



**British
Geological Survey**

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**Office of the
Deputy Prime Minister**

Creating sustainable communities

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

Greater Manchester (Comprising
Cities of Manchester and Salford
and Metropolitan Boroughs of
Bolton, Bury, Oldham, Rochdale,
Stockport, Tameside, Trafford
and Wigan).

Commissioned Report CR/05/182N



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D J Minchin, D G Cameron, D J Evans, G K Lott,
S F Hobbs and D E Highley.

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Fletcher Bank Quarry, Bury;
producing concreting aggregate,
crushed rock, grit sand and block
for walling stone.

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1 Introduction

This report is one of a series prepared by the British Geological Survey for various administrative areas in England for the Office of the Deputy Prime Minister's research project *Mineral Resource Information in Support of National, Regional and Local Planning*.

The accompanying map relates to Greater Manchester, comprising the cities of Manchester and Salford and Metropolitan Boroughs of Bolton, Bury, Oldham, Rochdale, Stockport, Tameside, Trafford and Wigan, and delineates the mineral resources of current, or potential, economic interest in the area and the sites where minerals are or have been worked. It also relates these to national planning designations, which may represent constraints on the extraction of minerals.

Three major elements of information are presented:

- the geological distribution and importance of mineral resources
- the extent of mineral planning permissions and the location of current mineral workings
- the extent of selected, nationally-designated planning constraints

This wide range of information, much of which is scattered and not always available in a consistent and convenient form, is presented on a digitally-generated summary map on the scale of 1:100 000. This scale is convenient for the overall display of the data and allows for a legible topographic base on which to depict the information. However, all the data are held digitally at larger scales using a Geographical Information System (GIS), which allows easy revision, updating and customisation of the information together with its possible integration with other datasets. The information will form part of a *Summary of the Mineral Resources of the North West Region*.

The purpose of the work is to assist all interested parties involved in the preparation and review of development plans, both in relation to the extraction of minerals and the protection of mineral resources from sterilisation. It provides a knowledge base, in a consistent format, on the nature and extent of mineral resources and the environmental constraints, which may affect their extraction. An important objective is to provide baseline data for the long term. The results may also provide a starting point for discussions on specific planning proposals for mineral extraction or on proposals, which may sterilise resources.

It is anticipated that the maps and report will also provide valuable background data for a much wider audience, including the different sectors of the minerals industry, other agencies and authorities (e.g. The Planning Inspectorate Agency, the Environment Agency, the Countryside Agency and English Nature), environmental interests and the general public.

Basic mineral resource information is essential to support mineral exploration and development activities, for resource management and land-use planning, and to establish baseline data for environmental impact studies and environmental guidelines. It also enables a more sustainable pattern and standard of development to be achieved by valuing mineral resources as national assets.

The mineral resources covered are sand and gravel, crushed rock aggregate, brick clay, building stone, peat, coal, and hydrocarbons.

1.1 RESOURCES AND RESERVES

Mineral resources are natural concentrations of minerals or bodies of rock (or fluids such as oil and gas) that are, or may become, of potential interest as a basis for the economic extraction of a mineral product. They exhibit physical and/or chemical properties that make them suitable for specific uses and are present in sufficient quantity to be of intrinsic economic interest. Areas that are of potential economic interest as sources of minerals change with time as markets decline or expand, product specifications change, recovery technology is improved or more competitive sources become available.

That part of a mineral resource, which has been fully evaluated and is commercially viable to work is called a mineral reserve. In the context of land-use planning, the term mineral reserve should strictly be further limited to those minerals for which a valid planning permission for extraction exists (i.e. permitted reserves). Without a valid planning consent no mineral working can take place and consequently the inherent economic value of the mineral resource cannot be released and resulting wealth created. The ultimate fate of mineral reserves is to be either physically worked out or to be made non-viable by changing economic circumstances.

Mineral resources defined on the map delineate areas within which potentially workable mineral 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 individual sites can only be proved by a detailed evaluation programme. Such an investigation is also 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 reflects local or specific situations.

1.2 ENVIRONMENTAL DESIGNATIONS

The map shows the extent of selected, nationally-designated planning constraints as defined for the purposes of this study. These are defined on a common national basis and therefore represent a consistent degree of constraint across the country. No interpretation should be made from the map with regard to the relative importance of the constraints, either in relation to mineral development proposals or in relation to each other. Users should consult policy guidelines issued by the relevant Government department, statutory agency or local authority.

The constraints shown on the map are:

- National nature conservation designations – National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI);
- International nature designations – Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites;
- Part of the Peak District National Park; and
- Scheduled Monuments

Mineral development may also be constrained by many other factors not shown on the map, including local landscape designations, considerations relating to the protection of other resources, such as groundwater, and local amenity or environmental concerns, such as noise, traffic and visual impact. These have been excluded because the constraint is not defined on a national basis or the information is not generally available. The extent or degree of relevance of such constraints can be ascertained from the relevant statutory agency or the appropriate Mineral Planning Authority.

2 Sand and gravel

Sand and gravel are defined on the basis of particle size rather than composition. In current commercial practice, following the introduction of new European standards from 1st January 2004, the term 'gravel' (or more correctly coarse aggregate) is used for general and concrete applications to define particles between 4 and 80 mm, and the term 'sand' for material that is finer than 4 mm, but coarser than 0.063 mm. For use in asphalt 2 mm is now the division between coarse and fine aggregate. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint), but other rock types 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 are also used for construction fill.

Production of sand and gravel in Greater Manchester is about 0.24 million tonnes in 2004, according to the Annual Minerals Raised Inquiry, Office for National Statistics. No separate figures are available for permitted reserves in Greater Manchester but these are believed to be small. In 2003 total permitted reserves of sand and gravel in Greater Manchester, Merseyside, Halton and Warrington were 6.7 million tonnes. (North West Regional Aggregates Working Party Annual Report, 2003).

Sand and gravel resources occur in a variety of geological environments. In Greater Manchester these resources occur mainly within superficial or 'drift' deposits, subdivided into river sand and gravel and glaciofluvial sand and gravel; the most important are the glaciofluvial deposits.

2.1 SUPERFICIAL DEPOSITS

2.1.1 Glaciofluvial sand and gravel

These are deposits mapped as the products of deposition by glacial melt waters and are nowadays commonly labelled 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-like layers above till deposits or as elongate, irregular lenses within the till sequence. Areas of wholly concealed, and thus unknown, bodies of sand and gravel may occur under spreads of till and other drift deposits.

Glaciofluvial deposits cover large areas of Rochdale, Bury and Trafford but are mainly fine-grained and are largely devoid of gravel. They vary considerably in thickness but may be over 30 m thick where they fill pre-glacial hollows or buried valleys or form moraines. Sands and gravels are derived from the erosion of local bedrock rock by the action of ice and water and, as such, mudstone and coal fragments can be common and make the working of a deposit difficult. Glaciofluvial sand and gravel are being worked at Pilsworth South pit in Heywood, Bury. Large areas of potential resource have been sterilized by urban development.

Extensive sheets of sand and gravel, averaging 2 m to 3m thick, were laid down in the valleys of the Mersey west of Stockport, the Bollin below Styal, Moberley Brook, the Irwell, the Dane and

the Weaver, all of which drain into the Mersey Estuary. In the lower reaches of all these rivers is the same pattern of a top terrace, in places more than 10 m above present river level, and very wide compared with the later terraces, which form a group including present day alluvium confined to the immediate vicinity of the river. After the formation of the high terrace there took place an event that suddenly lowered the base level to which the rivers were being graded. This happened to all the rivers mentioned above simultaneously, for their high terraces are at grade with one another. This high terrace phenomenon is limited in this area to the Mersey watershed.

The high terraces of the Mersey Basin were most probably formed at the end of the last Ice Age when the mouth of the river was still blocked by ice in the Irish Sea; thus water was ponded up in the lower Mersey valley and escaped over the neck of the Wirral peninsula. The spillway over the Wirral controlled the base level and it is to this that the high terrace is graded to. The sudden fall in the base level of the rivers took place when the last glacial ice melted and the present Mersey channel became open. The high terrace is currently being worked along with more recent river terraces of the River Goyt in Offerton Quarry near Stockport.



Figure 1. Pilsworth Quarry, Bury, Tarmac Ltd – North West, working glaciofluvial sands.

2.1.2 River sand and gravel (terrace and sub-alluvial deposits)

Resources occur in both raised river terrace sequences flanking the modern floodplains and in floodplain terrace deposits associated with, and underlying, present day alluvium. This sequence of deposits are best developed along the River Mersey, Irwell, Croal and Roch with a succession of deposits formed, representing accumulations of sand and gravel in response to falling sea level in Pleistocene times. Less developed terrace deposits occur along the River Tame, Middle Brook, Hey Brook and Moss Brook. The deposits typically consist of upwardly fining and laterally graded spreads of gravel, sand, silt and clay. Alluvium deposits in Manchester are usually thin and of little significance when compared to the sands and gravels of the high terrace. The composition of river sand and gravel generally reflects the rocks drained by the river and its tributaries. In this case it is mainly Carboniferous sandstones and mudstone, which are weak and friable and only suitable for low-grade uses such as construction fill.

2.1.3 Blown sand

Overlying the glacial till is an irregular, discontinuous layer of wind-blown sand referred to as the Shirdley Hill Sand. The sand, which is typically only about 1 to 1.3 m thick, although locally

thicker, is younger than the glacial deposits and lies immediately beneath a cover of topsoil. The sand is characteristically uniform in both composition and grain size distribution, reflecting its wind-blown origin. Most of the sand particles fall in the range 0.5 mm to 0.1 mm, which is unsuitable for construction use. The Shirdley Hill Sand was formerly worked in St Helens and Lancashire for glass sand, and particularly for flat glass manufacture. However, these operations ceased in the mid-1970s. A number of thin spreads of blown sand resembling Shirdley Hill Sand have been noted on the terraces of the Mersey and Bollin but are too thin to be considered economic. Wind-blown sands are generally too fine-grained and uniform size for aggregate use. They are therefore not shown on the map.

2.2 BEDROCK DEPOSITS

Additional resources of sand and gravel may be won from exploiting suitable bedrock deposits. Triassic sandstones of the Sherwood Sandstone Group are being worked at Morleys Hall Quarry southeast of Leigh to produce sand for mortar and asphalt. The Sherwood Sandstone has been deeply weathered in places by a tropical climate during pre-glacial times. The upper part of the sandstone, immediately below the drift cover, is sometimes weathered to the extent that the cementing material between the sand grains has disintegrated leaving the original quartz grains in the form of sand that can be worked without substantial crushing. The weathered portions of the Sherwood Sandstone usually do not have an ideal particle size distribution for use in mortar, concrete or asphalt and usually the sand is too fine grained or too weak for use as concrete aggregate. Difficulties in removing overburden in the form of glacial till and extra treatment in crushing, however minor, together with washing and slime removal can often make the resource uneconomic compared to more easily worked glacial sands. The Sherwood Sandstone is, therefore, rarely worked and is not shown on the map



Figure 2. Morleys Hall Quarry, Wigan, Sandtime Ltd, working Triassic, Sherwood Sandstone.

3 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.

The crushed rock aggregate resources of Greater Manchester are confined to Carboniferous sandstones which, whilst relative extensive, do not provide a source of high quality aggregate.



Figure 3. Fletcher Bank Quarry, Bury, Marshalls Natural Stone, producing concreting aggregates, crushed rock aggregate and walling stone.

3.1 SANDSTONE

The Carboniferous sandstones of the Millstone Grit and Pennine Coal Measures of Greater Manchester have traditionally been extensively used as a source of building stone and today both disused and working quarries are a common feature of the landscape.

Carboniferous sandstones consist of sand-sized particles, with minor pebbles, composed dominantly of quartz, but also with some feldspar, which are cemented by silica, to a greater or lesser extent. The sandstones are typically buff-coloured, although locally grey, and vary from fine- to coarse-grained. Most of the sandstones are too weak and porous to make good quality

aggregate for roadstone and concrete, but may be suitable for fill and for the production of manufactured sand to produce reconstituted stone products.

There are currently seven working sandstone quarries working Carboniferous sandstones in Greater Manchester. Most quarries produce blockstone or a range of masonry products and some also produce crushed aggregate for less demanding specifications. There are many sandstones of Carboniferous age, but the Haslingden Flags, the Fletcher Bank Grit and the Kinderscout Grit (all Millstone Grit) and the Ousel Nest Grit and Old Lawrence Rock (Pennine Lower Coal Measures) are the most extensively worked. Sandstone production in Greater Manchester was just over 1 million tonnes in 2004. Permitted reserves are of the order of 20 million tonnes.

4 Brick clay (including Fireclay)

Brick clay is the term used to describe ‘clay and shale’ used in the manufacture of structural clay products, such as facing and engineering bricks, pavers, clay tiles and vitrified clay pipes. These clays may also be used in cement manufacture, as a source of constructional fill and for lining and sealing landfill sites. Brick manufacture is the largest tonnage use in England. Clay bricks are versatile construction materials and one of the most visible components of the built environment. They make an important contribution to local architectural styles.

Brick clays are essentially mudstones of different geological ages and compositions. Their mineralogy, chemistry and physical properties are critical to determining their suitability for the manufacture of structural clay products. These properties affect the forming behaviour of the clay (the process of shaping the ware) and also its behaviour during drying and firing. They will also determine the technical properties of the fired product, such as strength, water absorption (porosity) and frost resistance, and thus its durability and performance in service and, importantly, its architectural appearance, such as colour and texture. 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 therefore increasingly dependent on raw material 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.

In Greater Manchester, brick clay has been produced for local consumption from small brick pits for over two hundred years. Historically, a variety of clays were extracted for common brick making including boulder clay, the Triassic, Mercia Mudstone and mudstone from the Pennine Lower and Middle Coal Measures. Fireclay, the fine-grained seatearths that commonly underlie coal seams, was formerly mined alongside coal in opencast and underground mines for use in pipe making. With the demise of the ‘common’ brick and consolidation of the brick industry most of these clay quarries closed. Today, one active clay quarry remains in Manchester, at Harwood, northeast of Bolton, working the Pennine Lower Coal Measures. This quarry produces high quality brick clay for use in facing, engineering and paving bricks but has no associated brickworks. The clay is delivered to a brickworks at Denton in Tameside, which has no associated quarry and sources clay from a variety of locations, but mainly from a site in Glossop, approximately 13 km away in Derbyshire.

Pennine Coal Measures mudstones, which occur interbedded with siltstone, sandstone, coal seams and seatearths, are the principal brick clay resource in North West England. Resources occur across the north and east of the area but are only worked in Bolton. The clay mineralogy of Coal Measures

mudstones is dominated by kaolinite and illite which tend to provide optimum firing characteristics. Carbon and sulphur contents are also critical to firing performance. Excessive amounts of either may lead to firing problems and sulphur may also give unacceptable emission levels, although blending of clays may reduce these problems. In general, carbon and sulphur contents should be less than 1.5% and 0.2% respectively. Both fireclays and mudstones occur in association with opencast coal, with which they may be worked. However, this is only rarely the case because of the variable quality of the clay, particularly of the fireclays, and due to operational and planning difficulties. Fireclays have relatively low iron content compared to other brick clays and they are primarily valued for the manufacture of buff-coloured bricks and pavers. There is no current fireclay extraction in the area.

5 Building stone

Natural stone is the traditional building material of Britain and the built environment is perhaps the most visible aspect of our cultural heritage. Production and usage of natural stone has declined since the high point of the industry in the late 19th Century, largely because of competition from cheaper alternatives, such as brick and concrete. However, more recently there has been an increased interest in natural stone and the prospects for the industry remain buoyant.

A wide range of rock types is used as building stones. In Greater Manchester these comprise building sandstones, principally of Carboniferous and Permo-Triassic sandstones age. The working of local sandstones for block stone, flagstone and roofing 'slate' was very widespread in the past and almost every Carboniferous sandstone outcrop shows evidence of quarrying. However, currently only four quarries in the area are working Carboniferous sandstone for building stone.

The oldest rocks that were quarried for building stone and flagstone are from the Millstone Grit Group (Carboniferous) which crops out along the northern and eastern margins of the area. The principal sandstone quarries were located around Littleborough (Calderbrook and Long Lees) in the Huddersfield White Rock; at Stalybridge (Buckton Moor) in the Kinderscout Grit; around Horwich (Smithills Moor), Ramsbottom (Quarlton, Crowthorne, Limefield, Baldingstone, Holcombe, Rooley, Asworth), Milnrow, Gee Cross and Marple Bridge in the Rough Rock.

Quarrying of the Pennine Lower Coal Measures sandstones was extensive e.g. at Whitworth (Middle Hill, Hades Hill and Higher Slack), Burnt House Moor (Pinfold); near Bolton (Doffcocker, Moor Gate, Ridgeway in the Ouzel Nest Grit); and near Stalybridge. The Pennine Middle Coal Measures sandstones were quarried at Oldham Edge, Farnworth and Peel Hall. The small outcrop of Pennine Upper Coal Measures at Collyhurst (Worsley Delf Rock) was also an important source of building stone in the past.

The red Permian and Triassic sandstones at Collyhurst (Appleby Group) and Timperley (Sherwood Sandstone Group) were worked for building stone to limited extent in the past.

6 Peat

Peat is an unconsolidated deposit of compressed plant remains in a water-saturated environment such as a bog or fen. Bogs occur in areas where water inputs, almost exclusively from precipitation, have a low nutrient content and where the rainfall is sufficient to maintain the ground surface in a waterlogged condition. Bog vegetation is characterised by acid-tolerant plant

communities of which the moss genus *Sphagnum* is dominant. The two main types of bog are (i) raised bogs, characteristic of flat underlying topography and found on plains and broad valley floors and (ii) blanket bogs, which occur mainly in upland areas where conditions are suitably cool and wet. Many lowland raised bogs have been designated as sites of international and national conservation areas. Peat is dug in England mainly from raised lowland bogs, almost entirely (98%) for horticultural use, either as growing media or as a soil improver. Areas of upland blanket peat are not worked and therefore are not shown on the map.

Peat is being extracted from three sites on Chat Moss to the west and north west of Irlam on the Wigan/Salford boundary. The peat deposits cover an area of 2587 ha of raised bogs up to 9 m thick on a flat underlying topography. Planning permission for peat extraction covers 305 ha, both in the Wigan and Salford districts. Smaller lowland peat deposits such as Carrington Moss and Ashton Moss cover approximately 2 km² each, but are not worked.

Many of the peat deposits have been worked extensively in the past and today a large percentage of these areas have been 'reclaimed' to agricultural land. Due to the unavailability of up-to-date linework defining the extent of the reclamation, the entire resource as mapped is shown on the map face.

7 Coal

Greater Manchester lies predominantly within the South Lancashire Coalfield. The coal-bearing strata of the Lower and Middle Coal Measures (Upper Carboniferous) generally dip to the southwest and west. The South Lancashire Coalfield crops out across an area of approximately 970 km², stretching from Rochdale in the east to St Helens in the west. A spur runs southwards from Rochdale to just south of Stockport. In the east and north older Namurian strata are present at outcrop and to the west and south Permo-Triassic strata unconformably overlie the Coal Measures. To the south, the coalfield deepens significantly to greater than 3000 m below Ordnance Datum beneath Permo-Triassic strata and passes into the Cheshire Basin. A substantial portion of the coalfield is covered by urban development.

Coal seams are numerous with in excess of 36 named seams, which vary laterally in both thickness and composition, chiefly by variation in the number of dirt partings present within the seam. Coals are mainly present within the Pennine Lower and Middle Coal Measures, with a few additional coals in the lower part of the Pennine Upper Coal Measures. The main coal-bearing interval typically varies from about 590 m in the west to 880 m in the east. The lower part of the Lower Coal Measures, below the Arley seam, typically contains coals that are thin and of variable quality. The rest of the Lower and Middle Coal Measures form the most important coal-bearing interval, with a number of coals in excess of 2 m in thickness. Coals from the Upper Coal Measures are generally thin, the exception being the Worsley Four Foot, which can be up to 1.6 m in thickness. Coal rank ranges from high to medium volatile.

There are no operating deep mines in the area, the last Parkside, was closed in 1993. Any future commercial interest in coal extraction is likely to be confined to coal that can be recovered by surface mining. Historic opencast mining has occurred in the Wigan Coalfield, which has been mined for seven centuries, and across the north of the county. Opencast mining in the east has been limited by the steeper dip of the strata in this area. Recent, small-scale opencast production has been confined to the Wigan Coalfield, but there has been no production since 2000. Although there is potential for further opencast mining this is reduced by a number of factors. Firstly the basal part of the Lower Coal Measures does not contain many thick seams. Hence

areas on the northern and eastern flank of the coalfield are probably not economically viable. Secondly there are thick drift deposits (up to 50 m in places) across the coalfield and, thirdly, much of the area is sterilised by urban development. Areas of shallow coal resources and former worked areas are shown on the map and opencast prospects remain. A new opencast site, Cutacre, in Bolton is due to start in 2006 and has a permitted reserve of 964,000 tonnes.

8 Hydrocarbons

8.1 CONVENTIONAL OIL AND GAS

Greater Manchester is perceived as having poor hydrocarbon prospectivity. Permo-Triassic strata in the south of the area form the Cheshire Basin. This is linked to the offshore East Irish Sea Basin, within which hydrocarbons (mainly gas) have been discovered in a number of fields. Oil has also been produced from the Douglas and Lennox fields. There is also the presence of the small enigmatic Formby Oilfield onshore to the west in Merseyside. The oilfield is thought to owe its existence to the breaching and migration from a deeper (older) Carboniferous trap and is capped by glacial boulder clay.

Carboniferous strata (Namurian mudstones and Westphalian Coal Measures) provide source rock potential both in Greater Manchester area and surrounding districts and the wider area has attracted interest from oil companies. Exploration has been ongoing for many years, with many kilometres of seismic reflection data acquired and hydrocarbon exploration wells drilled. Many of these wells have tested Triassic prospects within the Cheshire Basin, but have proved to be dry. Within the Greater Manchester area, the Fletcherbank 1 and Heywood 1 wells (see Table below) tested Carboniferous plays. Both wells were plugged and abandoned as dry, although Heywood had minor hydrocarbon shows.

Perhaps the best prospects, therefore, represent an intra-Carboniferous plays with accumulations that have been little disturbed since their formation and charging. The yields from such plays would be small; and the current hydrocarbon licence situation reflects the fact that prospectivity in Greater Manchester is not presently perceived as great. Indeed, the small licence blocks presently operated are from former larger licence block areas and relate not to oil exploration, but to coalbed methane or mine gas (methane) development (see below).

Table 1 Hydrocarbon exploration wells within the area.

Exploration wells	Drilling date	Original operator	Current licence area and operator	Status
Fletcherbank 1	1958-59	Steel Brothers Company Ltd	Open acreage	Plugged & abandoned, dry
Heywood 1	1984	BP Development Company Ltd	Open acreage	Plugged & abandoned, dry, minor hydrocarbon shows

8.2 ABANDONED MINE METHANE (AMM), COAL MINE METHANE (CMM) and COALBED METHANE (CBM) POTENTIAL

During the process of coal formation through the conversion of plant matter into coal, gases are produced which are either adsorbed onto the coal or dispersed into pore spaces around the coal seam. The generic term for this gas is coalbed methane (CBM). The majority of the gas is attached to the coal surface in micropores. However, during mining the coal is destressed or fractured which releases significant quantities of CBM. Further gas is released during the life of the mine and after mining has ceased. This gas is an environmental hazard but it is also a potential source of energy. This potential depends on the gas content, permeability and total thickness of the coal present.

CBM can be exploited in various ways:

- Extraction from operational mines for safety reasons prior to it entering the mine air stream (coal mine methane - CMM).
- Coal extracted from abandoned mines (abandoned mine methane - AMM).
- Extraction from virgin or unmined coal from surface boreholes (virgin coalbed methane - VCBM)

There are no operational coal mines in the area and thus there is no CMM potential.

The Pennine Lower-Middle Coal Measures of the South Lancashire Coalfield comprise a succession up to 880 m thick, with 36 named coals present, attaining a maximum seam thickness of >3 m and producing 20-25 m total coal thickness. Historically, gas has been encountered in the coalfield, with some seams noted for their 'coal gas' (the fuel gas produced from a high-volatile bituminous coal). The coals are high to medium, volatile bituminous types with methane contents of up to 9.53 m³ per tonne of coal, and average methane contents of 8.2 m³ per tonne of coal.

The concept of Abandoned Mine Methane capture in the UK goes back to the 1950s when Old Boston mine in the Lancashire Coalfield was sealed and then tapped to supply gas to the adjacent Wood colliery. This previously successful scheme has perhaps been influential in the interest generated in Abandoned Mine Methane (AMM), Coal Mine Methane (CMM) and Coalbed Methane (CBM) in the South Lancashire and North Wales coalfield areas over recent years.

Old Boston Mine lies just to the west of the county in Merseyside. Currently, the small licence areas EXL253 (Eastern/Pegasus) and PEDL039 (Alkane Energy) representing AMM and CBM interests in the west of the county, adjacent to the Old Boston Mine area, represent the retained areas of formerly much larger licence block areas. The relinquishment of large areas of these licence blocks perhaps suggests that prospects for AMM (and CBM) in the area are not now perceived as particularly good. This may be because any former mines are long abandoned and thus are likely to be flooded, provide poor yields, or that the financial/taxation scheme is unhelpful at present.

In the USA, coalbed methane is produced from virgin coals containing 7 or more m³ of methane per tonne of coal. The average gas content of the coals in the South Lancashire coalfield is 8.2 m³ of methane per tonne of coal, which is above the economic threshold in America. However, the South Lancashire Coalfield has been heavily worked and CBM development from virgin coal seams may only be a prospect in unmined area.

9 Aims and limitations

The purpose of the maps in this series is to show the broad distribution of those mineral resources that 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 reflects very local or specific situations.

The maps are intended for general consideration of mineral issued 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.

10 Planning permissions for the extraction of minerals

The extent of all known extant and former planning permissions for mineral working is shown on the map, irrespective of their current planning or operational status. The polygons were supplied as digital files by the Greater Manchester Geological Unit and were also digitised by BGS from plotting sheets and other documents supplied by Bury, Rochdale and Wigan. In addition, planning permission information was digitally acquired from Ministry of Housing and Local Government maps for the area and incorporated in the data. These data have been checked and amended by the local Authorities shown below. Any queries regarding the sites shown should be directed to these 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 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.

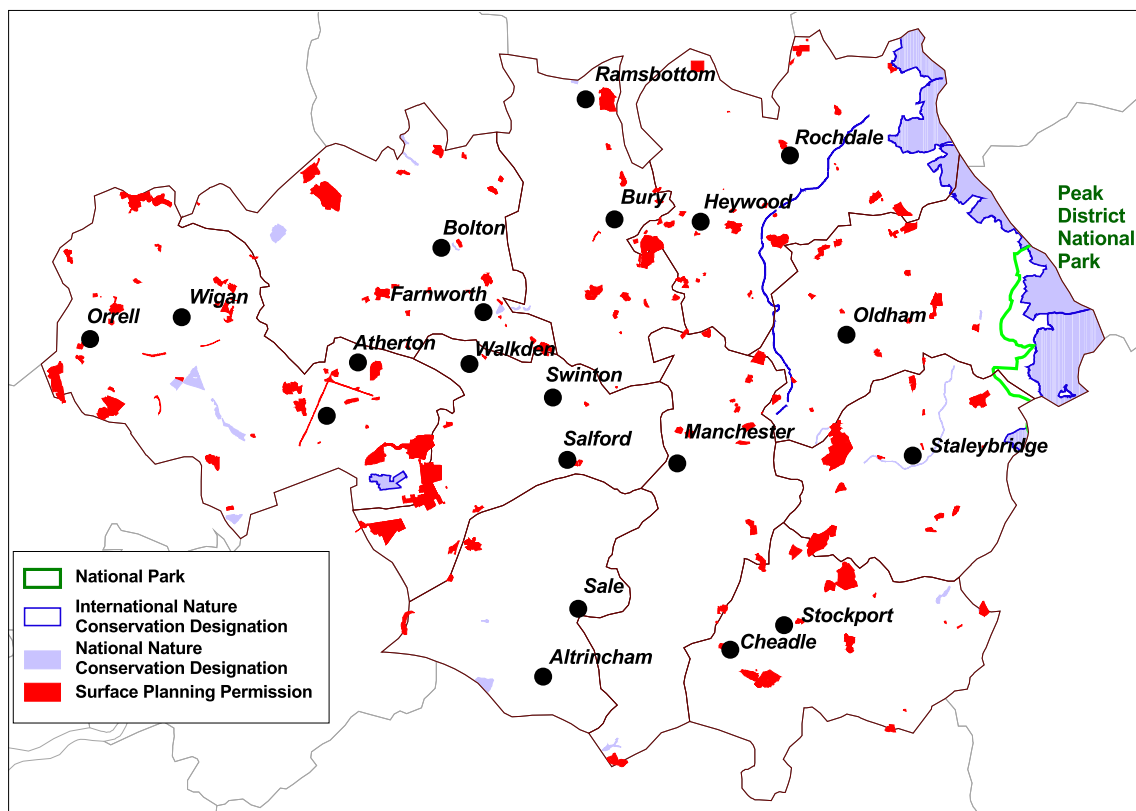


Figure 4. Surface mineral planning permissions and landscape and nature conservation designations in Greater Manchester.

Contact addresses:

Bolton Metropolitan Borough Council, Environment Department, Town Hall, Bolton BL1 1RU, Tel: 01204 522311, Fax: 01204 387153, web address: www.bolton.gov.uk

Bury Metropolitan Borough Council, Development and Environmental Services Department, Craig House, 5 Bank Street, Bury BL9 0DN, Tel: 0161 253 5000, Fax: 0161 253 5290, web address: www.bury.gov.uk

Greater Manchester Geological Unit, University of Manchester, Oxford Road, Manchester M13 9PL, Tel: 0161 275 7150, Fax: 0161 275 7151, web address: www.gmg.uo.ac.uk

Oldham Metropolitan Borough Council, Environmental Services Department, PO Box 30, Civic Centre, West Street, Oldham OL1 1UQ, Tel: 0161 911 3000, Fax: 0161 911 3104, web address: www.oldham.gov.uk

Rochdale Metropolitan Borough Council, Planning Services and Environmental Department, PO Box 32, Telegraph House, Baillie Street, Rochdale OL16 1JH, Tel: 01706 647474, Fax: 01706 864185, web address: www.oldham.gov.uk

Salford City Council, Development Services Directorate, Planning and Building Control Division, Civic Centre, Chorley Road, Swinton M27 5BW, Tel: 0161 794 4711, Fax: 0161 727 8269, web address: www.salford.gov.uk

Stockport Metropolitan Borough Council, Environment and Economic Development Division, Hygarth House, 103 Wellington Road South, Stockport SL1 3TT, Tel: 0161 480 4949, Fax: 0161 953 0013, web address: www.stockport.gov.uk

Tameside Metropolitan Borough Council, Environmental Services Department, Council Offices, Wellington Road, Ashton under Lyne OL6 6DL, Tel: 0161 342 8355, Fax 0161 342 3111, web address: www.tameside.gov.uk

Trafford Metropolitan Borough Council, Trafford Town Hall, Talbot Road, Stretford, Manchester M32 0YY, Tel: 0161 912 1212, Fax: 0161 912 4490, web address: www.trafford.gov.uk

Wigan Metropolitan Borough Council, Borough Planning Department, Civic Buildings, New Market Street, Wigan WN1 1RP, Tel: 01942 244991, Fax: 01942 404222, web address: www.wiganmbc.gov.uk

11 Appendix

11.1 TOPOGRAPHIC BASE

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11.2 CONSTRAINT INFORMATION

Constraint information published on the accompanying map has been provided from the various agencies listed below; any enquires on the information should be addressed to the relevant agency.

11.2.1 English Nature

Digital SSSI, NNR, SAC, SPA and RAMSAR boundaries © English Nature 2004

Contact address: English Nature, Northminster House, Northminster, Peterborough PE1 1UA. Tel: 01733 455000. Fax: 01733 455103. Web page: www.english-nature.org.uk

11.2.2 English Heritage

Positions of scheduled monuments at 25th September 2003.

The majority of monuments are plotted using a centred NGR symbol. Consequently the actual area and/or length of a monument protected by the legal constraints of scheduling cannot be represented here. Monuments scheduled since that date are not accounted for. © Copyright English Heritage.

Contact address: English Heritage, 23 Savile Row, London W1S 2ET. Tel: 0207 973 3132. Web page: www.english-heritage.org.uk

11.2.3 Countryside Agency

Digital AONB boundaries © Countryside Commission 1986 (now Countryside Agency).

Contact address: Countryside Agency, John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA. Tel: 01242 521381. Fax: 01242 584270. Web page: www.countryside.gov.uk

11.2.4 The Coal Authority

Coal Licence Areas © The Coal Authority 2006

Contact address: The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire NG18 4RG. Tel: 01623 427162. Fax: 01623 638338