British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

OFFICE OF THE DEPUTY PRIME MINISTER

SUFFOLK

Mineral Resource Information in Support of National, Regional and Local Planning

Mineral Resources

Scale 1:100 000

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This map comprises part of a summary of the 'Mineral Resources of the East of England Region'.
For further information see www.mineralsUK.com

BIBLIOGRAPHIC REFERENCE

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SAND & GRAVEL

Superficial deposits

- Sub-alluvial: Inferred resources
- Sub-alluvial: Indicated resources (only in area assessed by BGS)
- River Terrace deposits
- Glaciofluvial sand and gravel (including Kesgrave Formation)
- Glaciofluvial sand and gravel: Concealed (only in area assessed by BGS)
- Glacial sand and gravel deposits
- Glacial sand and gravel deposits: Concealed (only in area assessed by BGS)
- Head gravel (only in area assessed by BGS)
- Blown Sand
- Beach and Shoreface deposits
- Crag (only in area assessed by BGS)
- Westleton Beds (within Norwich Crag Formation)
- Undifferentiated deposits: concealed (only in area assessed by BGS)
- Boundary of area assessed for sand and gravel at the indicated resource level
- Approximate limit of Anglian ice sheet

BRICK CLAY

- Brick Clay } Chillesford Clay, Norwich Crag Formation

PEAT

- Peat

CHALK

- High purity chalk (93-98% $CaCO_3$) } White Chalk Subgroup
- Low purity chalk (<93% $CaCO_3$) } Grey Chalk Subgroup
- Undifferentiated Chalk (1:50 000 Sheet 174 Thetford only)

MINERAL PLANNING PERMISSION (as at 31.12.02)

Source: Mineral Planning Authorities

- Surface planning permission (valid and expired)

MINERAL WORKINGS

- Kesgrave — Active site
- *Haverhill Quarry* — Inactive (including sites not yet worked), worked-out and/or restored site
- Active wharf
- Active rail aggregate depot

Mineral commodity

Sg	Sand and gravel	Peat	Peat	Chert	Chert
Cl	Common clay and shale	Ch	Chalk	Sst	Sandstone
MSg	Marine sand and gravel	Fi	Flint	CR	Crushed Rock

ENVIRONMENTAL DESIGNATIONS (as at 30/04/03)

- National nature conservation designations (SSSIs and NNRs)
- International nature conservation designations (SACs, SPAs and Ramsar sites)
- Heritage Coast
- National Park: Norfolk Boards (part)
- Area of Outstanding Natural Beauty (AONB): Dedham Vale (part) and Suffolk Coast & Heaths
- + Scheduled Monument

ADMINISTRATIVE AREAS

- Mineral Planning Authority
- District

PLANNING PERMISSIONS FOR MINERAL EXTRACTION

The extent of all known extant and non-extant planning permissions for the extraction of minerals is shown on the map, irrespective of their current planning or operational status. The polygons were either supplied as digital files by Suffolk County Council or digitised by BGS from Plotting Sheets and other documents supplied by Suffolk County Council. Any queries regarding the sites shown should be directed to the authority at the address shown below. The polygons cover active, former and restored mineral workings and, occasionally, unworked deposits.

Planning Permissions represent areas where a commercial decision to work mineral has been made, a successful application has been dealt with through the provisions of the Town and Country Planning legislation and the permitted reserve will have been depleted to a greater or lesser extent. The current planning status is not qualified on the map but is available in the underlying database.

Contact address:

Suffolk County Council, Environment and Transport Department, St Edmund House, County Hall, Ipswich IP4 1LZ, Tel: 01473 583000, Fax: 01473 288221, Webpage: www.suffolkcc.gov.uk

SAND AND GRAVEL

Sand and gravel are defined on the basis of particle size rather than composition. In current usage, the term 'gravel' is used for material that is coarser than 5 mm, with a maximum size of 40 mm, and the term 'sand' for the material that is finer, but coarser than 0.075 mm. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint), but other rock types may occur locally.

Glaciofluvial Sand and Gravel

This unit broadly corresponds to the Kesgrave Formation (includes Bytham and Ingham sand and gravels in north of county) and its equivalents and is one of the most widespread and important aggregate resources in Suffolk. At the base of the unit unfossiliferous marine sands of the Norwich Crag Formation may locally have been included within the unit during surveying. It is also probable that in parts of the area the upper part of the unit has been reworked by meltwaters issuing from the Anglian ice-sheet but such reworking has not significantly modified the composition of the deposits.

The deposits form a semi-continuous sheet across the county comprising 5-15 m of clean, pale coloured sands and pebbly sands with subordinate gravels. The clasts present are rounded quartz, quartzite and well-rounded flint in sub-equal proportions together with small amounts of angular-nodular flint, and rare volcanic lithologies. The sand fraction is sharp, predominantly medium-angular to sub-angular quartz with flint, although locally the incorporation of significant quantities of sand from the underlying more mature marine Crag deposits increases the content of rounded and coarse sand grains. A series of levels aligned SW-NE have been identified within the Formation; these fall southeastwards across the county and become progressively younger in age. A reddened soil horizon comprising 1-2 m of grey-red mottled silty clay cryoturbated together with sand and loessic silt is commonly found as a capping on several of these levels even when they are buried beneath younger deposits.

The upper parts of the Kesgrave Formation generally lie above the watertable but at depth the deposits may be saturated especially where they rest directly on impermeable Tertiary clays.

The deposits were laid down during successive cold phases between about 1.5 and 0.5 million yrs BP (up to the beginning of the Anglian glaciation) in braided rivers; the main swathe represents ancestral deposits of the River Thames which formerly flowed NE across the area.

Glacial Sand and Gravel

This category comprises waterlain sands and gravels deposited in close proximity to the Anglian ice-sheet which was the most extensive of the Quaternary glaciations in East Anglia and covered most of Suffolk; its limit broadly corresponds to the dashed blue line on the map. In Suffolk these deposits have been termed the Barham Sands and Gravels.

These deposits mainly occur on top of the sheet of till (boulder clay) and on the shoulders of the existing valleys indicating early downcutting along the present lines of drainage that were established by the Anglian glaciation. The deposits tend to form as discrete patches and channel infills, they are best developed in the northwest of the county especially where chalk bedrock is present. The deposits locally reach 15 m thick where they infill channels on the sides of the modern valleys but generally they are less than 5 m thick. Gravel predominates and is variably clayey and sandy. The deposits are commonly very variable in grain size, poorly sorted and can contain interbeds of glacial silt, clay and till. The abundance of clay and its oxidation leads to orange-red coloration of most deposits. The clasts are predominantly angular-nodular flint and chalk . Other material includes rounded quartz, quartzite and flint derived from the Kesgrave Formation and Jurassic sedimentary rocks reflecting a derivation from the northwest.

River Terrace Deposits

Since the Anglian glaciation the present day drainage pattern has become established. Terraced river deposits occur at several levels in most of the major valleys in the county flanking the present floodplain.

The deposits commonly comprise sequences of sands and gravels around 3-6 m in thickness and with a sheet like body geometry. The basal contact is usually gently scalloped but locally the deposits infill deep channels. Compositionally the deposits reflect their derivation from Glacial and Fluvioglacial deposits up-stream and up-slope. Locally they are overlain by fine grained alluvial and loessic deposits (brickearth).

The terrace deposits are commonly dry in their upper parts and saturated to the base. They are post-Anglian in age and were deposited under cold periglacial climatic conditions.

Sub-Alluvial Gravels

Sub-alluvial gravels are encountered beneath the alluvium of the major valleys throughout the county. The deposits are compositionaly similar to the river terrace deposits, indeed some are their downstream equivalents where they pass below OD. They were mainly laid down during periods of deep downcutting during the ultimate Devensian cold phase when sea-levels fell to at least -100 m OD. The subsequent rise in sea-level enabled silting up of these river channels producing thick overlying alluvial deposits (silty clays, peat). The deposits rest on an irregular channelled surface and are thus of very variable thickness; locally 5-10 m of deposits are present but they are commonly thinner. These deposits are always saturated and require wet working.

Head Gravels

These comprise gravelly deposits that have been involved in mass movement downslope to their present position. Such movement commonly takes place under cold climatic conditions when vegetation is sparse and frozen ground leads to increased run off. The gravel is commonly mixed with other lithologies present on the slope and so the resulting lithologies are very variable, most contain significant clay contents and are only suitable for working as hoggin. The clast composition reflects that of the parent material. The deposits often accumulate as lobes or fans which are then dissected by subsequent downcutting.

Blown Sand

This is generally composed of clean, well sorted, fine to medium grained sand and comprises sub-rounded to well-rounded quartz grains. These deposits are largely Recent in age, resulting from aeolian reworking of adjacent dry beaches. The most favourable sites for blown sand accumulation in Suffolk are along the coast. Deposits are generally thin, mostly less than 2 m, but locally up to 5 m thick and occur mainly as dunes but also as thin linear spreads of sand. The most extensive areas occur on the coast around Lowestoft.

Beach Sand and Gravel

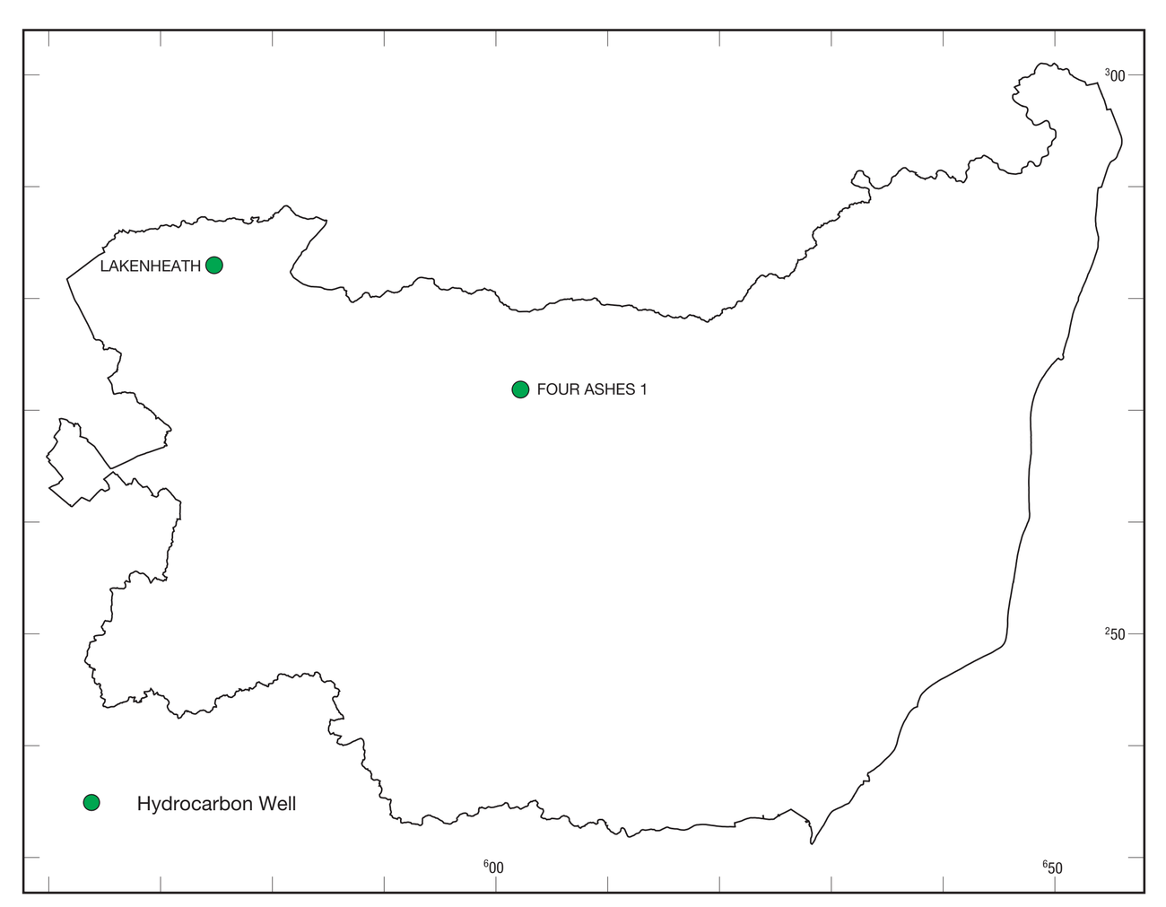
Included in this category are deposits marked on BGS maps as 'Shoreface and Beach Deposits', 'Storm Beach Deposits' and a variety of raised beach deposits. Typically these occur as accumulations of sand and gravel restricted to the modern coast and a relatively narrow belt of country adjacent to it. Typically the shingle is composed of 10 to 15 mm diameter clasts of well-rounded flint with subordinate quartz and quartzite, with a matrix of medium grained sand. The most extensive deposits of this type are found to the south of Aldburgh, at Orford Ness.

Bedrock Sand & Gravel

Sand and gravel, of varying quality, are extracted from members of the Pliocene Coralline, Red and Norwich Crag Formations. Two members of the uppermost Norwich Crag Formation are exploited, the Westleton Gravel member and the Chillesford Sand member. The former represents a series of gravel-rich fossil shoreline deposits whilst the underlying Chillesford Sands, composed of yellow- brown, well-sorted, fine to medium-grained micaceous quartz sands, are thought have been deposited as tidal sand flats. The Westleton Gravel is extracted for aggregate whilst the Chillesford Sand is used as building sand.

The Red Crag Formation is comprises medium to coarse-grained, poorly-sorted shelly sands which was deposited in an open marine environment. It is exploited mainly as a poor quality aggregate material as fill and for track and footpath repairs.

The Coralline Crag Formation is composed of a series of shelly calcarenites and shelly sands and has been worked both for building stone and as coarse aggregate for trackway and footpatch repairs.



HYDROCARBONS

Conventional Oil and Gas

To the north of the Variscan Front in southern Britain, the county of Suffolk occupies a tract of land beneath which Palaeozoic basement, forming part of the northern margin of the ancient London-Brabant Massif, lies at relatively shallow depths. Mesozoic rocks are relatively thin, with Chalk and Tertiary rocks mostly at crop over the western and eastern halves of the county respectively.

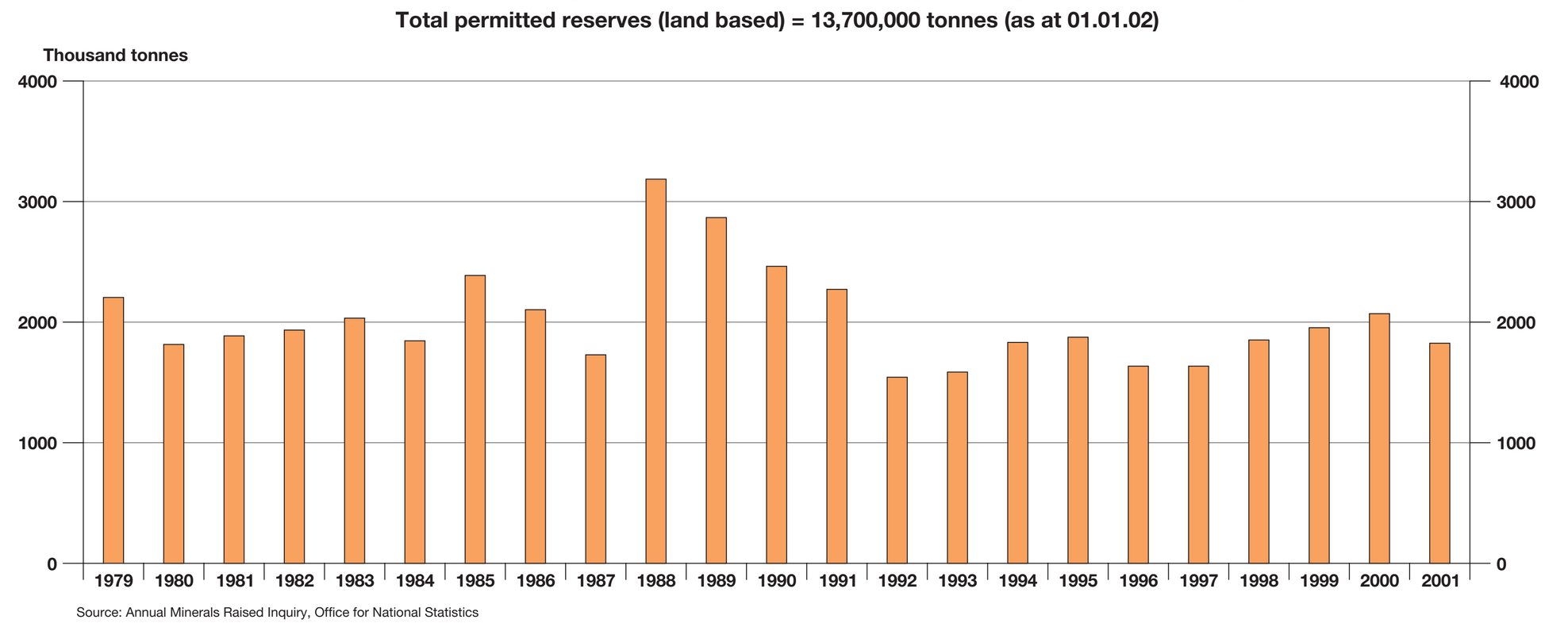
No seismic lines have been acquired in the county and Superior Oil in 1964 drilled the only two hydrocarbon exploration wells in the county at Lakenheath and Four Ashes. The former proved thin Triassic rocks overlying Silurian rocks, the latter Gault upon Devonian rocks. The wells were plugged and abandoned as dry upon completion. By mid-2002, there was no licensed acreage in the county, which appears to have little or no hydrocarbon potential.

Coal Bed Methane (CBM) potential

Strata of Silurian age form the majority of the pre-Permian and Mesozoic basement to the county of Suffolk (Smith, 1985). A small patch of Devonian rocks has been proved in the area of the Four Ashes borehole that have been connected with similar rocks encountered in the Breckles and Rocklands boreholes to the north in Norfolk. To date, no boreholes drilled in the county have encountered Westphalian Lower to Middle Coal Measures. The nearest occurrences of these strata in the pre-Permian subcrop are found some 10 km to the NE around Somerton in Norfolk and just offshore to the east (Smith, 1985).

No deposits of Tertiary age are encountered in the county, Jurassic and Cretaceous rocks cropping out at surface across the county. There is therefore thought to be little or no likelihood of lignite occurrences in the county. Consequently, it is thought that the county shows negligible CBM development potential.

Production of sand and gravel, 1979 - 2001 (including landings of marine-dredged)
Total permitted reserves (land based) = 13,700,000 tonnes (as at 01.01.02)



CHALK

Chalk is a relatively soft, fine-grained, white limestone consisting mostly of the debris of planktonic algae. The Chalk is of Upper Cretaceous age and occurs extensively in eastern and southern England where it forms an important resource of 'limestone raw materials'.

The White Chalk Subgroup (formerly known as the Middle and Upper Chalk) occurs extensively in the western half of the county, although much of the outcrop is concealed by a thick cover of superficial deposits. Over much of the county it is around 250 m in thickness and is grey or white coloured, with layers of flint. This part of the sequence is generally of high purity (93 - 98% $CaCO_3$), in contrast to the underlying Grey Chalk Subgroup (formerly Lower Chalk), which is expected to be mainly of lower purity (<93% $CaCO_3$) due to the numerous calcareous mudstone bands.

Until recently the Chalk was extracted on a large scale for cement manufacture at Masons Cement Works, Great Blakenham. This quarry, however, closed in 1999 and the site is now used for landfill. Chalk is currently extracted at several sites in the county, but on a relatively small scale, for the production of agricultural lime.

PEAT

Peat is an unconsolidated deposit of plant remains in a water saturated environment such as a bog or fen. Bogs occur in areas where they are dependent on rainfall for supply of water and the vegetation is characterised by acid tolerant plant communities of which the genus *Sphagnum* is dominant. The two main types of bog are (i) raised bogs, characteristic of flat underlying topography and found on low plains and broad valley floors and (ii) blanket bogs which occur mainly in upland areas where conditions are suitable cool and wet. Many lowland raised bogs have been designated as sites of international and national conservation status. 98% of the peat extracted in the UK is used as growing media by amateur and professional gardeners. In NW Suffolk there are peat deposits similar to those in Lincolnshire and Cambridgeshire. These represent 2 main groups, the Lower Peat and the Nordelph Peat. The older Lower Peat infills erosional depressions in older superficial deposits or in the bedrock and is thus of variable thickness, from 10 cm at the Fen margin up to 1.7 m in some boreholes. This peat is thought to have been deposited from 6000 BP up until the Neolithic. This is overlain by the Nordelph Peat which is much more extensive and ranges in thickness from 10 cm at the Fen margin up to 5 m in some boreholes. Its formation dates from 4000 BP up to the early 19th century. Extensive peat shrinkage has occurred due to the network of artificial drainage systems in the Fens, reducing the original area of coverage.

BRICK CLAY

'Brick clay' is the term used to describe clay and shale used predominantly in the manufacture of bricks and, to a lesser extent, roof tiles and clay pipes. These clays may sometimes be used in cement making, as a source of constructional fill and for lining and sealing landfill sites. The suitability of a clay for the manufacture of bricks depends principally on its behaviour during shaping, drying and firing. This will dictate the properties of the fired brick such as strength and frost resistance and, importantly, its architectural appearance.

Most facing bricks, engineering bricks and related clay-based building products are manufactured in large automated factories. These represent a high capital investment and are increasingly dependent, therefore, on raw materials with predictable and consistent firing characteristics in order to achieve high yields of saleable products. Blending different clays to achieve improved durability and to provide a range of fired colours and textures is an increasingly common feature of the brick industry. Continuity of supply of consistent raw materials is of paramount importance.

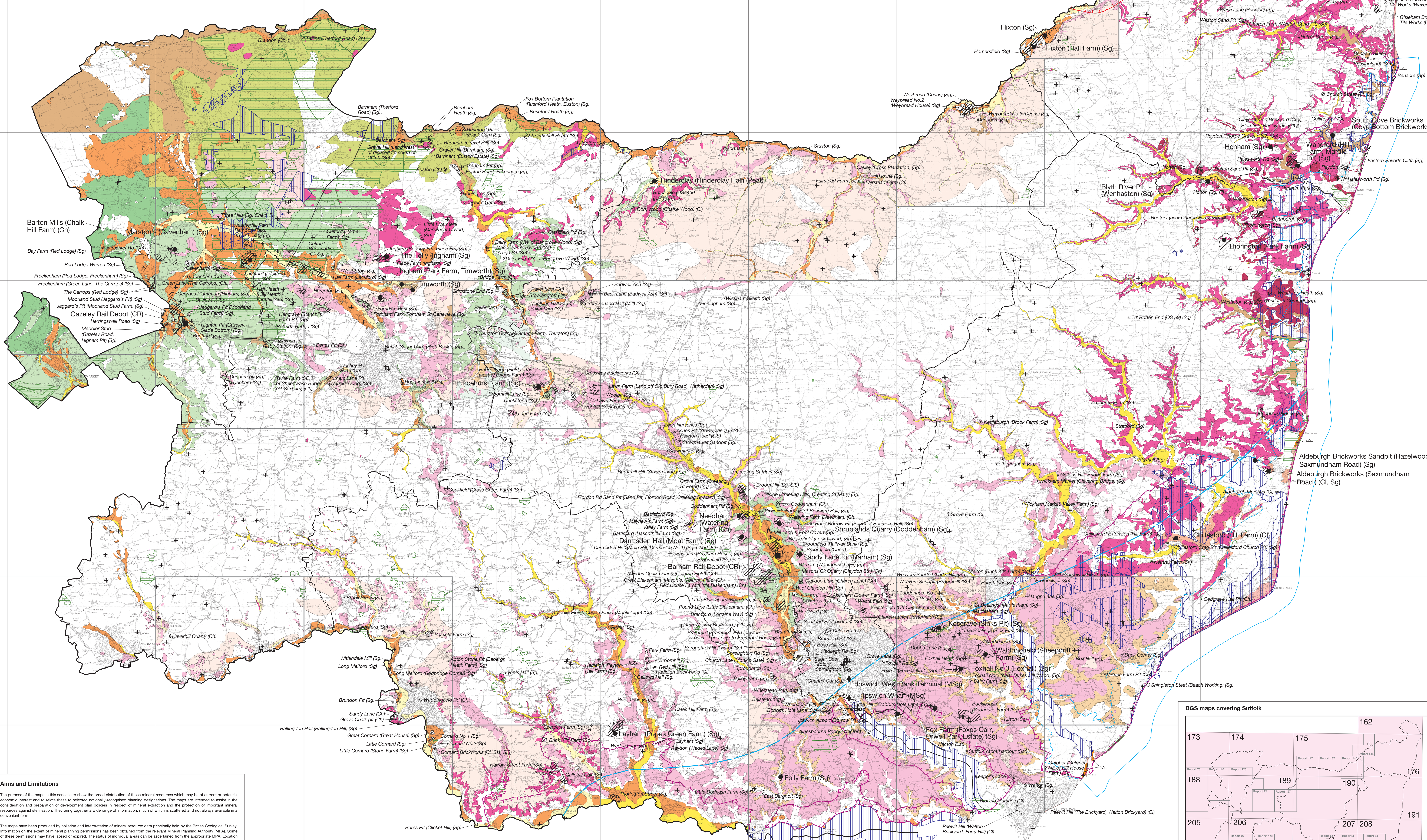
A relatively small brick manufacturing site at Aldeburgh uses clays from the Chillesford Clay Member of the Norwich Crag Formation to produce the characteristic 'Aldeburgh Red' brick which is valued for restoration work as well as for the construction of new quality buildings. The Chillesford Clay forms a thin (3 - 6 m) deposit of pale grey or orange/buff sandy clays. Extraction is on a small scale at Chillesford and the material is transported to Aldeburgh to make the red-fired bricks. A small amount of the underlying Chillesford Sand is dug to face the bricks.

Until recently large amounts of Quaternary Lowestoft Till (Chalky Boulder Clay) has been extracted for use as a raw material in cement manufacture at Masons Cement Works, Great Blakenham. The works closed, however, in 1999 and the former clay pit has now been restored. In addition clay from the Lowestoft Till at the former Gisleham Brick and Pipe Works, has been used for other non- brick manufacturing purposes, including the construction of flood defences.

Although the outcrop of Tertiary age London Clay is extensive in the south-east of the county, this clay is not shown as a resource since it is generally unsuitable for use in modern brickmaking processes. This is due the presence of relatively high levels of the clay mineral montmorillonite.

BUILDING STONE

The Cretaceous and Tertiary rocks have provided a limited range of building stones for local use. The succession contains no freestones and therefore much of the building stone found in the county (principally Lincolnshire Limestone-Barnack Stone etc) was imported into the area from medieval times onwards. The Upper Cretaceous Chalk yielded both chalk block stone (or Clunch) as well as flint for building purposes, the latter being the most common building stone in the county. The Tertiary succession provided concretionary limestones (or Septarian nodules) and occasional fossiliferous limestones, as at Sutton (Bryozoan Rock), for local building. Pebbles of flint and other more exotic lithologies, derived from the glacial drift, were frequently used for building purposes. No building stone quarries are currently operating in the county.



Aims and Limitations

The purpose of the maps in this series is to show the broad distribution of those mineral resources which may be of current or potential economic interest and to relate these to selected nationally-recognised planning designations. The maps are intended to assist in the consideration and preparation of development plan policies in respect of mineral extraction and the protection of important mineral resources against sterilisation. They bring together a wide range of information, much of which is scattered and not always available in a convenient form.

The maps have been produced by collation and interpretation of mineral resource data principally held by the British Geological Survey. Information on the extent of mineral planning permissions has been obtained from the relevant Mineral Planning Authority (MPA). Some of these permissions may have lapsed or expired. The status of individual areas can be ascertained from the appropriate MPA. Location information on national planning designations has been obtained from the appropriate statutory body (Countryside Agency, English Nature and English Heritage). For further information the relevant body should be contacted.

The mineral resource data presented are based on the best available information, but are not comprehensive and their quality is variable. The inferred boundaries shown are, therefore, approximate. Mineral resources defined on the map delineate areas within which potentially workable minerals may occur. These areas are not of uniform potential and also take no account of planning constraints that may limit their working. The economic potential of specific sites can only be proved by a detailed evaluation programme. Such an investigation is an essential precursor to submitting a planning application for mineral working. Extensive areas are shown as having no mineral resource potential, but some isolated mineral workings may occur in these areas. The presence of these operations generally reflect very local or specific situations.

The maps are intended for general consideration of mineral issues and not as a source of detailed information on specific sites. The maps should not be used to determine individual planning applications or in taking other decisions on the acquisition or use of a particular piece of land, although they may give useful background information which sets a specific proposal within context.

BGS maps covering Suffolk