The Landscape History of Hadstock Parish

Part 6
Geology, Terrain,
Watersheds and Soils

The Hadstock Society

Background

- The following images and notes describe geological factors that have created the landscape of Eastern England and Hadstock Parish in particular.
- This presentation (Part 6) deals with the geology of the bedrock and superficial deposits, old quarries, the terrain, drainage, and soils.
- Part 1 of the Landscape History Series is concerned with boundaries, roads, woods and paths. Other presentations cover Field systems, field names and ownership (Part 2), the 1801 Inclosure Act (Part 3), the Built environment (Part 4) and Notable buildings (Part 5).
- Parts 1-5 are available online as pdf documents at hadstock.org.uk in the Community Archive section. Many of the illustrations were created using Adobe Illustrator 2024 software.
- Parts 1-6 were developed as an output of the work of the Hadstock Society.

Richard Dolby February 2025

Main Sources of Information

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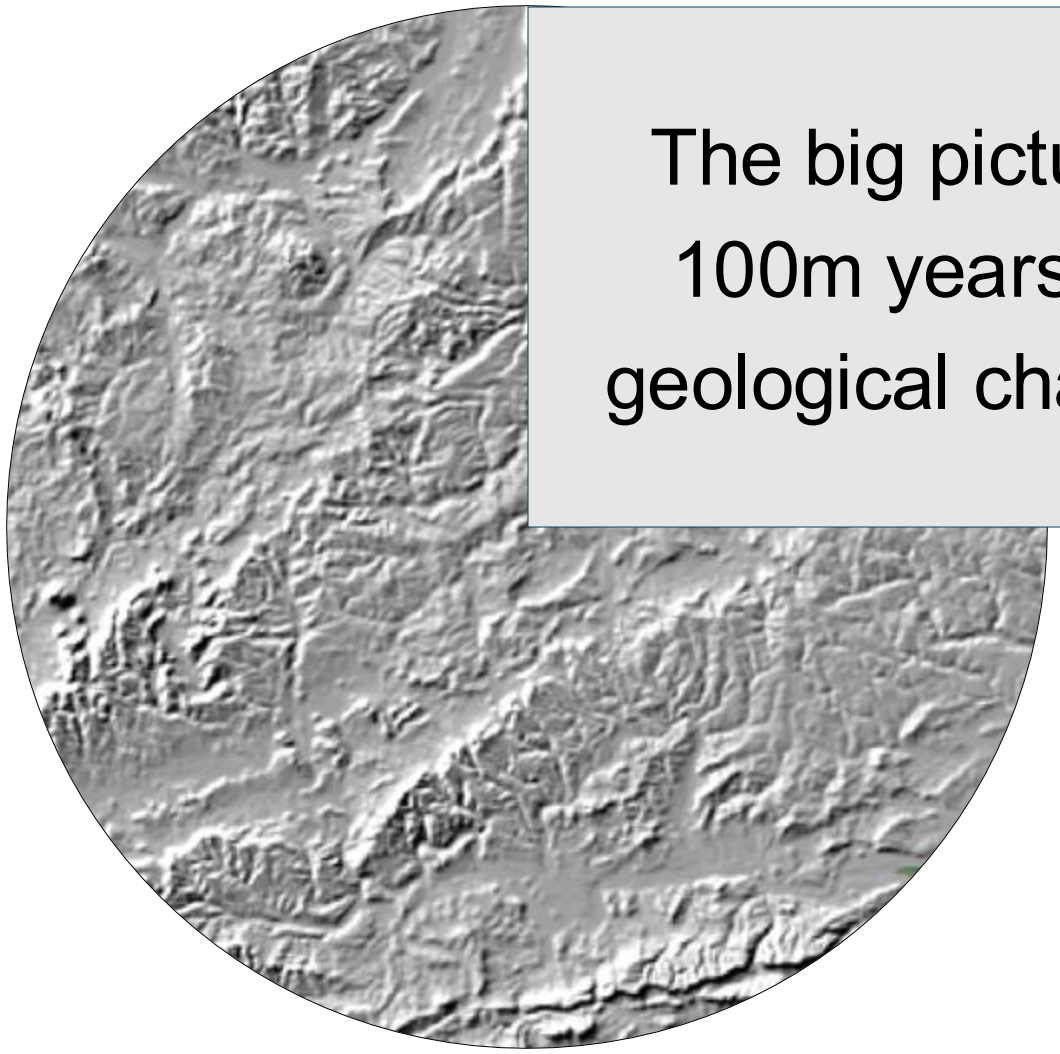
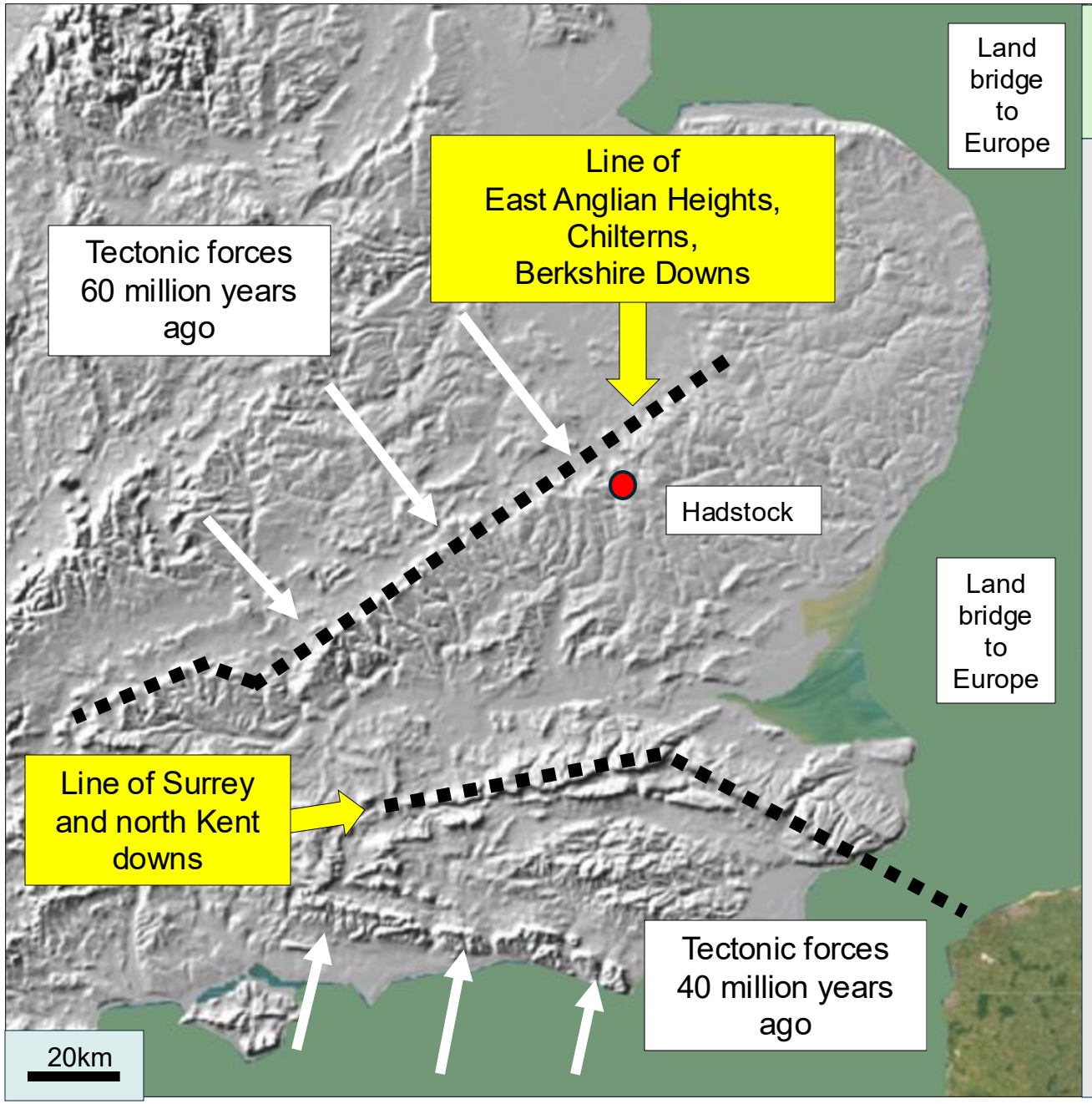
Thanks to Mark Goddard for the Hadstock soil map information and to my family and Society colleagues for helpful comments on the several drafts.

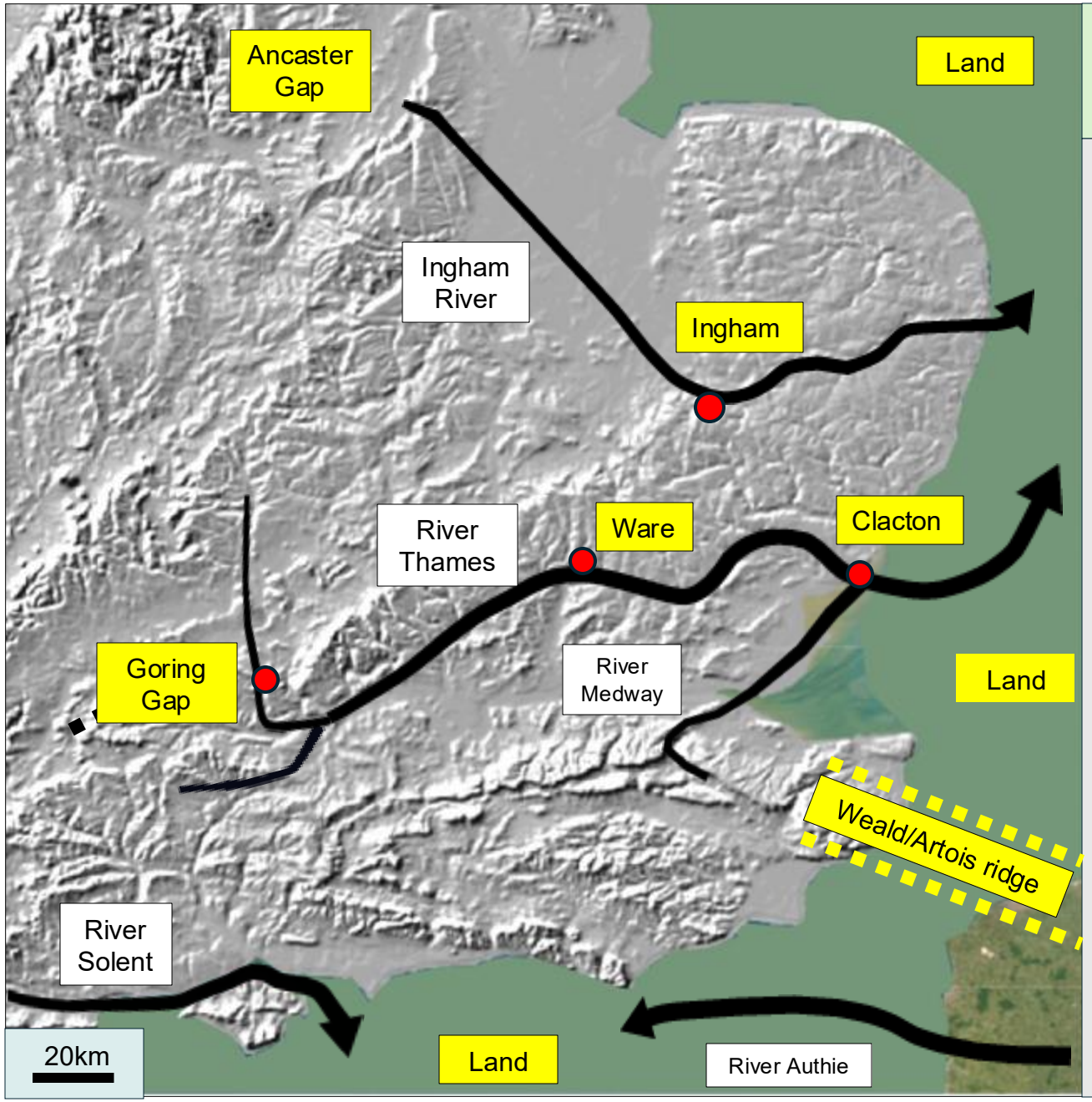


The big picture: 100m years of geological change



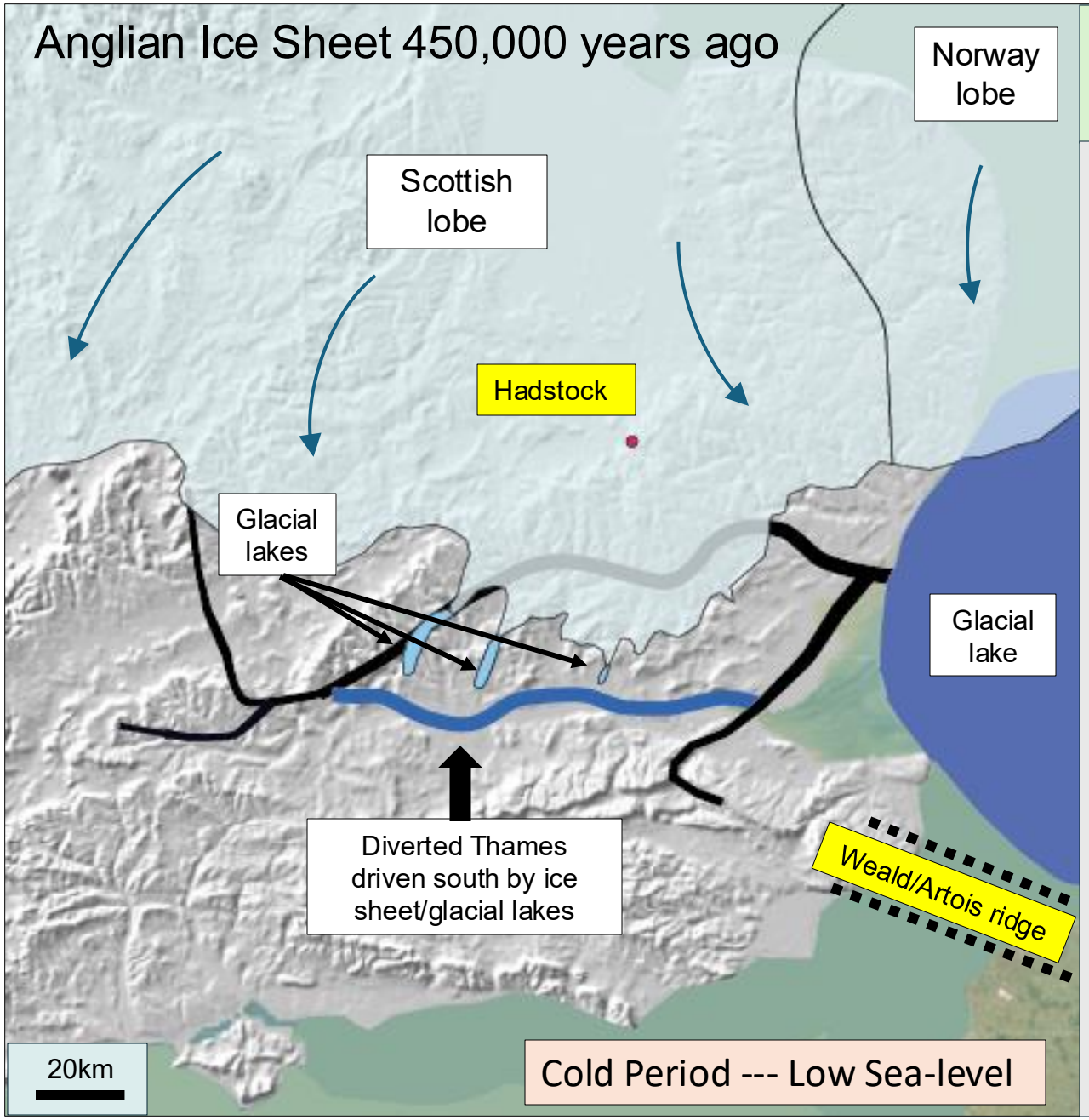
Tectonic Plate movement – formation of the London Basin

- This LiDAR (light detection and ranging) image of Eastern England shows features of the terrain caused by geological changes over the last 100m years.
- 70m years ago, much of Britain and northern Europe had been under a tropical sea. The seabed had accumulated 500m of white calcite sediment which turned into chalk after compaction.
- 60m years ago, a major tectonic movement in the Atlantic lifted and tilted the England/Wales land mass to the south-east. It compressed the thick chalk layer and uplifted a series of chalk hills (East Anglian Heights, Chilterns, Berkshire Downs).
- 40m years ago, a second tectonic movement came from the south, compressing the bedrock and uplifting the Kent, Surrey and Sussex chalk weald area. New chalk uplands were created. The north downs extended from Surrey into Kent and across the land bridge to France.
- The triangular area between the dotted lines is known as the London Basin. The hills of Cambridgeshire, north Essex, and Hertfordshire dip gently down to the south-east while those in Surrey and north Kent dip down to the north.



The big rivers of the time……

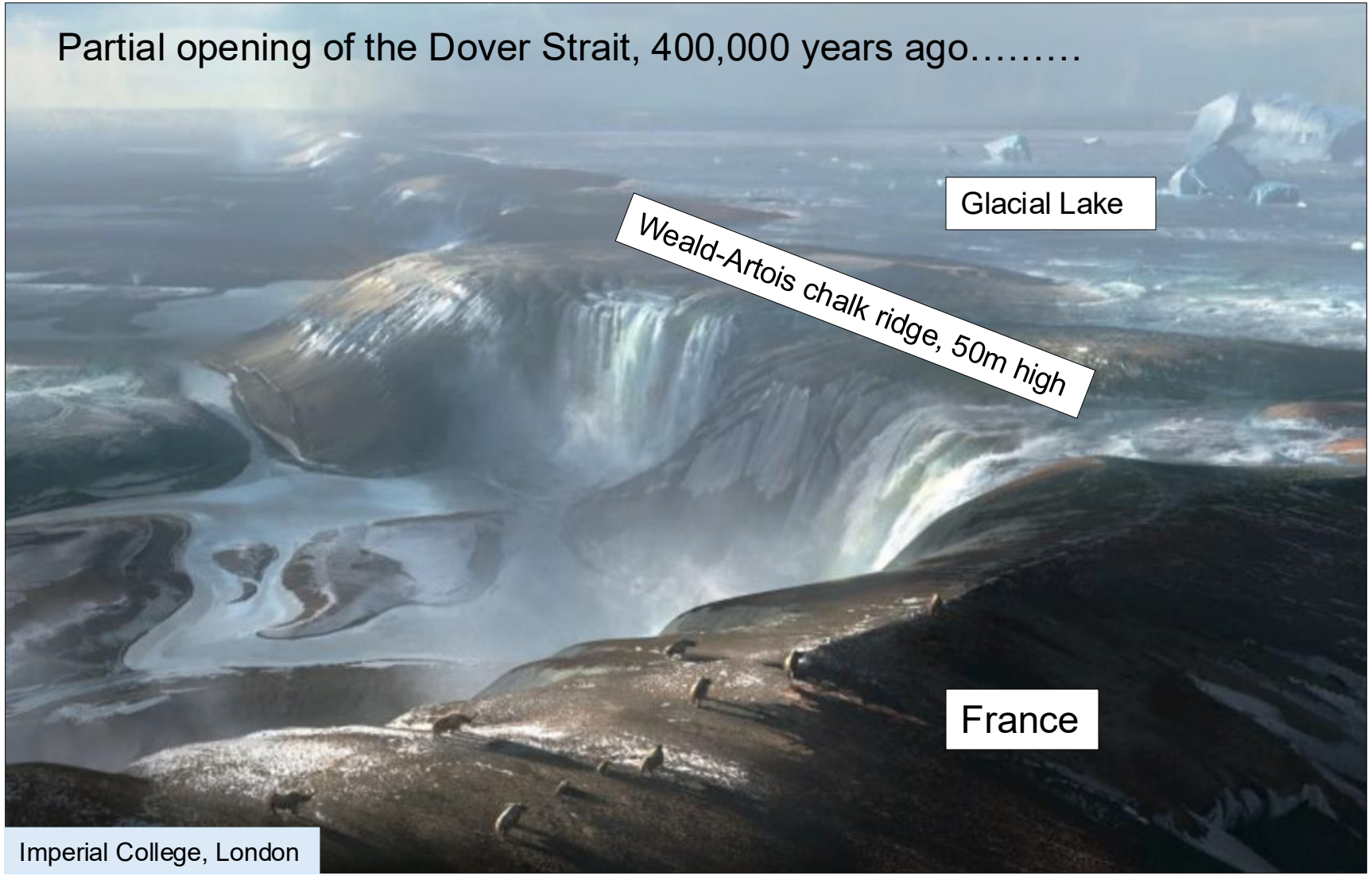
- 700,000 years ago, much of south and east England was still connected by land to Europe. Large rivers crisscrossed this low-lying basin, draining water from England and continental Europe to the North Sea and south to the Atlantic.
- Several ancestral English rivers (Thames, Medway, Ingham), flowed east and north out of East Anglia, merging with the Rhine and Meuse, and entering the sea at the Dogger bank, close to Belgium, Germany and Jutland.
- The Thames drained water from the Midlands but just prior to the arrival of Anglian ice sheet, its main track to the coast passed through Goring, St Albans, Ware, Chelmsford and Clacton, well north of its current Thames valley location.
- There were chalk hills over 50m high across the gap between Dover and Calais. This upland feature was known as the Weald/Artois ridge. Later, this ridge would act as a dam for a massive glacial lake created off the East Anglian coast.
- Large rivers south of the Weald/Artois ridge, such as the Solent, Seine, Somme, and Authie flowed south-west across low-lying land (now the English Channel) to enter the Atlantic near the continental shelf edge beyond Cornwall.



The Anglian Ice Sheet arrives…..

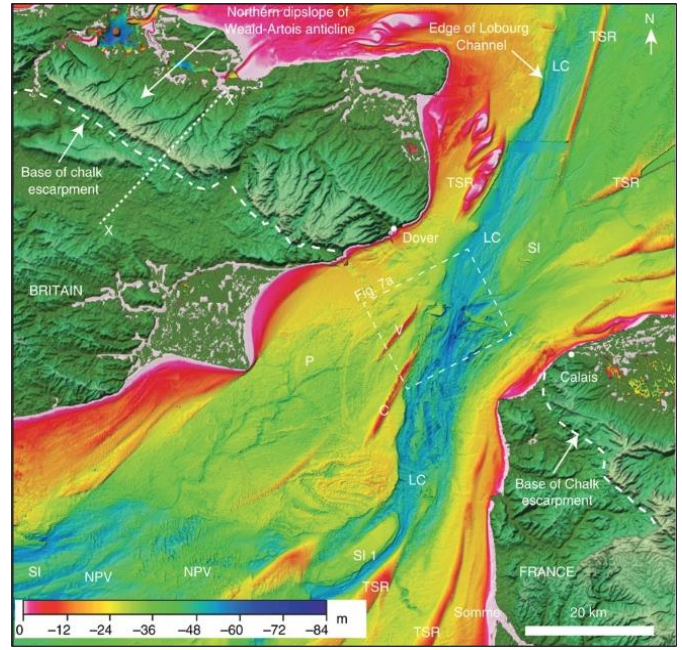
- About 450,000 years ago, two ice sheets grew south from Scotland and Norway, collided and merged over Norfolk.
- The Scottish lobe (50-100m high) exploited the gap between the chalk hills of Lincolnshire and Norfolk. It scoured out the clay bedrock and part-formed the Wash and Fenland basins. This Anglian ice sheet obliterated the Ingham river.
- North of London, the ice sheet and associated glacial lakes blocked the ancestral Thames forcing the river course to move south and to occupy its current position through London.
- The advancing ice sheet compressed and ground the land surface leaving a thick layer of glacial till (boulder clay).
- River flows to the North Sea (incl Thames and Rhine) were blocked and a massive glacial lake formed off the coasts of Eastern England and the Netherlands. At first, the Weald/Artois chalk ridge prevented the lake from draining south to the Atlantic.
- About 400,000 years ago, the ridge was breached and much of it collapsed. A mega flood occurred opening the Dover Strait for the first time. Britain became an island when the ice sheet had gone, warm periods arrived, and sea levels rose more than 100m.

Partial opening of the Dover Strait, 400,000 years ago……

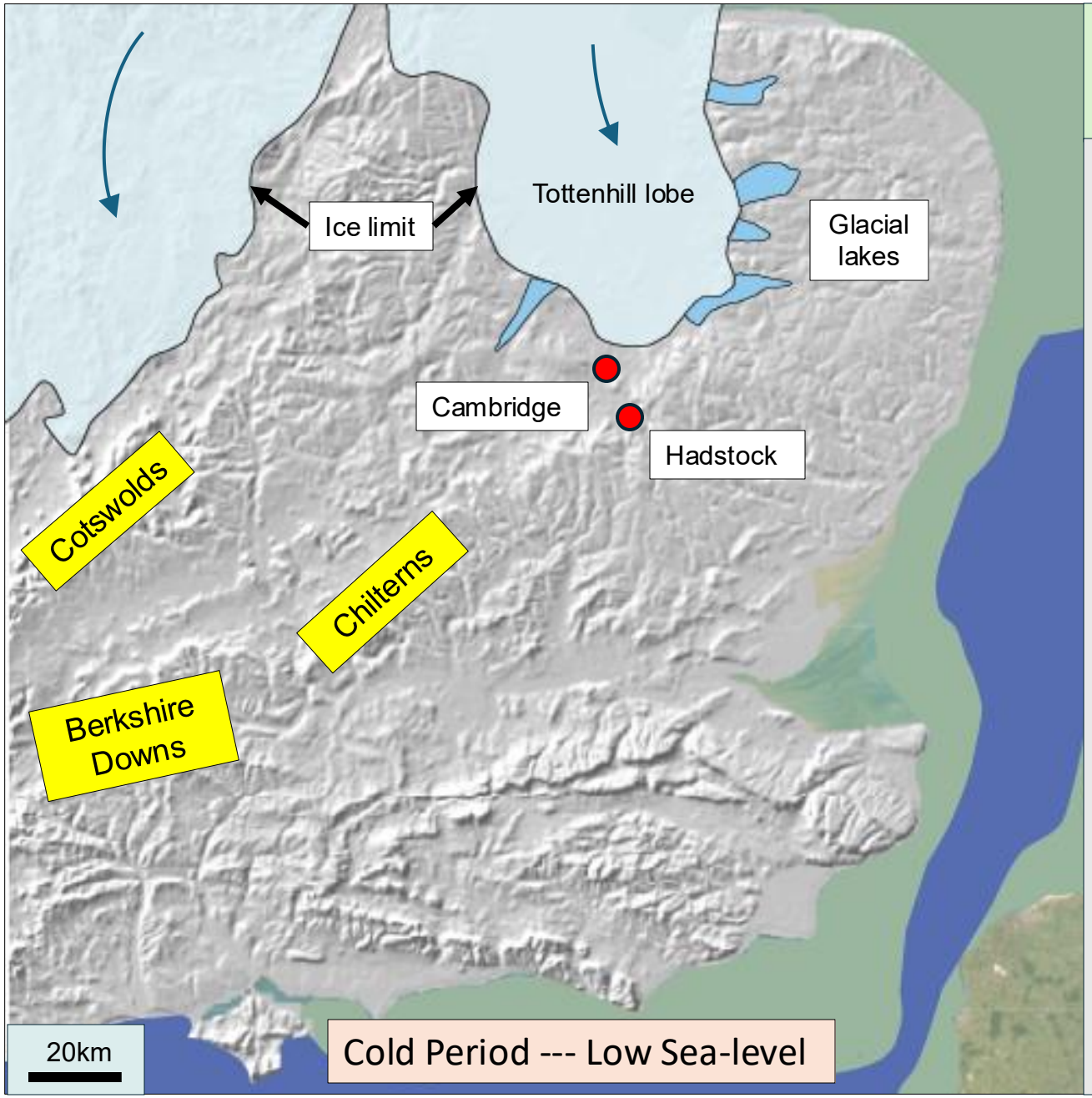


Imperial College, London

An artist's impression of the glacial lake spilling over the Weald – Artois ridge in a series of Niagara type waterfalls. Much later, a second ice sheet created another massive lake in the southern North Sea. This is thought to have finally removed the ridge as the ice retreated around 120,000 years ago.

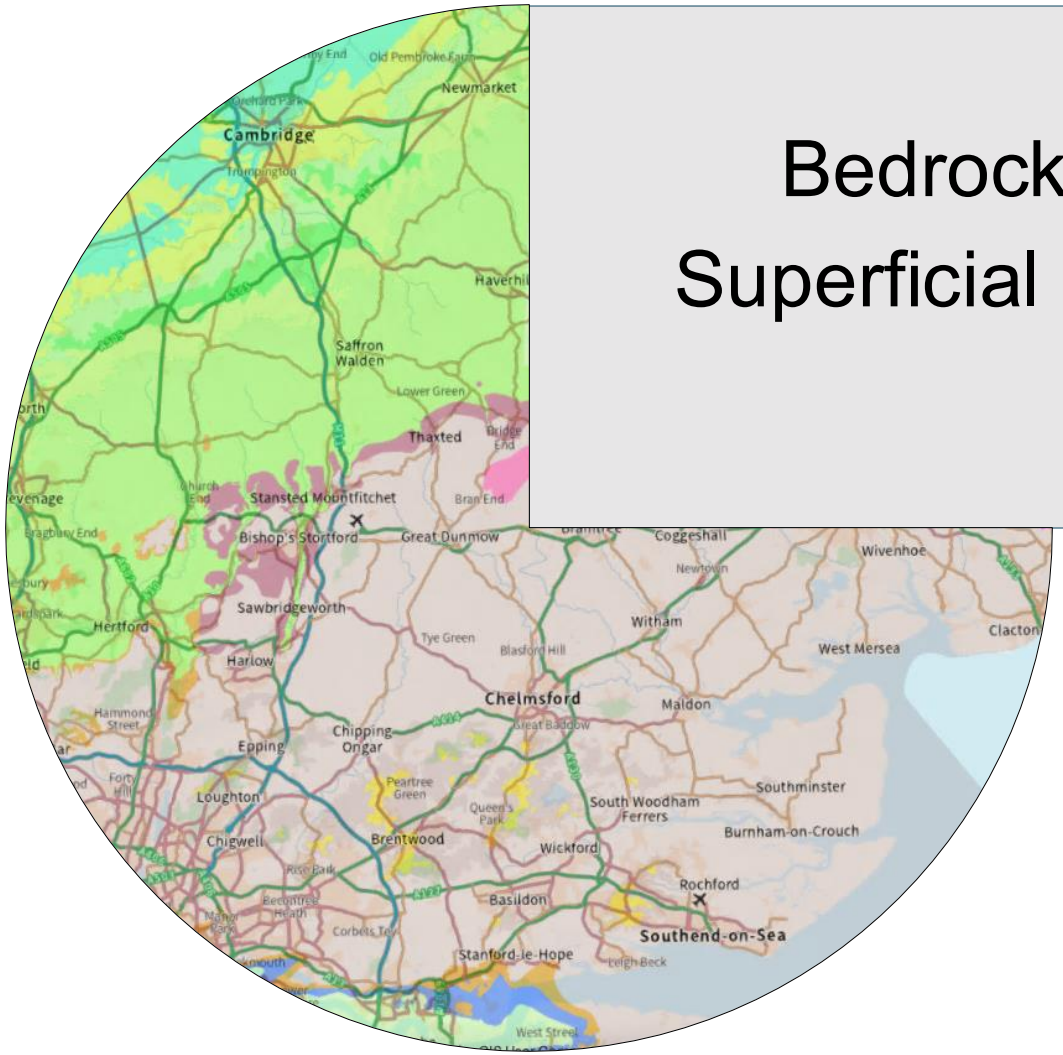


The Dover Strait today showing the old river channels gouged into the sea-bed by two mega floods. These floods occurred when first, the Anglian and later, the Wolstonian ice sheets had retreated, and their associated glacial lakes breached and then took away the Weald-Artois chalk ridge (S Gupta et al).

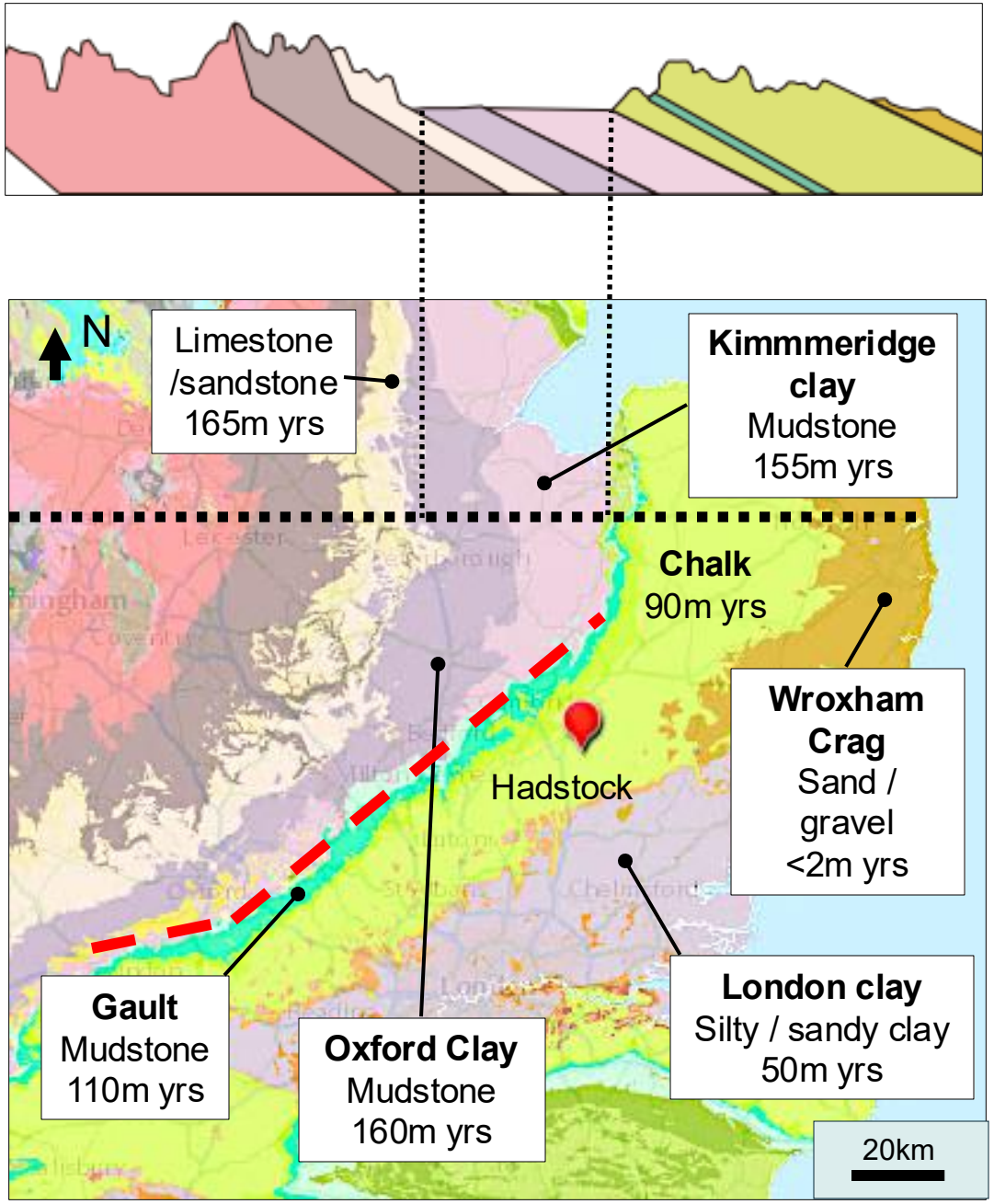


The second major glaciation - the Wolstonian ice sheet

- This second ice sheet came from the north and part of it, the Tottenhill lobe, entered East Anglia around 160,000 years ago.
- The Tottenhill ice lobe scoured out more of the Fen basin but stalled when it met the chalk hills in the west, south and east of the basin.
- Almost reaching Cambridge, it dammed various rivers flowing to the Wash such as the Lark and Little Ouse. This created valley glacial lakes at the ice edge when the ice sheet was melting and retreating.
- The ice front oscillated both when advancing and retreating and created ice-pushed ridges and hollows at the edges of the basin. We see these today in the form of significant ridges and isles at Stretham and Ely.
- Hadstock was close to the ice limit of this second glaciation but was not affected except by freeze/thaw cycles which eroded exposed chalk.
- For Hadstock, the main legacy of successive glaciations has been the thick layer of chalky boulder clay and associated soils, originating from the Anglian ice sheet visit, 450,000 years ago.

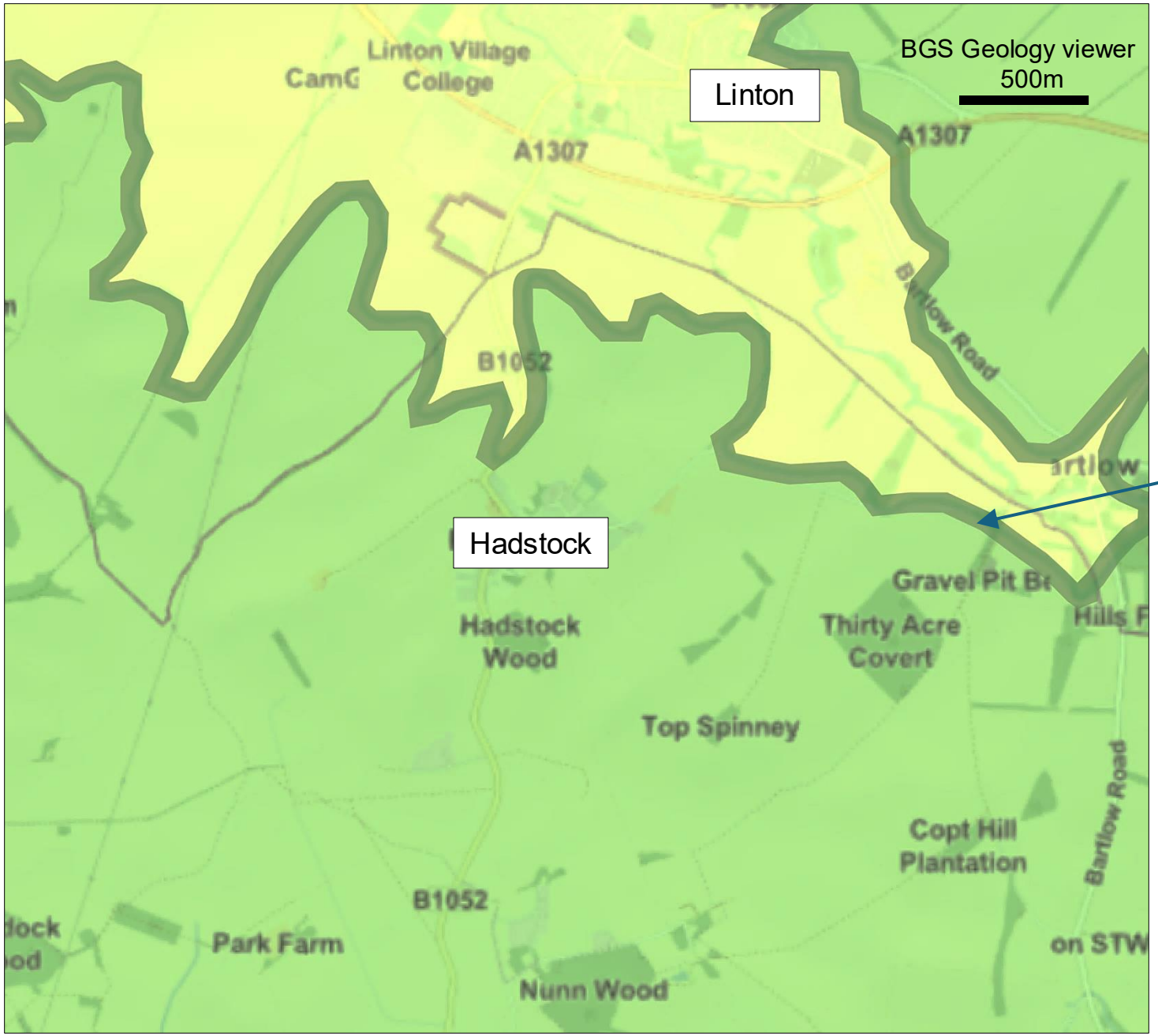


Bedrocks and Superficial Deposits



Bedrock: South-East England

- The British Geological Survey has an online map which details the types and age of the underlying bedrock across England.
- Bedrocks are hard rocks older than 2.5m years sitting beneath 'superficial' deposits such as tills, soils, sand and gravel. Bedrocks may be buried many hundreds of metres deep or can outcrop at the earth's surface.
- The distinct SW–NE orientation of the main bedrock types across south-east England is evident. This was caused by the tectonic plate movements 40-60m years ago, described earlier.
- The upper figure in the illustration shows that all bedrocks are tilted to the west with those in the E and SE being the youngest rock forms, and those in the west the oldest. This reflects the direction of the receding tropical sea 60m years ago.
- Hadstock sits on **white chalk** bedrock and is close to the escarpment of the chalk hills (red dashed line) which forms the north edge of the London basin.



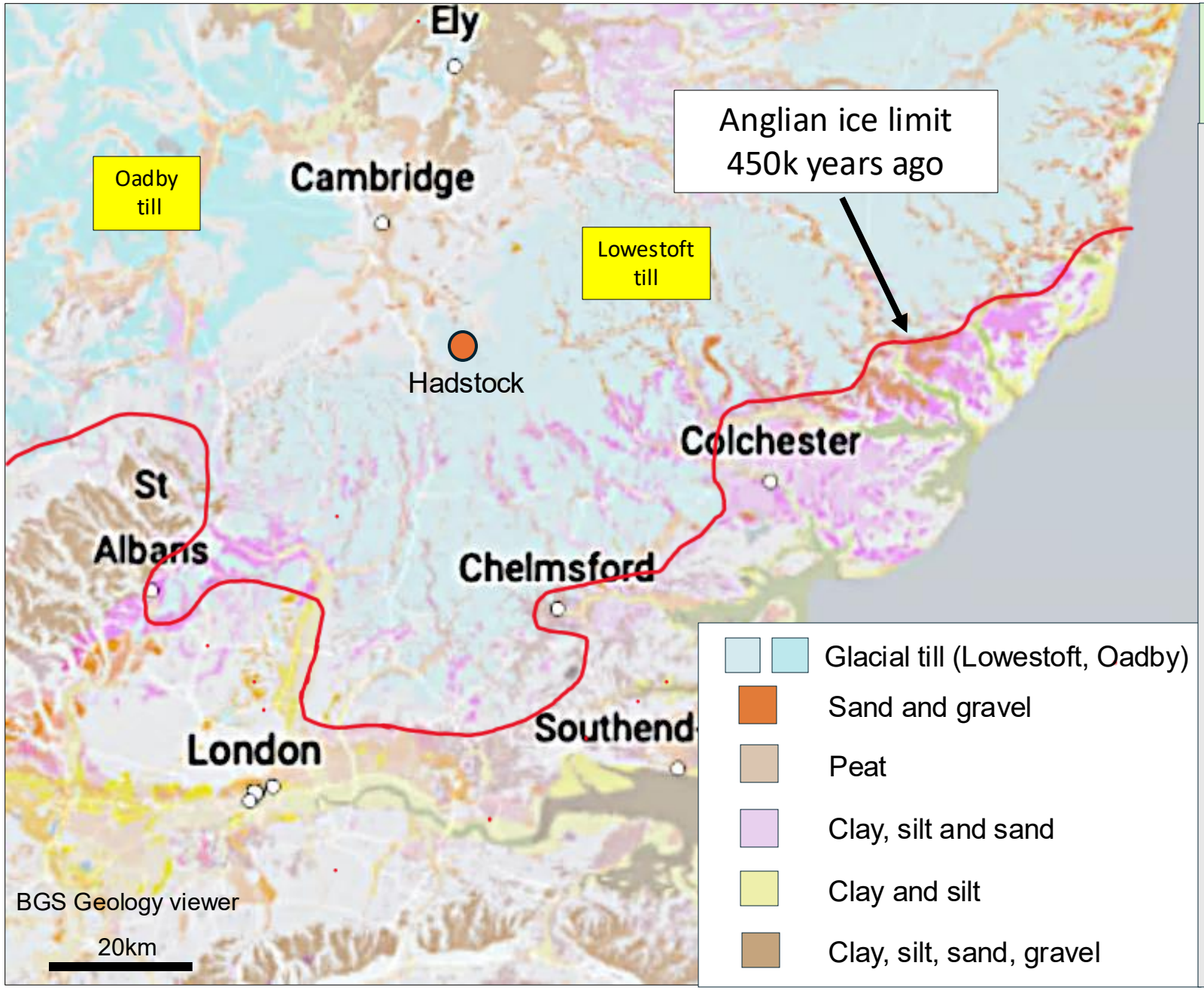
New Pit
chalk
94-90m yrs

Chalk Rock
chalk
94-90m yrs

Lewes Nodular
chalk
94-84m yrs

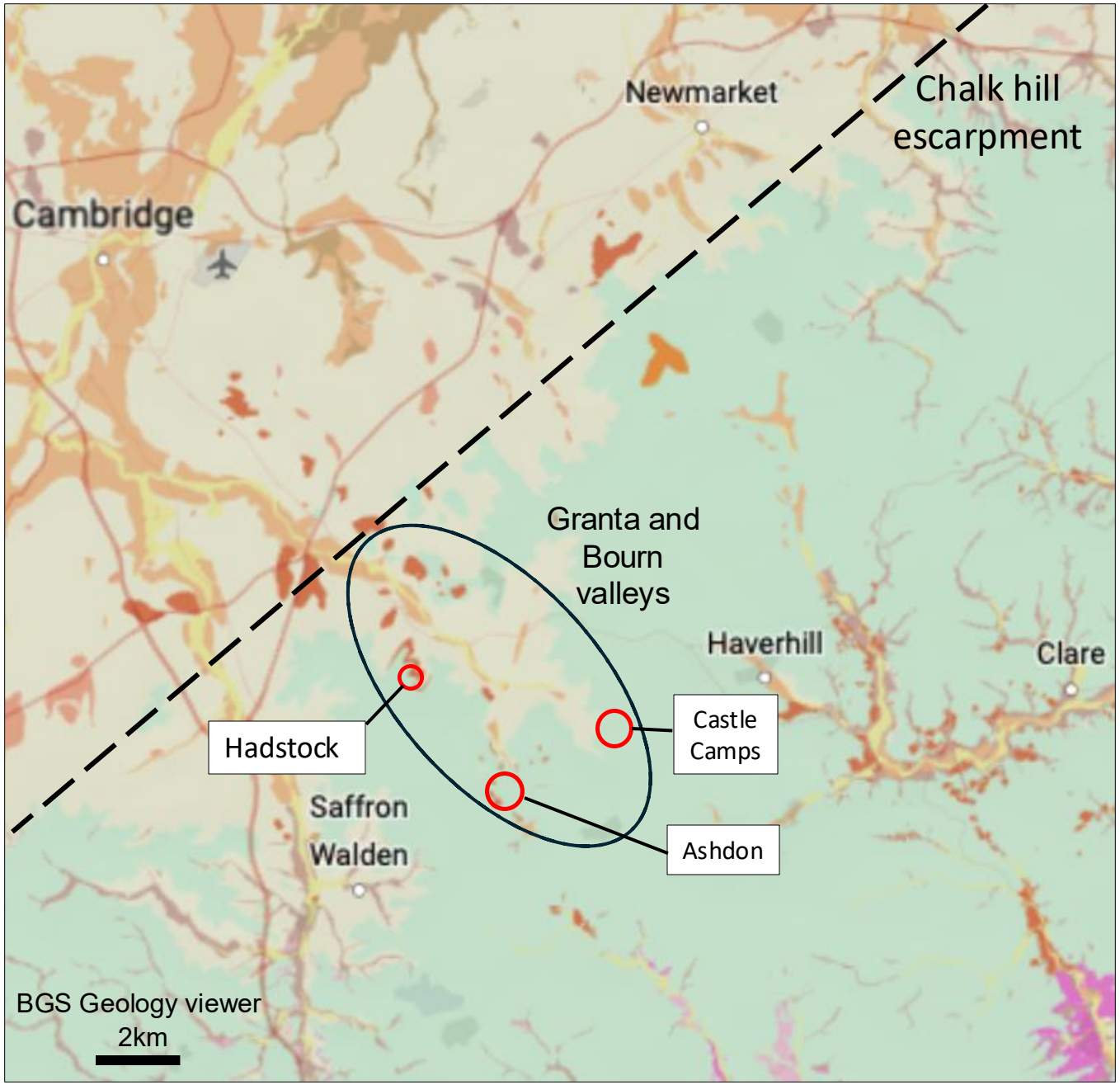
Bedrock under Hadstock

- This shows the chalk bedrock under Hadstock Parish. There are three chalk formations here, all part of the **white chalk** group.
- *Lewes Nodular Chalk* sits under most of the Parish and is hard, lumpy, white or cream with bands of flints and clay rich chalk (marl). Typically, it is in beds 35-80m depth.
- *New Pit Chalk* under the River Granta valley is an older bedrock. Greyish white, smooth, with thin bands of marl, it is harder than Lewes Nodular and has very few flints. The beds are 35-50m thick.
- *Chalk Rock* is a narrow layer of very hard rock, lying between the New Pit and Lewes Nodular chalks. Typically, it is < 5m thick.



Superficial Deposits: South-East England

- Superficial deposits are tills, soils, gravel, sand, silt and clay overlaying the bedrock.
- Less than 2.5m years old and unlike bedrock, they are not consolidated or cemented.
- The East Midlands, Suffolk and North Essex, including Hadstock, sit on large areas of glacial till (light blue in image).
- In the East and around Hadstock, the till is a chalky boulder clay known as the Lowestoft Formation. It is a mix of grey/brown clay, silt, sand, gravel, and stones, and has a high chalk and flint content.
- West of Cambridge, it is the Oadby till, with various rock fragments but very little chalk.
- The till was formed at the base of the Anglian ice sheet which brought the clay, silt, stones and rocks from the north (see previous section). The ice sheet arrested at the red line and retreated around 420,000 years ago.



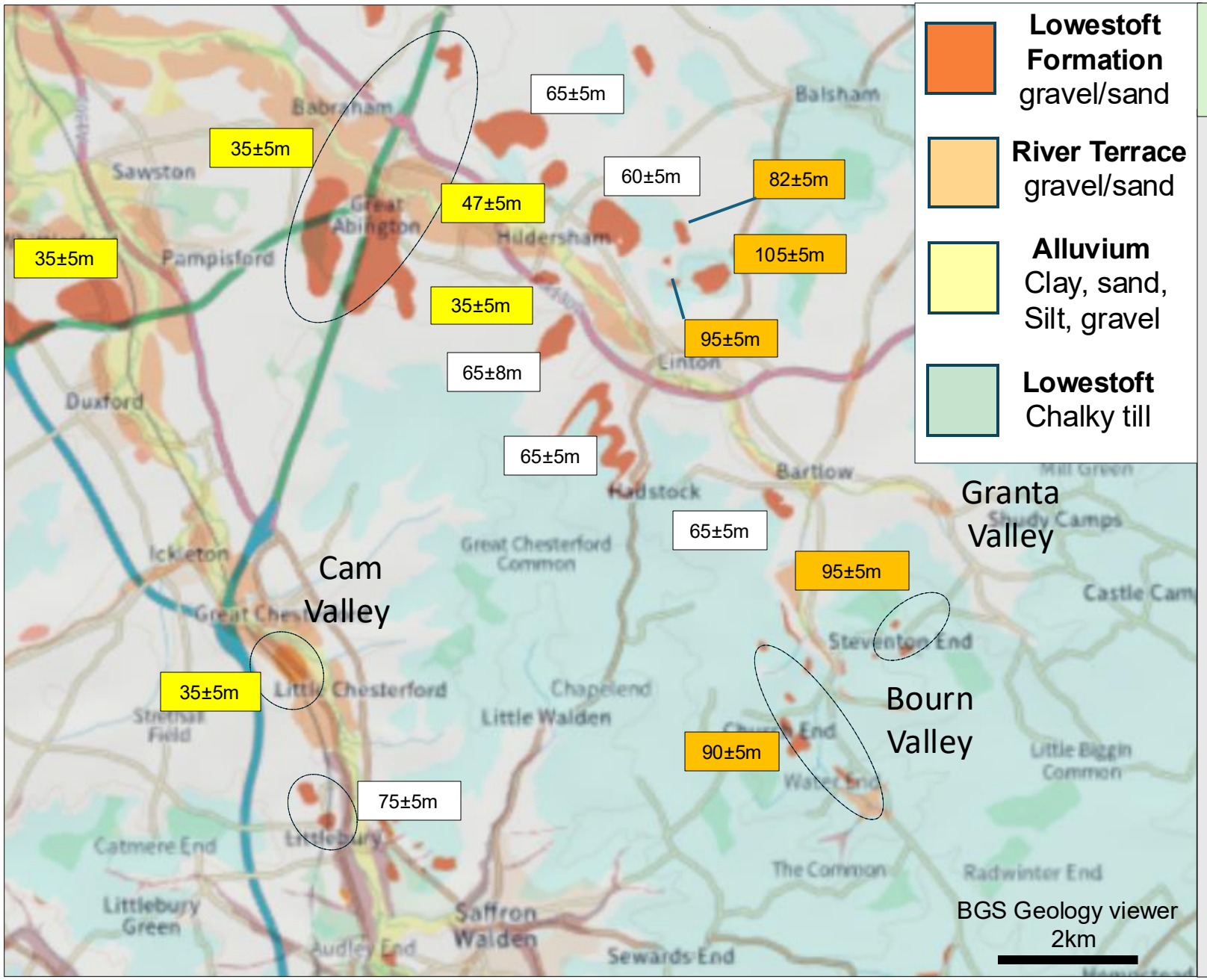
Lowestoft
Chalky till

Lowestoft
Gravel/sand

River Terrace
Gravel/sand

Superficial deposits in Hadstock area (1)

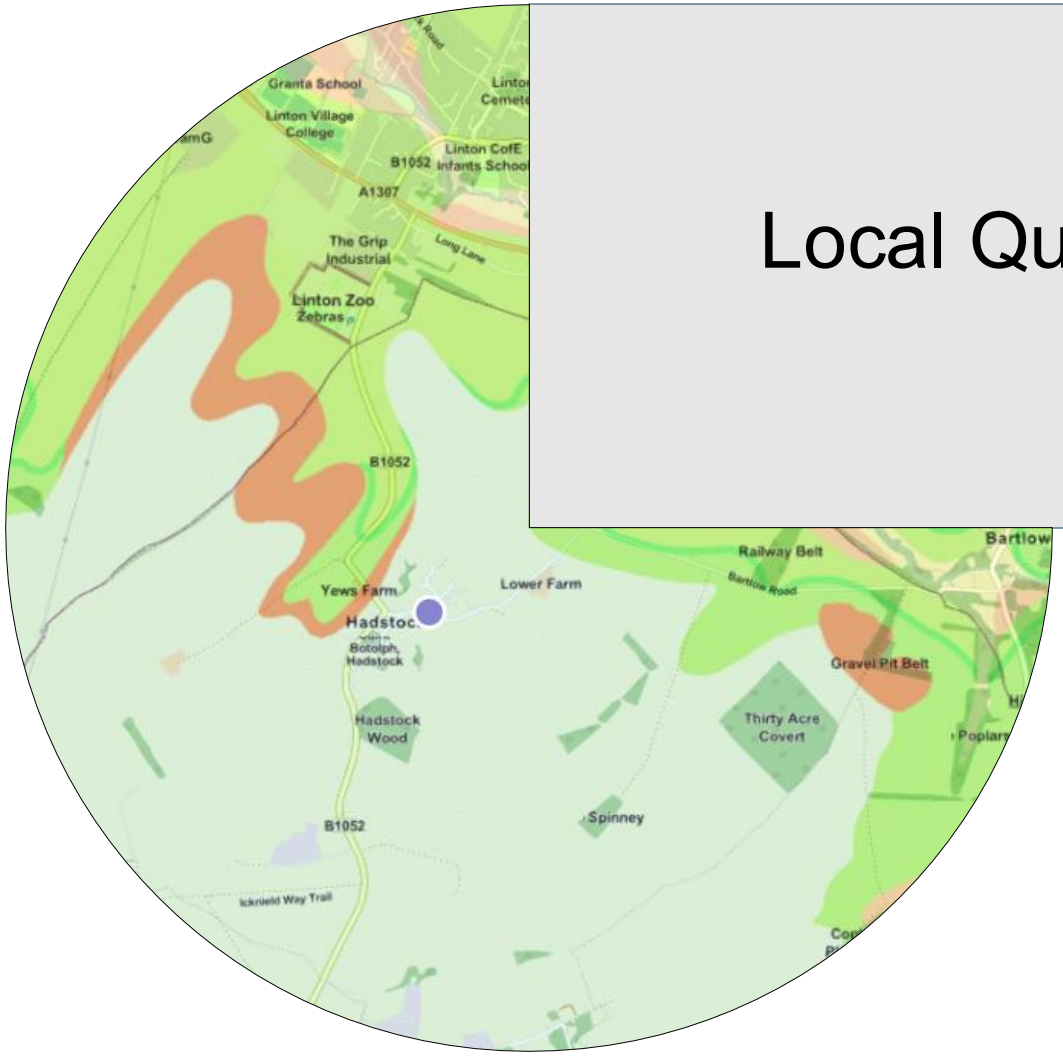
- Hadstock Parish sits at the north–east edge of the line of chalk hills comprising the East Anglian Heights and the Chilterns.
- The Lowestoft till area extends east from this line to the Suffolk coast and south to Chelmsford and St Albans.
- The till is 5-50m thick on plateau regions of the chalk hills but thinner on the lower slopes of the many valleys which dissect the hills. The valleys were created by massive rivers cutting into the chalk hills when the Anglian ice sheet retreated.
- Such valleys are visible in the Lowestoft till regions (light blue) because they contain areas of sand and gravel aligned along the river paths (orange).
- Around Hadstock, several gravel and sand areas are seen around the River Granta, extending back up to Castle Camps, and also up to Ashdon along the River Bourn.

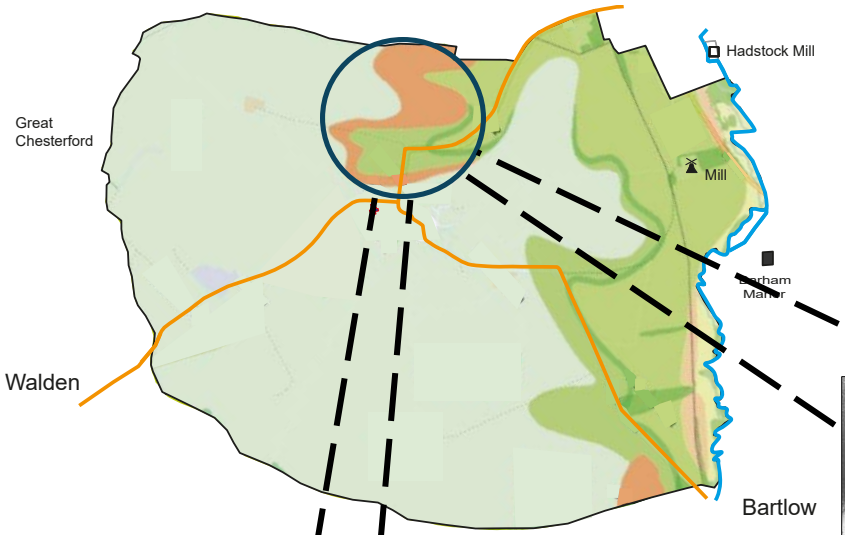


Superficial deposits in Hadstock area (2)

- This higher magnification illustration shows the gravel and sand outcrops in the Granta and Bourn valleys and along the Cam valley.
- The Lowestoft Formation gravel/sand areas (deep orange) were formed during the Anglian ice sheet retreat about 420,000 years ago. The gravel/sand areas along riverbeds (light orange) were created over the last 11,000 years.
- Grouping by elevation shows that the Anglian gravel/sand layers were deposited at different times during the ice sheet retreat from the south. Elevations range from 95m to 35m with a 65m terrace in Hadstock Parish.
- They are all outwash deposits from melt water which, starting around 100m elevation, periodically cut through its flood plane to successively lower levels.
- Most of these deposits and those on river terraces were quarried in the 19th/20thC.

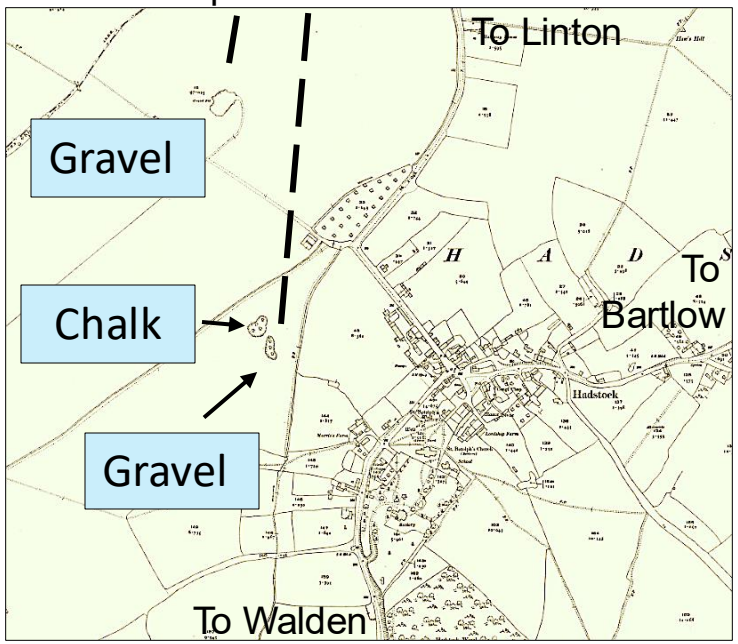
Local Quarries





BGS Geology map of Hadstock Parish (bedrock and superficial deposits)

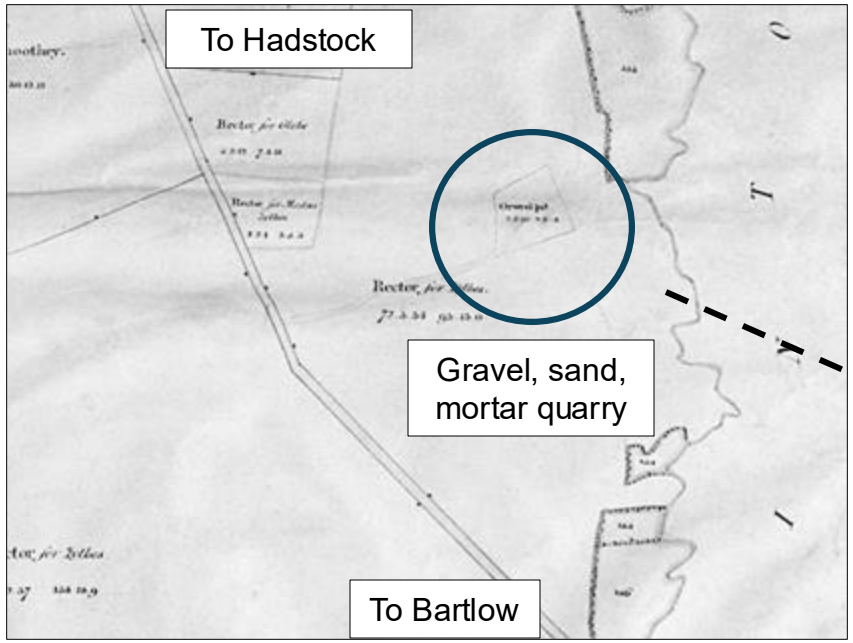
1921 OS map



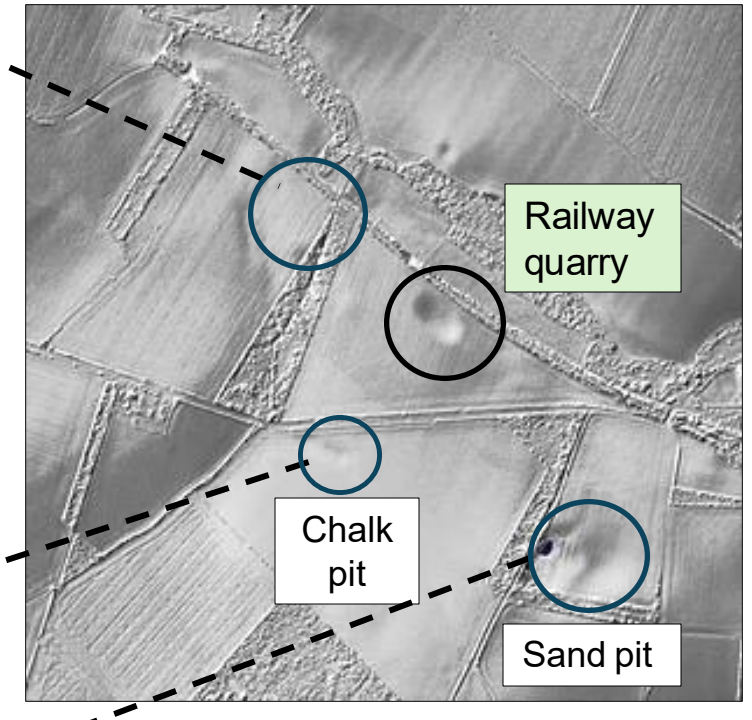
2020 LiDAR

Quarries/pits near Hadstock

- The 1877/1901/1921 OS maps show where gravel, sand and clay deposits, along with chalk bedrock, were exploited in the 19th/early 20thC.
- The 1921 OS map (left) shows that three quarry pits had been dug into the gravel outcrop at 65m elevation, west of Hadstock. A fourth pit was for chalk.
- The 2020 LiDAR image reveals the two quarry pits in the most westerly quarry. The 1801 Inclosure map recorded a 'Gravel Pit' Shot in this area, indicating an old quarry existed there in the 18thC. Since it is not seen in later 19thC maps it must have been re-opened in the early 1900s.
- At high magnification, the LiDAR image shows that the second quarry area, sited close to Penn Farm track, consisted of several pits for both gravel and chalk.

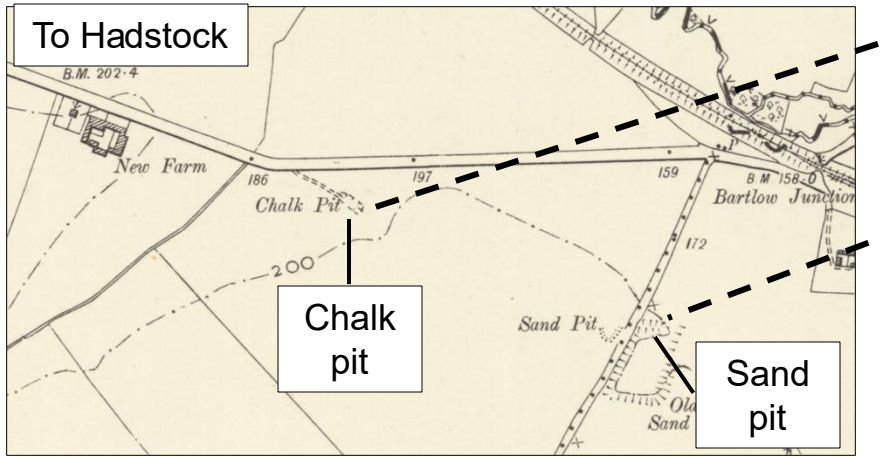


1805 Award map



2020 LiDAR

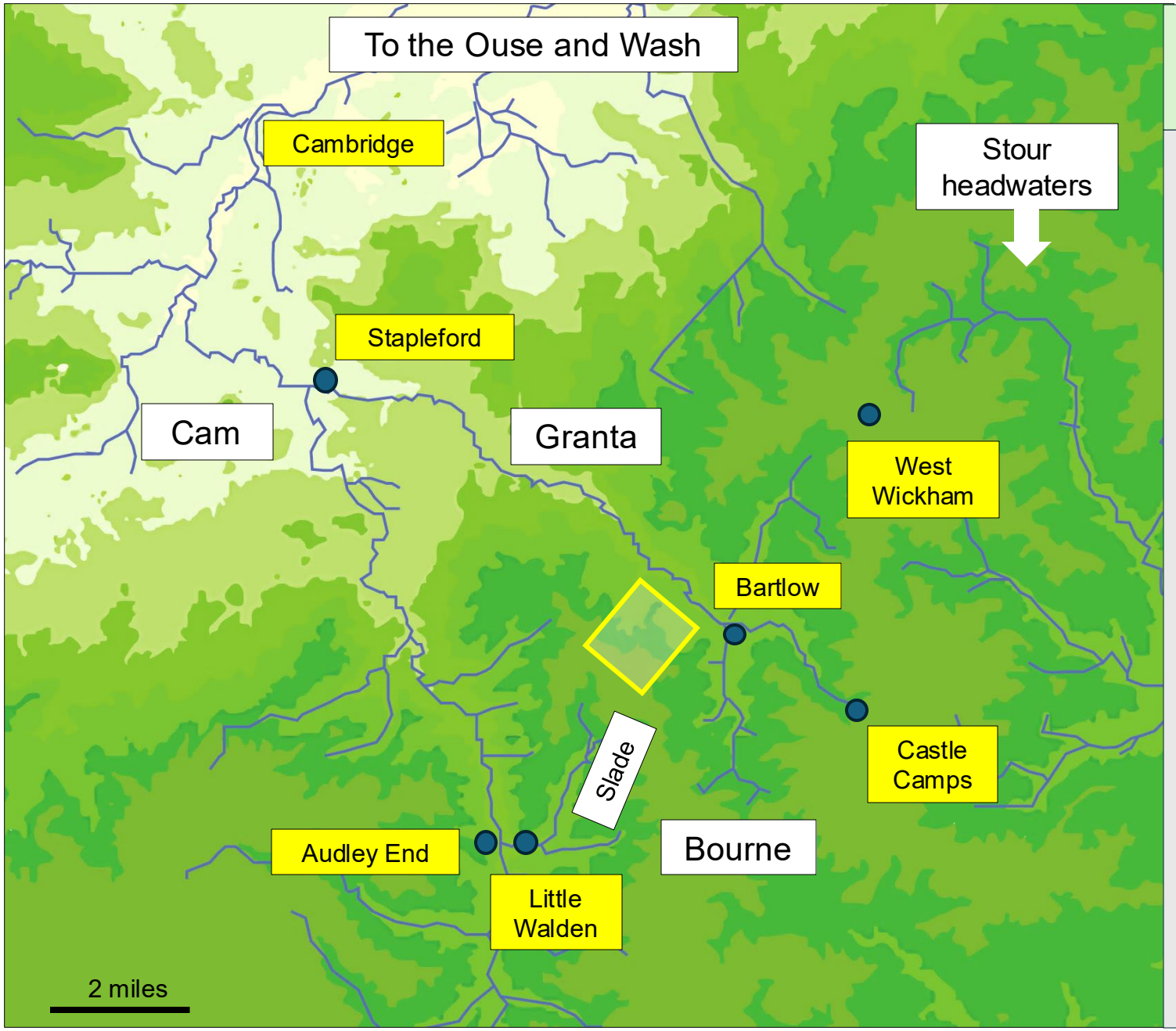
1921 OS map



More Parish quarries and pits

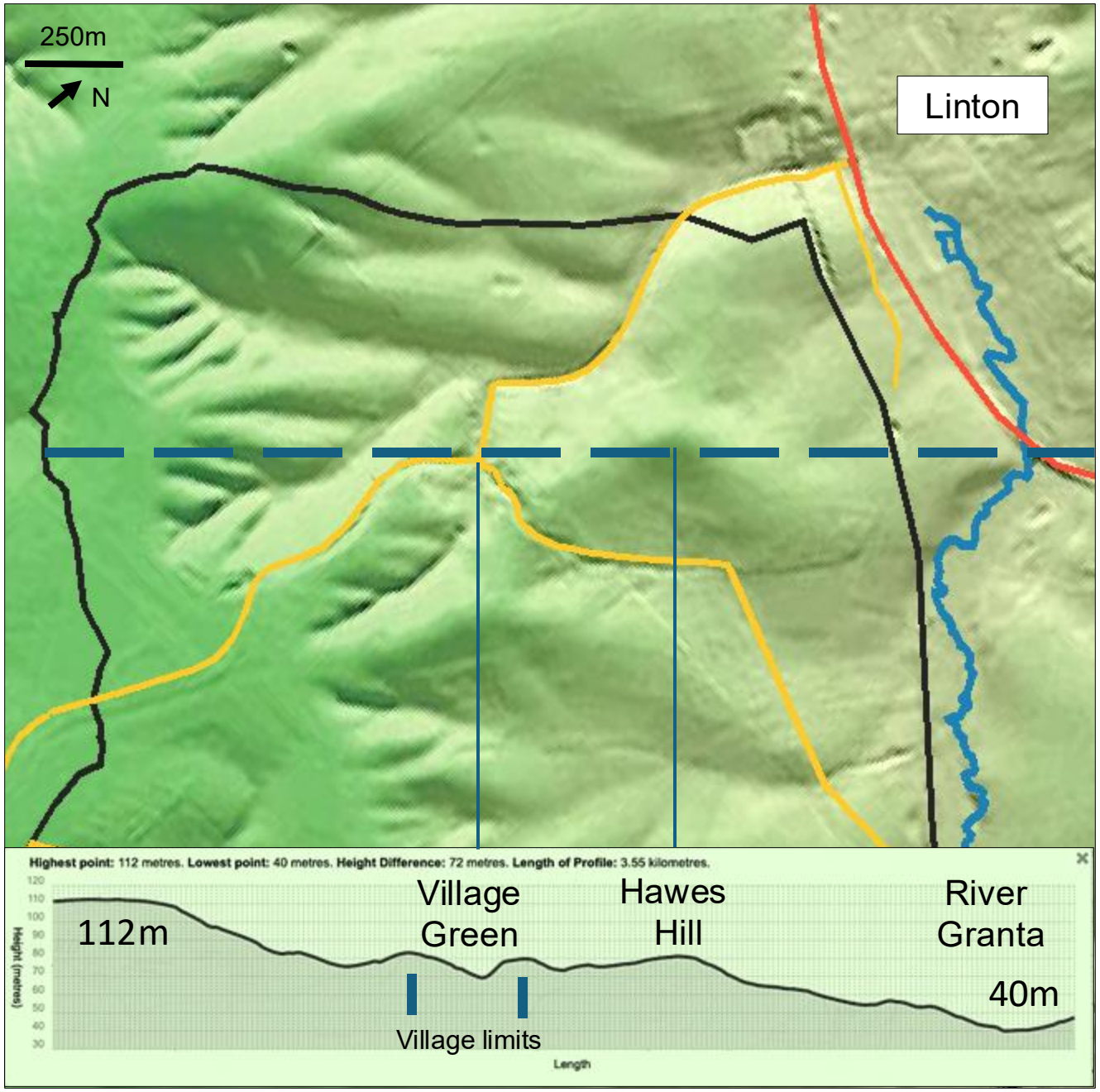
- The 1803/1805 Inclosure maps reveal a large gravel/sand pit off the Bartlow Rd, near the River Granta (see upper left).
- It was the only Parish quarry noted on the maps and was sited in the BGS geology area of river terrace gravel/sand deposits put down in the last 11,000 yrs.
- The Parish 1921 OS map (lower left) shows it had been later abandoned but a chalk pit had opened close to New Farm just off the Bartlow Road.
- The map also shows a large sand pit at the Hadstock/Bartlow boundary on the 65m contour, the same elevation as the gravel outcrop west of Hadstock. Oddly, the former is revealed as a gravel quarry in the OS 1884 Gt Dunmow map.
- LiDAR also reveals a large pit close to the old railway line, no doubt created to help with 1863 construction.

Terrain, Watersheds and Drainage



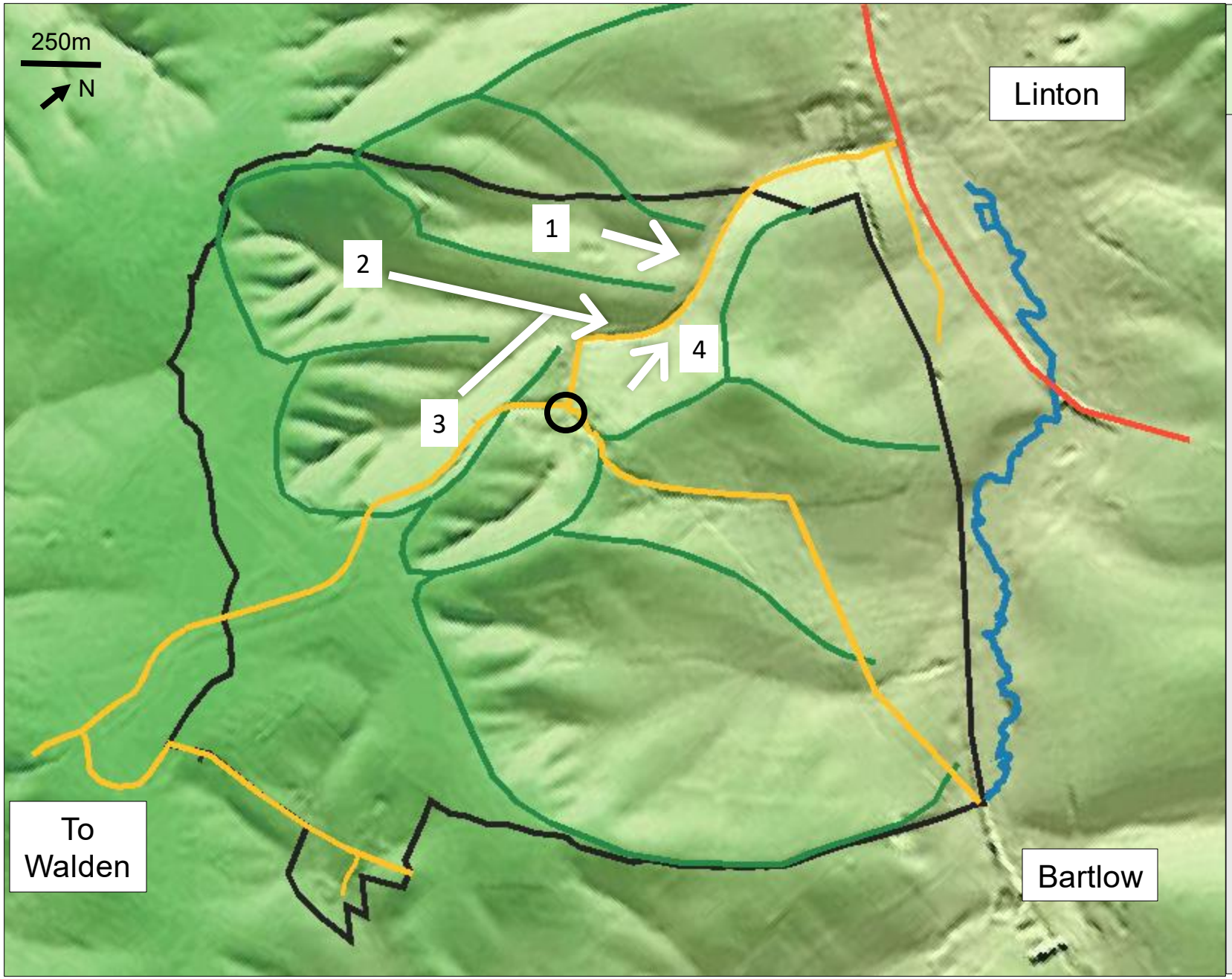
Terrain and drainage
N W Essex / S Cambridgeshire

- Today's river patterns in North-West Essex and South Cambridgeshire have been added to a LiDAR elevation terrain map to show how the Hadstock region is drained both north to the Wash and east to the Essex Coast.
- Hadstock Parish is shown by the yellow rectangle much of it sitting on the northern dip slope down to the river Granta.
- The source of the river Granta is near Castle Camps. The Granta and Bourne merge at Bartlow and flow into the River Cam at Stapleford. Passing through Cambridge, the Cam joins the Great Ouse close to Stretham and then enters the Wash.
- Near to Hadstock, the Little Walden Slade initially flows south-west and joins the River Cam at Audley End and then flows north to Cambridge.
- West Wickham is one source of several streams which drain east, merge at Sturmer to form the Stour river and then flow through Sudbury and out to the Essex Coast at Manningtree.



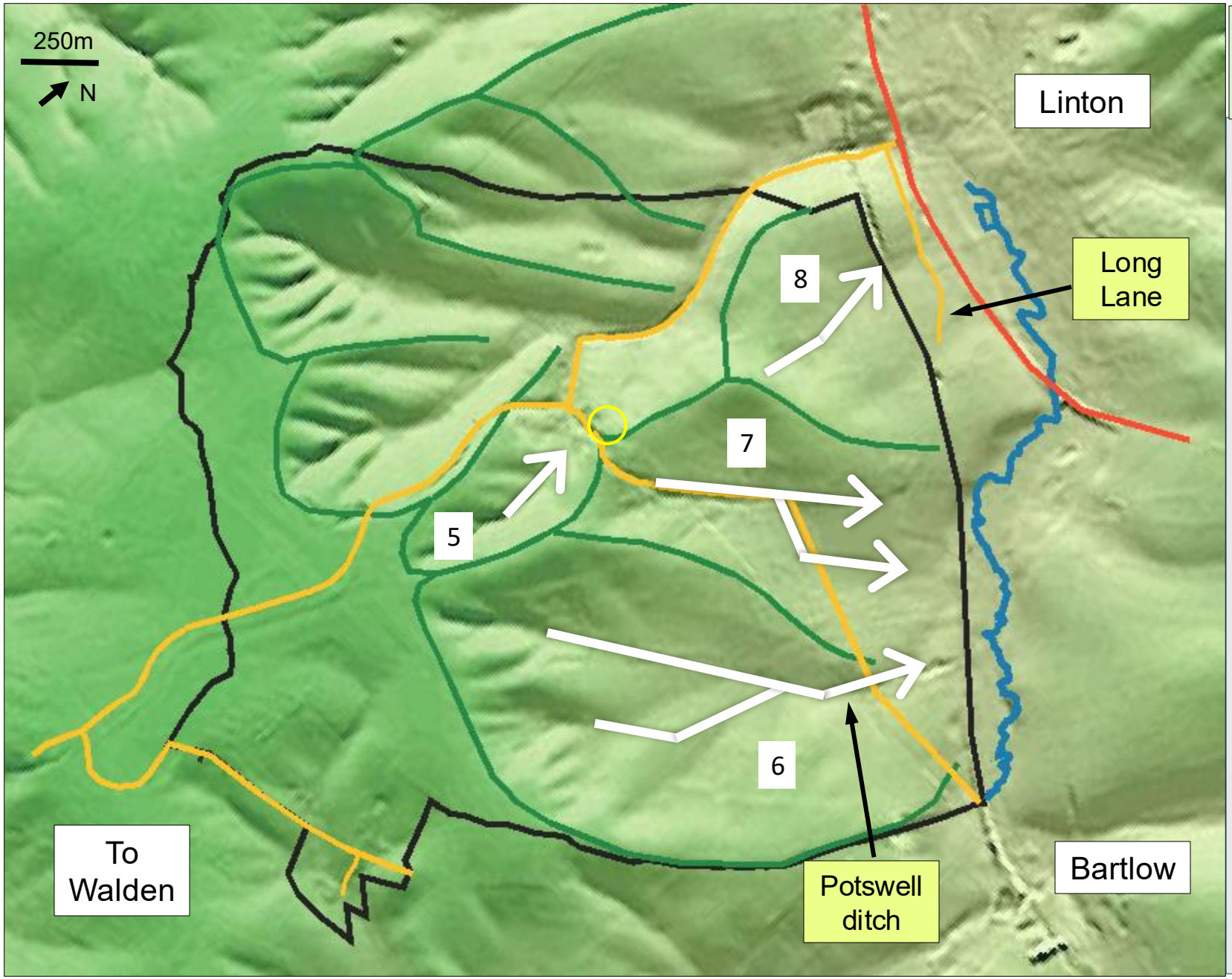
Terrain – Hadstock Parish

- This is a 2020 LiDAR image of the Hadstock area overlaid with the 2024 Parish boundary and main roads, together with the River Granta.
- The map reveals the watersheds, slopes, and drainage channels that have been a feature of the Parish since the Anglian glaciation, 450,000 years ago.
- The flattish south end of the Parish towards Walden (darker green) is a plateau and sits around 70m (230ft) above the River Granta at the northern end of the Parish.
- The elevation change across the Parish along the dashed line is shown in the lower figure.
- This also shows that the village green sits in a small basin and the two marker lines indicate the outer boundaries of most of the village housing, which has been built in and around the basin over many centuries.



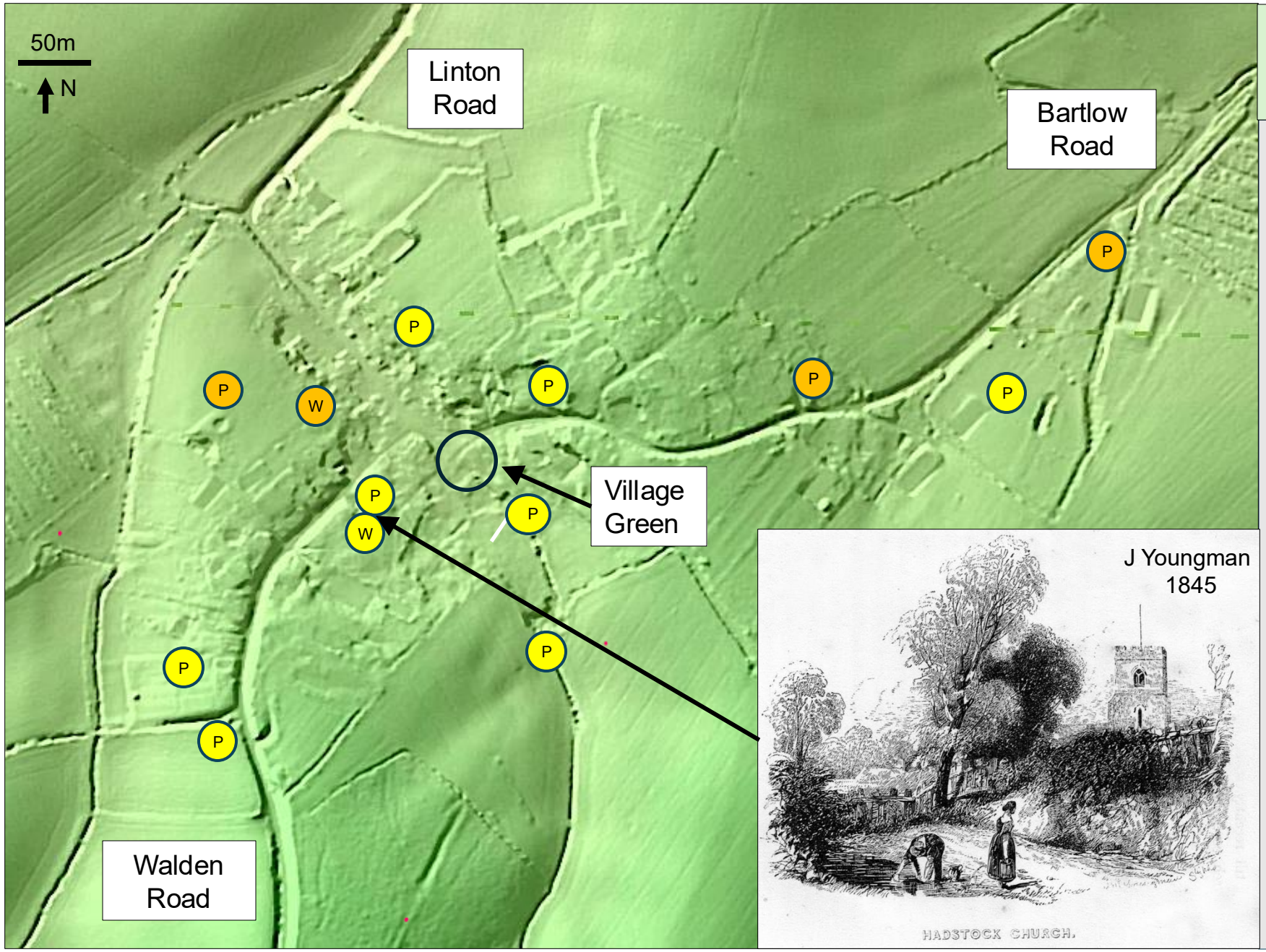
Hadstock watersheds (1)

- The eight watershed areas in the Parish have been outlined with green lines.
- Each watershed shows how surface and ground water is collected over a local area and drains from the 110m (360ft) high plateau in the south down to the River Granta in the north.
- The distinct leaf pattern of the main watersheds in the south of the Parish is indicative of water flow on a steepish slopes where the bedrock has few geological faults and erodes uniformly.
- Hadstock's village green area is indicated by the black ring.
- In the west of the Parish, watersheds 1,2,3 and 4 all lead to the Linton Road and show why heavy rain has caused regular flooding of this route over centuries and continues to do so.



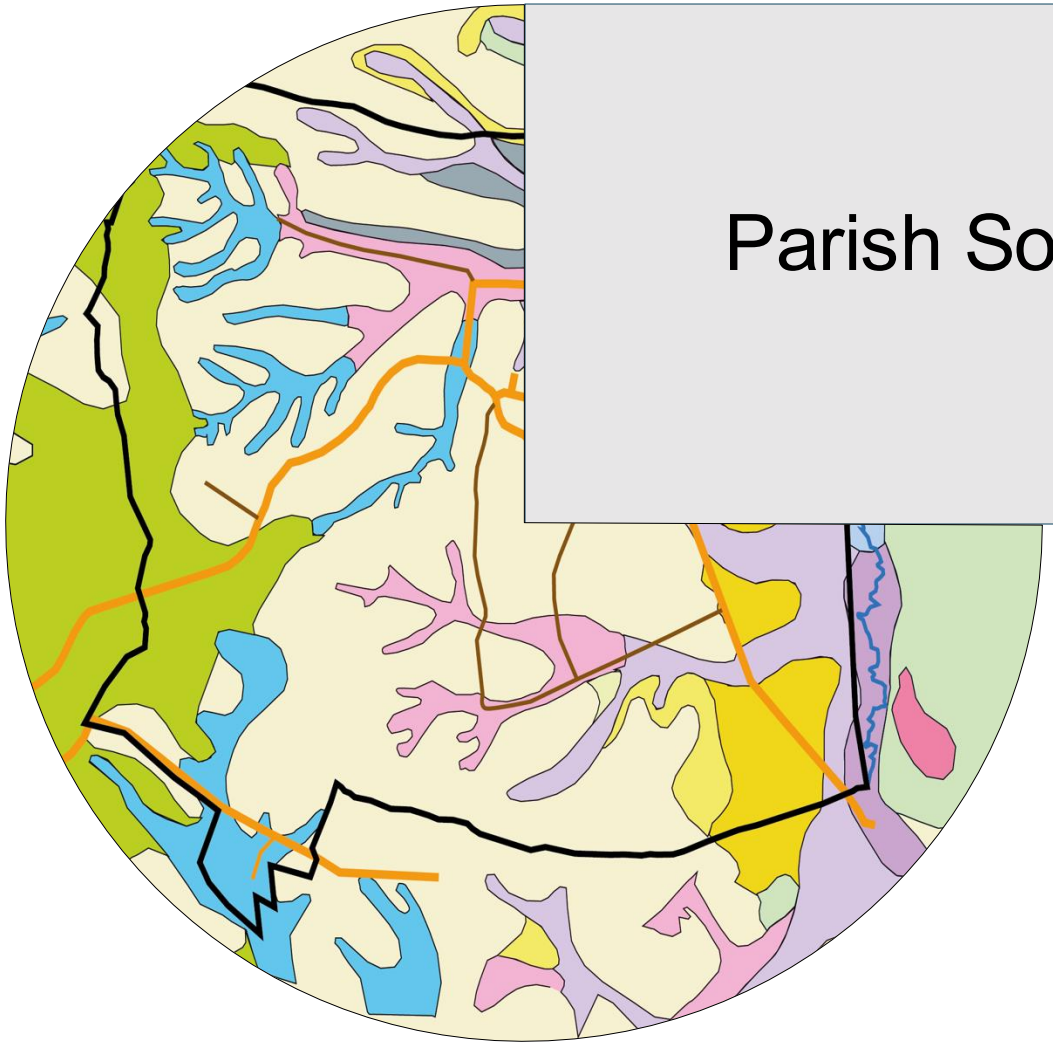
Hadstock watersheds (2)

- Watershed 5 drains water from the area around Hadstock Wood through the small basin containing much of Hadstock village.
- It created several wells/ponds and led directly to the nucleation of the settlement here over a thousand years ago,
- The largest Parish watershed (6) has two collection areas which merge to deliver water to the Potswell ditch. The ditch crosses under the Bartlow Road reaching the Granta via a small spinney.
- Bordered by the high ground of Hawes Hill and the elevated ground reached from Arnolds Lane, watershed 7 delivers streams down ditches alongside the Bartlow Road to reach the Granta either via Chalky Lane or further along the Bartlow Road.
- Watershed 8 feeds ground water from Hawes Hill to meet Long Lane.

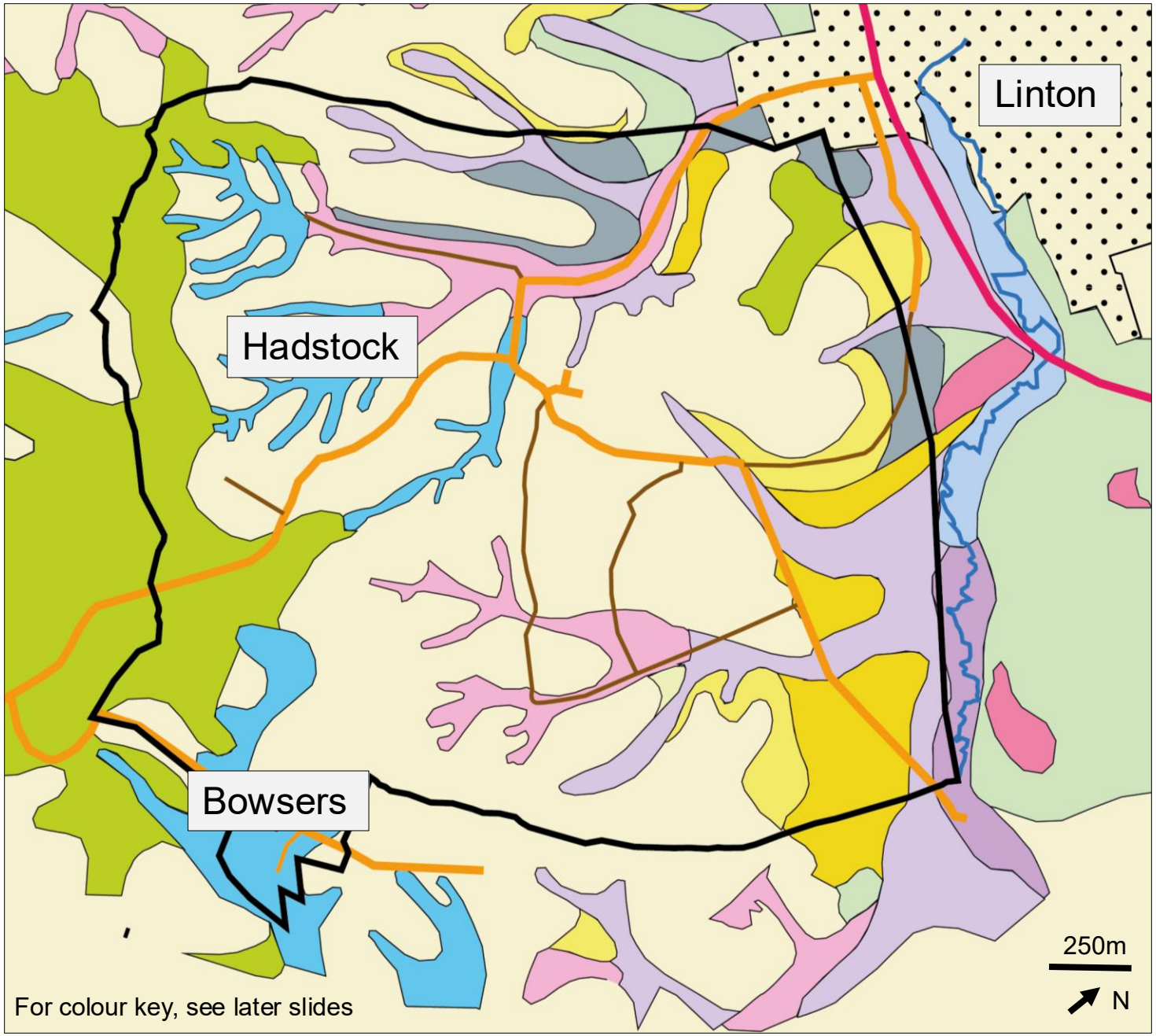


Ponds, wells and springs

- Early maps of the Parish show various ponds (P), wells (W) and springs, some no longer with us. This illustration shows their locations seen from the 1805 Inclosure Award (yellow label) and 1877 OS (orange label) maps.
- They are mostly clustered close to the village. In the 19th century each major farm in the village area had man-made dew ponds for cleaning carts, watering animals etc., such as Morris's farm, Hill farm, Lordship farm and Lower farm.
- St Botolph's Well with its pond below the church (see inset) was the main source of water for the village until mains supply arrived in 1930s. In 1877, there was also a second well behind Davey's farm (now Yew Tree farm).

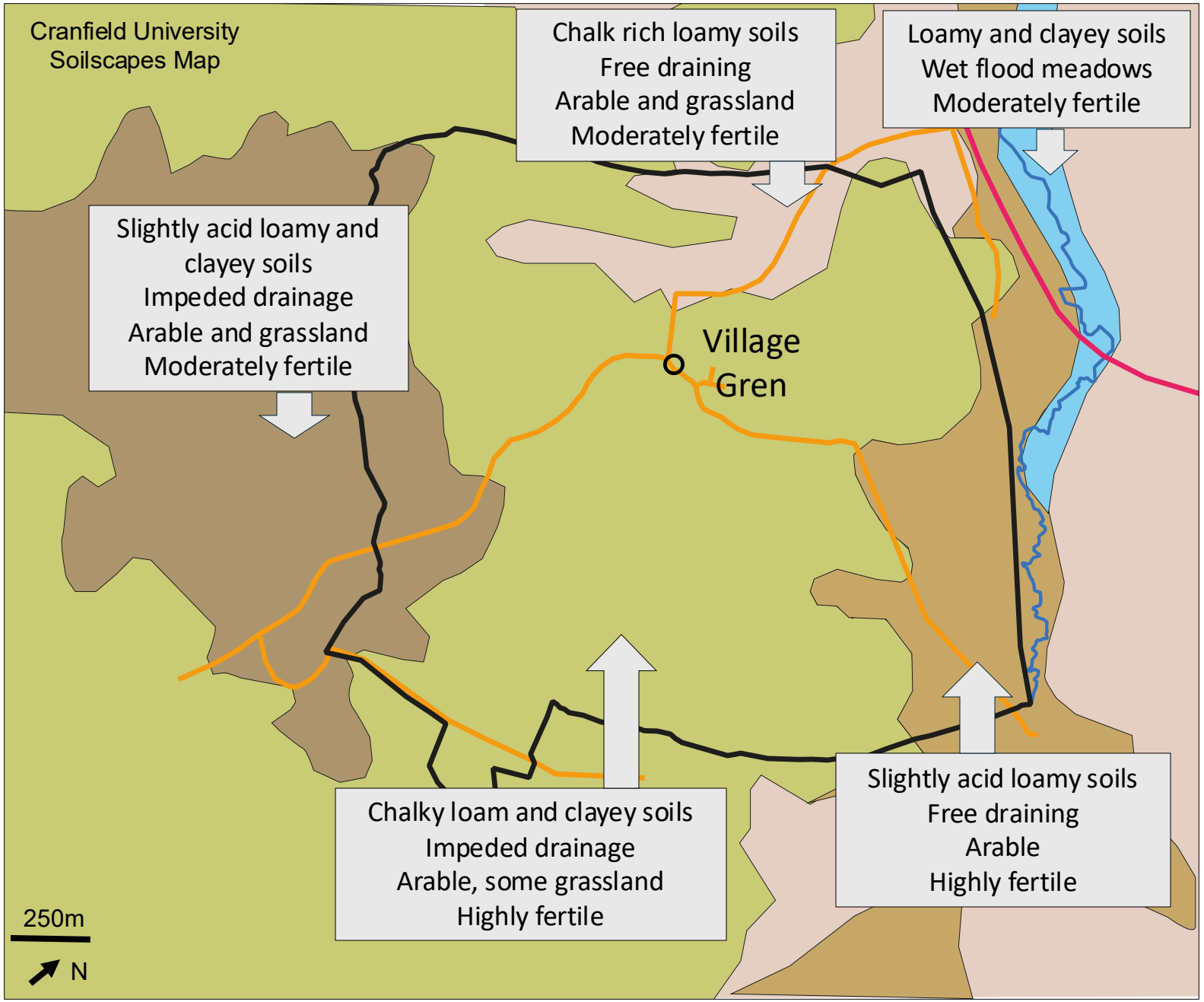


Parish Soils



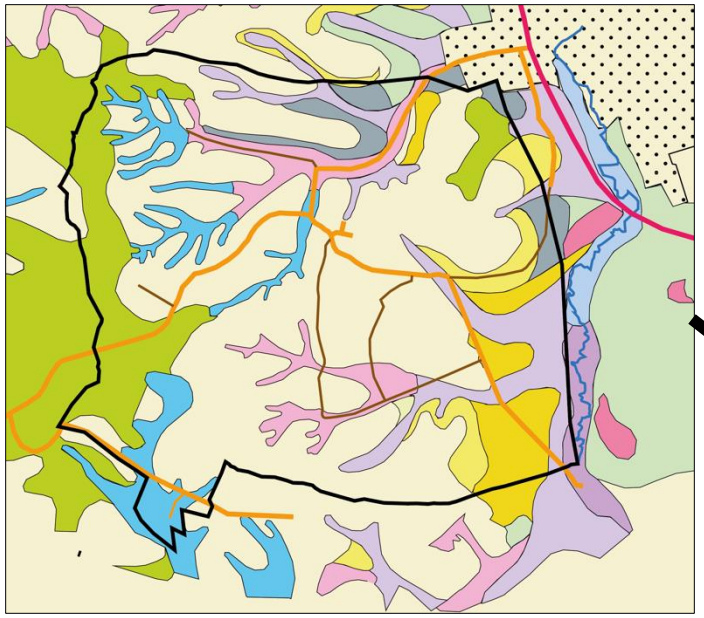
Parish Soils

- This illustration is based on a detailed soil map of Hadstock Parish published in 1985 by the Soil Survey of England and Wales. Surveys were mapped on Ordnance Survey publications at 1:25,000 scale.
- The 2024 Parish boundary is shown in black.
- Each soil type has been given a separate colour. The colour significance is discussed in later illustrations.
- In 1987, the Soil Survey unit was disbanded to form the National Soil Resources Institute in Cranfield University, now incorporated in the Cranfield Environment Centre.
- The Centre then simplified the data by reducing the 753 soil types down to 27 Soilscapes, keeping the maps at the same 1:250,000 scale. These are available online for England / Wales.
- Four of these Soilscapes cover Hadstock and these are shown and discussed next.

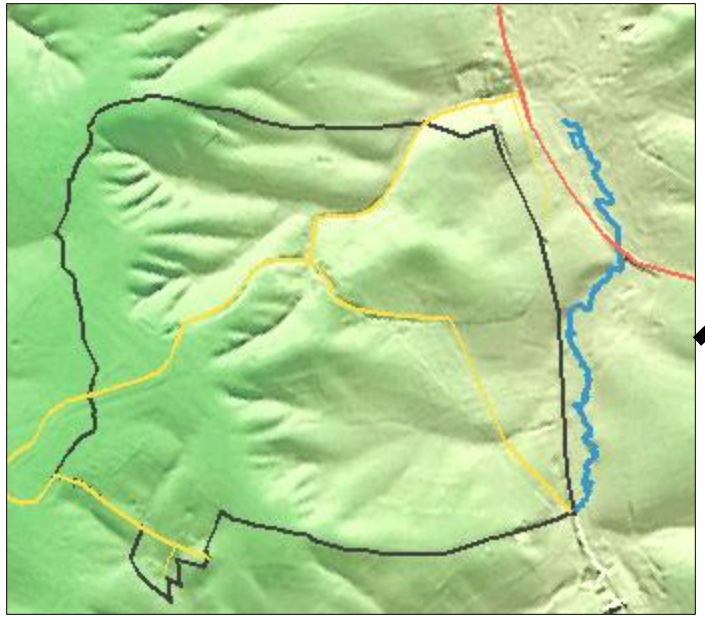


Parish Soilscapes

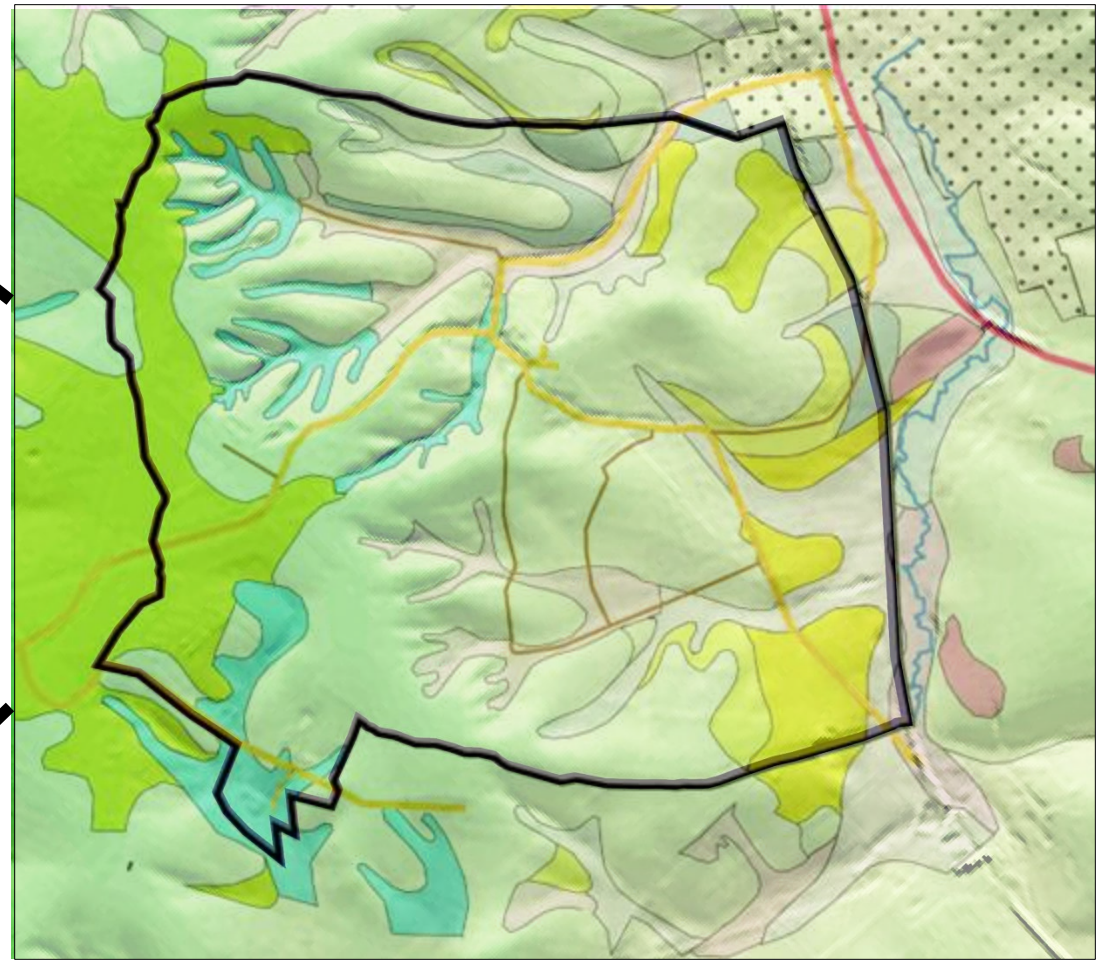
- Soilscape maps and related information are available from LandIS, managed by Cranfield University.
- Soils are classified in 27 soilscapes across England and Wales. In Hadstock Parish today, there are four, as shown in the attached figure. A fifth, associated with the river Granta flood meadows, could be found inside the Parish before 1960s.
- Each soilscape is characterised by (i) description (ii) ease of drainage (iii) form of landcover (iv) level of fertility.
- Drainage improves as the Granta valley is approached in the north of the Parish, and soils become less clayey and slightly acid.
- Soil fertility is good over much of the Parish, with arable crops being the main farm output for centuries.



1985 soil map



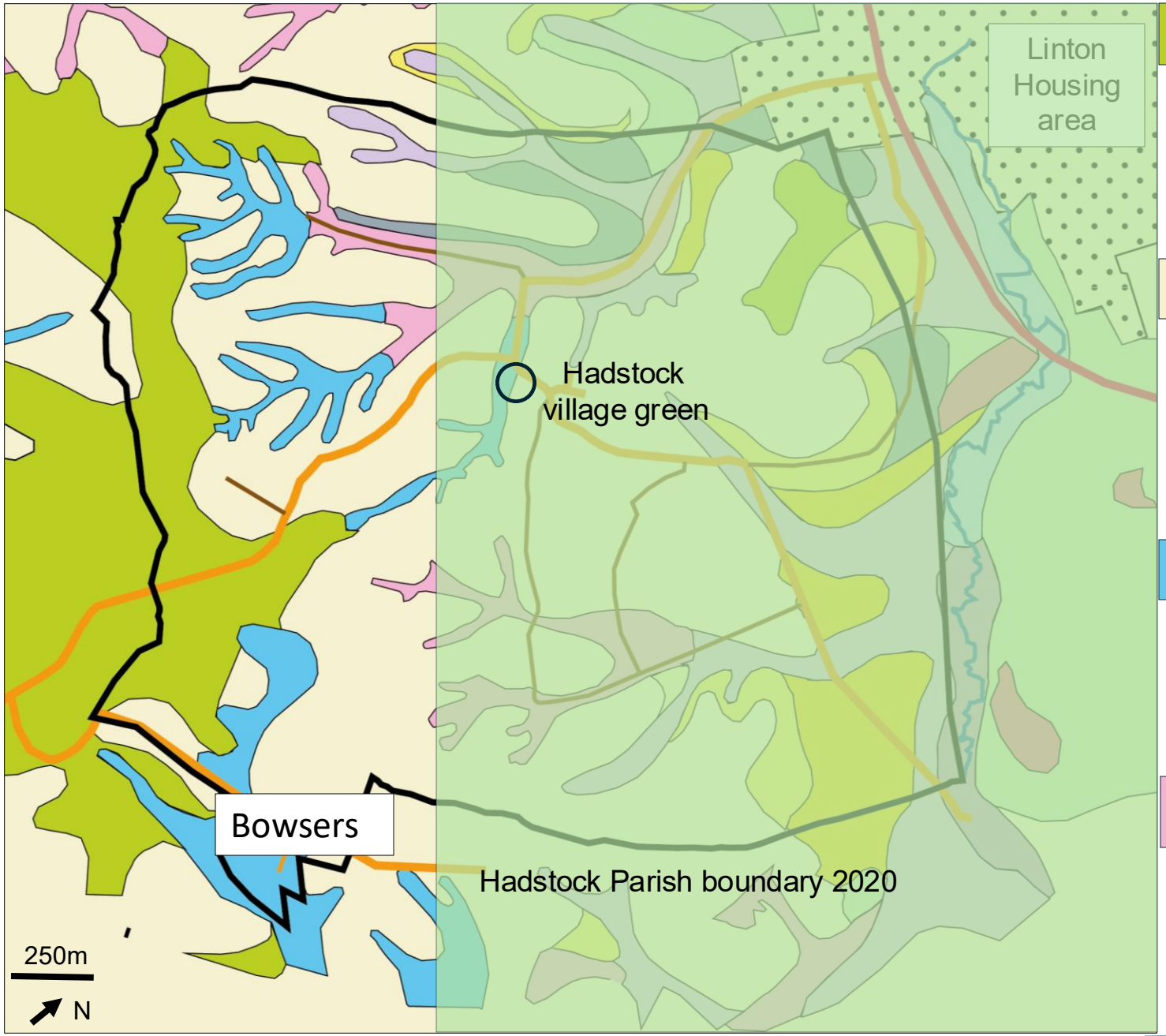
2020 LiDAR image



Merged soil map and LiDAR image

Soils and Terrain

- The detailed Parish soil map of 1985 is shown here, along with the 2020 LiDAR image.
- It is immediately clear that the spatial distribution of the various soil types corresponds to the main watershed areas.
- Merging the two images on the right shows how many of the soil types are coincident with the troughs and small valleys of the main watersheds.



Faulkbourne

Heavy clay loam, not chalky,
Slowly permeable,
Plateau/level ground

Hanslope

Clay loam with chalk,
Slowly permeable,
Valley flanks and upper slopes

Ravenstock

Clay loam, not chalky
Permeable
Troughs and valleys on upper slopes

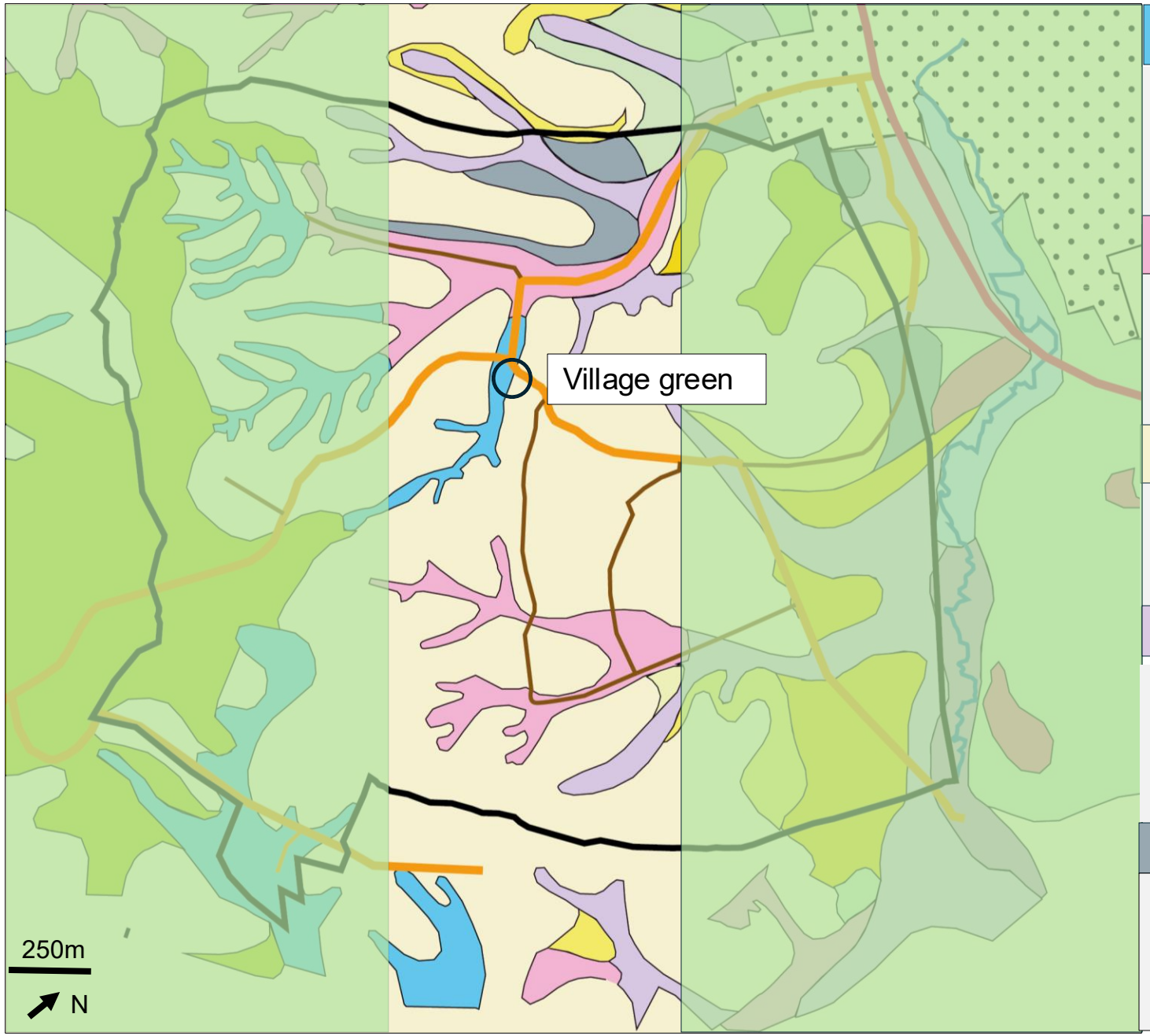
Dullingham

Clay loam, chalky,
Permeable,
Narrow valleys on middle slopes

Soil Types

Plateau and Fringes

- This diagram focuses on the south of the Parish, and the soils types and properties associated with the plateau and the upper slopes.
- The till plateau mainly comprises Faulkbourne chalk-free soils on level ground, with Hanslope chalky soil on moderate to steep slopes. Both can show slight waterlogging at times and cracking in dry conditions.
- Good draining loam soils of the Ravenstock and Dullingham series are found in troughs / small valleys on upper /middle slopes, caused by rain wash off valley sides.



Ravenstock

Clay loam, not chalky,
Permeable
Narrow valleys on upper slopes

Dullingham

Clay loam, chalky,
Permeable
Narrow valleys and middle slopes

Hanslope

Clay with chalk
Slowly permeable
Upper/middle slopes

Moulton

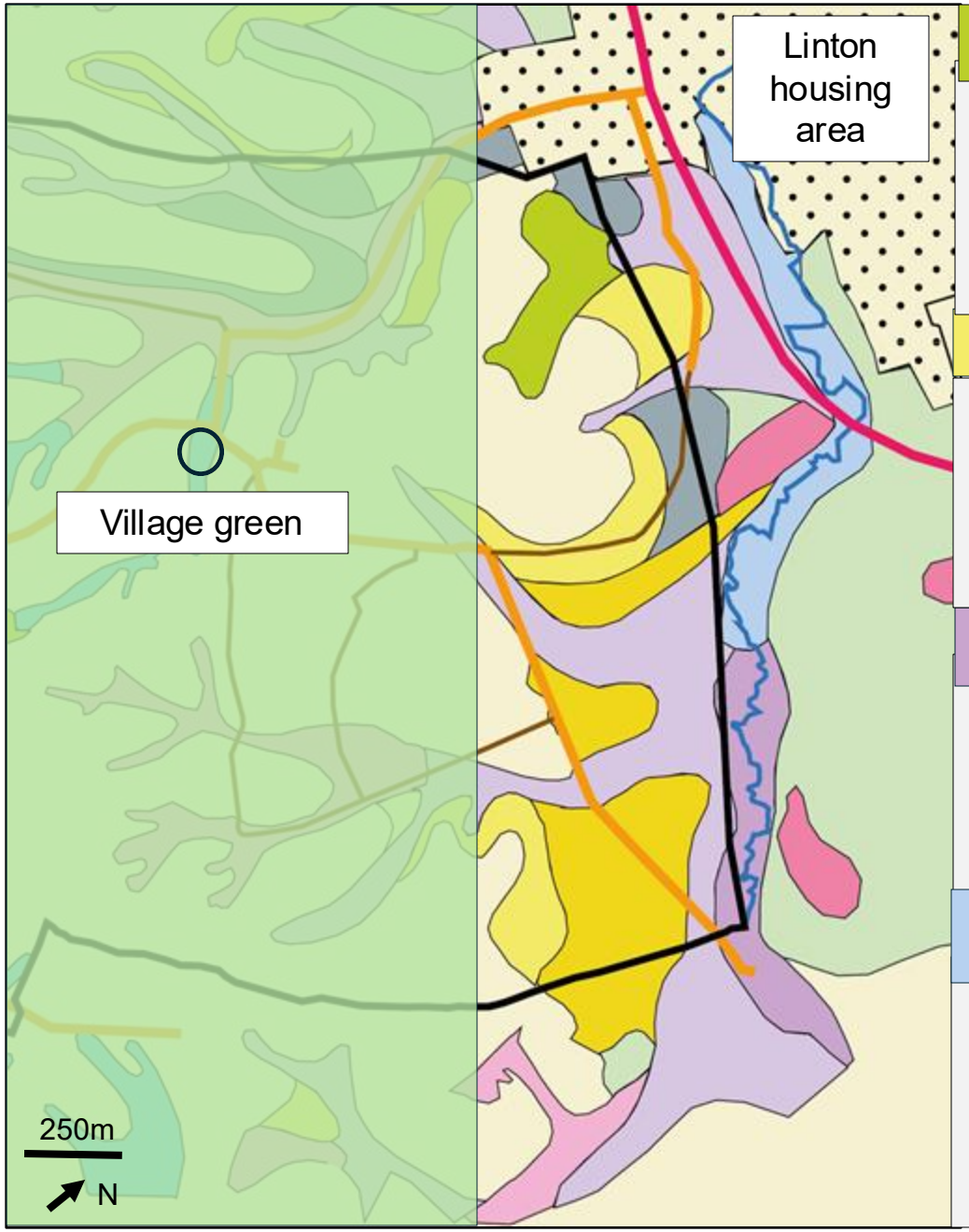
Chalky sandy loam,
Permeable
Valley flanks in middle slopes

Soham

Chalky sandy clay loam
Permeable
Middle slopes

Soil Types
Middle Slopes

- In Parish areas closer to Hadstock, the dominant soil type is Hanslope, which occupies c70% of the middle slope area.
- Chalky loam Dullingham soil can be seen in the troughs and valley floors of the main watersheds.
- There are adjacent areas of Moulton sandy soil in middle to lower slopes which stretch down to the flood plain of the Granta.
- Small areas of Soham loamy soil occur on the slopes in the west of the Parish but are more clayey and less sandy than the Moulton series.



Faulkbourne

Heavy clay loam, not chalky,
Slowly permeable,
Plateau / level ground

Melford

Clay and clay loam
Permeable,
Lower slopes

Linnet

Chalky clay,
Permeable,
Less wet than Thames flood plain

Thames

Chalky clay,
Permeable,
More wet than Linnet flood plain

Moulton

Chalky sandy loam,
Permeable,
Adjacent to flood plain

Soham

Chalky sandy clay loam
Permeable
Middle slopes

Frilsham

Clay/Sandy clay loam
Permeable,
Lower slopes

Newmarket

Sandy/clay loam,
Permeable,
Lower slopes

Swaffham Prior

Chalky sandy loam over chalk rubble
Permeable,
Lower slopes

Soil Types

Lower Slopes / Flood Plain

- This image focuses on the land around the river Granta.
- Most soil types on the lower slopes are well drained.
- There is less clay and increasing sand in the soil as the river is approached. All five of the soil series shown in the right-hand key comprise sandy loams.

Summary

- Hadstock village sits in small north-west facing basin halfway down a 70metre (230ft) high chalk escarpment of the East Anglian heights, which is the north edge of the London Basin.
- The bedrock of the Parish is mainly Lewes Nodular chalk, formed c90m years ago.
- The superficial deposits lying over the chalk comprise Lowestoft chalky till, a mixture of clay, chalk, sand, gravel, flints and boulders.
- There are some sand and gravel outcrops on north facing upper slopes at the 65m (220 ft) level. There were several quarries associated with these outcrops in the 18/19/20thC.
- There are 8 watershed areas in Hadstock which drain water down to the river Granta via field and roadside ditches.
- There are 4 Soilscapes in the Parish, ranging from slightly acid loamy and clayey soil on the plateau to chalky loam and clayey soils on north facing slopes (both of impeded drainage) to free draining slightly acid loamy soils near the river Granta.
- Within these 4 Soilscapes are 12 individually named Soil series which can be found on the plateau, the slopes and the flood plain.

Hadstock Hedges, Houses, and Trees