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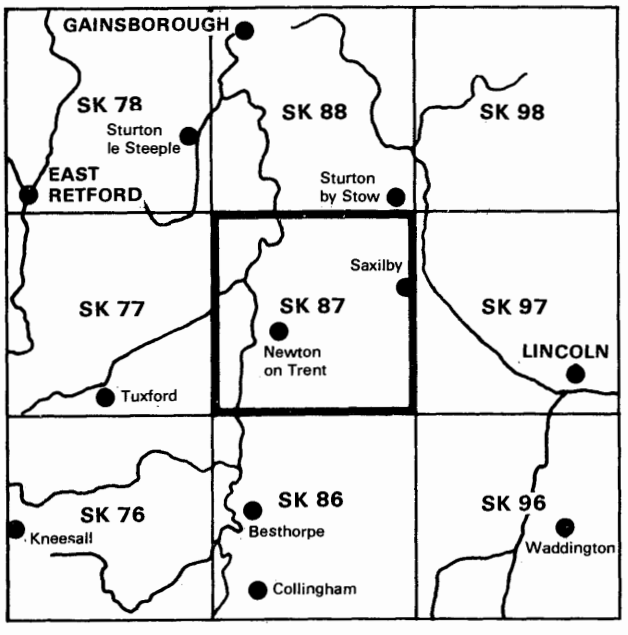

The sand and gravel resources of the country around Newton on Trent, Lincolnshire

Description of 1:25 000 resource sheet SK 87

D. Price, BSc

London Her Majesty's Stationery Office 1975

The Institute of Geological Sciences was formed by the incorporation of the Geological Survey of Great Britain and the Museum of Practical Geology with Overseas Geological Surveys and is a constituent body of the Natural Environment Research Council.

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PREFACE

National resources of many industrial minerals may seem so large that stocktaking appears unneccessary, 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 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 an area in the Trent Valley around Newton on Trent, shown on the accompanying 1:25 000 resource map SK 87. The survey was conducted by Mr D. Price assisted by Mr J.H. Lovell and Mr J.R. Gozzard, who, as field officers, supervised the major part of the drilling and sampling programme. The work, which was controlled from the sub-unit based in Leeds (Officer-in-Charge, J.H. Hull), is based on a one-inch scale geological survey published in 1886 on Old Series Lincoln (83) Sheet and six-inch scale geological surveys carried out in 1908-1909 and 1957-1961, and published on New Series one-inch sheets East Retford (101) and Ollerton (113). The geological lines, now presented at the 1:25 000 scale, incorporate minor amendments resulting from the present work.

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.

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Summary

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 58 boreholes drilled for the Mineral Assessment Unit, form the basis of the assessment of sand and gravel resources of the Newton on Trent area of Lincolnshire and Nottinghamshire.

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 seven resource blocks containing between 6.0 and 12.3 km^2 of sand and gravel. For each block the geology of the deposits is described and the mineral-bearing area, the mean thickness of overburden and mineral and the mean gradings are stated. Detailed borehole data are also given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying map.

Sommaire

Les sources des renseignements qui constituent la base de l'évaluation des ressources en sable et en gravier dans la région de Newton on Trent, Lincolnshire et Nottinghamshire, comprennent les cartes géologiques de l'Institute of Geological Sciences, des données obtenues de trous de sonde déjà en existence et 58 trous de sonde forés pour le Mineral Assessment Unit.

Tous les dépôts dans la région qui pourraient être exploités pour le sable et le gravier ont été étudiés et on s'est servi d'une méthode statistique simple pour en évaluer le volume. Les évaluations de volume ont été tenues d'être à 95 pour cent exactes.

La carte 1:25 000 est divisée en sept blocs de ressources avec d'entre 6.0 et 12.3 km^2 de sable et de gravier. Pour chaque bloc on décrit la géologie des dépôts et on donne l'étendue du terrain minéralise, l'épaisseur moyenne de recouvrement et de minéral et les triages moyens. Des données detaillées des trous de sonde aussi présentées. La géologie, la situation des trous de sonde et les profils des blocs de ressources sont montrées sur la carte.

Zusammenfassung

Die geologischen Karten vom Institute of Geological Sciences, vorher-existierende Information, und 58 für die Mineral Assessment Unit gebohrten Bohrlöcher, bilden den Grund der Einschätzung von Sand- und Schottermittel im Newton on Trent, Lincolnshire und Nottinghamshire.

Alle Ablagerungen im Gebiet, die möglich bearbeitbar für Sand und Schotter sind, wurden untersucht, und eine einfache statistische Methode wurde benutzt, um den Volumen zu schätzen. Man gibt die Zuverlässigkeit der Volumenschätzungen mit symmetrischen 95 Prozent Vertrauenswerten.

Man teilt die 1:25 000 Karte in 7 Mittelsblöcke, die zwischen 6.0 und 12.3 km^2 von Sand und Schotter umfassen. Für jeden Block beschreibt man die Geologie der Ablagerungen, und das mineralhaltige Gebiet, die mittleren Dicken von Überlastung und Mineral und die mittleren Klassifizierungen werden erklärt. Ausführliche Bohrlöcherdaten werden auch gegeben. Die Geologie die Lage der Bohrlöcher und die Skizzen der Mittelsblöcke werden auf der Begleitkarte gezeigt.

The sand and gravel resources of the country around Newton on Trent, Lincolnshire

Description of 1:25 000 resource sheet SK 87

D. PRICE, BSc[1]

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).

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" (Anon., 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.

1. The deposit should average at least one metre in thickness.
2. The ratio of overburden to sand and gravel should be no more than 3:1.
3. The proportion of fines (particles passing the No. 240 mesh BS sieve, about 1/16 mm) should not exceed 40 per cent.
4. 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.

If a deposit of sand and gravel broadly meets these criteria, it 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 particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale 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 grade material, are placed at 1/16 mm and 4 mm respectively (see Appendix C).

The volume and other characteristics are assessed within resource blocks, each of which, ideally, contains approximately 10 km^2 of sand and gravel. No account is taken of any factors, for example, roads, villages 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 conclus ions cannot be drawn about the mineral in parts of a block, except in the immediate vicinity of the actual sample points.

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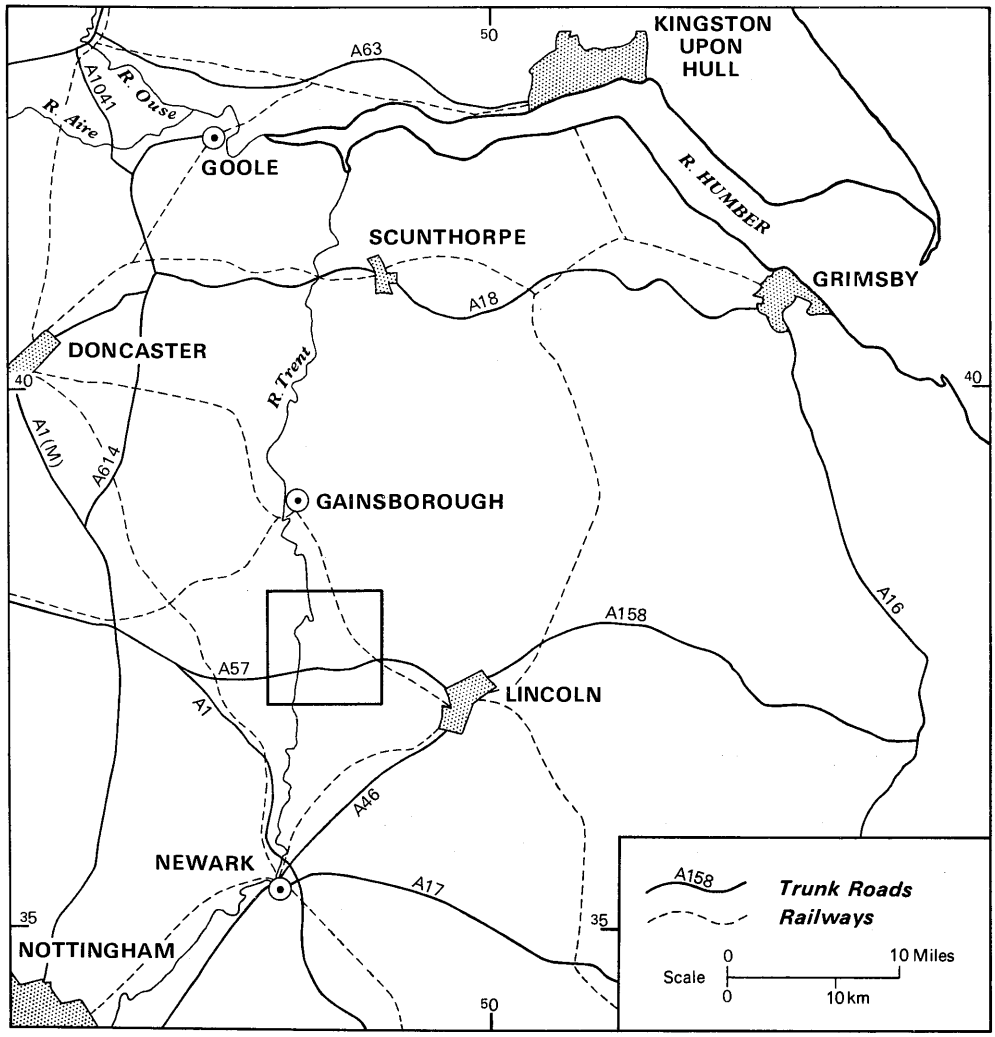


Fig. 1. Map showing location of sheet SK 87

Description of the Area Shown on Sheet SK 87

TOPOGRAPHY AND GENERAL

The regional setting of the district is shown in Fig. 1. The lowest point in this area of gentle relief lies close to the River Trent at about 10 ft (3 m) OD and the highest in the south-east corner of the district at a little over 75 ft (23 m) OD. About two-thirds of the ground, including almost all the sand and gravel resources, lies below the 25 ft (7.6 m) contour. The higher areas are for the most part drift free.

The River Trent, tidal and navigable throughout the district, flows from south to north in a somewhat meandering course across a flood plain from 1 to 2 km ($\frac{1}{2}$ to $1\frac{1}{4}$ mile) wide. It has no large tributaries but is fed by a few small streams and a system of artifical drains. The water table generally lies within 2.5 m (8 ft) of the surface.

The district is almost entirely devoted to agriculture and includes a high proportion of arable land. The only important non-agricultural undertakings are the large power stations at Cottam [815 792][1] and High Marnham [807 710].

GEOLOGY

Solid rocks outcropping within the district comprise higher Permo-Triassic and lower Jurassic strata. They are for the most part concealed by Quaternary superficial deposits. The geological sequence is summarised in Table 1.

Keuper Marl

Keuper Marl occupies the western part of the district. It comprises soft red, with subordinate green and grey mudstones with scattered thin sandstone bands (skerries); a series of green mudstones at the top is known as the Tea Green Marl. Nodular and lenticular masses of gypsum occur near the top of the Keuper Marl and these

[1]National Grid References lie within the 100 km square SK

Table 1. Geological sequence

DRIFT	
Recent and Pleistocene	Blown Sand
	Peat
	Alluvium
	Older River Deposits
	Glacial Sand and Gravel
	Boulder Clay
SOLID	
Jurassic	Lower Lias, including Hydraulic Limestones
Permo-Triassic	Rhaetic
	Keuper Marl

gypsiferous beds form cliffs [8223 7357] on the banks of the Trent near Newton on Trent. Pellets of the mudstones are not uncommon near the base of overlying sand and gravel deposits; pebbles of 'skerry' are more widely distributed though only in small numbers.

Rhaetic

The Rhaetic is from about 11 to 17 m (36 to 56 ft) thick and outcrops, mainly beneath drift, on a low scarp running north to south through Brampton and Kettlethorpe. The Lower Rhaetic consists of dark mudstones interbedded with usually thin sandstones and, in the upper part, impure limestones. The Upper Rhaetic comprises grey, pink and brown clays and mudstones with a little sandstone, siltstone and calcareous shale. No constituent of the sand and gravel assessed can be related with certainty to this group.

Lower Lias

The Lower Lias occupies the eastern part of the district. It comprises dark mudstones and clays with thin argillaceous limestone bands; the latter are abundant in the lowest 8 m (25 ft) where they form the Hydraulic Limestones. The fossil Gryphaea incurva is common at certain horizons and, together with tabular pebbles of the argillaceous limestones is not uncommon in overlying sands and gravels.

Boulder Clay

Boulder clay is found in small patches at Rampton and Ragnall on the western margin of the district and near Inglesby in the east. Exposures are poor but the deposits appear to be brown and reddish brown partly pebbly and sandy clays. They rest directly on the 'solid' rocks.

Glacial Sand and Gravel

Fine grained sands with little or no gravel, which extend from Brampton southwards to Newton on Trent, have been mapped as Glacial Sand and Gravel. West of Fenton, at Laughterton [838 759] and at Newton on Trent these sands rest directly on Keuper Marl. To the north and east, however, boreholes have penetrated sands and gravels similar to those of the Older River Deposits below Glacial Sand and Gravel which may, therefore, postdate the Older River Deposits. As it is difficult to distinguish between these deposits in the field, the boundaries at Torksey and Newton on Trent are largely conjectured. Small thin patches of Glacial Sand and Gravel near Laneham [806 762] appear to be gravel free and rest directly on Keuper Marl.

Older River Deposits

Under this heading are grouped deposits mapped variously as Plateau Gravels, River Gravel and First Terrace of the Trent which outcrop over almost a third of the sheet area and are present below flood plain alluvium. They constitute the principal aggregate resource in the district.

In the eastern and central parts of the district the Older River Deposits fill valleys (see Fig. 2) and are unrelated to any important present-day drainage system. The borehole data available is insufficient to allow accurate determination of their form, but the floors of these valleys appear to grade southwards. The deposits comprise sands, sometimes 'clayey' (see Appendix B), pebbly sands, sandy gravels and gravels, and thicknesses up to 10.8 m (35.5 ft) have been proved. Towards its margin the uppermost sand passes into a locally derived clay, which generally it has proved impractical to delineate. Straw (1963, fig. 2) has correlated these deposits with the Flood plain Terrace of the Trent (Clayton, 1953) which can be followed upstream to beyond Nottingham; he assigns the aggradation of the terrace to an episode of the Last Glaciation when an ice sheet to the north ponded back drainage to the Humber.

West of the Trent the Older River Deposits take the form of a conventional river terrace. They are commonly thin and mainly of sand, possibly representing only the upper part of the sequence generally found to the east. Terrace remnants protrude through the alluvium of the present day flood plain and it is probable that the sands and gravels below the alluvium are the lower part of the Older River Deposits. These suballuvium sands and gravels have a maximum proved thickness of 11.9 m (39 ft) but the average thickness is probably a little over 5 m (16.5 ft).

Alluvium

Except where older gravelly deposits are at surface the flood plain of the Trent is underlain by alluvium consisting of clay, silty clay and silt with, in places, beds of peat and sand. Near Dunham Bridge [8194 7448] these deposits have been proved to a depth of 8.8 m (29 ft) in a relatively recently abandoned course of the river; the average thickness is about 3.4 m (11 ft). Narrow

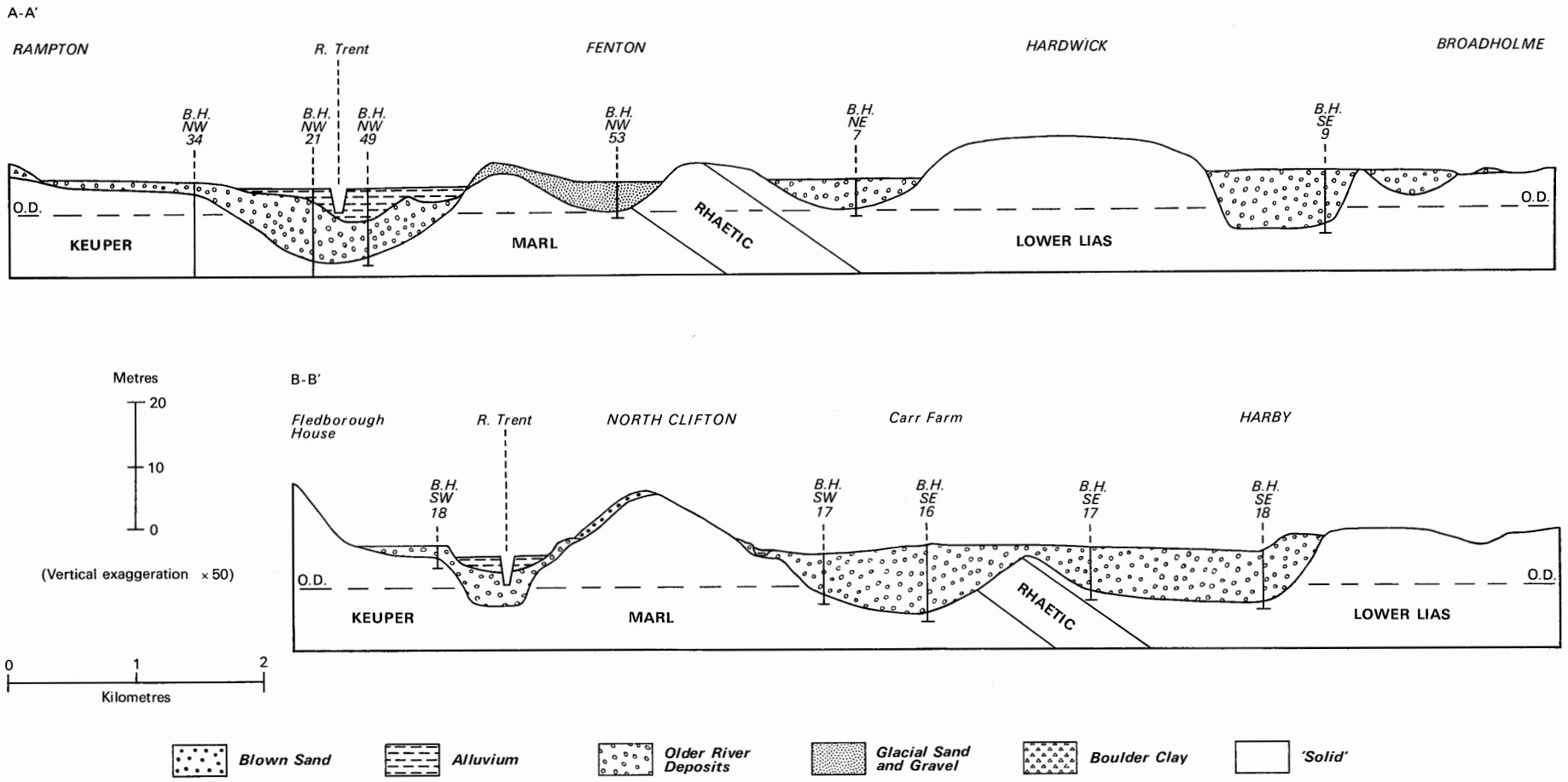


Fig. 2. Diagrammatic sections to show the general relations of drift and solid deposits (the lines of sections are marked on the resource sheet)

strips of similar alluvium are associated with a number of small tributary streams.

Blown Sand

A number of deposits of blown sand have been mapped in a narrow belt immediately east of the Trent flood plain. They generally cap low hills of Keuper Marl or are banked against their western slopes. The sands are well rounded and fine grained. In many places wind action has modified the surface of sand deposits; little movement has taken place, only the highest parts have been affected and the nature of the deposit remains essentially unaltered. A distinction between such modified deposits and truly blown sand cannot be made readily everywhere and the distribution of the latter may be more or less extensive than is shown on the map.

Peat

Peat occurs in small wind-sculpted hollows in sand near Brampton and in places associated with alluvium.

COMPOSITION OF THE SAND AND GRAVEL

Older River Deposits

These deposits, which account for about 85 per cent by volume of the potentially workable sand and gravel in the district, have a mean grading of fines, 4 per cent; sand, 70 per cent; gravel, 26 per cent. However, they are by no means homogeneous; on the basis of gravel content two types of deposit can be recognised. One comprises sands and pebbly sands with a mean gravel content of only 3 per cent; the other consists of gravel and sandy gravel with a mean gravel content of 47 per cent. The mean proved thicknesses of the two deposits are 2.3 m (7.6 ft) and 2.5 m (8.2 ft) respectively. East of the Trent flood plain the sands and pebbly sands appear to be somewhat more common than the gravels, which generally underlie them, but beneath the flood plain the gravelly deposit predominates. West of the Trent, the Older River Deposits as a whole are generally thin and contain only about 7 per cent gravel.

Rounded pebbles of quartzite and quartz, together with angular to rounded chert pebbles, usually account for over 80 per cent by weight of the gravel fraction. Minor constituents, most common in the finer parts of the fraction, include sandstone, siltstone, mudstone, limestone and dark fine grained igneous rock. Pebble counts for selected samples are given in Table 2. The sand is almost everywhere medium grained and comprises subangular to rounded quartz with some chert and subordinate rounded red and dark grey mudstone.

Glacial Sand and Gravel.

The mean grading of these deposits is fines, 7 per cent; sand, 92 per cent; gravel, 1 per cent: otherwise their composition is generally similar to that of the Older River Deposits.

Blown Sand

Blown sand was encountered in only four boreholes; samples are of fine to medium grained quartz sand with fines ranging from 1 to 16 per cent. Because their compositions are similar it is sometimes difficult to distinguish between blown sand and underlying Glacial Sand and Gravel or gravel-free Older River Deposits.

THE MAP

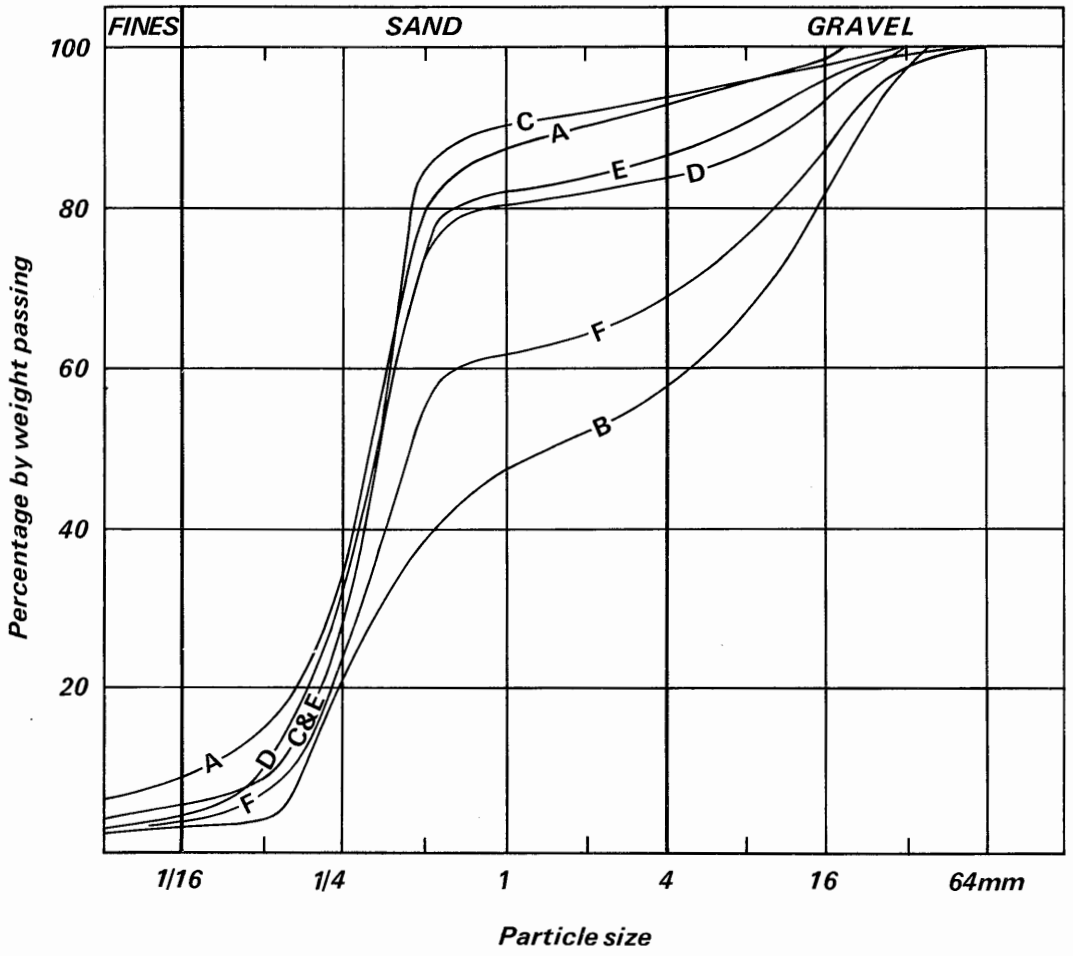
The sand and gravel resource map is folded into the pocket at the end of this report. The base map is the Ordnance Survey 1:25 000 Outline Edition in grey, on which the topography is shown by contours in green, the geological data in black and the mineral resource information in shades of red.

Geological Data

The geological boundary lines are derived from the sources indicated on the diagram at the foot of the map. As is to be expected when field surveys are separated by such long intervals of time, the geological classification of certain potential sand and gravel resources has not been uniform. Thus, north of Dunham, G.H. Rhys identified a First Terrace of the River Trent, whereas south of Dunham Bernard Smith mapped the same deposit as River Gravel; east of the Trent Smith's River Gravel appears to be the same as the Plateau Gravel of the Old Series one-inch geological map. On the resource map these deposits are shown as Older River Deposits. At Newton on Trent and at Torksey sands classified by Rhys as Glacial Sand and Gravel were regarded as River Gravel by Smith and as Plateau Gravel by the primary surveyors. With the limited field work carried out in connection with this assessment it has not been possible to delineate accurately the extent of the Glacial Sand and Gravel beyond the area surveyed by Rhys, and conjectured boundaries have been introduced by the author.

The geological boundaries shown are the best interpretation of the information available at the time of the survey. However it is inevitable, particularly with respect to the superficial deposits, that local irregularities and discrepancies will be revealed as new evidence from boreholes and excavations becomes available.

Borehole data, which include the stratigraphic relations and mean particle size analysis of the sand and gravel samples collected during the assessment are also shown on the map.



BLOCK	Percentage by weight passing				
	1/16mm	1/4mm	1mm	4mm	16mm
A	9	36	87	93	98
B	3	11	48	58	83
C	6	28	90	93	98
D	5	33	80	84	93
E	4	30	82	85	96
F	4	24	61	69	87

Fig. 3. Calculated particle size distributions for the mineral in the resource blocks

Table 2. Pebble counts for samples of gravel from Older River Deposits (per cent by weight).

Borehole No.	Depth (m)	Quartzite	Quartz	Chert	Sand-stone	Lime-stone	Siltstone and mudstone	Igneous
NW 45	3.8 - 4.8	43	32	8	11	1	trace	5
	6.8 - 7.8	40	39	9	8	trace	1	3
NW 59	7.0 - 8.0	50	25	9	14	trace	1	1
SW 14	3.0 - 4.0	55	35	4	4	1	0	1
SE 19	6.4 - 7.4	35	41	14	6	2	1	1

Mineral Resource Information

For assessment purposes the map is divided into areas of mineral and areas where sand and gravel is either not potentially workable or is absent (for definitions of 'mineral' and 'potentially workable' see p. 1). On sheet SK 87 the mineral is subdivided into areas where it is at surface (except for thin soil cover) and areas where it is present in continuous spreads beneath overburden. However, within these areas there may be small patches where sand and gravel is absent or not potentially workable, for example, at Torksey (around borehole NE 5) and near Ragnall (around borehole SW 21). Similarly, within areas shown as free from overburden there may be small patches of non-mineral at the surface, the distribution of which is not sufficiently well known for them to be depicted on the resource map. Areas without potentially workable sand and gravel are shown uncoloured. Unassessed areas of sand and gravel carry a red stipple.

For the most part the depicted distribution of the various categories of deposits is based on the mapped geological boundaries. Where there is transition from one category to another which cannot be related to the geological map and which cannot be delineated accurately, inferred boundaries, shown by a distinctive symbol, have been inserted. 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.

RESULTS

The results are summarised in Table 3. Fuller grading particulars are shown in Fig. 3 and the mean grading and grading 'envelope' for each resource block are given in Fig. 4 to 9. Up to 11 data points have been used in plotting the cumulative grading curves.

The 95 per cent confidence limits for the six resource blocks range from 24 per cent to 49 per cent. It should be remembered, however, that the true values are likely to be nearer to the figure estimated than to the limits. It is probable that roughly the same percentage limits would apply for the estimate of volume of smaller parcels of ground containing similar sand and gravel deposits if results from similar numbers of sample points were used in the calculations. Thus if closer limits are needed for the quotation of reserves of part of a block, more sample points will probably be required, even if the area is quite small.

It must again be emphasised that the quoted volumes of sand and gravel have no simple relationship to the amounts that would be extracted in practice, as no allowance has been made in the calculations for any constraints imposed by other land use (such as existing buildings, roads and railways).

NOTES ON RESOURCE BLOCKS

Block A

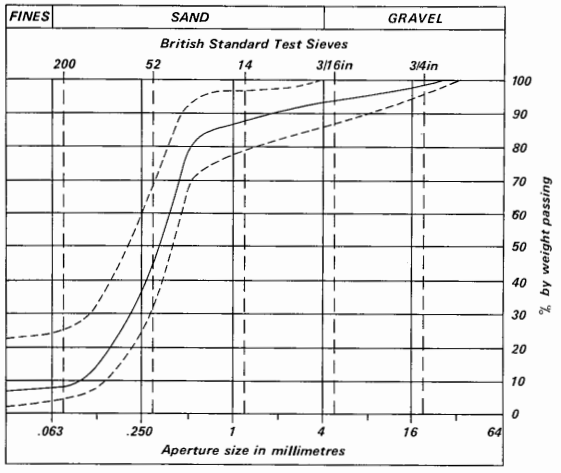


Fig. 4. Grading characteristics of the mineral in block A: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall.

Potentially workable deposits of sand and gravel in this block are confined to the Older River Deposits which occupy an area of 6.0 km^2

BLOCK	Area		Mean Thickness						Volume of Mineral				Grading Percentages		
	Block	Mineral	Overburden		Mineral		Waste		million	million	95% Confidence Limits		Fines	Sand	Gravel
	km²	km²	m	ft	m	ft	m	ft	m³	yd³	± %	± million	-1/16 mm	+1/16-4 mm	+4 mm
A	14•5	6•0	0•5	1•6	2•1	6•9	0•14	0•5	13	17	42	5	9	84	7
B	11•9	11•1	3•1	10•2	5•3	17•4	0•02	0•1	59	77	36	21	3	55	42
C	13•5	10•5	0•4	1•3	3•4	11•2	0•03	0•1	36	47	48	17	6	87	7
D	14•3	11•5	0•4	1•3	5•5	18•0	—	—	63	82	49	31	5	79	16
E	9•4	8•6	0•5	1•6	3•5	11•5	0•08	0•3	30	39	49	15	4	81	15
F	13•7	12•3	0•5	1•6	6•4	21•0	0•34	1•1	79	103	24	19	4	65	31
Total	77•3	60•0	0•9	3•0	4•7	15•4	0•10	0•3	282	369	16	45			

Subdivisions of Block D

Older River Deposits	c.10•3	0•5	1•6	5•9	19•4	—	—	61	80	47	29	5	78	17
Blown Sand	1•9	—	—	1•2	3•9	—	—	2	3	Speculative		13	87	—

Table 3. Statistical assessment of sand and gravel resources of sheet SK 87

(2.3 square miles). Glacial Sand and Gravel near Laneham has been shown by hand augering to be less than 0.9 m (3 ft) thick.

Results from seven Mineral Assessment Unit boreholes are supplemented by thickness data from a hand auger hole and 16 civil engineering site-investigation boreholes drilled in connection with the construction of Cottam Power Station (some of these data points cannot be shown on the resource map for lack of space). The maximum proved thickness of mineral, 6.4 m (21 ft), was found in borehole NW 37: the mean thickness is 2.1 m (7 ft). The wide variation in thicknesses recorded is due largely to the undulating nature of the bedrock surface, the level of which ranged, in the boreholes, from 2.4 m (7.9 ft) below OD to 5.0 m (13.1 ft) above OD. The mineral is mainly sand with some scattered pebbles; the mean grading for the block is fines, 9 per cent; sand, 84 per cent; gravel, 7 per cent. The estimated volume of mineral present is 13 million $m^3 \pm 5$ million m^3.

Although the mineral is shown on the resource map as free from overburden, except where alluvium has been mapped, several boreholes proved clay below the soil in the northern part of the block; its extent cannot be determined readily. Up to 1.1 m (3.6 ft) of overburden has been proved, but for the block as a whole the mean thickness is 0.5 m (1.6 ft). A number of boreholes found clay partings up to 1.2 m (3.9 ft) thick but the mean thickness of waste is only 0.14 m (0.5 ft).

Block B

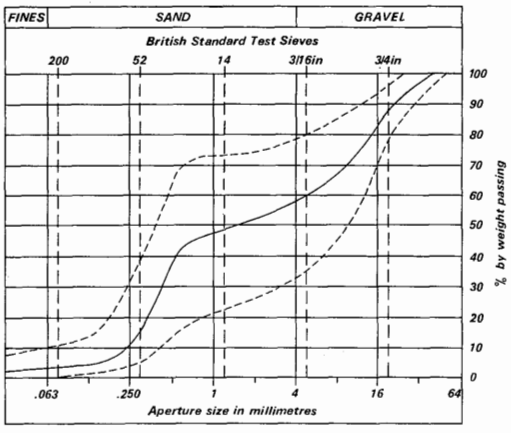


Fig. 5. Grading characteristics of the mineral in block B (For explanation see Fig. 4)

This block comprises the flood plain of the River Trent. As almost all of this block is covered by overburden, the boundaries of the mineral cannot be located accurately; its area is therefore considered to be the same as that of the block, less the area known to have been excavated.

As in block A the mineral is entirely Older River Deposits. The results from the 11 MAU boreholes are supplemented by thickness data from ten other boreholes, mainly site-investigation holes drilled in the northern part of the block. Again, lack of space prevents all these data points being shown on the resource map. Proved thicknesses of mineral range from 1.0 m (3.5 ft) in borehole NW 15 to 11.1 m (36.5 ft) in borehole NW 20 and the mean thickness is 5.3 m (17.4 ft). The proportion of gravel proved ranges from 20 per cent in borehole NW 45 to 68 per cent in borehole NW 49 and fines vary between a trace, in boreholes NW 42, 49 and 53, and 10 per cent in borehole SW 14 (see Fig. 5). The mean grading for the block is 3 per cent fines, 55 per cent sand and 42 per cent gravel. The estimated volume of mineral present is 59 million $m^3 \pm 21$ million m^3.

Overburden consists mainly of clay, silt and peat. In a recently abandoned course of the River Trent at Dunham, 29 ft (8.8 m) of overburden has been recorded, but elsewhere the proved thickness is less than 6.0 m (19.5 ft) and the mean thickness is 3.1 m (10.2 ft). A waste parting of 0.8 m (2.5 ft) was found in borehole NW 20.

Block C

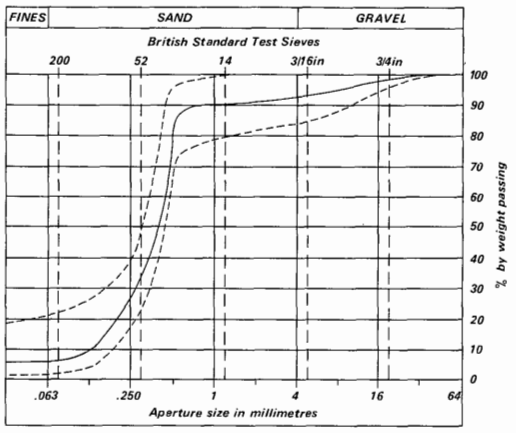


Fig. 6. Grading characteristics of the mineral in block C (For explanation see Fig. 4)

The potentially workable sand and gravel of this block, which is mapped as Glacial Sand and Gravel and Blown Sand, is generally thin. The exceptional thicknesses, 8.7 m (28.5 ft) and 6.6 m (21.5 ft), proved in boreholes NW 47 and SW 8 respectively, suggest that these may have passed down into Older River Deposits. The mean thickness of mineral, based on 12 data points, is 3.4 m (11.2 ft). Gravel was found in only six

boreholes, ranging from a trace (borehole NW 54) to 17 per cent (borehole SW 8). Exceptionally, the mineral from boreholes NW 41 and 48 contained as much as 13 per cent and 21 per cent fines, respectively. The mean grading for the block is fines, 6 per cent; sand, 87 per cent; gravel, 7 per cent.

The estimate of overburden thickness in Table 3 refers only to the sandy soil which generally overlies the mineral. The thickness of the small scattered patches of peat and alluvium, mainly near Brampton, which cover less than 3 per cent of the area of mineral are unknown and they are not taken into account. A waste parting 0.3 m (1 ft) thick, was found in borehole NW 58.

Block D

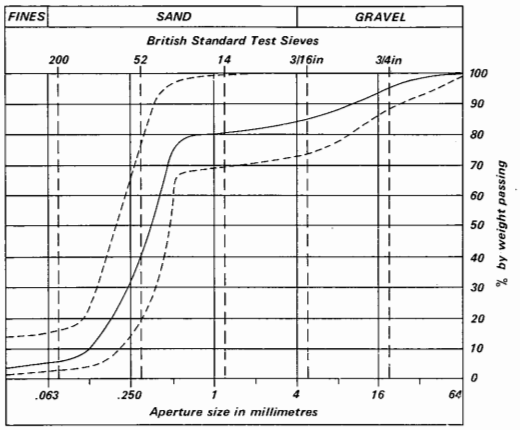


Fig. 7. Grading characteristics of the mineral in block D (for explanation see Fig. 4)

Older River Deposits account for most of the potentially workable sand and gravel of this block. Blown sand covers an area of about 2 km^2 (0.8 square miles) around North Clifton and a small area on the eastern margin of the block; it is generally thin and rests mostly on bedrock. The Older River Deposits floor a broad hollow between the low Rhaetic/Lias escarpment and hills of Keuper Marl south of Newton on Trent. In this hollow the maximum proved thickness of mineral is 10.6 m (35 ft), found in borehole SE 16. The Older River Deposits pass from this broad tract through a small hollow at South Clifton to link with similar deposits fringing the Trent flood plain; at South Clifton, borehole SW 21, which commenced in blown sand, found their base 3.6 m (12 ft) below surface. The thickness of the deposits alongside the flood plain is not known, but probably does not exceed about 2.5 m (8 ft).

The mean grading of the Older River Deposits of the block is fines, 5 per cent; sand, 78 per cent; gravel, 17 per cent. However, in three boreholes (SW 10, 20 and 21) they comprised only sand with a little gravel. In five other holes partly pebbly sands with a mean thickness of 4.3 m (15.1 ft) overlay gravel and sandy gravel with a mean thickness of 3.5 m (11.5 ft). The sands have a mean grading of 7 per cent fines, 90 per cent sand and 3 per cent gravel. The mean grading of the gravels is 2 per cent fines, 59 per cent sand and 39 per cent gravel. The blown sand has a mean fines content of 13 per cent and contains no pebbles.

Overburden is almost entirely restricted to sandy soil and subsoil.

The estimate of volume of mineral in the block is 63 million $m^3 \pm 31$ million m^3; about 2 million m^3 of this comprises blown sand.

Block E

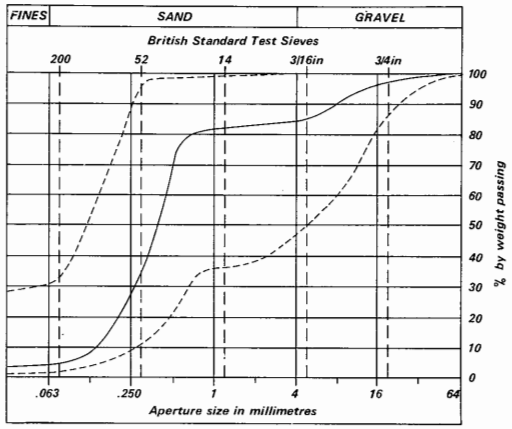


Fig. 8. Grading characteristics of the mineral in block E (For explanation see Fig. 4)

The mineral of this block is entirely Older River Deposits which occupy a hollow running north to south on Lower Lias. The maximum recorded thickness is 8.0 m (26 ft) found in borehole NE 6, and the mean thickness, based on data from 12 Mineral Assessment Unit and other boreholes is 3.5 m (11.5 ft). Around Torksey the deposit is thin and locally, for example at borehole NE 5 and near the northern end of the block, it is too thin to be regarded as potentially workable. The extent of the non-mineral is not sufficiently well known for it to be shown on the resource map, but all the data available has been used in calculating the volume of mineral in the block. Boreholes SE 11 and 12, near the southern margin of the block, proved mineral with 53 per cent and 24 per cent of gravel respectively; borehole NE 6 contained 20 per cent gravel and the remainder yielded less than 7 per cent. Fines range from 2 per cent (borehole NE 6) to 31 per cent (borehole NE 15). The mean grading of the block is fines, 4 per cent; sand, 82 per cent; gravel, 14 per cent.

The estimate of volume of mineral in the block is 30 million m^3 ± 15 million m^3.

Overburden is for the most part sandy soil. However, towards the edges of the mineral and in the extreme northern part, sand and gravel at the surface passes laterally into clay; the extent of this clay cannot readily be delineated. Narrow ribbons of younger clayey and peaty alluvium have been mapped close to the Fossdyke Navigation.

Block F

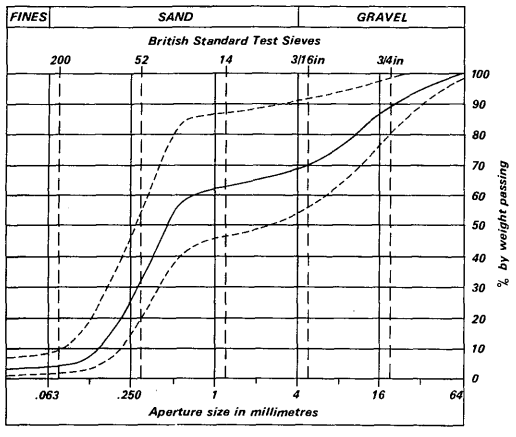


Fig. 9. Grading characteristics of the mineral in block F (For explanation see Fig. 4)

The mineral in this block comprises Older River Deposits, for the most part occupying a broad hollow on the Lower Lias, and a very small area of thin blown sand on the south-western margin. Up to 9.1 m (30 ft) of mineral have been recorded (borehole SE 19) and the mean proved thickness for the block, based on eleven boreholes, is 6.4 m (21 ft). In nine of the boreholes partly 'clayey' and partly pebbly sands from 0.5 m (1.5 ft) to 5.0 m (16.5 ft) thick overlie gravels and sandy gravels from 2.2 m (7 ft) to 6.6 m (21.5 ft) thick. Borehole SE 17 proved only pebbly sand and borehole SE 15 found 0.9 m (3 ft) of partly 'clayey' sand. These sandy and gravelly deposits have mean gravel contents of 4 per cent and 53 per cent respectively. The mean grading for the block is fines, 4 per cent; sand, 65 per cent; gravel, 31 per cent.

Waste partings were encountered in a number of the boreholes; the thickest, in borehole SE 7, measured 1.1 m (3.5 ft) but the mean thickness of waste for the block is only 0.3 m (1.0 ft).

Appendix A: Field Procedure

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^2, 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 (Anon., 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, Mineral Assessment Unit.

Appendix B: Statistical Procedure

STATISTICAL ASSESSMENT

1. A statistical assessment is made of an area of mineral greater than 2 km^2, if there is a minimum of five evenly spaced boreholes in the resource block (for smaller areas see para. 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

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

4. The above relationship may be transposed such that

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

From this it can be seen that as $\frac{S_A^2}{S_{\bar{l}_m}^2}$ 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 $l_{m_1}, l_{m_2}, \ldots l_{m_n}$, then the best estimate of mean thickness, $\bar{l}_m = \frac{\sum (l_{m_1} + l_{m_2} \ldots\ldots l_{m_n})}{n}$

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

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

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

6. The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of a deposit). Where the area is not defined by a mapped boundary, that is, where the boundary is inferred, a distinctive symbol is used. Experience suggests that the errors in determining area are small relative to those in thickness.
The relationship

$\frac{S_A}{S_{\bar{l}_m}} \leqslant 1/3$ is assumed in all cases

It follows from equation (2) that

$$S_{\bar{l}_m} \leqslant S_V \leqslant 1.05\ S_{\bar{l}_m} \quad \ldots\ldots(3)$$

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

$$\pm \sqrt{\frac{t}{n}} \times S_{\bar{l}_m}$$

or as a percentage

$$\pm \sqrt{\frac{t}{n}} \times S_{\bar{l}_m} \times \frac{100}{\bar{l}_m} \text{ per cent}$$

where t is Student's t at the 95 per cent probability level for (n - 1) degrees of freedom, evaluated by reference to statistical tables. (In applying Student's t it is assumed that the measurements are distributed normally).

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

n	t	n	t
1	∞	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 Ed. 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:

$$L_{\bar{l}_m} \leqslant L_V \leqslant 1.05\ L_{\bar{l}_m}$$

Block Calculation — 1:25 000 Block } Fictitious (see map in Fig. 11)

Area
- Block: 11.08 km^2
- Mineral: 8.32 km^2

Volume
- Overburden: 21 million m^3
- Mineral: 54 million m^3

Mean Thickness
- Overburden: 2.5 m
- Mineral: 6.5 m

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^3

Thickness estimate: measurements in metres
l_o = overburden thickness l_m = mineral thickness

Sample point	Weighting w	Overburden l_o	Overburden wl_o	Mineral l_m	Mineral wl_m	Remarks
SE 14	1	1.5	1.5	9.4	9.4	MAU boreholes
SE 18	1	3.3	3.3	5.8	5.8	
SE 20	1	nil	-	6.9	6.9	
SE 22	1	0.7	0.7	6.4	6.4	
SE 23	1	6.2	6.2	4.1	4.1	
SE 24	1	4.3	4.3	6.4	6.4	
SE 17	½	1.2	1.6	9.8	7.2	Hydrogeological Dept record
123/45	½	2.0		4.6		
1	¼	2.7	2.5	7.3	5.8	Close group of four boreholes (commercial)
2	¼	4.5		3.2		
3	¼	0.4		6.8		
4	¼	2.8		5.9		
Totals	$\Sigma w = 8$	$\Sigma wl_o = 20.1$		$\Sigma wl_m = 52.0$		
Means		$\bar{l}_o = 2.5$		$\bar{l}_m = 6.5$		

Calculation of confidence limits

l_m	$(l_m - \bar{l}_m)$	$(l_m - \bar{l}_m)^2$
9.4	2.9	8.41
5.8	0.7	0.49
6.9	0.4	0.16
6.4	0.1	0.01
4.1	2.4	5.76
6.4	0.1	0.01
7.2	0.7	0.49
5.8	0.7	0.49

$\Sigma(l_m - \bar{l}_m)^2 = 15.82$

$n = 8$

$t = 2.365$

L_V is calculated as

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

$$= 1.05 \times \frac{2.365}{6.5} \sqrt{\frac{15.82}{8 \times 7}} \times 100$$

$$= 20.3$$

$\simeq$ 20 per cent

Fig. 10. Example of resource block assessment: calculation and results

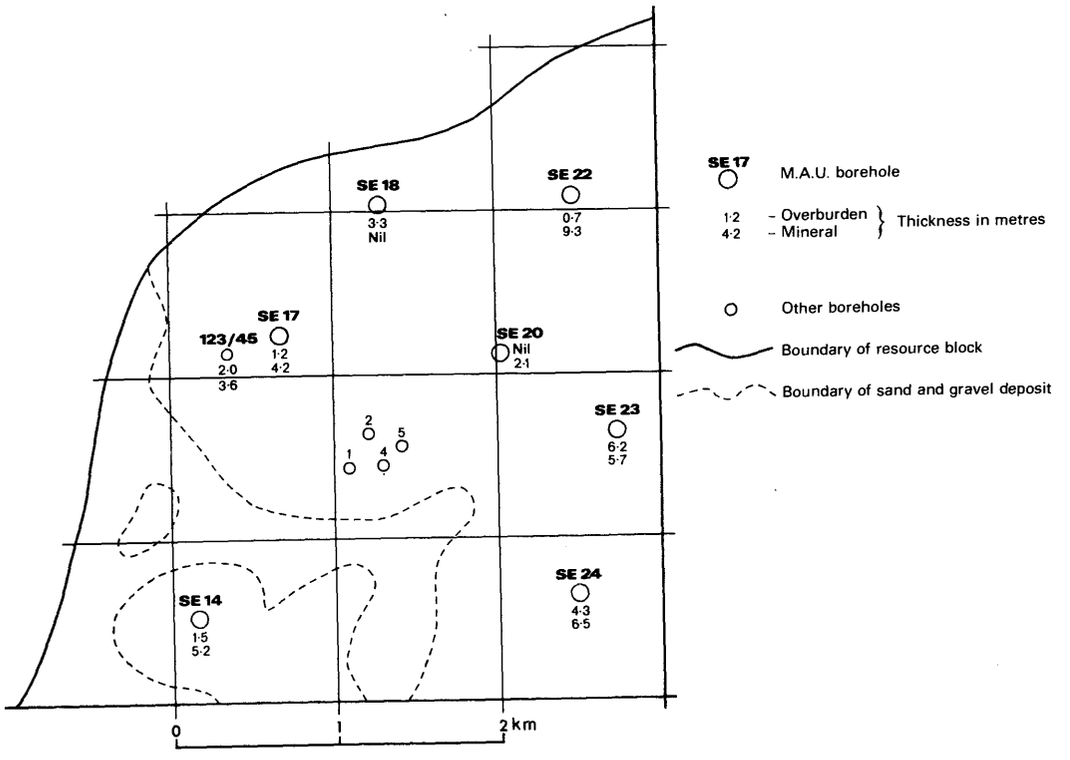
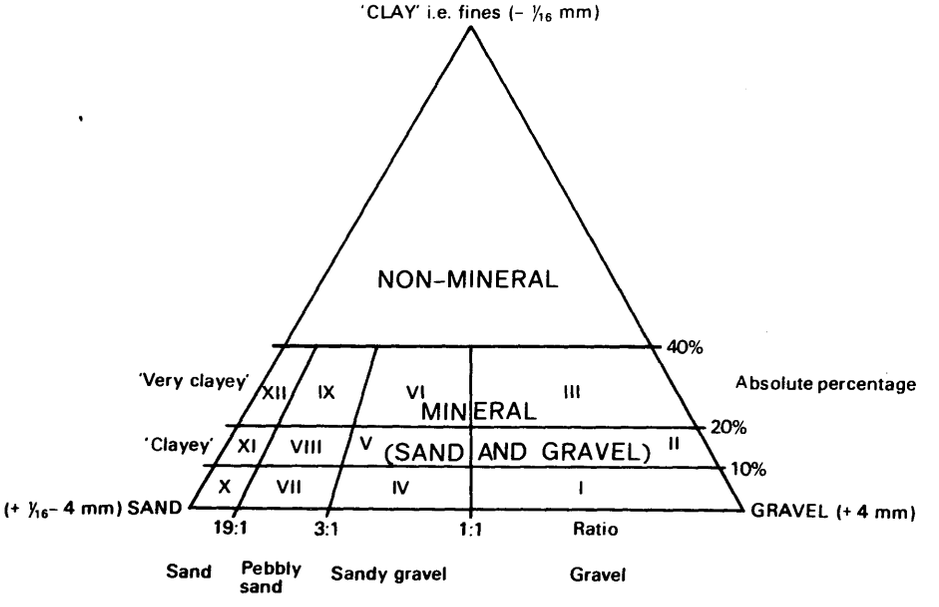


Fig. 11. Example of resource block assessment map of fictitious block



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

Fig. 12. Diagram to show the descriptive categories used in the classification of sand and gravel.

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

$$\frac{1.05 \times t}{\bar{l}_m} \times \sqrt{\frac{\Sigma(l_m - \bar{l}_m)^2}{n(n-1)}} \times 100 \text{ per cent}$$

and when n is greater than 20, as

$$\frac{1.05 \times 1.96}{\bar{l}_m} \times \sqrt{\frac{\Sigma(l_m - \bar{l}_m)^2}{n(n-1)}} \times 100 \text{ per cent}$$

11. The application of this procedure to a fictitious area is illustrated in Figs. 10 and 11.

INFERRED ASSESSMENT

12. If the sampled area of mineral in a resource block is between 0.25 km^2 and 2 km^2 an assessment is inferred, 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^2.

15. Note on Weighting
The thickness of a deposit at any point may be governed solely by the position of the point in relation to a broad trend. However, most sand and gravel deposits also exhibit a random pattern of local, and sometimes considerable, variation in thickness. Thus the distribution of sample points 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 1/16 mm) and coarser than pebbles (more than 64 mm 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 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 Fig. 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 11, p. 19).

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 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 4), 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 (-$\frac{1}{4}$ +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 (Anon., 1967). In this report the grading is tabulated on the borehole record sheets (Appendix F), the intercepts corresponding with the simple geometric scale 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 4. Classification of gravel, sand and fines

Size limits	Grain size description	Qualification	Primary classification
64 mm	Cobble		Gravel
16 mm	Pebble	Coarse	
		Fine	
4 mm	Sand	Coarse	Sand
1 mm		Medium	
¼ mm		Fine	
1/16 mm	Fines (silt and clay)		Fines

Appendix D: Explanation of the Borehole Records

Annotated Example

SK 87 SE 10[1] 8751 7344[2] Thorney[3] Block F

Surface level (+5.4 m) +18 ft[4]
Water level (+4.2 m) +14 ft[5]
September 1971[6]

Overburden[7] 0.3 m (1.0 ft)[8]
Mineral 7.2 m (23.5 ft)
Bedrock 1.5 m+ (5.0 ft+)[9]

		Thickness m	Thickness ft	Depth m	Depth ft
	Soil	0.3	(1.0)	0.3	(1.0)
Older River[10] Deposits	a) Sand, pebbly in parts[11] Sand: medium, rounded quartz with lithic grains. Gravel: fine, rounded quartz, chert and sandstone with some pale tabular quartzite.	5.0	(16.5)	5.3	(17.5)
	b) Gravel, sandy near base. Gravel, fine, rounded chert, quartz, quartzite and sandstone with igneous pebbles, limestone and, in lower part, some shell fragments. Sand: as above.	2.2	(7.0)	7.5	(24.5)
Lower Lias	Clay and mudstone, grey poorly fossiliferous.	1.5+	(5.0+)	9.0	(29.5)

		%	mm	%
a)[15]	Gravel	3	+16	: trace
			-16+4	: 3
	Sand	95	-4+1	: 3
			$-1+\frac{1}{4}$	: 67
			$-\frac{1}{4}+1/16$	: 25
	Fines	2	-1/16	: 2
b)	Gravel	52	+16	: 22
			-16+4	: 30
	Sand	47	-4+1	: 10
			$-1+\frac{1}{4}$	: 33
			$-\frac{1}{4}+1/16$	: 4
	Fines	1	-1/16	: 1

Depth below surface (m)[12]	Percentage[13] Fines	Sand	Gravel
0.3 - 1.3	5	95	0
1.3 - 2.3	1	97	2
2.3 - 3.3	[1	97	2][14]
3.3 - 4.3	trace	100	0
4.3 - 5.3	1	86	13
5.3 - 6.3	1	45	54
6.3 - 7.3	1	45	54
7.3 - 7.5	2	69	29

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

1. Borehole Registration Number.
Each Mineral Assessment Unit (MAU) 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 87.
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 SE 10.

Thus the full Registration Number is SK 87 SE 10. Usually this is abbreviated to SE 10 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
Four kinds of entry are made: the record indicates the level at which groundwater stood on completion of drilling (in metres and feet above or below OD); or that water was encountered but its level not recorded; or that water was not encountered; or that no note of groundwater conditions was made.

6. Type of drill and date of drilling
Unless otherwise stated, all boreholes were drilled by a Pilcon shell and auger rig using 8-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. Where waste occurs between the surface and mineral it is classified as overburden.

8. Thickness and Depth
All measurements were made in metres. Conversions from metres to feet (shown in brackets) have been rounded off to the nearest 0.5 ft. Where figures have been rounded in this way there may be a discrepancy between the sum of the thicknesses and the recorded depths.

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

10. Geological Classification
The geological classification is given whenever possible.

11. Lithological Description
When sand and gravel is recorded a general description based on the mean 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.

12. Sampling
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 within the sand and gravel or at every 3 ft or 1 m of depth.

13. Grading Results
The limits are as follows: gravel, +4 mm, sand, -4+1/16 mm; fines, -1/16 mm.

14. If, exceptionally, grading results are not available, an attempt is made to give grading information by comparing the grading and field descriptions of adjacent samples with the samples in question. Such estimates are shown in brackets.

15. Mean Grading
The grading of the full thickness of the mineral horizon identified in the log is the mean of the individual sample gradings weighted by the thicknesses represented, if these vary. The classification used is shown in Table 4. Unless otherwise stated all the material passes the 64 mm sieve.

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 proportions of fines and coarse gravel (+16 mm) may be lower.

Appendix E: List of Boreholes Used in the Assessment of Resources

MINERAL ASSESSMENT UNIT BOREHOLES

Borehole No. by sheet quadrant	Grid reference (all fall in 100 km square SK 87)
SK 87 NW (pp.21-39)	
41	8385 7999
42	8312 7962
43	8045 7965
44	8082 7864
45	8184 7872
46	8320 7885
47	8457 7890
48	8392 7844
49	8267 7810
50	8283 7724
51	8360 7725
52	8434 7743
53	8211 7690
54	8352 7638
55	8470 7617
56	8264 7584
57	8346 7530
58	8472 7538
59	8178 7520
SK 87 NE (pp. 40-45)	
5	8572 7845
6	8559 7769
7	8613 7669
8	8571 7598
9	8635 7511
15	8568 7952

Borehole No. by sheet quadrant	Grid reference (all fall in 100 km square SK 87)
SK 87 SW (pp. 46-62)	
7	8122 7440
8	8400 7446
9	8471 7359
10	8398 7346
11	8118 7374
12	8076 7319
13	8115 7272
14	8188 7234
15	8277 7279
16	8449 7261
17	8417 7170
18	8106 7183
19	8170 7112
20	8363 7096
21	8245 7046
22	8165 7028
23	8463 7042
SK 87 SE (pp. 63-78)	
5	8600 7446
6	8699 7430
7	8979 7472
8	8970 7396
9	8874 7398
10	8751 7344
11	8640 7343
12	8586 7262
13	8672 7246
14	8759 7270
15	8855 7296
16	8508 7138
17	8631 7143
18	8771 7136
19	8764 7076
25	8661 7037

OTHER BOREHOLES

SK 87 NW 2, 5, 9, 11, 15 and 18 to 37
SK 87 NE 12, 13 and 15
SK 87 SW 1 and 2

Appendix F: Mineral Assessment Unit Borehole Records

SK 87 NW 41 | 8385 7999 | Torksey | Block C

Surface level (+5.2 m) +17 ft
Groundwater conditions not recorded
November 1971

Overburden 0.4 m (1.5 ft)
Mineral 2.6 m (8.5 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Glacial Sand and Gravel	a) Sand, medium, subrounded quartz with some subrounded lithic grains; 'clayey' bands in parts.	2.0	(6.5)	2.4	(8.0)
	b) Very 'clayey' pebbly sand. Gravel: fine to coarse, well rounded chert and sandstone. Sand: medium, well rounded quartz.	0.6	(2.0)	3.0	(10.0)
Keuper Marl	Mudstone and clay, red.	1.5+	(5.0+)	4.5	(15.0)

a) + b)	%	mm	%
Gravel	5	+16	3
		-16+4	2
Sand	82	-4+1	1
		$-1+\frac{1}{4}$	66
		$-\frac{1}{4}+1/16$	15
Fines	13	-1/16	13

	Depth below surface (m)	Fines	Percentage Sand	Gravel
a)	0.4 - 1.4	3	97	0
	1.4 - 2.4	9	91	trace
b)	2.4 - 3.0	35	44	21

SK 87 NW 42 8312 7962 Cottam Block B

Surface level (+2.7 m) +9 ft
Water level (-1.9 m) -6 ft
November 1971

Overburden 4.6 m (15.0 ft)
Mineral 3.0 m (10.0 ft)
Bedrock 1.4 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on pale brown and black, part carbonaceous clay.	4.6	(15.0)	4.6	(15.0)
Older River Deposits	Gravel on pebbly sand. Gravel: fine, subrounded to well rounded quartz and quartzite and angular chert with some rounded mudstone. Sand: medium, subangular to subrounded quartz and quartzite.	3.0	(10.0)	7.6	(25.0)
Keuper Marl	Mudstone, red, finely laminated.	1.4+	(4.5+)	9.0	(29.5)

%	mm	%
Gravel 39	-16	: 14
	-16+4	: 25
Sand 61	-4+1	: 8
	-1+$\frac{1}{4}$	: 49
	-$\frac{1}{4}$+1/16	: 4
Fines trace	-1/16	: trace

Depth below surface (m)	Percentage Fines	Sand	Gravel
4.6 - 5.6	trace	11	89
5.6 - 6.6	trace	86	14
6.6 - 7.6	1	86	13

SK 87 NW 43 | 8045 7965 | Cottam | Block A

Surface level (+6.1 m) +20 ft
Groundwater conditions not recorded
November 1971

Overburden 1.1 m (3.5 ft)
Mineral 1.0 m (3.5 ft)
Bedrock 1.4 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Older River Deposits	Soil on pale brown clay.	1.1	(3.5)	1.1	(3.5)
	Very 'clayey' sand, with a little gravel. Sand: medium, subangular to sub-rounded quartz. Gravel: fine, rounded quartz, quartzite and chert.	1.0	(3.5)	2.1	(7.0)
Keuper Marl	Mudstone, red, finely laminated.	1.4+	(4.5)	3.5	(11.5)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	2	+16	:	0	1.1 - 2.1	26	72	2
		-16+4	:	2				
Sand	72	-4+1	:	5				
		-1+$\frac{1}{4}$	:	44				
		-$\frac{1}{4}$+1/16	:	23				
Fines	26	-1/16	:	26				

SK 87 NW 44 | 8082 7864 | Rampton | Block A

Surface level (+4.8 m) +16 ft
Groundwater conditions not recorded
November 1971

Overburden 0.8 m (2.5 ft)
Mineral 2.0 m (6.5 ft)
Waste 0.2 m (0.5 ft)
Mineral 3.5 m (11.5 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Older River Deposits	Soil on pale brown clay.	0.8	(2.5)	0.8	(2.5)
	a) 'Clayey' sandy gravel. Gravel: fine, subrounded to rounded, quartzite, quartz, sandstone with some mudstone. Sand: medium, subangular to subrounded quartz with lithic grains.	2.0	(6.5)	2.8	(9.0)
	Clay, pale brown.	0.2	(0.5)	3.0	(10.0)
	b) Sand, with a little gravel. Sand: as above. Gravel: fine, as above.	3.5	(11.5)	6.5	(21.5)
Keuper Marl	Mudstone, grey-green.	1.5+	(5.0+)	8.0	(26.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	33	+16	: 14	0.8 - 1.8	18	48	34
			-16+4	: 19	1.8 - 2.8	19	49	32
	Sand	48	-4+1	: 9				
			-1+¼	: 31				
			-¼+1/16	: 8				
	Fines	19	-1/16	: 19				
b)	Gravel	3	+16	: trace	3.0 - 4.0	1	96	3
			-16+4	: 3	4.0 - 5.0	1	97	2
					5.0 - 6.5	1	94	5
	Sand	96	-4+1	: 8				
			-1+¼	: 65				
			-¼+1/16	: 23				
	Fines	1	-1/16	: 1				

SK 87 NW 45 8184 7872 Rampton Block B

Surface level (+4.0 m) +13 ft
Water level (+0.5 m) +2 ft
November 1971

Overburden 0.8 m (2.5 ft)
Mineral 9.2 m (30.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on pale brown clay.	0.8	(2.5)	0.8	(2.5)
Older River Deposits	a) Sand, pebbly at top. Sand: medium, subangular to subrounded quartz and quartzite. Gravel: fine, subrounded to well rounded quartz and quartzite.	3.0	(10.0)	3.8	(12.5)
	b) Sandy gravel. Gravel: as above. Sand: medium, subangular to subrounded quartz, quartzite and chert.	4.0	(13.0)	7.8	(25.5)
	c) Sand. Sand: medium, subangular to subrounded quartz with quartzite and chert. Gravel: as above.	2.2	(7.0)	10.0	(33.0)
Keuper Marl	Mudstone, red, finely laminated.	1.0+	(3.5+)	11.0	(36.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	6	+16	0	0.8 - 1.8	1	88	11
			-16+4	6	1.8 - 2.8	1	96	3
					2.8 - 3.8	1	96	3
	Sand	93	-4+1	10				
			$-1+\frac{1}{4}$	74				
			$-\frac{1}{4}+1/16$	9				
	Fines	1	-1/16	1				
b)	Gravel	42	-16	13	3.8 - 4.8	1	62	37
			-16+4	29	4.8 - 5.8	trace	70	30
					5.8 - 6.8	trace	66	34
	Sand	58	-4+1	12	6.8 - 7.8	trace	35	65
			$-1+\frac{1}{4}$	42				
			$-\frac{1}{4}+1/16$	4				
	Fines	trace	-1/16	trace				
c)	Gravel	1	+16	0	7.8 - 8.8	1	98	1
			-16+4	1	8.8 - 10.0	1	98	1
	Sand	98	-4+1	2				
			$-1+\frac{1}{4}$	57				
			$-\frac{1}{4}+1/16$	39				
	Fines	1	-1/16	1				

SK 87 NW 46 | 8320 7885 | Rampton | Block B

Surface level (+3.4 m) +11 ft
Water level (+2.4 m) +8 ft
November 1971

Overburden 0.6 m (2.0 ft)
Mineral 6.4 m (21.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on pale brown clay.	0.6	(2.0)	0.6	(2.0)
Older River Deposits	a) Sand, 'clayey' in upper part. Sand: medium, subangular to sub-rounded quartz with quartzite, coal and other lithic grains.	3.0	(10.0)	3.6	(12.0)
	b) Sandy gravel. Gravel: mainly fine but some coarse, subrounded to well rounded quartz and quartzite and angular chert, with sandstone and mudstone. Sand: as above.	3.4	(11.0)	7.0	(23.0)
Keuper Marl	Mudstone, red, finely laminated.	1.0+	(3.5+)	8.0	(26.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	1	+16	: 0	0.6 - 1.6	11	88	1
			-16+4	: 1	1.6 - 2.6	8	91	1
					2.6 - 3.6	1	99	trace
	Sand	92	-4+1	: 2				
			-1+¼	: 80				
			-¼+1/16	: 10				
	Fines	7	-1/16	: 7				
b)	Gravel	39	+16	: 14	3.6 - 4.6	1	70	29
			-16+4	: 25	4.6 - 5.6	1	83	16
					5.6 - 6.6	trace	26	74
	Sand	60	-4+1	: 9	6.6 - 7.0	1	62	37
			-1+¼	: 46				
			-¼+1/16	: 5				
	Fines	1	-1/16	: 1				

SK 87 NW 47 8457 7890 Torksey Block C

Surface level (+6.4 m) +21 ft
Groundwater conditions not recorded
November 1971

Overburden 0.3 m (1.0 ft)
Mineral 8.7 m (28.5 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	Thickness (ft)	Depth m	Depth (ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Glacial Sand and Gravel	a) Sand, 'clayey' towards base. Sand: medium, well rounded quartz with some lithic grains.	4.0	(13.0)	4.3	(14.0)
?Older River Deposits	b) Gravel on part 'clayey' pebbly sand. Gravel: fine to coarse, rounded chert, quartz and sandstone. Sand: medium, well rounded quartz with lithic grains.	4.7	(15.5)	9.0	(29.5)
Keuper Marl	Mudstone, pale greenish grey and red.	1.5+	(5.0+)	10.5	(34.5)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	0	+16	:	0	0.3 - 1.3	5	95	0
			-16+4	:	0	1.3 - 2.3	3	97	0
						2.3 - 3.3	10	90	0
	Sand	93	-4+1	:	1	3.3 - 4.3	9	91	0
			-1+¼	:	75				
			-¼+1/16	:	17				
	Fines	7	-1/16	:	7				
b)	Gravel	20	+16	:	6	4.3 - 5.3	trace	46	54
			-16+4	:	14	5.3 - 6.3	5	87	8
						6.3 - 7.3	5	79	16
	Sand	76	-4+1	:	5	7.3 - 8.3	10	83	7
			-1+¼	:	63	8.3 - 9.0	1	89	10
			-¼+1/16	:	8				
	Fines	4	-1/16	:	4				

SK 87 NW 48 | 8392 7844 | Torksey | Block C

Surface level (+5.7 m) +19 ft
Water level (+3.7 m) +12 ft
October 1971

Overburden 0.3 m (1.0 ft)
Mineral 2.9 m (9.5 ft)
Bedrock 1.8 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil.	0.3	(1.0)	0.3	(1.0)
Glacial Sand and Gravel	Sand, very 'clayey' below 1.2, and pebbly below 2.2 m. Sand: medium, subrounded to well rounded quartz with lithic grains. Gravel: fine, rounded chert and quartz with some angular green sandstone.	2.9	(9.5)	3.2	(10.5)
Keuper Marl	Mudstone, green and red, and greenish clay.	1.8+	(6.0+)	5.0	(16.5)

	%	mm		%
Gravel	3	+16	:	1
		-16+4	:	2
Sand	76	-4+1	:	2
		-1+$\frac{1}{4}$	:	56
		-$\frac{1}{4}$+1/16	:	18
Fines	21	-1/16	:	21

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.3 - 1.2	2	98	0
1.2 - 2.2	25	74	1
2.2 - 3.2	35	57	8

SK 87 NW 49 | 8267 7810 | Fenton | Block B

Surface level (+4.3 m) +14 ft
Water level (+0.9 m) +3 ft
September 1971

Overburden 5.8 m (19.0 ft)
Mineral 5.6 m (18.5 ft)
Bedrock 1.1 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on red-brown and grey clay with sand pockets.	5.8	(19.0)	5.8	(19.0)
Older River Deposits	Gravel. Gravel: fine to coarse, well rounded quartz, quartzite and chert with sandstone and some limestone and igneous rock; red and green mudstone below 8.8 m. Sand: medium,well rounded quartz with lithic grains.	5.6	(18.5)	11.4	(37.5)
Keuper Marl	Mudstone, grey-green, with gypsum veins.	1.1+	(3.5+)	12.5	(41.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	68	-16	:	27	5.8 - 6.8	trace	48	52
		-16+4	:	41	6.8 - 7.8	0	30	70
					7.8 - 8.8	[trace	31	69]
Sand	32	-4+1	:	10	8.8 - 9.8	1	31	68
		-1+$\frac{1}{4}$	:	17	9.8 -10.8	trace	26	74
		-$\frac{1}{4}$+1/16	:	5	10.8 -11.4	[trace	26	74]
Fines	trace	-1/16	:	trace				

SK 87 NW 50 | 8283 7724 | Fenton | Block B

Surface level (+4.3 m) +14 ft
Water level (+1.3 m) +4 ft
September 1971

Overburden 4.4 m (14.5 ft)
Mineral 4.4 m (14.5 ft)
Bedrock 0.9 m+ (3.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on silty clay with scattered pebbles.	3.0	(10.0)	3.0	(10.0)
	Sandy silt, grey and black.	1.4	(4.5)	4.4	(14.5)
Older River Deposits	Gravel, part sandy. Gravel: fine to coarse, well rounded quartz, chert and sandstone with some limestone. Sand: mainly medium, rounded quartz with lithic grains.	4.4	(14.5)	8.8	(29.0)
Keuper Marl	Mudstone, greenish grey and red.	0.9+	(3.0+)	9.7	(32.0)

	%	mm		%
Gravel	50	+16	:	15
		-16+4	:	35
Sand	49	-4+1	:	14
		-1+$\frac{1}{4}$	:	23
		-$\frac{1}{4}$+1/16	:	12
Fines	1	-1/16	:	1

Depth below surface (m)	Percentage Fines	Sand	Gravel
4.4 - 5.4	trace	62	38
5.4 - 6.4	1	64	35
6.4 - 7.4	trace	26	74
7.4 - 7.8	3	60	35
7.8 - 8.8	4	38	58

SK 87 NW 51 8360 7725 Fenton Block C

Surface level (+5.8 m) +19 ft
Water not encountered
September 1971

Overburden 0.2 m (0.5 ft)
Mineral 1.2 m (4.0 ft)
Bedrock 0.9 m+ (3.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.2	(0.5)	0.2	(0.5)
Glacial Sand and Gravel	Sand, medium, rounded quartz with chert and lithic grains.	1.2	(4.0)	1.4	(4.5)
Keuper Marl	Mudstone and clay, greenish grey and red.	0.9+	(3.0+)	2.3	(7.5)

	%	mm		%
Gravel	0	+16	:	0
		-16+4	:	0
Sand	98	-4+1	:	2
		$-1+\frac{1}{4}$	:	78
		$-\frac{1}{4}+1/16$	:	18
Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.2 - 0.9	2	98	0
0.9 - 1.4	1	99	0

SK 87 NW 52 | 8434 7743 | Fenton | Block C

Surface level (+4.9 m) +16 ft
Water level (+1.8 m) +6 ft
September 1971

Overburden 1.6 m (5.0 ft)
Mineral 3.4 m (11.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Made ground.	0.8	(2.5)	0.8	(2.5)
Glacial Sand and Gravel	Sand.	0.3	(1.0)	1.1	(3.5)
	Clay, reddish brown, orange and grey, pebbly at top.	0.5	(1.5)	1.6	(5.0)
	Sand, medium, rounded quartz with red and grey lithic grains; a little gravel below 3.1 m.	3.4	(11.0)	5.0	(16.5)
Keuper Marl	Mudstone, soft, green and red in upper part, hard and red below; gravel embedded in upper surface.	1.0+	(3.5+)	6.0	(19.5)

	%	mm		%
Gravel	0	+16	:	0
		-16+4	:	0
Sand	98	-4+1	:	2
		-1+$\frac{1}{4}$	:	61
		-$\frac{1}{4}$+1/16	:	35
Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
1.6 - 2.6	3	97	0
2.6 - 3.1	2	98	0
3.1 - 4.1	1	99	0
4.1 - 5.0	1	99	0

SK 87 NW 53 | 8211 7690 | Laughterton | Block B

Surface level (+4.2 m) +14 ft
Water level not recorded
October 1971

Overburden 5.5 m (18.0 ft)
Mineral 2.8 m (9.0 ft)
Bedrock 1.2 m+ (4.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on clayey silt with some fine gravel.	4.0	(13.0)	4.0	(13.0)
	Peat with some clay.	1.5	(5.0)	5.5	(18.0)
Other river deposits	Gravel and sandy gravel. Gravel: fine to coarse, well rounded quartz, quartzite, chert and sandstone; some tabular greenish siltstone and sandstone especially below 8.0 m; small shells below 6.5. Sand: medium, generally rounded quartz with lithic grains.	2.8	(9.0)	8.3	(27.0)
Keuper Marl	Mudstone and clay, pale green, with gypsum.	1.2+	(4.0+)	9.5	(31.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	60	+16	:	22	5.5 - 6.5	trace	26	74
		-16+4	:	38	6.5 - 7.5	1	41	58
					7.5 - 8.3	trace	58	42
Sand	40	-4+1	:	10				
		-1+$\frac{1}{4}$	:	27				
		-$\frac{1}{4}$+1/16	:	3				
Fines	trace	-1/16	:	trace				

SK 87 NW 54 8352 7638 Fenton Block C

Surface level (c. +7.9) c. +26 ft
Water not encountered
September 1971

Overburden 0.3 m (1.0 ft)
Mineral 1.4 m (4.5 ft)
Bedrock 1.3 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Blown Sand on Glacial Sand and Gravel	Sand, medium, rounded quartz; a little gravel in lower part.	1.4	(4.5)	1.7	(5.5)
Keuper Marl	Mudstone, red-brown and green, with thin sandstone band at top.	1.3+	(4.5+)	3.0	(10.0)

	%	mm	%	Depth below surface (m)	Fines	Percentage Sand	Gravel
Gravel	trace	+16	: 0	0.3 - 1.0	2	98	0
		-16+4	: trace	1.0 - 1.7	1	98	1
Sand	98	-4+1	: 1				
		-1+¼	: 77				
		-¼+1/16	: 20				
Fines	2	-1/16	: 2				

SK 87 NW 55 8470 7617 Fenton Block C

Surface level (+4.9 m) +16 ft
Water level (+3.3 m) +10 ft
September 1971

Mineral 1.9 m (6.0 ft)
Bedrock 2.1 m+ (7.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Glacial Sand and Gravel	Sand, medium, rounded quartz with some lithic grains.	1.9	(6.0)	1.9	(6.0)
Keuper Marl	Mudstone and clay, greenish grey.	2.1+	(7.0)	4.0	(13.0)

	%	mm		%
Gravel	0	+16	:	0
		-16+4	:	0
Sand	98	-4+1	:	2
		$-1+\frac{1}{4}$	:	60
		$-\frac{1}{4}+1/16$	:	36
Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
0 - 1.0	2	98	0
1.0 - 1.9	2	98	0

SK 87 NW 56 | 8264 7584 | Laugherton | Block B

Surface level (+5.6 m) +18 ft
Water level not recorded
October 1971

Overburden 1.9 m (6.0 ft)
Mineral 3.8 m (12.5 ft)
Bedrock 1.8 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on brown and grey clayey silt with sand pockets.	1.9	(6.0)	1.9	(6.0)
Older River Deposits	Gravel, 'clayey' and sandy at top. Gravel: fine to coarse, subrounded chert and rounded to well rounded quartz, quartzite and sandstone with some igneous rock. Sand: medium, well rounded quartz with subrounded lithic grains.	3.8	(12.5)	5.7	(18.5)
Keuper Marl	Mudstone and clay, grey-green and red, gypsiferous below 6.7 m.	1.8+	(6.0+)	7.5	(24.5)

	%	mm		%
Gravel	48	+16	:	20
		-16+4	:	28
Sand	44	-4+1	:	8
		-1+$\frac{1}{4}$	:	29
		-$\frac{1}{4}$+1/16	:	7
Fines	8	-1/16	:	8

Depth below surface (m)	Percentage Fines	Sand	Gravel
1.9 - 2.9	18	53	29
2.9 - 3.9	7	43	50
3.9 - 4.9	4	32	64
4.9 - 5.7	4	44	52

SK 87 NW 57 | 8346 7530 | Laugherton | Block C

Surface level (+7.1 m) +23 ft
Water not encountered
September 1971

Mineral 2.6 m (8.5 ft)
Bedrock 0.9 m+ (3.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Blown Sand	Sand, medium, rounded quartz with some lithic grains.	2.6	(8.5)	2.6	(8.5)
Keuper Marl	Mudstone, red and greenish grey.	0.9+	(3.0+)	3.5	(11.5)

	%	mm		%
Gravel	0	+16	:	0
		-16+4	:	0
Sand	98	-4+1	:	trace
		-1+¼	:	71
		-¼+1/16	:	27
Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
0 - 0.3	3	97	0
0.3 - 1.0	1	99	0
1.0 - 2.0	2	98	0
2.0 - 2.6	3	97	0

SK 87 NW 58 | 8472 7538 | Kettlethorpe | Block C

Surface level (+5.9 m) +20 ft
Water level lower than (+4.4 m) +14 ft
September 1971

Overburden 0.5 m (1.5 ft)
Mineral 1.2 m (4.0 ft)
Waste 0.3 (1.0 ft)
Mineral 3.3 m (11.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Glacial Sand and Gravel	a) Sand, with 5 mm silty clay at 1.45 m and iron pan. Sand: medium, rounded to subangular quartz with some lithic grains. Gravel: fine, rounded chert, quartz and quartzite.	1.2	(4.0)	1.7	(5.5)
	Clay, grey.	0.3	(1.0)	2.0	(6.5)
	b) Sand with a little gravel. Sand: medium, rounded quartz with some lithic grains. Gravel: fine, subangular chert.	2.0	(6.5)	4.0	(13.0)
?Older River Deposits	c) Pebby sand. Sand: medium, rounded quartz with lithic grains. Gravel: fine, rounded quartz, quartzite and chert with some siltstone.	1.3	(4.5)	5.3	(17.5)
Keuper Marl	Mudstone, pale greenish grey, with fine grained 'cornstone'.	1.0+	(3.5+)	6.3	(20.5)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	3	+16	0	0.5 - 1.4	2	94	4
			-16+4	3	1.4 - 1.7	21	79	0*
	Sand	90	-4+1	1				
			$-1+\frac{1}{4}$	52				
			$-\frac{1}{4}+1/16$	37				
	Fines	7	-1/16	7				
b)	Gravel	1	+16	0	2.0 - 3.0	2	98	0
			-16+4	1	3.0 - 4.0	3	95	2
	Sand	97	-4+1	6				
			$-1+\frac{1}{4}$	39				
			$-\frac{1}{4}+1/16$	52				
	Fines	2	-1/16	2				
c)	Gravel	23	+16	1	4.0 - 5.0	1	77	22
			-16+4	22	5.0 - 5.3	3	70	27
	Sand	76	-4+1	9				
			$-1+\frac{1}{4}$	57				
			$-\frac{1}{4}+1/16$	10				
	Fines	1	-1/16	1				

*assuming ungraded clay comprises 100% fines

SK 87 NW 59 8178 7520 Dunham Block B

Surface level (+4.6 m) +15 ft
Water level not recorded
October 1971

Overburden 1.1 m (3.5 ft)
Mineral 11.9 m (39.0 ft)
Bedrock 2.0 m+ (6.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on brown clay.	1.1	(3.5)	1.1	(3.5)
Older River Deposits	a) Sand, very 'clayey' in upper part. Sand: fine to medium, well rounded quartz.	1.9	(6.0)	3.0	(10.0)
	b) Gravel and sandy gravel. Gravel: fine and coarse, subrounded to rounded quartz, quartzite and chert, with sandstone and mudstone below 7.0 m. Sand: medium, subangular to subrounded quartz with chert and lithic grains.	10.0	(33.0)	13.0	(42.5)
Keuper Marl	Mudstone, red, finely laminated.	2.0+	(6.5+)	15.0	(49.0)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	3	+16	:	0	1.1 - 2.0	35	65	0
			-16+4	:	3	2.0 - 3.0	2	92	6
	Sand	79	-4+1	:	1				
			$-1+\frac{1}{4}$	:	36				
			$-\frac{1}{4}+1/16$	:	42				
	Fines	18	-1/16	:	18				
b)	Gravel	54	+16	:	24	3.0 - 4.0	1	49	50
			-16+4	:	30	4.0 - 5.0	trace	50	50
						5.6 - 6.0	trace	42	58
	Sand	45	-4+1	:	12	6.0 - 7.0	1	52	47
			$-1+\frac{1}{4}$	:	28	7.0 - 8.0	trace	17	83
			$-\frac{1}{4}+1/16$	:	5	8.0 - 9.0	trace	29	71
						9.0 -10.0	4	64	32
	Fines	1	-1/16	:	1	10.0 -11.0	trace	41	59
						11.0 -12.0	trace	32	68
						12.0 -13.0	2	79	19

SK 87 NE 5 | 8572 7845 | Torksey | Block E

Surface level (+5.2 m) +17 ft
Groundwater conditions not recorded
November 1971

Waste 3.7 m (12.0 ft)
Bedrock 1.8 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.2	(0.5)	0.2	(0.5)
Older River Deposits	Very 'clayey' sand; mainly quartz, with brown silt and red-brown and grey clay.	0.4	(1.5)	0.6	(2.0)
	Clay, reddish brown and grey, with some gravel and pockets of sand.	3.1	(10.0)	3.7	(12.0)
Lower Lias	Mudstone and clay, dark grey.	1.8+	(6.0+)	5.5	(18.0)

	%	mm	%
Gravel	1	+16	: 0
		-16+4	: 1
Sand	72	-4+1	: trace
		-1+$\frac{1}{4}$	: 21
		-$\frac{1}{4}$+1/16	: 51
Fines	27	-1/16	: 27

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.2 - 0.6	27	72	1

SK 87 NE 6 | 8559 7769 | Torksey | Block E

Surface level (+4.0 m) +13 ft
Water level not recorded
October 1971

Overburden 0.8 m (2.5 ft)
Mineral 8.0 m (26.0 ft)
Bedrock 0.7 m+ (2.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	Clay, grey, with sand pockets.	0.5	(1.5)	0.8	(2.5)
	a) Sand, pebbly in lower part, peaty at 2.6 m. Sand: medium, rounded quartz with some more angular lithic grains. Gravel: fine, chert and quartz.	3.0	(10.0)	3.8	(12.5)
	b) Sandy gravel and pebbly sand. Gravel: fine, angular to rounded quartz, quartzite, sandstone and chert, with limestone and fossil shell debris increasing in proportion towards base. Sand: medium, rounded quartz with subangular to subrounded lithic grains.	5.0	(16.5)	8.8	(29.0)
Lower Lias	Limestone, hard grey fossiliferous, with clay and mudstone partings.	0.7+	(2.5+)	9.5	(31.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	3	+16	1	0.8 - 1.8	7	93	trace
			-16+4	2	1.8 - 2.8	4	95	1
					2.8 - 3.8	trace	91	9
	Sand	93	-4+1	2				
			$-1+\frac{1}{4}$	70				
			$-\frac{1}{4}+1/16$	21				
	Fines	4	-1/16	4				
b)	Gravel	30	+16	8	3.8 - 4.8	1	81	18
			-16+4	22	4.8 - 5.8	trace	69	31
					5.8 - 6.8	trace	64	36
	Sand	70	-4+1	9	6.8 - 7.8	trace	84	16
			$-1+\frac{1}{4}$	51	7.8 - 8.8	trace	51	49
			$-\frac{1}{4}+1/16$	10				
	Fines	trace	-1/16	trace				

SK 87 NE 7 | 8613 7669 | Hardwick | Block E

Surface level (+4.9 m) +16 ft
Water level not recorded
October 1971

Overburden 0.4 m (1.5 ft)
Mineral 4.0 m (13.0 ft)
Bedrock 1.6 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	Pebbly sand, with a little laminated clay in places. Sand: medium, rounded quartz with some lithic grains, including coal. Gravel: mainly fine, rounded quartz, sandstone and quartzite, subrounded chert and some rounded to angular mudstone, siltstone and limestone.	4.0	(13.0)	4.4	(14.5)
Lower Lias	Mudstone and clay, grey.	1.6+	(5.0+)	6.0	(19.5)

	%	mm	%
Gravel	7	+16	2
		-16+4	5
Sand	86	-4+1	2
		-1+¼	68
		-¼+1/16	16
Fines	7	-1/16	7

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.4 - 1.4	9	84	7
1.4 - 2.4	7	82	11
2.4 - 3.4	5	90	5
3.4 - 4.4	7	88	5

SK 87 NE 8 | 8571 7598 | Kettlethorpe | Block E

Surface level (+5.0 m) +16 ft
Water level (+3.5 m) +11 ft
September 1971

Overburden 0.4 m (1.5 ft)
Mineral 4.8 m (15.5 ft)
Bedrock 0.8 m+ (2.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Sand, with a little gravel. Sand: fine to medium, rounded quartz with dark mudstone. Gravel: fine, chert, quartz and quartzite with dark mudstone.	4.1	(13.5)	4.5	(15.0)
	b) Pebbly sand. Sand: as above. Gravel: fine to coarse, rounded quartz, quartzite and chert with some siltstone and argillaceous limestone.	0.7	(2.5)	5.2	(17.0)
Lower Lias	Mudstone and flaggy limestone, grey to dark grey.	0.8+	(2.5+)	6.0	(19.5)

a) and b) %		mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	4	+16	:	1	a) 0.4 - 1.5	4	95	1
		-16+4	:	3	1.5 - 2.5	1	98	1
					2.5 - 3.5	trace	98	2
Sand	94	-4+1	:	3	3.5 - 4.5	2	96	2
		-1+¼	:	48				
		-¼+1/16	:	43	b) 4.5 - 5.2	3	76	21
Fines	2	-1/16	:	2				

SK 87 NE 9 8635 7511 Kettlethorpe Block E

Surface level (+4.9 m) +16 ft
Water level (+2.9 m) +10 ft
September 1971

Overburden 0.4 m (1.5 ft)
Mineral 4.0 m (13.0 ft)
Waste 0.9 m (3.0 ft)
Mineral 1.3 m (4.5 ft)
Bedrock 0.8 m+ (2.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Sand, mainly medium, quartz with some lithic grains; some pockets of dark grey 'clayey' sand.	3.0	(10.0)	3.4	(11.0)
	b) Sandy gravel. Gravel: rounded to angular chert and rounded quartz and quartzite, with some tabular subangular siltstone. Sand: medium, quartz with some dark lithic grains.	1.0	(3.5)	4.4	(14.5)
	Clay, brown.	0.9	(3.0)	5.3	(17.5)
	c) Sand, medium, rounded to subrounded quartz with dark lithic grains; a little gravel.	1.3	(4.5)	6.6	(21.5)
Lower Lias	Mudstone and flaggy limestone, dark grey.	0.8+	(2.5+)	7.4	(24.5)

	%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a) and b)							
Gravel	9	+16	: 4	a) 0.4 - 1.4	3	97	0
		-16+4	: 5	1.4 - 2.4	2	98	0
				2.4 - 3.4	2	98	0
Sand	89	-4+1	: 3				
		$-1+\frac{1}{4}$	: 56	b) 3.4 - 4.4	1	63	36
		$-\frac{1}{4}+1/16$	: 30				
Fines	2	-1/16	: 2				
c)							
Gravel	trace	+16	: 0	c) 5.3 - 6.3	7	93	trace
		-16+4	: trace	6.3 - 6.6	3	97	0
Sand	94	-4+1	: 3				
		$-1+\frac{1}{4}$	: 65				
		$-\frac{1}{4}+1/16$	: 26				
Fines	6	-1/16	: 6				

SK 87 NE 15 | 8568 7952 | Torksey | Block E

Surface level (c. +5.8 m) c. +19 ft
Water level (c. +4.2 m) c. +14 ft
Hand auger
August 1972

Overburden 0.5 m (1.5 ft)
Mineral 1.1 m (3.5 ft)
Waste 3.5 m (11.5 ft)
Bedrock 0.1 m+ (0.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	'Clayey' and sandy soil.	0.5	(1.5)	0.5	(1.5)
Older River Deposits	'Clayey' sand. Sand: fine, angular to rounded quartz with some lithic grains.	1.1	(3.5)	1.6	(5.0)
	Clay, reddish brown and grey.	3.5	(11.5)	5.1	(16.5)
Lower Lias	Clay, hard, dark grey.	0.1+	(0.5+)	5.2	(17.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	0	+16	:	0	0.5 - 1.6	31	69	0
		-16+4	:	0				
Sand	69	-4+1	:	trace				
		$-1+\frac{1}{4}$	:	10				
		$-\frac{1}{4}+1/16$	:	59				
Fines	31	-1/16	:	31				

SK 87 SW 7 | 8122 7440 | Dunham | Block A

Surface level (+5.2 m) +17 ft
Water level (+2.4 m) +8 ft
November 1971

Overburden 0.4 m (1.5 ft)
Mineral 2.0 m (6.5 ft)
Bedrock 2.6 m+ (8.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	Sand, very 'clayey' and pebbly in upper part. Sand: medium, subangular to well rounded quartz and lithic grains. Gravel: fine, subrounded to well rounded quartz and quartzite.	2.0	(6.5)	2.4	(8.0)
Keuper Marl	Mudstone, red.	2.6+	(8.5+)	5.0	(16.5)

	%	mm		%
Gravel	3	+16	:	1
		-16+4	:	2
Sand	82	-4+1	:	2
		$-1+\frac{1}{4}$	:	48
		$-\frac{1}{4}+1/16$	:	32
Fines	15	-1/16	:	15

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.4 - 1.4	28	67	5
1.4 - 2.4	1	97	2

SK 87 SW 8 | 8400 7446 | Newton on Trent | Block C

Surface level (+5.2 m) +17 ft
Water level not recorded
October 1971

Overburden 0.5 m (1.5 ft)
Mineral 6.6 m (21.5 ft)
Bedrock 1.4 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Glacial Sand and Gravel	a) Sand, mainly 'clayey'. Sand: medium, subangular to subrounded quartz with subangular chert.	3.0	(10.0)	3.5	(11.5)
?Older River Deposits	b) Pebbly sand on sandy gravel. Gravel: fine, subrounded to well rounded quartz, quartzite and sandstone. Sand: medium, subrounded to rounded quartz and subangular chert.	3.6	(12.0)	7.1	(23.5)
Keuper Marl	Mudstone and clay, grey-green.	1.4+	(4.5+)	8.5	(28.0)

		%	mm		%	Depth below surface (m)	Fines	Percentage Sand	Gravel
a)	Gravel	3	+16	:	trace	0.5 - 1.5	1	96	3
			-16+4	:	3	1.5 - 2.5	24	73	3
						2.5 - 3.5	18	79	3
	Sand	83	-4+1	:	2				
			-1+¼	:	57				
			-¼+1/16	:	24				
	Fines	14	-1/16	:	14				
b)	Gravel	28	+16	:	9	3.5 - 4.5	1	77	22
			-16+4	:	19	4.5 - 5.5	trace	79	21
						5.5 - 6.5	trace	61	39
	Sand	72	-4+1	:	8	6.5 - 7.1	trace	68	32
			-1+¼	:	53				
			-¼+1/16	:	11				
	Fines	trace	-1/16	:	trace				

SK 87 SW 9 | 8471 7359 | Newton on Trent | Block D

Surface level (+5.2 m) +17 ft
Water level (+2.2 m) +7 ft
October 1971

Overburden 0.9 m (3.0 ft)
Mineral 4.6 m (15.0 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.9	(3.0)	0.9	(3.0)
Older River Deposits	a) Sand, mainly 'clayey' and very 'clayey', pebbly near base. Sand: medium, subangular to subrounded quartz with some chert and quartzite.	4.0	(13.0)	4.9	(16.0)
	b) Sandy gravel. Gravel: fine, subrounded to well rounded quartz, quartzite and chert. Sand: as above.	0.6	(2.0)	5.5	(18.0)
Keuper Marl	Mudstone and clay, dark grey.	1.5+	(5.0+)	7.0	(23.0)

a) + b)	%	mm		%
Gravel	5	+16	:	1
		-16+4	:	4
Sand	84	-4+1	:	3
		-1+$\frac{1}{4}$	:	54
		-$\frac{1}{4}$+1/16	:	27
Fines	11	-1/16	:	11

	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	0.9 - 1.9	12	87	1
	1.9 - 2.9	4	96	trace
	2.9 - 3.9	35	64	1
	3.9 - 4.9	trace	94	6
b)	4.9 - 5.5	trace	73	27

SK 87 SW 10 | 8398 7346 | Newton on Trent | Block D

Surface level (+5.5 m) +18 ft
Groundwater conditions not recorded
October 1971

Overburden 0.8 m (2.5 ft)
Mineral 3.2 m (10.5 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	Clay, pale grey with red and black mottling, under 5 mm 'clayey' sand.	0.5	(1.5)	0.8	(2.5)
	Sand, with high fines content in upper part, and mudstone pellets at base. Sand: medium, subangular to sub-rounded quartz with some lithic grains.	3.2	(10.5)	4.0	(13.0)
Keuper Marl	Mudstone, red, finely laminated.	1.0+	(3.5+)	5.0	(16.5)

	%	mm		%
Gravel	1	+16	:	0
		-16+4	:	1
Sand	93	-4+1	:	trace
		$-1+\frac{1}{4}$	:	34
		$-\frac{1}{4}+1/16$	:	59
Fines	6	-1/16	:	6

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.8 - 1.8	9	89	2
1.8 - 2.8	8	92	0
2.8 - 3.8	1	99	0
3.8 - 4.0	3	96	1

SK 87 SW 11 | 8118 7374 | Ragnall | Block A

Surface level (+6.8 m) +22 ft
Water level (+5.0 m) +16 ft
September 1971

Overburden 0.6 m (2.0 ft)
Mineral 1.8 m (6.0 ft)
Waste 0.5 m (1.5 ft)
Mineral 2.1 m (7.0 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.6	(2.0)	0.6	(2.0)
Older River Deposits	a) Pebbly sand, 'clayey' in lower part and with 15 cm (6 in) band of very 'clayey' sandy gravel at 1.6 m. Sand: medium, rounded to sub-angular quartz with lithic grains. Gravel: fine, rounded quartz, quartzite, chert and sandstone.	1.8	(6.0)	2.4	(8.0)
	Clay, reddish brown.	0.5	(1.5)	2.9	(9.5)
	b) Pebbly sand, gravel mainly below 3.9 m Sand: as above but part stained red. Gravel: fine, subrounded to rounded quartz, quartzite, sandstone and chert with some tabular siltstone.	2.1	(7.0)	5.0	(16.5)
Keuper Marl	Mudstone, red, laminated.	1.5+	(5.0+)	6.5	(21.5)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	8	-64+16	:	1	0.6 - 1.5	1	94	5
			-16+4	:	7	1.5 - 1.6	20	54	26
						1.6 - 2.4	15	76	9
	Sand	83	-4+1	:	8				
			-1+¼	:	56				
			-¼+1/16	:	19				
	Fines	9	-1/16	:	9				
b)	Gravel	10	-64+16	:	1	2.9 - 3.9	2	96	2
			-16+4	:	9	3.9 - 4.9	2	79	19
						4.9 - 5.0	3	87	10
	Sand	88	-4+1	:	5				
			-1+¼	:	58				
			-¼+1/16	:	25				
	Fines	2	-1/16	:	2				

SK 87 SW 12 | 8076 7319 | Ragnall | Block A

Surface level (+5.7 m) +19 ft
Water not encountered
September 1971

Waste 0.7 m (2.5 ft)
Bedrock 1.6 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.1	(0.5)	0.1	(0.5)
Older River Deposits	Clay, silty, grey and orange.	0.4	(1.5)	0.5	(1.5)
	Sand, part 'clayey', with some gravel.	0.2	(0.5)	0.7	(2.5)
Keuper Marl	Clay and mudstone, red with green patches.	1.6+	(5.0+)	2.3	(7.5)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	4	+16	:	0	0.5 - 0.7	4	92	4
		-16+4	:	4				
Sand	92	-4+1	:	3				
		-1+$\frac{1}{4}$	:	64				
		-$\frac{1}{4}$+1/16	:	25				
Fines	4	-1/16	:	4				

SK 87 SW 13 | 8115 7272 | Fledborough | Block A

Surface level (+6.6 m) +22 ft
Water level (+4.0 m) +13 ft
September 1971

Overburden 0.4 m (1.5 ft)
Mineral 1.3 m (4.5 ft)
Waste 0.4 m (1.5 ft)
Mineral 1.0 m (3.5 ft)
Bedrock 2.3 m+ (7.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Sand with a little scattered gravel. Sand: fine to medium, rounded and subrounded quartz with lithic grains. Gravel: fine, rounded and subrounded chert, quartz and quartzite.	1.3	(4.5)	1.7	(5.5)
	Clay, reddish brown.	0.4	(1.5)	2.1	(7.0)
	b) 'Clayey' sand. Sand: as above.	1.0	(3.5)	3.1	(10.0)
Keuper Marl	Mudstone and clay, brown, red and green.	2.3+	(7.5+)	5.4	(17.5)

a)+b)	%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	0	+16	: 0	a) 0.4 - 1.3	6	94	0
		-16+4	: 0	1.3 - 1.7	2	98	0
Sand	91	-4+1	: 3	b) 2.1 - 3.1	15	85	0
		-1+$\frac{1}{4}$	: 38				
		-$\frac{1}{4}$+1/16	: 50				
Fines	9	-1/16	: 9				

SK 87 SW 14 | 8188 7234 | North Clifton | Block B

Surface level (+5.5 m) +18 ft
Water level (+2.3 m) +8 ft
October 1971

Overburden 3.0 m (10.0 ft)
Mineral 1.7 m (5.5 ft)
Bedrock 2.3 m+ (7.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Sandy clay, pale brown and dark grey.	3.0	(10.0)	3.0	(10.0)
Older River Deposits	'Clayey' sandy gravel and pebbly sand. Gravel: fine, subrounded to well rounded quartz, quartzite and chert. Sand: medium, subangular to rounded quartz with chert.	1.7	(5.5)	4.7	(15.5)
Keuper Marl	Mudstone and clay, red and grey, with thin gypsum bands.	2.3+	(7.5+)	7.0	(23.0)

%		mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	33	+16	: 12	3.0 - 4.0	16	46	38
		-16+4	: 21	4.0 - 4.7	3	72	25
Sand	57	-4+1	: 7				
		-1+$\frac{1}{4}$	: 41				
		-$\frac{1}{4}$+1/16	: 9				
Fines	10	-1/16	: 10				

SK 87 SW 15 | 8277 7279 | North Clifton | Block D

Surface level (c. +21.0 m) c. +69 ft
Groundwater not encountered
Hand auger
September 1972

Mineral 1.3 m (4.5 ft)
Bedrock 0.2 m+ (0.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Blown Sand	Sand with a little gravel near base. Sand: medium, angular to rounded quartz with lithic grains. Gravel: fine, angular siltstone.	1.3	(4.5)	1.3	(4.5)
Keuper Marl	Mudstone, grey and green.	0.2+	(0.5+)	1.5	(5.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	1	+16	:	0	0 - 1.3	16	83	1
		-16+4	:	1				
Sand	83	-4+1	:	2				
		-1+$\frac{1}{4}$	:	47				
		-$\frac{1}{4}$+1/16	:	34				
Fines	16	-1/16	:	16				

SK 87 SW 16 | 8449 7261 | North Clifton | Block D

Surface level (+5.4 m) +18 ft
Water level not recorded
October 1971

Overburden 0.7 m (2.5 ft)
Mineral 7.6 m (25.0 ft)
Bedrock 1.2 m+ (4.0 ft+)

		Thickness m	Thickness (ft)	Depth m	Depth (ft)
	Soil	0.7	(2.5)	0.7	(2.5)
Older River Deposits	a) Sand, pebbly at base. Sand: fine, subangular to subrounded quartz with lithic grains and some carbonaceous matter. Gravel: fine, subrounded to well rounded quartz and quartzite with some red mudstone.	5.0	(16.5)	5.7	(18.5)
	b) Gravel, sandy near base. Gravel: fine, subrounded to well rounded quartz, quartzite and chert with sandstone and red mudstone. Sand: medium, angular to subrounded quartz with lithic grains including coal.	2.6	(8.5)	8.3	(27.0)
Keuper Marl	Mudstone, red, finely laminated.	1.2+	(4.0+)	9.5	(31.0)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	2	+16	:	0	0.7 - 1.7	7	93	0
			-16+4	:	2	1.7 - 2.7	5	95	0
						2.7 - 3.7	3	97	trace
	Sand	94	-4+1	:	1	3.7 - 4.7	5	95	0
			-1+¼	:	33	4.7 - 5.7	1	89	10
			-¼+1/16	:	60				
	Fines	4	-1/16	:	4				
b)	Gravel	58	+16	:	24	5.7 - 6.7	1	31	68
			-16+4	:	34	6.7 - 7.7	1	38	61
						7.7 - 8.3	1	65	34
	Sand	41	-4+1	:	6				
			-1+¼	:	26				
			-¼+1/16	:	9				
	Fines	1	-1/16	:	1				

SK 87 SW 17 | 8417 7170 | North Clifton | Block D

Surface level (+7.2 m) +24 ft
Water level not recorded
October 1971

Overburden 0.3 m (1.0 ft)
Mineral 6.2 m (20.5 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	a) 'Clayey' to very 'clayey' sand: subangular to subrounded quartz with lithic grains.	2.7	(9.0)	3.0	(10.0)
	b) Sandy gravel. Gravel: fine, subrounded to well rounded quartz, quartzite, sandstone and chert. Sand: medium, subangular to subrounded quartz, chert and lithic grains.	3.5	(11.5)	6.5	(21.5)
Keuper Marl	Mudstone, red, finely laminated, hard.	1.0+	(3.5+)	7.5	(24.5)

		%	mm		%
a)	Gravel	0	+16	:	0
			-16+4	:	0
	Sand	81	-4+1	:	1
			-1+$\frac{1}{4}$	:	32
			-$\frac{1}{4}$+1/16	:	48
	Fines	19	-1/16	:	19
b)	Gravel	33	+16	:	13
			-16+4	:	20
	Sand	66	-4+1	:	4
			-1+$\frac{1}{4}$	:	43
			-$\frac{1}{4}$+1/16	:	19
	Fines	1	-1/16	:	1

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.3 - 1.3	23	77	0
1.3 - 2.3	11	89	0
2.3 - 3.0	[23	77	0]
3.0 - 4.0	2	82	16
4.0 - 5.0	1	70	29
5.0 - 6.0	1	54	45
6.0 - 6.5	trace	53	47

SK 87 SW 18 | 8106 7183 | Fledborough | Block A

Surface level (+6.4 m) +21 ft
Water not encountered
September 1971

Overburden 0.3 m (1.0 ft)
Mineral 1.3 m (4.5 ft)
Bedrock 0.9 m+ (3.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	Sand, with a little gravel and 5 cm clay band at 1.45 m. Sand: medium to fine, rounded to sub-rounded quartz, iron-stained. Gravel: fine, rounded quartz, quartzite and chert.	1.3	(4.5)	1.6	(5.0)
Keuper Marl	Mudstone, red and green.	0.9+	(3.0+)	2.5	(8.0)

	%	mm		%
Gravel	2	+16	:	0
		-16+4	:	2
Sand	91	-4+1	:	1
		-1+¼	:	51
		-¼+1/16	:	39
Fines	7	-1/16	:	7

Depth below surface (m)	Percentage Fines	Sand	Gravel
0.3 - 1.3	3	94	3
1.3 - 1.4	3	97	0
1.4 - 1.6	30	70	0*

* Assuming ungraded clay band comprises 100% fines

SK 87 SW 19 | 8170 7112 | South Clifton | Block B

Surface level (+4.8 m) +16 ft
Water level not recorded
October 1971

Overburden 2.2 m (7.0 ft)
Mineral 2.3 m (7.5 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on pale grey and part yellow and black mottled clay.	2.2	(7.0)	2.2	(7.0)
Older River Deposits	Gravel. Gravel: fine, subrounded to well rounded, quartz, quartzite and sandstone. Sand: medium, angular to subrounded quartz with lithic grains.	2.3	(7.5)	4.5	(15.0)
Keuper Marl	Mudstone, red, finely laminated.	1.5+	(1.5+)	6.0	(20.0)

%		mm		%
Gravel	65	+16	:	27
		-16+4	:	38
Sand	33	-4+1	:	9
		-1+$\frac{1}{4}$	:	21
		-$\frac{1}{4}$+1/16	:	3
Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
2.2 - 3.2	3	42	55
3.2 - 4.2	trace	28	72
4.2 - 4.5	1	24	75

SK 87 SW 20 | 8363 7096 | South Clifton | Block D

Surface level (+7.2 m) +24 ft
Groundwater conditions not recorded
October 1971

Overburden 0.2 m (0.5 ft)
Mineral 2.5 m (8.0 ft)
Bedrock 4.3 m+ (14.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.2	(0.5)	0.2	(0.5)
Older River Deposits	Sand, with a little gravel. Sand: medium, subangular to subrounded quartz with some lithic grains. Gravel: fine, subrounded to rounded quartz and quartzite.	2.5	(8.0)	2.7	(9.0)
?Keuper Marl	Clay, pale grey.	1.8	(6.0)	4.5	(15.0)
Keuper Marl	Mudstone, greenish grey, with 20 cm sandstone at top.	2.5+	(8.0+)	7.0	(23.0)

%		mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	trace	+16	:	0	0.2 - 1.2	3	97	0
		-16+4	:	trace	1.2 - 2.2	4	95	1
					2.2 - 2.7	4	96	0
Sand	96	-4+1	:	1				
		-1+$\frac{1}{4}$	:	52				
		-$\frac{1}{4}$+1/16	:	43				
Fines	4	-1/16	:	4				

SK 87 SW 21 8245 7046 South Clifton Block D

Surface level (c. +8.3 m) c. +27 ft
Groundwater conditions not recorded
Hand auger
September 1972

Mineral 3.6 m (12.0 ft)
Bedrock 0.7 m+ (2.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Blown sand on Older River Deposits	Sand, part pebbly and part 'clayey'. Sand: medium, angular to rounded quartz with lithic grains. Gravel: fine, rounded to subrounded quartz, quartzite and chert and angular to subangular siltstone.	3.6	(12.0)	3.6	(12.0)
Keuper Marl	Clay, hard, red.	0.7+	(2.5+)	4.3	(14.0)

	%	mm		%
Gravel	3	+16	:	0
		-16+4	:	3
Sand	88	-4+1	:	2
		-1+¼	:	61
		-¼+1/16	:	25
Fines	9	-1/16	:	9

Depth below surface (m)	Percentage Fines	Sand	Gravel
0 - 1.0	8	92	trace
1.0 - 2.0	15	79	6
2.0 - 3.0	5	91	4
3.0 - 3.6	[9	88	3]

SK 87 SW 22 | 8165 7028 | South Clifton | Block B

Surface level (+5.8 m) +19 ft
Water level not recorded
October 1971

Overburden 6.0 m (19.5 ft)
Mineral 4.0 m (13.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
Alluvium	Soil on pale to dark, part carbonaceous clay.	6.0	(19.5)	6.0	(19.5)
Older River Deposits	Gravel, part sandy. Gravel: fine to coarse, subrounded to well rounded quartz, quartzite and sandstone, with mudstone above 7.0 m. Sand: medium, subangular to subrounded quartz with chert and lithic grains.	4.0	(13.0)	10.0	(33.0)
Keuper Marl	Mudstone, red, finely laminated.	1.0+	(3.5+)	11.0	(36.0)

%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel 50	+16	: 25	6.0 - 7.0	1	39	60
	-16+4	: 25	7.0 - 8.0	2	58	40
			8.0 - 9.0	1	37	62
Sand 47	-4+1	: 10	9.0 -10.0	9	53	38
	-1+¼	: 33				
	-¼+1/16	: 4				
Fines 3	-1/16	: 3				

SK 87 SW 23 8463 7042 Wigsley Block D

Surface level (+5.1 m) +17 ft
Water level not recorded
October 1971

Overburden 0.4 m (1.5 ft)
Mineral 10.1 m (33.0 ft)
Bedrock 2.0 m+ (6.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Sand, pebbly towards base. Sand: medium, subrounded to well rounded quartz with some chert, lithic grains, including coal, and shell fragments. Gravel: fine, well rounded quartz, quartzite, chert and sandstone.	4.0	(13.0)	4.4	(14.5)
	b) Sandy gravel. Gravel: fine, rounded quartz, quartzite, sandstone and chert with some siltstone, silicified limestone and igneous rock, and below 7.4 m, some red mudstone. Sand: medium, rounded quartz and subangular lithic grains.	6.1	(20.0)	10.5	(34.5)
Keuper Marl	Mudstone and clay, mainly red-brown, with pale green siltstone bands.	2.0+	(6.5+)	12.5	(41.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	4	+16	1	0.4 - 1.4	6	94	0
			-16+4	3	1.4 - 2.4	6	94	0
					2.4 - 3.4	6	89	5
	Sand	91	-4+1	2	3.4 - 4.4	1	89	10
			-1+¼	66				
			-¼+1/16	23				
	Fines	5	-1/16	5				
b)	Gravel	34	+16	11	4.4 - 5.4	trace	67	33
			-16+4	23	5.4 - 6.4	trace	91	9
					6.4 - 7.4	trace	80	20
	Sand	66	-4+1	7	7.4 - 8.4	trace	44	56
			-1+¼	52	8.4 - 9.4	trace	49	51
			-¼+1/16	7	9.4 -10.5	1	65	34
	Fines	trace	-1/16	trace				

SK 87 SE 5 | 8600 7446 | Thorney | Block E

Surface level (+5.7 m) +19 ft
Water level (+4.3 m) +14 ft
September 1971

Overburden 0.4 m (1.5 ft)
Mineral 2.5 m (8.0 ft)
Waste 0.8 m (2.5 ft)
Mineral 2.2 m (7.0 ft)
Bedrock 2.1 m+ (7.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
Older River Deposits	Sandy soil on grey clay.	0.4	(1.5)	0.4	(1.5)
	a) Sand: medium, well rounded quartz with some coal.	2.5	(8.0)	2.9	(9.5)
	Clay, brown.	0.8	(2.5)	3.7	(12.0)
	b) Sand with thin gravel at base. Sand: medium, well rounded quartz with lithic grains including coal. Gravel: fine, well rounded chert, sandstone, and quartz with tabular mudstone.	2.2	(7.0)	5.9	(19.5)
Lower Lias	Clay and soft mudstone, dark grey.	2.1+	(7.0+)	8.0	(26.0)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	0	+16	0	0.4 - 1.3	4	96	0
			-16+4	0	1.3 - 2.3	3	97	0
					2.3 - 2.9	1	99	0
	Sand	97	-4+1	9				
			-1+¼	63				
			-¼+1/16	25				
	Fines	3	-1/16	3				
b)	Gravel	12	+16	3	3.7 - 4.7	2	96	2
			-16+4	9	4.7 - 5.5	5	94	1
					5.5 - 5.9	1	43	56
	Sand	85	-4+1	3				
			-1+¼	40				
			-¼+1/16	42				
	Fines	3	-1/16	3				

SK 87 SE 6 | 8699 7430 | Drinsey Nook | Block E

Surface level (+5.2 m) +17 ft
Water level (+4.0 m) +13 ft
September 1971

Overburden 0.3 m (1.0 ft)
Mineral 2.0 m (6.5 ft)
Bedrock 1.2 m+ (4.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	Sand, pebbly in part. Sand: medium, well rounded quartz with lithic grains. Gravel: fine, rounded chert, sandstone and quartz.	2.0	(6.5)	2.3	(7.5)
Lower Lias	Mudstone and clay, dark grey, fossiliferous.	1.2+	(4.0+)	3.5	(11.5)

	%	mm		%	Depth below surface (m)	Fines	Percentage Sand	Gravel
Gravel	4	+16	:	0	0.3 - 1.3	7	93	0
		-16+4	:	4	1.3 - 2.3	3	89	8
Sand	91	-4+1	:	6				
		-1+¼	:	58				
		-¼+1/16	:	27				
Fines	5	-1/16	:	5				

SK 87 SE 7 | 8979 7472 | Saxilby | Block F

Surface level (c. +5.8 m) c. +19 ft
Water level not recorded
Shell and auger, 6 in diam.
October 1972

Overburden 0.3 m (1.0 ft)
Mineral 1.4 m (4.5 ft)
Waste 1.1 m (3.5 ft)
Mineral 4.5 m (15.0 ft)
Bedrock 1.7 m+ (5.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	a) 'Clayey' to very 'clayey' sand, with a little gravel. Sand: fine, rounded to angular quartz with lithic grains.	1.4	(4.5)	1.7	(5.5)
	Clay, pale grey.	1.1	(3.5)	2.8	(9.0)
	b) 'Clayey' sand. Sand: fine, rounded to angular quartz with some lithic grains.	1.4	(4.5)	4.2	(14.0)
	c) Sandy gravel. Gravel: fine to coarse, angular to well rounded quartz, quartzite, sandstone and chert, with limestone and Gryphaea between 5.2 and 6.2 m. Sand: medium, rounded to angular quartz with some lithic grains.	3.1	(10.0)	7.3	(24.0)
Lower Lias	Mudstone, grey.	1.7+	(5.5+)	9.0	(29.5)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	2	+16	:	0	0.3 - 1.3	25	73	2
			-16+4	:	2	1.3 - 1.7	16	81	3
	Sand	75	-4+1	:	1				
			$-1+\frac{1}{4}$	:	13				
			$-\frac{1}{4}+1/16$	:	61				
	Fines	23	-1/16	:	23				
b)	Gravel	0	+16	:	0	2.8 - 3.8	9	91	0
			-16+4	:	0	3.8 - 4.2	15	85	0
	Sand	89	-4+1	:	1				
			$-1+\frac{1}{4}$	:	3				
			$-\frac{1}{4}+1/16$	:	85				
	Fines	11	-1/16	:	11				
c)	Gravel	47	+16	:	23	4.2 - 5.2	1	43	56
			-16+4	:	24	5.2 - 6.2	1	56	42
						6.2 - 7.3	trace	55	45
	Sand	52	-4+1	:	10				
			$-1+\frac{1}{4}$	:	35				
			$-\frac{1}{4}+1/16$	:	7				
	Fines	1	-1/16	:	1				

SK 87 SE 8 | 8970 7396 | Broadholme | Block F

Surface level (+5.8 m) +19 ft
Water level (c. +2.8 m) c. +9 ft
October 1971

Overburden 0.5 m (1.5 ft)
Mineral 5.1 m (16.5 ft)
Bedrock 1.4 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Older River Deposits	a) Very 'clayey' pebbly sand. Sand: medium, rounded quartz with lithic grains.	0.5	(1.5)	1.0	(3.5)
	b) Sandy gravel and gravel. Gravel: fine to coarse, rounded chert, quartz and quartzite with friable sandstone and some igneous rock. Sand: medium, rounded quartz and lithic grains.	4.6	(15.0)	5.6	(18.5)
Lower Lias	Clay and mudstone, dark grey, fossiliferous.	1.4+	(4.5+)	7.0	(23.0)

a)+b)	%	mm		%
Gravel	46	+16	:	21
		-16+4	:	25
Sand	51	-4+1	:	9
		-1+¼	:	33
		-¼+1/16	:	9
Fines	3	-1/16	:	3

Depth below surface (m)	Percentage Fines	Sand	Gravel
a) 0.5 - 1.0	20	65	15
b) 1.0 - 2.0	4	73	23
2.0 - 3.0	2	60	38
3.0 - 4.0	1	36	63
4.0 - 5.0	[1	36	63]
5.0 - 5.6	1	35	64

SK 87 SE 9 8874 7398 Saxilby Moor Block F

Surface level (+5.6 m) +19 ft
Water level (+3.1 m) +10 ft
October 1971

Overburden 0.5 m (1.5 ft)
Mineral 1.0 m (3.5 ft)
Waste 0.6 m (2.0 ft)
'Mineral' 0.8 m (2.5 ft)
Waste 0.3 m (1.0 ft)
Mineral 5.6 m (18.5 ft)
Bedrock 1.2 m+ (4.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Older River Deposits	a) Sand, 'clayey' at base. Sand: fine, well rounded quartz. Fines: yellow, ferruginous.	1.0	(3.5)	1.5	(5.0)
	Clay, grey and red-brown.	0.6	(2.0)	2.1	(7.0)
	b) Sandy gravel. Gravel: fine, rounded quartz, quartzite and chert with some igneous rock and siltstone. Sand: medium, rounded quartz and lithic grains.	0.8	(2.5)	2.9	(9.5)
	Silt, red-brown sandy.	0.3	(1.0)	3.2	(10.5)
	c) Sandy gravel. Gravel: mainly fine but some coarse, quartz, quartzite and sandstone with subangular shelly limestone common below 6.0 m. Sand: medium, rounded quartz and lithic grains.	5.6	(18.5)	8.8	(29.0)
Lower Lias	Shelly limestone and clay, grey.	1.2+	(4.0+)	10.0	(33.0)

		%	mm	%
a)	Gravel	0	+16	0
			-16+4	0
	Sand	95	-4+1	0
			-1+¼	24
			-¼+1/16	71
	Fines	5	-1/16	5
c)+b)	Gravel	48	+16	17
			-16+4	31
	Sand	51	-4+1	14
			-1+¼	30
			-¼+1/16	7
	Fines	1	-1/16	1

Depth below surface (m)	Percentage Fines	Sand	Gravel
a) 0.5 - 1.5	5	95	0
b) 2.1 - 2.9	2	61	37
c) 3.2 - 4.2	1	57	42
4.2 - 5.2	2	54	44
5.2 - 6.2	trace	56	44
6.2 - 7.2	1	46	53
7.2 - 8.2	1	36	63
8.2 - 8.8	1	47	52

SK 87 SE 10 8751 7344 Thorney Block F

Surface level (+5.4 m) +18 ft
Water level (+4.2 m) +14 ft
September 1971

Overburden 0.3 m (1.0 ft)
Mineral 7.2 m (23.5 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	a) Sand, pebbly in parts. Sand: medium, rounded quartz with lithic grains. Gravel: fine, rounded quartz, chert and sandstone with some pale tabular quartzite.	5.0	(16.5)	5.3	(17.5)
	b) Gravel, sandy near base. Gravel: fine, rounded chert, quartz, quartzite and sandstone with igneous pebbles, limestone and, in lower part, some shell fragments. Sand: as above.	2.2	(7.0)	7.5	(24.5)
Lower Lias	Clay and mudstone, grey, poorly fossiliferous.	1.5+	(5.0+)	9.0	(29.5)

		%	mm	%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	3	+16	: trace	0.3 - 1.3	5	95	0
			-16+4	: 3	1.3 - 2.3	1	97	2
					2.3 - 3.3	[1	97	2]
	Sand	95	-4+1	: 3	3.3 - 4.3	trace	100	0
			-1+¼	: 67	4.3 - 5.3	1	86	13
			-¼+1/16	: 25				
	Fines	2	-1/16	: 2				
b)	Gravel	52	+16	: 22	5.3 - 6.3	1	45	54
			-16+4	: 30	6.3 - 7.3	1	45	54
					7.3 - 7.5	2	69	29
	Sand	47	-4+1	: 10				
			-1+¼	: 33				
			-¼+1/16	: 4				
	Fines	1	-1/16	: 1				

SK 87 SE 11 | 8640 7343 | Thorney | Block E

Surface level (+5.9 m) +20 ft
Water level (+5.1 m) +17 ft
September 1971

Overburden 0.5 m (1.5 ft)
Mineral 2.8 m (9.0 ft)
Bedrock 1.9 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Older River Gravel	a) Gravel, part 'clayey'. Gravel: fine and coarse, rounded quartz, quartzite, chert and sandstone with some igneous rock. Sand: medium to coarse, mainly well rounded quartz and lithic grains.	1.8	(6.0)	2.3	(7.5)
	b) Sand, medium, well rounded quartz and lithic grains.	1.0	(3.5)	3.3	(11.0)
Lower Lias	Clay, dark grey, shelly.	1.9+	(6.0+)	5.2	(17.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a) Gravel	83	+16	:	26	0.5 - 0.8	8	20	72
		-16+4	:	57	0.4 - 1.5	[1	14	85]
					1.5 - 2.3	1	14	85
Sand	15	-4+1	:	8				
		-1+¼	:	5				
		-¼+1/16	:	2				
Fines	2	-1/16	:	2				
b) Gravel	0	+16	:	0	2.3 - 3.3	5	95	0
		-16+4	:	0				
Sand	95	-4+1	:	20				
		-1+¼	:	62				
		-¼+1/16	:	13				
Fines	5	1-/16	:	5				

SK 87 SE 12 | 8586 7262 | Thorney | Block E

Surface level (+8.2 m) +27 ft
Groundwater conditions not recorded
October 1971

Overburden 1.0 m (3.5 ft)
Mineral 1.7 m (5.5 ft)
Bedrock 1.3 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil, clayey, sandy and pebbly.	1.0	(3.5)	1.0	(3.5)
Older River Deposits	Pebbly sand on 'clayey' sandy gravel. Gravel: fine, rounded quartz, chert, quartzite and sandstone with some limestone and igneous rock. Sand: medium, rounded quartz and lithic grains.	1.7	(5.5)	2.7	(9.0)
Lower Lias	Clay and mudstone, bluish grey.	1.3+	(4.5+)	4.0	(13.0)

	%	mm		%
Gravel	24	+16	:	10
		-16+4	:	14
Sand	67	-4+1	:	5
		-1+¼	:	38
		-¼+1/16	:	24
Fines	9	-1/16	:	9

Depth below surface (m)	Percentage Fines	Sand	Gravel
1.0 - 2.0	7	80	13
2.0 - 2.7	13	48	39

SK 87 SE 13 | 8672 7246 | Thorney | Block F

Surface level (+5.6 m) +19 ft
Water level (+4.4 m) +14 ft
October 1971

Overburden 0.5 m (1.5 ft)
Mineral 6.8 m (22.5 ft)
Bedrock 1.2 m+ (4.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Older River Deposits	a) Sand, part 'clayey'. Sand: medium, subangular to sub-rounded quartz with some coal below 1.2 m.	1.9	(6.0)	2.4	(8.0)
	b) Sandy gravel. Gravel: coarse at top, fine below, rounded quartz, chert, quartzite and sandstone with some limestone and ?igneous rock and, below 3.5 m, some tabular green siltstone. Sand: medium, rounded quartz and lithic grains including some coal.	4.9	(16.0)	7.3	(24.0)
Lower Lias	Mudstone and clay, grey to dark grey, scattered shell debris.	1.2+	(4.0+)	8.5	(28.0)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	1	+16	:	0	0.5 - 1.4	6	94	0
			-16+4	:	1	1.4 - 2.4	1	98	1
	Sand	96	-4+1	:	2				
			-1+¼	:	72				
			-¼+1/16	:	22				
	Fines	3	-1/16	:	3				
b)	Gravel	46	+16	:	19	2.4 - 3.4	trace	18	82
			-16+4	:	27	3.4 - 4.4	2	62	36
						4.4 - 5.4	2	66	32
	Sand	53	-4+1	:	9	5.4 - 6.4	1	66	33
			-1+¼	:	36	6.4 - 7.3	1	53	46
			-¼+1/16	:	8				
	Fines	1	-1/16	:	1				

SK 87 SE 14 | 8759 7270 | Thorney | Block F

Surface level (+5.8 m) +19 ft
Water level (+4.6 m) +15 ft
October 1971

Overburden 0.5 m (1.5 ft)
Mineral 3.5 m (11.5 ft)
Waste 1.1 m (3.5 ft)
Mineral 3.4 m (11.0 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.5	(1.5)	0.5	(1.5)
Older River Deposits	a) Sand, part very 'clayey' and pebbly; with 10-cm clay bands at 1.3 m and 1.9 m. Sand: fine to medium, well rounded quartz with lithic grains, including coal in lower part.	3.5	(11.5)	4.0	(13.0)
	Clay, reddish brown and grey with some green patches.	1.1	(3.5)	5.1	(16.5)
	b) Gravel, sandy at top. Gravel: mainly fine, well rounded quartz, quartzite and chert with some limestone, basalt and, especially towards base, tabular green siltstone. Sand: medium, rounded quartz with lithic grains including coal.	3.4	(11.0)	8.5	(28.0)
Lower Lias	Mudstone and clay, grey.	1.5+	(5.0+)	10.0	(33.0)

		%	mm		%
a)	Gravel	2	+16	:	1
			-16+4	:	1
	Sand	84	-4+1	:	1
			-1+$\frac{1}{4}$	:	48
			-$\frac{1}{4}$+1/16	:	35
	Fines	14	-1/16	:	14
b)	Gravel	53	+16	:	20
			-16+4	:	33
	Sand	45	-4+1	:	7
			-1+$\frac{1}{4}$	:	28
			-$\frac{1}{4}$+1/16	:	10
	Fines	2	-1/16	:	2

Depth below surface (m)	Percentage Fines	Sand	Gravel
a) 0.5 - 1.4	19	81	trace*
1.4 - 2.4	29	65	6*
2.4 - 3.4	4	96	0
3.4 - 4.0	1	99	trace
b) 5.1 - 6.1	3	66	31
6.1 - 7.1	1	39	60
7.1 - 8.1	1	38	61
8.1 - 8.5	1	34	65

*Assuming ungraded clay bands comprise 100% fines

SK 87 SE 15 8855 7296 Broadholme Block F

Surface level (+5.6 m) +19 ft
Groundwater conditions not recorded
October 1971

Overburden 1.3 m (4.5 ft)
Mineral 0.9 m (3.0 ft)
Bedrock 1.8 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	Sand, part 'clayey'.	0.3	(1.0)	0.7	(2.5)
	Clay, red-brown to grey, sandy.	0.6	(2.0)	1.3	(4.5)
	'Clayey' sand. Sand: fine, rounded quartz with lithic grains including some coal.	0.9	(3.0)	2.2	(7.0)
Lower Lias	Clay and mudstone, grey.	1.8+	(6.0+)	4.0	(13.0)

	%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
Gravel	0	+16	:	0	1.3 - 2.2	11	89	0
		-16+4	:	0				
Sand	89	-4+1	:	4				
		$-1+\frac{1}{4}$	:	35				
		$-\frac{1}{4}+1/16$	:	50				
Fines	11	-1/16	:	11				

SK 87 SE 16 | 8508 7138 | Wigsley | Block D

Surface level (+6.4 m) +21 ft
Water level not recorded
October 1971

Overburden 0.4 m (1.5 ft)
Mineral 10.6 m (35.0 ft)
Bedrock 1.8 m+ (6.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Pebbly sand and sand, part 'clayey' near top. Sand: mainly medium, rounded quartz with lithic grains including coal, and traces of mica. Gravel: fine, rounded quartz, quartzite and chert with sandstone and some mudstone, siltstone and igneous rock.	5.9	(19.5)	6.3	(21.0)
	b) Gravel, sandy near base. Gravel: mainly coarse, with some cobbles near top, rounded quartz, quartzite, chert and sandstone with some mudstone and igneous rock. Sand: medium, rounded quartz and subrounded lithic grains.	4.7	(15.5)	11.0	(36.0)
Keuper Marl	Clay and mudstone, red and greenish grey.	1.8+	(6.0+)	12.8	(42.0)

		%	mm		%	Depth below surface (m)	Fines	Percentage Sand	Gravel
a)	Gravel	6	+16	:	trace	0.4 - 1.3	3	96	1
			-16+4	:	6	1.3 - 2.3	10	86	4
						2.3 - 3.3	1	99	0
	Sand	92	-4+1	:	2	3.3 - 4.3	1	89	10
			-1+¼	:	59	4.3 - 5.3	trace	84	16
			-¼+1/16	:	31	5.3 - 6.3	trace	98	2
	Fines	2	-1/16	:	2				
b)	Gravel	53	+64	:	3	6.3 - 7.3	trace	51	49*
			-64+16	:	28	7.3 - 8.3	1	41	58
			-16+4	:	22	8.3 - 9.3	1	43	56
						9.3 -10.3	trace	37	63
	Sand	46	-4+1	:	6	10.3 -11.0	1	62	37
			-1+¼	:	34				
			-¼+1/16	:	6				
	Fines	1	-1/16	:	1				

*includes 12% cobbles

SK 87 SE 17 | 8631 7143 | Wigsley | Block F

Surface level (+5.9 m) +20 ft
Water level not recorded
October 1971

Overburden 0.4 m (1.5 ft)
Mineral 2.6 m (8.5 ft)
Waste 0.6 m (2.0 ft)
Mineral 3.0 m (10.0 ft)
Bedrock 1.4 m+ (4.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	a) Pebbly sand; pebbles mainly towards base. Sand: medium, mainly rounded quartz, part iron stained, with lithic grains including a little coal. Gravel: fine to coarse, rounded and subangular chert and rounded sandstone.	2.6	(8.5)	3.0	(10.0)
	Clay, red-brown and grey, with greenish root-like streaks.	0.6	(2.0)	3.6	(12.0)
	b) Pebbly sand; pebbles mainly below 4.6 m. Sand: medium, rounded quartz with lithic grains. Gravel: fine, rounded quartz, quartzite, chert and sandstone with, towards base, angular tabular calcareous and shaly mudstone.	3.0	(10.0)	6.6	(21.5)
Lower Lias	Mudstone and clay, grey.	1.4+	(4.5+)	8.0	(26.0)

a)+b)	%	mm		%
Gravel	9	+16	:	2
		-16+4	:	7
Sand	88	-4+1	:	4
		$-1+\frac{1}{4}$	:	59
		$-\frac{1}{4}+1/16$	:	25
Fines	3	-1/16	:	3

	Depth below surface (m)	Fines	Percentage Sand	Gravel
a)	0.4 - 1.4	9	87	4
	1.4 - 2.4	1	97	2
	2.4 - 3.0	1	81	18
b)	3.6 - 4.6	2	95	3
	4.6 - 5.6	2	82	16
	5.6 - 6.6	[2	82	16]

SK 87 SE 18 | 8771 7136 | Harby | Block F

Surface level (+5.2 m) +17 ft
Water level not recorded
October 1971

Overburden 0.2 m (0.5 ft)
Mineral 7.3 m (24.0 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.2	(0.5)	0.2	(0.5)
Older River Deposits	a) Sand, 'clayey' at top, pebbly near base. Sand: mainly fine, rounded quartz. Gravel: coarse, well rounded quartz and chert.	2.9	(9.5)	3.1	(10.0)
	b) Gravel, more sandy near base. Gravel: mainly fine, well rounded chert, quartz, sandstone and quartzite with limestone, mudstone and scattered fossil shells. Sand: medium, well rounded quartz with lithic grains.	4.4	(14.5)	7.5	(24.5)
Lower Lias	Mudstone and clay with few limestone nodules, bluish grey.	1.5+	(5.0+)	9.0	(29.5)

		%	mm		%
a)	Gravel	5	+16	:	3
			-16+4	:	2
	Sand	88	-4+1	:	1
			-1+¼	:	36
			-¼+1/16	:	51
	Fines	7	-1/16	:	7
b)	Gravel	59	+16	:	26
			-16+4	:	33
	Sand	40	-4+1	:	10
			-1+¼	:	23
			-¼+1/16	:	7
	Fines	3	-1/16	:	1

	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	0.2 - 1.1	18	81	1
	1.1 - 2.1	3	97	0
	2.1 - 3.1	2	83	15
b)	3.1 - 4.1	1	23	76
	4.1 - 5.1	trace	49	51
	5.1 - 6.1	1	45	54
	6.1 - 7.1	trace	29	71
	7.1 - 7.5	1	75	24

SK 87 SE 19 | 8764 7067 | Harby | Block F

Surface level (+5.8 m) +19 ft
Water level (+3.8 m) +12 ft
October 1971

Overburden 0.4 m (1.5 ft)
Mineral 9.1 m (3.0 ft)
Bedrock 1.5 m+ (5.0 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.4	(1.5)	0.4	(1.5)
Older River Deposits	Sand, part 'clayey' near top and with a little gravel. Sand: fine to medium, well rounded to subrounded quartz with lithic grains. Gravel: fine, quartz, quartzite, chert and sandstone.	3.0	(10.0)	3.4	(11.0)
	Gravel. Gravel: fine to coarse, rounded quartz, quartzite, chert and sandstone with some mudstone, siltstone and limestone, especially in lower part. Sand: medium, well rounded quartz with lithic grains.	6.1	(20.0)	9.5	(31.0)
Lower Lias	Clay and shelly limestone, grey.	1.5+	(5.0+)	11.0	(36.0)

a)	Gravel 2	+16	: 0	0.4 - 1.4	7	92	1
		-16+4	: 2	1.4 - 2.4	6	93	1
				2.4 - 3.4	1	96	3
	Sand 93	-4+1	: 1				
		-1+$\frac{1}{4}$	: 37				
		-$\frac{1}{4}$+1/16	: 55				
	Fines 5	-1/16	: 5				
b)	Gravel 67	+64	: 2	3.4 - 4.4	trace	47	53
		-64+16	: 32	4.4 - 5.4	trace	32	68
		-16+4	: 33	5.4 - 6.4	trace	36	64
				6.4 - 7.4	trace	31	69*
	Sand 33	-4+1	: 10	7.4 - 8.3	trace	20	80
		-1+$\frac{1}{4}$	: 21	8.3 - 9.5	trace	32	68
		-$\frac{1}{4}$+1/16	: 2				
	Fines trace	-1/16	: trace				

*Includes 10% cobbles

SK 87 SE 25 | 8661 7037 | Wigsley | Block F

Surface level (+6,5 m) +22 ft
Water level not recorded
October 1971

Overburden 0.3 m (1.0 ft)
Mineral 8.2 m (27.0 ft)
Bedrock 1.0 m+ (3.5 ft+)

		Thickness m	(ft)	Depth m	(ft)
	Soil	0.3	(1.0)	0.3	(1.0)
Older River Deposits	a) Pebbly sand, 'clayey' near top. Sand: fine to medium, well rounded quartz with lithic grains. Gravel: fine, rounded quartz, chert, quartzite and sandstone with some limestone.	3.9	(13.0)	4.2	(14.0)
	b) Gravel on pebbly sand. Gravel: fine to coarse, rounded quartz, quartzite, chert and sandstone with some siltstone and ?igneous rock. Sand: medium, well rounded quartz with lithic grains.	4.3	(14.0)	8.5	(28.0)
Lower Lias	Mudstone and clay, bluish grey.	1.0+	(3.5+)	9.5	(31.0)

		%	mm		%	Depth below surface (m)	Percentage Fines	Sand	Gravel
a)	Gravel	5	+16	:	1	0.3 - 1.2	18	78	4
			-16+4	:	4	1.2 - 2.2	1	94	5
						2.2 - 3.2	5	95	0
	Sand	89	-4+1	:	4	3.2 - 4.2	1	90	9
			-1+$\frac{1}{4}$	:	46				
			-$\frac{1}{4}$+1/16	:	39				
	Fines	6	-1/16	:	6				
b)	Gravel	51	+16	:	25	4.2 - 5.2	1	48	51
			-16+4	:	26	5.2 - 6.2	trace	13	87
						6.2 - 7.2	1	39	60
	Sand	48	-4+1	:	9	7.2 - 8.2	3	81	16
			-1+$\frac{1}{4}$	:	33	8.2 - 8.5	4	72	24
			-$\frac{1}{4}$+1/16	:	6				
	Fines	1	-1/16	:	1				

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
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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

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The following reports of the Institute relate particularly to sand and gravel resources:

REPORTS OF THE INSTITUTE OF GEOLOGICAL SCIENCES

Assessment of British Sand and Gravel Resources

No. 1 The sand and gravel resources of the country south-east of Norwich, Norfolk: Description of 1 : 25 000 resource sheet TG 20. By E. F. P. Nickless. Price £1.15. Report No. 71/20

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INSTITUTE OF GEOLOGICAL SCIENCES

MINERAL ASSESSMENT UNIT

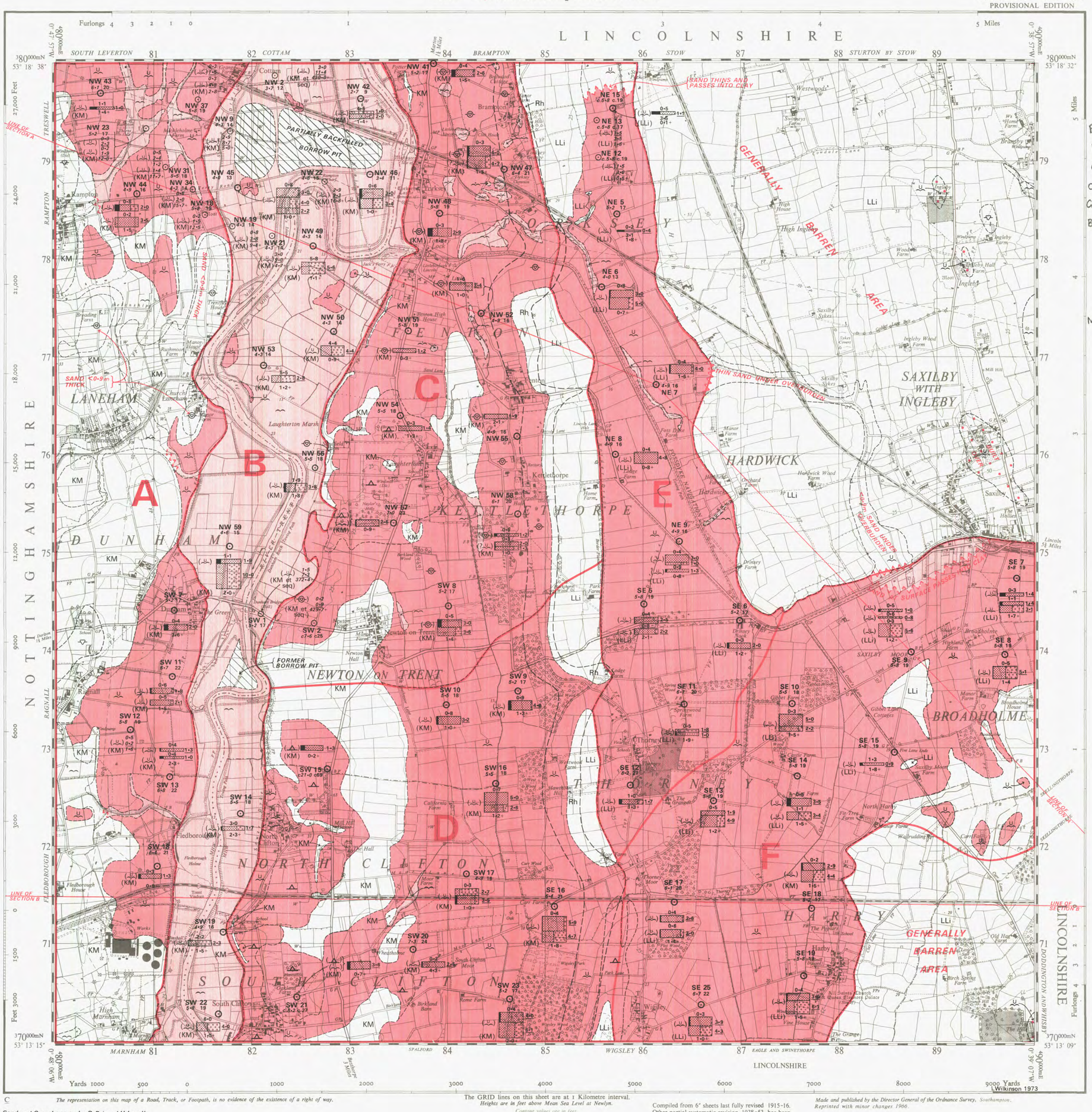
THE SAND AND GRAVEL RESOURCES of SHEET SK87 (NEWTON on TRENT, LINCS.)

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

ORDNANCE SURVEY
SHEET SK 87
PROVISIONAL EDITION

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

15



EXPLANATION OF SYMBOLS AND ABBREVIATIONS

RECENT AND PLEISTOCENE

DRIFT

- BS-1 — **Blown Sand**- fine to medium sands.
- P-1 — **Peat.**
- A-B — **Alluvium**- clays, silts and peat.
- OR-3 — **Older River Deposits (including 1st Terrace of Trent)**- sand and gravel commonly overlain by sand with little gravel.
- GS-5 — **Glacial Sand and Gravel**- sands with little gravel.
- BC-1 — **Boulder Clay**- tough stony clay.

JURASSIC AND PERMO-TRIASSIC

SOLID

- LLi — **Lower Lias**- dark impure limestones and mudstones.
- Rh — **Rhaetic**- mudstones and clays with some thin limestones and sandstones.
- KM — **Keuper Marl**- mudstones with thin sandstone and gypsum bands in parts.
- MG-1 — **Made ground** and areas from which sand and gravel have been removed.

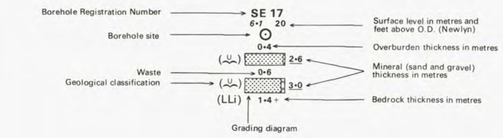
BOUNDARY LINES

- Geological boundary, Drift.
- Geological boundary, Solid. Broken line denotes uncertainty.
- Inferred boundary between recognised categories of deposits.
- Resource Block boundary.

BOREHOLE DATA

- Site of Mineral Assessment Unit (M.A.U.) borehole.
- Site of other borehole.

M.A.U. BOREHOLES



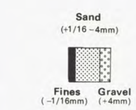
Note:
(i) Figures underlined denote thickness used in assessment of resources.
(ii) The + sign indicates that the base of the deposit was not reached.
(iii) The figures in ***italics*** are the metric conversions of measurements recorded in **feet**
(iv) The Geological Classification is given only for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

Borehole Registration Number

Each M.A.U. borehole is identified by a registration Number, eg. SE17. The letters refer to the quarter sheet and the figures to the I.G.S. Serial number for that quarter. The unique designation for borehole SE17 is SK87SE17

Grading Diagrams

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



The height of the diagram is proportional to the mineral thickness.

The widths of the divisions show the proportions of **Fines, Sand** and **Gravel** but small amounts of gravel may be omitted or exaggerated.

OTHER BOREHOLES

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

CATEGORIES OF DEPOSITS

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

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

RESOURCE BLOCKS

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

Horizontal sections showing the general relations of the drift and solid deposits along the lines of section A-A' and B-B' constitute Fig 2 of the Report.

Detailed records may be consulted, on application to Head, Mineral Assessment Unit, Institute of Geological Sciences, Exhibition Road, LONDON, SW7 2DE.

Sand and Gravel survey by D.Price, J.H.Lovell and J.R.Gozzard in 1971
R.G.Thurrell, Head, Mineral Assessment Unit.

1:25 000 Sand and Gravel Resources Sheet, published 1975.
Sir Kingsley Dunham, D.Sc., F.R.S., *Director, Institute of Geological Sciences.*

1550/75

The GRID lines on this sheet are at 1 Kilometre interval.
Heights are in feet above Mean Sea Level at Newlyn.
Contour values are in feet
1 square inch on this map represents 99·639 acres on the ground.

Compiled from 6" sheets last fully revised 1915-16. Other partial systematic revision 1938-53 has been incorporated.
Major roads revised 1965.

Made and published by the Director General of the Ordnance Survey, Southampton. Reprinted with minor changes 1966.

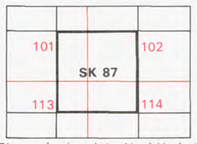
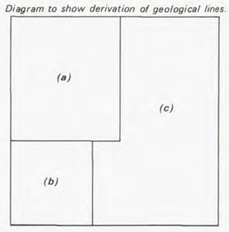


Diagram showing relationship of this sheet to the New Series One-Inch Geological sheets 101, 102, 113 and 114.

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

Diagram to show derivation of geological lines.



- ***(a) Geological survey on six-inch scale by G.H. Rhys in 1957-61. A.W.Woodland and D.R.A.Ponsford, District Geologists.***
- ***(b) Geological survey on six-inch scale by B.Smith in 1908-09. G.W.Lamplugh, District Geologist.***
- ***(c) Original geological survey on one-inch scale published in 1886, partially revised on six-inch scale by D.Price in 1972.***

Compiled and drawn in the Leeds Office of the Institute of Geological Sciences.

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