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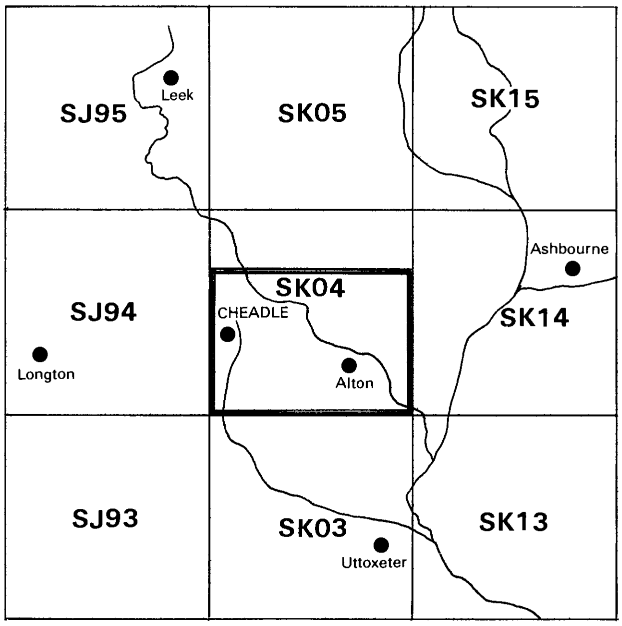

The conglomerate resources of the Sherwood Sandstone Group of the country around Cheadle, Staffordshire

Description of part of 1 : 25 000 sheet SK 04

P. J. Rogers, D. P. Piper and T. J. Charsley

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Details of published reports appear at the end of this Report.

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PREFACE

National resources of many industrial minerals may seem so plentiful that stocktaking appears to be unnecessary, but the demand for minerals and for land for all purposes is intensifying and it has become apparent in recent years that assessments of the resources of these minerals should be undertaken. The publication of information about the quantity and quality of deposits over large areas is intended to provide a comprehensive factual background against which planning decisions about these resources can be made.

Sand and gravel, considered together as naturally occurring aggregate, was selected as the bulk mineral demanding the most urgent attention, initially in the south-east of England, where about half the national output is won and very few sources of alternative aggregates are available. Following a short feasibility project, initiated in 1966 by the Ministry of Land and Natural Resources, the Industrial Minerals Assessment Unit (formerly the Mineral Assessment Unit) began systematic surveys in 1968. The work is now being financed by the Department of the Environment and is being undertaken with the cooperation of the Sand and Gravel Association of Great Britain.

This report is the first to describe the conglomerate resources within the Sherwood Sandstone Group (formerly the Bunter Pebble Beds) and follows a successful feasibility study begun in 1975. The Sherwood Sandstone Group rocks, which crop out over 27.6 km^2 of country around Cheadle, Staffordshire, have been assessed and the results are summarised in this report and shown on the accompanying 1 : 25 000 resource map, which is part of Ordnance Survey sheet SK 04. The survey was conducted by Dr P. J. Rogers and Mr D. P. Piper between 1976 and 1978 and is based on a geological survey at the 1 : 10 560 scale by Mr P. J. Strange, Mr T. J. Charsley and Mr J. I. Chisholm of the Institute's North Wales, Cheshire and Lancashire Field Unit.

Mr J. W. Gardner, CBE (Land Agent) was responsible for negotiating access to land for drilling. The following members of the Institute's staff helped with various aspects of the work: Mr K. E. Thornton and Mr R. S. Hildred of the Photographic Department; the late Mr T. K. Tate, Miss A. Robertson and Mr K. H. Murray of the Hydrogeology Unit and Mr G. G. Baxter of the Computer Unit. The assistance provided by local quarrying companies and the ready cooperation of landowners and tenants in this work are gratefully acknowledged.

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The conglomerate resources of the Sherwood Sandstone Group of the country around Cheadle, Staffordshire

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SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information and 8 boreholes drilled for the Industrial Minerals Assessment Unit, form the basis of the assessment of the conglomerate resources of the Sherwood Sandstone Group of the country around Cheadle, Staffordshire.

All deposits of the Sherwood Sandstone Group in the area which might be potentially workable for aggregate have been investigated and a simple statistical method has been used to estimate the volume. The reliability of the volume estimate is given at the 95 per cent probability level.

The 1 : 25 000 map is divided into three resource blocks containing between 3.3 and 14.8 km^2 of Sherwood Sandstone Group outcrop. For each block the geology of the deposits is described, the mineral-bearing area and the mean thicknesses of overburden and mineral are stated. Detailed borehole data are given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying maps.

Note All National Grid references fall within the 100-km square SK

Bibliographic reference

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INTRODUCTION

In recent years it has become apparent that more detailed information about the quality and quantity of bulk mineral deposits is required. Such information will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971; Harris and others, 1974). The main objective of this survey is the provision of such data for the conglomerate resources of the Sherwood Sandstone Group, formerly known as the Bunter Pebble Beds, of the West Midlands.

This survey is concerned with the estimation of resources, which include deposits that may not be currently exploitable but have a forseeable use, rather than reserves, which can only be assessed in the light of current economic conditions. Information is provided at the 'indicated level', "for which tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout" (Bureau of Mines and Geological Survey, 1948, p. 15). It follows that the whereabouts of reserves must still be established and their size and quality proved by the customary detailed exploration and evaluation undertaken by industry. However, the information provided by this survey should assist in the selection of the best targets for further evaluation.

The conglomerate-rich members within the Sherwood Sandstone Group are prized as a source of aggregate for a wide variety of uses in the construction industry. Present-day working is concentrated in a number of large workings, up to 50 metres deep, the largest within the study area having an annual production of about 1.5×10^6 tonnes. Working is confined to those parts of the deposit lying above the water table and the aggregate is won either by blasting or ripping methods. Average yields are in the order of 120×10^3 to 200×10^3 $m^3\,ha^{-1}$ (Staffordshire County Council, 1966), but much higher yields are thought to obtain within this district.

The assessment methods adopted for this survey were developed during a short feasibility study, which included an experimental drilling, logging and sampling exercise; they provide the most cost-effective procedure for a resource assessment on a regional scale (Piper and Rogers, 1980). The physical criteria and procedures adopted for this assessment are outlined in Appendices at the back of this report.

This survey embodies data obtained from boreholes, quarry faces and natural sections. The data points are somewhat more closely spaced than one per 4 km^2, which is the frequency estimated as necessary for a regional resource assessment of the Sherwood Sandstone Group. Specially commissioned boreholes were drilled to investigate the resources to a depth of 60 m and were not constrained by the water table, which formed the effective lower limit of working at the time of survey.

The volume and other characteristics of the mineral (for definition of mineral see Appendix C) are assessed within resource blocks. It must be emphasised that the results are presented for each block as a whole and valid conclusions cannot be drawn about the mineral in parts of a block except in the immediate vicinity of the actual sample points.

No account is taken in the assessment of such factors as, for example, roads, villages and high agricultural or landscape values, which might prevent the conglomerate resource being exploited, although towns are excluded. The estimated total volume therefore bears no simple relationship to the amount of conglomerate that could be extracted in practice.

DESCRIPTION OF THE DISTRICT

GENERAL

The resource sheet represents an area of 70 km^2 around and to the east of Cheadle, Staffordshire (Figure 1). The district is principally agricultural, although mining and quarrying have played an important part in its development. Cheadle was formerly the centre of a small coalfield, but industrial sands, limestone and sand and gravel are at present produced from the rocks which crop out in the district.

TOPOGRAPHY

The district is one of considerable relief; it is more subdued in the west than in the east where the ground rises from below 300 ft (90 m) in the Churnet Valley at Denstone [100 421] to over 1200 ft (365 m) on the Weaver Hills to the north [095 464].

The most striking feature of the district is the Sherwood Sandstone Group escarpment, which rises to about 825 ft (251 m) Ordnance Datum at Mount Pleasant Farm [032 423] and forms a horseshoe-shaped surround to the lower ground of the Cheadle Coalfield. The escarpment is breached at Huntley [007 412] by the River Tean, which drains southwards through the gap.

To the east, the River Churnet has cut a deeply incised valley into the Sherwood Sandstone Group sandstones, which form prominent crags on the higher slopes, particularly around the village of Alton [073 423].

GEOLOGY

The solid rocks exposed at the surface belong to the Carboniferous and Triassic systems, while superficial deposits of Pleistocene and Recent age are found in discrete patches throughout the district.

The Carboniferous rocks were deposited in deltaic or estuarine environments and range in age from Namurian to Westphalian B. They include a number of coal seams that have been worked extensively both underground and in opencast operations.

Towards the end of Carboniferous times severe earth movements, involving extensive uplift, folding and faulting, affected Staffordshire and were followed by a period of intense subaerial erosion, during which the Carboniferous rocks were dissected into a landscape of considerable relief.

Throughout late Permian and early Triassic times the district remained land and the strong topography was slowly buried by fluviatile sands and gravels, now forming the Sherwood Sandstone Group, which built up a broad plain dominated by isolated inselbergs. As the relief decreased the sediments became finer and the coarse sands gave way to muds, silts, fine sands and evaporites, now consolidated into the Mercia Mudstone Group, which were deposited as flood-basin deposits and in vast playa lakes occasionally modified by marine incursions.

Subsequent erosion has removed all evidence of the many changes that must have affected the district between late Triassic and Quaternary times. By the onset of the Quaternary glaciation, however, the landscape probably bore some resemblance to its present form, even though considerable local modification resulted from the erosive and depositional effects of glaciation. In the latter part of the Pleistocene, glacial melt-waters largely followed pre-existing valleys, so that the alluvial valley-fills are generally composite, including some Pleistocene material underlying more recent silts, sands and gravels.

Triassic stratigraphy

The conglomerates under consideration in this report occur within the Triassic sandstones of the district and details of the Carboniferous and Quaternary sequences are not discussed; the higher Triassic rocks are, for the same reason, only briefly considered. The Carboniferous rocks are not differentiated on the accompanying geological map (in pocket).

The nomenclature of the Triassic rocks is in a state of transition and until recently the strata were assigned to the Bunter and Keuper series, terms widely employed in Britain for over a century. However, recent developments in palynology have, for the first time, enabled chronostratigraphic correlations to be made within the Triassic and have indicated both that the main lithological boundaries are diachronous across the country and that the British 'Bunter' and 'Keuper' rocks are not contemporaneous with their German equivalents. Consequently these terms were being incorrectly used in Britain and they have been replaced in the present report by a terminology suggested by a Working Party of the Geological Society of London (Warrington and others, 1980).

The Triassic succession in the Cheadle district is divisible into two lithostratigraphic groups, the Sherwood Sandstone Group and the Mercia Mudstone Group. The dividing line between the two is taken broadly where a dominantly sandstone sequence is succeeded upwards by a dominantly mudstone one. While it is possible that part of the Sherwood Sandstone Group may be of Permian age, in the absence of chronological data it is thought best to follow precedent for the district and regard the whole of the Group as Triassic in age.

The mapped units within these groups, their dominant lithologies and their approximate correlation with formerly used units are shown in Table 1.

Sherwood Sandstone Group

The Sherwood Sandstone Group comprises up to 205 m of conglomerates, pebbly sandstones and sandstones, with scattered siltstone and mudstone bands, while locally there is a thin basal conglomerate. In this district the Group has been divided into three lithostratigraphic formations, in ascending order the Huntley Formation, the Hawksmoor Formation and the Hollington Formation.

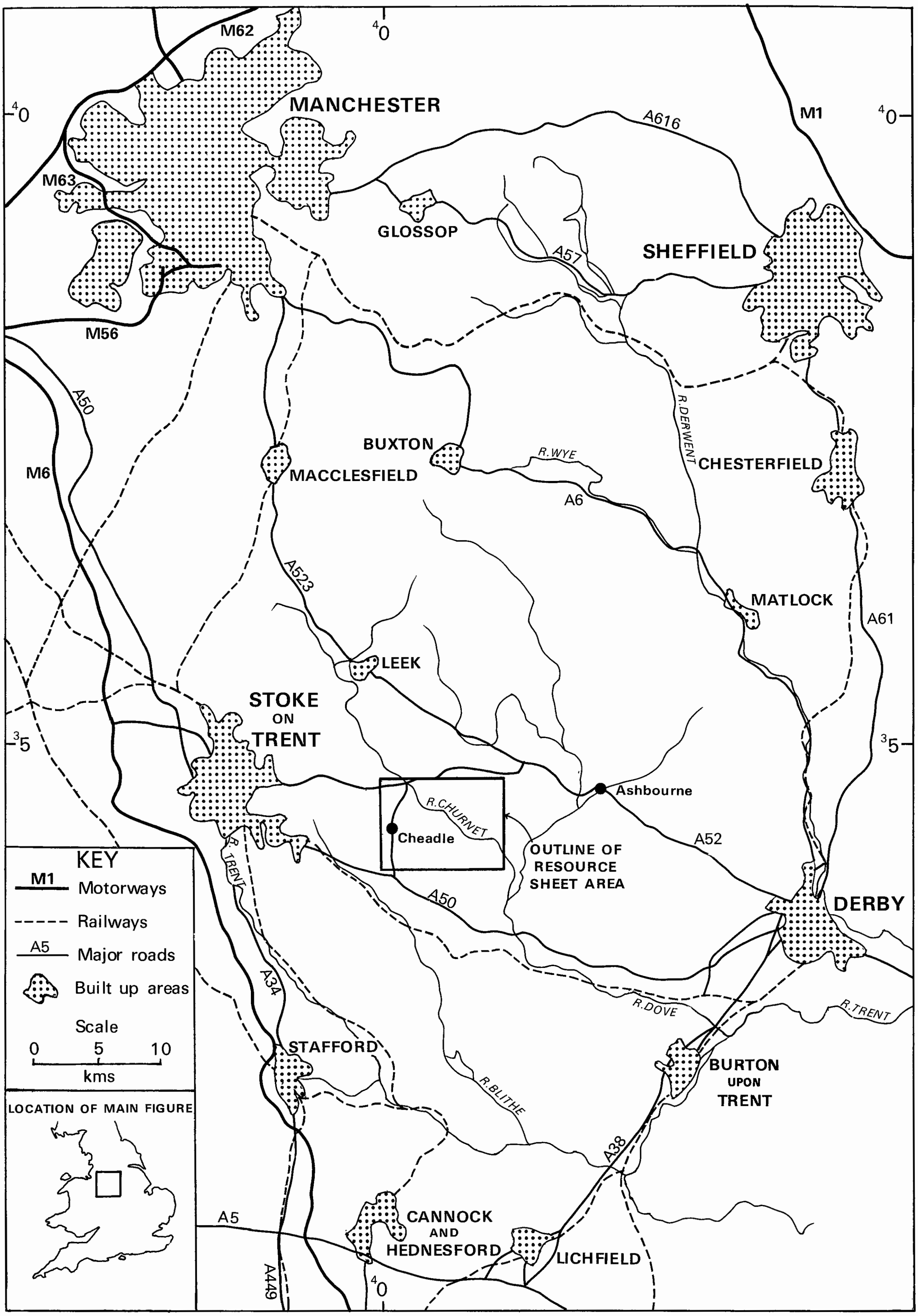


Figure 1 Sketch-map showing the location of the resource sheet, part of sheet SK 04

Table 1 Lithostratigraphic nomenclature for the Triassic on sheet SK 04 (with approximate correlations with formerly used units)

Formation, lithology	Member, lithology	Approximate correlation with formerly used units
MERCIA MUDSTONE GROUP		
Undivided Mercia Mudstone Group Interlayered mudstones and siltstones		**Keuper Marl**
Denstone Formation Siltstones interlayered with fine-grained sandstones and mudstones		**Waterstones** (Hull, 1869)
SHERWOOD SANDSTONE GROUP		
Hollington Formation Sandstones with mudstone beds and scattered pebbly beds		**Lower Keuper Sandstone below Waterstones** (Hull, 1869)
Hawksmoor Formation Soft sandstones, pebbly sandstones and conglomerates with rare mudstone and siltstone beds	**Lodgedale Member** Sandstones with conglomerates	
	Freehay Member Conglomerates with subordinate sandstone beds and lenses	**Bunter Pebble Beds** (Hull, 1869)
Huntley Formation Basal conglomerate and pebbly sandstone with many angular pebbles		

The *Huntley Formation* is the name given to local developments, up to 15 metres thick, of a basal conglomerate with pebbly sandstone, which immediately overlie an irregular sub-Triassic erosion surface; the formation is characterised by an abundance of locally derived angular clasts.

The *Hawksmoor Formation* consists of up to 185 m of brownish red, commonly yellow, fine-grained to coarse-grained cross-bedded sandstones and conglomerates, with rare mudstone beds. The rocks are typically poorly cemented and friable at outcrop. Pebbly lithologies occur at random throughout, but are more common in the lower part, which was formerly referred to as 'Bunter Pebble Beds' (after Hull, 1869); in the Cheadle area this was sub-divided by Barrow (1903) into a conglomerate unit and a pebbly sandstone unit.

The regional use of the term 'Pebble Beds' as a formational name has now been discontinued, since it has been established that concentrations of pebbles occur at more than one horizon, making a workable definition impracticable. Furthermore the pebbly sandstones pass laterally into non-pebbly ones and the concept of a vertical sequence as implied by the older nomenclatures is fallacious. During the present survey, correlation of the conglomeratic horizons recorded in boreholes with individual surface outcrops has not proved possible; however, locally, it has been practicable to map out two dominantly conglomeratic units within the Hawksmoor Formation.

In the area to the east of Cheadle, around Freehay and Threapwood, a lithological unit, here defined as the *Freehay Member*, has proved to be mappable. It consists of a body of conglomerate up to 56 m in thickness with impersistent sandstone bands and lenses up to about 4 m thick. It appears to represent gravel spreads and bars laid down in a high-energy braided stream environment when the stream remained closely confined to a particular course for a long period.

To the south-east borehole records indicate that, although the unit as a whole is still recognisable, sandstones increase in importance within it, splitting the conglomerate into a series of separate horizons, with a total conglomerate thickness of about 28 m, noted in the Greatgate No. 3 borehole [0534 4000]. Surface mapping in the north in Hayes and Hawksmoor woods [03 44] indicates that the unit is also split there into at least two separate parts. The bulk of the gravel that has been extracted in the vicinity of Cheadle has been won from the Freehay Member and many sections up to about 40 m in height are visible in the faces of both operating and disused quarries.

A second unit, the *Lodgedale Member*, has been distinguished within the Hawksmoor Formation in the area south and east of Winnothdale. This consists of a sequence of variably pebbly sandstones in which conglomerates, while locally dominant, are likely to be impersistent over the area as a whole. The conglomerates formerly worked for gravel at the Intake Plantation Quarry [045 403] are part of this unit, and an analogous conglomerate 17 m thick was recorded in the Heath House Borehole [0305 3959], just to the south of the district. It should be noted that the base of the unit can be located only approximately, owing to the impersistent nature of the beds of conglomerate and the mapping problem presented by downwash of pebbles on the sandy slopes.

The *Hollington Formation* lies at the top of the Sherwood Sandstone Group and is overlain by the Mercia Mudstone Group. It consists of a number of fining-upwards cycles of hard, fine-grained to medium-grained sandstone with many impersistent mudstone beds – some of which are shown on the map – which represent the fines of the cycles; within the district its thickness varies between 20 and 50 m. The formation is dominantly non-pebbly, except at the base where it is locally conglomeratic. A common feature is its hardness relative to the underlying sandstones, often as the result of cementation by baryte or calcite. The sandstone is valuable locally as a building stone.

Mercia Mudstone Group

The *Denstone Formation* is the basal formation of the Group and consists of a succession of between 25 m and 50 m of thinly bedded reddish brown siltstones interlayered with fine-grained sandstones and mudstones. It is characterised by the presence of ripple-marked surfaces, mica-covered bedding planes and scattered halite pseudomorphs. The formation is lithologically similar to many units referred to the 'Waterstones' of the Midlands and the Cheshire Basin, but has been established as a unit in its own right in the Ashbourne area to avoid confusion with the variously defined 'Waterstones' of the literature.

Plate 2 Minor normal faulting disrupting cross-bedded sandstones and conglomerates within the Freehay Member of the Sherwood Sandstone Group [at 0396 4162] (L1640)

The lower face is approximately 9 m high

The overlying strata consist mainly of mudstones with scattered bands of siltstone and fine-grained sandstone, which are locally called 'skerries' and which commonly form marked topographic features. These rocks are the 'Keuper Marl' of the literature, now classified as an undifferentiated part of the Mercia Mudstone Group.

Geological structure

The earth movements responsible for the intense folding and faulting of the Carboniferous rocks continued into Triassic times and probably played a major role in landscape evolution throughout the Permo-Triassic. Many horst and graben structures initiated during the Carboniferous may have been active while Triassic sedimentation was in progress. For example, the Triassic sandstone on which the town of Cheadle partly stands appears to lie in a deep elongate hollow in the Carboniferous rocks, closely conforming in direction with east–west faults known from underground workings in the Coal Measures to the west.

The main controls on the present distribution of Triassic rocks are strong post-Triassic faulting coupled with a shallow tilting of the strata, generally to the south-south-east. The fault pattern is similar to that in the Carboniferous rocks, with major faults, some of which have throws of 50 m or more, trending along approximately north–south and east–west lines. Minor faulting is common and can be seen in the faces of many gravel pits in the area (Plate 2).

Superficial deposits

Except for the alluvium and terrace deposits in the valleys, drift is of limited extent in the district. However, small patches of boulder clay occur on some of the high ground and one small area of Glacial Sand and Gravel is known. In addition to these deposits, a thin mantle of downwash or solifluction material is common at the surface throughout the district, but this has not been mapped separately. It is best developed in the area underlain by rocks of the Sherwood Sandstone Group, where pebbles have often been spread well beyond the actual outcrops of conglomerate. Relict concentrations of pebbles also occur locally, overlying sandstones which may or may not themselves contain abundant pebbles. The problem of mapping the surface extent of conglomerate bodies presented by these various pebble spreads should not be underestimated.

THE MAP

The conglomerate resource map and accompanying solid and drift geology map are printed on the same sheet and folded into the pocket at the end of this report. The base map for both is the Ordnance Survey 1 : 25 000 Provisional Edition. For cartographic reasons only geological data likely to have a bearing on the evaluation of conglomerate resources are shown on the resource map. A series of horizontal sections and a generalised vertical section at the margins of the maps explain the stratigraphical relationships of the mapped deposits.

Mineral resource information: The Sherwood Sandstone Group outcrop is divided into resource blocks whose boundaries are drawn to enclose geologically similar areas and to facilitate the statistical assessment of the mineral-bearing ground. Within each block, shades of brown indicate the category into which the mineral resource is subdivided (see Appendix C for definitions).

The mineral is identified as 'exposed' where the overburden, commonly consisting only of soil and subsoil, averages less than 2 m in thickness.

Areas of exposed Sherwood Sandstone Group, where aggregate is not present or does not satisfy the definition of mineral, are coloured within the category 'Exposed Sherwood Sandstone Group rocks generally barren'.

Rocks other than those of the Sherwood Sandstone Group, including sand and gravel which may occur within the Alluvium and River Terrace deposits of the district, have not been assessed and are not coloured on the resource map.

Borehole site data: At the site of each borehole the lithologies penetrated are indicated in a tablet. In non-IMAU boreholes, the presence of mineral is indicated by a thick line to the right of the log defining the thickness and position of the mineral deposit, but for IMAU boreholes this is replaced by grading boxes showing the mean gradings of samples collected from the depth intervals indicated by the thickness of each box.

Some data collected during the field survey from natural and quarry sections have been included on the resource map. Data from sections are shown in the same way as borehole data and may be identified by the letter 'S' following the Registration Number. The inaccessibility of the high quarry faces made detailed logging and collection difficult, so that the data are generally less detailed than those from IMAU boreholes.

RESULTS

The data obtained from the laboratory investigations are reported in the following sections.

Grading data: A total of 59 bulk samples of conglomerate from natural and quarry sections were graded. The mean grading and the envelope within which the grading curves for individual samples fall, are shown in Figure 2. It can be seen that the particle-size distribution of the conglomerates is clearly bimodal with a gravel-grade mode at +16 mm and a sand-grade mode at $+\frac{1}{4}$ mm. The gravel grades (clasts greater than 4 mm in size) are represented in the mean grading by a total of 73.1 per cent by weight. The sand-sized particles are not so evenly distributed with 18.2 per cent by weight in the $+\frac{1}{16}-\frac{1}{2}$ mm interval compared with only 3.6 per cent by weight in the $+\frac{1}{2}-4$ mm grades.

The grading information from IMAU boreholes is given in the map tablets for depth intervals of about 10 metres, each interval being drawn with regard to the lithological log of the borehole. The mean gradings for each box and for the total thickness of mineral in each borehole are given in Appendix F. The mean gradings for resource blocks A and B and for the sheet as a whole are given in Table 4.

The action of the drilling machine used in this survey breaks up the coarser particles of gravel so that the individual grade proportions of the samples recovered do not accurately reflect the natural grading of the deposit. It has been shown (Piper and Rogers, 1980) that lowering the gravel/sand boundary for the drilled bulk samples from 4 mm to $\frac{1}{2}$ mm largely overcomes this problem. For this reason, grading data for the drilled bulk samples are not shown by individual grade but for the three fractions: fines ($-\frac{1}{16}$ mm), sand ($+\frac{1}{16}-\frac{1}{2}$ mm) and gravel ($+\frac{1}{2}$ mm).

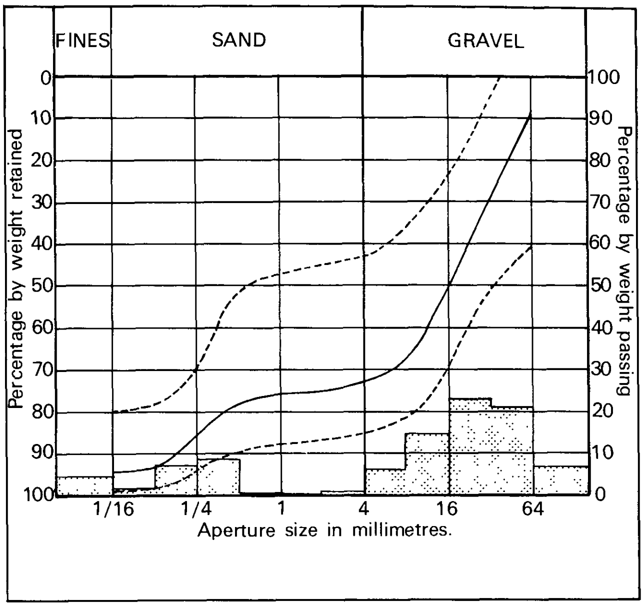


Figure 2 Grading characteristics of 59 samples of conglomerate from natural and quarry sections in the Cheadle district. The continuous line represents the mean grading, the broken lines denote the envelope within which the grading curves for individual samples fall. The mean grading is also shown as a histogram.

Composition of the conglomerates

The suite of pebbles found in the conglomerates of the Sherwood Sandstone Group of the Midlands has been examined by numerous petrologists; general descriptions are found in Bonney (1900) and Wills (1976, pp. 42–44), while Campbell-Smith (1963) reviewed the igneous pebbles.

Table 2 Summary of pebble count analyses from 45 selected conglomerate samples from natural and quarry sections

Pebble lithology	Mean (weight %) $n = 45$	Range (weight %)
Quartzite	72	40.0–88.0
Vein-quartz	19	8.9–50.0
Acid igneous	1	trace–11.0
Basic igneous	0.5	0.0–2.7
Igneous and metamorphic	1	0.0–16.1
Sandstone	4	0.5–9.8
Limestone	1	0.0–6.0
Chert	trace	0.0–0.3
Jasper	trace	0.0–0.1
Mudstone	1.5	0.5–6.0
Undifferentiated	trace	0.0–3.2

Pebble counts were performed on the gravel fractions of 45 selected bulk samples from quarry and natural sections in the district and the results are given in Table 2, where the pebbles are grouped by lithology. During the counting it became possible to delineate three broader classes based on the hardness and friability of the pebbles and their probable behaviour in an aggregate mix. The most durable group predominates throughout the samples and is commonly the sole constituent of the coarser grades. The pebbles are indurated, well rounded, equant, elongate or oblate and show little sign of chemical alteration or decomposition, but they are commonly pitted and frequently split along well-developed fractures when removed from the supporting matrix. The grey, red and white quartzite and vein-quartz pebbles together with the pebbles of granite, tourmaline granite, quartz feldspar porphyry and diorite all belong to this group, which makes up over 90 per cent of the total pebble assemblage.

Pebbles which are friable and tend to disintegrate when removed from the matrix form a second class. This group, which might prove deleterious in an aggregate mix, is common only in the finer gravel grades and includes the softer sedimentary lithologies and the weathered and partially decomposed igneous pebbles. The mean gravel composition includes about 7 per cent by weight attributable to this group.

Sandstones included in this class are fine-grained and medium-grained, silty, decalcified and commonly ferruginous, and rare examples have been found to be fossiliferous with external moulds of brachiopods. Similar specimens from two, now disused, quarries in the district are attributed to the Upper Llandovery stage of the Silurian (Lamont, 1940). Other friable lithologies include limestone and chert, which are clearly derived from rocks of Lower Carboniferous age and contain many moulds and casts of crinoids, brachiopods and corals. The soft white 'limestones' are thoroughly decalcified and silicified and are regarded (Campbell-Smith, 1963, p. 4) as cherts which have undergone thorough alteration and decomposition. Black and brown varieties of chert and maroon red jaspers also occur.

In contrast with the sedimentary lithologies, the friable igneous pebbles are often well-rounded suggesting that they have decomposed since their deposition in the conglomerates. The quartz porphyries, rhyolites and felsites consist principally of quartz and feldspar phenocrysts in varying proportions set in a fine-grained or glassy groundmass, which has been partially or completely altered to a white or pink powdery matrix. Some specimens show clear flow textures.

The third group includes the relatively soft mudstones, which are likely to be deleterious in an aggregate mix, and account for 1.5 per cent by weight of the average gravel composition. The mudstone clasts occur in two forms: as small, rounded 'pellets' up to 10 mm in diameter and as 'fresher', flattened, angular or deformed blocks up to 300 mm in diameter. These pellets and clasts probably represent mudstone beds reworked by influxes of flood water and redeposited a short distance along the river's course.

Table 3 Mechanical properties of the conglomerates of Huntley Wood Quarry (immediately west of district assessed). Data by permission of BCA Limited

	Gravel	Sand
Specific Gravity:		
Oven dry	2.58	2.60
Surface Saturated	2.61	2.62
Apparent	2.66	2.65
Water Absorption	1.2%	0.8%
Aggregate Impact Value	17%	—
10% Fines	350 kN	—
Aggregate Abrasion Value	1.3%	—
Polished Stone Value	49	—

Mechanical properties: No mechanical tests have been carried out on samples collected during this survey but the data in Table 3 refer to the conglomerates of the Freehay Member at Huntley Wood Quarry (1 : 25 000 sheet SJ 94) immediately to the west of the district surveyed. (Written communication from Mr J. C. Ramsey, BCA Limited, December, 1978). Similar values are likely to hold good for gravels produced in the present district.

Statistical results: In common with sand and gravel resource assessments carried out by the Industrial Minerals Assessment Unit, calculations of the volume of mineral are given at the 95 per cent probability level. That is, it is probable that 19 times out of 20 the true volume lies within the stated limits. The statistical results are summarised in Table 4.

Table 4 Summary of statistical results

Resource block	Area		Mean thickness		Mineral extracted*		Volume of mineral			Mean grading percentage		
	Sherwood Sandstone Group	Mineral	Over-burden	Mineral	Area	Volume		Limits at the 95% probability level		Fines	Sand	Gravel
	km²	km²	m	m	km²	$\times 10^6 m^3$	$\times 10^6 m^3$	$\pm\%$	$\pm m^3 \times 10^6$	$-\frac{1}{16}$ mm	$+\frac{1}{16}-\frac{1}{2}$ mm	$+\frac{1}{2}$ mm
A	9.5	7.6	2.5	34.4	1.5	50	211†	29	61	10	39	51
B	3.3	1.0	Not calculated		Negligible		7‡	Not calculated		11	51	38
C	14.8	Nil										
A to C	27.6	8.6				50	218			10	41	49

* Mineral extracted is calculated as the product of the total area of aggregate quarries in the block and the mean thickness of mineral.

† A figure of $261 \times 10^6 m^3$ is calculated as the product of the mean thickness of mineral and the area of mineral within the block. The volume of mineral extracted ($50 \times 10^6 m^3$) has been subtracted to provide the figure quoted.

‡ The inferred assessment is based on geological evidence and data from three IMAU records (see notes on resource Block B).

NOTES ON RESOURCE BLOCKS

For the purposes of the statistical assessment, the outcrop of the Sherwood Sandstone Group is subdivided into three resource blocks. The boundaries between the blocks are drawn, as far as possible, along the major faults which disrupt the Triassic outcrop in the district. Each block is discussed below.

Block A

This block occupies the south-west part of the district and includes 7.6 km^2 of mineral-bearing ground within 9.5 km^2 of Sherwood Sandstone Group outcrop. The block is limited to the east by the fault which crops out along Sandy Lane and to the west by the Carboniferous rocks of the Cheadle Coalfield, which crop out to the north-west at the base of the prominent Triassic escarpment.

Thin impersistent conglomerates of the Huntley Formation and the barren basal sands of the Hawksmoor Formation crop out on the lower scarp slope but the upper slope and crest are formed largely by the principal mineral deposit, the conglomeratic Freehay Member. IMAU boreholes SW 12B, SW 14 and SW 15 were sited on the outcrop and proved thicknesses of 38, 50 and 51.5 m of mineral respectively. The extensive aggregate workings in Block A are largely confined to the area around Cheadle Common [025 415], where the Freehay Member crops out. These quarries provide excellent sections through the conglomerates but rarely expose the full thickness of the member. Selected sections from the quarries in this area are given in Appendix F and shown on the resource map.

To the south-east the conglomerates are overlain by the sandstones, pebbly sandstones and sporadic thin conglomerates of the Hawksmoor Formation. These beds are generally pebble-free and give rise (in borehole SW 18) to 9.0 m of sandstone overburden. In the Winnothdale area [028 404] this formation is thin and only 3.0 m of overburden was proved in borehole SW 16 and 2.5 m in borehole SW 17.

In the south-east portion and along the southern margin of the resource block the conglomerates and intercalated sandstones of the Lodgedale Member crop out over 1.1 km^2. These have been worked for aggregate at Intake Plantation [045 403]. In general this member has a higher proportion of interbedded sandstones than the Freehay Member and is very much thinner, hence its inclusion in the category: 'Exposed mineral generally less than 25 m thick'.

In the south-west corner of the block the Sherwood Sandstone Group is disrupted by a series of faults with a north-westerly trend, which downthrow to the south-west. No IMAU borehole was drilled in this area. Water bore SW 18 [006 407] within the Tenford fault block proved 23 m of conglomerate beneath 4 m of river alluvium. To the south in the Croft Mill area [006 402], the rocks which crop out are thought to be high in the Sherwood Sandstone Group succession. If the conglomerates of the Freehay and Lodgedale members persist beneath these sandstones they are likely to be too deeply buried to be considered as mineral, and therefore this area has been included within the category 'Exposed Sherwood Sandstone Group rocks generally barren'.

The statistical assessment of Block A is based on 6 IMAU boreholes and 26 other records, giving a mean proved thickness of mineral of 34.4 m with a mean grading of fines 10 per cent, sand 39 per cent and gravel 51 per cent. The calculated volume of mineral for the block is 261 million m^3 $\pm$ 29 per cent, but an area of 1.5 km^2 has already been quarried away reducing the estimated volume by some 50 million m^3 to 211 million m^3.

The thickness of overburden varies across the block and has a mean of 2.5 m.

Block B

This block includes an area of 3.3 km^2 of Sherwood Sandstone Group outcrop, which forms an east–west ridge from Lightoaks Wood [047 443] in the east, through the town of Cheadle to the western margin of the map. It is bounded to the north and south by the outcrops of Carboniferous rocks, while the south-eastern boundary is drawn along the major fault which occupies Stony Dale.

The conglomeratic Huntley Formation has been mapped to the west of Woodhouse Cottage [031 442] and proved at depth in borehole SW 6 [034 448], in which it attains a thickness of 11.4 m. Neither this formation nor the sandy Hawksmoor Formation, which crop out over 2.2 km^2 of the block, is regarded as being potentially workable.

The higher parts of the ridge are capped by the conglomerates of the Freehay Member, which are regarded as mineral-bearing where they crop out over 1.0 km^2 between Highshutt [032 439] and Lightoaks Wood [046 442]. This outcrop is disrupted by faults, so that IMAU borehole SW 13 proved 17 m of mineral while borehole SW 43, 200 m to the east, proved 41.5 m. In both these borings the Freehay Member was noticeably sandier than in boreholes in resource Block A, and this is reflected in the mean gradings for the blocks (Table 4). The intercalated sandstones and conglomerates are well displayed in the disused quarry at Highshutt (Plate 3). Section SW 48 S [0323 4393] was measured on the bluff at the left of the photograph.

The small outcrops of the Freehay Member at Cheadle Park and Rosehills to the north and west of Cheadle have not been sampled during this survey although water borehole SW 8 at Rosehill [0008 4321] recorded pebbly sandstones only. Neither outcrop is regarded as mineral bearing.

No statistical assessment of the volume of mineral has been attempted for the block because there are insufficient sample points. However, an inferred assessment is given in Table 4 for the Lightoaks Wood-Highshutt outcrop, which is classified and coloured as 'Exposed mineral generally less than 25 m thick'.

The inferred assessment is based on evidence from the geological mapping of the area together with the records of IMAU boreholes SW 13 and SW 43 and section SW 48 S.

Block C

This block includes 14.8 km^2 of Sherwood Sandstone Group outcrop but no mineral-bearing ground has been identified. The block is limited to the north by the outcrop of Carboniferous rocks and to the south by the outcrop of rocks assigned to the Mercia Mudstone Group. To the west and north-west the block adjoins blocks A and B along the major faults which disrupt the Sherwood Sandstone Group outcrop.

Within the block, the rounded sandstone hills, rising to some 700 ft (213 m), are capped in the area east and south of Farley [069 442] by the siltstones and mudstones of the Mercia Mudstone Group.

Plate 3 Sherwood Sandstone Group conglomerates and sandstones in the disused quarry at Highshutt, near Cheadle [032 439] (L1641)

The River Churnet has cut a deeply incised valley through the block, exposing the soft sandstones and sporadic conglomerate lenses of the Hawksmoor Formation in the lower valley sides, while around the village of Alton [073 423] the cemented sandstones of the Hollington Formation form prominent crags.

Conglomerates have been proved in the numerous water boreholes in the block, for example SE 8, SE 11 and SE 15, but these are not regarded as potentially workable because they are either too thin or are buried beneath considerable thicknesses of sandstone overburden. Water borehole SE 3 [053 400] penetrated 13 m of conglomerate attributed to the Lodgedale Member beneath alluvium in the valley at Greatgate, but on the higher ground immediately to the north, the Hollington Formation crops out and it is unlikely that the conglomerates, if they persist to the north, would be potentially workable beneath this sandstone cover.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

The procedures used in this resource assessment were developed from a successful experimental drilling, sampling and logging programme begun in 1975 and presented in detail elsewhere (Piper and Rogers, 1980).

Conglomerate members within the Sherwood Sandstone Group are identified by preliminary lithostratigraphic mapping. A pattern of boreholes is then drilled to provide reliable data about the nature and thickness of the deposit. This information is complemented by data from pre-existing boreholes and natural and quarry sections. The cooperation of sand and gravel operators has enabled data from commercial boreholes to be incorporated in the calculations although they are held in confidence by the Institute and cannot be disclosed.

The drilling machine employed provides a continuous series of bulk samples, though the action of the down-the-hole hammer breaks up the coarser particles of gravel so that the samples recovered are not completely representative of the *in-situ* grading of the deposit. On completion, the boreholes are logged photographically using a specially developed camera module. The colour photographs provide a reliable guide to the size of *in-situ* pebbles. Below the water table the camera module cannot be used and the boreholes are logged with a black and white television system, which provides a videotape record of the lithologies. Plate 4 shows a sequence of borehole photographs between 12 and 18.5 m down borehole SW 16, south of Lord's Coppice.

A new bulk sample is commenced at every 1 m depth because it proved impossible to detect lithological changes to any greater degree of accuracy. The samples are despatched to a laboratory for grading, while random checks on the accuracy of the results are carried out in the Institute's own laboratories. The grading procedure is based on British Standard 1377 (1967).

APPENDIX B

CLASSIFICATION AND DESCRIPTION OF SAMPLES

The particle-size distribution of borehole samples determined by the grading laboratory do not correspond with the *in-situ* grading of the deposit because the coarser grades are comminuted during drilling. Lowering the gravel/sand boundary for the drilled samples from $+4$ mm to $+\frac{1}{2}$ mm has been shown (Piper and Rogers, 1980) largely to overcome this problem. In this report the mean grading for each group of borehole samples is tabulated on the borehole record sheets for the three grades: fines ($-\frac{1}{16}$ mm), sand ($+\frac{1}{16} - \frac{1}{2}$ mm) and gravel ($+\frac{1}{2}$ mm). Natural and quarry face samples which have not been comminuted are graded in the usual way and the results for these samples are regarded as fully representative.

The classification and description of samples is a two-stage process: the absolute percentages of fines, sand and gravel are used to locate the sample within a field of the triangular diagram in Figure 3. The name of this field is used to describe the sample in the borehole log (see Appendix F). The term 'clayey' (as printed, with single quote marks) is used to describe all material passing $\frac{1}{16}$ mm. It has no mineralogical significance and includes particles falling within the size range of silt.

Samples falling within the six conglomerate and sandy conglomerate fields are further described. The sand and gravel grades are qualified as in Table 5 and the rock types present are indicated. The relative proportions of the grades and rock types are indicated by the use of the words 'and' or 'with'. For example, 'quartzite and vein-quartz' indicates, very approximately, equal proportions with neither constituent accounting for less than 25 per cent of the whole; 'quartzite with vein-quartz' indicates that quartzite is dominant and vein-quartz, the principal accessory rock type, comprises 5 to 25 per cent of the whole. Where rock types account for less than 5 per cent of the whole but are readily apparent, the phrase 'with some' is used as a prefix.

The terms used in the field to describe the degree of rounding of particles, which is concerned with the sharpness of the edges and corners of a clastic fragment and not its shape (after Pettijohn, 1975), are as follows:

Angular: showing little or no evidence of wear; sharp edges and corners.

Subangular: showing definite effects of wear. Fragments still have their original form but edges and corners begin to be rounded off.

Subrounded: showing considerable wear. The edges and corners are rounded off to smooth curves. Original grain shape is still distinct.

Rounded: original faces almost completely destroyed, but some comparatively flat surfaces may still remain. All original edges and corners have been smoothed off to rather broad curves. Original shape is still distinct.

Well-rounded: no original faces, edges or corners remain. The entire surface consists of broad curves; flat areas are absent. The original shape is suggested by the present form of the grain.

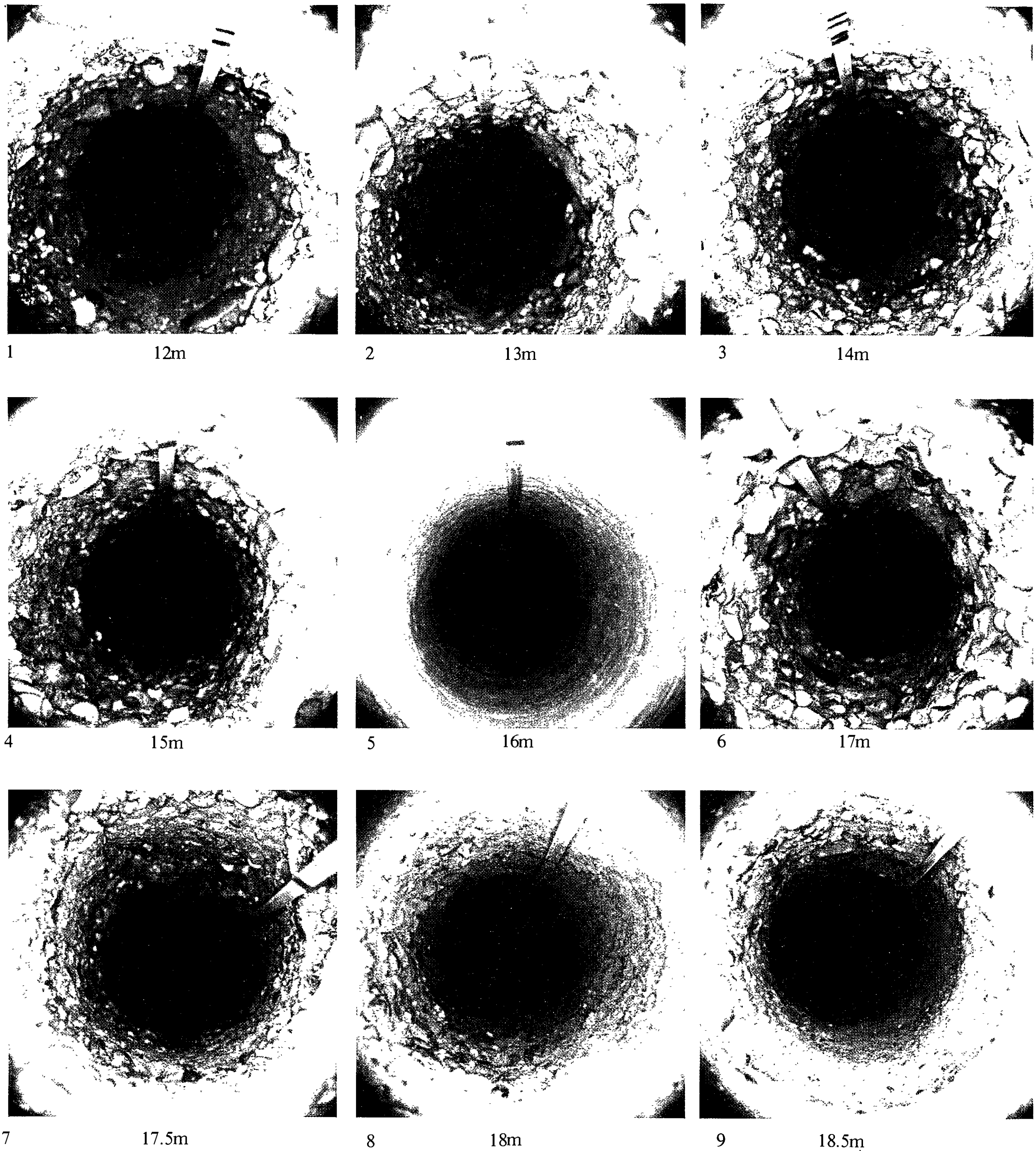


Plate 4 Sequence of photographs from 12.0 m to 18.5 m down borehole SW 16 (south of Lord's Coppice) (MLD 11440)

The conglomerate unit in photographs 1–4 is rather sandy at the top (1 and 2) and becomes coarser towards its base (4). The underlying 'clayey' sandstone is visible in photograph 5 while 6 to 9 show a second, 'clayey', conglomerate unit, rather coarser than the higher one. The tape measure is 10 mm wide and the lit portion of the borehole visible in each picture is approximately ½ m

Table 5 Classification of fines, sand and gravel

Size limits	Grain size description	Qualification	Primary classification
	Cobble		
64 mm –			
		Coarse	Gravel
16 mm –	Pebble		
		Fine	
4 mm –			
		Coarse	
1 mm –			
	Sand	Medium	Sand
$\frac{1}{4}$ mm –			
		Fine	
$\frac{1}{16}$ mm –			
	Fines (silt and clay)		Fines

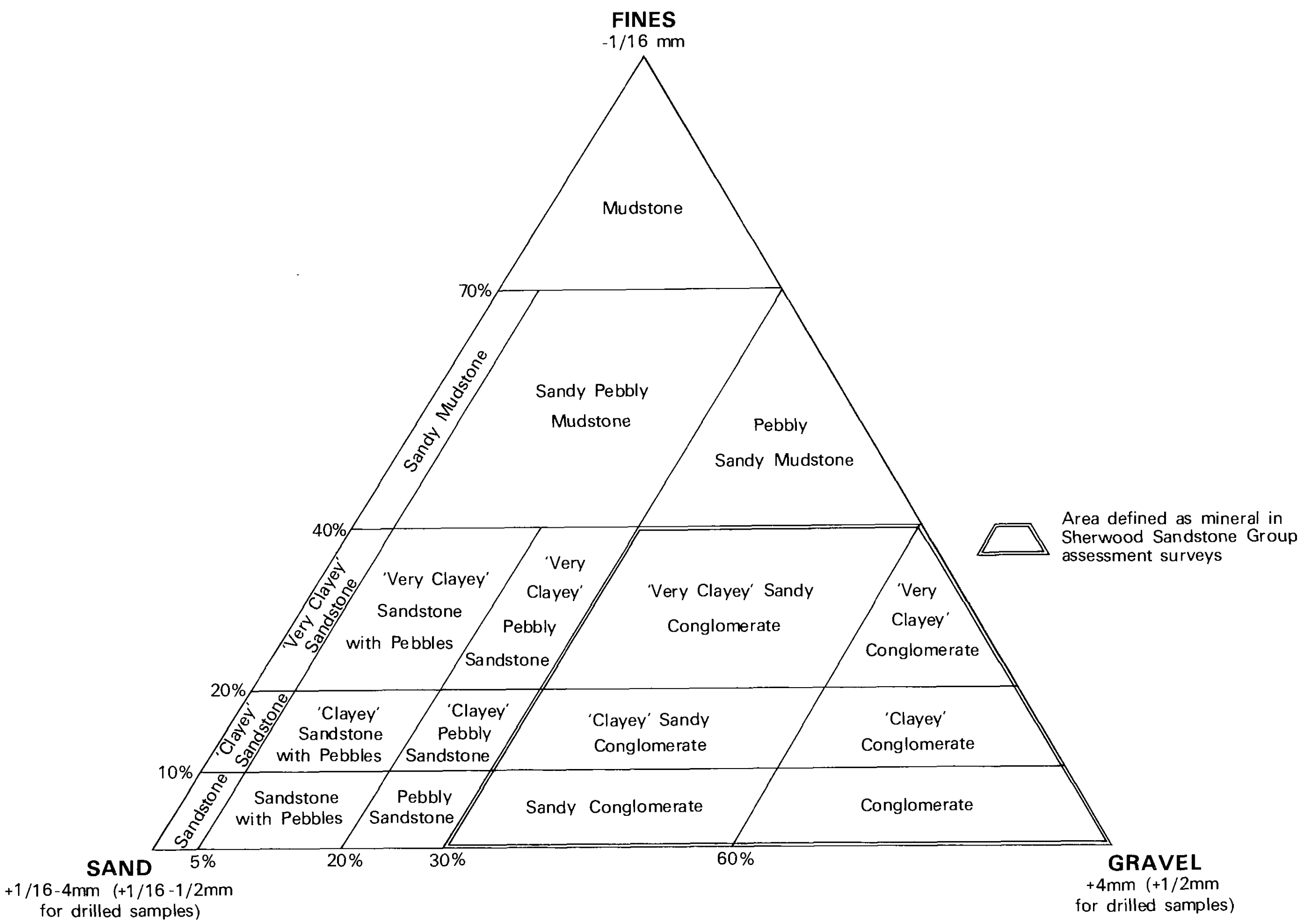


Figure 3 Diagram to show the descriptive categories used in the classification of samples of the Sherwood Sandstone Group

APPENDIX C

DEFINITION OF MINERAL AND CATEGORIES OF DEPOSIT

DEFINITION OF MINERAL

The statistical assessment of the aggregate resource is based on that part of the deposit which is defined as potentially workable and called mineral. The following criteria are used in this report to define mineral:

a The deposit should average at least 5 m in thickness.

b The ratio of overburden to conglomerate should be no more than 1 : 2.

c The gravel (+ 4 mm) content of the deposit should be not less than 30 per cent by weight of the whole.

d The proportion of fines ($-\frac{1}{16}$ mm) should not exceed 40 per cent by weight.

e The deposit must lie within about 60 m of the surface, this being taken as the likely maximum working depth under most circumstances.

It follows from the second and fifth criteria that boreholes are drilled no deeper than 20 m if no mineral deposit has been encountered.

Beds of sandstone or other deposits lying between the surface and the top of the mineral deposit are regarded as overburden. Sandstone partings within the conglomerate sequence are regarded as mineral and included in calculations of its thickness and overall grading.

CATEGORIES OF DEPOSIT

The resource map is divided into five categories of deposit each distinctively coloured. The boundaries between categories are drawn, as far as possible, along geological boundaries and thus the categories correspond to a large degree with the lithological units recognised during the mapping of the district. The following categories are used for the resource map of the Cheadle district:

a Exposed mineral generally greater than 25 m thick
b Mineral, generally greater than 25 m thick, beneath overburden
c Exposed mineral generally less than 25 m thick
d Exposed Sherwood Sandstone Group rocks generally barren
e Rocks other than the Sherwood Sandstone Group

APPENDIX D

STATISTICAL PROCEDURE

The simple methods used in the statistical assessment are consistent with the amount of data provided by the survey. The procedure is similar to that adopted for the sand and gravel surveys of the Industrial Minerals Assessment Unit and is reproduced in Piper and Rogers (1980) as Appendix A.

The volume estimate for the mineral in a given resource block is the product of the sampled area and the mean thickness, calculated from the thicknesses at the sample points. Conventional symmetrical confidence limits are calculated for the 95 per cent probability level, that is, there is a 5 per cent or one in twenty chance of a result falling outside the stated limits.

If the area of mineral within a resource block is too small, or the number of data points too few to allow a statistical assessment, an assessment is inferred based on the available data; confidence limits are not quoted in these circumstances.

APPENDIX E

EXPLANATION OF THE BOREHOLE RECORDS

Annotated example

SK 04 SW 15[1] 0267 4168[2] Block A
Cheadle Common[3]

Surface level + 236.0 m[4]
Water not struck[5]
Down-the-hole hammer with air flush[6]
225 mm diameter
April 1976

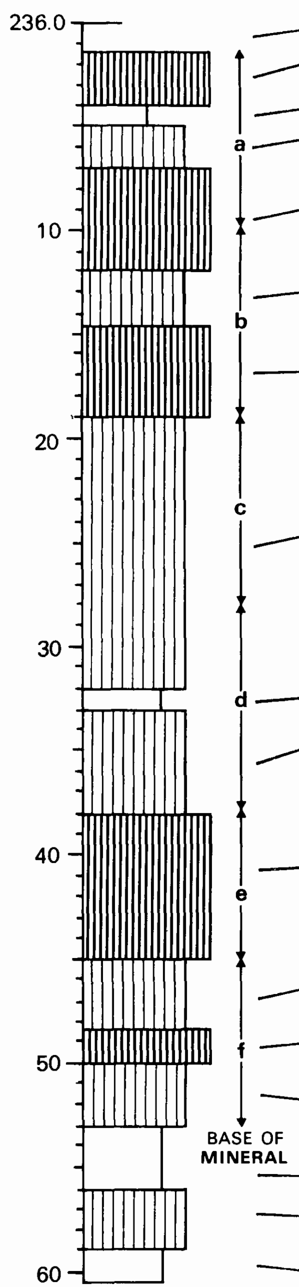
[7]Overburden 1.5 m
Mineral 51.5 m

Grading

[8]Mineral sample	Depth below surface (m)	[9]*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	1.5–10.0	12	53	35
b	10.0–19.0	15	72	13*
c	19.0–28.0	12	34	54
d	28.0–38.0	18	36	46
e	38.0–45.0	10	16	74
f	45.0–53.0	15	24	61
Mean for deposit	1.5–53.0	14	40	46

* Samples unreliable

SK 04 SW 15



Log[10]

Soil: sandy, pebbly
Conglomerate
Gravel: coarse and fine, max. diameter 40 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, well rounded to subangular quartz
'Clayey' Sandstone with Pebbles
'Clayey' Sandy Conglomerate
Gravel: coarse and fine, max. diameter 30 mm, quartzite and vein-quartz
Sand: medium and fine, subrounded to well rounded quartz
'Clayey' Conglomerate
Gravel: coarse and fine, max. diameter 30 mm, quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz with mica
Fines: silty clay, especially 7.0–10.0
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 10 mm, well rounded quartzite and vein-quartz
Sand: fine and medium, angular to subrounded quartz with mica
Fines: clayey silt. Quartz and mica observed
'Clayey' Conglomerate
Gravel: fine, max. diameter 5 mm, very well rounded quartzite and vein-quartz
Sand: fine and medium, subangular to subrounded quartz
Fines: clayey silt
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 6 mm, coarser at top, well rounded quartzite and vein-quartz
Sand: medium and coarse with fine, subangular to well rounded quartz with mica
Fines: clayey micaceous silt
Cementation: deposit very loose
'Clayey' Pebbly Sandstone
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 5 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz
Fines: silty clay
Conglomerate
Gravel: fine and coarse, max. diameter 20 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, subangular to well rounded quartz
Fines: red-brown silty clay, especially 41.0–43.0
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 8 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz
'Clayey' Conglomerate
Gravel: fine well rounded
Sand: medium and coarse, very well rounded quartz
Fines: red-brown silty clay
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 7 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, well rounded quartz
'Clayey' Pebbly Sandstone
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 4 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, subrounded to well rounded quartz
'Clayey' Pebbly Sandstone

The numbered paragraphs below correspond with the annotations given on the specimen record:

1 Borehole Registration Number
Each Industrial Minerals Assessment Unit (IMAU) borehole is identified by a Registration Number. This consists of two statements:

1 The number of the 1 : 25 000 sheet on which the borehole lies, for example SK 04, and
2 The quarter of the 1 : 25 000 sheet on which the borehole lies and its number in a series for that quarter, for example SW 15.

Thus the full Registration Number is SK 04 SW 15, which is abbreviated to SW 15 in the text.

Natural and quarry sections are registered in the same series of numbers, suffixed by the letter 'S'.

2 National Grid reference
Unless otherwise stated all National Grid references in this publication lie within the 100-km square SK. Grid references are given to eight figures, accurate to within 10 m for borehole locations. (In the text, six-figure grid references are used for more approximate locations, for example, for farms).

3 Location
The position of the borehole is generally referred to the nearest named locality on the 1 : 25 000 base map. The resource block in which the borehole lies is also given.

4 Surface level
The surface level at the borehole site is given in metres above Ordnance Datum.

5 Rest-water level
If groundwater was present in the borehole, its level 24 hours after the cessation of drilling is given in metres above Ordnance Datum. The level in the borehole is indicated by the apex of an inverted solid triangle to the left of the graphical log.

6 Type of drill and date of drilling
All the boreholes in this survey were drilled with a truck-mounted Dando 250 rotary-percussion rig equipped with a down-the-hole hammer using compressed air to flush out the drilled material. The diameter of the borehole and the month and year of its completion are stated.

7 Overburden and mineral
Mineral is conglomerate and intercalated sandstones which, as part of a deposit, fall within the arbitrary definition of potentially workable material (see Appendix C). Overburden is waste material which occurs between the ground surface and the top of the mineral deposit.

8 Sample intervals and depths
Individual samples are grouped into lettered intervals, which reflect the changing lithologies within the mineral deposit. The upper and lower limits of each interval are quoted in metres below the surface. The intervals are indicated on the graphical log of the borehole by double-ended arrows and the appropriate letters.

9 Sample percentages
The mean grading of the bulk samples within each lettered interval is expressed in weight per cent for the three grades, fines ($-\frac{1}{16}$ mm), sand ($+\frac{1}{16}$ mm $-\frac{1}{2}$ mm) and gravel ($+\frac{1}{2}$ mm). The mean gradings are weighted by the appropriate thickness for each sample and used to calculate the weighted mean grading for the total thickness of mineral in the borehole.

10 Lithology
The borehole log is shown graphically in such a way that conglomerates and sandy conglomerates are emphasised by wider bars which are ruled, whereas sandier deposits are indicated by narrower bars, left unornamented. The bars are drawn schematically so that, in a general way, the widths of the bars indicate the relative gravel contents of the deposits. For cartographic reasons the 'clay' content is omitted.

Each bar is accompanied by a brief description of the deposit based on the scheme of descriptive categories (Figure 3), while conglomerates and sandy conglomerates are further described in terms of their grading characteristics and rock types.

All rocks shown on the borehole logs in this report belong to the Sherwood Sandstone Group.

APPENDIX F

RECORDS OF INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLES AND SECTIONS

RESOURCE BLOCK A, pp. 16–25.

	Registration number*	Grid reference†
BOREHOLES	SW 12B	0322 4217
	14	0354 4264
	15	0267 4168
	16	0356 4070
	17	0287 4040
	18	0188 4091
SECTIONS	SW 44 S	0380 4170
	45 S	0348 4122
	46 S	0174 4140
	47 S	0464 4019

RESOURCE BLOCK B, pp. 26–28.

	Registration number*	Grid reference†
BOREHOLES	SW 13	0350 4384
	43	0369 4387
SECTIONS	SW 48 S	0323 4393

* By sheet quadrant
† All fall within SK 04

SK 04 SW 12 B 0322 4217 Block A

South of Mount Pleasant Farm

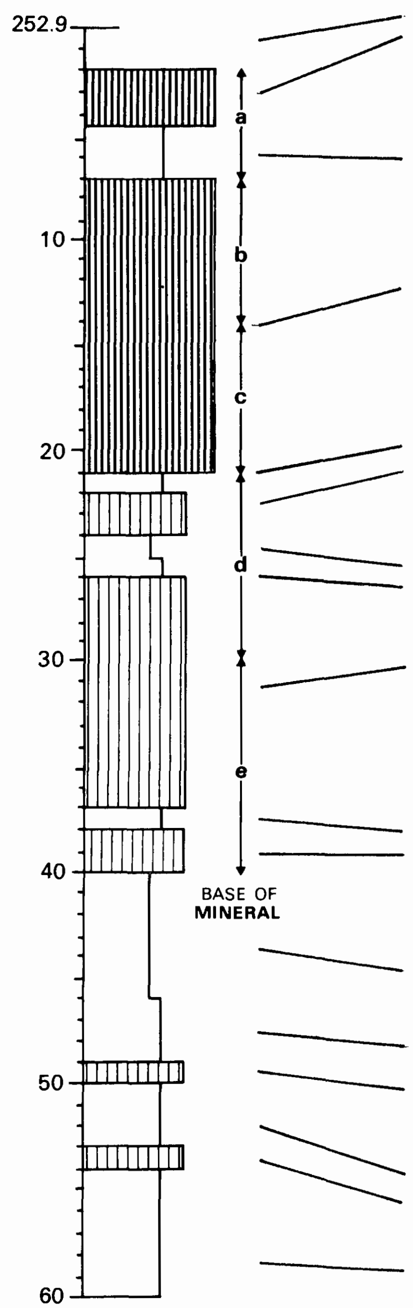
Surface level +252.9 m
Water not struck
Down-the-hole hammer with air-flush
200 mm diameter
October 1975

Overburden 2.0 m
Mineral 38.0 m

Grading

Mineral sample	Depth below surface (m)	*percentages*		
		Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	2.0–7.0	28	44	28
b	7.0–14.0	8	22	70
c	14.0–21.0	9	24	67
d	21.0–30.0	12	52	36
e	30.0–40.0	10	53	37
Mean for deposit	2.0–40.0	12	41	47

SK 04 SW 12 B Log



Soil: pebbly, sandy.
Conglomerate
Gravel: coarse and fine, well rounded quartzite and vein-quartz pebbles
Sand: medium–fine, quartz

Pebbly Sandstone

Conglomerate, with sporadic sandy lenses
Gravel: fine, max. diameter observed 10 mm, well rounded, quartzite and vein-quartz pebbles
Sand: medium with fine, quartz

'Very Clayey' Pebbly Sandstone
'Clayey' Sandy Conglomerate
Gravel: fine with coarse, quartzite and vein-quartz
Sand: medium with fine and coarse, quartz
Fines: clayey silt

'Clayey' Sandstone with Pebbles
'Clayey' Pebbly Sandstone

'Clayey' Sandy Conglomerate
Gravel: fine and coarse, quartzite and vein-quartz
Sand: medium with fine and coarse, quartz sand
Fines: clayey silt
Cementation: patchy, widespread at base

Pebbly Sandstone
Sandy Conglomerate
Gravel: fine with coarse, quartzite and vein-quartz
Sand: medium quartz
Fines: increasing to base
Cementation: widespread

'Clayey' Sandstone with Pebbles

Pebbly Sandstone

Sandy Conglomerate
Gravel: fine with coarse, quartzite and vein-quartz
Sand: medium with fine, quartz

Pebbly Sandstone

Sandy Conglomerate
Gravel: fine with coarse, quartzite and vein-quartz
Sand: medium and fine, quartz
'Clayey' Pebbly Sandstone

SK 04 SW 14 0354 4264 **Block A**
Counslow Plantation

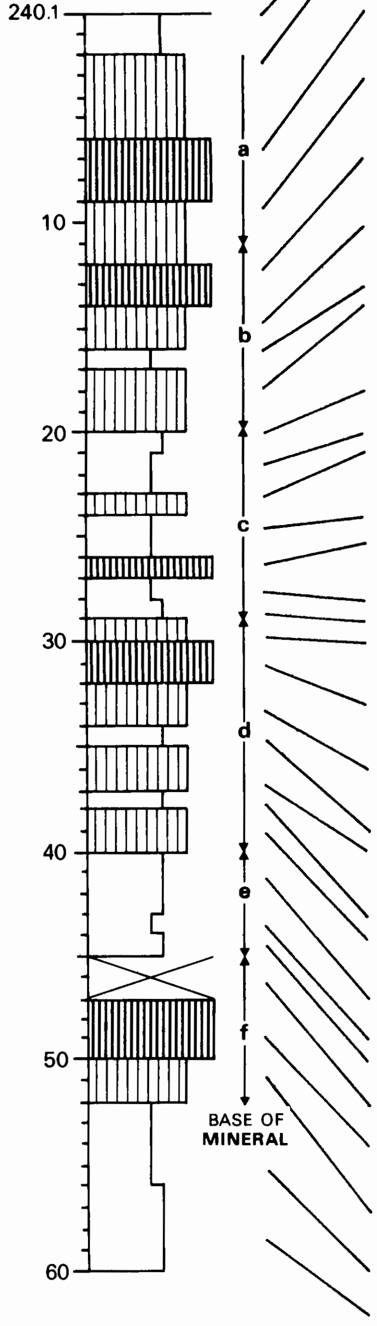
Surface level +240.1 m
Water not struck
Down-the-hole hammer with air-flush
225 mm diameter
March 1976

Overburden 2.0 m
Mineral 50.0 m

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $+\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	2.0–11.0	8	40	52
b	11.0–20.0	11	50	39
c	20.0–26.0	13	68	19
d	26.0–35.0	6	48	46
e	35.0–45.0	11	60	29
f	45.0–52.0	13	27	60
Mean for deposit	2.0–52.0	10	49	41

SK 04 SW 14



Soil
'Clayey' Sandy Conglomerate
Gravel: coarse and fine, max. diam. 60 mm, well rounded quartzite and vein-quartz with some limestone and friable volcanic pebbles
Sand: medium and coarse, subrounded and well rounded quartz
Conglomerate
Gravel: fine and coarse, max. diam. 30 mm, subangular to well rounded quartzite and vein-quartz
Sand: medium and coarse, subangular and subrounded quartz
Sandy Conglomerate
Gravel: coarse and fine, max. diam. 30 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, rounded quartz sand
Fines: clayey silt especially 11.0–12.0
Conglomerate
Gravel: coarse with fine, max. diam. 20 mm, well rounded quartzite and vein-quartz with some limestone
Sand: medium with fine, subangular to well rounded quartz
'Clayey' Sandy Conglomerate
Gravel: fine and coarse, well rounded quartzite and vein-quartz
Sand: medium and fine, quartz
Sandstone with Pebbles
'Clayey' Sandy Conglomerate
Gravel: fine with coarse, quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz
Cementation: patchy
'Clayey' Pebbly Sandstone
'Clayey' Sandstone with Pebbles
'Clayey' Sandy Conglomerate
Gravel: fine, quartzite with vein-quartz
Sand: fine with medium, quartz
'Clayey' Sandstone with Pebbles
Conglomerate
Gravel: coarse and fine, max. diam. 30 mm quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz
'Clayey' Sandstone with Pebbles
Pebbly Sandstone
Sandy Conglomerate
Gravel: fine, quartzite and vein-quartz
Sand: fine and medium, quartz
Conglomerate
Gravel: fine, quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz, some material caving from 28.0–30.0?
Sandy Conglomerate
Gravel: fine and coarse, quartzite and vein-quartz
Sand: fine and medium, subrounded and well rounded quartz
Pebbly Sandstone
Sandy Conglomerate
Gravel: fine and coarse, quartzite and vein-quartz
Sand: medium with fine, subrounded to well rounded quartz
'Clayey' Pebbly Sandstone
Sandy Conglomerate
Gravel: fine? quartzite and vein-quartz
Sand: medium and fine, very well rounded quartz
'Clayey' Pebbly Sandstone
'Very Clayey' Sandstone with Pebbles
'Clayey' Pebbly Sandstone
No data
Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz with some ? shale
Sand: medium and coarse, subangular to subrounded quartz
'Clayey' Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: fine and medium, very well rounded quartz, some material caving from above
'Very Clayey' Sandstone with Pebbles
'Clayey' Pebbly Sandstone

SK 04 SW 15 0267 4168 **Block A**

Cheadle Common

Surface level +236.0 m
Water not struck
Down-the-hole hammer with air-flush
225 mm diameter
April 1976

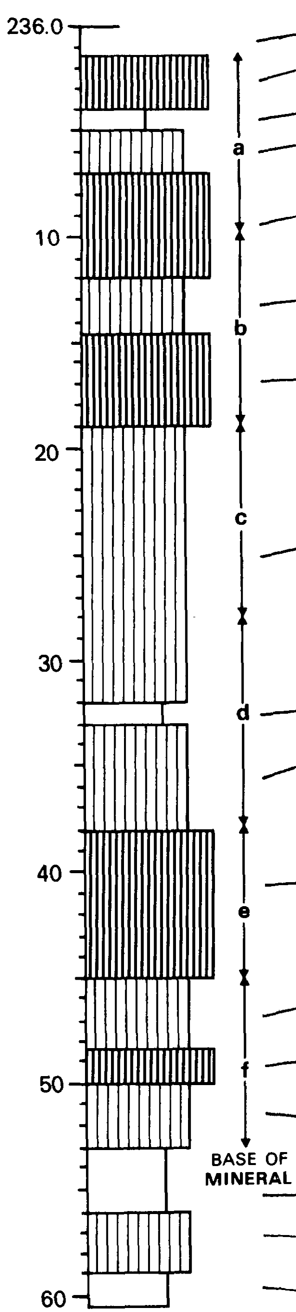
Overburden 1.5 m
Mineral 51.5 m

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	1.5–10.0	12	53	35
b	10.0–19.0	15	72	13*
c	19.0–28.0	12	34	54
d	28.0–38.0	18	36	46
e	38.0–45.0	10	16	74
f	45.0–53.0	15	24	61
Mean for deposit	1.5–53.0	14	40	46

* Samples unreliable

SK 04 SW 15 **Log**



Soil: sandy, pebbly
Conglomerate
Gravel: coarse and fine, max. diameter 40 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, well rounded to subangular quartz
'Clayey' Sandstone with Pebbles
'Clayey' Sandy Conglomerate
Gravel: coarse and fine, max. diameter 30 mm, quartzite and vein-quartz
Sand: medium and fine, subrounded to well rounded quartz
'Clayey' Conglomerate
Gravel: coarse and fine, max. diameter 30 mm, quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz with mica
Fines: silty clay, especially 7.0–10.0

'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 10 mm, well rounded quartzite and vein-quartz
Sand: fine and medium, angular to subrounded quartz with mica
Fines: clayey silt. Quartz and mica observed
'Clayey' Conglomerate
Gravel: fine, max. diameter 5 mm, very well rounded quartzite and vein-quartz
Sand: fine and medium, subangular to subrounded quartz
Fines: clayey silt

'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 6 mm, coarser at top, well rounded quartzite and vein-quartz
Sand: medium and coarse with fine, subangular to well rounded quartz with mica
Fines: clayey micaceous silt
Cementation: deposit very loose

'Clayey' Pebbly Sandstone
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 5 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz
Fines: silty clay

Conglomerate
Gravel: fine and coarse, max. diameter 20 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, subangular to well rounded quartz
Fines: red-brown silty clay, especially 41.0–43.0

'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 8 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to well rounded quartz
'Clayey' Conglomerate
Gravel: fine well rounded,
Sand: medium and coarse, very well rounded quartz
Fines: red-brown silty clay
'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 7 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, well rounded quartz
'Clayey' Pebbly Sandstone

'Clayey' Sandy Conglomerate
Gravel: fine, max. diameter 4 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, subrounded to well rounded quartz
'Clayey' Pebbly Sandstone

SK 04 SW 16 0356 4070 **Block A**

South of Lord's Coppice

Surface level +197.0 m
Rest water level +170.6 m
Down-the-hole hammer with air-flush
225 mm diameter
May 1976

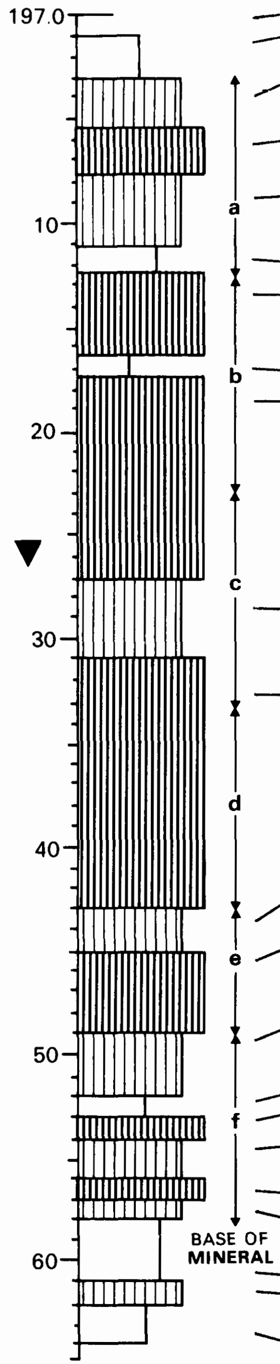
Overburden 3.0 m
Mineral 55.0 m

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	3.0–13.0	16	46	38
b	13.0–23.0	12	32	56
c	23.0–33.0	10	20	70
d	33.0–43.0	9	17	74
e	43.0–49.0†	4	32	64
f	49.0–58.0†	4	55	41
Mean for deposit	3.0–58.0	10	33	57

† Samples taken below the water table with some fines loss

SK 04 SW 16



Log

Soil: sandy, pebbly
'Very Clayey' Sandstone with Pebbles
'Very Clayey' Sandy Conglomerate
Gravel: fine and coarse, max. diameter 40 mm, quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz
Fines: red-brown silty clay
'Clayey' Conglomerate
Gravel: coarse, max. diameter 40 mm, quartzite and vein-quartz
Sand: medium and coarse, subangular to well rounded quartz
Sandy Conglomerate
Gravel: fine and coarse, max. diameter 25 mm, quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz
Fines: red-brown silty clay especially at top
'Clayey' Pebbly Sandstone
'Clayey' Conglomerate
Gravel: coarse and fine, max. diameter 40 mm, quartzite and vein-quartz
Sand: medium with fine, subangular to well rounded quartz
'Clayey' Sandstone
'Clayey' Conglomerate, with sporadic sandy lenses
Gravel: coarse, max. diameter 40 mm well rounded quartzite and vein-quartz, with traces of limestone, volcanics and sandstone
Sand: medium and coarse with fine, well rounded quartz
Fines: silty clay
'Clayey' Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to rounded quartz
Conglomerate
Gravel: coarse with fine, max. diameter 40 mm, well rounded quartzite and vein-quartz with some limestone, sandstone and friable volcanic pebbles
Sand: medium and fine with coarse, subangular to rounded quartz
Fines: red-brown clayey silt
Sandy Conglomerate
Gravel: fine, max. diameter 7 mm well rounded quartzite and vein-quartz
Sand: medium and fine, quartz
Conglomerate
Gravel: fine and coarse, max. diameter 20 mm, well rounded quartzite and vein-quartz with some limestone and volcanic pebbles
Sand: medium and coarse quartz
Sandy Conglomerate
Gravel: coarse, max. diameter 50 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, rounded quartz
Fines: mudstone bed at 49.4–49.7
Sandstone with Pebbles
'Clayey' Conglomerate
Gravel: coarse, max. diameter 45 mm, quartzite and vein-quartz
Sandy Conglomerate
Gravel: coarse, well rounded quartzite and vein-quartz
Sand: medium and coarse, quartz
Conglomerate
Gravel: fine, max. diameter 10 mm, well rounded quartzite and vein-quartz
Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Pebbly Sandstone
Sandy Conglomerate
Gravel: coarse, quartzite and vein-quartz
Sand: medium and fine quartz
'Very Clayey' Sandstone with Pebbles

SK 04 SW 17 **0287 4040** **Block A**
Winnothdale

Surface level +181.6 m
Rest water level +173.6 m
Down-the-hole hammer with air-flush
225 mm diameter
May 1976

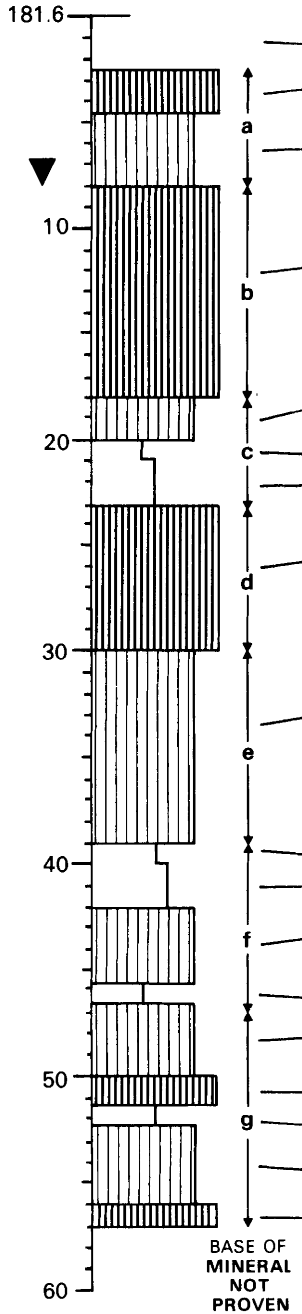
Overburden 2.5 m
Mineral 54.5 m +

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	2.5–8.0	7	20	73
b	8.0–18.0	9	15	76
c	18.0–23.0†	15	45	40
d	23.0–30.0†	3	30	67
e	30.0–39.0†	2	39	59
f	39.0–47.0†	2	40	58
g	47.0–57.0†	2	54	44
Mean for deposit	2.5–57.0	5	34	61

† Samples taken below the water table with some fines loss

SK 04 SW 17 **Log**



Made ground
Conglomerate
Gravel: coarse and fine, max. diameter 40 mm, well rounded quartzite and vein-quartz
Sand: coarse and medium, subangular to rounded quartz with mica
Sandy Conglomerate
Gravel: coarse with fine, max. diameter 100 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, well rounded quartz
Conglomerate
Gravel: coarse and fine, max. diameter 45 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, subrounded to well rounded quartz
'Very Clayey' Sandy Conglomerate
Gravel: coarse and fine, well rounded quartzite and vein-quartz
Sand: fine and medium, quartz with traces of mica and dark minerals
Fines: silty clay
'Clayey' Sandstone
Sandstone with pebbles
Conglomerate
Gravel: fine with coarse, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to rounded quartz
Sandy Conglomerate, with sporadic sandstone lenses
Gravel: coarse and fine, max. diameter 30 mm, well rounded quartzite and vein-quartz
Sand: medium and fine with coarse, especially at base, subangular to rounded quartz
'Clayey' Sandstone with Pebbles
Pebbly Sandstone
Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to rounded quartz
Sandstone
Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium with fine and coarse, subangular to rounded quartz with mica
Conglomerate
Gravel: fine, max. diameter 6 mm, well rounded quartzite and vein-quartz
Sandstone with Pebbles
Sandy Conglomerate
Gravel: fine, max. diameter 15 mm, quartzite and vein-quartz
Conglomerate
Gravel: coarse and fine, max. diameter 45 mm, quartzite and vein-quartz

SK 04 SW 18 0188 4091 **Block A**

East of Gorsty Hill Farm

Surface level + 212.8 m
Rest water level + 175.6 m
Down-the-hole hammer with air-flush
225 mm diameter
May 1976

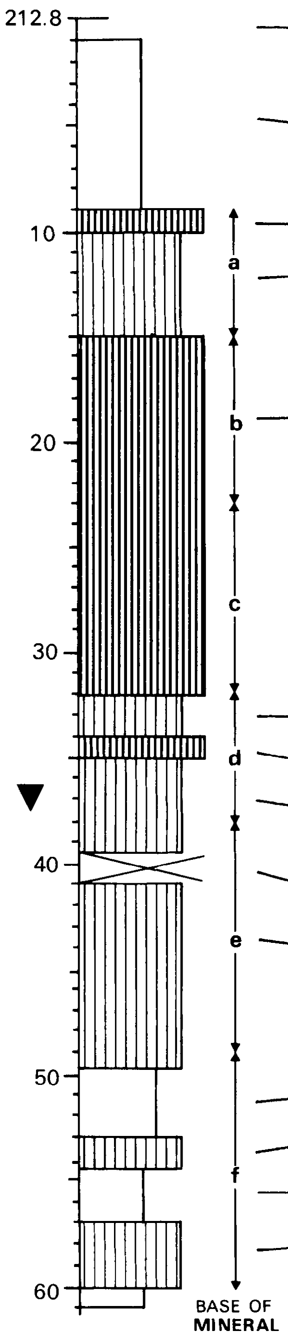
Overburden 9.0 m
Mineral 51.0 m

Grading

Mineral sample	Depth below surface (m)	*percentages*		
		Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	9.0–15.0	10	33	57
b	15.0–23.0	7	26	67
c	23.0–32.0	8	27	65
d	32.0–38.0	11	36	53
e	38.0–49.0	No grading data		
f	49.0–60.0†	7	49	44
Mean for deposit	9.0–60.0	9	35	56

† Samples taken below the water table with some fines loss

SK 04 SW 18



Log

Soil: sandy, pebbly

'Clayey' Sandstone with Pebbles

'Very Clayey' Conglomerate
Gravel: coarse with fine, quartzite and vein-quartz

Sandy Conglomerate
Gravel: coarse, max. diameter 40 mm, well rounded quartzite and vein-quartz
Sand: medium with coarse and fine, subrounded to very well rounded quartz

Conglomerate, with thin sandstone lenses
Gravel: coarse with fine, max. diameter 45 mm, well rounded quartzite and vein-quartz with traces of subangular limestone, rounded friable volcanics and sandstone
Sand: medium and fine with coarse, subrounded to well rounded quartz with traces of mica
Cementation: widespread becoming patchy towards base

Sandy Conglomerate
Gravel: coarse and fine, well rounded quartzite and vein-quartz
Sand: medium and coarse, subrounded to well rounded quartz

Conglomerate
Gravel: coarse, well rounded quartzite and vein-quartz with traces of limestone and sandstone

Sandy Conglomerate
Gravel: coarse, well rounded quartzite and vein-quartz with traces of limestone, sandstone and volcanic pebbles
Sand: medium and coarse, subrounded to well rounded quartz with traces of mica and dark minerals

No data

Sandy Conglomerate, with thin sandstone lenses. *No samples recovered*
Gravel: coarse and fine, max. diameter 30 mm, quartzite and vein-quartz
Cementation: widespread

Pebbly Sandstone

Sandy Conglomerate
Gravel: coarse and fine, max. diameter 20 mm, quartzite and vein-quartz

Sandstone with Pebbles

Sandy Conglomerate
Gravel: coarse, max. diameter 40 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, subangular to rounded quartz with mica

Sandstone with Pebbles

SK 04 SW 44 S 0380 4170
Mud-dale Wood, quarry

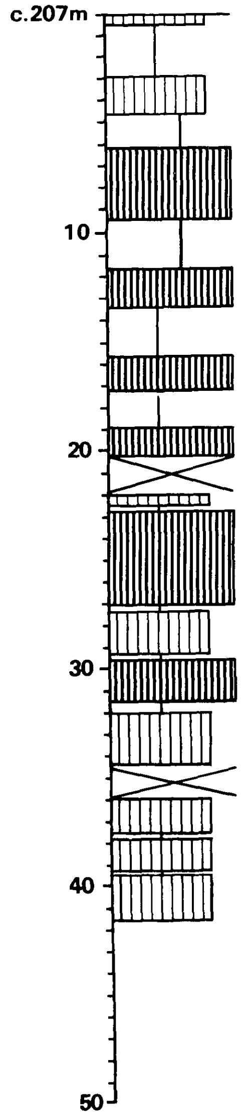
Surface level +207 m (approx.)

Block A

Overburden Nil
Mineral 41.5 m +

SK 04 SW 44 S
0380 4170

Log



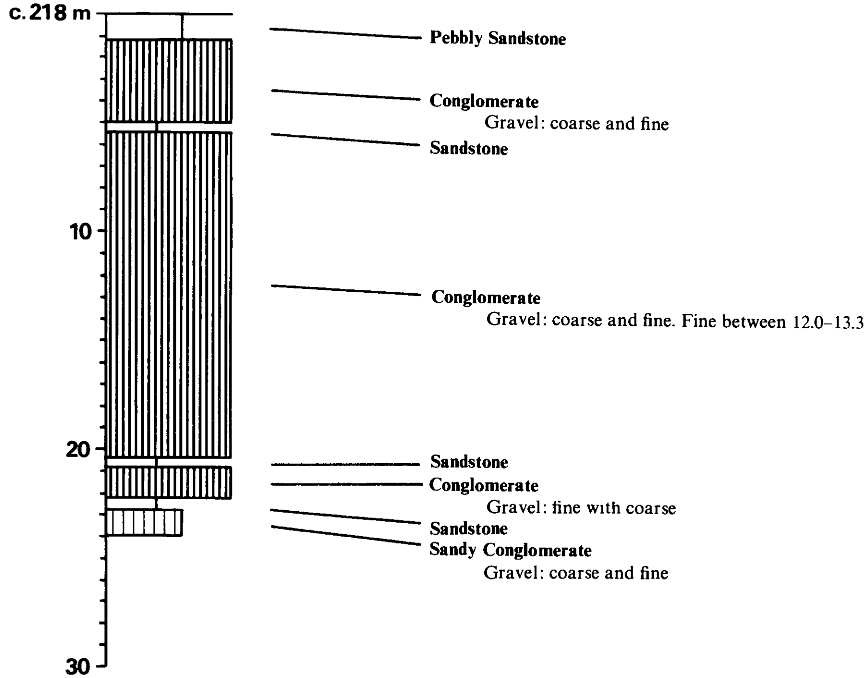
Sandy Conglomerate Gravel: coarse and fine
Sandstone
Sandy Conglomerate
Gravel: coarse and fine
Pebbly Sandstone
Conglomerate
Gravel: coarse and fine, cross bedded
Pebbly Sandstone
Conglomerate
Gravel: fine and coarse
Sandstone
Conglomerate
Gravel: fine and coarse
Sandstone
Conglomerate
Gravel: fine and coarse
No data
Sandy Conglomerate Gravel: coarse and fine
Sandstone
Conglomerate Gravel: coarse with fine, some cobbles observed
Sand: medium and fine, quartz
?Cemented
Sandstone
Sandy Conglomerate Gravel: coarse and fine Flat bedded
Sandstone
Conglomerate Gravel: coarse and fine Flat bedded
'Very Clayey' Sandstone
'Clayey' Sandy Conglomerate Gravel: coarse and fine
Sand: fine, quartz matrix and sporadic thin sandstone lenses
Fines: silty mud in matrix
No data
Sandy Conglomerate Gravel: coarse and fine and some cobbles
'Very Clayey' Sandstone
Sandy Conglomerate Gravel: coarse and fine
Sandstone
Sandy Conglomerate Gravel: coarse and fine

SK 04 SW 45 S 0348 4122 **Block A**
Mud-dale Wood, quarry

Surface level +218 m (approx.)

Overburden 1.2 m
Mineral 22.8 m +

SK 04 SW 45 S **Log**
0348 4122



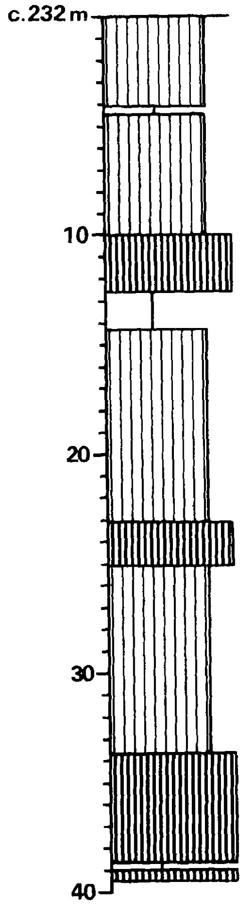
SK 04 SW 46 S 0174 4140 **Block A**
Freehay Wood, quarry

Surface level +232 m (approx.)

Overburden Nil
Mineral 39.4 m +

SK 04 SW 46 S
0174 4140

Log



Sandy Conglomerate
Gravel: coarse and fine

Sandstone

Sandy Conglomerate
Gravel: coarse and fine

Conglomerate
Gravel: fine with coarse, cross bedded

Sandstone

Sandy Conglomerate
Gravel: coarse and fine

Conglomerate
Gravel: fine with some coarse
Sand: very little sand matrix present

Sandy Conglomerate
Gravel: coarse and fine
Sand: medium and fine, quartz as matrix and in sporadic thin sandstone lenses
Fines: mudstone clasts common at 28.4.
Flat bedded

Conglomerate
Gravel: coarse with fine, cross bedded

Sandstone

Conglomerate
Gravel: fine with some coarse

SK 04 SW 47 S 0464 4019 **Block A**

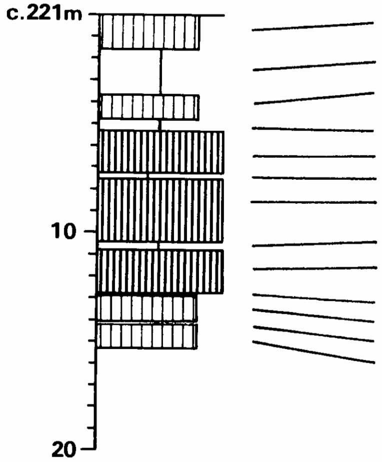
Intake Plantation, quarry

Surface level +221 m (approx.)

Overburden Nil
Mineral 15.2 m +

SK 04 SW 47 S
0464 4019

Log



Sandy Conglomerate Gravel: fine and coarse, very well rounded quartzite with vein-quartz

Sandstone with Pebbles

Sandy Conglomerate Gravel: fine with coarse, very well rounded quartzite and vein-quartz and some mudstone clasts. Cross bedded. Cemented

Sandstone with Pebbles

Conglomerate Gravel: coarse with fine, sporadic cobbles, quartzite with vein-quartz and some sandstone. Flat bedded

Sandstone

Conglomerate Gravel: coarse and fine, very well rounded quartzite with vein-quartz
Sand: fine and medium, quartz Flat bedded

Sandstone with Pebbles

Conglomerate Gravel: fine and coarse with some cobbles, quartzite with vein-quartz
Sand: fine and medium, quartz, in matrix and in thin sand lenses

Pebbly Sandstone

Sandy Conglomerate Gravel: coarse and fine, quartzite with vein-quartz. Sand: fine and medium, quartz

Sandstone with Pebbles

Sandy Conglomerate
Gravel: coarse and fine, very well rounded quartzite with vein-quartz, pebbles commonly fractured
Sand: fine and medium, angular to subrounded quartz
Flat bedded

SK 04 SW 13 0350 4384 **Block B**
East of Highshutt

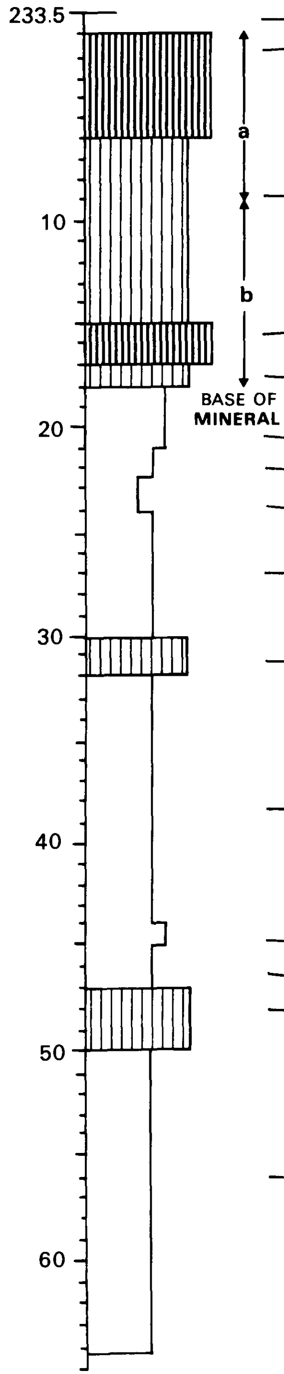
Surface level +233.5 m
Water not struck
Down-the-hole hammer with air-flush
225 mm diameter
March 1976

Overburden 1.0 m
Mineral 17.0 m

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	1.0–9.0	9	44	47
b	9.0–18.0	12	43	45
Mean for deposit	1.0–18.0	11	43	46

SK 04 SW 13



Log

Soil

Conglomerate
Gravel: coarse with fine, max. diameter 40 mm, well rounded quartzite and vein-quartz with some volcanics
Sand: coarse with medium, quartz with mica

'Clayey' Sandy Conglomerate, with sporadic sandy lenses
Gravel: fine with coarse, max. diameter 30 mm, well rounded quartzite and vein-quartz
Sand: medium and fine, quartz with mica
Fines: clayey silt

Conglomerate
Gravel: coarse and fine, max. diameter 20 mm, well rounded quartzite and vein-quartz
Sand: medium and coarse, quartz

Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium and coarse, quartz

'Clayey' Pebbly Sandstone

'Clayey' Sandstone with Pebbles

'Very Clayey' Sandstone

'Clayey' Sandstone with Pebbles

'Clayey' Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium, well rounded quartz

'Clayey' Sandstone with Pebbles

'Clayey' Pebbly Sandstone

'Clayey' Sandstone with Pebbles

'Clayey' Sandy Conglomerate
Gravel: fine, well rounded quartzite and vein-quartz
Sand: medium, well rounded quartz

'Clayey' Sandstone with Pebbles

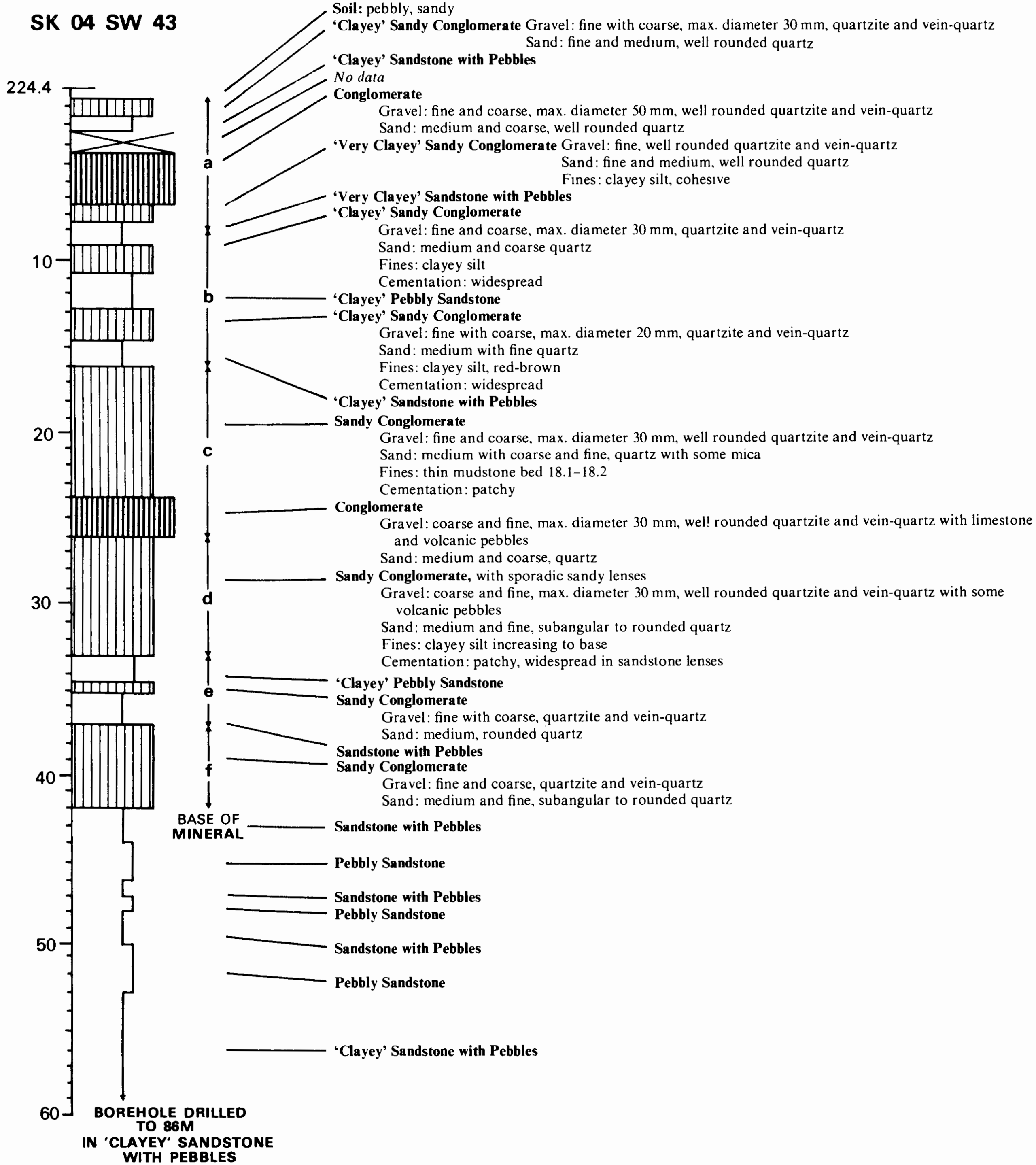
SK 04 SW 43 0369 4387 **Block B**

West of Greendale

Surface level +224.4	Overburden 0.5 m
Water not struck	Mineral 41.5 m
Down-the-hole hammer with air-flush	
225 mm diameter	
April 1978	

Grading

Mineral sample	Depth below surface (m)	*percentages* Fines $-\frac{1}{16}$	Sand $+\frac{1}{16}-\frac{1}{2}$	Gravel $+\frac{1}{2}$
a	0.5–7.5	12	47	41
b	7.5–16.0	16	69	15
c	16.0–26.0	9	49	42
d	26.0–33.0	8	45	47
e	33.0–37.0	10	64	26
f	37.0–42.0	7	55	38
Mean for deposit	0.5–42.0	11	54	35

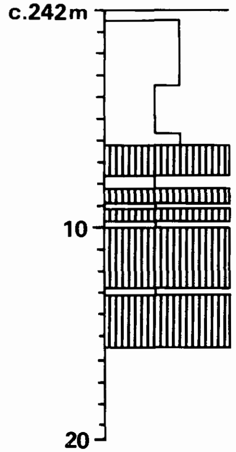


SK 04 SW 48 S **0323 4393** **Block B**
Highshutt, quarry

Surface level +242 m (approx.)

Overburden 6.3 m
Mineral 9.3 m +

SK 04 SW 48 S **Log**
0323 4393



Soil
Pebbly Sandstone
'Clayey' Sandstone
Pebbly Sandstone
Conglomerate Gravel: fine with coarse, quartzite with vein-quartz and some volcanics
Sand: fine and medium, quartz
'Clayey' Sandstone
Conglomerate Gravel: fine with coarse, quartzite with vein-quartz
'Clayey' Sandstone
Conglomerate Gravel: fine with coarse, quartzite with vein-quartz
Sandstone
Conglomerate Gravel: coarse and fine, very well rounded quartzite with vein-quartz and sandstone, mudstone clasts, volcanics, quartz porphyry
'Very Clayey' Sandstone
Conglomerate
Gravel: coarse and fine, very well rounded quartzite with vein-quartz
Sand: fine and medium quartz in matrix and in thin sand lenses

GLOSSARY

Barytes Mineral form of barium sulphate, $BaSO_4$; 'heavy spar'

Brachiopod Marine animal with a bivalved calcareous or chitinous shell and belonging to the Phylum Brachiopoda; a 'lampshell'

Calcite Mineral form of calcium carbonate, $CaCO_3$

Chronostratigraphy The study of stratified rock units, their subdivisions and correlation based on the time of their deposition

Clastic Refers to a rock or sediment composed principally of broken fragments derived from pre-existing rocks and transported individually for some distance from their place of origin

Conglomerate A coarse-grained sedimentary rock composed of rounded clasts (pebbles, cobbles, boulders) set in a finer-grained matrix of sand, silt or clay and commonly consolidated by a natural cement

Crinoid Marine animal of the Phylum Echinodermata, characterised by having a subspherical body enclosed by calcareous plates (calyx) and bearing five 'arms', commonly branching and extending radially about the mouth. Most crinoids have a stem composed of platy vertebrae. The dissociated stem fragments (ossicles) are very common in some of the Carboniferous limestones

Cross-stratified Refers to a series of beds deposited at an angle to the original depositional surface as a result of wind or water building the loose grains into ripples, dunes, bars, etc.

Diachronous Refers to beds of rock or sedimentary formations which appear to be continuous but which in fact represent the development of the same rock type at different places at different times

Diorite A coarsely crystalline igneous rock consisting essentially of plagioclase feldspar and ferromagnesian minerals. Quartz may be present.

Down-the-hole hammer A hard-rock drill whose compressed air-powered piston immediately follows the drill bit and causes it to batter the strata to be penetrated. The system is automatic and not directly controlled from the surface.

Escarpment A more or less continuous inland cliff or steep slope (the Scarp) formed by the erosion of inclined strata and generally marking the outcrop of a resistant rock layer occurring in a series of softer strata. The feature may also be produced as the direct result of a fault.

Evaporite A sedimentary rock composed principally of minerals concentrated and precipitated from solution by the continual evaporation of the solvent (usually water).

Facies The sum of all the primary lithological and palaeontological features which characterise a sedimentary rock as having been deposited in a given environment.

Fining-upward cycle A sequence of sediments which change their character by becoming progressively finer-grained from the base to the top of the sequence and are succeeded by an abrupt return to a coarser sediment at the base of the next cycle. The fining-upward cycle is common in river-deposited sediments, amongst others.

Formation The primary unit in lithostratigraphy, consisting of a succession of strata useful for mapping or description. Formations may be combined into groups or subdivided into members.

Graben An elongate trough of rocks downthrown, relative to the rocks on either side, along subparallel faults.

Horst A block of the Earth's crust that has been uplifted, relative to the rocks on either side, along subparallel faults.

Inselberg A steep-sided remnant hill, isolated by the erosion of the surrounding area into a nearly-level plain out of which the inselberg rises abruptly. A feature typical of arid and semi-arid regions.

Lithology A term usually applied to sedimentary rocks referring to their general, physical and textural characteristics. (Hence: lithological).

Lithostratigraphy The study and classification of sedimentary rocks and their subdivisions based on their physical or petrographic features. (Hence: lithostratigraphical, lithostratigraphically).

Mode The unit along a scale (here size intervals) which occurs most frequently when a group of samples is analysed. A bimodal distribution occurs when the results for the samples analysed show two separate modes on the same scale.

Palynology The study of pollen and other plant spores and their distribution through geological time.

Phenocrysts Relatively large crystals set in the finer-grained groundmass of an igneous rock.

Playa lake A shallow, intermittent lake in an arid region, often extensive in the wet season but drying up in summer to leave thinly stratified sheets of sand, silt, clay or evaporites.

Porphyry A medium-grained igneous rock containing phenocrysts of any mineral. The name of the phenocryst mineral is commonly used as a prefix. (Hence: quartz-porphyry).

Pseudomorph One mineral occurring in the crystal form of another mineral which it has replaced.

Quartzite A very hard sandstone consisting principally of quartz grains that have been completely and solidly cemented with secondary silica so that the original pore spaces are entirely filled. The rock being now hard and homogeneous, will tend to fracture across and through the original grains rather than round them.

Solifluction (or solifluxion) A slow downhill movement of a mass of soil and loose rock as a result of the alternate freezing and thawing of the water contained within it.

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INSTITUTE OF GEOLOGICAL SCIENCES

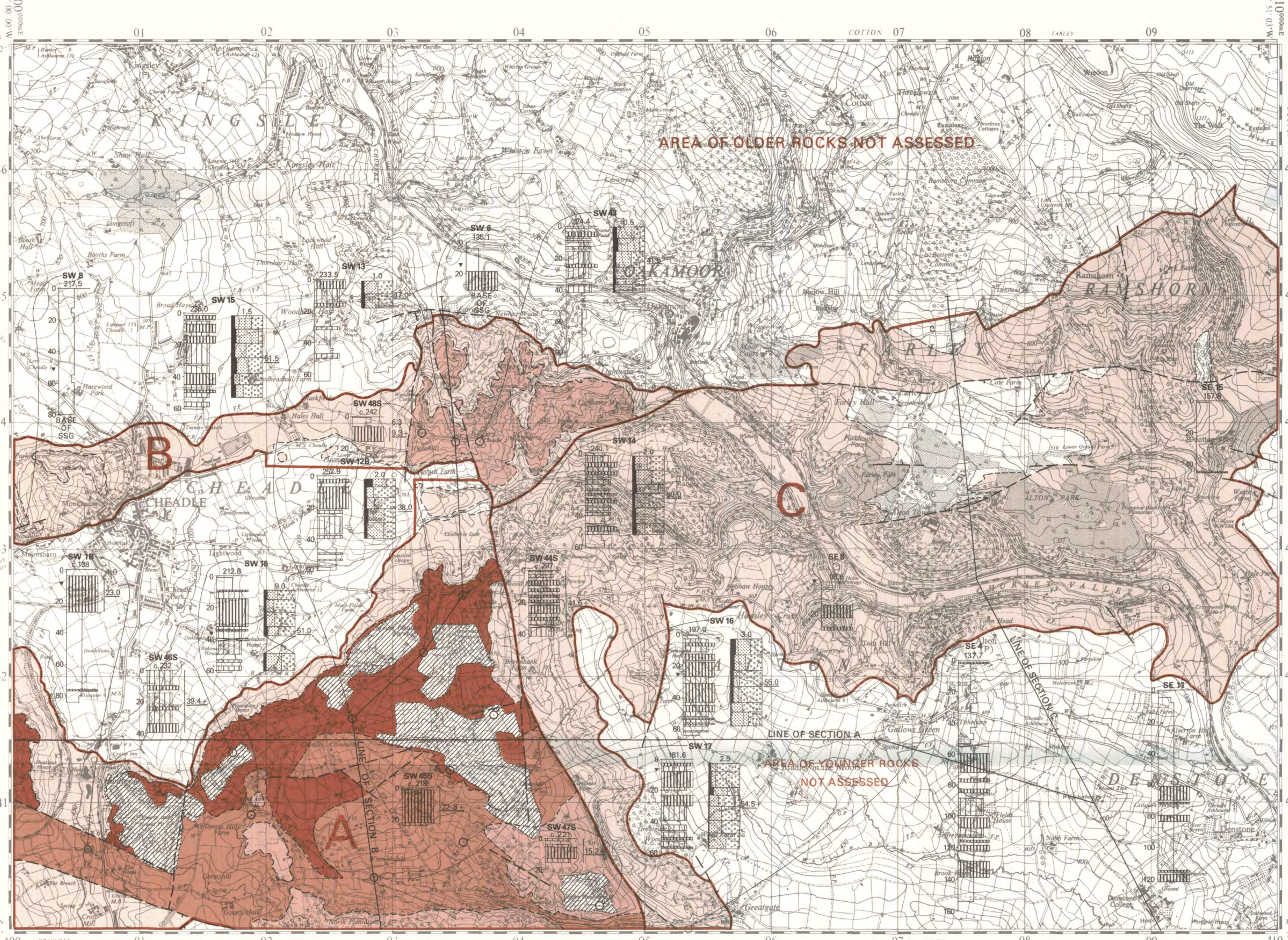
INDUSTRIAL MINERALS ASSESSMENT UNIT

THE CONGLOMERATE RESOURCES OF THE SHERWOOD SANDSTONE GROUP OF THE COUNTRY AROUND CHEADLE, STAFFORDSHIRE

THE RESOURCE MAP

Scale 1:25 000 or about 2½ Inches to 1 Mile

ORDNANCE SURVEY
PART OF SHEET SK 04
PROVISIONAL EDITION



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R.G. Thurrell, Head, Industrial Minerals Assessment Unit.
1:25 000 Conglomerate Resource Sheet published 1980.
G.M. Brown, D.Sc., F.R.S., Director, Institute of Geological Sciences

Data quoted for an individual borehole refer strictly to that site; reliable conclusions cannot be drawn about the thickness and grading elsewhere in the deposit, particularly in material as variable as sand and gravel. However, estimates of the volume and mean grading of the mineral as a whole in each Resource Block are given in the Report.

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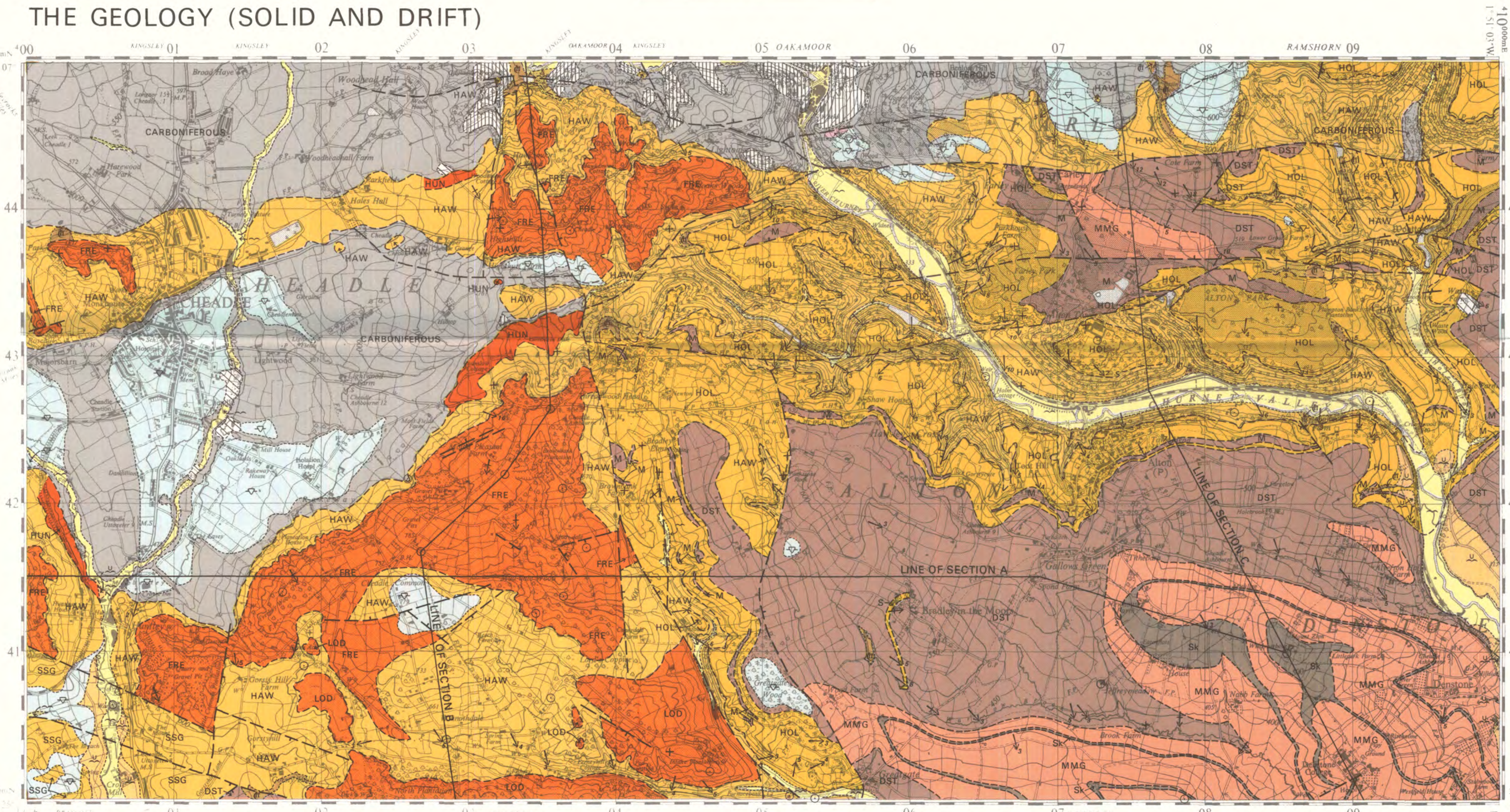
THE GEOLOGY (SOLID AND DRIFT)



Scale 1:25 000

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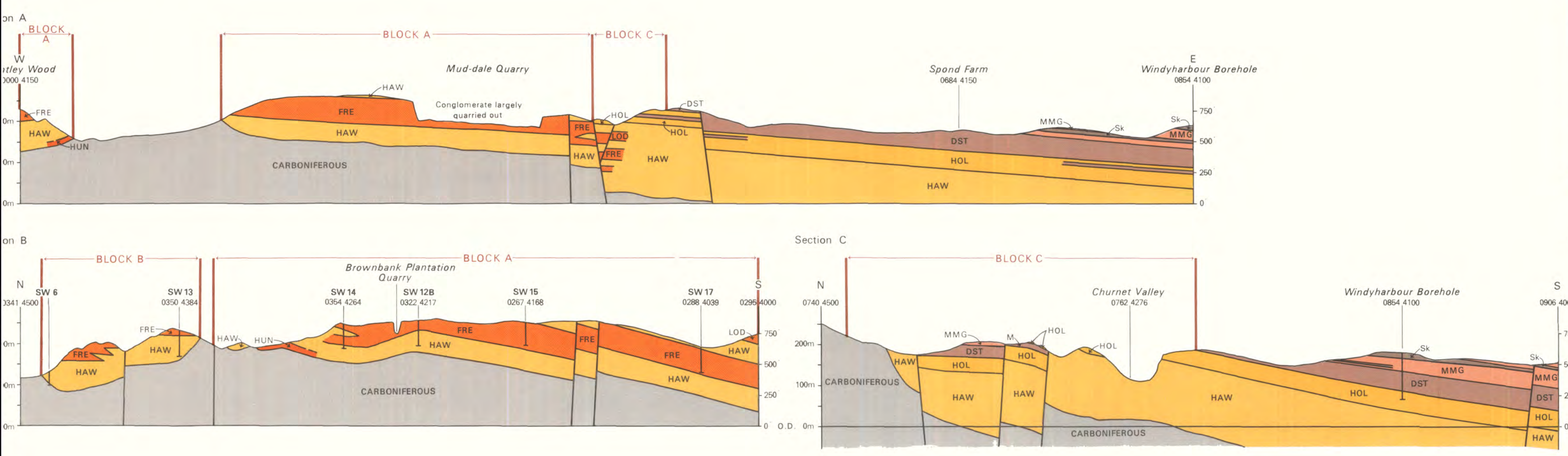
HORIZONTAL SECTIONS

Horizontal Scale 1:25 000
Vertical Scale 3 × horizontal scale



THE CONGLOMERATE RESOURCES OF THE SHERWOOD SANDSTONE GROUP OF THE COUNTRY AROUND CHEADLE, STAFFORDSHIRE

57

This map should be read in conjunction with the accompanying Report which contains details of the assessment of resources

EXPLANATION OF SYMBOLS AND ABBREVIATIONS (RESOURCE MAP)

CATEGORIES OF DEPOSITS

- Exposed mineral, generally greater than 25m. thick. CAT- CON1
- Mineral, generally greater than 25m. thick beneath overburden. CAT- CON6
- Exposed mineral, generally less than 25m. thick. CAT- CON2
- Exposed Sherwood Sandstone Group rocks, generally barren. CAT- CON 7
- Rocks other than the Sherwood Sandstone Group. CAT- CON5
- Areas worked for conglomerate. WG-12

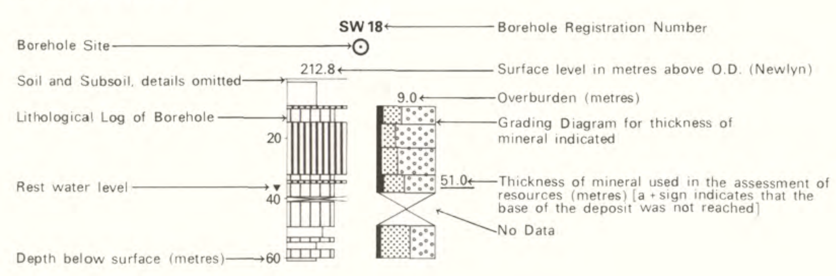
CAPTURE Geological Boundary, Solid and Faults and Resource Block Boundar[y]

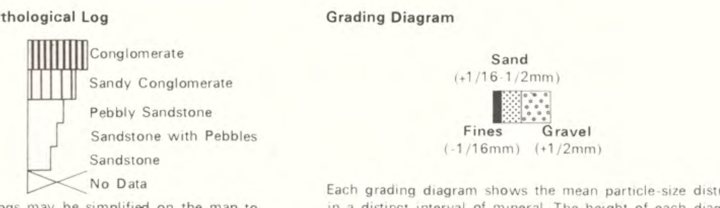
BOREHOLE DATA

SITE LOCATIONS

- Industrial Minerals Assessment Unit (I.M.A.U.) Boreholes and Sections
- Other Boreholes

I.M.A.U. BOREHOLES





Logs may be simplified on the map to omit small scale lithological changes. The detailed logs appear in the Report.

Each grading diagram shows the mean particle-size distribution in a distinct interval of mineral. The height of each diagram is proportional to the thickness of each interval, while the widths of the divisions show the proportions of **Fines, Sand** and **Gravel**.

Borehole Registration Number

Each I.M.A.U. borehole is identified by a Registration Number, e.g. SW 18. The letters refer to the quarter sheet and the figures to the I.G.S. serial number for that quarter. The unique designation for borehole SW 18 is SK 04 SW 18. Sections are registered in the same series, suffixed by the letter S.

OTHER BOREHOLES

The layout of information is the same as for I.M.A.U. boreholes, although data available may not be as comprehensive. They are registered in the same series.

RESOURCE BLOCKS

For the purpose of assessment; the Sherwood Sandstone Group outcrop is divided into Resource Blocks (see Report). Each is designated by a letter.

Resource Block boundary

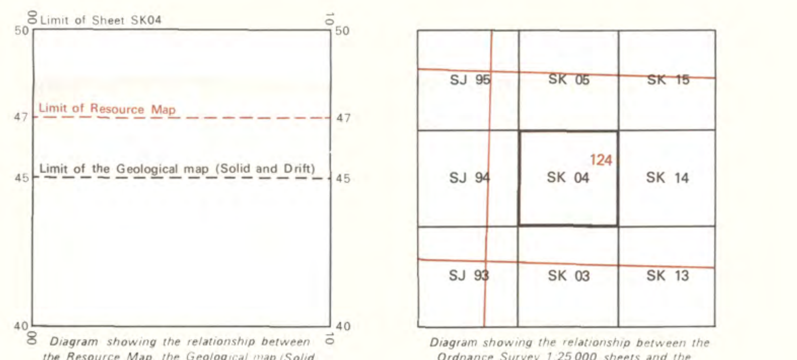


Diagram showing the relationship between the Resource Map, the Geological map (Solid and Drift) and the Ordnance Survey 1:25 000 sheet SK04

Diagram showing the relationship between the Ordnance Survey 1:25 000 sheets and the 1:50 000 New Series Geological Sheet 124 (Ashbourne)

EXPLANATION OF SYMBOLS AND ABBREVIATIONS (GEOLOGY)

Landslip

DRIFT (QUATERNARY)

- Peat
- Alluvium
- Alluvial Fan
- River Terrace Deposits, undifferentiated
- Head
- Glacial Sand and Gravel
- Till (Boulder Clay)

SOLID (TRIASSIC)

- MMG Mercia Mudstone Group
- Sk Skerry in Mercia Mudstone Group
- DST Denstone Formation
- S Sandstone in Denstone Formation
- HOL Hollington Formation
- M Mudstone in Hollington Formation
- SSG Sherwood Sandstone Group, undifferentiated
- HAW Hawksmoor Formation
- LOD Lodgedale Member
- FRE Freehay Member
- HUN Huntley Formation

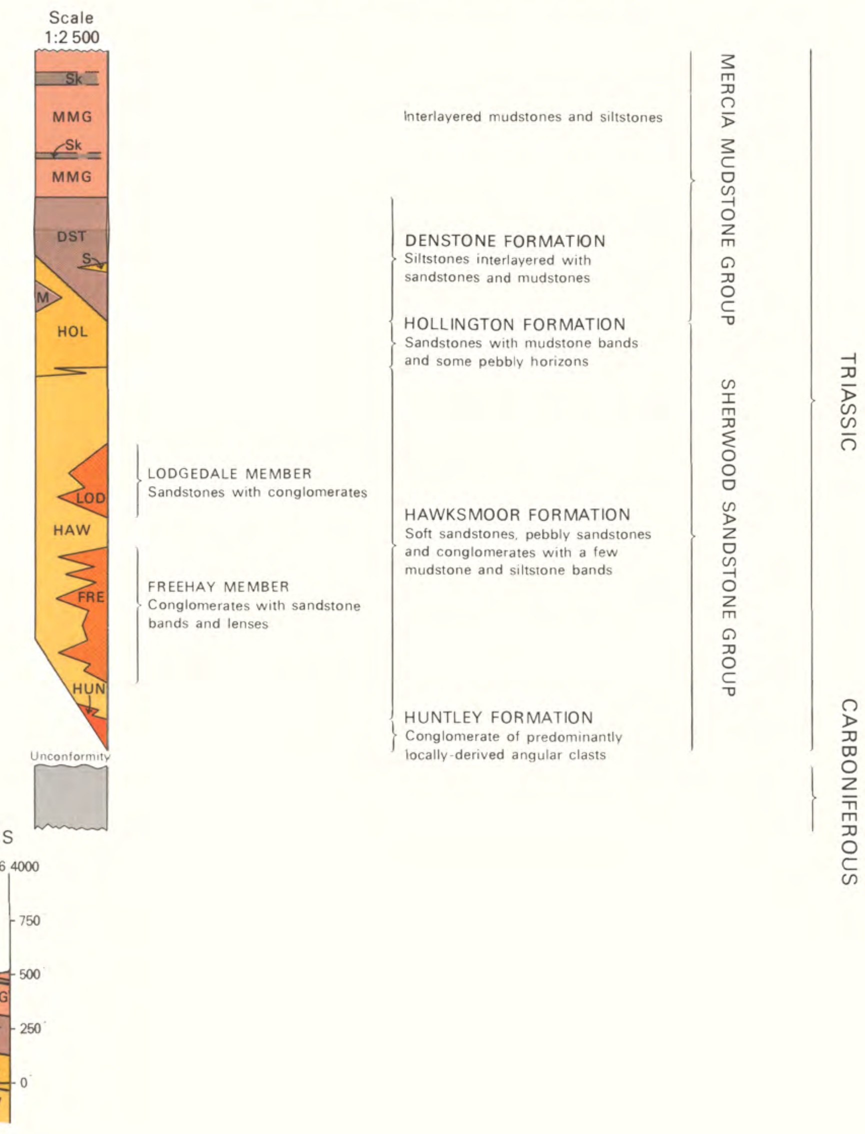
See also Generalized Vertical Section

- Horizontal strata
- Gently inclined strata
- Inclined strata, dip in degrees
- Geological boundary, Drift
- Geological boundary, Solid
- Fault at surface, crossmark indicates downthrow side

Broken lines denote uncertainty

- Borehole
- Made Ground

GENERALIZED VERTICAL SECTION



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INDUSTRIAL MINERALS ASSESSMENT UNIT

THE CONGLOMERATE RESOURCES OF THE SHERWOOD SANDSTONE GROUP OF THE COUNTRY AROUND CHEADLE, STAFFORDSHIRE

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Scale 1:25 000 or about $2\frac{1}{2}$ Inches to 1 Mile

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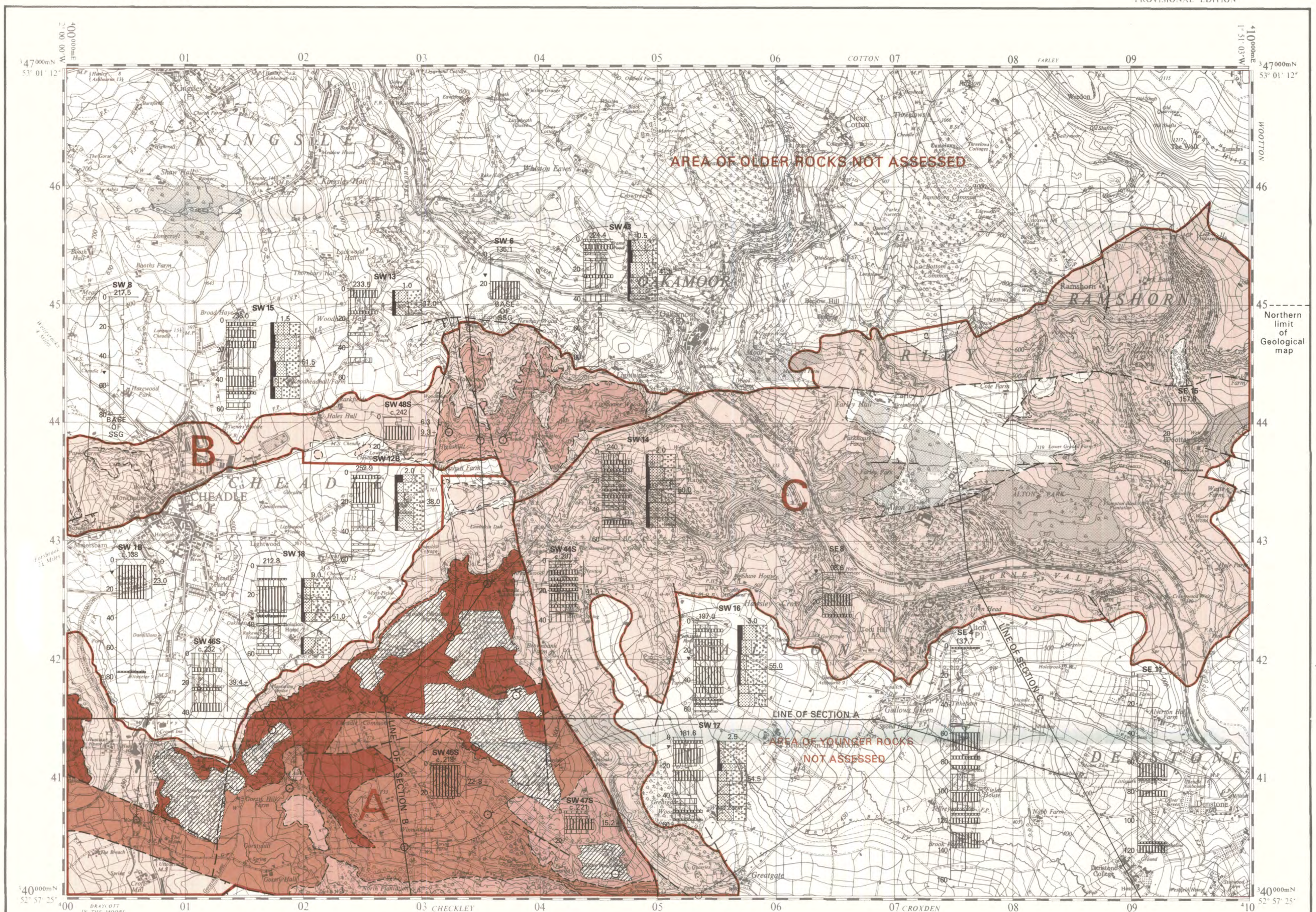

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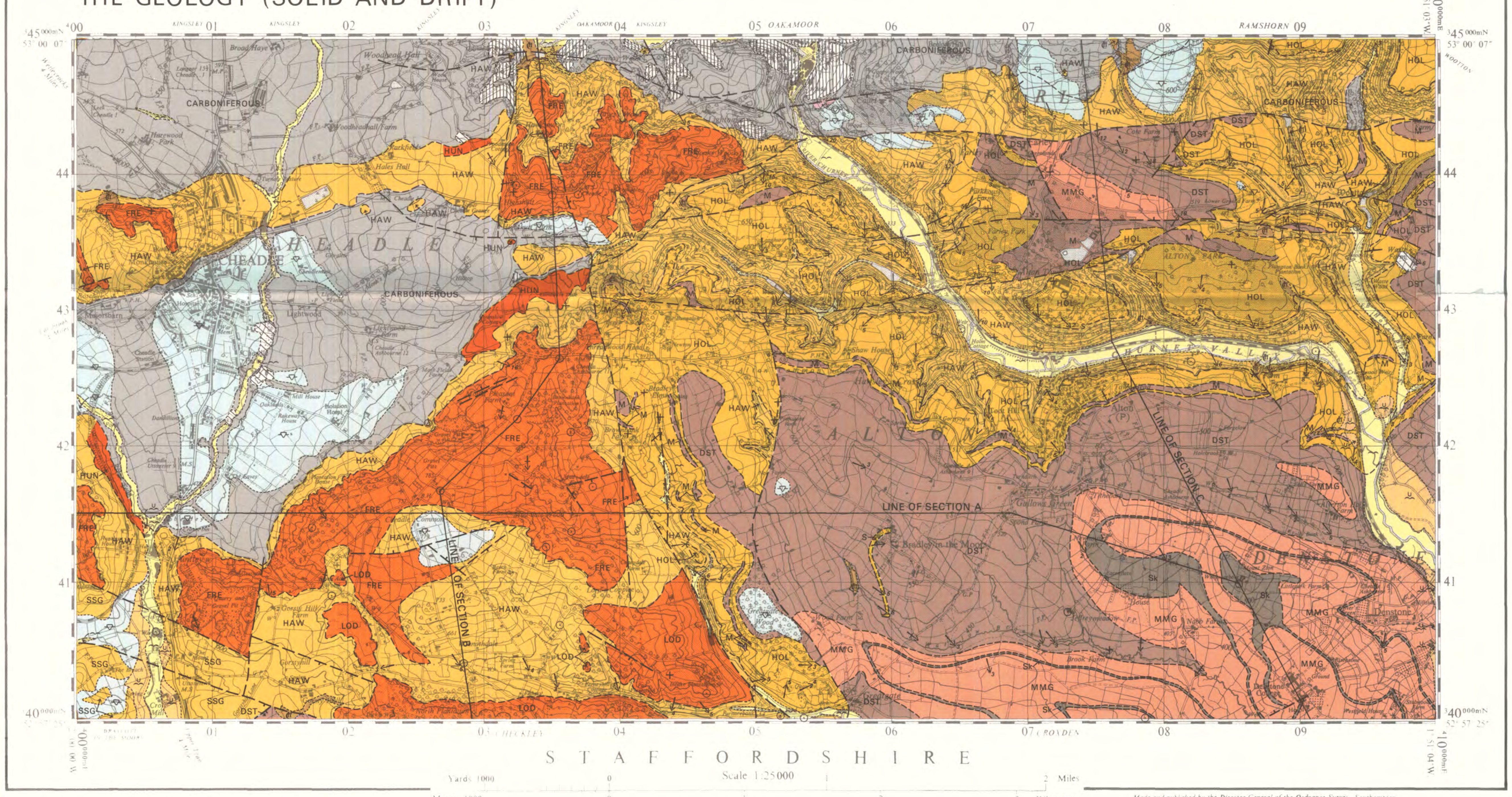

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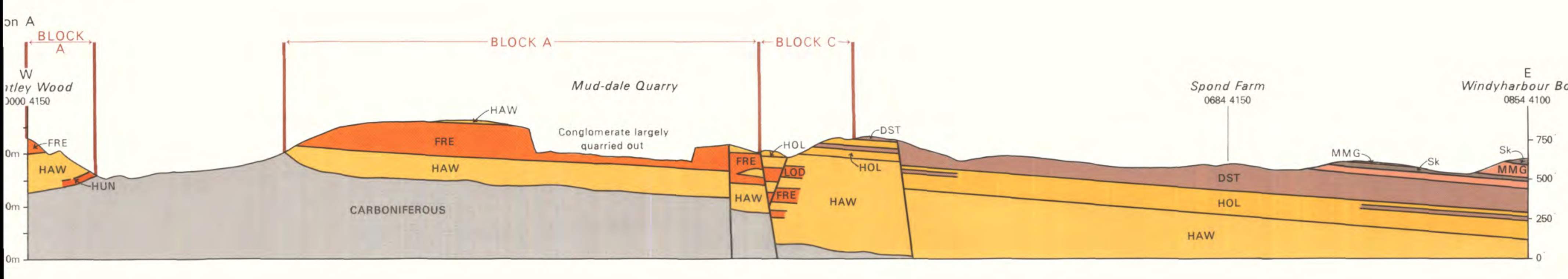

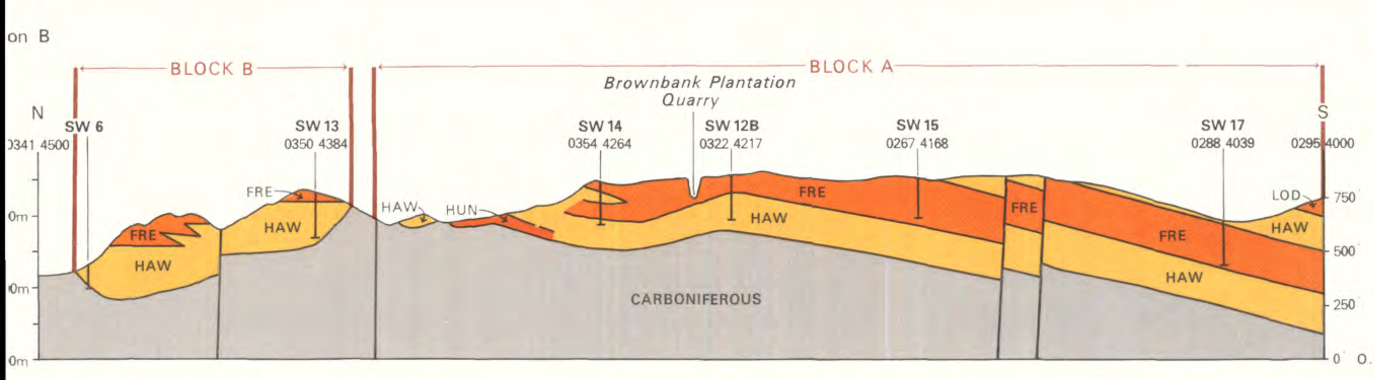

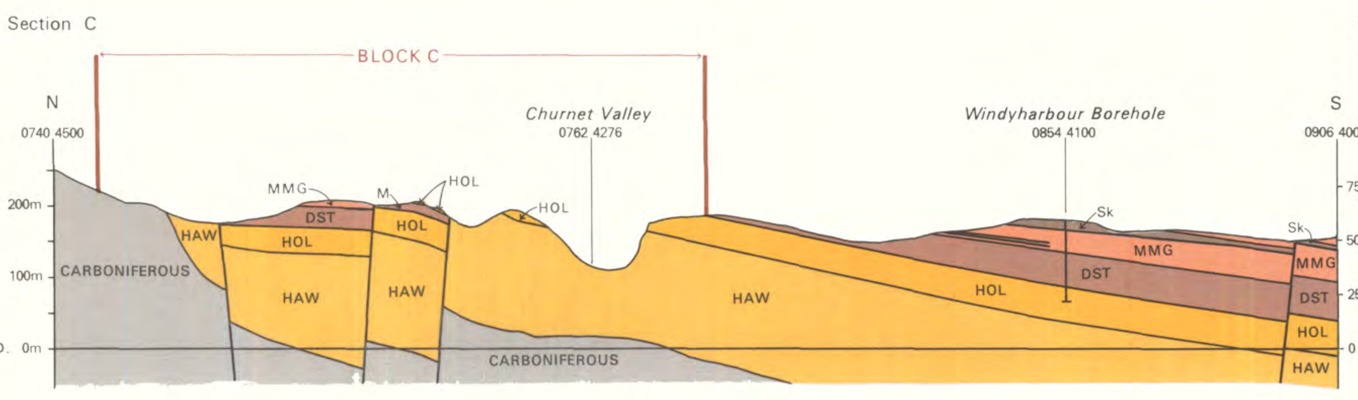

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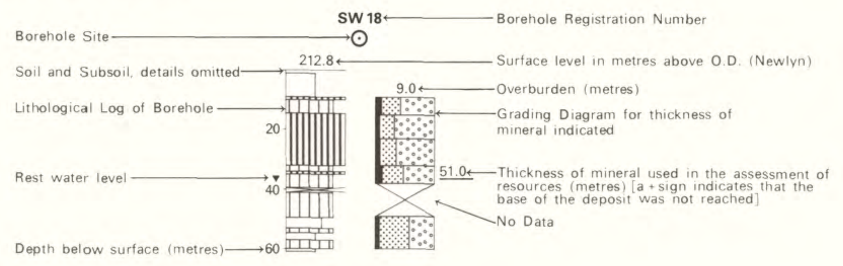

Lithological Log

Conglomerate
Sandy Conglomerate
Pebbly Sandstone
Sandstone with Pebbles
Sandstone
No Data

Logs may be simplified on the map to omit small scale lithological changes. The detailed logs appear in the Report.

Grading Diagram

Sand (+1/16-1/2mm)
Fines (-1/16mm)
Gravel (+1/2mm)

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For the purpose of assessment; the Sherwood Sandstone Group outcrop is divided into Resource Blocks (see Report). Each is designated by a letter.

Resource Block boundary

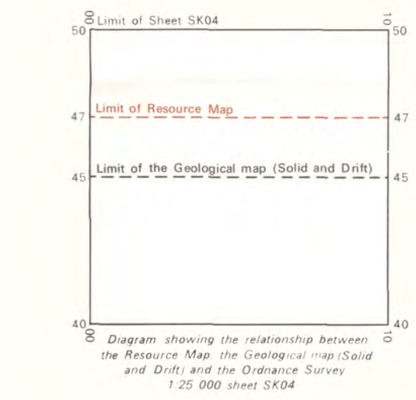

Diagram showing the relationship between the Resource Map, the Geological map (Solid and Drift) and the Ordnance Survey 1:25 000 sheet SK04

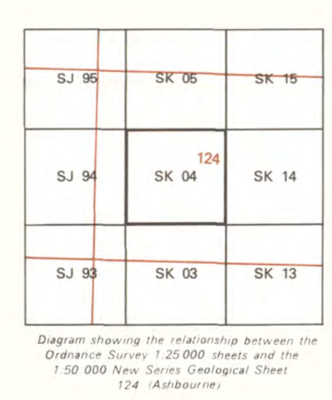

Diagram showing the relationship between the Ordnance Survey 1:25 000 sheets and the 1:50 000 New Series Geological Sheet 124 (Ashbourne)

EXPLANATION OF SYMBOLS AND ABBREVIATIONS (GEOLOGY)

Landslip

DRIFT (QUATERNARY)

- Peat
- Alluvium
- Alluvial Fan
- River Terrace Deposits, undifferentiated
- Head
- Glacial Sand and Gravel
- Till (Boulder Clay)

SOLID (TRIASSIC)

MMG	Mercia Mudstone Group
Sk	Skerry in Mercia Mudstone Group
DST	Denstone Formation
S	Sandstone in Denstone Formation
HOL	Hollington Formation
M	Mudstone in Hollington Formation
SSG	Sherwood Sandstone Group, undifferentiated
HAW	Hawksmoor Formation
LOD	Lodgedale Member
FRE	Freehay Member
HUN	Huntley Formation

See also Generalized Vertical Section

- Horizontal strata
- Gently inclined strata
- Inclined strata, dip in degrees
- Geological boundary, Drift
- Geological boundary, Solid
- Fault at surface, crossmark indicates downthrow side

Broken lines denote uncertainty

- Borehole
- Made Ground

GENERALIZED VERTICAL SECTION

Scale 1:2 500

MERCIA MUDSTONE GROUP — TRIASSIC

Interlayered mudstones and siltstones

DENSTONE FORMATION
Siltstones interlayered with sandstones and mudstones

HOLLINGTON FORMATION
Sandstones with mudstone bands and some pebbly horizons

SHERWOOD SANDSTONE GROUP

LODGEDALE MEMBER
Sandstones with conglomerates

HAWKSMOOR FORMATION
Soft sandstones, pebbly sandstones and conglomerates with a few mudstone and siltstone bands

FREEHAY MEMBER
Conglomerates with sandstone bands and lenses

HUNTLEY FORMATION
Conglomerate of predominantly locally-derived angular clasts

CARBONIFEROUS