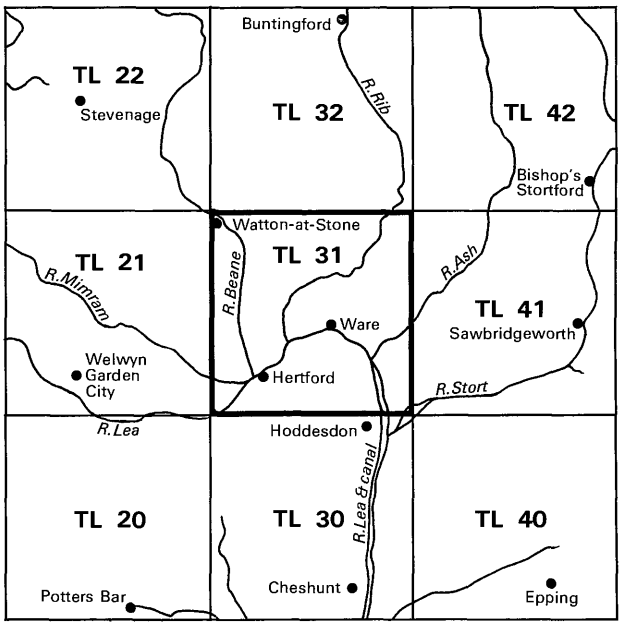
INSTITUTE OF GEOLOGICAL SCIENCES

Natural Environment Research Council

Mineral Assessment Report 112



The sand and gravel resources of the country around Hertford, Hertfordshire

Description of 1:25 000 resource sheet TL 31

P. M. Hopson and M. D. A. Samuel

ISBN 0 11 884312 5*

London Her Majesty's Stationery Office 1982

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

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

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

PREFACE

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

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

This report describes the sand and gravel resources of the country around Hertford, Herfordshire shown on the accompanying 1:25 000 resource map TL 31. The survey was conducted by Mr C. Eaton and Mr G. M. Bladon. The work is based on six-inch geological surveys by R. L. Sherlock in 1911-14 and 1921, and published on new series 1:50 000 Geological Sheet 239 (Hertford).

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

G. M. Brown
Director

Institute of Geological Sciences
Exhibition Road
London SW7 2DE

28 November 1981

CONTENTS

FIGURES

MAP

TABLES

The sand and gravel resources of the country around Hertford, Hertfordshire

Description of 1:25 000 sheet TL 31

P. M. HOPSON and M. D. A. SAMUEL

SUMMARY

The geological maps of the Institute of Geological Sciences, pre-existing borehole information, and 72 boreholes drilled for the Industrial Minerals Assessment Unit form the basis of the assessment of the sand and gravel resources of the country around Hertford, Hertfordshire.

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

The 1:25 000 map is divided into 5 resource blocks, containing between 8.8 and 16.2 km^2 of sand and gravel. For each block the geology of the deposits is described, and the mineral-bearing area, the mean thickness of overburden and mineral and the mean gradings are stated. Detailed borehole data are also given. The geology, the position of the boreholes and the outlines of the resource blocks are shown on the accompanying map.

Notes

Each borehole registered with the Institute is identified by a four-element code (e.g. TL 31 NW 8). The first two elements define the 10-km square (of the National Grid) in which the borehole is situated; the third element defines a quadrant of that square, and the fourth is the accession number of the borehole. In the text of the report the borehole is normally referred to by the last two elements alone (e.g. NW 8).

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, four- and six-figure grid references are used for more extensive locations, for example for farms).

Bibliographical reference

Hopson, P. M. and Samuel, M. D. A. 1982. The sand and gravel resources of the country around Hertford, Hertfordshire; description of 1:25 000 resource sheet TL 31. **Miner. Assess. Rep. Inst. Geol, Sci,** No. 112.

Author

P. M. Hopson, BSc and M. D. A. Samuel, BSc
Institute of Geological Sciences
Keyworth
Nottingham NG12 5GG.

INTRODUCTION

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

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

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

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

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

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

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

The volume and other characteristics are assessed within resource blocks, each of which, ideally, contains

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

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

DESCRIPTION OF THE DISTRICT

Topography and general

The district is dominated by the valley of the River Lea and the incised valleys of its tributaries, the rivers Ash, Rib, Beane and Mimram. The River Lea flows north-eastwards from the south-west corner of the sheet area to Ware [360 140], then turns south-east and south to flow out of the district at Rye Meads [390 100]. These rivers dissect an extensive boulder clay plateau which generally lies between 60 and 90 m OD, rising to about 95 m at Hertford Heath [352 110] in the south and higher in the north of the sheet area where 114 m OD is reached at Sacombe Green [345 195].

The district is predominantly agricultural with forestry and market gardening being of importance locally, for example, at Hoddesdon, on the brickearth of the Taplow Terrace.

The urban areas of Hertford [325 125] and Ware and the northern part of Hoddesdon [375 100] together occupy 14.7 km^2 (see Table 2). These are dormitory towns for London, 15 miles to the south (see Figure 1), and they support some light industries. Around these towns are several, generally small, disused workings for gravel and sand; at Rye Meads however, River Terrace Deposits are still being worked on a large scale.

Geology

The deposits which crop out in the area of this sheet are shown in Table 1; they are listed as far as possible in order of increasing age. The general relationships of the deposits are illustrated in the diagrammatic cross-

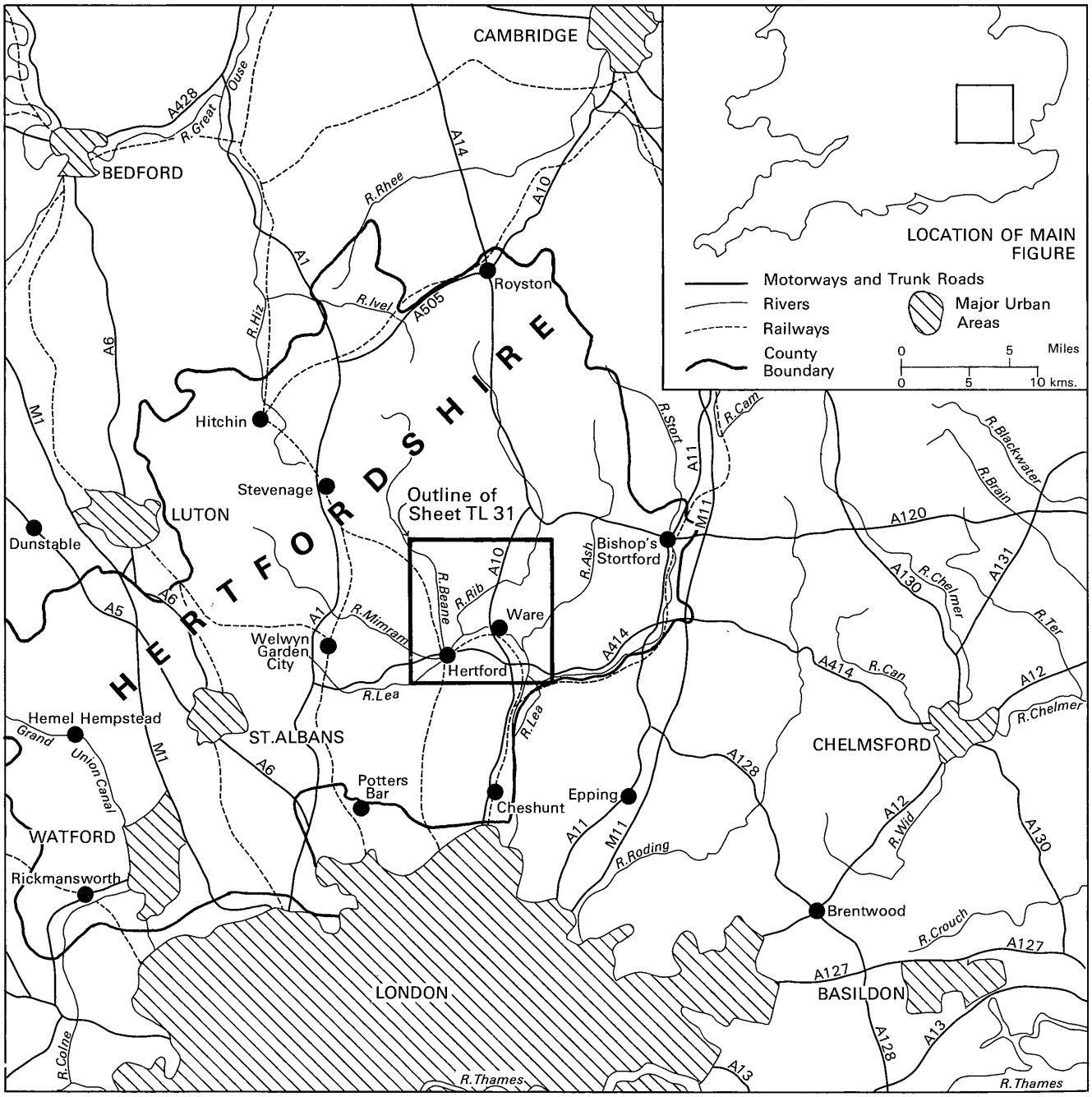


Figure 1 Sketch map showing the location of sheet TL 31.

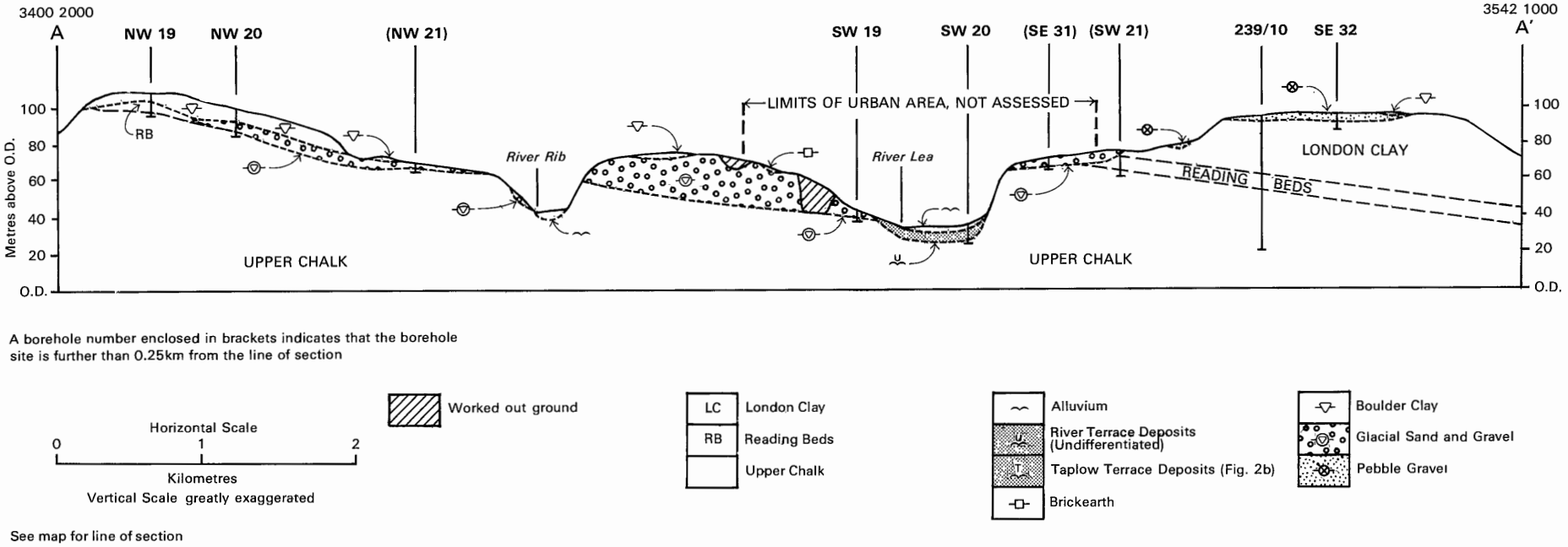


Figure 2a Generalised section showing relationships between Drift and Solid deposits.

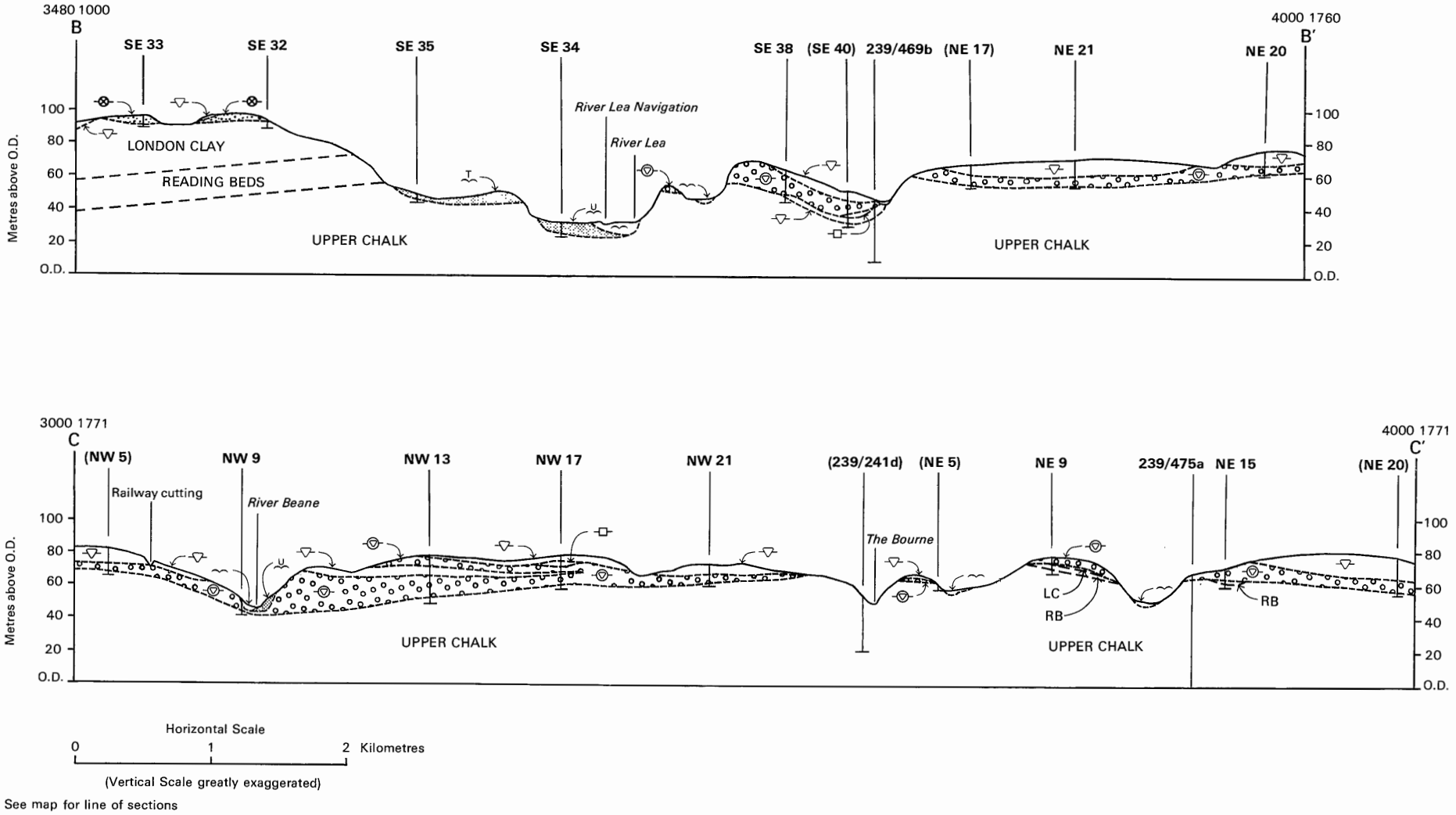


Figure 2b Generalised sections showing relationships between Drift and Solid deposits.

Table 1 Geological sequence.

DRIFT			
	Recent and Pleistocene	Alluvium - silty, fine sandy clay	
	River Terrace Deposits	River Terrace Deposits (Undifferentiated)	predominatly flint gravel with some quartz and quartzite
		River Brickearth (Taplow)	silty, fine sandy clay
		Taplow Terrace	'clayey' flint gravel
		Brickearth	Silt, clay and fine sand often interlaminated
		Boulder Clay	dark bluish grey silty with chalk and flint pebbles
		Glacial Sand and Gravel	generally 'clayey' sandy gravel
		Pebble Gravel	orange-brown 'clayey' gravel
SOLID			
	Eocene-Palaeocene	London Clay	stiff silty clay with some fine sand, dark bluish grey
		Reading Beds	stiff waxy variegated clays overlying 'clayey' fine sands
	Cretaceous	Upper Chalk	white and cream soft limestone with flint bands

sections (Figures 2a and 2b) and discussed in more detail in the Hertford memoir (Sherlock and Pocock 1924) which describes 1:50 000 New Series Geological Sheet 239. Maps at the scale of 1:63 360 are also available.

SOLID

Upper Chalk This is generally a soft white and cream-coloured limestone with seams of tabular and nodular flint and hard grey chalk.

The Chalk constitutes the bedrock beneath Recent and Pleistocene deposits over most of the sheet area, and commonly forms sinuous outcrops along the main valley sides. Around Sacombe [337 194] in the north-west, the Chalk crops out over part of the plateau where it is incompletely covered by Boulder Clay.

Reading Beds These deposits are a series of stiff waxy colour-mottled clays and fine 'clayey' sands. They are attributable respectively to the Reading Type and the Woolwich Type of Hester (1965).

In general the waxy clays overlie the 'clayey' sands although the boundary between them is not clear cut and the two lithologies interdigitate.

The Reading Beds are in the order of 10.0 m thick in this area; for example, borehole 239/10 proved 8.2 m of deposits. However, 24.1 m of sand apparently of Reading Beds lithology was proved in borehole 239/326; this exceptional thickness probably represents deposits infilling a solution pipe into the underlying chalk.

These deposits outcrop in the south on the partially buried Tertiary escarpment from Stanstead Abbots in the southeast, to west of Little Amwell [351 117]. In the north around High Cross [364 185] and in the vicinity of Sacombe small isolated patches of Reading Beds partially concealed beneath Boulder Clay are also found.

London Clay The London Clay is generally dark grey or blue-grey stiff silty clay with some disseminated fine sand; at the base it becomes drab olive green and very sandy. It contains disseminated and nodular pyrite, seams of comminuted shell debris and patches of carbonaceous material. The London Clay weathers to a typical ochre-brown colour due to the oxidation of the included pyrite.

This deposit outcrops around Little Amwell and north of Barwick and was proved in boreholes southeast of Stanstead Abbots and in borehole NE 1 [3590 1968] 1 km northwest of High Cross.

DRIFT

Pebble Gravel This deposit is present over an area of slightly more than 1 km^2 at Hertford Heath, overlying the London Clay. The base of the deposit in the south is about 90 m above OD and falls gently towards the north. It is generally a 'clayey' gravel although in places it is partially sorted into seams of gravel and 'clayey' gravel.

Glacial Sand and Gravel Occurring at levels between 38 m and 99 m above OD, this deposit is widespread and forms the principal potentially workable material in the district. It is generally concealed beneath Boulder Clay on the plateau but typically outcrops on valley sides. The Glacial Sand and Gravel is in places divided by a bed of boulder clay, for example in boreholes NE 8 [3753 1840] and SE 41 [3859 1320]. In these localities the relationship between the glacial gravels and boulder clays is complex. A discussion on the origin and relationships of these deposits will be found in Gibbard (1977).

Boulder Clay The Boulder Clay covers much of the high ground between the river valleys and forms the principal overburden resting on the Glacial Sand and Gravel. In some areas the deposit becomes excessively thick and in others cuts through the Glacial Sand and Gravel to rest directly on the Chalk, as, for example, in the north near Sacombe Green and in the north-east near Biggers Farm [397 190]. The deposit is generally grey or dark blue-grey, silty, fine sandy clay with pebbles of flint and chalk and some quartz. When weathered the Boulder Clay is brown or yellow mottled grey in colour and contains no chalk.

Brickearth This deposit occurs only in small patches in the vicinity of Ware, Stoneyhills [323 169] and southwest of Hertford [325 125]. These patches appear to be surface expressions of intercalated lenses within the Glacial Sand and Gravel and Boulder Clay. Sherlock (1924, pp. 47-48) tentatively suggested that the deposits in the vicinity of Stoneyhills and Ware were laid down in lakes marginal to the southward-advancing ice front.

The deposits are composed of fine sandy, silty clay and clay and are often laminated. They are pale orange, yellow-brown and grey in colour.

Taplow Terrace The Taplow Terrace occurs in the vicinity of Hoddesdon [375 100], predominantly to the west of the River Lea. Its upper surface ranges in height from 53 m above OD near Great Amwell [377 118] to 30 m above OD at the resource sheet margin [387 100]. It is overlain to the south by the Taplow Brickearth.

River Brickearth (Taplow) This deposit, resting on the Taplow Terrace, covers approximately 0.75 km^2 of ground predominantly in the urban area of Hoddesdon. Although no boreholes were sunk in this deposit where mapped, borehole SE 39 [3748 1142] proved 3.7 m of clayey and pebbly stiff orange-brown silt, overlying Taplow Terrace, which is considered here to be representative of the deposit as a whole.

River Terrace Deposits (Undifferentiated) The undifferentiated terrace sands and gravels are found in patches flanking the Alluvium of the River Lea, where they range in surface height from 48 m above OD to 30 m above OD, and in the valley north of Sacombe Pound [331 195] where they are found at 61 m above OD. In the vicinity of Stanstead Abbots these deposits extend beneath the Alluvium. They can be seen in the pits at Rye Meads [390 105] where up to 4.0 m of Alluvium and Peat rest on planar-bedded sand and gravel.

Alluvium Extensive spreads of Alluvium are found in the valley of the River Lea but only narrow sinuous beltsare mapped in the tributary valleys. The deposit is generally composed of silty, fine sandy clay with some pebbles but localized accumulations of carbonaceous material and thin impersistent gravels occur. The Alluvium is generally thin but up to 4.8 m (eg NE 14 [3837 1820]) has been proved in IMAU boreholes.

Composition of the sand and gravel deposits

Potentially workable sand and gravel is found in the Pebble Gravel, Glacial Sand and Gravel, the Taplow Terrace and the River Terrace Deposits (Undifferentiated). The mean grading of samples from each of 52 boreholes is shown in Figure 3.

Reading Beds Although the Reading Beds proved in boreholes NW 12 [3221 1970], SW 21 [3452 1261] and SE 42 [3871 1263] contain sand which falls within the definition of mineral, all the samples tested showed the deposit to be 'very clayey' sand chiefly of quartz with some pebbles of well rounded flint. The overall grading of these samples is fines 33 per cent, sand 65 per cent and gravel 2 per cent (see Figure 4). These data have not been included in the assessment of resources which is confined to sand and gravel resources of the drift deposits.

Pebble Gravel Based on samples from borehole SE 32 [3546 1130] and SE 33 [3503 1046] the mean grading of this deposit is fines 13 per cent, sand 36 per cent and gravel 51 per cent, giving an overall classification of 'clayey' gravel.

The gravel fraction, which contains equal proportions of fine and coarse grades with some cobbles, is mainly of flint, with quartz and quartzite. The clasts are predominantly rounded to subrounded although some of the flint is subangular.

The sand, which comprises quartz with some flint, is principally of medium grade with coarse and some fine material. The mean thickness of the Pebble Gravel, calculated from one Hydrogeology Unit record and data from two IMAU boreholes, is 2.5 m.

Glacial Sand and Gravel The mean grading of the Glacial Sand and Gravel is fines 14 per cent, sand 42 per cent and gravel 44 per cent, which classifies it as 'clayey' gravel; the deposit ranged from pebbly sand to gravel in IMAU boreholes. The fines content ranged from less than 10 per cent to 28 per cent. Recorded thicknesses of mineral range from less than 1 m to 12.4 m in borehole NW 10 [3185 1618], and the calculated mean is 6.2 m.

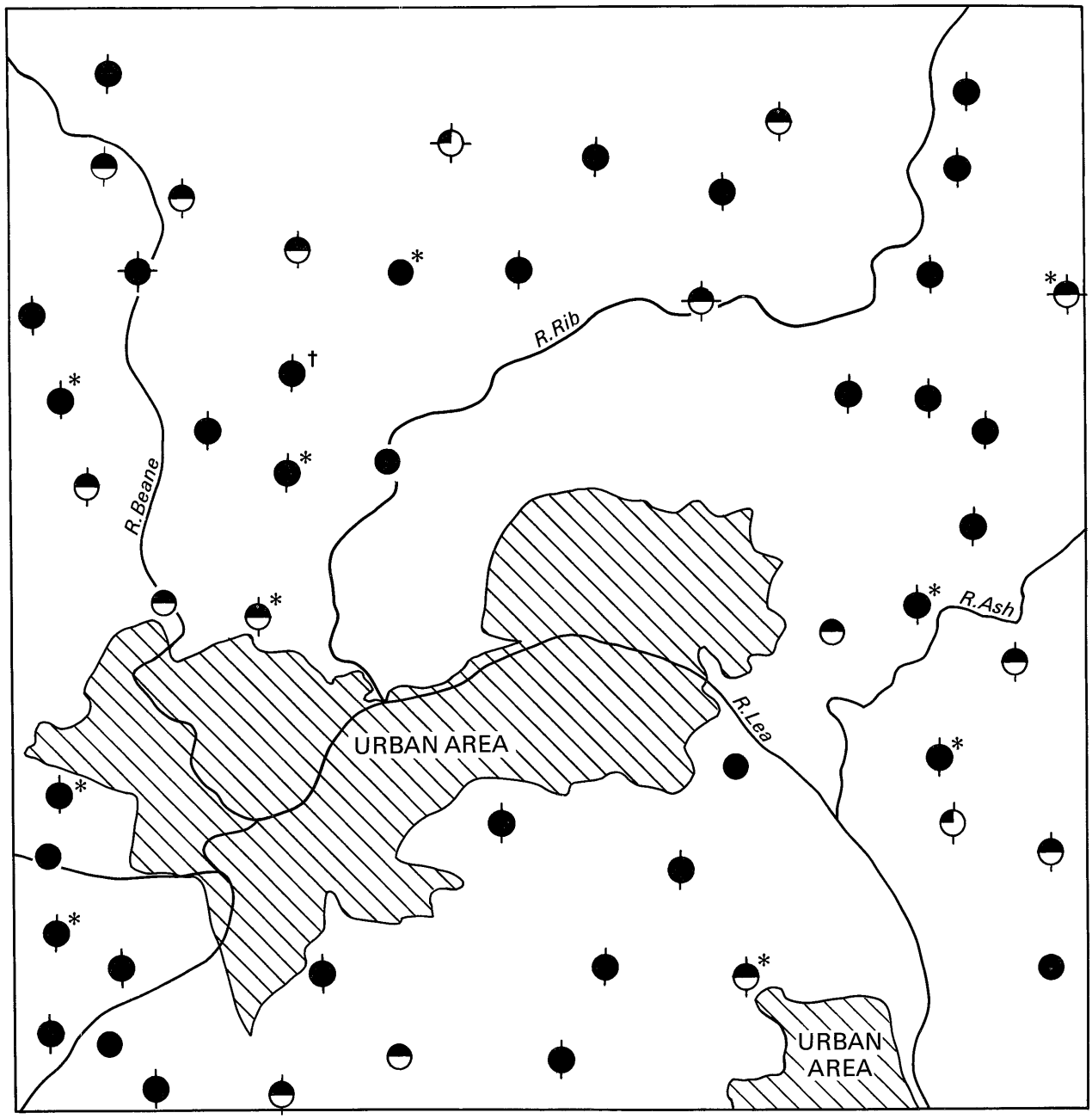
The gravel fraction, which contains approximately equal amounts of coarse and fine grades with some cobbles, is composed predominantly of angular and well rounded flint with rounded quartz and quartzite. In some boreholes, pebbles of chalk, sandstone, red mudstone and jasper were found, and, rarely, a trace of fossil debris. The sand is predominantly medium and coarse in grain size, with some fine material; it is composed of quartz with some flint and a trace of chalk.

Taplow Terrace The Taplow Terrace grades as 'very clayey' gravel, its mean grading being fines 22 per cent, sand 27 per cent and gravel 51 per cent. The gravel

Table 2 A statistical assessment of the sand and gravel resources of sheet TL 31.

Block	Area		Mean thickness			Volume of sand and gravel			Mean grading percentage		
	Block	Mineral	Overburden	Mineral	Waste		Limits at the 95% probability level		Fines $-\frac{1}{16}$ mm	Sand $+\frac{1}{16}-4$ mm	Gravel +4 mm
	km^2	km^2	m	m	m	$m^3 \times 10^6$	± %	± $m^3 \times 10^6$			
A	9.7	8.8	2.8	6.6	0.3	58.1	31	18	13	46	41
B	28.1	16.2	4.1	6.1	0.4	98.8	28	28	14	40	46
C	15.5	12.1	4.8	6.6	0.2	79.9	24	19	16	39	45
D	17.9	11.4	3.9	4.7	0.2	53.6	26	14	12	41	47
E	14.1	9.1	3.3	4.3	0.8	39.1	28	10.9	11	44	45
Total	**85.3***	**59.1**	**3.9**	**5.7**	**0.4**	**339.2**	**12**	**42**	**14**	**41**	**45**

*excluding urban area

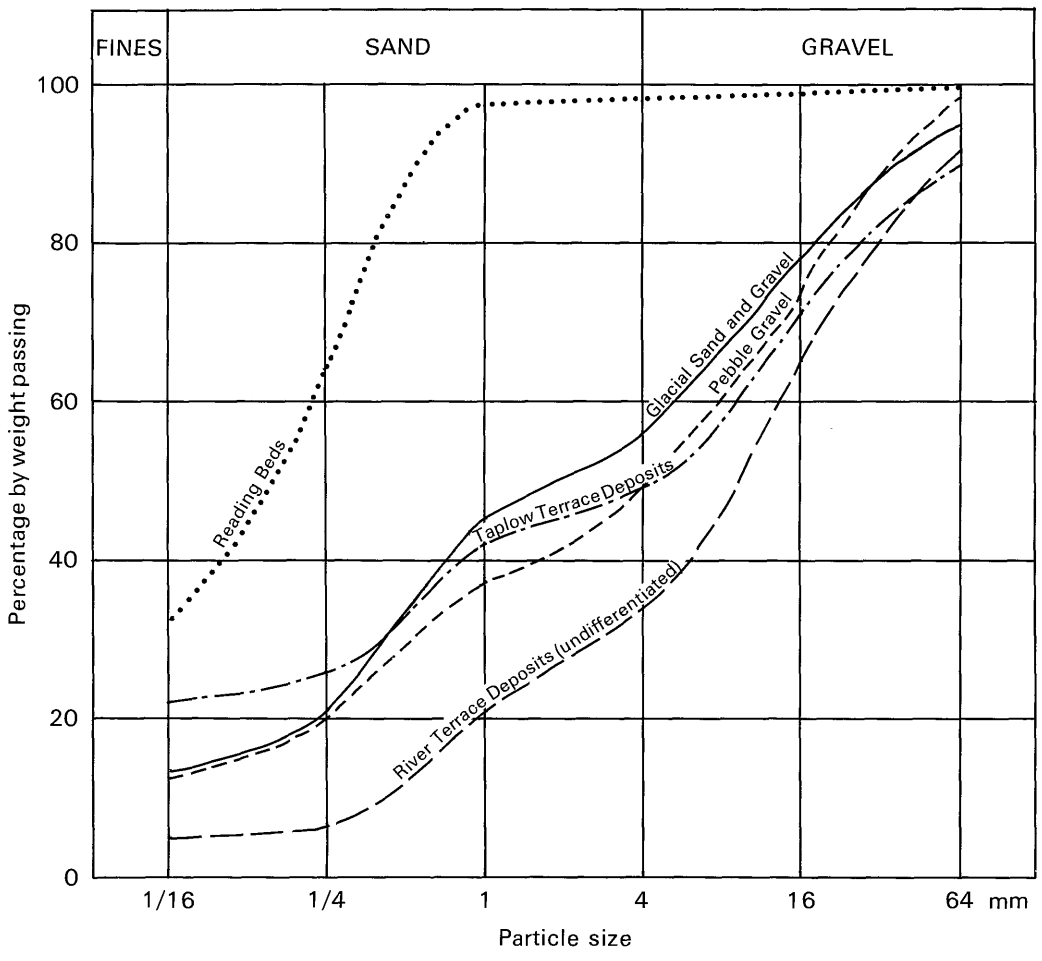


Gravel
'Clayey' gravel
'Very clayey' gravel
Sandy gravel
'Clayey' sandy gravel
'Very clayey' sandy gravel
'Clayey' pebbly sand
'Very clayey' pebbly sand

Scale
0 1 2 kms

* Mean grading of two beds of mineral
† Mean grading of three beds of mineral

Figure 3 Grading characteristics of the mineral in blocks A to E based on the mean grading results from 52 boreholes.



Deposit	Percentage by weight passing					
	$\frac{1}{16}$ mm	$\frac{1}{4}$ mm	1 mm	4 mm	16 mm	64 mm
River Terrace Deposits	5	7	21	34	65	91
Taplow Terrace Deposits	22	26	42	49	71	90
Glacial Sand and Gravel	14	21	45	56	78	95
Pebble Gravel	13	20	37	49	74	98
Reading Beds	33	64	97	98	99	100

Figure 4 Particle size distributions of the sand and gravel in each of the mineral bearing formations.

fraction is fine and coarse with 10 per cent of cobble grade; it is composed of subangular to rounded flint with some rounded quartz and quartzite. The sand is predominantly of medium grade with coarse and fine-grained material; it is of angular to subangular quartz and a trace of flint.

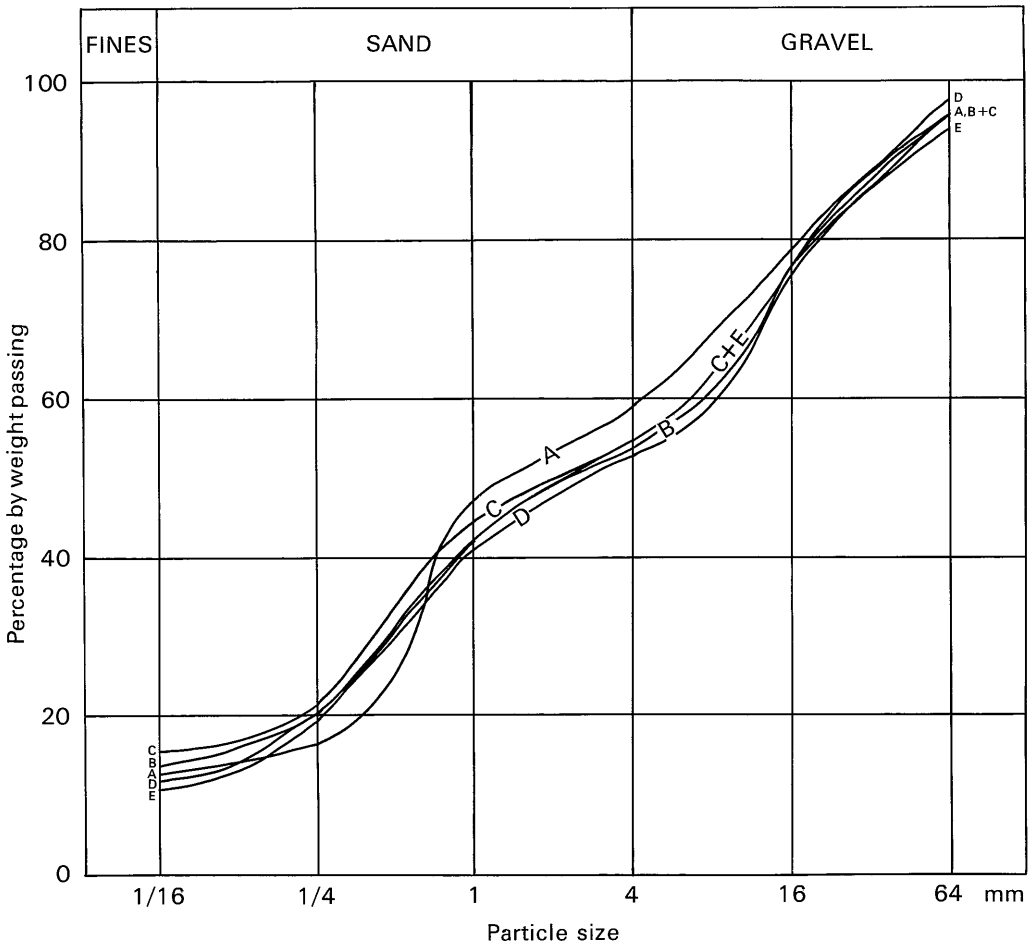
River Terrace Deposits (Undifferentiated) These deposits have a mean grading of fines 5 per cent, sand 29 per cent and gravel 66 per cent including 9 per cent of cobble grade, giving a mineral classification of gravel.

The gravel fraction is of coarse and fine grades with flint and, rarely, 'Bunter' quartzite cobbles. The pebbles are predominantly of angular, with some rounded flint, rounded quartz and quartzite, and a trace of jasperized flint. The sand, which consists of medium and coarse with a trace of fine grades, is composed of subangular to rounded flint and rounded quartz. The low fines content compared with that of the Taplow Terrace demonstrates the effect of drilling below the water table on the mean grading of the deposit.

The Map

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

Geological data The geological boundary lines, symbols, etc., shown are taken from the geological map of this area, which was surveyed at the scale of 1:10 560. This information was obtained by detailed application of field



Block	Percentage by weight passing					
	$\frac{1}{16}$ mm	$\frac{1}{4}$ mm	1 mm	4 mm	16 mm	64 mm
A	13	17	47	59	79	95
B	14	21	43	54	76	95
C	16	22	45	55	77	95
D	12	21	41	53	77	97
E	11	20	43	55	77	94

Figure 5 Particle size distributions for mineral in resource blocks A to E.

mapping techniques by the field staff in the Institute's East Anglia and South-East England Unit.

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

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

Mineral resource information The mineral-bearing ground is divided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is exposed, that is, where the overburden averages less than 1 m in thickness, and areas where it is present in continuous, or almost continuous, spreads beneath overburden. The recognition of these categories is dependent upon the importance attached to the proportion of boreholes which did not find potentially workable sand and gravel and the distribution of barren boreholes within a block. The mineral is described as 'almost continuous' if it is present in 75 per cent or more of the boreholes in a resource block. The 'discontinuous' category has not been recognised on this sheet.

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

The area of the mineral-bearing ground is measured, where possible, from the mapped geological boundary lines. The whole of this area is considered as mineral-

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

Results

The statistical results are summarised in Table 2. Fuller grading particulars are shown in Figures 5 to 10 and Tables 3 to 7.

Accuracy of results For each of the blocks, the accuracy of the results at the symmetrical 95 per cent probability level (that is, the probability that 19 times out of 20, the true volume of mineral present lies within the stated limits) varies between 24 per cent and 31 per cent (Appendix B). However, the true voumes are more likely to be nearer the figure estimated than either of the limits. Moreover, it is probable that roughly the same percentage limits would apply for the statistical estimate of mineral volume within a very much smaller parcel of ground (say 100 hectares) 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 quotation of reserves, data from more sample points would be required, even if the area were quite small. This point can be illustrated by considering the whole of the potentially workable sand and gravel in blocks A to E. The total volume (339.2 million m^3) can be estimated to limits of $\pm$ 12 per cent at the 95 per cent probability level by a calculation based on the date from the 157 sample points spread across the five resource blocks. However, it must be emphasised that the quoted volume of mineral has no simple relationship with the amount that could be extracted in practice, as no allowance has been made in the calculations for any restraints (such as existing buildings and roads) on the use of the land for mineral working.

Notes on resource blocks

Block A

This block covers an area of 9.7 km^2, in the west and north-west of the sheet, from Hertford northwards to Watton at Stone [303 194]. Of this area, 8.8 km^2 is mineral-bearing, the remainder comprising small patches of exposed bedrock and the worked out and made ground in the vicinity of Waterford [310 150].

The overburden has a mean thickness of 2.8 m (see Table 2) and ranges, in recorded thickness, from 0.6 m in borehole SW 3 [3046 1284] to 7.7 m in borehole NW 8 [3166 1831] (see Table 3); it is composed of Boulder Clay on the plateau and the Alluvium associated with the River Beane.

The Glacial Sand and Gravel is the only deposit classified as mineral in this block; it crops out on the valley sides and underlies the Boulder Clay and Alluvium. It has a mean thickness of 6.6 m and ranges, in IMAU boreholes, from 1.0 m in borehole NW 9 [3124 1769] to 9.2 m in borehole NW 4 [3039 1856]; exceptionally borehole NW 1 [3067 1927] near Watton at Stone proved a total thickness of 12.0 m of mineral in two distinct beds separated by boulder clay.

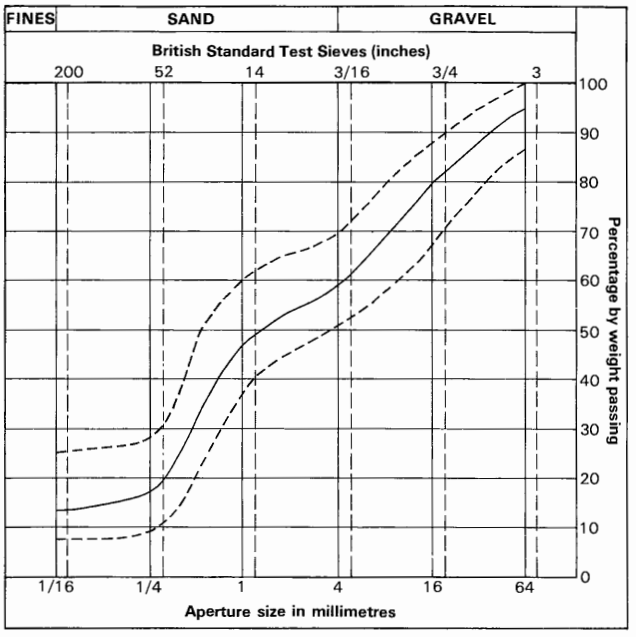


Figure 6 Grading characteristics of the mineral in Block A: the continuous line represents the weighted mean grading of the block; the broken lines denote the envelope within which the mean grading curves for individual boreholes fall. The gradings of sand and gravel which is not mineral (of which the thicknesses are bracketed in Tables 3 to 7 are excluded).

Table 3 Block A: data from assessment boreholes proving sand and gravel. Coarse gravel includes cobbles.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Over-burden	Mineral	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}$ -1 mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
NW 3	1.8	4.9	10	4	26	11	16	33
NW 4	5.6	9.2	13	4	32	11	16	24
NW 5	4.2	3.4	18	4	17	12	29	20
NW 6	1.0	7.5	13	5	24	12	23	23
NW 7	2.0	4.5	18	10	29	8	21	14
NW 8	7.7	6.8	15	6	39	10	13	17
NW 9	2.5	1.0	25	0	12	20	31	12
SW 3	0.6	8.6	15	4	29	9	19	24
SW 8	1.3	9.0	8	1	33	18	24	16

The mean grading for the block (see Figures 5 and 6) is fines 13 per cent, sand 46 per cent and gravel 41 per cent (including 5 per cent of cobble grade). Fuller grading information for individual boreholes is given in Table 3. The estimated volume of mineral for the block is 58.1 million m^3 ± 31 per cent at the 95 per cent probability level.

Block B

Block B covers the northern part of the resource sheet from Hertford in the south-west, north to Sacombe and east to Barwick; the Rivers Rib and Beane form the southern and western boundaries respectively. The block covers an area of 28.1 km^2 of which 16.2 km^2 is mineral-bearing.

Boulder Clay forms the predominant overburden within this block with Alluvium and Brickearth covering Glacial Sand and Gravel in the valleys. The overburden has a mean thickness of 4.1 m and ranges, in IMAU boreholes proving mineral, from 0.2 m in SW 11 [3230 1447] to 12.3 m in NE 7 [3713 1899]. In the north the overburden becomes excessively thick, for example in borehole NE 3 [3629 1969] where 22.1 m of Boulder Clay and Brickearth were proved resting directly on Upper Chalk.

The mineral is predominantly composed of Glacial Sand and Gravel, which crops out on the valley sides and underlies the Boulder Clay, and additionally two small patches of River Terrace Deposits (Undifferentiated) in the northwest. The mineral has a mean thickness of 6.1 m and ranges, in IMAU boreholes, from 2.0 m, for example in NE 5 [3642 1738], to 12.4 m in NW 10 [3185 1618].

The mean grading for the block (Figure 7) is fines 14 per cent, sand 40 per cent and gravel 46 per cent (including 5 per cent of cobble grade). Fuller grading information for individual boreholes is given in Table 4. The estimated volume of mineral for the block is 98.8 million m^3 ± 28 per cent at the 95 per cent probability level.

Block C

This block covers 15.5 km^2 of ground, from Ware north-eastwards towards Biggers Farm, on the interfluve between the Rivers Rib and Ash, to the north and south-east respectively. Of this block area 12.1 km^2 is mineral bearing.

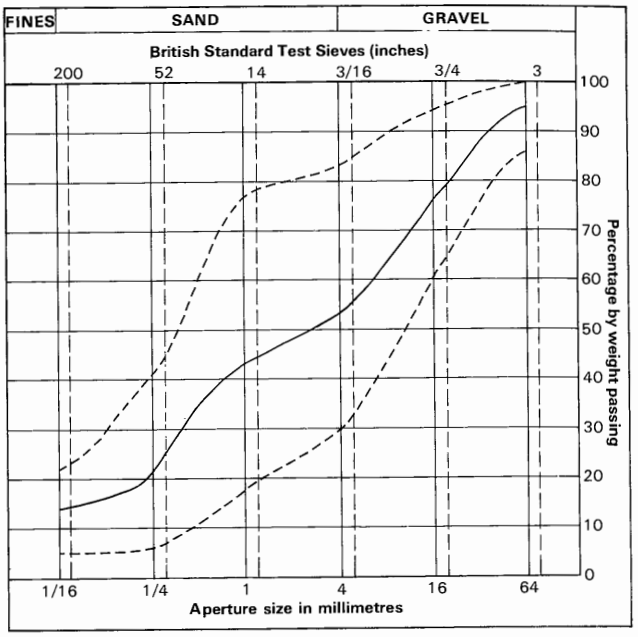


Figure 7 Grading characteristics of the mineral in Block B (for explanation see Figure 6).

The overburden is Boulder Clay which becomes excessively thick to the extreme north-east and north of Ware; up to 23.3 m has been proved (eg borehole NE 19 [3974 1877]). Elsewhere in the block the mean overburden thickness is 4.8 m and ranges from 0.2 m in borehole NE 12 [3887 1924] to 15.8 m in borehole NE 10 [3777 1648].

The mineral proved is exclusively Glacial Sand and Gravel; it has a mean thickness of 6.6 m and ranges from 2.5 m in borehole NE 6 [3612 1626] to 11.9 m in borehole SE 38 [3759 1437].

The mean grading for the block (Figure 8) is fines 16 per cent, sand 39 per cent and gravel 45 per cent (including 5 per cent of cobble grade). Fuller grading information for individual boreholes is given in Table 5. The estimated volume of mineral for the block is

Table 4 Block B: data from assessment boreholes proving sand and gravel. Coarse gravel includes cobbles.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Over-burden	Mineral	Fines $-\frac{1}{16}$ mm	Fine sand $+\frac{1}{16}-\frac{1}{4}$ mm	Medium sand $+\frac{1}{4}-1$ mm	Coarse sand +1 -4 mm	Fine gravel +4 -16 mm	Coarse gravel +16 mm
NW 10	2.0	12.4	11	4	21	12	23	29
NW 13	5.8	11.3	16	11	24	9	20	20
NW 14	0.3	8.9	16	4	19	11	22	28
NW 15	3.8	10.6	15	6	19	14	26	20
NW 16*	(9.0)	(2.9)	20	8	15	13	19	25
NW 17	9.5	8.8	6	3	13	14	34	30
NW 18	3.5	2.0	5	1	12	12	39	31
NW 20	9.2	6.1	22	19	36	6	8	9
NW 21	5.0	4.4	17	8	18	11	23	23
NE 2	9.0	6.0	18	7	26	6	20	23
NE 4	2.8	6.0	12	4	11	11	23	39
NE 5	2.2	2.0	22	8	26	11	27	6
NE 7	12.3	5.3	17	6	34	7	19	17
NE 8	(10.6)	(6.4)	17	10	32	8	21	12
SW 11	0.2	10.3	11	6	29	12	19	23

*Brackets in tables to indicate that the sand and gravel encountered does not satisfy the requirements for mineral as defined on p.1.

Table 5 Block C: data from assessment boreholes proving sand and gravel. Coarse gravel includes cobbles.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Over-burden	Mineral	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
NE 6	(17.3)	(2.5)	5	3	18	10	29	35
NE 10	15.8	8.5	14	5	14	13	26	28
NE 11	(10.7)	(1.0)	16	2	9	13	28	32
NE 12	0.2	11.6	18	2	18	11	27	24
NE 13	8.4	0.3	19	2	15	8	25	31
NE 15	1.2	7.5	19	6	27	6	21	21
NE 16	11.8	4.9	16	5	17	12	25	25
NE 20	5.6	5.2	28	8	27	8	14	15
NE 21	8.5	5.3	14	8	19	9	23	27
SE 38	7.5	11.9	9	11	41	8	14	17

79.9 million m^3 $\pm$ 24 per cent at the 95 per cent probability level.

Block D

This block covers 17.9 km^2 of ground, of which 11.4 km^2 is mineral-bearing, south of the Hertford/Ware urban area. The Pebble Gravel, Glacial Sand Gravel and River Terrace Deposits have been assessed as mineral within this area.

The overburden comprises Boulder Clay, Brickearth, Taplow Brickearth and Alluvium and has a mean thickness of 3.9 m; it ranges from 0.3 m for example in borehole SE 32 [3546 1130] to 17.0 m in borehole SW 22 [3417 1118]. West of Little Amwell the Boulder Clay becomes increasingly thick (for example borehole SW 17 [3340 1134] and the district in the vicinity of Balls Wood [343 106] is considered to contain no potentially workable sand and gravel.

The mineral has a mean thickness of 4.7 m and ranges in recorded thickness from 1.0 m for example in borehole SE 32 to 8.1 m in borehole SW 18 [3355 1049].

The mean grading for the block (Figure 9) is fines 12 per cent, sand 41 per cent and gravel 47 per cent (including 3 per cent of cobble grade). Fuller grading information for individual boreholes is given in Table 6. The estimated volume of mineral for the block is 53.6 million m^3 $\pm$ 26 per cent at the 95 per cent probability level.

Block E

Block E covers 14.1 km^2 of ground in the south-east and east and includes the River Ash and the lower reaches of the River Lea; of this area 9.1 km^2 is mineral-bearing. The overburden, which comprises Boulder Clay and Alluvium, has a mean thickness of 3.3 m and ranges from 0.3 m in borehole SE 45 [3963 1235] to 16.5 m in borehole SE 44 [3967 1349]. In the east around Newgate Wood [399 135] the Boulder Clay becomes thicker and the area is considered to contain no potentially workable sand and gravel.

The mineral is found within the Glacial Sand and Gravel and River Terrace Deposits (Undifferentiated)

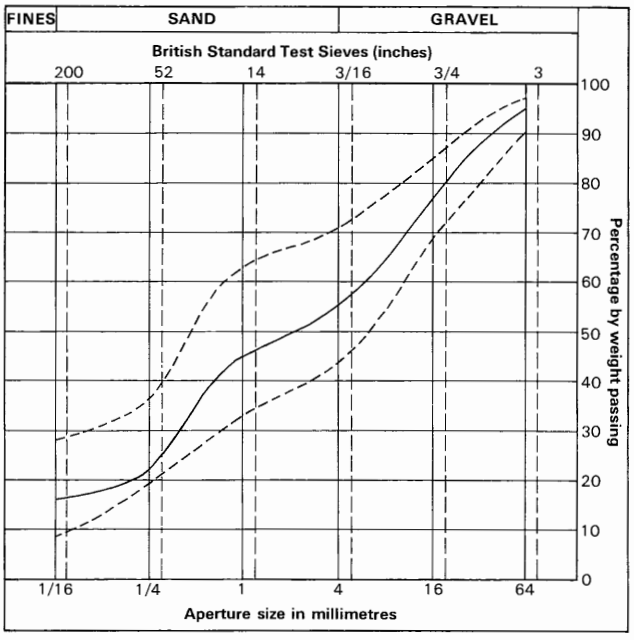


Figure 8 Grading characteristics of the mineral in Block C (for explanations see Figure 6).

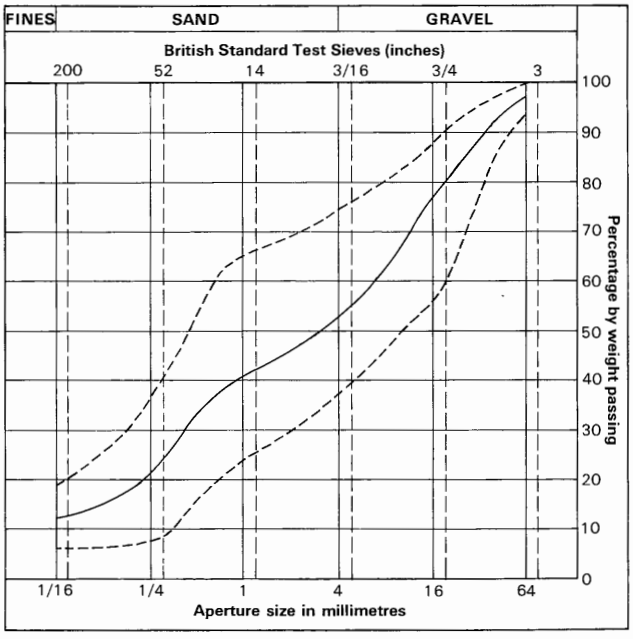


Figure 9 Grading characteristics of the mineral in Block D (for explanation see Figure 6).

Table 6 Block D: data from assessment boreholes proving sand and gravel. Coarse gravel includes cobbles.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Over-burden	Mineral	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
SW 4	1.3	3.0	6	2	16	16	34	26
SW 5	1.8	7.5	12	8	21	14	24	21
SW 6	8.8	4.3	14	9	15	13	22	27
SW 7	2.4	2.6	6	1	17	15	34	27
SW 9	1.5	1.5	11	2	16	8	19	44
SW 10	5.4	6.6	15	5	17	10	27	26
SW 12	9.9	3.7	16	13	16	13	26	16
SW 13	10.2	5.5	12	9	19	17	22	21
SW 17	(14.8)	(1.3)	11	6	13	13	28	29
SW 18	15.9	8.1	8	14	25	11	23	19
SW 21	0.3	5.7	13	4	27	11	22	23
SW 22	(17.0)	(4.3)	12	9	18	14	28	19
SE 32	0.3	1.0	19	6	16	11	20	28
SE 33	0.5	3.7	11	7	18	12	27	25
SE 35	0.4	4.4	17	6	18	8	27	24
SE 36	0.9	3.6	15	21	29	9	14	12
SE 37	(7.2)	(1.0)	7	8	18	8	23	36
SE 39	(3.8)	(1.2)	28	2	13	5	17	35

Table 7 Block E: data from assessment boreholes proving sand and gravel. Coarse gravel includes cobbles.

Borehole	Recorded thickness (m)		Mean grading percentage					
	Over-burden	Mineral	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
NE 17	5.9	4.1	13	5	27	9	20	26
SE 34	0.4	5.3	8	3	13	13	30	33
SE 40	5.1	4.9	14	5	18	15	29	19
SE 41	3.8	8.7	12	12	20	12	21	23
SE 42	1.2	3.2	10	22	50	5	8	5
SE 43	11.0	5.3	11	11	20	14	22	22
SE 44	(16.5)	(2.9)	19	9	45	7	13	7
SE 45	0.3	2.0	11	12	42	7	16	12
SE 46	1.5	2.2	8	6	18	9	27	32

and has a mean thickness of 4.3 m; it ranges from 2.0 m in borehole SE 45 to 8.7 m in borehole SE 41 [3859 1320].

The mean grading for the block (Figure 10) is fines 11 per cent, and 44 per cent and gravel 45 per cent (including 6 per cent of cobble grade). Fuller grading information for individual boreholes is given in Table 7. The estimated volume of mineral for the block is 39.1 million m^3 $\pm$ 28 per cent at the 95 per cent probability level.

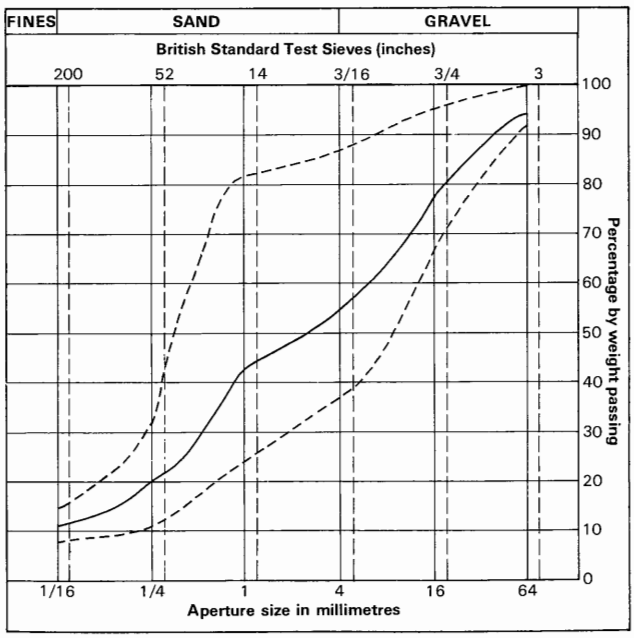


Figure 10 Grading characteristics of the mineral in Block E (for explanation see Figure 6).

List of workings

The following is a list of pits in the area of sheet TL31; they are mainly disused. Except for Ryegate Farm Pit, where River Terrace Deposits are extracted, all the pits are in Glacial Sand and Gravel.

Gravel Pits (in 1975)

Location	Grid Reference
West of Waterford	305 147
East of Waterford	317 156 and 136 152
Westmill Farm	340 159 and 342 160
South of Wadesmill	359 170
West of Ware	343 148
Ware (urban area)	349 148 and 351 150
South of Ware	357 128
Ryegate Farm	388 110
Sand Pits	
West of Bayfordbury	310 102
North-west of Ware	306 153

REFERENCES

ALLEN, V. T. 1936. Terminology of medium-grained sediments. **Rep. Natl. Res. Counc., Washington, 1935–1936, App. 1, Rep. Comm. Sediment.**, 18–47.

ARCHER, A. A. 1969. Background and problems of an assessment of sand and gravel resources in the United Kingdom. **Proc. 9th Commonw. Min. & Metall. Congr., 1969**, Vol. 2: Mining and petroleum geology, 495–508.

— 1970a. Standardisation of the size classification of naturally occurring particles. **Geotechnique**, Vol. 20, 103–107.

— 1970b. Making the most of metrication. **Quarry Managers' J.**, Vol. 54, No. 6, 223–227.

ATTERBERG, A. 1905. Die rationelle Klassifikation der Sande und Kiese. **Chem. Z.**, Vol. 29, 195–198.

BRITISH STANDARDS INSTITUTION. 1967. **B.S.1377: Methods of testing soils for civil engineering purposes.** (London: British Standards Institution.)

BUREAU OF MINES AND GEOLOGICAL SURVEY. 1948. Pp. 14–17 in **Mineral resources of the United States.** (Washington, DC: Public Affairs Press.)

GIBBARD, P. L. 1977. The Pleistocene history of the Vale of St Albans. **Phil. Trans. R. Soc. Lond.** Ser B, Vol. 280, 445–483.

HARRIS, P. M., THURRELL, R. G., HEALING, R. A., and ARCHER, A. A. 1974. Aggregates in Britain. **Proc. R. Soc.**, Ser. A, Vol. 339, 329–353.

HULL, J. H. 1981. Methods of calculating the volume of resources of sand and gravel. **Appendix** (pp. 192–193) to **THURRELL, R. G.** 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. **Quarry Management**, for March 1981, 181–193.

LANE, E. W., and others. 1947. Report of the sub-committee on sediment terminology. **Trans. Am. Geophys. Union**, Vol. 28, 936–938.

MITCHELL, G. F., PENNY, L. F., SHOTTON, F. W. and WEST, R. G. 1973. A correlations of Quaternary deposits in the British Isles. **Geol. Soc. Lond., Spec. Rep.** No. 4, 99 pp.

PETTIJOHN, F. J. 1975. **Sedimentary rocks.** 3rd edition. (London: Harper and Row.)

SHERLOCK, R. L. and POCOCK, R. W. 1924. The geology of the country around Hertford. **Mem. Geol. Surv. G. B.**

THURRELL, R. G. 1971. The assessment of mineral resources with particular reference to sand and gravel. **Quarry Managers' J.**, Vol. 55, 19–25.

— 1981. Quarry resources and reserves: the identification of bulk mineral resources: the contribution of the Institute of Geological Sciences. **Quarry Management**, for March 1981, 181–193.

TWENHOFEL, W. H. 1937. Terminology of the fine-grained mechanical sediments. **Rep. Natl. Res. Counc., Washington, 1936–37**, App. 1, Rep. Comm. Sediment., 81–104.

UDDEN, J. A. 1914. Mechanical composition of clastic sediments. **Bull. Geol. Soc. Am.**, Vol. 25, 655–744.

WENTWORTH, C. K. 1922. A scale of grade and class terms for clastic sediments. **J. Geol.**, Vol. 30, 377–392.

— 1935. The terminology of coarse sediments. **Bull. Natl. Res. Counc. Washington**, No. 98, 225–246.

WILLMAN, H. B. 1942. Geology and mineral resources of the Marseilles, Ottawa and Streator quadrangles. **Bull. Illinois State Geol. Surv.**, No. 66, 343–344.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

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

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

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

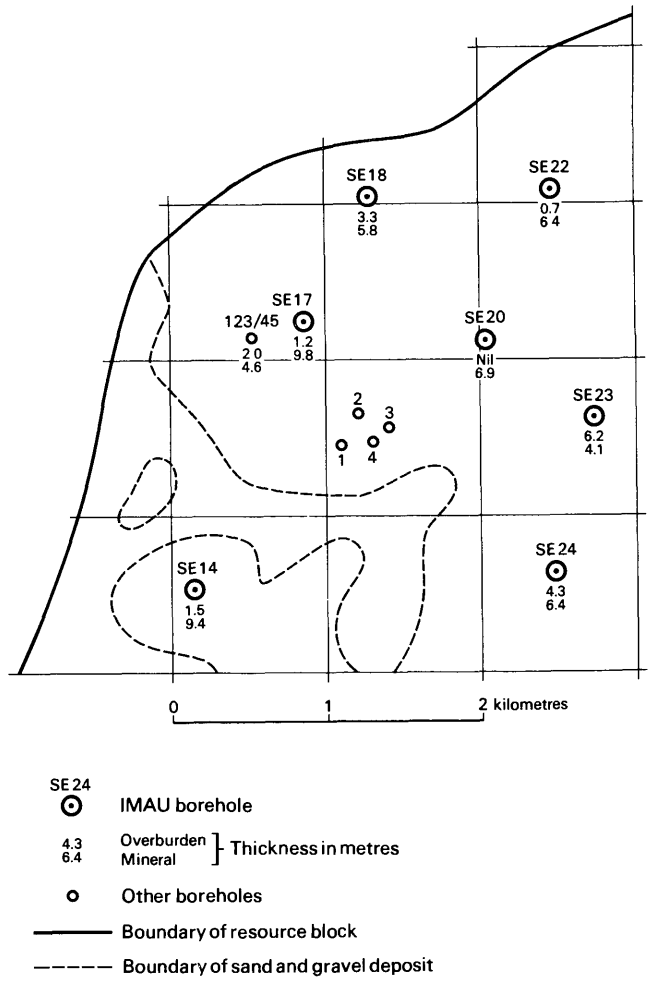
The drilling machine employed should be capable of providing a continuous sample representative of all unconsolidated deposits, so that the in-situ grading can be determined, if necessary, to a depth of 30 m (100 ft) at a diameter of about 200 mm (8 in), beneath different types of overburden. It should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

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

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

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

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



Example of resource block assessment: map of a fictitious block

APPENDIX B

STATISTICAL PROCEDURE

Statistical assessment

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

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

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

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

4 The above relationship may be transposed such that

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

per cent,

and when n is greater than 20, as

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

per cent.

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

Inferred assessment

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

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

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

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

Block calculation

Scale: 1:25 000
Block: Fictitious

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

Mean thickness
Overburden: 2.5 m
Mineral: 6.5 m

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

Confidence limits of the estimate of mineral volume at the 95 per cent probability level: $\pm$ 20 per cent
That is, the volume of mineral (with 95 per cent probability): 54 $\pm$ 11 million m^3

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

Sample point	Weighting w	Overburden l_o	Overburden wl_o	Mineral l_m	Mineral wl_m	Remarks
SE 14	1	1.5	1.5	9.4	9.4	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	$\frac{1}{2}$	1.2	1.6	9.8	7.2	
123/45	$\frac{1}{2}$	2.0		4.6		Hydrogeology Unit record
1	$\frac{1}{4}$	2.7	2.6	7.3	5.8	Close group of four boreholes (commercial)
2	$\frac{1}{4}$	4.5		3.2		
3	$\frac{1}{4}$	0.4		6.8		
4	$\frac{1}{4}$	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_Y is calculated as

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

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

$= 20.3$

$\simeq 20$ per cent.

APPENDIX C

CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Classification of gravel, sand and fines

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

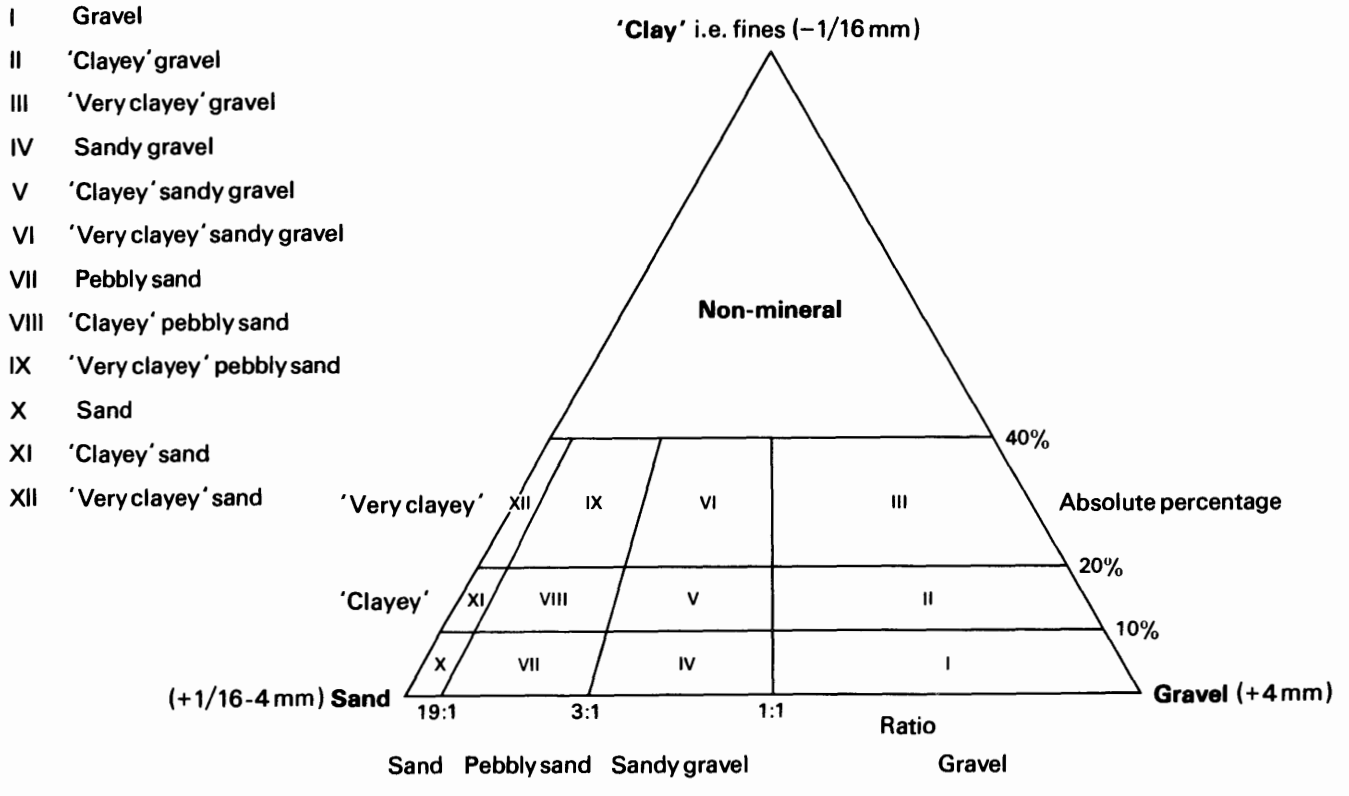


Diagram showing the descriptive categories used in the classification of sand and gravel

APPENDIX D

EXPLANATION OF THE BOREHOLE RECORDS

Annotated fictitious example

CK 66 NW 5[1] **6191 6962**[2] **Northfields**[3] **Block B**

Surface level (+49.7 m) +163 ft[4]
Water struck at +45.9 m[5]
October 1972[6]

Overburden[7] 2.8 m
Mineral 5.4 m
Waste 1.1 m
Mineral 1.4 m
Bedrock 0.7 m+[8]

LOG

Geological classification	Lithology[9]	Thickness m	Depth m
	Soil	0.2	0.2
Alluvium	Clay, silty, dark brown	2.6	2.8
River Terrace Deposits	**a** Gravel Gravel: fine to coarse, with cobbles towards base, angular to rounded flint and limestone with ironstone and some quartz and chalk Sand: medium with coarse and some fine, quartz and limestone	5.4	8.2
Boulder Clay	Clay, sandy and pebbly, red-brown	1.1	9.3
Glacial Sand and Gravel	**b** Sand, 'clayey' in part: fine, subangular to rounded, quartz with some coal	1.4	10.7
Lias	Mudstone, blue-grey, fossiliferous	0.7+	11.4

GRADING[10]

	Mean for deposit percentages			Depth below[11] surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
a	5	46	49	2.8-3.9	20	14	62	2	2	0	0
				3.8-4.8	2	2	12	18	42	24	0
				4.8-5.8	1	3	24	13	35	24	0
				5.8-6.8	0	4	21	20	26	29	0
				6.8-8.2	4	3	23	10	23	30	7
				Mean	**5**	**5**	**28**	**13**	**25**	**22**	**2**
b	5	95	0	9.3-10.3	3	73	23	1	0	0	0
				10.3-10.7	9	85	5	1	0	0	0
				Mean	**5**	**77**	**17**	**1**	**0**	**0**	**0**
a+b	**5**	**56**	**39**	**Mean**	**5**	**20**	**26**	**10**	**20**	**17**	**2**

COMPOSITION[12]

Depth below surface (m)	percentages by weight in the 8-16 mm fraction				
	Flint	Quartz	Limestone	Chalk	Ironstone
3.8-4.8	41	5	50	1	3
4.8-5.8	39	3	45	5	8
5.8-6.8	45	2	42	5	6
6.8-8.2	19	6	61	3	11
Mean	**35**	**4**	**51**	**3**	**7**

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

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

a The number of the 1:25 000 sheet on which the borehole lies, here CK 66.
b 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, here NW 5.

Thus the full Registration Number is CK 66 NW 5.

2 National Grid Reference
All National Grid References fall in the 100 km square identified by the first two letters of the Registration Number. Grid references are given to eight figures, accurate to within 10 m.

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 the borehole lies is stated.

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

5 Groundwater conditions
If groundwater was present the level at which it was encountered is normally given (in metres relative to Ordnance Datum).

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

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 (+) indicated 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 gravel and/or sand 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 deposits is based on visual examination in the field.

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

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

The mean grading of groups of samples making up an identified bed of mineral are also given in detail and in summary. Where more than one bed is recognised the mean grading for the whole of the mineral in the borehole may be given. Where necessary, in calculating mean gradings, data for individual samples are weighted by the thickness represented.

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

11 Sampling
A continuous series of bulk samples is taken throughout the thickness of sand and gravel. A new sample is taken wherever there is an appreciable lithological change within the sand and gravel or at every 1 m of depth. Samples obtained by bailing are indicated by an asterisk.

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

APPENDIX E

INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS AND LIST OF OTHER REGISTERED BOREHOLES

TL 31 NW 3 **3099 1940** **Bordulphs, Watton-at-Stone** **Block A**

Surface level (+75.0 m) +246 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 1.8 m
Mineral 4.9 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, brown, with cobbles, becoming sandy	1.7	1.8
Glacial Sand and Gravel	'Clayey' gravel, very coarse, becoming sandy below 2.8 m Gravel: fine, coarse and cobbles, subangular flint and rounded quartzite Sand: medium, with fine and coarse, subangular to rounded quartz and some flint; brown	4.9	6.7
Upper Chalk	Chalk	0.6+	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 mm
10	41	49	1.8-2.8	11	1	15	8	10	26	29
			2.8-3.8	12	3	17	9	19	26	14
			3.8-4.8	8	3	18	11	17	27	16
			4.8-5.8	10	5	44	13	19	9	0
			5.8-6.7	8	7	34	15	19	9	8
			Mean	**10**	**4**	**26**	**11**	**16**	**20**	**13**

TL 31 NW 4 **3094 1856** **Hertford Lodge, Watton-at-Stone** **Block A**

Surface level (+66.1 m) +217 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 5.6 m
Mineral 9.2 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	'Very clayey' sandy gravel Gravel: coarse and fine, subangular to rounded flint and subordinate subrounded quartz and rounded quartzite Sand: medium and coarse becoming fine; brown	0.8	1.1
Boulder Clay	Clay, grey, chalky, becoming mottled reddish brown	4.5	5.6

Glacial Sand and Gravel	'Clayey' sandy gravel with occasional clayey parting and becoming very chalky near base Gravel: fine and coarse with cobbles, subangular to rounded flint and subordinate rounded chalk and quartzite Sand: medium with coarse, subangular to rounded quartz and some flint; clean, brown	9.2	14.8
Upper Chalk	Chalk, soft, marly	0.4+	15.2

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 mm
13	47	40	5.6-6.6	13	3	14	9	19	27	15
			6.6-7.6	10	3	24	9	15	25	14
			7.6-8.6	16	6	43	13	13	9	0
			8.6-9.6	9	7	35	12	12	10	15
			9.6-10.6	10	5	37	16	8	19	5
			10.6-11.6	13	4	17	11	23	26	6
			11.6-12.6	11	6	35	15	20	13	0
			12.6-13.6	10	6	63	4	7	5	5
			13.6-14.6	17	3	20	12	26	15	7
			14.6-14.8	14	6	19	9	25	16	11
			Mean	**13**	**4**	**32**	**11**	**16**	**17**	**7**

TL 31 NW 5 **3024 1721** **Near Kitchencroft Spring, Stapleford** **Block A**

Surface level (+76.2 m) +250 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 4.2 m
Mineral 3.4 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Boulder Clay	Clay, stiff, brown to blue-grey with chalk and flint pebbles; sandy partings at 3 m	4.2	4.2
Glacial Sand and Gravel	'Clayey' gravel Gravel: coarse and fine, with subangular to rounded flint and subordinate rounded pebbles of chalk and quartz Sand: medium to coarse subangular and rounded quartz and flint with some chalk lenticles; brown	3.4	7.6
Upper Chalk	Chalk, soft, clayey with flint nodules	0.5+	8.1

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 mm
18	33	49	4.2-5.2	21	3	13	10	29	17	7
			5.2-6.2	13	6	20	13	26	20	2
			6.2-7.2	17	1	17	13	34	16	2
			7.2-7.6	21	5	20	13	22	12	7
			Mean	**18**	**4**	**17**	**12**	**29**	**17**	**3**

TL 31 NW 6 **3052 1646** **Near Little Gobions, Stapleford** **Block A**

Surface level (67.1 m) 220 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 1.0 m
Mineral 1.3 m
Waste 2.1 m
Mineral 6.2 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	1.0	1.0
Glacial Sand and Gravel	**a** 'Clayey' gravel Gravel: fine and coarse with some chalk Sand: medium to coarse: brown	1.3	2.3
Boulder Clay	Clay, varying shades of brown, with flint and chalk pebbles at some levels	2.1	4.4
Glacial Sand and Gravel	**b** 'Clayey' gravel, sandy in upper layers and very chalky at base Gravel: coarse and fine, subangular to rounded flint and subordinate rounded quartz, quartzite and soft chalk Sand: medium with coarse, subangular and rounded quartz and flint; becoming increasingly chalky below 8.8 m; brown to fawn	6.2	10.6
Upper Chalk	Chalk, soft, with flint nodules	0.6+	11.2

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
a	16	30	54	1.0-2.3	16	2	16	12	20	15	19
b	12	43	45	4.4-5.4	17	10	14	8	28	20	3
				5.4-6.4	8	6	16	10	37	14	9
				6.4-7.4	11	4	37	18	13	11	6
				7.4-8.4	10	5	34	11	19	16	5
				8.4-10.6	No grading available						
				Mean	**12**	**6**	**25**	**12**	**24**	**16**	**5**
a+b	**13**	**41**	**46**	**Mean**	**13**	**5**	**24**	**12**	**23**	**16**	**7**

TL 31 NW 7 **3074 1568** **Near Waterford Hill, Stapleford** **Block A**

Surface level (+72.8 m) +239 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
December 1971

Overburden 2.0 m
Mineral 4.5 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, soft, brown, silty, becoming stiff, brown with abundant chalk and flint pebbles	1.0	1.3
Brickearth	Silt, pale orange to yellow-brown with lenses of stiff brown clay	0.7	2.0
Glacial Sand and Gravel	'Clayey' sandy gravel, becoming more sandy at depth but with clay seams Gravel: fine to coarse, with subangular and rounded flint and subordinate rounded quartzite, silicified chalk and soft chalk Sand: medium with fine and coarse, subangular to rounded quartz and some flint and chalk; pale brown	4.5	6.5
Upper Chalk	Chalk, soft, white with flint nodules	0.6+	7.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
18	47	35	2.0-3.0	21	10	41	7	14	7	0
			3.0-4.0	18	16	35	7	17	7	0
			4.0-5.0	22	8	34	6	12	11	7
			5.0-6.0	12	6	14	10	34	20	4
			6.0-6.5	11	9	16	13	30	18	3
			Mean	**18**	**10**	**29**	**8**	**21**	**12**	**2**

TL 31 NW 8 **3166 1831** **Home Farm, Watton-at-Stone** **Block A**

Surface level (+61.0 m) +200 ft
Groundwater encountered at +49.0 m
Shell & Auger 152 mm diameter
November 1971

Overburden 7.7 m
Mineral 6.8 m
Waste 2.3 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, varying shades of brown to grey, with chalk, flint and sandstone pebbles	6.2	6.4
Brickearth	Silty clay, pale to orange-brown, and interbedded sands with trace of chalk pebbles	1.3	7.7

Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: mainly fine and coarse, with subangular to rounded flint and rounded chalk, pink quartzite and quartz Sand: medium with coarse, subangular to rounded quartz with flint and some chalk; brown	6.8	14.5
Boulder Clay	Clay, very stiff, dark brown and grey; very chalky in places, especially near bedrock	2.3	16.8
Upper Chalk	Chalk, soft	0.3+	17.1

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 mm
15	55	30	7.7-8.7	21	4	9	55	2	1	8
			8.7-9.7	9	5	14	13	28	26	5
			9.7-10.7	13	10	34	8	12	16	7
			10.7-11.7	18	5	45	8	12	7	5
			11.7-12.7	14	6	51	15	10	4	0
			12.7-13.7	24	2	36	12	12	9	5
			13.7-14.5	3	4	34	10	18	24	7
			Mean	**15**	**6**	**39**	**10**	**13**	**12**	**5**

TL 31 NW 9 **3124 1769** **Near Patchendon, Stapleford** **Block A**

Surface level (+47.2 m) +155 ft
Groundwater encountered at +45.2 m
Shell and Auger 152 mm diameter
July 1972

Overburden 2.5 m
Mineral 1.0 m
Waste 0.3 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Silty clay, soft, brown, with a little gravel from 2.1 m	2.4	2.5
Glacial Sand and Gravel	'Very clayey' gravel Gravel: fine with coarse, subangular to rounded flint Sand: coarse and medium; brown	1.0	3.5
? Boulder Clay	Clay in chalky lumps with chalk and sand and gravel as above	0.3	3.8
Upper Chalk	Chalk, soft and white	0.7+	4.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
25	32	43	2.5-3.5	25	0	12	20	31	12	0

TL 31 NW 10 **3185 1618** **Near Bullsmill, Stapleford** **Block B**

Surface level (+67.1 m) +220 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
December 1971

Overburden 2.0 m
Mineral 12.4 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
	Clay, soft, brown, silty	1.8	2.0
Glacial Sand and Gravel	'Clayey' gravel, with much clay in top 2.3 m, becoming sandy but with some clay lenticles below Gravel: fine and coarse, with subangular to rounded flint and subordinate rounded silicified chalk, quartz, quartzite and sandstone Sand: medium to coarse, subangular to rounded quartz, and some flint and rounded chalk	12.4	14.4
Upper Chalk	Chalk, soft, white, with rounded flint nodules	0.7+	15.1

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 mm
11	37	52	2.0-3.0	11	4	27	11	21	17	9
			3.0-4.0	6	4	27	19	24	16	4
			4.0-5.0	9	3	27	10	14	22	15
			5.0-6.0	12	2	19	12	17	21	17
			6.0-7.0	10	7	22	10	21	23	7
			7.0-8.0	7	6	16	10	15	22	24
			8.0-9.0	9	5	12	13	28	20	13
			9.0-10.0	14	4	19	9	29	23	2
			10.0-11.0	12	2	26	11	25	19	5
			11.0-12.0	15	2	19	13	23	24	4
			12.0-13.0	11	4	15	14	28	20	8
			13.0-14.0	8	9	19	15	26	19	4
			14.0-14.4	10	10	20	16	22	22	0
			Mean	**11**	**4**	**21**	**12**	**23**	**20**	**9**

TL 31 NW 11 **3110 1597** **Near Waterford Hall, Stapleford** **Block A**

Surface level (+53.0 m) +174 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
December 1971

Waste 2.8 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
	Silt, brown, slightly clayey and slightly sandy, with scattered flint and trace of quartz pebbles	0.4	0.8
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse, with some scattered small cobbles; subangular to rounded flint with subordinate rounded quartz and Bunter quartzite Sand: fine to coarse, angular quartz with flint; 'dirty' brown	0.8	1.6
Boulder Clay	Clay, stiff, brown with black film, and scattered fine and and coarse flint and Bunter quartzite gravel; pale brown silt band at base	0.4	2.0
Glacial Sand and Gravel	'Very clayey' gravel, increasingly chalky, with subangular to rounded flint and flint nodules and rounded Bunter quartzite; pale brown to off-white, passing into chalk	0.8	2.8
Upper Chalk	Chalk, soft and white with flint nodules	0.8+	3.6

TL 31 NW 12 **3221 1970** **Near Sacombe Hill, Sacombe** **Block B**

Surface level (+106.1 m) +348 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Waste 1.1 m
Bedrock 5.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
	Clay, very stiff, mottled brown-grey, sandy, with some flint and quartz pebbles	0.6	1.1
Reading Beds	Sand to sandy clay, varying fines content, but mean approximately 40 per cent; mostly a grey to brown silt but some fine sand layers with occasional small pebbles of variably rounded flint and quartz	5.5	6.6
Upper Chalk	Chalk, soft, white, with flint nodules	0.4+	7.0

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 mm
38	53	9	1.4-2.4	38	37	15	1	4	4	1

TL 31 NW 13 **3264 1781** **Burr's Green, Sacombe** **Block B**

Surface level (+83.8 m) +275 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 5.8 m
Mineral 11.3 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, brown to pale grey, with varying quantities of chalk pebbles and pellets and some rounded flint pebbles	5.6	5.8
Glacial Sand and Gravel	'Clayey' sandy gravel, with occasional silty sand layers of possible lacustrine origin Gravel: fine and coarse, subangular to rounded flint and subordinate white quartz, rounded red mudstone and brown quartzite Sand: medium with fine and coarse, mainly variably rounded flint, but some quartz; brown to pale brown	11.3	17.1
Upper Chalk	Chalk, soft, white	0.5+	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 mm
16	44	40	5.8-6.8	14	4	17	12	24	23	6
			6.8-7.8	18	10	18	10	23	21	0
			7.8-8.8	15	6	16	11	32	19	1
			8.8-9.8	25	28	29	3	10	5	0
			9.8-10.8	32	21	21	6	12	8	0
			10.8-11.8	12	4	14	12	24	27	7
			11.8-12.8	8	16	20	11	33	12	0
			12.8-13.8	18	6	18	8	22	19	9
			13.8-14.8	11	8	16	11	28	19	7
			14.8-15.8	9	8	52	14	9	7	1
			15.8-17.1	12	6	39	7	5	13	18
			Mean	**16**	**11**	**24**	**9**	**20**	**16**	**4**

TL 31 NW 14 **3261 1670** **Dimmings, Chapmore End** **Block B**

Surface level (+69.8 m) +229 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
January 1972

Overburden 0.3 m
Mineral 1.7 m
Waste 0.4 m
Mineral 2.5 m
Waste 1.9 m
Mineral 4.7 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	**a** 'Clayey' gravel, orange-brown, chalky Gravel: fine and coarse Sand: medium and coarse	1.7	2.0
Brickearth	Clayey silt, laminated, brown	0.4	2.4
Glacial Sand and Gravel	**b** 'Clayey' gravel, brown, slightly chalky Gravel: fine and coarse Sand: medium with coarse	2.5	4.9
Boulder Clay	Clay, stiff, brown, chalky, with some sand partings below a 0.1 m gravel band of brown quartz cobbles at 6.3 m	1.9	6.8
Glacial Sand and Gravel	**c** 'Clayey' gravel with some sand partings; brown Gravel: fine and coarse Sand: medium with coarse	4.7	11.5
Upper Chalk	Chalk, soft, white	0.4+	11.9

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
a	15	21	64	0.3-1.3	15	2	8	11	26	27	11
				1.3-2.0	sample lost						
				Mean	**15**	**2**	**8**	**11**	**26**	**27**	**11**
b	16	37	47	2.4-3.4	16	3	12	12	19	23	15
				3.4-4.0	14	6	28	11	11	22	8
				4.0-4.9	14	4	27	13	20	22	0
				Mean	**16**	**4**	**21**	**12**	**17**	**23**	**7**
c	16	36	48	6.8-7.8	18	6	28	5	16	16	11
				7.8-8.8	19	4	42	8	16	5	6
				8.8-9.8	13	4	13	10	28	24	8
				9.8-10.8	9	6	11	14	38	22	0
				10.8-11.5	16	4	14	13	18	30	5
				Mean	**16**	**4**	**22**	**10**	**23**	**19**	**6**
a+b+c	**16**	**34**	**50**	**Mean**	**16**	**4**	**19**	**11**	**22**	**21**	**7**

TL 31 NW 15 **3254 1579** **Rickneys, Hertford** **Block B**

Surface level (+71.0 m) +233 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
November 1971

Overburden 3.8 m
Mineral 3.6 m
Waste 2.6 m
Mineral 7.0 m
Waste 0.5 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	'Clayey' sandy gravel with clay seam at base	0.4	0.7
Brickearth	Clay, orange-brown, soft, sticky	0.9	1.6
Boulder Clay	Clay, stiff, brown, with chalk pebbles	2.2	3.8
Glacial Sand and Gravel	**a** 'Clayey' gravel with seams of brown clay Gravel: fine and coarse, with subangular to rounded flint and subordinate quartz and chalk Sand: medium and coarse subangular to rounded quartz; brown	3.6	7.4
Boulder Clay	Clay, sticky, brown and dark grey, with chalk and flint pebbles	2.6	10.0
Glacial Sand and Gravel	**b** 'Clayey' gravel, chalky at base Gravel: variable angular to rounded flint, chalk and rare quartz and quartzite Sand: fine, medium and coarse, quartz and some flint; pale brown	7.0	17.0
	Very chalky gravel, as above, mixed with chalk	0.5	17.5
Upper Chalk	Chalk, very soft	0.4+	17.9

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 mm
a	19	35	46	3.8-4.8	11	5	13	13	27	24	7
				4.8-5.8	41	2	9	8	19	20	1
				5.8-6.8	8	5	20	15	23	21	8
				6.8-7.4	9	8	41	11	16	12	3
				Mean	**19**	**4**	**19**	**12**	**21**	**21**	**4**
b	13	41	46	10.0-11.0	9	8	15	15	34	19	0
				11.0-12.0	14	4	14	16	34	15	3
				12.0-13.0	11	9	20	14	25	21	0
				13.0-14.0	15	6	18	17	31	12	1
				14.0-15.0	12	8	34	12	27	7	0
				15.0-16.0	12	8	20	15	25	14	6
				16.0-17.0	18	5	13	11	19	20	14
				Mean	**13**	**7**	**19**	**15**	**28**	**15**	**3**
a+b	**15**	**39**	**46**	**Mean**	**15**	**6**	**19**	**14**	**26**	**17**	**3**

TL 31 NW 16 **3364 1815** **North West of Bengeo Temple, Bengeo** **Block B**

Surface level (+85.3 m) +280 ft
Groundwater not encountered
Shell & Auger 152 mm diameter
December 1971

Waste 12.1 m
Bedrock 0.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
	Clay, brown with sand and gravel partings	0.8	1.0
Boulder Clay	Clay, stiff, dark grey and brown, with pebbles of chalk, fissile shale and sandstone	8.0	9.0
Glacial Sand and Gravel	'Very clayey' gravel Gravel: fine and coarse, subangular to rounded flint and subordinate rounded quartz and quartzite Sand: mainly medium and coarse, subangular to rounded quartz and flint; rust brown	2.9	11.9
? Boulder Clay	Clay, very stiff, rust brown with scattered flint pebbles	0.2	12.1
Upper Chalk	Chalk, soft, with flint bed at top	0.9+	13.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
20	36	44	9.0-10.0	22	11	14	14	16	23	0
			10.0-11.0	17	7	17	13	24	17	5
			11.0-11.9	18	7	13	11	19	15	17
			Mean	**20**	**8**	**15**	**13**	**19**	**19**	**6**

TL 31 NW 17 **3362 1761** **South West of Bengeo Temple, Bengeo** **Block B**

Surface level (+83.2 m) +273 ft
Groundwater encountered at +69.9 m (perched water table)
and at 63.3 m (main water table)
Shell & Auger 152 mm diameter
December 1971

Overburden 9.5 m
Mineral 2.1 m
Waste 1.7 m
Mineral 6.7 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
Boulder Clay	Clay, stiff, brown and grey, with flint, chalk and sandstone pebbles	6.0	6.0
Brickearth	Silts, clays and sandy clays, stiff, grey-brown to reddish, laminated in places	3.5	9.5
Glacial Sand and Gravel	**a** 'Clayey' gravel, becoming less clayey in lower half Gravel: fine and coarse, subangular to rounded flint and quartzite pebbles Sand: fine, medium and coarse, subangular to rounded quartz and flint with some chalk; brown	2.1	11.6
Boulder Clay	Clay, stiff, brown, with chalk pebbles and a thin gravel parting; gravelly, sandy and silty in basal 0.2 m	1.7	13.3

Glacial Sand and Gravel	**b** Gravel, sandy and slightly 'clayey' in places, but mostly clean: brown Gravel: fine and coarse, subangular and rounded flint and subordinate quartz, quartzite and jasper Sand: medium and coarse, subangular to rounded quartz and flint; brown	6.7	20.0
Upper Chalk	Chalk, soft, and flints	0.8+	20.8

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 mm
a	17	40	43	9.5-10.5	19	10	17	10	25	14	5
				10.5-11.6	15	7	22	14	16	18	8
				Mean	**17**	**8**	**20**	**12**	**20**	**16**	**7**
b	2	27	71	13.3-14.3	7	4	22	16	23	23	5
				14.3-15.3	2	3	20	16	34	25	0
				15.3-16.8	0	1	3	12	43	34	7
				16.8-17.3	1	1	6	17	49	21	5
				17.3-18.3	1	0	4	13	50	25	7
				18.3-19.3	0	1	7	11	39	28	14
				19.3-20.0	1	4	16	12	43	20	4
				Mean	**2**	**2**	**11**	**14**	**39**	**26**	**6**
a+b	**6**	**30**	**64**	**Mean**	**6**	**3**	**13**	**14**	**34**	**24**	**6**

TL 31 NW 18 **3346 1588** **River Rib, below Herts. Training College, Bengeo** **Block B**

Surface level (+40.2 m) +132 ft
Groundwater encountered at +36.7 m
Shell and Auger 152 mm diameter
June 1972

Overburden 3.5 m
Mineral 2.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, brown and grey, silty	3.4	3.5
Glacial Sand and Gravel	Gravel with some chalk near base Gravel: medium-coarse, angular to subangular flint and subrounded quartz with some jasper Sand: brown	2.0	5.5
Upper Chalk	Chalk, soft, white	0.2+	5.7

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
5	25	70	3.5-4.5	6	0	9	9	41	35	0
			4.5-5.5	4	1	15	15	38	27	0
			Mean	**5**	**1**	**12**	**12**	**39**	**31**	**0**

TL 31 NW 19 **3424 1940** **Near Sacombe Green, Sacombe** **Block B**

Surface level (+113.1 m) +371 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
December 1971

Waste 8.8 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown to dark grey, with some sand and gravel partings; very chalky in places	8.5	8.8
Reading Beds	Silt, 'very clayey' sand and silty clay, with 0.2 m gravel layer near base; red-brown, orange and green	6.1	14.9
Upper Chalk	Chalk, soft, white, with flints	0.4+	15.3

TL 31 NW 20 **3410 1880** **South of Sacombe House, Sacombe** **Block B**

Surface level (+101.8 m) +334 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
December 1971

Overburden 9.2 m
Mineral 6.1 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Boulder Clay	Clay, brown, with chalk and occasional flint and quartzite pebbles; silty below 8.7 m	8.8	9.2
Glacial Sand and Gravel	'Very clayey' pebbly sand with discrete clay partings Gravel: fine and coarse flint, mainly in bands Sand: medium with fine, slightly chalky; brown	6.1	15.3
Upper Chalk	Chalk	0.3+	15.6

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
22	61	17	9.2-11.2	No grading available						
			11.2-12.2	36	15	46	2	1	0	0
			12.2-13.2	21	22	44	4	4	5	0
			13.2-14.2	13	34	42	3	3	4	1
			14.2-15.3	17	7	16	12	22	17	9
			Mean	**22**	**19**	**36**	**6**	**8**	**6**	**3**

TL 31 NW 21 **3472 1763** **Chelsing Cottages, Bengeo** **Block B**

Surface level (+75.3 m) +247 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
December 1971

Overburden 5.0 m
Mineral 4.4 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, dark brown to dark grey, with common chalk and flint pebbles; becoming sandy from 4.9 m	4.8	5.0
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse Sand: medium, fine and coarse; brown	4.4	9.4
Upper Chalk	Chalk, soft	0.4+	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 mm
17	37	46	5.0-6.0	28	11	17	6	24	14	0
			6.0-7.0	7	7	16	12	34	22	2
			7.0-8.0	15	6	21	10	19	24	5
			8.0-9.0	17	9	19	13	16	20	6
			9.0-9.4	16	9	18	12	20	19	6
			Mean	**17**	**8**	**18**	**11**	**23**	**20**	**3**

TL 31 NE 1 **3590 1968** **South of Standon Green End, Standon** **Block B**

Surface level (+110.0 m) +361 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
December 1971

Waste 2.1 m
Bedrock 3.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
	Clay, brown pebbly, and stiff orange-brown silty	1.8	2.1
? London Clay	Silty clay and silt, soft, grey	2.3	4.4
London Clay	Clay and silty clay, stiff, dark grey	1.4+	5.8

TL 31 NE 2 **3544 1869** **West of Shepherdshill Wood, Standon** **Block B**

Surface level (+94.2 m) +309 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
December 1971

Overburden 9.0 m
Mineral 6.0 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown and grey with varying content of chalk and flint pebbles and occasional boulders of quartzite	8.7	9.0
Glacial Sand and Gravel	Generally 'clayey' gravel, cleaner in uppermost layers Gravel: fine and coarse, subangular to rounded flint, with subordinate quartz and trace of quartzite Sand: mainly medium, subangular to rounded quartz and some flint; brown, heavily iron-stained in places	6.0	15.0
Upper Chalk	Chalk, soft, white	0.1+	15.1

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
18	39	43	9.0-10.0	18	8	25	6	19	24	0
			10.0-11.0	20	5	39	5	16	12	3
			11.0-12.0	15	11	21	5	24	21	3
			12.0-13.0	16	7	23	7	22	25	0
			13.0-14.0	19	6	23	10	19	18	5
			14.0-15.0	16	4	25	8	20	21	6
			Mean	**18**	**7**	**26**	**6**	**20**	**21**	**2**

TL 31 NE 3 **3629 1916** **North of High Cross, Standon** **Block B**

Surface level (+88.7 m) +291 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
January 1972

Waste 22.1 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, sticky and pebbly, brown stiff clay, grey silty clay and soft black peat, and peaty clay	4.3	4.6
	Clay of top 1.4 m redeposited, stiff, grey, chalky, with sand lenses and pebbles of flint and quartzite; below, pale grey clay with chalk pellets and pebbles, passing into stiff dark grey clay, chalky in places and with scattered flint and other pebbles; chalky clayey silt at base	16.9	21.5
Brickearth	Sand, becoming very chalky Sand: fine, soft, orange-brown to darker brown, with lumps and grains of chalk	0.6	22.1
Upper Chalk	Chalk, soft, stained orange-brown at top	0.8+	22.9

TL 31 NE 4 **3663 1837** **East of High Cross, Standon** **Block B**

Surface level (+88.1 m) +289 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
December 1971

Overburden 2.8 m
Mineral 6.0 m
Bedrock 3.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, dark brown, containing chalk and scattered flint pebbles	2.6	2.8
Glacial Sand and Gravel	'Clayey' gravel, moderately well sorted Gravel: fine and coarse, subangular to rounded flint with subordinate rounded silicified chalk and some calcareous mudstone Sand: medium and coarse, with fine subangular flint and rounded chalk grains; brown	6.0	8.8
Reading Beds	Silty clay and silt mainly, with some 'very clayey' sandy gravel at the base	2.9	11.7
Upper Chalk	Chalk, soft, white	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 mm
12	26	62	2.8-3.8	13	4	12	10	25	31	5
			3.8-4.8	11	5	8	13	25	27	11
			4.8-5.8	12	3	11	10	22	25	17
			5.8-6.8	10	4	9	10	22	25	20
			6.8-7.8	11	3	10	11	25	17	23
			7.8-8.8	13	4	15	13	20	22	13
			Mean	**12**	**4**	**11**	**11**	**23**	**25**	**14**

TL 31 NE 5 **3642 1738** **East of Wadesmill** **Block B**

Surface level (+50.9 m) +167 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Overburden 2.2 m
Mineral 2.0 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
	Clay, soft, brown, with flint pebbles	0.9	1.0
Glacial Sand and Gravel	'Very clayey' gravel Gravel: fine and coarse with angular, subangular and well-rounded flint pebbles Sand, coarse with medium; brown	0.3	1.3
	Silt, soft, brown, clayey	0.9	2.2
	'Very clayey' sandy gravel Gravel: fine with some coarse, subrounded flint and occasional jasper Sand: fine to coarse; brown	2.0	4.2
Upper Chalk	Chalk, soft with lumps of harder rock	0.2+	4.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
22	45	33	2.2-3.2	22	8	26	11	27	6	0
			3.2-4.2	No grading available						

TL 31 NE 6 **3612 1626** **Mole's Farm, Thundridge** **Block C**

Surface level (+77.4 m) +254 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
January 1972

Waste 19.8 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, pale brown, heavily chalky, with scattered flint pebbles and occasional quartz, ironstone and chalk cobbles	0.8	1.0
Brickearth	Banded silts and 'clayey' sands with varying amounts of chalk pebbles	3.9	4.9
Boulder Clay	Clay, stiff, dark grey, with abundant chalk pellets and pebbles, and common quartz and flint cobbles	12.4	17.3
Glacial Sand and Gravel	Gravel, variable Gravel: fine and coarse, subangular to rounded flint Sand: medium and coarse, clayey at top, cleaner below; subangular to rounded quartz and flint	2.5	19.8
Upper Chalk	Chalk, soft, white, with flints	0.7+	20.5

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 mm
5	31	64	17.3-18.3	2	1	17	12	30	32	6
			18.3-18.6	10	3	36	13	21	8	9
			18.6-19.6	6	4	14	8	30	38	0
			19.6-19.8	No recovery						
			Mean	**5**	**3**	**18**	**10**	**29**	**32**	**3**

TL 31 NE 7 **3713 1899** **Sutes Wood, High Cross** **Block B**

Surface level (+94.2 m) +309 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
February 1972

Overburden 12.3 m
Mineral 5.3 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, sticky brown, rapidly changing to stiff brown, then to bluish-grey, containing abundant chalk pellets and pebbles of flint and quartz	12.2	12.3
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: medium, quartz with subordinate flint; brown	5.3	17.6
Upper Chalk	Chalk, soft, white, with flints	0.5+	18.1

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 mm
17	47	36	12.3-13.3	20	5	33	6	16	15	5
			13.3-14.3	22	5	53	5	10	5	0
			14.3-15.3	15	5	43	8	17	10	2
			15.3-16.3	13	3	20	8	28	28	0
			16.3-17.3	12	12	26	7	26	17	0
			17.3-17.6	15	10	25	7	16	16	11
			Mean	**17**	**6**	**34**	**7**	**19**	**16**	**1**

TL 31 NE 8 **3753 1840** **Haven End, Standon** **Block B**

Surface level (+93.0 m) +305 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
December 1971

Waste 20.4 m
Bedrock 3.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, brown and grey, very chalky with pellets and pebbles initially, becoming less chalky near base; flint pebbles common, with traces of other erratics	10.4	10.6
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: mainly fine, subangular to rounded quartz and subordinate flint Sand: medium with fine and coarse, subangular to rounded quartz and subordinate flint and chalk	2.0	12.6
Boulder Clay	Clay, stiff, dark brown and grey; moderately chalky with numerous flints	3.4	16.0
Glacial Sand and Gravel	'Clayey' sandy gravel, moderately chalky Gravel: fine and coarse, subangular to rounded flint and subordinate quartz Sand: mainly medium, subangular and rounded quartz and subordinate flint; orange-brown	4.4	20.4
Reading Beds	Silty clay, alternately green-grey and brown with occasional rounded flint pebbles and Bullhead Bed at base	2.5	22.9
Upper Chalk	Chalk, soft, with flints	0.6+	23.5

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 mm
a	19	54	27	10.6-11.6	15	13	33	10	29	0	0
				11.6-12.6	23	10	33	9	13	6	6
				Mean	**19**	**12**	**33**	**9**	**21**	**3**	**3**
b	16	49	35	16.0-17.0	25	14	30	5	12	14	0
				17.0-18.0	9	5	30	10	26	20	0
				18.0-19.0	14	7	27	8	24	20	0
				19.0-19.9	16	14	51	6	10	3	0
				19.9-20.4	12	6	15	19	34	14	0
				Mean	**16**	**9**	**32**	**8**	**21**	**14**	**0**
a+b	**17**	**50**	**33**	**Mean**	**17**	**10**	**32**	**8**	**21**	**11**	**1**

TL 31 NE 9 **3724 1776** **Youngbury** **Block B**

Surface level (+82.0 m) +269 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Waste 3.3 m
Bedrock 3.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Made Ground	Gravel, variable, silty at top, 'very clayey' towards base	1.8	1.9
Boulder Clay	Clay, stiff, brown and grey, with common rounded to subangular flint pebbles	1.4	3.3
Reading Beds	Clay, stiff, varicoloured	0.5	3.8
	Clay, mottled, brightly-coloured, silt and gravelly clay	1.9	5.7
Upper Chalk	Chalk, soft, white	0.9+	6.6

TL 31 NE 10 **3777 1648** **Ashridge Common, Thundridge** **Block C**

Surface level (+83.2 m) +273 ft
Groundwater encountered from +70.9 m to +70.8 m (perched water table)
Shell and Auger 203 mm and 152 mm diameter
February 1972

Overburden 15.8 m
Mineral 8.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, variable, soft, brown, chalky and stiff; grey-brown and grey with partings of dark brown silt; chalk pellets and pebbles common; other erratics include flint pebbles and broken chalk fossils; flint and quartz pebbles increasing in bottom 3 m	15.6	15.8
Glacial Sand and Gravel	'Clayey' gravel, fairly uniform throughout Gravel: fine and coarse, subangular to rounded flint with subordinate rounded quartz and quartzite Sand: medium and coarse with fine	8.5	24.3
Upper Chalk	Chalk, soft, white	0.3+	24.6

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 mm
14	32	54	15.8-16.8	13	8	12	12	28	25	2
			16.8-17.8	15	6	16	15	27	21	0
			17.8-18.8	19	4	14	15	25	21	2
			18.8-19.8	14	5	15	11	25	26	4
			19.8-20.8	12	5	21	10	26	20	6
			20.8-21.8	13	4	14	14	30	22	3
			21.8-22.8	No grading available						
			22.8-23.8	11	3	10	11	20	33	12
			23.8-24.3	14	5	11	13	28	27	2
			Mean	**14**	**5**	**14**	**13**	**26**	**24**	**4**

TL 31 NE 11 **3762 1564** **East of Fanhams Hall, Ware** **Block C**

Surface level (+64.6 m) +212 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Waste 11.7 m
Bedrock 1.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	0.9	0.9
Boulder Clay	Clay, stiff, brown and grey, chalky with some orange-brown streaks and layers; flint pebbles mostly common, reduced at some levels; some white quartz; chalk pellets to cobbles, less common near base where deposit becomes sandy	9.8	10.7
Glacial Sand and Gravel	'Clayey' gravel, markedly cobbly in upper part, more sandy in lower Gravel: coarse and fine with cobbles, subangular to rounded flint with traces of rounded quartz Sand: medium and coarse; brown	1.0	11.7
Upper Chalk	Chalk, soft, white, with flints	1.3+	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 mm
16	24	60	10.7-11.7	16	2	9	13	28	20	12

TL 31 NE 12 **3887 1924** **Round Wood, Barwick** **Block C**

Surface level (+82.0 m) +269 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Overburden 0.2 m
Mineral 11.6 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse, well-rounded to subangular flint Sand: medium to coarse; brown	11.6	11.8
Upper Chalk	Chalk, soft, white	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 mm
18	31	51	0.2-1.2	27	1	10	11	25	16	10
			1.2-2.2	17	3	23	10	28	19	0
			2.2-3.2	17	1	22	8	25	21	6
			3.2-4.2	17	0	17	11	31	24	0
			4.2-5.2	16	1	14	9	22	38	0
			5.2-6.2	No grading available						
			6.2-7.2	18	2	24	13	26	17	0
			7.2-8.2	19	2	18	11	27	23	0
			8.2-9.2	25	3	19	15	28	10	0
			9.2-10.2	8	4	13	12	31	15	17
			10.2-11.8	Not sampled						
			Mean	**18**	**2**	**18**	**11**	**27**	**20**	**4**

TL 31 NE 13 **3882 1858** **Sawtrees Wood, Barwick** **Block C**

Surface level (+82.3 m) +270 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Overburden 0.3 m
Mineral 8.4 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine to coarse, angular to well-rounded flint and trace of jasper Sand: medium with coarse; brown	8.4	8.7
Upper Chalk	Chalk, soft, white	0.3+	9.0

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 mm
19	25	56	0.3-1.3	15	1	11	6	19	16	32
			1.3-2.3	25	1	8	8	31	27	0
			2.3-3.3	10	1	17	8	25	39	0
			3.3-4.3	16	2	20	10	29	23	0
			4.3-5.3	11	4	18	10	23	15	19
			5.3-6.3	18	2	21	10	27	15	7
			6.3-7.3	15	3	16	6	32	17	11
			7.3-8.7	36	0	11	8	20	16	9
			Mean	**19**	**2**	**15**	**8**	**25**	**21**	**10**

TL 31 NE 14 **3837 1820** **North West of Sawtrees Farm, Barwick** **Block B**

Surface level (+53.6 m) +176 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Waste 4.8 m
Bedrock 0.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, brown, silty and soft, grey, becoming chalky	4.7	4.8
Upper Chalk	Chalk, soft, white, with hard fragments	0.1+	4.9

TL 31 NE 15 **3855 1756** **Burleigh Common, Thundridge** **Block C**

Surface level (+78.0 m) +256 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
February 1972

Overburden 1.2 m
Mineral 7.5 m
Bedrock 1.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
? Boulder Clay	Clay, stiff, dark brown, with numerous small round flint pebbles	0.7	1.2
Glacial Sand and Gravel	'Clayey' gravel with a thin layer of silt at 6.0 m depth Gravel: fine and coarse, subangular to rounded flint with subordinate rounded quartz Sand: mainly medium, predominantly quartz; orange-brown	7.5	8.7
Reading Beds	Silt, pale grey-green and brown, becoming pebbly near base	0.8	9.5
Upper Chalk	Chalk, soft, white, with flints	0.4+	9.9

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 mm
19	39	42	1.2-2.2	15	4	22	8	26	14	11
			2.2-3.2	13	5	33	9	25	14	1
			3.2-4.2	16	1	24	8	21	16	14
			4.2-5.2	12	6	21	9	25	14	13
			5.2-6.2	19	5	22	11	23	12	8
			6.2-7.2	25	7	48	3	9	8	0
			7.2-8.2	31	15	17	6	12	19	0
			8.2-8.7	19	2	13	11	22	29	4
			Mean	**19**	**6**	**27**	**6**	**21**	**14**	**7**

TL 31 NE 16 **3850 1645** **North West of Newhall Green, Ware** **Block C**

Surface level (+75.3 m) +247 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
February 1972

Overburden 11.8 m
Mineral 4.9 m
Waste 0.2 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown and grey, with some green marly layers; chalk pellets and pebbles common; other pebbles include fairly common flint and some quartzite, marl, and worn fossil fragments	11.5	11.8
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint and rounded quartz and quartzite Sand: mainly medium; brown	4.9	16.7
	Clay, chalky	0.2	16.9
Upper Chalk	Chalk, soft, white	0.3+	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 mm
16	34	50	11.8-12.8	19	4	19	9	25	24	0
			12.8-13.8	11	5	20	10	29	19	6
			13.8-14.8	19	3	13	10	27	21	7
			14.8-15.8	15	10	18	15	20	22	0
			15.8-16.7	14	6	13	15	27	25	0
			Mean	**16**	**5**	**17**	**12**	**25**	**22**	**3**

TL 31 NE 17 **3891 1529** **Marley House, Ware** **Block E**

Surface level (+65.8 m) +216 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Overburden 5.9 m
Mineral 4.1 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown and grey, chalky; initially sandy and gravelly, flint pebbles becoming less common with increasing depth	5.6	5.9
Glacial Sand and Gravel	'Clayey' gravel, becoming chalky near base Gravel: coarse with fine and some cobbles subangular to rounded flint and subordinate rounded quartzite and quartz Sand: mainly medium; brown and greenish	4.1	10.0
Upper Chalk	Chalk, soft, white, with flints	0.4+	10.4

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 mm
13	41	46	5.9-6.9	13	4	37	9	18	14	5
			6.9-7.9	15	5	25	9	19	25	2
			7.9-8.5	11	4	14	9	24	28	10
			8.5-10.0	No grading available						
			Mean	**13**	**5**	**27**	**9**	**20**	**21**	**5**

TL 31 NE 18 **3996 1953** **Bartram's Farm, Standon** **Block C**

Surface level (+93.9 m) +308 ft
Groundwater encountered at +71.9 m
Shell & Auger 152 mm diameter
January 1972

Waste 22.0 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, mainly stiff, brown and grey, with chalk pellets and pebbles and some flint pebbles	21.9+	22.0

TL 31 NE 19 **3974 1877** **South of Biggin's Farm, Standon** **Block C**

Surface level (+86.9 m) +285 ft
Groundwater encountered at +66.9 m
Shell & Auger 203 mm and 152 mm diameter
January 1972

Waste 23.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, brown and sandy, with a 1 m gravel layer at 10.5 m, composed mainly of chalk pellets and flint pebbles; a 0.1 m band of 'clayey' sand at 14.2 m	23.1	23.3
Upper Chalk	Chalk, soft, cream	0.2+	23.5

TL 31 NE 20 **3986 1738** **North East of Baker's End, Ware** **Block C**

Surface level (+75.0 m) +246 ft
Groundwater encountered from +69.4 m to +68.0 m (perched water table)
Shell and Auger 152 mm diameter
January 1972

Overburden 5.6 m
Mineral 1.4 m
Waste 0.7 m
Mineral 3.8 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
	Clay, stiff, silty, orange-brown	0.8	1.4
Boulder Clay	Clay, top 0.3 m gravelly and silty, passing into pale brown and grey, darkening with increasing depth; very chalky, with flint pebbles; pebble content decreasing in basal layers	4.2	5.6
Glacial Sand and Gravel	**a** 'Very clayey' pebbly sand Gravel: chalk and shell fragments, fine Sand: medium with coarse and fine, quartz	1.4	7.0
Boulder Clay	Clay, stiff, grey-brown, chalky	0.7	7.7
Glacial Sand and Gravel	**b** 'Clayey' sandy gravel, from overall grading but showing a degree of sorting; two well-marked sand layers at 9.4 m and 11.3 m Gravel: fine and coarse, subangular flint Sand: mainly medium; brown and grey-green	3.8	11.5
Upper Chalk	Chalk, soft, with flints	0.2+	11.7

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
a	23	69	8	5.6-6.6	23	13	44	12	7	1	0
				6.6-7.0	23	9	49	12	7	0	0
				Mean	**23**	**12**	**45**	**12**	**7**	**1**	**0**
b	30	33	37	7.7-9.7	No grading available						
				9.7-10.7	26	5	25	8	21	11	4
				10.7-11.5	36	6	14	6	12	23	3
				Mean	**30**	**6**	**20**	**7**	**17**	**16**	**4**
a+b	**28**	**43**	**29**	**Mean**	**28**	**8**	**27**	**8**	**14**	**12**	**3**

TL 31 NE 21 **3907 1617** **New Hall, Ware** **Block C**

Surface level (+70.1 m) +230 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
February 1972

Overburden 8.5 m
Mineral 5.3 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, mainly stiff, grey, chalky; soft and brown at top; well-marked layers of silty sand at 6.1 m and 8.5 m; flint pebbles common throughout, chalk content reduced at base	8.4	8.5
Glacial Sand and Gravel	'Clayey' gravel, moderately well sorted into beds of pebbly sand and interbedded silt and sand layers Gravel: fine, subangular to rounded flint and subordinate quartz and quartzite Sand: medium with coarse and fine, quartz with flint; pale grey-brown	5.3	13.8
Upper Chalk	Chalk, soft, white, with flint	0.7+	14.5

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 mm
14	36	50	8.5-9.5	35	13	18	6	10	12	6
			9.5-10.5	11	6	17	10	27	22	7
			10.5-11.5	8	7	20	11	24	23	7
			11.5-12.5	11	7	20	10	24	28	0
			12.5-13.5	6	6	21	10	27	24	6
			13.5-13.8	8	5	24	9	35	17	2
			Mean	**14**	**8**	**19**	**9**	**23**	**22**	**5**

TL 31 NE 22 **3976 1549** **Wareside** **Block E**

Surface level (+39.6 m) +130 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Waste 2.5 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, silty, brown	2.4	2.5
? Upper Chalk	Clay, soft, grey-white	0.4	2.9
Upper Chalk	Chalk, soft, white	0.1+	3.0

TL 31 SW 3 **3046 1284** **Blakemore Wood, Hertingfordbury** **Block A**

Surface level (+72.5 m) +238 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Overburden 0.6 m
Mineral 6.1 m
Waste 1.0 m
Mineral 2.5 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.6	0.6
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel, variable, with cobble layers Gravel: fine and coarse, subangular to rounded flint with subordinate rounded quartz and quartzite Sand: medium with coarse, mainly quartz; orange-brown	6.1	6.7
Boulder Clay	Clay, stiff, dark brown and black, with cobbles of flint and quartz; chalk cobble content decreasing with increasing depth	1.0	7.7
Glacial Sand and Gravel	**b** 'Clayey' gravel, variable, with more sandy layers Gravel: fine and coarse, subangular flint Sand: mainly medium, quartz and flint; orange-brown	2.5	10.2
Upper Chalk	Chalk, soft, white	0.4+	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 mm
a	15	44	41	0.6-1.6	15	7	33	6	13	13	13
				1.6-2.6	15	6	22	12	23	14	8
				2.6-3.6	14	1	29	8	16	32	0
				3.6-4.6	12	2	27	11	23	16	9
				4.6-5.6	15	4	23	11	21	21	5
				5.6-6.7	18	5	43	11	10	11	2
				Mean	**15**	**5**	**29**	**10**	**18**	**17**	**6**
b	17	37	46	7.7-8.7	17	2	38	4	15	14	10
				8.7-9.7	16	2	17	10	30	25	0
				9.7-10.2	20	4	28	7	20	18	3
				Mean	**17**	**2**	**28**	**7**	**22**	**19**	**5**
a+b	**15**	**42**	**43**	**Mean**	**15**	**4**	**29**	**9**	**19**	**18**	**6**

TL 31 SW 4 **3033 1230** **North West of Hertingfordbury** **Block D**

Surface level (+40.2 m) +132 ft
Groundwater encountered at +38.9 m
Shell and Auger 152 mm diameter
November 1971

Overburden 1.3 m
Mineral 3.0 m
Bedrock 2.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, brown, silty	1.2	1.3
?River Terrace Deposits	Gravel, passing into chalky clay at base Gravel: fine and coarse, angular and subrounded flint Sand: medium and coarse; brown	3.0	4.3
?Upper Chalk	Clay, chalky	1.7	6.0
Upper Chalk	Chalk, soft, white	0.5+	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 mm
6	34	60	1.3-2.3	1	1	13	11	42	32	0
			2.3-3.3	3	2	16	16	38	25	0
			3.3-4.3	15	1	20	20	23	21	0
			Mean	**6**	**2**	**16**	**16**	**34**	**26**	**0**

TL 31 SW 5 **3041 1159** **Bury Farm, Hertingfordbury** **Block D**

Surface level (+65.8 m) +216 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
October 1971

Overburden 1.8 m
Mineral 1.7 m
Waste 5.5 m
Mineral 5.8 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.8	0.8
Boulder Clay	Clay, stiff, grey-brown, becoming sandy with flint pebbles; chalk absent	1.0	1.8
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel Gravel: mainly fine, subangular to rounded flint and some micaceous sandstone Sand: mainly medium, subangular, subrounded and rounded quartz and subordinate flint; brown	1.7	3.5
Brickearth	Clay, silty, pale grey and brown	0.2	3.7
Boulder Clay	Clay, stiff, brown and dark grey with chalk and flint pebbles; some silty partings	5.3	9.0

Glacial Sand and Gravel	**b** 'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint and subordinate quartz and quartzite Sand: medium and coarse with fine, subangular to subrounded quartz, with chalk at base	5.8	14.8
Upper Chalk	Clay, chalky, soft, yellow-brown, with flints	0.5+	15.3

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 mm
a	14	53	33	1.8-2.8	14	9	17	10	28	13	9
				2.8-3.5	14	8	63	5	8	2	0
				Mean	**14**	**9**	**36**	**8**	**20**	**8**	**5**
b	12	40	48	9.0-10.0	9	8	15	13	23	25	7
				10.0-11.0	10	9	18	16	29	16	2
				11.0-12.0	12	7	23	16	26	16	0
				12.0-13.0	14	6	17	17	23	21	2
				13.0-14.0	12	9	16	17	22	18	6
				14.0-14.8	16	6	13	12	22	24	7
				Mean	**12**	**8**	**17**	**15**	**25**	**20**	**3**
a+b	**12**	**43**	**45**	**Mean**	**12**	**8**	**21**	**14**	**24**	**17**	**4**

TL 31 SW 6 **3033 1068** **Roxford, Hertingfordbury** **Block D**

Surface level (+64.0 m) +210 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
October 1971

Overburden 8.8 m
Mineral 4.3 m
Waste 0.2 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Boulder Clay	Clay, brown to grey, variably chalky, with flint pebbles and other resistant erratics throughout	8.4	8.8
Glacial Sand and Gravel	'Clayey' gravel, brown, with 'clean' and 'clayey' layers Gravel: fine and coarse Sand: medium, coarse and fine	4.3	13.1
	Clay, sandy and gravelly, with much soft chalk	0.2	13.3
Upper Chalk	Chalk, soft and clayey, with occasional flints	0.3+	13.6

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 mm
14	37	49	8.8-10.8	16	11	9	10	25	22	7
			10.8-12.0	11	8	18	16	19	23	5
			12.0-13.1	11	9	19	15	21	19	6
			Mean	**14**	**9**	**15**	**13**	**22**	**21**	**6**

TL 31 SW 7 **3096 1059** **Bayfordbury Lodge, Bayford** **Block D**

Surface level (+43.6 m) +143 ft
Groundwater encountered at +41.2 m
Shell and Auger 152 mm diameter
June 1972

Overburden 2.4 m
Mineral 2.6 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, silty, brown on grey	2.3	2.4
Glacial Sand and Gravel	Gravel, very chalky near base Gravel: fine and coarse, angular to rounded flint Sand: medium and coarse, brown	2.6	5.0
Upper Chalk	Chalk, white and hard	0.4+	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 mm
6	33	61	2.4-3.4	7	1	32	22	26	12	0
			3.4-4.4	4	1	3	7	43	42	0
			4.4-5.0	Not sampled						
			Mean	**6**	**1**	**17**	**15**	**34**	**27**	**0**

TL 31 SW 8 **3145 1459** **Waterford Marshes, Waterford** **Block A**

Surface level (+41.1 m) +135 ft
Groundwater encountered at +39.8 m
Shell and Auger 152 mm diameter
June 1972

Overburden 1.3 m
Mineral 9.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Alluvium	Clay, brown and silty, and sand with few flint pebbles	1.2	1.3
Glacial Sand and Gravel	Sandy gravel, becoming less gravelly below 7.5 m Gravel: fine and medium, occasionally coarse, angular and subangular flint and some subrounded sandstone Sand: medium and coarse, brown	9.0	10.3
Upper Chalk	Chalk, hard and white	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 mm
8	52	40	1.3-2.3	6	1	30	15	24	24	0
			2.3-3.3	4	3	47	10	26	10	0
			3.3-4.3	4	1	24	15	30	26	0
			4.3-7.5	No grading available						
			7.5-8.5	16	2	31	31	17	3	0
			8.5-10.3	Not sampled, very chalky						
			Mean	**8**	**1**	**33**	**18**	**24**	**16**	**0**

TL 31 SW 9 **3106 1126** **South of Hertingfordbury Station** **Block D**

Surface level (+53.9 m) +177 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Overburden 1.5 m
Mineral 1.5 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
	Clay, brown and silty, with some gravel	1.4	1.5
Glacial Sand and Gravel	'Clayey' gravel, partly sorted, with coarse gravel layers Gravel: fine and coarse, subangular to rounded flint and subordinate rounded quartz and quartzite Sand: medium with coarse, chiefly quartz with some flint; orange-brown	1.5	3.0
Upper Chalk	Chalk, soft	0.6+	3.6

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 mm
11	26	63	1.5-2.5	9	1	14	6	17	42	11
			2.5-3.0	13	5	20	11	23	28	0
			Mean	**11**	**2**	**16**	**8**	**19**	**37**	**7**

TL 31 SW 10 **3139 1016** **Bayfordbury, Bayford** **Block D**

Surface level (+64.9 m) +213 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
January 1972

Overburden 5.4 m
Mineral 6.6 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, brown, pebbly and silty, passing into stiff brown and grey with numerous chalk pebbles; traces only of chalk near base	5.2	5.4
Glacial Sand and Gravel	'Clayey' gravel, becoming sandy below 6.3 m Gravel: fine and coarse, subangular to rounded flint with some quartz and jasper Sand: mainly medium and coarse; chiefly quartz with some flint; brown	6.6	12.0
Upper Chalk	Chalk, soft, white to pale brown, with flints	0.4+	12.4

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 mm
15	32	53	5.4-6.4	21	4	8	8	27	22	10
			6.4-7.4	16	7	15	11	30	19	2
			7.4-8.4	15	5	21	12	27	20	0
			8.4-9.4	8	10	22	9	29	19	3
			9.4-10.4	11	3	22	8	24	27	5
			10.4-11.4	14	3	19	9	23	27	5
			11.4-12.0	17	2	14	10	28	26	3
			Mean	**15**	**5**	**17**	**10**	**27**	**22**	**4**

TL 31 SW 11 **3230 1447** **Bengeo House, Hertford** **Block B**

Surface level (+64.9 m) +213 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
October 1971

Overburden 0.2 m
Mineral 3.5 m
Waste 1.4 m
Mineral 6.8 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel, becoming more sandy as depth increases Gravel: fine and coarse; subangular to rounded flint and some quartzite Sand: medium with some fine and coarse; brown	3.5	3.7
Boulder Clay	Clay, stiff, grey-brown, with chalk pellets and some brown sandy layers	1.4	5.1
Glacial Sand and Gravel	**b** 'Clayey' gravel: some layers gravelly, others sandy Gravel: fine and coarse; subangular to rounded flint and some rounded chalk and quartzite Sand: medium, with fine and coarse; chalk lenticles; pale brown	6.8	11.9
Upper Chalk	Chalk, hard and nodular	0.3+	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 mm
a	10	66	24	0.2-1.2	10	8	24	11	22	20	5
				1.2-2.2	11	7	52	11	11	8	0
				2.2-3.2	8	6	63	13	9	1	0
				3.2-3.7	12	6	48	16	13	4	1
				Mean	**10**	**7**	**47**	**12**	**14**	**9**	**1**
b	11	37	52	5.1-6.1	11	4	24	15	21	21	4
				6.1-7.1	10	11	42	7	10	13	7
				7.1-8.1	12	7	19	13	22	21	6
				8.1-9.1	9	5	10	12	24	22	18
				9.1-10.1	10	6	13	11	24	25	11
				10.1-11.1	11	7	14	12	26	21	9
				11.1-11.9	16	5	15	9	30	21	4
				Mean	**11**	**6**	**20**	**11**	**22**	**21**	**9**
a+b	**11**	**47**	**42**	**Mean**	**11**	**6**	**29**	**12**	**19**	**17**	**6**

TL 31 SW 12 **3286 1125** **South East of Hertford Lodge, Hertford** **Block D**

Surface level (+68.0 m) +223 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
September 1971

Overburden 9.9 m
Mineral 3.7 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, chalky, stiff to soft, brown to dark grey	9.6	9.9
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse Sand: medium, fine and coarse	3.7	13.6
Upper Chalk	Chalk, marly	0.2+	13.8

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 mm
	16	42	42	9.9-10.9	8	8	20	11	33	18	2
				10.9-11.3	12	8	16	15	30	19	0
				11.3-12.0	35	18	9	7	17	14	0
				12.0-12.8	15	10	15	14	27	16	3
				12.8-13.6	11	16	21	15	25	10	2
				Mean	**16**	**13**	**16**	**13**	**26**	**15**	**1**

TL 31 SW 13 **3247 1009** **Clement's Farm, Brickendon** **Block D**

Surface level (+67.7 m) +222 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
October 1971

Overburden 10.2 m
Mineral 5.5 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, grey and dark brown, with a little chalk and scattered flint pebbles and boulders	9.9	10.2
Glacial Sand and Gravel	'Clayey' sandy gravel, showing some sorting, with more 'clayey' bands in the upper layers; chalky near base Gravel: fine and coarse; subangular to rounded flint and quartz Sand: medium and coarse, with fine; subangular to subrounded quartz and flint; brown	5.5	15.7
Upper Chalk	Clay, chalky, very soft	0.6+	16.3

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 mm
12	45	43	10.2-11.2	10	7	15	11	21	21	15
			11.2-12.2	12	11	20	17	22	16	2
			12.2-13.2	12	9	19	17	26	17	0
			13.2-14.2	10	12	22	17	20	19	0
			14.2-15.1	12	9	19	21	21	18	0
			15.1-15.7	Not sampled, very chalky						
			Mean	**12**	**9**	**19**	**17**	**22**	**18**	**3**

TL 31 SW 14 **3329 1484** **North West of Ware Park Farm, Ware** **Block B**

Surface level (+52.4 m) +172 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
June 1972

Waste 1.6 m
Bedrock 1.9 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
	Clay, silty, soft, brown, with medium subrounded flint pebbles increasing to c. 10% at base	1.5	1.6
Upper Chalk	Clay, chalky and creamy, with large angular flints, on hard rock chalk	1.9+	3.5

TL 31 SW 15 **3380 1365** **King's Meads, Hertford**

Surface level (+34.1 m) +112 ft
Groundwater encountered at +32.6 m
Shell and Auger 203 mm diameter
January 1972

Overburden 1.5 m
Mineral 3.2 m
Bedrock 0.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	Clay, mainly grey, silty, with brown partings from 0.3 m to 0.5 m; peat with some gravel from 0.5 m to 1.5 m	1.2	1.5
?River Terrace Deposits	Gravel, brown	3.2	4.7
Upper Chalk	Chalk, mainly soft but with hard fragments; white; with flints	0.8+	5.5

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 mm
3	36	61	1.5-4.7	3	1	20	15	33	28	0

TL 31 SW 16 **3366 1224** **Balls Park, Hertford**

Surface level (+59.7 m) +196 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
January 1972

Overburden 6.4 m
Mineral 2.6 m
Waste 2.3 m
Mineral 11.6 m
Bedrock 1.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, silty, with pebbles of flint and chalk: brown, firm	6.1	6.4
Glacial Sand and Gravel	**a** 'Clayey' gravel	2.6	9.0
Boulder Clay	Clay, silty, sandy, with pebbles of flint and chalk	2.4	11.4
Glacial Sand and Gravel	**b** 'Clayey' gravel	11.6	23.0
Readings Beds	Clay, red-brown, firm, with flints	0.5	23.5
Upper Chalk	Chalk, soft, white	0.9+	24.4

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 mm
a	17	40	43	6.4-9.0	No detailed grading information available						
b	19	27	54	11.4-23.0	No detailed grading information available						

TL 31 SW 17 **3340 1134** **Mangrove Lane, Hertford** **Block D**

Surface level (+70.1 m) +230 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
October 1971

Waste 16.8 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, pale brown to dark grey, with occasional sandy layers and some flint pebbles	12.8	13.1
Brickearth	Sand, silty, fine, brown, and clay	1.7	14.8
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint and quartz Sand: coarse and medium with fine, grey-brown	1.3	16.1
Brickearth	Clay, silty, soft, yellow-brown	0.7	16.8
Upper Chalk	Chalk with flints	0.2+	17.0

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 mm
11	32	57	14.8-15.8	11	6	13	13	28	22	7
			15.8-16.1	No grading available						

TL 31 SW 18 **3355 1049** **East of Brickendon Bury, Brickendon Liberty** **Block D**

Surface level (+70.4 m) +231 ft
Groundwater encountered at +50.6 m
Shell and Auger 152 mm diameter
October 1971

Overburden 15.9 m
Mineral 8.1 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown and dark grey, with varying amounts of pellet and pebble chalk and flint, and other rock types as pebbles and cobbles	15.6	15.9
Glacial Sand and Gravel	Sandy gravel Gravel: fine and coarse; mainly rounded, but some subangular flint and subordinate quartz Sand: fine, medium and coarse, subangular to subrounded quartz; yellow-orange-brown	8.1	24.0
Upper Chalk	Chalk, soft, clayey	0.3+	24.3

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 mm
8	50	42	15.9-16.9	11	8	30	9	24	16	2
			16.9-17.9	10	12	34	10	29	5	0
			17.9-18.9	12	8	18	13	26	22	1
			18.9-19.8	7	10	18	15	30	17	3
			19.8-21.0	1	1	6	20	40	26	6
			21.0-22.0	10	47	26	4	4	5	4
			22.0-23.0	5	21	65	3	3	3	0
			23.0-24.0*	7	5	10	12	25	25	16*
			Mean	**8**	**14**	**25**	**11**	**23**	**15**	**4**

TL 31 SW 19 **3469 1454** **Near Ware Park, Ware Rural**

Surface level (+41.1 m) +135 ft
Groundwater not encountered
Shell and Auger 203 mm diameter
October 1971

Overburden 1.5 m
Mineral 1.7 m
Waste 0.5 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Glacial Sand and Gravel	'Clayey' gravel from 1.5 m to 3.2 m, excessively 'clayey' pebbly sand from 0.5 m to 1.5 m; brown	2.7	3.2
?Boulder Clay	Clay, brown, silty, with flints and other rock types, chalk-free	0.5	3.7
Upper Chalk	Chalk, mainly soft; clay-contaminated; with flints and hard chalk fragments	0.3+	4.0

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 mm
19	37	44	1.5-3.2	19	10	17	10	27	17	0

TL 31 SW 20 **3490 1378** **King's Meads, Hertford**

Surface level (+32.6 m) +107 ft
Groundwater encountered at +30.2 m
Shell and Auger, 203 mm diameter
November 1971

Overburden 2.7 m
Mineral 1.9 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Alluvium	Grey and brown mottled clay from 0.3 m to 0.6 m; peat from 0.6 m to 2.5 m; grey peaty clay from 2.5 m to 2.7 m	2.4	2.7
?River Terrace Deposits	Gravel, grey	1.9	4.6
Upper Chalk	Chalk, mainly soft with some hard fragments; cream	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 mm
1	29	70	2.7-4.6*	1	3	12	14	42	28	0

TL 31 SW 21 **3452 1261** **North of Foxhole Farm, Hertford** **Block D**

Surface level (+66.8 m) +219 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Overburden 0.3 m
Mineral 5.7 m
Bedrock 6.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	**a** 'Clayey' gravel Gravel: fine and coarse; subangular amd rounded flint and trace of quartzite pebbles Sand: medium with coarse; orange-brown	5.7	6.0
Reading Beds	**b** 'Very clayey' sand, passing from silt through silty sand to sand, with the basal 1.2 m pebbly sand Gravel: fine and coarse, rounded flint Sand: fine and medium; chiefly quartz, fawn to pale brown and green-orange-brown	6.2	12.2
Upper Chalk	Chalk, soft, white, with flint nodules	0.2+	12.4

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 mm
a	13	42	15	0.3-1.3	15	1	17	8	23	36	0
				1.3-2.3	14	6	28	10	20	19	3
				2.3-3.3	14	4	23	14	29	14	2
				3.3-4.3	11	3	44	13	15	12	2
				4.3-5.3	11	4	33	13	22	17	0
				5.3-6.0	12	1	18	9	19	29	12
				Mean	**13**	**4**	**27**	**11**	**22**	**21**	**2**
b	35	64	1	6.0-6.7	No sample taken						
				6.7-7.8	34	34	32	0	0	0	0
				7.8-8.8	34	32	34	0	0	0	0
				8.8-9.8	40	32	28	0	0	0	0
				9.8-10.8	33	21	46	0	0	0	0
				10.8-11.8	32	25	36	1	4	2	0
				11.8-12.2	No grading available						
				Mean	**35**	**28**	**36**	**0**	**1**	**0**	**0**
a+b	**24**	**54**	**22**	**Mean**	**24**	**17**	**32**	**5**	**11**	**10**	**1**

TL 31 SW 22 **3417 1118** **North of Balls Wood, Brickendon** **Block D**

Surface level (+74.1 m) +243 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
October 1971

Waste 21.3 m
Bedrock 0.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, grey and brown, with variable amounts of chalky material and flint pebbles; red silty clay band at 11.5 m	16.7	17.0
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint Sand: medium, fine and coarse, subangular to subrounded quartz, brown	4.3	21.3
Upper Chalk	Chalk, soft, clayey	0.5+	21.8

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 mm
	12	41	47	17.0-17.5	11	12	18	15	35	9	0
				17.5-18.0	12	9	18	13	29	17	2
				18.0-19.0	14	8	20	15	27	14	2
				19.0-20.0	11	8	19	13	26	22	1
				20.0-21.0	No grading available						
				21.0-21.3	14	14	9	9	26	21	7
				Mean	**12**	**9**	**18**	**14**	**28**	**17**	**2**

TL 31 SE 31 **3534 1332** **Near Highfields, Ware Urban**

Surface level (+67.7 m) +222 ft
Groundwater not encountered
Shell and Auger 203 mm diameter
November 1971

Overburden 11.4 m
Mineral 5.6 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
? Laminated Clay	Brown and grey mottled, clayey and sandy silt with occasional fine gravel; proportion of sand increases with depth	10.9	11.4
Glacial Sand and Gravel	'Clayey' sandy gravel; brown, ironstained in parts from 13.8 m to 14.5 m	5.6	17.0
Upper Chalk	Chalk, soft, clay-contaminated; with flints	0.3+	17.3

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
11	48	41	11.4-17.0	11	8	27	13	23	18	0

TL 31 SE 32 **3546 1130** **Near Prior's Wood, Hertford Heath** **Block D**

Surface level (+94.5 m) +310 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 0.3 m
Mineral 1.0 m
Bedrock 4.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Pebble Gravel	'Clayey' gravel Gravel: fine and coarse, subangular to rounded flint with subordinate subrounded to rounded quartz Sand: medium, fine and coarse quartz, brown-black	1.0	1.3
London Clay	Clay, slightly silty, stiff, black	4.1+	5.4

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
19	33	48	0.3-1.3	19	6	16	11	20	28	0

TL 31 SE 33 **3503 1046** **Brides Farm, Hertford Heath** **Block D**

Surface level (+96.0 m) +315 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 0.5 m
Mineral 3.7 m
Bedrock 0.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil, very gravelly	0.5	0.5
Pebble Gravel	'Clayey' gravel overall, moderately well sorted into a succession of gravel and clay seams Gravel: fine and coarse, rounded flint with subordinate quartzite and quartz Sand: medium, fine and coarse, rounded to subangular quartz with flint, grey-green and orange-brown	3.7	4.2
London Clay	Clay, very stiff, dark grey and brown	0.7+	4.9

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
11	37	52	0.5-1.5	10	9	30	7	19	23	2
			1.5-2.5	8	6	16	19	32	17	2
			2.5-3.5	15	7	13	11	26	26	2
			3.5-4.2	9	6	14	11	32	27	1
			Mean	**11**	**7**	**18**	**12**	**27**	**23**	**2**

TL 31 SE 34 **3672 1314** **South of the Thrifts, Ware** **Block E**

Surface level (+32.0 m) +105 ft
Groundwater encountered at +29.6 m
Shell and Auger 152 mm diameter
February 1972

Overburden 0.4 m
Mineral 5.3 m
Bedrock 0.6 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
River Terrace Deposits (undifferentiated)	Gravel, very chalky at base Gravel: fine and coarse, subangular to rounded, mainly flint, but traces of quartz, quartzite and jasper Sand: medium and coarse, quartz with flint, brown	5.3	5.7
Upper Chalk	Chalk, soft, white	0.6+	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 mm
8	29	63	0.4-1.4	12	5	15	14	27	23	4
			1.4-2.4	15	4	13	13	30	19	6
			2.4-3.4	4	0	9	9	31	35	12
				4	1	13	12	37	28	5
			3.4-4.4	1	2	16	16	25	26	14
				3	0	13	12	34	25	13
			4.4-5.4	No grading available						
			5.4-5.7	7	2	12	13	34	20	12
			Mean	**8**	**3**	**13**	**13**	**30**	**25**	**8**

TL 31 SE 35 **3618 1219** **Hertford Road(A414), Great Amwell** **Block D**

Surface level (+50.9 m) +167 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 0.4 m
Mineral 4.4 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.4	0.4
Taplow Terrace	'Clayey' gravel, 'very clayey' at top Gravel: fine and coarse, subangular to rounded flint and subordinate rounded quartz and quartzite Sand: medium with fine and coarse, subangular to rounded quartz, brown	4.4	4.8
Upper Chalk	Chalk, hard and white	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 mm
17	32	51	0.4-3.3	No samples taken						
			3.3-4.3	16	7	17	8	30	22	0
			4.3-4.8	19	4	19	8	21	16	13
			Mean	**17**	**6**	**18**	**8**	**27**	**20**	**4**

TL 31 SE 36 **3679 1125** **South of Chardingleye Farm, Stanstead St. Margarets** **Block D**

Surface level (+64.6 m) +212 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 0.9 m
Mineral 1.3 m
Waste 0.8 m
Mineral 2.3 m
Waste 0.6 m
Bedrock 1.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.9	0.9
Glacial Sand and Gravel	**a** 'Clayey' sandy gravel Gravel: fine with coarse, subangular to rounded flint with subordinate chalk and flint Sand: mainly medium, subangular to rounded quartz with some flint, brown	1.3	2.2
Brickearth	Silt, brown, and clay, stiff and silty	0.8	3.0
Glacial Sand and Gravel	**b** Sand, very silty, grading into 'clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint and subordinate quartz Sand: fine and medium, quartz with some flint, brown	2.3	5.3
? London Clay	Clay, stiff, grey-brown, with scattered ferruginous nodules	0.6	5.9
London Clay	Clay, stiff, dark grey	1.1+	7.0

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 mm
a	10	67	23	0.9-1.9	9	6	47	17	15	6	0
				1.9-2.2	11	7	38	14	14	8	8
				Mean	**10**	**6**	**45**	**16**	**15**	**6**	**2**
b	18	55	27	3.0-4.0	27	52	17	2	2	0	0
				4.0-5.0	11	13	20	8	22	26	0
				5.0-5.3	9	6	29	9	25	20	2
				Mean	**18**	**29**	**20**	**6**	**13**	**14**	**0**
a+b	**15**	**59**	**26**	**Mean**	**15**	**21**	**29**	**9**	**14**	**11**	**1**

TL 31 SE 37 **3648 1017** **East of Dells Wood, Hoddesdon** **Block D**

Surface level (+68.6 m) +225 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Waste 8.6 m
Bedrock 0.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown to dark grey, with varying amounts of chalk, mostly as pellets; erratic pebbles include flint, quartz and siltstone	6.2	6.5
Brickearth	Clay, stiff, yellow-brown, and sand, silty, brown	0.7	7.2
Glacial Sand and Gravel	Gravel, homogeneous Gravel: fine and coarse, with rounded to subangular flints and a trace of rounded quartz Sand: medium, with fine and coarse, rounded to subangular quartz and flint, brown	1.0	8.2
?London Clay	Clay, very stiff, grey-brown to green-brown	0.4	8.6
London Clay	Clay, stiff, dark blue-grey	0.4+	9.0

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages							
Fines	Sand	Gravel		Fines	Sand			Gravel			
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm	
7	34	59	7.2-8.2	7	8	18	8	23	28	8	

TL 31 SE 38 **3759 1437** **Priorswood Farm, Ware** **Block C**

Surface level (+67.7 m) +222 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
October 1971

Overburden 7.5 m
Mineral 11.9 m
Waste 1.1 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, stiff, dark brown, with pellets and pebbles of chalk, and flint, quartzite and other erratic pebbles	1.7	1.8
	'Clayey' gravel, with layers of peaty and chalky sand	1.4	3.2
	Clay, stiff, pale brown to dark grey, with pellets of chalk and pebbles of chalk, flint, quartzite and other erratics	4.3	7.5
Glacial Sand and Gravel	Sandy gravel overall, composed of alternating more sandy and more gravelly layers; a thin seam of clay at 13.8 m Gravel: fine and coarse, subangular to rounded flint with subordinate quartz and tough chalk Sand: mainly medium, subangular to subrounded quartz and some flint; brown	11.9	19.4
Boulder Clay	Clay, brown and chalky, passing into a thin sandy gravel	1.1	20.5
Upper Chalk	Chalk, soft, white, with flints	0.3+	20.8

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 mm
9	60	31	7.5-8.5	9	11	37	12	19	12	0
			8.5-9.5	6	19	64	5	3	3	0
			9.5-10.5	8	8	57	11	12	4	0
			10.5-11.5	6	17	66	4	2	5	0
			11.5-12.5	5	19	73	2	1	0	0
			12.5-13.5	7	9	76	3	3	2	0
			13.5-13.8	8	13	56	4	6	10	3
			13.8-13.9	100	0	0	0	0	0	0*
			13.9-14.5	8	13	56	4	6	10	3
			14.5-15.5	9	8	23	8	29	20	3
			15.5-16.5	8	9	11	8	24	23	17
			16.5-17.5	10	9	16	20	24	21	0
			17.5-18.5	11	7	9	11	21	27	14
			18.5-19.4	11	9	12	10	26	29	3
			Mean	**9**	**11**	**41**	**8**	**14**	**13**	**4**

* 0.1-m clay seam

TL 31 SE 39 **3748 1142** **South-West of St. Margarets, Stanstead St. Margarets** **Block D**

Surface level (+40.2 m) +132 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
January 1972

Waste 5.0 m
Bedrock 0.3 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Taplow Terrace	Silt, clayey and pebbly, fairly stiff, orange-brown	3.7	3.8
	'Very clayey' gravel Gravel: coarse and fine, and cobbles, subangular to rounded flint Sand: mainly medium, brown	1.2	5.0
Upper Chalk	Chalk, soft and white, with flints	0.3+	5.3

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
28	20	52	3.8-5.0	28	2	13	5	17	17	18

TL 31 SE 40 **3837 1459** **North of Watersplace, Ware** **Block E**

Surface level (+50.3 m) +165 ft
Groundwater encountered at +34.0 m
Shell and Auger 203 mm and 152 mm diameter
October 1971

Overburden 5.1 m
Mineral 2.9 m
Waste 1.0 m
Mineral 2.0 m
Waste 6.5 m
Bedrock 1.5 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil and made ground	1.0	1.0
	Clay, soft, dark brown, with scattered chalk and flint pebbles: also in part silty, soft, orange, and in part silty, pebbly with 5-10% flint gravel	4.1	5.1
Glacial Sand and Gravel	**a** 'Clayey' gravel, becoming cleaner below 6 m Gravel: fine, with coarse, subangular to rounded flint and subordinate quartz, tough chalk and quartzite Sand: medium and coarse, quartz, flint and chalk	2.9	8.0
Boulder Clay	Clay, with sandy partings, fairly soft, brown; soft chalk pellets and cobbles of flint, quartzite and hard chalk scattered throughout	1.0	9.0
Glacial Sand and Gravel	**b** 'Clayey' gravel, sand increasing with depth Gravel: fine with coarse and cobbles, subangular to rounded flint and subordinate hard chalk Sand: mainly medium and coarse; yellow-brown	2.0	11.0
	Silt, brown and clayey, and grey with chalk pellets	3.2	14.2
Boulder Clay	Clay, soft and stiff, dark grey, containing rounded to subangular flint and chalk pebbles	3.3	17.5
Upper Chalk	Chalk, hard, white, with flints	1.5+	19.0

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 mm
a	14	36	50	5.1-6.1	19	4	21	16	30	8	2
				6.1-7.1	11	4	14	19	36	16	0
				7.1-8.0	11	5	10	17	31	8	18
				Mean	**14**	**4**	**15**	**17**	**33**	**11**	**6**
b	14	41	45	9.0-10.0	10	6	14	11	23	15	21
				10.0-11.0	18	6	29	16	24	7	0
				Mean	**14**	**6**	**22**	**13**	**24**	**11**	**10**
a+b	**14**	**38**	**48**	**Mean**	**14**	**5**	**18**	**15**	**29**	**11**	**8**

TL 31 SE 41 **3859 1320** **East of Easneye, Stanstead Abbots** **Block E**

Surface level (+67.1 m) +220 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
November 1971

Overburden 3.8 m
Mineral 1.4 m
Waste 8.1 m
Mineral 7.3 m
Bedrock 0.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff brown and grey, with varying numbers of chalk pellets, common subangular to rounded flint and trace of quartzite pebbles	3.6	3.8
Glacial Sand and Gravel	'Clayey' gravel Gravel: fine, coarse and cobbles, subangular to rounded flint, subordinate chalk, quartz and quartzite Sand: mainly medium with coarse, quartz with flint, brown	1.4	5.2
Boulder Clay	Clay, chalky, stiff, brown and dark grey with subangular to rounded flint pebbles common throughout; a thin gravel band at 8.5 m	8.1	13.3
Glacial Sand and Gravel	'Clayey' sandy gravel Gravel: fine and coarse, subangular to rounded flint with subordinate rounded quartz and quartzite Sand: medium, coarse and fine, subangular to rounded quartz with flint and some black organic matter, brown	7.3	20.6
Upper Chalk	Chalk, soft and white, with harder lumps and flints	0.2+	20.8

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 mm
a	10	32	58	3.8-4.8	8	4	17	12	23	22	14
				4.8-5.2	13	9	15	6	13	18	26
				Mean	**10**	**5**	**17**	**10**	**20**	**21**	**17**
b	13	46	41	13.3-14.3	9	7	14	12	37	21	0
				14.3-15.3	17	30	16	13	17	7	0
				15.3-16.3	26	9	20	7	22	12	4
				16.3-17.3	9	8	18	17	19	27	2
				17.3-18.3	10	7	17	17	28	20	1
				18.3-19.3	16	25	38	9	8	4	0
				19.3-20.6	8	7	16	13	19	21	16
				Mean	**13**	**13**	**20**	**13**	**21**	**16**	**4**
a+b	**12**	**44**	**44**	**Mean**	**12**	**12**	**20**	**12**	**21**	**17**	**6**

TL 31 SE 42 **3871 1263** **North of Warrax House, Stanstead Abbots** **Block E**

Surface level (+52.7 m) +173 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 1.2 m
Mineral 3.2 m
Bedrock 3.1 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
	Silt, brown-grey, and sand, fine	1.1	1.2
Glacial Sand and Gravel	**a** 'Clayey' pebbly sand, overall; mostly sandy, with higher gravel content below 3.3 m Gravel: fine and coarse, subangular to rounded flint with subordinate quartz and quartzite Sand: medium and fine, subrounded and rounded quartz with flint, brown	3.2	4.4
Reading Beds	**b** 'Very clayey' sand; stiff grey and red clayey sand and silt, well-sorted into layers near base	2.9	7.3
Upper Chalk	Chalk, soft, with flints	0.2+	7.5

GRADING

	Mean for deposit percentages			Depth below surface (m)	percentages						
	Fines	Sand	Gravel		Fines	Sand			Gravel		
					$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	+1 -4	+4 -16	+16 -64	+64 mm
a	10	77	13	1.2-2.3	18	30	49	2	1	0	0
				2.3-3.3	7	27	60	2	2	2	0
				3.3-4.4	5	10	42	10	20	13	0
				Mean	**10**	**22**	**50**	**5**	**8**	**5**	**0**
b	27	70	3	4.4-5.4	26	20	45	3	4	2	0
				5.4-6.4	30	46	23	1	0	0	0
				6.4-7.3	24	45	27	1	2	1	0
				Mean	**27**	**36**	**32**	**2**	**2**	**1**	**0**

TL 31 SE 43 **3930 1409** **Young Wood, Ware** **Block E**

Surface level (+66.4 m) +218 ft
Groundwater not encountered
Shell and Auger 203 mm and 152 mm diameter
November 1971

Overburden 11.0 m
Mineral 5.3 m
Bedrock 2.4 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.1	0.1
Boulder Clay	Clay, stiff, brown and grey, with occasional silty and sandy seams; variably chalky with pellets and pebbles, other erratics including flint cobbles, and pebbles of limestone and calcareous mudstone	10.9	11.0

Glacial Sand and Gravel	'Clayey' sandy gravel overall, sorted into layers and becoming more 'clayey' near base. Gravel: fine and coarse, subangular to rounded flint, with subordinate rounded quartz and quartztite Sand: medium, coarse and fine, subangular to rounded quartz and flint, brown	5.3	16.3
Reading Beds	Clay, brown, with silty clay, silt and sand and occasional scattered flint pebbles	2.4+	18.7

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 mm
11	45	44	11.0-12.0	7	6	20	11	30	20	6
			12.0-13.0	11	24	20	8	18	19	0
			13.0-14.0	14	7	16	15	19	15	14
			14.0-15.0	10	7	15	15	24	19	10
			15.0-16.0	12	12	30	17	23	6	0
			16.0-16.3	16	6	23	19	17	18	1
			Mean	**11**	**11**	**20**	**14**	**22**	**16**	**6**

TL 31 SE 44 **3967 1349** **Newgate Wood, Stanstead Abbots** **Block E**

Surface level (+74.1 m) +243 ft
Groundwater encountered from c.+56.5 m to c.+55.7 m, as perched water table only
Shell and Auger 152 mm diameter
November 1971

Waste 23.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.2	0.2
Boulder Clay	Clay, stiff, brown and grey to dark grey, with chalk pellets throughout and some sandy layers and partings; erratics variable, with occasional layers rich in flint and chalk pebbles	16.3	16.5
Glacial Sand and Gravel	**a** 'Clayey' pebbly sand, with 0.2 m band of chalky grey clay at 16.8 m, and two silt bands Gravel: subangular to rounded flint and chalk Sand: mainly medium quartz and flint, orange-brown	1.9	18.4
Boulder Clay	Clay, chalky, stiff and grey, with flint pebbles increasingly abundant in lower layers, and chalk pebbles decreasing below 20 m	4.4	22.8
Glacial Sand and Gravel	**b** 'Clayey' sandy gravel, with 0.1 m grey silty clay band containing flint and chalk, at 23.1 m, and silt seam below 23.5 m Gravel: fine and coarse, subangular to rounded flint and rounded quartz and siltstone Sand: medium and coarse, brown	1.0+	23.8

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 mm
a	17	76	7	16.5-16.8	7	18	64	4	5	2	0
				16.8-17.0	100	0	0	0	0	0	0
				17.0-17.5	7	18	64	4	5	2	0
				17.5-18.4	7	9	69	6	6	3	0
				Mean	**17**	**12**	**60**	**4**	**5**	**2**	**0**
b	23	32	45	22.8-3.1	14	5	18	13	31	19	0
				23.1-23.2	100	0	0	0	0	0	0
				23.2-23.8	14	5	18	13	31	19	0
				Mean	**23**	**4**	**16**	**12**	**28**	**17**	**0**
a+b	**19**	**61**	**20**	**Mean**	**19**	**9**	**45**	**7**	**13**	**7**	**0**

TL 31 SE 45 **3963 1235** **Home Farm, Stanstead Abbots** **Block E**

Surface level (+61.0 m) +200 ft
Groundwater encountered at +55.5 m, as perched water table only
Shell and Auger 152 mm diameter
November 1971

Overburden 0.3 m
Mineral 2.0 m
Waste 12.0 m
Bedrock 2.7 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Glacial Sand and Gravel	'Clayey' sandy gravel, becoming more sandy in the lower half Gravel: fine and coarse, subangular to rounded flint and rounded quartz and quartzite Sand: mainly medium, subangular to rounded quartz and flint, brown	2.0	2.3
Brickearth	Clay, silty clay, and silt, laminated, pale grey to pale brown, and chalky in lower layers	5.4	7.7
Boulder Clay	Clay, stiff, grey, with pale grey-brown silt bands predominating in uppermost layers, and occasional greenish silty seams and partings continuing to base: chalk content increasing with depth, flint pebbles uncommon	6.6	14.3
Reading Beds	Clay and silty clay, stiff, bright red to green, variegated, with some pale grey-green sand lenses	2.7+	17.0

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 mm
	11	61	28	0.3-1.3	9	9	30	10	24	16	2
				1.3-2.3	13	15	53	4	8	7	0
				Mean	**11**	**12**	**42**	**7**	**16**	**11**	**1**

TL 31 SE 46 **3960 1129** **Coldharbour, Stanstead Abbots** **Block E**

Surface level (+53.9 m) +177 ft
Groundwater not encountered
Shell and Auger 152 mm diameter
November 1971

Overburden 1.5 m
Mineral 2.2 m
Bedrock 3.8 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.3	0.3
Boulder Clay	Clay, stiff, brown, with some chalk pellets and pebbles: rounded flint pebbles common and some quartzite and mudstone pebbles in lower layers	1.2	1.5
Glacial Sand and Gravel	Gravel Gravel: fine and coarse, subangular to rounded flint and subordinate rounded quartz and quartzite Sand: medium with coarse and fine, quartz, brown	2.2	3.7
London Clay	Clay, stiff, greyish brown passing into dark grey with some silty seams and lenticles	3.8+	7.5

GRADING

Mean for deposit percentages			Depth below surface (m)	percentages						
Fines	Sand	Gravel		Fines	Sand			Gravel		
				$-\frac{1}{16}$	$+\frac{1}{16}-\frac{1}{4}$	$+\frac{1}{4}-1$	$+1-4$	$+4-16$	$+16-64$	$+64$ mm
8	33	59	1.5-2.5	8	6	22	8	26	26	4
			2.5-3.5	8	6	15	9	28	30	4
			3.5-3.7	12	7	17	12	24	28	0
			Mean	**8**	**6**	**18**	**9**	**27**	**28**	**4**

List of other boreholes

Hydrogeological Department boreholes:

221/319d, e; 239/9, 10, 18, 73, 77, 114a, 135, 195, 241a, 250a, b, 326, 461a, b, 469b, 475a-d, 526a, b, d-k, 539b, 613 and 615.

Other IGS-registered boreholes:

TL 31 NW 1 and 2; TL 31 SE 1, 2, 3, 4, 5, 6, 9, 10, 11, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, and 25.

Commercial boreholes: Information from a total of 208 boreholes generously supplied by St. Alban's Sand and Gravel Co. Ltd, and the former Ministry of Transport's Eastern Road Construction Unit has been used. This information is held in confidence by the Institute.

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

Reports of the Institute of Geological Sciences

Assessment of British Sand and Gravel Resources

1 The sand and gravel resources of the country south-east of Norwich, Norfolk: Resource sheet TG 20.
E. F. P. Nickless.
Report 71/20 ISBN 0 11 880216 X £1.15

2 The sand and gravel resources of the country around Witham, Essex: Resource sheet TL 81. H. J. E. Haggard.
Report 72/6 ISBN 0 11 880588 6 £1.20

3 The sand and gravel resources of the area south and west of Woodbridge, Suffolk: Resource sheet TM 24.
R. Allender and S. E. Hollyer.
Report 72/9 ISBN 0 11 880596 7 £1.70

4 The sand and gravel resources of the country around Maldon, Essex: Resource sheet TL 80. J. D. Ambrose.
Report 73/1 ISBN 0 11 880600 9 £1.20

5 The sand and gravel resources of the country around Hethersett, Norfolk: Resource sheet TG 10.
E. F. P. Nickless.
Report 73/4 ISBN 0 11 880606 8 £1.60

6 The sand and gravel resources of the country around Terling, Essex: Resource sheet TL 71. C. H. Eaton.
Report 73/5 ISBN 0 11 880608 4 £1.20

7 The sand and gravel resources of the country around Layer Breton and Tolleshunt D'Arcy, Essex: Resource sheet TL 91 and part of TL 90. J. D. Ambrose.
Report 73/8 ISBN 0 11 880614 9 £1.30

8 The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Resource sheet TM 23.
R. Allender and S. E. Hollyer.
Report 73/13 ISBN 0 11 880625 4 £1.60

9 The sand and gravel resources of the country around Attlebridge, Norfolk: Resource sheet TG 11.
E. F. P. Nickless.
Report 73/15 ISBN 0 11 880658 0 £1.85

10 The sand and gravel resources of the country west of Colchester, Essex: Resource sheet TL 92. J. D. Ambrose.
Report 74/6 ISBN 0 11 880671 8 £1.45

11 The sand and gravel resources of the country around Tattingstone, Suffolk: Resource sheet TM 13. S. E. Hollyer.
Report 74/9 ISBN 0 11 880675 0 £1.95

12 The sand and gravel resources of the country around Gerrards Cross, Buckinghamshire: Resource sheet SU 99, TQ 08 and TQ 09. H. C. Squirrell.
Report 74/14 ISBN 0 11 880710 2 £2.20

Mineral Assessment Reports

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

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

15 The sand and gravel resources of the country around Newton on Trent, Lincolnshire: Resource sheet SK 87.
D. Price.
ISBN 0 11 880746 3 £3.00

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

17 The sand and gravel resources of the country around Besthorpe, Nottinghamshire: Resource sheet SK 86 and part of SK 76. J. R. Gozzard.
ISBN 0 11 880748 X £3.00

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

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

20 The sand and gravel resources of the country east of Newark upon Trent, Nottinghamshire: Resource sheet SK 85.
J. R. Gozzard.
ISBN 0 11 880751 X £2.75

21 The sand and gravel resources of the Thames and Kennet Valleys, the country around Pangbourne, Berkshire: Resource sheet SU 67. H. C. Squirrell.
ISBN 0 11 880752 8 £3.25

22 The sand and gravel resources of the country north-west of Scunthorpe, Humberside: Resource sheet SE 81.
J. W. C. James.
ISBN 0 11 880753 6 £3.00

23 The sand and gravel resources of the Thames Valley, the country between Lechlade and Standlake: Resource sheet SP 30 and parts of SP 20, SU 29 and SU 39. P. Robson.
ISBN 0 11 881252 1 £7.25

24 The sand and gravel resources of the country around Aldermaston, Berkshire: Resource sheet SU 56 and SU 66. H. C. Squirrell.
ISBN 0 11 881253 X £5.00

25 The celestite resources of the area north-east of Bristol: Resource sheet ST 68 and parts of ST 59, 69, 79, 58, 78, 68 and 77. E. F. P. Nickless, S. J. Booth and P. N. Mosley.
ISBN 0 11 881262 9 £5.00

26 The limestone and dolomite resources of the country around Monyash, Derbyshire: Resource sheet SK 16.
F. C. Cox and D. McC. Bridge.
ISBN 0 11 881263 7 £7.00

27 The sand and gravel resources of the country west and south of Lincoln, Lincolnshire: Resource sheets SK 95, SK 96 and SK 97. I. Jackson.
ISBN 0 11 884003 7 £6.00

28 The sand and gravel resources of the country around Eynsham, Oxfordshire: Resource sheet SP 40 and part of SP 41. W. J. R. Harries.
ISBN 0 11 884012 6 £3.00

29 The sand and gravel resources of the country south-west of Scunthorpe, Humberside: Resource sheet SE 80.
J. H. Lovell.
ISBN 0 11 884013 4 £3.50

30 Procedure for the assessment of limestone resources.
F. C. Cox, D. McC. Bridge and J. H. Hull.
ISBN 0 11 884030 4 £1.25

31 The sand and gravel resources of the country west of Newark upon Trent, Nottinghamshire: Resource sheet SK 75.
D. Price and P. J. Rogers.
ISBN 0 11 884031 2 £3.50

32 The sand and gravel resources of the country around Sonning and Henley, Berkshire, Oxfordshire and Buckinghamshire: Resource sheet SU 77 and SU 78.
H. C. Squirrell.
ISBN 0 11 884032 0 £5.25

33 The sand and gravel resources of the country north of Gainsborough, Lincolnshire: Resource sheet SK 89.
J. R. Gozzard and D. Price
ISBN 0 11 884033 9 £4.50

34 The sand and gravel resources of the Dengie Peninsula, Essex: Resource sheet TL 90, etc. M. B. Simmons.
ISBN 0 11 884081 9 £5.00

35 The sand and gravel resources of the country around Darvel, Strathclyde: Resource sheet NS 53, 63, etc.
E. F. P. Nickless, A. M. Aitken and A. A. McMillan.
ISBN 0 11 884082 7 £7.00

36 The sand and gravel resources of the country around Southend-on-Sea, Essex: Resource sheets TQ 78, 79 etc. S. E. Hollyer and M. B. Simmons.
ISBN 0 11 884083 5 £7.50

37 The sand and gravel resources of the country around Bawtry, South Yorkshire: Resource sheet SK 69. A. R. Clayton
ISBN 0 11 884053 3 £5.75

38 The sand and gravel resources of the country around Abingdon, Oxfordshire: Resource sheet SU 49, 59, SP 40, 50. C. E. Corser.
ISBN 0 11 884084 5 £5.50

39 The sand and gravel resources of the Blackwater Valley (Aldershot) area: Resource sheet SU 85, 86, parts SU 84, 94, 95, 96. M. R. Clarke, A. J. Dixon and M. Kubala.
ISBN 0 11 884085 1 £7.00

40 The sand and gravel resources of the country west of Darlington, County Durham: Resource sheet NZ 11, 21. A. Smith.
ISBN 0 11 884086 X £5.00

41 The sand and gravel resources of the country around Garmouth, Grampian Region: Resource sheet NJ 36. A. M. Aitken, J. W. Merritt and A. J. Shaw.
ISBN 0 11 884090 8 £8.75

42 The sand and gravel resources of the country around Maidenhead and Marlow: Resource sheet SU 88, parts SU 87, 97, 98. P. N. Dunkley.
ISBN 0 11 884091 6 £5.00

43 The sand and gravel resources of the country around Misterton, Nottinghamshire: Resource sheet SK 79. D. Thomas and D. Price.
ISBN 0 11 884092 4 £5.25

44 The sand and gravel resources of the country around Sedgefield, Durham: Resource sheet NZ 32. M. D. A. Samuel.
ISBN 0 11 884093 2 £5.75

45 The sand and gravel resources of the country around Brampton, Cumbria: Resource sheet NY 55, part 56. I. Jackson.
ISBN 0 11 884094 0 £6.75

46 The sand and gravel resources of the country around Harlow, Essex: Resource sheet TL 41. P. M. Hopson.
ISBN 0 11 884107 6 £9.50

47 The limestone and dolomite resources of the country around Wirksworth, Derbyshire: Resource sheet SK 25, part 35. F. C. Cox and D. J. Harrison.
ISBN 0 11 884108 4 £15.00

48 The sand and gravel resources of the Loddon Valley area: Resource sheet SU 75, 76, parts 64, 65, 66 and 74. M. R. Clarke, E. J. Raynor and R. A. Sobey.
ISBN 0 11 884109 2 £8.75

49 The sand and gravel resources of the country around Lanark, Strathclyde Region: Resource sheet NS 94, part 84. J. L. Laxton and E. F. P. Nickless.
ISBN 0 11 884112 2 £11.00

50 The sand and gravel resources of the country around Fordingbridge, Hampshire: Resource sheet SU 11 and parts of SU 00, 01, 10, 20 and 21. M. Kubala.
ISBN 0 11 884111 4 £7.75

51 The sand and gravel resources of the country north of Bournemouth, Dorset: Resource sheet SU 00, 10, 20, SZ 09, 19 and 29. M. R. Clarke.
ISBN 0 11 884110 6 £9.75

52 The sand and gravel resources of the country between Hatfield Heath and Great Waltham, Essex: Resource sheet TL 51 and 61. R. J. Marks.
ISBN 0 11 884113 0 £8.00

53 The sand and gravel resources of the country around Cottenham, Cambridgeshire: Resource sheet TL 46 and 47. A. J. Dixon.
ISBN 0 11 884114 9 £9.25

54 The sand and gravel resources of the country around Huntingdon and St Ives. Cambridgeshire: Resource sheets TL 16, 17, 26, 27, 36 and 37. R. W. Gatliff.
ISBN 0 11 884115 7 £8.75

55 The sand and gravel resources of the country around Ipswich, Suffolk: Resource sheet TM 14. R. Allender and S. E. Hollyer.
ISBN 0 11 884116 5 £10.00

56 Procedure for the assessment of the conglomerate resources of the Sherwood Sandstone Group. D. P. Piper and P. J. Rogers.
ISBN 0 11 884143 2 £1.25

57 The conglomerate resources of the Sherwood Sandstone Group of the country around Cheadle, Staffordshire: Resource sheet SK 04. P. J. Rogers, D. P. Piper and T. J. Charsley.
ISBN 0 11 884144 0 £7.75

58 The sand and gravel resources of the country west of Peterhead, Grampian Region: Resource sheet NK 04 and parts of NJ 94 and 95, NK 05, 14 and 15. A. A. McMillan and A. M. Aitken.
ISBN 0 11 884145 9 £12.00

59 The sand and gravel resources of the country around Newbury, Berkshire: Resource sheet SU 46 and 57, parts of SU 36, 37 and 47. J. R. Gozzard.
ISBN 0 11 884146 7 £11.50

60 The sand and gravel resources of the country south-west of Peterborough, in Cambridgeshire and east Northamptonshire: Resource sheet TL 09 and 19 and SP 98 and TL 08. A. M. Harrisson.
ISBN 0 11 884147 5 £15.50

61 The sand and gravel resources of the country north of Wrexham, Clwyd: Resource sheet SJ 35 and part of SJ 25. P. N. Dunkley.
ISBN 0 11 884148 3 £11.75

62 The sand and gravel resources of the country around Dolphinton, Strathclyde Region, and West Linton, Borders Region: Resource sheet NT 04 and 14, parts of NT 05 and 15. A. A. McMillan, J. L. Laxton and A. J. Shaw.
ISBN 0 11 884149 1 £8.00

63 The sand and gravel resources of the valley of the Douglas Water, Strathclyde Region: Resource sheet NS 83 and parts of NS 82, 92 and 93. A. J. Shaw and E. F. P. Nickless.
ISBN 0 11 884150 5 £11.50

64 The sand and gravel resources of the country between Wallingford and Goring, Oxfordshire: Resource sheet SU 68 and part of SU 58. C. E. Corser.
ISBN 0 11 884151 3 £11.50

65 The sand and gravel resources of the country around Hexham, Northumberland: Resource sheet NY 86 and 96. J. H. Lovell.
ISBN 0 11 884152 1 £7.50

66 The sand and gravel resources of the country west of Chelmsford, Essex: Resource sheet TL 60. P. M. Hopson.
ISBN 0 11 884153 X £8.50

67 The sand and gravel resources of the country around Hatfield and Cheshunt, Hertfordshire: Resource sheet TL 20 and 30, and parts of TQ 29 and 39. J. R. Gozzard.
ISBN 0 11 884167 X £10.00

68 The sand and gravel resources of the country north-east of Halstead, Essex: Resource sheet TL 83. R. J. Marks and J. W. Merritt.
ISBN 0 11 884168 8 £13.25

69 The sand and gravel resources of the country around Welwyn Garden City. Hertfordshire: Resource sheet TL 11 and 21. J. R. Gozzard.
ISBN 0 11 884169 6 £10.50

70 The sand and gravel resources of the country east of Harrogate, North Yorkshire: Resource sheet SE 35. D. L. Dundas.
ISBN 0 11 884170 7 £15.50

71 The sand and gravel resources of the country around Hemel Hempstead, St Albans and Watford: Resource sheet TL 00, 10, and parts TQ 09, 19.
W. J. R. Harries, S. E. Hollyer and P. M. Hopson.
ISBN 0 11 884171 8 *not yet priced*

72 The sand and gravel resources of the country around Bury St Edmunds Suffolk: Resource sheet TL 86.
M. P. Hawkins.
ISBN 0 11 884172 6 £10.50

73 The sand and gravel resources of the country between Ely and Cambridge, Cambridgeshire: Resource sheet TL 56, 57. A. R. Clayton.
ISBN 0 11 884173 4 £9.50

74 The sand and gravel resources of the country around Blaydon, Tyne and Wear: Resource sheet NZ 06, 16.
J. R. A. Giles.
ISBN 0 11 884174 2 £10.50

75 The sand and gravel resources of the country around Stokesley, North Yorkshire: Resource sheet NZ 40, 50 and parts 41, 51. R. G. Crofts.
ISBN 0 11 884175 0 £11.50

76 The sand and gravel resources of the country around Ellon, Grampian Region: Resource sheets NJ 93 with parts 82, 83, 92, and NK 03 with parts 02, 13. J. W. Merrit.
ISBN 0 11 884176 9 £15.00

77 The limestone and dolomite resoures of the country around Buxton, Derbyshire: Resource sheet SK 07 and parts 06, 08. D. J. Harrison.
ISBN 0 11 884177 7 £13.50

78 The sand and gravel resources of the country west of Boroughbridge, North Yorkshire: Resource sheet SE 36.
D. A. Abraham.
ISBN 0 11 884178 5 £12.75

79 The limestone and dolomite resources of the country around Bakewell, Derbyshire: Resource sheet SK 26 and part 27. D. McC. Bridge and J. R. Gozzard.
ISBN 0 11 884179 3 £10.50

80 The sand and gravel resources of the country between Stamford, Lincolnshire, and Peterborough, Cambridgeshire: Resource sheet TF 00, 10. S. J. Booth.
ISBN 0 11 884180 7 £14.50

81 The sand and gravel resources of the country of the Thames and Thame valleys, the country around Dorchester and Watlington, Oxfordshire: Resource sheet SU 69 and part 59. C. E. Corser.
ISBN 0 11 884204 8 £14.25

82 The sand and gravel resources of the country around Sible Hedingham, Essex: Resource sheet TL 73.
R. J. Marks and D. W. Murray.
ISBN 0 11 884205 6 £10.75

83 The sand and gravel resources of the country around Hollesley, Suffolk: Resource sheet TM 34. S. E. Hollyer and R. Allender.
ISBN 0 11 884206 4 £13.25

84 The sand and gravel resources of the country around Kirk Hammerton, North Yorkshire: Resource sheet SE 45.
J. R. A. Giles.
ISBN 0 11 884207 2 £10.00

85 The sand and gravel resources of the country around Nayland, Suffolk: Resource sheet TL 93. P. M. Hopson.
ISBN 0 11 884208 0 £11.25

86 The sand and gravel resources of the country around Wem, Shropshire: Resource sheet SJ 42, 52. B. Cannell and W. J. R. Harries.
ISBN 0 11 884209 9 £15.50

87 The sand and gravel resources of the country around Ranskill and East Retford, Nottinghamshire: Resource sheet SK 68 and part 78. D. Thomas.
ISBN 0 11 884210 2 £8.50

88 The sand and gravel resources of the country around Tholthorpe, North Yorkshire: Resource sheet SE 46.
R. Stanczyszyn.
ISBN 0 11 884211 0 *not yet priced*

89 The sand and gravel resources of the country around Newport-on-Tay, Fife Region: Resource sheet NO 42 and parts 32, 52. J. L. Laxton and D. L. Ross.
ISBN 0 11 887413 6 £12.75

90 The sand and gravel resources of the country around Shrewsbury, Shropshire: Resource sheet SJ 41, 51.
B. Cannell.
ISBN 0 11 884213 7 £17.00

91 The conglomerate resources of the Sherwood Sandstone Group of the country east of Stoke-on-Trent, Staffordshire: Resource sheet SJ 94. D. Piper.
ISBN 0 11 884214 5 *not yet priced*

92 The sand and gravel resources of the country around Armthorpe, South Yorkshire: Resource sheet SE 60.
D. Price and D. P. Best.
ISBN 0 11 884215 3 £10.00

93 The sand and gravel resources of the country aound Whittlesey, Cambridgeshire: Resource sheet TF 20, TL 29.
S. J. Booth.
ISBN 0 11 884216 1 £12.50

94 The sand and gravel resources of the country north and west of Woodhall Spa, Lincolnshire: Resource sheet TF 16 and part 17. I. Jackson.
ISBN 0 11 884217 X £14.75

95 The sand and gravel resources of the country around Biggar, Strathclyde Region: Resource sheet NS 93, NT 03, and parts NS 92, NT 02. A. J. Shaw and J. W. Merritt.
ISBN 0 11 887414 4 £15.00

96 The sand and gravel resources of the country around Potter Hanworth and Reepham, Lincolnshire: Resource sheet TF 06, 07. R. G. Crofts.
ISBN 0 11 884216 6 £9.75

97 The sand and gravel resources of the country around Clare, Suffolk: Resource sheet TL 74. R. Marks.
ISBN 0 11 884297 8 £10.00

98 The limestone and dolomite resources of the country around Tideswell, Derbyshire: Resource sheet SK 17 and parts 18, 27. R. W. Gatliff.
ISBN 0 11 884298 6

99 The sand and gravel resources of the country north and west of Billingham, Cleveland: Resource sheet NZ 42 and part 52. J. W. C. James.
ISBN 0 11 884299 4 £10.50

100 The sand and gravel resources of the country around Billinghay, Lincolnshire: Resource sheet TF 15 and part 05.
J. B. L. Wild.
ISBN 0 11 884300 1 £13.75

101 The sand and gravel resources of the country around Glenrothes, Fife Region: Resource sheet NO 20 and parts 21, 30, 31. A. M. Aitken.
ISBN 0 11 8847415 2 £15.00

102 The sand and gravel resources of the country around Coggeshall, Essex: Resource sheet TL 82. S. J. Booth and J. W. Merritt.
ISBN 0 11 887416 0 £16.00

103 The sand and gravel resources of the country between Dorchester and Wareham, Dorset: Resource sheets comprising parts of SY 68, 69, 78, 79, 88, 89, 98, 99.
S. J. Mathers.
ISBN 0 11 884303 6 £17.00

104 The sand and gravel resources of the country around Stansted Mountfitchet, Essex: Resource sheet TL 52.
P. M. Hopson.
ISBN 0 11 884304 4 £11.75

105 The sand and gravel resources of the Welshampton area, Shropshire and Clwyd: Resource sheet SJ 43.
S. J. Mathers and A. C. Wilson.
ISBN 0 11 884305 2 *not yet priced*

106 The sand and gravel resources of the country south of Wrexham, Clwyd: Resource sheet SJ 34, and part 24.
D. F. Ball.
ISBN 0 11 884306 0 £11.00

107 The sand and gravel resources of the country between Rugby and Northampton, Warwickshire and Northamptonshire: Resource sheet SP 66 and parts 56, 57, 65, 67, 75 and 76.
M. R. Clarke and E. R. Moczarski.
ISBN 0 11 884307 9 £20.00

108 The sand and gravel resources of the country south of Horncastle, Lincolnshire: Resource sheet TF 26.
G. Power and J. B. L. Wild.
ISBN 0 11 884308 7 £9.75

109 The sand and gravel resources of the country around Great Dunmow, Essex: Resource sheet TL 62.
C. W. Thomas.
ISBN 0 11 884309 5 £12.75

110 The sand and gravel resources of the country north of Newmarket, Cambridgeshire and Suffolk: Resource sheet TL 67 and part 66. C. E. Corser.
ISBN 0 11 884310 9 £14.50

111 The sand and gravel resources of the country east and south-east of Darlington, Durham: Resource sheet NZ 30, 31. J. R. Gozzard and D. Price.
ISBN 0 11 884311 7 £14.25

112 The sand and gravel resources of the country around Hertford, Hertfordshire: Resource sheet TL 31.
P. M. Hopson and M. D. A. Samuel.
ISBN 0 11 884312 5 £11.75

113 The sand and gravel resources of the country around Mold, Clwyd: Resource sheet SJ 26 and part 16.
D. F. Ball and K. A. McL. Adlam.
ISBN 0 11 884313 3 *not yet priced*

114 The sand and gravel resources of the country around Kettering and Wellingborough, Northamptonshire: Resource sheets SP 86, 96, and SP 97 and parts of SP 87, TF 07.
A. M. Harrison.
ISBN 0 11 884314 1 *not yet priced*

115 The sand and gravel resources of the country east of Solihull, Warwickshire: Resource sheet comprising parts of SP 17, 18, 27, 28.
B. Cannell.
ISBN 0 11 884315 X *not yet priced*

Reports of the Institute of Geological Sciences

Other Reports

69/9 Sand and gravel resources of the Inner Moray Firth.
A. L. Harris and J. D. Peacock.
ISBN 0 11 880106 6 35p

70/4 Sands and gravels of the southern counties of Scotland.
G. A. Goodlet.
ISBN 0 11 880105 8 90p

72/8 The use and resources of moulding sand in Northern Ireland. R. A. Old.
ISBN 0 11 881594 0 30p

73/9 The superficial deposits of the Firth of Clyde and its sea lochs. C. E. Deegan, R. Kirby, I. Rae and R. Floyd.
ISBN 0 11 880617 3 95p

77/1 Sources of aggregate in Northern Ireland (2nd edition).
I. B. Cameron.
ISBN 0 11 881279 3 70p

77/2 Sand and gravel resources of the Grampian Region.
J. D. Peacock and others.
ISBN 0 11 881282 3 80p

77/5 Sand and gravel resources of the Fife Region.
M. A. E. Browne.
ISBN 0 11 884004 5 60p

77/6 Sand and gravel resources of the Tayside Region.
I. B. Paterson.
ISBN 0 11 884008 8 £1.40

77/8 Sand and gravel resources of the Strathclyde Region.
I. B. Cameron and others.
ISBN 0 11 884028 2 £2.50

77/9 Sand and gravel resources of the Central Region, Scotland. M. A. E. Browne.
ISBN 0 11 884016 9 £1.35

77/19 Sand and gravel resources of the Borders Region, Scotland. A. D. McAdam.
ISBN 0 11 884025 8 £1.00

77/22 Sand and gravel resources of the Dumfries and Galloway Region of Scotland. I. B. Cameron.
ISBN 0 11 884021 5 £1.20

78/1 Sand and gravels of the Lothian Region of Scotland.
A. D. McAdam.
ISBN 0 11 884042 8 £1.00

78/8 Sand and gravel resources of the Highland Region.
W. Mykura, D. L. Ross and F. May.
ISBN 0 11 884050 9 £3.00

Dd. 717412 K8

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

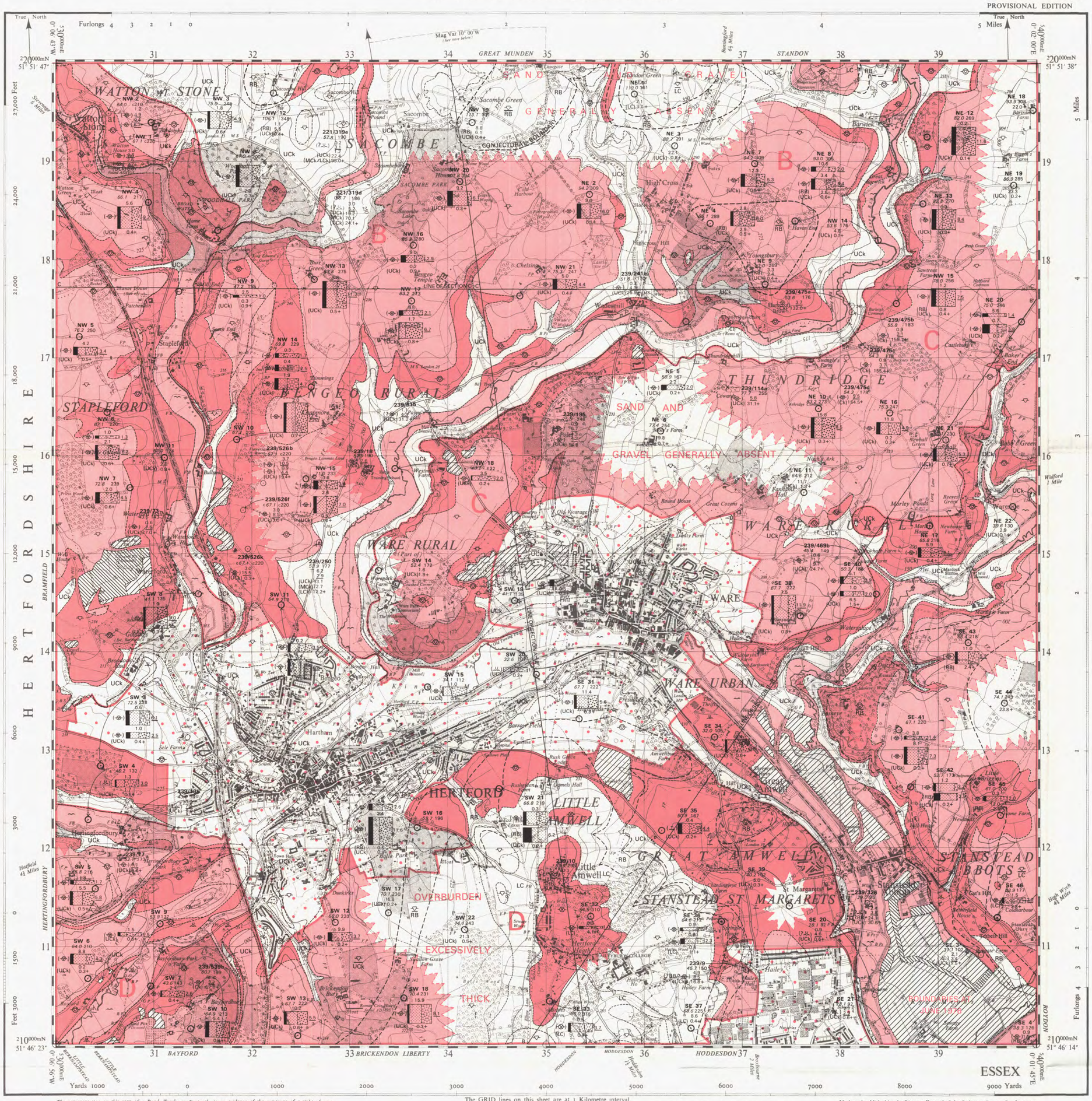
INSTITUTE OF GEOLOGICAL SCIENCES

INDUSTRIAL MINERALS ASSESSMENT UNIT

THE SAND AND GRAVEL RESOURCES OF HERTFORD, HERTFORDSHIRE

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

ORDNANCE SURVEY
SHEET TL31
PROVISIONAL EDITION



THE SAND AND GRAVEL RESOURCES OF HERTFORD, HERTFORDSHIRE SHEET TL 31

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

112

EXPLANATION OF SYMBOLS AND ABBREVIATIONS

DRIFT

- Alluvium — A-2
- River Terrace deposits, undifferentiated
- River Brickearth (Taplow) — RB-4
- Taplow Terrace — TT-2

→ RT-6 River Terrace Deposits → RECENT AND PLEISTOCENE

- Brickearth — B-14
- Boulder Clay — BC-11
- Glacial Sand and Gravel — GS-17
- Pebble Gravel — PG-2

SOLID

- LC London Clay
- RB Reading Beds
- UCk Upper Chalk

→ EOCENE CRETACEOUS

- Made Ground — MG-2
- Worked out areas of sand and gravel — WO-9

BOUNDARY LINES

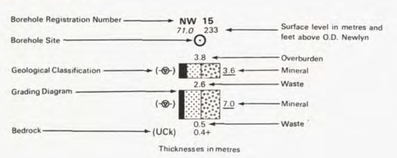
- Geological boundary, Drift
- Geological boundary, Solid
- Inferred boundary between recognised categories of deposits
- Resource Block boundary
  Broken lines denote uncertainty

BOREHOLE DATA

SITE LOCATIONS

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

I.M.A.U. BOREHOLES



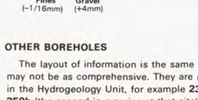
Note:
1. Figures underlined denote thicknesses used in the assessment of resources
2. The + sign indicates that the base of the deposit was not reached.
3. Figures in *italics* are conversions to metres of measurements in feet.
4. The geological classification is given only for sand and gravel and bedrock.

Borehole Registration Number

Each I.M.A.U. borehole is identified by a Registration Number e.g. **NW 15** the letters refer to the quarter sheet, and the figures following to the I.G.S. serial numbers to that quarter. The unique designation for borehole **NW 15** is **TL 31 NW 15.**

Grading Diagrams

Each grading diagram shows the mean particle size distribution of the samples collected from a single mineral horizon.



The height of the diagram is proportional to the mineral thickness

The width of the divisions shows the proportions of **Fines, Sand and Gravel.**

OTHER BOREHOLES

The layout of information is the same as for I.M.A.U. boreholes, although data available may not be as comprehensive. They are registered in the same series, except for records in the Hydrogeology Unit, for example **239/250b** signifies Hydrogeology Unit borehole **250b** (the second in a series at that site) on New Series One Inch Geology Sheet **239**.

CATEGORIES OF DEPOSITS

- **Sand and Gravel outcrop, as mapped. Accepted for assessment purposes as equal to mineral outcrop** — CAT-E5
- **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 (at surface and below overburden)** — CAT-N2

Where appropriate on other sheets a fifth category "Discontinuous spreads of sand and gravel 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

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

Diagram showing the relationship of the National Grid 1:25 000 sheets with the One Inch New Series Geological Sheets 221, 222, 239 and 240

TL 22	TL 32	TL 42
	221 222	
	239 240	
TL 21	TL 31	TL 41
TL 20	TL 30	TL 40

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 in 1911-14 and 1921. Sheet 239 and 221. Published (with Drift) in 1924. J.S.Flett, Director.

Sand and Gravel survey by C. Eaton and G.M. Bladon 1970-71.

1:25 000 Sand and Gravel Resource Sheet, published in 1982.
R.G. Thurrell, Head, Industrial Minerals Assessment Unit.
G.M. Brown D.Sc., F.R.S. Director, Institute of Geological Sciences.

The GRID lines on this sheet are at 1 Kilometre interval.
Heights are in feet above Mean Sea Level at Newlyn

1 square inch on this map represents 99·69 acres on the ground.

Compiled from 6" sheets last fully revised 1915-39. Other partial systematic revision 1938-51 has been incorporated.

Made and published by the Director General of the Ordnance Survey, Southampton.

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.

Printed in Great Britain by Cook, Hammond & Kell Ltd., Mitcham, Surrey