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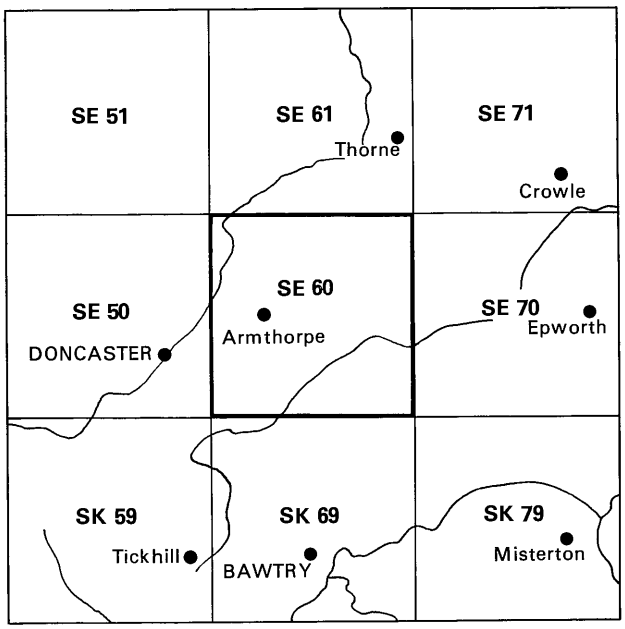

The sand and gravel resources of the country around Armthorpe, South Yorkshire

Description of 1:25 000 resource sheet SE 60

D. Price and D. P. Best

Contributor
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The first twelve reports on the assessment of British sand and gravel resources appeared in the Report Series of the Institute of Geological Sciences as a subseries. Report No. 13 and subsequent reports appear as Mineral Assessment Reports of the Institute.

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 large that stocktaking appears unnecessary, but the demand for minerals and for land for all purposes is intensifying and it has become increasingly clear in recent years that regional 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 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 describes the sand and gravel resources of the area around Armthorpe, east of Doncaster, South Yorkshire, shown on the accompanying 1:25 000 resource map SE 60. The survey was conducted by Mr D. P. Best, assisted in the supervision of drilling and sampling by Miss L. M. Cooper. The work is based on a six-inch scale geological survey carried out in 1963-64 by Dr G. D. Gaunt, who has contributed the section on the geology of the district.

Mr J. W. Gardner, CBE (Land Agent) was responsible for negotiating access to land for drilling. The ready cooperation of landowners and tenants in this work is gratefully acknowledged.

G. M. Brown
Director

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SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 73 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the country around Armthorpe, South Yorkshire.

All the deposits in the district that might be potentially workable for sand and gravel have been investigated and a simple statistical method has been used to estimate the volume. The reliability of the volume estimates is given at the symmetrical 95 per cent probability level.

The assessed area is divided into six resource blocks, containing between 7.2 and 12.5 km^2 of sand and gravel. For each block the geology of the deposits is described, and the mineral-bearing area, the mean thickness of overburden and mineral and the mean gradings are stated. Detailed borehole data are also given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying map.

Notes

Each borehole registered with the Institute is identified by a four-element alphanumeric descriptor (e.g. SE 60 NW 27). The first two elements define the 10-km square (of the National Grid) in which the borehole is situated; the third element defines a quadrant of that square, and the fourth is the accession number of the borehole. In the text of the report the borehole is normally referred to by the last two elements alone (e.g. NW 27).

All National Grid references in this publication lie within the 100-km square SE unless otherwise stated. Grid references may given to eight figures, accurate to within 10 m, or, for less precise locations, such as for quarries, to six figures, accurate to within 100 m.

Bibliographical reference

PRICE, D. and BEST, D. P. 1982. The sand and gravel resources of the country around Armthorpe, South Yorkshire: description of 1:25 000 resource sheet SE 60. **Miner. Assess. Rep. Inst. Geol. Sci.**, No. 92.

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INTRODUCTION

The survey is concerned with the estimation of resources, which include deposits that are not currently exploitable but have a foreseeable use, rather than reserves, which can only be assessed in the light of current, locally prevailing, economic considerations. Clearly, neither the economic nor the social factors used to decide whether a deposit may be workable in the future can be predicted; they are likely to change with time. Deposits not currently economically workable may be exploited as demand increases, as higher-grade or alternative materials become scarce, or as improved processing techniques are applied to them. The improved knowledge of the main physical properties of the resource and their variability, which this survey seeks to provide, will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971, 1981; Harris and others, 1974).

The survey provides information 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 the industry. However, the information provided by this survey should assist in the selection of the best targets for such further work. The following arbitrary physical criteria have been adopted:

a The deposit should average at least 1 m in thickness.

b The ratio of overburden to sand and gravel should be no more than 3:1.

c The proportion of fines (particles passing a 0.063-mm B.S. sieve) should not exceed 40 per cent.

d The deposit should lie within 25 m of the surface, this being taken as the likely maximum working depth under most circumstances. It follows from the second criterion that boreholes are drilled no deeper than 18 m if no sand and gravel has been proved.

A deposit of sand and gravel that broadly meets these criteria is regarded as 'potentially workable' and is described and assessed as 'mineral' in this report. As the assessment is at the indicated level, parts of such a deposit may not satisfy all the criteria.

Pre-Pleistocene rocks, which are usually consolidated and devoid of potentially workable sand and gravel, are referred to as 'bedrock'; 'waste' is any material other than bedrock or mineral; 'overburden' is waste that occurs between the surface and an underlying body of mineral.

For the purposes of this survey, the unconsolidated, friable parts of the Sherwood (Bunter) Sandstone occurring beneath superficial sand and gravel deposits have been taken to be mineral; the remainder of the Sherwood (Bunter) Sandstone has not been assessed.

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale 1/16 mm, ¼ mm, 1 mm, 4 mm, 16 mm, 64 mm has been adopted. The boundaries between fines (that is, the clay and silt fractions) and sand, and

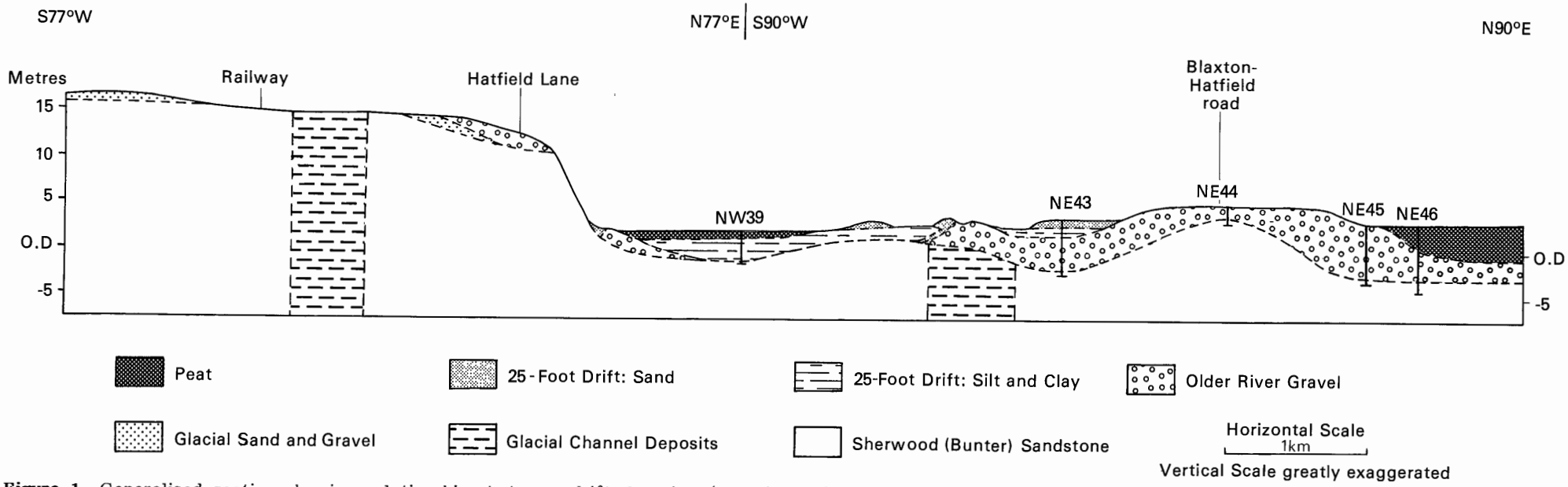


Figure 1 Generalised section showing relationships between drift deposits. (The lines of section are drawn on the resource map).

between sand and gravel material, are placed at 1/16 mm and 4 mm respectively (see Appendix C).

The volume and other characteristics are assessed within resource blocks, each of which, ideally, contains approximately 10 km^2 of sand and gravel. No account is taken of any factors, for example roads, villages or land of high agricultural or landscape value, which might stand in the way of sand and gravel being exploited, although towns are excluded. The estimated total volume therefore bears no simple relationship to the amount that could be extracted in practice.

It must be emphasised that the assessment applies to the resource block as a whole; valid conclusions cannot be drawn about mineral in parts of a block, except in the immediate vicinity of the actual sample points.

GENERAL AND TOPOGRAPHY

The area assessed lies to the east of Doncaster and includes some of the rapidly spreading suburbs of that industrial town. The village of Armthorpe has expanded close to Markham Main Colliery, and Dunscroft, to the west of the medieval market town of Hatfield, has developed in response to the needs of Hatfield Main Colliery just to the north.

Much of the non-urban area is intensely cultivated, yielding cereal, root and 'green' vegetable crops, in places with the aid of irrigation. There are extensive past and present sand and gravel workings in the area, notably around Dunsville, Holme Wood, Aukley and Blaxton Common. Peat was formerly extracted east of Lindholme Airfield but present-day workings are located further east. Glass is produced at Kirk Sandall but the major industrial sites of the district lie in the Don valley to the west.

The M18 motorway, linking the M1, the A1 (M) and the M62, crosses the district, as does the A18 (T) from Doncaster to Scunthorpe and Grimsby. Both these roads cross the A614 (T) which runs southward to Bawtry and the A1 (T).

The area is one of low relief, rising to over 25 ft (7.6 m) above OD only around Hatfield and in the western parts; appreciable stretches of ground in the east are lower than 15 ft (5 m) above OD.

The River Don crosses the north-west corner of the area but its drainage is only of local significance. Artificial drains serve the central and north-eastern parts, ultimately flowing via the River Torne, draining the south of the area, into the River Trent.

GEOLOGY

The geological deposits found at and near surface in the area are listed in Table 1 and the relationships between them are shown in Figure 1.

Table 1 Geological sequence.

DRIFT	
Quaternary	Alluvium
	Peat
	Blown Sand
	25-Foot Drift of Vale of York
	Head
	Older River Gravel
	Glacial Sand and Gravel
	Boulder Clay
	Glacial Channel Deposits*
SOLID	
Triassic	Sherwood (Bunter) Sandstone

* Not distinguished from Boulder Clay on the map.

Sherwood (Bunter) Sandstone Bedrock throughout the area consists of Sherwood Sandstone; it dips gently east-north-eastwards, increasing in thickness from approximately 60 m in the south-west to approximately 300 m in the north-east, and is the main aquifer in the region.

The sandstone is generally pink or brown, fine to medium-grained and commonly thickly cross-bedded, but micaceous laminae cause it to be fissile in places. Much of it is friable, even at depth, and near the surface it becomes largely unconsolidated. Quartzite pebbles, common in the Pebble Beds farther south, are rare in the area, but thin lenses and rolled fragments of red or green mudstone are present in places within the sandstone.

Glacial Channel Deposits Although shown on the geological map as 'Boulder Clay', these deposits consist mainly of virtually stoneless laminated clay, with sand and gravel at depth in places. They occupy four channels incised to considerable depths in the Sherwood Sandstone, and orientated WNW-ESE. The most northerly channel passes south of Thorpe Marsh Power Station and beneath Barnby Dun (where it reaches a depth of 58 m below OD), continuing to the south of Dunsville and under Huggin Carr. The second channel runs south of Long Sandall (where it reaches 42 m below OD) and under Shaw Wood and Armthorpe in the direction of Thornham Farm [654 034]. The third runs from a locality [600 043] south of Wheatley Hills, passing to the south of Sandall Beat Wood, and the fourth is present to the west and south of Bessacarr Grange [627 007]. Other similar channels may exist in the area, concealed beneath younger deposits.

These channels and the deposits occupying them are believed to result from sub-glacial drainage during a pre-Devensian glacial episode (Gaunt and others 1972, p. 3).

Boulder Clay Small deposits of boulder clay are present in the western part of the area. At Edenthorpe [620 063] up to 0.8 m has been seen in an excavation and boreholes indicate that up to 3.0 m is present beneath adjacent Older River Gravel. Boulder clay south-west of Armthorpe may overlie adjacent glacial channel deposits, and thin boulder clay appears to rest on glacial channel deposits (and to pass under adjacent Glacial Sand and Gravel) south-west of Bessacarr Grange.

Glacial Sand and Gravel Deposits mapped as Glacial Sand and Gravel occur in three localities. On the higher ground in the south-western part of the area sand and gravel up to 4 m thick and generally more than 15 m above OD contains pebbles which are mainly of quartzite derived from the Sherwood Sandstone, with small numbers of Carboniferous sandstone and flint pebbles. This deposit, which is partly cross bedded, rests locally on glacial channel deposits and probably also on boulder clay. Associated deposits to the south are interpreted as fluvio-glacial sediments "transported from the Midlands by northward-flowing meltwater during the Wolstonian glaciation" (Gaunt and others, 1972, p. 3).

The Glacial Sand and Gravel west of Armthorpe is possibly up to 7 m thick. It is similar to the deposit described above in elevation and stratigraphical relationships, but the contained pebbles are principally of Carboniferous sandstone, with only minor proportions of quartzite pebbles, and rare flints. On this evidence the deposit is considered to be pre-Devensian fluvio-glacial sediment transported from the west.

The small outcrop [694 099] of Glacial Sand and Gravel north of Ferne Carrs in the north-east of the area consists of sand with minor gravel beds containing pebbles of Carboniferous sandstone and of Permian limestone. It rests on Older River Gravel and is believed to have been deposited by ice in Devensian Lake Humber (Gaunt, 1976).

Older River Gravel Much of the area between about 5 and 12 m above OD is mantled by flattish spreads of sand

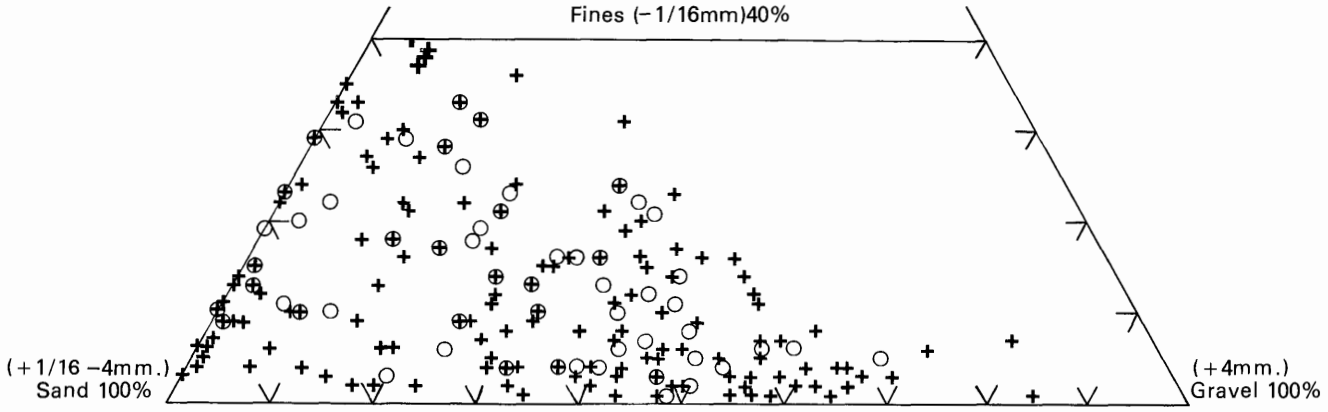


Figure 2 Variation in mechanical composition of the Older River Gravel. Each cross represents the grading of an individual sample; circles show the mean grading of the whole of the deposit in IMAU boreholes.

and gravel. These deposits, which exhibit low-angle cross bedding, are possibly up to 6 m thick. There is a distinct variation in their composition across the area. In the south-east the pebbles are mainly of quartzite from the Sherwood Sandstone with minor proportions of pebbles of Carboniferous sandstone and of flint, and the sand is red-brown and relatively clean. Toward the north-west the pebbles are mainly of Carboniferous sandstone. Here the sand is yellowish brown, contains detrital coal and is locally clayey. The deposits rest in places on glacial channel deposits and on boulder clay. Two fossiliferous beds diagnostic of interglacial environments have been found in these and adjacent deposits (Gaunt and others, 1972; 1974), and the entire complex is believed to be largely of fluvial origin and derived from the south and west during the Ipswichian interglacial.

Head Solifluction deposits, varying from silty sand to sandy clay and locally containing pebbles, occur in gentle valleys and depressions east of Barnby Dun, south of Armthorpe, east and south of Cantley and at other scattered localities. They are probably not more than 2 m thick.

25-Foot Drift of the Vale of York Bedded fine-grained sands and laminated clays up to 5 m thick occupy much of the lower ground. Clay forms the bulk of these deposits with sands at the base, around the margins and locally as thin spreads at the top. They occupy a wide irregular channel incised into Older River Gravel and Sherwood Sandstone running from Doncaster Race Course north-eastwards towards Hatfield Woodhouse. They are present also in the West Moor depression, in other low-lying localities towards the east (where they pass under the peat on Hatfield Moors) and under the alluvium of the River Don in the north-west. Most of these sands and clays are believed to have formed in the Devensian Lake Humber (Gaunt and others, 1971; Gaunt, 1974).

Blown Sand Small patches of blown sand generally less than 2 m thick, forming undulating ground, in places with incipient dunes, are present to the east and south of Hatfield Woodhouse and alongside the River Torne. They overlie the 25-Foot Drift locally and in many places pass beneath peat. Their formation can be attributed to an intense aeolian phase during terminal Devensian times (Gaunt and others, 1971).

Peat The western part of the raised bog of Hatfield Moors extends along the eastern edge of the area. It consists largely of sphagnum peat up to 4 m thick, strongly humified at depth, and has been extensively worked. According to Smith (1958) it was initiated as a blanket bog in early Atlantic (early Zone VIIa) times. Smaller and thinner deposits are present elsewhere, notably in the West Moor depression, on Potteric Carr in the south-western part of the area, and flanking the River Torne.

Alluvium The floodplain deposits of the River Don in the north-west are formed mainly of grey clay, locally silty and peaty, with sand at depth and a thin basal gravel in places. They occupy a deeply incised channel and are possibly up to 12 m thick under Thorpe Marsh Power Station. Alluvial clays are also present in the extreme north-east (forming part of Hatfield Chase across which the south branch of the River Don meandered prior to the Vermuyden drainage in the 1620's), on Potteric Carr in the south-west and locally adjacent to the more eastern part of the River Torne.

COMPOSITION OF THE SAND AND GRAVEL DEPOSITS

There are five sources of potentially workable sand and gravel in the district. They are: Sherwood (Bunter) Sandstone, Glacial Sand and Gravel, Older River Gravel, 25-Foot Drift and Blown Sand. However, in places these deposits are not readily distinguished one from another and the classification assigned to the mineral may then be subject to correction.

Sherwood Sandstone This rock, up to 300 m thick, is present at the surface or beneath drift throughout the district, but only the near-surface friable and unconsolidated part, here termed 'Bunter Sand', is regarded as mineral and then only when it occurs beneath Quaternary sands and gravels and is likely to be worked with them. The base of the 'Bunter Sand' is taken at the depth below which a Standard Penetration Test gives a penetration of less than 10 cm for 50 blows of the hammer, corresponding to 'very dense soil' (Terzaghi and Peck, 1967, pp. 304, 341).

'Bunter Sand' consists typically of 'clayey' sand. Gravel is generally absent or present only in trace amounts. The sand fraction is usually fine-grained; medium sand may be dominant locally but coarse sand rarely accounts for more than about 1 per cent of the fraction. The sand grains are subangular to rounded and consist mainly of quartz with subordinate feldspar and minor proportions of rock fragments and, in places, mica.

Glacial Sand and Gravel Deposits mapped under this heading are found mainly in the unassessed urban area and no detailed information is available as to their nature. They are thought to be similar in composition to the Older River Gravel described below and are distinguished from it by topographic expression.

Older River Gravel This is areally the most extensive of the drift deposits in the district. It consists almost entirely of potentially workable sand and gravel with a mean grading of 12 per cent fines, 57 per cent sand and 31 per cent gravel. However, in addition to gravel and sandy gravel it may include beds of sand and thus exhibits considerable variation in mechanical composition (see Figure 2).

The gravel fraction, which is fine- to coarse-grained, also shows petrographic variation across the district: in the south-east it consists predominantly of well rounded quartzite and quartz derived from the 'Bunter Pebble Beds' but northwards and westwards Carboniferous-derived pebbles, principally of sandstone and ironstone, become increasingly important and commonly account for more than 50 per cent of the fraction. The sand consists largely of fine- to medium-grained quartz but in places coarse sand accounts for a large proportion of the fraction (up to 50 per cent) and there rock fragments are conspicuous. In areas which include Carboniferous-derived material, coal detritus, usually of coarse sand grade, comprises up to 1 per cent of some samples.

25-Foot Drift This group of deposits includes mineral consisting of 'clayey' to 'very clayey' sand with a mean grading of 17 per cent fines and 83 per cent sand, although bands with low fines content are locally present. The sand fraction is predominantly fine-grained quartz; up to 35 per cent of medium sand has been recorded but coarse sand nowhere accounts for more than 1 per cent of the deposit.

Blown Sand These aeolian deposits, which locally overlie the 25-Foot Drift sands, consist typically of fine-grained 'clayey' quartz sand.

THE MAP

The sand and gravel resource map is folded into the pocket at the end of this report. The base map is the Ordnance Survey 1:25 000 Outline Edition in grey, on which the geological data are shown in black and the mineral resource information in shades of red.

Geological data The geological boundaries shown are based on a six-inch survey made in 1963-64 by G D Gaunt of the Institute's Yorkshire and East Midlands Unit, published on the six-inch scale in 1969-70 and on the one-inch scale as part of geological sheet 88 (Doncaster) in 1969. These boundaries are the best interpretation of the information available at the time of survey. However, it is inevitable that local irregularities or discrepancies will be revealed by new evidence from boreholes and excavations.

Borehole data, which include the stratigraphical relations and mean particle-size analyses of the sand and gravel samples collected during the assessment, are summarised on the map.

Mineral resource information The mineral-bearing ground is divided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is exposed, that is where the overburden averages less than 1 m in thickness, and areas where it is present in continuous, or almost continuous, spreads beneath overburden.

Areas where bedrock crops out, where boreholes indicate absence of sand and gravel beneath cover and where sand and gravel beneath cover is interpreted to be not potentially workable, are uncoloured on the map; where appropriate, the relevant criterion is noted. In such cases it has been assumed that mineral is absent except in infrequent and relatively minor patches that can neither be outlined nor assessed quantitatively in the context of this survey. Areas of unassessed sand and gravel, for example in built-up areas, are indicated by a red stipple.

The area of the mineral-bearing ground is measured, where possible, from the mapped geological boundary lines. The whole of this area is considered as mineral-bearing, even though it may include small areas where sand and gravel is not present or is not potentially workable. Inferred boundaries have been inserted to delimit areas where sand and gravel beneath cover is interpreted to be not potentially workable or absent. Such boundaries (for which a distinctive zigzag symbol is used) are drawn primarily for the purpose of volume estimation. The symbol is intended to indicate an approximate location within a likely zone of occurrence rather than to represent the breadth of the zone, its size being determined only by cartographic considerations. For the purpose of measuring areas the centre line of the symbol is used.

RESULTS

The statistical results are summarised in Table 2. Fuller grading particulars are shown in Figure 3 and Tables 3 to 8.

Accuracy of results For each of the blocks, the accuracy of the results at the 95 per cent probability level (that is, on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral) varies between 27 per cent and 43 per cent. However, the true volumes are more likely to be nearer the figure estimated than either of the limits. Moreover, it is probable that roughly the same percentage limits would apply for the statistical estimate of mineral volume within a very much smaller parcel of ground containing similar sand and gravel deposits, if the results from the same number of sample points were used in the calculation. Thus, if closer limits are needed for quotation of reserves, data from more sample points would be required, even if the area were quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel in this area. The total volume (270 million m^3) can be estimated to limits of $\pm$ 14 per cent at the 95 per cent probability level by a calculation based on the data from all the sample points spread across the six resource blocks. However, it must be emphasised that the quoted volume of mineral has no simple relationship with the amount that could be extracted in practice, as no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of the land for mineral working.

NOTES ON THE RESOURCE BLOCKS

The boundary of resource block B delimits an area in which mineral is predominantly sand. Block F encompasses high-quality gravels, which are heavily exploited, and is separated from the rest of the district by the River Torne. The remaining mineral-bearing ground is subdivided to produce blocks of acceptable size with a degree of internal consistency, at least as far as thickness of potentially workable sand and gravel is concerned.

Gravel yields quoted below are rough approximations intended mainly to express the results of variation in thickness and grading. They have been calculated assuming densities of 1.46 tonnes/m^3 for gravel and 1.6 tonnes/m^3 for sand and fines. Yields are given in tonnes per hectare (t/ha) and may be converted to tons per acre by multiplying by a factor of 0.4.

Block A (Table 3)

The mineral in this irregularly-shaped block consists almost entirely of Older River Gravel and 'Bunter Sand'. Sand of the 25-Foot Drift has been mapped over a small area in the south-east but has not been investigated.

The Older River Gravel varies widely in thickness. Exceptionally, borehole NE 34 penetrated 8.6 m of the

Table 2 Statistical assessment of the sand and gravel resources of sheet SE 60.

Block	Area		Mean thickness		Volume of sand and gravel			Mean grading percentage		
	Block	Mineral	Over-burden	Mineral		Limits at the 95% probability level		Fines $-\frac{1}{16}$ mm	Sand $+\frac{1}{16}$ -4 mm	Gravel +4 mm
	km^2	km^2	m	m	$m^3 \times 10^6$	± %	± $m^3 \times 10^6$			
Block A										
Older River Gravel	13.9	7.2	0.9	2.3	17	48	8	13	65	22
Total	13.9	7.2	0.9	6.3	45	43	19	12	80	8
Block B	10.7	10.7	0.9	3.7	40	31	12	13	86	1
Block C										
Older River Gravel	12.8	12.5	2.0*	3.0	36	36	13	10	53	37
Total	12.8	12.5	1.4	5.1	64	27	17	10	69	21
Block D										
Older River Gravel	10.4	9.1	1.2*	3.2	29	25	7	10	48	42
Total	10.4	9.1	1.1	4.7	43	33	14	11	58	31
Block E										
Older River Gravel	13.8	10.7	0.8	2.1	22	40	9	17	56	27
Total	13.8	10.7	0.8	3.4	36	31	11	14	70	16
Block F	15.4	9.9	0.8	4.3	43	34	15	10	72	18

*Includes some sand.

Table 3 Block A: data from IMAU boreholes and section.

Borehole or section	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$ -$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
OLDER RIVER GRAVEL								
NW 27	2.0	4.3	31	43	21	2	3	0
NW 29	1.0	0.3	13	41	15	2	16	13
NW 30	1.0	2.6	21	45	10	2	7	15
NW 31	5.4	0.1	10	20	55	4	4	7
NW 32	0.6	0.4	17	21	36	8	12	6
NW 33	1.0	0.2	9	37	19	11	6	18
NW 35	1.9	1.4	24	30	9	5	14	18
NW 37	5.2*	0.6	5	12	19	15	19	30
NW 38	0.5	0.0	18	40	24	5	8	5
NW 40	0.7	0.3	10	23	22	14	14	17
NE 34	8.6+	0.5	6	37	27	6	14	10
SW 41	5.2	0.3	19	48	32	1	trace	0
SW 42	2.9	0.8	12	15	18	14	13	28
NW E1	2.2	0.2	3	33	42	2	7	13
TOTAL MINERAL								
NW 27	2.0	4.3	31	43	21	2	3	0
NW 29	13.0	0.3	11	60	27	trace	1	1
NW 30	15.0	2.6	10	49	39	1	trace	1
NW 31	9.4	0.1	9	30	52	3	2	4
NW 32	0.6	0.4	17	21	36	8	12	6
NW 33	5.0	0.2	14	57	21	3	1	4
NW 35	12.9	1.4	19	58	17	1	2	3
NW 37	5.7*	0.6	5	15	20	15	17	28
NW 38	3.7	0.0	11	46	40	1	1	1
NW 40	3.7	0.3	11	56	24	3	3	3
NE 34	8.6+	0.5	6	37	27	6	14	10
SW 41	5.2	0.3	19	48	32	1	trace	0
SW 42	3.2	0.8	12	18	19	13	12	26
NE E1	4.7+†	0.2	3	62	25	1	3	6

* Excluding 0.7-m waste parting.
† Excluding 0.3 m waste parting.

Table 4 Block B: data from IMAU boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
NW 34	2.8	0.9	9	49	40	1	1	0
NW 39	5.7	3.4	17	56	26	1	0	0
NW 41	4.0*	1.2	15	55	23	4	2	1
NE 31	8.6	0.5	12	62	25	trace	trace	1
NE 32	absent							
NE 33	4.0	1.0	14	58	28	trace	0	0
NE 35	5.0	0.1	18	54	23	2	1	2
NE 36	1.9	0.5	7	62	29	1	1	0
NE 37	5.5	1.0	10	56	33	1	0	0
NE 42	3.0	0.3	17	50	31	1	1	0
NE 47	3.0	2.3	11	60	29	trace	0	0
NE 48	6.0	1.3	9	50	41	trace	0	0

* Excluding 0.8-m waste parting.

Table 5 Block C: data from IMAU boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
OLDER RIVER GRAVEL								
NE 38	0.6	6.4	3	26	19	6	39	37
NE 40	4.0	1.9	4	15	22	23	18	18
NE 41	1.0	0.5	14	27	29	5	25	0
NE 44	1.2	0.4	29	43	28	trace	0	0
NE 45	2.0	0.8	25	42	27	1	1	4
	3.0		6	12	18	7	20	37
NE 46	1.0	3.0	38	39	13	4	2	4
	2.4		5	6	15	16	29	29
NE 50	3.0	3.2	5	9	22	15	23	26
NE 51	4.0	3.0	6	17	23	13	22	19
SW 18	1.0?	1.9	23	71	6	trace	0	0
SE 19	3.8	3.2	4	9	21	14	18	34
SE 24	3.0	8.4	1	18	21	23	25	
SE 25	3.7	0.5	22	56	18	1	3	0
	1.4		6	10	11	2	35	36
TOTAL MINERAL								
NE 38	5.1*	0.5	15	54	24	1	1	5
NE 40	4.0	1.9	4	15	22	23	18	18
NE 41	3.2	0.5	15	49	26	2	8	0
NE 44	1.2	0.4	29	43	28	trace	0	0
NE 45	6.6	0.8	12	29	28	4	9	18
NE 46	8.4	3.0	11	40	26	5	9	9
NE 50	5.8	3.2	5	26	29	14	13	13
NE 51	5.0	3.0	6	24	11	18	15	
SE 18	4.4	1.9	9	64	27	trace	0	0
SE 19	3.8	3.2	4	9	21	14	18	34
SE 24	8.4†	0.6	6	44	28	5	8	9
SE 25	5.1	0.5	18	44	16	1	11	10

* Excluding 3.9-m waste parting.
† Excluding 1.4-m and 1.0-m waste partings.

Table 6 Block D: data from IMAU boreholes and section.

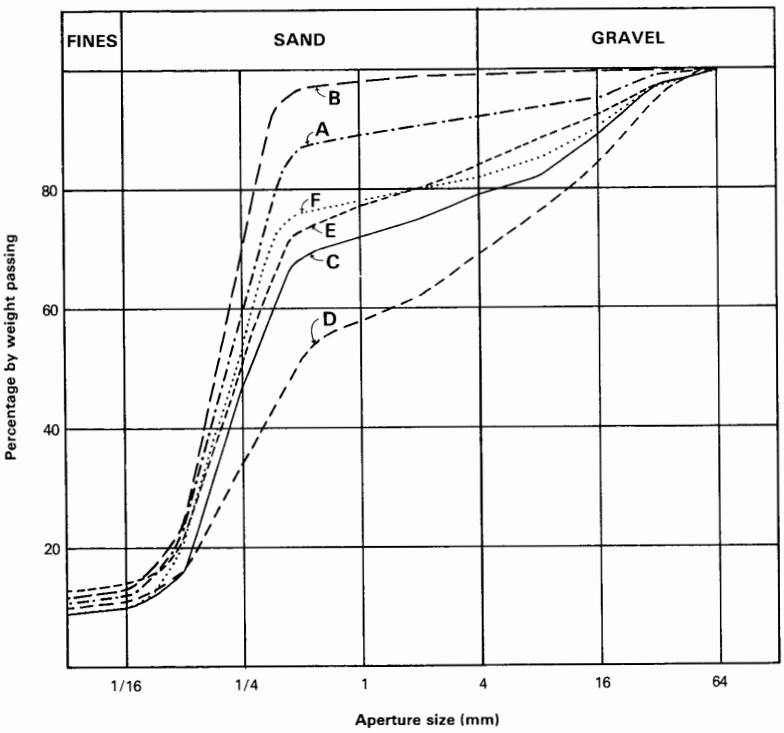
Borehole or section	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
OLDER RIVER GRAVEL								
NE 39	4.0	2.1	4	12	33	33	20	30
NE 43	3.4	1.7	4	11	24	23	24	14
NE 49	4.9	0.6	11	16	18	11	12	32
SW 46	5.0	1.5	5	5	9	14	31	36
SE 16	0.5+	2.3	27	32	31	4	3	3
SE 17	absent							
SE 20	2.8	1.3	16	19	22	13	18	12
SE 21	1.6+	0.2	22	20	19	16	18	5
SE 22	2.4	4.5	6	10	8	18	22	36
SE 26	1.8	0.0	25	35	15	6	7	12
SE 35	absent							
SE E1	4.6	0.4	13	10	23	18	23	13
TOTAL MINERAL								
NE 39	5.0	2.1	5	17	28	18	16	16
NE 43	3.4	1.7	4	11	24	23	24	14
NE 49	8.9	0.6	11	32	26	6	7	18
SW 46	5.8	1.5	5	11	14	12	27	31
SE 16	0.5+	2.3	27	32	31	4	3	3
SE 17	absent							
SE 20	2.8	1.3	16	19	22	13	18	12
SE 21	1.6+	0.2	22	20	19	16	18	5
SE 22	4.3*	1.7	14	27	14	11	13	21
SE 26	6.4	0.0	17	42	31	3	3	4
SE 35	absent							
SE E1	4.6	0.4	13	10	23	18	23	13

* Excluding 0.9-m waste parting.

Table 7 Block E: data from IMAU boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Over-burden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
OLDER RIVER GRAVEL								
SW 43	5.0	1.8	8	11	17	17	24	23
SW 44	1.0	1.5	33	40	12	3	3	9
SW 45	1.3	0.5	28	31	22	6	4	9
SW 47	0.7	2.1	16	15	23	12	13	21
SW 48	1.3	0.5	26	35	19	13	7	0
	2.0		18	14	22	15	18	13
SW 49	3.1*	0.6	22	19	14	10	11	24
SW 50	1.0?	0.7	15	36	48	trace	1	0
SW 51	3.2	0.5	19	29	20	11	12	9
SW 52	1.6	0.4	31	30	19	5	11	4
SW 53	1.1	0.6	13	45	41	1	0	0
SW 54	1.0?	0.8	13	59	25	1	2	0
SW 55	1.9	0.8	7	22	23	5	29	14
TOTAL MINERAL								
SW 43	6.0	1.8	7	15	20	18	21	19
SW 44	1.0	1.5	33	40	12	3	3	9
SW 45	2.0	0.5	22	46	17	5	3	7
SW 47	5.0	2.1	10	56	27	2	2	3
SW 48	3.3	0.5	21	22	21	14	14	8
SW 49	3.1*	0.6	22	19	14	10	11	24
SW 50	2.0	0.7	12	51	37	trace	trace	0
SW 51	5.3	0.5	17	38	24	8	8	5
SW 52	2.6	0.4	22	37	28	3	7	3
SW 53	5.7	0.6	8	45	46	1	trace	0
SW 54	1.8	0.8	13	57	28	1	1	0
SW 55	2.5	0.8	9	34	20	4	22	11

* Excluding 1.0-m waste parting.



Block	Percentage by weight					
	$-\frac{1}{16}$ mm	$+\frac{1}{16}-\frac{1}{4}$ mm	$+\frac{1}{4}$-1 mm	+1-4 mm	+4-16 mm	+16 mm
A	12	47	30	3	3	5
B	13	56	29	1	1	trace
C	10	37	25	7	10	11
D	11	23	24	11	15	16
E	14	37	26	7	8	8
F	10	43	25	4	8	10

Figure 3 Mean particle-size distributions of the mineral in the resource blocks.

deposit without bottoming it but, since the site and much of the sand and gravel around it have now been removed by motorway excavations, the result has not been used in assessing the resources of the block. Elsewhere proved thicknesses range upwards to 5.4 m and have a mean of 2.3 m. The estimated volume of this deposit is 17 million m^3 $\pm$ 48 per cent. The mean grading is 13 per cent fines, 65 per cent sand and 22 per cent gravel, but there is much lateral variation in composition: fines account for between 3 per cent and 31 per cent of the deposit; gravel content ranges from a trace to 49 per cent but generally exceeds 20 per cent. The variations in thickness and grading result in equally widely-ranging potential gravel yields: data from boreholes NW 37 and SW 42 lead to estimates exceeding 30 000 t/ha and 18 000 t/ha respectively, but the majority of boreholes represent less than 5000 t/ha. The gravel includes material from Carboniferous and Permo-Triassic sources.

'Bunter Sand' was absent from two IMAU boreholes. In the others it was generally less than 4.0 m thick but in places in the northern part of the block up to 14.0 m has been recorded. When this deposit is included in the assessment the estimated volume increases to 45 million m^3 $\pm$ 43 per cent, and the mean grading becomes 12 per cent fines, 80 per cent sand and 8 per cent gravel.

Overburden is generally thin, consisting of soil only, but at a number of borehole sites it exceeds 1.4 m and includes clays. A silty clay parting, 0.7 m thick, was found within the Older River Gravel in borehole NW 37.

Block B (Table 4)

The boundary of this block is drawn to encompass an area in which borehole evidence and field observation indicate the absence of gravel in all but minor amounts, notwithstanding the fact that part of the mineral present is classified as Older River Gravel. Borehole NE 32, although expected from the geological mapping to enter sand of the 25-Foot Drift, proved only 1.1 m of 'Bunter Sand' beneath soil and sandy clay sufficiently thick to render it not potentially workable. Since the extent of barren ground cannot be delineated readily the whole area is shown on the resource map as mineral-bearing but the findings of the borehole are taken into account in assessing resources.

Potentially workable sand in the block ranges in thickness from 1.7 m (borehole NE 27a) to 8.6 m, with a mean of 3.7 m. The mean grading for the block is 13 per cent fines, 86 per cent sand and 1 per cent gravel; in only 5 of 48 samples collected during the survey does the gravel content exceed 1 per cent. The estimated volume of resources is 40 million m^3 $\pm$ 31 per cent.

Where its presence is indicated on the map, overburden consists mainly of soil and sandy or silty clays, but at borehole NW 34 included peat. Elsewhere overburden is limited to thin sandy soil. A 0.8-m waste parting was encountered in borehole NW 41.

Block C (Table 5)

The mineral of this block consist mainly of Older River Gravel and 'Bunter Sand' but there are also small

Table 8 Block F: data from IMAU boreholes.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Mineral	Overburden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
OLDER RIVER GRAVEL								
SW 56	1.8	0.0	16	24	24	4	9	23
SE 23	absent							
SE 27	absent							
SE 28	0.5+	0.0	no data available					
SE 29	?absent							
SE 30	3.2	0.2	10	22	22	7	20	19
SE 31	1.3	0.2	4	21	38	6	10	21
SE 32	5.3	0.1	6	11	18	10	29	26
SE 33	3.2	0.0	21	25	13	4	14	23
SE 34	3.8	4.4	2	14	28	6	14	36
TOTAL MINERAL								
SW 56	3.0	0.0	14	28	35	3	6	14
SW 23	absent							
SE 27	6.5*	1.3	8	64	27	1	trace	0
SE 28	0.5+	0.0	no data available					
SE 29	2.4	0.6	16	71	13	0	0	0
SE 30	4.1	0.2	10	30	24	6	15	15
SE 31	5.3	0.2	10	43	37	2	3	5
SE 32	9.1	0.1	6	37	18	7	17	15
SE 33	9.5	0.0	15	41	28	2	6	8
SE 34	6.2†	1.0	9	30	26	4	9	22

* Excluding 0.5-m waste parting.
† Excluding 1.0-m waste parting.

amounts of sand of the 25-Foot Drift in the north and blown sand in the north and south. Much of the mineral is concealed beneath relatively thick overburden.

Older River Gravel at borehole sites NE 44 and SE 18, if present, consists only of 'very clayey' sand and boreholes NE 45 and 46 and SE 25 found its upper part to consist of 'very clayey' sand with few pebbles. Elsewhere in the block the deposit consists of gravel and sandy gravel varying in thickness from 0.6 m to 4.0 m, and in gravel content from 25 per cent to 71 per cent. Estimates of gravel yield range from zero to 30 000t/ha but are generally greater than 20 000 t/ha. The gravel includes pebbles of Carboniferous sandstone and, less commonly, ironstone, as well as Permo-Triassic-derived quartzites. The estimated volume of potentially workable Older River Gravel is 36 million $m^3 \pm 36$ per cent and its mean grading 10 per cent fines, 53 per cent sand and 37 per cent gravels.

Proved total mineral thicknesses, ie. thicknesses of Older River Gravel, underlying 'Bunter Sand' and any overlying, younger sand, range from 1.2 m to 8.4 m. The total volume is 64 million $m^3 \pm 27$ per cent and the mean grading 10 per cent fines, 69 per cent sand and 21 per cent gravel.

Much of the mineral lies beneath overburden up to 3.2 m thick, consisting mainly of silts and clays of the 25-Foot Drift and, in the eastern part of the block, peat. Substantial thicknesses of waste were encountered in boreholes NE 38 and SE 24 but most of the block is likely to be free of such partings.

Block D (Table 6)
The mineral of this block consists principally of Older River Gravel which is in places underlain by 'Bunter Sand' and overlain by sand of the 25-Foot Drift. Most of it lies beneath soil and clay overburden up to 2.3 m thick.

Borehole SE 21 sited on mapped Sherwood Sandstone encountered sandy gravel and pebbly sand more representative of the Older River Gravel than weathered bedrock and they are here assigned to that deposit. Borehole SE 17, sited on the Older River Gravel outcrop, encountered only stony, partly sandy, clay: the area of barren ground is not known but nearby sections indicate that it is of limited extent.

Boreholes SE 16 and 21 were abandoned when they repeatedly encountered obstructions, having proved only 0.5 m and 1.6 m, respectively, of Older River Gravel. Other boreholes show the deposit to be from 1.8 m to 5.0 m thick and the mean thickness is estimated as 3.5 m. In borehole SE 16 the Older River Gravel yielded only 6 per cent of gravel but elsewhere this fraction amounts to between 23 per cent and 67 per cent of the deposit. Estimated gravel yields range from 500 t/ha to 50 000 t/ha but generally exceed 20 000 t/ha. Fines content is commonly relatively high, especially in the upper parts of the deposit.

Five boreholes proved typical 'Bunter Sand' beneath the Older River Gravel; it ranged from 0.8 to 4.6 m in thickness and the mean proved thickness for the block as a whole is about 1.0 m. Sand in the 25-Foot Drift was found at only one IMAU borehole site, although the geological map suggests wider distribution; it consists of 1.9 m of 'very clayey' sand and was separated from the underlying Older River Gravel by 0.9 m of clay.

Proved total mineral thicknesses range up to 8.9 m, with a mean of 4.7 m. Several pits have extracted sand and gravel from the block; the volume of mineral remaining is estimated at 43 million $m^3 \pm 33$ per cent and its mean grading is 11 per cent fines, 58 per cent sand and 31 per cent gravel. Of this total, 29 million $m^3 \pm 25$ per cent consists of Older River Gravel with a mean grading of 10 per cent fines, 48 per cent sand and 42 per cent gravel.

Block E (Table 7)
The mineral of this block consists of Older River Gravel and 'Bunter Sand' and probably only minor amounts of

sand of the 25-Foot Drift, despite the fact that the latter is mapped at the surface over a considerable area.

Older River Gravel was proved by all IMAU boreholes except, possibly, SW 54. This and two other holes (SW 50 and 53) yielded no more than 2 per cent gravel and at site SW 48 the top 1.3 m of the deposit contains only 7 per cent of this fraction. Elsewhere the deposit includes gravelly sequences from 0.7 m to 5.0 m thick yielding 12 to 47 per cent of pebbles. 'Bunter Sand' up to 4.6 m thick underlies the Older River Gravel except at sites SW 44, 48 and 49 and proved total mineral thicknesses range from 1.0 m to 6.0 .

Older River Gravel totals about 22 million $m^3 \pm 40$ per cent and has a mean grading of 17 per cent fines, 56 per cent sand and 27 per cent gravel. Total mineral has an estimated volume of 36 million $m^3 \pm 31$ per cent and a mean grading of 14 per cent fines, 70 per cent sand and 16 per cent gravel.

Overburden proved by IMAU boreholes consists of soil, in places clayey, from 0.4 m to 0.8 m thick. However, where the presence of silts and clays of the 25-Foot Dirft is indicated on the map, overburden thicknesses are likely to be higher. A 1.0-m waste parting was found in Older River Gravel in borehole SW 49.

Block F (Table 8)

Sand and gravel has been worked extensively in this block, and, in addition to nine IMAU boreholes, the assessment takes into account numerous borehole records provided by industry on a confidential basis.

Mineral consists of Older River Gravel, 'Bunter Sand', blown sand and, at one site (SE 34), supposed sand of the 25-Foot Drift. The first is very variable in thickness and composition: in some areas where mapped it forms only a thin veneer on the underlying sandstone, but elsewhere it may be up to at least 5.3 m thick; it may yield up to 80 per cent of gravel, mostly high-quality quartzite derived from the Permo-Triassic, or it may consist entirely of sand. The remaining mineral consists of typical red 'Bunter Sand' and fine to medium drift sands.

Total mineral thickness ranges up to 9.5 m, with a mean of 4.3 m, leading to a volume estimate of 43 million $m^3 \pm 34$ per cent. The mean grading of the mineral proved by IMAU boreholes is 10 per cent fines, 72 per cent sand and 18 per cent gravel, but there is reason to believe that this is not representative of the mineral as a whole.

Where its presence is indicated on the resource map, overburden is up to 2.8 m thick and consists of silts and clays of the 25-Foot Drift and of peat. Elsewhere it commonly consists of sandy soil only. Waste partings are irregularly distributed and the mean thickness of waste for the block is of the order of 0.4 m.

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APPENDIX A

FIELD AND LABORATORY PROCEDURES

Trial and error during initial studies of the complex and variable glacial deposits of East Anglia and Essex showed that an absolute minimum of five sample points evenly distributed across the sand and gravel are needed to provide a worthwhile statistical assessment, but that, where possible, there should be not less than ten. Sample points are any points for which adequate information exists about the nature and thickness of the deposit and may include boreholes other than those drilled during the survey and exposures. In particular, the cooperation of sand and gravel operators ensures that boreholes are not drilled where reliable information is already available; although this may be used in the calculations, it is held confidentially by the Institute and cannot be disclosed.

The mineral shown on each 1:25 000 sheet is divided into resource blocks. The arbitrary size selected is a compromise to meet the aims of the survey by providing sufficient sample points in each block. As far as possible the block boundaries are determined by geological boundaries so that, for example, glacial and river terrace gravels are separated. Otherwise division is by arbitrary lines, which may bear no relationship to the geology. The blocks are drawn provisionally before drilling begins.

A reconnaissance of the ground is carried out to record any exposures and inquiries are made to ascertain what borehole information is available. Borehole sites are then selected to provide an even pattern of sample points at a density of approximately one per square kilometre. However, because broad trends are independently overlain by smaller-scale characteristically random variations, it is unnecessary to adhere to a square grid pattern. Thus such factors as ease of access and the need to minimise disturbance to land and the public are taken into account in siting the holes; at the same time it is necessary to guard against the possibility that ease of access (that is, the positions of roads and farms) may reflect particular geological conditions, which may bias the drilling results.

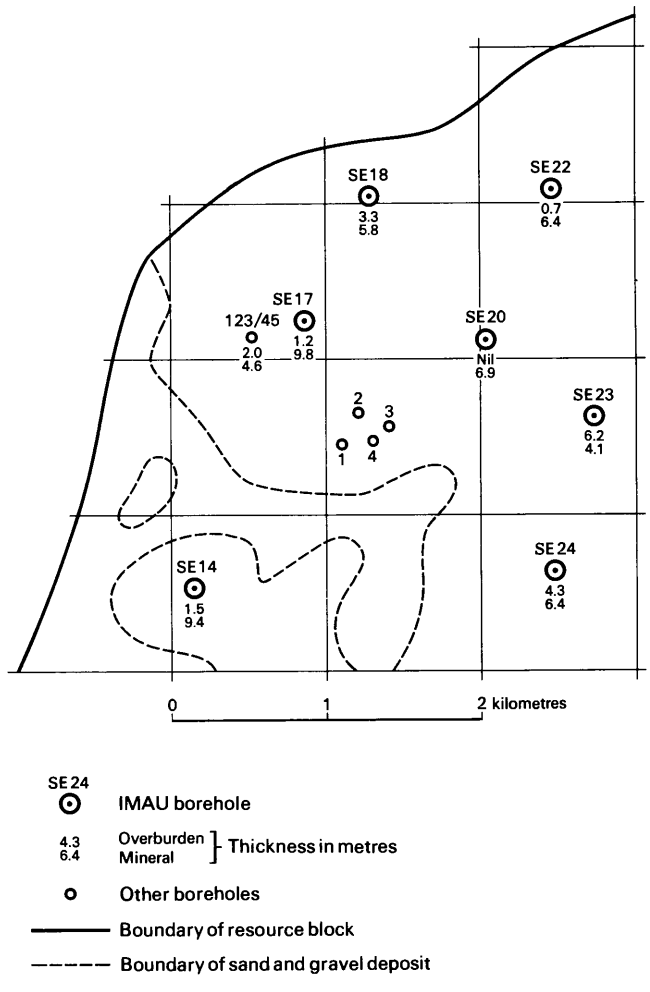
The drilling machine employed should be capable of providing a continuous sample representative of all unconsolidated deposits, so that the in-situ grading can be determined, if necessary, to a depth of 30 m (100 ft) at a diameter of about 200 mm (8 in), beneath different types of overburden. It should be reliable, quiet, mobile and relatively small (so that it can be moved to sites of difficult access). Shell and auger rigs have proved to be almost ideal.

The rigs are modified to enable deposits above the water table to be drilled 'dry', instead of with water added to facilitate the drilling, to minimise the amount of material drawn in from outside the limits of the hole. The samples thus obtained are representative of the in-situ grading, and satisfy one of the most important aims of the survey. Below the water table the rigs are used conventionally, although this may result in the loss of some of the fines fraction and the pumping action of the bailer tends to draw unwanted material into the hole from the sides or the bottom.

A continuous series of bulk samples is taken throughout the sand and gravel. Ideally samples are composed exclusively of the whole of the material encountered in the borehole between stated depths. However, care is taken to discard, as far as possible, material which has caved or has been pumped from the bottom of the hole. A new sample is commenced whenever there is an appreciable lithological change within the sand and gravel, or at every 1 m (3.3 ft) depth. The samples, each weighing between 25 and 45 kg (55 and 100 lb), are despatched in heavy-duty polythene bags to a laboratory for grading. The grading procedure is based on B.S. 1337 (British Standards Institution, 1967). Random checks of the accuracy of the grading are made in the Institute's laboratories.

All data, including mean grading analysis figures calculated for the total thickness of the mineral, are entered on standard record sheets, abbreviated copies of which are reproduced in Appendix E.

Detailed records may be consulted at the appropriate offices of the Institute, upon application to the Head, Industrial Minerals Assessment Unit.



Example of resource block assessment: map of a fictitious block

APPENDIX B

STATISTICAL PROCEDURE

Statistical assessment

1 A statistical assessment is made of an area of mineral greater than 2 km^2, if there are at least five evenly spaced boreholes in the resource block (for smaller areas, see Paragraph 12 below).

2 The simple methods used in the calculations are consistent with the amount of data provided by the survey (Hull, 1981). Conventional symmetrical confidence limits are calculated for the 95 per cent probability level, that is, on average nineteen out of every twenty sets of limits constructed in this way contain the true value for the volume of mineral.

3 The volume estimate (V) for the mineral in a given block is the product of two variables, the sampled areas (A) and the mean thickness ($\bar{l}_m$) calculated from the individual thicknesses at the sample points. The standard deviations for these variables are related such that

$$S_V = \sqrt{(S_A^2 + S_{\bar{l}_m}^2)} \qquad [1]$$

4 The above relationship may be transposed such that

$$S_V = S_{\bar{l}_m} \sqrt{(1 + S_A^2 / S_{\bar{l}_m}^2)} \qquad [2]$$

From this it can be seen that as $S_A^2 / S_{\bar{l}_m}^2$ tends to 0, S_V tends to $S_{\bar{l}_m}$.

If, therefore, the standard deviation for area is small with respect to that for thickness, the standard deviation for volume approximates to that for mean thickness.

5 Given that the number of approximately evenly spaced sample points in the sampled area is n with mineral thickness measurements $l_{m_1}, l_{m_2}, \ldots l_{m_n}$, then the best estimate of mean thickness, $\bar{l}_m$, is given by

$$\Sigma\ (l_{m_1} + l_{m_2} \ldots l_{m_n}) / n .$$

For groups of closely spaced boreholes a discretionary weighting factor may be applied to avoid bias (see note on weighting below). The standard deviation for mean thickness $S_{\bar{l}_m}$, expressed as a proportion of the mean thickness, is given by

$$S_{\bar{l}_m} = (1/\bar{l}_m) \sqrt{\ [\Sigma (l_m - \bar{l}_m)^2/(n-1)]}$$

where l_m is any value in the series l_{m_1} to l_{m_n}.

6 The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of a deposit). Where the area is not defined by a mapped boundary, that is, where the boundary is inferred, a distinctive symbol is used. Experience suggests that the errors in determining area are small relative to those in thickness. The relationship $S_A / S_{\bar{l}_m} \leqq 0.\dot{3}$ is assumed in all cases. It follows from Equation [2] that

$$S_{\bar{l}_m} \leqq S_V \leqq 1.05\ S_{\bar{l}_m} \qquad [3]$$

7 The limits on the estimate of mean thickness of mineral, $L_{\bar{l}_m}$, may be expressed in absolute units

$\pm (t/\sqrt{n}) \times S_{\bar{l}_m}$ or as a percentage

$\pm (t/\sqrt{n}) \times S_{\bar{l}_m} \times (100/\bar{l}_m)$ per cent, where t is Student's t at the 95 per cent probability level for $(n-1)$ degrees of freedom, evaluated by reference to statistical tables. (In applying Student's t it is assumed that the measurements are distributed normally).

8 Values of t at the 95 per cent probability level for values of n up to 20 are as follows:

n	t	n	t
1	infinity	11	2.228
2	12.706	12	2.201
3	4.303	13	2.179
4	3.182	14	2.160
5	2.776	15	2.145
6	2.571	16	2.131
7	2.447	17	2.120
8	2.365	18	2.110
9	2.306	19	2.101
10	2.262	20	2.093

(from Table 12 in *Biometrika Tables for Statisticians*, Volume 1, Second Edition, Cambridge University Press, 1962). When n is greater than 20, 1.96 is used (the value of t when n is infinity).

9 In calculating confidence limits for volume, L_V, the following inequality, corresponding to Equation [3], is applied:

$$L_{\bar{l}_m} \leqq L_V \leqq 1.05\ L_{\bar{l}_m}.$$

10 In summary, for values of n between 5 and 20, L_V is calculated as

$$[(1.05 \times t)/\bar{l}_m] \times [\sqrt{\Sigma (l_m - \bar{l}_m)^2 / n\ (n-1)}] \times 100$$

per cent,

and when n is greater than 20, as

$$[(1.05 \times 1.96)/\bar{l}_m] \times [\sqrt{\Sigma (l_m - \bar{l}_m)^2 / n\ (n-1)}] \times 100$$

per cent.

11 The application of this procedure to a fictitious area is illustrated in the accompanying Figure and example of a block calculation.

Inferred assessment

12 If the sampled area of mineral in a resource block is between 0.25 km^2 and 2 km^2, an assessment is inferred on the basis of geological and topographical information, usually supported by the data from one or two boreholes. The volume of mineral is calculated as the product of the area, measured from field data, and the estimated thickness. Confidence limits are not calculated.

13 In some cases a resource block may include an area left uncoloured on the map, within which mineral (as defined) is interpreted to be generally absent. If there is reason to believe that some mineral may be present, an inferred assessment may be made.

14 No assessment is attempted for an isolated area of mineral less than 0.25 km^2.

15 Note on weighting The thickness of a deposit at any point may be governed solely by the position of the point in relation to a broad trend. However, most sand and gravel deposits also exhibit a random pattern of local, and sometimes considerable, variation in thickness. Thus the distribution of sample points needs to be only approximately regular and in estimating the mean thickness only simple weighting is necessary. In practice, equal weighting can often be applied to thicknesses at all sample points. If, however, there is a distinctly unequal distribution of points, bias is avoided by dividing the sampled area into broad zones, to each of which a value roughly proportional to its area is assigned. This value is then shared between the data points with the zone as the weighting factor.

Block calculation

Scale: 1:25 000
Block: Fictitious

Area
Block: 11.08 km²
Mineral: 8.32 km²

Mean thickness
Overburden: 2.5 m
Mineral: 6.5 m

Volume
Overburden: 21 million m³
Mineral: 54 million m³

Confidence limits of the estimate of mineral volume at the 95 per cent probability level: ± 20 per cent
That is, the volume of mineral (with 95 per cent probability): 54 ± 11 million m³

Thickness estimate (measurements in metres)
l_o= overburden thickness l_m = mineral thickness

Sample point	Weighting w	Overburden l_o	Overburden wl_o	Mineral l_m	Mineral wl_m	Remarks
SE 14	1	1.5	1.5	9.4	9.4	IMAU boreholes
SE 18	1	3.3	3.3	5.8	5.8	
SE 20	1	nil	-	6.9	6.9	
SE 22	1	0.7	0.7	6.4	6.4	
SE 23	1	6.2	6.2	4.1	4.1	
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	½	1.2	1.6	9.8	7.2	
123/45	½	2.0		4.6		Hydrogeology Unit record
1	¼	2.7	2.6	7.3	5.8	Close group of four boreholes (commercial)
2	¼	4.5		3.2		
3	¼	0.4		6.8		
4	¼	2.8		5.9		
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.2$		$\Sigma wl_m = 52.0$		
Means		$\overline{wl}_o = 2.5$		$\overline{wl}_m = 6.5$		

Calculation of confidence limits

wl_m	$\lvert(wl_m - \overline{wl}_m)\rvert$	$(wl_m - \overline{wl}_m)^2$
9.4	2.9	8.41
5.8	0.7	0.49
6.9	0.4	0.16
6.4	0.1	0.01
4.1	2.4	5.76
6.4	0.1	0.01
7.2	0.7	0.49
5.8	0.7	0.49

$\Sigma(wl_m - \overline{wl}_m)^2 = 15.82$

$n = 8$

$t = 2.365$

L_V is calculated as

$1.05\ (t/\overline{wl}_m)\ \sqrt{[\Sigma(wl_m - \overline{wl}_m)^2 / n(n-1)]} \times 100$

$= 1.05 \times (2.365/6.5)\ \sqrt{[15.82/(8 \times 7)]} \times 100$

$= 20.3$

$\simeq 20$ per cent.

APPENDIX C

CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

For the purposes of assessing resources of sand and gravel a classification should take account of economically important characteristics of the deposit, in particular the absolute content of fines and the ratio of sand to gravel.

The terminology commonly used by geologists when describing sedimentary rocks (Wentworth, 1922) is not entirely satisfactory for this purpose. For example, Wentworth proposed that a deposit should be described as a 'gravelly sand' when it contains more sand than gravel and there is at least 10 per cent of gravel, provided that there is less than 10 per cent of material finer than sand (< $\frac{1}{16}$ mm) and coarser than pebbles (> 64 mm in diameter). Because deposits containing more than 10 per cent fines are not embraced by this system, a modified binary classification based on Willman (1942) has been adopted.

When the fines content exceeds 40 per cent the material is considered to be not potentially workable and falls outside the definition of mineral. Deposits which contain 40 per cent fines or less are classified primarily on the ratio of sand to gravel but qualified in the light of the fines content, as follows: less than 10 per cent fines - no qualification; 10 per cent or more but less than 20 per cent fines - 'clayey'; 20 to 40 per cent fines - 'very clayey'.

The term 'clay' (as written, with single quote marks) is used to describe all material passing $\frac{1}{16}$ mm. Thus it has no mineralogical significance and includes particles falling within the size range of silt. The normal meaning applies to the term clay where it does not appear in single quotation marks.

The ratio of sand to gravel defines the boundaries between sand, pebbly sand, sandy gravel and gravel (at 19:1, 3:1 and 1:1).

Thus it is possible to classify the mineral into one of twelve descriptive categories (see the accompanying Figure). The procedure is as follows:

1 Classify according to the ratio of sand to gravel.
2 Describe the fines.

For example, a deposit grading 11 per cent gravel, 70 per cent sand and 19 per cent fines is classified as 'clayey' pebbly sand. This short description is included in the borehole log (see Appendix D)

Many differing proposals have been made for the classification of the grain size of sediments (Atterberg, 1905; Udden, 1914; Wentworth, 1922; Wentworth, 1935; Allen, 1936; Twenhofel, 1937; Lane and others, 1947). As Archer (1970a, b) has emphasised, there is a pressing need for a simple metric scale acceptable to both scientific and engineering interests, for which the class limit sizes correspond closely with certain marked changes in the natural properties of mineral particles. For example, there is an important change in the degree of cohesion between particles at about the $\frac{1}{16}$-mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology (see the accompanying table), which is used in the Report.

The fairly wide intervals in the scale are consistent with the general level of accuracy of the qualitative assessments of the resource blocks. Three sizes of sand are recognised, fine ($+\frac{1}{16}$ -$\frac{1}{4}$ mm), medium ($+\frac{1}{4}$ -1 mm) and coarse (+1 -4 mm). The boundary at 16 mm distinguishes a range of finer gravel (+4 -16 mm), often characterised by abundance of worn tough pebbles of vein quartz, from larger pebbles, often of notably different materials. The boundary at 64 mm distinguishes pebbles from cobbles. The term 'gravel' is used loosely to denote both pebble-sized and cobble-sized material.

The size distribution of borehole samples is determined by sieve analysis, which is presented by the laboratory as logarithmic cumulative curves (see, for example, British Standards Institution, 1967). In this report the grading is tabulated on the borehole record sheets (Appendix E), the intercepts corresponding with the simple geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm and so on as required. Original sample grading curves are available for reference at the appropriate office of the Institute.

Each bulk sample is described, subjectively, by a geologist at the borehole site. Being based on visual examination, the description of the grading is inexact, the accuracy depending on the experience of the observer. The descriptions recorded are modified, as necessary, when the laboratory results become available.

The relative proportions of the rock types present in the gravel fraction are indicated by the use of the words 'and' or 'with'. For example, 'flint and quartz' indicates roughly equal proportions with neither constituent accounting for less than about 25 per cent of the whole; 'flint with quartz' indicates that flint is dominant and quartz, the principal accessory rock type, comprises 5 to 25 per cent of the whole. Where the accessory material accounts for less than 5 per cent of the whole, but is still readily apparent, the phrase 'with some' has been used. Rare constitutents are referred to as 'trace'.

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 the shape (after Pettijohn, 1957), 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. Origninal 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 apparent.

Well rounded: not original faces, edges or corners left. The entire surface consists of broad curves; flat areas are absent. The original shape is suggested by the present form of the grain.

Classification of gravel, sand and fines

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

I Gravel
II 'Clayey' gravel
III 'Very clayey' gravel
IV Sandy gravel
V 'Clayey' sandy gravel
VI 'Very clayey' sandy gravel
VII Pebbly sand
VIII 'Clayey' pebbly sand
IX 'Very clayey' pebbly sand
X Sand
XI 'Clayey' sand
XII 'Very clayey' sand

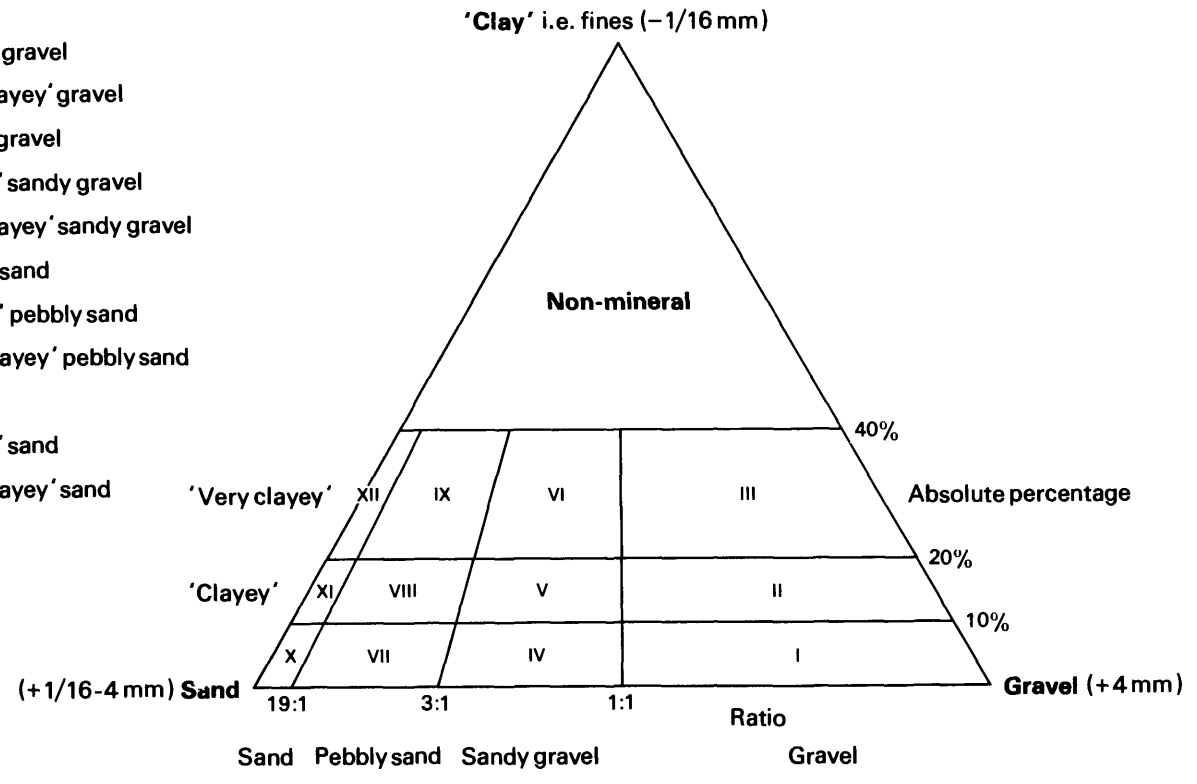


Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D
EXPLANATION OF THE BOREHOLE RECORDS

Annotated fictitious example

CK 66 NW 5 **6191 6962** **Northfields**[1] **Block B**

Surface level (+49.7 m) + 163 ft[2]
Water struck at +45.9 m[3]
October 1977[4]

Overburden[5] 2.8 m
Mineral 5.4 m
Waste 1.1 m
Mineral 1.4 m
Bedrock 0.7 m+[6]

LOG

Geological classification	Lithology[7]	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	Clay, silty, dark brown	2.6	2.8
River Terrace Deposits	**a** Gravel Gravel: fine to coarse, with cobbles towards base, angular to rounded, flint and limestone with ironstone and some quartz and chalk Sand: medium with coarse and some fine, quartz and limestone	5.4	8.2
Boulder Clay	Clay, sandy and pebbly, red-brown	1.1	9.3
Glacial Sand and Gravel	**b** Sand, 'clayey' in part: fine, subangular to rounded, quartz with some coal	1.4	10.7
Lias	Mudstone, blue-grey, fossiliferous	0.7+	11.4

GRADING[8]

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
a	5	46	49	2.8-3.8	20	14	62	2	2		
				3.8-4.8	2	2	12	18	42	24	
				4.8-5.8	1	3	24	13	35	24	
				5.8-6.8	0	4	21	20	26	29	
				6.8-8.2	4	3	23	10	23	30	7
				Mean	5	5	28	13	25	22	2
b	5	95	0	9.3-10.3	3	73	23	1			
				10.3-10.7	9	85	5	1			
				Mean	5	77	17	1			
a+b	5	56	39	Mean	5	20	26	10	20	17	2

COMPOSITION[9]

Depth below surface (m)	percentages by weight in gravel fraction				
	Flint	Limestone	Quartz	Chalk	Ironstone
3.8-4.8	41	50	5	1	3
4.8-5.8	39	45	3	5	8
5.8-6.8	45	42	2	5	6
6.8-8.2	19	61	6	3	11
Mean	35	51	4	3	7

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

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

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

3 Groundwater conditions
If groundwater was present, the level at which it was encountered or the level at which it stood on the completion of drilling is normally given (in metres relative to Ordnance Datum)

4 Type of drill and date of drilling
Unless otherwise stated the borehole was drilled by a shell and auger rig using 152-mm diameter casing. The month and year of completion of drilling are stated.

5 Overburden, Mineral, Waste and Bedrock
Mineral is sand and gravel which, as part of a deposit, falls within the arbitrary definition of potentially workable material (see p. 1). Bedrock is the 'formation', 'country rock' or 'rock head' below which potentially workable sand and gravel will not be found. Waste is any material other than bedrock or mineral. Where waste occurs between the surface and mineral it is classified as overburden.

6 The plus sign (+) indicates that the base of the deposit was not reached during drilling.

7 Lithological description
When sand and gravel is recorded a general description based on the grading characteristics (for details see Appendix C) is followed by more detailed particulars of the gravel and/or sand fractions. Where more than one mineral horizon is recognised each is designated by a letter, e.g. **a**, **b** etc. The description of other deposits is based on visual examination in the field.

8 Grading data
A continuous series of bulk samples is taken throughout the thickness of sand and gravel. A new sample is commenced whenever there is appreciable lithological change or at every 1 m of depth.

For each bulk sample the percentages of fines ($-\frac{1}{16}$ mm), fine sand ($+\frac{1}{16}$–$\frac{1}{4}$ mm), medium sand ($+\frac{3}{4}$–1 mm), coarse sand (+1–4 mm), fine gravel (+4–16 mm), coarse gravel (+16 mm) are stated.

The mean gradings of groups of samples making up an identified mineral horizon are also given in detail and in summary. Where more than one horizon is recognised the mean grading for the whole of the mineal in the borehole may be given. Where necessary, in calculating mean gradings, data for individual samples are weighted by the thickness represented. If, exceptionally, grading results are not available for a sample, an attempt may be made to estimate the grading by comparing the grading and field descriptions of adjacent samples with the sample in question. Such estimates are shown in square brackets.

Fully representative sampling of sand and gravel is difficult to achieve, particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures commonly suggests that in borehole samples the proportion of sand may be higher and the proportion of fines and corase gravel may be lower.

9 Composition
Details of the composition of selected gravel samples or groups of samples may be given. Where appropriate, the calculated weighted mean composition of groups of samples may be quoted.

APPENDIX E

INDUSTRIAL MINERALS ASSESSMENT UNIT
BOREHOLE AND EXPOSURE RECORDS

In addition to these, data from five pre-existing registered logs (SE 60 NE 1, 6 and 27a, SE 60 SW 11 and SE 60 SE 7) as well as numerous records held in confidence were used in the assessment of resources.

SE 60 NW 26 **6119 0937** **Barnby Dun**

Surface level (+5.5 m) +18 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 1.8 m
Mineral 1.8 m
Waste 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, clayey	1.8	1.8
Alluvium	'Very clayey' sand Sand: mainly medium, subrounded to angular; quartz with high coal content in coarse fraction Fines: grey-brown clay and silt, as matrix and as discrete lumps throughout	1.8	3.6
Glacial Channel Deposits	Clay, grey, silty, with many coal fragments	0.9+	4.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
21	78	1	1.8-2.7	22	15	45	17	1	0
			2.7-3.6	20	23	32	19	1	0
			Mean	21	21	39	18	1	0

SE 60 NW 27 **6221 0915** **Hatfield Lane, Barnby Dun** **Block A**

Surface level (+11.6 m) +38 ft
Water not encountered
March 1975

Overburden 4.3 m
Mineral 2.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.8	0.8
Older River Gravel	Clay, pebbly and sandy, partly laminated	3.5	4.3
	'Very clayey' sand, pebbly in upper part Gravel: fine, subrounded to subangular; quartzite, quartz and sandstone Sand: mainly fine, subrounded to subangular; quartz with some mica	2.0	6.3
Sherwood Sandstone	Sandstone, soft, micaceous	0.1+	6.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
31	66	3	4.3-5.3	39	38	14	3	6	0
			5.3-6.3	22	48	29	1	trace	0
			Mean	31	43	21	2	3	0

SE 60 NW 28 **6034 0878** **Thorpe Marsh, Barnby Dun**

Surface level (+ 4.6 m) + 15 ft
Water level + 1.6 m (+ 5 ft)
January 1975

Waste 20.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.3	0.3
Glacial Channel Deposits	Clay, grey and brown, mainly silty or sandy, part laminated, coal fragments in places, rootlets near top	20.0+	20.3

SE 60 NW 29 **6302 0892** **Barnby Dun Common** **Block A**

Surface level (+ 6.4 m) + 21 ft
Water not encountered
February 1975

Overburden 0.3 m
Mineral 13.0 m
Bedrock 12.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, sandy	0.3	0.3
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: fine, rounded quartzite Sand: mainly fine, subrounded quartz	1.0	1.3
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine, subrounded; quartz with some dark mineral grains	12.0	13.3
	Sandstone, friable, micaceous	12.0+	25.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	13	58	29	0.3- 1.3	13	41	15	2	16	13
b	11	89	0	1.3- 2.3	17	58	25	trace	0	0
				2.3- 3.3	17	63	18	1	1	0
				3.3- 4.3	16	41	43	0	0	0
				4.3- 5.3	12	76	12	0	0	0
				5.3- 6.3	9	74	17	0	0	0
				6.3- 7.3	9	64	27	0	0	0
				7.3- 8.3	5	60	35	trace	0	0
				8.3- 9.3	10	61	28	1	0	0
				9.3-10.3	7	68	25	0	0	0
				10.3-11.3	10	62	28	trace	0	0
				11.3-12.3	6	55	39	trace	0	0
				12.3-13.3	11	55	34	0	0	0
				Mean	11	61	28	trace	trace	0
a + b	11	87	2	Mean	11	60	27	trace	1	1

SE 60 NW 30 **6393 0853** **Dunsville** **Block A**

Surface level (+7.6 m) +25 ft
Water encountered at +4.1 m (+13 ft)
February 1975

Overburden 2.6 m
Mineral 15.0 m
Bedrock 8.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, gravelly	0.6	0.6
?Older River Gravel	Silty clay, grey, laminated; some rounded quartz and quartzite pebbles, and sand lenses below 2.3 m	2.0	2.6
Older River Gravel	**a** 'Very clayey' sandy gravel Gravel: fine, rounded; quartzite (including dreikanter) and some igneous rock Sand: fine, rounded; quartz with dark minerals Fines: brown clay and silt matrix and clay nodules	1.0	3.6
Sherwood Sandstone	**b** 'Clayey' sand: fine to medium; quartz with some mica	14.0	17.6
	Sandstone, friable, micaceous	8.0+	25.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	21	57	22	2.6 - 3.6	21	45	10	2	7	15
b	10	90	0	3.6 - 4.6	18	63	18	1		
				4.6 - 5.6	12	58	30	0		
				5.6 - 6.6	6	56	38	0		
				6.6 - 7.6	6	61	33	0		
				7.6 - 8.6	5	43	52	0		
				8.6 - 9.6	10	41	49	0		
				9.6 -10.6	8	46	45	1		
				10.6 -11.6	12	42	45	1		
				11.6 -12.6	10	41	48	1		
				12.6 -13.6	11	50	38	1		
				13.6 -14.6	7	53	40	trace		
				14.6 -15.6	10	53	37	0		
				15.6 -17.6	9	37	53	1		
				Mean	10	49	41	trace		
a + b	10	89	1	Mean	10	49	39	1	trace	1

SE 60 NW 31 **6190 0733** **Near Sandall Field, Sandall** **Block A**

Surface level (+12.2 m) + 40 ft
Water not encountered
February 1975

Overburden 0.1 m
Mineral 9.4 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Older River Gravel	**a** 'Clayey' pebbly sand Gravel: fine and course; quartzite and quartz, with traces of igneous rock Sand: medium, subrounded; quartz and dark minerals	5.4	5.5
Sherwood Sandstone	**b** Sand: fine and medium, subrounded; quartz with some lithic fragments	4.0	9.5
	Sandstone, micaceous	0.1+	9.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	10	79	11	0.1 - 1.5	16	35	28	6	7	8
				1.5 - 2.5	4	9	82	4	1	0
				2.5 - 3.5	9	13	70	5	3	0
				3.5 - 4.5	8	10	48	5	11	18
				4.5 - 5.5	10	25	57	1	1	6
				Mean	10	20	55	4	4	7
b	7	93	0	5.5 - 6.5	9	28	62	1		
				6.5 - 7.5	5	44	50	1		
				7.5 - 8.5	5	46	49	0		
				8.5 - 9.5	9	60	31	0		
				Mean	7	44	48	1		
a + b	9	85	6	Mean	9	30	52	3	2	4

SE 60 NW 32 **6295 0797** **Park Hill Farm, Kirk Sandall** **Block A**

Surface level at (+6.7 m) +22 ft
Water not encountered
January 1975

Overburden 0.4 m
Mineral 0.6 m
Waste 17.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, sandy and gravelly	0.4	0.4
Older River Gravel	'Clayey' pebbly sand Gravel: mainly fine, rounded brown and purple quartzite Sand: medium to fine, rounded to angular; quartz with some lithic grains	0.6	1.0
Glacial Channel Deposits	Silty clay, blue, stiff, part laminated; few sandstone and quartz pebbles	17.3+	18.3

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
17	65	18	0.4 - 1.0	17	21	36	8	12	6

SE 60 NW 33 **6286 0659** **Common Farm, Edenthorpe** **Block A**

Surface level (+11.3 m) +37 ft
Water not encountered
March 1975

Overburden 0.2 m
Mineral 5.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.2	0.2
Older River Gravel	**a** Sandy gravel Gravel: mainly coarse, subangular to subrounded; quartz, quartzite and sandstone Sand: mainly fine, subangular to subrounded; quartz with dark lithic grains	1.0	1.2
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine, subangular to subrounded; quartz with mica and dark minerals	4.0	5.2
	Sandstone, micaceous	0.1+	5.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	9	67	24	0.2 - 1.2	9	37	19	11	6	18
b	15	85	trace	1.2 - 2.2	18	59	21	2	trace	0
				2.2 - 3.2	16	71	13	trace	0	0
				3.2 - 4.2	9	65	26	trace	trace	0
				4.2 - 5.2	17	56	27	trace	0	0
				Mean	15	62	22	1	trace	0
a + b	14	81	5	Mean	14	57	21	3	1	4

SE 60 NW 34 6368 0689 **Green Lane Farm, Hatfield** **Block B**

Surface level (+3.4 m) +11 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.9 m
Mineral 2.8 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Peat	Topsoil, black and peaty	0.9	0.9
Older River Gravel on Bunter Sandstone	Sand: 'clayey' and pebbly at top, medium, subrounded quartz; pebbles of quartz, quartzite and sandstone near top	2.8	3.7
	Sandstone, soft, micaceous	0.1+	3.8

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
9	90	1	0.9 - 1.4	11	33	48	2	6	0
			1.4 - 1.8	9	53	37	1	0	0
			1.8 - 2.7	8	53	38	1	0	0
			2.7 - 3.7	[8	53	38	1	0	0]
			Mean	9	49	40	1	1	0

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
0.9-1.4	40	25	0	35	0	0	0

SE 60 NW 35 **6400 0711** **South-east of Wyndthorpe Hall** **Block A**

Surface level (+2.7 m) +9 ft
Water encountered at +1.4 m (+5 ft)
February 1975

Overburden 1.4 m
Mineral 12.9 m
Bedrock 1.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, peaty	1.0	1.0
	Sandy clay	0.4	1.4
Older River Gravel	**a** 'Very clayey' sandy gravel Gravel: fine and coarse, rounded to subrounded quartzite (including dreikanter) Sand: mainly fine, subrounded and subangular quartz Fines: blue and grey, yellowing with depth	1.9	3.3
Sherwood Sandstone	**b** 'Clayey' sand: fine, rounded and subrounded quartz with some mica; scattered green laminated clay bands	11.0	14.3
	Sandstone, weathered, micaceous	1.8+	16.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	24	44	32	1.4-3.3	24	30	9	5	14	18
b	18	82	trace	3.3-4.3	37	55	7	1	0	0
				4.3-5.3	11	71	18	0	0	0
				5.3-6.3	9	69	22	0	0	0
				6.3-7.3	17	81	2	0	0	0
				7.3-8.3	21	77	2	0	0	0
				8.3-9.3	29	67	4	0	0	0
				9.3-10.3	21	52	23	trace	2	2
				10.3-11.3	16	57	27	0	0	0
				11.3-12.3	17	56	27	0	0	0
				12.3-13.3	11	49	39	1	0	0
				13.3-14.3	8	52	38	2	0	0
				Mean	18	62	19	1	trace	trace
a + b	19	76	5	Mean	19	58	17	1	2	3

SE 60 NW 36 **6093 0577** **Sandall Cottages**

Surface level (+14.0 m) +46 ft
Water struck at +11.0 m (+36 ft)
February 1975

Overburden 1.0 m
Mineral 3.1 m
Waste 14.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill and soil	1.0	1.0
Glacial Sand and Gravel	Gravel Gravel: mainly fine, well rounded; sandstone and quartzite with quartz and some igneous rock, ironstone and chert Sand: medium and coarse; quartz and rock fragments	3.1	4.1
Glacial Channel Deposits	Clay, grey and green, micaceous and laminated	14.1+	18.2

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
2	49	49	1.0 - 2.0	3	9	27	19	25	17
			2.0 - 3.0	2	5	23	19	24	27
			3.0 - 4.1	1	3	20	22	38	16
			Mean	2	5	23	21	30	19

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
2.0-3.0	19	41	1	33	1	3	2

SE 60 NW 37 **6233 0620** **The Grange, Edenthorpe** **Block A**

Surface level (+11.9 m) +39 ft
Water not encountered
March 1975

Overburden 0.6 m
Mineral 2.4 m
Waste 0.7 m
Mineral 3.3 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, sandy	0.6	0.6
Older River Gravel	**a** Sandy Gravel Gravel: mainly coarse, subangular to subrounded; quartz, quartzite and igneous rock Sand: fine to coarse, subangular to subrounded; quartz and lithic grains	2.4	3.0
	Clay, silty, blue-grey	0.7	3.7
	b Gravel Gravel: fine, coarse and cobbles, subangular to rounded; quartzite with sandstone and some quartz and igneous rock Sand: fine to coarse, subangular to subrounded; quartz with lithic grains	2.8	6.5
Sherwood Sandstone	**c** Sand: mainly fine, subrounded to rounded; quartz with some mica.	0.5	7.0
	Sandstone, micaceous	0.1+	7.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	7	64	29	0.6 - 1.6	6	24	34	18	10	8
				1.6 - 3.0	8	10	26	20	11	25
				Mean	7	16	29	19	11	18
b	3	31	66	3.7 - 4.7	4	5	12	16	30	33
				4.7 - 5.7	3	7	11	10	25	44
				5.7 - 6.5	3	14	7	10	21	45
				Mean	3	8	11	12	26	40
a + b	5	46	49	Mean	5	12	19	15	19	30
c	9	91	trace	6.5 - 7.0	9	54	30	7	trace	0
a+b+c	5	50	45	Mean	5	15	20	15	17	28

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
3.7 - 4.7	9	56	0	31	0	4	0

SE 60 NW 38 **6335 0612** **Cozen Croft, Armthorpe** **Block A**

Surface level (+7.0 m) +23 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Mineral 3.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Older River Gravel	**a** 'Clayey' pebbly sand Gravel: fine and coarse, rounded quartzite Sand: fine to coarse; quartz and quartzite	0.5	0.5
Sherwood Sandstone	**b** 'Clayey' sand: fine and medium, rounded to subangular; quartz with dark minerals	3.2	3.7
	Sandstone, micaceous	0.1+	3.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	18	69	13	0.0 - 0.5	18	40	24	5	8	5
b	10	90	trace	0.5 - 0.9	10	33	56	1	0	0
				0.9 - 1.8	8	39	52	trace	trace	0
				1.8 - 2.7	10	50	39	trace	trace	0
				2.7 - 3.7	12	61	26	1	0	0
				Mean	10	47	42	1	trace	0
a + b	11	87	2	Mean	11	46	40	1	1	1

SE 60 NW 39 **6455 0626** **West Moor, Hatfield** **Block B**

Surface level (+1.8 m) + 6 ft
Water encountered at -1.6 m (-5 ft)
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 3.4 m
Mineral 5.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, black and peaty	0.9	0.9
25-Foot Drift	Clay, silty and sandy, yellow	2.5	3.4
?25-Foot Drift	'Clayey' sand: fine, subrounded; quartz with mica and some dark minerals	5.7	9.1
Sherwood Sandstone	Sandstone, red-buff, micaceous	0.1+	9.2

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
17	83	0	3.4 - 4.6	12	56	31	1		
			4.6 - 5.5	13	58	29	trace		
			5.5 - 7.3	20	53	26	1		
			7.3 - 8.2	15	60	24	1		
			8.2 - 9.1	20	58	22	0		
			Mean	17	56	26	1		

SE 60 NW 40 **6365 0540** **The Lings, Armthorpe** **Block A**

Surface level (+8.6 m) + 28 ft
Water not encountered
February 1975

Overburden 0.3 m
Mineral 3.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: fine and coarse, subrounded; quartz, quartzite and ironstone Sand: fine and medium, subangular to subrounded; quartz and rock fragments Fines: yellow, ochreous	0.7	1.0
Sherwood Sandstone	**b** 'Clayey' sand; mainly fine quartz; scattered pebbles at top	3.0	4.0
	Sandstone, micaceous	0.1+	4.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	10	59	31	0.3 - 1.0	10	23	22	14	14	17
b	11	89	trace	1.0 - 2.0	20	53	25	1	1	0
				2.0 - 3.0	8	59	33	0	0	0
				3.0 - 4.0	6	80	14	0	0	0
				Mean	11	64	24	trace	trace	0
a + b	11	83	6	Mean	11	56	24	3	3	3

SE 60 NW 41 **6425 0582** **West Moor Farm** **Block B**

Surface level (+2.1 m) +7 ft
Water not encountered
March 1975

Overburden 1.2 m
Mineral 1.0 m
Waste 0.8 m
Mineral 3.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark brown	0.3	0.3
25-Foot Drift	Sandy clay, yellow-brown, laminated	0.9	1.2
	a Sand: mainly fine, subangular to subrounded; quartz with some mica and dark minerals	1.0	2.2
	Clay, silty, laminated and micaceous	0.8	3.0
Older River Gravel	**b** 'Very clayey' pebbly sand Gravel: fine and coarse, subangular to rounded; quartzite, quartz and siltstone Sand: fine, medium and coarse, subrounded; quartz with some mica	1.0	4.0
Sherwood Sandstone	**c** 'Clayey' sand: fine, as above	2.0	6.0
	Sandstone, soft, micaceous	0.1+	6.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	6	94	0	1.2 - 2.2	6	60	34	trace	0	0
b	29	62	9	3.0 - 4.0	29	31	19	12	5	4
a + b	17	79	4	Mean	17	46	27	6	2	2
c	14	86	0	4.0 - 5.0	18	66	14	2	0	0
				5.0 - 6.0	9	65	24	2	0	0
				Mean	14	65	19	2	0	0
a+b+c	15	82	3	Mean	15	55	23	4	2	1

SE 60 NW E1 **6440 0820** **Dunsville** **Block A**

Surface level (+c. 7.6 m) +c.25 ft
1975

Overburden 0.2 m
Mineral 2.2 m
Waste 0.3 m
Mineral 2.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Older River Gravel	**a** Gravel and pebbly sand Gravel: mainly coarse, rounded to subrounded; sandstone, quartzite and quartz with some igneous rock Sand: fine to medium, subrounded to subangular; quartz with lithic grains	1.0	1.2
	b Sand: fine to medium, subrounded to subangular; quartz with mica and lithic grains	1.2	2.4
	Silty clay and clayey sand, yellow and grey	0.3	2.7
Sherwood Sandstone	**c** Sand: fine, subrounded to subangular, quartz with mica and lithic grains; small carbonaceous lenses	2.5+	5.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	2	54	44	0.2 - 0.4	1	15	27	9	17	31
				0.4 - 0.6	6	36	50	1	7	0
				0.6 - 1.2	1	18	25	2	18	36
				Mean	2	21	30	3	16	28
b	3	97	trace	1.2 - 2.4	3	44	52	1	trace	0
c	4	96	0	2.7 - 5.2	4	86	10	trace		
a+b+c	3	88	9	Mean	3	62	25	1	3	6

SE 60 NE 31 **6783 0979** **Acomb Common, Hatfield** **Block B**

Surface level (+2.7 m) +9 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.5 m
Mineral 8.6 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.5	0.5
25-Foot Drift and Older River Gravel on Sherwood Sandstone	'Clayey' to 'very clayey' sand: fine, subangular to rounded; quartz with rock fragments; some pebbles between 0.9 and 1.8 m	8.6	9.1
	Sandstone, buff, micaceous	0.1+	9.2

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
12	87	1	0.5 - 0.9	24	42	34	trace	0	0
			0.9 - 1.8	10	51	30	1	2	6
			1.8 - 3.7	9	63	27	1	trace	0
			3.7 - 4.6	12	60	28	trace	trace	0
			4.6 - 5.5	14	67	19	trace	0	0
			5.5 - 7.3	12	71	17	trace	0	0
			7.3 - 8.2	13	59	28	0	0	0
			8.2 - 9.1	17	59	24	trace	0	0
			Mean	12	62	25	trace	trace	1

SE 60 NE 32 **6920 0925** **Ferneholme Lodge** **Block B**

Surface level (+0.3 m) +1 ft
Water level -1.7 m (-6 ft)
March 1975

Waste 7.1 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark, peaty	0.5	0.5
25-Foot Drift	Clay, silty and sandy	1.0	1.5
	Clay, grey and red-brown, with silt laminae, patches of sand and carbonaceous debris	4.5	6.0
Sherwood Sandstone	'Clayey' sand: mainly fine, subangular to subrounded quartz; few fine rounded quartzite pebbles	1.1	7.1
	Sandstone, buff and grey, micaceous	0.1+	7.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
13	87	trace	6.0 - 6.3	21	46	26	6	1	0
			6.3 - 7.1	9	54	36	1	0	0
			Mean	13	52	33	2	trace	0

SE 60 NE 33 **6599 0809** **Lings Windmill, Hatfield** **Block B**

Surface level (+11.3 m) +37 ft
Water not encountered
March 1975

Overburden 1.0 m
Mineral 4.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.8	0.8
Older River Gravel on Sherwood Sandstone	Sandy clay, brown	0.2	1.0
	'Clayey' sand: fine and medium to 3.0 m, mainly fine below, subrounded to subangular; quartz with some mica and dark minerals; red and brown clay and yellow and green mudstone lenses	4.0	5.0
	Sandstone, soft, micaceous	0.1+	5.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
14	86	0	1.0 - 2.0	11	40	49	trace		
			2.0 - 3.0	10	42	48	trace		
			3.0 - 4.0	18	77	5	trace		
			4.0 - 5.0	17	72	11	trace		
			Mean	14	58	28	trace		

SE 60 NE 34 **6683 0868** **Field House, Hatfield** **Block A**

Surface level (+7.6 m) +25 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.5 m
Mineral 8.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, clayey and pebbly	0.5	0.5
Older River Gravel	Sandy gravel and pebbly sand Gravel: fine and coarse, rounded to subrounded; quartz and quartzite Sand: mainly fine and medium, subrounded to subangular; quartz with some mica and dark minerals	8.6+	9.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
6	70	24	0.5-1.8	9	20	36	10	15	10
			1.8-2.7	4	31	27	6	17	15
			2.7-3.7	5	36	24	6	14	15
			3.7-4.6	4	29	32	6	17	12
			4.6-5.5	2	39	37	5	9	8
			5.5-6.4	4	57	24	4	6	5
			6.4-7.3	6	39	28	8	12	7
			7.3-8.2	12	42	17	3	17	9
			8.2-9.1	7	46	18	2	19	8
			Mean	6	37	27	6	14	10

SE 60 NE 35 **6724 0821** **Balkend Farm, Hatfield** **Block B**

Surface level (+6.1 m) +20 ft
Water not encountered
February 1975

Overburden 0.1 m
Mineral 5.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.1	0.1
Older River Gravel	**a** 'Very clayey' pebbly sand Gravel: fine to coarse, rounded quartzite Sand: mainly fine, subrounded to subangular; quartz with dark minerals Fines: red, buff and yellow-orange clay	3.0	3.1
Sherwood Sandstone	**b** 'Clayey' sand: fine, subrounded to subangular; quartz with lithic grains, mica and some dark minerals	2.0	5.1
	Sandstone, micaceous	0.1+	5.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	22	73	5	0.1-1.1	12	59	25	1	3	0
				1.1-3.1	27	42	19	6	1	5
				Mean	22	48	21	4	2	3
b	12	88	0	3.1-4.1	13	64	23	trace		
				4.1-5.1	10	62	28	0		
				Mean	12	63	25	trace		
a+b	18	79	3	Mean	18	54	23	2	1	2

SE 60 NE 36 **6817 0871** **Hatfield Woodhouse** **Block B**

Surface level (+6.1 m) +20 ft
Water not encountered
March 1975

Overburden 0.5 m
Mineral 1.9 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil and dense brown clay	0.5	0.5
Older River Gravel on Sherwood Sandstone	Sand: fine, subrounded to subangular; quartz with mica and some dark minerals	1.9	2.4
	Sandstone, red, compact	0.1+	2.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
7	92	1	0.5-2.4	7	62	29	1	1	0

SE 60 NE 37 **6860 0824** **Hatfield Woodhouse Sewage Works** **Block B**

Surface level (+2.1 m) +7 ft
Water not encountered
March 1975

Overburden 1.0 m
Mineral 5.5 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
25-Foot Drift on Sherwood Sandstone	Sand, partly 'clayey': fine to medium, subangular to subrounded; quartz with some lithic grains and, below 4.3 m, mica	5.5	6.5
	Sandstone, red, micaceous	0.7+	7.2

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
10	90	0	1.0-2.0	17	47	35	1		
			2.0-3.0	8	63	28	1		
			3.0-4.3	3	59	38	trace		
			4.3-6.0	12	52	34	2		
			6.0-6.5	8	71	21	trace		
			Mean	10	56	33	1		

SE 60 NE 38 **6946 0834** **Chase Cottage, Hatfield** **Block C**

Surface level (+2.5 m) +8 ft
Water not encountered
March 1975

Overburden 0.5 m
Mineral 2.0 m
Waste 3.9 m
Mineral 3.1 m
Bedorck 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil; black, peaty	0.5	0.5
Blown Sand on 25-Foot Drift	**a** 'Very clayey' sand; fine subangular and subrounded; quartz with dark minerals; brown clay in matrix and as nodules	2.0	2.5
	Clay: red, brown and buff, part sandy, laminated; silty partings; organic matter in lower part	3.9	6.4
Older River Gravel	**b** Sandy gravel Gravel: mainly coarse, angular to rounded; quartz, quartzite and sandstone Sand: fine to medium, subangular to subrounded; quartz, some lithic grains	0.6	7.0
Sherwood Sandstone	**c** Sand; fine and medium, rounded; quartz with some mica	2.5	9.5
	Sandstone, red, hard	0.1+	9.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	26	74	0	0.5-1.5	28	52	20	trace		
				1.5-2.5	25	74	1	trace		
				Mean	26	63	11	trace		
b	3	51	46	6.4-7.0	3	26	19	6	9	37
a+b	21	68	11	Mean	21	54	13	1	2	9
c	9	91	trace	7.0-8.0	9	48	40	2	1	0
				8.0-9.5	9	56	34	1	0	0
				Mean	9	53	37	1	trace	0
a-b-c	15	79	6	Mean	15	54	24	1	1	5

SE 60 NE 39 **6668 0697** **Moor Hills, Hatfield** **Block D**

Surface level (2.7 m) +9 ft
Water not encountered
February 1975

Overburden 2.1 m
Mineral 5.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.3	0.3
25-Foot Drift	Clay, orange to light brown, laminated, with pockets of sand	1.0	1.3
	Sandy pebbly clay, laminated, with coal and plant debris	0.8	2.1
Older River Gravel	**a** Gravel, with pebbly sand at base Gravel: fine and coarse, well rounded; ironstone and sandstone with some quartzite and quartz and traces of igneous rock Sand: coarse and medium with some fine: subrounded and rounded; quartz and rock fragments Fines: mid brown silt and clay	4.0	6.1
Sherwood Sandstone	**b** Sand: mainly medium subrounded; quartz with some mica	1.0	7.1
	Sandstone, red, micaceous	0.1+	7.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	4	56	40	2.1-3.1	6	4	16	27	32	15
				3.1-4.1	4	4	10	22	21	39
				4.1-5.1	2	12	26	20	20	20
				5.1-6.1	3	26	37	20	7	7
				Mean	4	12	22	22	20	20
b	7	93	0	6.1-7.1	7	37	53	3	0	
a+b	5	63	32	Mean	5	17	28	18	16	16

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
3.1-4.1	5	22	0	55	0	1	17

SE 60 NE 40 **6671 0752** **Clownes Bridge, Blaxton** **Block C**

Surface level (+2.4 m) +8 ft
Water encountered at +1.9 m (+6.0 ft)
February 1975

Overburden 1.9 m
Mineral 4.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
25-Foot Drift	Topsoil, dark brown, sandy, on thin pale brown sand	0.7	0.7
Older River Gravel	Silty clay, orange, with some sand and gravel	1.2	1.9
	Sandy gravel Gravel: fine and coarse, subrounded to rounded; sandstone with quartzite and some ironstone, quartz and igneous rock Sand: fine to coarse, angular to rounded; quartz with ironstone and other lithic grains	4.0	5.9
Sherwood Sandstone	Sandstone, soft and weathered, brown	0.1+	6.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16$ mm	$+64$ mm
4	60	36	1.9-2.9	7	13	21	19	20	20	
			2.9-3.9	3	8	28	23	15	23	
			3.9-4.9	2	11	10	28	25	24	
			4.9-5.9	2	30	28	21	11	8	
			Mean	4	15	22	23	18	18	

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
1.9-2.9	3	35	0	52	0	3	7
2.9-3.9	2	22	trace	58	0	8	9

SE 60 NE 41 **6904 0748** **RAF Lindholme** **Block C**

Surface level (+3.6 m) +12 ft
Water not encountered
February 1975

Overburden 0.5 m
Mineral 3.2 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.5	0.5
Older River Gravel	**a** 'Clayey' sandy gravel	1.0	1.5
	Gravel: fine, subrounded to rounded; quartzite and quartz Sand: fine and medium, subrounded; quartz with some dark mineral grains		
Sherwood Sandstone	**b** 'Clayey' sand: fine; as above	2.2	3.7
	Sandstone, red, marly, micaceous	0.1+	3.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	14	61	25	0.5-1.5	14	27	29	5	25	0
b	15	84	1	1.5-2.5	14	56	28	1	1	0
				2.5-3.7	17	63	20	trace	0	0
				Mean	15	60	24	trace	1	0
a+b	15	77	8	Mean	15	49	26	2	8	0

SE 60 NE 42 **6533 0676** **Rake Bridge Farm, Hatfield** **Block B**

Surface level (+2.1 m) +7 ft
Water not encountered
February 1975

Overburden 0.3 m
Mineral 3.0 m
Waste 14.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.3	0.3
25-Foot Drift	'Clayey' sand; mainly fine, subrounded; quartz with traces of mica; lenses of clay throughout and thin clay parting at 3.0 m	3.0	3.3
Glacial Channel Deposits	Clay, silty, laminated in part, grey brown and red	14.7+	18.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16$ mm
17	82	1	0.3-2.3	14	53	31	1	1	0
			2.3-3.3	24	45	31	trace	0	0
			Mean	17	50	31	1	1	0

SE 60 NE 43 **6682 0639** **Low Grounds Farm** **Block D**

Surface level (+2.7 m) +9 ft
Water struck at +1.1 m (+4 ft)
February 1975

Overburden 1.7 m
Mineral 3.4 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
?25-Foot Drift	Clay, yellow-brown, sandy, laminated; rounded pebbles of quartzite	1.4	1.7
Older River Gravel	Sandy gravel with pebbly sand at base Gravel: mainly fine, subangular to rounded; sandstone with some quartzite, ironstone, quartz and igneous rock and traces of coal Sand: mainly medium to coarse, angular to rounded; quartz and lithic fragments	3.4	5.1
Sherwood Sandstone	Sandstone, grey; few pebbles	0.1+	5.2

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mmmm
4	58	38	1.7-2.7	4	7	24	29	25	11
			2.7-3.7	2	8	22	20	28	20
			3.7-4.7	4	14	22	21	25	14
			4.7-5.1	13	22	34	17	7	7
			Mean	4	11	24	23	24	14

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction — Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone	Coal
2.7-3.7	4	14	0	70	0	2	10	trace

SE 60 NE 44 **6793 0629** **RAF Lindholme** **Block C**

Surface level (+4.6 m) +15 ft
Water not encountered
February 1975

Overburden 0.4 m
Mineral 1.2 m
Waste 1.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, peaty	0.4	0.4
Older River Gravel	'Very clayey' sand: fine to medium, subangular to subrounded; quartz with dark minerals	1.2	1.6
	Clay, red, micaceous, firm	0.8	2.4
Sherwood Sandstone	'Very clayey' sand: mainly fine, subrounded; quartz with dark mineral and mica	0.4	2.8
	Sandstone, buff, micaceous	0.2+	3.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm	+64 mm
29	71	0	0.4-1.6	29	43	28	trace			

SE 60 NE 45 **6893 0632** **RAF Lindholme** **Block C**

Surface level (+2.7 m) +9 ft
Water not encountered
February 1975

Overburden 0.8 m
Mineral 6.6 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil on thin clay and peat	0.8	0.8
Older River Gravel	**a** 'Very clayey' sand, pebbly in lower part Gravel: mainly coarse, rounded to subrounded; sandstone with ironstone and some quartzite Sand: fine and medium, subrounded to subangular; quartz with sandstone and ironstone Fines: grey silt and clay	2.0	2.8
	b Gravel Gravel: mainly coarse, subrounded to subangular; quartzite quartz and sandstone Sand: fine to coarse, angular to rounded; quartz with ironstone, sandstone and siltstone Fines: brown and red-brown clay	3.0	5.8
Sherwood Sandstone	**c** Sand: fine and medium, subrounded; quartz with mica and dark minerals; few quartzite pebbles	1.6	7.4
	Sandstone, red, micaceous	0.1+	7.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	25	70	5	0.8-1.8	32	41	25	1	1	0
				1.8-2.8	18	43	28	1	2	8
				Mean	25	42	27	1	1	4
b	6	37	57	2.8-3.8	12	17	17	3	19	32
				3.8-4.8	4	16	10	23	41	
				4.8-5.8	3	13	22	9	17	36
				Mean	6	12	18	7	20	37
a+b	13	51	36	Mean	13	24	22	5	12	24
c	6	94	0	5.8-7.4	6	47	45	2		
a+b+c	12	61	27	Mean	12	29	28	4	9	18

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction								

SE 60 NE 46 **6929 0632** **Porters Drain, Hatfield Moors** **Block C**

Surface level (+2.7 m) +9 ft
Water encountered at -0.3 m (-1 ft)
February 1975

Overburden 3.0 m
Mineral 8.4 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Peat	Peat	3.0	3.0
Older River Gravel	**a** 'Very clayey' pebbly sand Gravel; fine and coarse, rounded quartz Sand: fine, angular and subangular quartz Fines: blue and grey clay matrix	1.0	4.0
	b Gravel Gravel: fine and coarse, subangular to rounded; quartzite with quartz, sandstone, some ironstone, and trace of igneous rock Sand; mainly medium and coarse, angular to rounded quartz and mainly angular lithic fragments	2.4	6.4
Sherwood Sandstone	**c** Sand, 'clayey' at top: fine, subangular to rounded quartz, with some mica	5.0	11.4
	Sandstone, soft, micaceous	0.1+	11.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	38	56	6	3.0-4.0	38	39	13	4	2	4
b	5	37	58	4.0-5.0	2	3	13	20	25	37
				5.0-6.4	7	7	16	14	31	25
				Mean	5	6	15	16	29	29
a+b	14	43	43	Mean	14	16	14	13	21	22
c	9	91	trace	6.4-7.4	17	47	35	1	trace	0
				7.4-8.4	9	55	35	1	trace	0
				8.4-9.4	6	60	33	trace	1	0
				9.4-11.4	7	62	31	trace	trace	0
				Mean	9	57	33	trace	trace	0
a+b+c	11	71	18	Mean	11	40	26	5	9	9

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
4.0-5.0	23	48	0	22	0	0	7

SE 60 NE 47 **6541 0578** **Holmwood Grange, Armthorpe** **Block B**

Surface level (+3.0 m) +10 ft
Water not encountered
February 1975

Overburden 2.3 m
Mineral 3.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.3	0.3
25-Foot Drift	Clay, stiff, well laminated, blue	2.0	2.3
?25-Foot Drift on Sherwood Sandstone	'Clayey' sand: mainly fine, subrounded quartz	3.0	5.3
	Sandstone, red, weathered, micaceous	0.1+	5.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
11	89	0	2.3-3.3	12	55	33	0		
			3.3-4.3	11	70	19	trace		
			4.3-5.3	10	57	33	0		
			Mean	11	60	29	trace		

SE 60 NE 48 **6608 0588** **Holme House, Armthorpe** **Block B**

Surface level (+6.1 m) +20 ft
Water encountered at +1.2 m (+4 ft)
February 1975

Overburden 1.3 m
Mineral 6.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.4	0.4
Older River Gravel	Clay, brown, with some sand and gravel and plant remains	0.9	1.3
?Older River Gravel on	Sand, 'clayey' in lower part: fine to medium, subangular to sub-rounded; quartz with mica and pale lithic grains	6.0	7.3
Sherwood Sandstone	Sandstone, buff	0.1+	7.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
9	91	0	1.3-2.3	6	46	47	1		
			2.3-3.3	6	51	42	1		
			3.3-4.3	7	49	44	0		
			4.3-5.3	12	51	37	0		
			5.3-6.3	11	52	37	0		
			6.3-7.3	11	51	38	0		
			Mean	9	50	41	trace		

SE 60 NE 49 **6734 0534** **Huggin Carr, Lindholme** **Block D**

Surface level (1.2 m) +4 ft
Water encountered at +0.2 m (+1 ft)
February 1975

Overburden 0.6 m
Mineral 8.9 m
Bedrock 4.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Older River Gravel	**a** Sandy gravel, 'very clayey' at top Gravel: mainly coarse, rounded to subangular; sandstone and quartzite with quartz, some igneous rock and ironstone, and traces of coal and mudstone Sand: fine to coarse, angular to rounded; quartz with rock fragments and some ironstone	4.9	5.5
Sherwood Sandstone	**b** Sand, pebbly at top, 'clayey' near base Gravel: coarse, rounded; quartzite with some sandstone Sand: mainly fine, subrounded to subangular; quartz with rock fragments and some mica	4.0	9.5
	Sandstone, red, micaceous	4.6+	14.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	11	45	44	0.6-2.0	31	23	13	4	7	22
				2.0-4.0	2	7	20	16	19	36
				4.0-5.5	4	21	22	11	7	35
				Mean	11	16	18	11	12	32
b	10	88	2	5.5-6.5	8	65	20	1	0	6
				6.5-7.5	9	53	37	1	0	0
				7.5-8.5	8	47	45	trace	0	0
				8.5-9.5	15	44	41	0	0	0
				Mean	10	52	35	1	0	2
a+b	11	64	25	Mean	11	32	26	6	7	18

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction —							
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone	Coal
2.0-4.0	12	44	0	35	trace	4	4	1

SE 60 NE 50 **6824 0547** **RAF Lindholme** **Block C**

Surface level (+3.6 m) +12 ft
Water not encountered
February 1975

Overburden 3.2 m
Mineral 5.8 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil and yellow stony subsoil	0.8	0.8
Older River Gravel	'Very Clayey' pebbly sand	0.6	1.4
	Clay, grey and brown, silty, with carbonaceous debris and some pebbles	1.8	3.2
	a Sandy gravel Gravel: fine to coarse, angular to rounded; quartzite with sandstone and quartz, some ironstone and trace of igneous rock Sand: mainly medium and coarse, angular to rounded; quartz and lithic grains	3.0	6.2
Sherwood Sandstone	**b** Sand: fine to medium, rounded quartz; scattered well rounded quartz pebbles	2.8	9.0
	Sandstone, red, micaceous	0.1+	9.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	5	46	49	3.2-4.2	6	8	17	24	30	15
				4.2-5.2	5	8	31	12	21	23
				5.2-6.2	3	12	17	10	18	40
				Mean	5	9	22	15	23	26
b	4	94	2	6.2-9.0	4	44	38	12	2	0
a+b	5	69	26	Mean	5	26	29	14	13	13

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction — Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
4.2-5.2	24	41	0	30	0	1	4

SE 60 NE 51 **6918 0551** **Porters Drain, Hatfield** **Block C**

Surface level (+3.4 m) +11 ft
Water encountered at +0.6 m (+2 ft)
February 1975

Overburden 3.0 m
Mineral 5.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Peat	Peat	3.0	3.0
Older River Gravel	**a** Gravel, with pebbly sand at base Gravel: fine and coarse, subangular to subrounded; sandstone and quartzite with ironstone and quartz Sand: fine, medium and coarse, subangular to subrounded; quartz and rock fragments	4.0	7.0
Sherwood Sandstone	**b** Sand: mainly fine, subrounded to subangular; quartz with some mica in lower part	1.0	8.0
	Sandstone, micaceous	0.2+	8.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	6	53	41	3.0-4.0	3	11	20	11	36	19
				4.0-5.0	16	13	18	6	20	27
				5.0-6.0	3	6	19	17	27	28
				6.0-7.0	4	38	34	18	6	0
				Mean	6	17	23	13	22	19
b	5	92	3	7.0-8.0	5	53	37	2	3	0
a+b	6	61	33	Mean	6	24	26	11	18	15

SE 60 SW 41 **6407 0467** **Holme Wood Lane, Armthorpe** **Block A**

Surface level (+6.7 m) +22 ft
Water not encountered
Minutemant Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.3 m
Mineral 5.2 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.3	0.3
Older River Gravel, on Sherwood Sandstone	'Clayey' sand: fine, subangular to rounded; quartz with some mica	5.2	5.5
	Sandstone, red-buff, micaceous	0.1+	5.6

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
19	81	trace	0.3-0.9	24	55	20	0	1	0
			0.9-1.8	33	63	4	trace	0	0
			1.8-3.7	6	49	44	1	0	0
			3.7-4.6	14	39	46	1	0	0
			4.6-5.5	35	35	30	trace	0	0
			Mean	19	48	32	1	trace	0

SE 60 SW 42 **6461 0473** **East of Holme Wood, Armthorpe** **Block A**

Surface level (+6.7 m) 22 ft
Water not encountered
January 1975

Overburden 0.8 m
Mineral 3.2 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Brown clayey soil	0.8	0.8
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: mainly coarse, subrounded to rounded; quartzite with some quartz Sand: fine to coarse, subrounded to subangular; quartz and lithic fragments	2.9	3.7
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine, subrounded; quartz with some mica	0.3	4.0
	Sandstone, red, micaceous	0.4+	4.4

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16$ mm
a	12	47	41	0.8-1.8	12	16	18	10	7	37*
				1.8-2.8	11	13	18	14	14	30
				2.8-3.7	13	16	19	17	18	17
				Mean	12	15	18	14	13	28
b	17	80	3	3.7-4.0	17	49	27	4	3	0
a+b	12	50	38	Mean	12	18	19	13	12	26

* Including 12 per cent cobbles

SE 60 SW 43 **6123 0379** **Sandall Beat Wood, Armthorpe** **Block E**

Surface level (+3.4 m) +11 ft
Water not encountered
February 1975

Overburden 1.8 m
Mineral 6.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, loamy	0.5	0.5
25-Foot Drift	Silty clay with plant debris and some gravel and sand	1.3	1.8
Older River Gravel	**a** Sandy gravel, clayey in upper part Gravel: fine and coarse, subangular to subrounded, sandstone with ironstone and some quartzite, mudstone and quartz Sand: fine to coarse, rounded to angular, quartz with sandstone, quartzite and ironstone	5.0	6.8
Sherwood Sandstone	**b** Sand; mainly fine and medium, subangular to subrounded; quartz with some mica (gravel in sample probably contamination from above)	1.0	7.8
	Sandstone, buff to red, micaceous	0.1+	7.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	8	45	47	1.8-2.8	12	14	20	15	20	19
				2.8-3.8	14	13	17	14	19	23
				3.8-4.8	11	11	15	15	14	34
				4.8-5.8	1	8	14	21	33	23
				5.8-6.8	1	10	18	24	33	14
				Mean	8	11	17	17	24	23
b	3	91	6	6.8-7.8	3	39	34	18	6	0
a+b	7	53	40	Mean	7	15	20	18	21	19

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction — Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
2.8-3.8	2	10	1	76	1	0	10

SE 60 SW 44 **6235 0379** **Tranmoor Wood, Armthorpe** **Block E**

Surface level (+8.6 m) +28 ft
Water not encountered
January 1975

Overburden 1.5 m
Mineral 1.0 m
Waste 3.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, clayey	0.5	0.5
Older River Gravel	Sandy and silty clay, bioturbated in upper part	1.0	1.5
	Very 'clayey' pebbly sand Gravel: mainly coarse, angular to subrounded; quartz and quartzite with some igneous material Sand: mainly fine, subrounded to angular: quartz and lithic fragments	1.0	2.5
Glacial Channel Deposits	Clay, very silty, with some pebbles and coal fragments	3.8	6.3
	'Iron-pan', incorporating fine and coarse gravel	0.1+	6.4
	Borehole abandoned due to technical difficulty.		

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
33	55	12	1.5-2.5	33	40	12	3	3	9

SE 60 SW 45 **6358 0344** **West Field Farm, Armthorpe** **Block E**

Surface level (+8.9 m) +29 ft
Water not encountered
January 1975

Overburden 0.5 m
Mineral 2.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.5	0.5
Older River Gravel	**a** 'Very clayey' pebbly sand Gravel: coarse with fine, rounded to subrounded quartzite Sand: fine and medium, subrounded to subangular; quartz with lithic material	1.3	1.8
Sherwood Sandstone	**b** 'Clayey' pebbly sand, red Gravel: mainly coarse, rounded; quartz and quartzite (?some contamination from above) Sand: fine, subrounded to subangular; quartz with some mica	0.7	2.5
	Sandstone, buff, micaceous	0.2+	2.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	28	59	13	0.5-1.8	28	31	22	6	4	9
b	13	82	5	1.8-2.5	13	71	9	2	1	4
a+b	22	68	10	Mean	22	46	17	5	3	7

SE 60 SW 46 **6489 0352** **Branton Grange** **Block D**

Surface level (+4.9 m) +16 ft
Water not encountered
March 1975

Overburden 1.5 m
Mineral 5.8 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, clayey, with pockets of sand and some pebbles	0.5	0.5
Older River Gravel	Clay, grey, silty and micaceous; pebbles of sandstone and quartzite and pockets of sand	1.0	1.5
	a Gravel, 'clayey' at top Gravel: fine to coarse, rounded to subrounded; quartzite and quartz with sandstone and some siltstone and igneous rock Sand: mainly medium to coarse, subangular to subrounded; quartz with some dark minerals and lithic fragments	5.0	6.5
Sherwood Sandstone	**b** 'Clayey' sand: fine to medium, subrounded to subangular; quartz with lithic grains	0.8	7.3
	Sandstone, buff to red, micaceous	0.1+	7.4

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	5	28	67	1.5 - 2.5	11	10	9	10	21	39
				2.5 - 3.5	8	8	13	16	22	33
				3.5 - 4.5	1	2	7	18	41	31
				4.5 - 5.5	2	3	13	11	40	31
				5.5 - 6.5	1	3	4	14	31	47
				Mean	5	5	9	14	31	36
b	10	90	0	6.5 - 7.3	10	48	41	1	0	0
a + b	5	37	58	Mean	5	11	14	12	27	31

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
4.5 - 6.5	23	63	0	14	0	trace	0

SE 60 SW 47 **6158 0319** **Sandall Beat Wood** **Block E**

Surface level (+8.0 m) +26 ft
Water encountered +2.0 m (+6 ft)
January 1975

Overburden 2.1 m
Mineral 5.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.4	0.4
25-Foot Drift	Clay, grey-brown, with pebbles, poorly laminated in parts	1.7	2.1
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: mainly coarse, subangular; sandstone, quartzite and ironstone with some quartz Sand: fine and medium, subrounded with subangular; quartz and rock fragments	0.7	2.8
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine; quartz with traces of dark minerals	4.3	7.1
	Sandstone, buff	0.1+	7.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	16	50	34	2.1 - 2.8	16	15	23	12	13	21
b	9	91	0	2.8 - 3.8	12	58	30	trace		
				3.8 - 4.8	13	61	26	0		
				4.8 - 5.8	10	74	16	0		
				5.8 - 7.1	3	60	37	0		
				Mean	9	63	28	0		
a + b	10	85	5	Mean	10	56	27	2	2	3

SE 60 SW 48 **6220 0294** **Crowther Wood** **Block E**

Surface level (+7.6 m) +25 ft
Water not encountered
February 1975

Overburden 0.5 m
Mineral 3.3 m
Waste 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
?25-Foot Drift on Older River Gravel	**a** 'Very clayey' pebbly sand Gravel: fine, subangular to subrounded quartzite and sandstone and rounded quartz Sand: mainly fine, subangular to subrounded quartz	1.3	1.8
	b 'Clayey' sandy gravel Gravel: fine and coarse, angular to rounded; quartz with some sandstone and ironstone and traces of igneous rock Sand: fine to coarse, subangular to subrounded quartz	2.0	3.8
	Clay, brown, stiff, stoney	1.0+	4.8
	Borehole abandoned due to technical difficulties		

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	26	67	7	0.5 - 1.8	26	35	19	13	7	0
b	18	51	31	1.8 - 2.8	21	14	19	14	17	15
				2.8 - 3.8	15	15	24	16	20	10
				Mean	18	14	22	15	18	13
a + b	21	57	22	Mean	21	22	21	14	14	8

SE 60 SW 49 **6326 0278** **South of Fore's Bridge** **Block E**

Surface level (+6.4 m) +21 ft
Water not encountered
February 1975

Overburden 0.6 m
Mineral 1.7 m
Waste 1.0 m
Mineral 1.4 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, clayey and stony	0.6	0.6
?25-Foot Drift on Older River Gravel	**a** 'Very clayey' sandy gravel Gravel: fine and coarse, rounded to subrounded quartzite Sand: fine to coarse, angular to rounded; quartz and lithic grains	1.7	2.3
	Clay, brown, compact, with some sand and scattered pebbles	1.0	3.3
	b 'Clayey' sandy gravel Gravel: mainly coarse, rounded; quartzite and sandstone with some quartz Sand: fine to coarse, angular to rounded; quartz and lithic grains	1.4	4.7
Sherwood Sandstone	Sandstone, red, micaceous	0.2+	4.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	29	47	24	0.6 - 1.6	36	25	15	8	8	8
				1.6 - 2.3	19	16	16	14	18	17
				Mean	29	21	15	11	12	12
b	14	37	49	3.3 - 4.7*	14	16	12	9	11	38
a + b	22	43	35	Mean	22	19	14	10	11	24

* Addition of water to facilitate drilling probably resulted in excessive loss of fines.

SE 60 SW 50 **6290 0234** **Cantley** **Block E**

Surface level (+8.3 m) +27 ft
Water not encountered
January 1975

Overburden 0.7 m
Mineral 2.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, clayey and stony	0.7	0.7
Older River Gravel on Sherwood Sandstone	Clayey sand: medium and fine, subrounded to rounded; quartz with some dark minerals; scattered nodules of yellow clay with carbonaceous debris	2.0	2.7
Sherwood Sandstone	Sandstone, red, micaceous	0.3+	3.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
12	88	trace	0.7 - 1.7	15	36	48	trace	1	0
			1.7 - 2.7	8	66	26	trace	0	0
			Mean	12	51	37	trace	trace	0

SE 60 SW 51 **6381 0243** **Gatewood Lane, Cantley** **Block E**

Surface level (+7.0 m) +23 ft
Water not struck
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.5 m
Mineral 5.3 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.5	0.5
Older River Gravel	**a** 'Clayey' pebbly sand Gravel: fine and coarse, subrounded to subangular; quartzite and sandstone with some ironstone Sand: fine and medium, subangular to angular quartz	3.2	3.7
Sherwood Sandstone	**b** 'Clayey' sand Sand: mainly fine, subrounded to subangular; quartz with some mica and dark minerals	2.1	5.8
	Sandstone, red, micaceous	0.1+	5.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	19	60	21	0.5 - 0.9	17	27	12	3	13	28
				0.9 - 1.8	22	41	22	3	4	8
				1.8 - 2.7	15	12	21	23	22	7
				2.7 - 3.7	21	35	20	11	9	4
				Mean	19	29	20	11	12	9
b	13	86	1	3.7 - 4.6	18	53	25	3	1	0
				4.6 - 5.8	9	53	35	2	1	0
				Mean	13	53	31	2	1	0
a + b	17	70	13	Mean	17	38	24	8	8	5

SE 60 SW 52 **6479 0234** **Kilham Plantation, Cantley** **Block E**

Surface level (+5.5 m) +18 ft
Water not encountered
January 1975

Overburden 0.4 m
Mineral 2.6 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.4	0.4
Older River Gravel	a Very 'clayey' pebbly sand Gravel: mainly fine, subrounded; quartzite with chert Sand: fine to medium, subrounded to rounded quartz	1.6	2.0
Sherwood Sandstone	b Sand: fine to medium, subrounded; quartz with some mica	1.0	3.0
	Sandstone, red, micaceous	0.1+	3.1

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	31	54	15	0.4 - 2.0	31	30	19	5	11	4
b	7	93	0	2.0 - 3.0	7	50	43	0	0	0
a + b	22	68	10	Mean	22	37	28	3	7	3

SE 60 SW 53 **6265 0119** **Black Carr Plantation, Cantley** **Block E**

Surface level (+8.8 m) +29 ft
Water not encountered
January 1975

Overburden 0.6 m
Mineral 5.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, clayey	0.6	0.6
Older River Gravel on Sherwood Sandstone	Sand: fine to medium, rounded to subrounded; quartz, with some dark minerals and, below 1.7 m, mica	5.7	6.3
	Sandstone, buff, micaceous	0.1+	6.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
8	92	trace	0.6 - 1.7	13	45	41	1	0	0
			1.7 - 2.7	6	30	62	1	1	0
			2.7 - 3.7	7	28	63	1	1	0
			3.7 - 6.3	8	57	35	0	0	0
			Mean	8	45	46	1	trace	0

SE 60 SW 54 **6350 0166** **Sandpit Hill, Branton** **Block E**

Surface level (+9.2 m) +30 ft
Water not encountered
January 1975

Overburden 0.8 m
Mineral 1.8 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, clayey	0.8	0.8
Older River Gravel on Sherwood Sandstone	'Clayey' sand: fine, rounded and subrounded; quartz with some dark minerals	1.8	2.6
	Sandstone, buff, micaceous	0.4+	3.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
13	86	1	0.8 - 1.8	13	59	25	1	2	0
			1.8 - 2.6	14	54	32	trace	0	0
			Mean	13	57	28	1	1	0

SE 60 SW 55 **6433 0158** **Branton** **Block E**

Surface level (+6.7 m) +22 ft
Water not encountered
January 1975

Overburden 0.8 m
Mineral 2.5 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, stony	0.8	0.8
Older River Gravel	**a** Sandy gravel, 'clayey' in upper part Gravel: mainly fine, rounded to subrounded; quartz and quartzite with sandstone and some ironstone and igneous rock Sand: fine and medium, subrounded to subangular quartz	1.9	2.7
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine, subrounded to subangular; quartz with some mica	0.6	3.3
	Sandstone, hard, red, micaceous	0.2+	3.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	7	50	43	0.8 - 1.8	10	23	19	5	22	21
				1.8 - 2.7	3	21	28	6	35	7
				Mean	7	22	23	5	29	14
b	15	84	1	2.7 - 3.3	15	74	10	trace	1	0
a + b	9	58	33	Mean	9	34	20	4	22	11

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
0.8 - 1.8	34	51	0	12	0	3	0

SE 60 SW 56 **6477 0045** **Mill Hill, Auckley** **Block F**

Surface level (+3.1 m) +10 ft
Water not encountered
January 1975

Mineral 3.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: mainly coarse, subrounded; quartzite and quartz Sand: fine and medium, subangular quartz	1.8	1.8
Sherwood Sandstone	**b** 'Clayey' sand: medium with fine; subangular to subrounded quartz	1.2	3.0
	Sandstone, red, micaceous	0.3+	3.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	16	52	32	0.0-1.0	14	25	22	3	7	29
				1.0-1.8	18	24	25	5	12	16
				Mean	16	24	24	4	9	23
b	11	87	2	1.8-3.0	11	33	51	3	2	0
a+b	14	66	20	Mean	14	28	35	3	6	14

SE 60 SE 16 **6507 0458** **Thornham Lane, Armthorpe** **Block D**

Surface level (+3.7 m) +12 ft
Water not encountered
Minuteman Auger, 4 in (100 m) diameter
April 1975

Overburden 2.3 m
Mineral 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
?25-Foot Drift	Soil on brown and yellow clay with some pebbles	2.3	2.3
Older River Gravel	'Very clayey' pebbly sand Gravel: fine and coarse, rounded; brown quartzite with some quartz Sand: fine and medium, subrounded to subangular quartz	0.5+	2.8
	Borehole stopped due to repeated obstruction		

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
27	67	6	2.3-2.8	27	32	31	4	3	3	

SE 60 SE 35 **6701 0457** **Great Gate Wood, Cantley** **Block D**

Surface level (+3.4 m) +11 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Waste 3.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.5	0.5
?Sherwood Sandstone	'Clayey' sand, pebbly at top Sand: mainly fine, subrounded; quartz with traces of mica	3.2	3.7
Sherwood Sandstone	Sandstone, red, micaceous	0.1+	3.8

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
17	82	1	0.5 - 0.9	26	31	22	13	8	0
			0.9 - 1.8	10	50	20	19	1	0
			1.8 - 2.7	15	53	17	15	0	0
			2.7 - 3.7	20	40	35	5	0	0
			Mean	17	45	24	13	1	0

SE 60 SE 34 **6985 0052** **Whin Covert, Blaxton** **Block F**

Surface level (+1.8 m) +6 ft
Water encountered at surface
January 1975

Overburden 1.0 m
Mineral 2.4 m
Waste 1.0 m
Mineral 3.8 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
25-Foot Drift	Soil on 0.2 m sandy clay	1.0	1.0
	a Sand, mainly 'very clayey': mainly fine, subangular to subrounded quartz	2.4	3.4
	Clay, firm, brown, slightly laminated	1.0	4.4
Older River Gravel	**b** Gravel Gravel: mainly coarse, rounded and subrounded; quartzite with quartz, some sandstone and traces of igneous rock Sand: mainly medium, subrounded to subangular; quartz with dark minerals	3.8	8.2
Sherwood Sandstone	Sandstone, green	0.8+	9.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
a	21	79	0	1.0 - 2.0	5	71	24	0		
				2.0 - 3.4	31	43	25	1		
				Mean	21	54	25	trace		
b	2	48	50	4.4 - 5.4	2	8	36	6	16	32
				5.4 - 6.3	2	11	54	10	10	13
				6.3 - 8.2	2	19	11	3	15	50
				Mean	2	14	28	6	14	36
a + b	9	60	31	Mean	9	30	26	4	9	22

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
4.4 - 5.4	25	66	0	8	0	1	

SE 60 SE 33 **6694 0069** **Poor's Land, Blaxton** **Block F**

Surface level (+4.9 m) +16 ft
Water not encountered
February 1975

Mineral 9.5 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Older River Gravel	**a** 'Very clayey' sandy gravel Gravel: coarse with fine, subrounded; quartzite with some quartz Sand: fine with medium, subangular to subrounded; quartz	3.2	3.2
?Older River Gravel on Sherwood Sandstone	**b** 'Clayey' sand with some pebbles Gravel: fine, rounded to subrounded; quartz and quartzite Sand: fine and medium, subrounded; quartz with some dark minerals	6.3	9.5
Sherwood Sandstone	Sandstone, brown, micaceous	0.2+	9.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
a	21	42	37	0.0 - 1.8	23	24	12	3	10	28
				1.8 - 3.2	20	26	13	5	20	16
				Mean	21	25	13	4	14	23
b	11	86	3	3.2 - 4.2	15	45	33	5	2	0
				4.2 - 5.2	12	50	35	1	2	0
				5.2 - 7.2	11	49	32	1	4	3
				7.2 - 9.5	9	49	41	1	0	0
				Mean	11	49	36	1	2	1
a + b	15	71	14	Mean	15	41	28	2	6	8

SE 60 SE 32 **6799 0145** **East of Blaxton Common Farm** **Block F**

Surface level (+4.3 m) +14 ft
Water not encountered
January 1975

Overburden 0.1 m
Mineral 9.1 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.1	0.1
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: fine with coarse, rounded to subrounded; quartzite and quartz with some igneous rock Sand: fine and medium, subrounded to subangular; iron stained quartz	2.3	2.4
	b Gravel Gravel: fine and coarse, angular to rounded; quartz and quartzite with sandstone and some igneous rock and ironstone Sand: medium to coarse, subrounded and rounded; quartz with some dark minerals	3.0	5.4
Sherwood Sandstone	**c** Sand: fine, subrounded to subanglar; quartz with some dark minerals	3.8	9.2
	Sandstone, red, micaceous	0.3+	9.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	13	51	36	0.1 - 0.4	16	24	12	4	20	24
				0.4 - 1.4	16	21	18	7	25	13
				1.4 - 2.4	9	17	34	9	20	11
				Mean	13	20	24	7	22	14
b	1	31	68	2.4 - 3.4	1	1	4	10	38	46
				3.4 - 4.4	1	5	20	16	37	21
				4.4 - 5.4	1	7	16	12	24	40
				Mean	1	4	14	13	33	35
a + b	6	39	55	Mean	6	11	18	10	29	26
c	5	95	0	5.4 - 7.3	4	90	4	2		
				7.3 - 8.4	9	60	30	1		
				8.4 - 9.2	2	48	38	12		
				Mean	5	72	19	4		
a+b+c	6	62	32	Mean	6	37	18	7	17	15

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
4.4 - 5.4	29	60	0	11	0	trace	trace

SE 60 SE 31 **6766 0143** **Blaxton Common Farm, Blaxton** **Block F**

Surface level (+4.3 m) +14 ft
Water not encountered
March 1975

Overburden 0.2 m
Mineral 5.3 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Fill	0.2	0.2
Older River Gravel	**a** Sandy gravel Gravel: mainly coarse, rounded to subrounded; quartzite and quartz Sand: mainly medium, subrounded to subangular quartz	1.3	1.5
Sherwood Sandstone	**b** 'Clayey' sand: mainly fine, subrounded to subangular; quartz with some mica and dark minerals; thin lenses of red, yellow and green marl from 2.5 to 3.5 m	4.0	5.5
	Sandstone, buff, micaceous	0.1+	5.6

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	4	65	31	0.2 - 1.5	4	21	38	6	10	21
b	12	88	trace	1.5 - 2.5	7	44	47	2	0	0
				2.5 - 3.5	21	56	21	1	1	0
				3.5 - 4.5	6	46	48	trace	0	0
				4.5 - 5.5	14	57	29	0	0	0
				Mean	12	51	36	1	trace	0
a + b	10	82	8	Mean	10	43	37	2	3	5

SE 60 SE 30 **6950 0242** **North of Carrside Farm, Blaxton** **Block F**

Surface level (+2.1 m) +7 ft
Water not encountered
January 1975

Overburden 0.2 m
Mineral 4.1 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, dark	0.2	0.2
Older River Gravel	**a** 'Clayey' sandy gravel Gravel: fine and coarse, angular to subangular; quartzite with quartz and some sandstone, ironstone and igneous rock Sand: fine and medium, subrounded to rounded quartz	3.2	3.4
Sherwood Sandstone	**b** Sand: mainly fine, rounded and subrounded; quartz with some mica	0.9	4.3
	Sandstone, red, micaceous	0.2+	4.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	10	51	39	0.2 - 1.2	8	29	19	4	18	22
				1.2 - 2.2	11	7	20	10	30	22
				2.2 - 3.4	11	28	26	9	12	14
				Mean	10	22	22	7	20	19
b	7	93	0	3.4 - 4.3	7	60	32	1		
a + b	10	60	30	Mean	10	30	24	6	15	15

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
0.2 - 3.4	26	58	0	7	0	8	1

SE 60 SE 29 **6830 0251** **East of Acomb Farm** **Block F**

Surface level (+1.8 m) +6 ft
Water not encountered
January 1975

Overburden 0.6 m
Mineral 2.4 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark, humus-rich	0.6	0.6
?Older River Gravel on Sherwood Sandstone	'Clayey' sand: mainly fine, subrounded to subangular; quartz with some mica; some lumps of clay in upper part and sandstone fragments towards base	2.4	3.0
	Sandstone, buff, micaceous	0.3+	3.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
	16	84	0	0.6 - 1.6	19	69	12	0		
				1.6 - 3.0	15	72	13	0		
				Mean	16	71	13	0		

SE 60 SE 27 **6654 0228** **Common Lane, Auckley** **Block FF**

Surface level (+3.1 m) +10 ft
Water encountered at -2.4 m (-8 ft)
January 1975

Overburden 1.3 m
Mineral 3.7 m
Waste 0.5 m
Mineral 2.8 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Blown Sand on 25-Foot Drift	Topsoil, dark, sandy	1.3	1.3
	a 'Clayey' sand: mainly fine, subangular to subrounded; quartz and pale lithic grains	3.7	5.0
	Silty clay, brown, poorly laminated	0.5	5.5
Sherwood Sandstone	**b** Sand: fine with medium, subrounded to subangular; quartz with some pale lithic grains; few rounded quartzite pebbles at 7.5 m	2.8	8.3
	Sandstone, red, micaceous	0.4+	8.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	11	89	0	1.3-2.3	13	54	33	0		
				2.3-3.3	9	61	29	1		
				3.3-4.3	7	85	8	0		
				4.3-5.0	15	80	5	0		
				Mean	11	69	20	trace		
b	6	93	1	5.5-6.5	7	45	48	0	0	0
				6.5-7.5	4	61	32	2	1	0
				7.5-8.3	6	64	28	1	trace	trace
				Mean	6	56	36	1	1	trace
a+b	8	92	trace	Mean	8	64	27	1	trace	0

SE 60 SE 28 **6722 0261** **Common Lane** **Block F**

Surface level (+3.1 m) +10 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Mineral 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Older River Gravel	'Very clayey' gravel	0.5+	0.5
	Borehole abandoned after meeting repeated obstruction		

SE 60 SE 27 **6654 0228** **Common Lane, Auckley** **Block F**

Surface level (+3.1 m) +10 ft
Water encountered at (-2.4 m) -8 ft
January 1975

Overburden 1.3 m
Mineral 3.7 m
Waste 0.5 m
Mineral 2.8 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Blown Sand on 25-Foot Drift	Topsoil, dark, sandy	1.3	1.3
	a 'Clayey' sand: mainly fine, subangular to subrounded; quartz and pale lithic grains	3.7	5.0
	Silty clay, brown, poorly laminated	0.5	5.5
Sherwood Sandstone	**b** Sand: fine with medium, subrounded to subangular; quartz with some pale lithic grains; few rounded quartzite pebbles at 7.5 m	2.8	8.3
	Sandstone, red, micaceous	0.4+	8.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	11	89	0	1.3 - 2.3	13	54	33	0		
				2.3 - 3.3	9	61	29	1		
				3.3 - 4.3	7	85	8	0		
				4.3 - 5.0	15	80	5	0		
				Mean	11	69	20	trace		
b	6	93	1	5.5 - 6.5	7	45	48	0	0	0
				6.5 - 7.5	4	61	32	2	1	0
				7.5 - 8.3	6	64	28	1	trace	trace
				Mean	6	56	36	1	1	trace
a + b	8	92	trace	Mean	8	64	27	1	trace	0

SE 60 SE 26 **6612 0279** **Outam Wood** **Block D**

Surface level (+4.3 m) +14 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Mineral 6.4 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Older River Gravel	**a** 'Very clayey' sandy gravel Gravel: coarse and fine, subrounded to subangular; quartzite and sandstone with some igneous rock Sand: fine, with medium, subrounded to subangular quartz	1.8	1.8
Sherwood Sandstone	**b** 'Clayey' sand: fine and medium, subrounded; quartz with some dark minerals	4.6	6.4
	Sandstone, buff, micaceous	0.1+	6.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	25	56	19	0.0 - 1.5	24	36	13	5	8	14
				1.5 - 1.8	29	27	24	13	3	4
				Mean	25	35	15	6	7	12
b	14	85	1	1.8 - 3.7	16	43	33	4	3	1
				3.7 - 4.6	12	48	39	1	trace	0
				4.6 - 5.5	12	47	40	trace	1	0
				5.5 - 6.4	12	42	45	1	0	0
				Mean	14	45	38	2	1	trace
a + b	17	76	7	Mean	17	42	31	3	3	4

SE 60 SE 25 **6952 0339** **Candy Farm, Blaxton** **Block C**

Surface level (+0.6 m) +2 ft
Water encountered at -1.2 m (-4 ft)
January 1975

Overburden 0.5 m
Mineral 5.1 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, black and peaty	0.5	0.5
Blown Sand on Older River Gravel	**a** 'Very clayey' sand; pebbly in places Gravel: fine, rounded; quartz and quartzite Sand: mainly fine, subrounded to rounded quartz	3.7	4.2
	b Gravel Gravel: fine and coarse, angular to subrounded; quartz and quartzite Sand: fine and medium, angular to subrounded; quartz and lithic fragments	1.4	5.6
Sherwood Sandstone	Sandstone, green, micaceous	0.4+	6.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	22	75	3	0.5 - 1.5	9	8	7	1	2	0
				1.5 - 2.5	33	48	16	1	2	0
				2.5 - 3.5	37	38	18	1	6	0
				3.5 - 4.2	5	58	35	1	1	0
				Mean	22	56	18	1	3	0
b	6	23	71	4.2 - 5.6	6	10	11	2	35	36
a + b	18	61	21	Mean	18	44	16	1	11	10

SE 60 SE 24 **6850 0334** **East of Torne Bridge** **Block C**

Surface level (+0.9 m) +3 ft
Water struck at -0.7 m (-2 ft)
January 1975

Overburden 0.6 m
Mineral 2.4 m
Waste 1.4 m
Mineral 2.0 m
Waste 1.0 m
Mineral. 4.0 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, brown, sandy	0.6	0.6
Blown Sand	**a** Sand: fine to medium quartz	2.4	3.0
25-Foot Drift	Clay, firm, brown	1.4	4.4
	b 'Clayey' sand: mainly fine, rounded to subangular; quartz with some coal	2.0	6.4
	Clay, firm, brown	1.0	7.4
	c 'Clayey' sand: mainly fine, subangular to subrounded; quartz with coal	1.0	8.4
Older River Gravel	**d** Sandy Gravel Gravel: fine to coarse, rounded to angular; quartzite, sandstone, and quartz. Sand: fine to coarse, angular to subrounded; quartz with rock fragments	3.0	11.4
Sherwood Sandstone	Sandstone, red, micaceous	0.4+	11.8

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	4	96	0	0.6 - 1.6	4	48	48	0	0	0
				1.6 - 3.0	4	65	31	0	0	0
				Mean	4	58	38	0	0	0
b	12	88	0	4.4 - 5.4	12	56	32	0	0	0
				5.4 - 6.4	13	64	23	0	0	0
				Mean	12	60	28	0	0	0
c	15	85	0	7.4 - 8.4	15	61	23	1	0	0
a+b+c	9	91	0	Mean	9	59	32	trace	0	0
d	1	51	48	8.4 - 9.4	1	8	21	12	28	30
				9.4 -11.4	1	23	21	12	20	23
				Mean	1	18	21	12	23	25
a+b+c+d	6	77	17	Mean	6	44	28	5	8	9

SE 60 SE 23 **6773 0310** **Torne Bridge, Blaxton** **Block F**

Surface level (+1.5 m) +5 ft
Water struck at -0.5 m (-2 ft)
January 1975

Waste 6.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, dark, peaty	0.8	0.8
25-Foot Drift	Clay, brown, poorly laminated; scattered rootlets	2.0	2.8
Sherwood Sandstone	Sand, mainly 'clayey': mainly fine, subangular to subrounded quartz	3.2	6.0
	Sandstone, red, micaceous	0.1+	6.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-$\frac{1}{16}$	+$\frac{1}{16}$ -$\frac{1}{4}$	+$\frac{1}{4}$ -1	+1 -4	+4 -16	+16 mm
9	91	0	2.8 - 3.8	13	71	16	0		
			3.8 - 4.8	10	73	17	0		
			4.8 - 6.0	5	69	25	1		
			Mean	9	71	20	trace		

SE 60 SE 22 **6705 0398** **East of Gate Farm, Blaxton** **Block D**

Surface level (+3.4 m) +11 ft
Water encountered at -1.8 m (-6 ft)
January 1975

Overburden 1.7 m
Mineral 1.9 m
Waste 0.9 m
Mineral 2.4 m
Waste 0.7 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil, dark	0.4	0.4
25-Foot Drift	Clay, brown, with grey silty laminations and rootlets	1.3	1.7
	a 'Very clayey' sand: mainly fine, subangular to subrounded; quartz with some dark minerals; lumps of brown clay throughout	1.9	3.6
	Clay, brown, with silty and micaceous laminae	0.9	4.5
Older River Gravel	**b** Gravel Gravel: coarse and fine, angular to rounded; quartz and quartzite with dark igneous rock Sand: fine to coarse, subangular to subrounded; quartz with some rock fragments	2.4	6.9
	Clay, brown	0.7	7.6
Sherwood Sandstone	Sandstone, grey-green, micaceous	0.4+	8.0

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
a	25	75	0	1.7 - 2.7	15	58	27	0		
				2.7 - 3.6	36	44	20	0		
				Mean	25	51	24	0		
b	6	36	58	4.5 - 5.2	8	19	6	8	17	42
				5.2 - 6.9	5	6	9	23	25	32
				Mean	6	10	8	18	22	36
a + b	14	52	34	Mean	14	27	14	11	13	21

SE 60 SE 21 **6629 0360** **Cock Wood** **Block D**

Surface level (+4.0 m) +13 ft
Water not encountered
Minuteman Auger, 4 in (100 mm) diameter
April 1975

Overburden 0.2 m
Mineral 1.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Older River Gravel	'Very clayey' sandy gravel Gravel: fine, subrounded to angular; sandstone with ironstone, quartzite and some quartz Sand: fine to coarse, rounded to angular; quartz with lithic fragments	1.6+	1.8
	Borehole abandoned after meeting repeated obstructions		

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
22	55	23	0.2 - 0.9	15	16	16	14	29	10
			0.9 - 1.8	27	24	21	17	10	1
			Mean	22	20	19	16	18	5

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
0.2 - 0.9	7	13	0	66	0	0	14
0.9 - 2.1	4	7	0	54	0	0	35
Mean	6	12	0	63	0	0	19

SE 60 SE 20 **6552 0339** **Thornham Wood Pumping Station** **Block D**

Surface level (+4.0 m) + 13 ft
Water not encountered
March 1975

Overburden 1.3 m
Mineral 2.8 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, stony	0.3	0.3
	Clay, mottled yellow and brown, stony	1.0	1.3
Older River Gravel	'Clayey' sandy gravel Gravel: fine to coarse, subrounded to angular; sandstone with ironstone, some quartz and quartzite and traces of siltstone and igneous rock Sand: fine to coarse, subrounded to angular quartz	2.8	4.1
Sherwood Sandstone	Sandstone, red, soft, micaceous	0.6+	4.7

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
16	54	30	1.3 - 2.3	16	24	20	9	16	15
			2.3 - 3.3	16	14	20	16	22	12
			3.3 - 4.1	17	19	27	14	15	8
			Mean	16	19	22	13	18	12

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
2.3 - 4.1	5	6	trace	72	trace	1	16

SE 60 SE 19 **6911 0490** **East of Tire'em Hall Hatfield, Woodhouse** **Block C**

Surface level (+3.0 m) +10 ft
Water level -2.0 m (-7 ft)
February 1975

Overburden 3.2 m
Mineral 3.8 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Peat	Peat	3.2	3.2
Older River Gravel	Gravel, sandy at top Gravel: fine to coarse, angular to rounded; quartzite and sandstone with quartz and some ironstone and igneous rock Sand: fine to coarse, angular to subangular; quartz with rock fragments	3.8	7.0
Sherwood Sandstone	Sandstone, red, micaceous	0.3+	7.3

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				-1/16	+1/16 -1/4	+1/4 -1	+1 -4	+4 -16	+16 mm
4	44	52	3.2 - 4.2	5	13	22	15	17	28
			4.2 - 5.2	2	7	21	10	10	50
			5.2 - 7.0	5	7	22	15	23	28
			Mean	4	9	21	14	18	34

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
3.2 - 5.2	16	44	0	33	0	3	4

SE 60 SE 18 **6824 0467** **East of Boston Park Farm** **Block C**

Surface level (+2.7 m) +9 ft
Water struck at +0.1 m (3 ft)
January 1975

Overburden 1.9 m
Mineral 4.4 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, brown, clayey	0.6	0.6
	Not recorded	1.3	1.9
?Older River Gravel on Sherwood Sandstone	Sand, 'very clayey' at top: mainly fine, subrounded to subangular; quartz with some dark minerals and mica near base	4.4	6.3
	Sandstone, red and grey, micaceous	0.2+	6.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines	Sand			Gravel	
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
9	91	0	1.9 - 2.9	23	71	6	trace		
			2.9 - 3.9	5	54	41	trace		
			3.9 - 4.9	5	60	35	trace		
			4.9 - 5.9	6	66	28	trace		
			5.9 - 6.3	5	72	23	trace		
			Mean	9	64	27	trace		

SE 60 SE 17 **6625 0446** **North of Great Gate Wood** **Block D**

Surface level (+3.7 m) +12 ft
Water not encountered
March 1975

Waste 4.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, clayey	0.3	0.3
Older River Gravel	Clay, brown, stony, sandy in lower part; thin coaly band at 2.7 m	3.7	4.0
Sherwood Sandstone	Sandstone, red, micaceous	0.2+	4.2

SE 60 SE E1 **6637 0452** **North of Great Gate Wood** **Block D**

Surface level (+3.7 m) +12 ft
March 1975

Overburden 0.4 m
Mineral 4.6 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Topsoil	0.4	0.4
Older River Gravel	**a** 'Very clayey' pebbly sand Gravel: fine, rounded and subrounded; sandstone with quartzite and quartz Sand: fine to coarse, subangular to subrounded; quartz with lithic grains	1.3	1.7
	b Gravel, partly sandy Gravel: mainly fine, subrounded to rounded; sandstone with quartzite and some quartz, mudstone and igneous rock Sand: medium to coarse, subangular to rounded; quartz and lithic fragments, including abundant coal at 2.6 m	3.3	5.0
Sherwood Sandstone	Sand, red, very firm	0.3+	5.3

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 mm
a	27	61	12	0.4 - 1.2	30	30	22	10	5	3
				1.2 - 1.7	22	15	23	22	13	.5
				Mean	27	24	22	15	8	4
b	8	46	46	1.7 - 2.5	7	5	16	18	32	22
				2.5 - 3.3	9	7	51	19	14	trace
				3.3 - 3.8	7	2	2	10	42	37
				3.8 - 5.0	9	2	19	23	33	14
				Mean	8	4	23	19	30	16
a + b	13	51	36	Mean	13	10	23	18	23	13

COMPOSITION

Depth below surface (m)	percentages by weight in gravel fraction						
	Quartz	Quartzite	Flint & Chert	Sandstone	Mudstone & Siltstone	Igneous Rock	Ironstone
0.4 - 1.7	16	13	0	70	1	0	0
1.7 - 3.3	2	9	0	86	3	trace	0

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THE SAND AND GRAVEL RESOURCES OF ARMTHORPE, SOUTH YORKSHIRE

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

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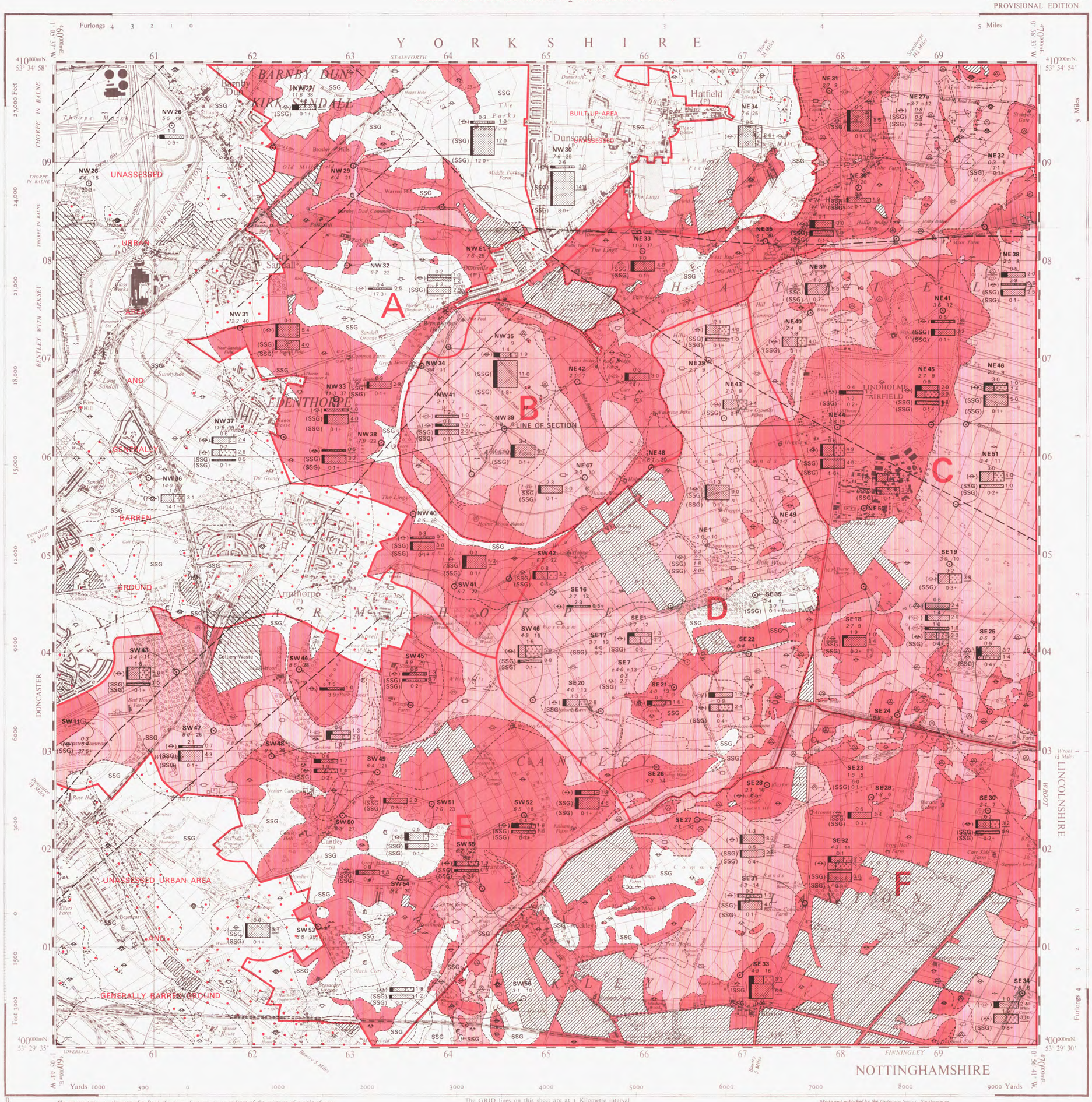

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Data quoted for an individual borehole refer strictly to that site; reliable conclusions cannot be drawn about the thickness and grading elsewhere in the deposit, particularly in material as variable as sand and gravel. However, estimates of the volume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

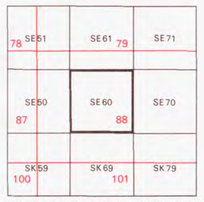

Diagram showing the relation of the National Grid 1:25 000 sheets with the New Series One-Inch Geological sheets.

THE SAND AND GRAVEL RESOURCES OF ARMTHORPE, SOUTH YORKSHIRE

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

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EXPLANATION OF SYMBOLS AND ABBREVIATIONS

DRIFT

- **Alluvium**-clay and silt — A-21
- **Peat** — P-1
- **Blown Sand**-fine sand — BS-7
- **Sand of 25-foot Drift of Vale of York**-mainly fine 'clayey' sand — SA-6
- **Silt and Clay of 25-foot Drift of Vale of York**-partly laminated silt and clay — SI-7
- **Head**-soliflucted sandy clay and 'clayey' sand — H-37
- **Older River Gravel** } sand and gravel, 'clayey' in part — OR-15
- **Glacial Sand and Gravel** } sand and gravel, 'clayey' in part — GS-28
- **Boulder Clay**-stiff grey clay with erratics — BC-34

RECENT AND PLEISTOCENE

SOLID

- SSG **Sherwood (Bunter) Sandstone**-red to red-brown, fine to medium sandstone

PERMO-TRIASSIC

- **Made Ground (excluding restored sand and gravel workings)** — MG-6
- **Approximate extent of ground worked for sand and gravel** — WG-4

BOUNDARY LINES

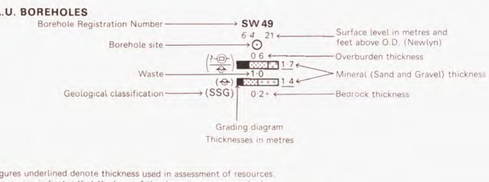
- Geological boundary, Drift.
- Geological boundary, Solid.
- Fault, crossmark indicates downthrow side.
- Inferred boundary between recognised categories of deposits.
- Resource Block boundary.

Broken line denotes uncertainty.

BOREHOLE DATA

- Site of Industrial Minerals Assessment Unit (I.M.A.U.) boreholes.
- Site of other boreholes.

I.M.A.U. BOREHOLES



Note:
(i) Figures underlined denote thickness used in assessment of resources.
(ii) The + sign indicates that the base of the deposit was not reached.
(iii) The figures in *italics* are the metric conversions of the measurements recorded in feet.
(iv) The geological classification is given only for mineral and bedrock.

Borehole Registration Number
Each I.M.A.U. borehole is identified by a registration number, e.g. **SW 49.**
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 49** is **SE 60 SW 49**

Grading Diagrams
Each grading diagram shows the mean particle size distribution of a distinct deposit of mineral.

The height of the diagram is proportional to the mineral thickness

The widths of the divisions show the proportions of **Fines, Sand** and **Gravel.**

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

EXPOSURE RECORDS
Information from the inspection of exposures is shown in the same way as for boreholes, but is located by an asterisk, thus ✳.

CATEGORIES OF DEPOSITS

- **Exposed mineral, assessed.** — CAT-E2
- **Continuous or almost continuous spreads of mineral beneath overburden.** — CAT-C1
- **Sand and gravel either not potentially workable (see Report) or absent.** — CAT-A2
- **Sand and gravel not assessed.** — CAT-N1

Where appropriate on other sheets a category 'Discontinuous spreads of mineral beneath overburden' is recognised.

RESOURCE BLOCKS

For the purpose of assessment the mineral is divided into Resource Blocks (see Report). Each is designated by a letter.

A horizontal section showing the general relationships of the drift and solid deposits along the line of section constitutes Fig 1 of the Report.

Detailed records may be consulted on application to the Director at the appropriate offices of the Institute of Geological Sciences.

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