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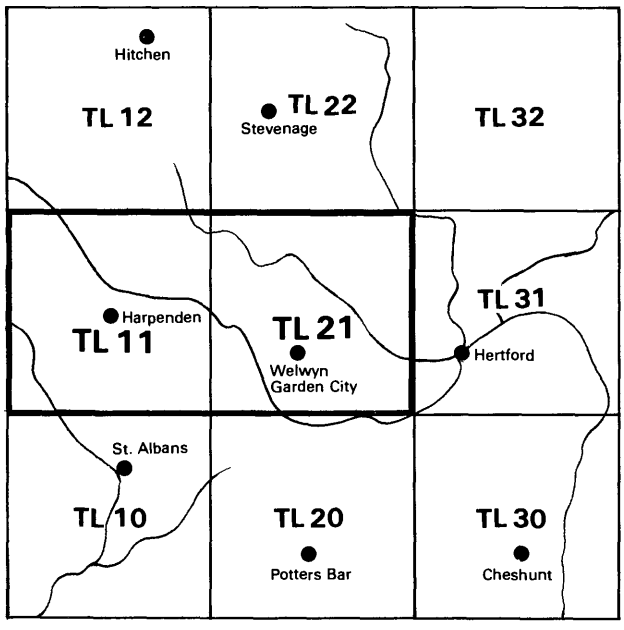

The sand and gravel resources of the country around Welwyn Garden City, Hertfordshire

Description of 1:25 000 resource sheet TL 11 and TL 21

J. R. Gozzard

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The first twelve reports on the assessment of British sand and gravel resources appeared in the Report series of the Institute of Geological Sciences as a subseries. Report 13 and subsequent reports appear as Mineral Assessment Reports of the Institute.

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

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PREFACE

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

Sand and gravel, considered together as naturally occurring aggregate, was selected as the bulk mineral demanding the most urgent attention, initially in the south-east of England, where about half the national output is won and very few sources of alternative aggregates are available. Following a short feasibility project, initiated in 1966 by the Ministry of Land and Natural Resources, the Industrial Mineral Assessment Unit (formerly the Minerals 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 co-operation of the Sand and Gravel Association of Great Britain.

This report describes the sand and gravel resources of 200 km^2 of country around Welwyn Garden City, Hertfordshire, shown on the accompanying 1:25 000 resource sheet TL 11 and TL 21. The survey was conducted by Mr S. Machin in 1971 and 1972. The report has been written by Mr J. R. Gozzard. The work is based on six-inch-scale geological surveys by Mr R. L. Sherlock and Mr R. W. Pocock in 1911–1914 and 1921 (published, in the past, on New Series one-inch sheets 238 (Aylesbury) and 239 (Hertford)) together with information from a one-inch scale survey published in 1889.

Mr J. W. Gardner, CBE (Land Agent), negotiated access to land for drilling. The ready cooperation of landowners 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 86 boreholes drilled for the Industrial Minerals Assessment Unit, form the basis of the assessment of sand and gravel resources in the area around Welwyn Garden City, Hertfordshire.

All the 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 their 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 six resource blocks.Five of the resource blocks contain between 5.5 and 13.9 km^2 of sand and gravel. Deposits in the sixth are classified as not potentially workable. For each block the geology of the deposits is described and the mineral-bearing area, the mean thicknesses of overburden and mineral and 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.

Bibliographic reference
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Note
National Grid references are given in square brackets. In this publication all lie within the 100-km square TL.

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INTRODUCTION

The survey is concerned with the estimation of resources, which include deposits that are not currently exploitable but have a foreseeable use, rather than reserves, which can only be assessed in the light of current, locally prevailing economic considerations. Clearly, both the economic and the social factors used to decide whether a deposit may be workable in the future cannot be predicted; they are likely to change with time. Deposits not currently economically workable may be exploited as demand increases, as higher grade or alternative materials become scarce, or as improved processing techniques are applied to them. The improved knowledge of the main physical properties of the resource and their variability, which this survey seeks to provide, will add significantly to the factual background against which planning policies can be decided (Archer, 1969; Thurrell, 1971; Harris and others, 1974).

The survey provides information at the 'indicated' level "for which tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout" (Bureau of Mines and Geological Survey, 1948, p.15).

It follows that the whereabouts of reserves must still be established and their size and quality proved by the customary detailed exploration and evaluation undertaken by the industry. However, the information provided by this survey should assist in the selection of the best targets for such further work.

The following arbitrary physical criteria have been adopted:

a The deposit should average at least 1 m in thickness.
b The ratio of overburden to sand and gravel should be no more than 3:1.
c The proportion of fines (particles passing the No. 240 mesh BS sieve, about $\frac{1}{16}$ mm) should not exceed 40 per cent.
d The deposit must lie within 25 m of the surface, this being taken as the likely maximum working depth under most circumstances. It follows from the second criterion that boreholes are drilled no deeper than 18 m if no sand and gravel has been proved.

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

For the particular needs of assessing sand and gravel resources, a grain-size classification based on the geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm has been adopted. The boundaries between fines (that is, the clay and silt fractions) and sand, and between sand and gravel-grade material, are placed at $\frac{1}{16}$ mm and 4 mm respectively (see Appendix C).

The volume and other characteristics are assessed within resource blocks, each of which, ideally, contains approximately 10 km² of sand and gravel. No account is taken of any factors, for example, roads, villages and high agricultural or landscape value, which might stand in the way of sand and gravel being exploited, although towns are excluded. The estimated total volume therefore bears no simple relationship to the amount that could be extracted in practice.

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

DESCRIPTION OF THE RESOURCE SHEET

GENERAL

The district described (Figures 1 and 2) surrounds Welwyn Garden City and Harpenden. It includes part of the Chiltern uplands to the north-west and the lower ground of the Vale of St Albans to the south-east. The area is dissected by the Rivers Lea and Mimram flowing in sub-parallel courses towards the south-east. The high ground formed by the Chalk generally lies above the 300-ft (91-m) contour and rises to over 525 ft (160 m) in the extreme north-west. The ground to the south-east is occupied by spreads of Glacial Sand and Gravel and Boulder Clay which form an undulating plain of low relief.

Welwyn Garden City and Harpenden are commercial, residential and industrial centres but the remainder of the area is devoted to agriculture and forestry.

GEOLOGY

The geological sequence is summarised in Table 1. The deposits are listed as far as possible in order of increasing age and their relationship is illustrated in the schematic cross section (Figure 3).

Table 1 Stratigraphy

DRIFT	
Recent and **Pleistocene**	Alluvium (including Sub-Alluvial Gravel)
	Valley Gravel
	Glacial Sand and Gravel
	Boulder Clay
	Clay-with-flints and associated Pebbly Clay and Sand
SOLID	
Eocene	London Clay
Palaeocene	Lower London Tertiaries
Cretaceous	Chalk (undivided)

SOLID

Chalk The Chalk is the bedrock of most of the area. The Middle Chalk crops out in the upper reaches of the Mimram valley west of Codicote [183 215] and of the Lea valley north-west of Harpenden [140 140]. It is a hard massive white limestone containing a few nodular and tabular flint beds. The outcrop of the base of the Upper Chalk, the Chalk Rock, is confined to the Mimram and Lea valleys and consists of hard creamy limestone, usually with scattered glauconite. The Upper Chalk consists of soft white chalk with abundant flints. On the map the Chalk is undifferentiated.

Lower London Tertiaries Outliers of Lower London Tertiaries occur at Kinsbourne Green [107 159], Rabley Heath [236 191], Bull's Green [272 173] and Ayot Green [221 141]. The outlier at Rabley Heath was previously unrecorded and was proved by borings made during this survey.

Lower London Tertiaries consist of basal sands with bands of rounded flint pebbles overlain by stiff variegated clays.

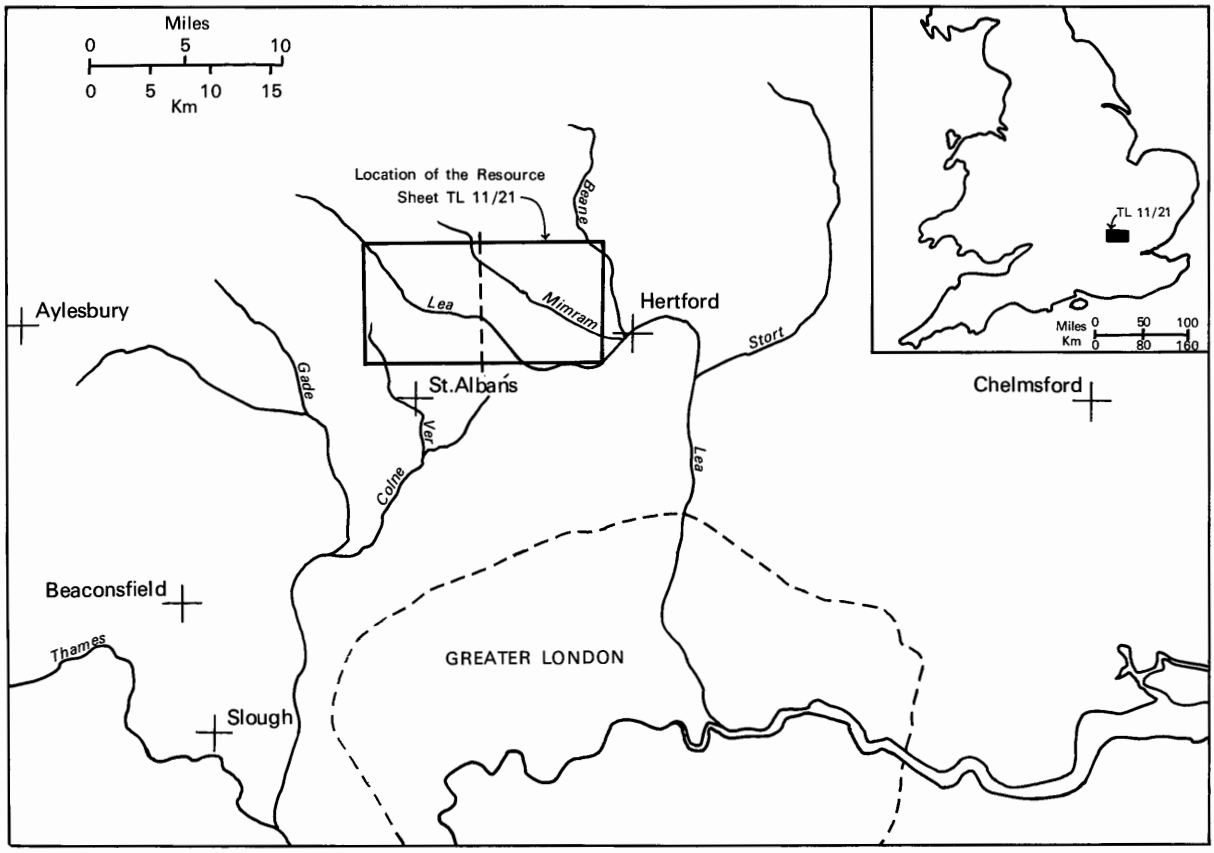


Figure 1 Sketch map showing the location of the resource sheet.

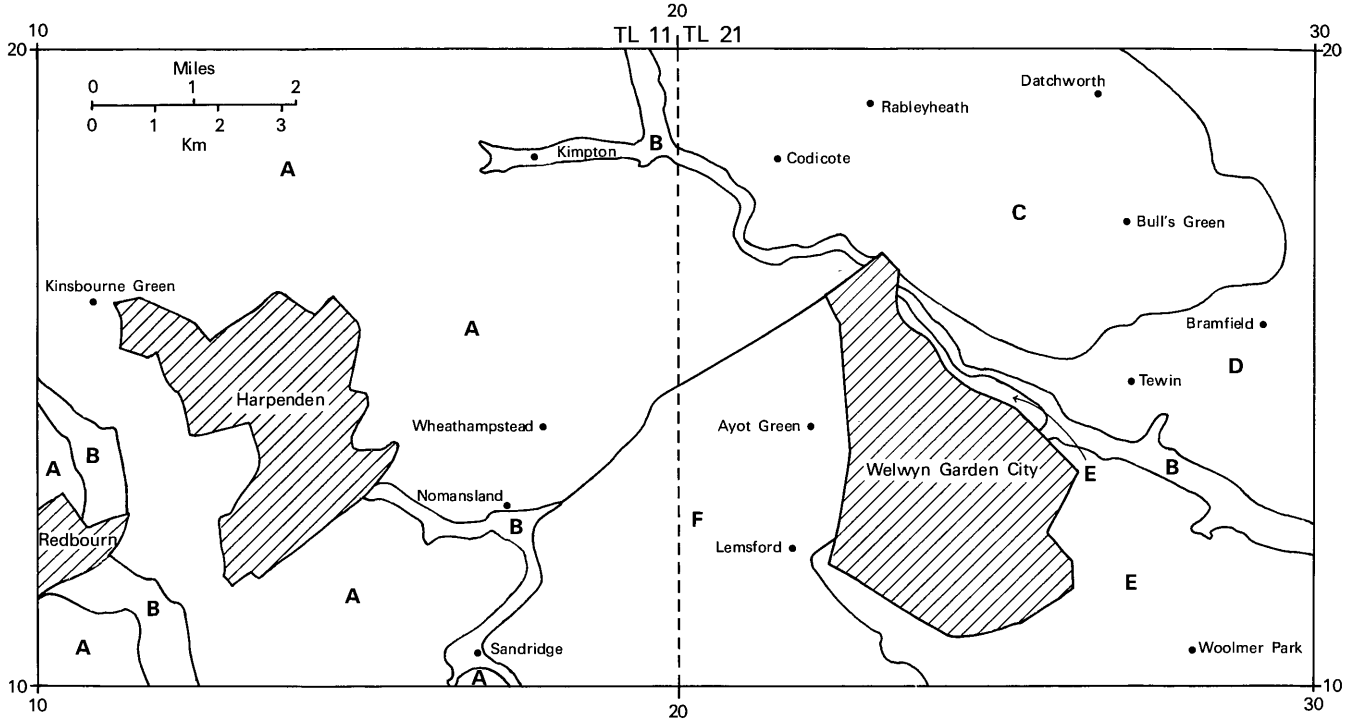


Figure 2 Sketch map showing resource block boundaries and localities mentioned in the text.

London Clay A small outlier of London Clay occurs to the east of Ayot Green where a borehole (21 SW 09) passed through 5.2 m of stiff brown and black clay.

DRIFT

Clay-with-flints and associated Pebbly Clay and Sand These deposits are confined to the Chalk outcrop where they cap the high ground. The Clay-with-flints consists of a brown clay with abundant angular flints and some rounded flint pebbles whereas Pebbly Clay and Sand is much sandier and contains a greater proportion of flint pebbles. Both may have been formed from degraded Tertiary material together with Chalk debris in late Tertiary and early Quaternary times (Hodgson, Catt and Weir, 1967; Loveday, 1962). Clay-with-flints passes laterally into Pebbly Clay and Sand, which is composed of the same constitutents as Clay-with-flints but in different proportions.

Boulder Clay Boulder Clay crops out in the eastern part of the district, and consists of stiff dark grey clay with chalk pellets, flint and quartz pebbles and Jurassic fossils. Locally the Boulder Clay becomes sandy and silty where it is in contact with other deposits, and at outcrop the whole of the clay may be decalcified and brown in colour.

Glacial Sand and Gravel Glacial Sand and Gravel occupies ground south-east of the chalk uplands, along the valleys of the Rivers Lea and Mimram and in patches on the high ground around Datchworth [267 194]. They generally rest on bedrock but are in places overlain and/or underlain by Boulder Clay. Accounts of previous work on these deposits have been published by Clayton and Brown (1958) and Gibbard (1977).

Valley Gravel Valley Gravel occurs in the valleys of the River Ver, the River Mimram around Kimpton [177 184] and in the dry valley running through Harpenden [135 150] to Sandridge [170 104]. It is thought that these gravels may have been laid down by overspill streams issuing from a glacial lake impounded by ice to the north-west of the Chiltern Hills (Sherlock, 1935; Wooldridge, 1953).

Alluvium Stretches of alluvium are found in the valleys of the Rivers Mimram, Lea and Ver. The deposit consists of grey silty clay with subordinate amounts of sand and gravel which are referred to as Sub-Alluvial Gravel in this report.

COMPOSITION OF THE SAND AND GRAVEL

Glacial Sand and Gravel

The Glacial Sand and Gravel is the main source of mineral in the area. It has a mean grading of 10 per cent fines, 48 per cent sand and 42 per cent gravel. Cobbles occur sporadically throughout the deposit and the gravel is composed of approximately equal proportions of the fine and coarse fractions. In the sand fraction, medium sand predominates over approximately equal proportions of fine and coarse grades. The Glacial Sand and Gravel is often a compact deposit held together by interstitial brown, silty clay. Iron pans occur in the area but are not widespread. The deposit in this district is rarely free of fines.

Angular flint makes up 70–80 per cent by weight of the gravel and is found in the fine and coarse size ranges and as cobbles. Rounded flint, which mostly occurs in the coarse gravel range and as cobbles usually constitutes less than 10 per cent by weight of the deposit. Angular and rounded quartzite, mainly of 'Bunter' (Triassic) derivation, is found in both fine and coarse grades and accounts for about 10 per cent of the gravel by weight. About 5 per cent of the gravel consists of angular and rounded vein-quartz pebbles, mostly to be found in the fine gravel range. Other constituents, also usually in the fine gravel range, such as igneous and metamorphic rocks, ironstone and chalk make up less than 5 per cent of the gravel. The medium and fine sand usually consists of subangular and subrounded quartz with some subangular flints; in the coarse sand fraction angular flint

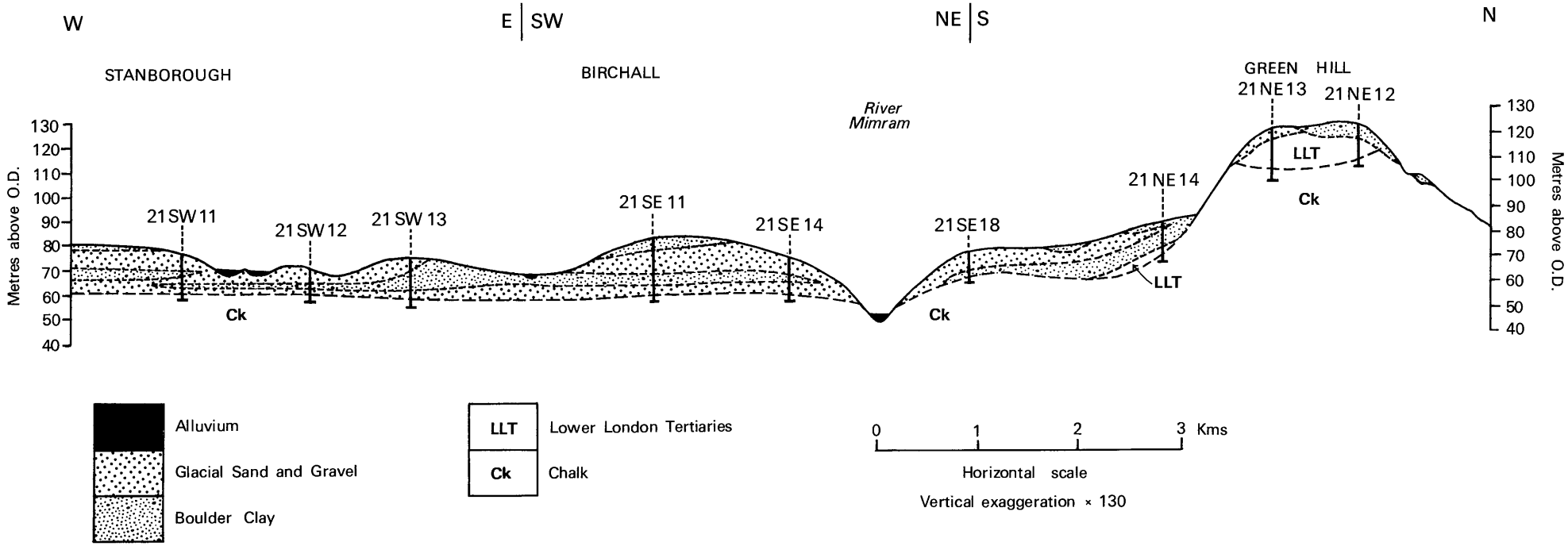


Figure 3 Horizontal section illustrating the drift geology of the district (the line of section is marked on the resource sheet).

predominates. Other components, for example, ironstone, tend to occur more commonly in the coarse sand range.

Valley Gravel
This deposit occupies the main valleys and has a mean grading of 17 per cent fines, 21 per cent sand and 62 per cent gravel. The gravel fraction includes scattered flint cobbles and approximately equal proportions of fine and coarse material. The sand is mainly coarse with medium, and traces of fine grades. The high fines content may be attributable to the proximity of the Clay-with-flints and associated Pebbly Clay and Sand from which the Valley Gravel may be partly derived and to the low level of eluviation by surface water.

Except for the slightly higher flint content, Valley Gravel is very similar in composition, though not in grading, to Glacial Sand and Gravel.

Sub-Alluvial Gravel
The Sub-Alluvial Gravel that lies in the valley of the River Mimram consists of redistributed glacial and Tertiary material from which much of the sand and clay has been washed. The mean grading is 6 per cent fines, 18 per cent sand and 76 per cent gravel. The low fines content makes this the cleanest gravel found in the sheet area. The gravel is coarse with fine pebbles and the sand is mainly coarse with some medium and traces of fine grades. The gravel is similar in composition to that of the Glacial Sand and Gravel, but the percentage of rounded material, particularly flint, is higher. This is probably due in part to the incorporation of already rounded material from the Tertiary 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 red.

Geological data: The geological boundary lines are based on six-inch geological surveys made between 1911 and 1914 and in 1921 and published on the one-inch scale on sheets 238 (Aylesbury) and 239 (Hertford), together with a one-inch geological survey published in 1889.

Borehole data, which include the stratigraphical relations and mean particle-size distributions of sand and gravel samples collected during the assessment survey, are also shown.

The geological boundaries are the best available interpretation of information available at the time of the survey. However, it is inevitable that local irregularities or discrepancies will be revealed by some boreholes; these are taken into account in the assessment of resources.

Mineral resource information: The mineral-bearing ground is subdivided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is 'exposed' and areas where it is present in continuous (or almost continuous) spreads beneath overburden. The mineral is identified as 'exposed' where overburden, commonly consisting only of soil and subsoil, averages less than 1.0 m in thickness.

Areas where bedrock outcrops or where evidence indicates the absence of potentially workable sand and gravel are uncoloured on the map. In such areas it has been assumed that the mineral is absent except, possibly, in infrequent and relatively minor patches, which can neither be outlined nor assessed in the context of this survey. Areas of unassessed sand and gravel, for example in built-up areas, are indicated by 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 represent the breadth of the zone, its size being limited only by cartographic considerations. For the purpose of measuring area the centre line of the symbol is used.

RESULTS
The statistical results of the survey are summarised in Table 2. Further grading particulars are given in Figures 5 to 9 and Tables 3 to 7. All limits quoted in this report have been calculated at the symmetrical 95 per cent probability level.

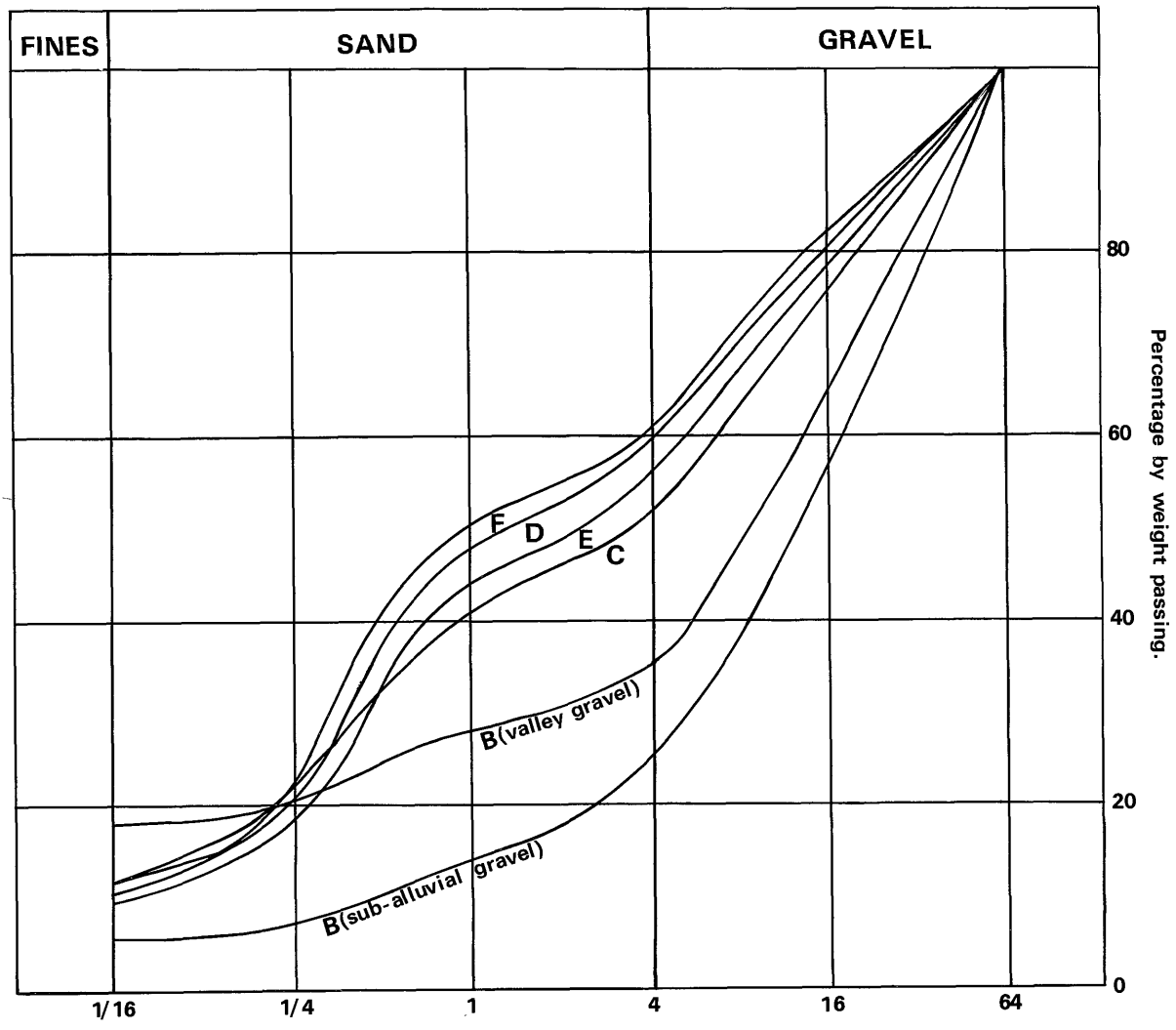
Accuracy of results: For the five resource blocks that have been statistically assessed, the accuracy of the results at the 95 per cent probability level varies between 25 per cent and 54 per cent (that is, it is probable that nineteen times out of twenty the true volumes present lie within these limits). However, the true values are more likely to be nearer the figures estimated than the limits. Moreover, it is probable that in each block approximately the same

Table 2 The sand and gravel resources of the country around Welwyn Garden City

Block*	Area		Mean thickness		Volume of mineral			Mean grading percentage		
	Block	Mineral	Overburden	Mineral		Limits at the 95% probability level		Fines $-\frac{1}{16}$ mm	Sand $+\frac{1}{16}$ -4 mm	Gravel +4mm
	km²	km²	m	m	$m^3 \times 10^6$	± %	± $m^3 \times 10^6$			
B	7.6	5.5	0.9	2.9	16	41	7	13	20	67
C	32.3	7.4	2.9	3.1	23	54	12	11	51	38
D	16.4	13.0	1.6	5.5	72	37	27	11	48	41
E	15.2	13.9	3.6	6.5	90	25	23	9	46	45
F	23.7	12.0	2.7	5.4	65	30	20	10	50	40
B to F	95.2	51.8	2.5	5.1	266	15	40	10	47	43

* No assessment has been made of Block A

percentage limits would apply for the estimate of volume of a very much smaller parcel of ground (say, 1 km^2) containing similar sand and gravel deposits if the results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for the quotation of reserves of



Block	Percentage by weight passing					
	Fines -1/16mm	Fine sand +1/16mm -1/4mm	Medium sand +1/4mm -1mm	Coarse sand +1mm -4mm	Fine gravel +4mm -16mm	Coarse gravel +16mm
B (sub-alluvial gravel)	6	1	6	11	32	44
B (valley gravel)	17	3	8	10	27	35
C	11	10	20	10	25	24
D	11	9	28	11	21	20
E	9	10	26	10	24	21
F	10	11	30	9	21	19

Figure 4 Mean particle-size distribution for the assessed thickness of sand and gravel in resource blocks B to F.

Table 3 Block B: data from IMAU boreholes

Borehole	Recorded thickness		Mean grading percentage					
	Mineral	Overburden	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m	m						
11 SW 1	absent							
11 SW 2	4.0	3.0	16	2	7	11	31	33
11 SE 26	1.9	0.9	17	4	8	11	19	41
11 SE 27	2.0	1.3	12	4	9	10	28	37
11 SE 29	3.4	0.4	20	3	9	9	27	32
21 NW 11	4.2	1.1	9	1	8	13	33	36
21 SE 24	2.1	1.1	1	0	3	6	30	60

part of a block it can be expected that data from more than ten sample points will be required, even if the area is quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel on this sheet. The volume (266 million m^3) can be estimated to limits of ± 15 per cent at the 95 per cent probability level, by a calculation based on the data from 55 sample points spread across the five resource blocks. However, it must be emphasised that the quoted volume of sand and gravel has no simple relationship with the amount that could be extracted in practice, as no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of the land for mineral working.

NOTES ON THE RESOURCE BLOCKS

Block A is defined by the extent of the Chalk uplands and includes the extensive deposits of Clay-with-flints and associated Pebbly Clay and Sand west of Welwyn Garden City. Block B includes the deposits of the rivers Ver and Mimram and the dry valley south-east of Harpenden. Block C encompasses the high ground north of Welwyn Garden City capped by Glacial Sand and Gravel and Boulder Clay. Blocks D, E and F include the extensive glacial deposits on the lower ground south and east of the Chalk uplands.

Block A

This is the largest block in the district, covering 79.9 km^2 and containing 2.4 km^2 of mineral. Clay-with-flints and Pebbly Clay and Sand are the most extensive drift deposits but small patches of Glacial Sand and Gravel occur around Wheathampstead and to the west of Sandridge.

Fourteen boreholes were drilled but only one, 11 SE 37, proved mineral; in it 2.3 m of 'very clayey' gravel was proved beneath 4.0 m of overburden. It has therefore not been possible in the absence of more data, to offer an assessment of this small area of mineral within the block. The Glacial Sand and Gravel has nevertheless been worked, notably to the north of Black Bridge [191 144], where most of the available material has been extracted and the ground partly restored.

Block B (Table 3, Figure 5)

In this block, which has an area of 7.6 km^2, mineral occupies 5.5 km^2, of which 2.7 km^2 is covered by overburden. The block includes parts of the valley of the River Ver near Redbourn in the south-western part of the area, the dry valley passing eastwards from Harpenden to Nomansland and thence southwards to Sandridge and the valley of the River Mimram running from Kimpton [177 184] south-eastwards towards Hertingfordbury. Seven IMAU boreholes and seven other records have been used in the assessment.

The overburden has a mean thickness of 0.9 m and reaches a maximum thickness of 3.0 m south of Redbourn. In the Ver and Nomansland valleys the overburden usually consists of brown pebbly clay and in the Mimram valley blue-grey silty clay.

In the Ver valley the mineral is composed of Valley Gravel with a mean thickness of 1.9 m and a range from 1.0 m in Water Department record 239/89 to 4.0 m in borehole 11 SW 2. Borehole 11 SW 1, north of Redbourn, failed to prove mineral and the area is therefore considered to be barren. Valley Gravel also forms the mineral in the now dry Nomansland valley where it has a mean thickness of 2.7 m and ranges from 1.9 m in borehole 11 SE 26 to 3.4 m in borehole 11 SE 29. In the Mimram valley the mineral is largely composed of Sub-Alluvial Gravel probably derived from the surrounding Glacial Sand and Gravel. The mean thickness of the deposit is 3.9 m, ranging from 2.0 m in Hydrogeology Unit record 239/525b to 7.6 m in Hydrogeology Unit record 239/289. Over the entire block the mineral has a mean thickness of 2.9 m.

Grading figures have been calculated separately for the

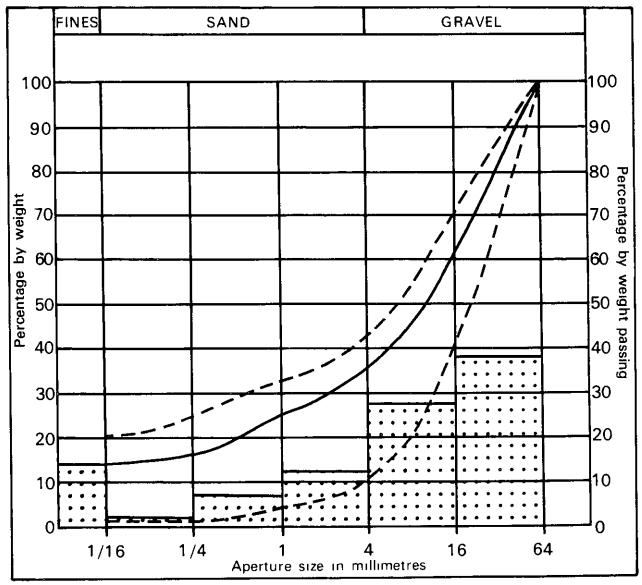


Figure 5 Grading characteristics of the mineral in block B: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading for the block is also shown as a histogram.

Table 4 Block C: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage					
	Mineral	Overburden	Waste partings*	Fines $\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m	m	m						
21 NW 2	absent								
21 NW 3	8.5	1.8		9	19	49	8	7	8
21 NW 4	absent								
21 NW 5	absent								
21 NW 7	2.3	0.1		7	5	10	9	33	36
21 NW 9	8.3	0.1	1.3	8	4	15	14	29	30
21 NW 10	1.0	2.8		11	12	16	11	31	19
21 NW 12	absent								
21 NE 1	absent								
21 NE 2	absent								
21 NE 3	absent								
21 NE 4	5.6	5.0		11	5	20	13	19	32
21 NE 5	4.6	5.8		19	24	24	8	16	9
21 NE 6	3.4	1.5		10	4	51	7	18	10
21 NE 7	absent								
21 NE 8	1.0	1.6		23	14	22	7	22	12
21 NE 9	1.8	1.1		13	7	54	9	11	6
21 NE 12	absent								
21 NE 13	1.5	1.5		14	9	24	8	26	19
21 NE 18	absent								
21 NE 19	3.2	1.4		15	4	34	8	22	17

* Does not include waste between mineral and bedrock

Sub-Alluvial Gravel and the Valley Gravel. From the mean grading the Sub-Alluvial Gravel in the Mimram valley is classified as gravel and the Valley Gravel in the Ver and Nomansland valleys as 'clayey' gravel. The higher fines content of the Valley Gravel probably reflects the clayey nature of the surrounding Clay-with-flints and associated Pebbly Clay and Sand from which the deposit has been partly derived.

Taken together, the mineral of the block has a mean grading of 13 per cent fines, 20 per cent sand and 67 per cent gravel and an estimated volume of 16 ± 6.6 million m^3.

Block C (Table 4; Figure 6)

The mineral of this block consists entirely of Glacial Sand and Gravel and caps the Bull's Green [272 174] outlier of Lower London Tertiaries and infills an abandoned river channel at Codicote [216 183]. Ten of the 21 IMAU boreholes proved no potentially workable sand and gravel. The overburden, mainly Boulder Clay, ranges in thickness from 0.1 m at boreholes 21 NW 7 and 21 NW 9 to 5.8 m at borehole 21 NE 5 giving a mean of 2.9 m.

The mineral ranges in composition from pebbly sand to gravel and in proved thickness from 1.0 m to 8.5 m; borehole 21 NW 9 included a waste parting 1.3 m thick.

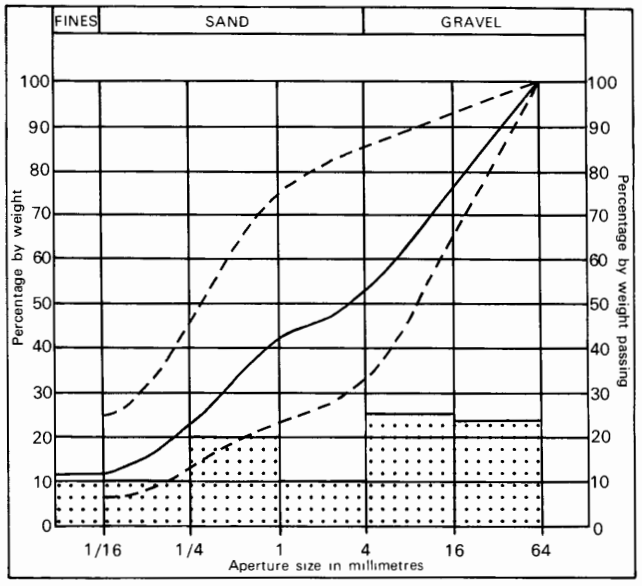


Figure 6 Grading characteristics of the mineral in block C: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading for the block is also shown as a histogram.

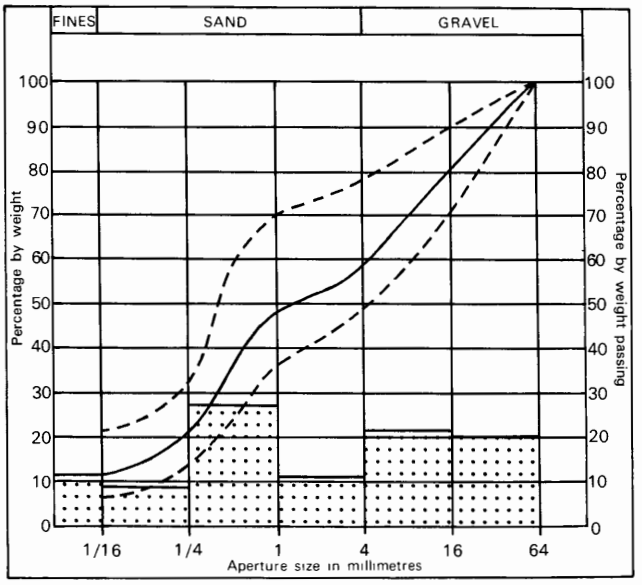


Figure 7 Grading characteristics of the mineral in block D: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading for the block is also shown as a histogram.

Table 5 Block D: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage					
	Mineral	Overburden	Waste partings*	Fines $\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m	m	m						
21 NE 10	7.4	0.8	3.1	11	15	44	8	12	10
21 NE 11	4.8	1.2		7	5	31	17	23	17
21 NE 14	9.4	1.0	5.6	12	16	25	9	22	16
21 NE 15	1.4	1.6		17	7	24	5	26	11
21 NE 16	2.2	1.5		21	10	13	10	16	30
21 NE 17	5.1	7.8		10	9	18	12	28	23
21 SE 8	5.0	0.2		10	8	21	10	25	26
21 SE 13	7.8	0.2		11	7	27	9	20	26
21 SE 17	8.6	0.1		8	8	36	10	19	19
21 SE 18	7.3	0.2		10	9	34	10	21	16
21 SE 21	9.0	0.3		10	6	25	11	22	26
21 SE 22	11.2	0.1		14	9	22	12	22	21

* Does not include waste between mineral and bedrock

The mean thickness of the mineral in the block is 3.1 m and the mean grading is 11 per cent fines, 51 per cent sand and 38 per cent gravel. The estimated volume is 23± 12.4 million m³.

Block D (Table 5; Figure 7)
The glacial deposits around Watton Place [229 195], Bramfield and Tewin form the mineral-bearing ground of this block. The block covers an area of 16.4 km², of which 13.0 km² contains mineral.

Overburden, consisting of Boulder Clay, extends across almost half the mineral-bearing ground; elsewhere it is limited to a thin sandy soil. Proved thicknesses range from 0.1 m in boreholes 21 SE 17 and 21 SE 22 to 7.8 m in borehole 21 NE 17, giving a mean thickness of 1.6 m calculated from twelve data points.

Mineral thicknesses proved range from 1.4 m in borehole 21 NE 15 to 11.2 m in borehole 21 SE 22, with a mean of 5.5 m. In boreholes 21 NE 10 and 21 NE 14 the mineral horizon is interrupted by a parting of boulder clay which is 3.1 m and 5.6 m thick respectively. Elsewhere the mineral occurs as a single horizon with no waste parting.

The grading characteristics of the mineral do not vary greatly across the block, the mean grading being 11 per cent fines, 48 per cent sand and 41 per cent gravel. The estimated volume of mineral is 72±27 million m³.

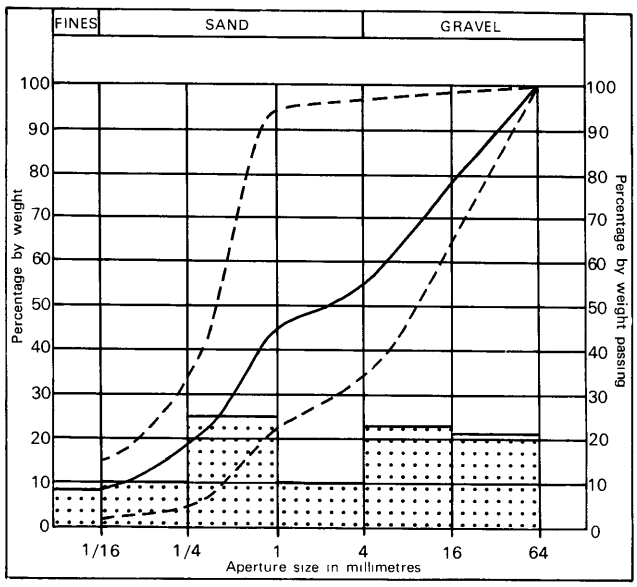


Figure 8 Grading characteristics of the mineral in block E: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading for the block is also shown as a histogram.

Block E (Table 6; Figure 8)
Block E lies to the south and east of Welwyn Garden City and has an area of 15.2 km², all of which, except for worked out areas amounting to some 1.3 km², is occupied by mineral, 9.0 km² is covered by overburden. The mineral is almost entirely Glacial Sand and Gravel, the exception being a patch of Valley Gravel to the south of Woolmer Park [287 100]. The assessment of resources is based on information from fourteen IMAU boreholes and thirteen other sites including Hydrogeology Unit records, commercial information and an exposure.

The overburden is usually Boulder clay and has a mean thickness of 3.6 m. It is thickest in the south-east, as for example, in the Water Hall gravel pit [2961 1046] where 15.6 m of Boulder Clay overlies 5.7 m of Glacial Sand and Gravel which in turn rests on the Chalk. Northwards towards the River Mimram the overburden thins out; boreholes 21 SE 9 and 21 SE 14 show Glacial Sand and Gravel at the surface. Mineral thicknesses range from 1.8 m in borehole 21 SE 20 to 14.5 m in borehole 21 SE 11, the thickest deposits generally occurring in the south of the block. Boulder Clay waste commonly divides the mineral into two horizons, as in boreholes 21 SW 12, 21 SW 13, 21 SE 11, 21 SE 14, 21 SE 16 and 21 SE 19. This waste has a mean thickness of 3.9 m reaching a maximum of 5.5 m in borehole 21 SE 16.

The mean grading results for the block of 9 per cent fines, 46 per cent sand and 45 per cent gravel show that the mineral is sandy gravel. However, in three of the six boreholes that contain two mineral horizons separated by boulder clay waste, there is a marked difference in grading between the two horizons (see Table 7), whilst in the other three boreholes the grading of the mineral horizons is much more consistent. These facts demonstrate the unpredictable variability in composition which often occurs in glacial deposits.

The estimated volume of mineral in the block is 90±23 million m³.

Table 6 Block E: data from assessment boreholes

Borehole	Recorded thickness			Mean grading percentage					
	Mineral	Overburden	Waste partings*	Fines $\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m	m	m						
21 NW 8	4.7	5.8		7	10	23	8	23	29
21 SW 12	6.8	1.8	3.1	6	18	42	6	16	12
21 SW 13	7.7	5.0	4.2	6	7	16	13	35	23
21 SE 7	7.7	2.3		6	7	18	13	29	27
21 SE 9	7.0			10	5	22	10	23	30
21 SE 10	8.0	1.8		15	6	14	12	24	29
21 SE 11	14.5	3.2	5.3	7	28	51	4	7	3
21 SE 12	6.3	1.6		3	2	16	13	31	35
21 SE 14	5.1		3.9	10	4	11	11	34	30
21 SE 15	2.9	0.9		13	18	66	1	1	1
21 SE 16	12.1+	8.2	5.5	5	7	29	12	25	22
21 SE 19	8.9	0.4	1.4	10	5	20	12	31	22
21 SE 20	1.8	2.2		8	23	14	3	22	30
21 SE 23	4.7	6.2		9	4	17	14	35	21

* Does not include waste between mineral and bedrock

Table 7 Mean grading of individual mineral deposits from selected boreholes in Block E

Borehole		Thickness	Fines	Sand	Gravel	Classification
		m	%	%	%	
21 SW 12	**a**	4.2	7	93	0	Sand
21 SW 12	**b**	2.7	3	27	70	Gravel
21 SE 11	**a**	10.5	8	91	1	Sand
21 SE 11	**b**	4.0	6	58	36	Sandy gravel
21 SE 16	**a**	2.6	4	81	15	Pebbly sand
21 SE 16	**b**	9.5	5	37	58	Gravel

Block F (Table 8; Figure 9)

This block includes the remainder of the glacial deposits south-east of the Chalk uplands. It covers 23.7 km² and contains 12.0 km² of mineral, 75 per cent of which is covered by overburden. Except where it occurs as a thin sandy soil, overburden comprises Boulder Clay. Its thickness ranges from 0.2 m in borehole 21 SW 6 to 4.4 m in borehole 21 SW 10, giving a mean thickness of overburden for the block of 2.7 m.

The mineral consists entirely of Glacial Sand and Gravel and was proved in 13 of the 18 assessment boreholes. It ranges in thickness from 2.2 m in borehole 11 SE 34 to 14.5 m in borehole 21 SW 8 with a mean thickness of 5.4 m. As in Block E, the thickest deposits occur in the south of the block and the mineral as a whole shows no great variation in grading characteristics. In the south-east of the block the usual single mineral horizon is divided into two horizons, and, in borehole 21 SW 11, into three horizons, by boulder clay waste. Ranging in thickness from 2.7 m to 4.9 m, the waste has a mean thickness of 3.9 m over the area within which it is assumed to occur.

The mean grading of the mineral in the block is 10 per cent fines, 50 per cent sand and 40 per cent gravel and the estimated volume is 65±20 million m³.

SAND IN THE LOWER LONDON TERTIARIES

The beds of sand in the lower subdivision of the Lower London Tertiaries fall within the definition of mineral, but they have not been included in the above assessment because a comprehensive investigation would have necessitated an unjustified amount of drilling. However, where sands were found to underlie gravel-bearing

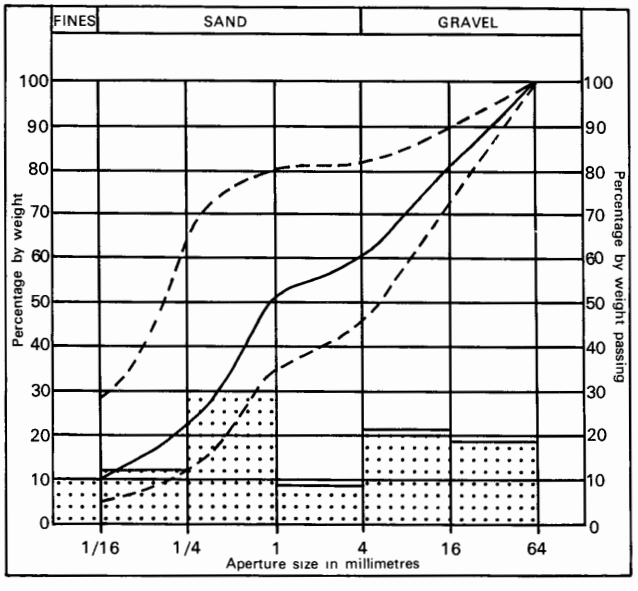


Figure 9 Grading characteristics of the mineral in block F: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The mean grading for the block is also shown as a histogram.

Table 8 Block F: data from IMAU boreholes

Borehole	Recorded thickness			Mean grading percentage					
	Mineral	Overburden	Waste partings*	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m	m	m						
11 SE 30	absent								
11 SE 31	absent								
11 SE 32	5.0	3.3		10	7	43	6	19	15
11 SE 33	absent								
11 SE 34	2.2	2.6		28	37	15	1	8	11
11 SE 35	4.0	1.0		12	14	49	5	9	11
11 SE 36	absent								
11 SE 40	absent								
21 SW 2	absent								
21 SW 3	3.3	1.3		14	7	12	12	30	25
21 SW 4	5.6	2.4		9	11	27	14	20	19
21 SW 5	7.4	3.2	3.2	7	9	27	10	25	22
21 SW 6	6.7	0.2	4.3	19	10	15	10	24	22
21 SW 7	10.0	1.7	4.6	6	10	26	9	24	25
21 SW 8	14.5	0.8	2.7	5	10	38	9	21	17
21 SW 9	4.8	0.8		11	6	35	8	20	20
21 SW 10	5.1	4.4		4	7	24	10	26	29
21 SW 11	9.6	0.8	4.9	12	16	34	9	15	14

* Does not include waste between mineral and bedrock

Table 9 The thickness and mean grading percentages of sands proved by IMAU boreholes in the Lower London Tertiaries

Borehole	Recorded thickness	Mean grading percentage					
		Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}$–$\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$–1 mm	Coarse sand +1–4 mm	Fine gravel +4–16 mm	Coarse gravel +16 mm
	m						
21 NW 7	3.5	33	56	8	0	2	1
21 NE 2	5.0	30	66	3	0	1	0
21 NE 6	5.6	28	67	4	1	0	0
21 NE 8	6.7	30	55	10	1	2	2
21 NE 9	4.7	26	70	4	0	0	0
21 NE 12	6.7	34	57	5	1	2	1
21 NE 13	6.8	38	52	10	0	0	0
21 SW 9	7.4	25	45	21	2	3	4

deposits, drilling was continued in order to investigate their grading characteristics as they have a potential use for making mortars.

One of the eight boreholes to prove sands in the Lower London Tertiaries, 21 SW 9, penetrated 5.2 m of London Clay before proving Lower London Tertiaries; elsewhere the sands were proved beneath gravel-bearing deposits. All boreholes except 21 NE 9 penetrated the base of the Lower London Tertiaries and show that they thicken locally towards the east: the data are given in Table 9.

Grading analyses were obtained for 51 samples of sand in the Lower London Tertiaries and the results are given separately in the borehole records (Appendix F). The mean grading is 31 per cent fines, 60 per cent fine sand, 6 per cent medium sand, 1 per cent coarse sand and 2 per cent gravel. Thus most of the mineral in the Lower London Tertiaries is classified as 'very clayey' sand, the sand being almost exclusively fine-grained. The small gravel fraction is most commonly present in the base of the sand and consists of fine-grained rounded black flint pebbles.

APPENDIX A:

FIELD AND LABORATORY PROCEDURES

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

The mineral shown on each 1:25 000 sheet is divided into resource blocks. The arbitrary size selected, 10 km^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 (1967). Random checks on the accuracy of the grading are made in the Institute's laboratories.

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

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

APPENDIX B

STATISTICAL PROCEDURE

Statistical assessment

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

2 The simple methods used in the calculations are consistent with the amount of data provided by the survey. Conventional symmetrical confidence limits are calculated for the 95 per cent probability level, that is, there is a 5 per cent or one in twenty chance of a result falling outside the stated limits.

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

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

4 The above relationship may be transposed such that

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

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

If, therefore, the standard deviation for area is small with respect to that for 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, $\bar{l}_m$, is given by

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

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

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

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

6 The sampled area in each resource block is coloured pink on the map. Wherever possible, calculations relate to the mineral within mapped geological boundaries (which may not necessarily correspond to the limits of deposit). Where the area is not defined by a mapped boundary, that is, where the boundary is inferred, a distinctive symbol is used. Experience suggests that the errors in determining area are small relative to those in thickness. The relationship $S_A/S_{\bar{l}_m} \leqslant \frac{1}{3}$ is assumed in all cases. It follows from equation [2] that

$$S_{\bar{l}_m} \leqslant S_v \leqslant 1.05\, S_{\bar{l}_m} \quad . \qquad [3]$$

7 The limits on the estimate of mean thickness of mineral, $L_{\bar{l}_m}$, may be expressed in absolute units
$\pm (t/\sqrt{n}) \times S_{\bar{l}_m}$ or as a percentage
$\pm (t/\sqrt{n}) \times S_{\bar{l}_m} \times (100/\bar{l}_m)$ per cent, where t is Student's t at the 95 per cent probability level for $(n-1)$ degrees of freedom, evaluated by reference to statistical tables. (In applying Student's t it is assumed that the measurements are distributed normally).

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

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

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

9 In calculating confidence limits for volume, L_1, the following inequality corresponding to equation [3] is applied: $L\bar{l}_m \leqslant L_1 \leqslant 1.05\, L\bar{l}_m$

10 In summary, for values of n between 5 and 20, L_1 is calculated as

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

per cent, and when n is greater than 20, as

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

per cent.

11 The application of this procedure to a fictitious area is illustrated in Figures 6 and 7.

Inferred assessment

12 If the sampled area of mineral in a resource block is between 0.25 km² and 2 km² 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 km².

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

APPENDIX C

CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

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

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

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

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

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

Thus it is possible to classify the mineral into one of twelve descriptive categories (see Figure 12). 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 9, Appendix D).

Many differing proposals exist for the classification of the grain size of sediments (Atterberg, 1905, Udden, 1914; Wentworth, 1922; Wentworth, 1935; Allen, 1936; Twenhofel, 1937; Lane and others, 1947). As Archer (1970a, b) has emphasised, there is a pressing need for a simple metric scale acceptable to both scientific and engineering interests, for which the class limit sizes correspond closely with certain marked changes in the natural properties of mineral particles. For example, there is an important change in the degree of cohesion between particles at about the $\frac{1}{16}$-mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology (Table 10), 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 (+ $\frac{1}{16}$ − $\frac{1}{4}$ mm), medium (+ $\frac{1}{4}$ − 1 mm) and coarse (+ 1 − 4 mm). The boundary at 16 mm distinguishes a range of finer gravel (+ 4 − 16 mm), often characterised by abundance of worn tough pebbles of vein quartz, from larger pebbles often of notably different materials. The boundary at 64 mm distinguishes pebbles from cobbles. The term 'gravel' is used loosely to denote both pebble-sized and cobble-sized material.

The size distribution of borehole samples is determined by sieve analysis, which is presented by the laboratory as logarithmic cumulative curves (see, for example, British

Block calculation 1:25 000 Block } Fictitious

Area
Block: 11.08 km²
Mineral: 8.32 km²

Mean thickness
Overburden: 2.5 m
Mineral: 6.5 m

Volume
Overburden: 21 million m³
Mineral: 54 million m³

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

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

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

Calculation of confidence limits

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

$\Sigma(wl_m - \overline{wl_m})^2 = 15.82$
$n = 8$
t = 2.365

L_1 is calculated as

$$1.05\,(t/\overline{wl_m})\,\sqrt{[\Sigma\,(wl_m - \overline{wl_m})^2 / n\,(n-1)]} \times 100$$
$$= 1.05 \times (2.365/6.5)\,\sqrt{[15.82/(8 \times 7)]} \times 100$$
$$= 20.3$$
$$\simeq 20 \text{ per cent}$$

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

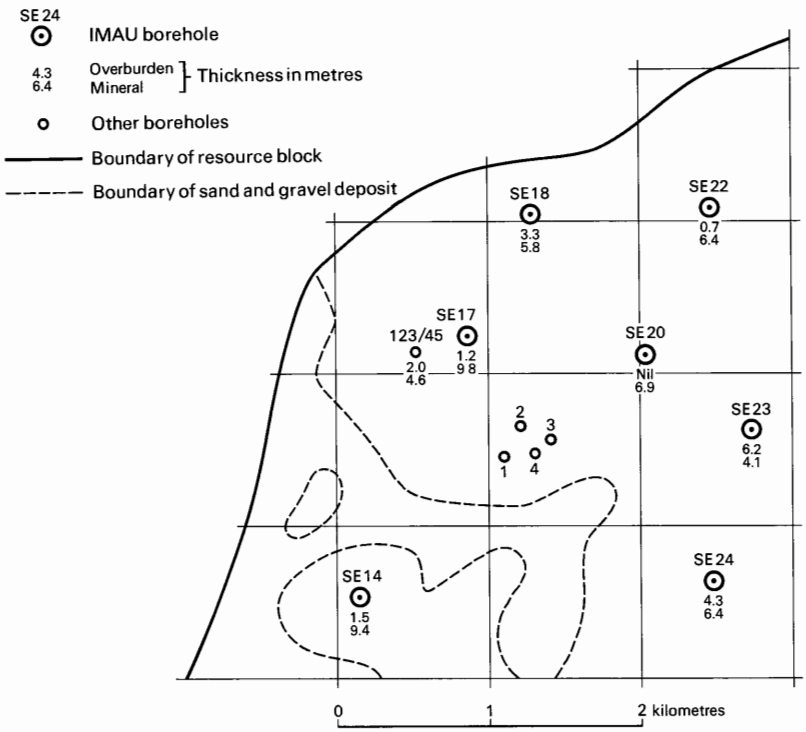


Figure 11 Example of resource block assessment: map of fictitious block.

Standard 1377: 1967). In this report the grading is tabulated on the borehole record sheets (Appendix F), the intercepts corresponding with the simple geometric scale $\frac{1}{16}$ mm, $\frac{1}{4}$ mm, 1 mm, 4 mm, 16 mm and so on as required. Original sample grading curves are available for reference at the appropriate office of the Institute.

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

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

The terms used in the field to describe the degree of rounding of particles, which is concerned with the sharpness of the edges and corners of a clastic fragment and not the shape (after Pettijohn, 1957), are as follows.

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

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

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

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

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

Table 10 Classification of gravel, sand and fines

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

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

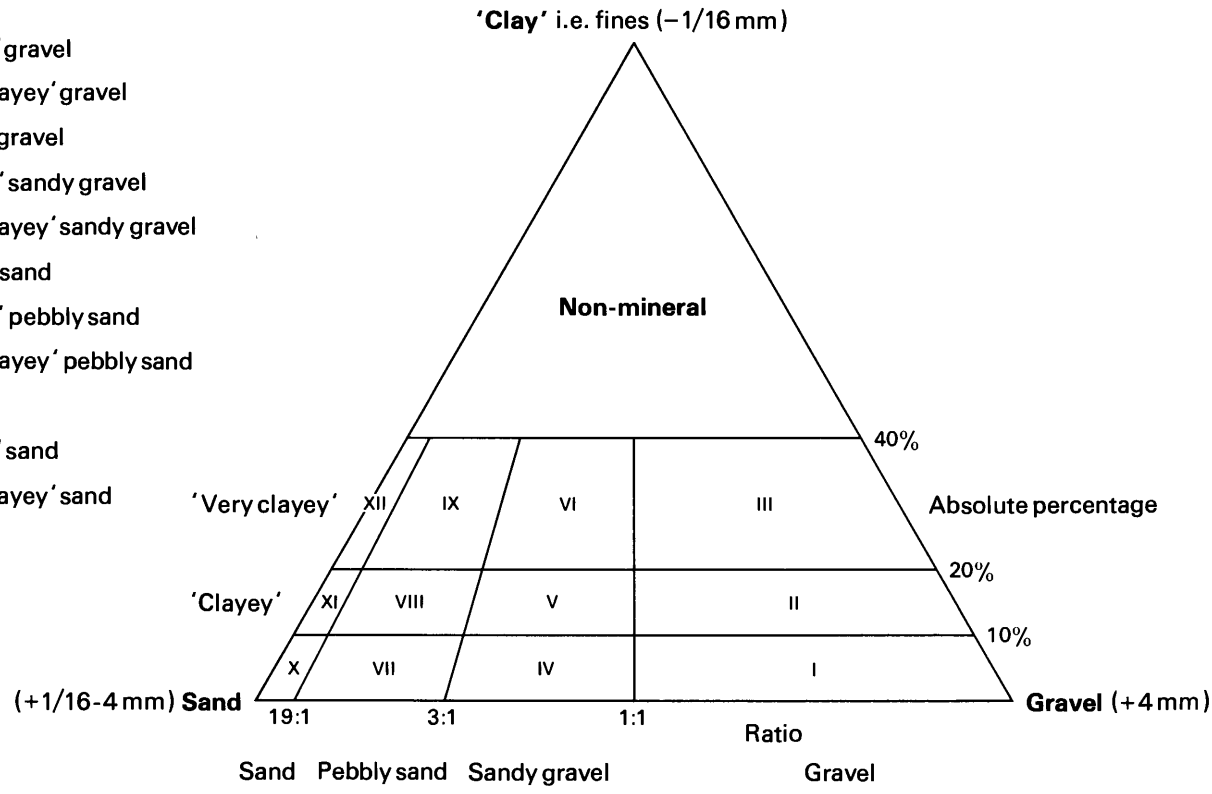


Figure 12 Diagram to show the descriptive categories used in the classification of sand and gravel.

APPENDIX D:
EXPLANATION OF THE BOREHOLE RECORDS

Annotated Example

TL 21 NE 10[1] **2729 1522**[2] **Tewin** **Block D**[3]

Surface level (+85.6 m)[4] +281 ft
Water not struck[5]
January 1972[6]

Overburden[7] 0.8 m
Mineral 3.5 m
Waste 3.1 m
Mineral 3.9 m
Waste 2.7 m
Bedrock 0.2 m+[8]

LOG

Geological classification	Lithology	Thickness[8] m	Depth m
	Soil,	0.3	0.3
Boulder Clay	Clay, orange-brown, silty, contains flints	0.5	0.8
Glacial Sand and Gravel	**a** 9'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flints with subrounded quartz Sand: medium, orange-brown	3.5	4.3
Boulder Clay	Clay, dark grey, stiff, chalky	3.1	7.4
Glacial Sand and Gravel	**b** Pebbly sand, gravel content increases to base Gravel: fine and coarse, subangular to rounded flint with some quartz Sand: medium, orange-brown	3.9	11.3
	Silt, brown, sandy, contains some fine flint pebbles	2.7	14.0
Upper Chalk	Chalk, soft, white	0.2+	14.2

GRADING

	Mean for deposit[12] *percentages*			Depth below surface (m)	*percentages*[11]						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	13	54	33	[10]0.8–1.2	15	25	30	4	14	12	0
				1.2–2.0	17	14	44	8	10	7	0
				2.0–2.5	7	12	26	16	25	14	0
				2.5–3.0	11	25	57	1	4	2	0
				3.0–4.0	12	6	20	13	27	22	0
				4.0–4.3	15	3	9	11	29	33	0
				Mean	13	13	32	9	18	15	0
b	9	79	12	7.4–8.2	6	24	67	2	0	1	0
				8.2–9.2	15	18	49	13	5	0	0
				9.2–10.2	5	16	58	4	11	6	0
				10.2–11.0	5	8	55	12	10	10	0
				11.0–11.3	23	17	21	9	15	15	0
				Mean	9	17	54	8	7	5	0
a+b	11	67	22	Mean	11	15	44	8	12	10	0

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

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

1 The number of the 1:25 000 sheet on which the borehole lies, for example, TL 21.

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, NE 10.

Thus the full registration number is TL 21 NE 10.
Usually this is abbreviated to 21 NE 10 in the text.

2 The National Grid reference
All National Grid references in this publication lie within the 100 km square TL 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
Three kinds of entry are made: the record indicates the level at which groundwater stood on completion of drilling (in Metres above or below OD;) or that water was not encountered.

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

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

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

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

10 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 1 m of depth.

11 Grading results
The limits are as shown in the borehole records.

12 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 10.

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

1 INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLES

Borehole	Grid reference*
11 NW 1	1026 1733
2	1280 1643
3	1450 1831
11 NE 1	1701 1562
2	1765 1991
3	1878 1697
11 SW 1	1088 1345
2	1067 1163
3	1194 1375
4	1326 1150
11 SE 25	1541 1488
26	1539 1303
27	1692 1057
28	1743 1474
29	1746 1243
30	1852 1321
31	1862 1241
32	1889 1009
33	1938 1356
34	1925 1230
35	1983 1120
36	1984 1045
37	1574 1393
38	1576 1133
39	1705 1360
40	1895 1123

Borehole	Grid reference*
21 NW 2	2032 1955
3	2092 1824
4	2165 1782
5	2242 1719
6	2271 1654
7	2387 1803
8	2362 1554
9	2451 1834
10	2415 1649
11	2071 1785
12	2384 1889
21 NE 1	2563 1845
2	2548 1680
3	2629 1954
4	2646 1849
5	2623 1769
6	2640 1658
7	2647 1586
8	2706 1753
9	2769 1634
10	2729 1522
11	2879 1967
12	2842 1727
13	2821 1658
14	2864 1538
15	2943 1909
16	2965 1825
17	2966 1581
18	2790 1825
19	2906 1700

Borehole	Grid reference*
21 SW 2	2003 1352
3	2076 1227
4	2049 1172
5	2034 1031
6	2157 1262
7	2176 1149
8	2127 1066
9	2240 1423
10	2219 1275
11	2249 1055
12	2358 1060
13	2459 1061
21 SE 7	2566 1014
8	2653 1427
9	2662 1337
10	2618 1256
11	2673 1167
12	2647 1029
13	2750 1462
14	2777 1249
15	2760 1151
16	2785 1073
17	2855 1429
18	2882 1363
19	2858 1225
20	2867 1172
21	2943 1481
22	2952 1339
23	2971 1167
24	2809 1329

* All fall within 100-km grid square TL

2 Other boreholes

Twenty-six boreholes registered in the files of the Hydrogeology Unit of the Institute were also used.

APPENDIX F:
INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS

TL 11 NW 1 **1026 1733** **Luton Hoo Home Farm, Hyde** **Block A**

Surface level (+147.5 m) +484 ft
Water not struck
June 1972

Waste 4.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.4	0.4
Clay-with-flints	Clay, orange-brown, stiff, with fine and coarse flints	3.8	4.2
Upper Chalk	Chalk, white, hard	0.2+	4.4

TL 11 NW 2 **1280 1643** **Cootersend Lane, Harpenden** **Block A**

Surface level (+126.8 m) +416 ft
Water not struck
June 1972

Waste 4.1 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Pebbly Clay and Sand	Clay, dark brown and black, with fine and coarse flints	3.5	4.1
Upper Chalk	Chalk, white, soft	0.1+	4.2

TL 11 NW 3 **1450 1831** **Great Plummers, Kimpton** **Block A**

Surface level (+139.6 m) +458 ft
Water not struck
June 1972

Waste 4.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Clay-with-flints	Clay, orange-brown, stiff, with fine and coarse flints	3.6	4.0
Upper Chalk	Chalk, white, soft	0.3+	4.3

TL 11 NE 1 **1701 1562** **Heron's Farm, Wheathampstead** **Block A**

Surface level (+122.8 m) +403 ft
Water not struck
June 1972

Waste 8.9 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Pebbly Clay and Sand	Clay, orange-brown and grey, sandy in part, with some flint pebbles	8.6	8.9
Upper Chalk	Chalk, white, soft	0.1+	9.0

TL 11 NE 2 **1765 1991** **Hoo End Grange, St. Paul's Walden** **Block A**

Surface level (+137.2 m) +450 ft
Water not struck
July 1972

Waste 3.7 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Clay-with-flints	Clay, dark brown mottled black, with coarse flint pebbles	3.3	3.7
Upper Chalk	Chalk, white, soft	0.3+	4.0

TL 11 NE 3 **1878 1697** **Priors Wood, Kimpton** **Block A**

Surface level (+126.5 m) +415 ft
Water not struck
June 1972

Waste 5.5 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Clay-with-flints	Clay, orange-brown mottled grey, with fine flint pebbles	5.2	5.5
Upper Chalk	Chalk, white	0.1+	5.6

TL 11 SW 1 **1088 1345** **Scout Spring, Redbourn** **Block B**

Surface level (+105.5 m) +346 ft
Water not struck
August 1972

Waste 5.9 m
Bedrock 1.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Valley Gravel	Clay, grey-brown, with flint bands	5.6	5.9
Upper Chalk	Chalk, white, soft	1.3+	7.2

TL 11 SW 2 **1067 1163** **Redbourn Village** **Block B**

Surface level (+96.0 m) +315 ft
Water not struck
July 1972

Overburden 3.0 m
Mineral 4.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Valley Gravel	Clay, orange-brown, with fine and coarse flint gravel	2.8	3.0
	'Clayey' gravel Gravel: fine and coarse subangular and subrounded flint Sand: medium and coarse	4.0	7.0
Upper Chalk	Chalk, white, soft	0.3+	7.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
16	20	64	3.0–4.0	2	1	13	18	37	29	0
			4.0–5.0	15	2	7	8	31	37	0
			5.0–6.0	25	2	6	6	27	34	0
			6.0–7.0	20	3	5	9	29	34	0
			Mean	16	2	7	11	31	33	0

TL 11 SW 3 1194 1375 Rothamsted Experimental Farm **Block A**

Surface level (+127.7 m) +419 ft
Water not struck
July 1972

Waste 8.5 m
Bedrock 1.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Clay-with-flints	Clay, orange-brown mottled brown and black, with flint pebbles and shell fragments	8.1	8.5
Upper Chalk	Chalk, white, soft	1.0+	9.5

TL 11 SW 4 1326 1150 Beesonend Farm, Redbourn **Block A**

Surface level (+125.9 m) +413 ft
Water not struck
August 1972

Waste 4.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Clay-with-flints	Clay, brown, stiff, contains flints	4.2	4.5
Upper Chalk	Chalk, white, soft, contains flints	0.3+	4.8

TL 11 SE 25 1541 1488 Cherry Trees, Wheathampstead **Block A**

Surface level (+89.0 m) +292 ft
Water not struck
February 1972

Waste 2.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
? Glacial Sand and Gravel	Clay, brown, stiff, with flint and quartzite pebbles	2.3	2.3
Upper Chalk	Chalk, soft	0.2+	2.5

TL 11 SE 26 1539 1303 Ayre's End Lane, Wheathampstead **Block B**

Surface level (+95.4 m) +313 ft
Water not struck
February 1972

Overburden 0.9 m
Mineral 1.9 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Valley Gravel	Clay, brown, with flint pebbles	0.8	0.9
	'Clayey' gravel Gravel: coarse with fine and some cobbles, subangular to subrounded flint and quartz Sand: medium and coarse, some brown clay in matrix	1.9	2.8
Upper Chalk	Chalk, white, hard	0.2+	3.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
17	23	60	0.9–1.9	14	4	13	14	23	32	0
			1.9–2.8	21	2	5	6	15	39	12
			Mean	17	4	8	11	19	35	6

TL 11 SE 27 1692 1057 Sandridge **Block B**

Surface level (+84.1 m) +276 ft
Water not struck
February 1972

Overburden 1.3 m
Mineral 2.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Valley Gravel	Clay, brown, with flint and quartz pebbles	1.2	1.3
	'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium and coarse with some brown clay in matrix	2.0	3.3
Upper Chalk	Chalk, white, soft	0.2+	3.5

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
12	23	65	1.3–2.3	14	4	6	10	29	37	0
			2.3–3.3	9	5	12	10	26	38	0
			Mean	12	4	9	10	28	37	0

TL 11 SE 28 1743 1474 The Dell, Wheathamstead **Block A**

Surface level (+99.7 m) +327 ft
Water not struck
February 1972

Waste 3.4 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.3	0.3
Glacial Sand and Gravel	Clay, brown, stiff, with flint and quartz pebbles	3.1	3.4
Upper Chalk	Chalk, white, soft	0.3+	3.7

TL 11 SE 29 1746 1243 Nomansland Common, Sandridge **Block B**

Surface level (+90.5 m) +297 ft
Water not struck
September 1972

Overburden 0.4 m
Mineral 3.4 m
Waste 1.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Valley Gravel	'Clayey' gravel, two thin clays at 1.1 m and 2.1 m Gravel: fine and coarse with some cobbles, subangular to rounded flints, quartz and quartzite Sand: medium	3.4	3.8
	Clay, brown with flint and quartz pebbles	1.0	4.8
Upper Chalk	Chalk, white, soft	0.2+	5.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
20	21	59	0.4–1.1	10	3	12	15	26	21	13
			1.1–1.3 clay band *							
			1.3–2.1	11	6	17	3	25	38	0
			2.1–2.3 clay band *							
			2.3–3.3	5	3	4	15	37	36	0
			3.3–3.8	13	1	7	10	30	39	0
			Mean	20	3	9	9	27	29	3

* Assumed to comprise 100% fines in calculating mean grading

TL 11 SE 30 1852 1321 Beech-hyde Lane, Wheathamstead **Block F**

Surface level (+ 107.6 m) + 353 ft
Water not struck
February 1972

Waste 2.8 m
Bedrock 0.2 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, brown mottled black, some flint and quartz pebbles	2.6	2.8
Upper Chalk	Chalk, white, soft	0.2 +	3.0

TL 11 SE 31 1862 1241 Coleman Green, Sandridge **Block F**

Surface level (+ 111.6 m) + 366 ft
Water not struck
February 1972

Waste 2.2 m
Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Clay, brown mottled black, with flint pebbles	1.9	2.2
Upper Chalk	Chalk	0.1 +	2.3

TL 11 SE 32 1889 1009 Fairfold's Farm, Sandridge **Block F**

Surface level (+96.9 m) +318 ft
Water not struck
March 1972

Overburden 3.3 m
Mineral 5.0 m
Waste 1.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, brown and grey, sandy, with flint and quartz pebbles	3.1	3.3
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse, subangular to rounded flint with quartz Sand: medium, some brown clay in matrix	5.0	8.3
	Clay, dark brown mottled black, with coarse flints	1.2	9.5
Upper Chalk	Chalk, white with flints	0.2+	9.7

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
10	56	34	3.3–4.3	14	3	31	6	30	16	0
			4.3–5.3	18	8	49	4	9	12	0
			5.3–6.3	8	13	56	4	10	9	0
			6.3–7.3	6	6	55	10	13	10	0
			7.3–8.3	4	4	24	8	33	27	0
			Mean	10	7	43	6	19	15	0

TL11 SE 33 1938 1356 Chalkdell Farm, Wheathampstead **Block F**

Surface level (+108.8 m) +357 ft
Water not struck
February 1972

Waste 1.0 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel	Clay, brown, stiff with coarse flints	1.0	1.0
Upper Chalk	Chalk, white, soft	0.5+	1.5

TL 11 SE 34 1925 1230 Upper Cromer Hyde Farm, Hatfield **Block F**

Surface level (+115.8 m) +380 ft
Water not struck
February 1972

Overburden 2.6 m
Mineral 2.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Boulder Clay	Clay, orange-brown mottled grey, with some flint pebbles	2.3	2.6
Glacial Sand and Gravel	'Very clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint with quartz and quartzite Sand: fine with medium	2.2	4.8
Upper Chalk	Chalk	0.2+	5.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
28	53	19	2.6–3.6	33	48	18	0	1	0	0
			3.6–4.0	24	45	11	3	10	7	0
			4.0–4.8	24	19	12	4	16	25	0
			Mean	28	37	15	1	8	11	0

TL 11 SE 35 1983 1120 Symondshyde Farm, Hatfield **Block F**

Surface level (+92.7 m) +304 ft
Water not struck
March 1972

Overburden 1.0 m
Mineral 4.0 m
Waste 0.1 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, brown, stiff, sandy, with some flint and quartz pebbles	0.9	1.0
Glacial Sand and Gravel	'Clayey' pebbly sand Gravel: fine and coarse, subangular and subrounded flint and quartz Sand: medium	4.0	5.0
	Clay, brown and black, sandy	0.1	5.1
Upper Chalk	Chalk	0.7+	5.8

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
12	68	20	1.0–2.0	15	15	56	5	6	3	0
			2.0–3.0	17	12	41	9	13	8	0
			3.0–4.0	10	14	52	3	6	15	0
			4.0–5.0	4	16	48	3	11	18	0
			Mean	12	14	49	5	9	11	0

TL 11 SE 36 1984 1045 Symondshyde Great Wood **Block F**

Surface level (+82.0 m) +269 ft
Water struck at (+69.8 m)
August 1972

Waste 13.8 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Boulder Clay	Clay, grey and brown, silty	1.2	1.6
	Clay, brown mottled grey, chalky	6.3	7.9
	'Clayey' gravely sand Gravel: fine and coarse Sand: medium, brown clay in matrix	0.1	8.0
	Silt, brown, clayey and sandy	3.8	11.8
Glacial Sand and Gravel	Gravel Gravel: fine Sand: medium and coarse	2.0	13.8
Upper Chalk	Chalk, white, soft	0.2+	14.0

TL 11 SE 37 1574 1393 Aldwickbury, Wheathampstead **Block A**

Surface level (+123.1 m) +404 ft
Water not struck
July 1972

Overburden 4.0 m
Mineral 2.3 m
Waste 0.1 m
Bedrock 0.1+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Pebbly Clay and Sand	Clay, brown, sandy, with some flint and quartz pebbles	3.7	4.0
	'Very clayey' gravel Gravel: fine and coarse, subrounded and rounded flint and quartz Sand: medium and coarse, some brown and grey clay in matrix	2.3	6.3
	Clay, brown mottled black and green, some flint pebbles	0.1	6.4
Upper Chalk	Chalk, white	0.1+	6.5

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
23	24	53	4.0–5.0	7	5	16	15	39	18	0
			5.0–6.3	35	3	8	5	25	24	0
			Mean	23	4	11	9	32	21	0

TL 11 SE 38 1576 1133 Well Wood, Sandridge **Block A**

Surface level (+123.1 m) +404 ft
Water not struck
July 1972

Waste 7.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Pebbly Clay and Sand	Clay, brown, with flint and quartz pebbles	7.5	7.5
Upper Chalk	Chalk, white, soft	0.3+	7.8

TL 11 SE 39 1705 1360 Dawn Green, Wheathampstead **Block A**

Surface level (+120.1 m) +394 ft
Water not struck
July 1972

Waste 6.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Clay-with-flints	Clay, brown mottled black, some fine and coarse flints	6.0	6.3
Upper Chalk	Chalk, white	0.2+	6.5

TL 11 SE 40 **1895 1123** **Hollybush, Sandridge** **Block F**

Surface level (+115.2 m) +378 ft
Water not struck
July 1972

Waste 5.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Glacial Sand and Gravel	Clay, brown, some flint and quartz pebbles	5.2	5.5
Upper Chalk	Chalk, white, hard	0.3+	5.8

TL 21 NW 2 **2032 1955** **Three Houses Lane, Knebworth** **Block C**

Surface level (+112.8 m) +370 ft
Water not struck
February 1972

Waste 2.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Glacial Sand and Gravel	Clay, brown, some flint pebbles	1.7	2.0
Upper Chalk	Chalk	0.2+	2.2

TL 21 NW 3 2092 1824 Codicote Bottom, Codicote **Block C**

Surface level (+84.7 m) +278 ft
Water not struck
February 1972

Overburden 1.8 m
Mineral 8.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Clay, pale brown with flint and quartz pebbles	1.5	1.8
	Pebbly Sand Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium	8.5	10.3
Upper Chalk	Chalk	0.3+	10.6

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
9	76	15	1.8–2.8	17	18	22	8	13	22	0
			2.8–3.8	10	46	40	1	1	2	0
			3.8–4.8	25	33	29	4	3	6	0
			4.8–5.8	7	5	23	26	21	18	0
			5.8–6.8	7	5	49	10	10	9	0
			6.8–7.8	1	19	69	4	4	3	0
			7.8–8.8	5	15	67	4	4	5	0
			8.8–9.8	3	11	75	6	4	1	0
			9.8–10.3	9	8	73	6	3	1	0
			Mean	9	19	49	8	7	8	0

TL 21 NW 4 2165 1782 Codicote Village **Block C**

Surface level (+95.4 m) +313 ft
Water not struck
April 1972

Waste 12.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown with some flint pebbles	0.9	1.2
	Clay, grey-brown, sandy, chalky, some flint pebbles	6.6	7.8
	Sand: medium, brown	0.2	8.0
	Clay, grey-brown, chalky, some flint pebbles	1.8	9.8
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine with coarse Sand: medium, some brown clay and chalk in matrix	2.2	12.0
Upper Chalk	Chalk, white, soft	0.2+	12.2

TL 21 NW 5 2242 1719 Catchpole Wood, Codicote **Block C**

Surface level (+74.7 m) +245 ft
Water not struck
Shell and auger 8-inch (203 mm) diameter
April 1972

Waste 2.3 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown, silty, some flint pebbles	2.0	2.3
Upper Chalk	Chalk, white, soft, some flints	0.7+	3.0

TL 21 NW 6 2271 1654 Near Welwyn Village **Block A**

Surface level (+72.5 m) +238 ft
Water struck (+56.0 m)
August 1972

Waste 19.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
Boulder Clay	Clay, brown and grey, chalky, some flint pebbles, thin sand at 16.5 m	18.3+	19.2

TL 21 NW 7 **2387 1803** **Pottersheath, Codicote** **Block C**

Surface level (+121.9 m) +400 ft
Water not struck
February 1972

Overburden 0.1 m
Mineral 2.3 m
Bedrock 5.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint with quartz Sand: medium and coarse	2.3	2.4
Lower London Tertiaries	Clay, red, grey and brown,with some flint and quartz pebbles	1.1	3.5
	'Very clayey' sand, coarse flints at base Sand: fine, some grey clay nodules and trace of flint and quartz pebbles	3.5	7.0
	Clay, stiff, brown and black, with fine and coarse flints	0.8	7.8
Upper Chalk	Chalk	0.2+	8.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
7	24	69	0.1–1.1	10	4	7	5	31	43	0
			1.1–2.1	4	4	11	15	36	30	0
			2.1–2.4	10	6	19	1	32	32	0
			Mean	7	5	10	9	33	36	0
Sand in the Lower London Tertiaries (not included in the assessment)										
33	64	3	3.5–4.5	29	57	13	1	0	0	0
			4.5–5.5	34	60	5	0	0	1	0
			5.5–6.5	40	53	5	0	1	1	0
			6.5–7.0	23	53	7	3	8	6	0
			Mean	33	56	8	0	2	1	0

TL 21 NW 8 **2362 1554** **Near Welwyn** **Block E**

Surface level (+65.8 m) +216 ft
Water struck (+61.3 m)
February 1972

Overburden 5.8 m
Mineral 4.7 m
Waste 19.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, brown and grey, silty, chalky, some flint pebbles	3.7	3.8
Glacial Sand and Gravel	Clay, brown, sandy	2.0	5.8
	Gravel Gravel: fine and coarse, subangular and subrounded flint and quartz Sand: medium with some fine	4.7	10.5
	Clay, brown, sandy	0.5	11.0
Boulder Clay	Clay, brown and grey, chalky	19.0+	30.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
7	41	52	5.8–6.5	26	42	31	1	0	0	0
			6.5–7.5	4	8	17	7	28	36	0
			7.5–8.5	2	3	28	11	24	28	4
			8.5–9.5	4	2	20	12	32	30	0
			9.5–10.5	4	6	19	10	21	35	5
			Mean	7	10	23	8	23	27	2

TL 21 NW 9 2451 1834 Mardley Heath, Welwyn **Block C**

Surface level (+120.7 m) +396 ft
Water not struck
March 1972

Overburden 0.1 m
Mineral 4.3 m
Waste 1.3 m
Mineral 4.0 m
Waste 0.7 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial Sand and Gravel	**a** Gravel Gravel: fine and coarse with trace of cobbles, subangular to rounded flint and quartz Sand: medium and coarse	4.3	4.4
? Boulder Clay	Clay, brown, soft, micaceous	0.2	4.6
	Clay, stiff, mottled red and grey	1.1	5.7
Glacial Sand and Gravel	**b** 'Clayey' gravel Gravel: fine with coarse, subangular to rounded flint with subrounded to rounded quartz Sand: medium with coarse, some stiff brown clay	4.0	9.7
	Clay, stiff, brown mottled black, with flint and quartz pebbles	0.7	10.4
Upper Chalk	Chalk, white	0.6+	11.0

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	4	31	65	0.1–1.1	1	2	9	13	21	49	5
				1.1–2.1	3	1	12	19	31	34	0
				2.1–3.1	9	4	13	19	23	32	0
				3.1–4.1	3	3	7	16	37	31	3
				4.1–4.4	8	8	30	9	29	16	0
				Mean	4	3	12	16	28	35	2
b	11	36	53	5.7–6.7	20	2	5	7	34	32	0
				6.7–7.7	3	5	24	18	33	15	0
				7.7–8.7	9	7	25	11	31	17	0
				8.7–9.7	13	4	22	13	24	21	3
				Mean	11	5	19	12	30	22	1
a+b	8	33	59	Mean	8	4	15	14	29	29	1

TL 21 NW 10 2415 1649 Lockleys Farm, Welwyn **Block C**

Surface level (+117.0 m) +384 ft
Water not struck
September 1972

Overburden 2.8 m
Mineral 1.0 m
Waste 7.8 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	Clay, brown, sandy, some flint and quartz pebbles	2.4	2.8
	'Clayey' gravel Gravel: fine, subangular to well rounded flint and quartz Sand: medium and coarse	1.0	3.8
	Clay, pale brown and grey, sandy, some flint pebbles	7.8	11.6
Upper Chalk	Chalk, white	0.1+	11.7

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
11	39	50	2.8–3.8	11	12	16	11	31	19	0

TL 21 NW 11 2071 1785 The Elms, Codicote **Block B**

Surface level (+74.1 m) +243 ft
Water struck at (+73.0 m)
July 1972

Overburden 1.1 m
Mineral 4.2 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	Clay, chalky and sandy	0.9	1.1
Sub-Alluvial Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: coarse with medium	4.2	5.3
Upper Chalk	Chalk, white, soft	0.1+	5.4

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
9	22	69	1.1–3.0	2	1	10	13	30	44	0
			3.0–3.3 clay band *							
			3.3–4.3	0	1	1	12	53	33	0
			4.3–5.3	2	1	16	17	30	34	0
			Mean	9	1	8	13	33	36	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NW 12 2384 1889 Rabley Heath Farm, Welwyn **Block C**

Surface level (+128.6 m) +422 ft
Water not struck
July 1972

Waste 8.7 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Clay-with-flints	Clay, brown and grey, silty, some flint pebbles	6.0	6.3
	Clay, brown, silty	2.4	8.7
Upper Chalk	Chalk, white, soft	0.3+	9.0

TL 21 NE 1 2563 1845 Woolmer Green, Welwyn **Block C**

Surface level (+91.1 m) +299 ft
Water not struck
January 1972

Waste 9.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	1.2	1.2
Boulder Clay	Clay, orange-brown and grey, sandy	5.9	7.1
Glacial Sand and Gravel	Sand: fine and medium, some clay in matrix	1.9	9.0
Upper Chalk	Chalk, white, soft	0.2+	9.2

TL 21 NE 2 2548 1680 Harmer Green, Welwyn **Block C**

Surface level (+122.5 m) +402 ft
Water not struck
February 1972

Waste 9.3 m
Bedrock 5.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, orange-brown, with some chalk and flint pebbles at top	7.0	7.3
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium with coarse	2.0	9.3
Lower London Tertiaries	'Very clayey' sand: fine, some thin grey clay bands throughout and some fine black rounded flints at base	5.0	14.3
	Clay, contains coarse black flints	0.5	14.8
Upper Chalk	Chalk, white	0.1+	14.9

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
8	51	41	7.3–8.3	6	5	29	11	19	30	0
			8.3–9.3	10	6	34	16	20	14	0
			Mean	8	6	31	14	19	22	0
Sand in the Lower London Tertiaries (not included in the assessment)										
30	69	1	9.3–10.3	22	73	5	0	0	0	0
			10.3–11.3	18	79	2	1	0	0	0
			11.3–12.3	36	60	3	0	1	0	0
			12.3–13.3	30	69	1	0	0	0	0
			13.3–14.3	43	48	4	1	3	1	0
			Mean	30	66	3	0	1	0	0

TL 21 NE 3 2629 1954 Datchworth Village **Block C**

Surface level (+ 115.8 m) +380 ft
Water not struck
December 1971

Waste 10.2 m
Bedrock 0.3 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
? Glacial Sand and Gravel	Clay, orange-brown, some flint pebbles, sand from 7.6 m to 7.9 m	9.4	10.2
Upper Chalk	Chalk	0.3 +	10.5

TL 21 NE 4 2646 1849 Datchworth Green **Block C**

Surface level (+95.7 m) +314 ft
Water not struck
December 1971

Overburden 5.0 m
Mineral 5.6 m
Waste 2.0 m
Bedrock 0.4 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Boulder Clay	Clay, orange-brown, with flint pebbles	4.4	5.0
Glacial Sand and Gravel	'Clayey' gravel Gravel: coarse with fine and trace of cobbles, subangular to rounded flint with a trace of quartz Sand: medium with coarse	5.6	10.6
	Gravel: contains mostly chalk pebbles	2.0	12.6
Upper Chalk	Chalk	0.4 +	13.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
11	38	51	5.0–6.0	13	7	15	9	21	35	0
			6.0–7.0	12	7	23	13	16	24	5
			7.0–8.0	12	6	22	11	10	29	0
			8.0–9.0	17	4	10	11	14	24	10
			9.0–10.0	2	4	14	17	10	33	0
			10.0–10.6	5	9	30	11	17	28	0
			Mean	11	5	20	13	19	29	3

TL 21 NE 5 2623 1769 Welch's Farm, Welwyn **Block C**

Surface level (+94.5 m) +310 ft
Water not struck
February 1972

Overburden 5.8 m
Mineral 4.6 m
Bedrock 0.2 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown and grey, chalky, stiff	5.5	5.8
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: fine with coarse, subangular to rounded flint and quartz with limestone and chalk Sand: fine and medium	4.6	10.4
Upper Chalk	Chalk	0.2 +	10.6

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
19	56	25	5.8–6.8	39	28	20	7	5	1	0
			6.8–7.8	15	25	40	8	12	0	0
			7.8–8.8	19	45	26	3	6	1	0
			8.8–9.8	5	7	19	15	38	16	0
			9.8–10.4	13	10	11	8	22	36	0
			Mean	19	24	24	8	16	9	0

TL 21 NE 6 2640 1658 Burnham Green, Datchworth **Block C**

Surface level (+125.0 m) +410 ft
Water not struck
April 1972

Overburden 1.5 m
Mineral 3.4 m
Waste 0.2 m
Bedrock 7.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.5	0.5
Boulder Clay	Clay, red-brown, stiff, contains some sand pockets and gravel	1.0	1.5
Glacial Sand and Gravel	'Clayey' sandy gravel, sandy at top Gravel: fine with coarse Sand: medium, black carbonaceous streaks between 2.5 m and 3.5 m	3.4	4.9
	Clay, contains some sand and gravel	0.2	5.1
Lower London Tertiaries	Clay, grey and brown, silty	0.6	5.7
	'Very clayey' sand, stiff grey clay between 8.0 m and 8.7 m Sand: fine, brown and grey, some thin grey clay seams	5.6	11.3
	Clay, grey and brown, stiff with fine sand	0.5	11.8
	Clay, brown and black, stiff with flint pebbles	0.4	12.2
Upper Chalk	Chalk, soft, white	0.1+	12.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
10	62	28	1.5–2.5	12	5	65	5	11	2	0
			2.5–3.5	12	3	62	5	13	5	0
			3.5–4.5	6	3	36	11	25	19	0
			4.5–4.9	10	6	30	3	30	21	0
			Mean	10	4	51	7	18	10	0
Sand in the Lower London Tertiaries (not included in the assessment)										
28	72	0	5.7–6.7	16	81	2	1	0	0	0
			6.7–7.7	6	91	2	1	0	0	0
			7.7–8.0	22	71	6	1	0	0	0
			8.0–8.7 clay band *							
			8.7–9.7	19	77	3	1	0	0	0
			9.7–10.7	12	76	11	1	0	0	0
			10.7–11.3	49	44	4	2	1	0	0
			Mean	28	67	4	1	0	0	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NE 7 2647 1586 Tewin Wood, Tewin **Block C**

Surface level (+119.2 m) +391 ft
Water not struck
January 1972

Waste 18.0 m
Bedrock 6.3 m

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Glacial Sand and Gravel	Clay, brown and grey, thin seams of sand and gravel	17.7	18.0
Lower London Tertiaries	Clay, orange-brown and grey, contains sand pockets and some coarse flints at base	6.1	24.1
Upper Chalk	Chalk, white, hard	0.2+	24.3

TL 21 NE 8 2706 1753 Bull's Green, Datchworth **Block C**

Surface level (+121.0 m) +397 ft
Water not struck
January 1972

Overburden 1.6 m
Mineral 1.0 m
Bedrock 10.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Boulder Clay	Clay, orange-brown, trace of flint and quartz pebbles	0.8	1.6
Glacial Sand and Gravel	'Very clayey' sandy gravel Gravel: fine with coarse, flint and quartz Sand: medium with fine	1.0	2.6
Lower London Tertiaries	Clay, red, brown and grey, micaceous	2.9	5.5
	Clay, pale brown, sandy	1.0	6.5
	'Very clayey' sand, coarse flint pebbles at base: fine, silty	6.7	13.2
Upper Chalk	Chalk, white, with flints	0.1+	13.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
23	43	34	1.6–2.6	23	14	22	7	22	12	0
Sand in the Lower London Tertiaries (not included in the assessment)										
30	66	4	6.5–7.5	35	54	5	2	2	2	0
			7.5–8.5	19	74	4	1	0	2	0
			8.5–9.5	29	66	3	0	1	1	0
			9.5–10.5	25	71	3	1	0	0	0
			10.5–11.5	37	49	10	2	1	1	0
			11.5–12.5	32	33	33	2	0	0	0
			12.5–13.2	34	31	10	3	8	14	0
			Mean	30	55	10	1	2	2	0

TL 21 NE 9 2769 1634 Nancybury, Tewin **Block C**

Surface level (+122.5 m) +402 ft
Water not struck
January 1972

Overburden 1.1 m
Mineral 1.8 m
Bedrock 14.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Boulder Clay	Soil and sandy clay	1.1	1.1
Glacial Sand and Gravel	'Clayey' pebbly sand, gravelly at base Gravel: fine with coarse, subangular and subrounded flint Sand: medium, grey-brown	1.8	2.9
Lower London Tertiaries	Clay, dark grey, mottled brown, stiff	2.8	5.7
	Clay, brown, silty, sand and fine chalk pebbles at base	5.2	10.9
	'Very clayey' sand: fine, thin grey clay seams throughout	4.7	15.6
	Clay, grey, with sand pockets and bands of fine, rounded flint pebbles	1.6+	17.2

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
13	70	17	1.1–2.1	17	5	63	5	8	2	0
			2.1–2.6	8	9	51	16	13	3	0
			2.6–2.9	10	6	29	11	20	19	5
			Mean	13	7	54	9	11	5	1
Sand in the Lower London Tertiaries (not included in the assessment)										
26	74	0	10.9–11.9	29	66	5	0	0	0	0
			11.9–12.9	32	64	3	1	0	0	0
			12.9–13.9	23	75	2	0	0	0	0
			13.9–14.9	18	77	5	0	0	0	0
			14.9–15.6	28	68	3	0	0	0	0
			Mean	26	70	4	0	0	0	0

TL 21 NE 10 2729 1522 Tewin **Block D**

Surface level (+85.6 m) +281 ft
Water not struck
January 1972

Overburden 0.8 m
Mineral 3.5 m
Waste 3.1 m
Mineral 3.9 m
Waste 2.7 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, orange-brown, silty, contains flints	0.5	0.8
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flints with subrounded quartz Sand: medium, orange-brown	3.5	4.3
Boulder Clay	Clay, dark grey, stiff, chalky	3.1	7.4
Glacial Sand and Gravel	**b** Pebbly sand, gravel content increases to base Gravel: fine and coarse, subangular to rounded flint with some quartz Sand: medium, orange-brown	3.9	11.3
	Silt, brown, sandy, contains some fine flint pebbles	2.7	14.0
Upper Chalk	Chalk, soft, white	0.2+	14.2

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	13	54	33	0.8–1.2	15	25	30	4	14	12	0
				1.2–2.0	17	14	44	8	10	7	0
				2.0–2.5	7	12	26	16	25	14	0
				2.5–3.0	11	25	57	1	4	2	0
				3.0–4.0	12	6	20	13	27	22	0
				4.0–4.3	15	3	9	11	29	33	0
				Mean	13	13	32	9	18	15	0
b	9	79	12	7.4–8.2	6	24	67	2	0	1	0
				8.2–9.2	15	18	49	13	5	0	0
				9.2–10.2	5	16	58	4	11	6	0
				10.2–11.0	5	8	55	12	10	10	0
				11.0–11.3	23	17	21	9	15	15	0
				Mean	9	17	54	8	7	5	0
a+b	11	67	22	Mean	11	15	44	8	12	10	0

TL 21 NE 11 2879 1967 Broom Hall, Watton-at-Stone **Block D**

Surface level (+79.2 m) +260 ft
Water not struck
January 1972

Overburden 1.2 m
Mineral 4.8 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Glacial Sand and Gravel	Clay, sandy with some flint pebbles	0.4	1.2
	Sandy gravel Gravel: fine with coarse, angular to subrounded flint and some chalk Sand: medium with coarse	4.8	6.0
Upper Chalk	Chalk	0.3+	6.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
7	53	40	1.2–2.2	11	5	36	15	17	16	0
			2.2–3.2	8	5	18	22	29	18	0
			3.2–4.2	6	4	26	17	24	23	0
			4.2–5.2	4	6	40	18	21	11	0
			5.2–6.0	5	5	34	15	26	15	0
			Mean	7	5	31	17	23	17	0

TL 21 NE 12 2842 1727 New Wrens Wood, Watton-at-Stone Block C

Surface level (+121.0 m) +397 ft
Water not struck
January 1972

Waste 3.1 m
Bedrock 9.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Boulder Clay	Clay, orange-brown, stiff, contains fine flint pebbles	2.6	3.1
Lower London Tertiaries	Clay, orange-brown, silty, sandy at base	2.2	5.3
	'Very clayey' sand, pebbly at base: fine, brown and grey, grey clay between 10.5 m and 11.0 m	6.7	12.0
	Clay, brown and grey, contains fine flint pebbles	0.1	12.1
Upper Chalk	Chalk, white	0.1+	12.2

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
Sand in the Lower London Tertiaries (not included in the assessment)										
34	63	3	5.3–6.3	32	60	3	1	3	1	0
			6.3–7.3	21	74	3	0	1	1	0
			7.3–8.3	27	62	9	1	1	0	0
			8.3–9.3	32	60	6	0	1	1	0
			9.3–10.5	32	63	4	0	1	0	0
			10.5–11.0 clay band *							
			11.0–12.0	28	47	11	4	4	6	0
			Mean	34	57	5	1	2	1	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NE 13 2821 1658 Open Bailey Plantation, Bramfield **Block C**

Surface level (+120.1 m) +394 ft
Water not struck
January 1972

Overburden 1.5 m
Mineral 1.5 m
Waste 6.0 m
Bedrock 7.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Glacial Sand and Gravel	Clay, stiff, brown, contains fine subangular flints and round quartz pebbles	0.9	1.5
	'Clayey' gravel Gravel: fine with coarse, subangular to rounded flint with some rounded quartz Sand: medium, contains stiff brown clay	1.5	3.0
Boulder Clay	Clay, grey and brown, stiff, some fine flint and quartz pebbles and sand pockets	6.0	9.0
Lower London Tertiaries	**a** 'Very clayey' sand: fine, brown and grey, clay seams throughout	5.2	14.2
	Clay, grey, stiff, iron stained	1.0	15.2
	b 'Very clayey' sand: fine and medium, some grey clay bands and fine rounded flint pebbles	1.6	16.8
Upper Chalk	Chalk, white	0.1+	16.9

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
14	41	45	1.5–2.5	19	8	25	8	25	15	0
			2.5–3.0	3	11	21	11	27	27	0
			Mean	14	9	24	8	26	19	0
Sand in the Lower London Tertiaries (not included in the assessment)										
a	39	60	1	9.0–10.0	39	57	2	1	1	0	0
				10.0–11.0	23	65	10	1	1	0	0
				11.0–12.0	40	57	2	0	1	0	0
				12.0–12.2	44	52	4	0	0	0	0
				12.2–12.6 clay band *							
				12.6–13.6	28	70	2	0	0	0	0
				13.6–14.2	39	57	4	1	1	0	0
				Mean	39	56	4	0	1	0	0
b	27	71	2	15.2–16.2	26	34	36	1	1	2	0
				16.2–16.8	28	48	22	1	0	1	0
				Mean	27	39	31	1	0	2	0
a+b	38	62	0	Mean	38	52	10	0	0	0	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NE 14 2864 1538 Bramfieldbury **Block D**

Surface level (+85.6 m) +281 ft
Water Struck at (+82.6 m)
January 1972

Overburden 1.0 m
Mineral 3.5 m
Waste 5.6 m
Mineral 5.9 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, orange-brown, stiff	0.8	1.0
Glacial Sand and Gravel	**a** 'Very clayey' sandy gravel, clay band 1.8 m to 2.0 m Gravel: fine and coarse, subangular to rounded flint with some rounded quartz Sand: fine and medium, brown	3.5	4.5
Boulder clay	Clay, brown and dark grey, with some chalk pebbles	5.6	10.1
Glacial Sand and Gravel	**b** Gravel, gravel content increases with depth Gravel: fine and coarse, angular to rounded flint with subrounded quartz Sand: medium, with some fine and coarse	5.9	16.0
Upper Chalk	Chalk, white	0.1+	16.1

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	23	55	22	0.8–1.8	17	7	15	14	33	14	0
				1.8–2.0 clay band *							
				2.0–3.0	22	58	19	0	1	0	0
				3.0–4.0	18	26	36	6	7	7	0
				4.0–4.5	14	13	13	12	26	22	0
				Mean	23	28	20	7	14	8	0
b	5	47	48	10.1–11.1	3	9	57	8	13	10	0
				11.1–12.1	5	8	31	12	30	14	0
				12.1–13.1	3	13	29	10	32	13	0
				13.1–14.1	4	7	14	14	27	34	0
				14.1–15.1	4	5	18	14	30	29	0
				15.1–16.0	10	10	16	12	31	25	0
				Mean	5	8	28	11	27	21	0
a+b	12	50	38	Mean	12	16	25	9	22	16	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NE 15 2943 1909 Near Watton-at-Stone **Block D**

Surface level (+77.1 m) +253 ft
Water not struck
January 1972

Overburden 1.6 m
Mineral 1.4 m
Bedrock 0.5 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Glacial Sand and Gravel	Clay, pale brown, with flint and chalk pebbles	0.8	1.6
	'Clayey' sandy gravel Gravel: fine with some coarse and a trace of cobbles, subangular to subrounded flint Sand: medium with coarse	1.4	3.0
Upper Chalk	Chalk	0.5 +	3.5

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
17	46	37	1.6–2.6	16	7	27	16	28	6	0
			2.6–3.0	19	9	15	13	20	17	7
			Mean	17	7	24	15	26	9	2

TL 21 NE 16 2965 1825 Penywood Lane, Watton-at-Stone **Block D**

Surface level (+74.7 m) +245 ft
Water not struck
January 1972

Overburden 1.5 m
Mineral 2.2 m
Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, brown, sandy	1.3	1.5
Glacial Sand and Gravel	'Very clayey' gravel Gravel: fine and coarse with cobbles, subangular to rounded flint and quartz Sand: fine, medium and coarse, some brown clay in matrix	2.2	3.7
Upper Chalk	Chalk, white, soft	0.1 +	3.8

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
21	33	46	1.5–2.0	27	12	12	8	17	16	8
			2.0–3.0	12	11	14	10	17	20	16
			3.0–3.7	28	9	12	10	15	16	10
			Mean	21	10	13	10	16	18	12

TL 21 NE 17 2966 1581 Bramfield House, Bramfield **Block D**

Surface level (+81.4 m) +267 ft
Water not struck
January 1972

Overburden 7.8 m
Mineral 5.1 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown, sandy with chalk and flint pebbles	7.5	7.8
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium with coarse	5.1	12.9
Upper Chalk	Chalk	0.2+	13.1

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
10	39	51	7.8–8.3	27	11	18	8	21	15	0
			8.3–8.4 clay band *							
			8.4–9.4	7	18	25	10	26	14	0
			9.4–10.4	8	7	12	12	34	24	0
			10.4–11.4	3	6	16	14	28	27	0
			11.4–12.3	4	8	29	10	32	30	0
			12.3–12.9	8	5	18	12	28	18	0
			Mean	10	9	18	12	28	23	0

* Assumed to comprise 100% fines in calculating mean grading

TL 21 NE 18 2790 1825 Rivershill Green, Watton-at-Stone **Block C**

Surface level (+112.5 m) +369 ft
Water not struck
July 1972

Waste 5.2 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Boulder Clay	Clay, orange-brown and grey, with fine and coarse flint and quartz pebbles, some sand pockets	4.6	5.2
Upper Chalk	Chalk, pale yellow, soft	0.3+	5.5

TL 21 NE 19 2906 1700 Bright's Hill Plantation, Bramfield **Block C**

Surface level (+119.8 m) +393 ft
Water struck at (+116.8 m)
September 1972

Overburden 1.4 m
Mineral 3.2 m
Bedrock 12.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	Clay, orange-brown, sandy, some flint and quartz pebbles	1.0	1.4
	'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium, some brown clay in matrix	3.2	4.6
Lower London Tertiaries	Clay, brown and dark grey, coarse flints at base	12.5	17.1
Upper Chalk	Chalk, white	0.1+	17.2

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
15	46	39	1.4–2.4	14	4	29	10	28	15	0
			2.4–4.6	16	4	35	8	19	18	0
			Mean	15	4	34	8	22	17	0

TL 21 SW 2 2003 1352 Waterend, Wheathampstead **Block F**

Surface level (+89.6 m) +294 ft
Water not struck
July 1972

Waste 12.5 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Glacial Sand and Gravel	Clay, brown, silty, some pockets of fine and coarse flint gravel and medium and coarse sand	6.2	6.5
	Clay, brown mottled black, some flint pebbles	6.0	12.5
Upper Chalk	Chalk, white, soft	0.5+	13.0

TL21 SW 3 2076 1227 Cromer Hyde, Hatfield **Block F**

Surface level (+88.7 m) +291 ft
Water not struck
February 1972

Overburden 1.3 m
Mineral 3.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown, with flint and quartz pebbles	1.0	1.3
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine with coarse and some cobbles, subangular and subrounded flint and quartz Sand: medium and coarse	3.3	4.6
Upper Chalk	Chalk, white	0.2+	4.8

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
14	31	55	1.3–1.6	38	22	18	3	6	3	0
			1.6–2.6	12	6	12	17	46	17	0
			2.6–3.6	14	3	9	10	31	28	5
			3.6–4.6	9	6	12	13	24	31	5
			Mean	14	7	12	12	30	22	3

TL 21 SW 4 **2049 1172** **Cromerhyde Farm, Hatfield** **Block F**

Surface level (+86.9 m) 285 ft
Water not struck
February 1972

Overburden 2.4 m
Mineral 5.6 m
Waste 0.5 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, orange-brown and grey, with some flint and quartz pebbles	2.1	2.4
Glacial Sand and Gravel	Sandy Gravel Gravel: fine and coarse, subrounded flint and quartz Sand: medium with fine and coarse	5.6	8.0
	Clay, brown mottled black, with some coarse flints	0.5	8.5
Upper Chalk	Chalk, white	0.2+	8.7

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
9	52	39	2.4–3.4	11	20	25	11	16	17	0
			3.4–4.4	6	4	37	14	25	14	0
			4.4–5.4	9	2	36	27	14	12	0
			5.4–6.4	6	4	20	14	27	29	0
			6.4–7.4	5	7	12	12	30	34	0
			7.4–8.0	26	39	34	1	0	0	0
			Mean	9	11	27	14	20	19	0

TL 21 SW 5 2034 1031 Furze Field, Hatfield **Block F**

Surface level (+77.7 m) +255 ft
Water struck at (+67.9 m)
Shell and auger 8-inch (203 mm) diameter
June 1972

Overburden 3.2 m
Mineral 1.4 m
Waste 3.2 m
Mineral 6.0 m
Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, grey and brown, sandy, chalky	3.1	3.2
Glacial Sand and Gravel	**a** Gravel Gravel: fine and coarse, angular to rounded flint Sand: medium and coarse	1.4	4.6
Boulder Clay	Clay, grey and brown, chalky	3.2	7.8
Glacial Sand and Gravel	**b** Sandy gravel, very sandy at top Gravel: fine and coarse with occasional cobbles, subangular flints and rounded quartz Sand: medium, brown	6.0	13.8
Upper Chalk	Chalk, white, soft	0.1 +	13.9

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	9	34	57	3.2–4.6	9	5	16	13	39	18	0
b	7	49	44	7.8–8.8	19	30	47	3	1	0	0
				8.8–9.8	11	9	27	10	28	15	0
				9.8–10.8	3	7	23	5	29	33	0
				10.8–11.8	4	8	31	16	29	12	0
				11.8–12.8	2	5	23	11	20	32	7
				12.8–13.8	2	3	24	12	20	39	0
				Mean	7	10	28	10	21	22	1
a+b	7	46	47	Mean	7	9	27	10	25	21	1

TL 21 SW 6 2157 1262 Brocket Park, Hatfield **Block F**

Surface level (+74.4 m) +244 ft
Water struck at (+65.7 m)
February 1972

Overburden 0.2 m
Mineral 4.2 m
Waste 4.3 m
Mineral 2.5 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
	a 'Very clayey' sandy gravel, gravelly at top Gravel: fine and coarse, subangular to subrounded flint with quartz Sand: fine and medium, contains orange-brown and brown clay	4.2	4.4
Boulder Clay	Clay, dark grey and brown, stiff, chalky, scattered flint and quartz pebbles	4.3	8.7
Glacial Sand and Gravel	**b** 'Clayey' gravel Gravel: fine and coarse, angular to subrounded flint, with subrounded quartz Sand: medium and coarse, with grey and brown clay, chalky at base	2.5	11.2
Upper Chalk	Chalk, white, soft	0.5+	11.7

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	23	39	38	0.2–1.2	8	3	8	12	37	32	0
				1.2–2.2	9	5	15	11	35	25	0
				2.2–3.2	26	20	32	7	12	3	0
				3.2–4.2	25	47	15	4	5	6	0
				4.2–4.4	28	19	15	9	15	14	0
				Mean	23	13	18	8	22	16	0
b	12	30	58	8.7–9.7	4	5	12	17	26	36	0
				9.7–10.7	20	4	8	10	31	27	0
				10.7–11.2	9	7	19	13	28	24	0
				Mean	12	4	13	13	28	30	0
a+b	19	35	46	Mean	19	10	15	10	24	22	0

TL 21 SW 7 2176 1149 New Gosmoor, Hatfield **Block F**

Surface level (+79.6 m) +261 ft
Water struck at (+74.6 m) and (+66.3 m)
March 1972

Overburden 1.7 m
Mineral 6.0 m
Waste 4.6 m
Mineral 4.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, grey and brown, stiff, contains some flint pebbles	1.5	1.7
Glacial Sand and Gravel	**a** Gravel Gravel: fine and coarse, subangular to rounded flint and rounded quartz Sand: medium, with fine and coarse	6.0	7.7
Boulder Clay	Clay, dark grey and brown, chalky	4.6	12.3
Glacial Sand and Gravel	**b** Gravel, 'clayey' and sandy at top Gravel: fine and coarse, angular to rounded flint, with some rounded quartz Sand: medium with some fine and coarse	4.0	16.3
Upper Chalk	Chalk, white	0.1+	16.4

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	6	47	47	1.7–2.7	16	14	29	11	19	11	0
				2.7–3.7	7	8	25	7	25	23	5
				3.7–4.7	7	12	40	4	11	26	0
				4.7–5.7	3	3	15	12	41	26	0
				5.7–6.7	2	7	22	12	27	30	0
				6.7–7.7	3	8	35	17	24	13	0
				Mean	6	9	28	10	25	21	1
b	7	40	53	12.3–13.3	18	31	44	3	3	1	0
				13.3–14.3	5	7	19	8	30	31	0
				14.3–15.3	1	3	17	6	26	47	0
				15.3–16.3	2	3	11	10	33	41	0
				Mean	7	11	22	7	23	30	0
a+b	6	45	49	Mean	6	10	26	9	24	25	0

TL 21 SW 8 2127 1066 Whitegate Cottages, Hatfield **Block F**

Surface level (+78.3 m) +257 ft
Water struck at (+63.9 m)
Shell and auger 8-inch (203 mm) diameter
March 1972

Overburden 0.8 m
Mineral 7.9 m
Waste 2.7 m
Mineral 6.6 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown and orange-brown, contains flint and quartz pebbles	0.5	0.8
Glacial Sand and Gravel	**a** Sandy gravel, sand content increases with depth Gravel: fine and coarse, subangular and rounded flint and quartz Sand: medium, brown	7.9	8.7
Boulder Clay	Clay, dark grey and brown, chalky, contains flint and quartz and some shale pebbles	2.7	11.4
Glacial Sand and Gravel	**b** Gravel Gravel: fine and coarse subangular flint and some quartz Sand: medium with some coarse and fine	6.6	18.0
Upper Chalk	Chalk, soft	0.2+	18.2

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	5	66	29	0.8–1.8	8	7	17	11	27	30	0
				1.8–2.8	7	9	20	9	29	26	0
				2.8–3.8	6	5	33	7	28	21	0
				3.8–4.8	4	5	47	4	16	24	0
				4.8–5.8	4	11	61	5	8	11	0
				5.8–6.8	4	56	33	1	2	4	0
				6.8–7.8	6	6	86	1	1	0	0
				7.8–8.7	4	9	83	3	1	0	0
				Mean	5	14	47	5	14	15	0
b	4	44	52	11.4–12.4	5	6	35	11	32	11	0
				12.4–13.4	6	10	32	13	27	12	0
				13.4–14.4	4	10	36	18	24	18	0
				14.4–15.4	4	4	27	15	29	11	0
				15.4–16.4	0	6	18	13	33	30	0
				16.4–17.4	5	2	14	9	35	35	0
				17.4–18.0	1	4	21	14	29	31	0
				Mean	4	6	26	12	31	21	0
a+b	5	57	38	Mean	5	10	38	9	21	17	0

TL 21 SW 9 **2240 1423** **Red Lion, Welwyn** **Block F**

Surface level (+127.7 m) +419 ft
Water not struck
March 1972

Overburden 0.8 m
Mineral 4.8 m
Bedrock 12.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, brown, with scattered pebbles	0.5	0.8
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium with a trace of fine and coarse	4.8	5.6
London Clay	Clay, stiff, brown mottled black and green, micaceous	5.2	10.8
Lower London Tertiaries	'Very clayey', pebbly sand Sand: fine with some coarse and medium and with traces of gravel Clay: stiff, pale grey occurring in bands	7.0	17.8
	Sand with large modular flints	0.4	18.2
Upper Chalk	White chalk	0.1+	18.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
11	49	40	0.8–1.8	16	6	57	6	12	3	0
			1.8–2.8	12	8	65	7	5	3	0
			2.8–3.8	10	6	29	10	20	25	0
			3.8–4.8	9	5	11	11	30	34	0
			4.8–5.6	7	4	10	7	36	36	0
			Mean	11	6	35	8	20	20	0
Sand in the Lower London Tertiaries (not included in the assessment)										
25	68	7	10.8–11.8	15	29	54	2	0	0	0
			11.8–12.8	14	27	57	2	0	0	0
			12.8–13.8	27	57	15	1	0	0	0
			13.8–14.8	16	79	4	1	0	0	0
			14.8–15.8	28	49	6	2	10	7	0
			15.8–16.8	35	39	5	4	5	12	0
			16.8–17.8	42	32	11	2	2	11	0
			Mean	25	45	21	2	3	4	0

TL 21 SW 10 **2219 1275** **Lemsford, Hatfield** **Block F**

Surface level c. (+88.4 m) c. +290 ft
Water not struck
February 1972

Overburden 4.4 m
Mineral 5.1 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
? Glacial Sand and Gravel	Clay, orange-brown, some flint pebbles	0.8	1.1
	'Very clayey' sandy gravel: fine and coarse flint gravel with fine sand	0.4	1.5
? Boulder Clay	Clay, orange-brown and grey, with some flint pebbles	2.9	4.4
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint Sand: medium with coarse and some fine	5.1	9.5
Upper Chalk	Chalk, hard	0.3+	9.8

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
4	41	55	4.4–5.4	6	16	48	9	11	10	0
			5.4–6.4	8	5	29	11	25	22	0
			6.4–7.4	1	2	7	5	38	47	0
			7.4–8.4	5	7	21	13	24	30	0
			8.4–9.4	1	5	13	11	33	37	0
			9.4–9.5	5	7	17	13	25	24	9
			Mean	4	7	24	10	26	29	0

TL 21 SW 11 **2249 1055** **Stanborough, Hatfield** **Block F**

Surface level (+76.5 m) +251 ft
Water struck at (+66.0 m)
February 1972

Overburden 0.8 m
Mineral 6.1 m
Waste 3.1 m
Mineral 1.9 m
Waste 1.8 m
Mineral 1.6 m
Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium, some brown clay in matrix	6.1	6.9
Boulder Clay	Clay, dark grey and brown, contains flint, quartz and chalk pebbles and Jurassic fossils	3.1	10.0
Glacial Sand and Gravel	**b** Pebbly sand Gravel: fine and coarse, subangular flint with quartz Sand: medium	1.9	11.9
Boulder Clay	Clay, dark grey, contains chalk, flint and quartz pebbles	1.8	13.7
Glacial Sand and Gravel	**c** 'Clayey' pebbly sand Gravel: fine, flint and chalk pebbles Sand: medium and fine	1.6	15.3
Upper Chalk	Chalk, white, soft	0.9+	16.2

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	16	47	37	0.8–1.8	7	5	31	11	21	25	0
				1.8–2.8	11	20	28	8	19	14	0
				2.8–3.8	34	22	17	15	6	6	0
				3.8–4.8	11	10	17	13	27	22	0
				4.8–5.8	14	5	12	8	35	26	0
				5.8–6.9	20	14	33	13	15	5	0
				Mean	16	13	23	11	21	16	0
b	7	82	11	10.0–11.0	8	21	56	4	5	6	0
				11.0–11.9	5	10	72	3	5	5	0
				Mean	7	16	63	3	5	6	0
c	14	78	8	13.7–14.7	13	33	46	5	2	1	0
				14.7–15.3	17	30	28	9	10	6	0
				Mean	14	32	40	6	5	3	0
a+b+c	12	59	29	Mean	12	16	34	9	15	14	0

TL 21 SW 12 2358 1060 Woodhall Farm, Hatfield **Block E**

Surface level (+69.5 m) +228 ft
Water struck at (+58.5 m)
August 1972

Overburden 1.8 m
Mineral 4.2 m
Waste 3.1 m
Mineral 2.7 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Sand and Gravel	Clay, brown, some flint and quartz pebbles	1.6	1.8
	a Sand: medium with fine	4.2	6.0
Boulder Clay	Clay, dark grey, with chalk and flint pebbles	3.1	9.1
Glacial Sand and Gravel	**b** Gravel Gravel: fine with coarse, subangular to rounded flint and quartz Sand: coarse with medium	2.7	11.8
Upper Chalk	Chalk, white, soft	0.1+	11.9

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	7	93	0	1.8–2.8	8	19	71	2	0	0	0
				2.8–3.8	4	25	69	2	0	0	0
				3.8–4.8	13	32	54	1	0	0	0
				4.8–6.0	5	38	56	1	0	0	0
				Mean	7	29	63	1	0	0	0
b	3	27	70	9.1–11.0	3	2	11	12	40	32	0
				11.0–11.8	2	2	14	17	43	22	0
				Mean	3	2	11	14	41	29	0
a+b	6	66	28	Mean	6	18	42	6	16	12	0

TL 21 SW 13 **2459 1061** **Ascots, Hatfield** **Block E**

Surface level (+73.2 m) +240 ft
Water struck at (+68.2 m) and (+57.7 m)
August 1972

Overburden 5.0 m
Mineral 1.3 m
Waste 4.2 m
Mineral 6.4 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
? Boulder Clay	Clay, brown and grey, silty	4.4	5.0
Glacial Sand and Gravel	**a** Gravel Gravel: fine with coarse, subangular to rounded flint and quartz Sand: medium and coarse	1.3	6.3
Boulder Clay	Clay, dark grey, contains flint and quartz pebbles	4.2	10.5
Glacial Sand and Gravel	**b** Gravel Gravel: fine and coarse, subangular to rounded flint with subrounded quartz Sand: medium with coarse and some fine	6.4	16.9
Upper Chalk	Chalk, white, soft	0.7+	17.6

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	3	33	64	5.0–6.0	2	2	14	17	41	24	0
				6.0–6.3	5	4	20	11	35	25	0
				Mean	3	2	16	15	40	24	0
b	17	37	56	10.5–11.5	22	18	15	5	27	13	0
				11.5–12.5	7	7	11	21	40	14	0
				12.5–13.5	5	13	19	13	29	21	0
				13.5–14.5	5	7	20	13	30	25	0
				14.5–15.5	3	9	16	9	27	26	0
				15.5–16.5	1	0	10	13	46	30	0
				16.5–16.9	1	4	14	8	28	45	0
				Mean	7	8	17	12	33	23	0
a+b	6	36	58	Mean	6	7	16	13	35	23	0

TL 21 SE 7 **2566 1014** **Hertford Road, Hatfield** **Block E**

Surface level (+60.7 m) +199 ft
Water not struck
August 1972

Overburden 2.3 m
Mineral 7.7 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, flint Sand: medium and coarse	0.8	1.2
Boulder Clay	Clay, brown with flints	1.1	2.3
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subrounded flint Sand: medium with coarse	7.7	10.0
Upper Chalk	Chalk, white, soft	0.3+	10.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
6	38	56	2.3–3.3	5	3	23	13	34	22	0
			3.3–4.3	7	4	21	15	29	24	0
			4.3–5.3	5	3	13	13	23	33	0
			5.3–6.3	5	3	9	13	46	24	0
			6.3–7.3	2	7	22	19	25	25	0
			7.3–8.3	5	13	27	9	23	23	0
			8.3–10.0	9	14	15	7	23	32	0
			Mean	6	7	18	13	29	27	0

TL 21 SE 8 2653 1427 Tewinbury, Tewin **Block D**

Surface level (+70.1 m) +230 ft
Water not struck

Overburden 0.2 m
Mineral 5.0 m
Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium, some brown clay in matrix	5.0	5.2
Upper Chalk	Chalk, white, soft	0.1 +	5.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
10	39	51	0.2–1.2	14	5	17	8	19	37	0
			1.2–2.2	9	10	24	12	20	25	0
			2.2–3.2	15	13	34	8	19	11	0
			3.2–4.2	4	6	8	14	33	35	0
			4.2–5.2	9	5	20	11	32	23	0
			Mean	10	8	21	10	25	26	0

TL 21 SE 9 2662 1337 Panshanger Aerodrome **Block E**

Surface level (+76.2 m) +250 ft
Water not struck
July 1972

Mineral 7.0 m
Bedrock 0.2 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel	Gravel Gravel: fine and coarse with some cobbles, subangular to rounded flint and quartz Sand: medium, some brown clay in matrix	7.0	7.0
Upper Chalk	Chalk, white, soft	0.2 +	7.2

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
10	37	53	0.0–1.0	12	4	16	6	24	38	0
			1.0–2.0	7	3	10	9	23	44	4
			2.0–3.0	17	5	16	14	26	22	0
			3.0–4.0	12	4	20	7	22	35	0
			4.0–5.0	13	9	60	7	6	5	0
			5.0–6.0	6	2	14	12	32	34	0
			6.0–7.0	5	3	24	10	29	26	0
			Mean	10	5	22	10	23	29	0

TL 21 SE 10 2618 1256 Panshanger Aerodrome Block E

Surface level (+78.3 m) +257 ft
Water not struck
July 1972

Overburden 1.8 m
Mineral 8.0 m
Waste 0.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Clay, brown, sandy, some flint pebbles	1.5	1.8
	'Clayey' gravel Gravel: fine and coarse, flint with quartz Sand: medium and coarse with fine, some brown clay in matrix	8.0	9.8
	Clay, brown	0.2	10.0
Upper Chalk	Chalk, white, soft	0.2+	10.2

GRADING

Mean for deposit *percentages*			Death below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
15	32	53	1.8–2.8	27	5	6	9	35	18	0
			2.8–3.8	15	4	29	13	26	13	0
			3.8–4.8	11	5	30	8	26	20	0
			4.8–5.8	10	5	13	10	17	45	0
			5.8–6.8	15	5	5	33	22	20	0
			6.8–7.8	9	6	11	9	21	44	0
			7.8–8.8	14	8	10	6	12	50	0
			8.8–9.8	16	9	14	8	34	19	0
			Mean	15	6	14	12	24	29	0

TL 21 SE 11 **2673 1167** **Welwyn Garden City** **Block E**

Surface level (+80.5 m) +264 ft
Water struck at (+71.3 m)
June 1972

Overburden 3.2 m
Mineral 10.5 m
Waste 5.3 m
Mineral 4.0 m
Bedrock 0.1 m +

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, brown, with chalk, flint and quartz pebbles	3.0	3.2
Glacial Sand and Gravel	**a** Sand: medium with fine, thin clay seam at 5.5 m	10.5	13.7
Boulder Clay	Clay, dark grey, chalky and silty	5.3	19.0
Glacial Sand and Gravel	**b** Sandy gravel Gravel: fine with coarse and occasional cobbles, flint and quartz Sand: medium with some fine and coarse	4.0	23.0
Upper Chalk	Chalk, white, soft	0.1 +	23.1

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	8	91	1	3.2–4.2	4	27	67	1	1	0	0
				4.2–5.2	5	6	83	5	1	0	0
				5.2–6.2	23	23	51	3	0	0	0
				6.2–7.2	5	25	69	1	0	0	0
				7.2–8.2	5	31	59	2	2	1	0
				8.2–9.2	21	26	45	6	2	0	0
				9.2–10.2	5	35	59	1	0	0	0
				10.2–11.2	4	44	52	0	0	0	0
				11.2–12.2	4	52	43	1	0	0	0
				12.2–13.7	5	70	25	0	0	0	0
				Mean	8	36	53	2	1	0	0
b	6	58	36	19.0–20.0	9	1	35	9	31	15	0
				20.0–21.0	3	3	39	12	28	15	0
				21.0–22.0	7	18	58	5	8	4	0
				22.0–23.0	4	3	40	10	25	14	4
				Mean	6	6	43	9	23	12	1
a+b	7	83	10	Mean	7	28	51	4	7	3	0

TL 21 SE 12 2647 1029 Near Bunside, Hatfield **Block E**

Surface level (+60.4 m) +198 ft
Water not struck
July 1972

Overburden 1.6 m
Mineral 6.3 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made ground	0.4	0.4
Glacial Sand and Gravel	Clay, brown, silty, some flint and quartz pebbles	1.2	1.6
	Gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium and coarse, some brown clay in matrix	6.3	7.9
Upper Chalk	Chalk	0.1+	8.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
3	31	66	1.6–2.6	8	5	22	10	29	26	0
			2.6–3.6	3	0	3	17	45	32	0
			3.6–4.6	3	2	15	11	33	36	0
			4.6–5.6	1	3	19	15	30	32	0
			5.6–6.6	1	3	21	10	29	36	0
			6.6–7.6	2	1	18	14	22	43	0
			7.6–7.9	1	1	6	12	34	46	0
			Mean	3	2	16	13	31	35	0

TL 21 SE 13 **2750 1462** **Tewin Village** **Block D**

Surface level (+78.3 m) +257 ft
Water not struck
February 1972

Overburden 0.2 m
Mineral 7.8 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse with some cobbles, subangular to rounded flint and quartz Sand: medium with fine and coarse	7.8	8.0
Upper Chalk	Chalk	0.2+	8.2

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}\ \frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
11	43	46	0.2–1.2	8	5	17	6	15	49	0
			1.2–2.2	29	3	25	9	24	10	0
			2.2–3.2	10	15	35	11	12	17	0
			3.2–4.2	14	11	30	5	24	16	0
			4.2–5.2	9	6	13	12	48	32	0
			5.2–6.2	5	5	19	12	28	31	0
			6.2–7.2	2	8	58	8	12	12	0
			7.2–8.0	9	5	13	11	22	35	5
			Mean	11	7	27	9	20	25	1

TL 21 SE 14 2777 1249 High Grove, Hertingfordbury **Block E**

Surface level (+71.0 m) +233 ft
Water not struck
July 1972

Mineral 1.3 m
Waste 3.9 m
Mineral 3.8 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Glacial Sand and Gravel	**a** Gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium with coarse	1.3	1.3
Boulder Clay	Clay, dark grey, with chalk, flint and quartz pebbles	3.9	5.2
Glacial Sand and Gravel	**b** 'Clayey' gravel Gravel: fine with coarse and some cobbles, subangular to rounded flint and quartz Sand: coarse with medium	3.8	9.0
Upper Chalk	Chalk, soft	0.2+	9.2

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$
a	8	28	64	0.0–1.0	5	2	12	9	29	43	0
				1.0–1.3	15	5	33	10	20	17	0
				Mean	8	2	17	9	27	37	0
b	11	26	63	5.2–6.2	4	3	9	10	40	34	0
				6.2–7.2	6	4	13	17	41	19	0
				7.2–8.2	12	4	6	12	36	27	3
				8.2–9.0	24	6	10	9	28	23	0
				Mean	11	4	9	13	36	26	1
a+b	10	26	64	Mean	10	4	11	11	34	29	1

TL 21 SE 15 **2760 1151** **Cole Green, Hertingfordbury** **Block E**

Surface level (+71.6 m) +235 ft
Water not struck
June 1972

Overburden 0.9 m
Mineral 2.9 m
Waste 10.5 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made Ground	0.9	0.9
Glacial Sand and Gravel	'Clayey' sand: medium with some fine	2.9	3.8
Boulder Clay	Clay, dark grey and brown, contains chalk and flint pebbles	10.5	14.3
Upper Chalk	Chalk, white, soft	0.1+	14.4

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
13	85	2	0.9–1.9	20	19	56	1	2	2	0
			1.9–2.9	10	18	70	1	0	1	0
			2.9–3.8	9	16	72	2	1	0	0
			Mean	13	18	66	1	1	1	0

TL 21 SE 16 2785 1073 Deadfield Lane, Hertingfordbury **Block E**

Surface level (+72.5 m) +238 ft
Water struck at (+64.3 m)
July 1972

Overburden 8.2 m
Mineral 2.6 m
Waste 5.5 m
Mineral 9.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, dark grey, stiff, chalky	8.0	8.2
Glacial Sand and Gravel	**a** Sand, gravel at base Gravel: fine and coarse, flint pebbles Sand: medium with some fine and coarse	2.6	10.8
Boulder Clay	Clay, dark grey, contains chalk pebbles	5.5	16.3
Glacial Sand and Gravel	**b** Gravel Gravel: fine and coarse with cobbles, subangular flint and subrounded quartz Sand: medium and coarse, some brown silty clay in matrix	9.5+	25.8

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
a	4	81	15	8.2–9.2	5	25	68	2	0	0	0
				9.2–10.2	3	9	83	5	0	0	0
				10.2–10.8	4	3	11	17	49	16	0
				Mean	4	13	61	7	11	4	0
b	5	37	58	16.3–17.3	5	2	11	12	28	36	6
				17.3–18.3	No grading data available						
				18.3–19.3	5	3	21	21	29	21	0
				19.3–20.3	4	6	20	16	31	23	0
				20.3–21.3	8	8	27	12	28	17	0
				21.3–22.3	4	8	27	12	24	25	0
				22.3–23.5	9	6	23	11	31	20	0
				23.5–25.0	3	2	4	14	31	39	7
				25.0–25.8	No grading data available						
				Mean	5	5	17	15	29	27	2
a+b	5	48	47	Mean	5	7	29	12	25	20	2

TL 21 SE 17 2855 1429 Bacon's Farm, Bramfield **Block D**

Surface level (+74.4 m) +244 ft
Water not struck
February 1972

Overburden 0.1 m
Mineral 8.6 m
Waste 3.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse with some cobbles, subangular and subrounded flint and quartz Sand: medium with coarse and some fine	8.6	8.7
Boulder Clay	Clay, brown mottled grey, chalky	3.0	11.7
Upper Chalk	Chalk	0.3+	12.0

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
8	54	38	0.1–1.1	3	8	26	13	20	30	0
			1.1–2.1	13	5	63	6	7	6	0
			2.1–3.1	14	7	39	6	18	16	0
			3.1–4.1	9	14	40	8	21	8	0
			4.1–5.1	6	10	40	9	20	15	0
			5.1–6.1	7	7	25	11	24	26	0
			6.1–7.1	8	5	15	14	25	28	5
			7.1–8.1	5	9	38	14	16	18	0
			8.1–8.7	10	6	34	13	19	18	0
			Mean	8	8	36	10	19	18	1

TL 21 SE 18 2882 1363 Holly Bushes, Hertingfordbury **Block D**

Surface level (+73.5 m) +241 ft
Water not struck
February 1972

Overburden 0.2 m
Mineral 7.3 m
Waste 1.1 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Made Ground	0.2	0.2
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse, subangular to subrounded flint and quartz Sand: medium with some fine and coarse	7.3	7.5
	Clay, orange-brown, contains coarse flints	1.1	8.6
Upper Chalk	Chalk	0.1+	8.7

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
10	53	37	0.2–1.2	12	15	43	6	13	11	0
			1.2–2.2	8	10	43	9	17	13	0
			2.2–3.2	11	4	39	12	23	11	0
			3.2–4.2	10	10	30	14	26	10	0
			4.2–5.2	10	7	33	10	18	22	0
			5.2–6.2	9	7	24	16	24	20	0
			6.2–7.2	7	10	31	8	19	25	0
			7.2–7.5	29	2	5	9	34	21	0
			Mean	10	9	34	10	21	16	0

TL 21 SE 19 2858 1225 Birch Green, Hertingfordbury Block E

Surface level (+73.2 m) +240 ft
Water not struck
July 1972

Overburden 0.4 m
Mineral 3.2 m
Waste 1.4 m
Mineral 5.7 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Glacial Sand and Gravel	**a** 'Clayey' gravel. Gravel: fine and coarse, angular to rounded flint and quartz Sand: medium with some coarse	3.2	3.6
Boulder Clay	Clay, brown and grey, silty, chalky	1.4	5.0
Glacial Sand and Gravel	**b** Gravel Gravel: fine and coarse with occasional cobbles, subangular to rounded flint and quartz Sand: medium and coarse with fine	5.7	10.7
Upper Chalk	Chalk, soft	0.2+	10.9

GRADING

	Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
a	11	39	50	0.4–1.4	8	2	22	12	31	25	0
				1.4–2.4	17	1	25	7	26	24	0
				2.4–3.6	8	5	33	9	27	18	0
				Mean	11	3	27	9	30	20	0
b	9	36	55	5.0–6.0	7	2	8	14	49	20	0
				6.0–6.8	6	4	11	12	32	28	7
				6.8–7.5	19	9	54	16	2	0	0
				7.5–8.5	4	7	15	17	34	23	0
				8.5–9.5	12	7	21	10	28	22	0
				9.5–10.5	11	3	7	10	36	33	0
				10.5–10.7	7	2	2	15	41	33	0
				Mean	9	6	17	13	32	22	1
a+b	10	37	53	Mean	10	5	20	12	31	21	1

TL 21 SE 20 **2867 1172** **Birch Green, Hertingfordbury** **Block E**

Surface level (+73.5 m) +241 ft
Water not struck
July 1972

Overburden 2.2 m
Mineral 1.8 m
Waste 5.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Glacial Sand and Gravel	Clay, red-brown, some sand and gravel pockets	1.6	2.2
	Gravel Gravel: fine and coarse with some cobbles, subangular to rounded flint and quartz Sand: fine with medium and coarse	1.8	4.0
Boulder Clay	Clay, brown and grey, silty, chalky	3.6	7.6
	Clay, brown mottled black, with some flint and quartz pebbles	1.7	9.3
Upper Chalk	Chalk, pale yellow	0.2+	9.5

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
8	40	52	2.2–3.2	3	37	14	0	20	26	0
			3.2–4.0	15	5	14	7	24	30	5
			Mean	8	23	14	3	22	28	2

TL 21 SE 21 **2943 1461** **Bramfield** **Block D**

Surface level (+75.6 m) +248 ft
Water not struck
February 1972

Overburden 0.3 m
Mineral 9.0 m
Waste 0.2 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, angular to subrounded flint and quartz Sand: medium with coarse, some brown clay in matrix	9.0	9.3
	Gravel, most fine and coarse chalk pebbles	0.2	9.5
Upper Chalk	Chalk	0.1+	9.6

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1–4	+4–16	+16–64	+64
10	42	48	0.3–1.3	16	4	32	13	17	18	0
			1.3–2.3	3	4	33	13	25	22	0
			2.3–3.3	8	13	28	12	24	15	0
			3.3–4.3	11	9	31	8	21	20	0
			4.3–5.3	9	7	33	15	22	14	0
			5.3–6.3	6	6	24	6	28	30	0
			6.3–7.3	6	3	16	15	20	40	0
			7.3–8.3	14	4	14	10	23	35	0
			8.3–9.3	15	7	11	7	18	42	0
			Mean	10	6	25	11	22	26	0

TL 21 SE 22 2952 1339 Selebroom Wood, Hertingfordbury **Block D**

Surface level (+73.5 m) +241 ft
Water not struck
February 1972

Overburden 0.1 m
Mineral 11.2 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: fine and coarse, subangular to subrounded flint, quartz and chalk Sand: medium with coarse and fine, some brown clay in matrix	11.2	11.3
Upper Chalk	Chalk, white, soft	0.2+	11.5

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
14	43	43	0.1–1.1	12	6	19	12	30	25	0
			1.1–2.1	13	5	17	7	20	38	0
			2.1–3.1	12	12	21	12	24	19	0
			3.1–4.1	10	5	17	10	21	37	0
			4.1–5.1	47	27	11	1	3	11	0
			5.1–6.1	14	9	24	16	21	16	0
			6.1–7.1	4	6	33	13	26	18	0
			7.1–8.1	12	5	22	23	26	12	0
			8.1–9.1	11	9	20	18	25	17	0
			9.1–10.1	11	5	30	9	29	16	0
			10.1–11.3	9	6	31	14	16	24	0
			Mean	14	9	22	12	22	21	0

TL 21 SE 23 2971 1167 Staines Green, Hertingfordbury **Block E**

Surface level (+70.4 m) + 231 ft
Water not struck
July 1972

Overburden 6.2 m
Mineral 4.7 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Boulder Clay	Clay, brown and dark grey, chalky	5.6	6.2
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, angular to subrounded flint and quartz Sand: medium and coarse, some brown silty clay in matrix	4.7	10.9
Upper Chalk	Chalk	0.4+	11.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
9	35	56	6.2–7.2	11	4	23	14	31	17	0
			7.2–8.2	12	4	14	17	33	20	0
			8.2–9.2	5	3	8	13	44	27	0
			9.2–10.2	9	4	24	15	31	17	0
			10.2–10.9	4	6	15	15	34	26	0
			Mean	9	4	17	14	35	21	0

TL 21 SE 24 2809 1329 Poplars Green, Tewin **Block B**

Surface level (+48.5 m) +159 ft
Water struck at (+46.4 m)
July 1972

Overburden 1.1 m
Mineral 2.1 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	Silt, dark grey, clayey	0.9	1.1
Sub-Alluvial Gravel	Gravel Gravel: coarse with fine, angular to subrounded flint and quartz Sand: some coarse and medium, some blue clay in matrix	2.1	3.2
Upper Chalk	Chalk	0.1+	3.3

GRADING

Mean for deposit *percentages*			Depth below surface (m)	*percentages*						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$\frac{1}{16}$	$+\frac{1}{16}$–$\frac{1}{4}$	$+\frac{1}{4}$–1	+1–4	+4–16	+16–64	+64
1	9	90	1.1–2.1	1	1	2	6	30	60	0
			2.1–3.2	1	0	3	6	30	60	0
			Mean	1	0	3	6	30	60	0

APPENDIX G

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

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

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INDUSTRIAL MINERALS ASSESSMENT UNIT

THE SAND AND GRAVEL RESOURCES OF SHEET TL 11 & TL 21 (WELWYN GARDEN CITY, HERTS)

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

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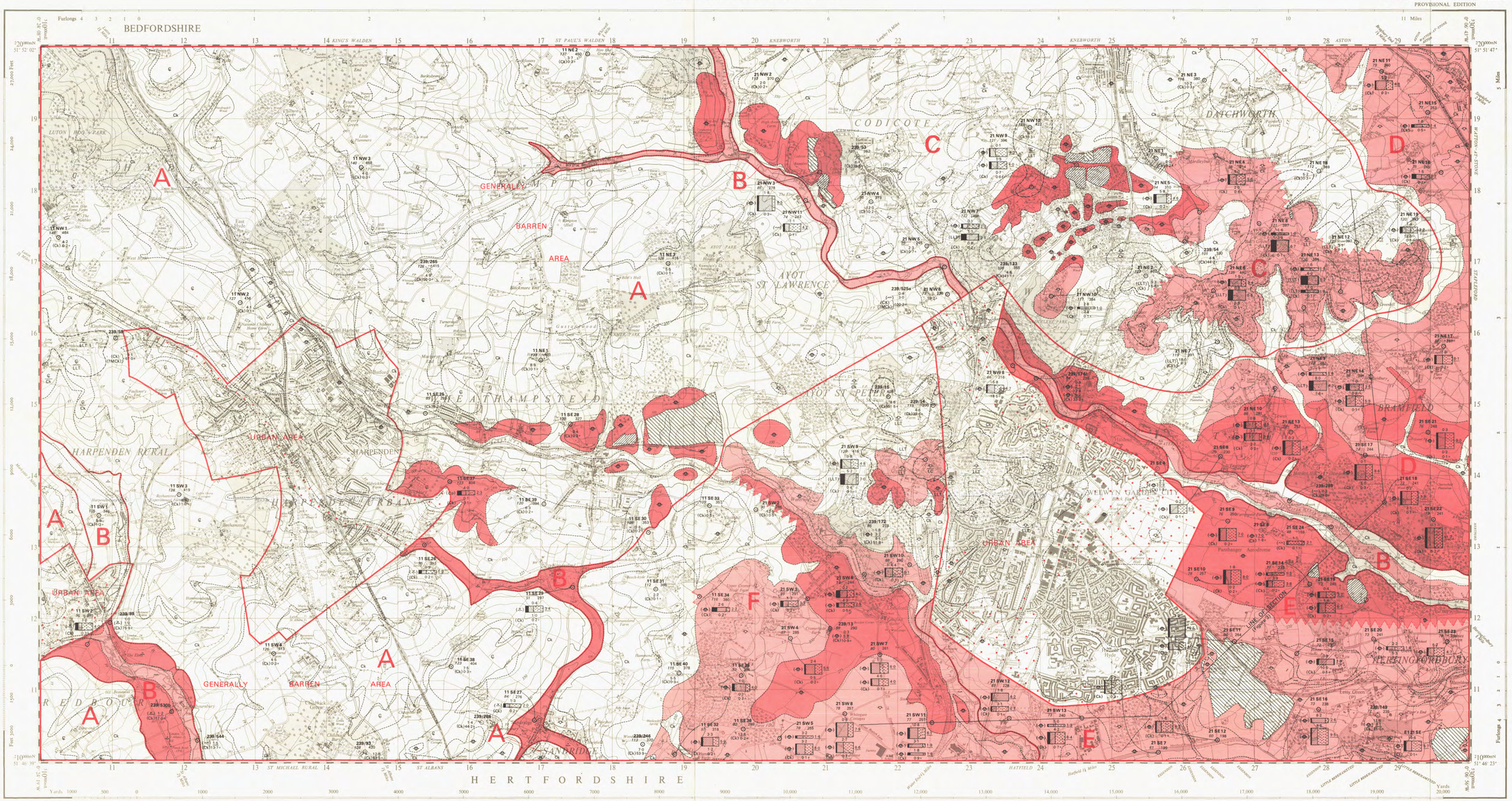


EXPLANATION OF SYMBOLS AND ABBREVIATIONS

DRIFT (RECENT AND PLEISTOCENE)

- **Alluvium**-clay and silt with some sand A-46
- **Valley Gravel**-fine and coarse flint gravel VG-2
- **Glacial Sand and Gravel**-flint gravel with sand GS-48
- **Boulder Clay**-stiff dark grey clay with chalk pebbles BC-26
- **Clay-with-flints**-clay with angular flint pebbles CF-7
- **Pebbly Clay and Sand**-sandy clay with flint pebbles PC-2

SOLID (PALAEOCENE EOCENE CRETACEOUS)

- LC **London Clay**-grey and brown stiff clay and silty clay
- LLT **Lower London Tertiaries**-grey and brown stiff clay and fine sand
- Ck **Chalk (undivided)**-white chalk with flints

- **Made ground** MG-2
- **Worked out areas** WO-5

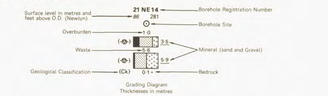
BOUNDARY LINES

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

BOREHOLE DATA
SITE LOCATIONS

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

I.M.A.U BOREHOLES



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

Borehole Registration Number

Each I.M.A.U. borehole is indentified by a Registration Number, e.g. **NE 14**. The letters refer to the quarter sheet and the final figures to the I.G.S. serial number for that quarter. The unique designation for borehole **NE 14** is **TL 21 NE 14.**

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.

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

EXPOSURE RECORDS

Information from the inspection of exposures is given in the same way as for boreholes, but they are located by an asterisk *, Reference Number and details of thicknesses and quality are shown.

CATEGORIES OF DEPOSITS

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

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

RESOURCE BLOCKS

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

A horizontal section showing the general relations of the drift deposits along the line shown, constitutes Figure 3 of the report.

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

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

THE SAND AND GRAVEL RESOURCES OF
SHEET TL 11 & TL 21 (WELWYN GARDEN CITY, HERTS)

69

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

The representation on this map of a Road, Track, or Footpath, is no evidence of the existence of a right of way.

Original geological survey on the Old Series one-inch maps, published in 1861-1898.
Resurveyed on the six-inch scale by R. L. Sherlock and R. W. Pocock in 1911-14 and 1921.
Included in one-inch geological sheets 238 and 239.
Sheet 238 published 1923 (reprinted 1946).
Sheet 239 published 1924 (reprinted 1948) and reprinted onto 1st Series 1:50 000 base, 1978.

Sand and Gravel survey by S. Machin in 1972.
R. G. Thurrell, Head, Industrial Minerals Assessment Unit.

1:25 000 Sand and Gravel Resource Sheet published 1981.
G. M. Brown, D.Sc., F.R.S., Director, Institute of Geological Sciences.
(180.9)

Index to the Six-Inch (County Series) Maps in this Sheet
Hertfordshire

19	20	21
27	28	29
34	35	36

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.

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

Compiled from 6" sheets last fully revised 1922-39.
Other partial systematic revision 1937-51 has been incorporated
Major Roads partly revised 1968.
Building development partly revised 1966.

TL 02	TL 12	TL 22	TL 32
220		221	
TL 01	TL 11	TL 21	TL 31
238		239	
TL 00	TL 10	TL 20	TL 30

Diagram showing the relation of the National Grid 1:25 000 sheets with the One-inch Geological Sheets 220, 221, 238 and 239

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