

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

Description of 1:25 000  
resource sheet SK 69

A. R. Clayton

*Contributor*

G. D. Gaunt

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.

Any enquiries concerning this report may be addressed to Head, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Keyworth, Nottingham NG12 5GG.

## 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 resources of sand and gravel of the country around Bawtry, South Yorkshire, shown on the accompanying 1:25 000 resource map SK 69. The survey was conducted by Mr A. R. Clayton under the supervision of Mr D. Price, assisted in the drilling and sampling programme by Mr D. P. Best. The work, which was controlled from the sub-unit in Leeds (J. H. Hull, Officer-in-Charge) is based on six-inch scale geological surveys carried out by Institute Field Staff in 1946, 1958-60, 1962 and 1969, and published on new-series one-inch geological sheets 88 (Doncaster) and 101 (East Retford). The account of the geology of the area has been contributed by Dr G. D. Gaunt of the Yorkshire and East Midlands Unit. Mr J. W. Gardner, CBE (Land Agent) has been responsible for negotiating access to land for drilling. The ready cooperation of land owners and tenants in this work is gratefully acknowledged.

Austin W. Woodland  
*Director*

Institute of Geological Sciences  
Exhibition Road  
London SW7 2DE

8 December 1977

## CONTENTS

<b>Summary</b>	1
<b>Introduction</b>	1
<b>Description of the resource sheet</b>	2
General	2
Topography	3
Geology	3
Composition of the sand and gravel deposits	5
The map	6
Results	7
Notes on resource blocks	9
Notes on the sand and gravel workings in the area	15
<b>Appendix A:</b> Field and laboratory procedures	16
<b>Appendix B:</b> Statistical procedure	16
<b>Appendix C:</b> Classification and description of sand and gravel	18
<b>Appendix D:</b> Explanation of the borehole records	20
<b>Appendix E:</b> List of boreholes and exposures used in the assessment of resources	22
<b>Appendix F:</b> Industrial Minerals Assessment Unit borehole records	23
<b>Appendix G:</b> Conversion table—metres to feet	84
<b>References</b>	85

## FIGURES

1	Map showing the location of sheet SK 69	2
2	Schematic sections across the area showing the relationships between the Drift deposits	4
3	Map showing the relationship between the principal sand and gravel deposits and the resource block boundaries	6
4	Mean particle size distributions for the assessed thickness of mineral in resource blocks A to H	8
5	Comparison of the grading characteristics of the upper and lower mineral deposits of resource blocks B, C, E, F and G	9
6	Example of resource block assessment: calculation and results	17
7	Example of resource block assessment: map of a fictitious block	17
8	Diagram showing the descriptive categories used in the classification of sand and gravel	19

## MAP

The sand and gravel resources of the country around Bawtry, South Yorkshire *in pocket*

## TABLES

1	List of geological deposits	3
2	The sand and gravel resources of the country around Bawtry, South Yorkshire: summary of statistical results	7
3	Block A: data from IMAU boreholes	10
4	Block B: data from IMAU boreholes	11
5	Block C: data from IMAU boreholes	11
6	Block D: data from IMAU boreholes	12
7	Block E: data from IMAU boreholes	12
8	Block F: data from IMAU boreholes	13
9	Block G: data from IMAU boreholes	14
10	Block H: data from IMAU boreholes	15
11	List of active and disused workings	15
12	Classification of gravel, sand and fines	19



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

Description of 1:25 000 resource sheet SK 69

A. R. CLAYTON

## SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information and 81 boreholes drilled for the Industrial Minerals Assessment Unit, form the basis of the assessment of sand and gravel resources of the country around Bawtry, South Yorkshire.

All deposits in the area which 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 1:25 000 map is divided into eight resource blocks, containing between 2.2 and 14.0 km<sup>2</sup> of sand and gravel. For each block the geology of the deposits is described and the mineral-bearing area, the mean thicknesses 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.

## 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, both the economic and the social factors used to decide whether a deposit may be workable in the future cannot 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; 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 geological evidence. The sites available for inspection, measurement, and sampling are too widely 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 the No. 240 mesh B.S. sieve, about  $\frac{1}{16}$  mm) should not exceed 40 per cent.
- d The deposit must 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 which 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.

For the purposes of this survey, the unconsolidated, friable parts of the Bunter Sandstone occurring beneath superficial sand and gravel deposits have been taken to be mineral; the remainder of the Bunter Sandstone has not been assessed (see p. 5).

### *Bibliographical reference*

CLAYTON, A. R. 1979. The sand and gravel resources of the country around Bawtry, South Yorkshire: description of 1:25 000 resource sheet SK 69. *Miner. Assess. Rep. Inst. Geol. Sci.*, No. 37.

### *Author and contributor*

A. R. Clayton,  
Institute of Geological Sciences, Keyworth,  
Nottingham NG12 5GG

G. D. Gaunt, BSc, PhD  
Institute of Geological Sciences, Ring Road Halton,  
Leeds LS15 8TQ

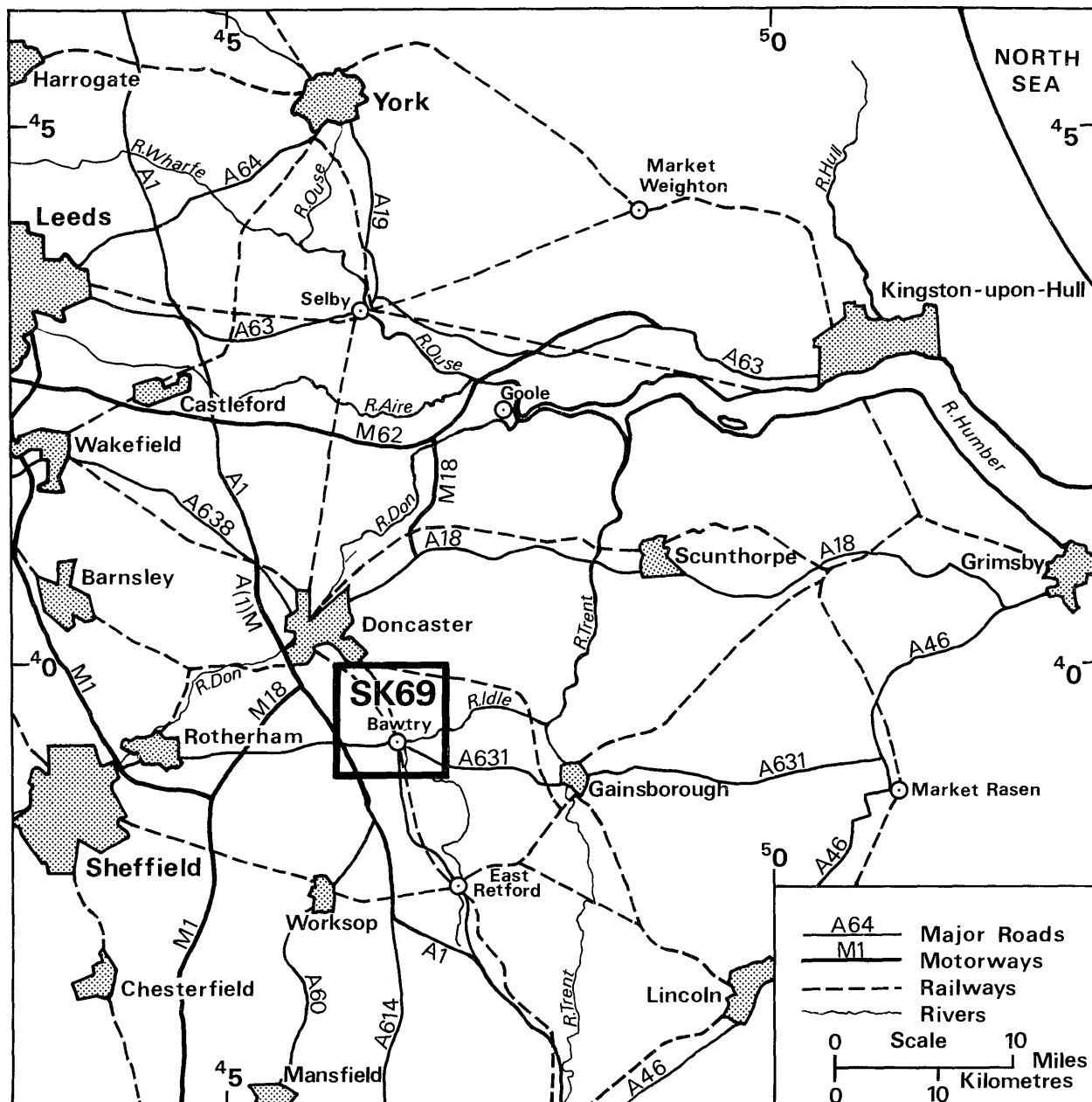


Figure 1 Map showing the location of sheet SK 69

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale  $\frac{1}{16}$  mm,  $\frac{1}{4}$  mm, 1 mm, 4 mm, 16 mm has been adopted. The boundaries between fines (that is, the clay and silt fractions) and sand, and between sand and gravel material, are placed at  $\frac{1}{16}$  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<sup>2</sup> of sand and gravel. No account is taken of any factors, for example, roads, villages and 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 the mineral in parts of a block, except in the immediate vicinity of the actual sample points.*

## DESCRIPTION OF THE RESOURCE SHEET

### GENERAL

Bawtry is situated on the River Idle, 14 km (9 miles) south-east of Doncaster (Figure 1). It is served by the Great North Road (A638) and the Rotherham-Gainsborough road (A631); the main Leeds to London railway line passes close to the town. The surrounding country is intensively cultivated, producing cereals, root and green crops, with pasture-land confined to the lower ground. Two collieries are present within the area and have given rise to the settlements of New Rossington [615 980] and Bircotes [635 917].

In the northern and central part of the area there are extensive gravel workings which have been a feature of the landscape since the turn of the century. These workings extend over approximately 750 hectares (1850 acres) and an estimated 20 million m<sup>3</sup> of sand and gravel have been extracted. Some of the worked areas may still contain quantities of sand and gravel or gravel-bearing backfill.

## TOPOGRAPHY

The area is one of generally low relief lying between 5 and 125 feet (1.5 and 38 m) above OD. A north–south ridge rises from about 50 feet (15 m) above OD near Rossington to about 125 feet (38 m) in the far south near Bircotes; in the south-east the isolated Barrow Hills [675 920] reach a similar elevation. The area west of the ridge is drained by the northwards flowing River Torne and to the east are the Rivers Ryton and Idle, the latter flowing northwards to Bawtry and then eastwards past Misson.

## 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 2. A detailed account of the geology of the southern part of the area is given by Smith and others (1973).

*Bunter Sandstone:* The term ‘Bunter Sandstone’ is used here for all Triassic rocks older than the Keuper Marl, which in the south are divided into Lower Mottled Sandstone below and Bunter Pebble Beds above. The entire area is underlain by Bunter Sandstone so defined. It is up to 300 m thick, has a gentle easterly dip and is the main aquifer of the region.

The sandstone is generally pink or brown, commonly cross-bedded and is fine to coarse grained and locally micaceous. It is commonly friable, even at depth, and near the surface maybe unconsolidated (see ‘Bunter Sand’, p. 5). In the north pebbles are rare, but in the south, notably around Harworth and west of Everton, some beds contain small rounded pebbles. The sandstone commonly contains lenses and rolled fragments of red or green mudstone. It is exposed around New Rossington [605 980], Harworth (620 920) and Everton [692 910].

*Keuper Marl:* The Keuper Marl crops out on the higher ground south of Everton, giving rise to clayey soils. It consists of mainly red mudstones and siltstones but with some greyish green beds. Gypsum, present elsewhere, has not been recorded in this area. White or blue clay recorded in an old clay pit [698 909] east of Everton (Aveline, 1880, pp. 24–25) probably indicates the presence of Green Beds at the base of the Keuper Marl (Smith and Warrington, 1971, p. 204), but they have not been mapped.

**Table 1** List of geological deposits

DRIFT		
Quaternary	Peat	Flandrian
	Alluvium	
	Blown sand	Devensian
	First Terrace	
	25-Foot Drift of the Vale of York	
	Head	
	Older River Gravel	Ipswichian
	Glacial Sand and Gravel	Wolstonian
Sandy boulder clay	and/or Anglian	
Boulder clay		
Glacial channel deposits*		
SOLID		
Triassic	Keuper Marl	
	Bunter Sandstone (= Lower Mottled Sandstone + Bunter Pebble Beds in the south)	

*Glacial channel deposits:* Several channels have been excavated to appreciable depths in the solid rocks of the area and infilled with a variety of deposits, chiefly laminated clay and, in the basal parts of the channels, sand and gravel. One of the channels, with a west–north-westerly trend, passes close to Rossington and is shown by borehole NW 54 to have been incised to a depth of more than 20 m below OD. Another channel with a similar trend passes to the south of Hunster Grange [624 967], and its easterly extension may be indicated by borehole NW 67, which proved 11.9 m of laminated silty clay beneath 0.5 m of soil. A third channel, apparently having an east–north-easterly trend, is present between Harworth and Bircotes, and was proved in boreholes SW 57, SW 61 and SW 62. There is evidence of other smaller channels, particularly east of Limpool Farm [614 948], where borehole SW 54 proved 14.6 m of silty sand and laminated clay. The cutting and filling of these channels are inexplicable except as a result of sub-glacial drainage (Gaunt and others, 1972, p. 3).

*Boulder clay:* This deposit occurs chiefly on the relatively high ground east of Rossington [645 985] and between Rossington and Austerfield [645 965]. It is generally thin and probably not more than a metre thick in most places. It rests directly on Bunter Sandstone, or, in a few places, on glacial channel deposits.

*Sandy boulder clay:* Between Harworth and Bawtry, and in a small area north-west of Austerfield, there are deposits of reddish brown clayey sand containing pebbles and cobbles, termed sandy boulder clay (Smith and others, 1973, pp. 217, 221–223). Thicknesses of up to 6 m have been proved in boreholes. Most of the contained pebbles are of quartzite, together with a few of Carboniferous and Permian rocks. Borehole information suggests that these deposits have similar lithological (and mechanical) characteristics to those of the adjacent Glacial Sand and Gravel. Sandy boulder clay rests mainly on Bunter Sandstone, but also on glacial channel deposits.

*Glacial Sand and Gravel:* Widespread deposits of Glacial Sand and Gravel, generally less than 5 m thick, but locally up to 8 m, occur above 15 m OD. They exhibit some cross bedding and are locally cryoturbated at the top. Most of the contained pebbles are of quartzite but a few consist of Carboniferous sandstone and flint. The deposits rest variously on Bunter Sandstone, boulder clay and glacial channel deposits, and are ‘interpreted as sediments transported from the Midlands by northward-flowing meltwater during the Wolstonian glaciation’ (Gaunt and others, 1972, p. 3).

*Older River Gravel:* These deposits form extensive outcrops at elevations up to 12 m above OD and are generally not more than 6 m thick. The sands and gravels making up the deposits exhibit both parallel and cross bedding, and locally contain thin clayey lenses. The pebble content of the gravel is similar to that of the Glacial Sand and Gravel. The Older River Gravel is of fluvial origin and was derived from the south, largely, if not entirely, in Ipswichian times (Gaunt and others, 1972; Gaunt, 1974).

\* Not distinguished from boulder clay on the map.





*Head:* Solifluxion has resulted in the localised accumulation of sandy clay and clayey sand, in places with scattered pebbles, in valleys and depressions. The main outcrops are at Twelve Months Carr [643 998], along the margins of the Torne valley and between Rossington and Bawtry. These Head deposits are generally less than 2 m thick.

*25-Foot Drift:* Deposits correlated with the 25-Foot Drift of the Vale of York occupy a channel incised into Older River Gravel north-east of Austerfield and also form a small outcrop north of Mission. They occur below 5 m OD and are up to 7 m thick. They consist of laminated clays which pass into thinly-bedded, fine-grained silty sand downwards and near the outcrop margins, and were accumulated in a low-level phase of Devensian Lake Humber (Gaunt and others, 1971; Gaunt, 1974).

*First Terrace:* Deposits of silty and clayey sand, in places pebbly, form a terrace feature along the margins of the Idle valley south of Austerfield. To the north they pass laterally into the 25-Foot Drift of the Vale of York.

*Blown sand:* To the east of Finningley there are small outcrops of fine grained blown sand up to 1.5 m thick, which rest mainly on 25-Foot Drift but extend westwards on to Older River Gravel. They are believed to be late Devensian in age (Gaunt and others, 1971).

*Alluvium:* Sandy clay forms the alluvium of the rivers Torne, Idle and Ryton. The deposit is generally less than 4 m thick but may be thicker beneath the low-lying ground north-west of Rossington.

*Peat:* Extensive peat is present in the Idle and Torne valleys and to the north of Rossington, and smaller outcrops occur east of Austerfield and Finningley. The peat is commonly less than 2 m thick, although in the Idle valley it may reach 4 m locally.

#### COMPOSITION OF THE SAND AND GRAVEL DEPOSITS

Eight potentially workable sand and gravel deposits occur within this area; blown sand, First Terrace, sand of the 25-Foot Drift of the Vale of York, Older River Gravel, Glacial Sand and Gravel, sandy boulder clay, glacial channel deposits and part of the Bunter Sandstone, here termed 'Bunter Sand'.

'*Bunter Sand*': 'Bunter Sand' is defined as the upper, friable and unconsolidated part of the Bunter Sandstone; its base is taken as the depth below which a Standard Penetration Test gives a penetration of less than 10 cm (4 inches) for 50 blows of the hammer, corresponding to a 'very dense' soil (Terzaghi and Peck, 1967, pp. 304, 341). Deposits of 'Bunter Sand' are considered to be 'mineral' where they occur beneath Drift sand and gravel deposits, and where they are likely to be worked along with the overlying sand and gravel. In such areas 'Bunter Sand' has been assessed separately wherever possible, but where it occurs beneath waste or at the surface it has not been included in the assessments which follow. 'Bunter Sand' is predominantly a 'clayey' sand with traces of gravel (usually less than 2 per cent) but with variable proportions of fines which may occur as soft mudstone pellets. The sand fraction is most commonly fine grained, although medium sand may be dominant locally; coarse

sand averages about 1 per cent of the fraction. The sand is well sorted and mainly consists of rounded grains of quartz; dark-coloured mineral grains and finely comminuted mica are conspicuous constituents although they are present only in minor proportions (generally less than 5 per cent of the fraction). The gravel comprises fine, subrounded quartz and quartzite pebbles, with variable amounts of Carboniferous sandstone.

*Glacial channel deposits:* The mineral occurring within these deposits is predominantly pebble-free 'clayey' sand, although beds of pebbly sand or sandy gravel are present locally, for example in boreholes SW 61 and SW 62. The sand fraction is predominantly fine grained and well sorted with conspicuous fragments of mica and coal; the fines content is generally more than 15 per cent. Pebbles are of subrounded quartz and quartzite together with subangular siltstone.

*Sandy boulder clay:* Although this deposit consists predominantly of 'clayey' pebbly sand, the fines content ranges from about 2 to 33 per cent and the gravel content rarely exceeds 10 per cent. The sand fraction is commonly fine or medium grained with coarse sand generally comprising less than 3 per cent of the fraction. Major constituents are quartz and quartzite; finely comminuted mica and coal are conspicuous, though together they make up less than 2 per cent of the sand by weight. The gravel fraction is fine and coarse grained; the pebbles are of quartzite and sandstone, in approximately equal proportions, together with quartz and traces of limestone and mudstone.

*Glacial Sand and Gravel:* This deposit has a mean grading of fines 11 per cent, sand 65 per cent and gravel 24 per cent, but it varies both vertically and laterally from pebble-free sand to sandy gravel. The sand fraction is usually medium grained in the north (Block B) but is generally finer to the south (Block C); coarse sand is present only in minor proportions. The sand grains are rounded and well sorted, but locally may be poorly sorted, and consist mainly of quartz and quartzite. The gravel comprises mainly fine and coarse pebbles but beds of cobbles occur in places. The pebbles and cobbles are predominantly subrounded and commonly comprise about 60 per cent quartzite, 20 per cent quartz and 15 per cent sandstone, with smaller proportions of limestone, chert and igneous or metamorphic rocks. A hard, ferruginous cement is present in varying proportions in the gravelly beds to the south of Cadmans Plantation [642 981].

*Older River Gravel:* Locally this deposit ranges from gravel to 'clayey' pebbly sand, but has a mean grading of fines 13 per cent, sand 59 per cent and gravel 28 per cent. The sand fraction is fine or medium grained; coarse sand is rare. The principal constituents are subrounded quartz and quartzite. The gravel fraction may be fine or coarse grained and may include cobbles locally. The pebbles are usually subrounded and comprise about 50 per cent quartzite, 25 per cent quartz and 15 per cent sandstone, with smaller proportions of limestone, mudstone, chert, igneous and metamorphic rock types. Thin clay seams are present throughout the deposit; coal fragments which are abundant farther north are generally absent.

*Sand of the 25-Foot Drift of the Vale of York:* This deposit has a mean grading of fines 14 per cent, sand

85 per cent and gravel 1 per cent; locally the fines content may reach 35 per cent; the gravel content rarely exceeds 5 per cent. For the most part the sand fraction is fine grained, well sorted and composed of subrounded quartz grains and quartzite fragments. Pebbles are of fine size, generally subrounded and predominantly of quartzite with subordinate amounts of quartz, sandstone, igneous rocks, soft mudstones and siltstones.

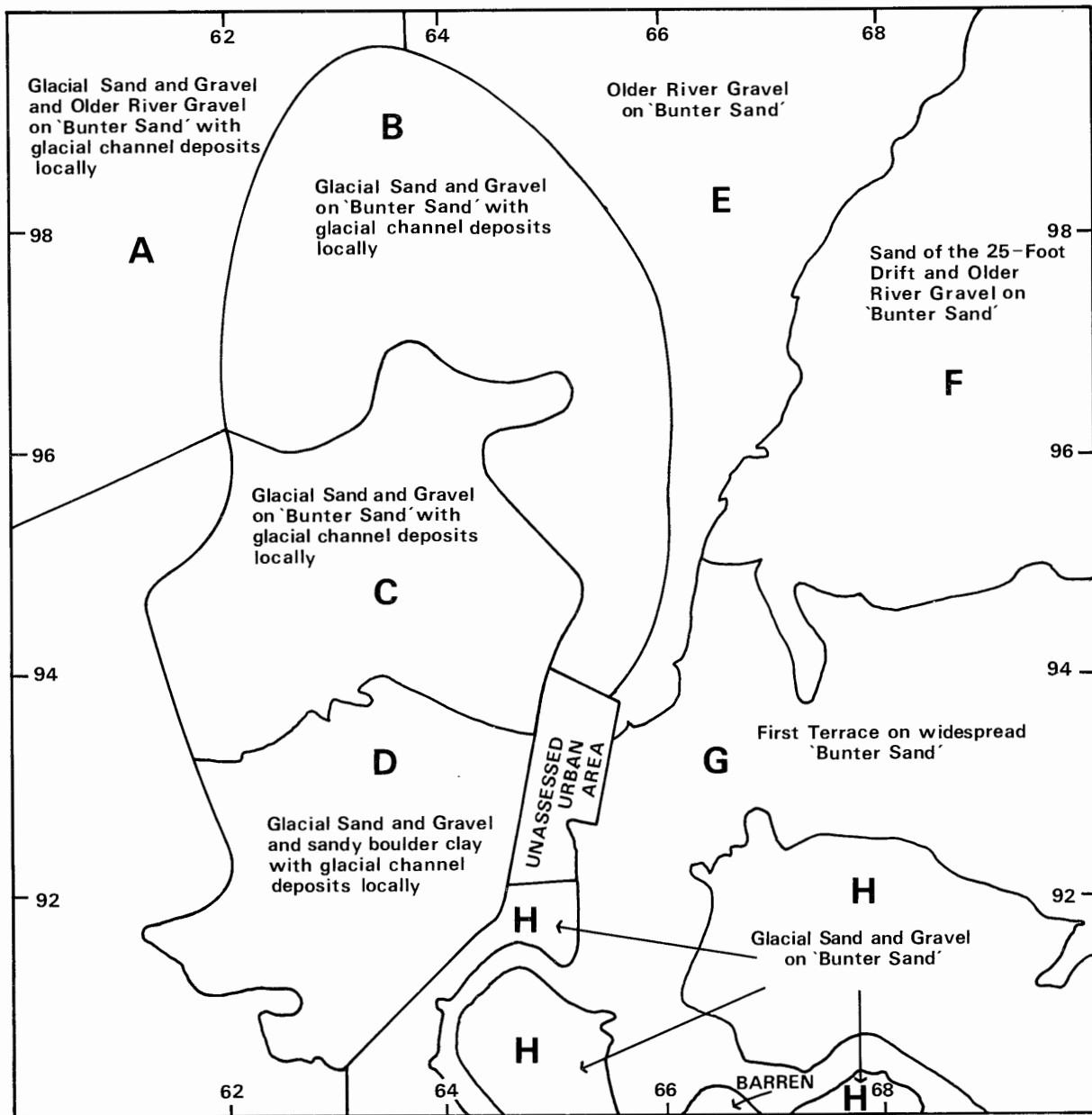
*First Terrace:* The First Terrace deposits range from gravel to 'clayey' sand, but have a mean grading of fines 8 per cent, sand 62 per cent and gravel 30 per cent. The sand fraction is poorly sorted, predominantly medium grained and composed of subrounded quartz, with lithic fragments similar to those occurring in the gravel fraction. The pebbles are mainly of coarse size, subrounded, and comprise about 65 per cent quartzite, 20 per cent quartz and 10 per cent sandstone, with smaller proportions of limestone, siltstone and mudstone together with harder metamorphic or igneous rocks.

*Blown sand:* These deposits consist of clean, fine-grained, quartz sands.

**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 topography is shown by contours in green, the geological data in black and the mineral resource information in shades of red.

*Geological data:* The geological boundary lines, symbols, etc., shown are taken from the geological map of this area recently surveyed at the scale of 1:10 560. This information was obtained by detailed application of field mapping techniques by the field staff of the Institute's Yorkshire and East Midlands Unit. Borehole data, which include the stratigraphic relations, thicknesses and mean particle size distribution of the sand and gravel samples collected during the assessment, are also shown.



**Figure 3** Map showing the relationship between the principal sand and gravel deposits and the resource block boundaries

**Table 2** The sand and gravel resources of the country around Bawtry, South Yorkshire: summary of statistical results.

Block	Subdivision†	Area		Mean thickness		Volume of sand and gravel			Mean grading percentage		
		Block	Mineral	Overburden	Mineral	Limits at the 95% confidence level			Fines - 1/8 mm	Sand + 1/8 - 4 mm	Gravel + 4 mm
		km <sup>2</sup>	km <sup>2</sup>	m	m	m <sup>3</sup> × 10 <sup>6</sup>	± % Speculative	± m <sup>3</sup> × 10 <sup>6</sup>			
A	Undivided*	10.0	3.6	1.8	3.3	12			9	78	13
B	Upper	12.6	6.6	0.4	2.0	13	45	6	14	56	30
	Lower	12.6	6.8	-	3.3	23	84	19	17	82	1
	Combined	12.6	6.8	0.4	5.4	36	45	16	16	72	12
C	Upper	9.3	5.2	0.4	1.9	10	56	5	15	62	23
	Lower	9.3	5.2	-	2.5	13	41	5	15	84	1
	Combined	9.3	5.2	0.4	4.4	23	41	9	15	74	11
D	Undivided	7.9	5.6	0.9	5.2	28	45	13	16	78	6
E	Upper	10.0	4.9	1.3	3.5	17	55	9	12	60	28
	Lower*	10.0	4.9	-	0.7	3	Speculative		18	82	trace
	Combined	10.0	4.9	1.3	4.2	20	65	13	13	64	23
F	Upper	15.1	14.1	2.3	2.9	41	35	14	14	59	27
	Lower	15.1	14.1	-	3.0	42	53	22	13	86	1
	Combined	15.1	14.1	2.3	5.9	83	24	20	13	73	14
G	Upper	14.0	10.5	1.4	3.2	44	34	15	8	62	30
	Lower	14.0	14.0	-	2.0	28	50	14	10	89	1
	Combined	14.0	14.0	1.4	5.2	72	17	12	9	73	18
H	Undivided	11.2	2.2	0.1	4.0	9	52	5	9	87	4
BLOCKS A to H		90.1	56.4	1.2	5.1	288	11	32	13	74	13

\* Inferred assessments. † See notes on resource blocks.

The geological boundaries are regarded as the best interpretation of the information available at the time of the survey. However, it is inevitable, particularly with deposits (such as those represented in this area) which change rapidly vertically and laterally, that local irregularities or discrepancies will be revealed by some boreholes (as, for example, at borehole NE 51). These are taken into account in the assessment of the resources (see Appendix B).

*Mineral resource information:* The mineral-bearing ground is subdivided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is exposed, that is where overburden averages less than 1 m in thickness, and areas where it is present in continuous spreads beneath overburden. The 'almost continuous' or 'discontinuous' mineral categories have not been recognised in this area.

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 which 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 sand and gravel is measured, where possible, from the mapped geological boundary lines.

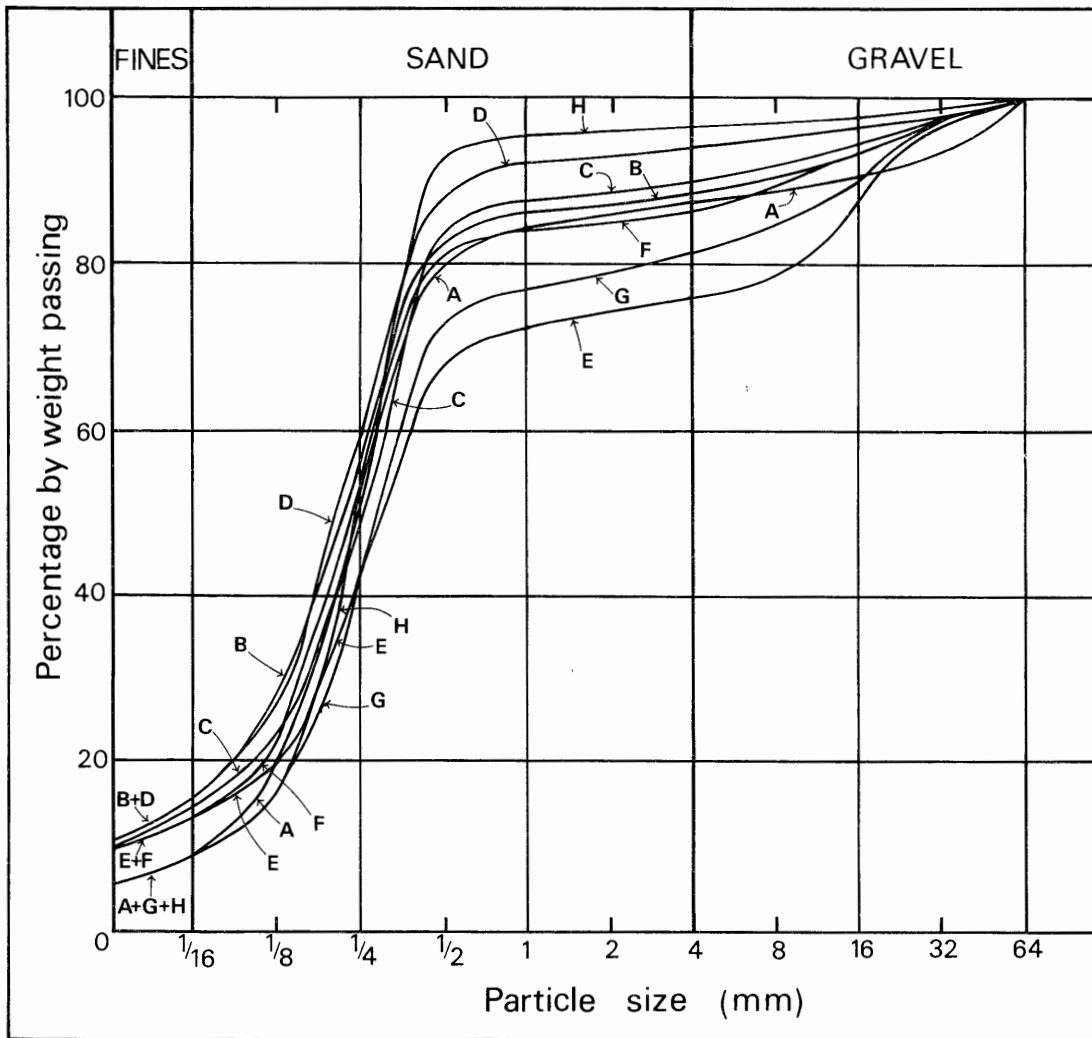
The whole of this area is considered as mineral, although it may include small areas where sand and gravel is not present or is not potentially workable. Inferred boundaries have been inserted where sand and gravel beneath cover is interpreted to be not potentially workable or absent. Such boundaries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

*Worked areas and made ground:* The approximate extent of known sand and gravel workings to Spring 1976 are shown on the map; active and disused workings are indicated, together with areas which have been returned to agricultural use and areas partly backfilled with waste from the sand and gravel industry. Workings which have been filled with mixed waste or refuse, together with colliery waste heaps, are shown as 'made ground'.

## RESULTS

The statistical results are summarised in Table 2. Fuller grading particulars are shown in Figures 4 and 5.

*Accuracy of results:* Seven of the eight resource blocks have been statistically assessed although an inferred assessment was made for part of Block E; for Block A an

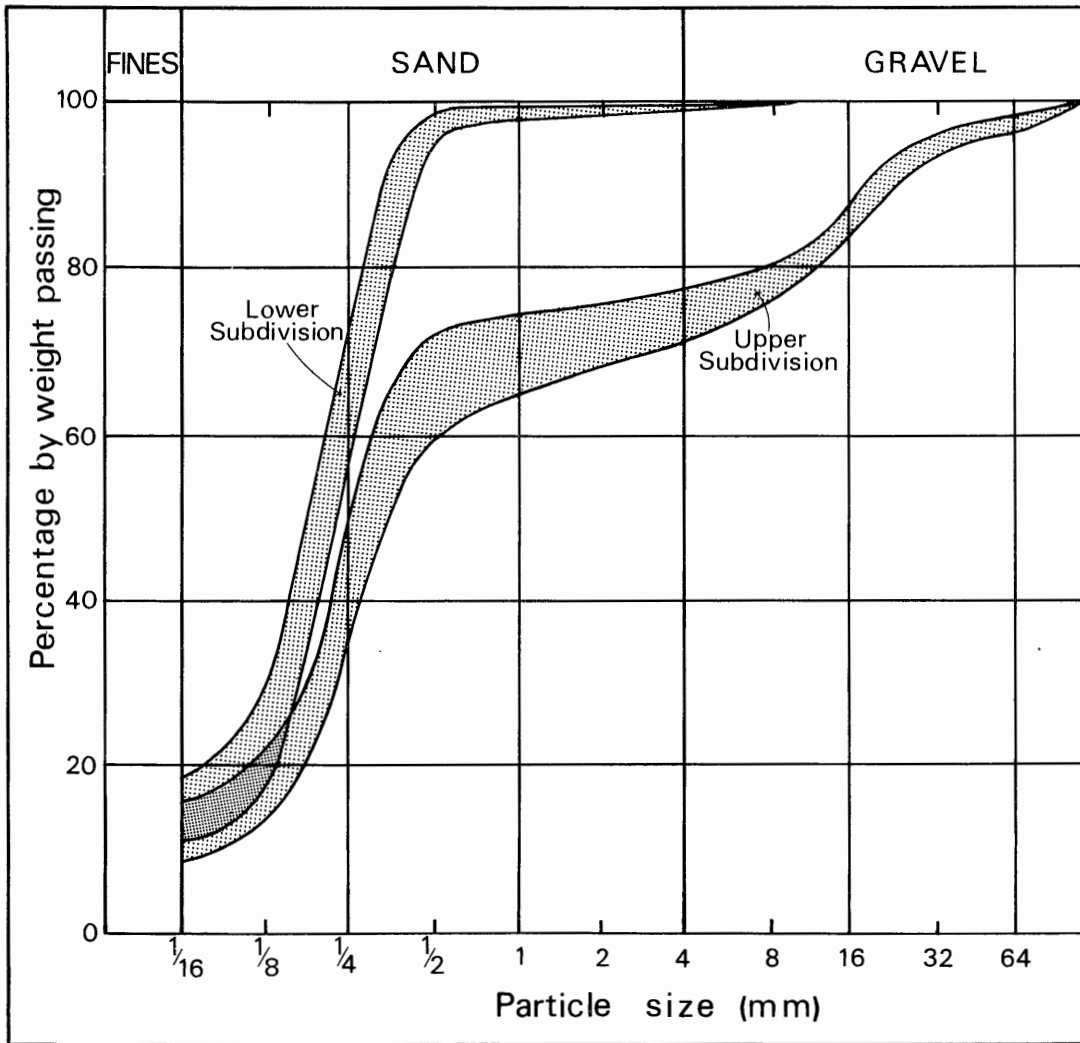


Block	Percentage by weight passing									
	$\frac{1}{16}$ mm	$\frac{1}{8}$ mm	$\frac{1}{4}$ mm	$\frac{1}{2}$ mm	1 mm	2 mm	4 mm	8 mm	16 mm	32 mm
A	9	20	53	81	84	86	87	88	90	98
B	16	29	58	83	86	87	88	90	93	98
C	15	23	52	85	87	88	89	91	94	98
D	16	28	60	89	92	93	94	95	96	98
E	13	20	46	69	72	74	77	79	88	98
F	13	22	54	82	84	85	86	89	93	98
G	9	16	45	74	77	79	82	85	90	97
H	9	16	53	93	95	95	96	96	97	99

Figure 4 Mean particle size distributions for the assessed thickness of mineral in resource blocks A to H.

inferred assessment has been made (Table 2). For the statistically assessed resource blocks the accuracy of the combined results at the 95 per cent probability level ranges from 17 to 65 per cent (that is, it is probable that 19 times out of 20 the true volumes lie within the given limits of the mean). However, the true values are more likely to be nearer the figures estimated than the limits. Where the mineral within a block is subdivided, the limits for each subdivision are usually greater than for the whole, thereby reflecting the variable thickness of the respective deposits and the reduced number of sample points available for the calculation. Moreover, it is probable that in each block approximately the same percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say 200 acres)

containing similar sand and gravel deposits, if the results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for the quotation of the reserves in part of a block, it can be expected that data from more than ten sample points will be required, even if the area is quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel on this sheet. The total volume (288 million m<sup>3</sup>) can be estimated to limits of  $\pm 11$  per cent at the 95 per cent probability level, by a calculation based on the data from eighty-eight sample points spread across the eight resource blocks. However it must be emphasised that the quoted volume of sand and gravel has no simple relationship with the amount that could be extracted in



**Figure 5** Comparison of the grading characteristics of the upper and lower mineral deposits of resource blocks B, C, E, F and G: the shaded areas indicate the envelope within which the mean grading curves of the respective deposits fall

practice, as no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of land for mineral working.

#### NOTES ON RESOURCE BLOCKS

Within the area covered by sheet SK 69 an assessment has been made of all sand and gravel-bearing Drift (Quaternary) deposits, together with those parts of the underlying Bunter Sandstone which are considered to be 'mineral' ('Bunter Sand' deposits). Exposed Bunter Sandstone and that present beneath sand and gravel-free Drift deposits has not been assessed. Two mineral components are assessed in most blocks: the lower consists mainly of 'Bunter Sand', but locally includes glacial channel deposits and sand of the 25-Foot Drift; the upper subdivision comprises the remaining Drift sand and gravel deposits. These subdivisions are not identified in blocks A, D or H where the assessments refer to all the mineral in each block. The relationships between the resource blocks and the principal sand and gravel deposits are shown in Figure 3. Block boundaries have been chosen which encompass areas of sand and gravel of similar characteristics, without particular regard to the age or genesis of the deposits.

#### Block A

The mineral in this block comprises small elevated outcrops of Glacial Sand and Gravel and Older River Gravel (about 1.5 km<sup>2</sup> in area) which overlie 'Bunter Sand' deposits; in addition, glacial channel deposits are present beneath 2.1 km<sup>2</sup> of the peat and alluvium of the block. The assessed deposits occur in two areas, respectively to the north and south of Rossington.

The Glacial Sand and Gravel and Older River Gravel of the block vary widely in grade and thickness, locally they may be indistinguishable from underlying 'Bunter Sand' deposits. Mineral within the glacial channel deposits varies in grade from sandy gravel to 'clayey' sand, and in many places it also has similar characteristics to the 'Bunter Sand'. Only deposits of 'Bunter Sand' occurring beneath the Glacial Sand and Gravel and Older River Gravel have been included in the assessment. These deposits are not generally present beneath the glacial channel deposits; they are not considered to be potentially workable where they are not directly associated with other potentially workable sand and gravel. Mineral was proved in five assessment boreholes, and was absent from boreholes NW 52 and NW 54 (Table 3).

Only an inferred assessment has been attempted for the combined thicknesses of Drift and 'Bunter Sand' deposits. The mean proved thickness of mineral is 3.3 m

**Table 3** Data from IMAU boreholes: Block A, all deposits

Borehole	Recorded thickness		Mean grading percentage					
	Mineral	Overburden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm
	m	m						
NW 50	1.7	2.8	29	54	16	1	0	0
NW 51	5.2	0.8	9	43	46	1	0	1
NW 52	absent	-	-	-	-	-	-	-
NW 53	3.7	0.0	15	48	10	1	9	17
NW 54	absent	-	-	-	-	-	-	-
NW 55	3.9	8.0	8	25	28	5	5	29
NW 56	7.5	0.7	1	51	37	2	5	4
<b>Block Mean Grading</b>			<b>9</b>	<b>44</b>	<b>31</b>	<b>3</b>	<b>3</b>	<b>10</b>

and the estimate of mineral volume is approximately 12 million m<sup>3</sup>. The mean grading of the mineral in the block is fines 9 per cent, sand 78 per cent and gravel 13 per cent, although grading characteristics vary markedly between boreholes. The mean proved thickness of overburden is 1.8 m.

#### Block B

Mineral is present over a little more than half the area of this block; a further 2 km<sup>2</sup> have been worked for sand and gravel and the remainder is barren. The mineral has been subdivided into an upper part, consisting of Glacial Sand and Gravel, and a lower part comprising 'Bunter Sand' with local developments of mineral within the glacial channel deposits. Both mineral subdivisions are locally present beneath Head deposits in the south and east of the block but in the north-west near Littleworth [627 988] only the lower subdivision is present.

The Glacial Sand and Gravel has a mean thickness of 2.0 m but ranges in assessment boreholes from 0.6 m thick near the edges of the outcrop (borehole NE 37) to a maximum recorded thickness of 4.0 m (borehole NE 38) near the extensively worked areas of the south of the block (Table 4). The mean grading is fines 14 per cent, sand 56 per cent and gravel 30 per cent.

In six IMAU boreholes the lower mineral subdivision comprises 'Bunter Sand' between 1.2 and 4.7 m thick, whereas in three others mineral, between 4.7 and 13.4 m thick, was proved within the glacial channel deposits. There is little compositional variation between these two deposits; the mean grading is fines 17 per cent, sand 82 per cent and gravel 1 per cent.

The mean recorded thickness of the combined mineral horizons in the block is 5.4 m with a range from 0.8 m in borehole NE 6 to 14.3 m in borehole NW 61 where both Glacial Sand and Gravel and glacial channel deposits are recorded. The total volume of mineral in the block is estimated at 36 ± 16 million m<sup>3</sup>: its mean grading is fines 16 per cent, sand 72 per cent and gravel 12 per cent. Overburden has a mean proved thickness of 0.4 m. Waste bands are present within the mineral in boreholes NW 61 and NW 62 but were not found elsewhere.

#### Block C

The geology, lithology and grading characteristics of this block are similar to those of Block B. Slightly more than half of the area of the block comprises mineral. The mineral has again been subdivided into an upper part,

composed of Glacial Sand and Gravel with a small area of sandy boulder clay, and a lower part comprising 'Bunter Sand' with some glacial channel deposits. No potentially workable sand and gravel has been proved beneath the Head deposits of the block. Data from the eight IMAU boreholes are given in Table 5.

The upper mineral subdivision exhibits a range of thicknesses from 0.3 m in the north-east up to 6.0 m in the south and has a mean proved thickness of 1.9 m. The mean grading is fines 15 per cent, sand 62 per cent and gravel 23 per cent. The mean gravel content ranges from 2 to 64 per cent but it generally exceeds 20 per cent. The fines content is usually between 17 and 23 per cent, although in boreholes NW 60 and SW 54 it is only 2 and 5 per cent respectively.

Taken together the 'Bunter Sand' and the glacial channel deposits have a mean thickness of 2.5 m and range from 1.1 m thick in hand auger holes east of borehole SW 64 to 5.4 m thick in borehole SW 63. The lower mineral component was not found in borehole SW 59. The mean grading is fines 15 per cent, sand 84 per cent and gravel 1 per cent, but the fines content ranges from 7 to 27 per cent and the gravel content up to 4 per cent.

Overall, the mineral in the block has a mean thickness of 4.4 m and a total estimated volume of 23 ± 9 million m<sup>3</sup>. The mean grading of the total mineral is fines 15 per cent, sand 74 per cent and gravel 11 per cent. Overburden, mainly topsoil, reaches a maximum proved thickness of 0.8 m in borehole NW 64 and has a mean thickness of 0.4 m.

#### Block D

This block contains almost all of the sandy boulder clay which occurs on the resource sheet. Glacial Sand and Gravel is present in the northern part of the block and glacial channel deposits occur beneath the sandy boulder clay of the southern part, particularly between Harworth and Bircotes. 'Bunter Sand' is not usually present beneath the Drift deposits of the block. The Glacial Sand and Gravel, sandy boulder clay and the mineral within the glacial channel deposits are all broadly similar in composition and grade: they are therefore assessed together.

The proved mineral thickness ranges from 2.7 m in borehole SW 61 to 9.0 m in borehole SW 57; the mean proved thickness is 5.2 m. The total volume of mineral is estimated at 28 ± 13 million m<sup>3</sup> and its mean grading

**Table 4** Data from IMAU boreholes: Block B

Borehole	Recorded thickness		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
	m	m						
<b>a UPPER MINERAL SUBDIVISION</b>								
NW 57	1.2	0.6	21	36	10	4	9	20
NW 58	1.0	0.6	17	26	23	3	10	21
NW 59	2.0	0.7	8	8	29	11	24	20
NW 61	1.1	0.4	12	12	20	7	19	30
NW 62	1.8*	0.2	16	32	32	1	5	14
NW 65	1.0	0.3	8	9	28	7	23	25
NW 66	3.6	0.4	14	13	23	8	22	20
NE 37	0.6	0.8	29	32	17	3	12	7
NE 38	4.0	0.0	14	32	45	1	3	5
Overall mean grading			14	22	29	5	14	16
<b>b LOWER MINERAL SUBDIVISION</b>								
NW 57	3.1		18	56	25	1	0	0
NW 58	2.5		17	43	38	2	trace	0
NW 59	1.6		0	53	43	2	2	0
NW 61	9.5†		20	67	12	1	0	0
NW 62	1.9*		13	31	54	1	1	0
NW 65	4.7		21	65	11	1	2	0
NW 66	1.8		16	41	41	1	1	0
NE 37	1.2		14	39	45	1	1	0
NE 38	absent		-	-	-	-	-	-
Overall mean grading			17	57	24	1	1	0

\* Excluding 2.5-m waste parting.

† The upper and lower mineral subdivisions in this borehole are separated by a 0.5-m thick waste band.

**Table 5** Data from IMAU boreholes: Block C

Borehole	Recorded thickness		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
	m	m						
<b>a UPPER MINERAL SUBDIVISION</b>								
NW 60	2.0	0.6	2	8	19	7	25	39
NW 63	1.0	0.4	17	20	15	2	11	35
NW 64	1.0	0.8	23	25	19	2	18	13
NW 67	absent	-	-	-	-	-	-	-
SW 54	3.0	0.4	5	54	39	0	0	2
SW 55	1.0	0.5	22	15	16	2	10	35
SW 59	3.0	0.3	17	53	26	1	1	2
SW 63	6.0	0.5	19	27	30	4	10	10
Overall mean grading			15	32	27	3	9	14
<b>b LOWER MINERAL SUBDIVISION</b>								
NW 60	2.3		7	30	61	1	1	0
NW 63	3.7		16	39	39	2	3	1
NW 64	4.7		11	38	50	0	1	0
NW 67	absent		-	-	-	-	-	-
SW 54	2.0		27	68	5	0	0	0
SW 55	3.4		22	41	36	1	0	0
SW 59	absent		-	-	-	-	-	-
SW 63	5.4		12	40	46	1	1	0
Overall mean grading			15	41	42	1	1	0

**Table 6** Data from IMAU boreholes: Block D, all deposits

Borehole	Recorded thickness		Mean grading percentage					
	Mineral	Overburden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm
m	m							
SW 56	4.3	0.4	19	32	41	1	2	5
SW 57	9.0	2.8	33	60	7	trace	0	0
SW 58	3.6	0.0	13	40	44	trace	1	2
SW 60	8.0	1.3	2	47	48	2	1	0
SW 61	2.7*	0.6	trace	43	48	3	2	4
SW 62	3.3†	0.7	9	24	24	14	9	20
SW 64	5.5	0.5	19	42	29	1	1	8
Block mean grading			16	44	32	2	2	4

\* Excluding 0.6-m waste parting.

† Excluding 3.0-m waste parting.

is fines 16 per cent, sand 78 per cent and gravel 6 per cent, although in borehole SW 62 a mean gravel content of 29 per cent was recorded in the sandy boulder clay and glacial channel deposits. Overburden consists of sandy, pebbly clay and has a mean thickness of 0.9 m; it is absent from borehole SW 58 and reaches a maximum proved thickness of 2.8 m in borehole SW 57. Waste bands were found only in boreholes SW 61 and SW 62 and were 0.6 and 3.0 m thick respectively.

**Block E**

Mineral is present over about half the area of this block, the remainder comprising worked ground and small outcrops of Bunter Sandstone. The workings are interspersed by small outcrops of mineral but the most extensive tract of mineral unaffected by quarrying is currently occupied by Finningley airfield. The mineral is divided into an upper part, composed of Older River Gravel, and a discontinuous lower part, comprising 'Bunter Sand' (Table 7).

The Older River Gravel proved in the assessment boreholes ranges from 1.9 m to 5.2 m thick and has a

mean thickness of 3.5 m. The mean grading is fines 12 per cent, sand 60 per cent and gravel 28 per cent. However, the mean gravel content ranges widely from only 5 per cent in borehole NE 35 to a maximum of 46 per cent in borehole SE 30 (Table 7).

The 'Bunter Sand', although found consistently throughout the worked areas of the block, was proved in only two assessment boreholes and for this reason only an inferred assessment has been attempted.

The mean combined thickness of mineral in the block is 4.2 m and the total volume is estimated at  $20 \pm 13$  million m<sup>3</sup>. The mean grading is fines 13 per cent, sand 64 per cent and gravel 23 per cent. Overburden has a mean proved thickness of 1.3 m.

**Block F**

The mineral in this block comprises Older River Gravel, sand of the 25-Foot Drift, First Terrace, blown sand and 'Bunter Sand'. In the north and west of the block and north of Misson, the mineral is extensively overlain by silts and clays of the 25-Foot Drift and by small deposits of peat and alluvium. The mineral has been divided into

**Table 7** Data from IMAU boreholes: Block E

Borehole	Recorded thickness		Mean grading percentage					
	Mineral	Overburden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+1-4 mm	+4-16 mm	+16 mm
m	m							
<b>a UPPER MINERAL SUBDIVISION</b>								
NE 35	1.9	0.5	12	54	28	1	2	3
NE 36	4.9	0.6	12	46	25	3	9	5
NE 39	5.2	1.0	10	14	31	7	18	20
NE 40	2.3	0.6	11	19	24	8	18	20
SE 30	2.3	3.9	15	20	11	8	26	20
Overall mean grading			12	30	25	5	14	14
<b>b LOWER MINERAL SUBDIVISION</b>								
NE 35	absent		-	-	-	-	-	-
NE 36	2.0		16	55	28	1	0	0
NE 39	absent		-	-	-	-	-	-
NE 40	1.4		20	55	23	1	1	0
SE 30	absent		-	-	-	-	-	-
Overall mean grading			18	55	26	1	trace	0



an upper part comprising all of the Drift sand and gravel deposits, and a lower part comprising 'Bunter Sand' only.

The upper mineral division was proved in all boreholes except NE 57; it is probably absent from beneath most of the deposits of silt and clay of the 25-Foot Drift in the vicinity of borehole NE 57. The mean proved thickness is 2.9 m and the deposit ranges in thickness from 0.6 m in borehole NE 48 to 8.3 m in NE 50. The mean grading for all Drift mineral is fines 14 per cent, sand 59 per cent and gravel 27 per cent; however the sand of the 25-Foot Drift contains no more than 17 per cent gravel.

The lower mineral division was proved in all but four assessment boreholes, and may be totally absent along the extreme western edge of the block. The mean proved thickness of the 'Bunter Sand' is 3.0 m but it ranges in

thickness from 0.5 m in borehole NE 52 to 12.5 m in borehole NE 57. The mineral in borehole NE 57 has some lithological similarities to 25-Foot Drift deposits but in all other respects is identical to 'Bunter Sand'; it has therefore been classified as such. The mean grading of the lower division is fines 13 per cent, sand 86 per cent and gravel 1 per cent.

The combined mean thickness of all mineral is 5.9 m and the maximum range is from 3.5 m in borehole NE 52 to 12.5 m in borehole NE 57. The total estimated volume is  $83 \pm 20$  million m<sup>3</sup>. The mean grading of all mineral in the block is fines 13 per cent, sand 73 per cent and gravel 14 per cent. The mean thickness of overburden throughout the block is 2.3 m. In the west and to the north of Misson, overburden comprising mainly silt and

**Table 8** Data from IMAU boreholes: Block F

Borehole	Recorded thickness		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
	m	m						
<b>a UPPER MINERAL SUBDIVISION</b>								
NE 41	4.6*	1.7	16	38	24	5	11	6
NE 42	3.5	1.5	34	46	17	0	2	1
NE 43	3.9	1.1	12	48	23	2	8	7
NE 44	2.0	5.5	9	12	17	12	29	21
NE 46	3.1†	0.4	30	36	18	4	7	5
NE 47	4.5	0.0	12	12	19	9	24	24
NE 48	0.6	0.6	17	53	15	1	6	8
NE 49	2.8	0.2	9	10	19	9	25	28
NE 50	8.3	3.7	4	34	26	7	9	20
NE 51	1.6	5.2	16	20	14	4	16	30
NE 52	3.0	5.6	1	6	31	9	25	28
NE 53	1.4	6.0	30	27	19	2	6	16
NE 54	2.5	0.3	21	17	17	5	20	20
NE 55	1.1	0.6	16	31	30	4	11	8
NE 56	0.9	0.0	20	27	15	3	12	23
NE 57	absent	5.5	-	-	-	-	-	-
NE 58	0.9	1.3	19	35	24	3	11	8
SE 39	5.6	0.6	9	35	43	2	5	6
SE 44	3.3	0.9	16	46	17	2	6	13
Overall mean grading			14	30	24	5	12	15
<b>b LOWER MINERAL SUBDIVISION</b>								
NE 41	absent		-	-	-	-	-	-
NE 42	absent		-	-	-	-	-	-
NE 43	absent		-	-	-	-	-	-
NE 44	3.1		4	39	55	2	0	0
NE 46	5.2†		9	46	43	1	1	0
NE 47	3.5		22	56	21	trace	1	0
NE 48	3.3		14	60	26	0	0	0
NE 49	6.0		14	54	32	trace	0	0
NE 50	absent		-	-	-	-	-	-
NE 51	4.8		7	55	36	1	1	0
NE 52	0.5		2	52	43	3	0	0
NE 53	4.6		11	37	51	1	0	0
NE 54	2.0		20	44	33	1	1	1
NE 55	4.3		12	53	35	0	0	0
NE 56	6.4		16	61	21	0	2	0
NE 57	12.5		16	39	45	trace	0	0
NE 58	2.7		17	61	22	0	0	0
SE 39	4.8		8	46	42	2	2	0
SE 44	1.8		10	53	37	0	0	0
Overall mean grading			13	49	37	trace	1	0

\* Not included in the assessed thickness of mineral is a 0.4-m waste band.

† The upper and lower mineral subdivisions in this borehole are separated by a 1.7-m thick waste band.

clay of the 25-Foot Drift ranges from 0.4 m to 6.0 m thick, although elsewhere overburden, usually comprising soil, ranges from 0.2 to 1.3 m thick. Borehole NE 52 proved 5.6 m of overburden comprising clay with a thin sand and gravel parting. Waste bands are present within the mineral in boreholes NE 41 and NE 46 but were not proved elsewhere.

**Block G**

Again upper and lower mineral subdivisions are recognised in the block. The upper comprises First Terrace and alluvial sand and gravel deposits of the Idle and Ryton valleys, whereas the lower comprises discontinuous 'Bunter Sand' deposits. Although shown on the map as First Terrace, deposits lying immediately to the north of Scaftworth and Everton were found to be indistinguishable from the 'Bunter Sand' and are therefore included in the lower subdivision.

The upper mineral component has a mean thickness of 3.2 m. The mean grading is fines 8 per cent, sand 62 per cent and gravel 30 per cent, but the deposits vary in grade both laterally and vertically. For example, the gravel content ranges from 72 per cent in borehole SE 32 down to 5 per cent in borehole SE 51.

The lower mineral component was not found in boreholes close to the present course of the River Idle but elsewhere ranges from 0.9 m to 6.1 m thick; it has a mean thickness of 2.0 m. The mean grading is fines 10 per cent, sand 89 per cent and gravel 1 per cent, but the fines content ranges from 1 to 20 per cent (Table 9).

The mean thickness of all mineral in the block is 5.2 m and proved thicknesses range from 3.5 m to 9.1 m. The estimated total volume of mineral is  $72 \pm 12$  million m<sup>3</sup>. The mean grading for the block is fines 9 per cent, sand 73 per cent and gravel 18 per cent.

Overburden has a mean proved thickness of 1.4 m. However in areas where sand and gravel is mapped at the

**Table 9** Data from IMAU boreholes: Block G

Borehole	Recorded thickness		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
	m	m						
<b>a UPPER MINERAL SUBDIVISION</b>								
SE 31	4.6	4.4	2	26	31	7	12	22
SE 32	4.2	1.1	1	10	10	7	33	39
SE 33	3.3	0.9	15	17	21	6	22	19
SE 34	5.4	1.2	5	16	40	9	17	13
SE 35	4.4	0.7	8	23	30	5	13	21
SE 36	4.5	3.7	2	20	67	3	5	3
SE 37	3.0	0.6	12	18	21	8	14	27
SE 38	4.6	1.8	7	29	44	8	8	4
SE 40	1.8	3.7	3	19	20	6	14	38
SE 41	absent	-	-	-	-	-	-	-
SE 45	5.0	2.3	4	21	30	11	11	23
SE 46	absent	-	-	-	-	-	-	-
SE 47	absent	-	-	-	-	-	-	-
SE 49	5.0*	0.5	12	29	23	7	11	18
SE 50	6.0†	1.9	17	48	19	4	8	4
SE 51	2.6	0.6	27	51	16	1	2	3
SE 52	absent	-	-	-	-	-	-	-
Overall mean grading			8	26	30	6	13	17
<b>b LOWER MINERAL SUBDIVISION</b>								
SE 31	absent	-	-	-	-	-	-	-
SE 32	1.8	-	4	42	49	3	2	0
SE 33	0.9	-	1	62	34	2	1	0
SE 34	absent	-	-	-	-	-	-	-
SE 35	3.2	-	10	40	45	2	2	1
SE 36	absent	-	-	-	-	-	-	-
SE 37	6.1	-	8	47	42	2	1	0
SE 38	absent	-	-	-	-	-	-	-
SE 40	1.7	-	7	43	46	3	1	0
SE 41	3.5	0.7	16	51	33	trace	0	0
SE 45	2.7	-	8	51	40	1	0	0
SE 46	4.1	0.9	20	73	7	trace	0	0
SE 47	4.4	0.5	9	57	34	trace	0	0
SE 49	1.5	-	5	43	49	3	0	0
SE 50	absent	-	-	-	-	-	-	-
SE 51	1.7	-	3	46	50	1	0	0
SE 52	4.0	0.5	12	49	38	trace	trace	0
Overall mean grading			10	51	37	1	1	0

\* Excluding 1.5-m waste parting.

† Excluding 0.6-m waste parting.

**Table 10** Data from IMAU boreholes: Block H, all deposits

Borehole	Recorded thickness		Mean grading percentage					
	Mineral	Overburden	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
			- $\frac{1}{16}$ mm	+ $\frac{1}{16}$ - $\frac{1}{4}$ mm	+ $\frac{1}{4}$ -1 mm	+ 1-4 mm	+ 4-16 mm	+ 16 mm
	m	m						
SW 65	1.8+	0.0	9	49	36	0	2	4
SW 66	3.7	0.8	11	34	49	0	1	5
SE 42	6.4	0.0	6	43	44	1	2	4
SE 43	5.8+	0.0	12	49	38	1	0	0
SE 48	4.5	0.0	8	47	38	1	3	3
Overall mean grading			9	44	42	1	1	3

surface, overburden comprises sandy or pebbly soil and is consistently less than 0.9 thick; elsewhere it is composed of soil or sandy clay ranging in thickness from 0.6 m to 4.4 m. The only waste bands proved were found in boreholes SE 49 and SE 50 in the extreme east of the block.

#### Block H

This block consists of four separate areas in the southern part of the district. The total area of the block is 11.2 km<sup>2</sup> but mineral is present over only 2.2 km<sup>2</sup>, the remainder comprising Bunter Sandstone and Keuper Marl at outcrop or beneath small patches of mineral-free superficial deposits. The mineral consists of Glacial Sand and Gravel and underlying 'Bunter Sand' deposits; it has not been subdivided and only a combined assessment has been attempted.

The mean thickness of the mineral is 4.0 m, and the estimated total volume is approximately 9 million m<sup>3</sup>. The mean grading is fines 9 per cent, sand 87 per cent and gravel 4 per cent, although, where it is distinguishable from 'Bunter Sand', the Glacial Sand and Gravel is found to include beds containing between 10 and 20 per cent of gravel. Overburden is commonly absent and was found only in borehole SW 66.

#### NOTES ON THE SAND AND GRAVEL WORKINGS OF THE AREA

Sand and gravel has been worked, particularly in the north and central part of the area, since the turn of the century. To date workings in the principal areas around Finningley and Austerfield have extended over about 750 hectares (1850 acres). Estimates suggest that some 20 million m<sup>3</sup> of sand and gravel have been removed from the Older River Gravel and Glacial Sand and Gravel deposits and, to a much lesser extent, from the underlying Bunter Sandstone. Many of the older workings, particularly between Finningley Park [656 975] and Cadman's Plantation [642 982], either still contain unworked sand and gravel deposits or have been partly backfilled with sandy or gravelly material which, although not considered in the assessment, may contain potentially workable material. A few disused workings are used as tips although many have been returned to agricultural or forestry use. One disused working has been converted into a golf course.

Brief details of workings indicating their known extent up to Spring 1976 are given in Table 11.

**Table 11** List of active and disused workings

Location	Grid reference	Area* ha	Principal deposit worked
ACTIVE WORKINGS			
Misson Springs	696 978	20	Older River Gravel
East of Misson Grange	685 973	10	Older River Gravel
East of Misson	699 955	15	Older River Gravel
West of Misson	681 952	5	Older River Gravel
South of Scrooby	656 903	2	First Terrace
DISUSED WORKINGS			
North of Hunster Grange	624 972	1	Glacial Sand and Gravel
Gravel Hill Plantation	633 977	35	Glacial Sand and Gravel
Tickhill High Common	620 940	35	Glacial Sand and Gravel
South of Bircotes	627 907	2	Bunter Sandstone
South of Bircotes	629 904	2	Bunter Sandstone
Between Hurst Wood and Austerfield Pumping Station	642 985 to 661 965	190	Glacial Sand and Gravel
North of Finningley	655 999 to 690 999	90	Older River Gravel
Between Finningley and Austerfield	676 993 to 665 953	340	Older River Gravel
North-west of Austerfield	657 950	75	Glacial Sand and Gravel
Misson Grange	680 972	12	Older River Gravel
West of Misson	679 956	35	Older River Gravel
West of Harwell	682 917	2	Glacial Sand and Gravel
South of Scrooby	659 903	10	First Terrace

\* Areas are approximate. 1 ha (hectare) is about 2.47 acres.

## 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, 10 km<sup>2</sup>, 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 British Standard 1377 (1967). Random checks on 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 F.

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

## APPENDIX B

### STATISTICAL PROCEDURE

#### *Statistical assessment*

1 A statistical assessment is made of an area of mineral greater than 2 km<sup>2</sup>, if there is a minimum of 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. Conventional symmetrical confidence limits are calculated for the 95 per cent probability level, that is, there is a 5 per cent or one in twenty chance of a result falling outside the stated limits.

3 The volume estimate ( $V$ ) for the mineral in a given block is the product of the 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

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

4 The above relationship may be transposed such that

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

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 mean 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  $l_{m1}, l_{m2}, \dots, l_{mn}$ , then the best estimate of mean thickness,  $\bar{l}_m$ , is given by

$$\sum (\bar{l}_{m1} + \bar{l}_{m2} \dots \bar{l}_{mn})/n.$$

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

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

where  $l_m$  is any value in the series  $l_{m1}$  to  $l_{mn}$ .

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 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  $S_A/S_{\bar{l}_m} \leq \frac{1}{3}$  is assumed in all cases. It follows from equation [2] that

$$S_{\bar{l}_m} \leq S_V \leq 1.05 S_{\bar{l}_m} \quad [3]$$

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).

Block calculation 1: 25 000 } Fictitious  
Block

Area  
Block: 11.08 km<sup>2</sup>  
Mineral: 8.32 km<sup>2</sup>

Mean thickness  
Overburden: 2.5 m  
Mineral: 6.5 m

Volume  
Overburden: 21 million m<sup>3</sup>  
Mineral: 54 million m<sup>3</sup>

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 m<sup>3</sup>

Thickness estimate: measurements in metres  
*l*<sub>o</sub> = overburden thickness *l*<sub>m</sub> = mineral thickness

Sample point	Weighting <i>w</i>	Overburden		Mineral		Remarks
		<i>l</i> <sub>o</sub>	<i>wl</i> <sub>o</sub>	<i>l</i> <sub>m</sub>	<i>wl</i> <sub>m</sub>	
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 17 123/45	$\frac{1}{2}$ $\frac{1}{2}$	1.2 2.0	1.6	9.8 4.6	7.2	} Hydrogeology Unit record
1 2 3 4	$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$	2.7 4.5 0.4 2.8	2.6	7.3 3.2 6.8 5.9	5.8	
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.2$		$\Sigma wl_m = 52.0$		
Means		$\bar{l}_o = 2.5$		$\bar{l}_m = 6.5$		

Calculation of confidence limits

<i>l</i> <sub>m</sub>	( <i>l</i> <sub>m</sub> - $\bar{l}_m$ )	( <i>l</i> <sub>m</sub> - $\bar{l}_m$ ) <sup>2</sup>
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

$\Sigma(l_m - \bar{l}_m)^2 = 15.82$   
*n* = 8  
*t* = 2.365

*L<sub>v</sub>* is calculated as

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

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

$$= 20.3$$

$$\approx 20 \text{ per cent.}$$

Figure 6 Example of resource block assessment: calculation and results

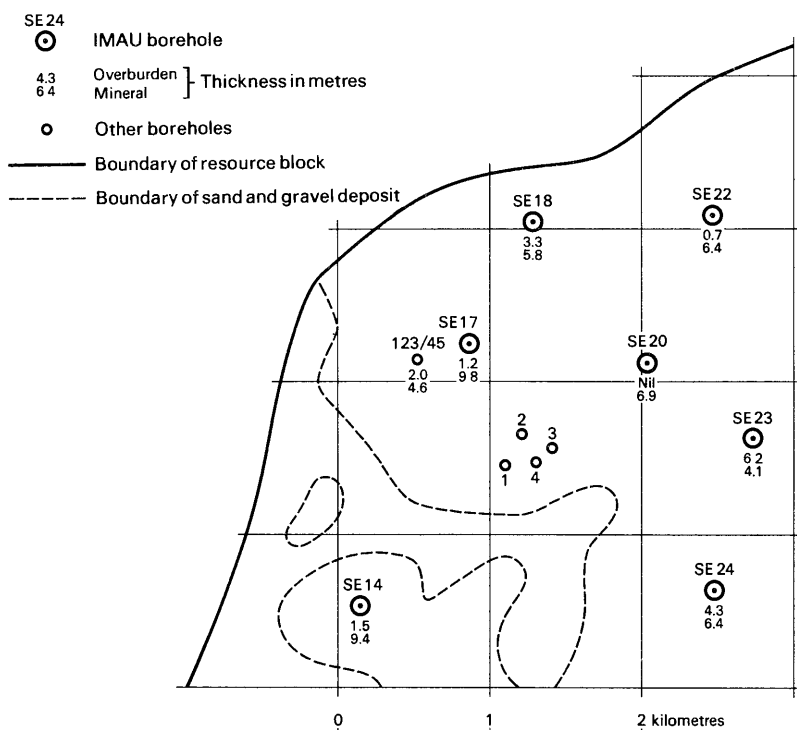


Figure 7 Example of resource block assessment: map of a fictitious block

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, *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:  $L_{\bar{l}_m} \leq L_v \leq 1.05 L_{\bar{l}_m}$

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 Figures 6 and 7.

#### *Inferred assessment*

12 If the sampled area of mineral in a resource block is between 0.25 km<sup>2</sup> and 2 km<sup>2</sup> an assessment is inferred, based on 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<sup>2</sup>.

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 need 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 within the zone as the weighting factor.

## 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 (less than  $\frac{1}{16}$  mm) and coarser than pebbles (more than 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 not considered to be 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 Figure 8). The procedure is as follows:

- 1 Classify according to ratio of sand to gravel.
- 2 Describe 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 Note 10, p. 21).

Many differing proposals exist 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 (Table 12), which is used in this 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 ( $-\frac{1}{4} + \frac{1}{16}$  mm), medium ( $-1 + \frac{1}{4}$  mm) and coarse ( $-4 + 1$  mm). The boundary at 16 mm distinguishes a range of finer gravel ( $-16 + 4$  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

Standard 1377: 1967). In this report the grading is tabulated on the borehole record sheets (Appendix F), 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 very approximate 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 constituents 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.

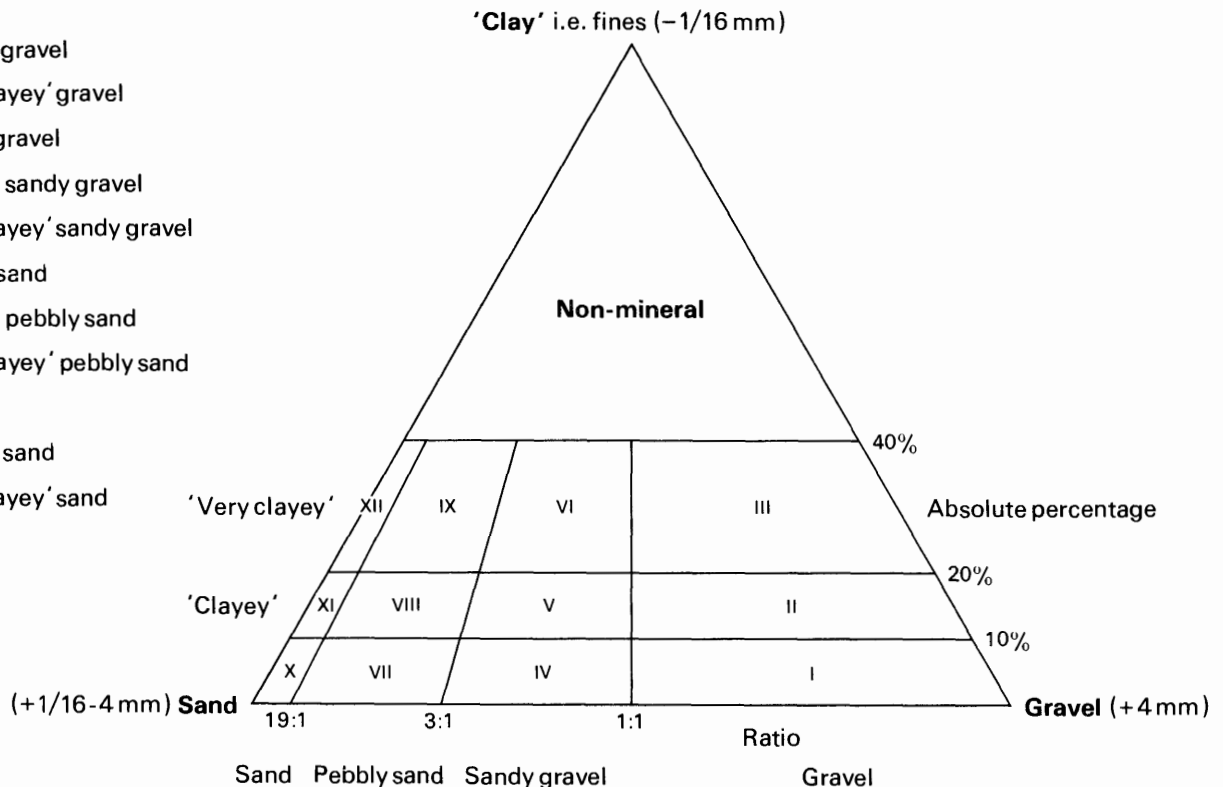
Subrounded: showing considerable wear. The edges and corners are rounded off to smooth curves. Original grain shape is still distinct.

Rounded: original faces almost completely destroyed, but some comparatively flat surfaces may still remain. All original edges and corners have been smoothed off to rather broad curves. Original shape is still apparent.  
Well-rounded: no 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.

**Table 12** Classification of gravel, sand and fines

Size limits	Grain size description	Qualification	Primary classification
64 mm -	Cobble		
16 mm -	Pebble	Coarse	Gravel
4 mm -		Fine	
1 mm -		Coarse	
$\frac{1}{4}$ mm -	Sand	Medium	Sand
$\frac{1}{16}$ mm -		Fine	
	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
- IX 'Clayey' sand
- IIIX 'Very clayey' sand



**Figure 8** Diagram to show the descriptive categories used in the classification of sand and gravel

**APPENDIX D**

**EXPLANATION OF THE BOREHOLE RECORDS**

**Annotated example**

SW 69 NW 59<sup>1</sup> 6282 9669<sup>2</sup> East of Hunster Grange, Rossington<sup>3</sup>

**Block B**

Surface level (+ 25.6 m) + 84 ft<sup>4</sup>

Water not encountered<sup>5</sup>

October 1974<sup>6</sup>

Overburden<sup>7</sup> 0.7 m

Mineral 3.6 m

Bedrock 0.1 m +<sup>8</sup>

**Log**

<i>Geological classification</i> <sup>9</sup>	<i>Lithology</i> <sup>10</sup>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.7	0.7
Glacial Sand and Gravel	<b>a</b> Sandy gravel, 'clayey' in upper 1 metre Gravel: fine to coarse, mainly subrounded, quartzite with quartz and traces of limestone and igneous rocks Sand: medium, subrounded, mainly quartz; grey to reddish brown	2.0	2.7
Bunter Sandstone	<b>b</b> Sand, with scattered pebbles Gravel: fine quartz and quartzite Sand: fine, subrounded to rounded, mainly quartz with some mica; reddish brown Sandstone, reddish brown	1.6	4.3
		0.1+	4.4

**Grading**<sup>11</sup>

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines	Sand			Gravel	
						+ 1/16 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16
<b>a</b>	8	48	44	0.7-1.7	13	9	16	10	25	27
				1.7-2.7	2	8	41	14	22	13
				Mean	8	8	29	11	24	20
<b>b</b>	trace	98	2	2.7-3.1	0	34	56	6	3	1
				3.1-4.1	0	63	36	1	0	0
				4.1-4.3	1	44	53	1	0	1
				Mean	trace	53	43	2	2	0
<b>a + b</b>	4	71	25	0.7-4.3	4	28	35	8	14	11

**Composition**<sup>12</sup>

	Depth below surface (m)	Percentages by weight in gravel fraction					
		Quartz	Quartzite	Sandstone	Igneous	Limestone	Others
<b>a</b>	0.7-1.7	11	76	4	6	2	1
	1.7-2.7	31	62	4	-	3	-
	Mean	19	70	4	4	2	1



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

#### 1 Borehole Registration Number

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

1 The number of the 1:25 000 sheet on which the borehole lies, for example SK 69.

2 The quarter of the 1:25 000 sheet on which the borehole lies and the number of the borehole in a series for that quarter, for example NW 59.

Thus the full Registration Number is SK 69 NW 59.

Usually this is abbreviated to NW 59 in the text.

#### 2 The National Grid reference

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

#### 3 Location

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

#### 4 Surface level

The surface level at the borehole site is given in metres and feet above Ordnance Datum. All measurements were made in feet; approximate conversions to metres are given in brackets.

#### 5 Groundwater conditions

If groundwater was present the level at which it was encountered is normally given (in metres and feet above OD).

#### 6 Type of drill and date of drilling

Unless otherwise stated, all boreholes were drilled by a shell and auger rig using 6-inch casing. The month and year of completion of the hole are stated.

#### 7 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, and may include deposits of 'Bunter Sand' which are not associated with Drift sand and gravel deposits: detailed grading data may be given for such 'Bunter Sand' deposits. Where waste occurs between the surface and mineral it is classified as overburden.

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

#### 9 Geological classification

The geological classification (p. 3) is given whenever possible.

#### 10 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. The description of other rocks is based on visual examination, in the field. Where more than one mineral deposit is recognised, each is designated by a letter, e.g. a, b, etc.

#### 11 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 an 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 ( $+\frac{1}{4}$   $-1$  mm), coarse sand ( $+1$   $-4$  mm), fine gravel ( $+4$   $-16$  mm) and coarse gravel ( $+16$  mm) are stated. The mean grading of groups of samples making up an identified mineral horizon are also given in detail and, to the left, in summary. Where more than one horizon is recognised the mean grading for the whole of the mineral in the borehole is also given. Where necessary in calculating the mean grading, data for individual samples are weighted by the thickness represented.

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

#### 12 Composition

Details of the composition of the gravel fraction of selected samples or grouped samples may be given. Where appropriate the calculated weighted mean composition of grouped samples may be indicated.

APPENDIX E

LIST OF BOREHOLES AND EXPOSURES USED IN THE ASSESSMENT OF RESOURCES

Borehole number*	Grid reference†	Resource block	Borehole number*	Grid reference†	Resource block	Borehole number*	Grid reference†	Resource block
1 MINERAL ASSESSMENT BOREHOLES			NE 48	6835 9617	F	SE 34	6587 9095	G
NW 50	6046 9983	A	49	6860 9548	F	35	6652 9455	G
51	6080 9898	A	50	6981 9962	F	36	6657 9372	G
52	6016 9671	A	51	6913 9932	F	37	6638 9283	G
53	6038 9560	A	52	6972 9875	F	38	6686 9019	G
54	6156 9913	A	53	6904 9807	F	39	6731 9422	F
55	6158 9666	A	54	6936 9759	F	40	6755 9342	G
56	6229 9990	A	55	6965 9680	F	41	6737 9285	G
57	6268 9824	B	56	6942 9642	F	42	6742 9192	H
58	6270 9752	B	57	6947 9618	F	43	6793 9089	H
59	6282 9669	B	58	6960 9537	F	44	6779 9497	F
60	6247 9540	C	SW 50‡	6051 9490		45	6823 9421	G
61	6347 9869	B	51‡	6067 9409		46	6865 9327	G
62	6358 9755	B	52‡	6064 9276		47	6842 9284	G
63	6384 9631	C	53‡	6040 9268		48	6810 9190	H
64	6331 9542	C	54	6200 9479	C	49	6960 9438	G
65	6414 9812	B	55	6238 9398	C	50	6984 9360	G
66	6467 9727	B	56	6257 9309	D	51	6929 9310	G
67	6436 9561	C	57	6211 9155	D	52	6956 9209	G
NE 35	6547 9975	E	58	6276 9086	D	2 OTHER BOREHOLES		
36	6579 9885	E	59	6348 9453	C	NW 3	6039 9990	A
37	6541 9707	B	60	6362 9336	D	4	6019 9838	A
38	6534 9568	B	61	6305 9230	C	5	6242 9674	A
39	6679 9923	E	62	6351 9253	D	10	6368 9825	B
40	6631 9772	E	63	6451 9438	C	NE 6	6598 9530	B
41	6730 9726	F	64	6408 9289	D	SW 67	6402 9044	G
42	6731 9631	F	65	6463 9175	H	3 EXPOSURES		
43	6695 9557	F	66	6463 9032	H	E1 NW	624 971	B
44	6884 9863	F	SE 30	6584 9381	F	E1 NE	656 950	B
45	Not allocated	—	31	6558 9263	G	E1 SW	628 907	D
46	6818 9773	F	32	6589 9176	G	E1 SE	666 913	G
47	6872 9704	F	33	6539 9150	G	E2 SE	656 901	G

\* By sheet quadrant.

† All fall in 100-km square SK.

‡ These boreholes fall outside the assessed areas.

**APPENDIX F**

**INDUSTRIAL MINERALS ASSESSMENT UNIT  
BOREHOLE RECORDS**

**SK 69 NW 50 6046 9983 North-west of New Rossington**

**Block A**

Surface level (+1.8 m) + 6 ft  
Water struck at (-1.8 m) - 6 ft  
November 1974

Overburden 2.8 m  
Mineral 1.7 m  
Waste 16.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Alluvium	Soil, on sandy and silty clay	2.8	2.8
Glacial channel deposits	'Very clayey' sand: fine, well sorted, subangular, quartz with traces of carbonaceous material and some clay lumps; dark brown	1.7	4.5
	Clay, laminated, grey with brown silt partings	16.1+	20.6

**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
29	71	0	2.8-3.8	32	50	17	1	0	0
			3.8-4.5	26	60	13	1	0	0
			Mean	29	54	16	1	0	0

**SK 69 NW 51 6080 9898 West End Wood, near Rossington**

**Block A**

Surface level (+7.0 m) + 23 ft  
Water struck at (+4 m) + 13 ft  
October 1974

Overburden 0.8 m  
Mineral 5.2 m  
Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.8	0.8
Older River Gravel on Bunter Sandstone	Sand, 'clayey' to 'very clayey' with traces of gravel in upper 1.6 m Gravel: mainly coarse subrounded quartzite Sand: medium, subangular to subrounded, mainly quartz with some mica below 2.4 m; traces of soft sandstone near base; orange-brown	5.2	6.0
	Sandstone, brown	0.1+	6.1

**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
9	90	1	0.8-1.4	28	34	33	0	1	4
			1.4-2.4	12	30	56	0	1	1
			2.4-3.4	13	55	31	1	0	0
			3.4-6.0	3	44	52	1	0	0
			Mean	9	43	46	1	0	1

**SK 69 NW 52 6016 9671 North-west of Stancil**

**Block A**

Surface level (+6.1 m) +20 ft  
 Water struck at (+3 m) +10 ft  
 November 1974

Waste 6.0 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil on grey and brown laminated clay	3.0	3.0
Bunter Sandstone	'Clayey' sand: fine, well sorted, subangular, mainly quartz; grey becoming red below 4 m. Occasional fine quartzite pebbles	3.0	6.0
	Sandstone, reddish brown	0.1+	6.1

**SK 69 NW 53 6038 9560 South-west of Stancil**

**Block A**

Surface level (+14.9 m) +49 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 July 1974

Mineral 3.7 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Glacial Sand and Gravel	a 'Clayey' sandy gravel Gravel: coarse with fine, mainly subrounded, quartzite with quartz and sandstone and some igneous pebbles Sand: medium, poorly sorted, mainly subangular with subrounded, quartz and quartzite; mid brown	1.8	1.8
Bunter Sandstone	b 'Clayey' pebbly sand. Pebbles in upper 0.9 m probably derived by contamination from overlying deposit Gravel: mainly coarse, subrounded to subangular, quartzite with quartz and some sandstone and igneous pebbles Sand: fine, very well sorted, subrounded, mainly quartz with scattered mica flakes; reddish brown. Becomes very compact at 3.7 m	1.9	3.7
	Sandstone, reddish brown	0.1+	3.8

**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
<b>a</b>	15	48	37	0.0-0.5	23	41	31	1	4	0
				0.5-0.9	14	15	11	3	12	45
				0.9-1.4	13	35	13	2	13	24
				1.4-1.8	7	12	20	4	33	24
				Mean	15	27	19	2	15	22
<b>b</b>	16	71	13	1.8-2.7	16	57	3	1	6	17
				2.7-3.7	16	78	3	0	0	3
				Mean	16	68	3	0	3	10
<b>a+b</b>	15	59	26	0.0-3.7	15	48	10	1	9	17

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction						
		Quartz	Quartzite	Sandstone	Igneous	Mudstone	Chert	Others
<b>a</b>	0.5-0.9	15	47	26	9	1	2	trace
<b>a</b>	1.4-1.8	20	55	17	4	1	3	0
<b>b</b>	1.8-2.7	10	72	1	15	1	1	trace

SK 69 NW 54 6156 9913 R. Torne, north of New Rossington

Block A

Surface level (+5.5 m) +18 ft  
 Water not encountered  
 October 1974

Waste 25.4 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Glacial channel deposits	Clay, grey, laminated above 4 m and below 9 m; coal detritus to 4 m	25.4+	25.4

SK 69 NW 55 6158 9666 West of Hunster Grange, Rossington

Block A

Surface level (+7.9 m) +26 ft  
 Water struck at (+0.7 m) +2 ft  
 October 1974

Overburden 8.0 m  
 Mineral 3.9 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.4	0.4
Glacial channel deposits	Clay, laminated with silty partings, dark grey	7.6	8.0
	Sandy gravel, 'clayey' in top metre Gravel: mainly coarse, subangular with subrounded limestone and sandstone with angular buff siltstone Sand: medium, poorly sorted, subangular, quartz with some buff siltstone; mid brown	3.9	11.9
Bunter Sandstone	Sandstone, reddish brown	0.1+	12.0

**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
8	58	34	8.0- 9.0	11	27	24	12	8	18
			9.0-10.0	5	13	19	3	5	55
			10.0-11.9	9	31	34	3	3	20
			Mean	8	25	28	5	5	29

**Composition**

Depth below surface (m)	Percentages by weight in gravel fraction				
	Quartz	Quartzite	Sandstone	Siltstone	Limestone
9.0-10.0	0	0	12	27	61

Surface level (+14.0 m) +46 ft  
 Water not encountered  
 October 1974

Overburden 0.7 m  
 Mineral 7.5 m  
 Bedrock 0.1 m+

**Log**

Geological classification	Lithology	Thickness m	Depth m
	Sandy soil	0.7	0.7
Glacial Sand and Gravel	a Sand with traces of gravel in upper 3 m Gravel: fine, subrounded, quartzite, quartz and sandstone Sand: fine to medium, mainly quartz, with quartzite; reddish brown	6.0	6.7
	b Sandy gravel Gravel: fine and coarse mainly subrounded, quartzite, and quartz and sandstone Sand: fine, well sorted, subrounded to subangular, mainly quartz and quartzite; mid brown	1.5	8.2
Bunter Sandstone	Sandstone, reddish brown	0.1+	8.3

**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
<b>a</b>	1	98	1	0.7-1.7	1	45	50	1	3	0
				1.7-2.7	0	40	60	0	trace	0
				2.7-3.7	1	28	70	trace	1	0
				3.7-4.7	3	48	49	0	0	0
				4.7-5.7	0	81	19	0	0	0
				5.7-6.7	1	90	9	0	0	0
			Mean	1	55	43	0	1	0	
<b>b</b>	1	60	39	6.7-8.2	1	35	17	8	17	22
<b>a+b</b>	1	90	9	0.7-8.2	1	51	37	2	5	4

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
<b>a</b>	0.7-2.7	25	33	41	1	0
	2.7-6.7	gravel generally absent				
<b>b</b>	6.7-8.2	27	43	27	3	0

SK 69 NW 57 6268 9824 South of Rossington

Block B

Surface level (+10.4 m) +34 ft  
 Water not encountered  
 October 1974

Overburden 0.6 m  
 Mineral 4.3  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.6	0.6
Glacial Sand and Gravel	a 'Very clayey' sandy gravel Gravel: coarse subrounded, quartzite and quartz Sand: fine, well sorted, subrounded, mainly quartz; orange-brown	1.2	1.8
Bunter Sandstone	b 'Clayey' sand: fine, well sorted, subangular, dominantly quartz, slightly micaceous; some clay lumps; dark reddish brown	3.1	4.9
	Sandstone, reddish brown	0.1+	5.0

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
a	21	50	29	0.6-1.8	21	36	10	4	9	20
b	18	82	0	1.8-2.9	20	76	3	0	1	0
				2.9-3.9	23	42	34	1	0	0
				3.9-4.9	12	49	38	1	0	0
				Mean	18	56	25	1	0	0
a+b	19	72	9	0.6-4.9	19	50	21	1	3	6

SK 69 NW 58 6270 9752 South of Rossington

Block B

Surface level (+19.8 m) +65 ft  
 Water not encountered  
 October 1974

Overburden 0.6 m  
 Mineral 3.5 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological Classification	Lithology	m	m
	Soil	0.6	0.6
Glacial Sand and Gravel	a 'Clayey' sand gravel Gravel: coarse, subrounded, quartz and quartzite Sand: fine to medium—subrounded, dominantly quartz; orange to reddish brown	1.0	1.6
Bunter Sandstone	b 'Clayey' sand: fine to medium, subrounded, mainly quartz; reddish brown	2.5	4.1
	Sandstone, reddish brown	0.1+	4.2

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
a	17	52	31	0.6-1.6	17	26	23	3	10	21
b	17	82	1	1.6-2.6	18	55	24	2	0	1
				2.6-3.6	18	33	47	1	1	0
				3.6-4.1	16	39	41	3	1	0
				Mean	17	43	38	2	trace	0
a+b	17	74	9	0.6-4.1	17	38	34	2	3	6

Surface level (+25.6 m) +84 ft  
 Water not encountered  
 October 1974

Overburden 0.7 m  
 Mineral 3.6 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.7	0.7
Glacial Sand and Gravel	a Sandy gravel, 'clayey' in upper 1 metre Gravel: fine to coarse, mainly subrounded, quartzite with quartz and traces of limestone and igneous rocks Sand: medium, subrounded, mainly quartz; grey to reddish brown	2.0	2.7
Bunter Sandstone	b Sand, with scattered pebbles Gravel: fine quartz and quartzite Sand: fine, subrounded to rounded, mainly quartz with some mica; reddish brown Sandstone, reddish brown	1.6	4.3
		0.1+	4.4

**Grading**

	<i>Mean for deposit percentages</i>			<i>Depth below surface (m)</i>	<i>percentages</i>					
	<i>Fines</i>	<i>Sand</i>	<i>Gravel</i>		<i>Fines</i>		<i>Sand</i>		<i>Gravel</i>	
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16$
a	8	48	44	0.7-1.7 1.7-2.7 Mean	13 2 8	9 8 8	16 41 29	10 14 11	25 22 24	27 13 20
b	trace	98	2	2.7-3.1 3.1-4.1 4.1-4.3 Mean	0 0 1 trace	34 63 44 53	56 36 53 43	6 1 1 2	3 0 0 2	1 0 1 0
a+b	4	71	25	0.7-4.3	4	28	35	8	14	11

**Composition**

	<i>Depth below surface (m)</i>	<i>Percentages by weight in gravel fraction</i>					
		<i>Quartz</i>	<i>Quartzite</i>	<i>Sandstone</i>	<i>Igneous</i>	<i>Limestone</i>	<i>Others</i>
a	0.7-1.7 1.7-2.7 Mean	11 31 19	76 62 70	4 4 4	6 - 4	2 3 2	1 - 1



Surface level (+29.6 m) +97 ft

Water not encountered

September 1974

Overburden 0.6 m

Mineral 4.3 m

Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Pebbly soil	0.6	0.6
Glacial Sand and Gravel	a Gravel Gravel: fine to coarse, mainly subrounded with some subangular, dominantly quartzite with quartz and traces of sandstone and igneous rocks Sand: medium, subrounded to subangular, mainly quartz with quartzite, scattered clayey lumps; mid brown	2.0	2.6
Bunter Sandstone	b Sand: medium, well sorted, subrounded numerous clayey lumps throughout; reddish brown Sandstone, mottled dark and pale brown	2.3	4.9
		0.1+	5.0

## Grading

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
a	2	34	64	0.6-1.6	2	7	19	7	26	39
				1.6-2.6	2	8	19	7	24	40
				Mean	2	8	19	7	25	39
b	7	92	1	2.6-3.6	10	24	65	1	0	0
				3.6-4.6	4	31	63	0	2	0
				4.6-4.9	8	39	52	1	0	0
				Mean	7	30	61	1	1	0
a+b	5	64	31	0.6-4.9	5	19	42	3	13	18

## Composition

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
a	1.6-2.6	17	73	4	4	2

Surface level (+19.2 m) +63 ft  
 Water struck at (+15.5 m) +51 ft  
 September 1974

Overburden 0.4 m  
 Mineral 4.1 m  
 Waste 2.5 m  
 Mineral 6.5 m  
 Waste 4.5 m+

**Log**

Geological classification	Lithology	Thickness	Depth
		m	m
	Soil	0.4	0.4
Glacial Sand and Gravel	a 'Clayey' gravel Gravel: mainly coarse with some fine, subrounded and rounded, quartzite and quartz Sand: medium, subrounded, quartz with quartzite; mid brown	1.1	1.5
Glacial channel deposits	b 'Clayey' sand: fine, subrounded, mainly quartz, with traces of fine coal and mica in lowest metre; grey to reddish brown	3.0	4.5
	Sandy clay, pale grey, silty with fine coal grains	2.5	7.0
	c 'Very clayey' sand: fine, well sorted, subrounded, mainly quartz with some fine coal and traces of mica; greyish brown	6.5	13.5
	Clay, grey, silty, soft	0.5	14.0
	Sandy and clayey silt, contains abundant fine coal grains; grey. No recovery	4.0+	18.0
	Borehole terminated due to technical difficulties		

**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
<b>a</b>	12	39	49	0.4-1.5	12	12	20	7	19	30
<b>b</b>	17	82	1	1.5-2.5	16	23	57	2	1	1
				2.5-3.5	19	49	31	1	0	0
				3.5-4.5	16	70	13	1	0	0
				Mean	17	48	33	1	1	0
<b>c</b>	22	78	0	7.0- 8.0	24	73	2	1	0	0
				8.0- 9.0	23	73	3	1	0	0
				9.0-10.0	25	72	3	0	0	0
				10.0-11.0	22	75	2	1	0	0
				11.0-12.0	17	81	2	0	0	0
				12.0-13.5	20	79	1	0	0	0
			Mean	22	76	2	0	0	0	
<b>a+b</b>	16	70	14	0.4- 4.5	15	36	29	3	7	10
<b>a+b+c</b>	20	75	5	Mean	20	61	13	1	2	3

Surface level (+27.1 m) +89 ft  
 Water not encountered  
 September 1974

Overburden 0.2 m  
 Mineral 1.8 m  
 Waste 0.5 m  
 Mineral 1.9 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Pebbly soil	0.2	0.2
Glacial Sand and Gravel	a 'Clayey' pebbly sand Gravel: mainly coarse, subrounded quartzite Sand: fine to medium subrounded, quartz with traces of finely comminuted coal; reddish brown	1.8	2.0
Glacial channel deposits	Sandy clay, with traces of finely comminuted coal; reddish brown	0.5	2.5
Bunter Sandstone	b Sand, 'very clayey' in upper 1 m Gravel: scattered fine subrounded quartz Sand: medium, well sorted, subrounded, quartz with traces of finely comminuted coal; mid brown	1.9	4.4
	Sandstone, greyish brown	0.1+	4.5

Grading

	Mean for deposit percentages			Depth below surface (m)	Depth below surface (m) percentages					
	Fines	Sand	Gravel		Fines			Gravel		
					- 1/8	+ 1/8-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
a	16	65	19	0.2-1.0	18	36	25	1	8	12
				1.0-2.0	15	28	38	1	2	16
				Mean	16	32	32	1	5	14
b	13	86	1	2.5-3.5	20	32	47	0	1	0
				3.5-4.4	6	31	60	2	1	0
				Mean	13	31	54	1	1	0
a+b	15	75	10	Mean	15	31	43	1	3	7

Surface level (+29.9 m) +98 ft  
 Water not encountered  
 October 1974

Overburden 0.4 m  
 Mineral 4.7 m  
 Bedrock 0.2 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.4	0.4
Glacial Sand and Gravel	a 'Clayey' gravel Gravel: mainly coarse, subrounded quartzite with sandstone and some igneous rocks Sand: fine, subangular to subrounded; orange-brown	1.0	1.4
Bunter Sandstone	b 'Clayey' sand, with some gravel Gravel: mainly fine, subrounded to well rounded, quartzite and sandstone Sand: medium, subangular to subrounded; reddish brown	3.7	5.1
	Sandstone, greyish brown	0.2+	5.3

**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
<b>a</b>	17	37	46	0.4-1.4	17	20	15	2	11	35
<b>b</b>	16	80	4	1.4-2.2	21	43	29	2	4	1
				2.2-3.2	15	33	42	3	6	1
				3.2-3.7	18	45	33	1	1	2
				3.7-5.1	14	38	45	1	2	0
				Mean	16	39	39	2	3	1
<b>a+b</b>	16	71	13	0.4-5.1	16	35	34	2	5	8

Surface level (+32.3 m) +106 ft  
 Water not encountered  
 October 1974

Overburden 0.8 m  
 Mineral 5.7 m  
 Bedrock 0.1 m+

**Log**

Geological classification	Lithology	Thickness m	Depth m
	Pebbly soil	0.8	0.8
Glacial Sand and Gravel	a 'Very clayey' sandy gravel Gravel: fine to coarse, subrounded, quartzite with quartz and traces of sandstone and igneous pebbles Sand: fine to medium, well sorted, subrounded to rounded, dominantly quartz; reddish orange	1.0	1.8
Bunter Sandstone	b Sand, 'very clayey' in parts: some gravel in upper 1.4 m Gravel: fine to coarse, subrounded, quartzite with some quartz and traces of sandstone Sand: fine and medium, subrounded, mainly quartz and quartzite; reddish brown	4.7	6.5
	Sandstone, reddish brown	0.1+	6.6

**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
<b>a</b>	23	46	31	0.8-1.8	23	25	19	2	18	13
<b>b</b>	11	88	1	1.8-2.2	1	44	49	2	1	3
				2.2-3.2	34	26	39	0	1	0
				3.2-4.2	0	55	45	0	0	0
				4.2-4.7	36	39	25	0	0	0
				4.7-5.7	1	31	67	1	0	0
				5.7-6.5	0	37	62	1	0	0
				Mean	11	38	50	0	1	0
<b>a+b</b>	13	81	6	0.8-6.5	13	36	44	1	4	2

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction					
		Quartz	Quartzite	Sandstone	Igneous	Limestone	Others
<b>a</b>	0.8-1.8	21	75	1	3	trace	0
<b>b</b>	1.8-2.2	3	92	3	0	0	2
	2.2-3.2	30	64	6	0	0	0
	3.2-6.5	gravel generally absent					
<b>a+b</b>	0.8-3.2	20	76	1	3	0	0

Surface level (+25.5 m) +84 ft  
 Water struck at (+23.2 m) +76 ft  
 September 1974

Overburden 0.3 m  
 Mineral 5.7 m  
 Waste 11.5 m  
 Bedrock 0.3 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Pebbly soil	0.3	0.3
Glacial Sand and Gravel	a Gravel Gravel: fine to coarse, subrounded, quartzite with sandstone and quartz; some limestone and igneous rocks in fine range Sand: medium, subrounded, mainly quartz, some ironstone cement throughout; pale brown	1.0	1.3
Glacial channel deposits	b 'Very clayey' sand, pebbly in upper 1 m Gravel: fine, mainly subrounded quartz and quartzite Sand: mainly fine, well sorted, subrounded, mainly quartz with traces of fine coal detritus in lower 1.7 m; dark reddish brown  Clay, dark brown, silty, tenacious, finely laminated below 7 m, traces of coal below 9 m	4.7	6.0
Bunter Sandstone	Sandstone, reddish brown	11.5	17.5
		0.3+	17.8

**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	
a	8	44	48	0.3-1.0	6	9	34	8	20	23	
				1.0-1.3	10	10	15	5	32	28	
				Mean	8	9	28	7	23	25	
b	21	77	2	1.3-2.3	10	60	20	2	7	1	
				2.3-3.3	14	66	19	1	0	0	
				3.3-4.3	28	61	10	1	0	0	
				4.3-5.3	24	73	2	1	0	0	
				5.3-6.0	30	67	2	1	0	0	
Mean	21	65	11	1	2	0					
a + b	18	73	9	0.3-6.0	18	56	15	2	5	4	

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Limestone
a	0.3-1.3	11	64	21	2	2

SK 69 NW 66 6467 9727 East of Great North Road, Austerfield

Block B

Surface level (+30.2 m) +99 ft

Water not encountered

October 1974

Overburden 0.4 m

Mineral 5.4 m

Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.4	0.4
Glacial Sand and Gravel	a 'Clayey' sandy gravel Gravel: fine to coarse, mainly subrounded, dominantly quartzite with quartz; some sandstone and igneous pebbles in fine range Sand: medium, poorly sorted, subangular, mainly quartz; orange to reddish brown	3.6	4.0
Bunter Sandstone	b 'Clayey' sand: medium, subrounded, mainly quartz; some soft sandstone lumps in lower part; mid brown	1.8	5.8
	Sandstone, dull brown	0.1+	5.9

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
a	14	44	42	0.4-1.4	17	10	20	5	19	29
				1.4-2.4	13	11	30	12	25	9
				2.4-3.0	9	13	28	9	26	15
				3.0-4.0	14	20	16	6	18	26
				Mean	14	13	23	8	22	20
b	16	83	1	4.0-5.0	15	47	35	1	2	0
				5.0-5.8	17	33	49	1	0	0
				Mean	16	41	41	1	1	0
a+b	15	57	28	0.4-5.8	15	22	30	5	15	13

SK 69 NW 67 6436 9561 Bawtry Forest

Block C

Surface level (+19.5 m) +64 ft

Water not encountered

September 1974

Waste 15.0 m

Bedrock 0.8 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.5	0.5
Head on Glacial channel deposits	Laminated clay, brown to grey, occasionally mottled, sandy and silty throughout, tenacious	9.2	9.7
	Clay, chocolate brown, silty and sandy; occasional coal pellets and sandstone pebbles	2.7	12.4
Bunter Sandstone	'Very clayey' sand: fine, well sorted, subrounded, quartz; reddish brown	2.6	15.0
	Sandstone, mid brown	0.8+	15.8

SK 69 NE 35 6547 9975 North-west of Finningley Airfield

Block E

Surface level (+9.1 m) + 30 ft  
Water not encountered  
October 1974

Overburden 0.5 m  
Mineral 1.9 m  
Bedrock 0.2 m+

Log

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Older River Gravel	'Clayey' sand, pebbly in upper 0.6 m Gravel: coarse with fine, subrounded to rounded, quartzite with some sandstone Sand: fine, well sorted, subangular to subrounded, mainly quartz; reddish brown	1.9	2.4
Bunter Sandstone	Sandstone, orange-brown	0.2+	2.6

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
12	83	5	0.5-1.1	13	49	21	2	6	9
			1.1-2.1	11	59	28	1	1	0
			2.1-2.4	12	48	39	1	0	0
			Mean	12	54	28	1	2	3

SK 69 NE 36 6579 9887 Finningley Airfield

Block E

Surface level (+10.9 m) + 36 ft  
Water not encountered  
October 1974

Overburden 0.6 m  
Mineral 6.9 m  
Bedrock 0.1 m+

Log

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Older River Gravel	a 'Clayey' pebbly sand Gravel: fine with coarse, subangular to subrounded, quartzite with quartz and sandstone Sand: fine, well sorted, subangular to subrounded, mainly quartz; orange to brown	4.9	5.5
Bunter Sandstone	b 'Clayey' sand: fine, well sorted, subangular to subrounded, mainly quartz; some clayey lumps towards base; reddish orange Sandstone, orange	2.0	7.5
		0.1+	7.6

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
a	12	74	14	0.6-1.4	19	33	18	5	13	12
				1.4-2.3	26	43	22	1	4	4
				2.3-3.5	11	40	24	6	13	6
				3.5-5.5	3	56	30	2	7	2
			Mean		12	46	25	3	9	5
b	16	84	0	5.5-6.5	14	47	38	1	0	0
				6.5-7.5	18	63	19	0	0	0
			Mean		16	55	28	1	0	0
a+b	13	77	10	0.6-7.5	13	49	26	2	6	4



SK 69 NE 37 6541 9707 North of Partridge Hill Farm, Austerfield

Block B

Surface level (+20.3 m) + 66 ft  
Water not encountered  
October 1974

Overburden 0.8 m  
Mineral 1.8 m  
Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Made ground	0.8	0.8
Glacial Sand and Gravel	a 'Clayey' sandy gravel Gravel: fine to coarse, mainly subrounded, quartzite with quartz Sand: fine, well sorted, subrounded, mainly quartz; reddish brown	0.6	1.4
Bunter Sandstone	b 'Clayey' sand: fine to medium, subrounded, mainly quartz; mid brown Sandstone, mid brown	1.2 0.1+	2.6 2.7

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
a	29	52	19	0.8-1.4	29	32	17	3	12	7
b	14	85	1	1.4-2.6	14	39	45	1	1	0
a+b	19	74	7	0.8-2.6	19	37	35	2	5	2

SK 69 NE 38 6534 9568 South of Partridge Hill Farm, Austerfield

Block B

Surface level (+20.4 m) + 67 ft  
Water not encountered  
September 1974

Mineral 4.0 m  
Waste 2.0 m  
Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Glacial Sand and Gravel	'Clayey' pebbly sand Gravel: fine to coarse, subrounded, quartzite with quartz Sand: medium, subrounded, mainly quartz; some clayey lumps in lower metre; reddish brown Clay, pale green at the top, reddish brown below, indurated, mica present throughout	4.0 2.0	4.0 6.0
Bunter Sandstone	Sandstone, pale brown	0.1+	6.1

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
14	78	8	0.0-1.0	8	28	49	0	4	11	
			1.0-2.0	14	29	47	1	4	5	
			2.0-3.0	18	32	50	0	0	0	
			3.0-4.0	17	39	36	1	1	6	
			Mean	14	32	45	1	3	5	

Composition

Depth below surface (m)	Percentages by weight in gravel fraction				
	Quartz	Quartzite	Sandstone	Igneous	Others
0.0-1.0	18	75	2	trace	5

Surface level (+7.6 m) +25 ft  
 Water not encountered  
 October 1974

Overburden 1.0 m  
 Mineral 5.2 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	1.0	1.0
Older River Gravel	Sandy gravel, 'clayey' in parts Gravel: fine to coarse, subangular to rounded, mainly quartzite with quartz, sandstone and some igneous pebbles Sand: mainly medium, angular to subrounded, mainly quartz with some other rock types; mid brown	5.2	6.2
Bunter Sandstone	Sandstone, reddish brown	0.1+	6.3

**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
10	52	38	1.0-2.0	10	22	37	4	18	9
			2.0-3.0	5	6	18	6	22	43
			3.0-4.0	11	9	40	10	20	10
			4.0-5.3	8	12	17	8	20	35
			5.3-6.2	14	23	37	6	12	8
			Mean	10	14	31	7	18	20

**Composition**

Depth below surface (m)	Percentages by weight in gravel fraction				
	Quartz	Quartzite	Sandstone	Igneous	Others
2.0-3.0	15	71	10	4	0
4.0-5.3	31	44	21	4	0

Surface level (+9.1 m) + 30 ft  
 Water not encountered  
 October 1974

Overburden 0.6 m  
 Mineral 3.7 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.6	0.6
Older River Gravel	a 'Clayey' sandy gravel Gravel: coarse and fine, subrounded, quartzite with quartz and some igneous and sandstone pebbles Sand: fine to medium, subangular to subrounded, mainly quartz; brown	2.3	2.9
Bunter Sandstone	b 'Clayey' sand with a little gravel Gravel: fine, subrounded, quartzite with sandstone and some quartz Sand: fine, well sorted, subangular to subrounded, quartz with traces of ? carbonaceous material; orange Sandstone, orange; thin mudstone band at top	1.4	4.3
		0.1+	4.4

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
<b>a</b>	11	51	38	0.6-2.9	11	19	24	8	18	20
<b>b</b>	20	79	1	2.9-4.3	20	55	23	1	1	0
<b>a+b</b>	15	61	24	0.6-4.3	15	32	24	5	12	12

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction			
		Quartz	Quartzite	Sandstone	Others
<b>a</b>	0.6-2.9	12	80	6	2
<b>b</b>	2.9-4.3	4	85	11	0
<b>a+b</b>	0.6-4.3	12	80	6	2

Surface level (+ 3.0 m) + 10 ft  
 Water not encountered  
 October 1974

Overburden 1.7 m  
 Mineral 1.2 m  
 Waste 0.4 m  
 Mineral 3.4 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Peaty soil on brown sandy clay	1.7	1.7
25-Ft Drift of the Vale of York	a 'Clayey' sand: fine, well sorted, mainly subrounded, quartz with traces of mica and coal; dark brown Clay, laminated and generally silty, mid brown to grey	1.2	2.9
? Older River Gravel	b 'Clayey' sandy gravel Gravel: fine and coarse, rounded to subrounded, dominantly quartzite with fine quartz and some sandstone Sand: fine, well sorted, subangular to subrounded, mainly quartz; occasional clay lumps; mid brown	3.4	6.7
Bunter Sandstone	Sandstone, mid-brown	0.1+	6.8

**Grading**

	<i>Mean for deposit percentages</i>			<i>Depth below surface (m)</i>	<i>percentages</i>					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/16	+ 1/16-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
a	17	83	0	1.7-2.9	17	61	22	0	0	0
b	16	60	24	3.3-4.3	19	21	14	9	29	8
				4.3-5.1	19	24	24	9	17	7
				5.1-6.1	11	32	29	5	8	15
				6.1-6.7	14	50	33	2	1	0
				Mean	16	30	24	6	15	9
a + b	16	67	17	Mean	16	38	24	5	11	6

**Composition**

	<i>Depth below surface (m)</i>	<i>Percentages by weight in gravel fraction</i>				
		Quartz	Quartzite	Sandstone	Igneous	Others
b	3.3-4.3	30	47	19	2	2

SK 69 NE 42 6731 9631 North of Austerfield

Block F

Surface level (c. +3.0 m) c. +10 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 October 1975

Overburden 1.5 m  
 Mineral 3.5 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
25-Ft Drift of the Vale of York	Soil, on brown bioturbated silty and peaty clay	1.5	1.5
25-Ft Drift of the Vale of York on Older River Gravel	'Very clayey' sand with clay parting between 4.1 and 4.3 m Gravel: fine to coarse, subrounded quartzite Sand: fine, well sorted, subrounded, quartz with some finely comminuted coal; mid brown	3.5+	5.0
Borehole terminated due to technical difficulties			

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
34	63	3	1.5-2.8	26	58	16	0	0	0
			2.8-4.1	35	49	16	0	0	0
			4.1-4.3	clay parting, assumed to comprise 100% fines					
			4.3-5.0	28	29	25	4	7	7
			Mean	34	46	17	0	2	1

SK 69 NE 43 6695 9557 North-east of Austerfield

Block F

Surface level (+3.4 m) +11 ft  
 Water not encountered  
 October 1974

Overburden 1.1 m  
 Mineral 3.9 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
25-Ft Drift of the Vale of York	Peaty soil on firm brownish grey clay	1.1	1.1
	a 'Clayey' sand: fine, well sorted, subangular, mainly quartz with scattered mica flakes; mid brown	2.2	3.3
Older River Gravel	b 'Clayey' sandy gravel Gravel: fine and coarse, mainly subrounded, quartzite with quartz and some sandstone and igneous pebbles Sand: medium, mainly subangular quartz with traces of mica; mid brown	1.7	5.0
Bunter Sandstone	Sandstone, reddish brown	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
a	12	88	0	1.1-2.1	13	69	17	1	0	0
				2.1-3.3	12	67	21	0	0	0
				Mean	12	68	19	1	0	0
b	13	55	32	3.3-4.3	14	21	26	4	22	13
				4.3-5.0	11	27	32	2	14	14
				Mean	13	23	29	3	19	13
a+b	12	73	15	1.1-5.0	12	48	23	2	8	7

Surface level (+1.8 m) + 6 ft  
 Water struck at (-3.4 m) - 11 ft  
 September 1974

Overburden 5.5 m  
 Mineral 5.1 m  
 Bedrock 0.2 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
25-Ft Drift of the Vale of York	Soil on reddish brown clay, locally poorly laminated, sandy in lowest 2.5 m	5.5	5.5
Older River Gravel	a Gravel, 'very clayey' in upper 0.5 m Gravel: fine to coarse, subrounded with some subangular, quartzite with quartz and some sandstone Sand: fine to coarse, poorly sorted, subangular with some subrounded, mainly quartz and quartzite; mid brown	2.0	7.5
Bunter Sandstone	b Sand: medium, well sorted, subrounded with subangular, quartz and quartzite; mid brown. Scattered fine quartzite pebbles Sandstone, pale grey	3.1 0.2+	10.6 10.8

**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
a	9	41	50	5.5-6.5	18	21	17	7	21	16
				6.5-7.5	0	3	17	16	38	26
				Mean	9	12	17	12	29	21
b	4	96	0	7.5-8.5	5	33	59	3	0	0
				8.5-9.5	4	41	52	3	0	0
				9.5-10.6	4	41	53	2	0	0
				Mean	4	39	55	2	0	0
a+b	6	74	20	5.5-10.6	6	28	40	6	12	8

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction			
		Quartz	Quartzite	Sandstone	Others
a	5.5-6.5	19	68	10	3

Surface level (+2.7 m) +9 ft  
 Water struck at (+0.6 m) +2 ft  
 September 1974

Overburden 0.4 m  
 Mineral 3.1 m  
 Waste 1.7 m  
 Mineral 5.2 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.4	0.4
25-Ft Drift of the Vale of York	a 'Very clayey' pebbly sand; gravel absent from upper 1.1 m Gravel: fine with coarse, subrounded, quartzite with quartz and some sandstone and igneous rocks Sand: mainly fine, well sorted, subangular to subrounded, mainly quartz; dark brown	3.1	3.5
	Clay, chocolate brown, slightly sandy and laminated in parts	1.7	5.2
Bunter Sandstone	b Sand, 'clayey' in upper 2 m; some pebbles in upper 3 m Gravel: fine and coarse, subrounded quartzite and quartz Sand: fine to medium, mainly subrounded quartz with traces of black lithic grains; mid brown	5.2	10.4
	Sandstone, pale brown	0.1+	10.5

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
a	30	58	12	0.4-1.5	35	52	13	0	0	0
				1.5-2.5	29	30	20	6	9	6
				2.5-3.5	25	23	25	6	12	9
				Mean	30	36	18	4	7	5
b	9	90	1	5.2-6.2	12	49	37	1	1	0
				6.2-7.2	18	41	37	1	2	1
				7.2-8.2	5	46	46	0	1	2
				8.2-9.2	5	45	50	0	0	0
				9.2-10.4	5	50	45	0	0	0
				Mean	9	46	43	1	1	0
a+b	17	78	5	Mean	17	42	34	2	3	2

Composition

	Depth below surface (m)	Percentages by weight in gravel fraction			
		Quartz	Quartzite	Sandstone	Igneous
a	2.5-3.5	22	71	4	3

Surface level (+6.4 m) +21 ft  
 Water not encountered  
 September 1974

Mineral 8.0 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Older River Gravel	a 'Clayey' sandy gravel Gravel: fine and coarse, subrounded to rounded, quartzite, with quartz, sandstone, and some igneous pebbles Sand: mainly medium, poorly sorted, subrounded, quartz with some quartzite; mid brown	4.5	4.5
Bunter Sandstone	b 'Very clayey' sand: fine, well sorted, subrounded with some subangular, mainly quartz, some mica; sandstone lumps throughout with occasional small lumps of green clay; bright red	3.5	8.0
	Sandstone, bright red	0.1+	8.1

**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
a	12	40	48	0.0-1.0	16	19	16	8	23	18
				1.0-2.0	12	10	23	7	20	28
				2.0-3.0	10	9	20	8	29	24
				3.0-4.0	10	8	18	9	22	33
				4.0-4.5	13	15	20	12	25	15
			Mean	12	12	19	9	24	24	
b	22	77	1	4.5-5.5	20	48	30	1	1	0
				5.5-6.5	25	59	16	0	0	0
				6.5-7.5	20	61	17	0	2	0
				7.5-8.0	25	53	21	1	0	0
				Mean	22	56	21	trace	1	0
a + b	16	56	28	0.0-8.0	16	31	20	5	14	14

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
a	0.0-1.0	27	60	12	1	0
a	3.0-4.0	21	44	32	3	0
a	4.0-4.5	26	57	10	5	2



SK 69 NE 48 6835 9617 Bracken Hill Lane, Misson

Block F

Surface level (+6.4 m) +21 ft  
 Water not encountered  
 September 1974

Overburden 0.6 m  
 Mineral 3.9 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Pebbly soil	0.6	0.6
Older River Gravel	a 'Clayey' pebbly sand Gravel: fine and coarse, subrounded, occasionally tabular, quartzite with quartz, sandstone, and some igneous rock Sand: fine, well sorted, subrounded to rounded, mainly quartz; mid brown	0.6	1.2
Bunter Sandstone	b 'Clayey' sand: fine well sorted, subrounded to rounded quartz with some mica; brown to yellow	3.3	4.5
	Sandstone, yellow	0.1+	4.6

**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
<b>a</b>	17	69	14	0.6-1.2	17	53	15	1	6	8
<b>b</b>	14	86	0	1.2-2.2	4	72	24	0	0	0
				2.2-3.2	21	67	12	0	0	0
				3.2-4.2	16	45	39	0	0	0
				4.2-4.5	18	49	33	0	0	0
				Mean	14	60	26	0	0	0
<b>a+b</b>	14	84	2	0.6-4.5	14	60	24	0	1	1

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction					
		Quartz	Quartzite	Sandstone	Igneous	Siltstone and Mudstone	Others
<b>a</b>	0.6-1.2	19	66	10	4	1	0

Surface level (+7.6 m) +25 ft  
 Water struck at (+1.5 m) +5 ft  
 September 1974

Overburden 0.2 m  
 Mineral 8.8 m  
 Bedrock 1.0 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.2	0.2
Older River Gravel	a Gravel Gravel: fine and coarse, mainly subrounded to rounded, quartzite with quartz, sandstone, and some igneous rocks Sand: medium, poorly sorted, subangular to subrounded, mainly quartz with some lithic grains; mid brown	2.8	3.0
Bunter Sandstone	b 'Clayey' sand: fine, subrounded quartz with some mica; orange-brown Sandstone, reddish brown	6.0 1.0+	9.0 10.0

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines			Gravel		
					- 1/16	+ 1/16-1/4	+ 1/4-1	+1-4	+4-16	+16
a	9	38	53	0.2-1.0	7	9	17	8	28	31
				1.0-2.0	10	10	18	8	25	29
				2.0-3.0	11	9	22	10	23	25
				Mean	9	10	19	9	25	28
b	14	86	0	3.0-4.0	23	60	17	trace	0	0
				4.0-5.0	19	50	31	trace	0	0
				5.0-6.0	21	54	25	trace	0	0
				6.0-7.0	11	55	34	trace	0	0
				7.0-8.0	4	51	45	trace	0	0
				8.0-9.0	4	53	43	trace	0	0
				Mean	14	54	32	trace	0	0
a + b	12	71	17	0.2-9.0	12	40	28	3	8	9

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
a	0.2-1.0	28	52	10	10	0

SK 69 NE 50 6981 9962 Bank End, near Finningley

Block F

Surface level (+1.5 m) + 5 ft  
 Water struck at (-2.2 m) - 7 ft  
 October 1974

Overburden 3.7 m  
 Mineral 8.3 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Peaty soil	1.0	1.0
25-Ft Drift of the Vale of York	Clay, brown; sandy to 2 m, laminated below: generally silty with traces of mica and coal detritus	2.7	3.7
Older River Gravel	Sandy gravel, with sand parting between 6.2 and 8.2 m Gravel: mainly coarse with occasional cobbles, subrounded, quartzite with quartz and traces of igneous rock and limestone Sand: fine to medium, subrounded, mainly quartz with quartzite and traces of mica; mid brown	8.3	12.0
Bunter Sandstone	Sandstone, reddish brown	0.1+	12.1

**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
4	67	29	3.7- 5.2	8	12	26	16	24	14
			5.2- 6.2	0	4	13	8	21	54
			6.2- 8.2	6	56	36	2	0	0
			8.2-10.2	3	42	12	3	5	35
			10.2-12.0	2	32	40	7	5	13
			Mean	4	34	26	7	9	20

Surface level (+3.0 m) +10 ft  
 Water struck at (-3.0 m) -10 ft  
 September 1974

Overburden 5.2 m  
 Mineral 6.4 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
25-Ft Drift of the Vale of York	Peaty soil on brown laminated sandy clay	4.0	4.0
	Very clayey sand, fine, chocolate brown	0.5	4.5
	Silty clay, laminated in parts, dark brown	0.7	5.2
? Older River Gravel	a Gravel, with green clay lumps in upper 0.6 m. Gravel: coarse with fine, subrounded to rounded, mainly quartzite with quartz Sand: fine to medium, poorly sorted, mainly subrounded quartz; mid brown	1.6	6.8
Bunter Sandstone	b Sand: fine, well sorted, mainly subrounded quartz with traces of mica; reddish brown	4.8	11.6
	Sandstone, reddish brown	0.1+	11.7

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+1-4	+4-16	+16
<b>a</b>	16	38	46	5.2-6.0	27	31	16	2	8	16
				6.0-6.8	4	11	11	5	24	45
				Mean	16	20	14	4	16	30
<b>b</b>	7	92	1	6.8- 7.8	6	63	26	2	1	2
				7.8- 8.8	7	47	44	1	1	0
				8.8- 9.8	5	54	40	1	0	0
				9.8-10.8	7	56	37	0	0	0
				10.8-11.6	11	54	34	1	0	0
Mean	7	55	36	1	1	0				
<b>a+b</b>	9	79	12	5.2-11.6	9	47	30	2	4	8

Surface level (+1.8 m) +6 ft  
 Water struck at (-3.6 m) -12 ft  
 September 1975

Overburden 5.6 m  
 Mineral 3.5 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
25-Ft Drift of the Vale of York	Soil on dark brown sandy clay	1.0	1.0
	'Very clayey' sand: fine, subangular to subrounded: some clay lumps; reddish brown	0.6	1.6
	Sandy clay, dark brown, tenacious	4.0	5.6
Older River Gravel	a Gravel	3.0	8.6
	Gravel: fine to coarse, rounded, quartzite with quartz Sand: medium, well sorted, mainly subrounded quartz, mid brown		
Bunter Sandstone	b Sand: fine, sub-angular to subrounded, mainly quartz; mid brown	0.5	9.1
	Sandstone, mid brown	0.1+	9.2

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
a	1	46	53	5.6-6.6	0	4	18	7	32	39
				6.6-7.6	1	8	49	9	15	18
				7.6-8.6	1	7	26	12	28	26
				Mean	1	6	31	9	25	28
b	2	98	0	8.6-9.1	2	52	43	3	0	0
a+b	1	54	45	5.6-9.1	1	13	32	9	21	24

Surface level (+3.0 m) +10 ft  
 Water struck at (-4.2 m) -14 ft  
 September 1974

Overburden 6.0 m  
 Mineral 6.0 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
25-Ft Drift of the Vale of York	Soil on brown silty clay becoming sandy and pebbly below 3.2 m	6.0	6.0
Older River Gravel	<b>a</b> 'Very clayey' sandy gravel Gravel: coarse with fine, subrounded quartzite with quartz and sandstone Sand: mainly fine, subrounded, quartz and quartzite; grey to reddish brown	1.4	7.4
Bunter Sandstone	<b>b</b> Sand, 'clayey' at top and base: medium, subrounded, mainly quartz; mid brown becoming yellow towards base Sandstone, pale brown	4.6 0.1+	12.0 12.1

**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
<b>a</b>	30	48	22	6.0- 7.0	30	28	20	2	5	15
				7.0- 7.4	32	23	17	2	9	17
				Mean	30	27	19	2	6	16
<b>b</b>	11	89	0	7.4- 8.4	11	46	42	1	0	0
				8.4- 9.4	4	37	58	1	0	0
				9.4-10.4	3	40	55	2	0	0
				10.4-11.4	2	42	55	1	0	0
				11.4-12.0	13	32	52	2	1	0
Mean	11	37	51	1	0	0				
<b>a + b</b>	12	83	5	6.0-12.0	12	37	44	2	1	4

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Mudstone and Siltstone
<b>a</b>	7.0-7.4	19	62	18	1	trace

Surface level (+5.5 m) +18 ft  
 Water not encountered  
 September 1974

Overburden 0.3 m  
 Mineral 4.5 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, with sandy pebbly clay between 1.2 and 1.4 m Gravel: fine and coarse, mainly subrounded, quartz and quartzite with sandstone. Sand: fine to medium, poorly sorted, subangular with subrounded, mainly quartz and quartzite; mid brown	2.5	2.8
Bunter Sandstone	b 'Very clayey' sand: fine, mainly subrounded quartz; reddish brown Sandstone, dull red	2.0 0.1+	4.8 4.9

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+1-4	+4-16	+16
<b>a</b>	21	39	40	0.3-1.2	18	18	16	4	22	22
				1.2-1.4	clay parting, assumed to comprise 100% fines					
				1.4-2.4	11	14	18	7	26	24
				2.4-2.8	13	29	25	6	14	13
				Mean	21	17	17	5	20	20
<b>b</b>	20	78	2	2.8-3.8	21	50	23	1	3	2
				3.8-4.8	19	38	42	1	0	0
				Mean	20	44	33	1	1	1
<b>a+b</b>	21	56	23	0.3-4.8	21	29	24	3	12	11

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
<b>a</b>	2.4-2.8	30	45	24	1	0

Surface level (+5.5 m) +18 ft  
 Water not encountered  
 September 1974

Overburden 0.6 m  
 Mineral 5.4 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.6	0.6
Older River Gravel	a 'Clayey' pebbly sand Gravel: fine and coarse, subrounded, mainly quartz Sand: fine to medium, subrounded quartz; grey to brown	1.1	1.7
Bunter Sandstone	b 'Clayey' sand: fine, well sorted, subrounded, mainly quartz with traces of mica; pale grey to brown	4.3	6.0
	Sandstone, mid brown	0.1+	6.1

**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
<b>a</b>	16	65	19	0.6-1.7	16	31	30	4	11	8
<b>b</b>	12	88	0	1.7-2.5	12	16	71	1	0	0
				2.5-3.5	3	55	42	0	0	0
				3.5-4.2	18	68	14	0	0	0
				4.2-5.2	16	57	27	0	0	0
				5.2-6.0	16	65	19	0	0	0
			Mean	12	53	35	0	0	0	
<b>a+b</b>	13	83	4	0.6-6.0	13	48	34	1	2	2



Surface level (+3.4) +11 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 June 1974

Mineral 7.3 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Older River Gravel	a 'Clayey' sandy gravel Gravel: coarse with fine, subrounded, quartz and quartzite with sandstone and some igneous rocks Sand: fine, subangular to subrounded, mainly quartz; mid brown	0.9	0.9
Bunter Sandstone	b 'Clayey' sand with scattered pebbles Gravel: fine, subrounded quartzite Sand: fine, well sorted, subrounded, quartz with traces of mica; reddish brown	6.4	7.3
	Sandstone, reddish brown	0.1+	7.4

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
a	20	45	35	0.0-0.5	24	27	12	2	7	28
				0.5-0.9	15	28	18	4	18	17
				Mean	20	27	15	3	12	23
b	16	82	2	0.9-1.8	20	56	16	3	5	0
				1.8-2.7	14	69	16	0	1	0
				2.7-3.6	13	59	28	0	0	0
				3.6-4.6	15	64	18	0	3	0
				4.6-5.5	15	64	20	0	1	0
				5.5-6.4	13	57	30	0	0	0
				6.4-7.3	19	63	17	0	1	0
Mean	16	61	21	0	2	0				
a+b	16	78	6	0.0-7.3	16	58	20	0	3	3

Composition

	Depth below surface (m)	Percentages by weight in gravel fraction							
		Quartz	Quartzite	Sandstone	Igneous	Limestone	Coal	Mudstone	Others
a	0.0-0.5	47	44	3	4	1	trace	0	1
	0.5-0.9	60	17	18	3	0	0	1	1
	Mean	52	34	9	4	trace	0	trace	1

**SK 69 NE 57 6947 9618 Near Nettleham Well Farm, Misson**

**Block F**

Surface level (+2.8 m) +9 ft  
 Water struck at (-2.7 m) -9 ft  
 September 1974

Overburden 5.5 m  
 Mineral 12.5 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
25-Ft Drift of the Vale of York	Soil on brown sandy and pebbly clay, poorly laminated below 3.2 m	5.5	5.5
Bunter Sandstone	'Clayey' sand: medium, mainly subrounded, quartz with quartzite and traces of siltstone; mid brown  Borehole terminated due to rising sand	12.5+	18.0

**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
16	84	0	5.5- 6.5	18	49	33	trace	0	0
			6.5- 7.5	14	42	44	trace	0	0
			7.5- 8.5	15	40	45	trace	0	0
			8.5- 9.5	13	44	43	trace	0	0
			9.5-10.5	17	44	39	trace	0	0
			10.5-11.5	13	43	44	trace	0	0
			11.5-12.5	39	27	34	trace	0	0
			12.5-14.5	10	35	55	trace	0	0
			14.5-16.5	16	42	41	0	1	0
			16.5-18.0	15	32	53	trace	0	0
			Mean	16	39	45	trace	0	0

**SK 69 NE 58 6960 9537 North-east of Misson**

**Block F**

Surface level (+6.5 m) +21 ft  
 Groundwater conditions not recorded  
 September 1974

Overburden 1.3 m  
 Mineral 3.6 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil, clayey and pebbly	1.3	1.3
Older River Gravel	a 'Clayey' pebbly sand Gravel: fine with some coarse, mainly subrounded, quartzite with quartz Sand: fine and medium, subangular to subrounded; mid brown	0.9	2.2
Bunter Sandstone	b 'Clayey' sand: fine, well sorted, subangular to subrounded; clay lumps throughout; mid brown  Sandstone, orange-brown	2.7	4.9

**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
a	19	62	19	1.3-2.2	19	35	24	3	11	8
b	17	83	0	2.2-3.0	15	41	43	1	0	0
				3.0-3.5	16	60	24	0	0	0
				3.5-4.0	19	70	11	0	0	0
				4.0-4.9	18	73	9	0	0	0
			Mean	17	61	22	0	0	0	
a+b	18	77	5	1.3-4.9	18	54	22	1	3	2

**SK 69 SW 50 6051 9490 North-east of Tickhill Low Common**

Surface level (+7.3 m) +24 ft  
 Water struck at (+5.0 m) +16 ft  
 September 1974

Waste 5.9 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat	Soil on silty peat	0.7	0.7
Alluvium	Clay, brown, with thin silty laminae	1.7	2.4
Bunter Sandstone	'Very clayey' sand: fine, well sorted, subrounded, mainly quartz; mid brown	3.5	5.9
	Sandstone, mid brown	0.1+	6.0

**SK 69 SW 51 6067 9409 Sheepwash Lane, near Tickhill**

Surface level (+8.2 m) +27 ft  
 Water struck at (+4.8 m) +16 ft  
 October 1974

Waste 6.2 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat on ? Alluvium	Peat on brown pebbly and sandy clay	2.8	2.8
Bunter Sandstone	Sand, 'very clayey' between 3.8 and 4.8 m: fine, well sorted, subangular with subrounded, quartz, with some mica in the lower part; reddish brown	3.4	6.2
	Sandstone, reddish brown	0.1+	6.3

**SK 69 SW 52 6064 9276 Moor House Farm, Tickhill**

Surface level (+10.4 m) +34 ft  
 Water struck at (+7.9 m) +25.8 ft  
 November 1974

Waste 7.9 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat on Alluvium	Peat on soft blue silty clay	1.2	1.2
Bunter Sandstone	Sand, 'clayey' in upper 2 m: fine, well sorted, mainly subangular quartz; reddish brown	6.7	7.9
	Sandstone, reddish brown	0.1+	8.0

**SK 69 SW 53 6040 9268 Tickhill Low Common**

Surface level (+10.0 m) +33 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 June 1974

Waste 4.6 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat	Peat, silty	2.3	2.3
Alluvium	Sandy clay, grey to brown	0.4	2.7
Bunter Sandstone	'Very clayey' sand, gravelly in upper 0.5 m Gravel: coarse with fine, mainly subrounded quartz and quartzite, some sandstone Sand: fine, well sorted, mainly subangular, quartz with some mica; mid brown	1.9	4.6
	Sandstone, reddish brown	0.1+	4.7

Surface level (+29.9 m) +98 ft  
 Water struck at (+24.4 m) +80 ft  
 September 1974

Overburden 0.4 m  
 Mineral 5.0 m  
 Waste 12.6 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Pebbly soil	0.4	0.4
Glacial Sand and Gravel	a Sand, pebbly in upper 1 m Gravel: mainly coarse, subrounded, quartz and quartzite Sand: fine, well sorted, mainly subangular, occasional 'clayey' lumps; mid brown	3.0	3.4
Glacial channel deposits	b 'Very clayey' sand: fine, well sorted, mainly subrounded; reddish brown Silt, grey; very clayey and generally fluid, traces of finely comminuted coal and mica, firm clay seam between 9.0 and 9.5 m Laminated clay, dark brown, generally silty with traces of mica	2.0 9.6 3.0+	5.4 15.0 18.0

**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
<b>a</b>	5	93	2	0.4-1.4	6	54	33	1	1	5
				1.4-2.4	4	50	45	1	0	0
				2.4-3.4	5	57	38	0	0	0
				Mean	5	54	39	trace	0	2
<b>b</b>	27	73	0	3.4-4.4	23	70	7	0	0	0
				4.4-5.4	32	65	3	0	0	0
				Mean	27	68	5	0	0	0
<b>a+b</b>	14	85	1	0.4-5.4	14	59	25	trace	trace	1

SK 69 SW 55 6238 9398 East of Tickhill High Common

Block C

Surface level (+33.8 m) +111 ft  
 Water not encountered  
 September 1974

Overburden 0.5 m  
 Mineral 4.4 m  
 Bedrock 0.1 m+

**Log**

Geological classification	Lithology	Thickness m	Depth m
	Pebbly soil	0.5	0.5
Glacial Sand and Gravel	a 'Very clayey' gravel Gravel: coarse with some fine, mainly subrounded, quartzite with some quartz Sand: fine to medium, poorly sorted, generally subangular quartz with some quartzite; mid brown	1.0	1.5
Bunter Sandstone	b 'Very clayey' sand: fine to medium, subrounded; some clay lumps throughout; orange-brown Sandstone, orange-brown	3.4 0.1+	4.9 5.0

**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
a	22	33	45	0.5-1.5	22	15	16	2	10	35
b	22	78	0	1.5-2.5	20	44	36	0	0	0
				2.5-3.5	21	39	39	1	0	0
				3.5-4.5	22	43	34	1	0	0
				4.5-4.9	31	33	36	0	0	0
				Mean	22	41	36	1	0	0
a+b	22	68	10	0.5-4.9	22	35	32	1	2	8

SK 69 SW 56 6257 9309 South of Tickhill Grange

Block D

Surface level (+33.2 m) +109 ft  
 Water not encountered  
 September 1974

Overburden 0.4 m  
 Mineral 4.3 m  
 Bedrock 0.1 m+

**Log**

Geological classification	Lithology	Thickness m	Depth m
	Sandy soil	0.4	0.4
Glacial Sand and Gravel	'Clayey' pebbly sand Gravel: coarse with some fine, mainly subrounded quartzite with quartz Sand: medium, subangular to subrounded, mainly quartz; scattered clay lumps; mid brown	4.3	4.7
Bunter Sandstone	Sandstone, grey	0.1+	4.8

**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
	19	74	7	0.4-1.5	21	30	28	1	3	17
				1.5-2.5	20	36	42	1	1	0
				2.5-3.5	11	29	53	1	2	4
				3.5-4.7	23	33	43	0	1	0
				Mean	19	32	41	1	2	5

SK 69 SW 57 6211 9155 Hill Road, Harworth

Block D

Surface level (+27.4 m) +90 ft  
 Water struck at (+21.0 m) +69 ft  
 October 1974

Overburden 2.8 m  
 Mineral 9.0 m  
 Waste 8.5 m+

Log

Geological classification	Lithology	Thickness m	Depth m
Sandy boulder clay on glacial channel deposits	Soil on brown, tenacious sandy clay	2.8	2.8
	'Very clayey' sand with clay seam between 4.4 and 4.8 m and clay lumps throughout Sand: fine, well sorted, subangular quartz with traces of coal and mica; brownish grey	9.0	11.8
	Laminated clay, brownish grey, silty, with traces of fine coal and mica	1.0	12.8
	Clayey silt, grey, traces of coal with traces of coal and mica	3.7	16.5
	Laminated clay, dark grey, tenacious, containing coal and mica on partings	3.8+	20.3
	Borehole terminated due to technical difficulties		

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
33	67	0	2.8- 4.4	29	59	12	0	0	0
			4.4- 4.8	clay seam, assumed to be 100% fines					
			4.8- 5.8	28	62	10	0	0	0
			5.8- 6.8	30	64	6	0	0	0
			6.8- 7.8	34	60	6	trace	0	0
			7.8- 9.8	29	63	8	trace	0	0
			9.8-16.5	30	66	4	trace	0	0
			Mean	33	60	7	trace	0	0

SK 69 SW 58 6276 9086 East of Glass Bulb Factory, Harworth

Block D

Surface level (+32.9 m) +108 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 June 1974

Mineral 3.6 m  
 Bedrock 0.1 m+

Log

Geological classification	Lithology	Thickness m	Depth m
Sandy boulder clay on Bunter Sandstone	'Clayey' sand, pebbly in upper part Gravel: fine and coarse, mainly subrounded quartzite and sandstone Sand: fine and medium, subrounded, quartz with traces of mica; mid brown. Becomes very compact below 3.5 m	3.6	3.6
	Sandstone, reddish brown	0.1+	3.7

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
13	84	3	0.0-0.5	22	41	29	1	2	5
			0.5-0.9	18	33	37	1	2	9
			0.9-1.8	10	44	45	1	0	0
			1.8-2.7	9	32	58	1	0	0
			2.7-3.6	12	47	40	0	1	0
			Mean	13	40	44	trace	1	2

Surface level (+31.7 m) +104 ft  
 Water not encountered  
 September 1974

Overburden 0.3 m  
 Mineral 3.0 m  
 Waste 4.2 m  
 Bedrock 0.8 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Gravelly soil	0.3	0.3
Glacial Sand and Gravel	'Very clayey' sand, pebbly near top Gravel: mainly coarse, subrounded quartzite Sand: fine, well sorted, subrounded, quartz; reddish brown	3.0	3.3
Glacial channel deposits	Clay, dark grey, generally laminated but containing quartz pebbles between 4.9 and 5.8 m, firm, silty and slightly micaceous	4.2	7.5
Bunter Sandstone	Sandstone, friable and clayey in upper 0.6 m, red	0.8+	8.3

**Grading**

Mean for deposit percentages			Depth below surface (m)	percentages					
Fines	Sand	Gravel		Fines		Sand		Gravel	
				- 1/8	+ 1/8 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16
17	80	3	0.3-1.3	17	35	40	2	1	5
			1.3-2.3	16	60	22	0	1	1
			2.3-3.3	17	63	20	0	0	0
			Mean	17	53	26	1	1	2

SK 69 SW 60 6362 9336 Near Swinnow Wood, Bircotes

Block D

Surface level (+ 32.3 m) +106 ft  
 Water not encountered  
 September 1974

Overburden 1.3 m  
 Mineral 8.0 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil on orange to brown sandy and pebbly clay	1.3	1.3
Glacial Sand and Gravel	Sand: fine to medium, mainly subrounded quartz; mid brown. Scattered fine rounded pebbles	8.0	9.3
Bunter Sandstone	Sandstone, pale brown	0.1+	9.4

**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
2	97	1	1.3-2.3	2	49	45	1	3	0
			2.3-3.3	2	44	52	2	0	0
			3.3-4.3	2	48	47	2	1	0
			4.3-5.3	3	36	58	3	0	0
			5.3-6.3	2	50	46	1	1	0
			6.3-7.3	2	52	45	1	0	0
			7.3-8.3	3	48	46	1	2	0
			8.3-9.3	3	45	50	1	1	0
			Mean	2	47	48	2	1	0

**Composition**

Depth below surface (m)	Percentages by weight in gravel fraction					
	Quartz	Quartzite	Sandstone	Igneous	Mudstone	Others
1.3-3.3	17	73	2	4	2	2



Surface level (+35.4 m) +116 ft  
 Water struck at (+23.5 m) +77 ft  
 October 1974

Overburden 0.6 m  
 Mineral 1.2 m  
 Waste 0.6 m  
 Mineral 1.5 m  
 Waste 7.8 m  
 Bedrock 0.2 m +

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.6	0.6
Sandy boulder clay	<b>a</b> Pebbly sand Gravel: fine to coarse, subrounded to rounded quartzite with quartz and some sandstone Sand: fine, subangular to subrounded, mainly quartz; mid brown	1.2	1.8
Glacial channel deposits	Clay, greyish brown, sandy and pebbly throughout	0.6	2.4
	<b>b</b> Pebbly sand Gravel: fine to coarse, mainly subrounded quartzite with some subangular siltstone fragments Sand: fine to medium, mainly subrounded quartz; orange-brown	1.5	3.9
	Laminated clay, grey, generally silty, tenacious	6.3	10.2
	Clay, sandy and pebbly, reddish brown, firm	1.5	11.7
Bunter Sandstone	Sandstone, reddish brown	0.2+	11.9

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1-4	+4-16	+16
<b>a</b>	1	91	8	0.6-1.8	1	53	34	4	3	5
<b>b</b>	0	95	5	2.4-3.1	0	28	60	2	3	7
				3.1-3.9	0	40	58	2	0	0
				Mean	0	34	59	2	2	3
<b>a+b</b>	0	94	6	Mean	trace	43	48	3	2	4

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
<b>a+b</b>	0.6-3.9	24	67	7	1	1

Surface level (+36.0 m) +118 ft  
 Water not encountered  
 October 1974

Overburden 0.7 m  
 Mineral 1.2 m  
 Waste 3.0 m  
 Mineral 2.1 m  
 Bedrock 0.2 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Pebbly soil	0.7	0.7
Sandy boulder clay	a Gravel Gravel: coarse with some fine, subrounded quartzite with traces of quartz Sand: fine to medium, poorly sorted, subangular with subrounded, mainly quartz; mid brown	1.2	1.9
	Laminated clay, grey, silty, with traces of coal and mica in places, tenacious	3.0	4.9
Glacial channel deposits	b 'Clayey' pebbly sand Gravel: fine to coarse, subangular, mainly siltstone with some quartzite Sand: fine to medium, poorly sorted, subangular, quartz and siltstone, traces of coal; mid brown	2.1	7.0
Bunter Sandstone	Sandstone, reddish brown	0.2+	7.2

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
<b>a</b>	1	46	53	0.7-1.2	0	23	21	8	12	36
				1.2-1.9	1	20	18	5	10	46
				Mean	1	21	19	6	11	42
<b>b</b>	14	71	15	4.9-7.0	14	26	27	18	7	8
<b>a+b</b>	9	62	29	Mean	9	24	24	14	9	20

Surface level (+31.7 m) +104 ft

Water not encountered

September 1974

Overburden 0.5 m

Mineral 11.4 m

Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Pebbly soil	0.5	0.5
Glacial Sand and Gravel	a 'Clayey' pebbly sand, 'very clayey' in lower 3 m Gravel: fine and coarse, subrounded with some subangular, quartzite and quartz Sand: fine to medium, rounded, mainly quartz; reddish brown	6.0	6.5
Bunter Sandstone	b 'Clayey' sand with scattered pebbles Gravel: fine and coarse with occasional cobbles below 7.5 m, dominantly subrounded quartzite Sand: fine to medium, subrounded, mainly quartz; mid brown  Sandstone, mid brown	5.4	11.9
		0.1+	12.0

**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
<b>a</b>	19	61	20	0.5- 1.5	17	15	26	6	20	16
				1.5- 2.5	14	9	22	10	18	27
				2.5- 3.5	14	12	47	8	14	5
				3.5- 4.5	22	37	28	2	3	8
				4.5- 5.5	22	46	29	1	2	0
				5.5- 6.5	26	42	24	1	2	5
				Mean	19	27	30	4	10	10
<b>b</b>	12	87	1	6.5- 7.5	10	49	39	1	1	0
				7.5- 8.5	12	45	41	1	1	0
				8.5- 9.5	11	32	53	1	1	2
				9.5-10.5	12	39	46	1	2	0
				10.5-11.5	9	35	53	1	2	0
				11.5-11.9	25	41	33	1	0	0
				Mean	12	40	46	1	1	0
<b>a+b</b>	16	73	11	0.5-11.9	16	33	37	3	6	5

SK 69 SW 64 6408 9289 East of Swinnow Wood

Block D

Surface level (+34.1 m) +112 ft  
 Water not encountered  
 September 1974

Overburden 0.5 m  
 Mineral 5.5 m  
 Bedrock 0.1 m+

Log

Geological classification	Lithology	Thickness m	Depth m
	Pebbly soil	0.5	0.5
Sandy boulder clay	'Clayey' pebbly sand Gravel: mainly coarse, subrounded quartzite with quartz Sand: fine, well sorted, subrounded with some subangular, mainly quartz; reddish brown	5.5	6.0
Bunter Sandstone	Sandstone, mid brown	0.1+	6.1

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
19	72	9	0.5-1.5	15	25	22	2	9	27
			1.5-2.5	22	43	35	0	0	0
			2.5-3.5	22	54	24	0	0	0
			3.5-4.5	18	35	32	0	1	14
			4.5-5.5	20	54	26	0	0	0
			5.5-6.0	18	41	38	0	1	2
			Mean	19	42	29	1	1	8

SK 69 SW 65 6463 9175 Gibbet Hill, east of Bircotes

Block H

Surface level (+16.2 m) +53 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 June 1974

Mineral 1.8 m  
 Bedrock 0.1 m+

Log

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel on Bunter Sandstone	Sand, pebbly near top Gravel: coarse with fine, mainly subrounded sandstone and quartz Sand: fine, well sorted, subrounded, quartz with scattered mica; reddish brown. Becomes very compact at about 1.5 m	1.8	1.8
	Sandstone, reddish brown	0.1+	1.9

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
9	85	6	0.0-0.9	8	45	36	1	3	7
			0.9-1.8	9	54	36	0	1	0
			Mean	9	49	36	0	2	4

SK 69 SW 66 6463 9032 Neales Covert, west of Scrooby

Block H

Surface level (+24.4 m) + 80 ft  
 Water not encountered  
 November 1974

Overburden 0.8 m  
 Mineral 3.7 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Sandy soil	0.8	0.8
Glacial Sand and Gravel	a 'Clayey' pebbly sand Gravel: mainly coarse, subrounded quartzite Sand: fine, subangular to subrounded; pale brown	1.2	2.0
Bunter Sandstone	b 'Clayey' sand: medium, well sorted, mainly subrounded quartz with traces of mica, some 'clayey' lumps; pale brown	2.5	4.5
	Sandstone, pale brown	0.1+	4.6

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
a	12	73	15	0.8-2.0	12	31	42	0	2	13
b	11	88	1	2.0-3.0	7	38	53	0	0	2
				3.0-4.0	11	33	55	0	1	0
				4.0-4.5	16	35	48	0	1	0
				Mean	11	35	53	0	trace	1
a + b	11	83	6	0.8-4.5	11	34	49	0	1	5

SK 69 SE 30 6584 9381 Bawtry Carr, Bawtry

Block F

Surface level (+8.2 m) + 27 ft  
 Groundwater conditions not recorded  
 September 1974

Overburden 3.9 m  
 Mineral 2.3 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Peat and pebbly soil	1.0	1.0
	Clay, reddish brown, laminated in parts, becomes sandy and pebbly below 3.2 m	2.9	3.9
Older River Gravel	'Clayey' gravel Gravel: fine to coarse, mainly subrounded quartzite with some quartz and traces of fine pebbles Sand: fine, subangular to subrounded, mainly quartz; reddish brown	2.3	6.2
Bunter Sandstone	Sandstone, pale brown	0.1+	6.3

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
	15	39	46	3.9-4.4	23	20	9	3	18	27
				4.4-5.4	12	20	13	7	26	22
				5.4-6.2	14	20	12	10	31	13
				Mean	15	20	11	8	26	20

Surface level (+4.0 m) +13 ft  
 Water struck at (-0.3 m) -1 ft  
 November 1974

Overburden 4.4 m  
 Mineral 4.6 m  
 Bedrock 0.3 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Made ground on silty peat	1.4	1.4
First Terrace	Clay, grey, silty and sandy	3.0	4.4
	<b>a</b> Gravel	2.5	6.9
	Gravel: coarse with fine, some cobble between 6.4 and 6.9 m, mainly subrounded, quartzite with some quartz		
	Sand: fine, subrounded with subangular, mainly quartz; mid brown		
? Older River Gravel	<b>b</b> Pebbly sand	2.1	9.0
	Gravel: fine to coarse, scattered cobbles, mainly subrounded quartzite		
	Sand: fine, mainly subrounded with subangular, quartz, mid brown		
Bunter Sandstone	Sandstone, reddish brown	0.3+	9.3

**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
					—		—		—	
<b>a</b>	1	46	53	4.4-5.4	1	3	17	12	32	35
				5.4-6.4	0	12	44	7	9	28
				6.4-6.9	1	14	23	6	7	49
				Mean	1	8	29	9	18	35
<b>b</b>	4	85	11	6.9-8.2	5	57	37	1	0	0
				8.2-9.0	2	30	31	10	10	17
				Mean	4	47	34	4	5	6
<b>a+b</b>	2	64	34	4.4-9.0	2	26	31	7	12	22

Surface level (+3.7 m) +12 ft  
 Water struck at (+1.0 m) +3 ft  
 October 1974

Overburden 1.1 m  
 Mineral 6.0 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Alluvium	Peat	1.1	1.1
First Terrace	a Gravel Gravel: coarse with fine, mainly subrounded with some subangular, quartzite with quartz and sandstone, igneous pebbles Sand: fine to coarse poorly sorted, mainly subangular with some subrounded, dominantly quartz; mid brown	4.2	5.3
Bunter Sandstone	b Sand with a few pebbles Gravel: fine, subrounded quartzite with quartz and sandstone and traces of igneous rocks Sand: medium, mainly subrounded with a little subangular, quartz with some quartzite; dull reddish brown Sandstone, reddish brown	1.8	7.1
		0.1+	7.2

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+1-4	+4-16	+16
a	1	27	72	1.1-2.1	1	10	10	7	33	39
				2.1-3.1	0	6	10	8	42	34
				3.1-4.1	3	4	7	14	33	39
				4.1-5.3	0	18	12	2	24	44
				Mean	1	10	10	7	33	39
b	4	94	2	5.3-6.3	6	43	48	2	1	0
				6.3-7.1	2	42	50	2	3	1
				Mean	4	42	49	3	2	0
a+b	2	47	51	1.1-7.1	2	19	22	6	23	28

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
a	1.1-3.1	18	57	20	4	1
	3.1-5.3	18	73	6	3	trace
	Mean	18	65	13	4	trace
b	5.3-7.1	24	46	26	3	1
a+b	1.1-7.1	18	61	17	4	trace

Surface level (+5.8 m) +19 ft  
 Water struck at (+0.6 m) +2 ft  
 October 1974

Overburden 0.9 m  
 Mineral 4.2 m  
 Bedrock 0.2 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
First Terrace	Soil on brown sandy bioturbated clay	0.9	0.9
	a Sandy gravel, mainly 'clayey' to 'very clayey'	3.3	4.2
	Gravel: fine and coarse, subrounded quartzite with some quartz and scattered sandstone and igneous pebbles		
	Sand: fine to medium, poorly sorted, subrounded to rounded, mainly quartz; orange-brown		
Bunter Sandstone	b Sand: fine, well sorted, mainly subrounded quartz; reddish brown Sandstone, reddish brown	0.9	5.1
		0.2+	5.3

**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
a	15	44	41	0.9-1.3	24	22	21	2	20	11
				1.3-2.3	25	20	14	1	21	19
				2.3-3.0	18	25	20	6	19	12
				3.0-4.2	1	8	29	11	26	25
				Mean	15	17	21	6	22	19
b	1	98	1	4.2-5.1	1	62	34	2	1	0
a+b	12	56	32	0.9-5.1	12	28	23	5	18	14

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction					
		Quartz	Quartzite	Sandstone	Igneous	Chert	Others
a	0.9-1.3	26	66	4	1	2	1
	1.3-2.3	10	88	1	1	0	0
	2.3-3.0	33	61	2	2	2	0
	3.0-4.2	11	85	2	2	trace	trace
	Mean	16	80	2	2	trace	trace
b	4.2-5.1	36	57	6	0	1	0
a+b	0.9-5.1	16	80	2	2	trace	trace



Surface level (+4.0 m) +13 ft  
 Water struck at (+2.8 m) +9 ft  
 October 1974

Overburden 1.2 m  
 Mineral 5.4 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Alluvium	Peat	1.2	1.2
First Terrace	a Sandy gravel	4.0	5.2
	Gravel: fine to coarse, mainly subrounded, quartzite with quartz Sand: medium, subangular with subrounded, mainly quartz; mid brown		
	b Pebbly sand	1.4	6.6
	Gravel: mainly coarse, subrounded quartzite Sand: medium, well sorted, subrounded, quartz; reddish brown		
Bunter Sandstone	Sandstone, reddish brown	0.1+	6.7

**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
a	6	56	38	1.2-2.2	11	11	35	8	25	10
				2.2-3.2	9	17	50	9	14	1
				3.2-4.2	3	13	44	26	13	1
				4.2-5.2	1	2	6	4	38	49
				Mean	6	10	34	12	23	15
b	2	91	7	5.2-5.9	2	32	51	2	1	12
				5.9-6.6	2	30	66	2	0	0
				Mean	2	31	58	2	1	6
a+b	5	65	30	1.2-6.6	5	16	40	9	17	13

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction						
		Quartz	Quartzite	Sandstone	Igneous	Ironstone	Chert	Others
a	1.2-5.2	23	64	4	2	2	2	3

Surface level (+4.9 m) +16 ft  
 Water struck at (+0.7 m) +2.5 ft  
 October 1974

Overburden 0.7 m  
 Mineral 7.6 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
First Terrace	Soil on brownish grey sandy clay	0.7	0.7
	<b>a</b> Sandy gravel	4.4	5.1
	Gravel: coarse with fine, mainly subrounded, quartzite with quartz and occasional igneous pebbles		
	Sand: medium, generally subangular quartz; buff		
Bunter Sandstone	<b>b</b> Sand, 'clayey' in lowest 1.3 m	3.2	8.3
	Gravel: mainly fine, subrounded quartzite		
	Sand: medium, subrounded, quartz with scattered mica; reddish brown		
	Sandstone, reddish brown	0.1+	8.4

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/8 - 1/4	+ 1/4 - 1	+ 1 - 4	+ 4 - 16	+ 16
<b>a</b>	8	58	34	0.7-1.7	13	21	37	3	7	19
				1.7-2.7	6	9	19	8	28	30
				2.7-4.1	9	20	37	7	10	17
				4.1-5.1	7	37	30	5	4	17
				Mean	8	23	30	5	13	21
<b>b</b>	10	87	3	5.1-6.0	7	35	49	4	2	3
				6.0-7.0	7	39	48	3	2	1
				7.0-8.3	15	43	41	1	0	0
				Mean	10	40	45	2	2	1
<b>a+b</b>	9	71	20	0.7-8.3	9	29	38	4	8	12

Surface level (+3.0 m) +10 ft  
 Water struck at (+0.7 m) +2 ft  
 September 1974

Overburden 3.7 m  
 Mineral 4.5 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat	Soil and brown peat	3.7	3.7
First Terrace	Pebbly sand Gravel: fine with coarse, mainly subrounded with some subangular, quartzite with quartz and sandstone Sand: medium, well sorted, subangular to subrounded, mainly quartz; pale brown	4.5	8.2
Bunter Sandstone	Sandstone, reddish brown	0.1+	8.3

**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
2	90	8	3.7-5.0	2	14	74	4	3	3
			5.0-5.7	2	21	68	3	4	2
			5.7-6.3	1	18	72	3	2	4
			6.3-7.0	2	21	71	4	2	0
			7.0-7.9	2	14	59	5	12	8
			7.9-8.2	3	63	33	1	0	0
			Mean	2	20	67	3	5	3

**Composition**

Depth below surface (m)	Percentages by weight in gravel fraction				
	Quartz	Quartzite	Sandstone	Igneous	Others
3.7-5.0	12	76	10	2	0
7.0-7.9	16	62	20	2	0

Surface level (+6.7 m) +22 ft  
 Water struck at (+2.6 m) +85 ft  
 September 1974

Overburden 0.6 m  
 Mineral 9.1 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Gravelly soil	0.6	0.6
First Terrace	a 'Clayey' sandy gravel Gravel: fine and coarse, mainly subrounded, quartzite with quartz and traces of chert Sand: fine to medium, subrounded, mainly quartz with traces of chert; pale brown	3.0	3.6
Bunter Sandstone	b Sand, 'clayey' in upper 2 m: fine to medium, mainly subrounded quartz with traces of mica; buff	6.1	9.7
	Sandstone, grey	0.1+	9.8

**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
<b>a</b>	12	47	41	0.6-1.6	12	17	19	3	13	36
				1.6-2.6	8	10	15	9	18	40
				2.6-3.6	16	27	28	13	11	5
				Mean	12	18	21	8	14	27
<b>b</b>	8	91	1	3.6-4.1	17	47	29	5	1	1
				4.1-4.6	15	45	37	3	0	0
				4.6-5.6	10	46	43	1	0	0
				5.6-6.6	2	53	44	1	0	0
				6.6-7.6	3	45	48	1	3	0
				7.6-9.7	8	47	42	2	1	0
				Mean	8	47	42	2	1	0
<b>a+b</b>	10	72	18	0.6-9.7	10	34	33	5	6	12

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction					
		Quartz	Quartzite	Sandstone	Igneous	Chert	Others
<b>a</b>	0.6-2.6	8	78	8	1	5	0

Surface level (+4.9 m) +16 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 July 1974

Overburden 1.8 m  
 Mineral 4.6 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Peat	Peaty clay	1.8	1.8
First Terrace	a Sand with scattered pebbles	2.8	4.6
	Gravel: fine, quartz with sandstone Sand: medium and fine subrounded, mainly quartz; brown		
	b Sandy gravel	1.8	6.4
	Gravel: fine with coarse, subrounded to subangular, mainly quartzite with quartz and some sandstone Sand: medium, rounded, mainly quartz; reddish brown		
Bunter Sandstone	Sandstone, reddish brown	0.1+	6.5

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		percentages					
					Fines		Sand		Gravel	
					- 1/8	+ 1/8-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
a	8	91	1	1.8-2.7	8	42	49	1	0	0
				2.7-3.7	10	36	47	6	1	0
				3.7-4.6	7	31	46	12	4	0
				Mean	8	37	47	7	1	0
b	4	67	29	4.6-5.5	5	21	40	12	22	0
				5.5-6.4	4	16	37	6	16	21
				Mean	4	19	38	10	18	11
a+b	7	81	12	1.8-6.4	7	29	44	8	8	4

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
b	4.6-5.5	23	46	19	10	2
	5.5-6.4	21	69	6	3	trace
	Mean	22	60	11	6	1

Surface level (+8.6 m) +28 ft  
 Water struck at (+0.0 m) +0.0 ft  
 November 1974

Overburden 0.6 m  
 Mineral 10.4 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Soil	0.6	0.6
Older River Gravel	<b>a</b> Pebbly sand, 'clayey' in upper 4 m, very gravelly at base Gravel: fine and coarse, but predominantly coarse at base, mainly quartz and quartzite Sand: medium to fine, subangular to subrounded, mainly quartz; orange-brown	5.6	6.2
Bunter Sandstone	<b>b</b> Sand: fine to medium, mainly subrounded quartz with some subangular ? siltstone; buff Sandstone, pale brown	4.8	11.0
		0.1+	11.1

**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
<b>a</b>	9	80	11	0.6- 1.5	11	37	44	1	4	3
				1.5- 2.5	10	43	41	1	2	3
				2.5- 3.6	12	32	49	1	2	4
				3.6- 4.6	11	35	42	3	7	2
				4.6- 5.6	4	32	50	3	7	4
				5.6- 6.2	8	25	27	3	10	27
				Mean	9	35	43	2	5	6
<b>b</b>	8	90	2	6.2- 8.8	6	55	37	1	1	0
				8.8- 9.8	18	44	36	2	0	0
				9.8-10.8	4	30	59	2	5	0
				10.8-11.0	8	40	49	3	0	0
				Mean	8	46	42	2	2	0
<b>a+b</b>	9	84	7	0.6-11.0	9	40	43	1	4	3

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction				
		Quartz	Quartzite	Sandstone	Igneous	Others
<b>b</b>	9.8-10.8	16	67	16	trace	trace

Surface level (+3.0 m) +10 ft  
 Water struck at (-0.7 m) -2 ft  
 November 1974

Overburden 3.7 m  
 Mineral 3.5 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Alluvium	Peat	2.2	2.2
	Clay, grey, silty	1.5	3.7
First Terrace	a Gravel	1.8	5.5
	Gravel: mainly coarse with fine, subangular to subrounded, quartz and quartzite with traces of sandstone, limestone and igneous rocks		
	Sand: fine to medium, subangular to subrounded, mainly quartz and quartzite with some limestone, sandstone and igneous fragments; grey		
Bunter Sandstone	b Sand: medium to fine, subangular to subrounded, mainly quartz and quartzite; mid brown	1.7	7.2
	Sandstone, mid brown	0.1+	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
a	3	45	52	3.7-4.7	1	6	11	4	20	58
				4.7-5.5	6	34	32	9	7	12
				Mean	3	19	20	6	14	38
b	7	92	1	5.5-6.5	6	41	49	4	0	0
				6.5-7.3	9	45	41	4	1	0
				Mean	7	43	46	3	1	0
a+b	5	69	26	3.7-7.3	5	31	33	5	7	19

SK 69 SE 41 6737 9285 North-east of Scaftworth Grange

Block G

Surface level (+3.4 m) +11 ft  
 Water struck at (-0.2 m) -0.5 ft  
 October 1974

Overburden 0.7 m  
 Mineral 3.5 m  
 Bedrock 1.7 m+

Log

Geological classification	Lithology	Thickness m	Depth m
	Pebbly soil	0.7	0.7
? First Terrace on Bunter Sandstone	Sand: fine, well sorted, subrounded to rounded, mainly quartz with scattered mica; buff	3.5	4.2
	Mudstone, olive green	0.2	4.4
	No recovery: traces of fine, compact, well-sorted sand in bottom 0.1 m only	1.5+	5.9

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
16	84	0	0.7-1.7	15	48	37	trace	0	0
			1.7-2.7	14	46	40	trace	0	0
			2.7-3.7	18	55	27	trace	0	0
			3.7-4.2	17	60	23	trace	0	0
			Mean	16	51	33	trace	0	0

SK 69 SE 42 6742 9192 Barrow Hills, near Scaftworth

Block H

Surface level (+36.6 m) +120 ft  
 Water not encountered  
 October 1974

Mineral 6.4 m  
 Bedrock 0.1 m+

Log

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel	a Pebbly sand, 'clayey' and gravelly between 2.1 and 2.8 m Gravel: mainly coarse, subrounded, quartzite with quartz Sand: medium, subangular to subrounded, mainly quartz; mid brown	4.8	4.8
Bunter Sandstone	b Sand: fine to medium, subrounded, mainly quartz with scattered mica; grey Sandstone, grey	1.6	6.4
		0.1+	6.5

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	
a	6	86	8	0.0-1.0	2	37	57	1	1	2
				1.0-2.1	4	46	44	0	0	6
				2.1-2.8	16	20	29	4	10	21
				2.8-3.8	4	50	43	0	1	2
				3.8-4.8	5	44	47	0	1	3
			Mean	6	40	45	1	2	6	
b	7	93	0	4.8-5.8	4	46	50	0	0	0
				5.8-6.4	12	51	37	0	0	0
				Mean	7	48	45	0	0	0
a+b	6	88	6	0.0-6.4	6	43	44	1	2	4



SK 69 SE 43 6793 9089 Stone Hill Cottages, west of Everton

Block H

Surface level (+20.4 m) +67 ft  
 Water not encountered  
 Minuteman Auger, 4 inch diameter  
 July 1974

Mineral 5.8 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
? Glacial Sand and Gravel on Bunter Sandstone	Sand, 'clayey' below 3.7 m: fine to medium, well sorted, subrounded, mainly quartz; pale brown	5.8+	5.8
	Sandstone, mid brown	0.1+	5.9

**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
12	88	0	0.0-0.9	10	50	40	0	0	0
			0.9-1.8	7	42	50	1	0	0
			1.8-2.7	8	50	41	1	0	0
			2.7-3.7	11	46	43	0	0	0
			3.7-4.6	17	49	33	1	0	0
			4.6-5.5	15	51	34	0	0	0
			5.5-5.8	15	52	33	0	0	0
			Mean	12	49	38	1	0	0

SK 69 SE 44 6779 9497 North of Bawtry Road, Misson

Block F

Surface level (+8.0 m) +26 ft  
 Water not encountered  
 November 1974

Overburden 0.9 m  
 Mineral 5.1 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
	Gravelly soil	0.9	0.9
Older River Gravel	a 'Very clayey' pebbly sand, with scattered clay lumps Gravel: coarse with fine, subrounded to rounded, mainly quartzite with quartz Sand: fine, well sorted, subangular, mainly quartz with traces of mica	3.3	4.2
Bunter Sandstone	b Sand, with clay lumps between 5.2 and 6.0 m: fine, subrounded, mainly quartz, mid-brown Sandstone, buff	1.8	6.0
		0.1+	6.1

**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
a	16	65	19	0.9-2.0	15	48	17	2	6	12
				2.0-3.0	16	45	18	2	4	15
				3.0-4.2	17	46	14	2	6	15
				Mean	16	46	17	2	6	13
b	10	90	0	4.2-5.2	3	56	41	0	0	0
				5.2-6.0	18	50	32	0	0	0
				Mean	10	53	37	0	0	0
a + b	14	74	12	0.9-6.0	14	48	24	2	4	8

Surface level (+2.7 m) +9 ft  
 Water struck at (-0.6 m) -2 ft  
 November 1974

Overburden 2.3 m  
 Mineral 7.7 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Peat	Peat	1.8	1.8
First Terrace	Clay, brown, silty	0.5	2.3
	<b>a</b> Sandy gravel; gravel absent from top 1.7 m Gravel: coarse with fine, some cobbles between 5 and 6 m, subangular to subrounded, quartzite with quartz and some igneous rock Sand: medium to fine, becomes coarser towards base, poorly sorted, subangular to subrounded, quartz with some dark grains; mid brown	5.0	7.3
Bunter Sandstone	<b>b</b> Sand: fine to medium, well sorted, subrounded, mainly quartz with scattered mica; reddish brown Sandstone, reddish brown	2.7	10.0
		0.1+	10.1

**Grading**

	<i>Mean for deposit percentages</i>			<i>Depth below surface (m)</i>	<i>percentages</i>					
	<i>Fines</i>	<i>Sand</i>	<i>Gravel</i>		<i>Fines</i>		<i>Sand</i>		<i>Gravel</i>	
					<i>- 1/16</i>	<i>+ 1/16-1/4</i>	<i>+ 1/4-1</i>	<i>+ 1-4</i>	<i>+ 4-16</i>	<i>+ 16</i>
<b>a</b>	4	62	34	2.3- 4.0	7	38	51	1	3	0
				4.0- 5.0	2	19	15	8	15	41
				5.0- 6.0	1	13	15	5	22	44
				6.0- 6.3	1	8	15	15	26	35
				6.3- 7.3	1	12	25	35	7	20
				Mean	4	21	30	11	11	23
<b>b</b>	8	92	0	7.3- 8.3	7	41	49	3	0	0
				8.3-10.0	9	56	34	1	0	0
				Mean	8	51	40	1	0	0
<b>a + b</b>	5	73	22	2.3-10.0	5	32	33	8	7	15

SK 69 SE 46 6865 9327 River Idle, north of Everton

Block G

Surface level (+3.4 m) +11 ft  
 Water struck at (-1.8 m) -6 ft  
 October 1974

Overburden 0.9 m  
 Mineral 4.1 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.9	0.9
? First Terrace on Bunter Sandstone	'Very clayey' sand: fine, well sorted, subangular with subrounded, mainly quartz with traces of mica; brown to grey	4.1	5.0
	Sandstone, grey-brown	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
20	80	0	0.9-1.7	25	62	13	trace	0	0
			1.7-2.7	21	67	12	trace	0	0
			2.7-3.7	15	83	2	trace	0	0
			3.7-5.0	21	75	4	trace	0	0
			Mean	20	73	7	trace	0	0

SK 69 SE 47 6842 9284 Pasture Farm, north-west of Everton

Block G

Surface level (+3.4 m) +11 ft  
 Water struck at (+1.8 m) +6 ft  
 November 1974

Overburden 0.5 m  
 Mineral 4.4 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.5	0.5
? First Terrace on Bunter Sandstone	Sand 'clayey' in part: fine, well sorted, subangular and subrounded, mainly quartz with some ? igneous grains; grey	4.4	4.9
	Sandstone, grey	0.1+	5.0

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
9	91	0	0.5-2.5	9	54	37	trace	0	0
			2.5-4.5	11	61	28	0	0	0
			4.5-4.9	6	52	41	1	0	0
			Mean	9	57	34	trace	0	0

Surface level (+40.5 m) +133 ft  
 Water not encountered  
 November 1974

Mineral 4.5 m  
 Bedrock 0.1 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness m</i>	<i>Depth m</i>
Glacial Sand and Gravel	a 'Clayey' pebbly sand Gravel: fine and coarse, mainly subrounded, calcareous mudstone quartzite with quartz and some sandstone Sand: fine to medium, subangular to subrounded, mainly quartz; mid brown	1.0	1.0
	b Sand with a little gravel Gravel: fine and coarse, subrounded, quartz and quartzite with some sandstone Sand: fine to medium, well sorted, subrounded, quartz; mid brown	2.0	3.0
Bunter Sandstone	c Sand: fine, subrounded, quartz; grey	1.5	4.5
	Sandstone; greyish brown	0.1+	4.6

**Grading**

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines		Sand		Gravel	
					- 1/8	+ 1/16-1/4	+ 1/4-1	+1-4	+4-16	+16
a	11	69	20	0.0-1.0	11	34	31	4	9	11
b	5	92	3	1.0-2.0	4	46	45	1	2	2
				2.0-3.0	6	46	44	1	2	1
				Mean	5	46	45	1	2	1
c	11	89	0	3.0-4.0	8	59	33	0	0	0
				4.0-4.5	17	53	30	0	0	0
				Mean	11	57	32	0	0	0
a+b+c	8	86	6	0.0-4.5	8	47	38	1	3	3
a+b	7	84	9	0.0-3.0	7	42	40	2	4	5

**Composition**

	Depth below surface (m)	Percentages by weight in gravel fraction						
		Quartz	Quartzite	Sandstone	Igneous	Calcareous	Mudstone	Others
a	0.0-1.0	8	40	2	trace	48		2

Surface level (+2.4 m) + 8 ft  
 Water struck at (+0.6 m) + 25 ft  
 January 1975

Overburden 0.5 m  
 Mineral 1.5 m  
 Waste 1.5 m  
 Mineral 5.0 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.5	0.5
First Terrace	a 'Very clayey' sand: fine, well sorted, subrounded, mainly quartz, mid brown	1.5	2.0
	Sandy clay, brown	1.5	3.5
	b Sandy gravel, with thin clay seam between 5.1 and 5.3 m Gravel: coarse with fine, subrounded to subangular, mainly quartzite with some quartz Sand: fine to medium, poorly sorted, subangular, mainly quartz; brown	3.5	7.0
Bunter Sandstone	c Sand: medium, subangular to subrounded, mainly quartz with traces of mica and scattered dark grains; grey	1.5	8.5
	Sandstone, grey	0.1+	8.6

Grading

	Mean for deposit percentages			Depth below surface (m)	percentages					
	Fines	Sand	Gravel		Fines			Gravel		
					- 1/16	+ 1/16-1/4	+ 1/4-1	+ 1-4	+ 4-16	+ 16
a	22	78	0	0.5-1.0	6	48	46	0	0	0
				1.0-2.0	30	54	15	1	0	0
				Mean	22	52	25	1	0	0
b	8	51	41	3.5-5.1	5	37	33	7	7	11
				5.1-5.3	clay seam, assumed to be 100% fines					
				5.3-6.3	0	3	11	13	26	47
				6.3-7.0	1	5	22	14	28	30
				Mean	8	19	22	10	16	25
c	5	95	0	7.0-8.5	5	43	49	3	0	0
a+b+c	11	67	22	Mean	11	32	29	6	9	13

Surface level (+2.7 m) +9 ft  
 Water struck at (+6.0 m) +19.5 ft  
 January 1975

Overburden 1.9 m  
 Mineral 2.0 m  
 Waste 0.6 m  
 Mineral 4.0 m  
 Bedrock 0.2 m+

**Log**

<i>Geological classification</i>	<i>Lithology</i>	<i>Thickness</i> m	<i>Depth</i> m
Alluvium	Soil on grey sandy and silty clay	1.9	1.9
First Terrace	a 'Clayey' sand: fine, well sorted, subangular, mainly quartz with traces of coal; mid brown	2.0	3.9
	Clay, brown, slightly sandy	0.6	4.5
	b 'Very clayey' sand: fine, well-sorted, subangular quartz with quartzite and some dark grains	1.5	6.0
	c Sandy gravel Gravel: fine with coarse, mainly quartz with quartzite, some dark rock fragments in finer range Sand: fine and medium, mainly subangular quartz with quartzite; mid brown	2.5	8.5
Bunter Sandstone	Sandstone, reddish brown	0.2+	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
a	17	83	0	1.9-2.9	20	67	13	0	0	0
				2.9-3.9	14	68	18	0	0	0
				Mean	17	67	16	0	0	0
b	31	66	3	4.5-5.0	32	36	18	7	7	0
				5.0-6.0	31	52	15	1	1	0
				Mean	31	47	16	3	3	0
c	2	61	37	6.0-7.5	2	23	27	12	21	15
				7.5-8.5	3	30	21	8	25	13
				Mean	2	26	25	10	23	14
a+b+c	17	71	12	Mean	17	48	19	4	8	4

SK 69 SE 51 6929 9310 North of Claybank Farm, Everton

Block G

Surface level (+2.7 m) +9 ft  
 Water struck at (-0.2 m) -1 ft  
 October 1974

Overburden 0.6 m  
 Mineral 4.3 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
Alluvium	Sandy soil	0.6	0.6
First Terrace	a 'Very clayey' pebbly sand Gravel: fine and coarse, subrounded quartzite with quartz Sand: fine, well-sorted, subangular, quartz; brown and grey	2.6	3.2
Bunter Sandstone	b Sand: medium, mainly subrounded quartz with scattered mica; greyish brown Sandstone, greyish brown	1.7	4.9
		0.1+	5.0

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
a	27	68	5	0.6-1.9	27	43	20	1	3	6
				1.9-2.2	26	57	15	1	1	0
				2.2-3.2	27	60	11	1	1	0
				Mean	27	51	16	1	2	3
b	3	97	0	3.2-4.2	3	47	49	1	0	0
				4.2-4.9	3	44	52	1	0	0
				Mean	3	46	50	1	0	0
a+b	18	79	3	0.6-4.9	18	49	29	1	1	2

SK 69 SE 52 6956 9209 North of Everton

Block G

Surface level (+3.6 m) +12 ft  
 Water struck at (+0.8 m) +3 ft  
 October 1974

Overburden 0.5 m  
 Mineral 4.0 m  
 Bedrock 0.1 m+

Log		Thickness	Depth
Geological classification	Lithology	m	m
	Soil	0.5	0.5
? First Terrace on Bunter Sandstone	'Clayey' sand: fine to medium, subrounded, mainly quartz; clay lumps throughout; pale brown Sandstone, mid brown	4.0	4.5
		0.1+	4.6

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
	12	88	0	0.5-1.5	11	55	33	trace	trace	0
				1.5-2.5	11	41	48	0	0	0
				2.5-3.5	12	40	48	0	0	0
				3.5-4.5	14	58	27	trace	trace	0
				Mean	12	49	38	trace	trace	0

**APPENDIX G**  
**CONVERSION TABLE, METRES TO FEET (to nearest 0.5 ft)**

m	ft	m	ft	m	ft	m	ft	m	ft
0.1	0.5	6.1	20	12.1	39.5	18.1	59.5	24.1	79
0.2	0.5	6.2	20.5	12.2	40	18.2	59.5	24.2	79.5
0.3	1	6.3	20.5	12.3	40.5	18.3	60	24.3	79.5
0.4	1.5	6.4	21	12.4	40.5	18.4	60.5	24.4	80
0.5	1.5	6.5	21.5	12.5	41	18.5	60.5	24.5	80.5
0.6	2	6.6	21.5	12.6	41.5	18.6	61	24.6	80.5
0.7	2.5	6.7	22	12.7	41.5	18.7	61.5	24.7	81
0.8	2.5	6.8	22.5	12.8	42	18.8	61.5	24.8	81.5
0.9	3	6.9	22.5	12.9	42.5	18.9	62	24.9	81.5
1.0	3.5	7.0	23	13.0	42.5	19.0	62.5	25.0	82
1.1	3.5	7.1	23.5	13.1	43	19.1	62.5	25.1	82.5
1.2	4	7.2	23.5	13.2	43.5	19.2	63	25.2	82.5
1.3	4.5	7.3	24	13.3	43.5	19.3	63.5	25.3	83
1.4	4.5	7.4	24.5	13.4	44	19.4	63.5	25.4	83.5
1.5	5	7.5	24.5	13.5	44.5	19.5	64	25.5	83.5
1.6	5	7.6	25	13.6	44.5	19.6	64.5	25.6	84
1.7	5.5	7.7	25.5	13.7	45	19.7	64.5	25.7	84.5
1.8	6	7.8	25.5	13.8	45.5	19.8	65	25.8	84.5
1.9	6	7.9	26	13.9	45.5	19.9	65.5	25.9	85
2.0	6.5	8.0	26	14.0	46	20.0	65.5	26.0	85.5
2.1	7	8.1	26.5	14.1	46.5	20.1	66	26.1	85.5
2.2	7	8.2	27	14.2	46.5	20.2	66.5	26.2	86
2.3	7.5	8.3	27	14.3	47	20.3	66.5	26.3	86.5
2.4	8	8.4	27.5	14.4	47	20.4	67	26.4	86.5
2.5	8	8.5	28	14.5	47.5	20.5	67.5	26.5	87
2.6	8.5	8.6	28	14.6	48	20.6	67.5	26.6	87.5
2.7	9	8.7	28.5	14.7	48	20.7	68	26.7	87.5
2.8	9	8.8	29	14.8	48.5	20.8	68	26.8	88
2.9	9.5	8.9	29	14.9	49	20.9	68.5	26.9	88.5
3.0	10	9.0	29.5	15.0	49	21.0	69	27.0	88.5
3.1	10	9.1	30	15.1	49.5	21.1	69	27.1	89
3.2	10.5	9.2	30	15.2	50	21.2	69.5	27.2	89
3.3	11	9.3	30.5	15.3	50	21.3	70	27.3	89.5
3.4	11	9.4	31	15.4	50.5	21.4	70	27.4	90
3.5	11.5	9.5	31	15.5	51	21.5	70.5	27.5	90
3.6	12	9.6	31.5	15.6	51	21.6	71	27.6	90.5
3.7	12	9.7	32	15.7	51.5	21.7	71	27.7	91
3.8	12.5	9.8	32	15.8	52	21.8	71.5	27.8	91
3.9	13	9.9	32.5	15.9	52	21.9	72	27.9	91.5
4.0	13	10.0	33	16.0	52.5	22.0	72	28.0	92
4.1	13.5	10.1	33	16.1	53	22.1	72.5	28.1	92
4.2	14	10.2	33.5	16.2	53	22.2	73	28.2	92.5
4.3	14	10.3	34	16.3	53.5	22.3	73	28.3	93
4.4	14.5	10.4	34	16.4	54	22.4	73.5	28.4	93
4.5	15	10.5	34.5	16.5	54	22.5	74	28.5	93.5
4.6	15	10.6	35	16.6	54.5	22.6	74	28.6	94
4.7	15.5	10.7	35	16.7	55	22.7	74.5	28.7	94
4.8	15.5	10.8	35.5	16.8	55	22.8	75	28.8	94.5
4.9	16	10.9	36	16.9	55.5	22.9	75	28.9	95
5.0	16.5	11.0	36	17.0	56	23.0	75.5	29.0	95
5.1	17	11.1	36.5	17.1	56	23.1	76	29.1	95.5
5.2	17	11.2	36.5	17.2	56.5	23.2	76	29.2	96
5.3	17.5	11.3	37	17.3	57	23.3	76.5	29.3	96
5.4	17.5	11.4	37.5	17.4	57	23.4	77	29.4	96.5
5.5	18	11.5	37.5	17.5	57.5	23.5	77	29.5	97
5.6	18.5	11.6	38	17.6	57.5	23.6	77.5	29.6	97
5.7	18.5	11.7	38.5	17.7	58	23.7	78	29.7	97.5
5.8	19	11.8	38.5	17.8	58.5	23.8	78	29.8	98
5.9	19.5	11.9	39	17.9	58.5	23.9	78.5	29.9	98
6.0	19.5	12.0	39.5	18.0	59	24.0	78.5	30.0	98.5



## REFERENCES

- ALLEN, V. T. 1936. Terminology of medium grained sediments. *Rep. Natl Res. Coun. Washington* 1935-36, *App. 1, Rep. Comm. Sedimentation*, pp. 18-47.
- ARCHER, A. A. 1969. Background and problems of an assessment of sand and gravel resources in the United Kingdom. *Proc. 9th Commonw. Min. Metall. Congr., 1969*, Vol. 2: Mining and petroleum geology, pp. 495-508.
- 1970a. Standardisation of the size classification of naturally occurring particles. *Géotechnique*, Vol. 20, pp. 103-107.
- 1970b. Making the most of metrication. *Quarry Managers' J.*, Vol. 54, No. 6, pp. 223-227.
- ATTERBERG, A. 1905. Die rationelle Klassifikation der Sande und Kiese. *Chem. Z.*, Vol. 29, pp. 195-198.
- AVELINE, W. T. 1880. The geology of parts of Nottinghamshire, Yorkshire and Derbyshire, 2nd edition. *Mem. Geol. Surv. GB*.
- BRITISH STANDARD 1377. 1967. *Methods of testing soils for civil engineering purposes*. (London: British Standards Institution.)
- BUREAU OF MINES AND GEOLOGICAL SURVEY. 1948. *Mineral Resources of the United States*. (Washington DC: Public Affairs Press.) pp. 14-17.
- GAUNT, G. D. 1974. A radiocarbon date relating to Lake Humber. *Proc. Yorkshire Geol. Soc.*, Vol. 40, pp. 195-197.
- BARTLEY, D. D. and HARLAND R. 1974. Two interglacial deposits proved in boreholes in the southern part of the Vale of York and their bearing on contemporaneous sea levels. *Bull. Geol. Surv. GB*, No. 48, pp. 1-23.
- COOPE, G. R., OSBOURNE, P. J. and FRANKS, J. W. 1972. An interglacial deposit near Austerfield, southern Yorkshire. *Rep. Inst. Geol. Sci.*, No. 72/4.
- JARVIS, R. A. and MATTHEWS, B. 1971. The late Weichselian sequence in the Vale of York. *Proc. Yorkshire Geol. Soc.*, Vol. 38, pp. 281-284.
- HARRIS, P. M., THURRELL, R. G., HEALING, R. A. and ARCHER, A. A. 1974. Aggregates in Britain. *Proc. R. Soc., Ser. A*, Vol. 339, pp. 329-353.
- LANE, E. W. and others. 1947. Report of the sub-committee on sediment terminology. *Trans. Am. Geophys. Union*, Vol. 28, pp. 936-938.
- PETTIJOHN, F. J. 1957. *Sedimentary rocks*, 2nd edition. (London: Harper and Row.)
- SMITH, E. G., RHYS, G. H. and GOOSENS, R. F. 1973. Geology of the country around East Retford, Worksop and Gainsborough. *Mem. Geol. Surv. GB*, Sheet 101.
- and WARRINGTON, G. 1971. The age relationships of the Triassic rocks assigned to the lower part of the Keuper in north Nottinghamshire, north-west Lincolnshire and south Yorkshire. *Proc. Yorkshire Geol. Soc.*, Vol. 38, Pt 2, No. 10, pp. 201-227.
- TERZAGHI, K. and PECK, R. B. 1967. *Soil mechanics in engineering practice*, 2nd edition. (New York: Wiley International.)
- THURRELL, R. G. 1971. The assessment of mineral resources with particular reference to sand and gravel. *Quarry Managers' J.*, Vol. 55, pp. 19-25.
- TWENHOFEL, W. H. 1937. Terminology of the fine-grained mechanical sediments. *Rep. Natl Res. Coun. Washington*, 1936-37. *App. 1, Rep. Comm. Sedimentation*, pp. 81-104.
- UDDEN, J. A. 1914. Mechanical composition of clastic sediments. *Bull. Geol. Soc. Am.*, Vol. 25, pp. 655-744.
- WENTWORTH, C. K. 1922. A scale of grade and class terms for clastic sediments. *J. Geol.*, Vol. 30, pp. 377-392.
- 1935. The terminology of coarse sediments. *Bull. Natl Res. Coun. Washington*, No. 98, pp. 225-246.
- WILLMAN, H. B. 1942. Geology and mineral resources of the Marseilles, Ottawa and Streator quadrangle. *Bull. Illinois State Geol. Surv.*, No. 66, pp. 343-344.

The following reports of the Institute relate particularly to bulk mineral resources

### Reports of the Institute of Geological Sciences

#### *Assessment of British Sand and Gravel Resources*

1 The sand and gravel resources of the country south-east of Norwich, Norfolk: Resource sheet TG 20. E. F. P. Nickless.

Report 71/20 ISBN 0 11 880216 £1.15

2 The sand and gravel resources of the country around Witham, Essex: Resource sheet TL 81. H. J. E. Haggard.

Report 72/6 ISBN 0 11 880588 6 £1.20

3 The sand and gravel resources of the area south and west of Woodbridge, Suffolk: Resource sheet TM 24. R. Allender and S. E. Hollyer.

Report 72/9 ISBN 0 11 880596 7 £1.70

4 The sand and gravel resources of the country around Maldon, Essex: Resource sheet TL 80. J. D. Ambrose.

Report 73/1 ISBN 0 11 880600 9 £1.20

5 The sand and gravel resources of the country around Hethersett, Norfolk: Resource sheet TG 10. E. F. P. Nickless.

Report 73/4 ISBN 0 11 880606 8 £1.60

6 The sand and gravel resources of the country around Terling, Essex: Resource sheet TL 71. C. H. Eaton.

Report 73/5 ISBN 0 11 880608 4 £1.20

7 The sand and gravel resources of the country around Layer Breton and Tolleshunt D'Arcy, Essex: Resource sheet TL 91 and part of TL 90. J. D. Ambrose.

Report 73/8 ISBN 0 11 990614 9 £1.30

8 The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Resource sheet TM 23. R. Allender and S. E. Hollyer.

Report 73/13 ISBN 0 11 880625 4 £1.60

9 The sand and gravel resources of the country around Attlebridge, Norfolk: Resource sheet TG 11. E. F. P. Nickless.

Report 73/15 ISBN 0 11 880658 0 £1.85

10 The sand and gravel resources of the country west of Colchester, Essex: Resource sheet TL 92. J. D. Ambrose.

Report 74/6 ISBN 0 11 880671 8 £1.45

11 The sand and gravel resources of the country around Tattingstone, Suffolk: Resource sheet TM 13. S. E. Hollyer.

Report 74/9 ISBN 0 11 880675 0 £1.95

12 The sand and gravel resources of the country around Gerrards Cross, Buckinghamshire: Resource sheets SU 99, TQ 08 and TQ 09. H. C. Squirrell.

Report 74/14 ISBN 0 11 880710 2 £2.20

#### Mineral Assessment Reports

13 The sand and gravel resources of the country east of Chelmsford, Essex: Resource sheet TL 70. M. R. Clarke. ISBN 0 11 880744 7 £3.50

14 The sand and gravel resources of the country east of Colchester, Essex: Resource sheet TM 02. J. D. Ambrose. ISBN 0 11 880745 5 £3.25

15 The sand and gravel resources of the country around Newton on Trent, Lincolnshire: Resource sheet SK 87. D. Price.

ISBN 0 11 880746 3 £3.00

16 The sand and gravel resources of the country around Braintree, Essex: Resource sheet TL 72. M. R. Clarke. ISBN 0 11 880747 1 £3.50

17 The sand and gravel resources of the country around Besthorpe, Nottinghamshire: Resource sheet SK 86 and part of SK 76. J. R. Gozzard.

ISBN 0 11 880748 X £3.00

18 The sand and gravel resources of the Thames Valley, the country around Cricklade, Wiltshire: Resource sheets SU 09/19 and parts of SP 00/10. P. R. Robson. ISBN 0 11 880749 8 £3.00

19 The sand and gravel resources of the country south of Gainsborough, Lincolnshire: Resource sheet SK 88 and part of SK 78. J. H. Lovell. ISBN 0 11 880750 1 £2.50

20 The sand and gravel resources of the country east of Newark-upon-Trent, Nottinghamshire: Resource sheet SK 85. J. R. Gozzard.

ISBN 0 11 880751 X £2.75

21 The sand and gravel resources of the Thames and Kennet Valleys, the country around Pangbourne, Berkshire: Resource sheet SU 67. H. C. Squirrell.

ISBN 0 11 880752 8 £3.25

22 The sand and gravel resources of the country north-west of Scunthorpe, Humberside: Resource sheet SE 81. J. W. C. James.

ISBN 0 11 880753 6 £3.00

23 The sand and gravel resources of the Thames Valley, the country between Lechlade and Standlake: Resource sheet SP 30 and parts of SP 20, SU 29 and SU 39. P. Robson.

ISBN 0 11 881252 1 £7.25

24 The sand and gravel resources of the country around Aldermaston, Berkshire: Parts of resource sheets SU 56 and SU 66. H. C. Squirrell.

ISBN 0 11 881253 X £5.00

25 The celestite resources of the area north-east of Bristol: Resource sheet ST 68 and parts of ST 59, 69, 79, 58, 78, 68 and 77. E. F. P. Nickless, S. J. Booth and P. N. Mosley.

ISBN 0 11 881262 9 £5.00

26 The limestone and dolomite resources of the country around Monyash, Derbyshire: Resource sheet SK 16.

F. C. Cox and D. McC. Bridge.

ISBN 0 11 881263 7 £7.00

27 The sand and gravel resources of the country west and south of Lincoln, Lincolnshire: Resource sheets SK 95, SK 96 and SK 97. I. Jackson.

ISBN 0 11 884003 7 £6.00

28 The sand and gravel resources of the country around Eynsham, Oxfordshire: Resource sheet SP 40 and part of SP 41. W. J. R. Harries.

ISBN 0 11 884012 6 £3.00

29 The sand and gravel resources of the country south-west of Scunthorpe, Humberside: Resource sheet SE 80. J. H. Lovell.

ISBN 0 11 884013 4 £3.50

30 Procedure for the assessment of limestone resources. F. C. Cox, D. McC. Bridge and J. H. Hull.

ISBN 0 11 884030 4 £1.25

31 The sand and gravel resources of the country west of Newark upon Trent, Nottinghamshire. Resource sheet SK 75. D. Price and P. J. Rogers.

ISBN 0 11 884031 2 £3.50

32 The sand and gravel resources of the country around Sonning and Henley. Resource sheets SU 77 and SU 78. H. C. Squirrell.

ISBN 0 11 884032 0 £5.25

33 The sand and gravel resources of the country north of Gainsborough. Resource sheet SK 89. J. Gozzard and D. Price.

ISBN 0 11 884033 9 £4.50

34 The sand and gravel resources of the Dengie Peninsula, Essex: Resource sheet TL 90, etc. M. B. Simmons.

ISBN 0 11 884081 9 *not yet priced*

35 The sand and gravel resources of the country around Darvel: Resource sheet NS 53, 63, etc. E. F. P. Nickless and others.

ISBN 0 11 884082 7 £7.00

36 The sand and gravel resources of the country around Southend-on-Sea, Essex: Resource sheets TQ 78/79 etc.

S. E. Hollyer and M. B. Simmons.

ISBN 0 11 884083 5 £7.50

37 The sand and gravel resources of the country around Bawtry, South Yorkshire: Resource sheet SK 69.

A. R. Clayton.

ISBN 0 11 884053 3 £5.75

38 The sand and gravel resources of the country around Abingdon, Oxfordshire: Resource sheet SU 49, 59, SP 40, 50. C. E. Corser.

ISBN 0 11 884084 5 £5.50

### **Reports of the Institute of Geological Sciences**

#### *Other Reports*

69/9 Sand and gravel resources of the inner Moray Firth.

A. L. Harris and J. D. Peacock.

ISBN 0 11 880106 6 35p

70/4 Sands and gravels of the southern counties of Scotland. G. A. Goodlet.

ISBN 0 11 880105 8 90p

72/8 The use and resources of moulding sand in Northern Ireland. R. A. Old.

ISBN 0 11 881594 0 30p

73/9 The superficial deposits of the Firth of Clyde and its sea lochs. C. E. Deegan, R. Kirby, I. Rae and R. Floyd.

ISBN 0 11 880617 3 95p

77/1 Sources of aggregate in Northern Ireland (2nd edition). I. B. Cameron.

ISBN 0 11 881279 3 70p

77/2 Sand and gravel resources of the Grampian Region. J. D. Peacock and others.

ISBN 0 11 881282 3 80p

77/5 Sand and gravel resources of the Fife Region.

M. A. E. Browne.

ISBN 0 11 884004 5 60p

77/6 Sand and gravel resources of the Tayside Region.

I. B. Paterson.

ISBN 0 11 884008 8 £1.40

77/8 Sand and gravel resources of the Strathclyde Region. I. B. Cameron and others.

ISBN 0 11 884028 2 £2.50

77/9 Sand and gravel resources of the Central Region, Scotland. M. A. E. Browne.

ISBN 0 11 884016 9 £1.35

77/19 Sand and gravel resources of the Borders Region, Scotland. A. D. McAdam.

ISBN 0 11 884025 8 £1.00

77/22 Sand and gravel resources of the Dumfries and Galloway Region of Scotland. I. B. Cameron.

ISBN 0 11 884025 8 £1.20

78/1 Sand and gravel resources of the Lothian Region of Scotland. A. D. McAdam.

ISBN 0 11 884042 8 £1.00

Dd 595730 K8

Typeset for the Institute of Geological Sciences  
by John Wright and Sons Ltd, Bristol

Printed in England for Her Majesty's Stationery Office  
by Commercial Colour Press, London E7



THE SAND & GRAVEL RESOURCES OF SHEET SK 69 (BAWTRY, SOUTH YORKSHIRE)

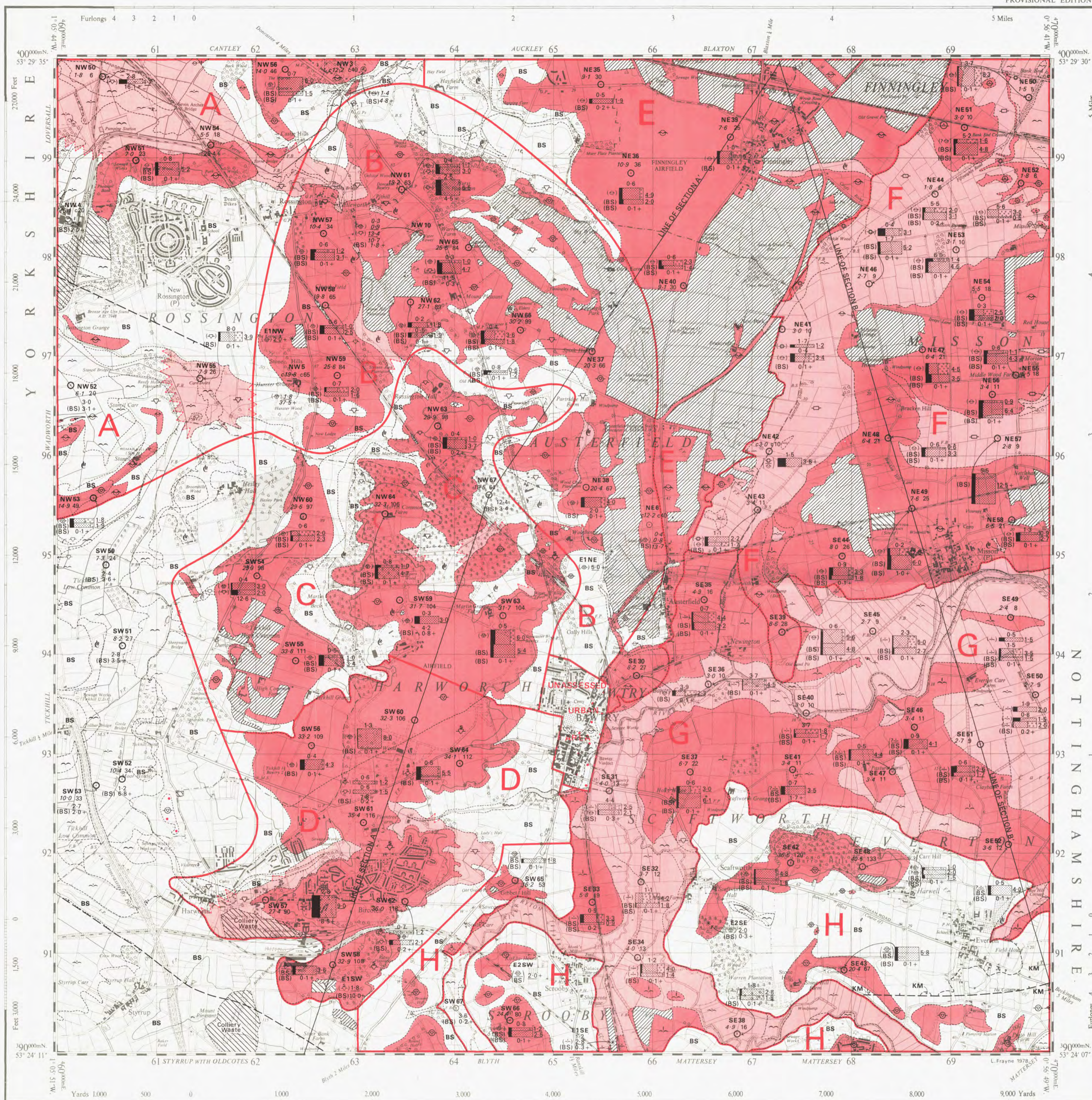
Scale 1:25 000 or about 2½ Inches to 1 Mile

ORDNANCE SURVEY  
SHEET SK 69  
PROVISIONAL EDITION

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

37

EXPLANATION OF SYMBOLS AND ABBREVIATIONS



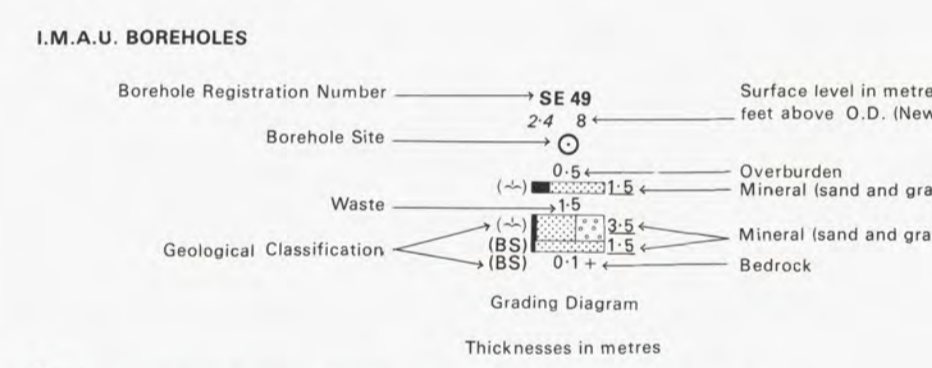
- DRIFT**
- Peat P-1
  - Alluvium - variably sandy clay. A-25
  - Blown Sand - fine sand. BS-7
  - First Terrace - sand, locally clayey, and sandy gravel. 1T-15
  - Sand of the 25-Ft Drift of the Vale of York - sand locally pebbly. SA-4
  - Silt and Clay of the 25-Ft Drift of the Vale of York - silty clay. SI-2
  - Head - clay with some sand. H-17
  - Older River Gravel - pebbly sand and gravel. OR-11
  - Glacial Sand and Gravel - sand and sandy gravel. GS-23
  - Sandy Boulder Clay - clayey sand with some pebbles. SB-1
  - Boulder Clay and glacial channel deposits - clays with sand lenses. BC-13

- SOLID**
- KM Keuper Marl - mainly reddish brown mudstone and siltstone.
  - BS Bunter Sandstone (including Bunter Pebble Beds and Lower Mottled Sandstone) - pink to reddish brown fine-grained sandstone with some pebbly beds, particularly in the south.

- Made Ground
- Areas worked for sand and gravel

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

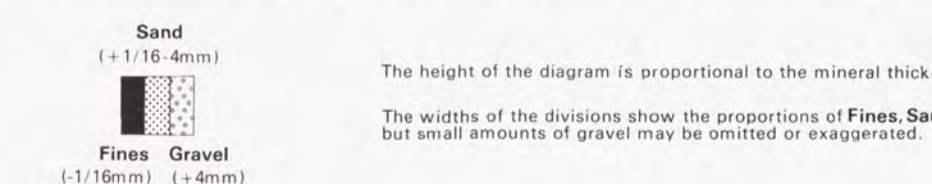
- BOREHOLE DATA**
- SITE LOCATIONS**
- Industrial Minerals Assessment Unit (I.M.A.U.) Boreholes.
  - Other Boreholes



Note:  
(i) Figures underlined denote thicknesses used in the 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. SE 49. The letters refer to the quarter sheet and the figures to the I.G.S. serial numbers for that quarter. The unique designation for borehole SE 49 is SK 69 SE 49.

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



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

**EXPOSURE RECORDS**  
Information from the inspection of exposures is shown in the same way as for boreholes but they are located by an asterisk, thus \* Reference number and details of thickness are shown.

- 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

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

Detailed records may be consulted on application to the Head, Industrial Minerals Assessment Unit, Institute of Geological Sciences, Keyworth, Nottingham, NG12 5GG.

Made and published by the Director General of the Ordnance Survey, Southampton, for the Institute of Geological Sciences.

Geological lines from six-inch surveys by R.F. Goossens and E.G. Smith in 1946 and 1958-60 (southern half) and by G.D. Gaunt in 1962 (northern half). Worked areas updated by A.R. Clayton and G.D. Gaunt in 1976. V.A. Eyles, A.W. Woodland and D.R.A. Pansford, District Geologists. Included in One-Inch Geological Sheets 88 and 101.

Sand and Gravel Survey by A.R. Clayton in 1974. R.G. Thurrell, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1978. Austin W. Woodland, C.B.E., Director, Institute of Geological Sciences, incorporating the Geological Survey of Great Britain, the Museum of Practical Geology and Overseas Geological Surveys.

1100/78

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.

Compiled from 6" sheets last fully revised 1919/29. Other partial systematic revision 1938/53 has been incorporated. Major roads revised 1965. Airfield restored 1965.

Made and published by the Director General of the Ordnance Survey, Chesham, Surrey. Reprinted with the restoration of airfield, 1965.

SE 50	SE 60	SE 70
87	88	SK 79
SK 58	SK 68	SK 78
100	101	SK 78
SK 58	SK 68	SK 78

Diagram showing the relation of the National Grid 1:25,000 sheets with the One-Inch Geological Sheets 87, 88, 100 and 101.