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NATURAL ENVIRONMENT RESEARCH COUNCIL

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Mineral Resource Information for Development Plans

Dorset, Bournemouth and Poole:
Resources and Constraints

TECHNICAL REPORT WF/01/01
Mineral Resources Series

Mineral Resource Information for Development Plans: Phase One Dorset, Bournemouth and Poole

D E Highley, D G Cameron,
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This report accompanies the 1:100 000 scale map:
Dorset, Bournemouth and Poole Mineral
Resources

Cover Photograph
Aerial view of Tatchells Sandpit, Wareham, working Poole Formation sands.
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CONTENTS

SUMMARY

This report is one of a series prepared by the British Geological Survey for various administrative areas in England and Wales for Phase One of the Department of the Environment, Transport and the Region's Research Project *Mineral Resource Information for Development Plans*.

The report and accompanying maps relate to the area of the Mineral Planning Authorities of Dorset, Bournemouth and Poole. The report and maps delineate and describe the mineral resources of current, or potential, economic interest in the area and relate these to national planning designations which may represent constraints on the extraction of minerals. Three major elements of information are presented and described:

- 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 planning constraints (national statutory designations)

This wide range of information, much of which is scattered and not always available in a consistent and convenient form, is presented on two digitally-generated summary maps. For reasons of clarity, sand and gravel resources are separated from all other mineral resources. The maps are produced at 1:100 000 scale, which is convenient for overall display and allows for a legible topographic base on which to depict the information. In addition, as the data are held digitally using a Geographical Information System (GIS), easy revision, updating and customisation are possible, including presentation of subsets of the data at larger scales.

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 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, by providing a knowledge base on the nature and extent of mineral resources and the environmental constraints which may affect their extraction. However, it is anticipated that the maps and report will also provide valuable data for a much wider audience, including the minerals industry, the Planning Inspectorate, the Environment Agency, the Countryside Commission, other

agencies and government bodies, environmental interests and the general public.

The mineral resource information has been produced by the collation and interpretation of data principally held by the British Geological Survey. The methodology for the collection and display of the data is described and a range of sources of information and further contacts is presented. The mineral resources covered are ball clay, sand and gravel, limestone, hydrocarbons, common clay, silica sand, chalk and salt.

INTRODUCTION

'........ it will become increasingly important to have reliable information about the nature, quantity and location of mineral resources as workable reserves in environmentally acceptable areas become scarcer.'…

Sustainable Development: The UK Strategy.
The UK Government's response to the Rio Earth Summit.

'Resources of some minerals are extensive whilst others are more localised. Environmental and development constraints mean that not all resources can be worked. It is important to identify where extraction will have least effect on landscape, environment and quality of life…'

A Better Quality of Life. A Strategy for Sustainable Development for the United Kingdom. Department of the Environment, Transport and the Regions. May 1999.

This report is one of a series that has been prepared by the British Geological Survey for various areas in England and Wales as part of the Department of the Environment, Transport and the Regions' research project *Mineral Resource Information for Development Plans*.

The report relates to Dorset and the unitary authorities of Bournemouth and Poole. It should be used in conjunction with the mineral resource map of the area which accompanies this report. All references to 'Dorset' or 'the county' made in this report should be taken to also include the administrative areas of Bournemouth and Poole. The report and the associated map delineate and describe the mineral resources of current or potential economic interest in Dorset and relate these to national planning designations which may represent constraints on the extraction of minerals. 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.

All the data are held in digital form which can be readily revised on a regular basis. This also provides scope for producing customised maps of selected information, including the display of part of an administrative area in greater detail or a grouping of administrative areas to provide a broader picture. The mineral resources map is at 1:100 000 which is a convenient scale for overall display and to show the information on a legible topographic base. The report and map represents the situation at 1st January 2001.

Mineral resources are valuable national assets and adequate supplies are essential for the sustainable development of our economy. Society enjoys important benefits from their extraction and, most importantly, use, through their contribution to wealth creation, our infrastructure and the quality of life of individuals.

Minerals can only be worked where they occur, both in sufficient quantity and of the desired quality. However, their extraction, particularly in the densely populated landmass of Britain, causes conflicts with other desirable aims of society, either by loss or change to valued landscapes, habitats or features of historical and archaeological interest, or due to amenity impact. Ultimately, however, a well-restored mineral site may provide new and diverse environmental or development assets.

Basic mineral resource information is essential to support mineral exploration and development activities. In the wider context of sustainable development, mineral resource data are required for resource management and land-use planning. These data also contribute to the baseline information needed for environmental impact studies and environmental guidelines. Moreover, knowledge of the extent and quality of mineral resources, and their rate of extraction, can help value them as national assets. This ensures that the capital they represent is managed properly and rates of depletion monitored.

MINERALS PLANNING

It is the function of the planning system through the development plan and individual decisions to assist with the provision of essential minerals at best balance between economic, social and environmental costs. Achieving that balance requires adequate data on the relevant competing objectives, including the extent and details of mineral resources. As the development of workable resources in environmentally acceptable areas is becoming more difficult, it will become increasingly important in the policy development process to have comparative and reliable data on the distribution and quality of such resources.

The 'development plan' includes structure plans, which contain strategic planning policies, and local plans, containing detailed policies and proposals, or unitary development plans, which combine both functions. In addition, relevant authorities must produce local plans on minerals and/or waste. Development plans set out the main considerations on which planning applications are determined and form the essential framework of the planning system. The importance of the development plan system in planning decisions is emphasised by Section 54A of the Town and Country Planning Act 1990, which requires that planning applications and appeals be determined in accordance with the development plan unless material considerations indicate otherwise. The planning system is, therefore, a plan-led system. Development plans are produced through an extensive process of consultation with prospective developers and the general public. Development plan preparation must take account of Government guidance. This is primarily set out in Planning Policy Guidance notes (PPGs), Mineral Planning Guidance notes (MPGs) and Regional Planning Guidance notes (RPGs). These provide advice on a range of general and specific issues.

The Planning and Compensation Act 1991 introduced a mandatory requirement that all Mineral Planning Authorities (MPAs) in England and Wales prepare either a local plan or a unitary development plan which set out the policies and proposals against which planning applications and appeals are determined. Mineral local plans are intended to provide a clear guide to mineral operators and the public where mineral extraction is likely in principle to be acceptable and where not. They cover a period of at least 10 years and are reviewed periodically to take account of new information and changing circumstances. MPAs are, therefore, required to undertake regular assessments of the existing resources in their areas and of the reserves for which planning permissions have been granted.

The key elements of a minerals local plan or of the mineral policies of a unitary development plan are:

- to balance through its policies the essential need for minerals against protection of the environment and local amenity
- to make an appropriate provision for the supply of minerals and provide an effective framework within which the minerals industry may make planning applications
- to set policies for the control of mineral working and associated development
- to identify areas of possible future mineral working

- to prevent unnecessary sterilisation of resources by the use of safeguarding policies, including defining mineral consultation areas

It follows from the above that information on the extent, quality and, if possible, quantity of mineral resources is an essential prerequisite for the production of mineral local plans, both in the context of identifying areas of future mineral working and the longer term objective of protecting important mineral resources against sterilisation. Such data should be available to all parties to assist them in their contribution to the development plan process, both to protect mineral resources from sterilisation and to provide for sufficient resources to meet the needs of society. This work is intended to assist that process.

Three major elements of information are presented and described:

- 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 planning constraints (national statutory designations)

The map brings together a wide range of information, much of which is scattered and not always available in a consistent and convenient form. The data are held digitally using a Geographical Information System (GIS), which allows for easy revision, updating and customisation, including presentation of subsets of the data at larger scales. 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.

MINERAL RESOURCE CLASSIFICATION

Mineral resources are natural concentrations of minerals, or bodies of rock that are or may become of potential economic interest as a basis for the extraction of a commodity. They will exhibit physical and/or chemical properties and be present in sufficient quantity to be of intrinsic economic interest. Mineral resources are thus economic as well as physical entities.

The identification and delineation of mineral resources is inevitably somewhat imprecise as it is limited not only by the quantity and quality of data currently available but also involves predicting what might, or might not, become economic to work in the future. The assessment of mineral resources is, therefore, a dynamic process which must take into account a range of factors. These include geological reinterpretation as additional data becomes available, as well as the continually evolving demand for minerals, or specific qualities of minerals, due to changing economic, technical and environmental factors. Consequently areas that are of potential economic interest as sources of minerals may change with time. Criteria used to define resources, for example in terms of mineral to waste ratios, also change with location and time. Thus a mineral deposit with a high proportion of waste may be viable if located in close proximity to a major market, but uneconomic if located further away. The criteria used to delineate mineral resources are outlined in the relevant commodity section of the report. These criteria vary depending on the quality of the information available.

The map of Dorset mainly shows the extent of **inferred mineral resources**, that is those mineral resources that can be defined from available geological information. They have neither been evaluated by drilling or other sampling methods, nor had their technical properties characterised, on any systematic basis. Mineral resources defined on the map delineate areas within which potentially workable minerals may occur. These areas are not of uniform potential, nor do they take account of planning constraints which may limit their working. A detailed evaluation programme can only prove the economic potential of specific sites. Such an investigation is an essential precursor to submitting a planning application for mineral working. The individual merits of the site must then be judged against other land-use planning issues.

That part of a **mineral resource** which has been fully evaluated and is commercially viable to work is called a **reserve** or **mineral reserve**. The relationship between **measured, indicated** and **inferred resources** and evaluated commercial deposits (**reserves**) is described in more detail in Appendix 3. In the context of land-use planning, however, 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 rendered non-viable by changing economic circumstances.

The map has been produced by the collation and interpretation of data principally held by the British Geological Survey. The geological lines are taken, with some generalisations, from available BGS 1:25 000 and 1:50 000 scale maps which are currently digitally available. These published maps are based on 1:10 560 or 1:10 000 scale surveys, which cover most of the county. In general, the more recent the survey the more detailed it is likely to be.

Where mineral assessment studies have been undertaken by the British Geological Survey, sufficient information may be available to define mineral resources at the **indicated resource level.** The sand and gravel resources of the area to the north of Bournemouth fall into this category. Here the linework is based on the 1:25 000 scale mineral assessment maps, where these are available. In addition, information from the recently completed 'Wareham Basin' project is included. This is based on 1:10 000-scale mapping.

MINERAL WORKINGS AND PLANNING PERMISSIONS

The location and name of mineral workings that are currently active or temporarily inactive, together with the main mineral commodities produced, are shown on the map and in Appendix 1.

The extent of all known mineral planning is also shown on the Mineral Resources Map. They include all permissions granted since 1st July 1948 and all IDO permissions, whatever their subsequent status in relation to legislation relating to the Planning and Compensation Act 1991 and the Environment Act 1995. Planning permissions cover active mineral workings, former mineral workings and, occasionally, unworked deposits. They represent areas where a commercial decision to work minerals has been taken in the past and where the permitted mineral reserve may have been depleted to a greater or lesser extent. Within the overall site, there may be a number of individual planning permissions at various stages of development and restoration. All planning permissions data were obtained from Dorset County Council, who also provided such information for Bournemouth and Poole Borough Councils.

The present physical and legal status of individual permissions is not qualified on the maps or in the report. The areas shown may, therefore, include inactive sites, where the permission has expired due to the terms of the permission, i.e. a time limit, and inactive sites where the permission is still valid. Sites which have been restored have not been separately identified. A planning permission may extend beyond the mapped resource as it may make provision for operational land, including plant, overburden tips and landscaping, or it may extend to an easily identified or ownership boundary. Information on the precise status and extent of individual planning permissions should be sought from the appropriate Mineral Planning Authority (Appendix 4).

ENVIRONMENTAL DESIGNATIONS

The maps show 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:

- Areas of Outstanding Natural Beauty (AONB)
- National Nature Reserves (NNR)
- Sites of Special Scientific Interest (SSSI)
- Scheduled Monuments

Mineral development may also be constrained by other factors not shown on the maps 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 (Appendix 4).

AONBs have been digitised from maps obtained from the Countryside Agency and English Nature provided digital data on SSSIs and NNRs. Information on the location of Scheduled Monuments has been obtained in digital form from English Heritage. The areas shown as NNRs and SSSIs may also be subject to international designations reflecting their wider ecological importance. They may include Ramsar sites (wetlands of international importance as listed in accordance with the Ramsar Convention), or proposed Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) as identified in accordance with EC Directives on wild birds and natural habitats, respectively.

MINERAL RESOURCES

Overview

The county of Dorset is underlain by strata of the western part of the large geological structure known as the Wessex Basin. The exposed sequence consists of sedimentary rocks ranging from Jurassic to Holocene (Recent) in age. In general, the rocks are inclined towards the east, so that the oldest strata crop out in the west of the county, with successively younger beds appearing to the east. The cliffs of Dorset, from Lyme Bay to the Isle of Purbeck, display a spectacular succession of Jurassic, Cretaceous and Eocene rocks, which have been the subject of intense interest to naturalists and scientists for over two centuries. Most of this coastline is a candidate for World Heritage Site status.

Dorset has a long history of mineral working. Shale artefacts, clay pottery and building stone from the area were utilised throughout Britain from at least the Romano-British period. Purbeck Marble was much used in the Middle Ages and polished ‘marble’ columns and fonts are found in most of the churches and cathedrals of southern England. The Portland Stone and ball clay resources of the area were first developed on a commercial scale during the 17th and 18th centuries. The architect Inigo Jones first used Portland Stone in London in the 17th century and, more importantly, it was used by Sir Christopher Wren in the rebuilding of many London buildings following The Great Fire of 1666.

The valuable properties of ball clay were recognised and led to its use in the rapidly growing ceramics industry of Stoke-on-Trent around 1775. Ball clay from Dorset remains important to the national ceramics industry and has also become of international importance and is widely exported, particularly to Europe.

Oil shales have been worked in Dorset since ancient times. More recently oil exploration has been very successful. The county hosts Europe’s largest onshore oilfield, Wytch Farm, which had an output of 3.86 million tonnes in 1999 and accounted for 90 per cent of Britain’s’ onshore production and 3 per cent of total production from onshore and offshore resources.

Today the main emphasis of mineral production in Dorset is the extraction of sand and gravel, ball clay and oil, with limestone for use as building stone and a source of crushed rock aggregate being of somewhat lesser importance. The supply of these minerals, and notably ball clay, and sand and gravel, within or close to areas of high landscape and nature-conservation value, will be the major mineral planning issues in the county for the foreseeable future.

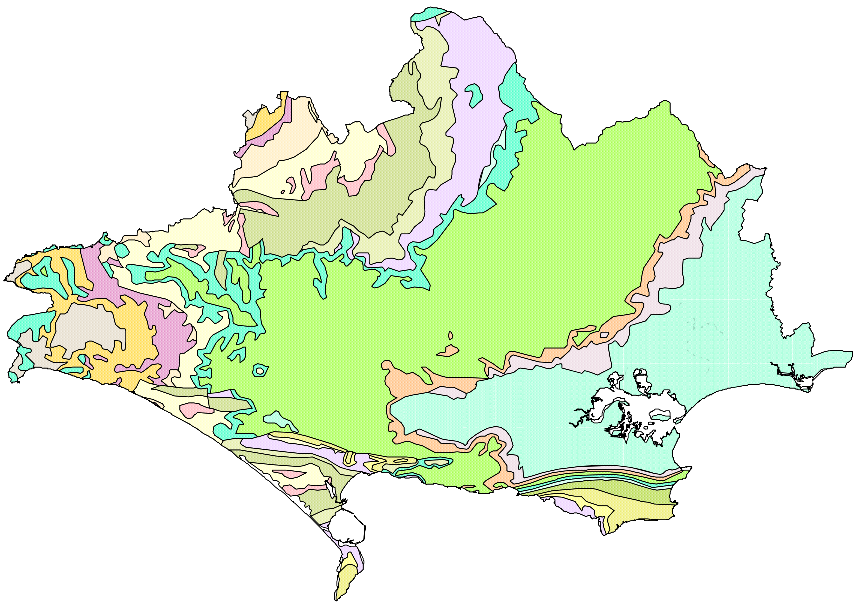


Figure 1. Simplified geological map of Dorset. Based on 1:625 000 Geological Survey Ten Mile Map, South Sheet (Solid).

Quaternary omitted for clarity

Tertiary	Bracklesham Group inc Poole Fm.	clays, sands	ball clays, building and construction sand
	London Clay	clays, sands	brick and tile making, building sand
	Reading Formation	sands, clays	brick and tile making, building sand
Cretaceous	Chalk	chalk, flint	lime, aggregates, building stone
	Upper Greensand, Gault	sands, clay	aggregates, building stone
	Lower Greensand	sand	
	Weald Clay	clays	brick and tile making
Jurassic	Purbeck Limestone Group	limestone	building stone, aggregates
	Portland Limestone Formation	limestone	building stone, aggregates
	Kimmeridge Clay	sands, clays ironstone	Oil source rock iron making
	Corallian	limestone, clays	building stone
	Oxford Clay, Kellaways Beds	clays	brick making
	Cornbrash	limestone	building stone, aggregates, lime
	Great Oolite	clays	
	Inferior Oolite	limestone	building stone, aggregates, lime
	Upper Lias	sand	
	Middle Lias	sandy clay	brick and tile making
	Lower Lias	limestone, clays	building stone, lime

Figure 1a. Key for Figure 1. Commodities and their resources which are no longer worked are shown in blue text.

BALL CLAY

Ball clays suitable for use in the manufacture of ceramic whiteware have a limited distribution, both nationally and internationally, and Britain is a leading world producer and major exporter. Deposits of commercial interest are confined to three Palaeogene (Tertiary) basins in southern England; the Bovey (the most important) and Petrockstow basins in Devon, and the Wareham Basin in Dorset. The Wareham Basin accounts for about 20 per cent of national production and output has been on a rising trend in recent years due to a buoyant export market (Figure 2).

Ball clays are fine-grained, highly plastic clays, which fire to a light colour and are used chiefly in the manufacture of ceramic whiteware. Dorset ball clays are particular noted for their high plasticity and strength and are mainly used in the manufacture of wall and floor tiles, but are also used in tableware, sanitaryware and electrical porcelain production. Ball clays consist of natural mixtures of three main minerals; kaolinite, a micaceous mineral (illitic mica) and quartz in varying proportions and each in very finely divided form. The clay mineral kaolinite, which is of a highly plastic, disordered variety, is the key component. Each mineral contributes different properties to the clay and ultimately, therefore, to a ceramic body. In addition, minor components including carbonaceous matter, and iron and titanium oxides, occur as impurities and adversely effect the ceramic properties of the clay. In particular, iron oxides (Fe_2O_3) and titania (TiO_2) markedly effect the fired colour of the clay and are serious contaminants. Carbon affects the rate at which a ceramic product can be fired.

The desirable properties of ball clays are:

- high kaolinite content (the higher the better and generally >30 per cent)
- light-firing properties (low Fe and Ti oxides <3 per cent)
- high plasticity (a high proportion of fine kaolinite particles)
- low carbon content (<0.3 per cent)

Modern ceramic manufacturing, with its trend towards increasing automation and fast firing to improve energy efficiency, is placing increasingly stringent demands on ball clay quality. Raw materials with consistent and predictable compositions and ceramic properties are required.

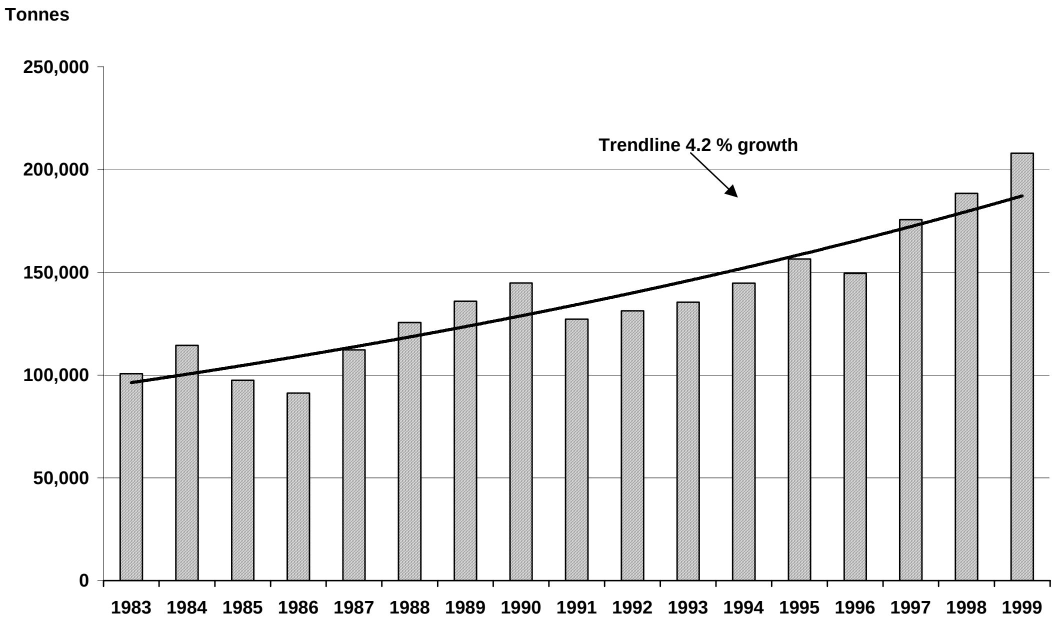


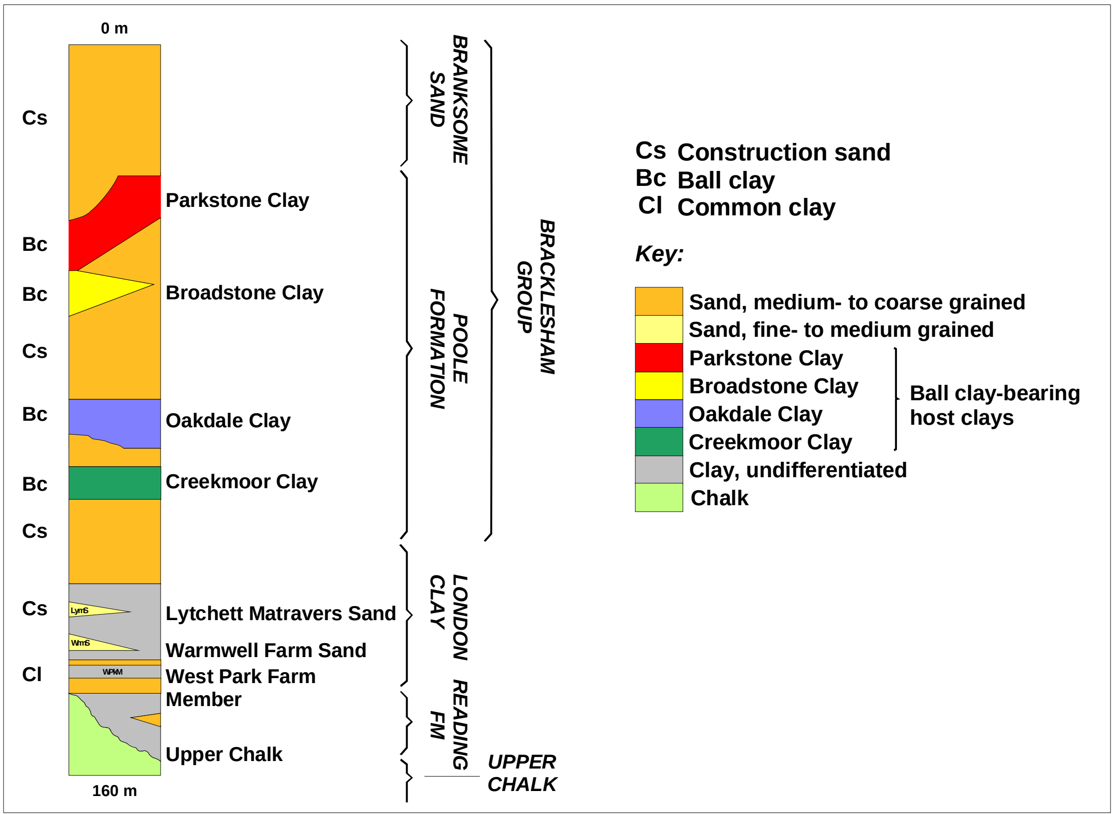
Figure 2. Ball clay production in Dorset, 1983–1999.

Ball clays were formerly worked on a modest scale by underground mining in the Wareham Basin but this is no longer commercially viable. The last two small mines closed in August 1999. Production is now solely by opencast methods and is usually confined to a single bed between 3 m and 6 m thick at each quarry, although each bed may contain several production grades.

Dorset ball clays undergo very little processing other than shredding, which involves size reduction allowing the clays to be more easily handled and, more importantly, blended to provide a balance of technical properties. This not only smoothes out variations in the properties of individual clays, but allows the desirable properties of two or more clays to be combined. Blending, therefore, creates a combination of properties which would not naturally occur in a single clay. The extraction and subsequent processing/blending of ball clays is, therefore, geared to the production of homogeneous and standard grades of clay. Some 26 different production clays are extracted in Dorset to produce 24 saleable blends, which each contain on average four production clays. The properties of ball clays from different areas and seams complement each other. The continuing availability of a wide range of clays is, therefore, an essential feature of ball clay supply. It provides the industry with a greater degree of flexibility in balancing supply and demand, and ensures a greater degree of security of supply. However, without the most versatile (high-quality) clays, blending of less versatile clays becomes difficult, if not impossible. Supplies of both high and lower-quality clays are required in the proper proportions to sustain the industry.

Resources

Ball clays occur in four host clays in the Poole Formation in the central and eastern parts of the Wareham Basin (Figure 3). Their extent is shown on the inset on the Minerals Resources map. In ascending sequence the host clays are the Creekmoor, Oakdale, Broadstone and Parkstone clays. The average thickness of an individual host clay ranges from 6 m to 16 m, but thickness can vary rapidly over short distances. It may exceed 50 m but ball clays are also locally absent. The host clays exhibit vertical and lateral variations in properties which markedly affect their potential as ball clays. Each host clay contains potentially workable ball clay, together with beds of inferior quality clays of no commercial value. Individual ball clay deposits are laterally impersistent and commercial grade clay may pass into non-commercial grade material over short distances. The proportion of ball clay in a host clay varies considerably, but may be up to 25 per cent. The main reasons why parts of host clays are not commercial ball clays are the levels of impurities present, such as iron oxides, carbonaceous matter, or silica. Clay quality can vary quite rapidly over short distances. The presence of a host clay is, therefore, not a guarantee



that it will contain workable ball clay.

Figure 3. Generalised vertical section of the rocks through the Palaeogene Wareham Basin showing the position of the host clays.

The Creekmoor Clay is the most important host clay, providing the highest quality ball clay, and accounting for 55 per cent of total output. It is only worked south of the River Frome. The Oakdale Clay has a more extensive outcrop, but is worked only on the Arne Peninsula. It accounts for about 15 per cent of output. The Broadstone Clay has the largest outcrop of the host clays. However, ball clay tends to occur only as sinuous channel fills in the host clay making it difficult to locate and work these relatively small deposits. The Broadstone Clay is no longer worked other than as small pockets in the overburden at the Povington quarry. The Parkstone Clay has a limited outcrop and is worked both north and south of the Frome. It accounts for 30 per cent of total production.

Table 1. Summary geochemistry and mineralogy of the host clays.

	Average value (Wt %)					
	SiO_2		$Fe_2O_3 + TiO_2$		Kaolinite	
Host clays	**range**	**mean**	**range**	**mean**	**range**	**mean**
Parkstone Clay	50.9 – 78.75	64.9	1.86 – 4.52	2.9	19.21 – 47.46	31.9
Broadstone Clay	41.33 – 77.00	60.9	1.95 – 9.10	3.4	17.20 – 79.44	45.1
Oakdale Clay	48.00 – 76.00	59.9	1.81 – 9.45	3.1	16.10 – 70.90	36.1
Creekmoor Clay	44.63 – 73.00	53.7	1.75 – 10.85	3.2	12.20 – 81.42	52.6

The geochemistry of the host clays shows wide variations but average values are given in Table 1, together with mean kaolinite values. The Creekmoor Clay has the lowest average silica and highest kaolinite values and this is consistent with it being the source of the highest quality ball clays. The Parkstone Clay is the most siliceous and the Broadstone Clay exhibits the second highest kaolinite values but has the highest average iron and titanium oxides values. The highly variable nature of the host clays means that they are not everywhere considered to be potential targets for ball clay extraction. North of the River Frome, the Oakdale Clay is the most extensive host clay but this is generally of lower quality. In addition, the quality of the host clays decreases north-eastwards (north-east of Wareham), where they grade into common clays only suitable for the manufacture of structural clay products. High-quality ball clays are, therefore, restricted to the area south of the Frome. The lower quality ball clays north of the Frome are potentially less valuable because of their lack of versatility in blending.

SAND AND GRAVEL

The commodity ‘sand and gravel’ includes all sand and gravel used for construction purposes, but excludes relatively small amounts of sand used for industrial applications, which is referred to as ‘silica’ or ‘industrial’ sand. Although conveniently grouped together, sand and gravel are separate commodities, the term ‘gravel’ being used for material that is coarser than 5 mm, with a maximum size of 40 mm, and the term ‘sand’ to material that is finer, but coarser than 0.075 mm.

The principal uses of sand in the county are as fine aggregate in concrete, mortar and asphalt, although small amounts of sand are also used in the manufacture of calcium silicate bricks. The main use of gravel is as coarse aggregate in concrete. Substantial quantities of sand and gravel may also be used for constructional fill. Sand and gravel production in Dorset was just over 1.3 million tonnes in 1999, of which only 67 000 tonnes was marine dredged and landed at Poole. Recent production is shown in Figure 4.

The sand and gravel resources of Dorset fall into two main categories:

- bedrock, or ‘solid,’ sand deposits (mainly the Poole Formation), and
- superficial, or ‘drift,’ deposits (mainly gravel-bearing river terrace deposits).

Bedrock sand deposits account for the major proportion of the output in Dorset.

The variability of sand and gravel means that, in comparison with other bulk minerals, it is more difficult to infer the location and likely extent of potentially workable resources from geological maps. The properties, which influence the economic potential of a sand and gravel deposit, include:

- sand to gravel ratio
- proportion of fines and oversize material
- presence of deleterious rock types (such as chalk or mudstone)
- thickness of deposit and overburden ratio
- position of the water table
- possible presence of unwanted interbedded material
- the ease with which material can be processed to produce a saleable product (clay fines are more difficult to remove than silt)
- location relative to demand

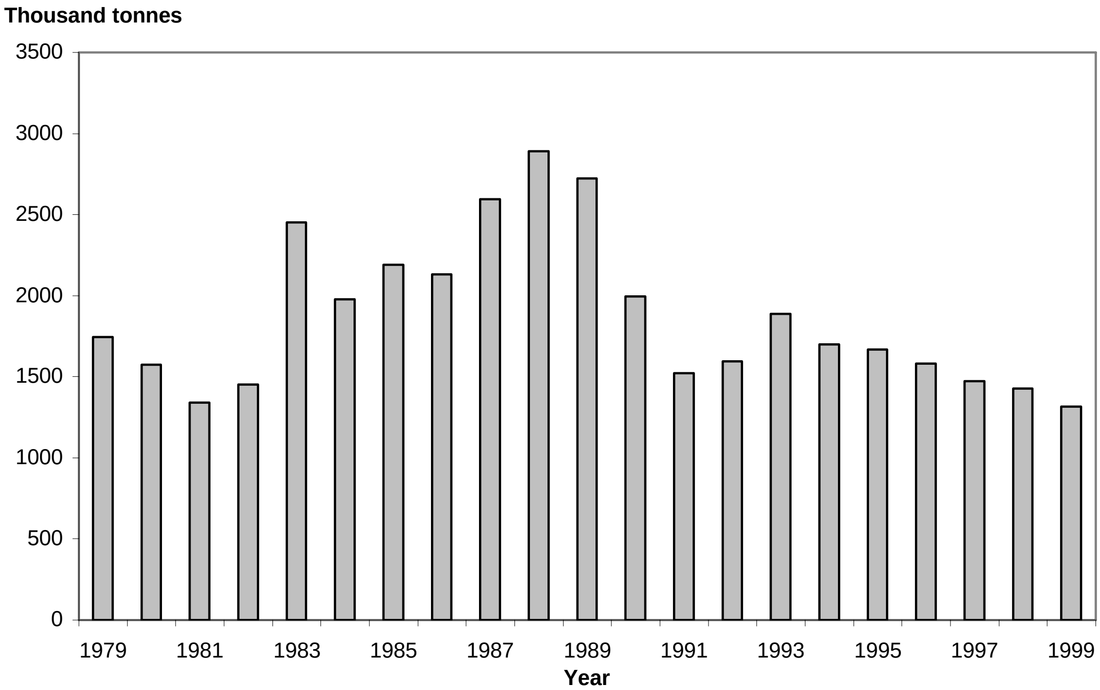


Figure 4. Sand and gravel production in Dorset, 1979-1999.
Source: *Annual Minerals Raised Inquiry. Office for National Statistics.*

Bedrock sands

Sediments of Palaeogene (Tertiary) age form an extensive resource of sand in the south and east of the county. Their physical characteristics are shown in Table 2.

Table 2. Typical particle sizes of Palaeogene sands
(Source: BGS Mineral Assessment Reports).

Geological unit	*Fines (<65µm)*	*Fine Sand (65µm-0.25mm)*	*Med Sand (0.25-1mm)*	*Coarse Sand (1-4mm)*	*Gravel (>4mm)*
			Wt %		
Boscombe Sand	21	76	1	1	1
Branksome Sand	12	43	42	1	2
Poole Formation (East)	12	36	48	2	2
Poole Formation (West)	6	19	65	8	2
London Clay sands	16	49	32	2	1

The principle resource of bedrock sand is the Poole Formation which crops out extensively in the south and east of the area. The sands are extensively worked and are the main source of fine aggregate in Dorset. They are also of regional importance as a source of concreting and building sand and are being transported to west London by rail on a trial basis.

The Poole Formation consists of an alternating sequence of clays and fine to coarse-grained, locally pebbly sands. Individual sand units are typically 10–15 m thick and have mean particle sizes in the range 0.4 to 0.6 mm. The sands vary locally in particle size, both laterally and vertically. Deposits within the Wareham Basin (west of Poole) show no overall variation in particle size, but are cleaner and coarser than deposits to the east. Quarrying operations are concentrated in the western outcrop. Selective extraction and/or processing and blending allow the sands to meet specifications. There are no significant geological constraints that preclude their extraction anywhere in the Basin. The sands are also worked on a modest scale for industrial purposes (see below). The distribution of the sand resources within the Poole Formation is shown on the mineral resources map.

The Branksome Sand and Boscombe Sand formations were worked in the past. The deposits tend to be finer and less clean than the Poole Formations sands. They are included on the map but most of the outcrop is sterilised by development.

Thin sand units also occur in the London Clay, but are much finer grained (mean particle size 0.22 mm) than those in the Poole Formation, which significantly limits their commercial use. Consequently they are not shown on the map. Three thin sand units have been named; the Warmwell Sand, Lytchett Matravers Sand and sand within the West Park Farm Member. The Lytchett Matravers Sand is worked in conjunction with Poole Formation sands at Henbury for use in the manufacture of clay bricks.

Superficial sand and gravel

The principal resource of gravels in Dorset are the superficial sand and gravel deposits that occur as thin layers overlying the bedrock formations. These deposits are mainly associated with the main rivers in Dorset, notably the flint gravels of the Frome, Piddle, Stour and Avon in the east and the chert gravels of the Axe in the west.

The most important resources are river terrace deposits, which are locally fairly widespread, but generally fairly thin (average about 2.3 m). River terrace deposits occur at various levels above the present alluvial flood plain of the main rivers. They represent the eroded remnants of formerly more extensive, relatively gravel-rich alluvial deposits laid down when the rivers were at higher elevations than today. Individual river terraces may vary both in thickness and composition. In places, they are worked with the underlying Poole Formation sands.

High level terraces (formerly known as ‘Plateau Gravels’) have provided most of the gravel of the area, but most of these are now worked out or are sterilised by development. Considerable spreads of low-level terraces also border the lower reaches and confluences of the main rivers in the south east. These deposits generally deteriorate away from the courses of the main rivers with an increase in clay content and a decrease in thickness.

Table 3. Physical properties of selected superficial sand and gravel deposits. Source: BGS Mineral Assessment Reports.

Geological unit	*Fines* (<65μm)	*Fine Sand* (65μm-0.25mm)	*Med Sand* (0.25-1mm)	*Coarse Sand* (1-4mm)	*Fine Gravel* (4-16mm)	*Coarse Gravel* (16-64mm)
	Wt %					
High level Terrace Frome/Piddle	12	6	20	12	24	26
Low level Terrace Frome/Piddle	5	5	22	13	25	30
Sub-alluvial Frome/Piddle	5	5	28	14	21	27
Low level Terrace Avon	6	6	15	9	33	31
Sub-alluvial Avon	6	9	20	7	29	29

Gravel resources also occur beneath floodplain alluvium (sub-alluvial gravel) and extend along the length of the major rivers and possibly beneath the marine alluvium of Poole Harbour. The thickness ranges generally between 0.6 and 6 m, but up to 10 m has been recorded. However, these deposits have not been worked to any extent because of operational and restoration difficulties associated with wet working beneath the water table.

The conditions leading to the formation of the River Axe gravels downstream from Chard created clean, gravel-rich and exceptionally thick deposits but which are of very limited extent. However, these deposits rapidly deteriorate in quality and thickness upstream and away from the main river valley. The gravel associated with the River Yeo consists predominantly of oolitic limestone. They have not been worked commercially. Deposits associated with the River Stour and its tributaries in the north also have a variable composition and little is know about their thickness.

Storm beach deposits occur along parts of the coast but are of limited extent. Deposits along Lyme Bay have been worked for gravel for construction and industrial purposes.

LIMESTONE

The limestone resources of Dorset are of commercial value both as a source of building stone and crushed rock aggregate. Economic interest is centred on the Portland and Purbeck limestones of the Portland Stone, Lulworth and Durlston formations, which are of Jurassic age. Operations are located on the Isle of Portland, working the Portland Stone Formation and the basal Lulworth Formation for building stone and aggregate, and the Isle of Purbeck working the

Portland Stone Formation, mainly for aggregate, and the Lulworth and Durlston formations principally for building stone. Resources outside these areas are more variable, thin and occur in structurally complex deposits.

The Portland Stone Formation consists of a lower sequence of oolitic limestones containing numerous nodules and large slabs of chert (formerly referred to as the 'Cherty Series') which, although unsuitable for use as building stone, are utilised for aggregate purposes and armour stone. These are overlain by mainly chert free, oolitic limestones (formerly referred to as the 'Freestone Series') which are worked for both aggregate and building stone. The limestones ('caps') comprising the basal Lulworth Formation are used for aggregate; the limestones at the junction of the Lulworth and Durlston formations are used as building stone.

Crushed Rock Aggregate

Crushed rock and armour stone are produced from the Portland Stone Formation and the overlying basal limestones of the Lulworth Formation. Most of the crushed rock is now used as unbound roadstone aggregate, drainage media and fill, and agricultural lime, but was formerly also used for coated roadstone and as concrete aggregate in concrete blocks, pre-cast units and reconstructed stone. The rock is relatively soft and porous and can be variable in its physical and chemical properties, and this restricts its application to less demanding roadstone uses. The Portland Stone Formation is also worked for aggregate at the Swanworth quarry on the Isle of Purbeck. Representative aggregate properties are given in Table 4.

Table 4. Typical aggregate test data from the Portland Stone Formation.

Formation	AIV	ACV	TFV kN	WA %
Portland Stone ('Cherty Series')	21	24	170	2.9

Definitions:

Aggregate Crushing Value **(ACV)**: Resistance of an aggregate to crushing when subjected to a crushing force as measured by the aggregate crushing test. The smaller the value, the more resistant the rock is to crushing.

Aggregate Impact Value **(AIV)**: Resistance of an aggregate to repeated impact as measured by the aggregate impact test. The smaller the value, the more resistant the *rock is to impact.*

Ten per cent fines value (**TFV**): Resistance of an aggregate to crushing as measured by the force in kN applied in the ten per cent fines value test. The larger the value, the more resistant the rock is to crushing.

Water absorption (WA): Percentage of water by mass that can be absorbed by an aggregate when in a saturated surface-dried condition.

Building stone

The many limestone units that crop out in Dorset have all been quarried for building stone in the past (*see* Woodward 1894; Thomas, 1990; 1998). Only a few of these limestones, however, have achieved a national reputation and commercial importance as sources of building stone.

Dorset is fortunate in having one of Britain's premier building limestones. Portland Stone is perhaps the best known and possibly the most widely used building stone in Britain. Its use is synonymous with major secular and ecclesiastical architecture and civic design both in Britain and abroad. The coastal location of the resource was an important factor in the stone rising to pre-eminence. The stone is primarily even-grained, white, oolitic limestone with subtle variations in quantities of shell and cement, between and along beds, which defines the characteristics of different quarry areas. Three main beds have been quarried on the Isle of Portland; the Whitbed, Basebed and the Roach – the latter distinguished by being honeycombed by the empty moulds of particularly distinctive gastropod and bivalve fossils.

The main characteristics that make Portland Stone of value are its combination of resistance to weathering, high strength, and ease of extraction and processing, coupled with colour and the height and mass of block available (up to $9.3m^3$). Local quarry area and bed names are used to define different varieties of stone. A significant element of the use of the stone is in repair and extensions. Due to the need to match stone from the original source, so as to ensure precise similarity in colour, texture and weathering characteristics, quarry areas may be worked on a very intermittent basis. Portland Stone is worked at a number of locations on the Isle of Portland and was also formerly extracted from cliff edge adits in the Isle of Purbeck. It is now worked at only one quarry in Purbeck. The range of physical properties of Portland Stone is shown in Table 5.

Table 5. Some physical properties of Portland Stone.

Quarry area **Local bed name**	**Coombefield** **Whitbed**	**FancyBeach** **Basebed**	**Perryfield** **Perrycott**
Porosity	18.7%	20.86%	14.84%
Saturation Coefficient	0.58	0.73	0.63
Water Absorption	4.96%	7.11%	5.90%
Bulk SG	2.199	2.143	2.310
Salt Crystallisation	25.00%	9.83%	9.60%
Compressive Strength Mpa	39.04	62.72	58.00
Flexural Strength Mpa	7.55	8.22	6.90
Slip Resistance	80.3	-	79
Abrasion Resistance	23.36	-	23.70

Limestones from the Purbeck Limestone Group (Lulworth and Durlston formations), are known to have been quarried on the Isle of Purbeck since at least Roman times. Perhaps the best known of these stones are the hard, fossiliferous limestones known as Purbeck Marble which occur as two thin limestone beds containing myriads of shells of the freshwater gastropod *Viviparus* sp. They were extensively worked up until the beginning of the 16th century and intermittently since then. Today the supply of Purbeck Marble is limited and is quarried only on demand at a single site near Langton Matravers.

Quarrying of limestones for building stone remains an important local industry in the Isle of Purbeck. Some fifteen small quarries between Swanage and Worth Matravers produce hard, pale grey, cream or brown limestones from the Purbeck Limestone Group (top of Lulworth and base of Durlston formations) for new build and conservation work. The stone is a hard, thinly bedded shelly limestone used for walling, roofing and flooring.

Although a number of other limestone units have been worked for building stone in Dorset in the past, today only the hard, shelly and oolitic limestones of the Corallian Group are currently of economic interest. These include the Todber Freestone and the Cucklington Oolite, which are still quarried at Marnhull and Silton.

SILICA (INDUSTRIAL) SAND

Silica sands contain a high proportion of silica in the form of quartz and are valued for their chemical purity and physical properties on which their diverse industrial applications are based. For most uses silica sands have to conform to very closely defined specifications. Thus physical and/or chemical properties effectively govern their usefulness and value

The distinction between silica sand and construction sand is based principally on application and market specifications, different uses demanding different combinations of properties. These include high silica content in the form of quartz, an absence of deleterious impurities, such as clay and iron oxides, and typically a narrow grain-size distribution (generally in the range 500–100 µm). Preferred sands are those that are clean, free of impurities and well sorted (closely sized). Depending on end-use application, the processing of silica sand varies in degree of complexity and often requires a high capital investment in plant. Silica sands command, therefore, higher prices than construction sands, which allows them to serve a wider geographical market.

Sands in the Poole Formation are principally valued as a source of fine aggregate, but they are also highly siliceous and relatively clean and are worked on a modest scale for industrial applications. The Poole Formation is not a nationally important resource of silica sand. This is probably a function of a lack of important local markets and increased competition from other silica sand resources in more distant markets. Silica sand, including resin-bonded foundry sand, has been produced at Binnegar in the past. Dried silica sand is currently produced at Warmwell for use, after grinding, in glass-fibre manufacture, where it is particularly valued for its low alkalis content. Typical chemical analyses of Poole Formation sands are shown in Table 6. Sands for semi-industrial applications, including facing bricks and sports-turf sand, are produced from sand in the London Clay at Henbury.

Table 6. Typical chemical analyses of sands produced from the Poole Formation.

Weight %	Binnegar	Warmwell
SiO_2	99.24	99.4
TiO_2	0.05	0.03
Al_2O_3	0.28	n.a.
Fe_2O_3	0.07	0.35
CaO	0.01	0.05
MgO	<0.02	0.02
K_2O	0.03	0.01
Na_2O	0.08	0.01
Loss	0.24	0.20

COMMON CLAY

The term ‘common clay’ defines clays primarily used in the manufacture of structural clay products, such as facing and engineering bricks, pavers, roofing and floor tiles, and vitrified clay drainage pipes. They are more siliceous and less plastic than ball clays and also fire to a reddish colour, due to the presence of appreciable amounts of iron oxides. They are, therefore, quite distinct commodities from ball clays and have a widespread distribution in Britain where they are principally worked for brick manufacture. Common clay may also be used as a source of constructional fill and for lining and sealing landfill sites.

The suitability of a clay for the manufacture of structural clay products depends principally on its behaviour during shaping, drying and, most importantly, firing. This behaviour will dictate the final properties of the fired product, including its strength, porosity (water absorption), durability and aesthetic qualities.

Common clay is produced only on a very modest scale in Dorset (14 000 tonnes in 1999). High-quality, hand-made facing bricks are produced at a small plant at Swanage. The raw material used is the Weald Clay (a major brick clay resource in its main outcrop in the Weald), which occurs in a narrow east-west outcrop in the Isle of Purbeck. Clay in the West Park Farm Member of the London Clay is worked at Knoll Manor, near Corfe Mullen for the manufacture of red-bodied, unglazed floor tiles. The clay is always blended with other raw materials, principally Dorset ball clay, china clay and feldspar. These resources are only of very local importance and are not shown on the map.

In the past, common clay has been extensively worked in the Poole area for the manufacture of bricks, drainage pipes and tiles. Until the 1960s the area was one of the main centres for salt-glazed pipe manufacture in Britain. The clays used were derived from the Poole Formation host clays, which are more siliceous and red-firing in the Poole area and, thus, not of ball clay quality. The inherent mineralogy of the Poole Formation host clays make them potentially suitable for the manufacture of facing bricks and roofing/cladding tiles where they are not of ball clay quality.

CHALK

Chalk is the name given to the relatively soft, white or pale grey, fine-grained limestone of Late Cretaceous age, which forms extensive outcrops in the south and east of England. In Dorset, a broad south-west to north-east trending tract of land, occupying much of the downland in the centre of the county and extending to the southern part of Salisbury Plain is underlain by chalk.

The total thickness of the Chalk in Dorset is up to 430 m, and it is geologically subdivided into the Lower, Middle and Upper Chalk formations, which can be distinguished as follows:

Lower Chalk – commonly occurs with a significant proportion of admixed clay, so that the calcium carbonate content is less that 93.5 per cent. Bands of marl (very clay-rich chalk) and nodules of iron sulphide (pyrite or marcasite) are common.

Middle Chalk –this sequence comprises a lower unit of hard nodular chalk overlain by soft, blocky white chalk of medium- to high-purity (93.5–98.5 per cent). Flint bands occur locally in the top part of the Middle Chalk

Upper Chalk – generally of high chemical purity, with a calcium carbonate content in the range 97.0 to 98.5 per cent, but also with numerous flint bands (not included in the $CaCO_3$ figures).

In terms of its value as a mineral resource, the chalk represents a very considerable volume of high- and medium-purity calcium carbonate. In the past, numerous pits were opened for agricultural lime, and to provide lime for mortar and flint for building and roadstone. Today only two pits are in production, at Cocknowle, near Wareham, for construction chalk, and at Shillingstone for agricultural use and lime.

HYDROCARBONS

Oil Shales

The extraction of oil shales goes back to at least the Iron Age, when the Kimmeridge Clay oil shales, which extend from the Dorset coast to Yorkshire, were used as a fuel (Gallois, 1978). At varying times since then they have been used at Kimmeridge as a local coal substitute and were used as a fuel for the 18th century alum and sea-salts industries. Attempts to establish commercial oil production by the distillation of oil shale have been made on various occasions, most notably at Kimmeridge and Portesham in Dorset (Gallois, 1978).

Oil and Gas

South Dorset has been known to be prospective for hydrocarbons for most of the 20th century. A number of hydrocarbon shows and seepages occur in the Wessex Basin. They are found (e.g. Selley, 1992) onshore at, for example, Upwey [3660 0851], but most are known from along the Dorset coastline between Osmington Mills in the west [3741 0814] and Anvil Point in the east [4025 0765]. Stratigraphically they occur in rocks ranging from the Wealden to the Bencliffe Grit of the Corallian Group.

The search for hydrocarbons in the 20th century was initiated by the D'Arcy Exploration Company (now BP), following the granting of the first prospecting licences under the Petroleum Production Act 1934. Exploration was prompted by these coastal seepages and drilling for hydrocarbons started in 1936. Various exploration wells were drilled, with generally disappointing results, providing in most cases only shows or short term production (Table 7). However, the initial tests provided further impetus for continued exploration, which is ongoing today.

As a result of the exploration, three producing oilfields exist in Dorset; namely Wytch Farm, Wareham and Kimmeridge Bay and a number of wells are suspended as oil producers (see map). The Kimmeridge oilfield, discovered in 1959, was the first commercial discovery in the Wessex Basin. The discovery well for the Wareham

Oilfield was drilled in 1964, although production testing did not commence until 1970, with shut-in occurring in 1979 to conserve energy in up-dip accumulations. Production finally commenced in 1991. Wytch Farm was discovered in 1973 and has proved to be the most important find. Initially it was believed to be a modest discovery (30 million barrels). However, subsequent drilling proved deeper target horizons in the Sherwood Sandstone Group (Triassic) and it is now both the largest onshore oilfield in Britain and in the top ten of British fields, including those in the North Sea. The oilfield extends offshore far to the east of the discovery well and present technology, involving drilling up to 10 km long horizontal wells, permits greater reserves to be exploited from existing onshore production sites on Goathorn Peninsula (e.g. McClure et al., 1995; McKie et al., 1998).

Outside the Wytch Farm/Kimmeridge/Wareham area, exploration drilling has produced only disappointing results and oil shows. The significant exploration programme over the last 30 years suggests, therefore, that large reserves do not exist elsewhere in Dorset. Instead targets must be special, local structural or stratigraphic trap developments. The most likely prospective areas are in the south of the county, developed in the footwall block (or structurally similar positions elsewhere in the Wessex Basin) to the Purbeck Disturbance, or to the south of it, along the coast and into Bournemouth Bay. The area around Weymouth appears less prospective, with the majority of prospective structures drilled. Indeed, it has been proposed that the oil shows in and around Mupe Bay represent the remnants of a former larger accumulation or oilfield, perhaps the size of Wytch Farm, which was uplifted and breached during erosion following Palaeogene compression and inversion (Miles et al., 1993). To the north of the county, many wells have been drilled with no success. It is likely that little potential exists in these areas.

Table 7. Hydrocarbon shows and indications for wells released to 1996 in the Dorset area.

Well	Date	Shows	Tests/flows/ resources	Hydrocarbons in
Radipole	1958	Oil & gas 'smells'	Tested slight gas production	Bridport Sands, 'oily smell' in Junction Beds
Langton Herring	1959	Oil & gas 'smells', bituminous stains		Bridport Sands, staining of Junction Beds
Langton Herring North	1959	Oil and reference to oil exuded in varying amounts		Bridport Sands
Wareham	1964	Oil	1270 barrels oil/day 6 million barrels oil	Bridport Sands
Arne	1975	Oil	196.6 bbls in 90 hours	Bridport Sands
Stoborough	1977/1981	Oil	1 million barrels oil	Bridport Sands
Bushey Farm	1981	Oil		Cornbrash, Bridport Sands
Waddocks Cross	1982	Oil	28 barrels oil/day	Bridport Sands
Martinstown	1986	Oil		Bridport Sands, Downcliff, Langport, Sherwood Sst
Chickerell	1987	Oil		Bridport Sands, Langport, Sherwood Sst
Creech	1988	Oil		Cornbrash, Bridport Sands
Coombe Keynes	1989	Oil		Bridport Sands, Sherwood Sst
Southard Quarry	1989	Gas		Bridport Sands, Sherwood Sst

SALT

Halite ('rock salt', NaCl) occurs in the Dorset Halite Formation of the Triassic Mercia Mudstone Group, which is concealed beneath Jurassic and younger rocks and is known only from boreholes. Salt underlies at least 1200 km^2 of central, southern and most western parts of the county.

The mineral is interbedded with mudstone through a sequence of varying thickness. Depths to the highest halite bed generally increase eastwards, from 1036.6 m at Ryme Intrinseca to 1699 m at Spetisbury, and from 422.5 m at Marshwood to 1936 m at Winterborne Kingston. In south Dorset, depths range from 1150 m at Chickerell to 2141.6 m at the most easterly proving, at Southard

Quarry, but local variations on this trend occur; for example, at Martinstown, 5 km north of Chickerell, the top is at 1428 m.

The thickness of the halite-bearing sequence ranges from 55 m to 488 m. The total thickness of halite present also varies, ranging from 45 m to 280 m. Mudstone is usually subordinate to halite but the mudstone:halite ratio is very variable, ranging from 1:1.2 at Chickerell to 1:4.9 at Creech. Individual units of relatively pure halite exceed 60 m in thickness at Martinstown, Chickerell and Southard Quarry, but most are between 20 m and 41 m.

The Dorset halite is highly unlikely to be utilised for salt production, because of its location and depth. However, thick, relatively pure halite units could be considered for storage cavity purposes where depths are appropriate.

SECONDARY AND RECYCLED AGGREGATES

The term 'secondary aggregates' is used to describe a range of materials which may be used as alternatives to primary aggregates (subject to considerations of quality and contamination), but which arise as wastes from a variety of activities. These may be considered under three main headings:

- Naturally-occurring materials arising from mineral extraction and processing operations, such as slate waste, colliery spoil, overburden and quarry/processing waste.
- Materials arising from industrial processes, such as slags and power station ash, which may be of variable composition.
- Recycled construction and demolition wastes, which may be either in a natural or manufactured state and include asphalt planings, road sub-base, concrete rubble and masonry. These materials are excluded from this study as their sources are highly variable in location, type and duration.

Utilising the aggregate potential of such materials may have the advantage of both reducing the demand for primary aggregates and thus land for mineral extraction, and the problems of disposing of waste. In general, however, secondary aggregates are only suitable for less demanding aggregate applications and their production and use may not always be environmentally or economically desirable.

Large quantities of waste from the production of building stone have been utilised as aggregate. Waste foundry sand is used in coated aggregate.

MINERAL RESOURCES AND PLANNING CONSTRAINTS

The landscape character of Dorset reflects the nature and structure of the underlying rocks, the erosive forces to which they have been subjected and the soil and vegetation that they support. This character is constantly changing due to economic and social pressures in the short-term and to geomorphological processes in the long-term. Mineral extraction can cause irrevocable, but not necessarily harmful, change to a locality over a relatively short timescale. In order to ensure that such changes are sustainable and do not harm the environment the most valuable landscapes and habitats (AONB, SSSIs, NNRs, SACs, SPAs) are given a greater degree of protection from mineral working. The need for mineral workings in such areas has to be justified by a most rigorous examination of the merits of the proposal. This examination considers the wider public interest in the development of the resource and the social and economic issues as well as the need to protect the environment.

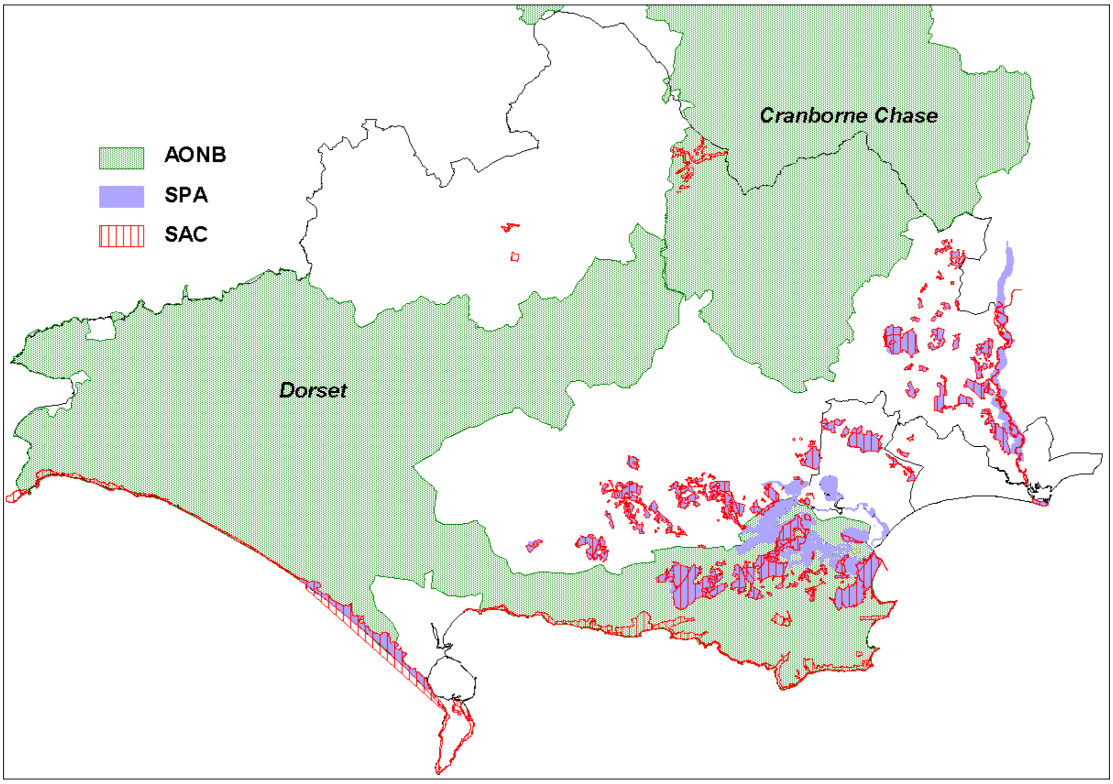


Figure 5. Principal environmental designations in Dorset. For NNRs and SSSIs see map.

Mineral extraction may only be acceptable in areas designated as SPAs or SACs if there are no alternatives and if there are imperative reasons of overriding public interest. For certain priority SACs, development can only be considered to be acceptable if there are overriding reasons of public health or safety or due to beneficial environmental consequences. Whilst the requirement to assess the acceptability of mineral working in such designated areas is, therefore, stringent there is no total prohibition on working minerals in such areas.

The resolution of conflicts between mineral resource development and other considerations is undertaken through the development plan framework and the development control system with a balanced appraisal of the issues raised. The Mineral Resources Map of Dorset provides a synthesis of the available information which can be revised and updated as additional data becomes available. Additional constraint information can be incorporated as required. It is hoped that these maps and the associated report will assist local and national government, the minerals industry and other interests in the consideration and production of policies in development plans.

The interplay between the erosion of a sequence of variable sedimentary rocks, the sea, vegetation and climate has created highly distinctive landscapes and habitats in Dorset. This distinctiveness is concentrated along the coastline and in the Wareham Basin where there are internationally important geological exposures, spectacular geomorphological features and globally rare habitats. This is reflected in the extensive landscape and nature-conservation designations in these areas. Many of the habitat areas are designated as Ramsar, SPA and SAC sites of international conservation importance. Much of the County is included in an AONB and virtually all the undeveloped coastline is within Heritage Coast designations and is a candidate World Heritage Site. Numerous Scheduled Monuments are found over the Chalk, limestone areas and in the Wareham Basin.

These designated areas also define the general centre of interest for the extraction of mineral resources. This is particularly apparent for those ‘unique’ Dorset resources, such as ball clay or Portland Stone, where extensive habitat and archaeological interests overlie parts of the resource. Aggregate resources (sand and gravel, crushed rock) are also significantly affected by such national and international designations. This inter-relationship will complicate decision making for the majority of mineral resource developments in the future.

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For further information on national planning policy, users should consult the following :

- Planning Policy Guidance
- Mineral Planning Guidance Notes
- Regional Planning Guidance Notes

published by the HMSO for the Department of the Environment, Transport and the Regions.

Information from the following documents and maps was used.

a) British Geological Survey 1:50 000 geological map sheets

Sheet	Name	Edition	Published
297	Wincanton	S & D	1996
311	Wellington	S & D	1976
312	Yeovil	S & D	1997
313	Shaftesbury	S & D	1994
314	Ringwood	S & D	1976
326	Sidmouth	S & D	1974
327	Bridport	S & D	1974
327	Bridport	SwD	1977
328	Dorchester	S & D	2000
329	Bournemouth	S & D	1991
341 and part of 342	West Fleet & Weymouth	S & D	2000
342 east and 343	Swanage	S & D	2000
	S+D Solid and Drift combined SwD as above with uncoloured drift sheet	F – 1:50000 scale	

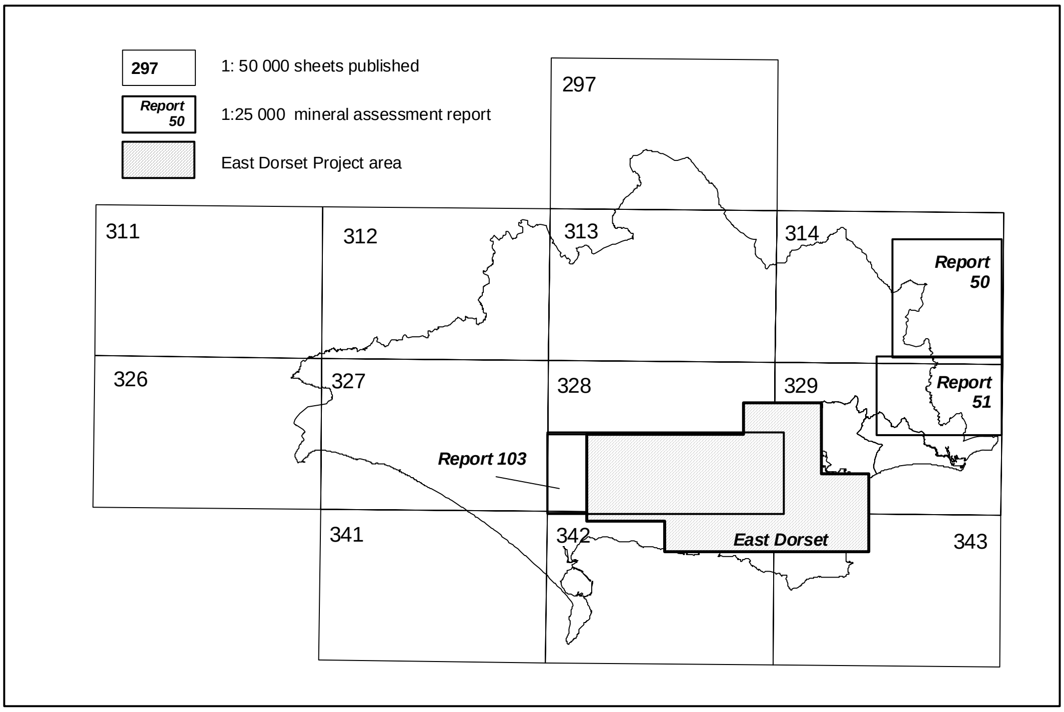

Figure 6. Availability of British Geological Survey 1:25 000 and 1:50 000 geological map coverage.

b) British Geological Survey Sheet Memoirs.

ARKELL, W J 1947. Geology of the country around Weymouth, Swanage, Corfe and Lulworth. *Memoir of the British Geological Survey*, Sheets 341, 342 and 343

BRISTOW, C R, BARTON, C M, FRESHNEY, E C, WOOD, C J, EVANS, D J, COX, B M, IVIMEY-COOK, H C and TAYLOR, R T. 1995. Geology of the country around Shaftsbury. *Memoir of the British Geological Survey*, Sheet 313.

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APPENDIX 1 Active Mineral Workings (at January 2001)

Name of Working	Operator	Commodity
Arne	Imerys Minerals Ltd	Ball Clay
Doreys	Imerys Minerals Ltd	Ball Clay
Furzeyground	Imerys Minerals Ltd	Ball Clay
Hawkpost	Imerys Minerals Ltd	Ball Clay
Povington	Imerys Minerals Ltd	Ball Clay
Trigon Hill	Imerys Minerals Ltd	Ball Clay
Cocknowle Chalkpit	Imerys Minerals Ltd	Chalk
Shillingstone Chalkpit	Shillingstone Lime & Stone Co Ltd	Chalk
Godlingston (Swanage)	Ibstock Building Products Ltd	Common Clay & Shale
Knoll Manor (Red Lane)	Pilkingtons Tiles Ltd	Common Clay & Shale
Belle Vue Farm	W J Haysom & Son	Limestone
Blacklands	H F Bonfield & Son	Limestone
Bonfield's Acton Quarry	R Bonfield	Limestone
Bowers	Albion Stone Quarries Ltd	Limestone
California	J Suttle Swanage Quarries	Limestone
Cobbs Quarry	R R Cobb	Limestone
Downs	D & P Lovell	Limestone
Eastington Farm	A Lander	Limestone
Gannetts Farm	F T L Warren	Limestone
Independent & Admiralty	Albion Stone Quarries Ltd	Limestone
Keates	K W & H E Keates	Limestone
Landers (Lander & Fratton)	Landers Quarries	Limestone
Lewis Quarry	Lewis & Son	Limestone
NT Quarry No 46	W J Haysom & Son	Limestone
P B Lovell's Acton Quarry	P B Lovell	Limestone
Portland (Broadcroft)	Hanson Bath & Portland Stone	Limestone
Portland (Coombefield)	Hanson Bath & Portland Stone	Limestone
Portland (Inmosthay)	Hanson Bath & Portland Stone	Limestone
Portland (Perryfield)	Hanson Bath & Portland Stone	Limestone
Queen's Ground (Spyway Barn)	K Keates	Limestone
Silton (Whistley Farm)	R H Harris & Son	Limestone
Southard	W J Haysom & Son	Limestone
St Aldhelm's Head	W J Haysom & Son	Limestone
Sunny Down Farm	R Notley	Limestone
Swanage	J Suttle Swanage Quarries	Limestone

Swanworth	Tarmac Southern Ltd	Limestone
Wellman & Harris Acton	D & P Lovell	Limestone
Whiteway	Marnhull Stone Ltd	Limestone
Wytch Farm Oilfield	BP Exploration Operating Co Ltd	Natural Gas
Kimmeridge Oilfield	BP Exploration Operating Co Ltd	Oil
Wareham Oilfield	BP Exploration Operating Co Ltd	Oil
Wytch Farm Oilfield	BP Exploration Operating Co Ltd	Oil
Beacon Hill Brickworks	SITA Landfill & Quarries (South)	Sand & Gravel
Bestwall and Swineham	Aggregate Industries Southern	Sand & Gravel
Chapel Lane	SITA Landfill & Quarries (South)	Sand & Gravel
Chard Junction	Aggregate Industries Southern	Sand & Gravel
Clockhouse Copse	R Bartlett	Sand & Gravel
Henbury	M B Wilkes Ltd	Sand & Gravel
Longham	RMC Aggregates (Southern) Ltd	Sand & Gravel
Masters North (Hyde & Masters)	Hanson Aggregates - Southern	Sand & Gravel
Masters South	Hanson Aggregates - Southern	Sand & Gravel
Masters South (Hyde Pit)	Hanson Aggregates - Southern	Sand & Gravel
Tatchells	Aggregate Industries Southern	Sand & Gravel
Binnegar	Wareham Ball Clay Co Ltd	Sand & Gravel
Warmwell	Aggregate Industries Southern	Sand & Gravel
West Knighton	Hanson Aggregates - Southern	Sand & Gravel
Whites Pit (Canford Heath)	W H White Plc	Sand & Gravel
Wessex Wharf	RMC Aggregates (Southern) Ltd	Marine sand & gravel

APPENDIX 2 Oilfields in Dorset

Kimmeridge Oilfield

Block and License number: ML5 ***Discovery well drilled by:*** BP Exploration Company Ltd
Date of Discovery: Feb/Mar. 1959. ***Production start:*** March 1961.
Licensees and company interest in block (%) at end 1997:

BP/Amoco Exploration Operating Co. Ltd. 100.00

Operator's estimate of:

Reserves originally present (million barrels): 10-25
Peak production (million barrels/year) circa 0.5 (1972):

Cumulative total production from 1961-1999 (million barrels): 4 (estimated)

Formations tested/producing: Fractured limestones of the Cornbrash Group
Remarks: Current (since 1986) single well production of 100 bbl/day (0.36 million bbl/year)

Wareham Oilfield

Block and License number: L97/10, PL.089 ***Discovery well drilled by:*** BP Exploration Company Ltd
Date of Discovery: Oct. 1964. ***Production start:*** March 1991
Licensees and company interest in block (%) at end 1999:

BP Exploration Operating Co. Ltd.	25.00
Arco British Ltd.	17.50
Premier Oil Dorset Ltd.	12.50
Kerr-McGee Oil (UK) plc	22.50
ONEPM Exploration Ltd.	7.50
Talisman North Sea Ltd.	15.00

Operator's estimate of:

Recoverable reserves originally present (million barrels/million tonnes): 5.33/0.71
First year of peak production: 1992
Peak production (million tonnes per year): 0.10
Cumulative total from 1975-1999 ('000 tonnes): 500

Formations tested/producing: Inferior Oolite and Bridport Sands
Remarks: Discovery oil well drilled in 1964, production testing starting in Nov. 1970, with shut-in in 1979 to conserve energy in accumulation updip.

Wytch Farm Oilfield

Block and License number: L97/10, L98/6, PL.089

Licensees and company interest in block (%) <u>at end 1997</u>:

BP Exploration Operating Co. Ltd.	50.00
Arco British Ltd.	17.50
Premier Oil Dorset Ltd.	12.50
Kerr-McGee Oil (UK) Ltd	7.50
ONEPM Exploration Ltd.	7.50
Talisman North Sea Ltd.	5.00

Extension into other UK blocks: PL.259, 98/6a & P.534 ***Discovery well drilled by:*** Gas Council (Exploration) Ltd/BP Group

Date of Discovery: Dec. 1973. ***Production start:*** March 1979.

Operator's estimate of:

Recoverable reserves originally present (million tonnes):

Oil	61.96
Natural gas liquids	4.73
Gas (billion cubic metres)	1.42
First year of peak production:	1991
Peak production (million barrels/million tonnes per year):	25.5/3.4
Cumulative total from 1975-1999 (million tonnes):	40.279

Formations tested/producing Bridport Sands and Sherwood Sandstone Group

Remarks: Reserves include an offshore extension, development commenced in 1993 via extended reach drilling from the Goathorn Peninsula

Status: Oilfield

APPENDIX 3 Hydrocarbon Wells and Boreholes, Dorset

Arne 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	21/11/75
Shows:	Oil
Tested:	Bridport Sands - peak 45 bbls, cumulative production 199.6 bbls in 90 hours
Penetrated:	To Middle Lias
Total Depth (RKB):	3731 ft/1137 m
Status:	Suspended oil producer (part of Wytch Farm)

Batcombe 1

Drilled by:	Carless
Spudded:	12/03/85
Shows:	Minor gas shows throughout
Tested:	Not indicated
Penetrated:	To Sherwood Sandstone Group
Total Depth (RKB):	7638 ft/2328 m
Status:	Plugged & abandoned

Bere Regis 1

Drilled by:	BP Exploration Company Ltd
Spudded:	05/08/59
Shows:	Not indicated
Tested:	Penarth Group, Bridport Sands & Cornbrash
Penetrated:	To MMG
Total Depth (RKB):	5533 ft/1687 m
Status:	Plugged & abandoned, no production

Bransgore 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	10/03/86
Shows:	Minor fluorescence in Bridport Sands
Tested:	Not indicated, sidewall cores
Penetrated:	To Sherwood Sandstone Group
Total Depth (RKB):	5712 ft/1741 m
Status:	Plugged & abandoned

Bushey Farm 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	15/2/81
Shows:	Fluorescence in Kellaways, Cornbrash, Forest Marble, Inferior Oolite & Bridport Sands
Tested:	Not indicated, Inferior Oolite & Bridport Sands cored
Penetrated:	To Downcliffe Clay below Bridport Sands
Total Depth (RKB):	4094 ft/1248 m
Status:	Plugged & abandoned. Dry hole

Chaldon Down 2

Drilled by:	D'Arcy Exploration Company Ltd
Spudded:	06/12/39
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	To Kimmeridge Clay
Total Depth (RKB):	1793 ft/547 m
Status:	Plugged & abandoned

Chaldon Herring 3

Drilled by:	D'Arcy Exploration Company Ltd
Spudded:	23/2/55
Shows:	Not indicated
Tested:	DST's in Cornbrash & Forest Marble
Penetrated:	To Lower Fullers Earth
Total Depth (RKB):	2244 ft/684 m
Status:	Plugged & abandoned. Dry hole

Chickerell 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	01/07/87
Shows:	Oil shows in Bridport Sands, Penarth Group & Sherwood Sandstone Group
Tested:	Tested in Bridport Sands
Penetrated:	To ?Permian
Total Depth (RKB):	7139 ft/2176 m
Status:	Abandoned with shows

Compton Valence G1

Drilled by:	D'Arcy Exploration Company Ltd
Spudded:	Late 1930s
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	Top Inferior Oolite
Total Depth (RKB):	174 ft/53 m
Status:	Plugged & abandoned. Dry

Coombe Keynes 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	22/1/89
Shows:	Minor oil shows in Bridport Sands
Tested:	Tested in Bridport Sands & Sherwood Sandstone Group
Penetrated:	To ?Permian
Total Depth (RKB):	8200 ft/2499 m
Status:	Plugged & abandoend. Minor oil shows

Cranborne 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	03/06/72
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	Sherwood Sandstone Group on ?Upper Devonian
Total Depth (RKB):	6696 ft/2041 m
Status:	Plugged & abanoned. Dry

Creech 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	15/10/88
Shows:	Minor oil shows
Tested:	Tested in Bridport Sands
Penetrated:	To middle Sherwood Sandstone Group
Total Depth (RKB):	7516 ft/2291 m
Status:	Abandoned, dry with oil show

Encombe 1

Drilled by:	BP Petroleum Exploration Ltd
Spudded:	04/01/65
Shows:	Slight fluorescence
Tested:	DST's in Corallian, Kellaways & Cornbrash
Penetrated:	To Forest Marble
Total Depth (RKB):	2862 ft/872 m
Status:	Plugged & abandoned

Fifehead Magdalen 1

Drilled by:	Carless
Spudded:	26/7/85
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	Jurassic on Carboniferous
Total Depth (RKB):	4492 ft/1369 m
Status:	Plugged & abandoned

Hewish 1

Drilled by:	Brabant Petroleum Ltd
Spudded:	12/01/91
Shows:	Not indicated
Tested:	Tested in Sherwood Sandstone Group, no results indicated
Penetrated:	To Sherwood Sandstone Group
Total Depth (RKB):	6889 ft/2100 m
Status:	Plugged and abandoned. Dry

Hurn 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	06/09/86
Shows:	Not indicated
Tested:	Cores throughout Jurassic & Triassic
Penetrated:	To ?Permian
Total Depth (RKB):	6670 ft/2033 m
Status:	Plugged & abandoned with shows

Langton Herring 1

Drilled by:	BP Exploration Company Ltd
Spudded:	01/12/59
Shows:	Slight signs of oil & gas
Tested:	Packer tests in Bridport Sands
Penetrated:	To Middle Lias
Total Depth (RKB):	1400 ft/427 m
Status:	Plugged & abandoned. Dry

Langton Herring North

Drilled by:	BP Exploration Company Ltd
Spudded:	04/03/59
Shows:	Strong oily smells & oil exuded
Tested:	Tested in Bridport Sands
Penetrated:	To Middle Lias
Total Depth (RKB):	1305 ft/398 m
Status:	Plugged & abandoned

Lulworth Banks 1

Drilled by:	BP Exploration Company Ltd
Spudded:	23/9/63
Shows:	Minor gas shows/production
Tested:	Tests over Kellaways, Cornbrash & Bridport Sands
Penetrated:	To Bridport Sands
Total Depth (RKB):	2500 ft/762 m
Status:	Plugged & abandoned. Dry

Lychett 1

Drilled by:	BP Exploration
Spudded:	27/4/91
Shows:	Minor fluorescence in Cornbrash & Forest Marble
Tested:	Not indicated
Penetrated:	To ?Permian
Total Depth (RKB):	6483 ft/1976 m
Status:	Plugged & abandoned. Dry

Mappowder 1

Drilled by:	Carless
Spudded:	17/12/84
Shows:	Minor gas recorded at intervals in Jurassic
Tested:	Not indicated
Penetrated:	?Permian on ?Lower Palaeozoic
Total Depth (RKB):	8378 ft/2554 m
Status:	Plugged & abandoned

Marshwood 1

Drilled by:	Canada Geothermal Oil Ltd
Spudded:	Dec-73
Shows:	Faint fluorescence in Sherwood Sandstone Group
Tested:	Tested in Sherwood Sandstone Group
Penetrated:	Sherwood Sandstone Group on ?Devonian
Total Depth (RKB):	6229 ft/1899 m
Status:	Plugged & abandoned

Martinstown 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	14/1/86
Shows:	Fluorescence in Sherwood Sandstone Group, minor oil shows in Bridport Sands
Tested:	Not indicated, core analysis in Bridport Sands
Penetrated:	To Sherwood Sandstone Group
Total Depth (RKB):	7448 ft/2270 m
Status:	Plugged & abandoned. Dry

Nettlecombe 1

Drilled by:	Berkeley Petroleum (UK) Ltd
Spudded:	07/04/72
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	?Permian on Lower Carboniferous
Total Depth (RKB):	7005 ft/2135 m
Status:	Plugged & abandoned. Dry

Osmington 2

Drilled by:	Norris Oil Company Ltd
Spudded:	14/11/70
Shows:	Slight gas near TD in Bridport Sands
Tested:	Not indicated
Penetrated:	To Bridport Sands
Total Depth (RKB):	1193 ft/364 m
Status:	Plugged & abandoned. Dry

Poxwell 1

Drilled by:	D'Arcy Exploration Company Ltd
Spudded:	24/5/37
Shows:	Not indicated
Tested:	Packer tests in Corallian, Forest Marble & Cornbrash
Penetrated:	To Fuller's Earth
Total Depth (RKB):	1666 ft/508 m
Status:	Plugged & abandoned. Dry

Radipole 1

Drilled by:	BP Exploration Company Ltd
Spudded:	22/9/58
Shows:	Minor oil & gas
Tested:	DST's in Inferior Oolite & Bridport Sands. Production test water only
Penetrated:	To Lower Lias
Total Depth (RKB):	2030 ft/619 m
Status:	Plugged & abandoned. Dry

Ringstead 1

Drilled by:	D'Arcy Exploration Company Ltd
Spudded:	19/3/37
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	To Nothe Clay
Total Depth (RKB):	161 ft/49 m
Status:	Plugged & abandoned. Dry

Ryme Intrinseca 1

Drilled by:	Carless
Spudded:	10/03/85
Shows:	Slight gas indications throughout
Tested:	Not tested
Penetrated:	?Permian on Devonian
Total Depth (RKB):	5991 ft/1826 m
Status:	Plugged & abandoned. Dry

Seaborough 1

Drilled by:	Berkeley Petroleum (UK) Ltd
Spudded:	21/1/74
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	Permian on Carboniferous
Total Depth (RKB):	6294 ft/1918 m
Status:	Plugged & abandoned. Dry

Shapwick 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	06/05/58
Shows:	Not indicated
Tested:	Not tested
Penetrated:	To Kimmeridge Clay
Total Depth (RKB):	1623 ft/495 m
Status:	Plugged & abandoned. Dry

Southard Quarry 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	25/9/ 89
Shows:	Minor oil & gas shows
Tested:	Not indicated
Penetrated:	To lower Sherwood Sandstone Group
Total Depth (RKB):	9022 ft/2750 m
Status:	Plugged & abandoned

Spetisbury 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	14/12/84
Shows:	Not indicated
Tested:	Not indicated
Penetrated:	Sherwood Sandstone Group on ?Lower Palaeozoic
Total Depth (RKB):	8570 ft/2612 m
Status:	Plugged & abandoned. Dry

Stoborough 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	28/7/77
Shows:	Oil shows and fluorescence
Tested:	Tested in Cornbrash, Forest Marble, Inferior Oolite & Bridport Sands
Penetrated:	To Black Ven Marls
Total Depth (RKB):	4035 ft/1230 m
Status:	Oil producer

Waddocks Cross 1

Drilled by:	Gas Council (Exploration) Ltd
Spudded:	31/10/82
Shows:	Minor oil shows and fluorescence
Tested:	Not indicated
Penetrated:	To ?Permian
Total Depth (RKB):	6035 ft/1840 m
Status:	Oil producer

Woodlands 1

Drilled by:	BP Petroleum Development Ltd
Spudded:	07/09/68
Shows:	Not indicated
Total Depth (RKB):	2194 ft/669 m
Status:	Plugged & abandoned. Dry

Kimmeridge Oilfield

Drilled by:	BP Exploration Company Ltd
Discovery well drilled:	01/02/59
Shows:	Oil
Tested/Reservoirs:	Fractured Inferior Oolite and Cornbrash
Status:	Oilfield
Estimated recoverable reserves	1 Million barrels

Wareham Oilfield

Drilled by:	BP Exploration Company Ltd
Discovery well drilled:	Oct. 1964
Shows:	Oil
Tested/Reservoirs:	Inferior Oolite and Cornbrash
Status:	Oilfield
Estimated recoverable reserves	3.2 Million barrels

Wytch Farm Oilfield

Drilled by:	Gas Council (Exploration) Ltd
Discovery well drilled:	2/12/1973
Shows:	Oil
Tested/Reservoirs:	Bridport Sands & Sherwood Sandstone Group
Status:	Oilfield
Estimated recoverable reserves	c. 500 Million barrels (including offshore extension)
Additional Information	Delivers circa: 110,000 bbl/day, 17.6 x 10^6 ft^3 of gas and 725 tonnes of LPG

APPENDIX 4 Contact addresses for further enquiries

Dorset County Council County Hall Colliton Park Dorchester Dorset DT1 1XJ Tel: 01305 251000 Fax: 01305 224839 Webpage: www.dorset-cc.gov.uk/	Bournemouth District Council Town Hall Annexe St Stephens Road Bournemouth Dorset BH2 6EA Tel: 01202 451451 Fax: 01202 451005 Webpage: www.bournemouth.gov.uk/
Poole Borough Council Civic Centre Poole Dorset BH15 2RU Tel: 01202 633633 Fax: 01202 633077 Webpage: www.poole.gov.uk/	Christchurch Borough Council Civic Offices Bridge Street Christchurch Dorset BH23 1AZ Tel: 01202 495000 Fax: 01202 482200 Webpage: www.christchurch.gov.uk/
East Dorset District Council Furzehill Wimbourne Dorset BH21 4HN Tel: 01202 886201 Fax: 01202 841390 Webpage: www.eastdorsetdc.gov.uk/	North Dorset District Council Nordon Salisbury Road Blandford Forum Dorset DT11 7LL Tel: 01258 454111 Fax: 01258 480179 Webpage: www.ruraldorset.com/
West Dorset District Council Stratton House 58/60 High West Street Dorchester Dorset DT1 1UZ Tel: 01305 251010 Fax: 01305 251481 Webpage: w3w.westdorset-dc.gov.uk/	Weymouth and Portland Borough Council Council Offices North Quay Weymouth Dorset DT4 8TA Tel: 01305 761222 Fax: 01305 760971 Webpage: www.weymouth.gov.uk/
Countryside Agency John Dower House Crescent Place Cheltenham Gloucestershire GL50 3RA Tel: 01242 521381 Fax: 01242 584270 Webpage: www.countryside.gov.uk	English Nature Northminster House Northminster Peterborough PE1 1UA Tel: 01733 455000 Fax: 01733 455103 Webpage: www.english-nature.org.uk

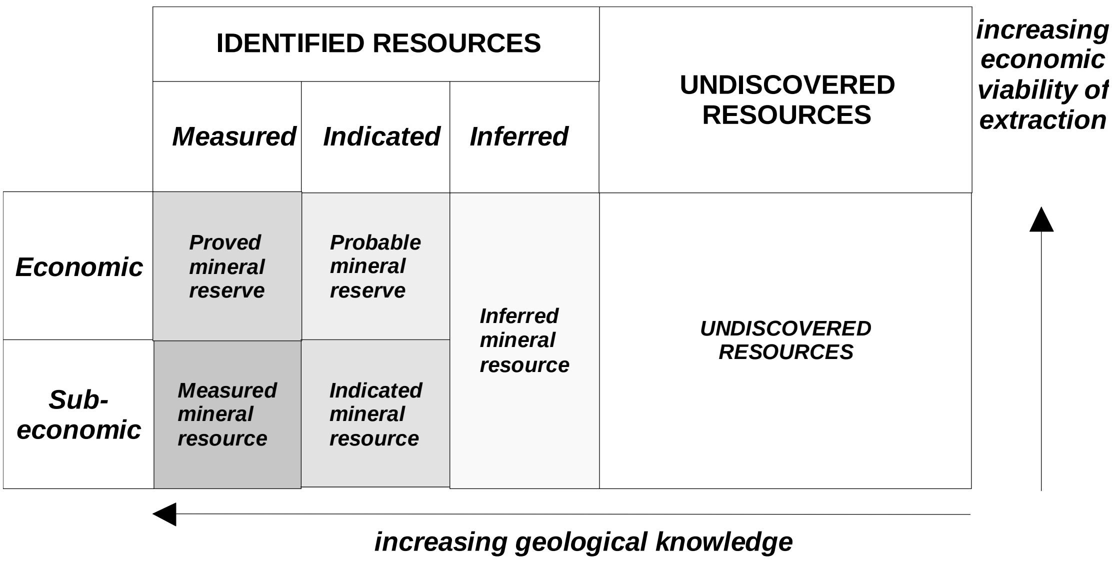
English Heritage Fortress House Savile Row London SW1X 1AB Tel: 0207 973 3000 Fax: 0207 973 3001 Webpage: www.english-heritage.org.uk/	The Environment Agency South Wessex Area Office Rivers House, Sunrise Park Higher Shaftesbury Road Blanford Dorset DT11 8ST Tel: 01258 456080 Fax: 01258 455998 Webpage: www.environment-agency.gov.uk/

APPENDIX 5: Methodology

The British Geological Survey (BGS) was commissioned in 1993 by the Department of the Environment to prepare, on a trial basis, a set of concise statements mainly in map form, to show the broad distribution of mineral resources in selected counties and to relate these to selected, nationally-designated planning constraints. The trial study developed a methodology for the collection and display of data in a consistent and comparable format for four Mineral Planning Authority (MPA) areas - Bedfordshire, Derbyshire, Staffordshire and the Peak District National Park. The concept developed by the BGS for the trial study is now being extended to some twenty mineral planning authorities in England and Wales through a further phase of the project which started in 1996.

The main element of the trial study was the production of maps, with accompanying interpretative reports, for each MPA area. All mineral resource and planning constraint information has been collated digitally on a PC-based system using Intergraph Microstation to produce a cartographic database. Data has been captured as a series of files, structured on separate levels so that they can be viewed either independently or in various combinations, as required. Most of the information has been taken digitally from hard copy maps, mainly with scales between 1:50 000 and 1:10 000. Other material was obtained in a variety of digital formats which have had to be converted for use by the Intergraph Microstation System. The structure of the information will allow the data to be transferred in digital form to the BGS MINGOL (MINerals GIS On-Line) system. MINGOL is being developed to provide a decision-support system for the rapid solution of minerals-related problems to aid corporate and public mineral resource management. It applies a state-of-the art GIS to relate the nature and distribution of mineral resources to other information such as planning and environmental constraints, and mineral exploration, borehole and commodity statistics datasets.

Figure 1 Classification of resources and reserves



Based on McKelvey, 1972

As the data are held digitally, map output can be on any scale but 1:100 000 has been found to be a convenient size to summarise the information for individual MPAs. This provides a legible topographic base which enables both the broad implications of the information, and sufficiently accurate detail, to be shown. The particular advantage of holding all the information in digital form is that it is comparatively easy to update and revise as additional information becomes available, and also provides scope for producing customised maps of selected information or areas on request.

Classification of reserves and resources

The diagram, Figure 1, is a representation of a conventional method for classifying mineral reserves and resources, based on a system introduced the US Bureau of Mines and the US Geological Survey and adapted by the British Geological Survey. In this conceptual diagram the vertical dimension of the diagram represents the economic viability of the resource and consists simply of two categories, **economic** and **sub-economic**, depending on whether or not the mineral deposit is commercially viable under prevailing economic circumstances. As demand, mineral prices and costs of extraction may change with time, so mineral resources may become reserves and vice versa.

The horizontal dimension represents degrees of geological knowledge about the resource, from mere speculation about its existence (right-hand side) to thorough assessment and sampling on a systematic basis (left-hand side).

In the present study the mineral resource information has been produced by the collation and interpretation of data principally held by the British Geological Survey. Since the mineral resource data presented are not comprehensive and the quality is variable, the boundaries shown are approximate. Most of the mineral resource information presented is, therefore, in the **inferred resource** category (Figure 1), that is to say, those resources that can be defined from available geological information and which may have some economic potential. They have neither been evaluated by drilling, or other sampling methods, nor had their technical properties characterised on any systematic basis. Inferred resources may be converted into indicated and measured resources with increasing degrees of investigation and assessment. However, where mineral resource studies (including drilling and testing) have been carried out, sufficient information is available to define the resource at the **indicated** level. Sand and gravel assessment studies have been carried out in parts of Dorset.

A mineral resource is not confirmed as economic until it is proved by a relatively expensive evaluation programme. This usually involves a detailed measurement of the material available for extraction together with an evaluation of the quality of the material, its market suitability, the revenues generated by its sale and, ultimately, the viability of the deposit. This activity is an essential precursor to submitting a planning application for mineral extraction. That part of a resource that is both 'measured' and 'economic', i.e. that has been fully evaluated and is commercially viable to work, is called a **reserve** or **mineral reserve**. It is customary to distinguish **proved** and **probable reserves**, which correspond to the economic parts of measured and indicated resources respectively (Figure 1).

It is invariably the case that there is a significant reduction in area or volume estimates as resources are further investigated to prove reserves. The reasons for this is that it is impossible to apply initially all the various constraints that working procedures and environmental issues may impose. This is particularly the case with extensive deposits like sand and gravel where physical constraints imposed by roads, railways and urban development may drastically reduce the potential area available for extraction, even before factors such as quality and mineral thickness are taken into consideration.

In the context of land-use planning the term **reserve** should strictly be further limited to those minerals for which a valid planning permission for extraction exists, i.e. **permitted reserves**. The extent of mineral planning permissions is shown on the Mineral Resources Map. These cover both active mineral workings and inactive mineral workings. Some mineral planning permissions may have remained unworked, and others may have become uneconomic prior to being worked out. In many cases the areas involved are likely to have been worked to some extent in the past, and may now be restored. In addition, parts of the resource areas may have been fully evaluated by the minerals industry, but either have not been subject to a planning application or have been refused permission for extraction. These areas are not depicted on the map.

A **landbank** is a stock of planning permissions and is commonly quoted for aggregates. It is composed of the sum of all **permitted reserves** at active and inactive sites at a given point of time, and for a given area, with the following provisos:

- it includes the estimated quantity of reserves with valid planning permission at dormant or currently non-working sites;
- it includes all reserves with valid planning permission irrespective of the size of the reserves and production capacity of particular sites;
- it does not include estimated quantities of material allocated in development plans but not having the benefit of planning permission; and
- it does not include any estimate for the contribution that could be made by marine dredged, imported or secondary materials.

It is important to recognise, however, that some of the permitted reserves contained within landbanks have not been fully evaluated with the degree of precision normally associated with the strict use of the term reserves, indeed some may not have been evaluated at all.

Mineral workings and planning permissions

The locations and names of mineral workings in Dorset are shown on the maps. The information is derived from the British Geological Survey's Mines and Quarries Database, updated as appropriate from Dorset County Council’s records. Letters (e.g. **Sg** = sand and gravel) are used to show the main mineral commodity produced.

The extent of the planning permissions shown on the Mineral Resources Map cover active mineral workings, former mineral workings and, occasionally, unworked deposits. The present physical and legal status of the planning permissions is not qualified on the map. The areas shown may, therefore, included inactive sites, where the permission has expired due to the terms of the permission, i.e. a time limit, and inactive (dormant) sites where the permission still exists. Sites which have been restored are not separately identified. Under the provisions of the 1995 Environment Act, after 1 November 1997, sites that are classified as dormant may no longer be worked until full modern planning conditions have been approved by the Mineral Planning Authority. A 'dormant site' is defined as a site where no mineral development has taken place to any substantial extent in the period 23 February 1982 and ending 6 June 1995. Information on the precise status and extent of individual planning permissions should be sought from Dorset County Council.

Most planning permissions appear on a mapped mineral resource area and thus the underlying resource colour identifies the mineral type. Planning permissions may fall outside resource areas for the following reasons:

- permissions shown partly off resource areas may extend to ownership, or other easily defined boundaries, or to include ground for ancillary facilities such as processing plants, roads and overburden tipping

- isolated workings occurring outside defined resource areas may reflect very local or specific situations, such as a borrow pit, not applicable to the full extent of the underlying rock type:

The latest data available for the total areas of planning permissions in Dorset, Bournemouth and Poole, collected for the Department of Environment Minerals Survey of 1994, is shown in Table 1. This information is updated at intervals.

Table 1. Areas of planning permissions for mineral workings in Dorset (as at 1.4.94).

	Commodity	Total permitted area (ha)	No. of sites	%
Surface workings	Chalk	23	7	1.49
	Clay/shale	216	14	14.03
	Limestone/dolomite	365	35	23.7
	Oil/gas (production)	96	12	6.23
	Sand and gravel	840	26	54.55
Total		**1540**	**94**	**100**
Underground workings	Clay/shale	323	6	99.38
	Limestone/dolomite	2	1	0.62
Total		**325**	**7**	**100**

Source: *Department of the Environment, 1996. Survey of Land for Mineral Workings in England, 1994*.