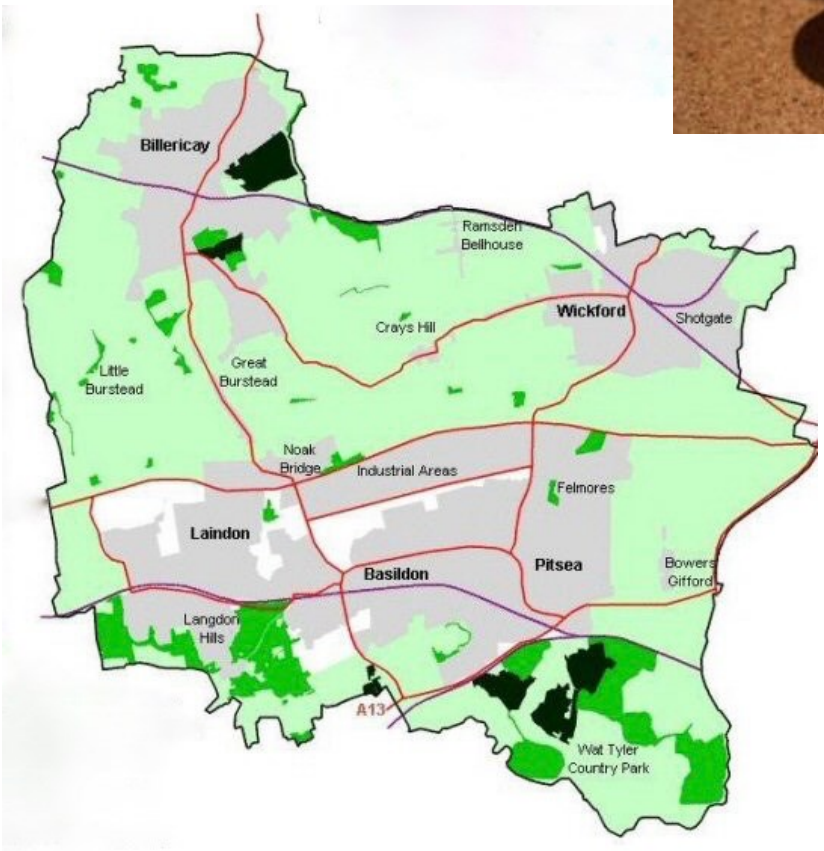
GeoEssex
Promoting the geology and landscape of Essex

Basildon Borough Council
Report on Local Geological Sites



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Contents

Cover photographs:

Left: The tower on the high ground of Pitsea Mount. It was originally part of the former parish church of St Michael. The hill consists of London Clay and is an example of landslipped ground, with fine views over the modern Thames Valley. *Photo: Wikipedia Commons*

Right: Pebbles from Norsey Wood Nature Reserve - rounded and smoothed on a beach around 50 million years ago. *Photo: G. Lucy*

1. Introduction

The rocks beneath the Essex landscape are a record of the county's prehistory. They provide evidence for ancient rivers, volcanoes, deserts, glaciers and deep seas. Some rocks also contain remarkable fossils, from subtropical sharks and crocodiles to Ice Age hippos and mammoths. The geology of Essex is a story that stretches back over 100 million years.

GeoEssex

GeoEssex is the primary source of information about the geology and physical landscape of Essex. The GeoEssex team, or 'Steering Group', consists of professional and amateur geologists, representatives from local authorities, geological and natural history societies, and from Natural England, the Government's nature conservation body.

GeoEssex promotes geology in all its aspects, from quarries, cliffs and boulders to spas, springs and building stones. The fascinating and often magical world of geology is all around us, if only we know where to look.

A primary task of GeoEssex is to identify the best places in Essex to find out about the Earth's distant past and the landscape processes going on today. These sites are called Local Geological Sites, or LoGS (formerly called Regionally Important Geological Sites or RIGS).

GeoEssex aims to advocate and represent geodiversity in planning processes and other initiatives.

View from the Langdon Hills towards London.

Photo: Ian Mercer

Geodiversity

What is geodiversity and why is it important?

Geodiversity is an integral part of the natural environment. It is the variety of rocks, fossils, minerals, landforms and soil, and all the natural processes that shape the landscape.

The only record of the history of our planet lies in the rocks beneath our feet. Here, and only here, can we trace the cycles of change that have shaped the Earth in the past, and that will continue to do so in the future. This is particularly true in Essex, where the record of climate change during the Ice Age is preserved in our quarries and coastal cliffs. The record is unique and much of it is surprisingly fragile.

Apart from the obvious benefits of providing mineral resources such as sand, gravel, chalk and clay, the diversity of the geology is what shapes the landscape, influencing soils, and in turn influencing all of our habitats and species. Geodiversity also has a cultural role to play, influencing the character of our built environment through building stones, providing inspiration to art, and helping to define where we live and our 'sense of place'. It is the link between geology, landscape, nature and people.

Local and national Geodiversity Action Plans

The UK Geodiversity Action Plan (UKGAP) sets out a shared framework for geodiversity action across the UK. It establishes a common aim, themes and targets which link national, regional and local activities. It encompasses how geodiversity can inspire people and what needs to happen to conserve Britain's geodiversity. The Plan for Essex has been drawn up within this framework.

A Local Geodiversity Action Plan (LGAP) has been produced for Essex. It sets out a framework for geodiversity action in Essex. It is an essential document to conserve the County's geodiversity.

The Essex Local Geodiversity Action Plan aims to:

- *Identify, conserve and enhance the best sites that represent the geological history of an area in a scientific, educational, recreational and cultural setting.*
- *Promote geological sites and make geoconservation relevant to people.*
- *Provide a local geodiversity audit (an audit of sites and skills).*
- *Influence local planning policy.*

2. The Geology of Essex

Compared to most other parts of Britain the rocks of Essex and adjoining counties are young in geological terms. Even the oldest surface rock in Essex (the Chalk) is only about 80 million years old. Much older rocks are, however, present at depth. We have some idea about these ancient rocks because of the records of boreholes that have been sunk in search of coal and oil.

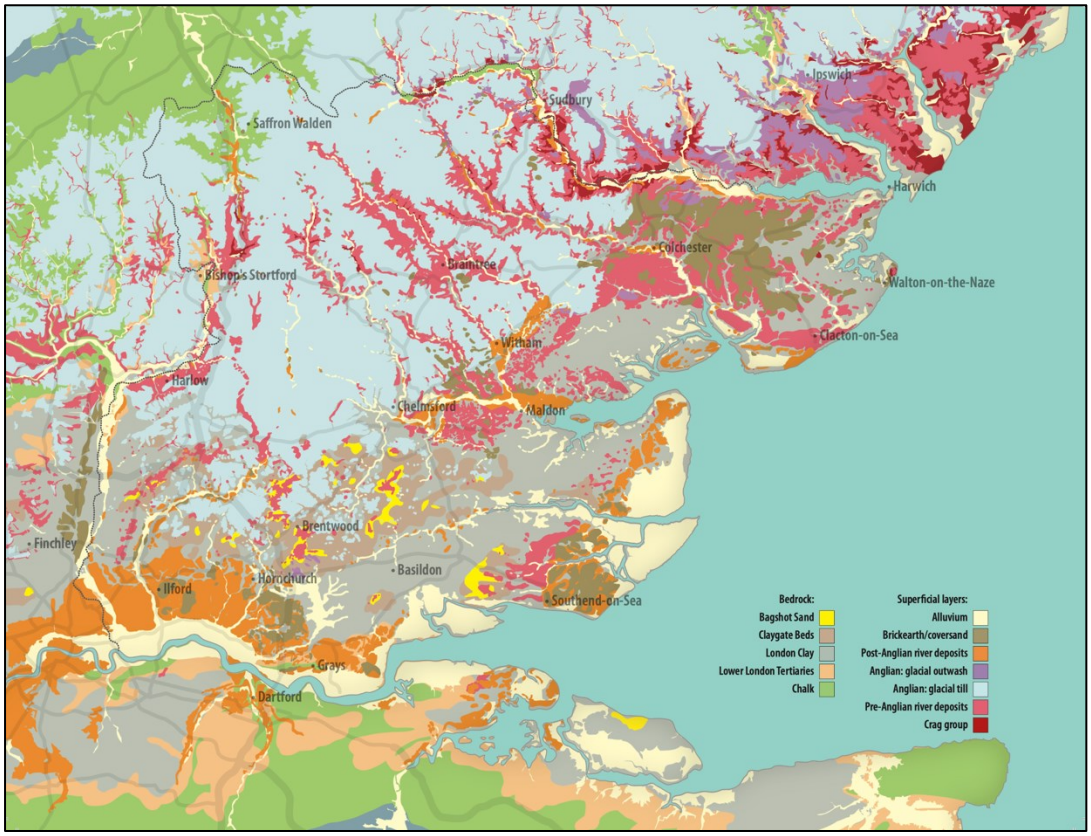
The surface rocks of Essex that were formed before the Ice Age (from the Chalk to the Red Crag) are described as the 'bedrock' or 'solid' geology. Much of this bedrock geology is concealed beneath the deposits left behind by glaciers and rivers during the Ice Age. The material laid down during the Ice Age is known as 'Superficial' or 'drift' deposits.

Geological timescale for Essex (not to scale)

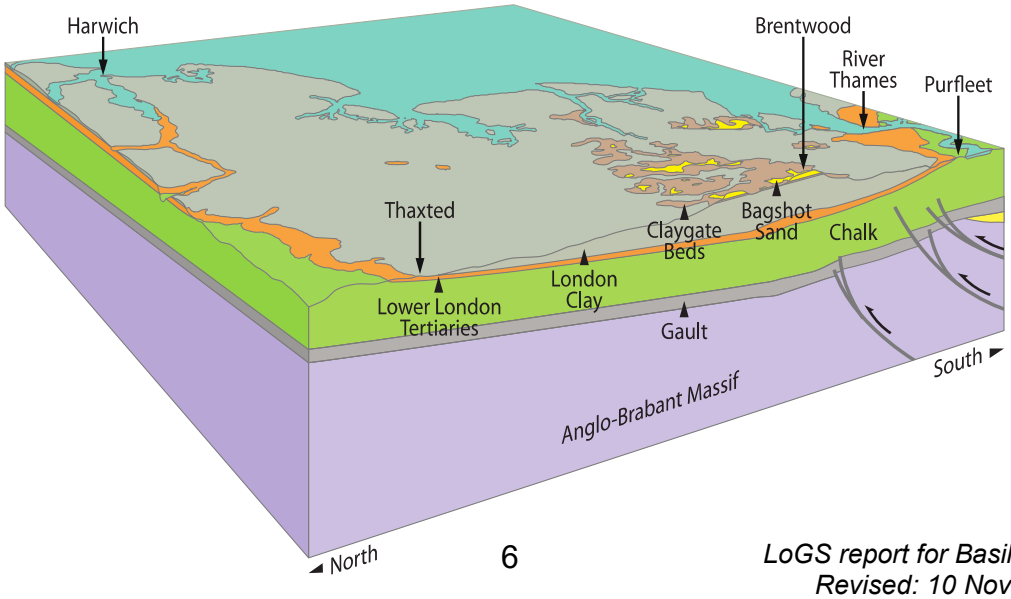
Era	Period or Epoch		Approx. age in millions of years	Geological formations in Essex
Caenozoic	Quaternary Ice Age	Holocene	0.01	Recent peat and alluvium
		Pleistocene	0.45	River terrace deposits and brickearth (loess)
				Boulder clay (till) and glacial gravel
			1	Kesgrave (Thames) sands and gravels
				Norwich Crag (Chillesford Sand)
			2.4	Red Crag
	Pliocene		10	*No evidence of deposits of this age in Essex but derived Miocene and Pliocene fossils are found in the Red Crag*
	Miocene			
	Oligocene		20	
	Eocene		50	Bagshot Sand
				Claygate Beds
				London Clay (includes the Harwich Formation)
	Palaeocene		55	Lambeth Group (Woolwich and Reading Beds)
				Thanet Sand
Mesozoic	Cretaceous		80	Chalk
			100	Gault and Upper Greensand (beneath Essex)
	Jurassic		150	*No evidence of rocks of these ages beneath Essex with the exception of Jurassic Oxford Clay in a graben (a sunken part of the crust bordered by faults) beneath East Tilbury.*
	Triassic		220	
Palaeozoic	Permian		250	
	Carboniferous		300	
	Devonian		400	Shales and mudstones dating from these periods occur at depth (about 300 metres) beneath Essex
	Silurian		420	
	Ordovician		450	*No evidence beneath Essex, however, boreholes have not been drilled deep enough to confirm.*
	Cambrian		500	
Pre-Cambrian	Precambrian		Age of Earth 4,600	

Geological Map of Essex

Geological map of Essex showing all the rocks exposed at the surface - bedrock and superficial deposits.



Cross section through Essex (bedrock only)



Essex through geological time

It is difficult to know where to begin with our geological story but the earliest evidence we have is the hard rocks deep beneath Essex that were formed some 400 million years ago in the Silurian and Devonian periods (part of the Palaeozoic era) and form what is known as the 'Palaeozoic basement' of Essex.

Deserts to Dinosaurs

- For a very long time (and before the age of the dinosaurs) these hard Silurian and Devonian rocks formed the surface of the land that was eventually to become Essex. During the Permian and Triassic periods Essex was a desert upland in the middle of a vast continent known as Pangea.
- By 200 million years ago, at the start of the Jurassic period, tropical seas had spread around this land forming a dinosaur-infested, forested island.

Buried Island

- If you could dig down 1000 feet (300 metres) under Essex you would reach the hard rocks of that dinosaur island.
- All trace of forests and animals from this time have been swept away from the eroded surface of the island, so there are no dinosaur fossils in Essex.
- By 100 million years ago, in the Cretaceous period, the sea flooded across the island to spread **Gault** Clay and **Greensand**. The sea then deepened to deposit hundreds of metres of soft white limestone known as **Chalk** all over the island as well as much of what is now Britain.

Pebbles and Clay

- The North Atlantic Ocean, which did not previously exist, began to open out to the west, the land of Essex lifted, chalk hills were worn down and flints were eroded out. Billions of these flints were tumbled on beaches to form layers of sand and beautifully-rounded pebbles across our area.
- Around 50 million years ago, in the Eocene period, a deep, sub-tropical sea fed by muddy rivers spread across what is now Essex and London depositing a great thickness of clay known as **London Clay** on the sea floor, together with the remains of many plants such as palms and cinnamon, and animals including birds, sharks, turtles, and horses no larger than a fox. Atlantic volcanoes showered their ash into this sea.

The Alps and the Thames

- Colliding continents pushed up the Alps, and in south and mid-Essex the Earth's crust was compressed to form a vale or syncline - the London Basin, occupied by an arm of the sea. About 2.4 million years ago, the western part of the London Basin began to rise and rivers poured vast amounts of material in the sea, forming offshore sandbanks formed red shelly sandstone layers across north-eastern Essex known as the **Red Crag**.
- Global cooling led to the Ice Age (the Pleistocene epoch), with many warm as well as cold periods; right now we are in a warm period known as the Holocene. With further uplift, the Red Crag sea retreated and was replaced by the ancestral River Thames, spreading a succession of flint-rich river gravels across the middle of Essex, through Harlow, Chelmsford and Colchester, and out across the area where the North Sea is now.

Ice and people cover Essex

- During an exceptionally cold stage 450,000 years ago a gigantic ice sheet covered most of Britain and Essex as far south as Hornchurch. The moving ice diverted the Thames towards its present-day course and dumped its load of boulder clay, or glacial till, on top of these old Thames gravels.
- During the past million years of the Ice Age, there have been numerous cold and warm stages and humans have migrated to and from Essex, together with the animals they have hunted. They have left thousands of flint tools and tool-making debris on the banks of the ever-changing Thames and its tributaries. Thus, in south Essex we have the best geo-environmental and archaeological record in Europe of the last half a million years.

3. Background to Geological Site designation in Basildon

What is special about Essex Geodiversity?

Essex is an area of predominantly subdued relief with gentle slopes, the result of its underlying geology of soft, relatively young rocks. These generally yield fertile soils. The result is an attractive 'lived in' landscape dominated by arable agriculture, but still retaining forested and heathland areas, particularly where gravels and sands, many of glacial and fluvial origin, have yielded poorer soils.

Although lacking the more dramatic geology and landforms of many 'hard rock' areas, Essex geology and geomorphology is still of great interest, possessing abundant evidence of the huge environmental and biodiversity changes that our area has witnessed over the last 100 million years. Among the key themes are dramatic and sometimes long-lasting changes in the distribution of land and sea, major shifts in climate, and mass species extinctions. Many of these phenomena are of great relevance today, and so an understanding of our past is essential in interpreting the challenges to come.

Geodiversity's influence on Essex's development

Essex's geodiversity has exerted a major influence on land use, agriculture and landscape:

The distribution of less fertile ancient river and glacial gravels has been a major influence on historical land use, resulting in the preservation through to the present day of extensive tracts of woodland and to a lesser extent heathland, in a predominantly arable county. These are of great significance both for biodiversity and recreation.

The chalky boulder clay, or till, found north and west of Chelmsford is highly suitable for cereal cultivation, especially wheat. London Clay outcrops south of Chelmsford, providing soils less suitable for arable agriculture and more suited to pasture. The brickearth of the Tendring district is the basis of the rich agricultural land of this peninsula.

In earlier times rivers penetrating deep inland, together with proximity to the Continent, provided a succession of invaders and colonisers – from Palaeolithic peoples, through to Roman, Viking and Saxon - with easy access.

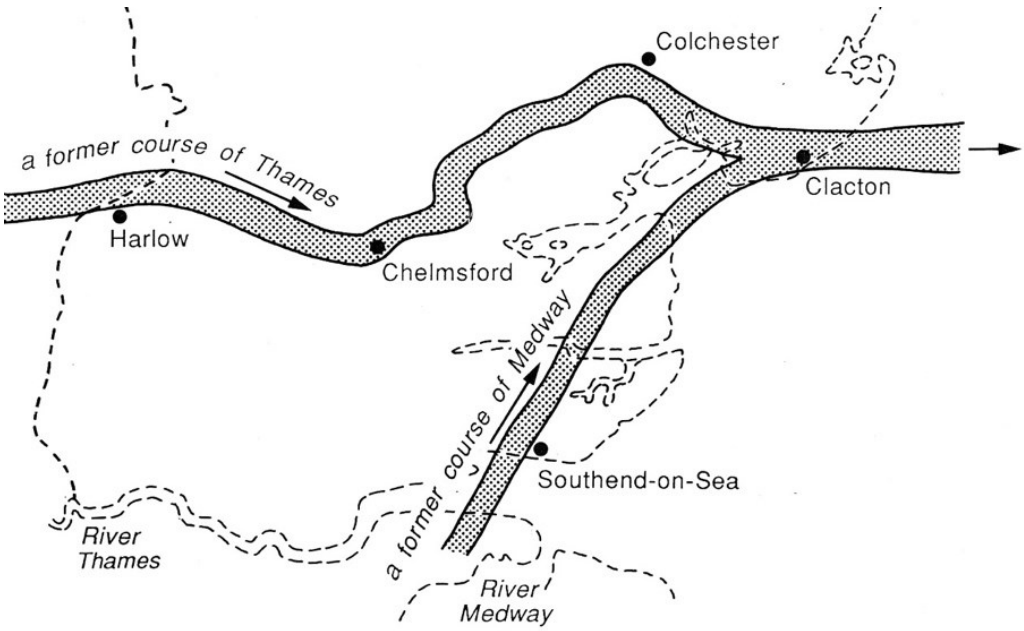
The deposits of the ancestral Thames and its tributaries have provided Essex with a source of gravel and sand for construction since Roman times. A special kind of gravel naturally cemented by iron called ferricrete was used extensively as a building stone and is found in many medieval churches.

The geology of Basildon district

The bedrock geology of the district is London Clay, laid down on the floor of a subtropical sea in the Eocene period some 50 million years ago. The Claygate Beds occur above the London Clay and represent a period of geological time when the London Clay Sea was becoming shallower and the clay was becoming increasingly sandy as the shoreline came closer. This culminated in deposition of the Bagshot Sand as the sea became very shallow. Bagshot Sand is therefore considered to be delta and near-coastal sands. Following extensive erosion during the Ice Age,

the Claygate Beds and overlying Bagshot Sand are now only exposed on the high ground such as the Langdon Hills and Billericay. These hills are capped by gravels laid down at various times by rivers during the Ice Age. These rivers are thought to have been south bank (northward-flowing) tributaries of the ancient Thames which then flowed far north of its present course.

During an exceptionally period of the Ice Age, 450,000 years ago, a gigantic ice sheet covered most of Britain and Essex as far south as Hornchurch. The moving ice diverted the Thames towards its present-day course and dumped its load of boulder clay, or till, across the landscape (shown pale blue on the geological map above). Much of this sheet of boulder clay has been removed by erosion but patches of it remain in the Basildon district, such as to the north and west of Billericay.



Above: Former courses of the Thames and the Medway before the arrival of the Anglian ice sheet in Essex. The ice sheet diverted the Thames to its present course and a combined 'Thames-Medway' river then flowed northeast along the former course of the Medway.

Gravels laid down on high ground in south Essex, such as at Langdon Hills and Billericay, may have been northward-flowing tributaries of the early Thames.

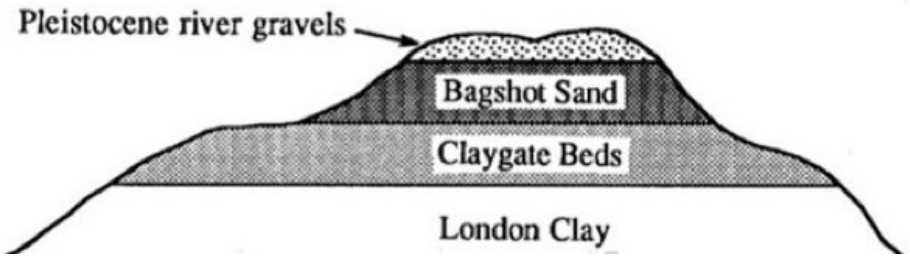
The Langdon Hills

The Bagshot Sand, Claygate Beds and London Clay were formed on the floor of an sub-tropical sea some 50 million years ago but the gravel at the very top of the hill is clearly much younger and of a different origin. Originally known as 'pebble gravel', and called Stanmore Gravel on modern geological maps, this gravel was for years thought to have been laid down under a sea but it is now thought that it may have been deposited by a river. But how could river gravel, of geological recent origin, be capping the tops of some of the highest hills in the region?

For many geologists the riddle of the pebble gravel has now been solved by studying the pebbles it contains. Although mostly of flint, a small proportion are distinctive pebbles of chert from the Lower Greensand of The Weald, and other rock types that could only have been deposited by a river flowing from the south. Similar gravels are found capping the high ground of the Rayleigh

Hills. These isolated outcrops of gravel date from the early part of the Ice Age, perhaps as much as a million years ago, and were probably laid down by northward-flowing tributaries of the Thames, when the Thames flowed across central Essex and Suffolk before its diversion to its present course by the Anglian ice sheet 450,000 years ago.

It is difficult to believe that this gravel may originally have been the floor of an ancient river valley. Curiously this gravel may even be the reason these hills are here, the gravel protecting these parts of Essex while the surrounding land was reduced to the present lowland by hundreds of thousands of years of erosion.



A cross section through the Langdon Hills at Westley Heights

The Langdon Hills (also called the Laindon Hills) are a remarkable natural feature; an isolated high point in an area of low relief. From here there are fine views where they have not been obscured by the rampant growth of trees in recent years. In 1767, the English writer Arthur Young commented on the view from the Langdon Hills:

> *"…near Horndon, on the summit of a vast hill, one of the most astonishing prospects to be beheld, breaks almost at once upon one of the dark lanes. Such a prodigious valley, everywhere painted with the finest verdure, and intersected with numberless hedges and woods, appears beneath you, that it is past description; the Thames winding thro' it, full of ships and bounded by the hills of Kent. Nothing can exceed it…"*

In some areas of high ground in the district, such as Norsey Wood near Billericay, the gravel seems to consist almost entirely of well-rounded flint 'beach pebbles' and sometimes referred to as the Bagshot Pebble Bed.

Instability of the London Clay

Even though it is some 50 million years old, the London Clay is too young to have been changed into a stronger 'mudstone' and it is therefore still able to absorb and lose moisture. London Clay contains montmorillonite, a mineral that absorbs water when wet and swells, and loses it when dry and shrinks. This is a common phenomenon in clays and makes them unstable. When dry, the shrinkage shows up at the ground surface as cracks, often seen in grassland such as parks, football pitches and the like. In buildings the frequent movement can cause cracks in walls. The cracks also allow surface water to penetrate more deeply into the soil when it rains. When wet, usually from rain, it is usually only the top 2 metres, rarely more than 5 metres, that is affected in our present climate. On slopes, notably those steeper than 8 degrees, the shrinking and swelling is affected by gravity and there is a slow movement downslope, again affecting buildings. In more severe conditions, the saturation of the clay makes it less cohesive and also heavier, so slow flows and landslipping can occur. These can be seen as hummocky ground, usually covered by brambles, scrub vegetation and small trees. These processes were the cause of the loss, for instance, of St Michael's Church at Pitsea.

Geodiversity and National Planning Policy

The importance of geodiversity as an integral part of nature conservation and the planning system is reflected in The National Planning Policy Framework (NPPF), and in legislation – Wildlife & Countryside Act 1981 and Countryside and Rights of Way Act 2000.

The NPPF states that:

> "Planning policies and decisions should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils" (Paragraph 170);
>
> "Plans should protect and enhance biodiversity and geodiversity" (Paragraph 174).

Site designations

The most important geodiversity sites have been declared as **Sites of Special Scientific Interest** (SSSIs) which are statutorily protected for their scientific importance (there are no geological SSSIs in the Basildon district).

The next tier of geodiversity sites are known as **Local Geological Sites** (LoGS) These have replaced the earlier 'Regionally Important Geological Sites' (RIGS) terminology in line with government guidance.

Local Geological Sites (LoGS) are broadly equivalent to Local Wildlife (species and habitats) Sites ('LoWS') but have a broader remit as they can be designated for their scientific, educational, historical and recreational benefits. Typical Essex LoGS include quarries, pits, walls, boulders, cliffs, springs, and river meanders. Local Wildlife Sites and Local Geological Sites are both designed to provide a system of locally-valued, non-statutory sites.

Most importantly, the NPPF gives Local Geological Sites a weighting equal to Local Wildlife Sites, and both are collectively referred to as 'Local Sites'. However, in actuality the attention and priority afforded to the designation and management of LoGS has historically lagged, and continues to lag well behind that of LoWS.

4. Objectives of current report

Supporting Local Planning Authorities

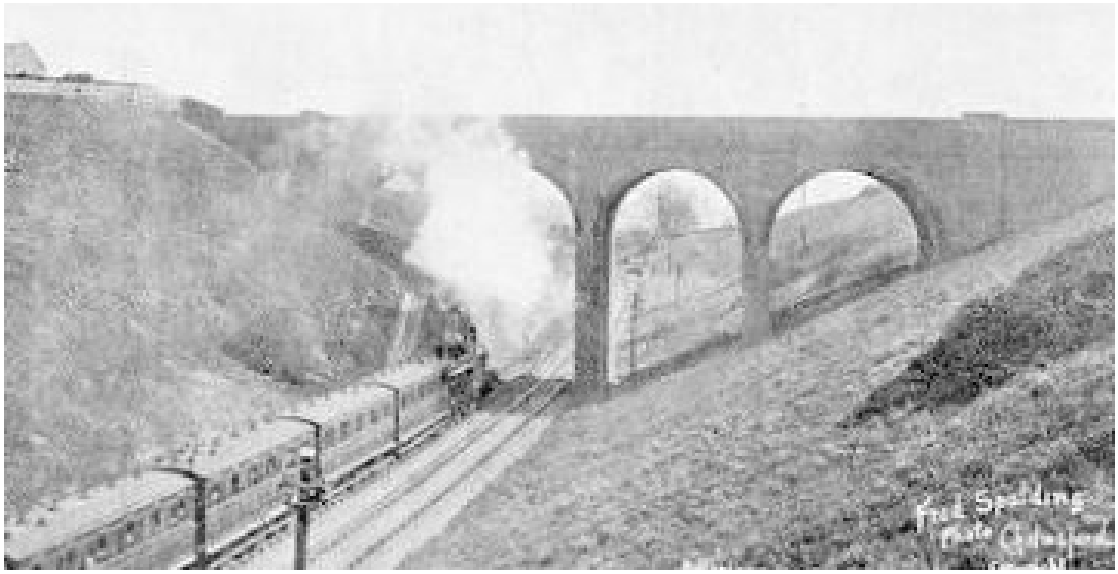
Biodiversity protection is familiar to planning authorities but geodiversity less so. This report will assist planning authorities in meeting their obligations under the National Policy Planning Framework and helping them identify potential development impacts on LoGS.

GeoEssex is therefore seeking to help Local Planning Authorities fulfil their responsibilities with respect to geodiversity.

> "*Local and neighbourhood plans and planning decisions have the potential to affect biodiversity or geodiversity outside as well as inside designated areas of importance for biodiversity or geodiversity"* (extract from: www.gov.uk/guidance/natural-environment)

Further guidance on statutory obligations is given in Circular 06/2005 (*Biodiversity and Geological Conservation*). Geodiversity should be therefore included alongside biodiversity in local authorities' Local Plans. Identifying these non-statutory sites therefore helps local authorities to meet their obligations.

LoGS can also contribute to *sustainability* programmes by providing information about a key element of the environment that contributes to our natural heritage. In addition, the *awareness raising* and *education* function fits well with the principle of community involvement and enabling people to regain their sense of place.



Above. The town of Billericay sits on a ridge of Bagshot Sand, underlain by Claygate Beds. This pattern is typical of many of the hill tops in south Essex, most notably the Langdon Hills, but Billericay is a good example with the High Street running along the ridge. This ridge was cut through for the construction of the railway in 1887 and the resulting cutting, nearly 20 metres deep, produced one of the finest sections through the Bagshot Sand ever encountered in Essex; the entire excavation being dug by hand. The photograph was taken from the Stock Road bridge looking east. There is considerably more vegetation in the cutting today. *Photo © Essex Record Office: Spalding Collection.*

5. Site selection

Site selection and notification to planning authorities

LoGS in Essex are identified by **GeoEssex**, a largely voluntary group composed of representatives from the major Essex geological and conservation bodies and supported by the Essex Field Club, Essex Wildlife Trust, Natural England and Essex County Council (Place Services). The site selection process is based on clearly defined criteria (see below) and includes scientific, educational, historical and aesthetic values. When selecting sites GeoEssex aims to gain the support of landowners whenever possible. The majority of LoGS are on private land and site selection does not infer any right of access.

Like LoWS, proposed LoGS are presented to the Local Sites Partnership (chaired by Essex Wildlife Trust) for endorsement and then passed to local authorities for inclusion in their Local Plans. Local authorities receive a citation and boundary map.

No sites have yet been selected as LoGS in the Basildon district, but there are sites which are potential LoGS, and these are summarised below. Other sites may be identified in the future, occasioned by housing or other development and restoration following mineral extraction.

Site protection

Like their biodiversity counterparts, LoGS have no statutory protection and the conservation and management of individual sites relies heavily on the support of landowners. Inclusion within local plans also forms a vital role in the protection of LoGS. An example of a comprehensive natural environment policy incorporating geodiversity can be provided on request.

It is recommended that the Local Sites Partnership (c/o Essex Wildlife Trust) should be consulted if any development is proposed that would affect a LoGS.

Site Assessment Criteria

The assessment criteria used for identifying LoGS are based on DEFRA document *Local Sites: Guidance on their identification, selection and site management* (2006). The guidance states that assessment is a matter of judgement but must be based on an understanding of geological principles and processes, and the distribution and abundance of the resource (national, regional and local). Those sites selected must be 'of substantive importance to the geodiversity of the local area'.

There are four value categories: scientific, educational, historical and aesthetic. A site qualifies for notification as a Local Geological Site if it fulfils the criteria under one or more of these categories. Each site is also given a site assessment score. This score is not a measure of the site's value or importance but a relative assessment of the usefulness of the site in promoting geodiversity.

Land Ownership Notification

Where the landowner is identified as a public body eg. a local authority, Forestry Commission etc., notification is by letter to that authority. For sites under private ownership, where the landowner can be identified, they will be informed by letter.

6. Additional Sources of Information

Scientific literature
If a LoGS has been referred to in the scientific literature these references are of given in the LoGS citation. If a site has been referred to in the scientific literature this means that the site is of historical interest and some of these sites will have potential for research.

Interpretation
If a site is accessible or simply visible to the general public, it is the aim of GeoEssex to provide interpretive information where possible and practical. This could be in the form of interpretive boards or leaflets. Such interpretation will be with the cooperation of landowners and other interested parties.

GeoEssex www.geoessex.org.uk
Background geological information for Essex, together with a selection of sites in each district (SSSIs and public accessible sites) can be found on the GeoEssex website

Essex Field Club www.essexfieldclub.org.uk
The Essex Field Club, founded in 1880, exists to promote the study of the county's natural history, and includes geology amongst its many activities. The club has a centre for Biodiversity and Geodiversity in Wat Tyler Country Park at Pitsea, near Basildon. It is open to the public most weekends. Their website provides comprehensive data on a large number of wildlife and geological sites which can be searched in a number of ways. Details of several hundred geological sites across Essex can be found here which includes LoGS and potential LoGS.

British Geological Survey www.bgs.ac.uk
Other geological resources, maps and borehole information are available on the website of the British Geological Survey.

Essex Rock & Mineral Society www.erms.org.
The Essex Rock and Mineral Society, founded in 1967, is the club for Essex amateur geological enthusiasts.

GeoEast
GeoEast is the East of England Geodiversity Partnership. It is a partnership of organisations active in conserving and promoting Earth heritage in this region.

Earth Heritage Magazine www.earthheritage.org.uk
Earth Heritage magazine is produced for the geological and landscape community by Natural England, Scottish Natural Heritage, the Countryside Council for Wales.

Geologists' Association www.geologistsassociation.org.uk
The Geologists' Association, founded in 1858, is Britain's largest society for amateur geologists.

Quaternary Research Association https://www.qra.org.uk
The Quaternary Research Association researches 'Ice Age' geology, palaeobiology and Palaeolithic archaeology and has published several field guides covering many sites in southern and Eastern Essex.

Books

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7. List of Sites

The following is a representative list of geological sites in the district. For completeness it includes geological SSSIs but these sites are statutory sites and do not form part of this report.

The list gives an idea of the range of sites that can qualify as Local Geological Sites (LoGS). It includes those LoGS that have already been approved by the Local Sites Partnership.

Note: *Not all of the sites here described are accessible. Some sites are on private land and can only be viewed from footpaths that pass through or alongside the site. Inclusion of a site on this list does not, therefore, imply any right of access.*

Sites of Special Scientific Interest (SSSIs)

There are no geological SSSIs in the district.

Local Geological Sites (LoGS)

Sites notified and agreed by Local Sites Partnership to date
Full descriptions of each site are contained in the citations.

BaG1 - Norsey Wood Nature Reserve, Billericay (TQ 691 955)
Norsey Wood is an area of mixed coppice woodland that is It is an easterly extension of the high ground of Billericay. The geology is similar to the Langdon Hills with the bedrock of London Clay overlain by Claygate Beds and Bagshot Sand. The Bagshot Sand gives rise to very sandy and brightly coloured soil, and the remarkable abundance of what appear to be 'beach pebbles' on the highest ground. These extremely well-rounded flint pebbles belong to an extensive outcrop of gravel that has been called the Bagshot Pebble Bed, considered by some to represent an ancient beach, laid down as the coastline of the London Clay Sea finally passed over Essex. Although there is no doubt that the pebbles in the gravel were rounded and smoothed on a beach around 50 million years ago (during the Eocene period), whether they were actually formed here has been the subject of a controversy amongst geologists which can be traced back to Victorian times.

Norsey Wood pebbles

The Bagshot Pebble Bed debate appears to be only of academic interest, but it is important in order to reconstruct the history of the Essex landscape. The view of many geologists is that the Eocene beach was not actually here in Billericay but somewhere to the south-west and that these pebbles were transported to this spot by a river during the Ice Age.

Norsey Wood, with its varied soil types, is an excellent location for demonstrating the importance of geology as the foundation of the landscape and how variations in underlying rock types affect not only the soils but also the flora and fauna. The London Clay and overlying Claygate Beds are occasionally exposed in the valleys and small ravines and there are exposures of Bagshot Sand and Bagshot Pebble Bed on the paths and in the roots of fallen trees.

BaG2 - Vange Hall Brick Pit, Vange (TQ 717 874)

The bedrock geology of Pitsea and Vange is London Clay, laid down in a subtropical sea some 50 million years ago. This clay passes up into a sandy clay called the Claygate Beds as the sea became shallower. Due to erosion during the Ice Age only isolated patches of Claygate Beds remain. One of these is a kilometre-long patch on Vange Hill, which is a prominent area of high ground with steep slopes and landslipped ground to the south. Basildon Golf Course occupies the western end of this hill, and in the centre of the golf course, at the highest point, is the former pit of Vange Hall Brickworks.

The brickworks started life in the 1890s and worked the Claygate Beds, which were described in 1922 as laminated clays with beds of current-bedded sands with occasional fossils. In 1974 a section of the pit face was cleared to revealed a 9 metre thick section, which was documented in detail. The section is now overgrown and obscured but it remains the only exposure of Claygate Beds in Essex.

Other sites of geological interest in the district

For completeness, the following sites also contribute to the geodiversity of the district.

Lincewood (part of Langdon Nature Reserve), Langdon Hills (TQ 675 873)

A short distance north-west of the Langdon Hills is an isolated, wooded hill known as Lincewood with an identical geology to the Langdon Hills. The hill is essentially an isolated patch of Bagshot Sand overlying Claygate Beds and London Clay, with the summit capped with flint gravel. Lincewood is part of Langdon Nature Reserve, Essex Wildlife Trust's largest inland reserve. There is a visitor centre and car park on Lower Dunton Road.

Westley Heights (Langdon Hills Country Park), Langdon Hills (TQ 683 867)

Straddling the border between the districts of Thurrock and Basildon is the high ground of the Langdon Hills. (formerly known as the Laindon Hills). The hills are composed of an isolated patch of Bagshot Sand overlying Claygate Beds and London Clay, and the summit, like other similar high points in the area, is capped with flint gravel known as 'pebble gravel'. The Bagshot Sand and the overlying gravel were formerly visible in several small pits in the area. (See above for a detailed description of the geology of the Langdon Hills).

Although partly within the district of Basildon the Country Park is run by Thurrock Council's Ranger Service. It consists of two areas: Westley Heights and One Tree Hill. There are panoramic views over the present Thames Estuary and across to London.

St. Michael's Hill (Pitsea Mount), Pitsea (TQ 738 878)

Landslips are common between here and One Tree Hill due to the steep slopes that represent an abandoned River Thames cliff line. The geology is London Clay, which is prone to landslipping on slopes exceeding 8 degrees. St. Michael's Hill consists of London Clay with slopes of 9 to 10 degrees, which is too steep to ensure stability. All around the hill are cracked paths as the ground continues to move. It may take thousands of years for the hill to achieve a stable profile. There are fine views over the modern Thames Valley including Wat Tyler Country Park and the creeks of Vange Marshes.

On the summit of the hill was St. Michael's Church. The original church was rebuilt in 1871, retaining the 15th Century tower, and was still in use for services in the early 1970s, but it was later abandoned due to instability of the London Clay. The nave and chancel were finally demolished in 1998. The tower was spared and is now a prominent landmark.