarch system (1996-1997) the SMR (now EHCR) migrated to an Exegesis format in 1998 which could be used to link the EHCR and GIS systems. This record provided the majority of evidence for date and function for sites recorded as deriving from more than just photographic sources.

5.2.2 National Monuments Record

The NMR holds copies of the maps and NMR records for each quarter sheet. The maps show the general location of features and the database entry records core information such as date and possible function as well as locational information and a short free text description.

5.3 Other sources

5.3.1 RCHME Inventories for Essex.

Much of the information held in these volumes has been incorporated into the EHCR and was referred to as the EHCR was consulted.

5.3.2 Map sources

Two main sources, held as part of the EHCR were consulted for each map sheet: a 1777 survey of the county of Essex by Chapman and Andre, and the Ordnance Survey First Edition 6 inch sheets. The first Edition OS maps were available as a GIS layer and could be used as an overlay to check features (especially the location of field boundaries).

6 METHODOLOGY AND STRATEGY

The objective of the Essex Mapping Project, in accordance with NMP, was to plot all the archaeological features visible on both oblique and vertical aerial photographs from early prehistory to 1945 at a scale of 1:10,000.

6.1 Mapping order

The county was tackled primarily on the basis of five main landscape zones identified in the Project Specification (Ingle 1993b). These zones were based on (though not identical to) the main landscape regions recognised in the county (see above). This divided the Boulder Clay plateau into two blocks: central Essex where the clay is dissected by the main river valleys, and the clay plateau to the north and west. The Bagshot Hills were included in the London Clay zone, both being areas in which few cropmarks are recorded.

For convenience of mapping the landscape zones of the project area were divided into mapping blocks of between 8 and 12 quarter sheets. This was done to organise photographic loans, though for most of the project loans have been organised in sub-blocks of c.4-6 sheets because of the large number of vertical prints available.

The mapping order has been amended on a number of occasions during the course of the project in order to respond to the needs of other archaeological research, survey and development control work in the county.

6.2 Mapping and interpretation

The methodology and procedures for interpretation, rectification and mapping were summarised in the original Project Design in 1993 (Ingle 1993b). The methods of transcription and recording applied were those developed by the RCHME for the National Mapping Programme pilot surveys, and subsequently developed during the main projects.

For each quarter sheet all the available oblique and vertical photographs were assembled prior to transcription and where possible examined simultaneously whilst plotting. The first stage was a pencil transcription. Photographs were not loaned from CUCAP and these were therefore consulted in Cambridge; after completion to mapping stage using material available at ECC (Inc NMP loans) the transcriptions were taken to Cambridge to incorporate detail from CUCAP photography for which there were no copies in the EHCR.

The information recorded by NMP was compared with the existing EHCR 1:10,560 overlays, with a view to using an enlarged version as the basis for NMP plotting. In the majority of instances, however, it was felt that the original EHCR plots were not of sufficient accuracy for use in this way, and mapping has been direct from the photographic evidence. In cases where features appear on the 1:10,560 plots not readily identified on photographs by the NMP staff, there has been considerable effort to verify these features. In some instances, where the same photography is available, this has been attributed to over interpretation and accordingly, these features have not been transferred to the NMP plot. In a few cases, where information

cannot be verified because the original source was not available, features have been transcribed to the new overlays as 'unconfirmed' sites.

The majority of the transcription has been completed using manual plotting methods, although the Bradford Aerial Rectification System (AERIAL) (Haigh, 1993, 1999) has been used to facilitate plotting of more complex sites. In the initial stages of the project AERIAL 4 enabled rectification of features traced from the aerial photograph, but with the upgrade of software to AERIAL 5, rectification of entire photographs has been possible. Although the latter enables digital traces to be created directly as a GIS layer, because the NMP plots have not been created digitally, rectified plots were printed for tracing onto the pencil 1:10,000 overlays.

Whether using manual transcription methds or the AERIAL programs features have been plotted to a level of accuracy of 5-15m. Following checking by the second member of the mapping team a final inked overlay was produced from each pencil transcription. Over the course of the project the introduction of GIS and changes to EH approaches to mapping and recording occurred. In Essex, to ensure a consistent output for the entire county the original methodology was maintained and there was no digital output. However, the inked hard copy of the quarter sheets was scanned and added to the GIS so a cropmark layer could be viewed.

6.3 Mapping conventions

A set of conventions was devised by RCHME for NMP enabling banks, ditches and a variety of other features to be depicted in different ways and thus identified on the transcribed 1:10,000 overlays. The conventions are shown in Appendix I.

6.4 Records created

The record comprises four main elements:

6.4.1 Graphical record

A film overlay at a scale of 1:10,000 was produced using a standard set of conventions, developed by the RCHME for use in NMP projects to delineate features.

6.4.2 Morph Database

On completion each map has been input to the MORPH2 database by the transcriber. "The MORPH2 classification system is a suite of programs that manage a number of relational databases providing a closely structured method of describing archaeological features…The database conforms to the dBase3 standard; the programs are run using FOXR (the runtime version of FoxPro) and the indexes are of the FoxPro type" (RCHME 1993). MORPH allows the systematic recording of archaeological features derived from aerial photographs in such a way that for the purposes of analysis the features can then be compared with one another. A standardised morphological description is produced for each site, which aids the development of classification schemes. Changes made by EH to the recording methodology of sites within MORPH during 1999 were not implemented to ensure consistency across the project.

6.4.3 Site Record Forms (SRF)

These have been completed for each 'site' – arbitrary parcels of land that could be identified on the 1:10,000 OS base map and that bounded the cropmarks or earthworks showing on the aerial photographs. Each parcel of land containing features was recorded on a copy of the 1:10,000 base map, with a single identifying number (a central grid reference) relating it to its SRF. The SRF contains observations on each site and additional information relevant to the interpretation of features, including notes on further investigations of the site, cartographic evidence, its survival, level of control on the photograph as it influences the accuracy of the plot. It also lists the aerial photographs used to plot the site. The forms have been retained and are currently held as part of the EHCR at ECC.

6.4.4 Map note sheet

Completed for each 1:10,000 map square these provide an opportunity for written notes and references, and a graphical method for showing the geology of the area, key topographical features and elements of land use (woodland, urban development) which influence the potential for visibility of archaeological sites on photographs. The forms are currently held as part of the EHCR at Essex County Council.

6.4.5 Essex Heritage Conservation Record

A significant number of features plotted had not previously been recorded on the EHCR. Record forms for addition of these were completed for each map sheet at the end of the transcription phase, which has ensured that all entries on the MORPH database have an EHCR number. In general, EHCR sites have equated to the groups of features noted on each Site Record Form, although where these include features of clearly different date different EHCR numbers have been assigned. The project has also noted a number of features on the photographs which have been recorded for the EHCR but which lie outside the scope of the NMP project and so have not been mapped.

Final map overlays have been copied and added to the EHCR where they are available to all users consulting the record. The overlays have also been scanned as raster images and are available as layers for use with the corporate GIS, ArcView.

6.5 Post-mapping tasks

A period of data checking and consolidation followed the completion of the mapping and recording stage in 2003. This included cleaning of the database to remove any anomalous entries.

7 PROJECT MANAGEMENT

7.1 Project personnel

Head of Aerial Survey (EH)	Bob Bewley	1994 – End of Project
Project Coordinator (RCHME)	Vikki Fenner	1994 - Jan 1996
Project Coordinator (RCHME/EH)	Simon Crutchley	Jan 1996 – End of project
NMP Officer	Caroline Ingle	1993 - End of Project
NMP Officer	David Strachan	1993 - June 2000
NMP Officer	Susan Tyler	July 2000 - June 2001
NMP Officer	Helen Saunders	Dec 2001 - End of project
SMR Officer (ECC)	Alison Bennett	1994 – End of project
Project Manager (internal)	Paul Gilman	1993 - End of project
Head of Heritage Conservation	David Buckley	1993 - End of project

All mapping has been carried out by staff of the Essex County Council Heritage Conservation Branch (formerly Archaeology Section). The RCHME/English Heritage provided training in both the plotting and the use of MORPH2.

There have been several staff changes during the course of the project. Between 1993 and mid 2000 mapping was carried out by Caroline Ingle and David Strachan. Following the departure of David Strachan in June 2000 the second project officer was Susan Tyler, replaced in December 2001 by Helen Saunders. Caroline Ingle left Essex in March 2002, after which the mapping stages were completed by Helen Saunders. Preparation of the publication synopsis and this management report has been completed jointly by Helen Saunders and Caroline Ingle. One additional member of staff, Martin Redding, was, with the approval of RCHME, employed for mapping of a single sheet, TL82SW but given the length of time and quality of mapping the experiment was not repeated.

7.2 Project team structure

The project was under the overall control of the Head of the National Mapping Programme, Dr Robert Bewley (Head of Aerial Survey, English Heritage) until September 2003 when Pete Horne took over, and throughout the project has been supervised and monitored by a Project Coordinator from English Heritage (and formerly RCHME). The Project coordinator was initially Vicky Fenner, RCHME, who was responsible for assisting with the setting up of the project, assisting in the production of the project specification, training staff, dealing with computer hardware and software issues, quality control and monitoring of progress. Since the beginning of 1996 the project co-ordinator has been Simon Crutchley, Aerial Survey, English Heritage. Within ECC the work of the project was undertaken under the supervision and management the Head of Heritage Information and Records (HIR), Paul Gilman, under the overall supervision of the Head of Heritage Conservation, David Buckley.

The project staff have been responsible for writing the Project Specification, arranging the ordering of maps, photographs and NAR printouts, organising the flow of work, reporting on the progress of the project and producing the final report. Additional support, for the addition of records to the EHCR has been provided during the course of the project by the SMR Officer, Alison Bennett, and Sally Gale (SMR Assistant).

7.3 Project time-scale

7.3.1 Project Design 1993

When the original project design was discussed in 1993 ECC estimated that the 190 quarter-sheets in this project would require up to 8 person years to complete, based on an average of 5-8 person days per quarter sheet (Ingle 1993b).

7.3.2 Project Specification 1994

The revised specification (Ingle 1994) contained a more detailed assessment of the length of the project. For this the 190 map sheets for the county were graded 1-5 based on the density of the air photo coverage in the Quantification Assessment according to a grading system set out in the RCHME *Guidelines for the Production of NMP Project Specification Documents*. Using this, time was allocated on the basis of grade, and ranged from 3 days for those sheets with the lowest density of coverage to 15 days for those with the highest. The cover searches for vertical photography undertaken for the quantification assessment did not provide a listing of the number of photographs per map square and the calculations were therefore made on the basis of the oblique coverage only. These figures gave estimates for mapping and inputting time per quarter sheet. This excluded administrative time so in addition two weeks were allocated for each mapping block for administrative tasks, including the checking of photograph loans on arrival and prior to their return, checking of pencil overlays before inking, travel to other photographic collections and addition of new sites to the SMR.

Using these calculations it was estimated that it would require 1016 person days to complete the pre-report writing phases of the project (mapping and inputting to Morph). With the scheduled 1.75 members of staff it was estimated that mapping would be completed in May 1996/7. This figure took into account bank holidays but not sick leave.

7.3.3 Project Specification 1999

An updated Project Specification was submitted to English Heritage in July 1999 (Gilman 1999). This outlined progress to date and set out a timetable for completion of the project. It noted that the times allocated per sheet by the initial grading process were not in accord with the actual time taken; and that at that stage the average number of days required per sheet were 4, 7, 10, 11 and 17 days for grades 1-5 respectively (compared with the original allocation of 3, 6, 9, 12 and 15 days). It was also reported that the administrative time was longer than originally estimated, particularly with loans supplied as sub-blocks. The revised timetable was based on these figures and estimated a total of 306 person days to complete mapping and inputting, rising to a total of 447 days when the additional tasks were taken into account. Based on 1.1 members of staff working on the project for the remainder of its duration, the completion date was set at the end of November 2000, although a later date was anticipated should there be continued delays in obtaining photo loans. The preparation of the management report and academic publication was expected to continue into the 2002/3 year.

7.3.4 Project Duration

In practice a number of factors have affected both the length of time required to complete the project, and to extend the date of completion.

- Following completion of the first few blocks, at the request of the RCHME Air Photo Library many of the blocks were further divided into sub-blocks to reduce loans to a more manageable volume (a maximum of c.2500 prints) and reduce the length of any one loan. In Essex this meant sub-blocks of 3-4 quarter sheets. Whilst it did not require the same length of time per block for checking in the smaller loans, nonetheless the total time spent in this exercise is estimated to have been greater than it would have been for the planned 20 loans with the effect of increasing the expected administrative time.
- The programming of loans at the NMR (largely a result of the level of demand from other projects) resulted in a number of delays in acquiring loans, reducing the amount of time that could be used for mapping in some quarters.
- Whilst a number of the sheets were completed in less than the allocated time according to the grade, most required longer than had been anticipated. Given the volume of photographs (in particular the vertical coverage for most of the county) examination of photography required longer than expected even in those areas in which few sites were identified and mapped. Three days has rarely been sufficient for even those map squares with small numbers of features. Thus whilst overall sheets of a higher grade took longer to complete, there is significant overlap between the grades (figure 9)

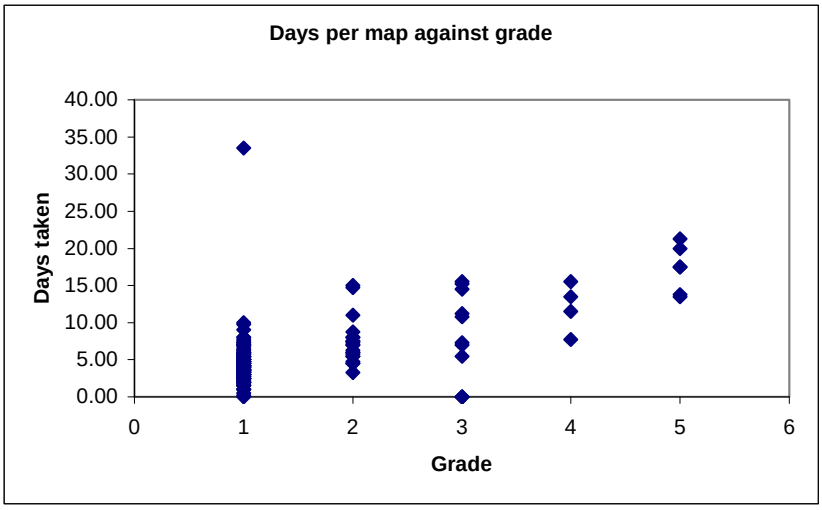


Figure 9 – Days per Map against Grade

- Time allocation for the initial map sheets did not allow for the additional time required in training and more detailed monitoring and checking of sites by RCHME project co-ordinator.
- There have been a number of changes of project staff, which has required allowance of additional time for training.
- NMP staff have been involved in additional tasks as an integral part of their role on NMP project within a local authority historic environment service, including provision of specialist advice, internal reports to committees, for annual publications and presentations to a range of organisations. It is clear that insufficient time was allotted for these tasks in the original specification.

Figures for number of days to complete mapping are not available for four sheets (TL60NE, TL61SE, TL71SE, TL71SW) that were completed at the very beginning of the project and those for TL82SW are generally not included in the following discussion.

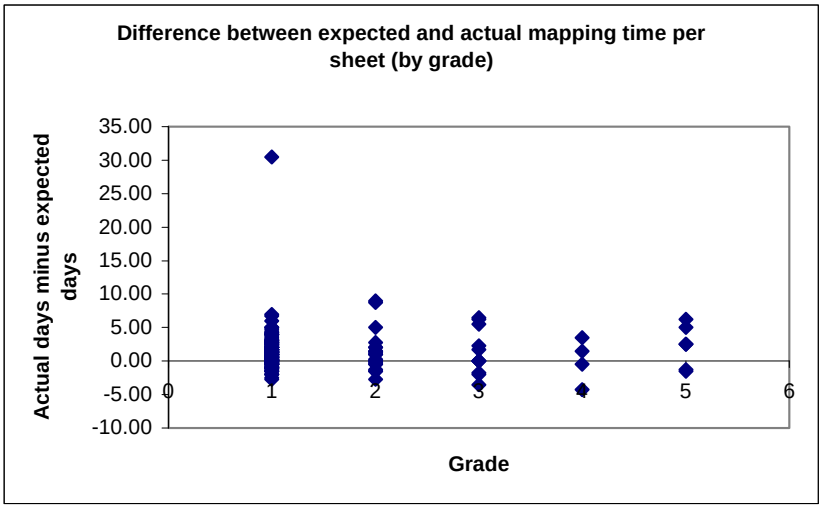


Figure 10 - Difference between expected and actual mapping time per sheet

Figure 10 shows the difference between expected and actual mapping time per sheet. The one anomaly within this graph is TL82SW, which, as mentioned above (section 7.1), was only a grade one map sheet but took considerably longer than expected. This spread of variation in time taken does not reflect the individual working patterns of the interpreters involved as is seen by figure 11 which demonstrates that there was a similar range for each interpreter in the variation between expected and actual time taken to complete each quarter sheet.

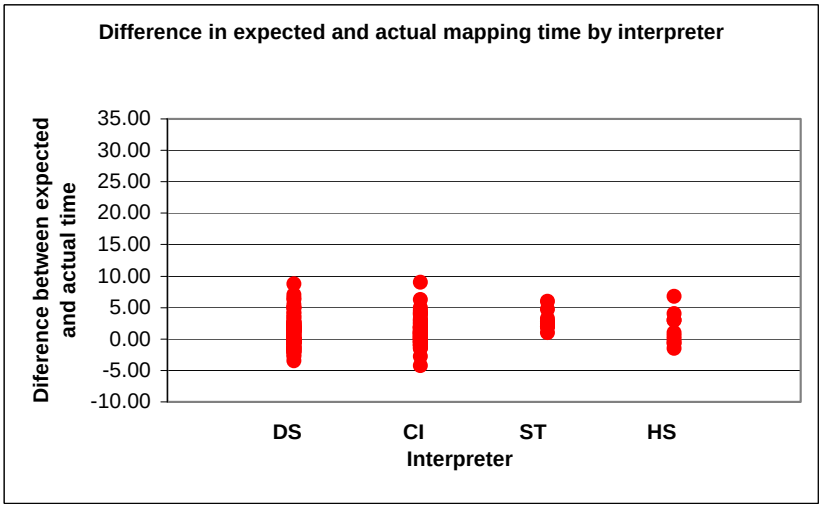


Figure 11 - Difference between expected and actual mapping time by interpreter

Accordingly the time required for each mapping block has, with three exceptions exceeded the original estimate (table 4)

Block/Sub-block as mappedf	**Estimated days for block**	**Actual days for block**	**Days difference**	
1	72	Over 77.5*		No figures available for 4 sheets; total estimated time for these is 42 days
2	39	64.25	25.25	N.B. figures omitted for 1 sheet (TL82SW) mapped by M Redding 33.5 days
3	42	51.5	9.5	
4	54	56.75	2.75	
5	27	29.75	2.75	
6	30	35	5	
7	27	26.5	-0.5	Block 14 in the 1994 Project Design
8	57	79.5	22.5	Block 15 in the 1994 Project Design
9	51	54	3	Block 7 in the 1994 Project Design
10	72	91	19	Block 8 in the 1994 Project Design
11	54	48.25	-5.75	Block 9 in the 1994 Project Design
12	45	53	8	Block 10 in the 1994 Project Design
13	24	32.25	8.25	Block 11 in the 1994 Project Design (which erroneously included 9th sheet)
14	24	36	12	Block 12 in the 1994 Project Design Includes TL60 SW which seems to have slipped to Block 15
15	33	32.75	-0.25	Block 13 in the 1994 Project Design Excludes TL60SW which seems to have slipped from Block 14
16	30	42.75	12.75	
17	24	33	9	N.B. excludes figures for 52SE and 52SW (from Blocks 18 and 19 respectively) which for block loans were included with 17
18	33	64.5	31.5	N.B. includes figures for 52SE in this Block in the 1994 Project Design
19	33	48.5	15.5	N.B. includes figures for 52SW in this Block in the 1994 Project Design
20	42	50.5	8.5	
Total	814	Over 1040.75		
For sheets with full records	**784**	**1040.75**		

Table 4: Days per block

There is a general relationship between the number of MORPH records created per sheet and the number of days required for completion in so far as those sheets with more MORPH records tend to take longer overall to map and interpret, although this was by no means a consistent relationship. (figure 12).

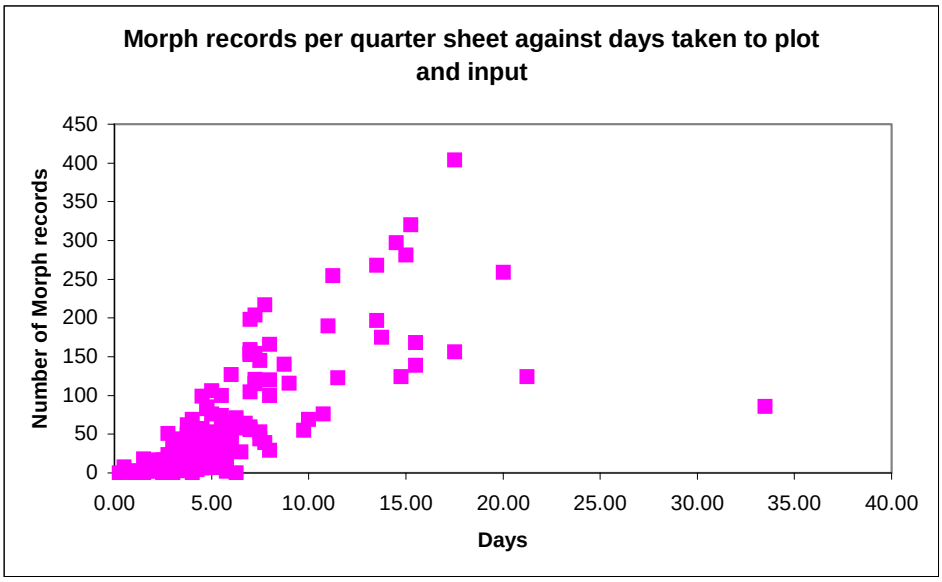


Figure 12 - Relationship between number of MORPH records per quarter sheet and the number of days required to create them (Data from 186 sheets)

There is a similar picture for the number of days taken relative to the number of oblique aerial photographs identified per quarter sheet in the Quantification Assessment (figure 14) suggesting that the general approach for the grading system based on density of photo coverage is valid but that various factors mean that this is not such a simple formula as suggested. In particular, by not taking account of the number of vertical photographs that would require at least assessment it is likely that many sheets were skewed to a lower grade than would be realistic.

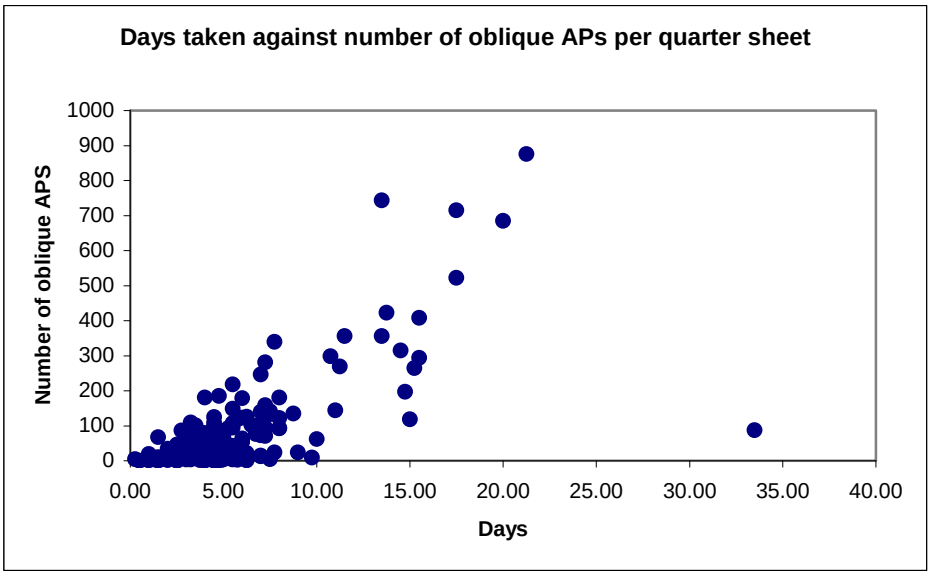


Figure 13 - Relationship between number of days taken and number of oblique aerial photographs from Quantification Assessment (Data for 186 sheets)

The reasons for the variation in time taken between quarter sheets are manifold. It is often the case that areas of complex articulated systems such as extensive settlements require considerable thought to produce archaeologically rigorous records but that these will probably be few in number. Conversely large numbers of disparate features can be recorded more quickly and result in a large number of unrelated records.

The time estimated also does not allow for the need for training and the fact that the earlier sheets (for each new interpreter) took longer as staff were less familiar with MORPH and required more detailed monitoring and supervision from RCHME/EH.

Considering the overall estimated timescale and the actual project length it is essential to note that the NMP-related tasks include loan arrangement, loan check-in, loan check-out, organisation of photographs from loans and NH collection, data copying and backup, reporting, ongoing training, system development and dealing with software/hardware issues. All of these are essential to the day-to-day operation of the NMP project, but are not allocated against a single map. Being based within a local authority historic environment service, the Essex project staff also had an integral role in the provision of specialist air photo interpretation advice to other officers within the County Council and to members of the public consulting the service. Also excluded from (or seriously underestimated) in the original estimate was the time needed for addition of records of newly identified sites to the EHCR; given that the project was based within the County Council this was considered to be a fundamental task of the project.

If all these NMP related tasks are included, for Blocks 3 (part) to 20 (blocks for which detailed figures available for staff NMP time), the initial estimates are exceeded by 90%.

This underestimation of the time required is not unique to Essex but has been seen in other projects. In Northamptonshire the average number of days actually taken to map and record each quarter-sheet and all the associated tasks exceeds initial estimates by nearly 28% and the estimates on which the projects was initially funded by more than 64%. The Lincolnshire NMP project, which followed a sketch plotting methodology and was initiated just one year previous to this project, for example, was originally allocated an average of 11 days per quarter-sheet for all tasks (RCHME 1994). At the end of the project it was demonstrated that the average time to complete each quarter sheet had exceeded sixteen days (Kershaw 1997). This was attributed in the main to a lack of appreciation of the time cost of the associated non-mapping NMP tasks. However, as more NMP projects have been carried out more realistic timetables have been devised. Indeed the revised 1999 specification for Essex gave a more accurate assessment of the number of days required for completion of the mapping and inputting phases, the actual figure being 464 days compared to an estimate of 447 days.

8 PROJECT RESULTS

8.1 Project outputs

The mapping has created a number of distinct outputs:

8.1.1 Additions to EHCR entries

The NMP has added significant numbers of new sites to the EHCR. These include newly identified cropmark and earthwork features, new details to known sites and features of classes which may not have been systematically recorded previously. For all new sites, records have been added to the EHCR on completion of each map quarter sheet. In general, individual EHCR entries equate to features as noted on the site record forms and so relate to MORPH groups or complexes rather than individual MORPH sites.

8.1.2 Map overlays

The map overlays have been copied for addition to the EHCR archive and in addition have been scanned as Tiff's at 72dpi and as a layer in GIS are available to all EHCR users. It is acknowledged that whilst these scanned versions can be viewed at any scale, like the hard copy overlays they cannot be considered accurate when enlarged to greater than 1:10,000 scale.

Digitised photographs and AERIAL plots were designated as working material and it was not possible to retain copies of all files. This was partly due to restrictions on electronic storage capacity and partly due to issues of copyright.

8.1.3 Site Record Forms and Map Note Sheets

These are currently stored at ECC as part of the EHCR but their long term archiving needs consideration. The Site Record Forms are a valuable source of information for a range of EHCR users since they provide the listing of photographs used to plot sites – information which has not yet been transferred to the EHCR except where sites are new to that record.

8.1.4 MORPH2 database

Over the course of the project 10,711 MORPH records were created. The MORPH 2.2 database is a recording module, custom-designed for the RCHME in 1989, for use by the NMP (Edis et al. 1989). MORPH was designed "as a systematic recording tool to allow for rapid retrieval and analysis" of NMP data (Bewley 1998:12). The database records information on the location and morphology of archaeological sites and the date and function of those sites as deduced by the interpreter. Invariably the date and function of archaeological features recorded from the air have not been verified by excavation and these interpretations should be treated with caution. All interpretations are qualified in the "Validity" field in which the interpreter has indicated their level of confidence in their assessment of the evidence. The MORPH manual provides a full account of the structure of the database and its content (RCHME 1993).

8.1.5 Acquisition of new data

Despite the long history of archaeological aerial survey and mapping in the county, the project has identified many new sites and added a significant number of newly recorded features, even in those areas that have been the subject of the most intensive aerial survey. These include, for example, a triple ditched enclosure on the Thames gravel terraces, at Brittons School, Hornchurch just over the border into Greater London. This appears on the 1947 RAF vertical photos and is comparable to that at Rainham, which was excavated in advance of gravel extraction. Recent mapping has also included a newly recorded circular enclosure near Passingford Bridge that has been interpreted as a possible hengiform monument (EHCR 19338) of Neolithic date. There are also significant additions in classes not previously systematically recorded on the EHCR, in particular WWII features (e.g. anti-aircraft batteries, DIVER sites, airfields, tank traps), oyster pits, duck decoys, intertidal timber structures and sea defences.

Even for many of the sites previously recorded on the EHCR NMP has added new detail, for example, in the vicinity of the long mortuary enclosure at Rivenhall where a number of ring ditches, linear features, pits and enclosure have been added to the record.

8.1.6 Improved quality of data

NMP highlighted the inaccuracies in the existing 1:10,560 EHCR plots, both in terms of interpretation and the accuracy in plotting of features. While providing an indication of the presence of features, the original plots did not provide a sufficiently reliable database for the assessment of the archaeological implications of proposed development, or for comparitive analysis or for other research purposes. The current plots provide a much more comprehensive and accurate map of features in the county, enabling the historic landscape to be better understood.

More accurate plotting of known features is also allowing their reassessment and reinterpretation and enabling the correction of what appears to have been over-interpretation in the past on some occasions. At Stisted, east of Braintree, analysis by NMP staff and other colleagues of photographs noted on the EHCR as recording 11 ring ditches concluded that there were no such features in the field in question. A rectangular and a curvilinear enclosure also recorded were clearly visible and remapped. Clearly such changes have significance for all uses of the data – e.g. development control, since inaccurate maps mean incomplete data and possible delays in the process. In other instances, there has been a change or refinement of interpretation. Remapping of the cropmark complex at Birch (west of Colchester) indicates that these enclosures, on the basis of size, morphology and spatial relationships, are similar to the excavated ‘warrior graves’ complex at Stanway, just outside Colchester. The larger enclosure at Birch, which also has a single large pit, may be another important burial enclosure. At Colchester the analysis of the RAF photography from the war was able to correct a serious misconception – that the system of regular ditches?? were not the remains of a planned Roman field system, but were in fact anti-glider ditches dug during the Second World War and showing clearly as such on the 1940s photography.

A key value of the NMP process is the ability to assess several years of photography and thus eliminate from the mapping features that prove to be ephemeral and the result of more recent and transient activities. Circular and linear parchmarks resulting from a circus at Saffron Walden is but one example.

8.1.7 Records relative to geology and topography

The results of the quantitative assessment demonstrated that aerial photographic coverage concentrates on the sands and gravels of the county with a consequent bias towards the south and east, and this bias can be seen in the overall distribution of mapped sites in figure 15. Much of the county is underlain by clay deposits, both the London Clay in the south, and the Boulder Clay in the north west. The focusing of the aerial reconnaissance on these areas in recent years has increased the number of cropmark features recorded here, although the air traffic control zone at Stansted Airport does hinder survey in the north west. The Southend peninsula has not produced the impressive air photographic evidence showing multiperiod cropmarks which are characteristic of large parts of south and east Essex, again due in a large part to restrictions on flying in the area because of the proximity of Southend airport. In contrast to the relative lack of evidence from the air, terrestrial investigation shows that the area has an especially high incidence of rich finds indicating intensive occupation since the Mesolithic period.

There are relatively few upstanding earthwork monuments in the county, a consequence of the intensive agriculture in the region, and the majority of features have been identified as cropmarks. As a result there is little additional detail from fieldwork whether intrusive or non-intrusive for a large percentage of sites.

It is essential to emphasise that although aerial survey is a very important technique, information gained from aerial photography is only one method of revealing archaeological sites and some sites are less well represented in the aerial photographic record than others. It is important when examining the data in the EHCR that users are aware of the inherent biases in the data set. As noted above, not only are there biases in the distribution of sites that reflect the underlying geology, but also certain types of sites and periods show more readily than others. There are plenty of examples of sites where features do shown on aerial photos, but excavation has proved that what is visible from the air is only part of the story. At Springfield Lyons what was thought to be the cropmark of a Neolithic henge was shown to be a Bronze Age settlement enclosure whilst excavation also revealed a Saxon cemetery and settlement, both features which in the right conditions might be expected to be visible on aerial photos.

The coastal landscape block includes both terrace gravels, on which cropmarks are particularly readily developed and which include some of the densest concentrations of features identified, and the coastal marshes. Here, prehistoric and Roman features that exist are to a large extent buried under later alluvium, and the main features plotted have been those of medieval and later date related to exploitation of coastal and marine resources, including duck decoy ponds and oyster pits.

The soil types developed on the Boulder Clay in the central and north-western part of the county do not readily lead to the development of cropmarks. In consequence relatively few sites are recorded on these clays, and what features there are tend to be seen as discrete and separated groups. It is clear,

demonstrated most recently by the excavations at Stansted Airport, that the distribution and density of sites mapped does not reflect the real pattern of buried archaeological features.

8.2 Overview of results

The following sections briefly summarise the type and distribution of sites assigned in MORPH to the various chronological periods. There are some biases towards certain chronological periods as sites can only be recorded as having a single period within MORPH. This means that sites are only recorded as Iron Age or Roman if they are occupied only for that period; otherwise they become "Unknown Prehistoric".

8.2.1 The Prehistoric Period

Figure 15 shows the distribution of sites recorded as being of "unknown prehistoric" origin. There are 3 areas of concentrated sites within this category, with the Tendring peninsula showing the highest concentration of sites. This is partly due to responsive soils and the fact that the area has been continuously flown for many years because of the good results that can be expected. High concentrations of sites can also be found along the north shore of the Blackwater estuary and following the Blackwater, Chelmer and Stour valleys. The Thurrock area also stands out as having a large proportion of unknown prehistoric sites. There are 1791 unknown prehistoric sites in total (figure 15) and 44% (800) of these are classified as enclosures with no further interpretation, most within areas of complex cropmarks. These enclosures could be settlement sites, but a more comprehensive interpretation was not possible at the recording stage.

When looking at the distribution of the sites that have been assigned a specific prehistoric date it is possible to see that there is a dramatic drop in the number of sites. In total there are only 35 sites (0.33%) placed in the Neolithic (figure 17). Of the sites several are classic excavated examples, such as the Springfield Cursus or the Orsett causewayed enclosure. The vast majority of other Neolithic sites have been classified as mortuary enclosures with a small number of linear features and maculae.

The Neolithic sites can be found across all the landscape zones and different geologies and because there are so few sites classified no discernible patterns can be distinguished. There is a similar picture with the sites classified as Iron Age (figure 18). A series of sites follow the Blackwater estuary and a small cluster of sites to the south west of Colchester. The sites at Colchester are part of the well known Gosbecks Iron Age and Roman site (EHCR 11643), which have been excavated. Similarly the sites in Thurrock are part of the Mucking complex (EHCR 13842).

Other Iron Age sites are isolated enclosures and linear features showing in all the landscape and geological zones. This would imply that there are other Iron Age settlement sites that are not necessarily visible from the air or recognisable when defined on morphological grounds alone.

Figure 17 shows the distribution of Bronze Age sites. A very high proportion of the total prehistoric sites are attributed to the Bronze Age (1075 in total). This is, in part, due to the classification of round barrows, which are generally assumed to be Bronze Age. Other barrow interpretative codes could be used if it was felt that a site was from another period, for example, in Thurrock there were examples of excavated Saxon round barrows (discussed later). It must be considered possible that not all of the sites recorded as Bronze Age

round barrows will be either round barrows or even Bronze Age, and this highlights one of the problems in assigning an interpretation based purely on morphology.

The distribution of sites follows some very distinct patterns. A substantially large proportion of sites are located on alluvium, sands and gravels with very few sites being situated on the London Clays in the south-west of the county. As with the distribution of Iron Age sites a large number of the Bronze Age sites follow the main river valleys of the Blackwater, Chelmer, Ter and the Stour. There are also a significant amount of sites found on the chalk in the very north-west of the county that follow minor rivers.

Interestingly a linear pattern of round barrows can be distinguished running north-east – south-west between the Rivers Blackwater and Crouch. The sites appear to follow the line where the geology changes, between the more responsive sands, gravels and alluvium and the less responsive London clays. These substantial numbers of sites are situated within large cropmark complexes, including a large Scheduled Area of enclosures, trackways, round barrows with internal features and possible house platforms. These sites may be contemporary but the other features within the complexes have been classified as unknown prehistoric. All these complexes run along this boundary between the different geologies. This could represent a true picture of the location of the archaeology or it may be that the cropmarks have not formed on the London Clays so the sites have not been recorded. However, the distribution of round barrows forms a narrow band and if the sole reason for this pattern was the geology then more sites may be expected over the rest of the Dengie peninsular where the geology remains the same.

This trend of Bronze Age round barrow sites being located in landscape zone one continues in Thurrock as a substantial number of round barrows and other unknown prehistoric sites fall into a tight geographical group. The round barrows in this area again fall within an area of very complex cropmarks.

The distribution of sites on the Tendring peninsular does not appear to follow the same pattern as elsewhere in the county. Although many of them are still on the responsive sands and gravels there are just as many on the London clays and boulder clays. This may be as a result of the amount of aerial reconnaissance completed in the area, as Tendring is one of the most responsive cropmark areas in the county.

8.2.2 The Roman Period

The distribution of Roman sites (shown in figure 19) shows a significant north-south split with a high proportion of the Roman sites being on the chalky boulder clays of landscape zone 3. There are small clusters around known Roman centres such as Colchester, Chelmsford and Great Chesterford. Although more Roman sites might have been expected in these areas, urban development has resulted in fewer aerial photographs. A large proportion of recorded Roman sites are linear features, of which many are sections of visible Roman Road. It could be implied that the distribution of some of the sites follow these routes from Chelmsford towards Colchester and north towards Great Chesterford.

8.2.3 The Medieval Period

The vast majority of the features within the "Unknown Medieval" period are field boundaries classified as linear features (figure 21). Although these sites are distributed across the county there are concentrations in

Tendring, the area immediately north of the Blackwater estuary, the area around Stansted and in Thurrock. There do appear to be more sites recorded as linear features on the less responsive boulder clays. Gaps in the distribution of sites assigned to this period can be seen around Chelmsford, but this can be explained, at least in part by the slightly different approaches of the individual interpreters for the area. This gap is filled when the post medieval sites are included in the distribution, and clearly reflects the differences in interpretation. There are also more moated enclosures in this period in the west of the county. Again this pattern can be partly explained in terms of dates assigned by different interpreters. Whilst there appears to be a cluster of moats in the area, in reality the cluster is only of sites assigned to the 'Unknown Medieval' period, as moats in the surrounding area have been classified as from the late medieval period and so the site type is fairly wide spread.

Salt production around the coast can explain some of the clusters of sites within the coastal zone in this period. There is evidence for prehistoric, Roman and medieval salt production, but salt mounds and red hills are extremely difficult to date and many have been attributed to the "Unknown Medieval" period. Low level vertical photography has enabled additional areas to be accurately mapped, including features which have subsequently been destroyed by development association with the expanding town.

Red hills are one class of feature for which the majority of the available photography revealed little new information – the irregular patches appear as grey amorphous maculae on black and white photographs, indistinguishable from numerous other natural and agricultural marks making reliable identification of red hills at best difficult. The 1995 Essex Aerial survey, using colour photography on which red hills show up more clearly, recorded over 40 new red hills for addition to the EHCR, the majority of these being concentrated in an area to the south of Peldon, Tollesbury (Strachan 1996). The area around Paglesham has a concentration of sites from several different periods, including some from the "unknown prehistoric" period, and for the "Unknown Medieval" period there is an increase in the number of sites. There is some documentary evidence supporting the medieval salt industry in the Paglesham area where the red hills mark the edge of the coastal marsh. This correlation with historic settlement and salt production is unsurprising as settlement in this area utilises the fertile well drained soils for agriculture and enables communities to maximise the use of local resources such as the sea.

This exploitation of the sea can also be seen with the distribution of fish weirs (kiddles) around the coast. Some have been radiocarbon dated, and so assigned a specific period in the MORPH record, but others have been attributed to the "Unknown Medieval period". A number of large timber inter-tidal fish weirs have been recorded in the Blackwater estuary, for example, the site at Collins Creek, which has produced radiocarbon dates in the 9th and 10th centuries AD. These sites have proved problematical to record as they are now only revealed by extremely low spring tides. Whilst the County Council's aerial survey programme has targeted the intertidal zone and produced a low level record of the sites which can show their detailed layout, at this scale there are often few, or no, control features on the photographs to allow location and mapping.

Conversely, high level photography, which does contain control, is rarely taken at very low tides, and if this is the case the scale does not lend itself to clear visibility of these features. Mapping therefore relies very much

on a combination of both sources – the vertical photography to map the overall size, shape and location of the site, and the obliques to record the detail. The positions of other unidentified timber structures, probably former groynes and booms, have also been recorded to form a basis for future research.

An unusual, and perhaps related, site runs parallel to the coast of Foulness Island and consists of a hard surfaced intertidal road. Known as 'the Broomway', the site was once considered to be possibly of Roman origin, although it is now thought that it simply offered easier access (albeit at low tide) for transportation of goods than following the land route around the creeks. It is possible that the road did have medieval origins and was used by inter-tidal fishermen, an industry for which there is documentary, although currently no archaeological, evidence.

Sites from the early medieval period (RO-1086 AD) only contribute 0.22% of total sites (figure 21) recorded on the MORPH database. The sites that are considered to be from the early medieval period are mostly excavated examples, such as a collection of round barrows with inhumation burials discovered and mapped in the Thurrock area (Hedges and Buckley 1985).

There is limited evidence for early medieval settlement in Essex, with the exception of the extensive settlement at Mucking. It has been noted that Saxon Settlements in the north west of the county are often difficult to locate (Hunter 1999: 67), and with the relatively poor development of cropmarks in this area it limits the potential for locating or interpreting Saxon sites from aerial photography alone. In Thurrock several early medieval grubenhauser have been identified. It is possible that some field boundaries and systems were established during this period as part of major land organisation, but these are almost impossible to date when not associated with sites of a known date.

The evidence for late medieval (1086 – 1540) archaeological sites is more common (figure 23). Unlike earlier periods there appears to be an east-west split across the county with more sites located in landscape zones 3 and 4, which are made up of the boulder clays and London Clays. Moats, both extant and appearing as cropmarks are a major site type in the MORPH records for this period. Essex has the highest concentration of moated sites in the country (Aberg 1978) with over 800 moated records in the EHCR. However, only a small proportion of moated sites were mapped as part of the NMP (A total of 182).

Mapping moated sites was problematic because many tend to be surrounded by trees obscuring them from view from the air and in accordance with the NMP methodology only sites visible from the air were mapped. Of the 182 that were mapped 109 (60%) were attributed to the late medieval period. Often sites such as ponds, water channels or dams were mapped as associated features and along with windmills or mill mounds made up a large proportion of sites included in this period.

8.2.4 Post medieval period

The post medieval (1540 – 1900) is dominated by field boundaries and other linear features (figure 23), which are concentrated in the centre of the county within landscape zone 3. The distribution pattern can be accounted for, in part, by the date assigned to these features by individual interpreters, but it could also be

due to the area being used for extensive settlement and agriculture which would have lead to an increase in field boundaries and field systems as the landscape became more organised.

Large numbers of oyster pits, recorded as maculae along the coast, especially around Blackwater and Foulness, are attributed to this period and may either be laid out in neat lines or in a more haphazard arrangement across any stretch of level saltings. Oyster fishing has for centuries been an important industry in the county. For example, Colchester's rights over the Colne may be traced back to the 11th century. However, by the end of the 19th century the industry had seriously declined from the height of production in the middle of the 19th century. The distribution and concentration of these features provide evidence for the scale of exploitation in earlier centuries.

The scale of production in the county is being shown to be more extensive than was perhaps thought before the systematic mapping of sites occurred. With the alarming rate of salt-marsh erosion along the coast, largely due to sea defence construction and sea level rise, many of these sites have been destroyed in the past or are now in the process of being lost. The use of early RAF vertical photography from the 1940s and 1950s has enabled the recording of sites that have already been lost to the sea (Strachan 1995).

Other sites along the coast assigned to this period are numerous duck decoy ponds, particularly concentrated along the Blackwater estuary and the Dengie coast. Duck decoys were constructed in medieval and post-medieval times (though predominantly in the 18th and 19th centuries) for the breeding and management of wildfowl, mostly ducks, in order to provide a constant and sustainable supply of food. In Essex the majority of these were constructed on the coastal marshes, partly because of the wildfowl and partly because this was marginal land. They are of distinctive shape, with a roughly circular central pond with radiating, and slightly spiralled, pipes (channels) often 6-8 in number. The north side of the Blackwater estuary has proved to contain a particularly significant concentration of decoy ponds, which were constructed on what was then marsh, often using stretches of natural creek as the basis for a central pond. Most of these sites have been infilled and/or destroyed by reclamation and the conversion of the land to arable, but many are visible as extant features on the earlier vertical photography, particularly the RAF material. Further south, examples include a rectangular pond at Paglesham and several ponds along the Dengie peninsula, such as an extant and now Scheduled example at Marshhouse near Tillingham. Other examples plotted include an example at Bradwell on Sea, which is now visible only as a cropmark feature, having been infilled and the land reclaimed for agriculture some time after the late 19th century.

The majority of the Essex coast is now enclosed by sea walls, which indicate either land reclamation or the need for defence from the encroaching sea. The NMP methodology provided a good opportunity to record these features quickly and at a suitable scale. By 1210, the 'law of the marsh' stated that each man who benefited from defences should contribute to their upkeep in proportion to the amount of land or his rights on the marsh (Smith 1970, 25). A number of former sea walls indicating land reclamation are visible in several areas, notably the Dengie peninsula and on Foulness Island. On Foulness there is a very clear development of 'inned' (reclaimed) land, much of which can be dated by the documentary and cartographic evidence. In other areas, however, the features do not appear on early OS maps, and the early RAF photography is probably the only form of evidence in many instances, recording the sites before large areas of reclaimed

marsh were converted to arable farming in the 1950s and 1960s. In other areas, natural reclamation of the land by the sea is evidenced.

As a result of the historic and on going changes to the sea defences a total of 93 separate sea defence records have been mapped, of which 45 (48.3%) have been recorded as post medieval sites, the remaining sites being considered to be of Unknown Medieval origin.

8.2.5 The Modern Period

The Modern period, considered to be from 1900 -1945 has a total of 505 sites (figure 24). A substantial number of these are along the coast, especially around Castle Point and Southend. Areas around Chelmsford and Colchester also have a higher proportion of sites. Many of these sites are along the main Second World War defence lines that ran across the county. During the war Colchester assumed great tactical importance and was on the Eastern Command line, barring the way of an invading force landing on the peninsula between Harwich and Brightlingsea. The River Colne served as a formidable anti-tank obstacle and the town was surrounded by a defensive perimeter strengthened by pillboxes and hurriedly adapted buildings. Pillboxes, as roofed structures, were not mapped but details of their locations were recorded and integrated into the County Council's ongoing survey of WWII defences. There appears to be a correlation of sites running from Basildon to Chelmsford along the GHQ defence line. Many of the sites found on these defence lines are tank traps, gun emplacements and anti-aircraft batteries. The large number of anti-aircraft battery sites were recorded and added to the EHCR for the first time. In addition a number of Diver anti-aircraft sites have been recorded along the Dengie coast. These were a type constructed towards the end of the war to counter attack by V1 rockets. Due to their small size and nature of construction, which did not necessitate the earth banks associated with the other anti-aircraft batteries, these have not been mapped onto the NMP overlay, but they have been added to the EHCR.

A number of examples of slit trenches have been recorded at Shoeburyness and Colchester and probably represent training sites for the military bases at these locations. Anti-glider ditches constructed across flat open land to deter landing of enemy aircraft have been mapped in a number of areas across the county, notably the Thames marshes at Rainham, Tilbury and Canvey. Small areas have also been mapped near Colchester where they may have represented training activities.

The position and general layout of RAF and USAAF World War II (and WWI) airfields have been mapped and added to the EHCR. Many of the associated features, including buildings, bomb dumps and camps are outside the scope of the NMP specification as defined for the Essex project and have not been plotted, but were noted for the EHCR. The airfields are scattered across the county, with a total of 23 being plotted. On occasion these airfield sites can be found with associated search light emplacements and protective gun emplacements.

The mapping of these site types demonstrates one of the major advantages of using the early RAF vertical photography. Much of this photographic material dates from 1945-47, with a lesser amount going back to 1942, and therefore shows WWII sites before dismantling or destruction (and in some cases recording them during construction) which in many instances makes these photographs the only record of the site. The

combination of scale of the vertical photography (i.e. high level) and the nature of many of these sites as complex areas of intense activity, often with related buildings, presents some difficulties of mapping at 1:10,000 scale. Many of the site types, such as the Diver anti-aircraft batteries cannot strictly be successfully mapped using the project conventions. It is suggested that a Military Complex category might be beneficial to enable better recording of the component elements of these sites rather than just isolating those features that are visible in the formats fitting the standard conventions.

Changes to the NMP methodology since the Essex project now allow recording of “structures” and “extent of area” on separate layers within AutoCAD, which leads to a more effective recording of military features.

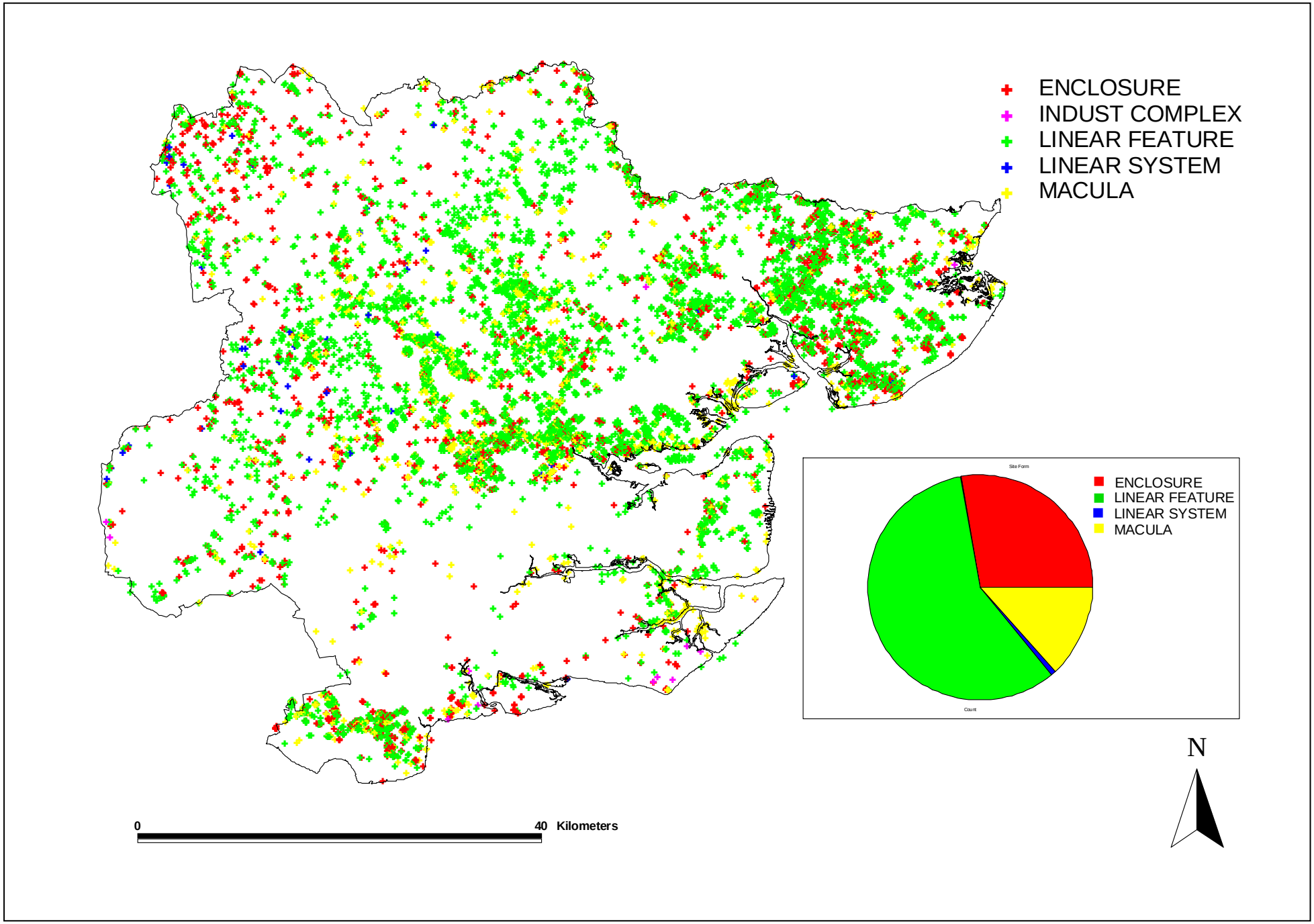


Figure 14. Overall distribution of Mapped sites

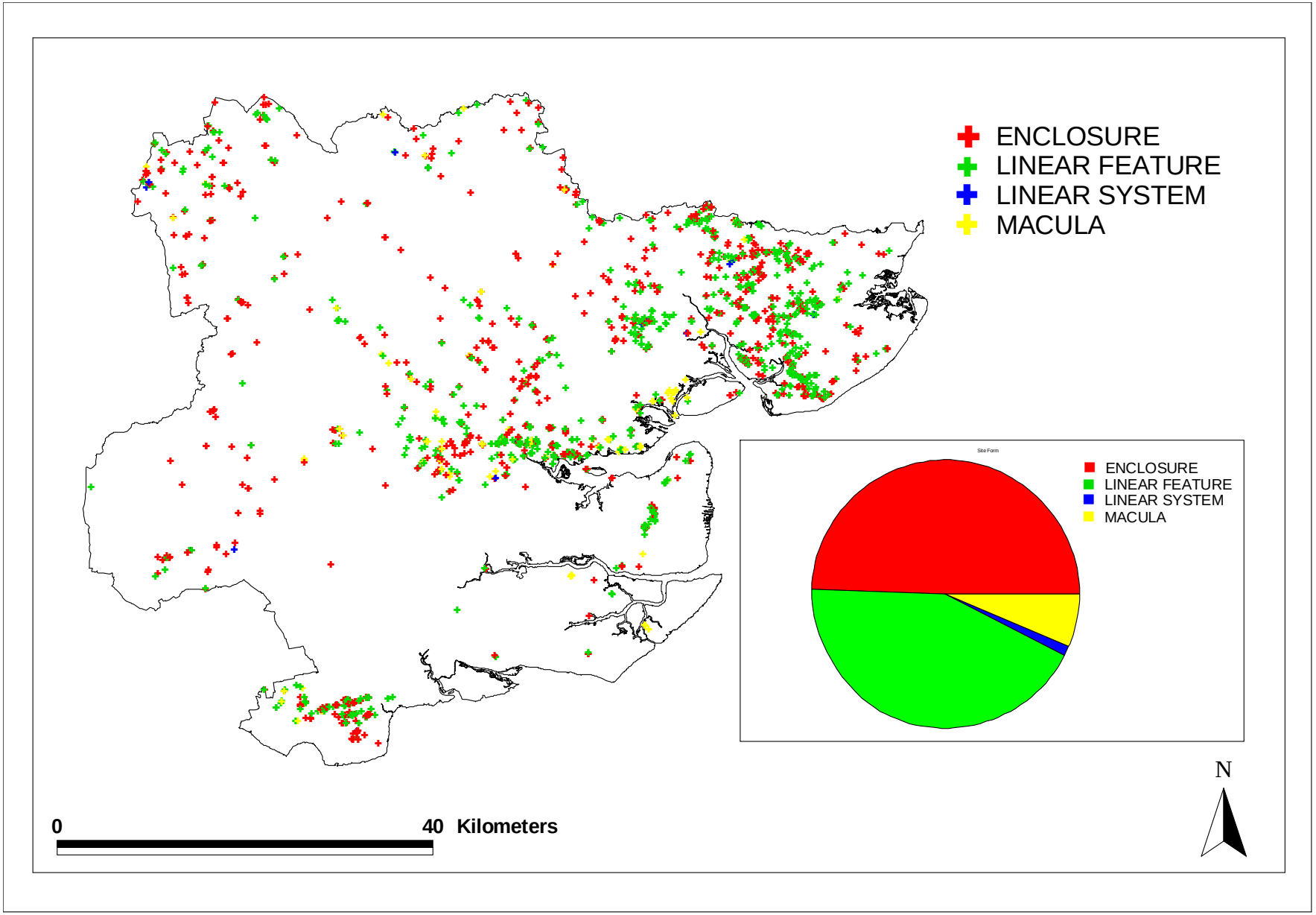


Figure 15. Distribution of Unknown Prehistoric Sites

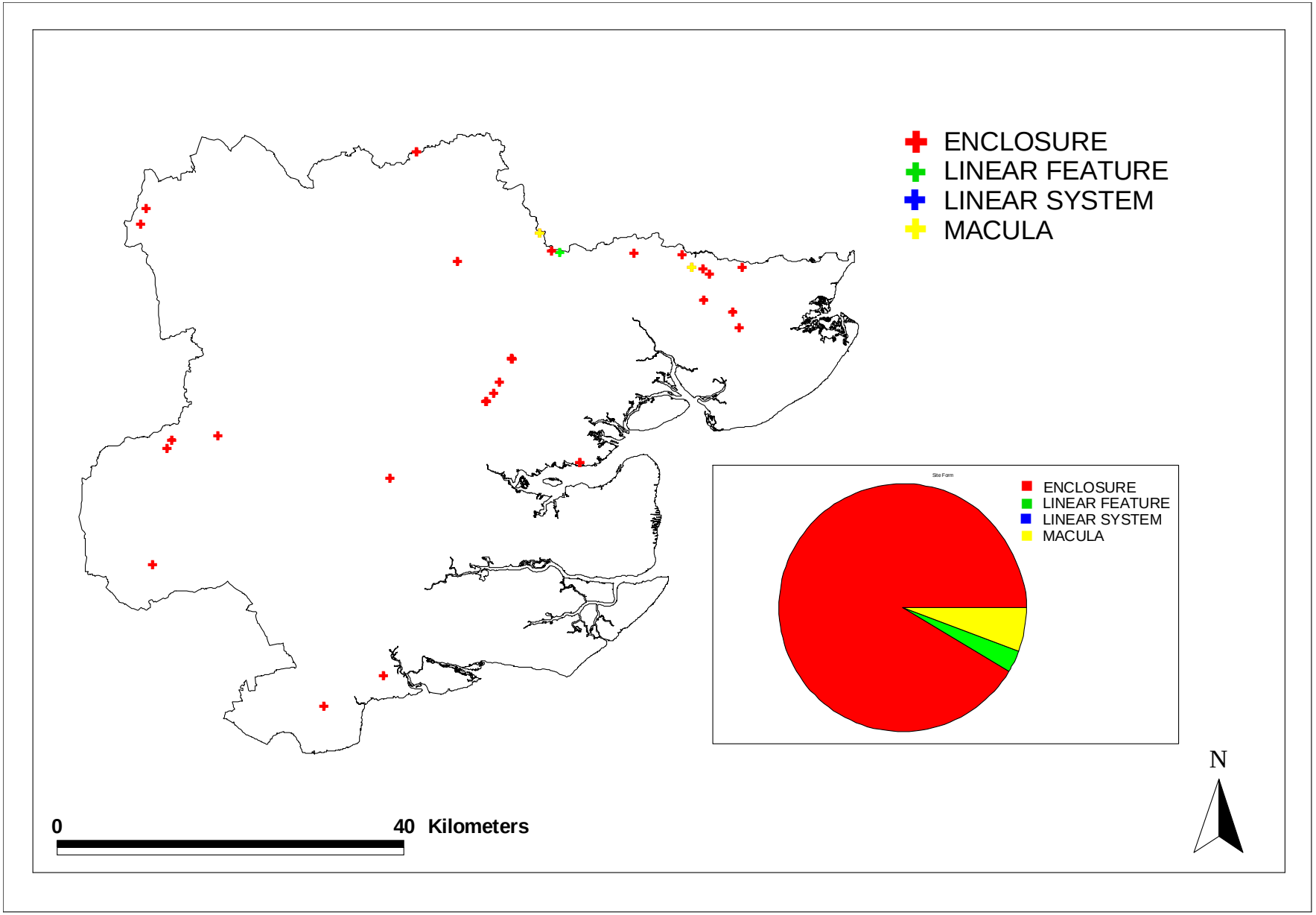


Figure 16. Distribution of Neolithic Sites

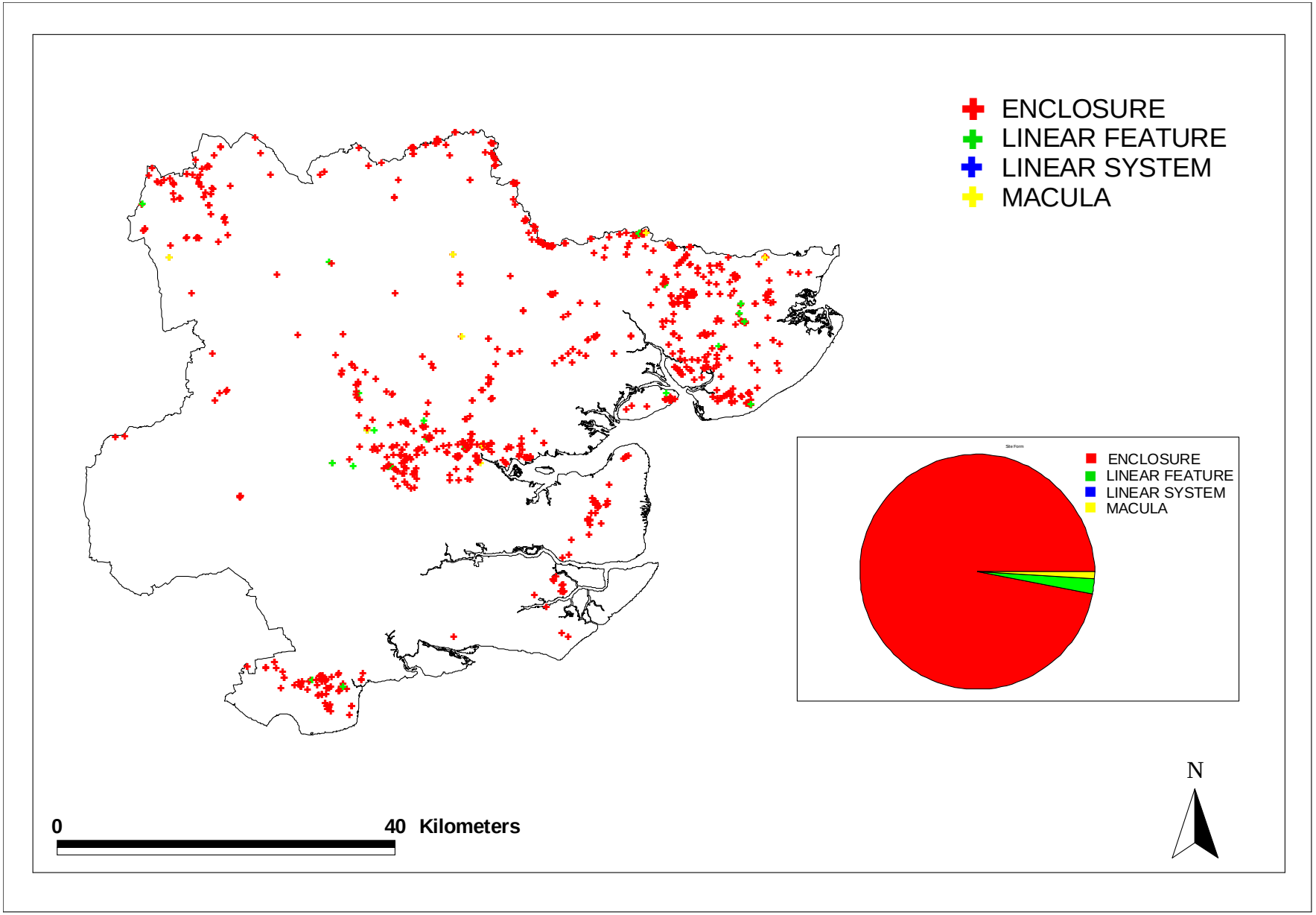


Figure 17. Distribution of Bronze Age Sites

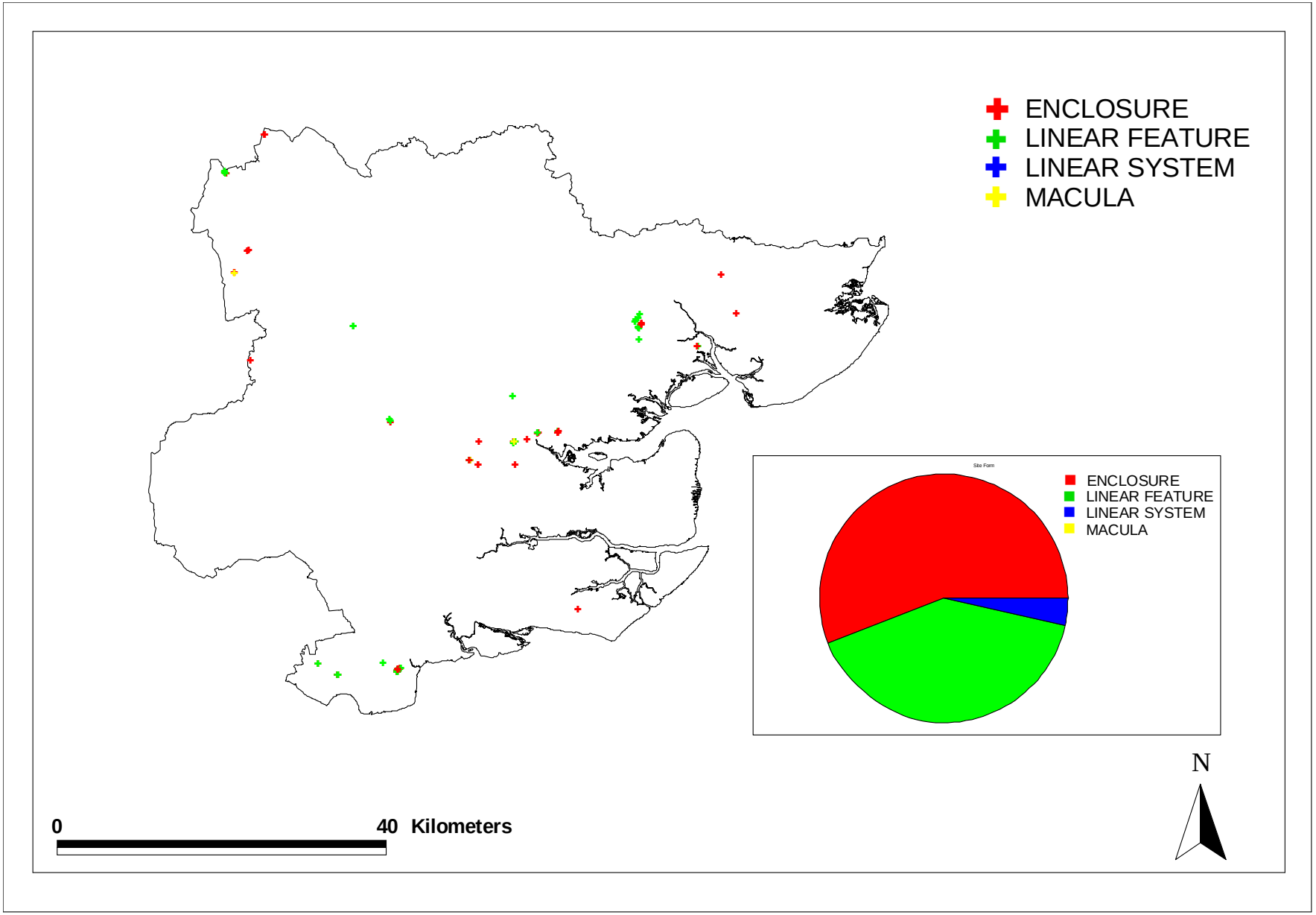


Figure 18. Distribution of Iron Age Sites

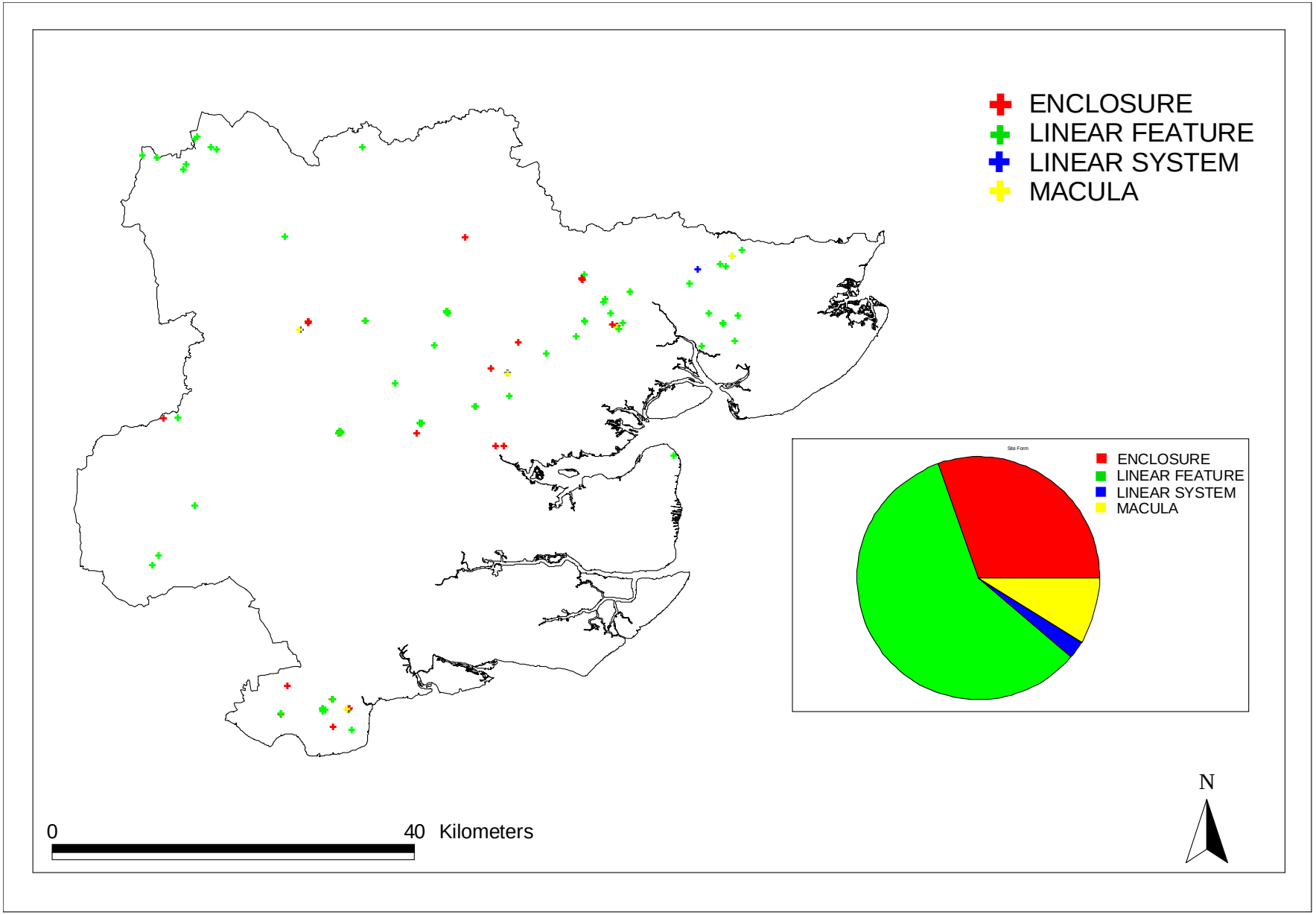


Figure 19. Distribution of Roman Sites

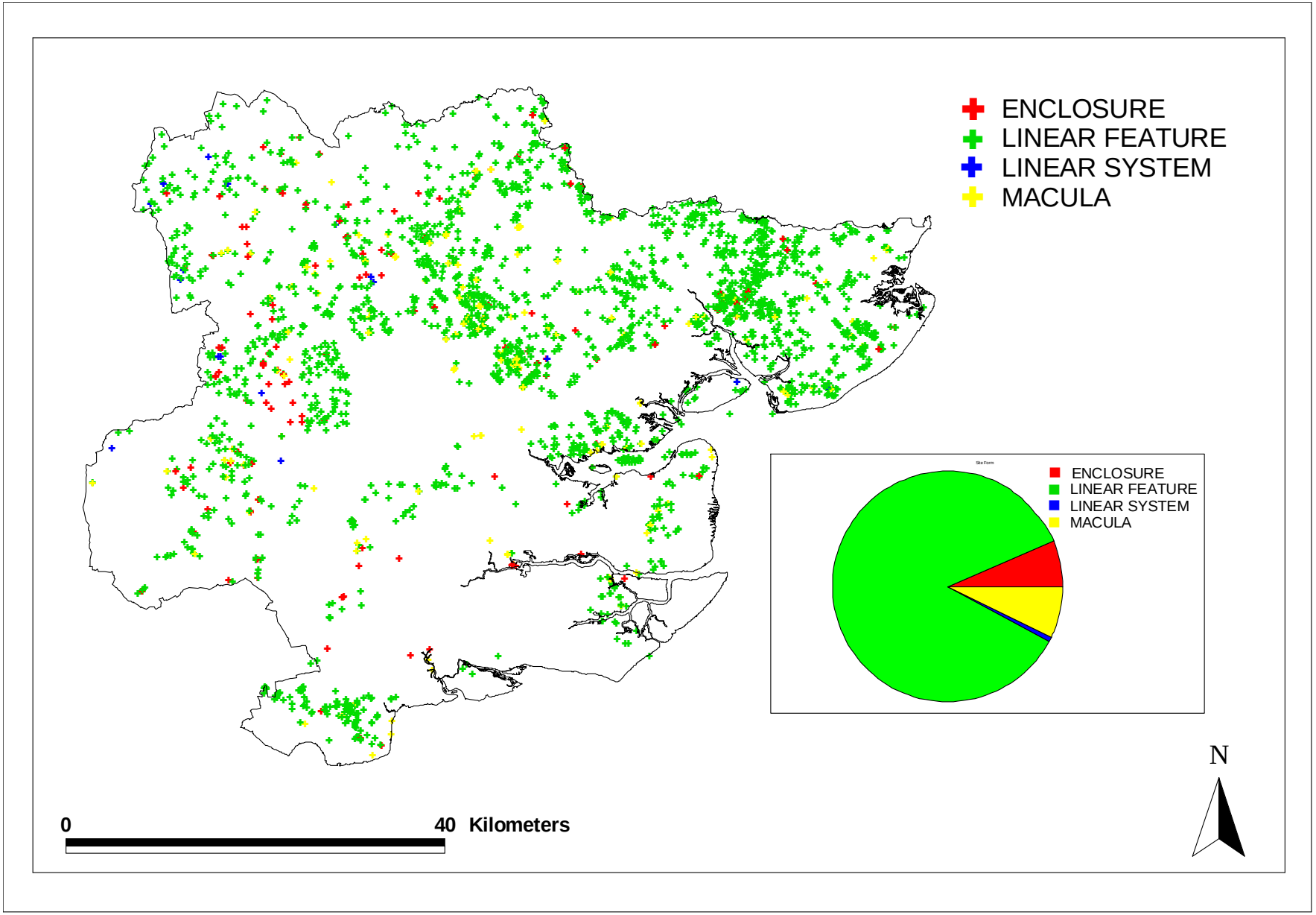


Figure 20. Distribution of Unknown Medieval Sites

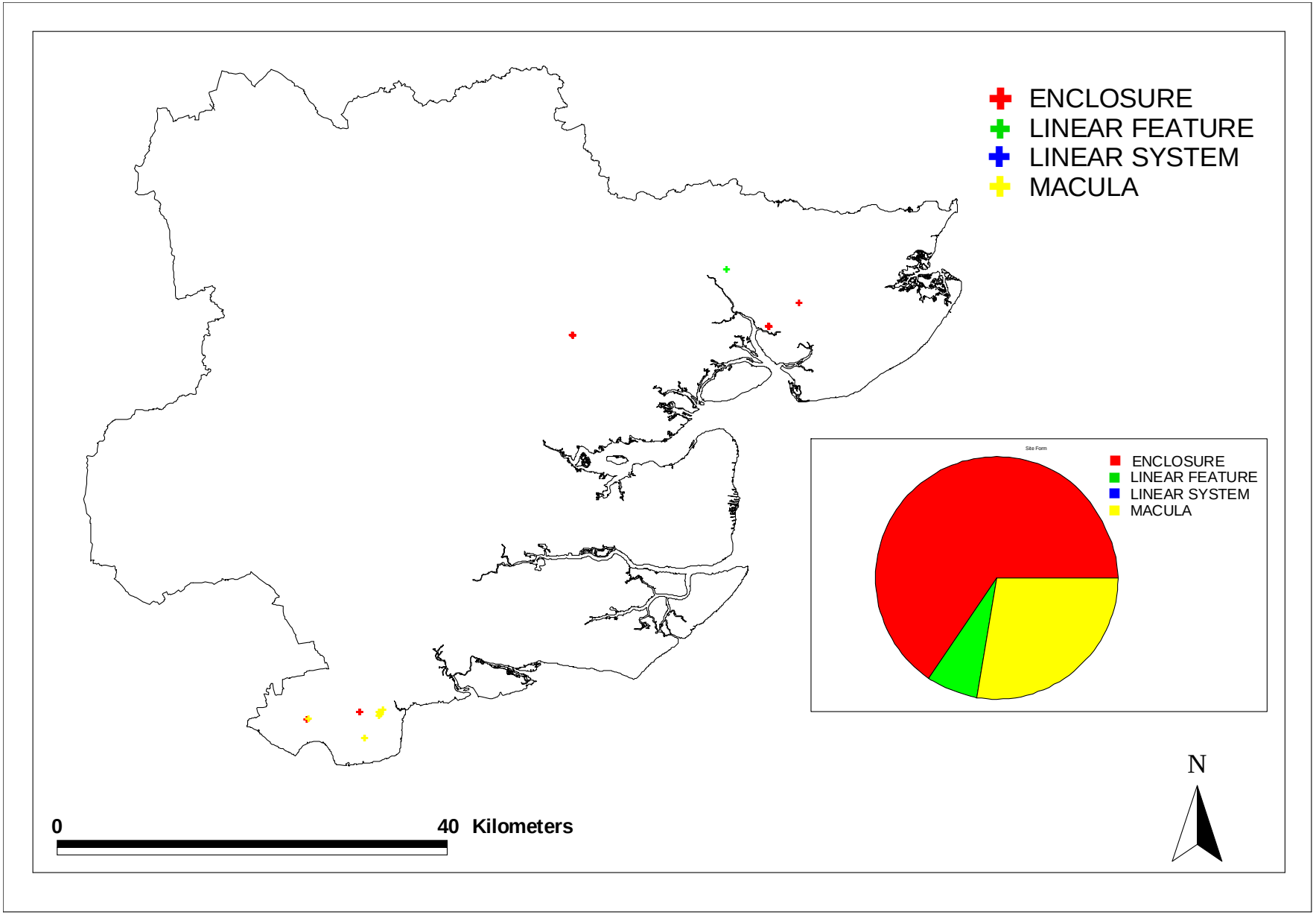


Figure 21. Distribution of Early Medieval Sites

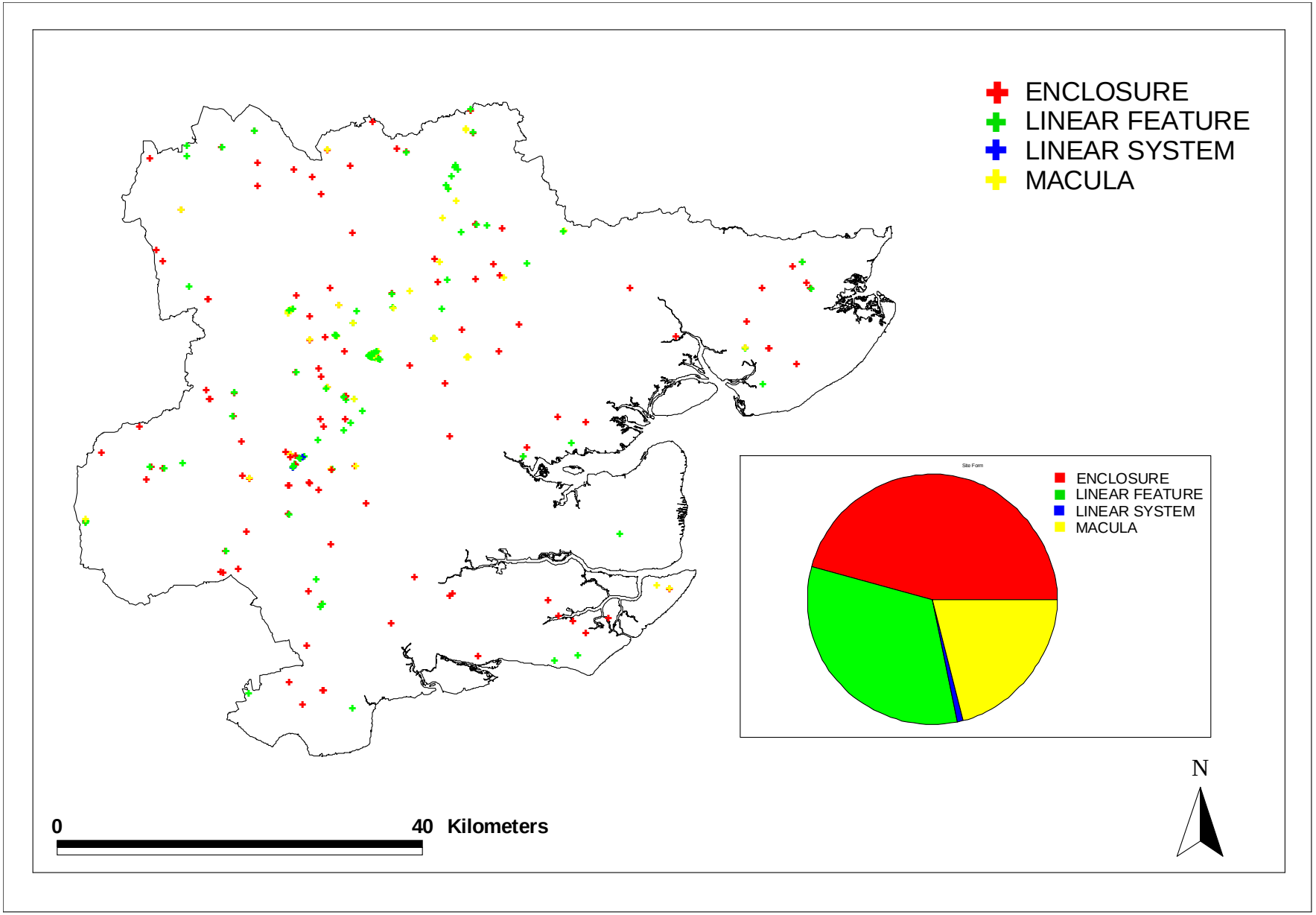


Figure 22. Distribution of Late Medieval Sites

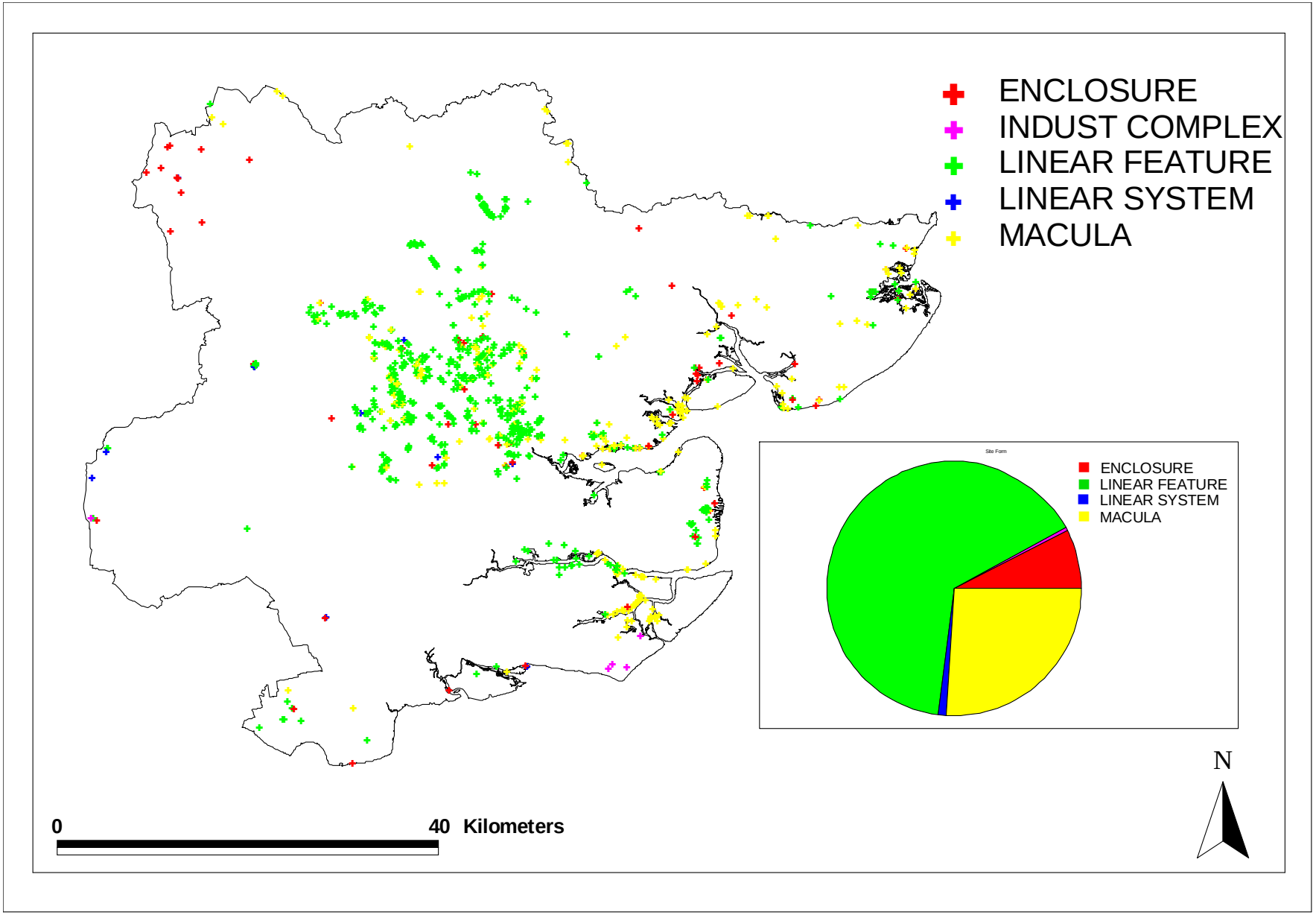


Figure 23. Distribution of Post Medieval Sites

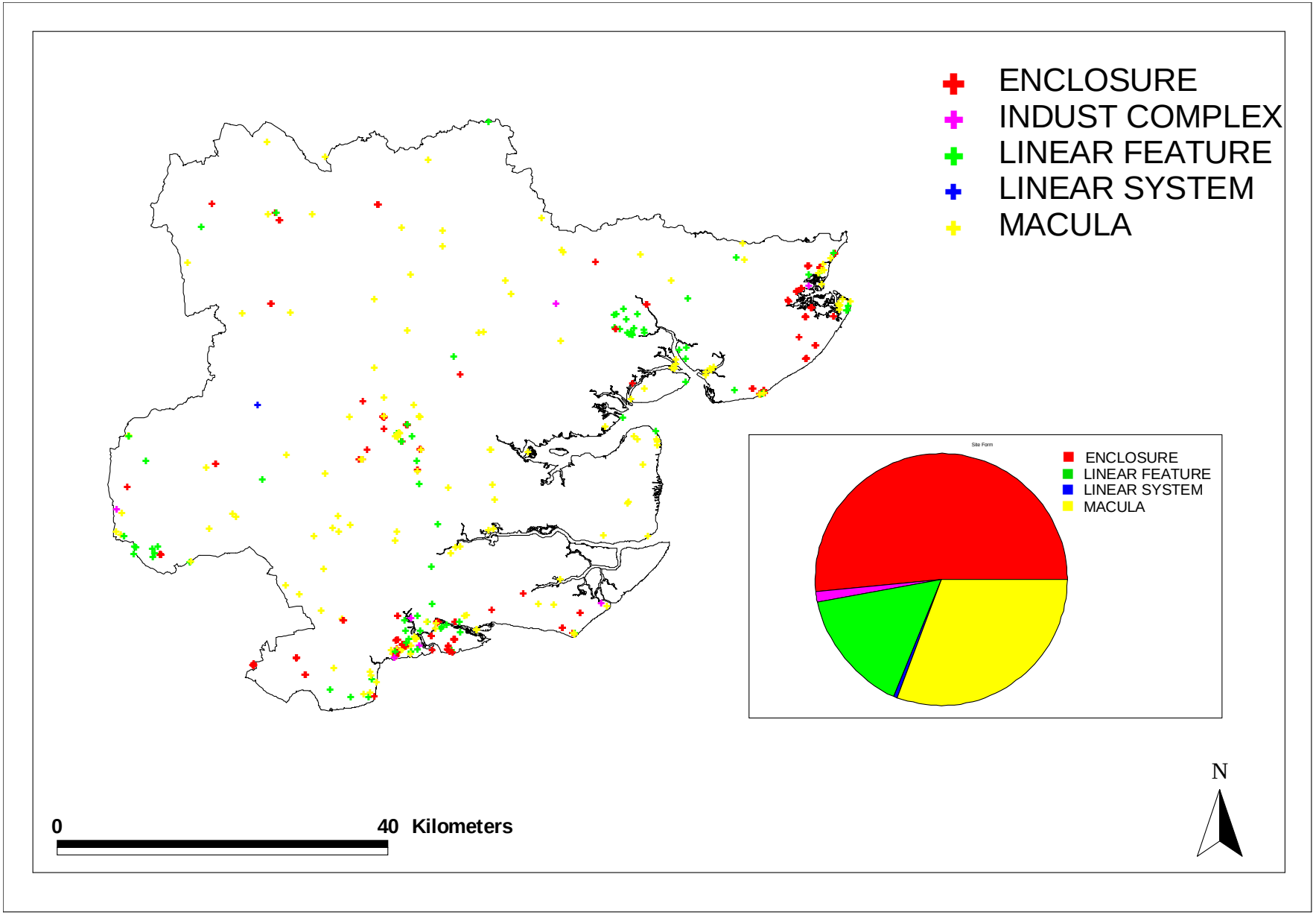


Figure 24. Distribution of Modern Sites

8.3 Using the database

8.3.1 Biases in the evidence

As noted above (8.1.7), it is essential to recognise that there are a number of biases in the Historic Environment Record caused by various factors and that the level of information derived from aerial photography depends as much on the nature of the ground and the inclination for flight paths of the photographers as what is actually in the ground, and as would be expected, distributions largely reflect the underlying geology.

As discussed above, the soil types developed on the Boulder Clay in the central and north-western part of the county do not readily lead to the development of cropmarks. In consequence relatively few sites are recorded on these clays, and features tend to be seen as discrete and separated groups. It is clearly demonstrated, most recently by the excavations at Stansted Airport, that the distribution and density of sites mapped does not reflect the real pattern of buried archaeological features. Given that cropmarks are the predominant form in which sites are seen from the air in the county it is acknowledged that the distribution of mapped sites is as much a reflection of the underlying geology as actual site distribution. This can be demonstrated on a very small scale by fieldwork at Great Dunmow, also within the Boulder Clay plateau. Here, topsoil stripping following fieldwalking survey revealed a Late Iron Age/Roman settlement and field system which had not previously been visible from the air. However, immediately to the south at Folly Farm, cropmarks of a similar rectilinear field system appear on a small patch of glacial sand and gravel overlying the clay.

The Southend peninsula has not produced the impressive air photographic evidence showing multi-period cropmarks which are characteristic of large parts of south and east Essex, due in part to restrictions on flying in the area because of the proximity of Southend airport. Despite the lack of evidence from the air the area has an especially high incidence of rich finds indicating intensive occupation since the Mesolithic period.

8.3.2 Variations in Recording by Interpreter

Due to the staff changes detailed in section 7 above, four different interpreters have input data to the Essex database: Caroline Ingle (CJI), David Strachan (DLS), Susan Tyler (SAT) and Helen Saunders (HPS) (figure 24). This has resulted in some internal variability in the data due to differing levels of confidence, training and experience using MORPH. To a certain extent the differences reflect the differing characteristics of the visible archaeology in the areas being plotted: the highest percentage of World War Two features fell within the areas mapped by CJI and DLS, and all the coastal areas had been completed prior to the arrival of HPS and SAT. Nonetheless the figures do seem to reflect a varying confidence in assigning features to specific periods (even unknown prehistoric) rather than allocating the ‘unknown’ date.

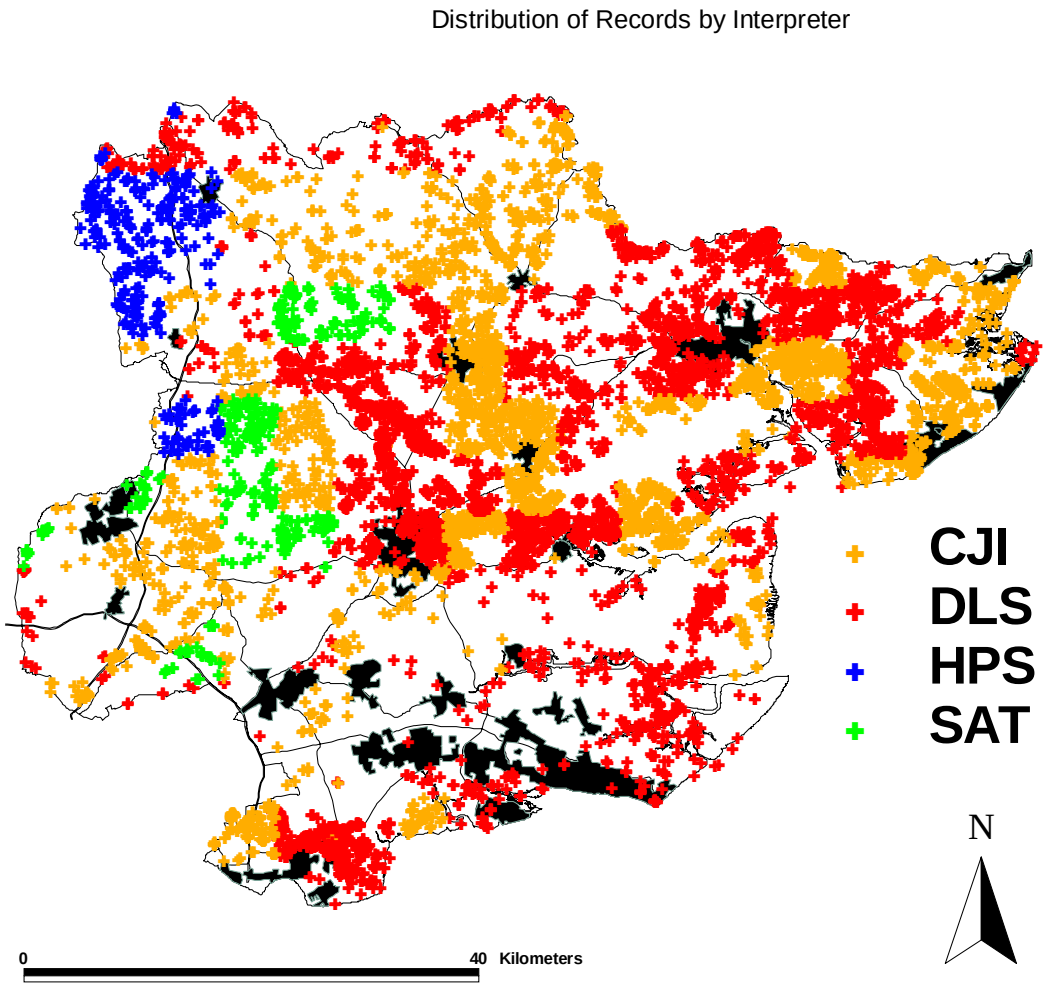


Figure 25 - Distribution of records created by each interpreter

8.3.3 Records by form

The majority of the sites recorded were visible as crop marks 88.6%, a small but significant proportion of the sites were visible as soilmarks, which were included in this category.

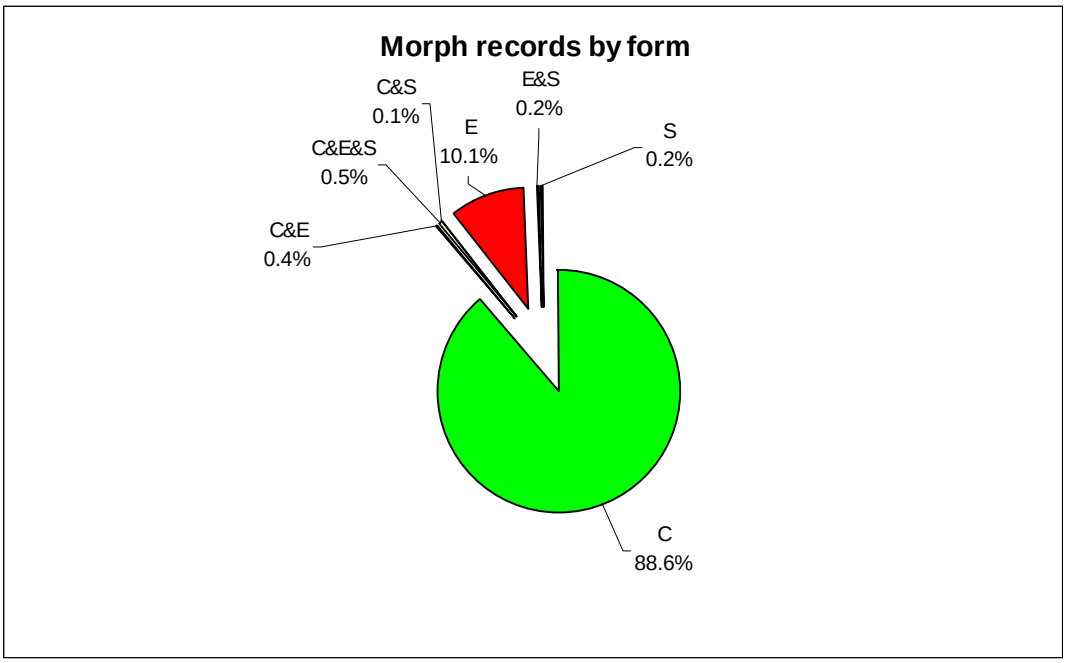


Figure 26 - MORPH records by form

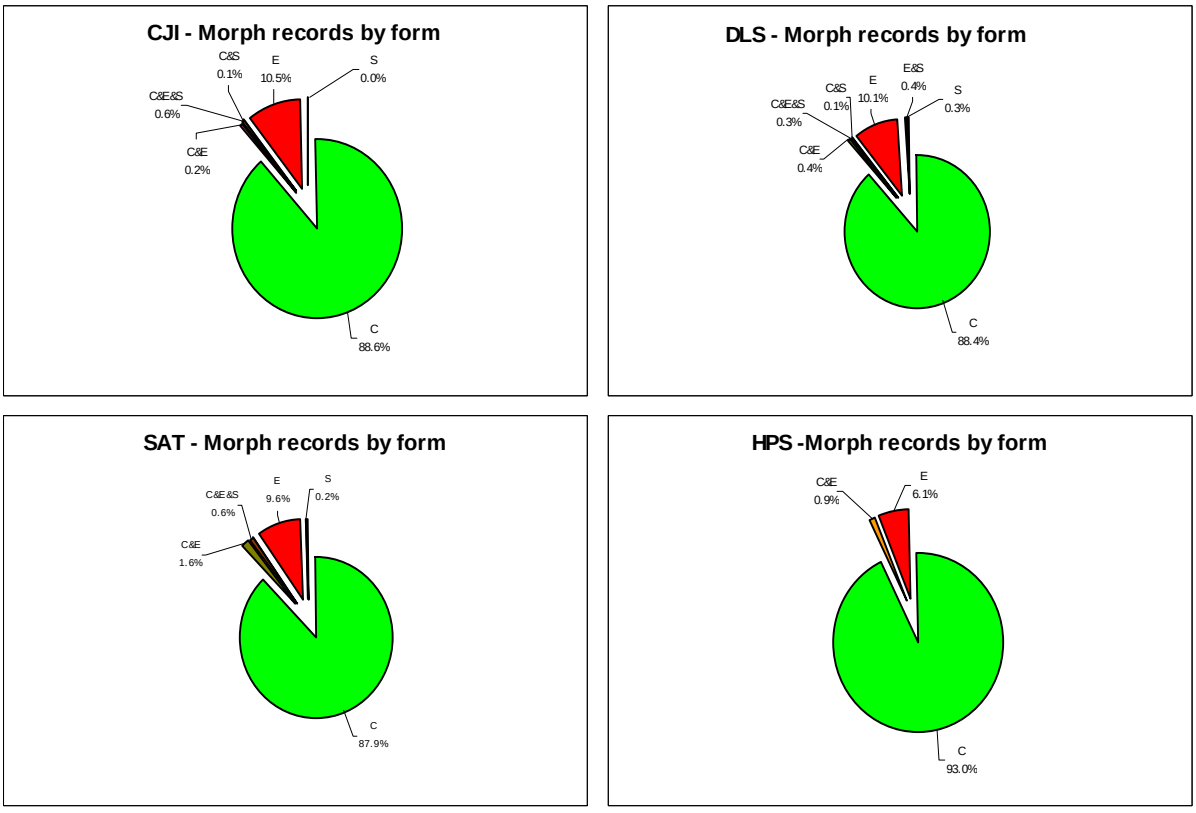


Figure 27 - Percentage of MORPH records per interpreter by form

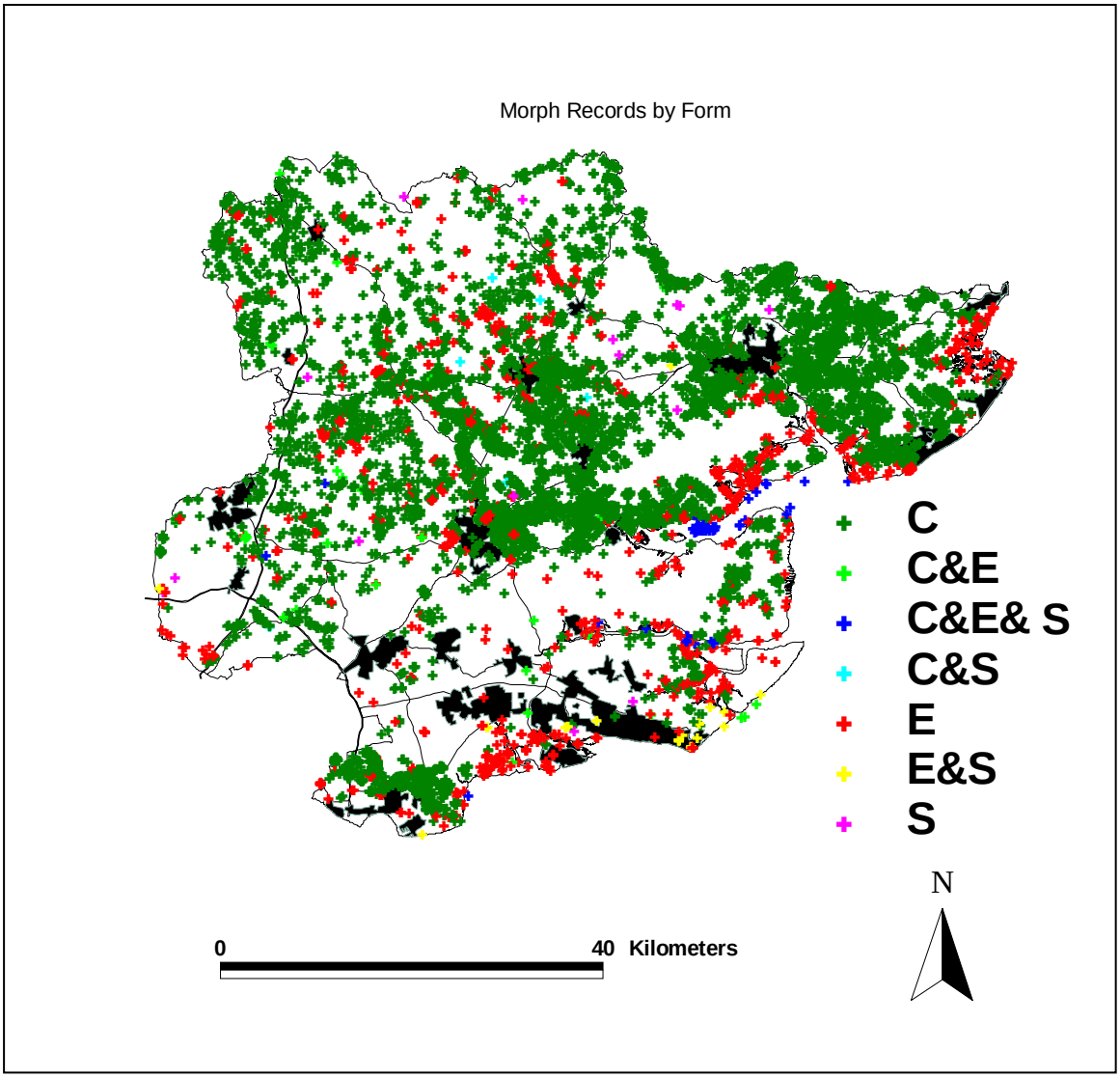


Figure 28 - The distribution of crop mark, soilmark and earthwork records.

The category of C+E+S (Cropmark, Earthwork and Stonework) was used to identify sites mapped that were not fully within the remit of the NMP, particularly off shore sites such as fish weirs and other underwater structures. Due to the nature of the archaeological sites within Essex there are very few stonework sites (mainly due to there being very little stone construction). Most of the earthwork sites are found in the coastal zone and are sites such as oyster pits and duck decoys. There are relatively few other earthwork sites that have been mapped inland, with the exception of the moated sites.

8.3.4 Records by period

Figure 29 shows the percentages of all records for each period:

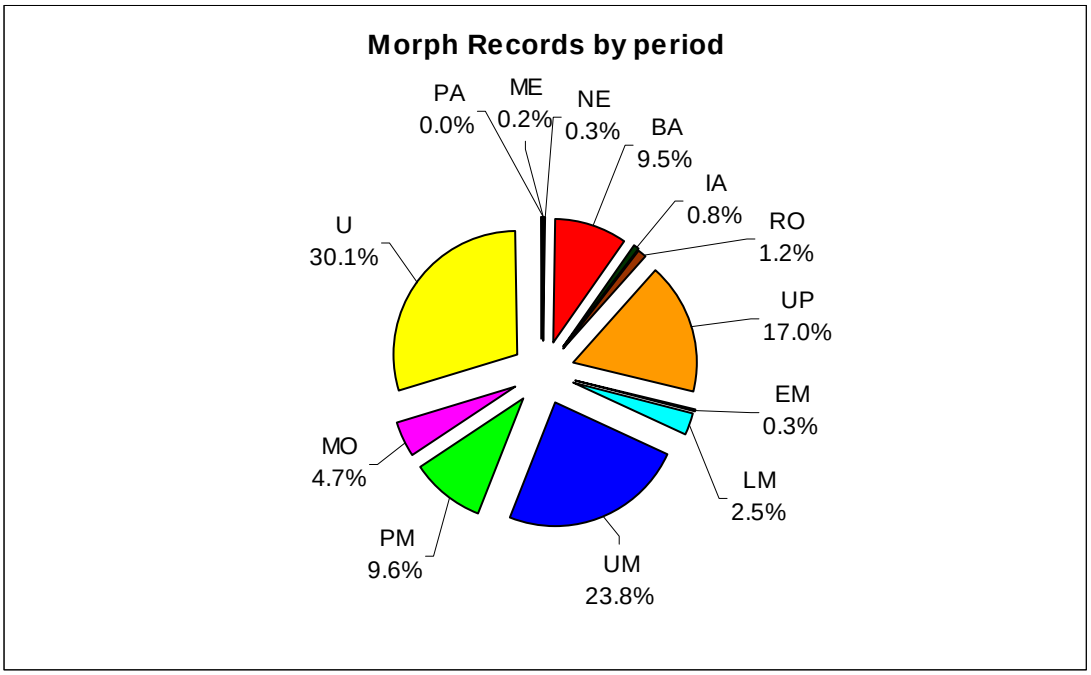


Figure 29 - All MORPH records by period

Figure 30 shows the relative percentages of sites attributed to each period by the four individual interpreters. There is a clear discrepancy between some interpreters in the variable use of the period values, and plotting of field boundaries. The most obvious discrepancy in the figures is the high percentage of sites attributed to unknown by SAT. SAT created 488 records between 2000-2001 of which 327 (71%) were considered to be of unknown date. This is compared to 18% (HPS), 28% (DLS) and 29% (CJI).

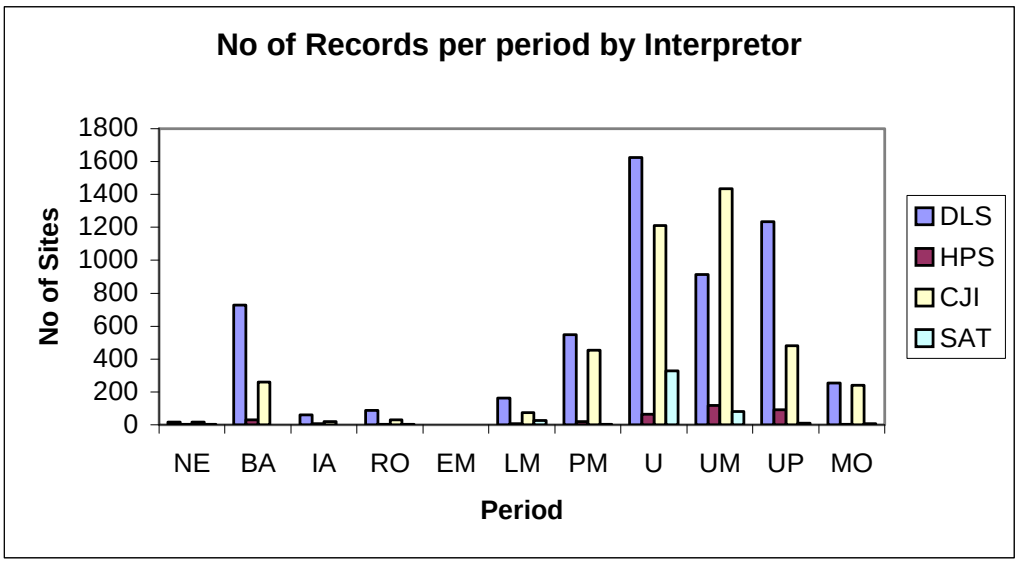


Figure 30 - The relative numbers of records attributed to each period by each interpreter.

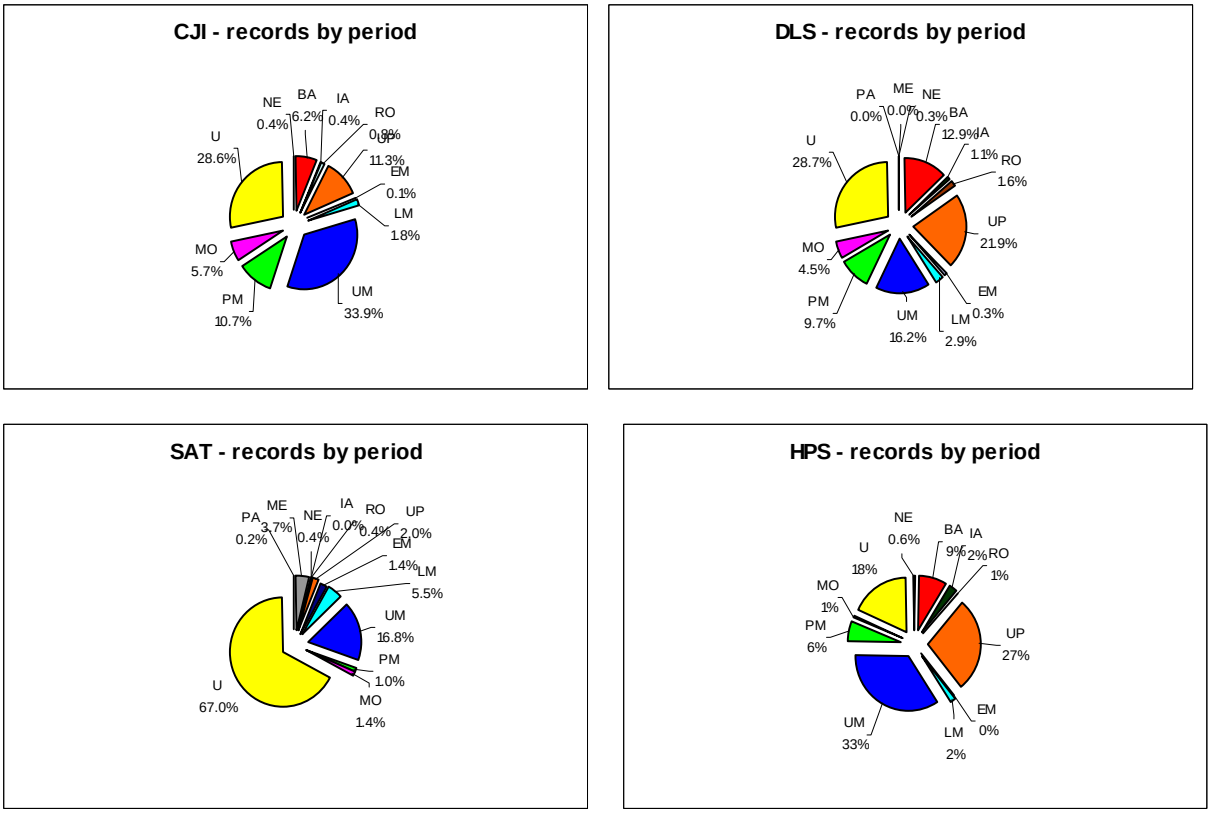


Figure 31 - The relative percentage of records attributed to each period by interpreter.

Of the unknown sites records by SAT figure 33 shows that 27% were field boundaries, a site type which the other interpreters have more frequently assigned to the Unknown Medieval period. The remainder were interpreted as pits (14%), ditches (23%), enclosures (11%) and other (25%). Site types such as ditches and enclosures can be difficult to assign a more specific interpretation and therefore almost impossible to assign a date to. Often a site would have been attributed a certain date because of an association with the surrounding archaeology.

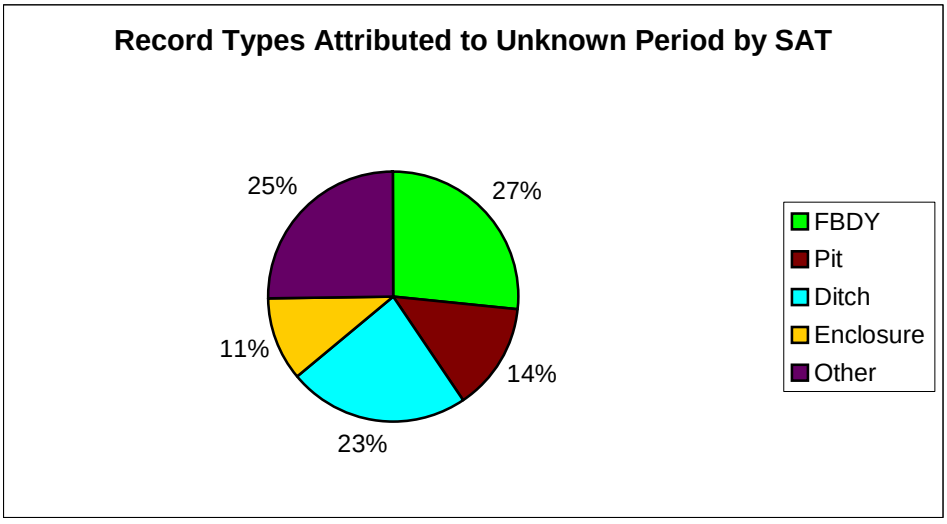


Figure 32 - Records attributed to Unknown Period by SAT.

Both HPS and CJI have a higher proportion of sites within the Unknown Medieval category and this can be explained by a high percentage of Field boundaries being classified as Unknown Medieval 75% (CJI) and 81% (HPS) (Figure 34). Other interpreters classed field boundaries as a range of different periods depending on the extent and orientation of the sites. The field boundaries were classed as Unknown Medieval when they appeared to follow modern land division such as roads and tracks.

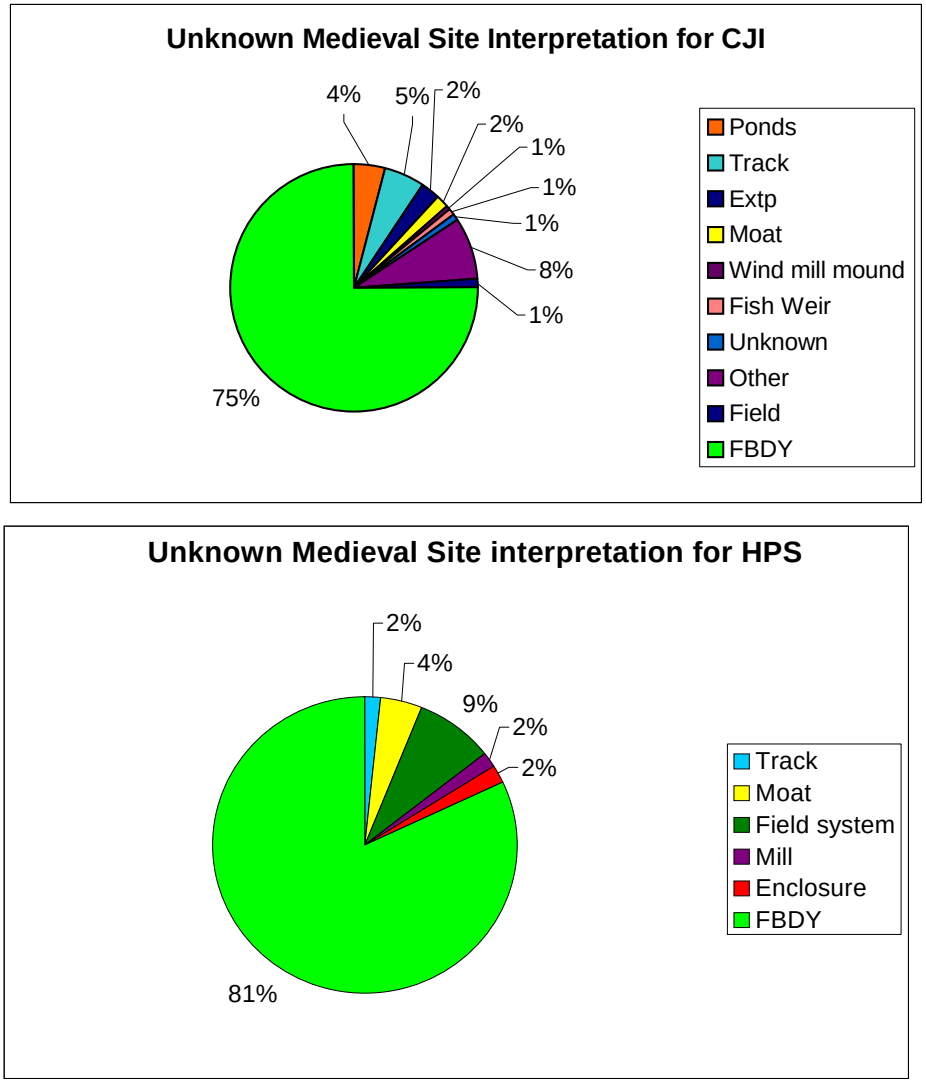


Figure 33 - Records attributed to Unknown Medieval by HPS and CJI.

Other discrepancies include a slightly higher proportion of sites being assigned an Unknown Prehistoric data by both HPS (27%) and DLS (22%) against 11% (CJI) and 2% (SAT). Of these sites 54% and 45% respectively are interpreted as simple enclosures and presumably have been classified as unknown prehistoric because of association to other surrounding sites or because they have a distinct morphology that is associated with the prehistoric period.

8.3.5 Records by site type

Figures 34 and 35 show MORPH records by site type, both total numbers and by interpreter:

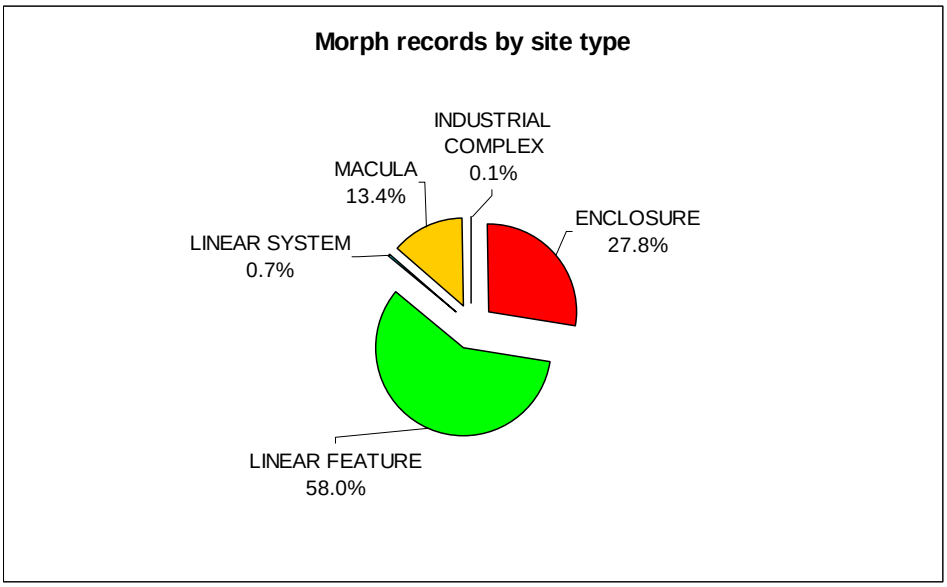


Figure 34 - Total MORPH records by site type

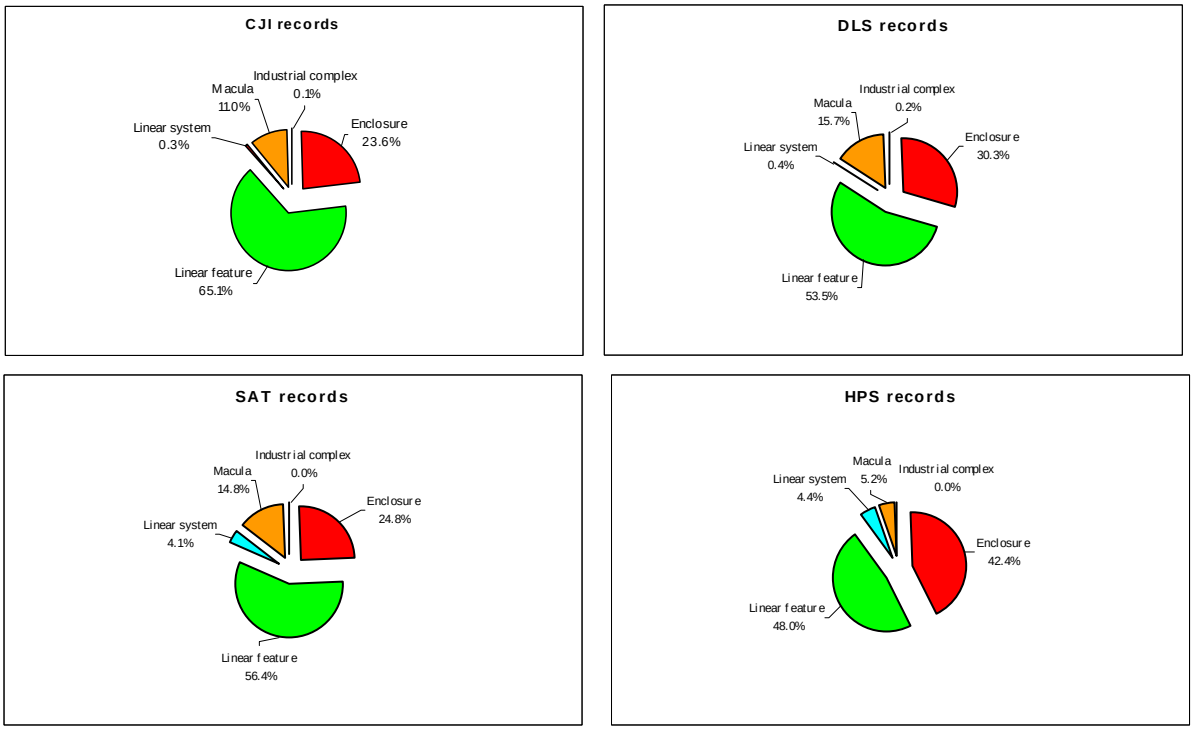


Figure 35 - The relative percentage of records attributed to each site type by each of the air photo interpreters

It would appear that the sites attributed to each site type by each interpreter are fairly consistent with only small variations between interpreters (e.g. CJI has a slightly higher percentage of linear features (65.1%) in comparison with the other interpreters. This can be attributed to the high number of field boundaries mapped by CJI).

9 DATA DISSEMINATION

9.1 Copyright

The copyright of the Essex NMP data is held jointly by Essex County Council (ECC) and English Heritage (EH). This arrangement covers the MORPH database and overlays.

9.2 Integration to the EHCR

As has been the case since the early 1980s there is an emphasis on the rapid dissemination of data from the air photographs to the planning archaeologists and other users within ECC. The preferred delivery route for the NMP data is via full integration into the EHCR but this is a long term rather that short term objective in view of current software issues and existing backlogs. exeGesIS is currently developing a module that will allow the extensive dataset available in MORPH to be integrated with the EHCR and thus ensure that the detailed morphological information will be accessible to all users. It is anticipated that this module will be available towards the end of this year.

It was considered from the outset to be essential to add new information to the EHCR as an ongoing exercise rather than to await completion of the Project. Accordingly copies of the NMP maps have been added to the EHCR as they have been completed, enabling the addition of new features and detail to the record. The new plots and supporting data have thus been immediately available to all users of the EHCR, something that has been especially useful for Development Control, field projects, and research projects. In addition, NMP Project Staff have been available to assist with the interpretation and mapping of photographic material in conjunction with other projects; fieldwork, development control and research.

All of the map overlays have been scanned and added to the GIS as a separate layer. These can be accessed by staff within the Heritage Conservation Branch for viewing against other datasets, including earlier editions of OS sheets.

9.3 Internal Reports and publications

Progress on the Essex NMP project has been reported in various internal reports and annual summaries (EAH 1994 onwards). Quarterly project figures have been returned to RCHME/English Heritage for monitoring progress.

- Annual written reports have been submitted to RCHME/English Heritage since 1995 detailing progress over the year and summarising key results.
- Summaries on progress have been included in quarterly and annual reports to ECC Members and Committees as appropriate.

9.4 Integration to the NMR

The project data will be transferred to the NMR as a set of map overlays, both hard copy and raster scans, and the MORPH database.

9.5 Wider dissemination

9.5.1 Publications and journals

- An annual report has been included in the county journal, *Essex Archaeology and History*, and *Essex Archaeology and History News*.
- Articles have been published in *Essex Journal*, AARG News.

The work of NMP contributed significantly to *Essex From the Air* (Strachan 1999).

9.5.2 Management Report (this document)

The Management Report is required as an account of the project. Over the duration of the Essex NMP project there have been developments in methodology and changes in personnel. This document, in conjunction with the metadata, serves as a manual to the creation of the various NMP data sets, which is essential background to enable users to make full and appropriate use of the project data.

9.5.3 Formal Publication

The Essex NMP project has mapped and recorded over 10,700 archaeological features that together reflect the diverse nature of settlement, agriculture, industry, defence and recreation in the county. There is enormous potential for this data to contribute to current archaeological research and heritage resource management issues. The East of England Research Frameworks have identified particular themes and problems that aerial photography and the NMP in particular may be able to address.

The formal publication is intended as a series of papers themed on current research objectives to be presented together in a monograph publication, to be published by East Anglian Archaeology (EAA), working title *Ancient Landscapes of Essex: An Aerial Survey*. The draft synopsis for the publication (included here as appendix II) was accepted by the EAA Editorial Committee at its January meeting 2003.

The proposed EAA volume will focus on a number of themes where the NMP data can make a particular contribution to the knowledge and understanding of the archaeological record, and of the development of the Essex landscape. This acknowledges the inevitable biases in the data, and recognition that the results of aerial photographic survey will not provide a full picture of the distribution of archaeological remains of the county. Visibility of features on aerial photographs is influenced by geomorphology, land use, climate, the nature of the archaeological remains, scope and timing of programmes of survey and the interaction of all of these. There is a need to be clear about what information the data does carry, and the extent to which this can be used in interpretation of the landscape. Analysis of landscape development may only be valid in discrete geographical areas.

9.5.4 Presentations

During the course of the project work on NMP and its results have been presented to a range of audiences including conferences (AARG, international conference on coastal and intertidal archaeology), EH Annual NMP Progress meetings, regional CBA conference, Local Societies and organisations (e.g. Essex Wildlife Trust, SE Essex Archaeology Society, Environment Agency).

An exhibition on the Essex Mapping Project was prepared to form part of a larger display on the National Mapping Programme for the 1993 Institute of Field Archaeologists annual conference, and was subsequently displayed at a number of events. An exhibition to accompany the Essex from the Air publication was widely displayed in the county, at events and libraries.

9.5.5 Web delivery of the NMP project data

The data produced from the NMP will be used to enhance the Unlocking Essex's Past web site (unlockingessex.essexcc.gov.uk). Scanning the EHCR collection of aerial photographs and making them available online is currently underway. It is anticipated that the interpretation that has been assigned by the NMP interpreters will be used to aid greater understanding of the aerial photographs available.

9.5.6 Archives

Long term archiving requirements need to be addressed. Currently the original inked NMP overlays are stored at County Hall, Chelmsford, but this may change in the future. There had been virtually no digital data produced by the Essex NMP so long term digital archiving is not currently an issue.

10 CONTRIBUTION TO OTHER INITIATIVES

The outputs of NMP are being integrated into many other projects that are making use of NMP data, as one of a range of information resources. Work on the mapping project has complemented, and been complemented by, various county-wide thematic surveys carried out to enhance the EHCR.

10.1 Survey of World War Two Defences

NMP has mapped significant numbers of features dating to World War II, recording a range of features complementing that recorded by the World War Two Defences' survey. It is adding to the record aspects of the defence of the county which fall outside the scope of the ground based survey. The vertical photography of the 1940s has proved particularly valuable for tracking the line of anti-tank ditches, significant earthworks that were nonetheless ephemeral features in the landscape, quickly filled in post war period, in many areas leaving little trace from the air, although also with the potential for confusion with pipelines.

NMP has also provided initial survey information on other categories, e.g. anti-aircraft batteries, that have subsequently been surveyed on the ground and been assessed for the Monuments Protection Programme. The scheduling of 6 heavy anti aircraft sites resulted from MPP after the sites had been mapped as part of the NMP. The Diver sites (anti-aircraft batteries constructed towards the end of the war to counter attack by V1 rockets) comprised relatively small emplacements, difficult to map successfully at the 1:10,000 scale but the project has enabled the addition of these to the EHCR.

Contemporary or near contemporary photography also helped avoid the misidentification of an earthwork site on Wennington Marshes, where a group of features reminiscent of a collection of barrows (albeit on the flood plain, not perhaps in the expected location) was in fact shown to be an un-manned anti-aircraft battery.

10.2 Aerial Survey

NMP has enabled assessment of the value of different categories of photography and helped in the targeting of future reconnaissance. For example, the county has evidence for prehistoric and Roman salt production revealed by the remains of large numbers of red hills. However, many of the photographic sources used for NMP proved to be of little help in identifying these sites. Whilst highly visible as patches of reddened soil on colour photography, in black and white (the medium for the majority of sources used for NMP) these features appear only as somewhat amorphous darker smudges, as do many natural features and it is difficult (if not impossible) to reliably decide whether small dark smudges are indeed archaeologically meaningful and the evidence of red hills or some insignificant shadow. Instead, to exploit the benefits of colour, coastal areas were specifically targeted for aerial

survey after ploughing. The 1995 aerial survey recorded over 40 new red hills for addition to the EHCR the majority of these being in a concentrated area to the south of Peldon. With the total figure for the site type standing at around 380 sites, such a high percentage of new sites, if repeated along the rest of the coast when subject to similar survey, could have serious implications for our understanding of early salt production in the county.

10.3 Cropmark assessment

10.3.1 The Cropmark Enclosures Project

The Cropmark Enclosures Project, carried out by ECC and funded by EH, looked at a number of examples of one specific class of monument, hengiform enclosures. EH funded trial excavation of four examples of circular enclosures initially interpreted as henges or hengiform monuments (Great and Little Bentley, Belchamp St Paul, and Rivenhall) comprising large circular enclosures 20 to 40 m in diameter. In order to examine something of their wider setting the area around the cropmarks was fieldwalked and where possible environmental sequences sampled. The assumption that the majority were Neolithic henge monuments was largely based on their cropmark morphology; few had been investigated by archaeological excavation. This situation was particularly true for north-east Essex where numerous examples of the class were known.

The results have confirmed the difficulties of interpreting on morphology alone, only one of the four having been shown to be of Neolithic date. That at Little Bentley was hitherto regarded as one of the best examples of a cropmark henge in eastern England, but on excavation it proved to be the site of an early medieval windmill.

Of the three other ‘henges’ investigated one, at Belchamp St Paul was Bronze Age in date, a second at Great Bentley also a medieval windmill with only the fourth, at Rivenhall, confirmed as Neolithic in origin. Neither of the Bentley sites showed evidence for cross trees – the classic means to distinguish cropmark windmills from cropmark hengiform monuments.

10.3.2. The Stour Valley Project

The Stour Valley Project, a survey of a single landscape region conducted by ECC funded by EH as part of the implementation of the Monuments at Risk Survey arose from the preparation of the East Anglian Framework (Glazebrook, 1997) and builds upon the work of NMP (Brown et al. 2003). Despite the limited development threat, much of the valley has been subject to intensive arable cultivation for many decades. Parts of the study area lie within the Suffolk Rivers Environmentally Sensitive Area (ESA) and the Dedham Vale Area of Outstanding Natural Beauty (AONB). The area also includes two Sites of Special Scientific Interest (SSSI). Management of the cropmark landscape is one of the long-term aims of the project. The dense concentration of cropmark sites along the Stour valley was regularly flown from the 1950's by the Cambridge University; RCHME; and the Archaeology Section of Essex

County Council, and this has continued to add new features most notably recently during the 1995-6 survey.

NMP mapping in 1997 to 98 recorded a range of features including prehistoric "Monument Complexes" consisting of ring-ditch cemeteries (including large dual concentric examples); elongated enclosures (interpreted as long mortuary enclosures and long barrows); and the two cursus monuments at Wormingford and Stratford St. Mary. The first stage of the Stour Valley project involved the large-scale mapping of the cropmark landscape, and the use of a digital terrain model (DTM) within a GIS environment, as the basis for study and interpretation alongside other datasets. The 5m contour data was used to create a surface elevation model on to which the archaeological data could be draped, and two Arcview extensions (3D Analyst and Spatial Analyst) then allowed the study of intervisibility of sites. Whilst this model did not take into account vegetation cover, it was a valuable tool for the analysis of the relationship between sites and their topographical setting.
This first phase of project provided a firm basis for developing understanding and management of the cropmarks in the valley and such an approach will be a significant contribution to a sustainable approach to the valley landscape.

The next stage of the project included enhancement of the GIS through the addition of other datasets, including existing management regimes, and landuse, which will assist in the consideration of future management proposals for the area. Also planned is targeted survey, and in the long term excavation, to improve understanding of the date and function of the various elements of this landscape.

Two campaigns of fieldwalking and one of trial trenching and environmental test pitting have been carried out at Belchamp St Paul which together enable something of the date of monuments and their relationship with the valley landscape to be discussed.

A third key strand of the project will be to raise awareness and appreciation of this historic environment by both landowners and the general public. In the case of cropmarks, with little or nothing on show for the public visiting the area, promotion can present particular difficulties.

10.4 Coastal Assessment

The Greater Thames Estuary Survey (Essex Zone) was conducted along selected areas of the Essex coastline to identify archaeological sites as part of a wider project, funded by English Heritage, to examine archaeological remains in the Greater Thames Estuary from Clacton round to Whitstable (Kent). The survey was an element of the European funded PLANARCH project involving partners from Holland, Wallonia, Flanders, Nord Pas de Calais, Kent and Essex. The Essex coastline is open and low-lying, split by river estuaries and

numerous creeks, interspersed with marshlands and saltings. There is a wide variety of archaeological evidence preserved along this coastline which can help us to understand the past landscape and its human exploitation. The Essex survey covers the Foulness group of islands, the north shore of Mersea Island and associated creeks, and the Canvey and Fobbing area, parts of the coastline which had not been examined in earlier studies.

In the late 19th and earlier 20th centuries work carried out by local archaeologists identified prehistoric and Roman sites, and also buried land surfaces. In 1982 a systematic survey on the intertidal archaeology of the Essex coast, the Hullbridge Survey, began, and much of the Essex coast was walked, locating a number of new sites. The potential for sites in the intertidal zone has since been demonstrated in the Blackwater Estuary by the excavation of a buried prehistoric land surface, and most recently by the discovery through aerial survey of Saxon fish traps. NMP has recorded large numbers of other features along the coast, including fish traps, oyster pits, decoy ponds, and an intertidal roadway (The Broomway).

10.5 Historic Landscape characterisation

As part of a regional study, this project is researching and characterising the historic landscape of the county to produce a digital map of the landscape types. In particular NMP is one of the sources used to look at former field patterns, which show high loss of field boundaries since World War II. The project will also provide data for MPP projects (e.g. Settlement Map of England, East Anglian Field System Project) and is generating information of value for the development of countryside and heritage management policies and strategies at a regional and local level.

10.6 Monuments Protection Programme

The MPP Additional Scheduling Project (funded by EH) carried out by Sue Tyler has included a number of monument classes plotted: long mortuary enclosures, coastal fish weirs, heavy anti-aircraft batteries, and duck decoy ponds.

10.7 Detailed mapping for projects

During the course of NMP more detailed and larger scale plots of specific areas have been completed to meet particular project requirements. These have included:

- Ardleigh: a transcription at 1:2500 was produced of the Ardleigh cropmark complex as part of the preparation for publication of the Central Excavation Unit's excavations during 1975-80. The NMP plot amended the original 1979 plot (which had been shown to be inconsistent with the position of some excavated features); adding new detail including a further ring ditch.
- Great Chesterford Historic Town: A 1:2500 scale plot of the Roman town and its immediate area was produced to provide information for the English Heritage funded Essex Historic Towns Survey. Mapping of two quarter sheets encompassing the town

produced a high percentage of new cropmark sites including ring ditches, enclosures and a stretch of Roman road.

- Tollesbury Wick Marsh: Air photographic interpretation, including plotting at 1:2500, was carried out prior to ground survey by the RCHME Cambridge Field Unit and excavation by the Field Unit of ECC. In addition to archaeological interpretation it allowed preliminary assessment of environmental change in the area over the past 50 years.

11 RECOMMENDATIONS FOR THE FUTURE

11.1 Further Reconnaissance

Over the last fifty years, the recording of cropmark sites has radically altered our understanding of the extent and complexity of archaeological landscapes in many parts of the country. Many new sites, however, continue to be discovered on an annual basis. Archaeologists must record these sites whenever possible as their appearance lasts only until the crop is fully ripened. While many sites may reappear year after year, some will appear only in the driest conditions, and then may lie under a non-cereal crop which may not produce a cropmark. In addition, continual ploughing, and modern deep ploughing in particular, can erode the buried archaeological sites which cause the cropmarks to form. It is important, therefore, that archaeologists continue to record sites from the air, not only in order to discover new sites, but also because it presents a rapid and efficient method of monitoring land-use changes and other developments which may threaten archaeology (Strachan 1995).

11.2 Continued Mapping

The NMP plot must not be permitted to become a static resource. One of the key initiatives it feeds into in Essex is the continuing programme of aerial survey, which is continuing to make new discoveries or is adding information to already known sites. As reconnaissance continues a strategy should be devised for updating the ‘cropmark’ layer and for updating the AP layer interpretation if this information resource is to maintain and enhance its value. This strategy may work in a similar way to the English Heritage reconnaissance recording programme which is carried out internally within English Heritage.

References

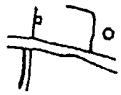
Aberg, F. A. (ed)	1978	*Medieval Moated Sites* Counc. Brit. Archaeol. Res. Rep. 17
Allen, R.H. and Sturdy, R.G.,	1980	*The Environmental Background.* In Buckley, D.G. (ed) *The Archaeology of Essex to AD 1500.* Counc. Brit. Archaeol. Res Rep No. 34 1-7.
Benson, D. & Miles, D.,	1974	*The Upper Thames Valley, An Archaeological Survey of the River Gravels*. Oxford Archaeological Unit Survey 2, Oxford
Bewley, R. (Ed)	1998a	Lincolnshire's Archaeology from the Air *Occasional Papers in Lincolnshire History and Archaeology, 11*
Bewley, R. H.,	1998b	England's National Mapping Programme: a Lincolnshire perspective. In B. Bewley (ed) *Lincolnshire's Archaeology from the Air*, Occasional Papers in Lincolnshire History and Archaeology 11, Society for Lincolnshire History and Archaeology.
Bewley, R. H.,	2001	Understanding England's historic landscapes: an aerial perspective. *Landscapes Vol 2, No.* 1, 74-84.
Brown, N.,	2000	*The Archaeology of Ardleigh, Essex, Excavations 1955-1980*. East Anglian Archaeol. 90
Brown, N., Germany, M.,	2003	*The Essex Cropmark Enclosures Project.* Essex Archaeology and History. 33. 8-53
Brown, N. and Glazebrook, J. (eds)	2000	*Research and Archaeology: a Framework for the Eastern Counties, 2. Research agenda and strategy.* East Anglian Archaeol. Occ. Pap. 8
Brown, N., Knopp, D., Strachan, D.,	2003	*The Archaeology of Constable Country: The Cropmarks of the Stour Valley.* Landscape Archaeology forthcoming
Drury, P.,	1980	*Archaeology of Essex to AD 1500. CBA*
Edis, J. and MacLeod, D.,	1989	*The Classification of Cropmarks in Kent: A report for the Monument Protection Programme.* RCHME Internal Report.
Edis, J., MacLeod, D. & Bewley, R. H.,	1989	An archaeologist's guide to the classification of cropmarks and soilmarks. *Antiquity* 63, 112-126.
Essex County Council,	1992	*The Essex Environment: A Report on the State of the County's Environment*. Essex County Council
Fenner, V.,	1992	*Cropmarks in Hertfordshire: A report for the National Mapping Programme.* RCHME. Swindon.
Fenner, V. E. P. & Dyer, C.,	1994	*The Thames valley Project. A Report for the National Mapping Programme Project*. RCHME Internal Report.
Gilman, P.J.,	1999	Essex Aerial Photographic Transcription: Project Specification Revised Specification July 1999 (Essex County Council Internal Report).
Glazebrook, J., (ed)	1997	*Research and Archaeology: a Framework for the Eastern Counties 1. resource assessment.* E. Anglian Archaeol. Occ. Pap. 3
Haigh, J. G. B.,	1993.	A new issue of AERIAL – Version 4.20. *AARGnews* 7, 22-25.
Haigh, J. G. B.,	1999	*AERIAL 5 A Windows program for the rectification of digital images from archaeological aerial photographs. User's manual for Version 5.12*. School of Computing & Mathematics University of Bradford.
Hodge, C.A.H., Burton, R.G.O., Corbett, W.M., Evans, R. and Seale, R.S.,	1984	*Soils and their uses in Eastern England* Soil Survey of England and Wales Bulletin No. 13 Harpenden

Hunter, J.,	1999	*The Essex Landscape: A study of its form and history.* Essex Record Office.
Ingle, C.J.,	1993a	Essex: Quantification Assessment for Aerial Photography (Essex County Council Internal report)
Ingle, C.J.,	1993b	Essex Aerial Photographic Transcription: Project Specification (Essex County Council Internal report)
Ingle, C.J.,	1994	Essex Aerial Photographic Transcription: Project Specification (Essex County Council Internal report) (Revision of Project Specification of August 1993)
Kershaw, A.,	1997	*National Mapping Programme, Lincolnshire Mapping Project, Project Review*. RCHME internal document.
Leech, R.,	1977.	*The Upper Thames Valley in Gloucestershire and Wiltshire: an Archaeological Survey of the River Gravels*. Committee for Rescue Archaeology Avon, Gloucestershire and Somerset
Lucy, G.,	1999	*Essex Rock: A look beneath the Essex Landscape.* Essex Rock and Mineral Society.
Palmer, R.,	1984.	*Danebury, an Iron Age Hillfort in Hampshire: An Aerial Photographic Interpretation of its Environs*. RCHME. London
Priddy, D. and Buckley, D.G.,	1987	'A review of excavated enclosures in Essex together with a selection of cropmark sites'. in *Excavation at Woodham Walter and an Assessment of Essex Enclosures.* E. Anglian Archaeol. 33
RCHME	1993	*MORPH 2: A Morphological Classification System for Mapped Archaeological Data.* RCHME Internal Document.
RCHME	1994	*The National Mapping Programme: Guidelines and Specification Manual*. RCHME Internal Document.
RCHME/EH	1998	*Thesaurus of Monument Types.* 2nd Edition. RCHME
Smith, J.R.,	1970	*Foulness: A History of an Essex Island Parish.* Essex Record Office
Scarfe, N. V.,	1942	*Essex: The Land of Britain. The report of the Land Utilisation Survey of Britain: part 82* (London) published for the survey by Geographical Publications Ltd
Strachan, D.,	1995	*Problems and Potentials of Coastal Reconnaissance In Essex*. AARGnews. 10, 28-35
Strachan, D.,	1996	*Aerial Survey 1995* in Bennett, A. (ed) *Work of the Essex County Council Archaeology Section, 1995.* EAH 27 261-276.
Strachan, D.,	1998	*Essex from the Air*. Essex County Council
Stoertz, C.,	1997	*Ancient Landscapes of the Yorkshire Wolds.* RCHME. Swindon.
Wallis, S. and Waughman, M.,	1998	*Archaeology and Landscape in the Lower Blackwater Valley*. East Anglian Archaeol. 82
Wilkinson, T. and Murphy, P.,	1988	*Archaeology and Environment in South Essex.* East Anglian Archaeol. 42
Williamson, T.,	1986	*The development of Settlement in North West Essex: The results of recent field survey.* EAH 17, 120-132.

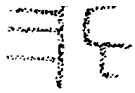
APPENDIX I. CONVENTIONS USED BY THE PROJECT

These are the line and fill types used in the depiction of archaeological and non-archaeological features for the Essex NMP project

Ditches: Extant or plough-levelled. Variable thickness.



Stone and/or earth banks/mounds: Extant or plough-levelled. Heavy stipple.

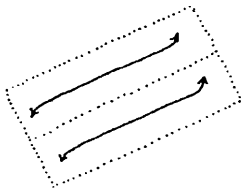


Hollow ways and unsurfaced trackways: Not defined by other depicted features. (1mm dashes. Single line per track where braided).

Area features (small): Storage pits, grubenhauser, clearance cairns, standing stones. Drawn solid as seen.

Compact or made stone surfaces/spreads: Paved areas, surfaced roads. medium stipple

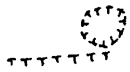
Ridge and furrow: Units are defined by dots (1mm spacing) if not bounded by headlands, banks or ditches, or by any other feature with a specific convention. Double arrow to show shape and direction of rig.



Water Meadows: Units are defined by the extant feature (1mm dashes at 0.5mm spacing) if not bounded by banks, ditches or any other feature with a specific convention. Within each area the main drains are depicted as ditches together with a sufficient number of subsidiary drains to give an impression of the form.

Pits and shafts: Including bell pits defined by a “doughnut” of spoil.

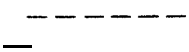
Negative features (large): Extant or back-filled fish ponds, quarries, etc. “T” hachure 0.5mm.



Railway lines/ tramways: (2mm spacing for cross-lines). This convention should be used even if the only visible remains are embankments/cuttings.

Extent of feature: (1mm dashes at 0.5mm spacing). A hard boundary marking the outline of a feature (e.g. the runways of a disused airfield).

Extent of area: (3mm dashes at 1mm spacing). A soft boundary marking the perceived limit of an activity (e.g. disused airfields or mining).



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