

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

LINCOLNSHIRE

Mineral Resource Information in Support of National, Regional and Local Planning
Mineral Resources (South)
Scale 1:100 000

Compiled by D.J. Harrison, P.J. Henney, D.G. Cameron, E.J. Steadman, S.F. Hobbs, D.J. Evans, G.K. Lott, E.L. Bartlett and D.E. Higley.
Project Leader: D.E. Higley.
Digital cartography by N.A. Spencer, British Geological Survey, Published 2002.

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

BIBLIOGRAPHIC REFERENCE
Harrison, D.J. and others, 2002. Mineral Resource Information for National, Regional and Local Planning, Lincolnshire. British Geological Survey Commissioned Report CR020/2002.

Production of this map was commissioned and funded by the Office of the Deputy Prime Minister (Contract MP0677).

SAND & GRAVEL

Superficial deposits

- Sub-alluvial: Inferred resources
- Sub-alluvial: Indicated resources in areas assessed by BGS
- River terrace deposits
- Glaciofluvial deposits
- Glaciofluvial deposits: Concealed (only in areas assessed by BGS)
- Blown sand
- Blown sand: Concealed
- Shore/Beach deposits
- Boundary of area assessed for sand and gravel at the indicated resource level

PEAT

- Peat

LIMESTONE

- Lincolnshire Limestone

COAL LICENCE AREAS (as at 01.08.00)
SOURCE: The Coal Authority

- Deep mine (withdrawn)

MINERAL PLANNING PERMISSION (as at 01.01.02)
SOURCE: Mineral Planning Authorities

- Surface planning permission (valid and expired)
- Planning permission for ironstone and overlying minerals

MINERAL WORKINGS

- South Witham Active site
- Great Ponton Inactive (including yet to be worked), worked-out and/or restored site

Mineral commodity

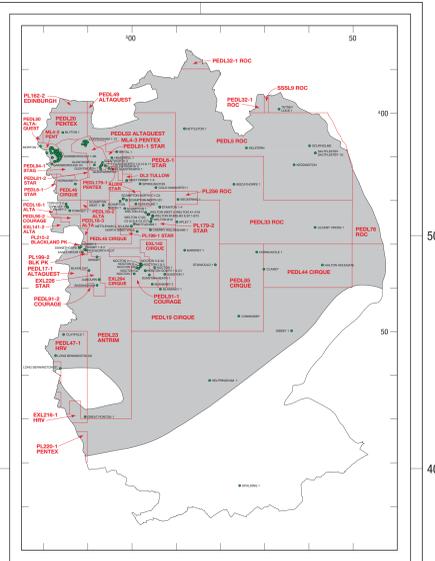
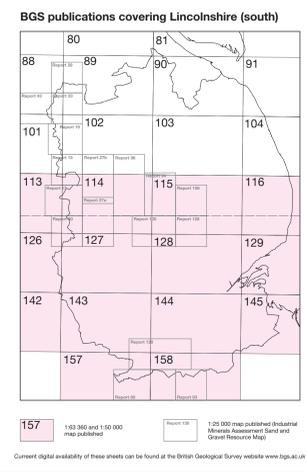
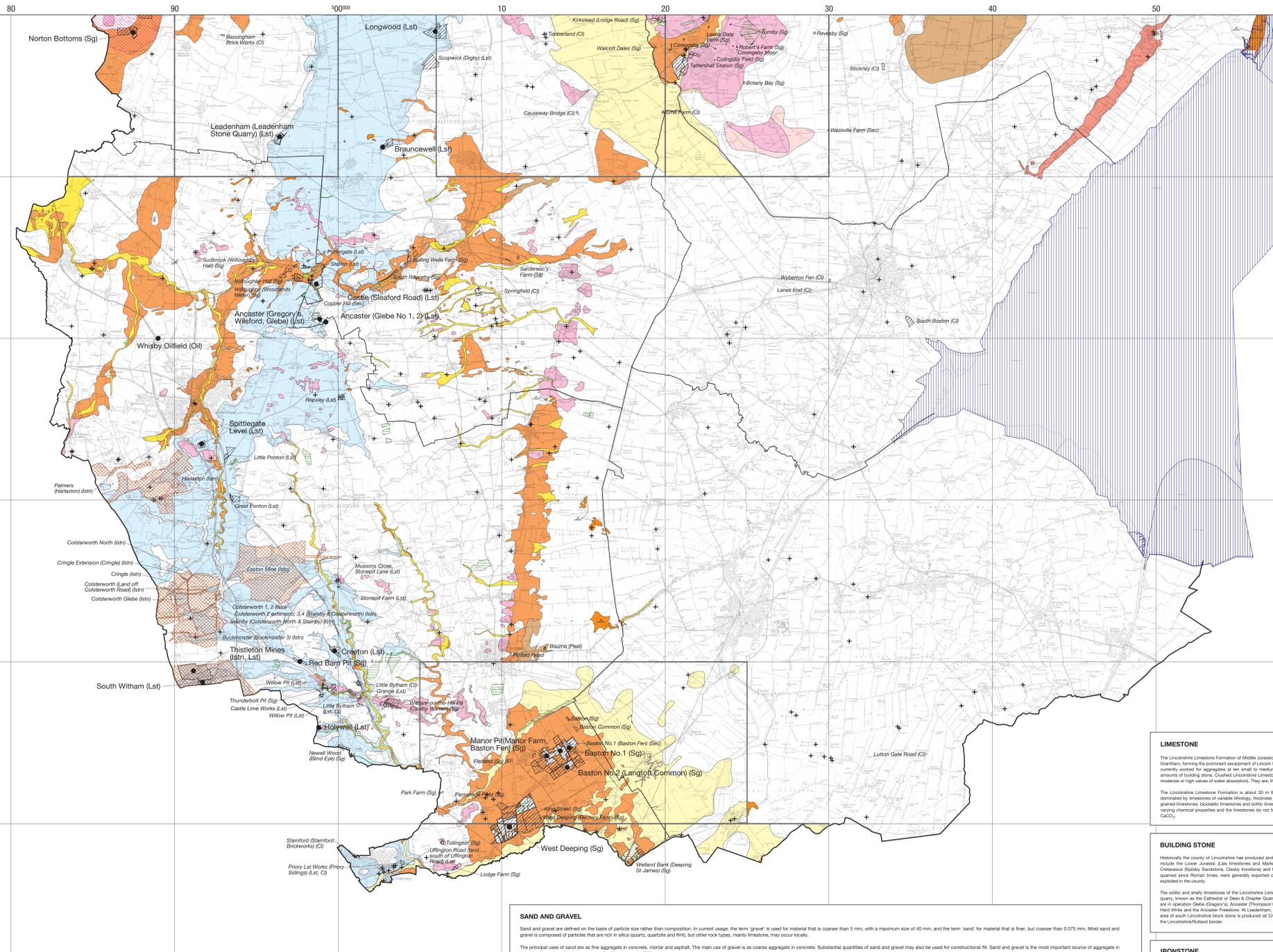
Lst	Limestone	lain	Ironstone	Sec	Secondary Aggregates
Oil	Oil	Sg	Sand and Gravel		
Gas	Natural Gas				

ENVIRONMENTAL DESIGNATIONS

- National nature conservation designations (SSSIs and NNRFs)
- International nature conservation designations (SACs, SPAs and Ramsar sites)
- Scheduled Monument

ADMINISTRATIVE AREAS

- Mineral Planning Authority
- District



HYDROCARBONS

Conventional Oil and Gas

The significant number of exploration wells (see inset map) and the existence of a dense network of seismic reflection surveys, particularly in some areas, Lincolnshire has been intensively explored for oil and gas since before the Second World War. This has led to many discovery wells and the development of a number of producing oilfields in the county. To date, 17 oil fields and a major gas condensate field have been developed, with eleven of fields known to be still producing. The total production for each field is shown in the table below.

Name of Oilfield	Field Type (oil or gas)	Operator at time of discovery	Current operator	Discovery Date	Production started	Produced to 2000	Total production to 2000
Beckingham	Oil	Shell Gas	Star Energy	1990	No details available	No details available	No details available
Beckingham extends into Notts	Oil	BP	Pentax	1959	1964	Oil production - total production to end of 1997 was 20,385,000	20,385,000
Cold Hamworth	Oil	Candoco	Star Energy	Sept-1997	Sept-1998	Still producing	5,000
Corringham	Oil	BP	Pentax	1958	1959	7 ceased	7,000
Cosby Warren	Oil	Edinburgh Oil & Gas	Edin Oil	May-1988	Oct-1987	Still producing	78,000
East Gleanthorpe	Oil	Pentax	BP	Mar-1987	Feb-1993	Still producing	10,000
Fiskerton Airfield	Oil	Cirque	Cirque	Nov-1997	Aug-1998	Still producing	43,000
Gainsborough	Oil	BP	Pentax	1959	1959	Oil production - total production to end of 1997 was 45,289,000	45,289,000
Gleanthorpe	Oil	BP	Pentax	1961	1961	Oil production - total production to end of 1997 was 41,800,000	41,800,000
Kiddington	Oil	Candoco	ROC Oil (UK) Ltd	Jan-1998	Sept-1998	Still producing	10,000
Netherham	Oil	BP	Star Energy	Mar-1983	Oct-1985	Still producing	191,000
Newton-on-Trent	Oil	Transwaco	AtaQuest	Apr-1998	Sept-1998	Suspended	3,000
Saffellby	Gas	Candoco	ROC Oil (UK) Ltd	Oct-1997	Dec-1999	Still producing	6.8 bblm
Scampton	Oil	BP	ROC Oil (UK) Ltd	Nov-1995	Apr-1996	7 still producing	4,000
Scampton North	Oil	BP	Star Energy	Oct-1986	Feb-1989	Still producing	175,000
Stanton	Oil	BP	Star Energy	Jan-1964	Jan-1967	Still producing	23,000
Turkey	Oil	BP	Star Energy	1962	1963	Still producing	1,881,000
West Firsby	Oil	Tullow	Jan-1988	Aug-1991	Still producing	146,000	
Whitby	Oil	East Midlands Oil & Gas	BP	Jan-1985	May-1990	Still producing	32,000
Total							3,427,000

Exploration to date indicates that the best potential for the discovery of oilfields lies in central parts of the county. In recent years exploration in the East Midlands has been dominated by operators such as ROC Oil (UK) (formerly Candoco), who developed a large acreage in the county that has led to large fields of oil and gas being currently licensed for oil and gas exploration. They have enjoyed significant success with the identification of small, stable accumulations around the larger fields such as Walton. However, the major gas condensate discovery by ROC Oil (UK) Ltd at Saffellby has diverted attention to the north eastern part of the county and it is likely that there will be further oil and gas discoveries in the future. There appears to be limited oil and gas prospectivity in the south and southeastern parts of the county.

LIMESTONE

The Lincolnshire Limestone Formation of Middle Jurassic age (Hertford Oolite) is a major limestone unit in Lincolnshire. Its outcrop runs north to south through Lincoln and Grantham, forming the prominent escarpment of Lincoln Edge. It has long been a source of building stone, but it is also a valuable resource of crushed rock aggregate. It is currently used for aggregate at ten small to medium sized quarries, mainly between Stamford and Lincoln, and several also produce agricultural lime and small amounts of building stone. Crushed Lincolnshire Limestone produces aggregates which are of relatively low strength and with poor resistance to frost damage (they have moderate to high values of water absorption). They are, therefore, generally only suitable for use as a construction fill or as a sub-base for road surfaces.

The Lincolnshire Limestone Formation is about 20 m thick and is commonly divided into two parts, the Lower and Upper Lincolnshire Limestone. The formation is dominated by limestone of variable thickness, thickness and distribution, with some silty, sandy or muddy beds. The Lower Lincolnshire Limestone is dominated by the great limestone, boulders limestone and oolite limestone and the Upper Lincolnshire Limestone by cross bedded, oolite limestone. The variable lithology results in varying chemical properties and the limestones do not form a high quality limestone resource. Even the great limestone beds are likely to contain less than 97 per cent CaCO₃.

BUILDING STONE

Historically the county of Lincolnshire has produced and used a wide range of indigenous stone for building purposes. Former sources of building stone in the county include the Lower Jurassic Eels Ironstone and Marston Rock Formation (sandy ironstone), the Middle Jurassic Lincolnshire Limestone Formation, the Lower Cretaceous Sibley Sandstone, Chalky Ironstone and the Upper Cretaceous Firsby Chalk. However, only the limestones of the Lincolnshire Limestone Formation, quarried since Roman times, were generally exported outside the county. The limestones of Lincolnshire Limestone now form the only building stone resource still available in the county.

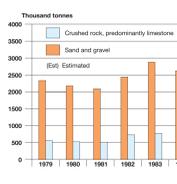
The soft and shaly limestones of the Lincolnshire Limestone Formation (Middle Jurassic), Bricerton are currently quarried in the county. In the City of Lincoln a single quarry, known as the Cathedral or Dean & Chapter Quarry, supplies stone principally for conservation work at the cathedral. In the Ancaster-Whitby area three quarries are in operation (Dean, Gregory & Ancaster (Thompson) Ltd). The quarry produces stone blocks for use in the repair of the Cathedral, the Whitby Abbey, the Hard White and the Ancaster Freestone. At Ancaster, a nearby limestone unit from the lower part of the formation has been quarried for paving stone. In the Stanton area of south Lincolnshire block stone is produced at Croston. The well known Clifton Stone (Hayward Quarry) is also still produced in a number of quarries that span the Lincolnshire-Nottingham border.

IRONSTONE

The Jurassic Marston Rock Formation consists principally of iron-rich, fossiliferous limestone which weathers to a deep brown colour. It is relatively resistant to erosion and it erodes where the formation has a high iron content it has been quarried away as a source of ironstone. It has also been worked on a small scale for building stone and lime. Relatively large scale iron ore extraction took place from around 1870 to about 1930. The ironstone bed is about 2.3 m in thickness. The ore was of variable quality with a relatively low iron content (around 52 per cent).

A good iron-bearing horizon in the Middle Jurassic Northampton Sand Formation. This was extensively worked for ironstone further south in the Northamptonshire area in the Midlands.

The Jurassic Marston Rock Formation is a source of iron ore and it is unlikely that the ironstone of Lincolnshire will have any future commercial value. For the reason they are not shown as a resource on the map. However, these reserves, pending permissions granted for the extraction of ironstone and overlying minerals within the county. They are an indication of the maximum extent of working.



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 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, mainly ironstone, may occur locally.

The principal uses of sand are as fine aggregate in concrete, mortar and asphalt. The main use of gravel is as coarse aggregate in concrete. Substantial quantities of sand and gravel may also be used for construction fill. Sand and gravel is the most important source of aggregate in Lincolnshire and production was some 3 million tonnes in 2000.

Areas assessed for sand and gravel by BGS are identified on the map and the resources here are taken from these maps. In these areas the possible concealed extent of sand and gravel beneath till (boulder clay) and alluvium is shown. Outside these areas, available data are more limited. Only assessed sand and gravel is defined. There are some differences in the classification of sand and gravel deposits between map sheets.

Sub-alluvial and River Terrace deposits

The main source of these materials in Lincolnshire are Quaternary and Recent age deposits in the valleys of the Trent, Great Ouse and Witham, where generally clean, well bedded sands and gravels rest on well sorted bedrock. Resources occur in both raised river terrace sequences flanking the modern floodplains and in flood plain terrace deposits associated with, and underlying, present day alluvium. This sequence of deposits is best developed along the River Trent with a succession of terrace deposits formed at heights up to 20 m above OD, representing accumulations of sand and gravel in response to falling sea level in post-glacial times. Thickness varies from between less than 1 m up to maximum values of around 10 m. The gravel content is highly variable and medium grained sand generally forms at least 50 per cent of the deposits. Individually massive units include, going from west to east, the Balaclava, Fulbeck, Barton and Sleaford sands and gravels. The Balaclava deposits are mostly between 5 and 7 m thick and have roughly equal proportions of gravel and sand. The gravel consists mainly of quartz and quartzite pebbles with minor flint within the sand is dominantly quartz, akin to the lithology in the Trent Valley. The Fulbeck and Sleaford deposits are generally much finer (1 to 2 m), the sand to gravel ratio is more variable and the pebbles consist mainly of shaly and oolite limestone together with minor amounts of sandstone and siltstone. The Barton deposits are generally sandy with only about 5 per cent gravel, again composed mainly of limestone fragments. Resource assessment data suggest that the Fulbeck sand and gravel has little mineral potential compared to the Balaclava and Barton deposits which are considered to be more promising. Some of these types of deposits are known as the Fen Gravels. This deposit, up to 1.8 m thick, consists of pebbly sands and gravels composed of local limestone with flint and other lithologies. It forms a discontinuous spread at the edge of the fen and extends up to the present day valleys. The sand and gravels were deposited as coarsening fans laid down by streams draining from the uplands to the west and are largely of late Quaternary age. The basal surface size eastward under the younger superficial deposits, and towards the North Sea, they become finer grained, containing less gravel, and pass into deposits containing marine shells.

Glaciofluvial sand and gravel

These are deposits mapped as the products of deposition by glacial meltwaters and are reworked more commonly indicated on BGS maps as glaciofluvial deposits, a more accurate description of their origin. The sequence of these deposits is complex with mappable units commonly exhibiting intricate relationships. Bodies of sand and gravel may occur as sheet or delta fan layers above till deposits, irregularly shaped areas of wholly concealed, and thin interbeds, bodies of sand and gravel may occur under deposits of till and other till deposits. These deposits include the individually mapped Eagle Moor sand and gravel which caps hillocks and high plateaus land north to north-west of Newark and which can reach thicknesses of up to 5 m. Boulder logs show that the deposit comprises about 60 per cent gravel, consisting of fine to medium grained, sub-rounded to well rounded quartz and quartzite with 30 per cent sand of similar composition and 10 per cent silt. The gravel component also includes mudstone fragments, sub-angular flint and pebbles.

Blown sand

These deposits are generally composed of fine to medium grained sand with a mean fines (<75 micron) content of around 6 per cent. The sand comprises sub-rounded to well rounded quartz grains. The deposits are believed to be largely of late Quaternary age resulting from aeolian reworking of fluvial and glaciofluvial sands. The most favourable sites for blown sand deposits are along the lower slopes of major west-facing escarpments. Deposits are generally thin (usually less than 2 m thick) and occur as both recognizable dunes and as thin linear deposits of sand, mainly in northern and eastern Lincolnshire. These deposits are important as a source of minor sands.

Shore/Beach deposits

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 a locally extensive deposits of this type are found mainly to the south of Gainsborough and between Boston and Gainsborough.

CRUSHED ROCK AGGREGATES

A variety of hard rocks are, when crushed, suitable for use as aggregates. Their technical suitability for different applications depends on their physical characteristics, such as crushing strength and resistance to impact and abrasion. Higher quality aggregates are required for coating with bitumen for road surfacing, or for mixing with cement to produce concrete. For applications, such as constructional fill and drainage media, with less demanding specifications, lower quality materials are acceptable. Lincolnshire has limited resources of rock suitable for use as crushed rock aggregate.

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 their water and the vegetation is characterised by acid tolerant plant communities of the genus Sphagnum in dominance. The two main types of peat are (a) raised bogs, characteristic of flat unproductive upland areas and found on low plateaus and broad valley floors and (b) blanket bogs which occur mainly in upland areas where conditions are suitable and wet. Many blanket bogs have been designated as areas of international and national conservation status.

Some 500 peat of the peat extracted in the UK is used for growing plants by amateur and professional gardeners. There is no extraction of peat in Lincolnshire but resources occur in both the north and south of the county.

PLANNING PERMISSION FOR MINERAL EXTRACTION

The extent of mineral, and former, 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 digitally by Lincolnshire County Council or were digitised by BGS from Planning Orders and other documents supplied by Lincolnshire County Council. Any queries regarding the data shown should be directed to the authorities at the addresses 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 reserves will have been declared in a greater or lesser extent. Current planning status is not updated on the map but is available in the underlying documents. Details of planning permission areas held on the Planning Registers which are kept by the District Councils.

Contact addresses:
Boston Borough Council, Municipal Buildings, Boston PO1 2QR, Tel: 01525 414000, Fax: 01525 540424
East Lindsey District Council, Towler Hill, Mabley LN11 6UR, Tel: 01507 601111, Fax: 01507 600206
Lincoln City Council, City Hall, Beaumont Park, Lincoln LN1 1DN, Tel: 01522 881188
North Kesteven District Council, PO Box 3, Kesteven Street, Sleaford NG34 7EF, Tel: 01529 414155, Fax: 01529 413966
South Holland District Council, Priory Road, Spalding PE11 2AE, Tel: 01775 781181, Fax: 01775 712523
South Kesteven District Council, St Peter's Hill, Grantham NG31 6PZ, Tel: 01474 406000
West Lindsey District Council, 26 Spittle Terrace, Gainsborough DN21 2HQ, Tel: 01427 615411, Fax: 01427 610623

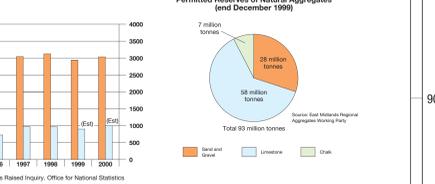
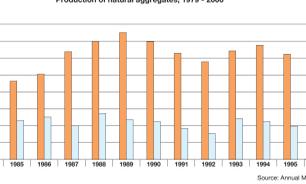
AIMS AND LIMITATIONS

The purpose of the map in this series is to show the broad distribution of mineral resources which may be of current or potential economic interest and to indicate those 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 disturbance. They bring together a wide range of information, much of which is outdated 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 bodies (Countrywide Agency, English Nature and English Heritage). For further information on the relevant bodies 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 viable resources 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 step in submitting a planning application for mineral working. Extensions areas are shown as an indication of potential resource, but some isolated mineral workings may occur in these areas. The presence of these outcrops 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 may be a specific planning constraint.



Topography reproduced from the OS map by British Geological Survey with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. License number: 02272/19/2002.

Administrative boundaries reproduced from Ordnance Survey Boundary Line Licence number: 02272/19/2002.

Digital 500M, A65, SAC, OFA, aerial-photos downloaded by English Nature 2000.

Contact address:
English Heritage, 20, Tavistock Square, Northampton, Northampton, NN1 1UA, Tel: 01733 455500, Web page: www.english-heritage.org.uk

Postcodes of Scheduled Monuments as 10th August 2001 as supplied by English Heritage.

The majority of monuments are defined using a central NGM symbol. Consequently the actual area and/or length of a monument protected by the legal constraints of scheduling cannot be represented here. Monuments scheduled but not shown are not recorded for © Copyright English Heritage.

Digital 500M, A65, SAC, OFA, aerial-photos downloaded by English Nature 2000.

Contact address:
English Heritage, 20, Tavistock Square, Northampton, Northampton, NN1 1UA, Tel: 01733 455500, Web page: www.english-heritage.org.uk

Digital A65 boundaries © Countryside Commission 1989 from Countryside Agency.

Contact address:
Countryside Agency, John Dower House, Crescent Place, Cheltenham, Gloucestershire, GL50 3RA, Tel: 01242 521381, Fax: 01242 542710, Web page: www.countryside.gov.uk

Coal Licence Areas © The Coal Authority 2001.

Contact address:
The Coal Authority, 200 Leifield Lane, Mansfield, Nottinghamshire, NG18 4PZ, Tel: 01623 427162, Fax: 01623 638838

Published for the Office of the Deputy Prime Minister © Queen's Printer and Controller of Her Majesty's Stationery Office 2002.

This publication includes logos which may be reproduced free of charge in any form or medium for research, private study or circulation within an organisation. This is subject to being reproduced accurately and not used in a misleading context. The text must be acknowledged as Crown Copyright and the title of the publication specified.

Applications for reproduction should be sent in writing to: The Copyright Unit, Her Majesty's Stationery Office, Commerce House, 1-18 Colindale Avenue, North Finchley, London N3 3BQ, Tel: 01632 733000 or e-mail: copyright@hms.gov.uk