Harrow & Hillingdon Geological Society

Chalk Connections

Rock layers to be found at the surface in our area (youngest to oldest):

Brickearth

Gravel and sand

Clay

Flint pebbles

Chalk

What is the connection between the gravel, flint pebbles and the underlying Chalk?

The Gravel Connection

Gravel has been deposited across our area by the River Colne and the ancestral River Thames

The Colne Valley Regional Park enjoys the legacy of gravel extraction with over 60 lakes filling former gravel pits.

Most of the gravel comprises small pieces of flint, transported by rivers and broken down over time. Flint only forms in chalk.

Summerleaze
a carbon negative group

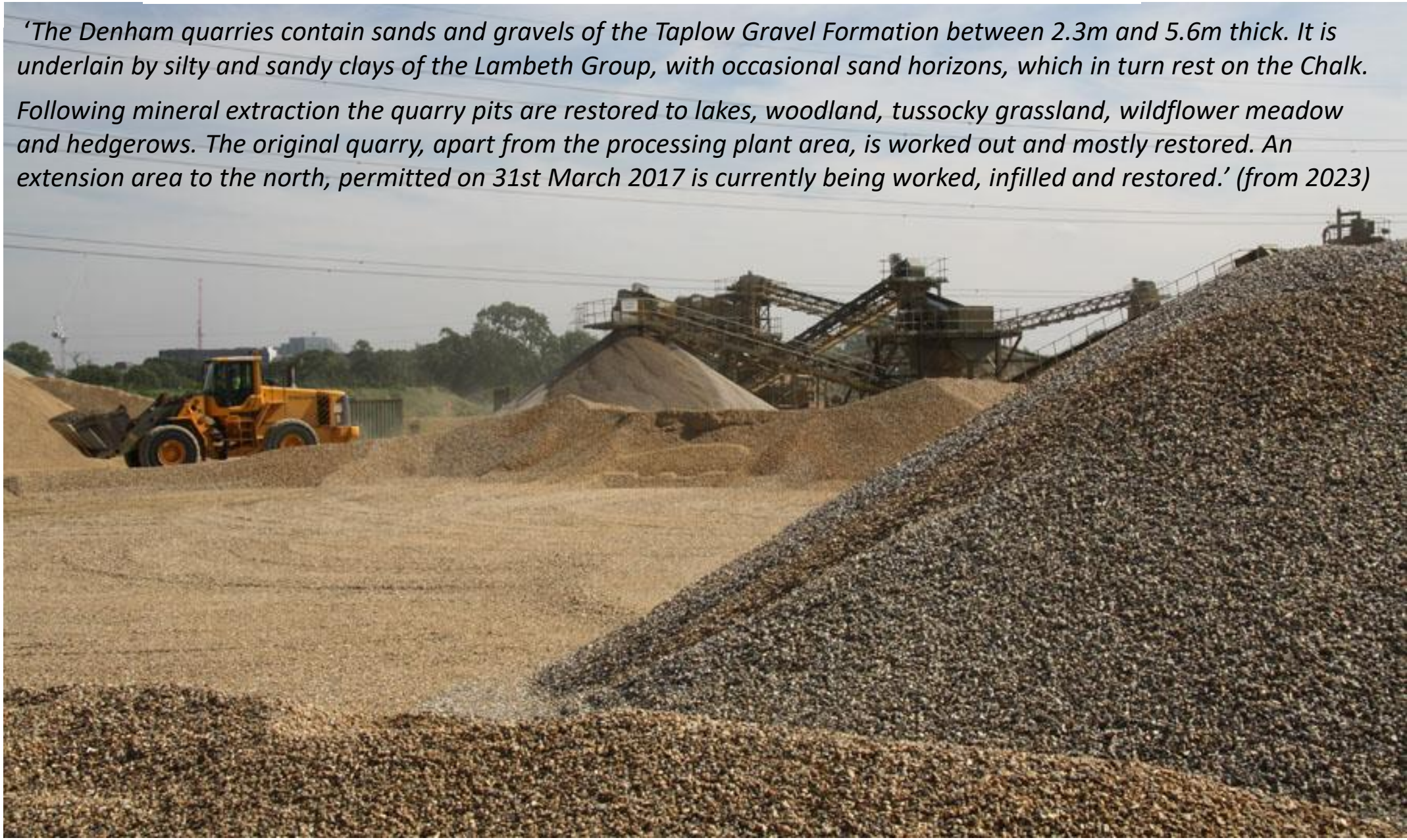
[Aggregates - Summerleaze]

The quarry at Denham in Buckinghamshire contains 2.4 million tonnes of high quality sand and gravel aggregate. A strategic partnership between Summerleaze and London Concrete has meant that much of the high quality aggregate at Denham is supplied directly to the on-site concrete plant, thereby removing unnecessary vehicle movements.

The New Denham Quarry can be seen on this image from Google Earth

Summerleaze
a carbon negative group

Aggregates – Summerleaze (see Summerleaze website for more detail)



'The Denham quarries contain sands and gravels of the Taplow Gravel Formation between 2.3m and 5.6m thick. It is underlain by silty and sandy clays of the Lambeth Group, with occasional sand horizons, which in turn rest on the Chalk.

Following mineral extraction the quarry pits are restored to lakes, woodland, tussocky grassland, wildflower meadow and hedgerows. The original quarry, apart from the processing plant area, is worked out and mostly restored. An extension area to the north, permitted on 31st March 2017 is currently being worked, infilled and restored.' (from 2023)

Geological maps show Shepperton Gravel in this area with alluvium above.

Worked out quarries nearby in the Colne Valley have been extracting Shepperton Gravel, which is the youngest of the Thames gravels.

The Flint Connection

We find huge quantities of flint across our area. So where did all this flint come from?

Chalk bedrock exposed at the surface in Harefield.

Fresh flint nodules emerge from the chalk.

The white cliffs of Harefield, Summerhouse Lane quarry

Resistant bands of flint nodules within the chalk are exposed by weathering and erosion, then fall to the quarry floor.

Bands of flint nodules can be seen within the chalk rock face

What is Flint?

Flint is a sedimentary rock made of silica, which forms in chalk. The process of formation is very complex as the silica accumulates in the seabed burrows of creatures like lobsters.

Chalk is made up the calcium-rich skeletons of plankton which once accumulated in great quantities on the seabed.

As well as plankton, there were also living organisms such as sponges which contained silica in their skeletons. As the seabed was compressed over time, the silica turned into a gel which filled burrows and other voids on the seabed, and this eventually hardened to form flint.

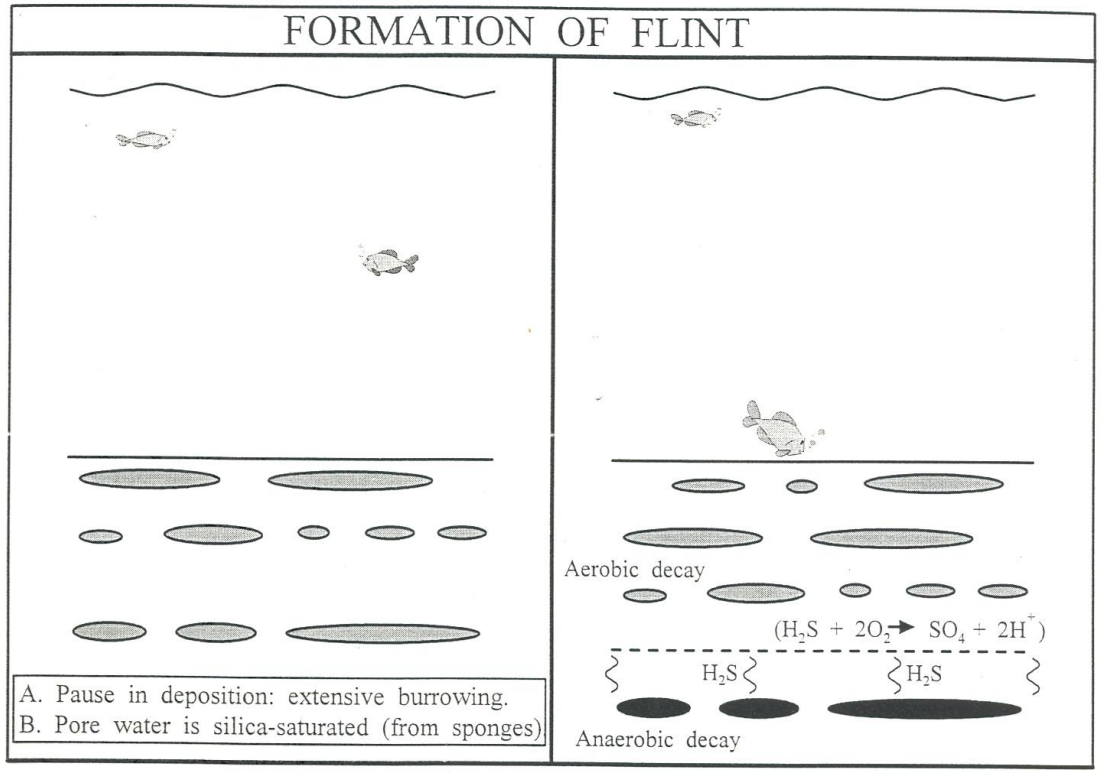


Diagram and explanation by the Surrey RIGS Group, 1999

1. A halt in deposition of the chalk.
2. Seabed animals create a layer of shallow burrows, rich in organic matter.
3. Chalk deposition resumes (chalk pore water is saturated with silica, from solution of sponge skeletons).
4. As the burrow layer is slowly buried, the organic matter within it decays aerobically (the bugs obtain their oxygen from the pore water).
5. By about 5m to 10m depth (also locally at shallower depth), the available oxygen in the pore water has been consumed, and decay continues anaerobically, giving off hydrogen sulphide gas.
6. The hydrogen sulphide rises through the chalk into the overlying aerobic layer, where it is oxidised by the bacteria in the burrow fills. This produces sulphate and hydrogen ions. The hydrogen ions cause acidic conditions which dissolves the chalk, with simultaneous precipitation of silica (contained in the pore water) to produce flint.

Flint is seen in the chalk cliffs and lying all around on the ground.

Fossils are found in the chalk and flint.

Dingles Chalk Mine, Pinner

Harrow & Hillingdon Geological Society site visit, 13 October 2001

Seven mines have been found in and around North Pinner. The earliest record in 1388 described 'marlpits', suggesting that the chalk was used on farms for agricultural purposes.

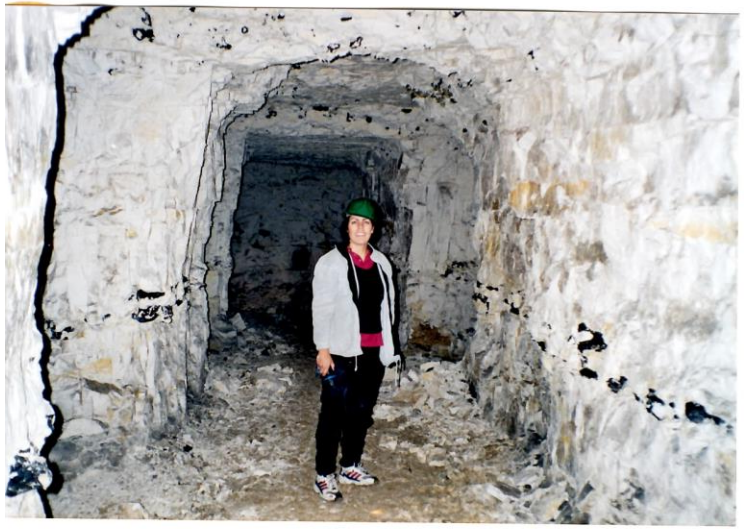
Huge volumes of chalk have been removed from beneath Pinner, leaving an extensive network of tunnels.

Most of the quarrying was done in the 19th Century, and the chalk was used for brick making and for soil improvement on local fields.

PINNER CHALK MINE
13 OCT 2001

A FALL IN THE 1840 MINE

? READING BEDS NOT SUPPORTED HERE BY PUDDING STONE (WHICH WAS NOT SEEN)

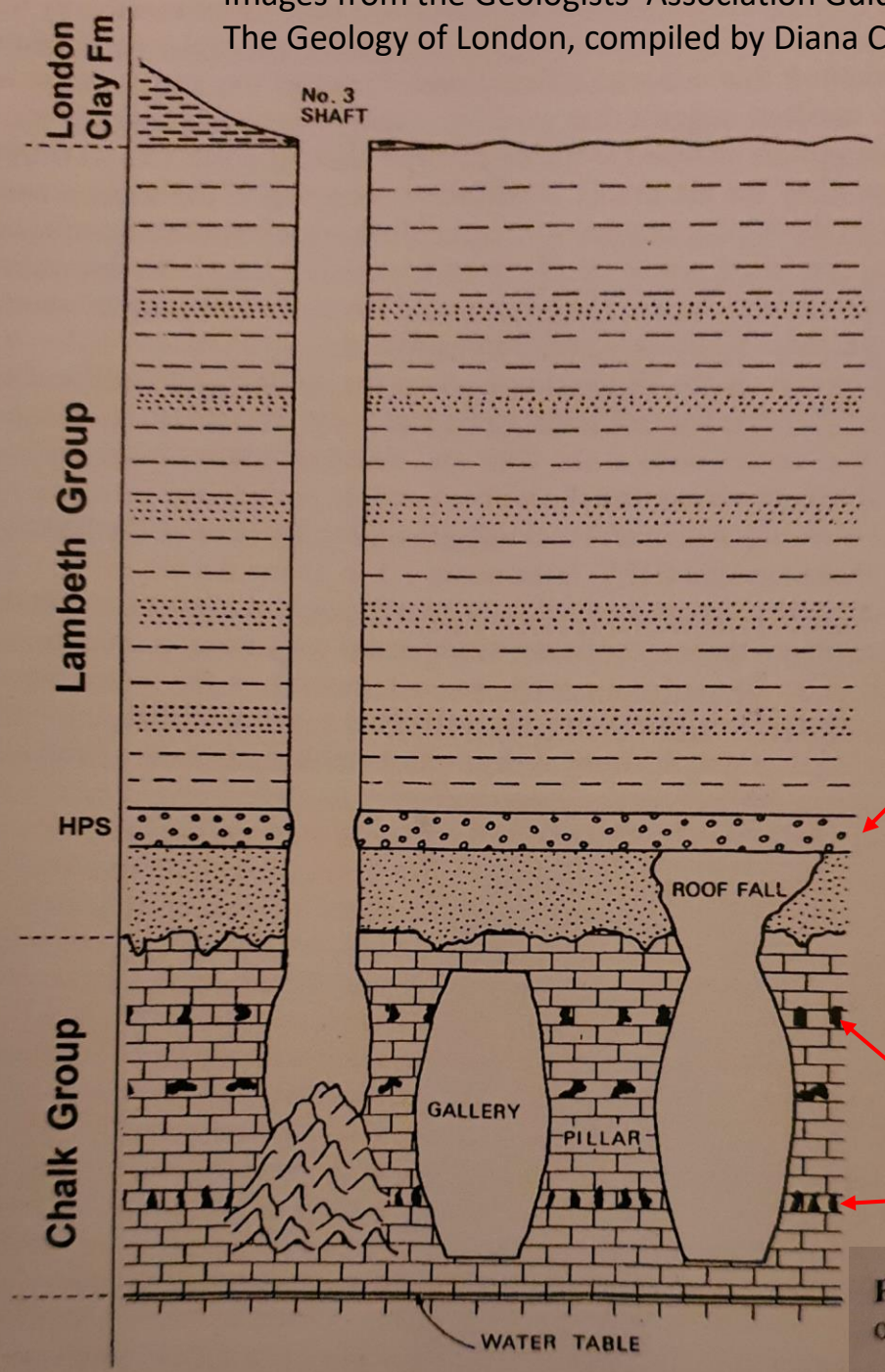


A GALLERY IN THE 1840 MINE.

NOTE NODULAR FLINTS

Images from the Geologists' Association Guide No.68:
The Geology of London, compiled by Diana Clements

Dingles Chalk Mine, Pinner



Above the chalk in Pinner we find a layer of Hertfordshire Puddingstone which is very hard and protects the tunnels from collapse.

Cementation indicates that the puddingstone formed in a hot climate at the time of the Paleocene-Eocene Thermal Maximum.

Flint layers

Dingles Chalk Mine in 2001 *(Photo: Bryan Cozens)*

Figure 22. Section through the Dingles Mine showing the geology and method of working. HPS = Hertfordshire Puddingstone. (*After Gallois, 1982*)

Chalk Group
White Chalk subgroup
Seaford Chalk Formation

Hertfordshire Puddingstone

The ‘puddingstone’ above the chalk in Pinner is composed of ancient pebbles in a naturally formed cement. The cement is silica-based, making it as tough as the pebbles within it.

Hertfordshire Puddingstone from a roof collapse in the Pinner Chalk Mines Length of clast is c. 10 cm
Source: Diana Clements (collection J. Pester)

Guide to London's Geological Sites (londongeopartnership.org.uk)

Hertfordshire Puddingstone – East Herts Geology Club (ehgc.org.uk)

“Found mainly in Hertfordshire with further sources in east Buckinghamshire and to a lesser extent west Essex. Most of it has derived from glacially disturbed Tertiary deposits on the Chilterns (‘Plateau Drift’) and has been moved from its source either by ice or by man. Much has been taken, mainly in the Roman period, so that Hertfordshire Puddingstone is actually an uncommon rock today. But where it does occur it cannot be missed; and since it is resistant to frost and other agents of weathering it is virtually indestructible.”

https://www.hertsgeolsoc.org.uk/puddingstone/

The Cement Connection

Chalk in cement manufacture

'Chalk has a special status in the history of cement manufacture, because, although Joseph Aspdin's "Portland Cement" of 1824 was made with Carboniferous Limestone, "Portland cement as we know it today" was first made commercially by William Aspdin in 1842, using Thames estuary chalk, and in the early industry, both in Britain and abroad, it was used almost exclusively.

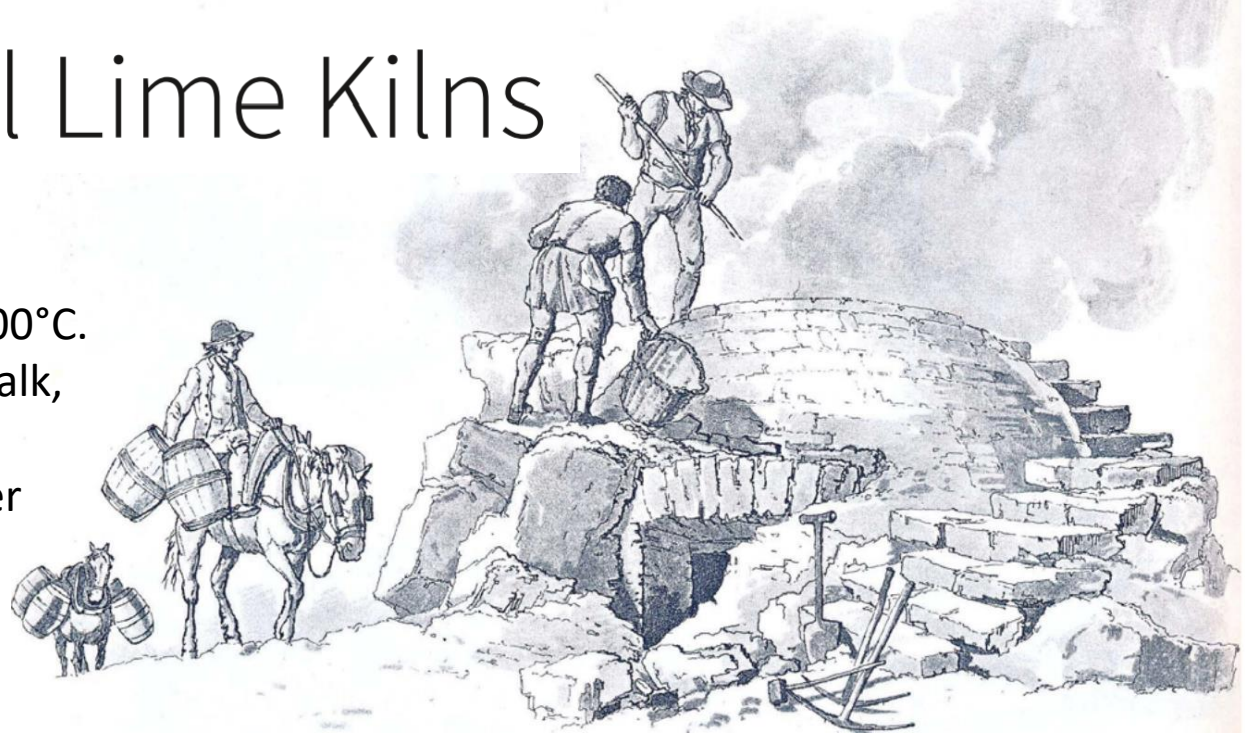
Chalk is a rock differentiated from other limestones by its softness, open structure and high moisture content. It is formed from the skeletal remains of plankton which settle on the sea bed in a loose, porous bed, and subsequent welding of the particle contacts preserves this structure, even under pressure. The high moisture content is almost never mentioned in texts, although it is a major pre-occupation for cement manufacturers: the structure of chalk is very much like a sponge, and water continually flows through its body as well as through joints and cracks.' Cement Plants: Chalk Raw Materials (cementkilns.co.uk)

A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete.

Cement is produced by heating limestone/chalk and clay minerals to form clinker, and after grinding adding 2-3% of gypsum. The most common type is known as portland cement - ordinary portland cement (OPC) is grey but white portland cement is also produced. It was developed from other types of hydraulic lime in England in the early 19th century by Joseph Aspdin and named 'portland' because it resembled Portland stone.

Historic England

Pre-industrial Lime Kilns



A lime kiln was a structure used to manufacture lime (calcium oxide) by burning calcium carbonate at temperatures above 900°C. The calcium carbonate burned was commonly limestone or chalk, but occasionally other materials such as oyster or egg shells. Most lime, also referred to as ‘quicklime’, was mixed with water water, a process known as ‘slaking’, to produce hydrated lime (calcium hydroxide). This product formed the basis of plasters, mortar and concrete.

The simplest method of producing lime was by using a ‘clamp kiln’. This was not really a kiln at all, but layers of fuel and limestone stacked together in a mound, covered with clay or turf and slowly burned in a method similar to that used in charcoal burning. The remains of such ‘kilns’ comprise merely a hearth on the floor of a pit, measuring up to 2.5 m in diameter and up to 2 m in depth.

[Historic England – Pre-industrial Lime Kilns – Introductions to Heritage Assets]

More sophisticated stone- or brick-built lime kilns were of two basic types: ‘Flare kilns’, also known as ‘intermittent’ or ‘periodic’ kilns; and ‘perpetual’, ‘running’ or ‘draw’ kilns. As their name suggests, ‘flare kilns’ were loaded with a single charge of limestone and burning had to stop for this to be removed before it could be re-loaded for the next firing. ‘Draw’ kilns were loaded with alternate layers of fuel and stone which was kept burning continuously while further supplies of raw material and fuel were fed in at the top and the lime was drawn off at the bottom. Both types had the same basic structure, consisting of a thick-walled stone chamber with a hearth at the base.

Harefield Cement Kilns

https://www.cementkilns.co.uk/cement.html

Established as Coles Shadbolt Works, the site was originally developed for brickworks. Coles Shadbolt made Roman Cement on the Regent's Canal in Islington, and a dock on the Grand Union Canal was constructed at Harefield to ship bricks to Islington. In charge of this, Percy Shadbolt, recognised the suitability of the site for Portland cement.

Location:

- Grid reference: TQ04868985
- x=504860
- y=189850
- 51°35'52"N; 0°29'10"W
- Civil Parish: Harefield, Middlesex

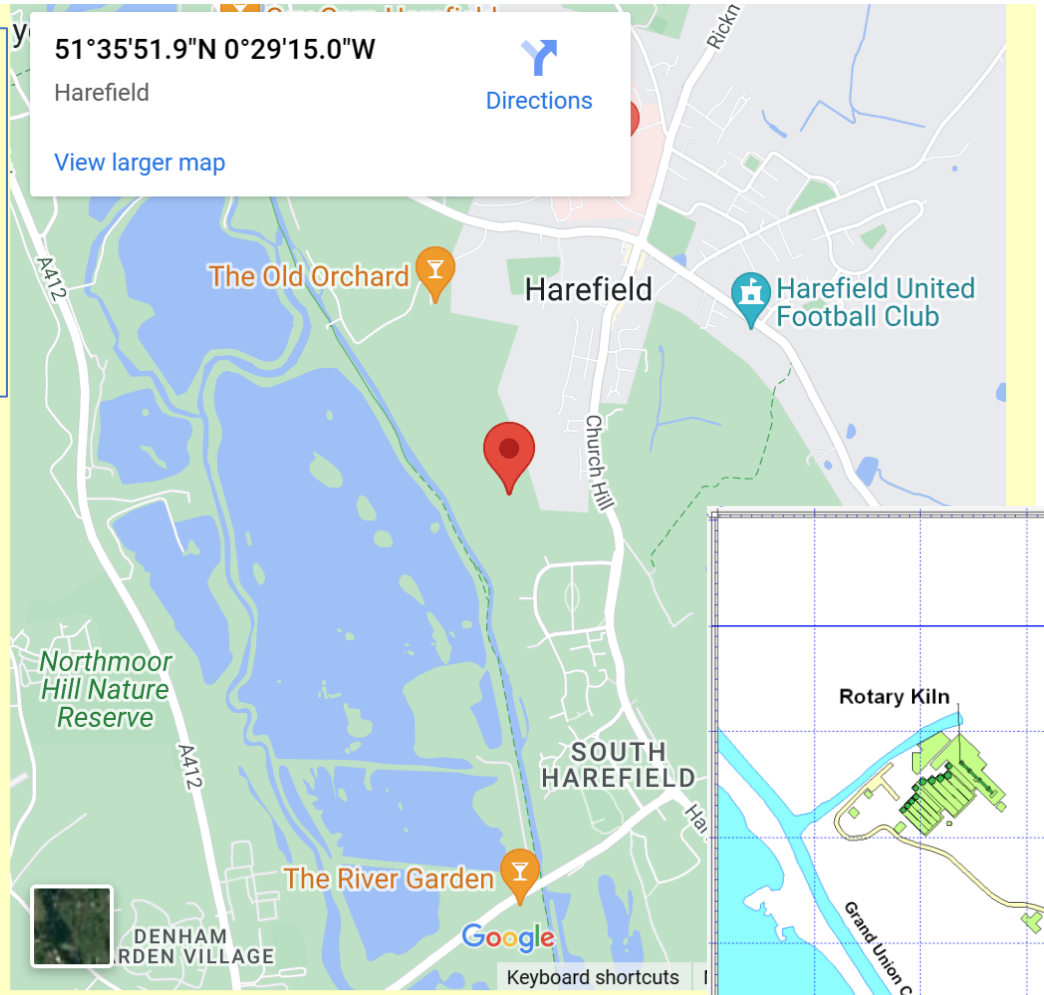
Cement clinker is a solid material produced in the manufacture of Portland cement as an intermediate product, Clinker occurs as lumps or nodules usually 3-25mm across. It is produced by heating limestone and clay/shale in the cement kiln stage. Difference between Roman and Portland cement

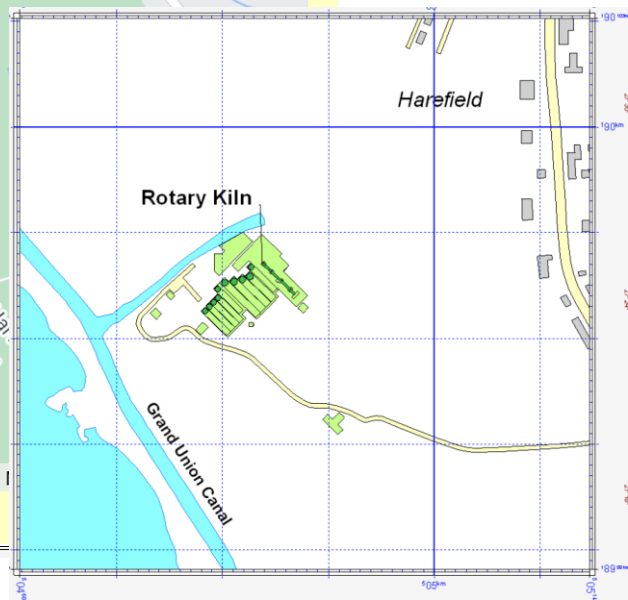
Clinker manufacture operational: 1880-7/1929

Approximate total clinker production: 790,000 tonnes

Raw materials:

- Upper Chalk (Seaford Chalk Formation: 85-88 Ma) from pits at
  - 505050,189750
  - 504950,189950
  - 504850,190000
  - 504650,190150
- Overlying London Clay (London Clay Formation: 48-55 Ma) and Colne Valley Alluvium



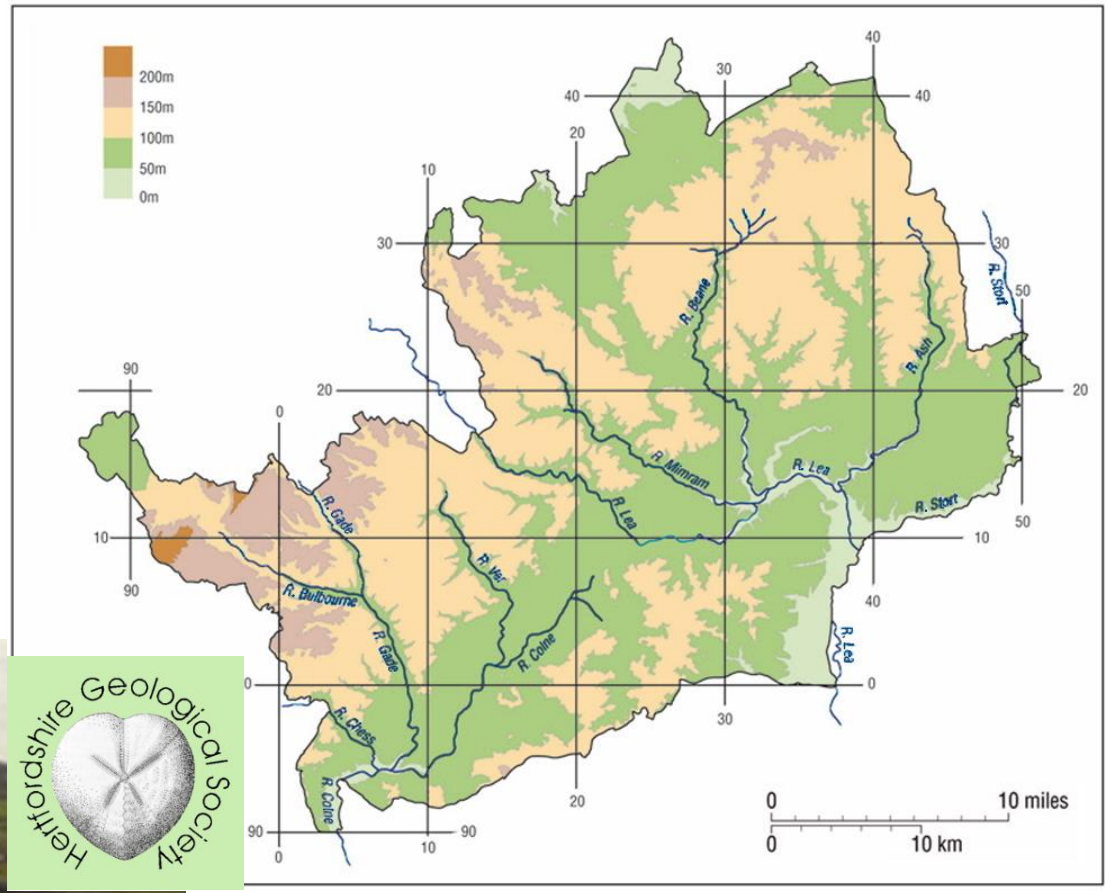


The Water Connection

[River Misbourne Restoration Project (affinitywater.co.uk)]

Chalk streams are rivers that receive most of their water from the underground chalk aquifer (water bearing rock). This water is known as groundwater, and it bubbles up through the riverbed. As it has been naturally filtered by the chalk it is often described as being 'gin clear' and is full of dissolved minerals that support many species of plants and animals.

Chalk streams are globally rare habitats. Of the 260 chalk streams in the world, 224 of them are in England and 10% of those are located within our supply area.



Hertfordshire Geological Society

https://www.hertsgeolsoc.org.uk/chalk-streams/

Read about local chalk streams on the Hertfordshire Geological Society website

AffinityWater is working with the support of the Environment Agency and others to Revitalise Chalk Rivers.

Local Water Projects

[River Misbourne Restoration Project (affinitywater.co.uk)]
The River Misbourne is a chalk stream that flows from its source just north of Great Missenden through several Buckinghamshire towns including Little Missenden, Old Amersham, Chalfont St Giles and Chalfont St Peter, to where it enters the River Colne downstream of Denham.

[River Colne Catchment Action Network (colnecan.org.uk)]
Hundreds of children use the River Misbourne next to the Colne Valley Park Visitor Centre for river dipping during the school holidays or on school visits during term time; this has led to erosion of the riverbank. The **Colne CAN River Dipping Project** has created a large access beach so that local children can safely enjoy the river. The riverbank was re-graded to a uniform slope over a 20m length, a sub-base was laid down and then topped with 20mm rounded gravel. Excavated material was used to build up berms in the river channel and other informal access points to the river were blocked off using dead hedging.

[Chilterns Chalk Streams (chilternstreams.org)]

CHILTERNS CHALK STREAMS PROJECT

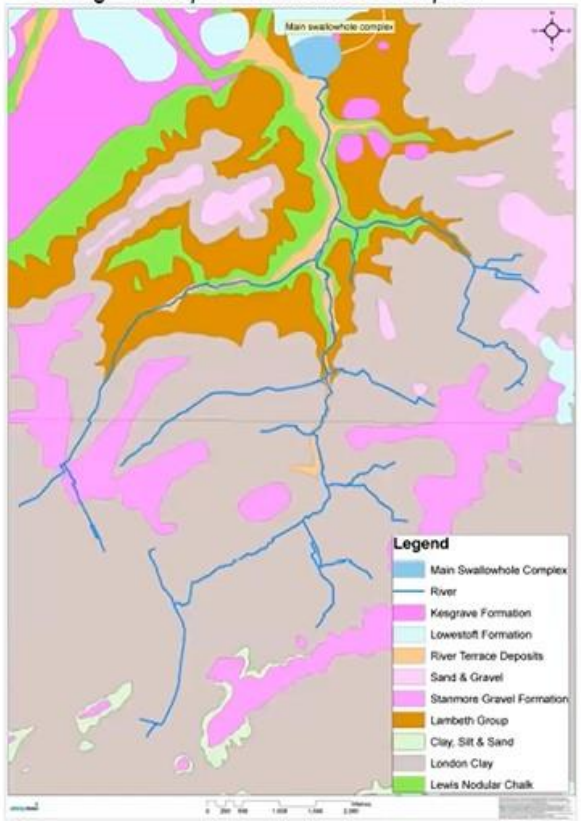
AffinityWater **Lecture for HHGS on 13th October 2021**

'Developments in understanding the flow mechanisms in chalk and Groundwater - Surfacewater interactions' by Dr Ilias Karapanos

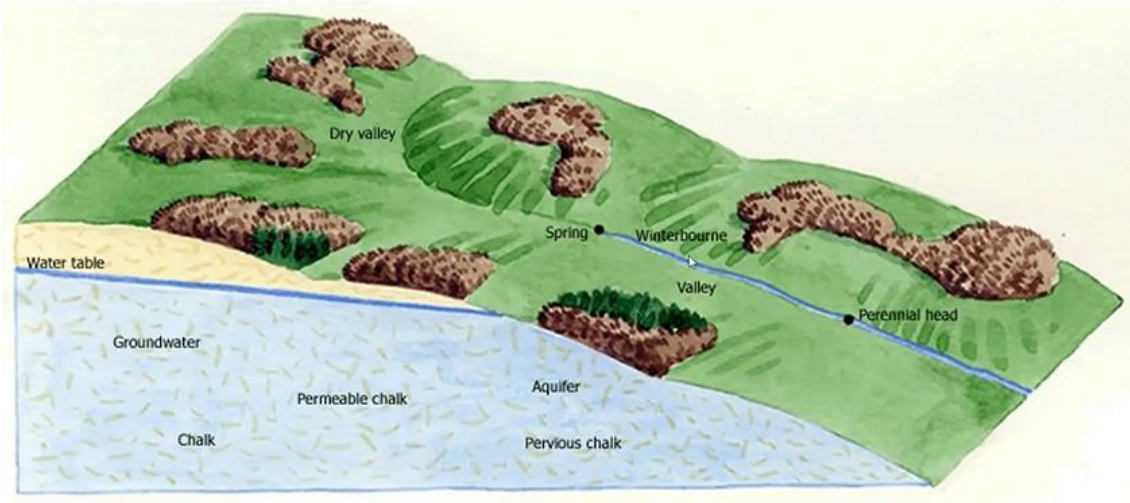
Watch the talk on our YouTube channel
https://www.youtube.com/playlist?list=PLsHG30PI0AOxmRUc4GAF5aJGq2atp38Ly

Karst– Swallow Holes – bypass recharge - contamination

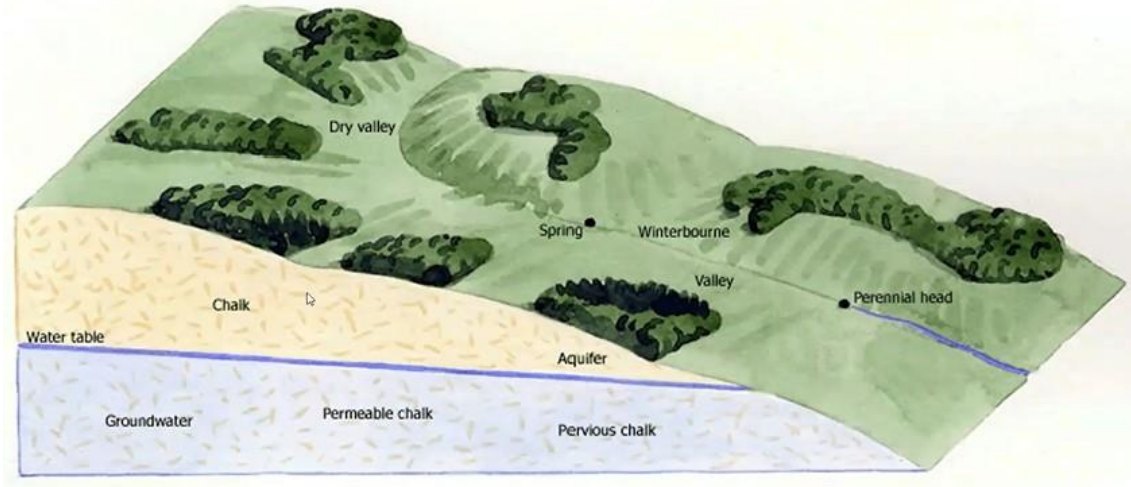
Geological map & swallowhole complex



Chalk Stream in 'winter'

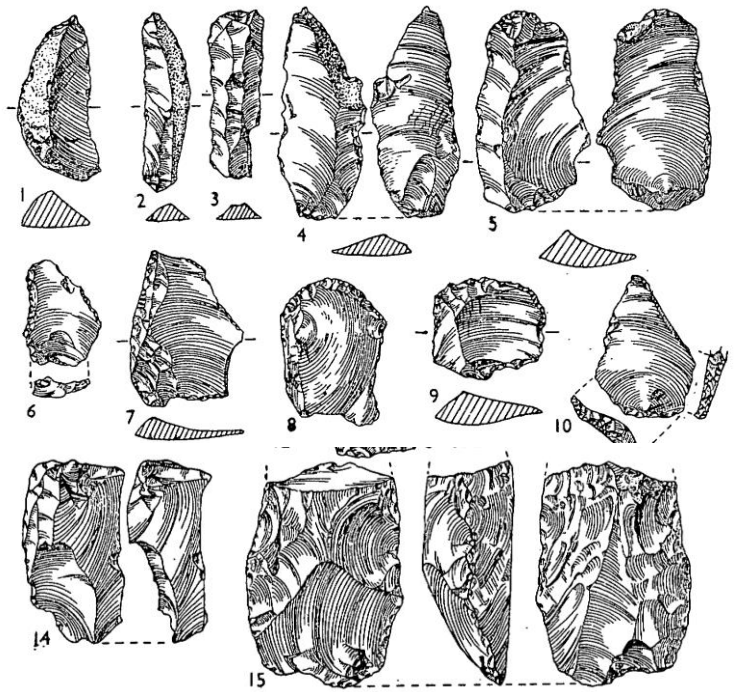


Chalk Stream in 'summer'



The Cultural Connection

Local Industry of Harrow and Hillingdon based on geological resources: flint, sand, gravel, clay, chalk



In **Harefield**, flint boulders and cobbles can be found lying on the ground, left behind due to erosion of the local chalk. Large pieces of flint, including fossils, have been used in garden walls.

Flint has been used in the construction of local walls for centuries, including the walls of some local churches. Here we can see the decorative knapped flint walls of St Mary's church in Harefield.

Flint: Stone Age Technology

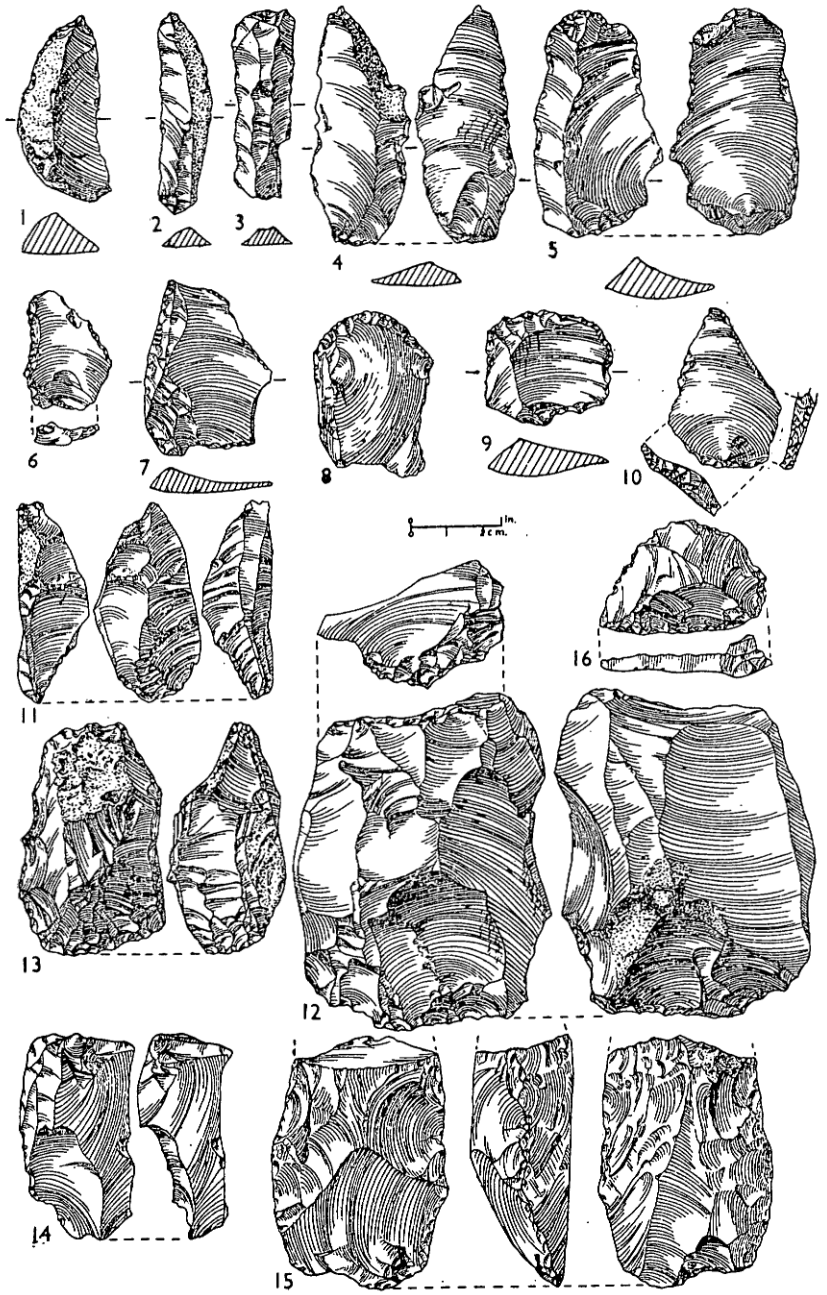
Flint only forms in Chalk

Hillingdon Council has around 170 prehistoric items in their museum collection - mostly flint tools from the Mesolithic and Neolithic periods, around 8,000-2,500 BC, from axes and arrowheads to scrapers for removing skin from meat and bone, which tell us much about our local ancestors.

[Stone age flints - Hillingdon Council]

At Croxley Green, near Rickmansworth, hundreds of hand-axes, flakes, and cores were found by gravel diggers in the early 20th century. Excavations were conducted by R.A. Smith of the British Museum and H. Dewey of the Geological Survey in 1914. Simple and refined tools were mixed together and the jumbled and distorted gravel was thought to be glacial outwash affected by periglacial agencies.

Archaeological digs in local gravel pits have revealed Stone Age and Iron Age pottery in West Drayton and Palaeolithic stone tools in Yiewsley.



Products of Flint Industry from Dewe's Farm, South Harefield

1-5, flakes and blades; 6-10, scrapers; 11, graver; 12, core; 13-14, trimmed cores; 15, lower part of *tranchet*.

Summerhouse Lane former chalk quarry, Harefield