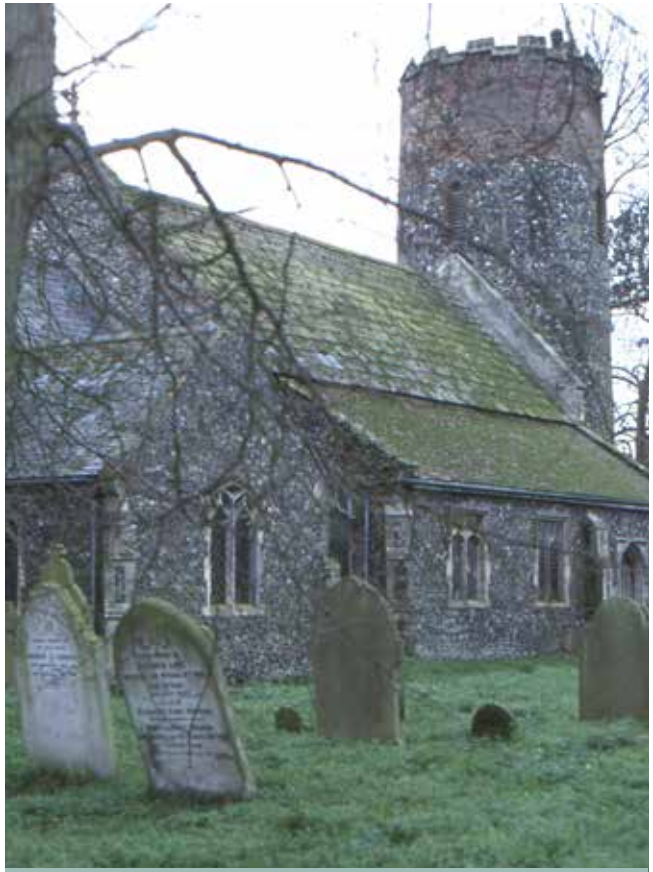
Section 1 *Evolution and history*

Image - Broads Authority

1.1 Introduction to the evolution of the Broads landscape

The landscape of the Broads is a product of dramatic landscape change over millennia. Who would have thought that millions of years ago the area was part of a warm tropical sea which led to the formation of the Chalk strata underlying the area. This is so important to us today as it provides an aquifer and has provided building materials, such as lime and flint, a common feature of buildings in the area.



Burgh Castle church has one of the characteristic Anglo Saxon round flint towers. Christopher Hilton

Changes in the relative sea levels saw coastlines advance and retreat and different river systems evolve. During certain periods the Broads was connected to the continent allowing people to travel between the two areas.

When the climate cooled there were periods of glaciation when ice sheets swept over the area depositing sands and gravels which are still exploited today as a source of aggregate.

Ice sheets retreated when the climate warmed and the swampy freshwater environment encouraged the formation of peat an important resource in Broads history and, as we have now come to realise, important as a carbon dioxide store.

The shaping of the Broads by humans to resemble the landscape we see today has only occurred during relative recent history. It initially started with the clearance of land for grazing but in the Roman period impressive structures such as Burgh Castle fort were built.

The Anglo Saxon period saw settlements established that still thrive today, their origins hinted at in their Scandinavian place names. Many of those settlements found skirting the Broads area on the higher land have unusual round-tower churches.

The broads, which give the area its name, were excavated in the mediaeval period to provide peat for fuel. The excavations subsequently flooded providing valuable areas of conservation and recreational activity today.

Humans have shaped and exploited the marshland as a valuable grazing resource for many centuries adapting to increases in water levels, through the construction of flood defences, mill structures and elaborate dyke networks which supplemented the natural creeks in helping to drain the area.

From the 19th century onwards, tourism and recreation activities have had a significant influence on the Broads landscape. The same can be said of the changing management regimes for the wetland landscape as traditional uses decline, economic drivers dictate land use for agricultural enterprises and conservation bodies increase their land ownership.

The following sections set out in more detail how the physical landscape has evolved over the millennia and what have been the most significant human actions that have contributed to the character of the Broads landscape today.

Burgh Castle fort - Two bastions on the east wall. The impressive defences are some of the best preserved in the UK, even Europe.
Ashley Dace - geograph.org.uk

Dredging and reed cutting are just two examples of how humans have shaped the Broads landscape.

1.1 How the Broads landscape has been shaped over many thousands of years.

The physical landscape of the Broads that we see today is the result of many thousands of years of gradual change. Natural land-forming processes, such as glaciation and variation of sea level, work together with climatic processes to bring about a slow but steady transition. The Broads is a low-lying landscape, and so slight shifts in water level and quality may easily have widespread effects.

The following text is a simplified version of the sequence of events that have taken place over deep time to shape the physical fabric of the Broads landscape. Some of the land-forming processes are particularly significant today for providing the 'raw materials' for the establishment of special wildlife habitat, and for humans to exploit for fuel or building purposes.

70 million years ago

This area was part of a warm, tropical sea in the Cretaceous period. Mud rich in fossils and microfossils was deposited on the sea bed, leading to the formation of thick layers of Chalk, which underlies all the Broads area.

Underwater scene showing Mosasaurus in a chalk sea.

Map of Europe in the Cretaceous period.
Image © Prof Ron Blakey, Colorado Plateau Geosystems, Arizona.

The Chalk is a vital aquifer for the Broads because it supplies groundwater to the rivers Waveney, Yare and Bure and their tributaries through seeps and springs in the valleys. It supplies most of the drinking water, directly through boreholes and indirectly from surface sources such as the River Bure at Belaugh and the River Waveney at Shipmeadow. Its calcareous nature produces lime-rich water, which influences the distinctive biodiversity of the Broads.

Flint is a mineral which formed as nodules in the Chalk. It is widely used in the Broads area as a building stone, whether as cobbles or knapped (broken) pieces.

The Chalk can be seen in the Broads area where valleys have cut down through younger geological layers to expose it. Chalk was quarried and mined along the valley sides of the rivers Bure and Yare.

▲*Flint is a hard grey rock consisting of nearly pure silica (chert), occurring chiefly as nodules in chalk, have been used extensively in local buildings.*

Lime workers at Whitlingham Chalk Pit.
Image courtesy Whitlingham Trust.

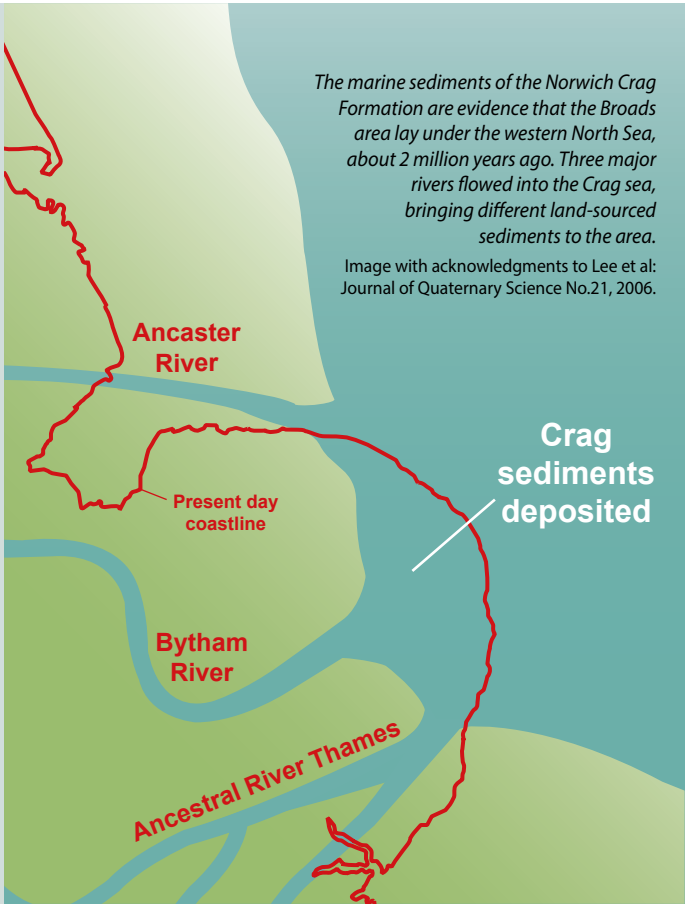
70 to 2.5 million years ago

The Broads area underwent many dramatic changes, as seas advanced and retreated and climates changed over millions of years. It eventually became a lowland area on the edge of the North Sea basin, to be strongly influenced by any changes of sea level.

2.5 to 1.8 million years ago

The area of what is now the Broads lay under the western edge of the North Sea, in a cool, temperate climate. Relative sea levels were high, and the coastline at that time lay somewhere near Norwich.

A geological profile through Norwich Crag sediments at Bramerton. The site is conserved as a Site of Special Scientific Interest.
Image courtesy Dr Peter Riches.



The marine sediments of the Norwich Crag Formation are evidence that the Broads area lay under the western North Sea, about 2 million years ago. Three major rivers flowed into the Crag sea, bringing different land-sourced sediments to the area.
Image with acknowledgments to Lee et al: Journal of Quaternary Science No.21, 2006.

Marine sands, gravels and clays of the Red Crag and Norwich Crag were laid down on the sea floor. Sediments of the Norwich Crag are exposed in the Broads area today, and form areas of sandy soils along the sides of valleys, such as the Ant, Bure and Yare.

The position of the shoreline shifted as the climate fluctuated between a succession of warmer and cooler periods, leading to deposition of a variety of estuarine and shallow marine sediments. By analysing the fossil pollen and foraminifera contained in these sediments, geologists have been able to divide the Crags into a series of time zones; some of these are named after place names and river names in the Broads, such as Pre-Ludhamian (about 2.5 million years ago), Ludhamian (about 2.3 million years ago), and Antian and Bramertonian (about 2.0 million years ago).

The Crag deposits are typically sandy, but sometimes contain layers of fossil shells, which may give a chalky quality to the groundwater in places. Many mammal fossils have been found in the Norwich Crag, providing evidence of life on land and sea at the time, including walrus, whale, mastodon and sabre-tooth cat.

As time went on, local sea-levels fell, due to uplift of the land. The shoreline generally retreated north-eastwards, and a major river (the early Thames) flowed into the Broads area from the south-west, leaving traces in the form of distinctive gravel deposits overlying the Crag.

1.8 to 0.5 million years ago

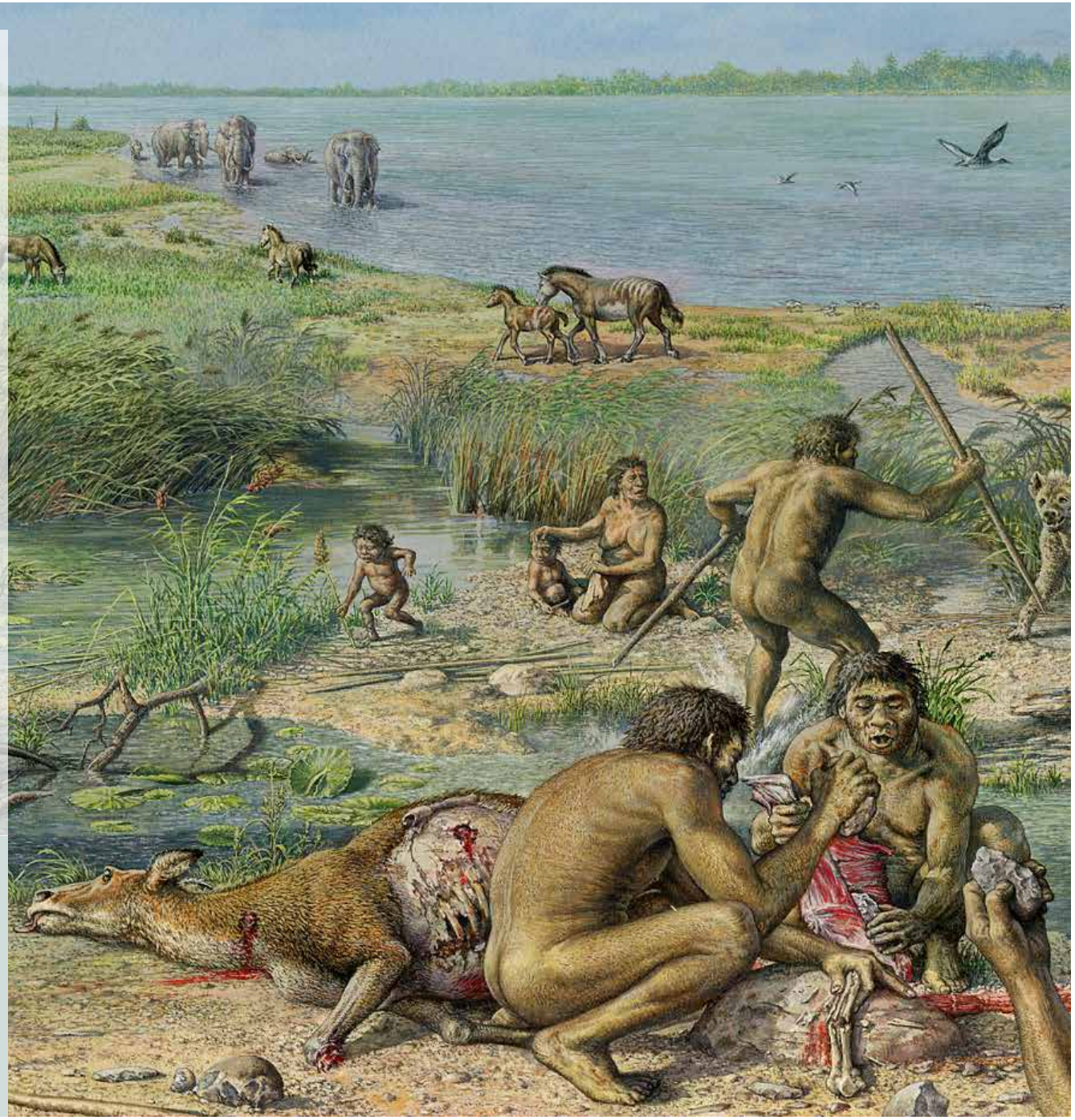
The Broads area gradually became land once again, as local sea-levels fell and the shoreline of the North Sea retreated north-eastwards. The area was influenced by two major rivers.

The Bytham and early Thames rivers are thought to have converged in the Broads area about a million years ago, with an estuary near Happisburgh.'
Image courtesy The British Museum.

Marine sands, gravels and clays of the Wroxham Crag were laid down on the sea floor. They can be distinguished from the older Norwich Crag by their higher proportion of of exotic, quartz-rich material they contain. These sediments are exposed in areas of sandy soil along the valley sides of the Yare and Bure. Later, local uplift of the land caused the coastline to shift north-eastwards, until about 0.8 million years ago, it lay somewhere near Mundesley.

As the land was uplifted, rivers flowed into the Broads area. Their deposits are known as the Cromer Forest-bed Formation. Notably about 0.9 million years ago we have evidence for a major estuary near Happisburgh. The earliest humans in north-west Europe lived along its banks. British Museum excavations have revealed flaked flint tools, and rich evidence of the local environment, including fossils of mammoth, beaver and elk as well as plants and beetles. Later, continuing land uplift in Norfolk caused this river to take a more southerly course, eventually entering the North Sea basin in Suffolk.

The influence of another major river became evident in the Broads area after about 0.8 million years ago. It originated in the English Midlands, and is known as the 'Bytham River'. Its distinctive suite of sands and gravels suggest that it flowed from the Waveney valley towards Great Yarmouth. A rich assemblage of fossil remains has been excavated from the mud of this river at Norton Subcourse. There is evidence that early humans known as *Homo heidelbergensis*, thought to be the ancestors of ourselves and the Neanderthals, lived along its banks, as flint tools have been found at Pakefield just south of the Broads area. The sediments here have been dated to around 0.7 million years ago.



Recent excavations at Happisburgh have revealed evidence of a site of earliest known human occupation in North-West Europe around 0.8 million years ago.

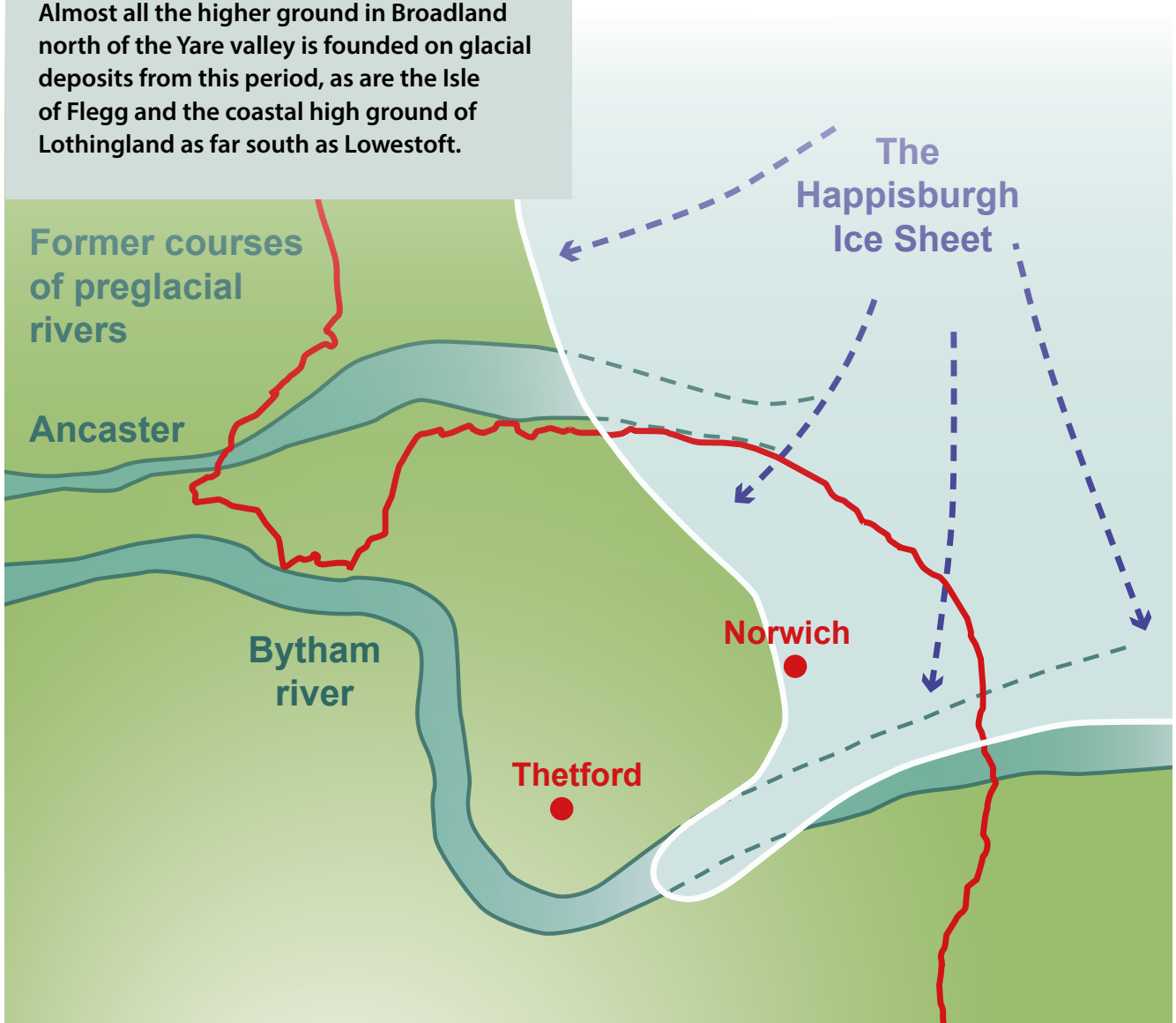
Habitats in the vicinity would have included the tidal river, salt marshes, freshwater marshes and a grass-dominated flood plain grazed by herbivores.

The West Runton Elephant, probably the largest elephant skeleton ever found and the best example of its species known, was preserved in the Cromer Forest Bed deposit.

Image courtesey John Sibbick/AHOB.

About 0.5 million years ago

The climate cooled and sea levels fell as the Broads area entered a cold period known as the Happisburgh glaciation. An ice sheet swept over the area from the north, as far south as Beccles and the Waveney valley. Almost all the higher ground in Broadland north of the Yare valley is founded on glacial deposits from this period, as are the Isle of Flegg and the coastal high ground of Lothingland as far south as Lowestoft.

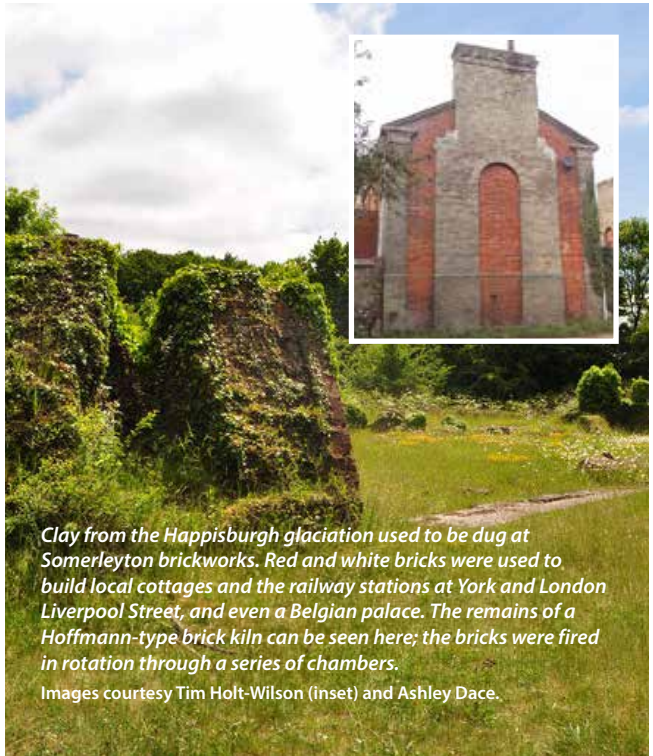


The ice sheet from the Happisburgh glaciation period extended to the Waveney valley. Almost all the higher ground north of the River Yare and the Isle of Flegg are formed from deposits of this period.

Image courtesy Lee et al: 'British Regional Geology. East Anglia'. British Geological Survey, 2015.

The Happisburgh ice sheet deposited layers of stony debris beneath it known as the Happisburgh Till, while meltwaters streaming from the ice-front gave rise to rivers which deposited layers of sand and gravel, and also lakes in which finer-grained material settled out to form silts and clays. The meltwaters in the area of the Waveney valley initially flowed along the route of the Bytham River towards Gt Yarmouth. Later, a thick sheet of outwash sand known as the Corton Sands was deposited as the ice sheet retreated; this may have been deposited under water on the margin of a big meltwater lake occupying the southern North Sea basin. The sands and gravels are exploited as a source of aggregate, as at Kirby Cane, and fine-grained, silty sediments have been exploited for brickearth, as at Somerleyton.

The exact dating of the Happisburgh glaciation is debated by geologists. Some place it at 0.63 million years ago; others closer to 0.47 million years ago. Geological research in the Broads and Norwich areas is likely to play an important role in resolving this question.



Clay from the Happisburgh glaciation used to be dug at Somerleyton brickworks. Red and white bricks were used to build local cottages and the railway stations at York and London Liverpool Street, and even a Belgian palace. The remains of a Hoffmann-type brick kiln can be seen here; the bricks were fired in rotation through a series of chambers.

Images courtesy Tim Holt-Wilson (inset) and Ashley Dace.

About 0.45 million years ago

A second ice sheet entered the Broads area, this time from the west. This episode is known as the Anglian glaciation. The ice sheet is thought to have overrun the whole area, and may have been over a half a mile thick. It deposited thick layers of clay and sand which now form tracts of higher ground, especially in the southern part of the Broads.

Characteristic deposits of the Anglian ice sheet include chalk-rich stony debris known as till (this particular deposit is called the Lowestoft Till), and meltwater sands and gravels. The uplands of the Cromer Ridge were deposited in North Norfolk, probably as a moraine of glacial debris shunted forward by an advancing phase of the ice sheet. Strangely, evidence for the Lowestoft Till is patchy in the areas north-east of the Yare valley; deposits are not found further north-east than Acle and the Isle of Flegg. This has not yet been satisfactorily explained by geologists. Some have suggested that a separate lobe of ice originating from the north-east may have occupied these areas and blocked the Lowestoftian ice sheet from advancing over them. Alternatively, later erosion may have removed evidence for its presence here.

When the Anglian ice sheet retreated, the Waveney and Yare valleys were major routes for escaping meltwaters, leaving evidence in the form of a relict river terrace (abandoned floodplain remnant) at Earsham. The Lowestoft Till has a high chalk content, which contributes to the lime-rich nature of ground-waters originating in the till.

A map of the southern North Sea at the height of the Anglia glaciation. Meltwater from the North Sea Lake escaped through the Straits of Dover.'

Image courtesy White et al: Journal of Quaternary Science, Jan 2016.

420,000 years ago

The climate warmed up into what is known as the Hoxnian period. The rivers of the Broads area we know today began to develop on the bare landscape left behind after the Anglian ice sheet retreated. We have evidence that early humans visited the area.

Lakes began to fill hollows in the land, and life returned, including early human settlement. Some of the gravels in the Yare valley contain Palaeolithic Acheulean hand axes which are thought to date from this time, as at Whitlingham. These are likely to have been made by *Homo heidelbergensis*.

400,000 to 30,000 years ago

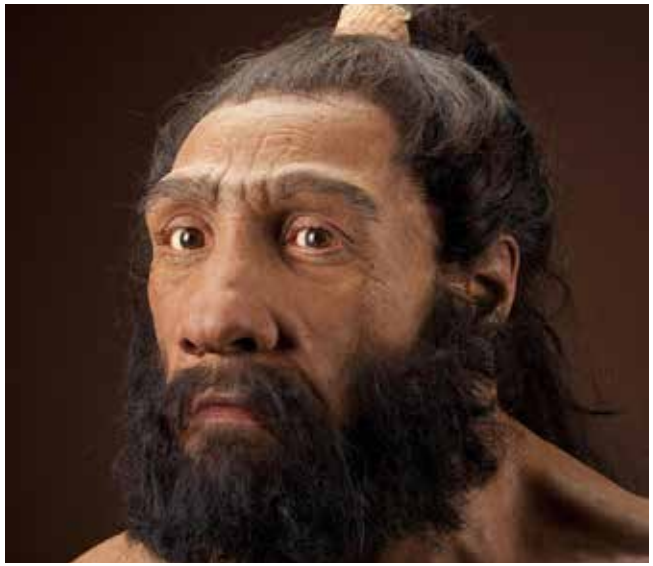
There was as a succession of alternating warm and cold climatic periods over the next 370,000 years. The familiar shape of the Broads landscape began to form in this period: the pattern of uplands and lowlands we know today, and the wide river valleys of the Ant, Bure, Thurne, Waveney and Yare flowing into the North Sea.

Several notable features of the landscape were formed during this time:
During warmer periods, sea level rose to approximately the same levels as today, though the coastline itself is likely to have lain somewhat further eastwards. Marine erosion has removed a slice of this extended land area; the shape of the Thurne and Lothing catchments suggests their rivers they must have had headwaters in this coastal land area now lost to the sea.

During colder periods, high-energy meltwaters deposited layers of sediment on wide gravelly floodplains in the Yare and Waveney valleys. There have been subsequently dissected by erosion to form terrace remnants; two post-Anglian terraces have been recognised in the Waveney valley, probably because it was an important route for meltwaters escaping from a proglacial lake (Lake Paterson) associated with an ice sheet occupying the Fenland basin, about 160,000 years ago. Terrace 2 in the valley may date from this time. When permeable sandy ground was frozen it could be eroded by meltwaters, so giving rise to some of the undulating slopes and dry valley features of the Broads area.

Neanderthal humans (*Homo neanderthalensis*) were able to colonise the area in warm periods, as evidenced by a distinctive flint hand axe found at North Cove in the Waveney valley.

Reconstructed head of Homo Neanderthalensis.
Image courtesy Smithsonian Institute.



30,000 to 12,000 years ago

This was a cold climatic period, which saw the advance of an ice sheet southwards as far as north Norfolk. This took place about 20,000 years ago, during what is called the Hunstanton glaciation. The Broads area was a chill, arctic landscape, and most of the North Sea was a low-lying plain at this time. Meltwater rivers were active in spring and summer, filling the valleys floors with transported sand and gravel.

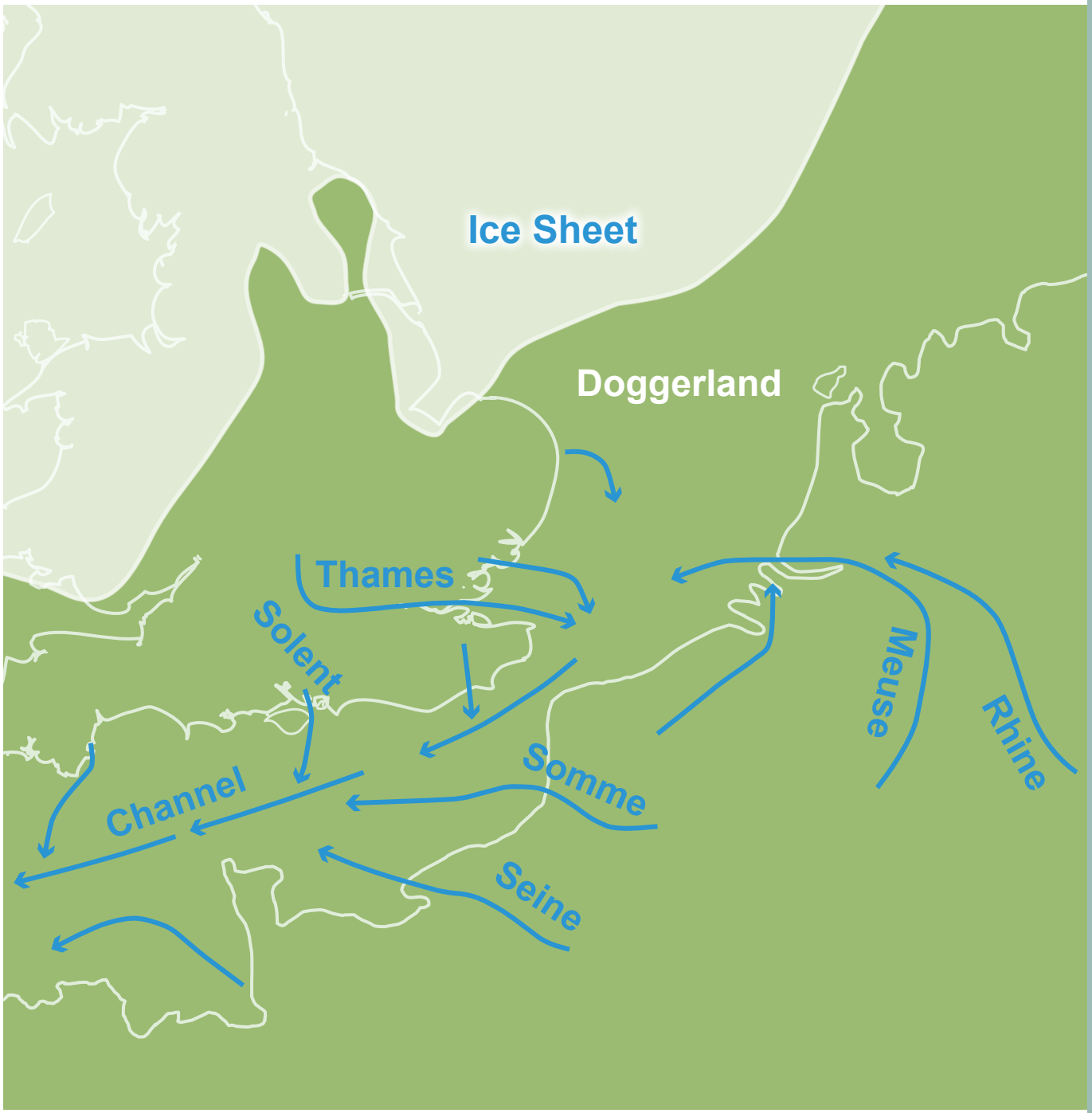
The fossils preserved during the Ice Ages in Norfolk are internationally important and show us how climate and geology interact. During cool periods reindeer, bison, woolly mammoth and rhinoceros grazed the steppe grasslands. In warm interglacial periods hippopotamus and pond turtle basked in the rivers and straight-tusked elephant browsed the forests.
Image courtesy Nick Arber Norfolk Museums service.

With so much water locked up in ice globally, sea levels were over 100 m lower than today. Broadland had a periglacial climate, with ground deeply frozen and arctic tundra-type vegetation. No human settlement was possible.

An ice sheet covered the area of The Wash and north-west Norfolk. A big meltwater lake was ponded up in Fenland at this time, and had its main outlet along the Little Ouse / Waveney valley corridor, flushing large quantities of sand and gravel through it.

The periglacial conditions affected the Broads landscape in several ways:

- Soil layers melted in summer, and tended to sludge slowly downhill, draping sides of valleys with layers of mixed sediment known as head. This is found at the head of fringing, minor valleys in the Broads area;
- Freeze-thaw process sapped the ground around springs and wetlands, creating pits and hollows;
- When permeable, sandy soils were frozen they could be eroded by meltwaters, so producing undulating slopes and dry valley features along upland edges;
- Desiccating winds blew storms of dust into the air, depositing layers of fine silt known as coverloam across the surface of the area. This is a major component of the fine, freely-draining soils of the upland areas of the Broads, particularly in Lothingland and areas north of the Yare Valley;
- Snow-melt and overspill from Lake Fenland swelled the rivers of the Broads area, and transported large volumes of sand and gravel through multiple (braided) channels and deposited them on the valley floors. In the upstream parts of rivers, these valley gravels underlie the floodplain in many places, as at Trowse and Ellingham, where they are labelled as Terrace 1 on geological maps. However, towards the sea, the rivers flowed through valleys deeper than those of today, because they were draining to a much lower base level out in the North Sea basin. These valley floors are now buried by later sediments; the sands and gravels which compose them are known as the Yare Valley Formation.

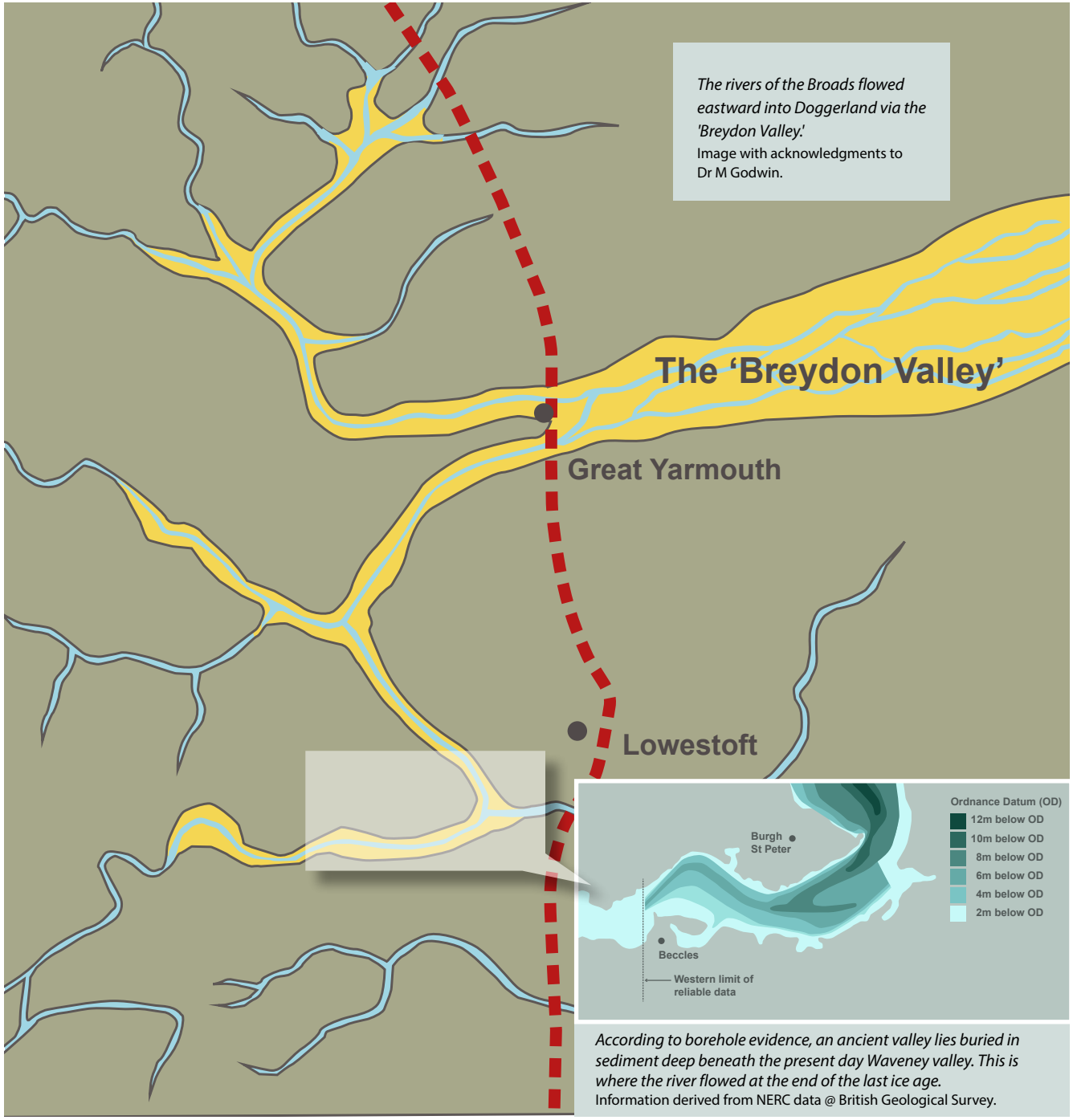


The Broads was a chill arctic landscape during the Hunstanton Glaciation. Image courtesy White et al 2016, Lost Landscapes of Palaeolithic Britain, Oxbow Books.

12,000 to 10,000 years ago
(10,000 - 8,000 BC)

Life returned to the Broads area, as the ice sheet retreated from north Norfolk and the climate became milder. The Broads area was upland on the south-western side of a huge, undulating, sandy plain where the North Sea now lies. This land area has been called Doggerland. The rivers of Broadland drained to a deeper base level than today, somewhere out in the North Sea basin, so their valleys were deeper and had steeper sides. Humans of our own species began to visit the area.

Seasonal snow-melt produced large volumes of runoff which fed the rivers of the Broads. Their floodplains were covered with sands and gravels and threaded with shifting channels. The Waveney was a tributary of the Yare, and the Yare and Waveney converged in the area of Great Yarmouth and flowed eastwards through the 'Breydon Valley'; the valley floor here was some 22 metres deeper than today. Their waters eventually joined the vast ancestral Rhine which flowed south-westwards through the Straits of Dover (the Channel River catchment). The Thurne and Lothing rivers drained south-west to the Bure and westwards to the Waveney respectively. This is called the Late Glacial period. Patchy forests of birch and willow developed in the valleys, and there were herds of horse, mammoth and reindeer. Late Upper Palaeolithic hunter-gatherers of our own species visited the area; they left evidence of their flint-knapping in the form of long blade tools, as at Earsham, Geldeston and Postwick. There may be other evidence of their settlement to the east, but if so it must lie buried beneath later deposits and/or the sea.



The rivers of the Broads flowed eastward into Doggerland via the 'Breydon Valley.'
Image with acknowledgments to Dr M Godwin.

According to borehole evidence, an ancient valley lies buried in sediment deep beneath the present day Waveney valley. This is where the river flowed at the end of the last ice age.
Information derived from NERC data @ British Geological Survey.

10,000 to 8,500 years ago
(8,000 - 6,500 BC)

10,000 years ago the climate warmed up. The rivers of the Broads flowed through deep-set valleys towards the sea. The Broads area was upland on the south-western side of Doggerland, and its rivers drained eastwards into the southern North Sea basin via the 'Breydon Valley'.

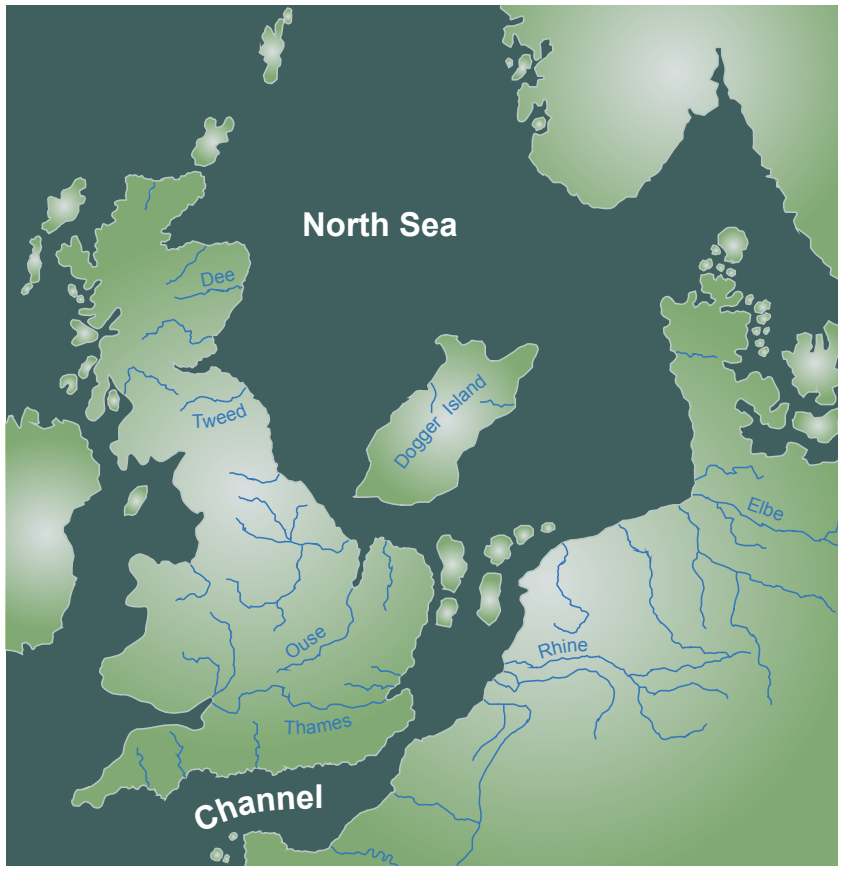
Mean sea levels were at about - 60 m OD at the beginning of this period, rising to about -10 m by the end. Around 8000 years ago the rate of rise was fast, something between 23 and 48 mm per year. Around 8,300 years ago the northern and southern North Sea basins were connected by a through-channel, so the Dogger Bank became an island between northern England and Denmark.

The rivers of the Broads flowed through valleys with steeper sides, and were faster flowing compared with today as they had steeper gradients. The River Yare between Postwick and Surlingham fell by about 1 metre / km, at this time, compared with 6 centimetres / km today.

The landscape of the Broads area was a patchwork of marshland, grassland and forests of birch, with willow, alder, hazel, juniper and pine; hazel began spreading after 9,000 BP. Lakes and marshes occupied low-lying land. This was the early Mesolithic period, during which humans lived by hunting and gathering, and tended to live close to water sources. Evidence for human occupation of the Broads at this time is scanty, and settlement sites may well lie buried beneath later deposits and the sea. Evidence of which has been has been found through artefacts recovered by fishermen from the southern North Sea.

The progressive inundation of Doggerland, pictured between 9,000 and 8,000 years ago.

Image with acknowledgements to Gaffney et al: 'Europe's Lost World'; CBA, 2009.

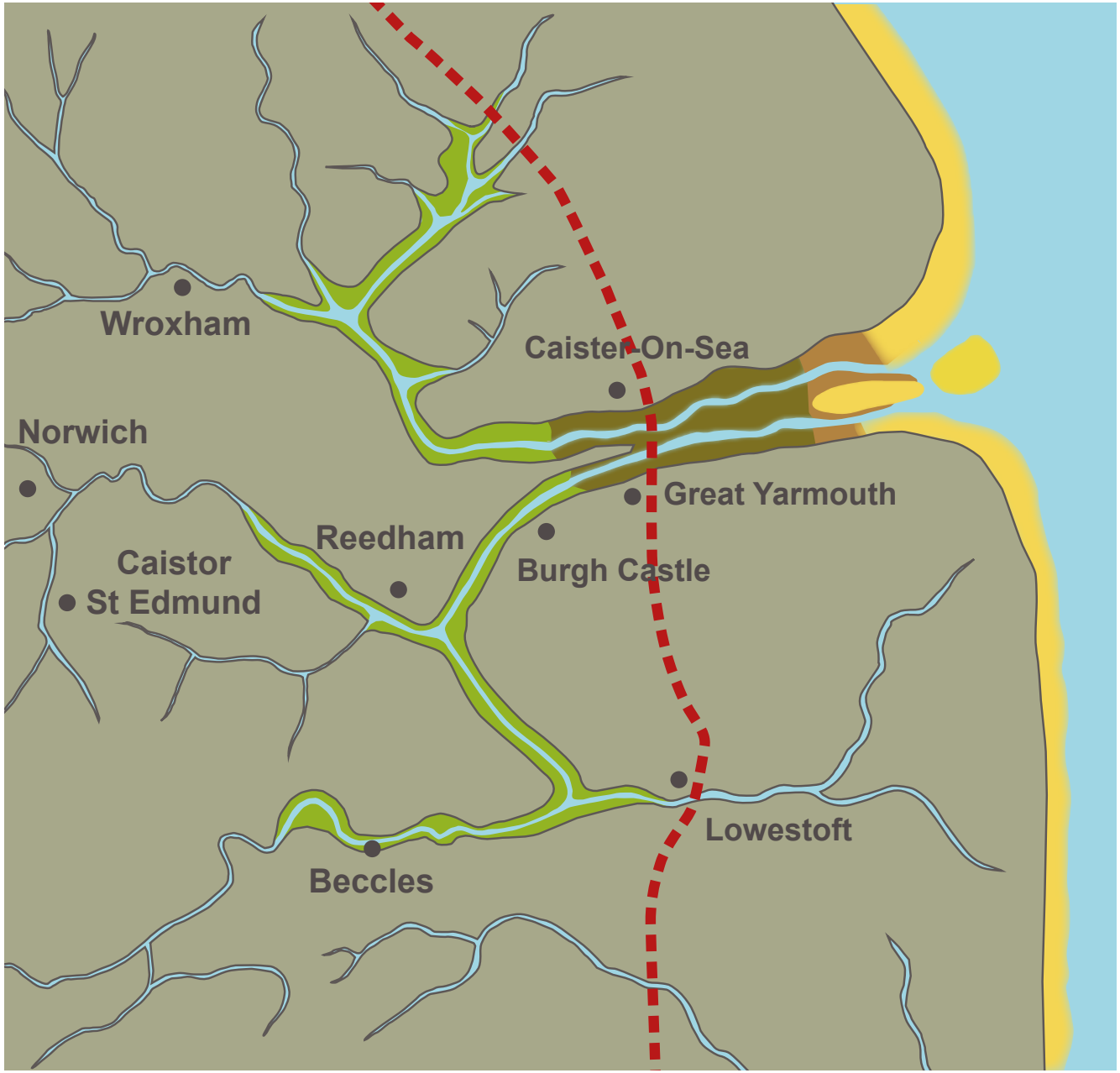


About 8,500 to 7,500 years ago
(6,500 - 5,500 BC)

Gradually, as sea levels rose, the rivers developed wider floodplains with reed-swamps and fens, thus forming a layer known as the Lower Peat which is extensive in the Broads but rarely exposed.

Around 7,800 years ago the sea levels rose had risen to about -8 metres OD, and the coastline of Norfolk and Suffolk lay somewhere about 7 km to eastward.

The Lower Peat is the earliest post-glacial sediment in the valleys of the Broads area (the lowest member of what geologists call the Breydon Formation). Fossil pollen shows that the land was forested, with oak, elm, lime and alder. This was the later Mesolithic period, during which humans continued to live by hunting and gathering. Evidence for their settlement is scattered through the Broads area, particularly along valley sides, as at Woodbastwick.

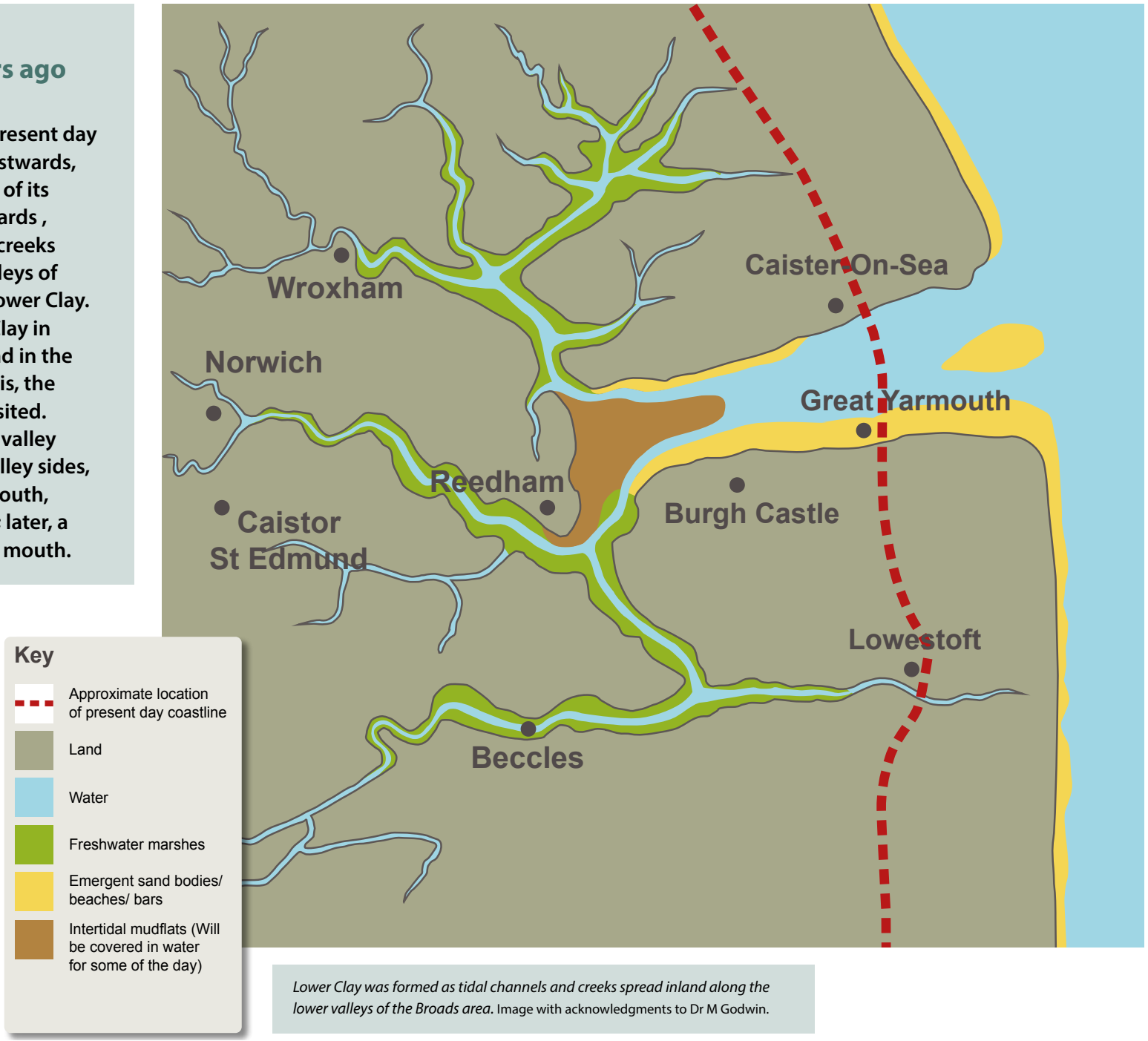


Lower Peat was formed in the widening floodplains as sea levels. rose. Image with acknowledgments to Dr M Godwin.

About 7,500 to 5,000 years ago
(5,500 - 3,000 BC)

Sea levels rose to slightly above present day levels, and the coast retreated westwards, perhaps reaching some 5 km east of its present line. 7,500 years ago onwards , mudflats with tidal channels and creeks spread inland along the lower valleys of the Broads area, depositing the Lower Clay. The upstream limit of the Lower Clay in the Yare valley was at Brundall, and in the Bure valley at Horning; beyond this, the Lower Peat continued to be deposited. The estuary was of drowned river valley (ria) type with strongly sloping valley sides, and had an unobstructed open mouth, probably containing some shoals; later, a sand spit began to form across its mouth.

This was the time of the 'climatic optimum', when Britain had a warmer climate than today. This period spanned the late Mesolithic and early Neolithic periods, with the transition from hunter-gatherer to farming lifestyles. People lived close to water, and farmed the easily worked soils of the valley floors and sides. A Neolithic long barrow and settlement have been recorded at Broome Heath, Ditchingham, and a henge monument in the Yare valley at Arminghall (3250 BC). A hoard of Neolithic axes was found in a valley bottom at Belton, showing that Lothingland was inhabited at this period.



Lower Clay was formed as tidal channels and creeks spread inland along the lower valleys of the Broads area. Image with acknowledgments to Dr M Godwin.

About 5,000 to 2,250 years ago
(3,000 - 250 BC)

The coastline lay perhaps 1 km to the east of its present position. About 4,500 years ago a spit is thought to have grown southward across the mouth of the Yare estuary. This strongly influenced the environment in the Broads area by preventing marine influence from extending up the valleys. A swampy freshwater environment thus developed behind this barrier, and the Middle Peat was deposited.

The composition of the Middle Peat changed over time, as reed swamp gave way to alder carr, though brushwood peat alone was deposited in headwaters areas. Remains of oak and birch trees buried in the peat at Somerton Level have been dated by radiocarbon to about 3540 and 2770 years ago respectively (1540 BC and 770 BC). About 2,250 years ago Middle Peat deposition ceased.
There is evidence that the land began gently subsiding by about 2mm per year around 4,000 years ago (2,000 BC) onwards. Henceforth, marine influence would become increasingly apparent in the Broads area.

This period spanned the late Neolithic, Bronze Age, and early and middle Iron Age. Settlement was scattered thinly across the area. Lothingland and the Isle of Flegg were notably settled, as shown by metalwork finds (e.g. the Somerleyton Hoard) and early Bronze Age round barrows (e.g. Woodbastwick).

The Broads area in Middle Peat times, perhaps 4,000 years ago.
Image with acknowledgments to Dr M Godwin.

2,250 to 1,600 years ago
(250 BC to 400 AD)

Sea levels began to rise, and the spit at the mouth of the Yare estuary was breached by the sea; its remains became a shingle bank in the mouth of the estuary. Marine conditions progressively returned to the Broads area, and a 'Great Estuary' was formed. Layers of Upper Clay were deposited, as estuarine and saltmarsh environments extended inland up the river valleys.

Relative sea levels began to rise again, probably because the spit at the mouth of the Yare estuary had been breached by the sea or by heavy river flows. Marine conditions extended up to 23 km inland in the Broads area, for example as far up-river as Whitlingham in the Yare valley, though freshwater peat deposits continued to form in the upper valleys. Relict shorelines with distinct breaks of slope may be found in the Broads area, as at Reedham, and the Isle of Flegg was truly an island at this time.

This was the later Iron Age and Roman period. Lines of late Iron Age posts in the marshes near Beccles may have marked prehistoric land boundaries; there is evidence here of a transition from a freshwater wetland to estuarine conditions as sea levels rose. The 'Great Estuary' was an important North Sea port and naval dock centre in Roman times. Access to the Great Estuary was controlled by two Roman forts at Caister on Sea and Burgh Castle. Aerial photography as identified a variety of likely Roman sites, including possible farmsteads and field systems and even villas, most notably at Beighton.

The Broads area in Roman times.
Image with acknowledgments to Norfolk Archaeological Trust.

1,600 to 1,000 years ago
(400 to 1,000 AD)

A new shingle spit developed at the mouth of the 'Great Estuary', leading to a loss of estuarine influence inland. Freshwater fen and alder carr re-advanced in the valleys, leading to deposition of the Upper Peat in Saxon times, although Upper Clay deposition continued in the tidal areas of the Broads

This was the Anglo-Saxon period, and the time of the Viking invasions. Villages were founded; the earliest have *–ham* names, e.g. Stalham, Wroxham and Worlingham. Scandinavian place names (e.g. Herringby) suggest Viking settlement, notably concentrated on the Isle of Flegg. People exploited the extensive wetland areas for fish and wildfowl. *'Ey'* sites such as Horsey and St Benet's developed as 'islands', 'holms' or 'eys' in the marshes. Great Yarmouth was founded at this time on the coastal spit, as a small town with fishing as the basis of its economy.

The Broads area in Anglo-Saxon times.
Image with acknowledgments to Dr M Godwin.

1,000 years ago to the present day
(1,000 AD onwards)

This period is essentially a continuation of the environmental story which began 1,600 years ago, but it has seen the increasing impact of human activity on the Broads environment through peat extraction, land reclamation and drainage, built development, flood control, pollution and water abstraction. The coast has continued to retreat, with numerous sea breaches of the coastal barrier through history.

Upstream development of the Upper Peat has continued, and the Upper Clay has continued to be deposited in tidal areas of the Broads area, though marine influence is mostly confined to Breydon Water now. Peat lying at the seaward ends of the valleys has been lost by wastage and oxidation of the exposed peat, and also from peat extraction in the Medieval period. The old peat diggings became flooded to form the Broads we know today.

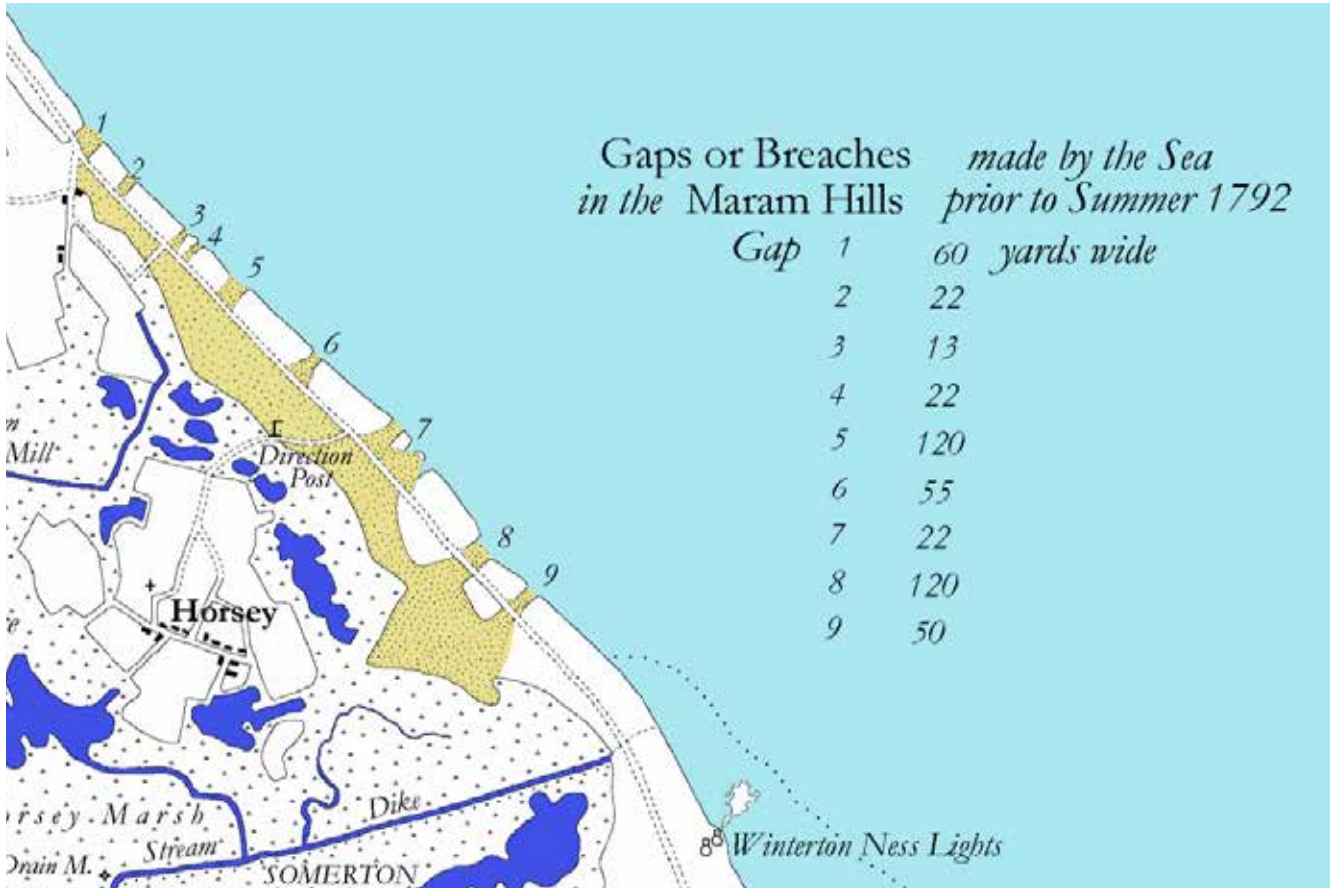
Coastal retreat has been ongoing during this period, and the sea has continued occasionally to break into low-lying coastal areas, but these events have been slowed in recent centuries by coastal defence work. Records show that extensive coastal floods have happened since the Middle Ages. The village of Waxham Parva has been lost to the sea, and in 1608 floodwaters reached as far inland as Trowse. Groynes, sea walls and offshore reefs have been installed to reduce the likelihood of sea breaches, as at Sea Palling; these were more frequent in the past; for example Faden's map of 1797 shows nine separate breaches between Horsey and Waxham. The possibility of future breaches cannot be ruled out, as climate change may raise sea levels by as much as 1m by the end of the 21st century.

Waves and tides have continued to shape depositional features along the coast, including sand dunes and Winterton Ness.
By the 12th century the coastal spit at Great Yarmouth extended almost as far south as Lowestoft; the present harbour entrance was created through it in about 1560.

Drinking water, a precious resource in dry parts of eastern England, is abstracted from rivers and broads, as at Ormesby, Fritton and Shipmeadow, and from groundwater boreholes, as at Cantley, Ludham and Beccles. It is stored in reservoirs at Ormesby and Lound. Water quality is an ongoing issue in the Broads.

The natural penetration of salty water is a problem along the coastal margin, as at Hickling and Horsey, where drainage has lowered freshwater levels. Pollution by phosphates from sewage and by nitrates from agricultural run-off is also a problem, leading to eutrophication of surface waters in some places.

Faden's map of 1797 shows nine separate breaches between Horsey and Waxham.
Courtesy of Faden's Map of Norfolk digitally redrawn by Andrew Macnair.



1.2 The Human Dimension.

The Broads landscape of today although perceived to be natural, is the result of both exploitation and modification by humans. This shaping and moulding has, relative to the physical processes, only taken place over relative recent history. Much is still to be learnt about past human exploitation and use of the Broads as opportunities for archaeological investigations to date have been quite limited. Occasionally though, fascinating glimpses of the past, such as the remarkable find of the Chet boat, come to light. Recent analysis of aerial photographs by historians as part of the National Mapping Project, have also highlighted the tantalising archaeological potential of the area. The following text sets out a summary of what we do know and understand about human intervention and use of the Broads and some of the mysteries still to unravel. Although not in historical time periods, it is in chronological order and it sets out some of the key human actions, which have had a profound, lasting impression on the Broads landscape.

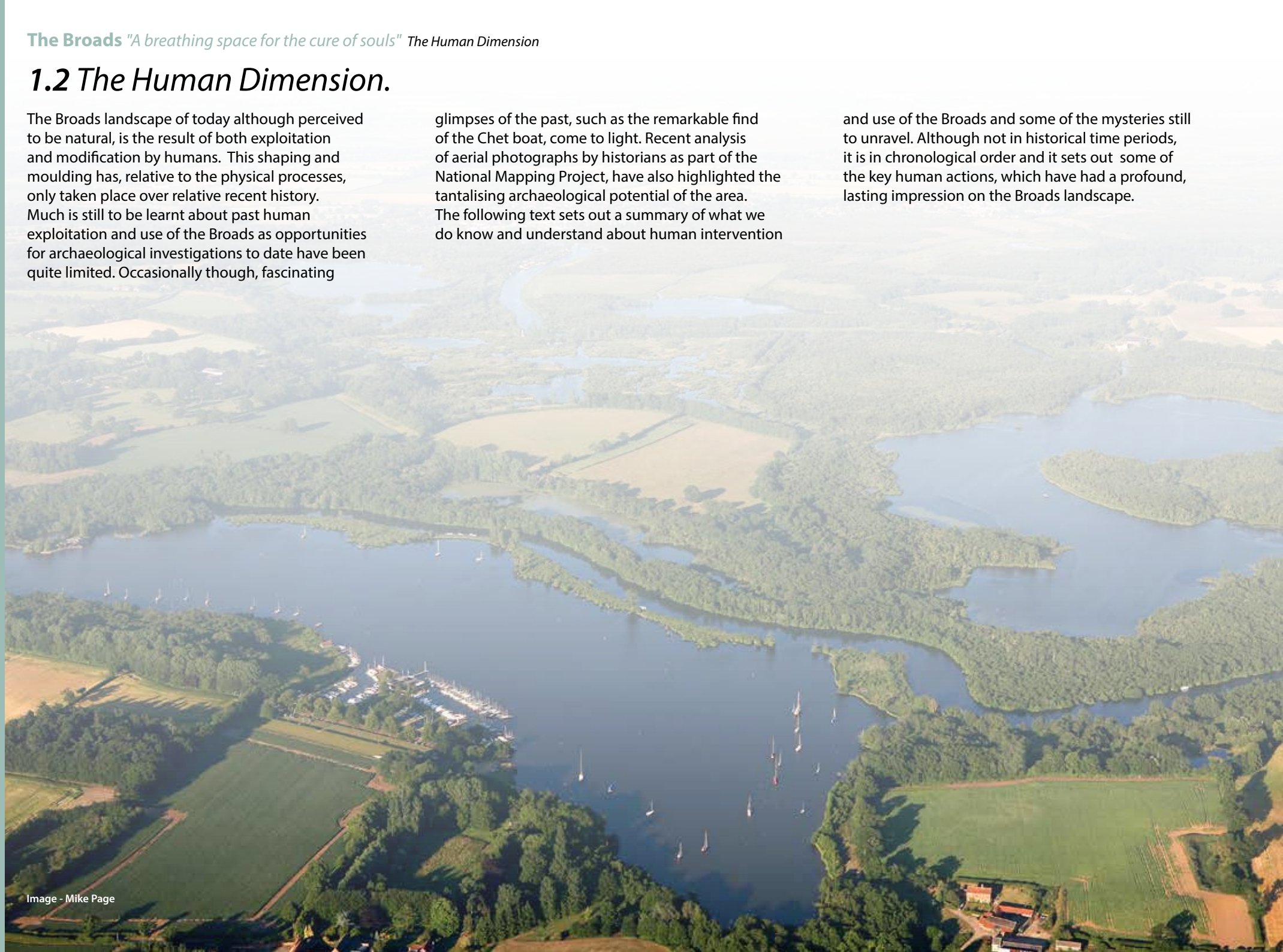


Image - Mike Page

Circa 4000 BC to 400 AD

Significant human influence on the landscape did not occur until the arrival of the Romans who constructed the massive Burgh Castle fort.

The Roman fort at Burgh Castle built during the 3rd and 4th century AD.

It is believed that sometime around 4000 BC people switched to procuring food by a combination of hunting and gathering, to growing cereals and raising domestic livestock. Around 1500 BC in the middle Bronze Age, the English landscape began to change as alongside the establishment of settlements relatively large areas of countryside began to be divided up into blocks of fields. Aerial photography has detected rectilinear cropmarks around the margins of the Great Estuary which may date from this period. They indicate field system complexes, probably associated with seasonal movement of livestock between summer and winter pastures. Traces of square, ditched enclosures have also been detected; these may be Iron Age burial sites (or perhaps later features of Roman age); one of them at Haddiscoe is associated with a Bronze Age cemetery. Further archaeological investigations of these archaeological could provide an insight about the relationship in both human and physical terms, between the land and the watery landscape of the "Great Estuary".

▲ *The green lines are cropmarks which may be ancient field systems.*

However there is little visible evidence left of human activity from this period on the land within the Broads. Occasionally some treasures come to light, often happening when development requires excavations. This was the scenario at Beccles Marshes when excavations for the recent Flood Alleviation works exposed what is thought to be a Bronze Age causeway from around 1000 BC. Historians believed that this was in use through the Iron Age, to Roman times and at least the 4th Century AD.

The Romans are responsible for the earliest, most significant structure in the Broads during this period. Burgh Castle fort (probably called Gariannonum by the Romans) was built during the 3rd and 4th century AD and was one of a chain of "forts of the Saxon Shore" sited at intervals around the coast of south east England. It is probably one of the most impressive Roman buildings to survive anywhere in Britain. As evidenced from aerial photographs and surveys, the fort was originally surrounded to the east by a large trading settlement.

The landscape of the Broads was very different during this period with river systems part of a vast "Great Estuary". Relict shorelines of this estuary, with distinct breaks of slopes and some complex and interesting geological and soil structures, can be found at a number of locations in the Broads.

It was on the southern cliff edge of this estuary where Burgh Castle fort was built. Breydon Water is now the only remnant of this strategically important and imposing estuary that the fort guarded.

Circa 400 AD to 1100 AD

Settlement patterns and settlement names become established and round tower churches so characteristic of the Broadland villages are being built.

In the course of the Anglo-Saxon period, the coastline was very slightly further east than its present line and in early Saxon times the 'Great Estuary' was still an area of tidal waters and mudflats, but as the bank of sand and shingle built across its mouth – where Yarmouth now stands – the extent of tidal influences was reduced. This allowed silts and clays to be deposited inland and areas of salt-marsh to form. (see previous section for more detail)

The estuary of the River Thurne, in contrast, was already largely closed by the movement of sand and gravel, so that deposits of peat, as well as estuarine clays, accumulated behind it. At this time the Thurne flowed north into the sea, rather than south into the River Bure as it does today, and its waters appear to have percolated slowly out through the accumulated bank of material. Its course at this time is marked today by the line of the 'hundred dyke', a minor watercourse which forms the boundary between the parishes of Somerton and Horsey and also, as its name suggests, that between the 'hundreds' – ancient administrative divisions – of Happing and West Flegg. The 'island' of Flegg was thus still at this time an actual island, bounded to north and south by estuaries, and was surrounded on all sides by water or marsh.

Between the mid-7th and late-9th century, it is possible that the higher ground was more densely wooded than other areas of Norfolk at the time. Place names such as Acle the *ac leah* "the oak wood", Fishley "the wood of fishermen" and East Ruston, which incorporates the term *hris tun* "the settlement amongst the brushwood", all indicate the presence of woodland.

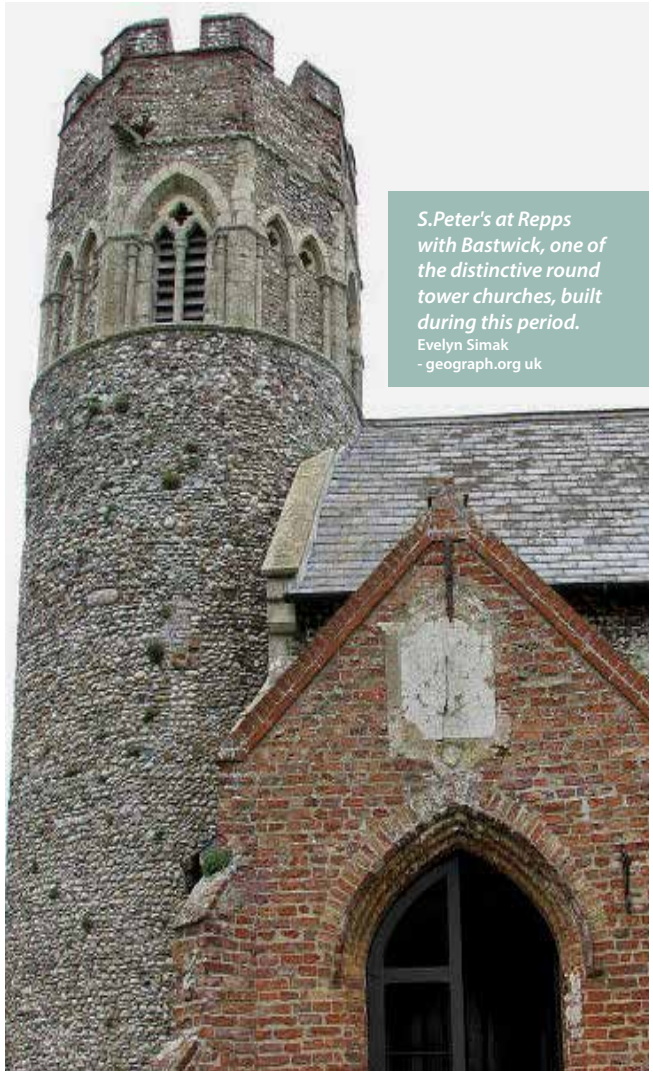
Other place names indicate the importance of grazing at that time as part of the local economy. Examples in the Broads include Horsey "the horse island" Woodbastwick and Bastwick both incorporating *wic* "a grazing farm, ranch" while Winterton and Somerton suggest the seasonal movement of grazing animals to different pastures.

During the latter part of this period in 9th and 10th centuries East Anglia was affected by Viking raiding and settlement. Historians continue to argue over the character of the Viking settlement: about whether it involved the take-over of eastern England by a small warrior elite, or a mass migration by soldiers and peasants from Denmark.

However what we do know is that the Isle of Flegg boasts the highest density of Old Scandinavian place-names in East Anglia, especially those bearing the suffix *by*, meaning a farm or settlement. Hemsby, Ormsby, Filby, and the rest suggest that in this area, at least, large numbers of Danish people settled. They may have been placed here for military reasons, for the island occupied an important strategic position, at the mouth of the 'Great Estuary', which provided the gateway to northern East Anglia for raiders coming by water.

It is during the middle Saxon periods that the current pattern of Broad's local settlements became established and it is quite probable that most parish boundaries were fixed by circa 1100 -1150 AD. The location of the Broads settlements often provided direct links to the river systems of the area as these were to provide the major transport networks for the next few centuries.

By the time of Domesday Book in 1086, the higher land around the Broads, especially in the northern areas, was one of the most densely settled areas in the whole of England. In part due to the fertility of the soil and how easy it was to cultivate and Gt Yarmouth was already a small but flourishing royal borough with a church and a population of perhaps 400 people.



S.Peter's at Repps with Bastwick, one of the distinctive round tower churches, built during this period.
Evelyn Simak
- geograph.org uk

The density of population is reflected by the large number of churches, and small size of parishes. Many of these churches – such as those at Repps, Barsham, Horsey, and Potter Heigham, Thorpe next Haddiscoe, Norton Subcourse – have round towers, a distinctive feature of East Anglia, and especially of East Norfolk and north east Suffolk. They may have been a fashion introduced from

north Germany and southern Scandinavia in the eleventh century – reflecting the close links between the countries bordering the North Sea at this time. But if so, the style was probably enthusiastically taken up by local people because the only available building stone in the locality is flint, and this cannot easily be used on its own to create the corners of buildings. For this, as for door and window openings, better-quality freestone – usually limestone brought from the English Midlands, or northern France – needs to be employed. In this populous region, many churches were erected by small local landowners, rather than my wealthy magnates.

During the 10th and 11th centuries the continued development of the shingle spits across the mouths of the two estuaries ensured a further reduction in tidal influence. Relative land sea levels were also more than 1.5 metres below those of today. This led to the establishment of very extensive areas of salt-marsh in much of the former extents of the "Great Estuary". It tended to remained dry, except when inundated by the highest tides.

On the marshes "curvilinear" dykes seen clearly from the air or maps are remnant ancient creeks.
Mike Page

These marshes were dissected by numerous creeks which filled and emptied with the daily tides. Some of these ancient creeks were later 'fossilized' when the land was drained, being adapted as drainage channels: many others are still visible from the air, as darker lines in the pastures. The most striking survivor is the Halvergate Fleet (from the Old English word *fleot*, 'a stream or watercourse'), which sweeps in bold curves across the Halvergate marshes from Halvergate itself to Breydon Water. By this time, Breydon was probably the only area of truly open water in the estuary, albeit perhaps rather larger than today. Its name – from the Old Scandinavian word meaning 'widening'.

The grazing marshes of the late Saxon period were valuable pastoral resources. The Domesday Book of 1086 provided some important clues as to land use on the marshes. Many parishes had areas of grazing land totally "detached" from their parish boundary. A number of examples can be found on the marshes of Halvergate and Haddiscoe Island.

People also exploited the "islands" of slightly higher round in the marshes for settlement. Sometime in the tenth or eleventh century a monastery, dedicated to St Benet, or Benedict, was founded on one such island called Cowholm near where the Thurne now enters the river Bure. By the time of Domesday, it owned many of the manors, or estates, in the surrounding district. Heigham Holmes is another example, a slightly raised area lying in the valley of the Thurne between Martham and Hickling. Again the influence of Scandinavian speakers can be found as the Scandinavian term *holmr*, 'as island' is particularly common on the local marshes.

Boat travel would have been one of the only methods of travelling through some parts of this area during this time. To date there is little knowledge about the types of boats that may have been used in the area. However the Chet boat, unearthed as part of the Broadland Flood Alleviation Project may be able to shed more light on river travel. Historians have had the opportunity to analyse the boat in more detail since it was found. They have

Preliminary photographic reconstruction of the Chetboat
(by Marcus Abbott, York Archaeological Trust)

established that clinker boat was built of oak, by a skilled craftsman using limited resources which were probably locally sourced. Wooden frames and a mast step were present in the remains, the latter indicating that the boat could have been propelled by sail, although it could also have been rowed or quanted (pushed with a long pole). Iron nails and wooden pegs fixed the timbers and frames together and moss between the boat strakes was as water-proofing.

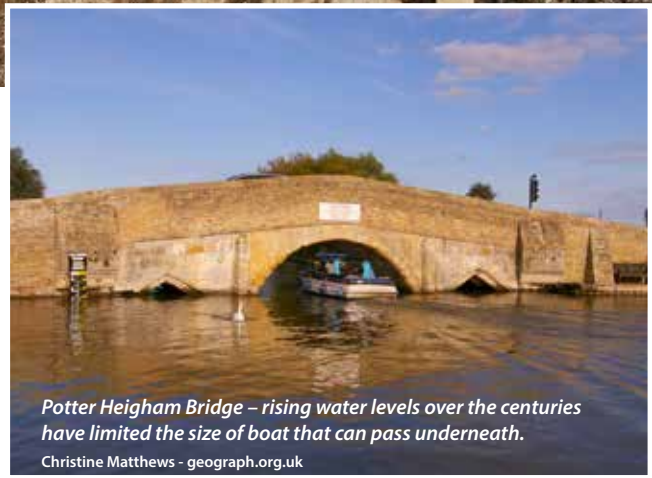
The boat itself was originally abandoned in a small channel in the Chet. Pollen evidence also provides an insight to the landscape of the period. It suggests that this body of water was shallow and very slow moving side channel of the main river. This channel appeared to have rapidly infilled becoming choked with emergent aquatic vegetation. The immediate surroundings were probably alder carr and perhaps reed beds with arable and pastoral fields beyond.

A single Radiocarbon date from the moss luting of the Chet boat gives a date range AD 1020-1155, this is backed up by two other radio-carbon dates taken from the silts within the channel in which the boat was abandoned. Overall this is an extremely early date which makes this a unique discovery.

Archaeological evidence from a second site just 150m east of where the boat was found indicates a further old channel. Deposits from this channel have also been dated using radiocarbon the results of which indicate a probable 8th century date for the infilling of this second channel. Between these two sites we can see that the River Chet has a complex history which experts have still unravel.

Although the rivers provided the main routes for moving people around the area, foot, horse and cart traffic was also needed. The river systems tended to impede movement across them. In the early middle ages river crossing points became established. These include those at Ludham, Potter Heigham, Wroxham, near Acle and Wayford Bridge. The water levels of this time were relatively lower, therefore making them easier to ford. But many bridges were built including that at Potter Heigham, which was potentially initially constructed during this period but later modified. Potter Heigham is testament to the difference in water levels that existed in earlier times as only a portion of the height of the bridge arches are now visible. The lack of room between river and bridge makes it extremely difficult to navigate under with larger boats. At other places in the Broads where the rivers were too wide to bridge or too deep to ford, river ferries were established.

Archaeologists carefully excavate the Chet boat found during the flood alleviation works.



Potter Heigham Bridge – rising water levels over the centuries have limited the size of boat that can pass underneath.
Christine Matthews - geograph.org.uk

Circa 1100 AD -1700 AD

Marshland improvement for pasture took place through river engineering, land drainage and flood protection schemes. Whilst peat extraction to provide fuel has left a permanent legacy in the form of "broads" the artificial lakes for which the area is famous.

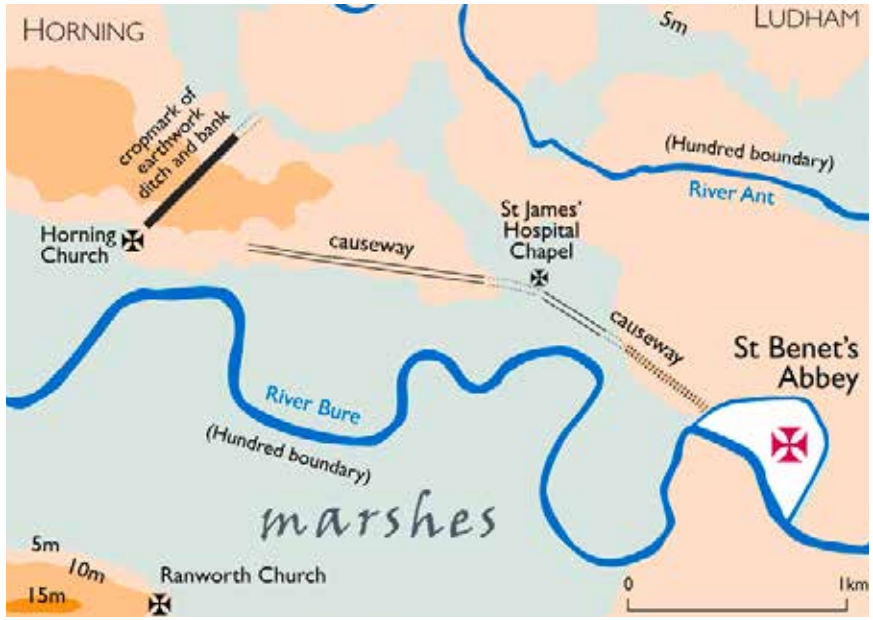
In the course of the 12th and 13th centuries, a period of rapid population growth and economic expansion throughout England, local communities made strenuous efforts to improve the quality of the marshes.

By surrounding portions of the low-lying wetlands with low 'walls', or embankments, they could prevent the daily ingress of the tides, and thus convert them from salt marsh to 'fresh' marsh. Drainage within each embanked area was assisted by the provision of surface drains (often adapted from the natural creek pattern) which led to 'flap sluices', held shut by water pressure at high tide, but which opened to allow the egress of water at low.

The quality of the vegetation rapidly improved, with grasses and pasture weeds replacing the kind of salt-tolerant plants, such as sea fern-grass (Catapodium marinum) and red fescue (Festuca rubra), which had formerly provided feed for the sheep.

Many of the 'walls' have since been levelled, but some of these ancient earthworks remain. Those beside the major rivers have been added to and augmented over the centuries; examples now left isolated within drained marsh are generally lower, although still often impressive.

Many areas of the low lying areas of the marshes were already in private ownership by the middle ages. These in the main, being in the areas of land lying in the lower reaches of the valleys of the silty clay soils of the former areas of estuary.



In the valley of the Thurne more complex scheme of hydraulic engineering appears to have been carried out in this period, perhaps directed by St Benet's Abbey – monks who had a long history of land reclamation and water management as the Abbey held numerous properties along its valley, the value of which it was doubtless keen to protect.

The River Thurne's direction of flow was reversed, probably in the thirteenth century, from north to south. Quite how this was achieved remains uncertain, but it is probable that originally the Thurne and Ant were a single river. Water flowed down the Ant but, when it reached Ludham, instead of continuing straight on to the Bure it turned to the east, passing along a watercourse now called (confusingly) the Hundred Dyke, just to the north of the Abbey, and then into the Thurne: the lower course of that river did not then exist. The waters from the Ant were diverted by digging a new course for the river due south, into the Bure; the end of the Thurne, now left isolated by the effective closure of the Hundred Dyke, was then likewise connected to the Bure, encouraging – in this flat land – its waters now to flow southwards. This endeavour was assisted by the fact that the rivers old outfall to the sea was now effectively blocked by accumulated sand and gravel. It was probably also motivated by this fact, for with its outfall clogged the Thurne must have flooded the surrounding marshes with increasing regularity.

It is thought that the monks of St Benet's Abbey dug new channels which connected the river Bure to the river Ant to help with drainage. The above plan illustrates the original routes and the aerial shows what exists today.

Plan image, Sue White
GOOGLE earth - Image © 2016 getmapping plc

Not all the low-lying wetlands of the Broads comprised salt marsh. Inland, away from the former estuaries, large areas of peat accumulated in the lower reaches of the principal rivers, giving rise to waterlogged freshwater fens.

Because the mouth of the Thurne estuary was sealed earlier than that of the Great Estuary, significant areas of peat were also to be found here, especially to the west of the old course of the river. Peatlands were seldom improved in the middle ages, by embanking and draining, and most remained as common land. They were used by local communities in a number of ways. The drier portions were grazed in the summer months, or cut for marsh hay, which was used to feed livestock over the winter when the grass does not grow. Other areas were cut to provide bedding for cattle, while the wetter portions were mown for reeds or saw sedge (Cladium mariscus), which were used to thatch farms and cottages.

The region at this time was one of the least wooded and one of the most densely populated areas of England, with Norwich being the second largest city in the country. The fen areas came to provide an important source of domestic fuel in the form of peat.

This was usually extracted from shallow excavations in the fen surface but, probably in the period from the 11th to the early 14th centuries, it was sometimes excavated from deeper pits averaging between 1.5 – 5 metres in depth.

The man-made origin of the broads was finally established in the 1960's. Before then, most scientists and academics believed that they had formed naturally, although the idea that they were old peat cuttings had, in fact, been circulating locally from at least the nineteenth century. Their artificial character was proved by the fact that they often have vertical sides, and parallel networks of underwater ridges, representing the edges of separate cuttings, which change direction suddenly where – as is often the case - a parish boundary runs through the middle of a broad. The local peat comes in a variety of forms and these deep cuttings were evidently made to reach the so-called 'brushwood peat', which lies at a depth of between two and five metres, and which burns more slowly, and in a manner more akin to coal, than the material lying at higher levels. In many places this better-quality peat lies beneath layers of clay laid down when much of the area was an estuary, so that the broads are only found where this deposit is thin or absent – in the higher reaches of the rivers, or along the margins of the wider valleys. There are around 50 individually-named broads still surviving: others once existed in the past but have been lost from the landscape, including Gages Broad, Wigg's Broad and Hare Park Broad in Hickling, and Honing Broad in Honing. Hickling, the largest of these artificial lakes, covers an area of around 140 hectares.

The deep peat cuttings filled with water in the 13th and 14th century which saw the open excavations flooded. It is thought that a rise in sea levels and climatic changes which brought more storm events were the cause of the flooding. However, the Black Death saw the local population decline and perhaps there was a much reduced demand for fuel which also rendered it uneconomic to keep excavations free of water.

There is still much that we do not understand about the broads: about why, when and in particular how they were dug.

This aerial illustrates the huge industry that must have existed for peat extraction. Wroxham, Hoveton Great Broad, Pound End, Hoveton Little Broad, Decoy Broad, Ranworth and Hickling in the very distance can be made out in this view. Mike Page

It is often assumed that, when first dug, the broads resembled large empty pits which were only subsequently flooded, perhaps as result of high tides and surges. But although those responsible for digging them were at pains to leave banks of solid uncut peat between the workings and the main watercourses, they must nevertheless have filled with water fairly rapidly through natural seepage. Rather than being dug out at one go, like a modern gravel pit, the peat was probably taken out in small strips, which slowly filled with water as extraction proceeded.

The peat, although bulky, could be transported with ease along the network of local waterways, especially to Norwich. It is possible, however, that not all the broads were excavated to extract peat. In the valley of the Thurne, in particular, while Hickling was evidently a peat pit, Martham, and to some extent Horsey, appear to have been dug in an area largely occupied by marine silts and clays. They may represent clay pits, used to supply a local medieval tile or pottery industry, preserved in the name of nearby Potter Heigham.

Rivers continued to be the main transport routes for cargo, produce and even people. Areas for offloading and on loading from boats became established. To become known as Staithes (from the old English steath ," landing place"). Public and private ones, appear to have been in existence in some numbers since mediaeval times.

Martham Pits is the site of an old brickworks which had kilns and later a small railway. Evelyn Simak - geograph.org.uk

Hickling Broad was the largest area excavated for peat. Mike Page

Circa 1700 AD – 1800 AD

Patterns of drainage dykes changed in the landscape as new linear dykes networks were constructed to supplement or replace the older creek networks and drainage mills started to appear in the landscape.

Although enclosure of land was already taking place in the early middle ages it took place more rapidly in the course of the 16th, 17th and 18th century. Where enclosure occurred by planned agreement roughly rectilinear dyke patterns were created such as you can see in many of the marshes. Occasionally this partitioning of land incorporated the original creeks which formed the natural patterns of watercourses when the area was an estuary.

The effects of parliamentary enclosure were greatest in the common grazing marshes of the lower Bure and Thurne valleys. Here new networks of dykes were established across what had formally been open land.

In addition to the dykes dug around and within individual allotments, there was usually a mill drain, mill dyke or "Commissioners Drain" which led to a drainage mill which lifted water into a higher level dyke leading to the river or more usually directly into the river itself.

The Enclosure Act for an area not only stipulated the erection of a new drainage mill but also established a Drainage Commission for its maintenance and for that of other drainage works. No less than 17 such Commissions were set up between 1800 and 1820. Today there are two internal drainage boards that serve the needs of the Broads area.

St Benet's Mill c.1818 engraving by J. Grieg from a sketch by L. Francis *Hulme or St. Bene't-at-Holme Abbey drainage mill was possibly originally built around 1740 to crush cole seed to make colza oil for lamps before being converted to a drainage pump and is one of the oldest tower mills in Norfolk and the oldest in the Broads.*

The drainage schemes on the peat areas in the Broads were far less successful than of the silty clay soils which marked the extent of the estuary. In 1870 there was a severe agricultural depression and many of the previously drained peat soils area were abandoned. However, many of these area continued provide traditional crops hay, litter, sedge and reed.

A significant feature of the Broads landscape even today are the drainage mill structures that were built in greater numbers during the course of the 18th century. The large drainage mill built within the abbey gatehouse at St Benet's is believed to have been erected around 1740. Information about these early mills is somewhat sketchy, but experts consider that the there was a slow improvement in agricultural prosperity after 1760 which led to the construction of more drainage mills.

Tourism in the Broads during this period had not yet become established, but there was local use of the broads and the rivers for entertainment and recreation. By the late 18th Century "water frolics" at Wroxham, Yarmouth and Thorpe St Andrew were social events of some importance and many landowners owned pleasure craft which they kept in boathouses on the river.

"Water Frolics"at Burgh Castle
Artist unknown, photo courtesy of Gt Yarmouth Museums Service

Circa 1800 AD - 1900AD

The Victorian period saw a boom in the number of drainage mills built as well as major transport infrastructure projects.

Land Drainage

At the turn of the century drainage mills were already common feature in the landscape of the Broads but there was a rapid proliferation in numbers during the early part of the 19th century. Map evidence of the time seems to indicate that by 1825 there were probably in excess of 80 in the Broads. This proliferation is believed to be a direct result of the Enclosure Acts. 72 drainage mills still survive in the Broads, most of these are those constructed from brick. Many of these have had alterations over the years, they were in use. One such practice was to increase the brick tower structures in height "hained" (to allow longer sails- therefore more powerful) which were, prior to the invention of the fantail, relatively low in height to allow the cap and sail to be winched around by their tailpole to face the wind.

The fantail was an ingenious innovation. It is a small vaned wheel attached to the back of the cap. It is connected through gears to a winding mechanism and as the wind changed direction the fan tail rotated and turned the cap into the wind thereby saving on the manual work.

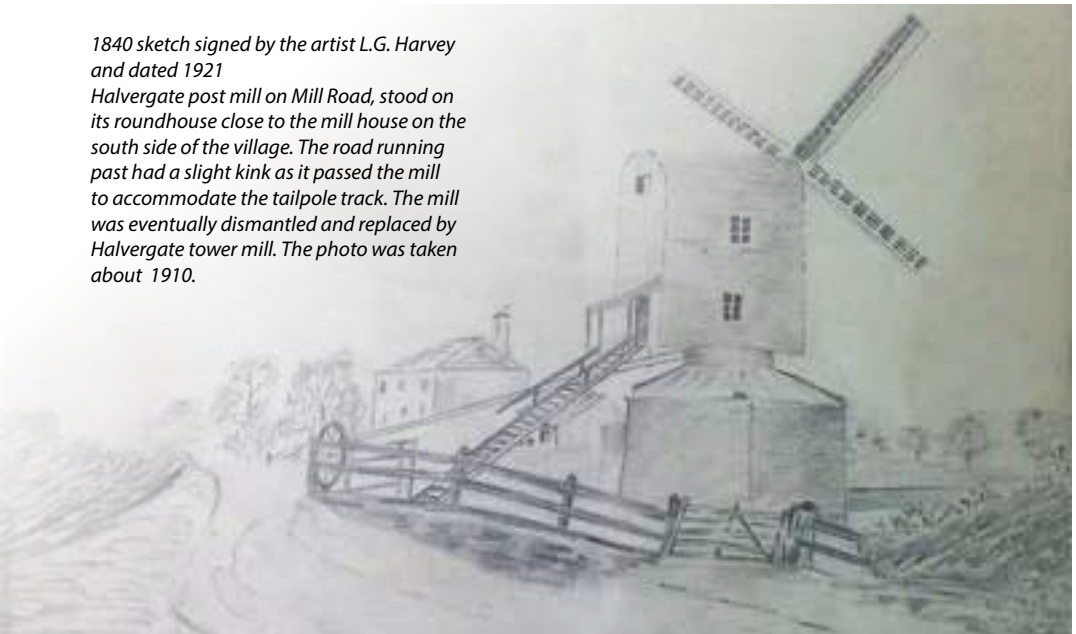
Halvergate Lockgate drainage mill is also known as Freethorpe Mill and in the past as Banham's Black Mill or Duffel's Mill. In 1988 a protective aluminium cap was fitted.

Some mills were constructed in timber. Herringfleet Mill is a surviving example of a wooden smock mill. Other types of wind pumps existed in the form of "skeleton" or trestle mills and the hollow post mill which were relatively cheap. This design was used to drain smaller areas of marshland.

◄ *Clayrack Windpump, How Hill, Ludham is an example of hollow post mill.*

▼ *Runham Swim north wind pump built in 1851, had a 3 storey tarred red brick tower, 30ft high to its curb, containing two doors, one window and a Norfolk boat shaped cap with a petticoat. Power to the internal scoop wheel designed to pump water from the marshes into the River Bure was supplied by patent sails and the cap was turned to wind by an 8 bladed fantail with a Y wheel. The name 'Swim' was coined by virtue of cattle being herded down the track to the river where they swam across to graze on the marshes on the opposite side.*

Steam drainage began to supplement wind power in Broadland in the first half of the 19th century and around 30 seem to have been working in 1930. They were housed in sheds of brick or corrugated iron with chimneys. But they were more expensive to build and run so they didn't entirely replace the wind powered drainage mills which were still being repaired and renewed until the early 1900's.



1840 sketch signed by the artist L.G. Harvey and dated 1921
Halvergate post mill on Mill Road, stood on its roundhouse close to the mill house on the south side of the village. The road running past had a slight kink as it passed the mill to accommodate the tailpole track. The mill was eventually dismantled and replaced by Halvergate tower mill. The photo was taken about 1910.

River transport

The river system, in the earlier part of this period were still providing vital transport routes for goods and produce around the area and beyond. This gave rise to the construction of facilities to support this type of transport such as boat building yards, warehouses and hostelries to cater for the passing trade. The staithes continued to provide the focal points in settlements for the transfer of goods from water to land and vice versa. The Enclosure Awards tended to ratify the existing customary landing places of the staithes stipulating that the staithes were to be used "for the laying and depositing of… corn, manure and other things belonging to landowners and proprietors".

Impressive navigation projects were undertaken in this period to improve the network of the river system. They include the construction of the North Walsham and the Dilham Canal which was nearly 14 km long with six locks, and larger than on conventional canals, to cater for the wherries. Water mills lying adjacent to the canal utilised the surplus water to generate power. Waxham New Cut ran from the northern end of Horsey Mere partly to facilitate drainage and partly to provide access to the villages in the area and a number of industrial concerns such as the brickworks at Lound Bridge. On the river Waveney the river section between Beccles and Bungay was improved involving the construction of three locks; one lying between Shipmeadow and Geldeston; the second at Ellingaham and the third at Wainford.

The most ambitious scheme was the New Cut which created Haddiscoe Island through driving a ruler straight channel through the marshes to join up the river Waveney at St Olaves to a point on the river Yare just east of Reedham. This major construction, completed in 1832, was part of an ambitious scheme to provide Norwich with direct links to the sea via Lowestoft, thereby allowing businesses in Norwich to avoid paying the hefty tolls then being charged by Yarmouth. The tidal influence necessitated the construction of the Mutford Lock. However the New Cut was not a financial or commercial success as the average size of ocean going vessels was increasing and they became too large to use the Cut which was only 21 metres wide. Water transport was also starting to lose out to rail.

Haddiscoe New Cut completed in 1832 to provide the port of Norwich with links to the sea via Lowestoft. Mike Page

Chalk, Lime, Bricks and Cement

There are certain cargoes that were transported around the area which had a direct connection with the Broads landscape as they spawned industries adjacent to the water where they had direct access to transport. One of these was the excavation and use of chalk and lime. From mediaeval times the process known as marling (the spreading of a calcareous subsoil on agricultural land to neutralise acidity) became more widespread and was adopted in an ever increasing scale in the 17th and 18th Century.

A postcard of "Little Switzerland" on the river Bure which were abandoned chalk workings which became a tourist attraction.

Chalk which underlies most of the Broads area only becomes readily accessible in a two areas in the Broads as it lies closer to the surface. At these locations major industries became established to exploit the resource. They were focused around Whitlingham and Thorpe –next – Norwich in the Yare valley and at Horstead, Wroxham and Coltishall in the Bure. The chalk extraction created a very industrial landscape. Chalk and lime were very bulky to transport. At Hortsead the workings were served by a network of canals, so the wherries could be brought right into the pits.

These extensive areas of quarries, spoil heaps and waterways became known as Little Switzerland and in the mid 1800's they actually became a tourist attraction.

In the 19th century chalk was burnt in kilns to produce lime which was used to make mortar and plaster for building. Raw chalk was also spread on sandy fields adjacent to the Broads area, to 'sweeten' the acidic soils. Riverside kilns sprang up in the 18th and 19th century. Locations included Acle bridge, Barton Turf, Reedham, Ludham, Stalham, Dilham and Yarmouth.

The largest concentration of industrial activity relating to the production of bricks and cement was in the Waveney valley near Breydon Water were there were three businesses. One of the former brickyards at Somerleyton (now occupied by boatyards) supplied bricks to construct the Somerleyton estate cottages and for parts of Liverpool Street station.

Perhaps more strangely was the use of the five storey drainage mill at Berney which was used to grind cement. Chalk from Whitlingham was mixed with mud from the river; it was then baked in kilns and then reground into a cement powder. The original mill was replaced by the present structure in 1865. It then doubled as a drainage mill. A sizeable settlement had developed by the late 19th century with kilns, cottages, a pub, and a chapel and the railway line with a station ran close by. Of the buildings only the pub and the mill remain.

Other buildings which reflect the industrial use of the area in this period are maltings, which were located next to the rivers for the easy transport of the raw material (barley) for the process and ultimately the transportation of malt out. Notable examples of these buildings can be seen beside: Malthouse Broad at Ranworth, the River Waveney at Wainford, Oulton Broad, Beccles and Ditchingham.

Berney Arms Mill was originally built to grind cement.

Road and rail transport

The most important road route established during this period was the "Acle straight" which was a turnpike roads established in the 1830's. Prior to this the main route from Norwich to Great Yarmouth followed the route of the meandering Halvergate fleet. It comprises of two straight sections of road one 7 km in length and one 4 km. These join at the Stracy Arms drainage mill and close to this point is a branch road which provides an interesting switchback ride in a car to Halvergate village. Construction methods of this period often used what we would call today, bio-engineering techniques. It is reputed that the road was constructed on "faggots" which are bundles of cut branches, which enabled the weight of the road and traffic to be spread out more evenly.

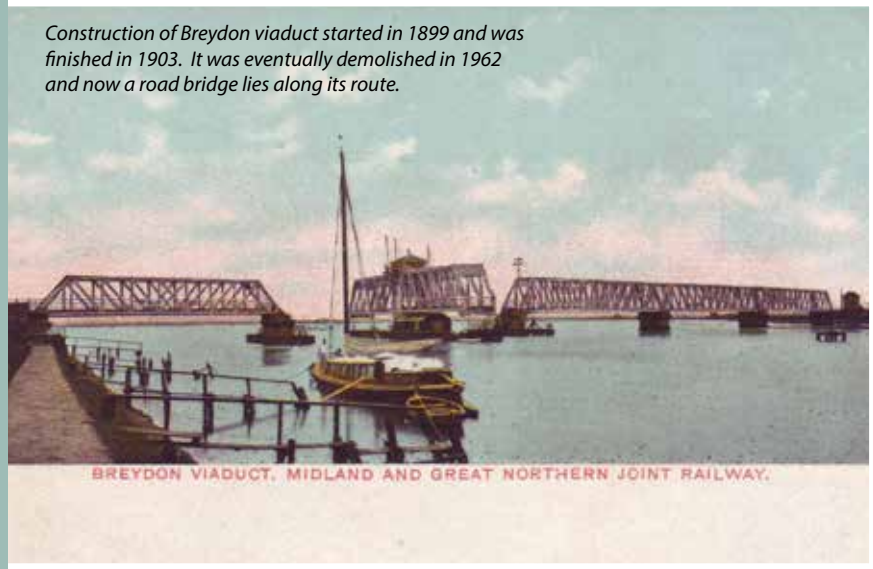
In addition historians and locals believe that willows were planted on the edge of the roads in order that their root systems helped bind the soils on the embankment. Some of these willows survive to this day and are regularly pollarded by the County Council. They provide an interesting landscape feature along some of the roadways in the Broads.

The Acle "straight" (to the left in the photo) established in the 1830's and the railway line (to the right in the photo)was opened in 1844. The increasing volume of traffic on the A47 allied to traffic safety issues mean that highway engineers have to continually adapt this Georgian construction to meet modern day needs. Mike Page ▼

Willows planted on the edge of the road to "hold it up"

The construction of the railway lines through the areas must have been a difficult task, given the soft terrain involved. A flurry of activity took place from the mid to late 1800's to establish a number of routes across the Broads area some of which involved the construction of river crossings. Those surviving today include those at Reedham, Trowse and Somerleyton. The bridges needed to open to allow fixed mast craft to travel along the waterways. These structure were replaced in the Edwardian period and have served well up until relatively recently. However, mechanically they have become less reliable and there is the possibility that they may ultimately be replaced.

As elsewhere in the country the Beeching cuts saw the closure of many of the railway lines. The alignment of old routes and abutments of bridge crossings can still be traced within the area. One of the more remarkable rail bridge structure in the area which was demolished in 1962 was the Breydon viaduct rail bridge which was opened in 1903. A 240 metre bridge of five spans with and opening section in the middle. Boat traffic on the River Yare had in those days, priority over rail.



Construction of Breydon viaduct started in 1899 and was finished in 1903. It was eventually demolished in 1962 and now a road bridge lies along its route.

Tourism

The tourism industry in the Broads developed gradually from the 1850's following the construction of the main railway lines to and across the area. The attractions of the area such as its beauty and the recreational activities that could be undertaken (shooting, fishing and sailing) were being widely written about by a number of authors of the period. Boats became available for hire including trading wherries which were adapted for the tourist period and reverted back for trading purposes at other times in the year. Purpose built pleasure wherries were also built including all the mod cons of the period, some including a small piano.

The 'Pleasure Wherry' Solace moored at Wroxham Broad. At first, they simply featured hammocks and a stove in the hold of a trader but later, boat builders began to make craft specifically for pleasure sailing and holidays, incorporating living quarters instead of a cargo hold.
David Dixon - geograph.org.uk

1900 AD – 1950 AD

Holidaying on the Broads 1910. Broadland Memories

The tourism industry

The expansion of the tourism industry continued apace with the range of craft available for hire extending to motorised craft. The first of the boats powered by the internal combustion engine was hired out in the 1920' by Alfred Ward from a boatyard in Thorpe. With the increase in tourists came settlement expansion with the need to provide facilities for the construction and maintenance of the craft, riverside public houses and the construction of holiday homes. Much of the development took place in the upper reaches of the river which allied to the greater ease of access by rail were also thought to be more attractive to the visitor than the lower reaches of the wide open grazing marshes.

The more affluent built villas on edges of broads as can be seen at Wroxham and Oulton Broad. Another style of development are the smaller holiday chalets which sprang up in the interwar years alongside the river's edge. Often accompanied by a small boat dyke they can be found lining the river banks as at Potter Heigham, Repps and Brundall. Many of the smaller distinctive chalets

"Dancing Light" 1930's.
Images Broadland Memories

The view looking downstream from Wroxham Bridge in the 1930's.

Riverside bungalows and villas at Wroxham in the 1930/40's.

The chalets established on the River Thurne by the 1950's.

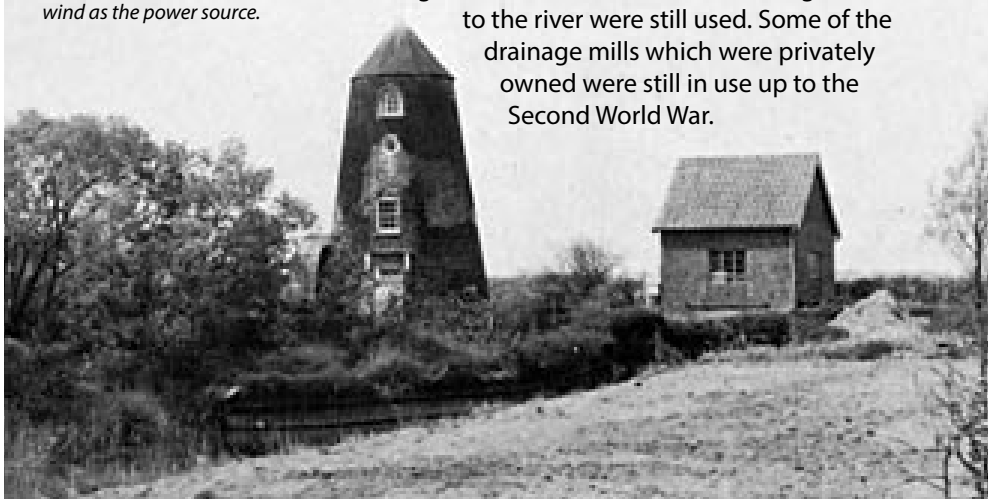
Many of the riverside bungalows have verandas and some use local reed for the roofing material.
Steve Daniels - geograph.org.uk

were built on tight plots. Some were constructed from kits supplied by a Norwich company Boulton and Paul who build prefabricated buildings which they exported over all the empire. They tended to have distinctive style often with verandas facing the river.

Drainage Mills

Norton Marsh drainage mill (built in 1863) was built on the south bank of the River Yare just to the east of the mouth of the River Chet and to the south of Reedham Ferry. This photo shows an example of the small red brick buildings constructed to house the pumping gear which was used once electricity had replaced wind as the power source.

The establishment of the national grid and use of electric pumps hand in hand with the reorganisation of the internal drainage meant that the wind powered drainage mills were starting to become obsolete. Electric pumps were smaller and more powerful and could drain larger areas. These pumps tend to be housed in small brick building with pantile roofs more often than not standing in close proximity to the original mill structure because the original outfalls to the river were still used. Some of the drainage mills which were privately owned were still in use up to the Second World War.



Ashtree Farm August 1950

Ashtree Farm mill was built in 1912 in an area known as Nowhere, on the site of an earlier mill. The boat shaped cap held a fantail and a tailpole. Nowhere, is a name that was officially given to the part of the Bure Loop just west of Yarmouth in 1862 when the area was annexed to the parish of Acle in the Assessment Act of that year. Ashtree Farm mill was only abandoned when in 1953 a storm badly damaged it.

1950 AD to the current day

Potter Heigham in the 1960's. Buildings constructed to cater for the booming tourism industry were starting to urbanise the landscape and river edges were piled for boat moorings. Broadland Memories

Tourism

Through the 1950's and 60's the Broads became increasingly congested and the wash from boats caused erosion to the banks. The solution at this time was to install wooden or metal piling which had a canalising, urbanising effect on the Broads rivers and was not helpful for the local wildlife. Today different methods of bank protection are encouraged, aimed at restoring the natural edges to the river. An increase in the boating numbers mid to late 1900's contributed to declining water quality as more chemicals used on boats ended up in the water. This allied to the sewerage and agricultural runoff which added nutrients upset the natural ecological balance and waters became murky effecting plants and animals. Today through various measures such as phosphate stripping at sewerage works and education programmes about use of chemicals on boats, water quality is gradually improving. But there are many factors which contribute to good water quality, some of these not yet fully understood by scientists, so there is much work to be done to get back to the pristine rivers and broads of centuries ago.

Boat recreation has had an effect on the landscape in that over the years, the drive to have bigger, more luxurious boats has required larger facilities for construction, maintenance and mooring. It is inevitable that when companies want to expand at locations which may lie in the open country or within the transitional zone between settlement and the countryside, there are pressures exerted on the natural and historic features in these areas.

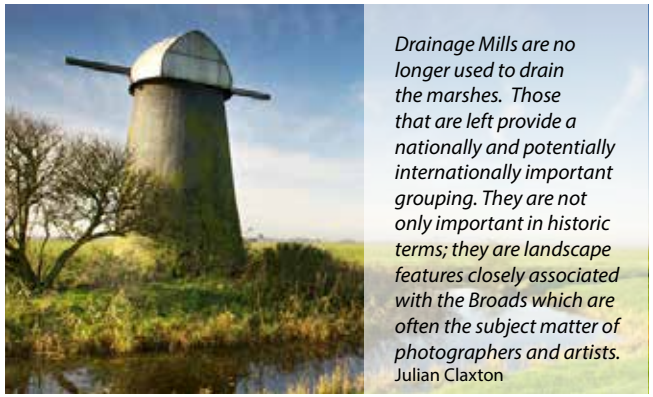
Other pressures come from the need to accommodate car use. Holiday makers, who would have once come by train, now drive to the Broads. This has resulted in the expansion of car parking facilities on or near boat hire companies.

Buildings and facilities have gradually increased in size to accommodate large more luxurious boats holidays, incorporating living quarters instead of a cargo hold.

Farming, land use and management

The 1970's saw a real threat to the Broad grazing marshes when they were deep drained affecting the landscape and the wildlife that it supported. Some dykes were even removed.

The 1970's saw a real threat to the grazing marshes of the Broads and the wildlife it supports. This was a result of changes to food pricing structures which meant that farmers could make more money from growing cereals than raising cattle. Allied to this, the national grant schemes offered at the time to deep drain and plough marshland saw many acres transformed from open marsh grassland with their dyke networks to arable fields where many of the dykes were filled in.



Drainage Mills are no longer used to drain the marshes. Those that are left provide a nationally and potentially internationally important grouping. They are not only important in historic terms; they are landscape features closely associated with the Broads which are often the subject matter of photographers and artists. Julian Claxton

A major public row ensued in the 1980's involving conservation and government bodies. Ultimately it resulted in new government legislation which instigated the Broads Grazing Marshes Conservation Scheme. This scheme spawned the first iteration of a national scheme which rewarded farmers for farming in the traditional manner and protecting the landscape and wildlife. The latest scheme is called Countryside Stewardship.

Traditional grazing techniques and sympathetic water management in the dyke networks can improve the habitat value of the grazing marsh environment.

However, it remains to be seen how, in the face of government funding cuts and the UK' s exit from Europe, farming practices may change and whether this is going to have a detrimental effect on the Broads landscape.

Unsettlingly, over the past 10 years, the trend of conversion to arable, which had been much slowed and reversed in some areas, appears to be on the increase again.

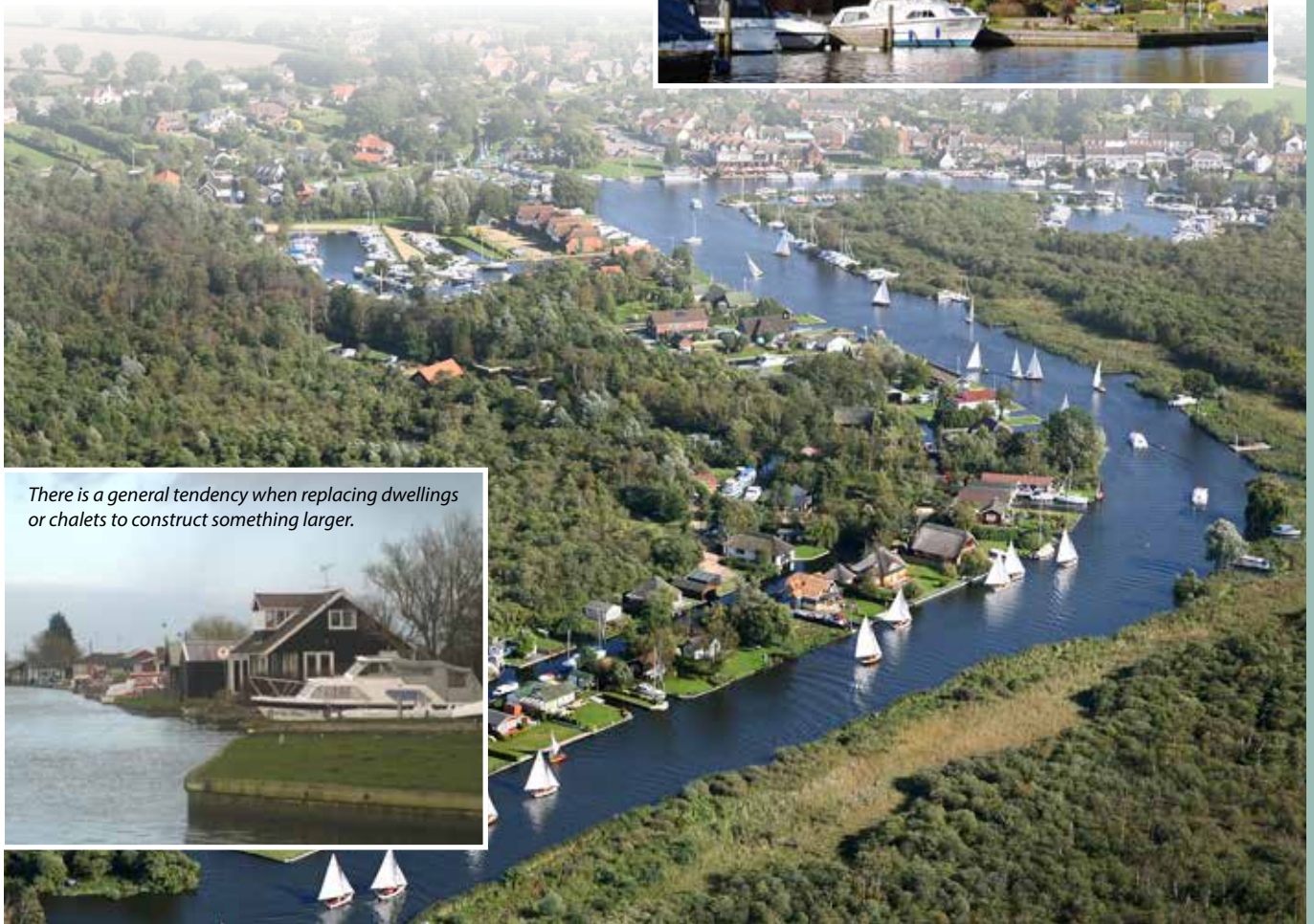
Commercial reed cutting is still undertaken in the Broads. It provides reed for thatching (sustainable building product), prevents scrub encroachment and contributes to the mosaic of habitats in the Broads.
Mike Page

Settlement development

Some settlements in the Broads are of ancient origin, having become established at convenient points to provide access to the water (at a river crossing point or staithe for instance) or the grazing marshes. Either way, there are continuing pressures exerted for further development in these areas. This may be to cater for improved living standards, commercial, farming reasons or recreational pressures. Climate change and anticipated relative increases in water levels is also having an effect by requiring the increase in floor level heights for development. These changes are in the main tightly controlled by planning processes. The Planning Authority however has the unenviable job of having to balance the needs of the local economy and residents and the requirements stipulated in the Broads Act to safeguard the special qualities of this nationally designated landscape.

Larger properties and the desire to have more outside space has led to pressures on the natural environment in the Broads .
Mike Page

The sub-urbanisation of the river frontage in Wroxham.



There is a general tendency when replacing dwellings or chalets to construct something larger.

Flood defence

In 2001 The Environment Agency awarded Broadland Environmental Services Ltd (BESL) a contract to implement a 20 year programme of flood defence improvements and maintenance to the Broads area. The main aim of the project was to strengthen existing flood defences (established and modified over centuries) and restore them to a height that existed in 1995. It is interesting to note that the techniques developed over the centuries were closely mirrored in this contract. Material was "won" from soke dykes that lie to the landward side of the flood banks. These dykes were widened and made deeper to provide sufficient material to undertake the bank strengthening. This replicates what would have happened centuries ago but on a much larger scale.

The construction works initially leave a raw scarred landscape, but within two seasons the areas will have recovered. The legacy, as well as the improved flood defence, is a greater volume of water within the soke dykes which is better for wildlife and in some areas the establishment of wide reed fringes on the river's edge to replace piled structures that were removed. Further detail can be found in the landscape types section.

One of the most significant changes to the Broads landscapeis the result of the Broadland Flood Alleviation Project. Flood banks have been made wider and taller and sometimes completely relocated. The material required has normally involved the enlargement of the soke dykes. The effects are softened once vegetation has become re-established in the dykes and on the banks. ▼
Mike Page

Conservation activities can sometimes have dramatic effects on the landscape. These are foot drains created by the RSPB. ▼
Mike Page

Conservation

The Broads area is renowned as a haven for rare plants and animals. A significant proportion of the landowning interests in the area are owned by nature conservation bodies such as the Norfolk and Suffolk Wildlife Trusts and the RSPB. The nature conservation bodies tend to use traditional land management techniques to protect and enhance the landscape in accordance with the aims of their individual organisations. Some practices, such as the creation of scrapes and the waterlogging of areas over the winter period however, can also have the effect of changing the landscape. As with many aspects which relate to the Broads environment, there is a balance to be achieved between recognising and protecting the historic landscape features which are important elements in defining the character of the Broads landscape and improving habitats for wildlife.

Infrastructure

The 20th and 21st century has seen rapid technological advancement. Communications and the supply and production of electricity are industries where this advancement has, and will continue to have an effect on the landscape of the Broads. Their requirements can lead to the installation of masts, pylons, cables, turbines all of which have the propensity to impact on open views within the Broads. They can also influence the landscape character. Where 20th /21st century development is not readily apparent visitors are transported back to a time when to life was perhaps simpler and more tranquil. This tranquillity is one of the key features of much of the Broads area which is important to safeguard.

It is quite likely that pressures for infrastructure requirements over the next few decades are likely to increase. However, some opportunities exist to remove at least the clutter of overhead electricity wires as OFGEM allowances are currently available to underground the cables, thereby allowing the removal of the poles.

Telephone and electricity cables and poles clutter the landscape and affect the landscape character.

The tall pylons over the cut at Haddiscoe feature in views over many kilometres Evelyn Simak - geograph.org.uk

Views from Howards drainage Mill towards Scroby Sands wind farm. Tim Heaton - geograph.org.uk