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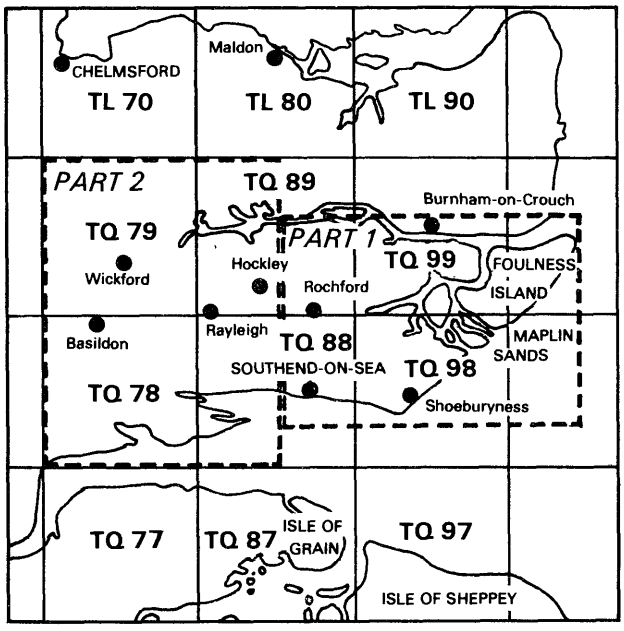

The sand and gravel resources of the country around Southend-on-Sea, Essex

Part 1 North-east of Southend-on-Sea Description of parts of 1:25 000 sheets TQ 88, 89, 98, 99 and TR 08, 09

S. E. Hollyer

Part 2 North and west of Southend-on-Sea Description of 1:25 000 sheets TQ 78, 79 and parts of TQ 88 and 89

S. E. Hollyer and M. B. Simmons

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The first twelve reports on the assessment of British sand and gravel resources appeared in the Report Series of the Institute of Geological Sciences as a subseries. Report No. 13 onwards appear in the Mineral Assessment Report Series of the Institute. Details of published reports appear at the end of this report.

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PREFACE

National resources of many industrial minerals may seem so large that stocktaking appears unnecessary, but the demand for minerals and 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 around Southend-on-Sea, Essex. The IMAU drilling programme began in October 1972, the main part of the field-work being finished in late 1973. The report incorporates information from boreholes, trenches and resistivity traverses carried out by the Engineering Geology Unit and the East Anglia and South-East England Field Unit for the Third London Airport Directorate of the Department of the Environment during geotechnical and geological surveys of the area.

The sand and gravel survey was conducted by Mr S.E. Hollyer, assisted in the field by Ms M.B. Simmons formerly of the IMAU, who supervised the drilling and sampling programme, Mr R.A. Ellison of the East Anglia and South-East England Field Unit and Mr M. Sarginson of the Engineering Geology Unit.

The work is based upon geological surveys at 1:10 560 by Dr C.R. Bristow in 1968 and by Mr G.W. Green, Dr M.R. Henson and Mr R.D. Lake in 1971-2, who, with Mr Ellison, advised the authors on the geology of the area. Mr Sarginson contributed to the interpretation of the resistivity results.

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 also gratefully acknowledged.

Financial support for the survey was provided by the Department of the Environment.

Austin W. Woodland
Director 23 June, 1978

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Part 1

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S. E. HOLLYER

SUMMARY

Data used in the assessment of the sand and gravel resources include 148 shell and auger boreholes drilled by the Institute, Dutch cone probes, pre-existing site-investigation and well-boring records, resistivity traverses, temporary trench sections and 1:10 560 geological maps of the East Anglia and South-East England Field Unit, surveyed between 1968 and 1972. Eighty-eight of the shell and auger boreholes were drilled by the Industrial Minerals Assessment Unit and sixty by the Engineering Geology Unit and the East Anglia and South-East England Field Unit.

All deposits in the area which might contain potentially workable amounts of sand and gravel (mineral) have been investigated and a simple statistical method has been used to estimate the volume of mineral present. Except for one small area of mineral, the reliability of the volume estimate is quoted at the 95 per cent confidence level.

The mineral-bearing ground is divided into resource blocks containing between 9.4 and 12.0 km^2 of mineral. For each block the mean thickness of overburden and mineral and mean grading are given. A brief description of the geomorphology and geology is included, together with an account of the main characteristics of each resource block.

The report includes a resource map showing the area of mineral-bearing ground, the geology and topography, the position and main details of boreholes and exposures and the outlines of the resource blocks.

Bibliographical reference:

HOLLYER, S.E. 1978. The sand and gravel resources of the country around Southend-on-Sea, Essex. Pt 1. North-east of Southend-on-Sea. Description of parts of 1:25 000 sheets TQ 88, 89, 98, 99 and TR 08, 09. Miner. Assess. Rep. Inst. Geol. Sci., No. 36.

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INTRODUCTION

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

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

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

The following arbitrary physical criteria have been adopted:

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

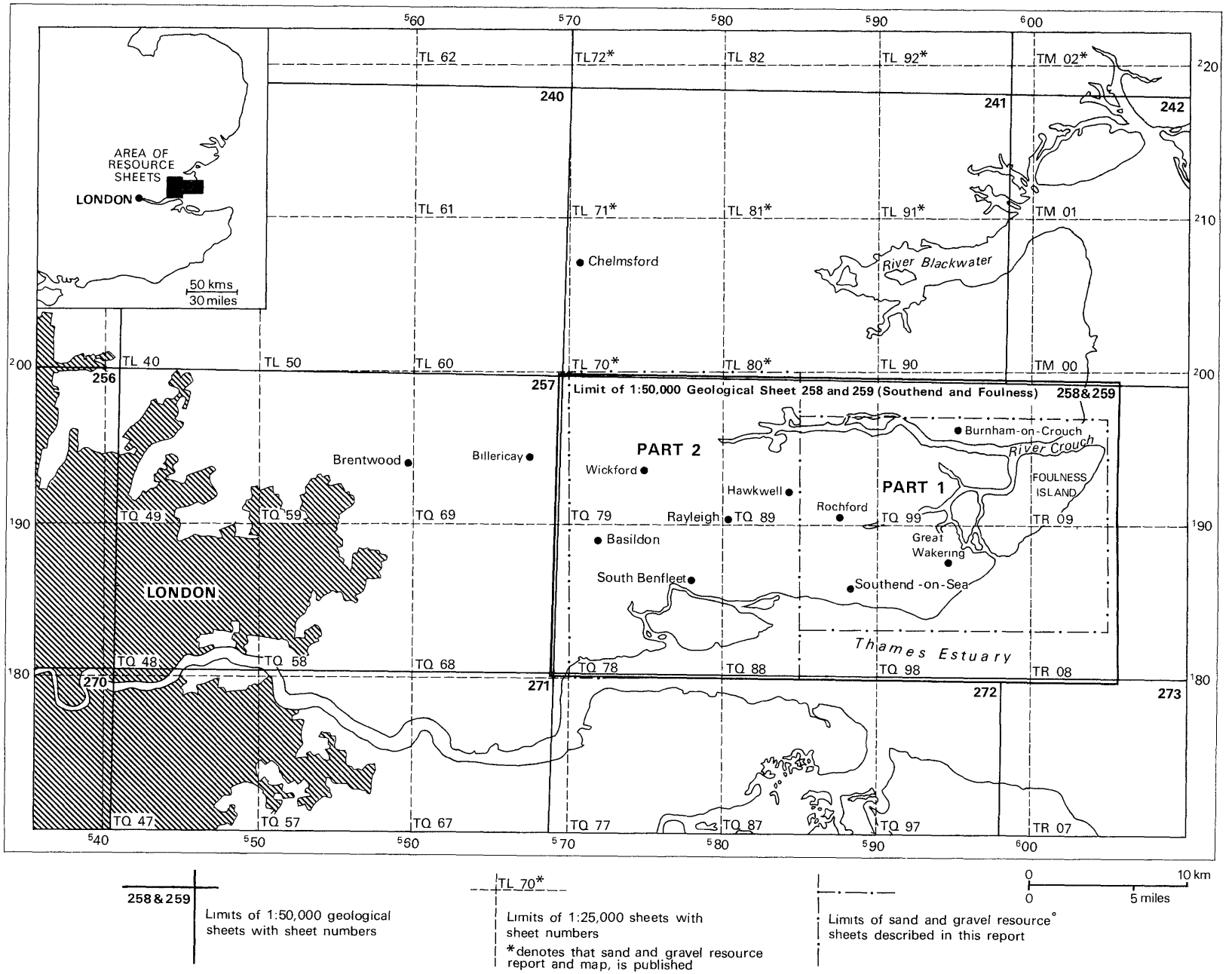


Fig. 1. Map showing the location of the resource sheets, the 1:50 000 Geological Sheet 258/9 (Southend and Foulness) and the National Grid

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

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

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

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

DESCRIPTION OF PART OF SHEETS TQ 88, 89, 98, 99, and TR 08, 09

GENERAL

The area lies to the north and east of Southend-on-Sea in south-east Essex (see Figure 1). To the south is the estuary of the River Thames and to the north the river and estuary of the Crouch. Running approximately north-eastward across the area is the River Roach, which joins the Crouch about 5 km from its mouth. Light engineering, agriculture and national and local government administration are the major occupations, but the proximity of Dagenham and London have led to the development of a large commuter population.

TOPOGRAPHY

The area is one of low to moderate relief. The low-lying areas, many of which are below high-tide level, include the marshes and tidal flats of the islands of Foulness, Potton, Wallasea, Rushley, and Havengore, as well as the perimeter of the mainland (e.g. Barling Marsh), all of which are protected by a sea wall, usually reaching 4.6 m (15 ft) to 4.9 m (16 ft) above Ordnance Datum. Immediately landward of the sea wall is a large water-filled ditch (a borrow area used in the construction of the sea wall), which also acts as a reservoir or collecting area for the many drainage channels that ramify throughout the area. Prior to the 15th century only limited sea defences were needed for Foulness and the adjacent islands. Since that time, the rise in sea level relative to the land and dewatering of the marshes by more efficient drainage (resulting in compaction of the deposits) have made it necessary for embankments of increasing height to be constructed. Reclamation by 'inning' of the flooded areas began in about 1420 on Foulness Island and continued into the late 19th century (Smith, 1970). These areas are therefore virtually flat.

To the west of the low-lying marshy area the ground rises gently up to about 15.2 m (50 ft) above Ordnance Datum, on which River Terrace Deposits, Brickearth and Head crop out. This area is enclosed by an arc of higher ground, which extends south-west from Canewdon, through Southend-on-Sea, north of Bournes Green [913 866], to Trotters [918 877]. In the north and west, this high ground is formed by London Clay and Claygate Beds, with occurrences of Head, River Terrace Deposits (at Canewdon) and Sand and Gravel of unknown age (at Ashingdon). In Southend, the ground above 15.2 m (50 ft) Ordnance Datum, comprises mostly Second, Third and Fourth Terrace Deposits and associated River Brickearth with some Head Brickearth underlain by London Clay.

The highest point in the area is west of Ashingdon where the surface level at borehole 89 SE 41 [8557 9337] is 55.1 m (181 ft) above Ordnance Datum.

GEOLOGY

London Clay, the oldest formation encountered during this survey, crops out mainly in the north-west between Ashingdon and Canewdon, at Stambridge, Southend-on-Sea and west of Rochford. Claygate Beds overlie the London Clay and occupy high ground at Ashingdon and south of Hawkwell. Overlying these Tertiary rocks and in the main occupying the lower ground are Pleistocene and Recent deposits. The Pleistocene comprises Sand and Gravel of unknown age, Brickearth and Head Brickearth, Head, Buried Channel Deposits and River Terrace Deposits. The last-named are associated with a former Thames-Roach drainage system. The Buried Channel Deposits and some of the Head may pre-date the River Deposits. Marine or Estuarine Alluvium and other recent deposits, which comprise over one third of the land area of the resource sheet, are found mainly in the eastern part of the area, including the islands of Foulness, Wallasea and Potton.

During the interval between the deposition of the Claygate Beds and the Marine or Estuarine Alluvium the area has undergone minor flexuring, which, with fluctuations of sea level and climate, produced periods of deposition and erosion. The present-day distribution of deposits is a result of the influence of these factors. Table 1 is a summary of the formations present on the resource sheet.

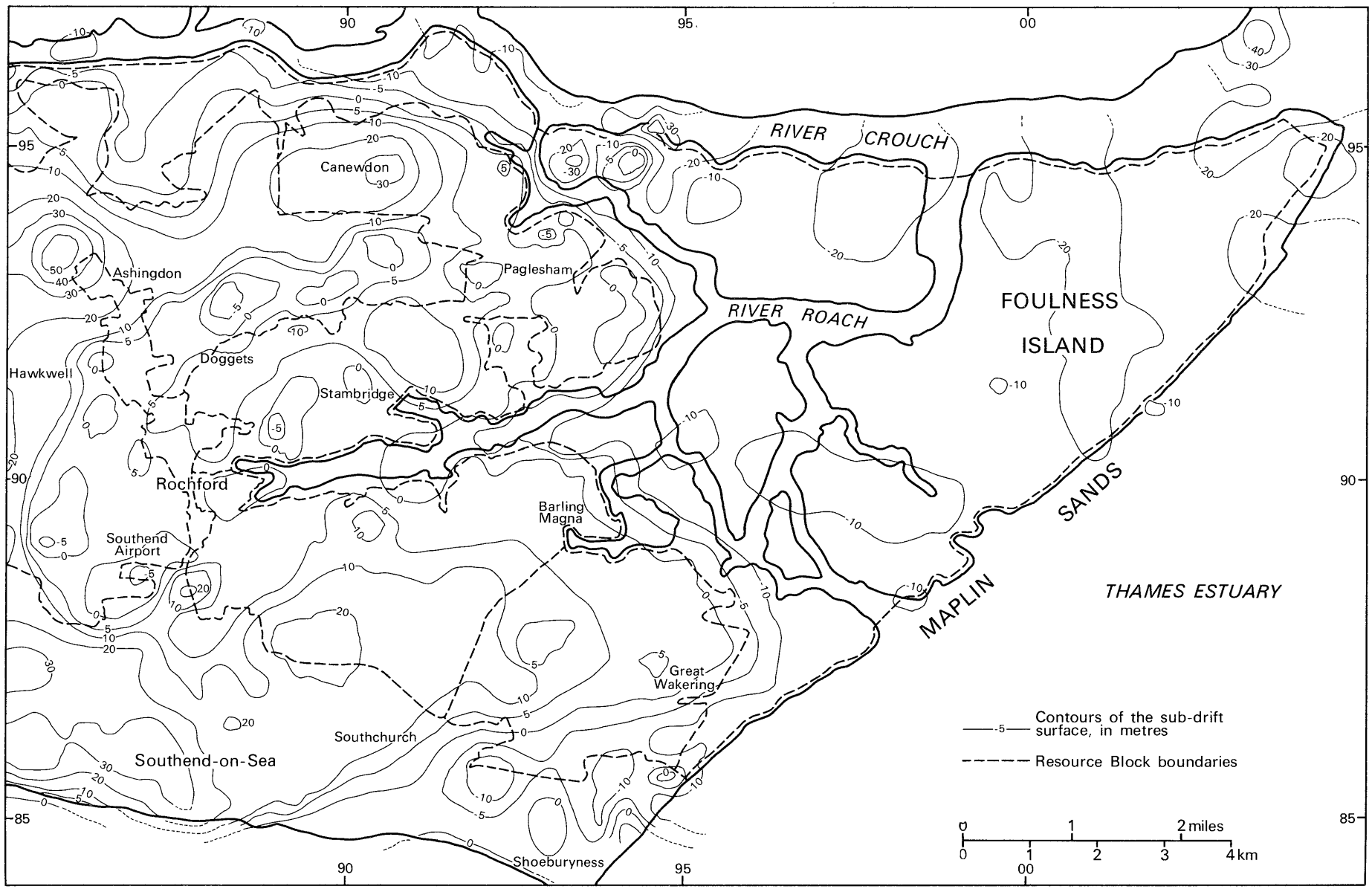


Fig. 2. Contour map of the sub-Drift surface

Table 1. Geological Succession

DRIFT - Recent and Pleistocene	
Blown Sand	
Alluvium	Recent and modern river deposits
Marine Beach or Tidal-Flat Deposits	Modern marine and estuarine deposits
Marine or Estuarine Alluvium	Marine or brackish-water deposits laid down in tidal, inter-tidal or sub-tidal conditions: mainly silty, sandy, rarely shelly
River Terrace Deposits	
Brickearth or Loam	River alluvium or loam representing late-stage silting up of river courses or overbank deposits
Sand and Gravel	Deposits laid down on the river flood-plain
Buried Channel Deposits (Proved by boreholes in the Rochford and Shoeburyness Channels and in channels beneath the Marine or Estuarine Alluvium)	Possibly a mixture of fluvioglacial, lacustrine and river deposits (Comprise the clay, silt, sand and gravel of the channel-fill)
Head	Disturbed and solifluxed material of local derivation developed under periglacial conditions (age uncertain)
Brickearth and Head Brickearth	Possibly aeolian deposits, often showing evidence of periglacial disturbance
Sand and Gravel of unknown age	Possibly glacial deposits
SOLID - Eocene	
Claygate Beds	Shallow marine deposits
London Clay	Marine deposits

SOLID

London Clay

The London Clay forms the bedrock over the whole resource sheet. Although predominantly clayey, it contains varying amounts of silt and sand: locally, there may be more silt than clay. The formation was deposited in a marine environment and contains a variety, though not an abundance, of macrofauna. As part of the geological and geotechnical study by the Institute in the area, three deep cored boreholes were drilled through the London Clay and a zonal scheme has been established on the basis of the micro-fauna. (Hughes, South Essex Geological and Geotechnical Survey, Part 6, Palaeontology: internal report prepared for the Department of the Environment).

The London Clay is olive to dark brownish grey in colour, but weathers to a paler chocolate brown (due in part to the oxidation of pyrite by percolating groundwater).

Greyish blue wisps of clay are commonly observed along fissures probably indicating reduction. The depth of weathering is dependent partly on the thickness and nature of the overlying sediments but also on the degree of fissuring. At outcrops, the London Clay may be weathered to a depth of up to nine metres, but beneath the superficial deposits the weathered zone may be as little as 0.1 m; beneath Marine or Estuarine Alluvium, however, it is usually thicker. Crystals of gypsum (calcium sulphate) commonly occur, in some places in abundance. Calcareous concretions (cementstones) up to 0.5 m in diameter and usually crossed by calcite veins are present at certain levels in the London Clay.

The upper surface of the London Clay undulates considerably, varying in height from about 50 m above Ordnance Datum in the west to 25 m below Ordnance Datum on Foulness Island, (see Figure 2). Although slightly obscured by minor structures the major features of the London Clay surface form important evidence in the reconstruction of the post-Tertiary history of the area.

The London Clay surface has four component parts.

(a) In the west, a ridge runs from Canewdon through Ashingdon, Hawkwell (just to the west of the resource sheet), and Southend-on-Sea and terminates in the Southchurch area. It reaches a height of over 55 m above Ordnance Datum at Ashingdon.

(b) East of this ridge, a complementary arcuate channel with its base at about Ordnance Datum can be traced from Southend Airport, west of Rochford, north of Stambridge to Paglesham. This channel is filled with up to 18 m of clay, silt, sand and gravel. The western limit of the channel is remarkably steep. Between boreholes 88 NE 276 [8508 8930] and 88 NE 274 [8519 8932] (locations not shown on the resource map for lack of space) the London Clay surface slopes at about 8° or 1 in 6.8.

(c) To the east of the channel, the London Clay surface lies mainly between Ordnance Datum and 10 m above Ordnance Datum and shows generally less relief than in the areas described in (a) and (b) above. The most prominent feature is a low ridge which trends approximately east-west, extending from Doggetts [880 920] to Stambridge, where it reaches about 15 m above Ordnance Datum and the London Clay is exposed.

(d) In the fourth area, which coincides approximately with the outcrop of the Marine or Estuarine Alluvium, the surface lies below Ordnance Datum. It has been eroded into ridges and channels, which follow two main trends. An east-west direction is represented by the channels occupied by the rivers Crouch and Roach (the former being the deeper) and by a channel east of Shoeburyness, which passes beneath the deposits ascribed to the First Terrace. Secondly, there are channels aligned approximately north-south: one crosses Foulness Island, and another, running west of Paglesham, Barling Magna and Great Wakering, deepens to the south (see Figures 2 and 8).

Claygate Beds

In two areas on the resource sheet, at Mount View [853 934], Ashingdon and west of Stroud Green [857 905], the London Clay passes conformably upwards into the Claygate Beds. These beds, first named by Dewey (1912), represent a shoaling of the sea responsible for the deposition of the London Clay. There is no distinct break between the London Clay and the Claygate Beds, which elsewhere pass gradually into the succeeding Bagshot Beds (not represented on this sheet area).

The Claygate Beds here differ slightly from the London Clay in lithology and colour. On the whole

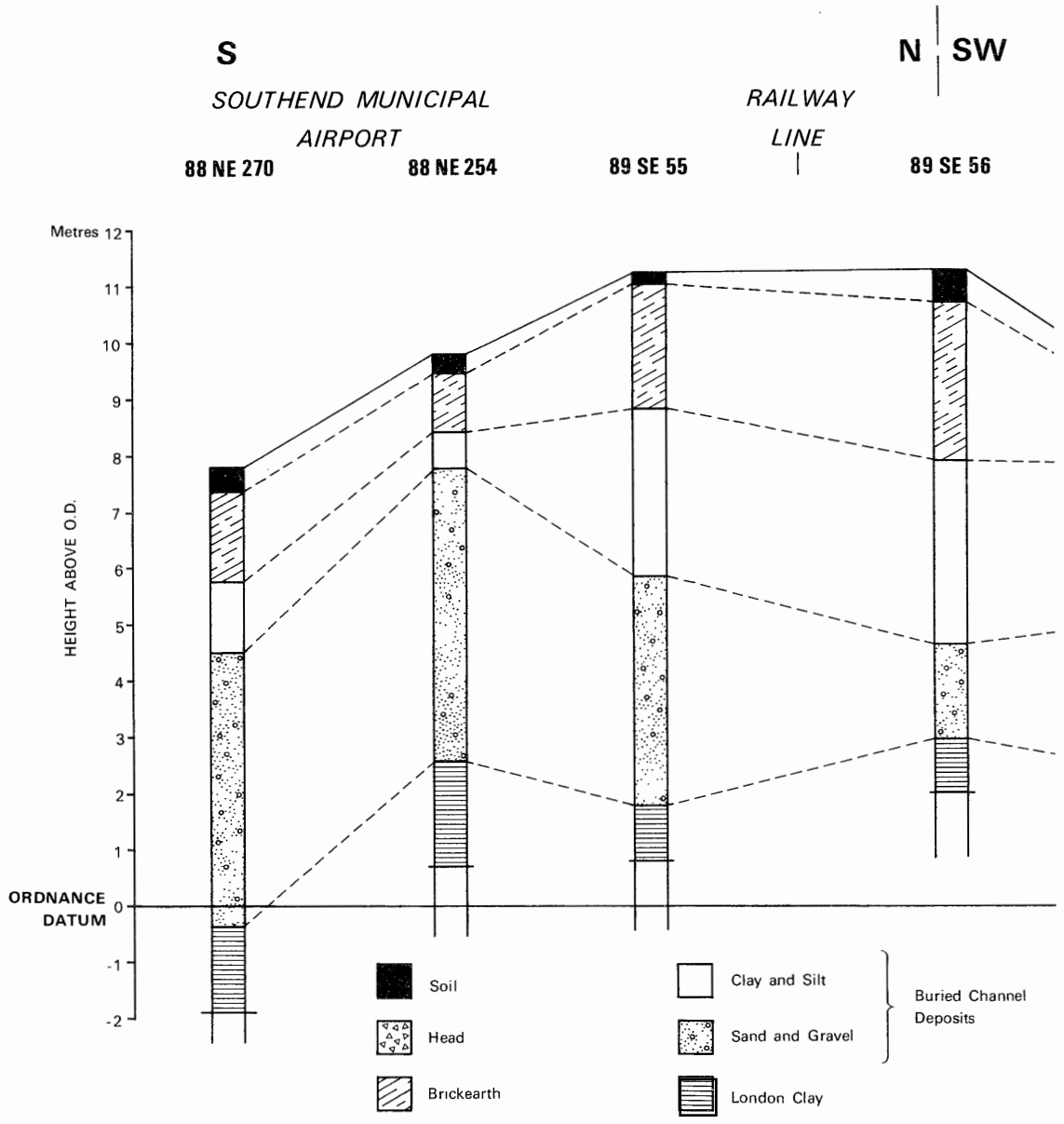


Fig. 3. Longitudinal profile of the Rochford Channel

they tend to be more arenaceous and the lowest major sandy member is taken as the base of the Claygate Beds. The boundary is sometimes marked by a weak break in slope and outcrop, often accompanied by seepage lines. The clays of the Claygate Beds are similar in colour to the London Clay, but they tend to weather to a distinctive lilac colour or, when highly weathered, to ochreous yellow-brown. The only borehole (89 SE 41) that penetrated the Claygate Beds demonstrated that the deposits are not likely to be potentially workable for aggregates.

DRIFT

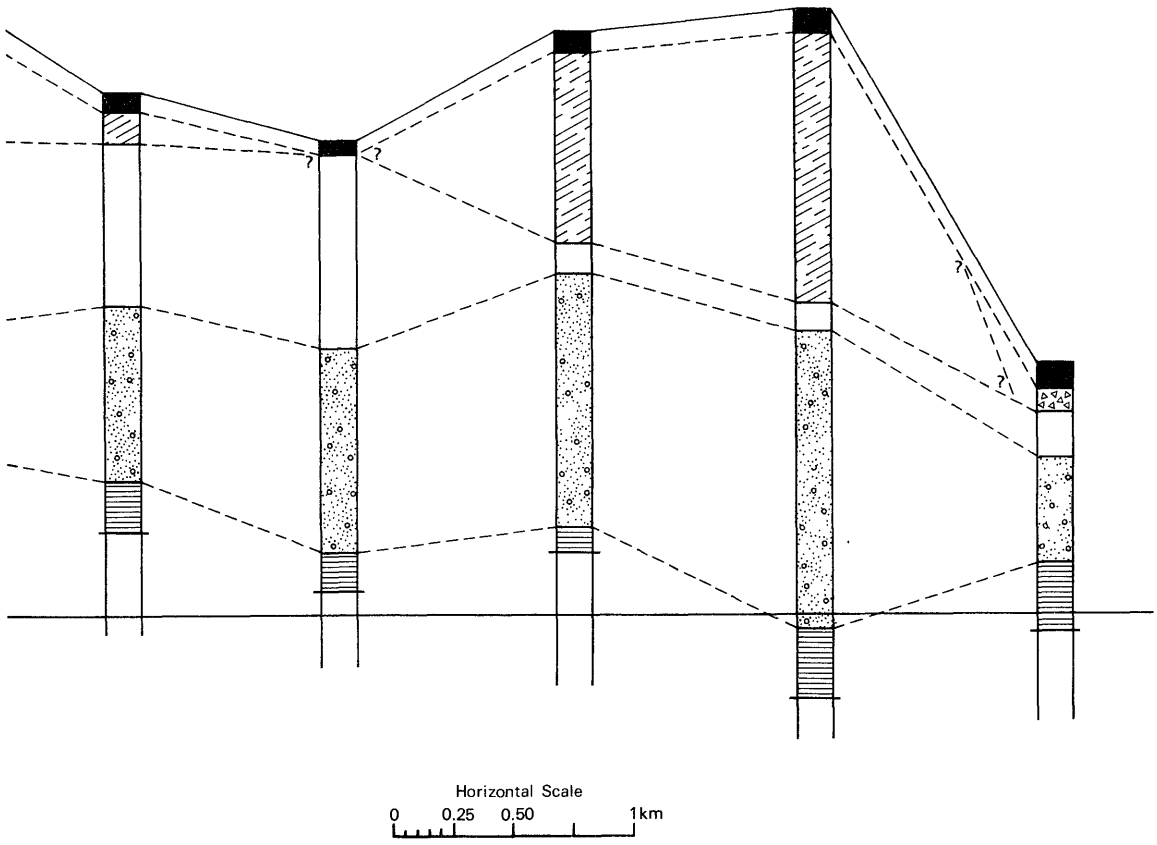
Sand and Gravel of unknown age

The only occurrence of these deposits on the resource sheet are outcrops at Mount View, Ashingdon, where they overlie Claygate Beds and London Clay. Borehole 89 SE 41, proved 0.9 m of clayey gravelly sand, based at 53.9 m above Ordnance Datum. Although their age is in doubt, from their height it is thought that these deposits pre-date the River Terrace Deposits and may represent an early glacial episode, dating back to at least the Anglian (Lake, Ellison, Henson and Conway, South Essex Geological and Geotechnical Survey, Part 2, Geology: internal report prepared for the Department of the Environment).

Brickearth and Head Brickearth

These deposits resemble the river brickearth or loam in their lithological appearance and colour. They are composed predominantly of silt with subordinate clay, sand and some gravel. The deposits are somewhat stiffer than the river brickearth or loam, with the sand usually present as small lenses or pockets, and the pebbles randomly scattered.

Both brickearth and head brickearth occur on predominantly north- and east-facing slopes. The grain-size analysis of the material suggests an aeolian mode of origin. The brickearth west of Cherry Orchard Lane on the western margin of the sheet shows evidence of solifluxion.



North of Bournes Green [913 864], the head brickearth is about 2.0 m thick; a trench section showed structures indicating movement of the material under periglacial conditions. Its precise age is uncertain, but as it directly overlies London Clay at between 11 and 16 m above Ordnance Datum it is probably older than the First Terrace deposits and younger than the river brickearth of the Third Terrace, which is a possible source of the material.

Brickearth is present west of Rochford at three places. Borehole 88 NE 276 proved the deposit at 28.0 m above Ordnance Datum, passing down into the channel-fill deposits of the Rochford Channel.

Head

These deposits, of varying age and composition are locally derived. They represent down-wash or solifluxed material or both and usually occur as a veneer mantling slopes and filling hollows at the base of the slopes. Although its composition varies considerably according to the source rock, in the present area head is generally clayey and contains a fairly high percentage of gravel (up to 30 per cent) and coarse sand. Only one borehole 99 SW 56, proved mineral beneath head. However, many boreholes (e.g. 88 NE 276) proved material similar in texture and colour to the mapped head deposits, but beneath river terrace deposits and brickearth.

Buried Channel Deposits

There are four major buried channels (see Figure 8); the Rochford Channel, the Shoeburyness Channel (Lake and others, 1977) and two unnamed channels beneath the Marine or Estuarine Alluvium. The last two are described below (p.16).

(1) Rochford Channel

This channel is an arcuate depression in the surface of the London Clay to the west and north of Rochford. Its base lies just above Ordnance Datum and the channel is roughly U-shaped in cross-section, but with the west flank showing a steeper profile than the east. It is filled with clay, silt and sand and gravel overlain by river

loam or brickearth of First to Third Terrace age. A typical sequence of deposits proved by boreholes in the channel is:

River loam or brickearth
Buried channel deposits - comprising clay and silt overlying sand and gravel
London Clay

The thicknesses of these deposits vary considerably (see Figures 3 and 4). The boundary between the clay and silt and the overlying river loam or brickearth is generally readily identifiable in trench sections, but is difficult to identify from material recovered in shell drilling. The basal sand and gravel shows similar grading to that of the river terrace sand and gravel. At Paglesham and Rochford, the basal sand and gravel has probably been reworked by the river responsible for the deposition of the First Terrace, resulting in a mixed origin for the deposit.

The clay and silt overlying the basal sand and gravel contains sandy intercalations, which become more frequent towards the base of the deposit. Structures such as small-scale channelling, cross-bedding and fine planar lamination have been seen in trench sections. The deposit has been identified in borehole 88 NE 276 at almost 22 m above Ordnance Datum, which is in the altimetric range of the Third Terrace (see Table 2). It is possible that these clays and silts crop out west of Rochford.

Two of the boreholes which proved channel deposits, 88 NE 251 and 88 NE 253, encountered sand and gravel between the channel-fill silt and clay and the overlying river loam or brickearth. These two occurrences of sand and gravel may be remnants of the Second and Third Terraces: their base levels are 7.9 m and 13.4 m above Ordnance Datum respectively. The channel deposits proved in borehole 88 NE 251 lie to the east of the main line of the channel.

The age of the channel has not definitely been established but evidence from pre-existing boreholes in Southend-on-Sea indicates that the channel extends south from the airport through the central area of Southend, where the sand and gravel of the Second to Third Terrace ($\overset{2-3}{\sim}$) is in contact with and probably overlies the sand and gravel in the base of the channel.

Faunal evidence from one part of the clay and silt in the channel suggests a fresh to brackish water environment with lagoonal conditions and restricted access to the sea during this period.

(2) Shoeburyness Channel
The form of this channel and its deposits are similar to those of the Rochford Channel, but it reaches a greater depth, the base being more than 10 m below Ordnance Datum. Site investigation and well records are the main source of evidence for its existence and two Industrial Minerals Assessment Unit boreholes, 98 NE 9 and 98 NE 34, also proved deposits associated with the channel. The channel-fill material is overlain by First Terrace sand and gravel as well as brickearth (see description of block D for typical sequence). The channel extends beneath the Marine or Estuarine Alluvium (see Figure 6). The clay and silt and the basal sand and gravel are 'cut-out' by the Marine or Estuarine Alluvium associated with the later channel trending north to south beneath Rushley and Potton islands. The channel deposits are probably similar in age to those in the Rochford Channel.

River Terrace Deposits
The river terrace deposits in the area comprise (1) sand and gravel overlain by (2) river loam or brickearth (clay and silt with some sand). Both deposits probably represent material laid down by a precursor of the River Thames when the sea was at a different level from that of today. The oldest deposits (Fourth Terrace) are at the highest level above Ordnance Datum and the youngest (First Terrace) at the lowest level. The terrace sequence indicates a progressive lowering of the sea level with periods of standstill or of aggradation, during which the deposits accumulated. The sand and gravel was probably laid down during the more active phases of the river régime, while the river brickearth might be associated with quieter phases representing, for example, the silting up of the channel.

(1) River Terrace Deposits (sand and gravel) Four river terraces of sand and gravel are identified on the resource sheet and they form the major mineral resource of the area. The relative ages of these four terraces can be demonstrated by reference to the height of the base of the deposits above Ordnance Datum. Table 2 shows that there is a considerable overlap of the base levels for deposits mapped as Third and Fourth Terrace, indicating that these are probably composite terraces, the higher level material having been reworked to be lower base level of the terrace in some places.

Fourth Terrace
Four small areas of Fourth Terrace are shown on the resource sheet, one at Canewdon and three in Southend. The deposits rest on a ridge of London Clay (see p.10). The only IMAU borehole in this terrace, 99 SW 68, proved 0.35 m of soil and 0.65 m of silty sandy clay on London Clay, although site investigation and well records at Canewdon and Southend indicate that the deposits also contain sand and gravel but with a high clay content.

Third Terrace
The sand and gravel deposits of this terrace crop out south of the Roach mainly in north-east Southend, with further small isolated outcrops at Beauchamps [908 885] and at Claystreet [919 879]. Third Terrace sand and gravel was also proved north-east of Great Stambridge in boreholes 99 SW 49 and 99 SW 57 underlying Third Terrace river brickearth. A trench near Stambridge sewage works [9118 9203] showed a tripartite sequence of sand and gravel, overlying river loam, which in turn overlay further sand

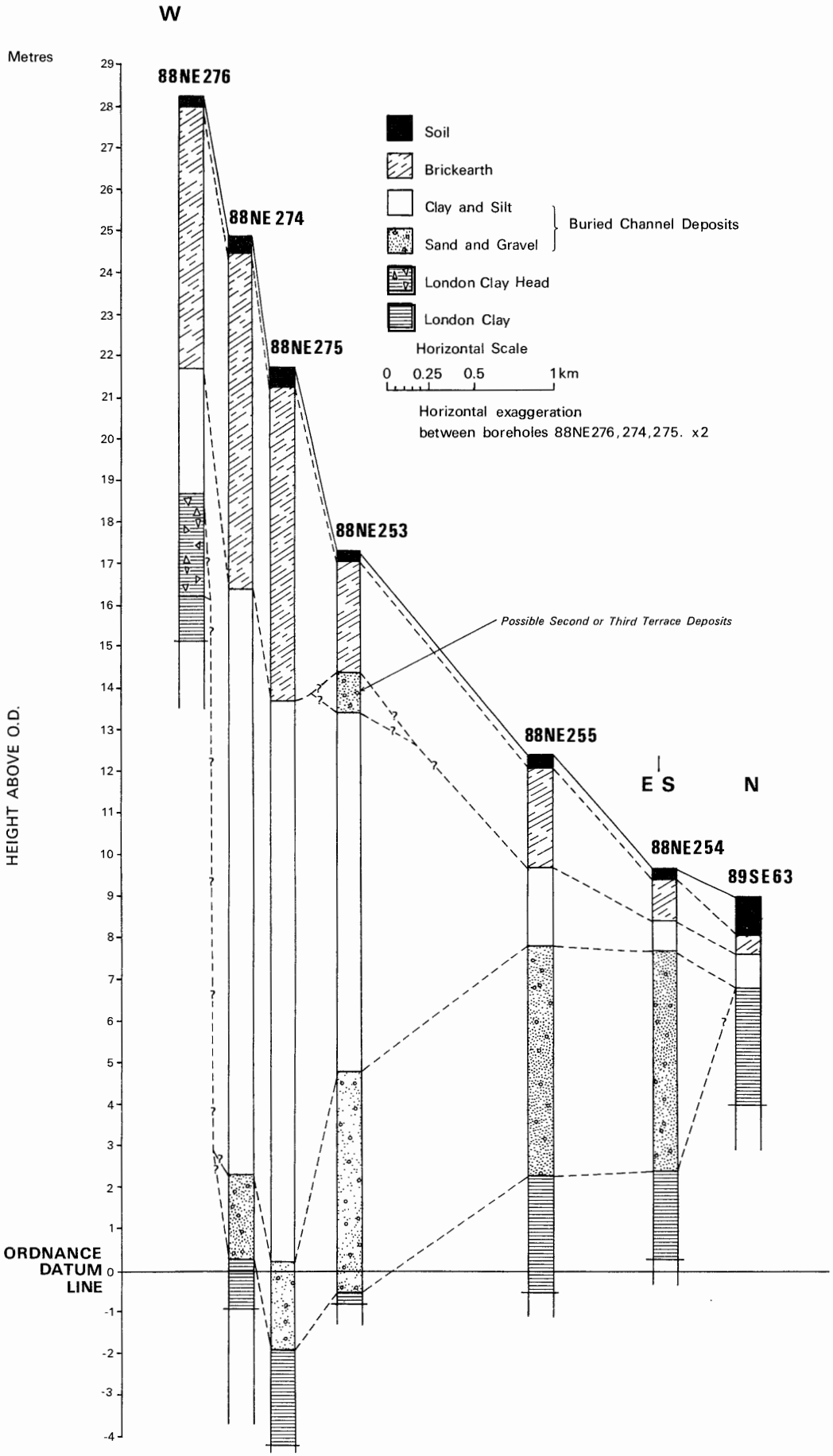


Fig. 4. Section across the western end of the Rochford Channel

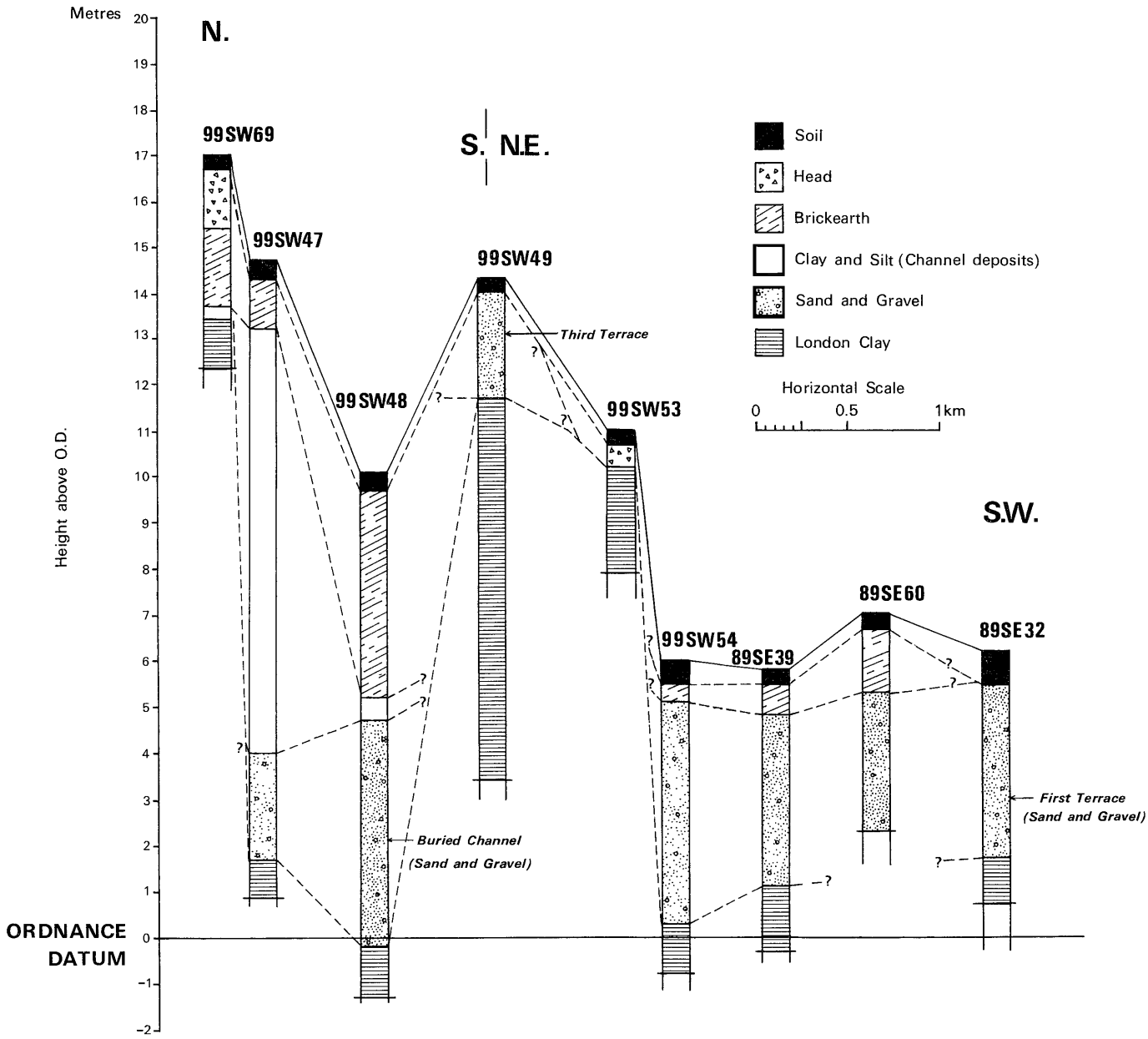


Fig. 5. Section across the eastern end of the Rochford Channel and the Third and First Terraces to the south

and gravel, indicating more than one phase of aggradation within the Third Terrace. The base level of this patch of terrace is 11.7 m above Ordnance Datum in 99 SW 49 and 15.65 m above Ordnance Datum in 99 SW 57.

The main area of the Third Terrace is found within Southend. On the resource sheet this outcrop is classified as Second-Third Terrace (²⁻³). Although the major part of the outcrop can be assigned to the Third Terrace (e.g. south of Shopland Hall [898 883]), farther to the west in the area of Prittlewell the deposits descend in height to a base level of about 8.0 m above Ordnance Datum, which is almost within the altimetric range of the Second Terrace. However, no satisfactory geological boundary can be drawn to separate Third Terrace from terrace deposits probably reworked during Second Terrace times, so that in the Prittlewell area a composite terrace is recognised.

The assessed sand and gravel of the Third Terrace has a mean thickness of 1.8 m, although within Southend site investigation records prove up to 13.7 m of sand and gravel, probably of composite Second-Third Terrace age. Grading results show mean percentages of fines 13, sand 64 and gravel 23.

Second Terrace

There are four outcrops of sand and gravel of this terrace north of the Roach; some parts of the Third Terrace north of Southend may have been reworked during Second Terrace time (see above). The two larger areas of terrace north of Rochford and south-east of Canewdon have been worked for sand and gravel. The thickest deposits were found in the outcrops south-east of Canewdon. Borehole 99 SW 80, south of Canewdon, proved 4.0 m of mineral. The area of terrace to the north of Rochford proved to be about 2.0 m thick. Fossil ice-wedge polygons are exposed at the surface and in the disused pits in both areas. In cross-section, the ice-wedges are vertical V-shaped structures, usually filled

Table 2. Altimetric ranges of the base levels of the river terraces as proved in boreholes (All heights are related to Ordnance Datum.)

Number of Terrace	Minimum base level proved m	Maximum base level proved m	Range m	Mean base level m
First Terrace	-3.75	4.5	8.25	1.3
Second Terrace	5.7	7.75	2.05	7.1
Third Terrace	11.5	23.35	11.85	15.5
Fourth Terrace	16.2	27.5	11.3	21.9

with solifluxion material and with a maximum width of 1 to 2 m and up to 2 m in depth. They are believed to have formed by water freezing in cracks or fissures in the ground, produced by thermal contraction of the permafrost (Gruhn and Bryan, 1969).

In boreholes 88 NE 253 and 88 NE 251 two beds of sand and gravel were proved. In both cases the basal sand and gravel is overlain by clay and silt of the Rochford Channel followed above by the second bed: they are based respectively at 13.4 m above Ordnance Datum and at +7.9 m above Ordnance Datum. These deposits may be the remnants of a more extensive spread of sand and gravel deposited in late Third Terrace and Second Terrace times. Resistivity traverses at Stambridge, confirmed that the Third Terrace sand and gravel (proved only in boreholes) is contiguous with the thin Second Terrace sand and gravel to the south; the later deposit was probably derived from the former. The mean thickness of the Second Terrace is 2.1 m with a mean grading of fines 6 per cent, sand 53 per cent and gravel 41 per cent. These figures do not include the results of borehole 89 SE 33 sited on the mapped limit of the terrace deposits, where they may have been re-worked.

First Terrace

Sand and gravel of this terrace constitutes the major mineral resource in the area. It is present both north and south of the Roach, and is overlain extensively by river brickearth. It is also the thickest of the River Terrace sand and gravel deposits with a mean of 3.3 m. Generally its base level is about 1.3 m above Ordnance Datum although it may occasionally be lower. For example, south-east of Paglesham borehole 99 SW 62 proved 6.2 m of sand and gravel resting on London Clay at 1.7 m below Ordnance Datum (the thickest recorded deposit of First Terrace sand and gravel north of the River Roach) and borehole 99 SW 79 proved 4.0 m of mineral based on London Clay at 3.75 m below Ordnance Datum.

South of the River Roach in the centre of the area bounded by Rochford, Southend-on-Sea and Shoeburyness, drilling shows that the river brickearth directly overlies London Clay, but around the periphery First Terrace sand and gravel intervenes and in some places is exposed. Beneath the river brickearth the limit of the sand and gravel, which is based on the evidence of boreholes and resistivity traverses, is indicated on the resource sheet by inferred (zig-zag) boundary lines. The absence of sand and gravel in the central area is thought to be due to the London Clay surface being above the altimetric level of the First Terrace sand and gravel.

In the Shoeburyness area, First Terrace sand and gravel overlies buried channel deposits and extends beneath the Marine or the Estuarine Alluvium (see Figure 6).

The mean grading of the First Terrace sand and gravel is fines 12 per cent, sand 58 per cent and gravel 30 per cent. However, there is great variation in the grading from fines 40 per cent, sand 54 per cent and gravel 6 per cent in 89 SE 32 to fines 10 per cent, sand 36 per cent and gravel 54 per cent in 98 NW 38. There is one working pit in the First Terrace sand and gravel at Barling Magna.

(2) River Terrace Deposits (river brickearth or loam) These deposits, which are brown to yellowish brown in colour and consist mainly of silt with clay and sand in varying proportions, are associated with the terrace sand and gravel deposits and are numbered accordingly. The area includes no Fourth Terrace river brickearth and that of the Third Terrace is restricted to the area north-east of Southend-on-Sea and east of Great Stambridge. Near Great Stambridge, the deposit completely covers the sand and gravel of the Third Terrace, the presence of which was proved only in boreholes (99 SW 49 and 99 SW 57). Second Terrace river brickearth is restricted to the outcrop north-east of Rochford.

By far the largest occurrence of river brickearth is of First Terrace age. It is in the Great Stambridge and Paglesham area north of the River Roach and in the Sutton, Barling Magna, Great Wakering area south of the Roach.

Many deposits of river brickearth of this age are probably of composite origin. This is certainly the case north and west of Southend Municipal Airport, where the river brickearth overlies deposits associated with the Rochford Channel and reaches 28 m above Ordnance Datum, well above the accepted altimetric limits of the First Terrace. The upper sand and gravel horizon in borehole 88 NE 253 based at 13.4 m above Ordnance Datum is thought to be a remnant

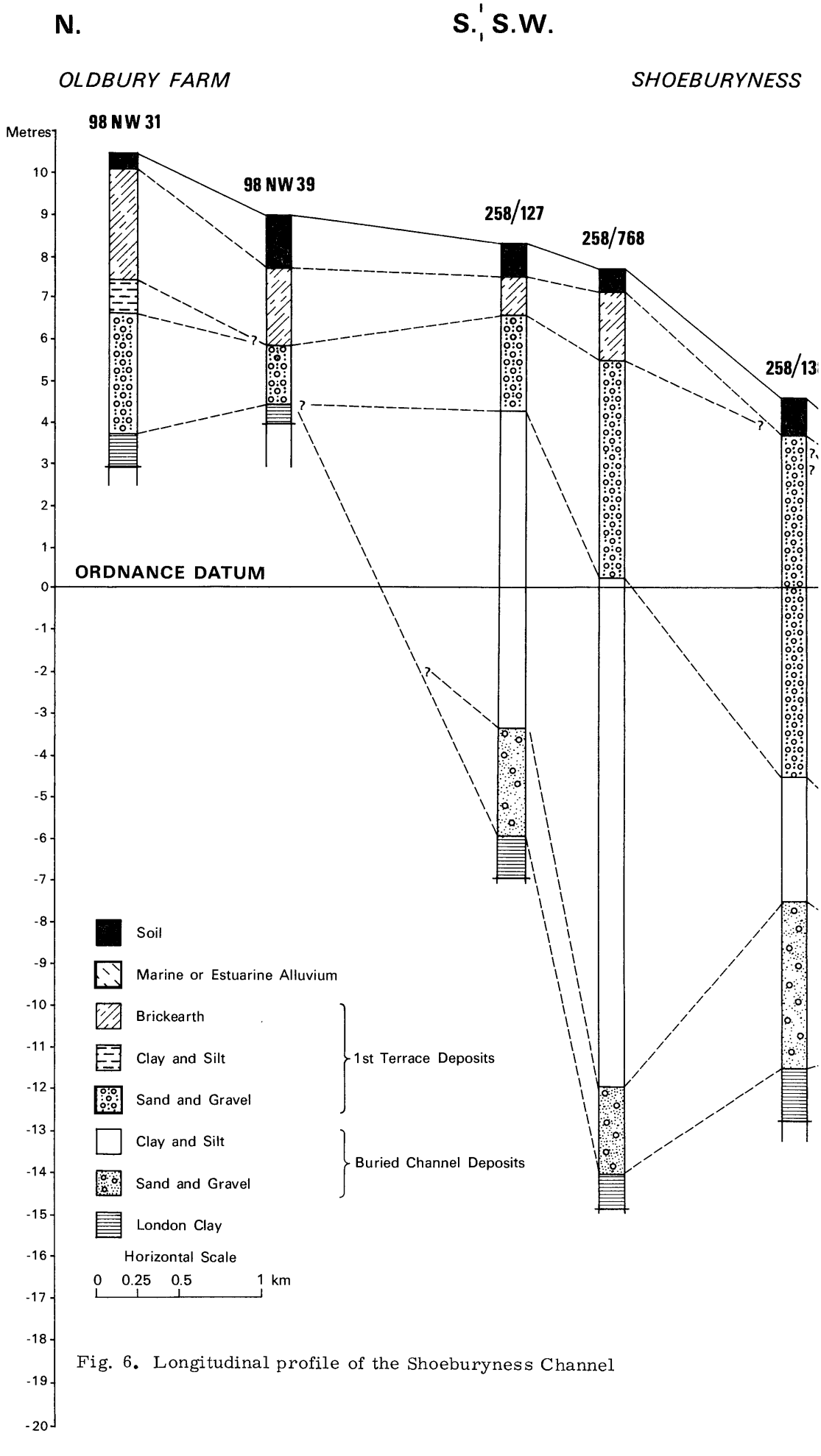
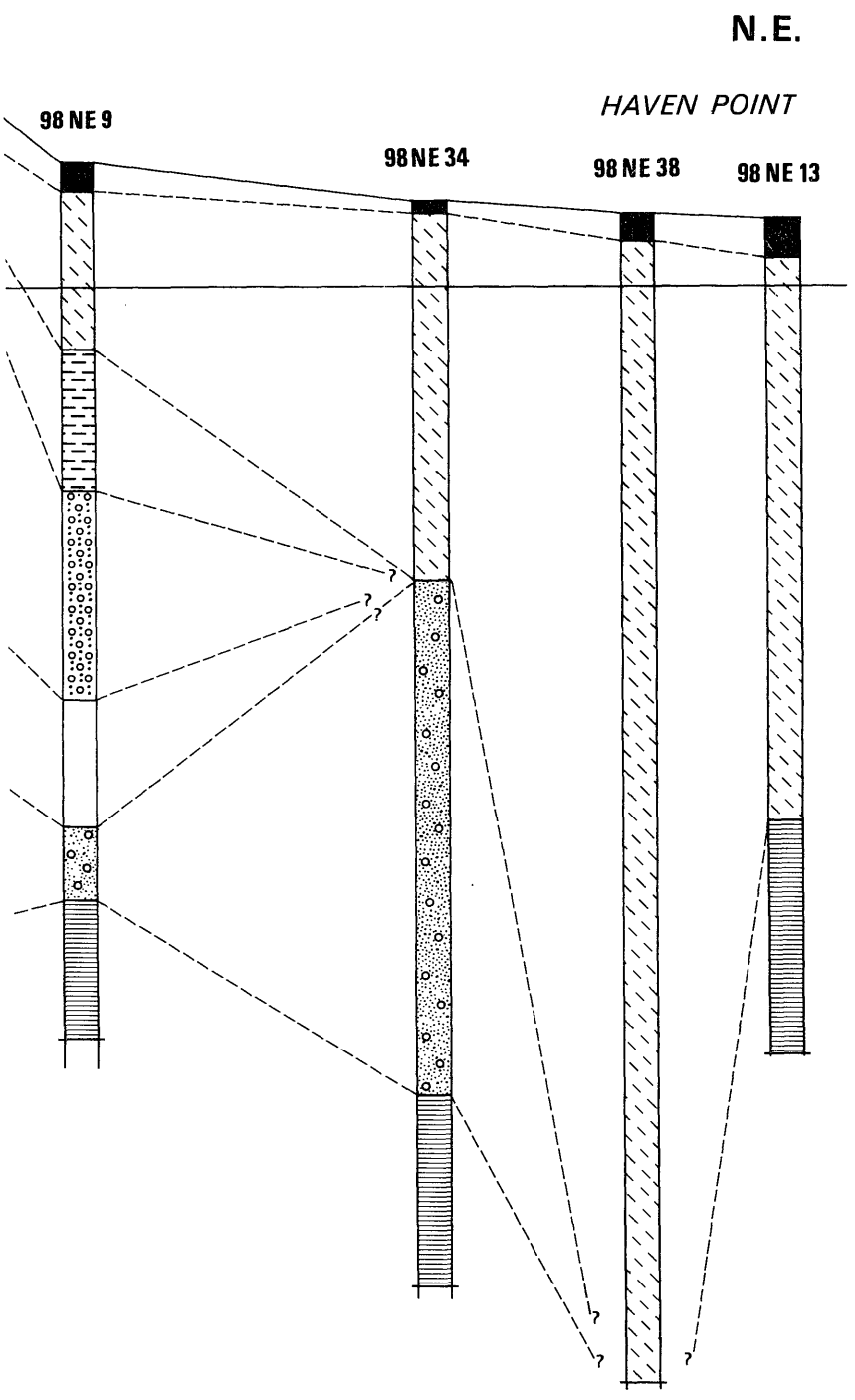


Fig. 6. Longitudinal profile of the Shoeburyness Channel


N.E.
HAVEN POINT
98 NE 9
98 NE 34
98 NE 38
98 NE 13

of the Second Terrace, similar to the upper mineral horizon in borehole 88 NE 251. Thus, although the overlying river brickearth may have been partly deposited during First Terrace times, it probably also includes material of the Third and Second terraces.

Commonly the brickearth of the First Terrace may be divided into lower calcareous and upper largely non-calcareous parts. Both contain evidence of rootlets in the form of thin calcareous veins or stringers and the lower part usually also contains abundant calcareous nodules (race), generally about 10 mm in diameter, but occasionally up to 50 mm. The bipartite division of the brickearth is well seen in the brick pit [85 89] at Cherry Orchard Lane, west of Rochford.

The mean thickness of the river brickearth calculated from data from 57 boreholes, is 1.9 m, the maximum thickness being 8.1 m in borehole 88 NE 274. The brickearth is generally thicker over the Rochford Channel, where the mean is about 3.0 m.

Marine or Estuarine Alluvium

These deposits cover more than a third of the area of the resource sheet. They can be divided into two major units:
(1) Basal sand and gravel, usually thickest in channels or basins in the London Clay surface, but present also on the interfluves (ridges or areas where the London Clay bedrock is at a higher level) and (2) an overlying complex succession of clay, silt and sand, with some gravel representing an upward progression from fresh-water to estuarine tidal-flat and saltmarsh deposition.

Radiocarbon dates and the fauna suggest a Pleistocene age for the basal sand and gravel present in the deep channel beneath Foulness Island (see Figures 7 and 8). These deposits are possibly fluvioglacial in origin, although the presence of marine shells in the upper parts of the gravels suggests reworking during the post-glacial rise in sea level. The age of the gravels found in the channel beneath Potton and Rushley islands and part of the Barling Marshes and as thin deposits on the interfluves, is uncertain. These shallower gravels may be remnant terrace deposits.

Apart from some of the deeper deposits, the soft clay and silt overlying the basal sand and gravel is thought to be Flandrian in age, laid down under estuarine tidal-flat conditions. It represents a comparatively rapid accumulation of sediments during the post-glacial period when the sea level rose as water was released from the ice sheets.

These deposits tend to coarsen upwards, though locally lenticles of sand and gravel (indicating channelling and increased current activity) and of over-consolidated clay bands (probably indicating temporary pauses in the rise or even a slight lowering of the sea level possibly producing sub-aerial conditions) are represented.

At the top of the succession on the south-east of Foulness and Havengore islands and at Wakering Stairs on the mainland, the deposits become predominantly sandy. This broad sheet-like formation thickens to the south and east, and the deposits are probably sub- or inter-tidal.

Marine Beach or Tidal-Flat Deposits

These deposits crop out on the seaward side of the sea wall, although many of the boreholes sited on Marine or Estuarine Alluvium proved deposits of similar environment at depth. They are thought to be developed on predominantly inter-tidal and sub-tidal flats (Greensmith and Tucker, 1971) and are composed of silty sand, commonly containing shells.

Alluvium

Alluvium, which comprises clay and silt, outcrops mainly in and north of Southend-on-Sea and west of Rochford. The deposits are of recent age and fairly thin (borehole 88 NE 250 proved 0.4 m of clayey silt with scattered pebbles). They are found on the floor of minor river valleys and pass downstream into Tidal-Flat Deposits.

COMPOSITION OF THE SAND AND GRAVEL

In the Southend-on-Sea area there are five formations which were proved to contain potentially workable sand and gravel. They are Marine or Estuarine Alluvium, First Terrace, Second Terrace, Third Terrace and the basal deposits in the Rochford and Shoeburyness channels.

Flint is the main constituent of the gravels, comprising about 80 per cent by weight and ranging in size from fine gravel to cobble. The cobbles are usually found immediately overlying the bedrock as, for example, in boreholes TQ 88 NE 255, TQ 99 SW 48 and TQ 99 SW 85.

Rounded reworked Tertiary flint pebbles and subangular fragments of flint occur in approximately equal proportions throughout most of the size range, although angular to subangular flint and patina chips form a high proportion of the fine gravel. Vein-quartz, quartzite and sedimentary rock fragments are present as subsidiary constituents. The vein-quartz and quartzite pebbles occur generally as fine gravel, rarely comprising more than 5 per cent of the deposit. They are rounded to well rounded and of medium to high sphericity. The sedimentary rock pebbles have been identified as being predominantly weathered fragments of Greensand making up between 5 per cent and 15 per cent with occasionally up to 23 per cent of the gravel (see Table 3). These pebbles are subangular and of low to medium sphericity. Grading results reveal that for the five major horizons of mineral the sand fraction exceeds gravel which, in turn, exceeds that of the fines. The mean percentages for each formation are as follows, the figures being given for fines, sand and gravel in that order: Marine or Estuarine Alluvium: 3, 65, 32; First Terrace: 12, 58, 30; Second Terrace: 6, 53, 41; Third Terrace: 13, 64, 23 and Rochford Channel: 10, 55, 35.

The unexpectedly low fines value recorded for the mineral at the base of the Marine or Estuarine Alluvium is thought to result mainly from the loss of the clay and silt fraction when sampling by

Table 3. Composition of gravel (+4 mm fraction) from random samples

Borehole Registration Number	Depth of sample below surface m	Deposit	Percentage (by weight)				
			Flint	Vein-quartz and Quartzite	Chalk	Sandstone (? Greensand)	Miscellaneous (includes igneous and sedimentary rocks)
88 NE 250	5.7 - 7.7	Rochford Channel sand and gravel	80	2.5	0	15	2.5
88 NE 253	13.5 - 15.0	Rochford Channel sand and gravel	71.5	0.5	0	18.5	9.5
88 NE 253	15.0 - 16.0	Rochford Channel sand and gravel	79.5	9	0	5.0	6.5
88 NE 254	2.8 - 3.8	First Terrace	79	1.5	0	14	5.5
98 NW 36	3.6 - 4.8	First Terrace	79.5	1	0	10.5	9
98 NE 11	5.0 - 6.0	First Terrace	88	1	1.5	2	7.5
98 NE 34	14.7 - 15.7	Shoeburyness Channel	74	1.5	0	23.5	1

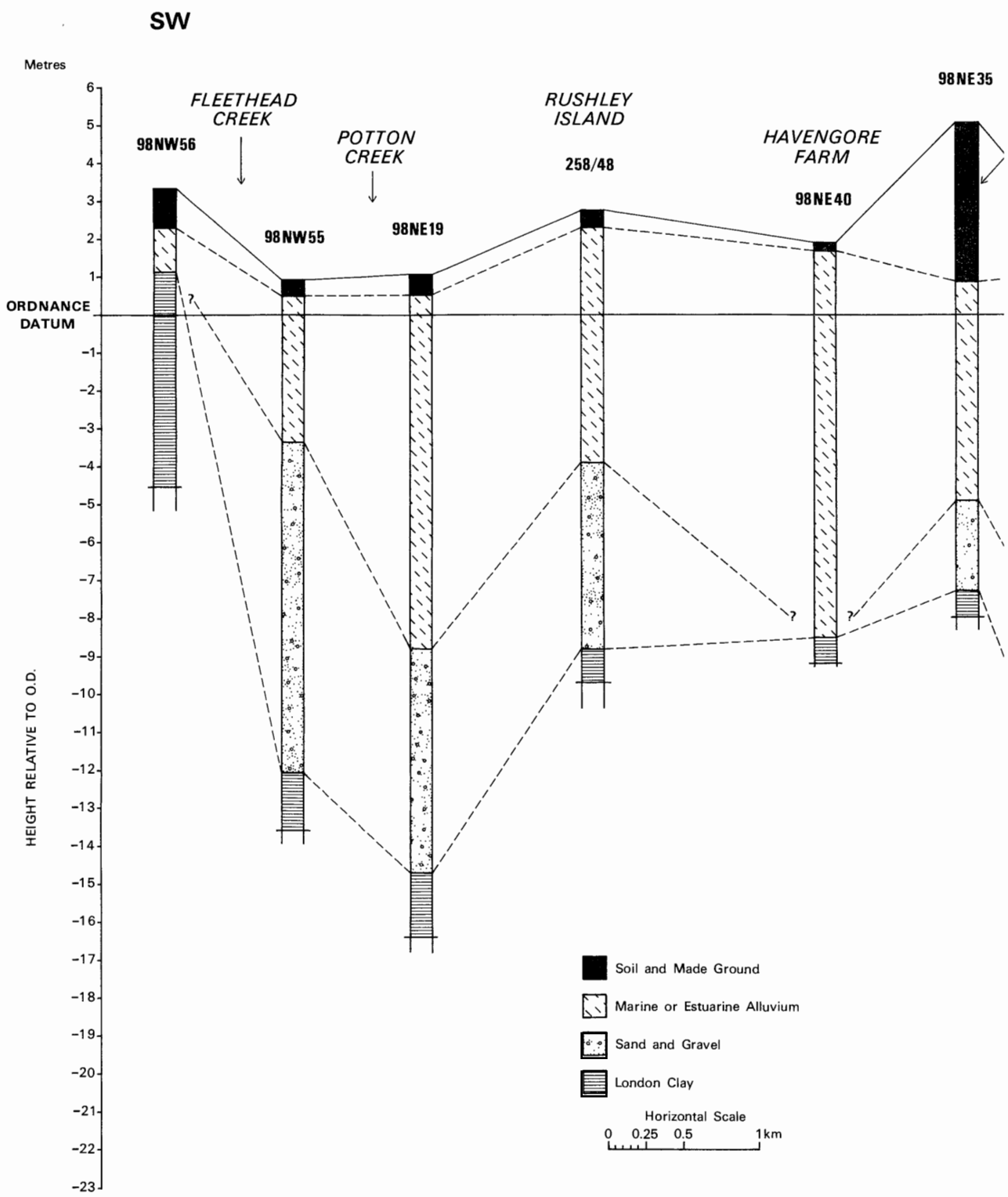


Fig. 7. Section across the Marine or Estuarine Alluvium

NE

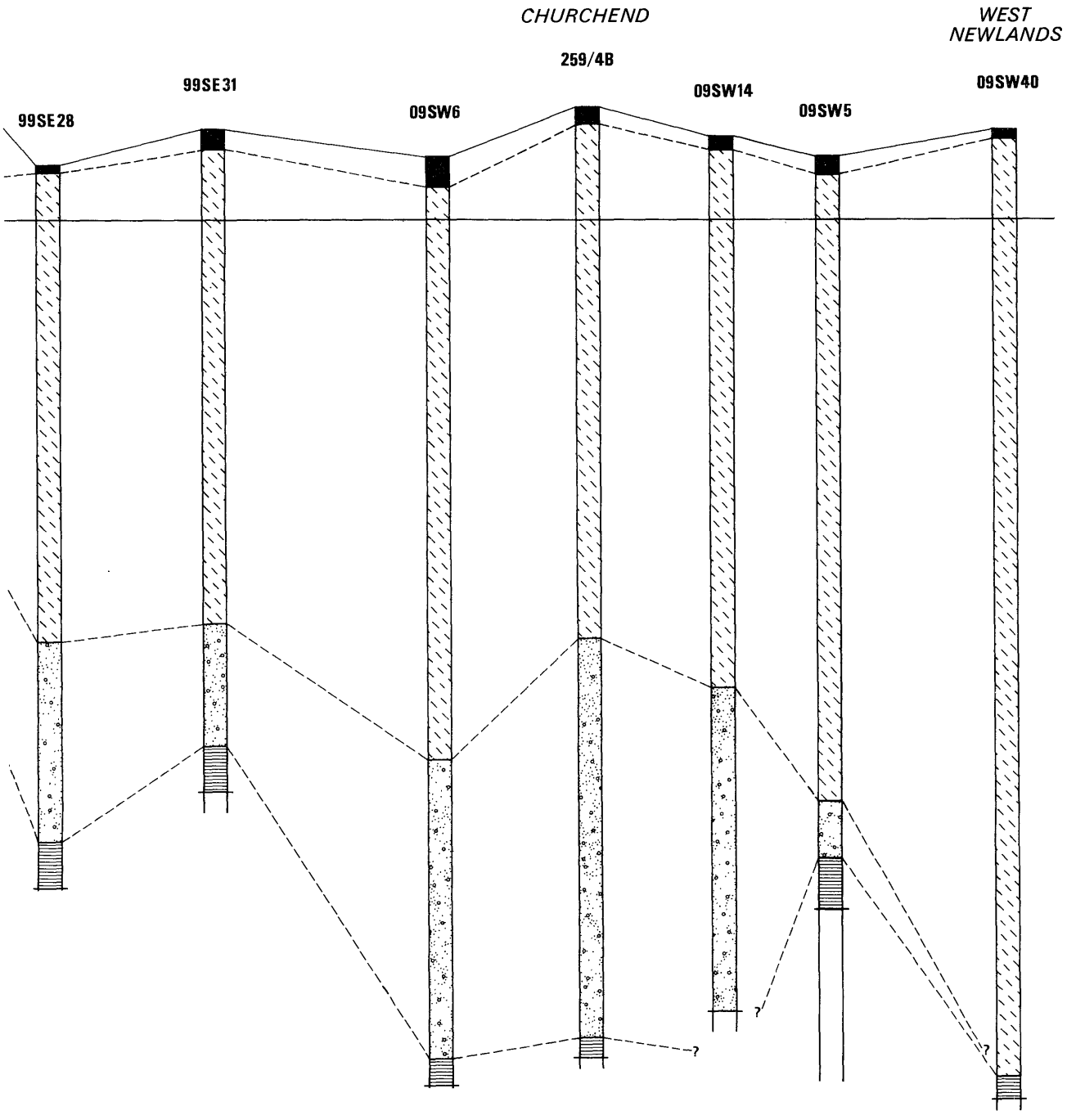

CHURCHEND
WEST NEWLANDS
259/4B
99SE31
09SW14
09SW40
99SE28
09SW6
09SW5
?
?
?

Table 4. Results of specific gravity, water absorption and 'ten per cent fines' tests carried out on some bulk samples (These figures are the mean of tests on two sub-samples from each sample.)

Location	Deposit	Depth below surface of sample tested m	Specific gravity			Water absorption (per cent)	Ten per cent fines value (tons)
			Apparent	Saturated and surface dried	Oven dried		
Borehole TQ 98 NW 37	First Terrace	6.2 - 7.5	2.628	2.549	2.500	1.941	28
Barling Magna Pit	First Terrace	From total thickness exposed (2.2 m)	2.618	2.536	2.485	2.056	28
Doggetts Lane Pit	Second Terrace	From total thickness exposed (1.2 m)	2.612	2.490	2.415	3.123	24
Creaksea Pit	Second Terrace	From total thickness exposed (1.7 m)	2.623	2.518	2.455	2.614	27
Borehole TQ 98 NE 10	Sub-alluvial sand and gravel	15.6 - 16.6	2.634	2.562	2.518	1.743	23
Borehole TQ 88 NE 250	Rochford Channel sand and gravel	4.7 - 5.7	2.632	2.548	2.497	2.058	28

bailing beneath the water table.

Tests were carried out on six samples representing the major mineral-bearing horizons, to determine the specific gravity, water absorption and ten per cent fines values. The standard tests were carried out according to BS 812 (1967a) and the results are given in Table 4.

THE MAP

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

Geological data

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

The geological boundaries show the best available interpretation of the information available at the time of survey. However, it is inevitable, particularly with Drift deposits such as those included in this area, which change rapidly vertically and laterally, that local irregularities or discrepancies will be revealed by some boreholes (for example, at boreholes 99 SW 60 and 99 SW 65). These are taken into account in the assessment of resources (see below and Appendix B).

Mineral resource information

The mineral-bearing ground is subdivided into resource blocks (see Appendix A). Within a resource block the mineral is subdivided into areas where it is 'exposed' and areas where it is present in continuous (or almost continuous) spreads beneath overburden. The mineral is identified as 'exposed' where the overburden, commonly consisting only of soil and subsoil, averages less than 1.0 m (3.5 ft) in thickness. Beneath overburden the mineral may be continuous (or almost continuous) or discontinuous. 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.

Areas where bedrock outcrops, 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 areas it has been assumed that mineral is absent except in infrequent and relatively minor patches which can neither be outlined nor assessed quantitatively in the context of this survey. Areas of unassessed sand and gravel, for example, built-up areas, are indicated by a red stipple.

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

RESULTS

A simple statistical procedure, explained in Appendix B, has been used to calculate the resources in the five blocks; the results are shown in Table 5.

The particle-size distribution for the assessed thickness of mineral in blocks A to E shown in Fig. 10, is based upon the weighted mean grading results for each assessment borehole.

Accuracy of results

For each of the five blocks, the accuracy of the results at the two-sided 95 per cent confidence level (that is, the probability that 19 times out of 20, the true volume of mineral present lies within the stated limits) varies between 20 per cent and 37 per cent. However, the true volumes are more likely to be nearer the figure estimated than either of the limits. Moreover, it is probable that roughly the same percentage limits would apply for the statistical estimate of mineral volume within a very much smaller parcel of ground (say 200 acres) containing similar sand and gravel deposits, if the results from the same number of sample points (as provided by, say, ten boreholes) were used in the calculation. Thus, if closer limits are needed for 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 D. The total volume (123 million m^3) can be estimated to limits of ± 13 per cent at the 95 per cent confidence level by a calculation based on the data from the 75 sample points spread across the four resource blocks. However, it must again be emphasised that the quoted volume of mineral has no simple relationship with the amount that could be extracted in practice, because apart from the exclusion of the Southend

Table 5. Sand and gravel resources of the area north-east of Southend-on-Sea

(i) Statistical assessment

Block	Area		Mean thickness		Volume of mineral			Mean grading percentages					
	Block	Mineral	Over-burden	Mineral	Million	Limits at the 95% confidence level		Fines	Sand			Gravel	
	km^2	km^2	m	m	m^3	±%	+Volume mill. m^3	-1/16 mm	+1/16 -$\frac{1}{4}$ mm	+$\frac{1}{4}$-1 mm	+1-4 mm	+4-16 mm	+16 mm
A	23.5	9.7	4.4	4.0	39	23	9	10	7	39	9	23	12
B	18.6	11.9	1.1	3.0	36	20	7	12	6	44	8	19	11
C	14.8	9.5	1.8	2.4	23	33	8	11	6	40	9	22	12
D	10.9	9.4	2.3	2.7	25	37	9	14	3	55	6	13	9
A-D (total)	67.8	40.5	2.3	3.0	123	13	16	12	6	44	8	19	11
E	69.5	12.0	10.2	6.3	76	25	19	3	11	42	12	24	8
Total area assessed	137.3												
Area of resource sheet not assessed	142.7	Comprises the urban area of Rochford and Southend (24.9 sq. km), the ground north of the Crouch (17.1 km^2) and 100.7 km^2 below the high-water mark											

(ii) Inferred assessment

D Shoeburyness Channel	c.1.8	c.8.3	c.4.1	c.7		No information available

and Rochford urban areas 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

The boundaries of this block have been drawn to include most of the deposits associated with the Rochford Channel, (see p. 9). Of the total of 23.5 km^2, 9.7 km^2 is mineral-bearing, the remaining 13.8 km^2 of barren ground being exposed London Clay and Claygate Beds, or head, head brickearth, brickearth and river brick-earth, beneath which there is no mineral. The urban area of Rochford (which extends northwards to include Ashingdon) covers part of the Rochford Channel and deposits of First and Second Terrace age. It divides the mineral of the block in two, with 5.8 km^2 in the north-east and 3.9 km^2 in the western part. Except for the area immediately west of Rochford and north-west of Southend-on-Sea, the mineral is overlain by river brickearth or buried channel deposits or both. Buried channel deposits have a maximum proved thickness of 8.6 m (borehole 88 NE 253). Towards the eastern end of the block, the basal sand and gravel in the channel is thought to pass laterally into First Terrace sand and gravel, which probably is partly composed of re-worked channel gravel.

The north-western limit of mineral in the Rochford Channel is beneath river brickearth and channel-fill deposits and is indicated on the resource map by an inferred boundary, its position being based on evidence from boreholes, trenches and resistivity traverses. All but three boreholes (88 NE 253, 89 SE 63 and 99 SW 56) sited within the mineral-bearing ground proved river brickearth and buried channel deposits overlying potentially workable sand and gravel.

In borehole 88 NE 253 an upper 1.0 m bed of mineral containing 75 per cent of pebbles lay between the river brickearth and channel-fill deposits. It is possibly a local remnant of the Second Terrace (see p.13), which may be represented elsewhere in the block (boreholes 88 NE 250 and 99 SW 47) by pebbly sandy clay. (An upper mineral horizon was found also in borehole 88 NE 251 in block C).

As borehole 89 SE 63 proved only river brickearth and channel silt and clay, and the bedrock (London Clay) was encountered at a higher level than expected, the borehole provides a 'nil-value' sample point in the assessment calculations. The third exception, borehole 99 SW 56, proved soil and head overlying mineral with no channel-fill silt or clay. It is not certain whether the mineral represents in situ or re-worked basal sand and gravel of the channel. The grading (77 per cent sand and 8 per cent gravel) reveals the lowest proportion of gravel and the highest of sand in any borehole proving mineral in block A.

The depth to bedrock in the channel varies from 17.8 m (0.5 m below Ordnance Datum) in borehole 88 NE 253 to 8.3 m (2.9 m above Ordnance Datum) in borehole 89 SE 56, the deepest part tending to lie near the outer edge of the channel. From borehole evidence, the surface of the basal sand and gravel has a mean level of 5.25 m above Ordnance Datum. As the mean water level is 6.55 m above Ordnance Datum most of the mineral in the channel is saturated.

The thickest recorded mineral was in borehole 89 SE 50 (7.2 m) and the most gravelly in borehole 89 SE 40 (59 per cent gravel). The mean thickness of mineral (4.0 m) and of over-burden (4.4 m) and the mean percentage of gravel (35 per cent) in block A are greater than in blocks B, C and D.

Borehole 89 SE 41 proved that the sand and gravel of unknown age west of Ashingdon [864 934] comprises 0.9 m of clayey gravelly sand and the deposit as a whole is assumed to be too thin to be considered in the assessment.

The estimate of the volume of mineral in block A is 39 million m^3 $\pm$23 per cent at the 95 per cent probability level.

Block B

This block, covering 18.6 km^2 is in two parts, the larger, by far, comprising deposits of the First, Second and Fourth Terraces north of the River Roach and the smaller, an outlier of the First Terrace on Wallasea Island. About 64 per cent of the block (11.9 km^2) is mineral and the remaining 6.7 km^2 head and river brickearth (beneath which no mineral is thought to be present) and exposed London Clay. As in block A the position of the inferred mineral boundaries beneath brickearth is based on the evidence of boreholes and resistivity traverses.

In contrast to block A, the major features of the London Clay surface in this block are two ridges or 'highs' on which older river terrace deposits are found. One runs from south of Doggetts [880 920], rising in altitude eastwards towards Stambridge where borehole 99 SW 57 proved London Clay at 15.6 m above Ordnance Datum. The second ridge is in the Canewdon area, where the London Clay rises to an altitude of over 30 m above Ordnance Datum; it is the terminal feature of a ridge which enters the resource sheet at Ashingdon and can be traced into the high ground at Hockley and Rayleigh, farther west.

At Canewdon is the only occurrence of the Fourth Terrace on the resource sheet that has been assessed; others are sterilised by the urban area of Southend-on-Sea. No grading information is available as assessment borehole 99 SW 68 proved, on London Clay, silty sandy clay with some pebble material, which probably represents the feather edge of the terrace or solifluxed material derived from higher up the slope.

However, well record 255/12 describes 3.9 m of 'ballast' overlying London Clay and examination of the abandoned gravel pit south of Canewdon Wick [911 948] confirmed the presence of mineral.

Deposits mapped as Third Terrace are found south of Ballards Gore [906 928]. The sand and gravel deposits of this terrace carry overburden

Table 6. Grading data from I.G.S. boreholes: block A

Borehole number	Recorded thickness		Mean grading percentage for borehole					
	Over-burden m	Mineral m	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel +16 mm
88 NE 250	4.7	6.4	17	4	51	7	13	8
88 NE 253	11.5	6.3	16	5	47	9	13	10
88 NE 254	1.8	5.2	11	3	59	9	15	3
88 NE 255	4.5	5.5	5	3	29	11	33	19
88 NE 270	3.3	4.8	4	33	34	8	15	6
88 NE 271	1.7	3.7	6	23	16	11	30	14
89 SE 35	3.4	3.4	8	3	31	6	26	26
89 SE 37	8.6	3.5	6	4	49	7	21	13
89 SE 40	4.0	4.2	2	3	27	9	37	22
89 SE 50	7.2	7.2	6	4	42	12	30	6
89 SE 51	9.4	3.7	22	3	28	6	30	11
89 SE 55	5.4	4.1	14	5	30	8	26	17
89 SE 75	3.5	2.9	3	8	31	8	31	19
99 SW 48	5.4	4.9	11	4	42	7	20	16
99 SW 56	0.8	2.45	15	5	59	13	8	0

Table 7. Grading data from I.G.S. boreholes: block B

Borehole number	Recorded thickness		Mean grading percentage for borehole					
	Over-burden m	Mineral m	Fines -1/16 mm	Fine sand $-\frac{1}{4}+1/16$ mm	Medium sand $-1+\frac{1}{4}$ mm	Coarse sand -4+1 mm	Fine gravel -16+4 mm	Coarse gravel +16 mm
89 SE 32	0.7	3.8	40	15	35	4	4	2
89 SE 33	1.7	1.3	15	14	68	2	1	0
89 SE 36	1.25	4.25	10	3	37	10	25	15
89 SE 38	1.2	2.05	7	1	32	15	43	2
89 SE 39	1.0	3.7	4	4	45	7	21	19
89 SE 64	0.6	2.8	4	8	50	9	18	11
99 SW 49	0.3	2.3	17	4	68	2	4	5
99 SW 51	0.6	3.6	13	2	52	9	14	10
99 SW 52	0.3	2.9	18	5	32	6	24	15
99 SW 54	0.9	4.8	19	8	52	7	11	3
99 SW 55	1.0	2.6	19	5	29	5	22	20
99 SW 57	2.4	1.0	24	5	68	3	0	0
99 SW 62	1.05	6.2	13	4	57	6	12	8
99 SW 66	1.4	4.1	10	2	30	10	29	19
99 SW 79	1.0	4.0	7	13	40	6	23	11
99 SW 80	0.6	4.0	5	6	37	9	28	15
99 SW 85	1.2	4.4	3	10	41	9	25	12
99 SW 87	1.0	2.5	8	6	43	12	21	10
99 SW 88	1.4	3.0	4	6	36	12	29	13

of brickearth up to 2.4 m thick. Two assessment boreholes, 99 SW 49 and 99 SW 57, proved mineral based at 11.7 m and 15.6 m above Ordnance Datum respectively. It comprises mainly medium sand with clay and silt; gravel is not invariably present.

Second Terrace crops out at four localities in block B. A resistivity traverse on the patch of Second Terrace immediately to the south of the Third Terrace at Stambridge established that the two deposits are contiguous, the former possibly containing re-worked sand and gravel from higher up the slope.

The larger of the deposits of Second Terrace south of Canewdon and that north-east of Rochford, have been extensively worked. Over half the area of the Canewdon deposit is now classified as worked out ground or made ground. The deposit carries little overburden: the pit face exposed 0.4 m and borehole 99 SW 80 proved 0.6 m.

The Second Terrace north-east of Rochford, contains an abandoned sand and gravel working west of the private road, Doggetts Chase, leading north from Rochford to Doggetts [881 920]. Much of this deposit is covered by brickearth, near the edge of which two assessment boreholes, 89 SE 38 and 33, proved 1.2 m and 1.7 m respectively of overburden, and another borehole, 89 SE 27 (a site investigation record registered with IGS but not detailed in this report), 2.8 m of overburden.

The First Terrace sand and gravel, much of which is overlain by river brickearth, contains most of the mineral in the block. The mineral is exposed along the Roach valley and north-west and east of Paglesham. The thickest (6.2 m in borehole 99 SW 62) and most gravelly (48 per cent in borehole 99 SW 66) recorded occurrences are part of the First Terrace. All but one of the assessment boreholes sited on exposed sand and gravel, as mapped, found mineral; the exception (99 SW 65) proved 0.8 m of soil and brickearth overlying 0.2 m of clayey sand. A resistivity traverse in the vicinity indicated thin deposits and an area of non-mineral has been inferred. The mineral in one borehole, 89 SE 32, contained 40 per cent fines; the sample collected from 1.6 m to 2.8 m below the surface contained 57 per cent of clay and silt.

Five boreholes sited on First Terrace river brickearth found little or no sand and gravel. The evidence from four of these boreholes (99 NW 34, 35, 99 SW 61 and 68) and from resistivity traverses, has made it possible to identify areas of barren ground beneath river brickearth. However, data from borehole 99 SW 59, which proved 0.75 m of sand and gravel (less than the minimum thickness criterion for this survey), are included in the assessment because a resistivity traverse showed that the results of the borehole are not typical of the general distribution of deposits in the area and the locality should be regarded as wholly mineral bearing.

The mean grading of the mineral in the block, (fines 12 per cent, sand 58 per cent, gravel 30 per cent), is similar to the mean grading for blocks A, C and D. The Third Terrace mineral contains very little gravel and the three boreholes in the Second Terrace showed that the proportion of gravel varies widely from 1 per cent in 89 SE 33 to 45 per cent in 89 SE 38.

The estimate of the volume of mineral for the block is 36 million $m^3 \pm 20$ per cent at the 95 per cent confidence level.

Block C

About 64 per cent of this block (9.5 km^2) is mineral, the remaining 5.3 km^2 being barren, with brickearth, head brickearth and head directly overlying London Clay. The mean thickness of mineral (2.4 m) is the lowest of all the resource blocks on the sheet (Table 5). Deposits mapped as First Terrace account for the major part of mineral.

The bedrock, London Clay, does not crop out. In the northern part of the block, the London Clay surface is fairly flat. However, in the south-west, towards Southend-on-Sea, the surface rises, reaching 24.90 m above Ordnance Datum in borehole 88 NE 258. The gradient reaches a maximum of about 1 in 38 between Smithers Farm [889 881] and borehole 88 NE 261.

Two boreholes sited on Third Terrace sand and gravel (88 NE 261 and 262) proved mineral, but borehole 88 NE 258 on Third Terrace river brickearth, proved only silty clay with scattered flint pebbles, lying directly on London Clay. The sand and gravel of the Third Terrace, which forms only a small part of the mineral of the block, is nevertheless generally similar in grain size and composition to that of the First Terrace. Second Terrace deposits are not represented in the block.

Sand and gravel of the First Terrace crops out along the Roach valley and in a shallow valley east of Sutton. The central and eastern part of the block is barren, either because the First Terrace sand and gravel was never deposited or it was removed prior to the deposition of the river brickearth. The southern limit of the First Terrace sand and gravel beneath overburden is an inferred boundary based on the evidence of boreholes and of the contour map of the London Clay surface (see Figure 2). Borehole 99 SW 60, sited on First Terrace sand and gravel proved the presence of sufficient clay and silt to make the deposit non-mineral and a generally barren area has been extended to include this borehole. Borehole 88 NE 257 showed head (beneath river brickearth) lying directly on London Clay, although a trench (88 NE 263) excavated about 400 m to the north-west, where the ground-surface level is 3.3 m higher, proved 1.7 m+ of mineral (possibly First Terrace) overlain by 2.1 m of brickearth.

Borehole 98 NW 51 proved 0.9 m of soil overlying 1.2 m of mineral, but as this was the only one of eight assessment boreholes and four site-investigation boreholes in the central area of the block that proved mineral, this borehole has been excluded from assessment calculations. Two patches of Third Terrace sand and gravel in the same area, which on borehole evidence and field investigations are thin and impersistent,

Table 8. Grading data from I.G.S. boreholes: block C

Borehole number	Recorded thickness		Mean grading percentage for borehole					
	Over-burden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
	m	m	-1/16 mm	$-\frac{1}{4}+1/16$ mm	$-1+\frac{1}{4}$ mm	-4+1 mm	-16+4 mm	+16 mm
88 NE 251	6.2	3.5						
88 NE 256	0.8	1.85	10	2	47	12	20	9
88 NE 260	0.7	3.5	7	5	48	9	24	7
88 NE 261	0.8	1.5	13	5	31	11	30	10
88 NE 262	0.8	2.8	10	7	52	7	18	6
88 NE 272	5.1	4.1	5	17	49	8	16	5
98 NW 37	1.2	6.3	12	3	26	8	32	19
98 NW 41	0.7	2.5	12	5	28	9	22	24
98 NW 42	1.0	1.5	7	7	73	6	7	0
99 SW 63	0.75	1.55	22	6	28	8	13	23
99 SW 70	1.5	1.5	25	6	49	7	7	6

Table 9. Grading data from I.G.S. boreholes: block D

Borehole number	Recorded thickness		Mean grading percentage for borehole					
	Over-burden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
	m	m	-1/16 mm	$-\frac{1}{4}+1/16$ mm	$-1+\frac{1}{4}$ mm	-4+1 mm	-16+4 mm	+16 mm
98 NW 31	3.8	2.9	18	4	41	7	15	15
98 NW 34	1.2	1.6	29	3	62	2	4	0
98 NW 36	2.35	2.45	11	2	73	6	7	1
98 NW 38	1.7	0.9	10	1	29	6	30	24
98 NW 39	3.1	1.4	12	5	73	3	5	2
98 NE 11	1.95	5.15	9	3	52	8	17	11

have been classified as barren ground.

The block has a mean overburden thickness of 1.8 m. It should be noted that this figure is inflated by the thick overburden proved in borehole 88 NE 272 (5.1 m), and well log 258/36 (4.8 m) and the combined overburden and waste thicknesses in borehole 88 NE 251 (6.2 m). The thickest and most gravelly mineral was found in borehole 98 NW 37 with figures of 6.3 m and 51 per cent respectively. The borehole proving the least gravel was 98 NW 42 with only 7 per cent gravel and 86 per cent sand, the highest value in the block.

The only working pit in the area of the resource sheet is situated at Barling Magna [935 895] in this block. Samples taken from the working face show a mean-grading analysis of fines 3 per cent, sand 54 per cent and gravel 43 per cent. South-east of Rochford there is an abandoned brick-field from which river brickearth has been extracted, but the underlying sand and gravel has not been worked.

The estimate for the total volume of mineral in block C is 23 million $m^3 \pm$ 33 per cent at the 95 per cent level of confidence.

Block D

A statistical assessment has been made of the First Terrace sand and gravel, which is present as a more or less continuous spread of mineral over 9.4 km^2 of the block, supported by an inferred assessment of the sand and gravel of the Shoeburyness Channel, which is overlain successively by clay and silt (the remainder of the buried channel deposits) and by sand and gravel and river brickearth of the First Terrace.

The London Clay does not crop out in this block but it was proved in all ten boreholes drilled for the Industrial Minerals Assessment Unit. In the north and east, the London Clay surface rises fairly uniformly from Ordnance Datum in the east to 5 m above Ordnance Datum towards the west; from the centre of the block the gradient increases, the surface reaching over 10 m above Ordnance Datum at the western boundary. In the south, towards the Shoeburyness Channel (Figure 6), the surface decreases in height rapidly: Hydrogeological Department well logs 258/117 and 258/138 record London Clay at about 12.8 m and 11.6 m below Ordnance Datum respectively.

Apart from outcrops mapped at Little Wakering [932 886], Crouchmans [947 867] and North Shoebury [929 861], the sand and gravel of the First Terrace is covered by river brickearth. Apart from Hydrogeological Department well log 258/138, which records 8.2 m of sand and gravel, the thickest mineral proved by the assessment boreholes (5.1 m) was in borehole 98 NE 11. Borehole 98 NW 38 contains the thinnest sand and gravel deposit (0.9 m) classified as mineral. Generally the mineral of the First Terrace thickens towards the south and east. The maximum overburden thickness overlying First Terrace mineral, proved by assessment boreholes, was in borehole 98 NW 31 with 0.3 m of soil, 2.7 m of brickearth and 0.8 m of Terrace clay and silt overlying mineral. However, a site-investigation borehole, 98 NW 72 [921 856] (not detailed in this report), proved 4.5 m of overburden, mainly made ground.

There is a large variation in the grading characteristics of the mineral of the First Terrace, the gravel content varying from only 4 per cent in borehole 98 NW 34 to 54 per cent in borehole 98 NW 38.

The extent of First Terrace mineral beneath overburden as shown by the inferred boundary in the west of the block is based on borehole evidence and resistivity traverses. Borehole 98 NW 35, sited in an area thought to be mineral, proved only brickearth containing rounded pebbles in the basal 0.2 m lying directly on London Clay. As the worked-out ground immediately to the north of the borehole is a clay pit in brickearth in the base of which sand and gravel is exposed, and aerial photographs of this area showed the presence of considerable numbers of ice-wedge polygons, one possible explanation of the lack of mineral is that the borehole was sited on ground disturbed by periglacial action.

Substantial areas of brickearth have been worked for manufacturing bricks. These areas are indicated on the resource sheet as 'Worked Out Ground' or 'Made Ground' depending on the amount of surface restoration that has taken place. Thus, although the areas of brick-pits are shown as 'Continuous or almost continuous spreads of mineral beneath overburden' there may be places where a sufficient thickness of brickearth has been extracted to expose the underlying mineral (e.g. the working [937 873] south-west of Great Wakering).

The deposits of mineral contained within block D, for which an inferred assessment is offered, are restricted to a channel in the London Clay surface, which passes through Thorpe Bay and Shoeburyness (see Figures 6 and 8). The north-west limit of the mineral in this channel is indicated by the inferred boundary passing from north of Thorpe Bay through North Shoebury to Crouchmans [947 866]. No assessment boreholes were drilled through this channel sequence and evidence for its form and stratigraphy is based on pre-existing well records and site investigation records. Thus the documentation of the sequence of the deposits is rather less complete than that for the Rochford Channel.

The typical sequence of the deposits found in the channel is:

First Terrace river brickearth
First Terrace sand and gravel
Buried channel deposits (clay and silt overlying sand and gravel)
London Clay

The site-investigation records on which the estimate of volume of mineral is based show that a number of boreholes failed to reach the London Clay or the lower sand and gravel deposits. However, well log 258/117 records 6.0 m of First Terrace Deposits overlying 10.4 m of clayey silt and 2.4 m of sand and gravel (non-mineral) on London Clay and well log 258/76b records 12.2 m of clay and silt and 2.1 m of sand below 6.7 m of First Terrace Deposits. Well log 258/138 records 0.9 m of soil and 8.2 m of First Terrace sand and gravel overlying 3.0 m of clay and silt and 3.9 m of sand and gravel at the base

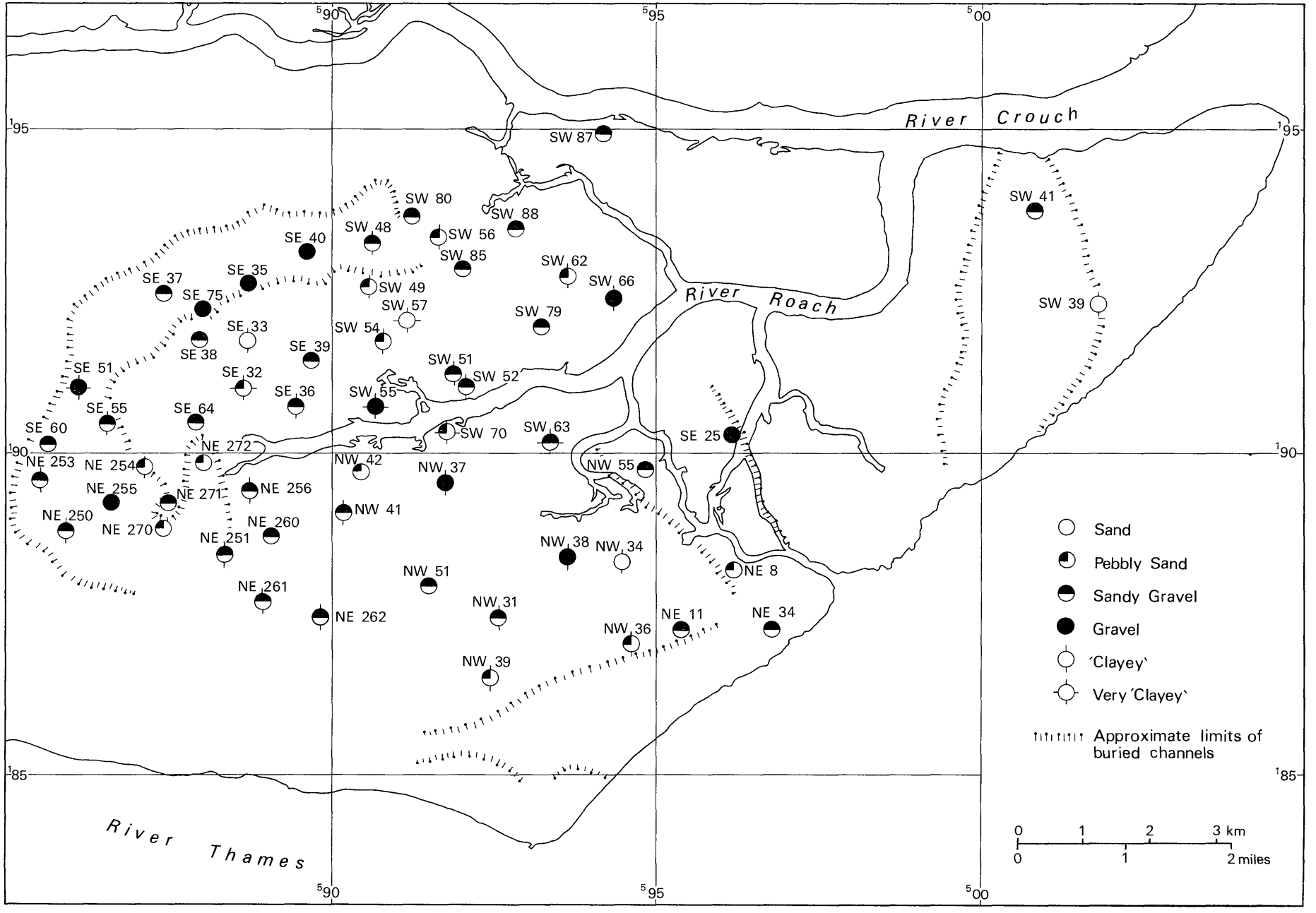


Fig. 8. Grading characteristics of the mineral at each borehole and location of the major buried channels

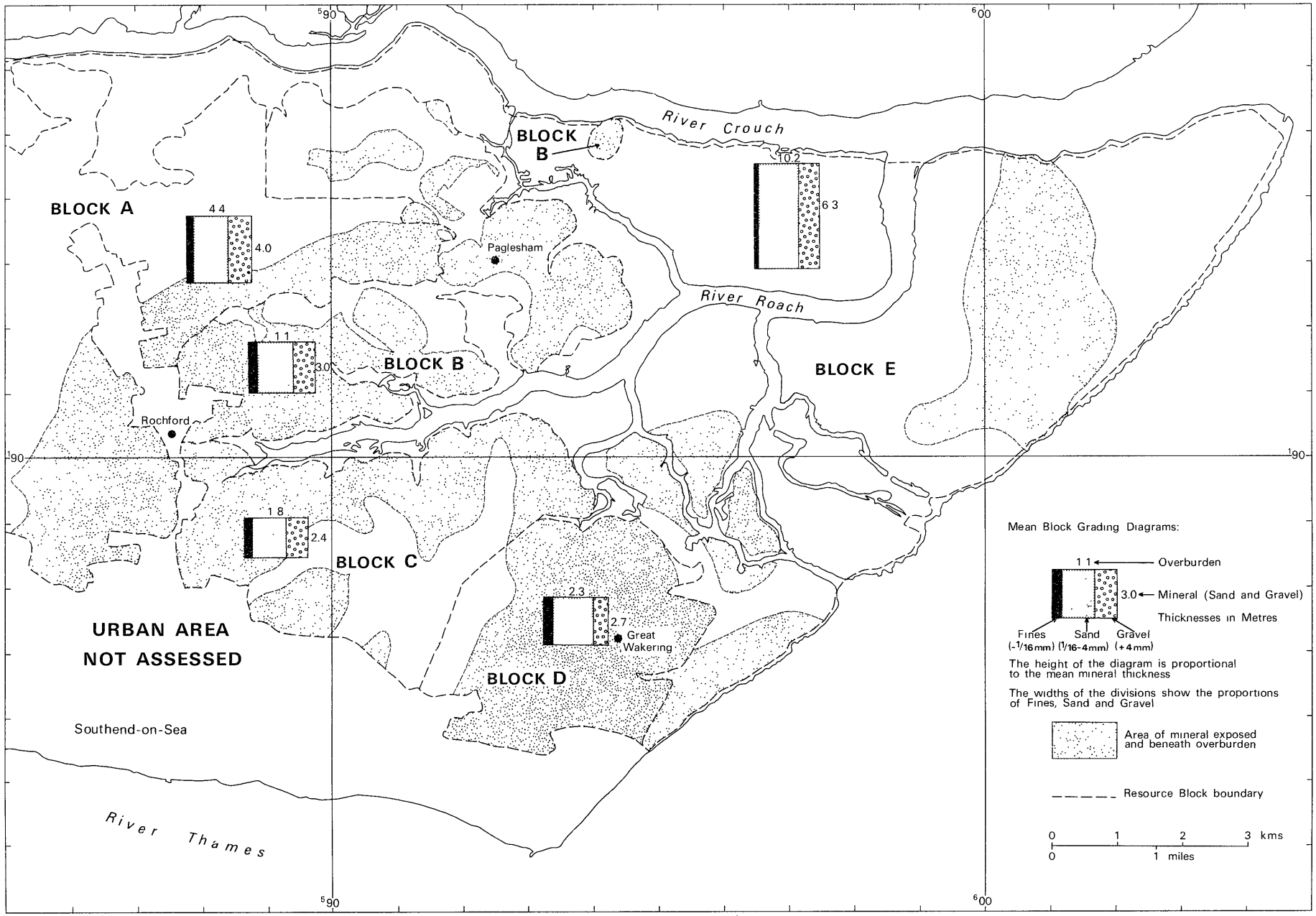


Fig. 9. Area, mean grading and thickness of the assessed mineral by blocks

Table 10. Grading data from I.G.S. boreholes: block E

Borehole number	Recorded thickness		Mean grading percentage for borehole					
	Over-burden	Mineral	Fines	Fine sand	Medium sand	Coarse sand	Fine gravel	Coarse gravel
	m	m	-1/16 mm	$-\frac{1}{4}+1/16$ mm	$-1+\frac{1}{4}$ mm	-4+1 mm	-16+4 mm	+16 mm
98 NW 55	4.25	8.65	1	6	47	12	23	11
98 NE 8	4.4	1.7	6	2	53	17	18	4
98 NE 34	6.7	9.05	2	4	34	15	36	9
99 SE 25	5.75	1.95	3	4	35	6	28	24
09 SW 39	16.4	6.0	13	51	32	2	2	0
09 SW 41	14.9	10.15	1	4	40	17	32	6

of the channel, both sand and gravel horizons being classified as mineral.

Because of the paucity of borehole information proving the basal gravels of the channel in block D, information from boreholes south of the block boundary in the urban area of Shoeburyness has been used as a guide to estimate the likely thickness and volume of mineral within the channel by extrapolation. Borehole evidence suggests that although the basal sand and gravel is a fairly persistent feature of the channel, variations in its thickness compared with that of the overlying channel-fill clay and silt result in the sand and gravel being classified as non-mineral in many parts of the channel area. No confidence limits or grading information are given for these deposits. The inferred volume of the mineral beneath the Shoeburyness Channel is 7 million m^3.

For the mineral in block D, for which a statistical assessment has been made, the estimate of volume is 25 million $m^3 \pm$ 37 per cent at the 95 per cent level of confidence.

Block E

This block, the largest on the sheet, covers 69.5 km^2 and includes most of the outcrop of the Marine or Estuarine Alluvium, the lower reaches of the Roach and the creeks surrounding Potton and Havengore islands. It contains 12.0 km^2 of mineral, in three separate areas: the largest on Foulness Island, a second area including Rushley Island, part of Potton Island and the marsh east of Barling Magna and Great Wakering, and the third and smallest area of mineral north-east of Shoeburyness, which is probably associated with the Shoeburyness Channel.

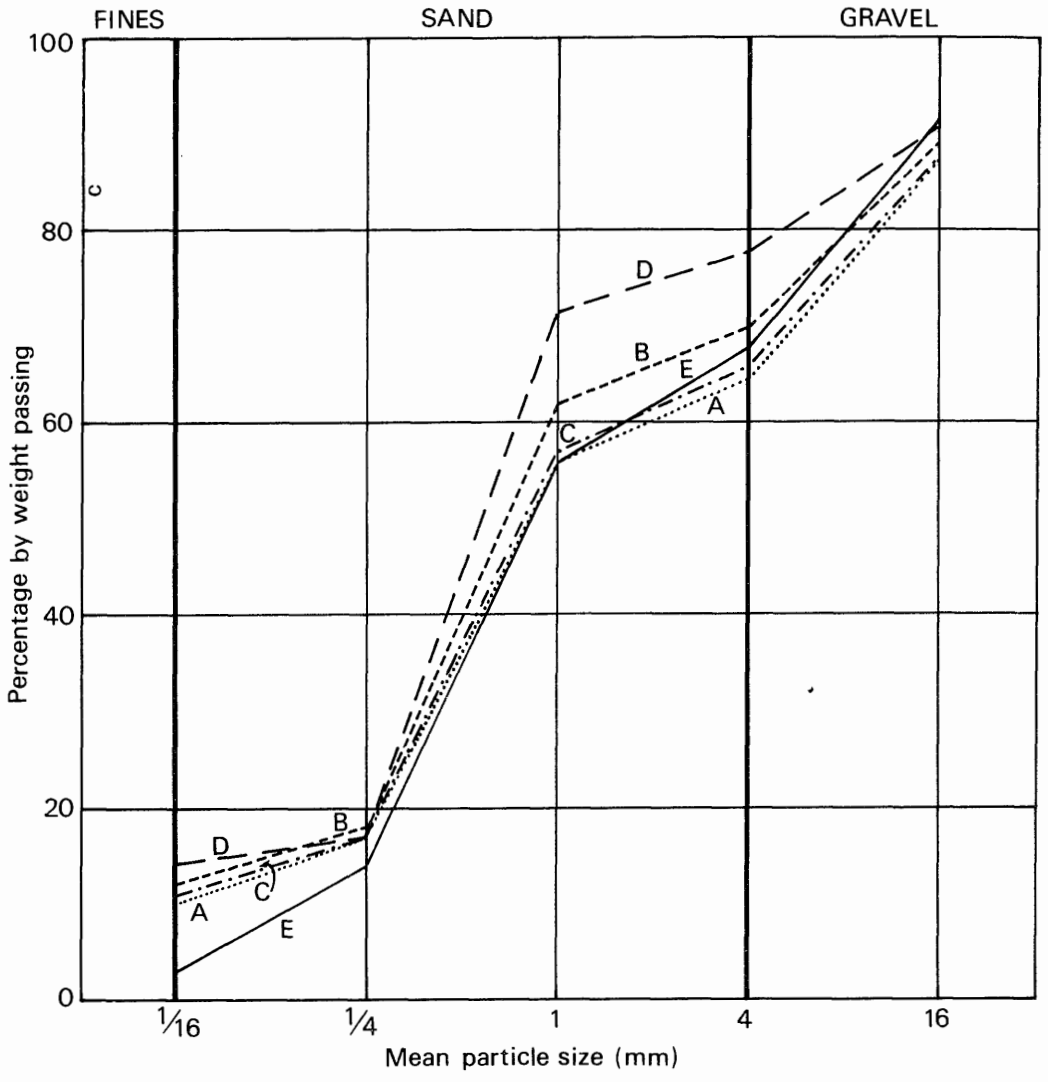
The clay, silt and sand of the Marine or Estuarine Alluvium, with locally developed layers of fresh-water deposits overlying basal sand and gravel tend to be thickest in the south and east, reaching over 25 m. The London Clay surface, which directly underlies these deposits, undulates considerably (see Figure 2) but rises generally towards the western boundary of the block where it reaches Ordnance Datum. The narrow outcrop of alluvium along the south bank of the River Crouch is thicker nearer the river, thinning rapidly towards the south.

No deposits of mineral were proved in the Marine or Estuarine Alluvium, which is mainly composed of clay and silt with locally developed sandy layers, shell and peat. The mineral proved in block E lies at the base of this fine-grained material and probably represents earlier fluvio-glacial deposits.

Only nine of the fifty-six shell and auger boreholes drilled by the Institute proved mineral, but Dutch cone probes, well records and site-investigation logs have been used to augment the Institute's boreholes, giving a total of forty-two sample points proving mineral. However, because of the close grouping of many of the records, weighting for calculation purposes gave a total of seventeen samples (see Appendix B, paragraph 15).

Although many of the boreholes drilled by the Institute proved a basal layer of sand and gravel, in only nine could it be regarded as potentially workable. As these boreholes are sited above channels or basins in the London Clay surface, it has been assumed that the mineral is therefore concentrated in such structures, with only occasional thin layers of sand and gravel crossing the interfluves (or 'highs') between them.

The eastern area of mineral on Foulness Island is more deeply buried than the two western deposits of mineral. The London Clay surface beneath the mineral on Foulness Island has a mean level of 20.5 m below Ordnance Datum and the upper surface level of the mineral a mean of -12.6 m calculated from borehole data. This mineral largely occupies a channel which trends approximately north-south in the London Clay surface (Figure 8).



Block	Percentage by weight passing				
	1/16 mm	$\frac{1}{4}$ mm	1 mm	4 mm	16 mm
A	10	17	56	65	88
B	12	18	62	70	89
C	11	17	57	66	88
D	14	17	72	78	91
E	3	14	56	68	92

Fig. 10. Particle-size distribution for the assessed thickness of mineral in resource blocks A to E

The mean height of the base of the mineral beneath Potton and Rushley islands is about -9.9 m below Ordnance Datum and the mean-surface level about 4.0 m below Ordnance Datum.

Between the mineral deposit on Foulness Island and that found in the channel or basin beneath Potton and Rushley islands and the marshes east of Barling Magna and Great Wakering, the London Clay surface rises to less than 10 m below Ordnance Datum and sand and gravel is generally present at the base of the Marine or Estuarine Alluvium (see borehole records 99 SE 27, 98 NE 40 and 98 NE 13), but it is too thin or too deeply buried to be classified as mineral.

The third area of mineral in block E, immediately north-east of Shoeburyness, is thought to be a continuation of the basal sand and gravel of the Shoeburyness Channel of block D. It has a mean base level of about 11.8 m below Ordnance Datum and a surface level of about 5.6 m below Ordnance Datum.

The areas of mineral in block E are mainly enclosed by inferred boundaries, which are based on borehole evidence. Resistivity traverses across areas of Marine or Estuarine Alluvium gave no assistance in identifying the underlying spreads of mineral, as there was insufficient contrast in the resistivity values for Marine or Estuarine Alluvium and London Clay for an objective interpretation of the geology to be made.

The mean thickness of mineral in block E is 6.3 m, the maximum proved being 10.6 m in site-investigation borehole TR 09 SW 7. The mineral is thickest in the channel beneath Foulness Island, where the mean thickness, based on eight sample points, is 8.3 m compared with 4.7 m for the mineral beneath Potton and Rushley islands and 5.9 m in the channel north-east of Shoeburyness.

The mean thickness of overburden for the block is 10.2 m; that for the Foulness mineral area is 13.9 m, for Potton and Rushley islands 6.3 m and for north-east Shoeburyness, 7.9 m.

The mean grading of the mineral in block E is based on the results from only six boreholes (Table 10). The highest gravel content was 52 per cent in borehole 99 SE 25. Borehole 98 SE 9 contained sand and gravel with up to 75 per cent gravel but the deposit is too deeply buried to be classified as mineral.

The estimate of the volume of mineral in block E is 76 million $m^3 \pm 25$ per cent at the 95 per cent level of confidence.

APPENDIX A: FIELD AND LABORATORY PROCEDURES

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

The mineral shown on each 1:25 000 sheet is divided into resource blocks. The arbitrary size selected, 10 km^2, is a compromise to meet the aims of the survey by providing sufficient sample points in each block. As far as possible the block boundaries are determined by geological boundaries so that, for example, channel and river terrace gravels are separated. Otherwise division is by arbitrary lines, which may bear no relationship to the geology.

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

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

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

A continuous series of bulk samples is taken throughout the sand and gravel. Ideally samples are composed exclusively of the whole of the material encountered in the borehole between stated depths. However, care is taken to discard, as far as possible, material which has caved or has been pumped from the bottom of the hole. A new sample is commenced whenever there is an appreciable lithological change within the sand and gravel, or at every 1 m (3.3 ft) depth. The samples, each weighing between 25 and 45 kg (55 and 100 lb), are despatched in heavy duty polythene bags to a laboratory for grading. The grading procedure is based on British Standard 1377 (1967b). Random checks on the accuracy of the grading are made in the Institute's laboratories.

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

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

APPENDIX B: STATISTICAL PROCEDURES

Statistical Assessment

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

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

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

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

4. The above relationship may be transposed such that

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

From this it can be seen that as $S_A^2/S_{\bar{l}_m}^2$ tends to 0, S_V tends to $S_{\bar{l}_m}$.
If, therefore, the standard deviation for area is small with respect to that for mean thickness, the standard deviation for volume approximates to that for mean thickness.

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

$$\frac{\sum (l_{m_1} + l_{m_2} \ldots l_{m_n})}{n}$$

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, $S_{\bar{l}}$, expressed as a proportion of the mean thickness is given by

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

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

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

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

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

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

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

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

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

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 Figs. 11 and 12

12. If the sampled area of mineral in a resource block is between 0.25 km² and 2 km² an assessment is inferred, based on geological and topographical information usually supported by the data from one or two boreholes. The volume of mineral is calculated as the product of the area, measured from field data, and the estimated thickness. Confidence limits are not calculated.

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

14. No assessment is attempted for an isolated area of mineral less than 0.25 km².

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

APPENDIX C: CLASSIFICATION AND DESCRIPTION OF SAND AND GRAVEL

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

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

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

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

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

Thus it is possible to classify the mineral into one of twelve descriptive categories (see Fig. 13). The procedure is as follows:

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

For example, a deposit grading 11 per cent gravel, 70 per cent sand and 19 per cent fines is classified as 'clayey' pebbly sand. This short description is included in the borehole log (see Note 11, page 40).

Many differing proposals exist for the classification of the grain size of sediments (Atterberg, 1905; Udden, 1914; Wentworth, 1922; Wentworth, 1935; Allen, 1936; Twenhofel, 1937; Lane and others, 1947). As Archer (1970a, b) has emphasised, there is a pressing need for a simple metric scale acceptable to both scientific and engineering interests, for which the class limit sizes correspond closely with certain marked changes in the natural properties of mineral particles. For example, there is an important change in the degree of cohesion between particles at about the 1/16-mm size, which approximates to the generally accepted boundary between silt and sand. These and other requirements are met by a system based on Udden's geometric scale and a simplified form of Wentworth's terminology (Table 11), which is used in this Report.

The fairly wide intervals in the scale are consistent with the general level of accuracy of the qualitative assessments of the resource blocks. Three sizes of sand are recognised, fine (−¼ +1/16 mm), medium (−1 +¼ mm) and coarse (−4 +1 mm). The boundary at 16 mm distinguishes a range of finer gravel (−16 +4 mm), often characterised by abundance of worn tough pebbles of vein quartz, from larger pebbles often of notably different materials. The boundary at 64 mm distinguishes pebbles from cobbles. The term 'gravel' is used loosely to denote both pebble-sized and cobble-sized material.

The size distribution of borehole samples is determined by sieve analysis, which is presented by the laboratory as logarithmic cumulative curves (see, for example, British Standard 1377: 1967b). In this report the grading is tabulated on the borehole record sheets (Appendix F), the intercepts corresponding with the simple geometric scale 1/16 mm, ¼ mm, 1 mm, 4 mm, 16 mm and so on as required. Original sample grading curves are available for reference at the appropriate office of the Institute.

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

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

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

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

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

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

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

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

Table 11. Classification of gravel, sand and fines

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

Block Calculation — 1:25 000 Block } Fictitious

Area

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

Volume

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

Mean Thickness

Overburden:	2.5 m
Mineral:	6.5 m

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

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

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

Calculation of confidence limits

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

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

$n = 8$

$t = 2.365$

L_V is calculated as

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

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

$$= 20.3$$

$$\simeq 20 \text{ per cent}$$

Fig. 11. Example of resource block assessment: calculations and results

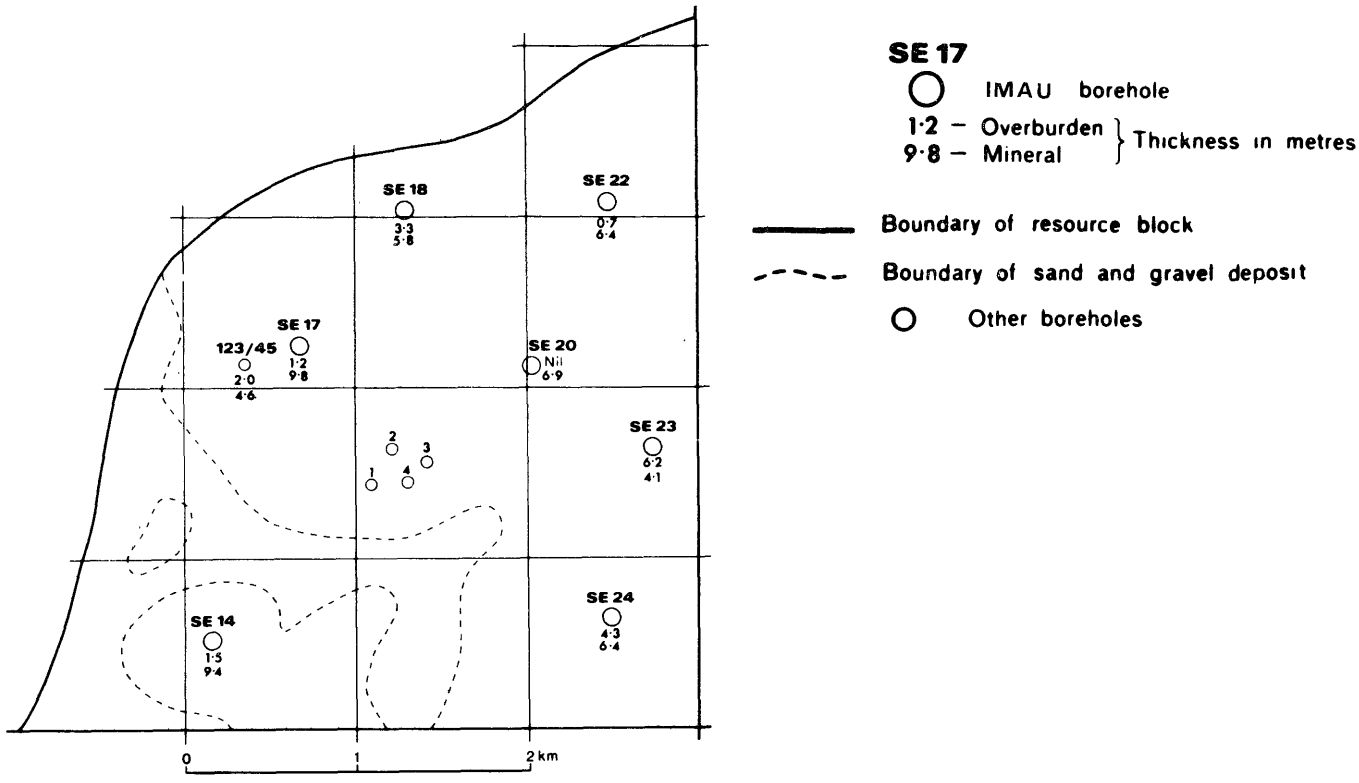
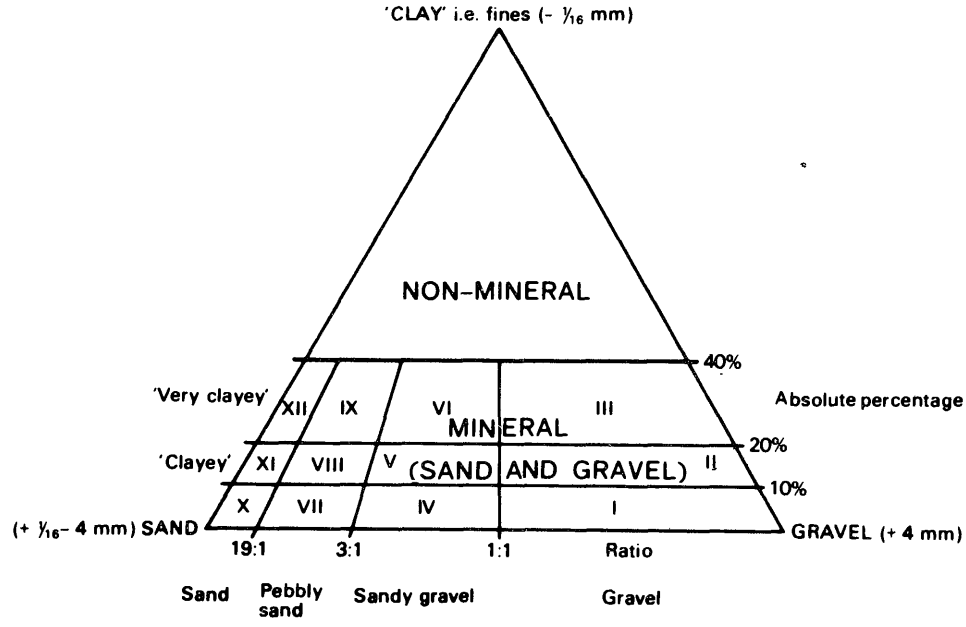


Fig. 12. Example of resource block assessment: map of a fictitious block



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

Fig. 13. Diagram to show the descriptive cateogries used in the classification of sand and gravel.

APPENDIX D: EXPLANATION OF BOREHOLE RECORDS

ANNOTATED EXAMPLE

TQ 88 NE 253[1] 8552 8959[2] Rochford, Essex[3] Block A

Surface level +17.3 m (+57.0 ft)[4]
Water struck at +9.1 m (+30.0 ft)[5]
Shell 152-203 mm diameter[6]
January 1973

Overburden 2.90 m[7]
Mineral 1.00 m
Waste 8.60 m
Mineral 5.30 m
Bedrock 0.30 m+

LOG

Geological Classification[10]	Lithology[11]	Thickness m	Depth[8] m
Soil		0.20	0.20
Brickearth	Sandy silt, light brown, moderately fissured with scattered carbonaceous patches, passing at 1.60 m into sandy clayey silt with calcareous veining and race pebbles	2.70	2.90
River Terrace Deposits	(a) Gravel Sand and gravel with some silt in the upper 0.20 m. Sand medium to coarse. Gravel fine to coarse; coarse mainly rounded quartzite; fine gravel composed of angular to sub-rounded flint and quartz	1.00	3.90
Buried Channel Deposits	Sandy silt and clay, scattered race pebbles in top 2.20 m. Deposit laminated, soft to firm, light brown to yellowish brown	8.60	12.50
	(b) 'Clayey' pebbly sand Medium sand with fine gravel; silt and clay content high from 15.00 to 16.00 m. Gravel of rounded quartzite and quartz and angular to rounded flint	5.30	17.80
London Clay	Silty clay, weathered to 0.10 m. Olive-black when unweathered	0.30+[9]	18.10

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
				From	To	Fines -1/16	Sand +1/16-¼	Sand +¼-1	Sand +1-4	Gravel +4-16	Gravel +16
(a) Mean grading as opposite				[12]2.9	3.9	4	1	8	9	40	38[13]
(b)	%	mm	%								
Gravel	13	+ 16	5[14]	12.5	13.5	14	11	62	6	5	2
		- 16 + 4	8	13.5	15.0	1	5	56	8	16	14
				15.0	16.0	51	4	37	4	2	2
		- 4 + 1	9	16.0	17.0	14	3	59	16	8	0
Sand	69	- 1 + ¼	55	17.0	17.8	16	4	60	13	6	1
		- ¼ + 1/16	5								
Fines	18	- 1/16	18								

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

1. Borehole Registration Number
Each Industrial Minerals Assessment Unit (IMAU) borehole is identified by a Registration Number. This consists of two statements.
1) The number of the 1:25 000 sheet on which the borehole lies, for example TQ 88
2) The quarter of the 1:25 000 sheet on which the borehole lies and its number in a series for that quarter, for example NE 253

Thus the full Registration Number is TQ 88 NE 253. Usually this is abbreviated to 88 NE 253 in the text.

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

3. Location
The position of the borehole is generally referred to the parish on the 1:25 000 base map and the resource block in which it lies is shown.

4. Surface level
The surface level at the borehole site is given in metres above or below Ordnance Datum: approximate conversions to feet are given in brackets.

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

6. Type of drill and date of drilling
One type of drilling machine has been used in this survey, a shell and auger rig; the external diameter of the casing used, and the month and year of completion of the borehole 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. 3).
Bedrock is the 'formation', 'country rock' or 'rock head' below which potentially workable sand and gravel will not be found. Waste is any material other than bedrock or mineral. Where waste occurs between the surface and mineral it is classified as overburden.

8. Thickness and depth
All measurements were made in metres. Some measurements were recorded to 0.01 m: in the borehole logs these are rounded to the nearest 0.05 m and on the resource sheet to the nearest 0.1 m. A table of conversions from metres to feet (to the nearest 0.5 ft) is at Appendix H.

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

10. Geological classification
The geological classification (Table 1) is given whenever possible.

11. Lithological description
When sand and gravel is recorded a general description based on the mean grading characteristics (for details see Appendix C) is followed by more detailed particulars. The description of other rocks is based on visual examination, in the field.

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

13. Grading results
The limits are as follows: gravel, +4 mm; sand, -4+1/16 mm; fines, -1/16 mm. If, exceptionally, grading results are not available, this is stated.

14. Mean grading
The grading of the full thickness of the mineral horizon identified in the log is the mean of the individual sample gradings weighted by the thicknesses represented, if these vary. The classification used is shown in Table 10.

Fully representative sampling of sand and gravel is difficult to achieve, particularly where groundwater levels are high. Comparison between boreholes and adjacent exposures suggests that in borehole samples the proportion of sand may be higher and the proportions of fines and coarse gravel (+16 mm) may be lower.

APPENDIX E: BOREHOLES USED IN THE ASSESSMENT OF RESOURCES

INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLES

Borehole number by sheet quadrant		Grid reference	Page
TQ 88 NE	250	8593 8880	45
	251	8835 8845	46
	252	8957 8840	47
	253	8552 8959	48
	254	8713 8980	49
	255	8662 8923	50
	256	8876 8943	51
	257	8945 8925	52
	258	8969 8792	52
	260	8907 8872	53
	261	8898 8771	54
	262	8988 8749	55
	270*	8742 8882	56
	271*	8756 8922	57
	272*	8803 8985	58
	274	8519 8932	59
	275*	8526 8934	60
	276	8508 8930	61
TQ 89 NE	11	8802 9572	62
	13*	8586 9617	62
	14	8551 9616	63
	15*	8551 9614	64
	16	8546 9613	65
	17	8546 9615	66
	18*	8780 9623	67
	20*	8712 9621	68
	21*	8724 9506	69
	22*	8905 9596	70
TQ 89 SE	32*	8865 9101	71
	33*	8875 9175	72
	34*	8884 9203	73
	35*	8877 9265	74
	36	8951 9072	75
	37	8745 9247	76
	38	8799 9177	77
	39	8975 9143	78
	40	8967 9312	79
	41	9557 9337	80
	49	8928 9239	80
TQ 89 SE	50	8572 9013	81
	51	8612 9104	82
	52	8582 9211	83
	53	8689 9457	83
	55	8657 9045	84
	56	8702 9175	85
	63*	8709 9038	85
	64*	8793 9044	86
	69*	8614 9188	87
	70*	8678 9487	88
	71*	8650 9451	88
	72*	8925 9449	89
	73*	8723 9449	89
	74*	8887 9311	90
	75*	8802 9223	91
TQ 98 NW	25	9053 8930	92
	26	9069 8837	92
	27	9167 8827	93
	28	9162 8765	93
	29	9162 8660	94
	30	9274 8813	94
	31	9258 8143	95
	32	9076 8776	96
	33	9266 8983	96
	34	9452 8826	97
	35	8371 8690	98
	36	9464 8703	99
	37	9175 8963	100
	38	9363 8839	101
	39	9245 8651	102
	41	9020 8909	103
	42	9049 8971	104
	43	9235 8898	105
	51	9150 8794	105
	55*	9485 8973	106
	56*	9428 8904	107
TQ 98 NE	8	9619 8817	108
	9	9532 8667	109
	10	9961 8976	110

*Denotes Engineering Geology Unit and East Anglian and South-East England Field Unit boreholes; all others are Industrial Minerals Assessment Unit boreholes

† Location not known precisely

Other boreholes
(Details of resource sheet only)

(1) Borehole records registered with the Hydrogeological Department

Borehole number	Grid reference	Borehole number	Grid reference
258/ 5	9174 9517	258/ 76b	9380 8553
12	9107 9480	78	9348 8503
16	9154 9399	117	9188 8567
33	8507 8976	127	9324 8540
36	8805 9005	137a	9451 8531
45	8873 9034	137b	9450 8518
46	9309 8736	138	9466 8618
47a	9562 8750	259/ 3a	0328 9472
48	9641 8857	4b	0049 9311

(2) Site investigation boreholes

Borehole number by sheet quadrant		Grid reference	Borehole number by sheet quadrant		Grid reference
TQ 88 NE	73	8600 8912	TQ 98 NE	4a	9689 8807
	80	8657 8949		5i	9507 8582
	263	8909 8941		20a	9652 8733
	269	8983 8870		41	9676 8700
TQ 89 SE	21	8664 9261	TQ 99 SW	5	9100 9243
	25	8768 9188		23	9302 9033
	58	8886 9362		27	9205 9211
	60	8925 9117		38	9212 9433
	61	8523 9173		44	9213 9372
	62	8513 9262		46	9186 9392
	66	8783 9313	TQ 99 SE	1a	9979 9386
TQ 98 NW	4e	9381 8530		1e	9994 9422
	4f	9434 8590	TR 09 SW	4	0196 9448
	4h	9403 8616		5	0200 9330
	4i	9368 8623		6	0080 9220
	22	9315 8981		7	0130 9120
	46	9066 8780		8	0020 9030
	48	9216 8921		11	0240 9210
	50	9074 8741			
	52	9184 8740			
	53	9095 8669			

(3) In addition 127 borehole records deposited by sand and gravel and other industrial interests have been incorporated in the assessment. These are held 'in confidence' by the Institute.

(4) Dutch cone records (results held by Engineering Geology Unit)

Borehole number by sheet quadrant	Grid reference	Borehole number by sheet quadrant	Grid reference
TQ 98 NE 35	9859 8976	TQ 99 SW 92	9469 9033
36	9901 8880	93	9357 9414
37	9809 8885		
38	9762 8779	TR 09 SW 42	0088 9037

APPENDIX F: INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS

TQ 88 NE 250 8593 8880 Rochford, Essex. Block A

Surface level +11.9 m (+39.0 ft)
Water Struck at +7.8 m (25.5 ft)
Shell, 203 mm diameter
January 1973

Overburden 4.70 m
Mineral 6.40 m
Bedrock 0.75 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt with scattered pebbles	0.40	0.40
Brickearth	Sandy clayey silt, pale yellowish brown with ferruginous staining. Some scattered pebbles, becoming more sandy and less clayey with depth	0.70	1.10
Buried Channel Deposits	Silty sandy gravel in top 0.70 m, becoming more clayey and silty with depth. Pale to moderate yellow brown, streaked with carbonaceous patches	3.60	4.70
	'Clayey' sandy gravel Mainly medium sand, dark yellowish brown, with fine angular to subangular gravel. Gravel concentrated in top 1.00 m, composed of flint with some rounded quartzite and vein quartz. Deposit becoming more silty and sandy with depth	6.40	11.10
London Clay	Silty clay, stiff, highly fissured, dark olive grey	0.75+	11.85

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Gravel	21	+16	8	4.7	5.7	2	1	6	5	40	46
		-16+4	13	5.7	7.7	9	2	57	15	16	1
				7.7	8.7	30	5	52	5	6	2
Sand	62	-4+1	7	8.7	9.7	25	7	64	2	2	0
		-1+$\frac{1}{4}$	51	9.7	10.7	24	5	67	2	2	0
		-$\frac{1}{4}$+1/16	4	10.7	11.1	19	9	63	2	4	3
Fines	17	-1/16	17								

TQ 88 NE 251 8835 8845 Sutton, Essex. Block C

Surface level +11.5 m (+37.5 ft)
Water struck at +4.3 m (+14.0 ft)
Shell, 203 mm diameter
February 1973

Overburden 2.60 m
Mineral 1.00 m
Waste 3.60 m
Mineral 2.50 m
Bedrock 2.30 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Made ground			1.00	1.00
Brickearth		Clayey silt, mottled moderate yellowish brown and light brown, becoming mainly silt at 1.5 m. Race present below 2.00 m. Roots present throughout	1.60	2.60
Terrace Deposits	(a)	'Clayey' sandy gravel Medium sand with fine and coarse gravel	1.00	3.60
Buried Channel Deposits		Silt or clay with variable amounts of fine sand. Carbonaceous material present and scattered pebbles	3.60	7.20
	(b)	'Clayey' sandy gravel Medium sand with fine and some coarse gravel. Gravel of subangular and rounded flint, mainly concentrated in top 1.00 m and basal 0.50 m. Rather silty except for basal 0.50 m	2.50	9.70
London Clay		Stiff silty clay, fissured, olive brown becoming olive grey with depth	2.30+	12.00

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages				
%	mm	%		From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
(a) Mean grading as opposite				2.6	3.6	19	3	39	6	19	14
(b) Gravel											
41	+16	12		7.2	8.2	17	1	13	9	40	20
	-16+4	29		8.2	9.2	15	1	56	10	15	3
				9.2	9.7	1	2	30	15	36	16
Sand 46	-4+1	11									
	-1+¼	34									
	-¼+1/16	1									
Fines 13	-1/16	13									

TQ 88 NE 252 8957 8840 Sutton, Essex. Block C

Surface level +17.65 m (+57.5 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 3.50 m
Bedrock 0.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Light yellowish brown silt	0.45	0.45
Head Brickearth	Sandy silt, mottled greyish orange and yellowish brown, becoming more sandy with depth	1.05	1.50
Terrace Deposits	Sand, silt and some clay, yellowish brown to orange with scattered pebbles in top 1.20 m and basal 0.20 m	2.00	3.50
London Clay	Silty clay, highly fissured with fine sand along fissure planes	0.30+	3.80

TQ 88 NE 253 8552 8959 Rochford, Essex. Block A

Surface level +17.3 m (+57.0 ft)
Water struck at +9.1 m (+30.0 ft)
Shell, 203 mm and 152 mm diameter
January 1973

Overburden 2.90 m
Mineral 1.00 m
Waste 8.60 m
Mineral 5.30 m
Bedrock 0.30 m+

LOG

Geological Classification		Lithology	Thickness m	Depth m
Soil			0.20	0.20
Brickearth		Sandy silt, light brown, firm, moderately fissured with scattered carbonaceous patches, passing at 1.60 m into sandy clayey silt with calcareous veining and race pebbles	2.70	2.90
Terrace Deposits	(a)	Gravel Sand and gravel with some silt in upper 0.20 m. Sand medium to coarse. Gravel fine to coarse; coarse gravel composed of mainly rounded quartzite; fine composed of angular to subrounded flint and quartz	1.00	3.90
Buried Channel Deposits		Sandy silt and clay, scattered race and pebbles in top 2.20 m. Deposit laminated, soft to firm, light brown to yellowish brown	8.60	12.50
	(b)	'Clayey' pebbly sand Medium sand with fine gravel; silt and clay content high from 15.00 m to 16.00 m. Gravel of rounded quartzite and quartz, and angular to rounded flint	5.30	17.80
London Clay		Silty clay, weathered in to 0.10 m. Olive black when unweathered	0.30+	18.10

GRADING

Mean for Deposit

%	mm	%	Depth below surface (m) From	To	Fines -1/16	Bulk Samples Percentages Sand +1/16-¼	+¼-1	Gravel +1-4	+4-16	+16
(a) Mean grading as opposite			2.9	3.9	4	1	8	9	40	38
(b) Gravel	+16	5	12.5	13.5	14	11	62	6	5	2
13	-16+4	8	13.5	15.0	1	5	56	8	16	14
			15.0	16.0	51	4	37	4	2	2
Sand	-4+1	9	16.0	17.0	14	3	59	16	8	0
69	-1+¼	55	17.0	17.8	16	4	60	13	6	1
	-¼+1/16	5								
Fines 18	-1/16	18								

TQ 88 NE 254 8713 8980 Rochford, Essex. Block A

Surface level +9.8 m (+32.0 ft)
Water struck at +7.3 m (+24.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 1.80 m
Mineral 5.20 m
Bedrock 2.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silt, yellowish brown	0.25	0.25
Brickearth	Silt, moderate to dark yellowish orange, gravelly towards base, slightly carbonaceous	0.95	1.20
Buried Channel Deposits	Stiff silty clay, very carbonaceous, abundent race becoming, at 1.40 m, gravelly sandy silt	0.60	1.80
	'Clayey' pebbly sand Mainly medium sand with fine gravel, rather silty in top 1.00 m. Gravel composed of subangular to subrounded flint and rounded flint and quartzite	5.20	7.00
London Clay	Stiff, highly fissured silty clay, brownish grey	2.10+	9.10

GRADING

Mean for Deposit

	%	mm	%
Gravel		+16	3
	18	-16+4	15
Sand		-4+1	9
	71	-1+¼	59
		-¼+1/16	3
Fines	11	-1/16	11

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
1.8	2.8	30	5	49	7	8	1
2.8	3.8	6	3	65	7	12	7
3.8	4.8	1	1	54	13	29	2
4.8	5.8	7	3	67	10	12	1
5.8	7.0	11	3	60	6	16	4

TQ 88 NE 255 8662 8923 Rochford, Essex. Block A

Surface level +12.4 m (+40.5 ft)
Water struck at +7.1 m (+23.5 ft)
Shell, 203 mm diameter
February 1973

Overburden 4.50 m
Mineral 5.50 m
Bedrock 2.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silt, dark yellowish brown	0.25	0.25
Brickearth	Silt, light brown, with roots, (becoming more abundant with depth). Pebbles of race from 1.70 m to base	2.35	2.60
	Sandy clayey silt, moderate yellowish orange	1.90	4.50
Buried Channel Deposits	Gravel Mainly fine gravel, some coarse with medium to coarse sand. Gravel fraction increasing and fines fraction decreasing with depth. Gravel composed of subangular to subrounded flint and rounded quartzite and flint pebbles. Some vein quartz. Coarse sand contains shards of flint patina. Scattered cobbles at base	5.50	10.00
London Clay	Silty clay, stiff, medium yellowish brown (weathered) becoming olive grey (unweathered) at 10.20 m	2.80+	12.80

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	52	+16	19	4.5	5.5	13	7	32	12	24	12
		-16+4	33	5.5	6.5	5	3	41	9	31	11
				6.5	7.5	6	4	28	10	36	16
Sand	43	-4+1	11	7.5	8.5	1	2	12	8	48	29
		-1+¼	29	8.5	10.0	2	1	28	15	29	25
		-¼+1/16	3								
Fines	5	-1/16	5								

TQ 88 NE 256 8876 8943 Sutton, Essex. Block C

Surface level +5.7 m (+18.5 ft)
Water struck at +0.85 m (+3.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 0.80 m
Mineral 1.85 m
Bedrock 2.45 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground and top soil	Sandy, clayey silt, dark grey brown with some gravel and recent shell fragments	0.80	0.80
Terrace Deposits	'Clayey' sandy gravel Medium sand with fine and coarse angular and rounded flint gravel. Gravel mainly concentrated in top 0.90 m	1.85	2.65
London Clay	Firm silty clay, moderate becoming dark yellowish brown with depth. Claystone layer at base	2.45+	5.10

GRADING

Mean for Deposit				Bulk Samples Percentages							
	%	mm	%	Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	29	+16	9	0.8	1.7	14	3	27	10	29	17
		-16+4	20	1.7	2.65	5	1	68	13	12	1
Sand	61	-4+1	12								
		-1+¼	47								
		-¼+1/16	2								
Fines	10	1/16	10								

TQ 88 NE 257 8945 8925 Sutton, Essex. Block C

Surface level +5.2 m (+17.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 2.15 m
Bedrock 5.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay with flints	0.30	0.30
Brickearth	Sandy clayey silt, soft yellowish brown. Becoming stiffer with scattered pebbles towards base	1.00	1.30
?Head	Firm silty clay, some race, mottled yellowish brown and bluish grey	0.85	2.15
London Clay	Firm to stiff silty clay, fissured at depth, dark yellowish brown becoming bluish grey towards base	5.10+	7.25

TQ 88 NE 258 8969 8792 Sutton, Essex. Block C

Surface level +26.1 m (+85.5 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 2.20 m
Bedrock 2.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey sandy silt with fine gravel	0.40	0.40
?Head	Silty clay, firm, sandy in top 0.20 m. Scattered flint pebbles in top 0.60 m; race common in lower 1.20 m. Moderate to dark yellowish brown	1.80	2.20
London Clay	Stiff silty clay light brown becoming dark yellowish brown with depth. Fissured with fine sand lenses	2.30+	4.50

TQ 88 NE 260 8907 8872 Sutton, Essex. Block C

Surface level +7.7 m (+25.5 ft)
Water struck at +6.1 m (+20.0 ft)
Shell, 152 mm diameter
June 1973

Overburden 0.70 m
Mineral 3.50 m
Bedrock 0.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Brown clay	0.70	0.70
Terrace Deposits	Sandy gravel Medium sand with fine angular to subangular flint gravel, rather silty; passing at 2.70 m into medium sand with fine and coarse angular to rounded gravel	3.50	4.20
London Clay	Stiff slightly silty clay, medium olive brown	0.70+	4.90

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	31	+16	7	0.7	1.7	8	9	41	14	28	0
		-16+4	24	1.7	2.7	9	6	72	4	9	0
				2.7	3.7	1	1	37	10	31	20
Sand	62	-4+1	9	3.7	4.2	15	3	32	9	30	11
		-1+¼	48								
		-¼+1/16	5								
Fines	7	-1/16	7								

TQ 88 NE 261 8897 8771 Southend-on-Sea, Essex. Block C

Surface level +25.7 m (+84.5 ft)
Water not struck
Shell, 152 mm diameter
June 1973

Overburden 0.80 m
Mineral 1.50 m
Bedrock 2.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Slightly gravelly sandy silt	0.80	0.80
Terrace Deposits	'Clayey' sandy gravel. Medium sand and fine with some coarse subangular to subrounded gravel. Clay and silt increasing with depth	1.50	2.30
London Clay	Stiff moderately fissured clay with carbonaceous material	2.20+	4.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	40	+16	10
		-16+4	30
Sand	47	-4+1	11
		-1+$\frac{1}{4}$	31
		-$\frac{1}{4}$+1/16	5
Fines	13	-1/16	13

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
0.8	1.8	11	5	33	11	31	9
1.8	2.3	17	4	27	11	29	12

TQ 88 NE 262 8988 8749 Southend-on-Sea, Essex. Block C

Surface level +26.2 m (+86.0 ft)
Ground water conditions not recorded
Shell, 152 mm diameter
June 1973

Overburden 0.80 m
Mineral 2.80 m
Bedrock 0.90 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Brown clay	0.50	0.50
Terrace Deposits	Sandy silt with gravel	0.30	0.80
	'Clayey' sandy gravel Medium sand and fine with some coarse gravel. Rather silty. Gravel angular to rounded flint with some quartzite. Gravel proportion increasing with depth	2.80	3.60
London Clay	Stiff highly fissured silty clay, yellow brown becoming dark olive brown with depth	0.90+	4.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	24	+16	6
		-16+4	18
Sand	66	-4+1	7
		-1+¼	52
		-¼+1/16	7
Fines	10	-1/16	10

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
0.8	1.8	11	4	68	7	10	0
1.8	2.8	9	9	37	8	25	10
2.8	3.6	No grading information available					

TQ 88 NE 270 8742 8882 Rochford, Essex. Block A

Surface level +7.8 m (+25.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Overburden 3.30 m
Mineral 4.80 m
Bedrock 1.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt	0.40	0.40
Brickearth	Sandy clayey silt, medium yellowish brown, with roots	1.60	2.00
Buried Channel Deposits	Clayey sandy silt, medium yellowish brown with light bluish grey mottling. Scattered carbonaceous material and race nodules	1.30	3.30
	Pebbly sand Fine to medium sand with gravel. Gravel, fine with some coarse, concentrated in top 1.10 m and composed of angular to subangular flint. Scattered cobbles present. Deposit becoming more sandy and silty with depth		
London Clay	Stiff silty clay, olive grey, fissured	1.60+	9.70

GRADING

Mean for Deposit

	%	mm	%
Gravel	21	+16	6
		-16+4	15
Sand	75	-4+1	8
		-1+$\frac{1}{4}$	34
		-$\frac{1}{4}$+1/16	33
Fines	4	-1/16	4

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
3.3	4.4	3	2	8	22	45	20
4.4	6.0	4	30	48	6	11	1
6.0	7.0	4	59	35	1	1	0
7.0	8.1	6	44	37	2	5	6

TQ 88 NE 271 8756 8922 Southend-on-Sea, Essex. Block A

Surface level +6.5 m (+21.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Overburden 1.70 m
Mineral 3.70 m
Bedrock 2.60 m+

LOG

Geological Classification	Lithology	Thickness mm	Depth mm
Soil	Slightly sandy clayey silt	0.30	0.30
Brickearth	Slightly sandy clayey silt, medium to dark yellowish brown passing at 0.80 m into clayey sandy silt, medium yellowish brown with scattered race nodules. Roots present throughout	1.10	1.40
Buried Channel Deposits	Gravelly sandy silt	0.30	1.70
	Sandy gravel Fine, medium and coarse sand with mainly fine but some coarse gravel. Gravel composed of angular, subangular and some rounded flint. Fine sand content increasing with depth. Gravel absent in basal 0.80 m. A 0.10 m band of greenish grey clay present at 4.50 m	3.70	5.40
London Clay	Stiff silty clay, dark yellowish brown becoming olive grey and fissured at 5.50 m	2.60+	8.00

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	44	+16	14	1.7	2.6	5	6	11	18	46	14
		-16+4	30	2.6	3.6	7	12	9	11	39	22
				3.6	4.5	6	18	18	14	28	16
Sand	50	-4+1	11	4.6	5.4	6	62	30	1	1	0
		-1+¼	16								
		-¼+1/16	23								
Fines	6	-1/16	6								

TQ 88 NE 272 8803 8985 Rochford, Essex. Block C

Surface level +7.1 m (+23.5 ft)
Water struck at +3.8 m (+12.5 ft)
Shell, 203 mm diameter
December 1973

Overburden 5.10 m
Mineral 4.10 m
Bedrock 1.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.50	0.50
Brickearth	Sandy clayey silt, medium yellowish brown, soft becoming stiff with depth. Roots and carbonaceous material present. Deposit passes, at 2.00 m into sandy clayey silt with some gravel and abundant race nodules	2.00	2.50
Terrace Deposits	Firm silty clay, medium yellowish brown streaked with pale blue and containing some gravel passing, at 3.60 m into soft clayey sandy silt, dark yellowish orange	2.60	5.10
	Pebbly sand Mainly medium and some fine sand with fine and coarse gravel. Gravel of angular and rounded flint, present in top 2.20 m and basal 0.50 m. A 0.20 m band of soft sandy silt, light olive green streaked with medium yellowish brown present at 6.10 m	4.10	9.20
London Clay	Stiff silty clay, olive grey	1.80+	11.00

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	21	+16	5	5.1	6.1	11	10	48	11	16	4
		-16+4	16	6.3	7.3	4	18	32	8	26	12
				7.3	8.7	3	22	60	7	8	0
Sand	74	-4+1	8	8.7	9.2	1	15	50	8	19	7
		-1+¼	49								
		-¼+1/16	17								
Fines	5	-1/16	5								

TQ 88 NE 274 8519 8932 Rochford, Essex. Block A

Surface level +24.9 m (+81.5 ft)
Water struck at +15.6 m (+51.0 ft)
Shell, 203 mm diameter
January 1974

Waste 24.60 m
Bedrock 2.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.40	0.40
Brickearth	Sandy silt, medium yellowish brown to medium yellowish orange with abundant carbonaceous material and calcified roots. Scattered angular flint pebbles in lower 3.00 m	4.60	5.00
? Brickearth or Buried Channel Deposits	Soft sandy silt, medium yellowish brown with abundant race	3.50	8.50
Buried Channel Deposits	Mainly silt but containing varying amounts of clay and sand with concentrations of flint pebbles. Colour varying from medium yellowish brown or orange through to olive grey. Becoming a sandy clay towards base	14.10	22.60
	Gravelly clay with sand. Gravel coarse and fine, angular, subangular and some rounded flint	2.00	24.60
London Clay	Silty sandy clay, olive grey to dark olive grey. Selenite crystals present and scattered pebbles (impressed from above?)	2.30+	26.90

TQ 88 NE 275 8526 8934 Rochford, Essex. Block A

Surface level +21.7 m (+71.0 ft)
Water seeping in at C. +14.7 m (+48.0 ft)
Shell, 203 mm diameter
January 1974

Waste 23.60 m
Bedrock 1.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.40	0.40
Brickearth	Slightly sandy silt, dark yellowish orange becoming medium yellowish brown, with roots in top 1.10 m and scattered race below 1.50 m, passing at 4.50 m into clayey silt with scattered angular pebbles, race and carbonaceous material; deposits becoming sandier with depth	7.60	8.00
Buried Channel Deposits	Firm to stiff silty sandy clay, medium yellowish brown to 8.50 m then becoming olive grey, greenish grey and olive black. Carbonaceous material present throughout and race present in basal 0.90 m	5.30	13.30
	Soft, friable clayey sandy silt, olive grey. Race and carbonaceous material common throughout	4.10	17.40
	Stiff silty clay, olive grey, sandy and gravelly in top 0.20 m	0.60	18.00
	Silty fine sand, clayey in places, medium olive grey, with scattered angular pebbles	3.50	21.50
	Gravelly sand, gravel coarse and fine, sand coarse to fine	2.10	23.60
London Clay	Stiff silty clay, dark yellowish brown in top 0.10 m becoming olive grey and containing selenite crystals with depth	1.10+	24.70

TQ 88 NE 276 8508 8930 Rochford, Essex, Block A

Surface level +28.2 m (+92.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Waste 12.00 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.20	0.20
Brickearth	Slightly clayey and sandy silt, medium yellowish brown, with scattered pebbles of subangular flint. Carbonaceous material present in top 0.30 m becoming abundant to a depth of 1.30 m	2.40	2.60
? Brickearth or Buried Channel Deposits	Soft clayey silt, medium yellowish brown, with carbonaceous material, becoming sandy and streaked with pale yellowish orange at depth	3.90	6.50
Buried Channel Deposits	Sandy very gravelly silt, medium yellowish orange with some carbonaceous material passing at 7.40 m into soft ferruginous silty clay, light brownish grey and at 8.30 m into stiff, silty and sandy clay, light bluish grey with ferruginous patches and scattered pebbles and carbonaceous material	3.00	9.50
? London Clay Head	Stiff silty clay, dark yellowish brown, mottled medium yellowish orange and medium bluish grey, with scattered gravel and carbonaceous material, becoming highly fissured at 10.30 m and containing abundant rounded flint pebbles and some race pebbles below 11.20 m	2.50	12.00
London Clay	Stiff slightly silty clay, dark yellowish brown streaked with medium bluish grey and containing selenite crystals	1.00+	13.00

TQ 89 NE 11 8802 9572 Canewdon, Essex. Block E

Surface level +2.2 m (+7.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 1.80 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil and made ground		0.40	0.40
Head	Silty clay, firm, fissured with scattered pebbles, mottled yellowish brown to greyish green, becoming sandier and yellowish orange with depth	1.40	1.80
London Clay	Stiff silty clay, dark yellowish brown	1.20+	3.00

TQ 89 NE 13 8586 9619 South Fambridge, Essex. Block E

Surface level +1.8 m (6.0 ft)
Water struck at -5.6 m (-18.5 ft)
Shell, 203 mm diameter
January 1974

Waste 10.00 m
Bedrock 10.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.20	0.20
Estuarine Alluvium	Firm silty clay, medium yellowish brown, mottled medium bluish grey, with 0.20 m of soft orange silt at base	1.00	1.20
	Very soft clayey sandy silt, medium olive grey becoming dark olive grey with depth and passing at 5.00 m into fine silty sand, laminated medium olive grey	6.20	7.40
	Clayey silt, firm, olive, with abundant oyster shells	0.20	7.60
	Silty sandy gravel. Gravel mainly rounded to subrounded flint, coarse and fine. Sand mainly coarse. Some scattered shells in lower part. Deposit split by a 0.20 m band of firm clayey silt containing shells at 8.50 m	2.40	10.00
London Clay	Stiff dark yellowish brown silty clay, moderately fissured, gradually becoming darker and passing at 15.50 m into olive grey silty clay	10.10+	20.10

TQ 89 NE 14 8551 9616 South Fambridge, Essex. Block E

Surface level +1.7 m (+5.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
December 1973

Waste 6.00 m
Bedrock 20.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.25	0.25
Estuarine Alluvium	Stiff dark yellowish brown silty clay, fissured, passing rapidly into soft slightly sandy silty clay, olive grey streaked with black	3.25	3.50
	Slightly sandy silty clay, olive grey, with some fine and coarse black angular flint gravel. Gravel content increasing and containing some rounded flint with depth. Basal 0.10 m of clayey gravel	1.90	5.40
London Clay Head	Stiff silty clay, medium to dark yellowish brown, some gravel in top 0.10 m. Scattered race nodules present in basal 0.30 m	0.60	6.00
London Clay	Stiff silty clay, fissured, dark yellowish brown with light bluish grey along fissure planes; selenite crystals	3.20	9.20
	Stiff silty clay, high open fissuring, dark olive black; selenite common	16.80+	26.00

TQ 89 NE 15 8551 9614 South Fambridge, Essex. Block E

Surface level +1.5 m (+5.0 ft)
Water not struck
Shell, 203 mm diameter
December 1973

Waste 5.60 m
Bedrock 10.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Estuarine Alluvium	Firm dark yellowish brown clay rapidly becoming soft and silty, changing from light olive grey through light bluish grey to dark olive black	2.30	2.60
	Clayey peat	0.20	2.80
	Silty sandy clay, soft becoming firm and then stiff and changing from olive grey to dark yellowish brown with depth. Some scattered coarse angular pebbles in top 0.70 m and race nodules in basal 0.60 m	2.00	4.80
London Clay Head	Stiff silty clay, fissured, dark yellowish brown streaked with blue along fissure planes. Some plant remains present	0.80	5.60
London Clay	Stiff dark yellowish brown silty clay, fissured with abundant selenite crystals and orange silt along fissure planes; passing at 9.40 m into olive grey silty clay	10.00+	15.60

TQ 89 NE 16 8546 9613 South Fambridge, Essex. Block E

Surface level +1.4 m (+4.5 ft)
Water not struck
Shell, 203 mm diameter
December 1973

Waste 5.50 m
Bedrock 10.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.25	0.25
Estuarine Alluvium	Silty clay, stiff becoming soft with depth and changing from olive grey with dark yellowish orange mottling to light olive grey and yellowish brown. Some plant remains in basal 0.30 m	1.05	1.30
	Clayey peat with large pieces of wood	0.80	2.10
	Soft to firm clayey silt, mottled medium to light bluish grey and light yellowish brown passing at 2.80 m into firm to stiff silty sandy clay, dark yellowish brown streaked with light bluish grey and containing abundant race nodules and scattered plant remains	3.00	5.10
	Gravelly silty clay, dark yellowish brown. Gravel composed of coarse angular flint	0.40	5.50
London Clay	Stiff silty clay, dark yellowish brown streaked with light bluish grey in upper part. Fissured, selenite crystals abundant	3.40	8.90
	Stiff silty clay, olive grey, fissured, abundant selenite crystals	6.60+	15.50

TQ 89 NE 17 8546 9615 South Fambridge, Essex. Block E

Surface level +1.4 m (+4.5 ft)
Water not struck
Shell, 203 mm diameter
December 1973

Waste 7.20 m
Bedrock 10.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.20	0.20
Estuarine Alluvium	Firm silty clay, medium olive grey passing into soft sandy silty clay, olive grey and light bluish grey with patches of yellowish orange and medium yellowish brown. Scattered plant remains present in lower part	2.00	2.20
	Peat	1.10	3.30
	Soft silty sandy clay, medium to light bluish grey passing at 3.50 m into gravelly silty clay. Gravel composed of fine angular black flint and coarse rounded flint	1.10	4.40
	Silty clay, soft, mottled light olive grey and light bluish grey, sandy, becoming olive grey with depth. Plant remains present in top 0.60 m. Basal 0.20 m firm	2.50	6.90
	Gravelly silty clay, medium yellowish brown, gravel composed of fine angular flint	0.30	7.20
London Clay	Stiff silty clay, medium yellowish brown becoming dark yellowish brown with depth; fissured	0.60	7.80
	Stiff silty clay, dark olive black, fissured. Fossil wood present at about 13.00 m	9.50+	17.30

TQ 89 NE 18 8780 9623 Canewdon, Essex. Block E

Surface level +1.6 m (+5.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 7.70 m
Bedrock 1.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground and soil		0.30	0.30
Estuarine Alluvium	Firm and soft silty clay, moderate brown to greyish black, modern roots in top 0.30 m	0.70	1.00
	Clayey silt, pale blue in upper 2.00 m becoming light olive grey to greenish grey. Carbonaceous plant remains in top 2.50 m. Gastropods common in lowest 1.50 m	4.00	5.00
	Fine sandy silt with shells, 5% gravel	0.30	5.30
	Firm silty sand, moderate yellowish brown with roots and race nodules from 5.80 m	2.40	7.70
London Clay	Silty clay, stiff, highly fissured with gravel. Moderate dark yellowish brown	1.40+	9.10

TQ 89 NE 20 8712 9621 South Fambridge, Essex. Block E

Surface level +1.6 m (+5.0 ft)
Water struck at -7.60 m (-25.0 ft)
Shell, 203 mm diameter
March 1974

Waste 10.40 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Estuarine Alluvium	Silty clay, soft, light brown to pale blue grey with roots in top 0.80 m	3.20	3.20
	Clayey silt, soft, light olive grey and greyish black with carbonized plants	2.40	5.60
	Silt becoming fine sand at 6.00 m, light olive grey and soft	1.70	7.30
	Silt, light olive grey, soft with clayey silt clasts, greyish black. Shells and carbonized roots	0.40	7.70
	Sand, fine, micaceous, light olive grey becoming medium olive grey. Shells below 8.50 m	2.00	9.70
	Fine to coarse sand with fine gravel. Gastropods present	0.40	10.10
Head	Silty clay, firm, medium yellowish brown and pale yellowish brown mottled, pebbles present	0.30	10.40
London Clay	Stiff silty clay, moderate yellowish brown with carbonized roots, fissuring and race nodules	0.80+	11.20

TQ 89 NE 21 8724 9506 South Fambridge, Essex. Block E

Surface level +1.8 m (+6.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Waste 5.70 m
Bedrock 1.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty clay	0.25	0.25
Estuarine Alluvium	Silty clay, firm, medium yellow brown with medium bluish grey patches passing at 0.50 m into soft to very soft silty clay, medium bluish grey with medium yellow brown patches, becoming medium greenish grey with depth. Some plant and carbonaceous material present	1.75	2.00
	Clayey peat	1.20	3.20
	Silty clay, olive grey becoming light olive grey with depth, soft to 4.00 m firm to 5.00 m then soft to base. Scattered angular gravel in top 0.80 m, some carbonaceous material in lower 1.50 m	2.20	5.50
?London Clay Head	Firm silty clay, medium yellowish brown	0.20	5.70
London Clay	Stiff slightly silty clay, medium yellowish brown with light bluish grey streaks. Cementstone layer present at about 6.00 m	1.70+	7.40

TQ 89 NE 22 8905 9596 Canewdon, Essex. Block E

Surface level +1.1 m (+3.5 ft)
Water struck at -6.4 m (21.0 ft)
Shell, 203 mm diameter
March 1974

Waste 7.80 m
Bedrock 1.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.15	0.15
Estuarine Alluvium	Clay and silt, mottled yellowish brown and light bluish grey, stiff in upper 0.45 m; soft in lower part. Plant remains present	1.35	1.50
	Clayey silt, greyish black streaked with medium olive grey, abundant carbonized roots present, passing at 3.30 m into greenish grey clayey silt, streaked with dark grey and containing shells between 5.50 m and 6.00 m	5.30	6.80
	Clayey silt, medium dark grey with fine subangular gravel and shells. Gravel increasing in content and becoming coarser with depth	1.00	7.80
London Clay	Firm silty clay dark yellowish brown with race nodules passing at 8.20 m into very silty clay, medium yellowish brown streaked with pale blue, fissured	1.40+	9.20

TQ 89 SE 32 8865 9101 Stambridge, Essex. Block B

Surface level + 6.2 m (+20.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Overburden 0.70 m
Mineral 3.80 m
Bedrock 0.95 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay with some gravel	0.20	0.20
Terrace Deposits	Gravelly sandy silty clay	0.50	0.70
	'Very clayey' pebbly sand Medium sand with fine subrounded flint concentrated in top 0.9 m. Very silty and clayey below 1.6 m	3.80	4.50
London Clay	Firm becoming stiff clay, yellow brown, passing at 4.60 m into dark yellow brown clay	0.95+	5.45

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	6	+16	2	0.7	1.2	14	3	41	16	17	9
		-16+4	4	1.2	1.6	15	4	46	12	19	4
				1.6	2.8	57	26	16	1	0	0
Sand	54	-4+1	4	2.8	3.2	39	19	41	1	0	0
		-1+¼	35	3.2	3.8	47	10	42	1	0	0
		-¼+1/16	15	3.8	4.2	39	7	51	1	1	1
				4.2	4.5	40	20	38	0	1	1
Fines	40	-1/16	40								

TQ 89 SE 33 8875 9175 Stambridge, Essex. Block B

Surface level +10.7 m (+35.0 ft)
Water struck at +8.7 m (+28.5 ft)
Shell, 203 mm diameter
October 1972

Overburden 1.70 m
Mineral 1.30 m
Bedrock 6.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey sandy silt	0.50	0.50
Brickearth	Clayey sandy silt, medium brown with carbonaceous material passing, at 1.10 m, into clayey sandy silt with race pebbles	1.20	1.70
Terrace Deposits	'Clayey' sand Medium sand with a trace of angular flint gravel. Fines content increasing with depth	1.30	3.00
London Clay	Firm to stiff silty clay, dark brown becoming dark olive brown with depth	6.60+	9.60

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	1	+16	0	1.7	2.4	8	13	75	2	2	0
		-16+4	1	2.4	3.0	22	16	60	2	0	0
Sand	84	-4+1	2								
		-1+¼	68								
		-¼+1/16	14								
Fines	15	-1/16	15								

TQ 89 SE 34 8884 9203 Stambridge, Essex. Block B

Surface level +8.2 m (+27.0 ft)
Ground water condition not recorded
Shell, 203 mm diameter
October 1972

Waste 3.00 m
Bedrock 4.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay	0.20	0.20
Head	Silty sandy clay with a trace of gravel	0.60	0.80
Head Brickearth	Gravelly clay passing at 1.00 m into silty clay with some sand and race pebbles	2.20	3.00
London Clay	Stiff sandy silty clay, medium yellow brown passing at 4.60 m into dark yellow brown clay with thin claystone bands	4.00+	7.00

TQ 89 SE 35 8877 9265 Stambridge, Essex. Block A

Surface level +7.9 m (+26.0 ft)
Water struck at +4.5 m (15.0)
Shell, 203 mm diameter
October 1972

Overburden 3.40 m
Mineral 3.40 m
Bedrock 0.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay with some gravel	0.20	0.20
Buried Channel Deposits	Silty sandy clay. Scattered race pebbles from 0.80 m to 1.60 m. Sand occurs in lenses	3.20	3.40
	Gravel Fine and coarse subrounded flint and rounded quartzite gravel with medium sand. Top 0.40 m rather silty	3.40	6.80
London Clay	Stiff silty clay, dark yellow brown	0.70+	7.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	52	+16	26
		-16+4	26
Sand	40	-4+1	6
		-1+$\frac{1}{4}$	31
		-$\frac{1}{4}$+1/16	3
Fines	8	-1/16	8

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
3.4	3.7	23	15	51	2	7	2
3.7	3.8	33	7	38	2	14	6
3.8	4.5	5	3	24	4	21	43
4.5	5.4	3	1	27	7	24	38
5.4	6.2	6	1	32	11	35	15
6.2	6.7	6	0	30	5	39	20
6.7	6.8	16	1	70	8	1	2

TQ 89 SE 36 8951 9072 Rochford, Essex. Block B

Surface level +6.6 m (+21.5 ft)
Water struck at +4.1 m (+13.5 ft)
Shell, 203 mm diameter
October 1972

Overburden 1.25 m
Mineral 4.25 m
Bedrock 0.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil over Brickearth	Sandy clayey silt, yellowish orange, loose, friable	1.25	1.25
Terrace Deposits	'Clayey' sandy gravel Medium sand with fine to coarse gravel. Gravel composed of subrounded flint and well rounded flint and quartzite. Main gravel horizon from 2.80 m to 4.50 m. Scattered cobbles	4.25	5.50
London Clay	Silty clay, stiff, dark yellowish brown	0.40+	5.90

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	40	+16	15	1.45	2.0	16	3	30	11	28	12
		-16+4	25	2.0	2.8	15	4	49	9	19	4
				2.8	3.5	0	0	10	2	46	42
Sand	50	-4+1	10	3.5	4.0	16	1	27	10	31	15
		-1+¼	37	4.0	4.5	3	2	31	8	32	24
		-¼+1/16	3	4.5	5.0	15	9	70	2	2	2
				5.0	5.5	7	2	43	32	12	4
Fines	10	-1/16	10								

TQ 89 SE 37 8745 9247 Ashingdon, Essex. Block A

Surface level +13.6 m (+44.5 ft)
Water struck at +5.4 m (+17.5 ft)
Shell, 203 mm diameter
November 1972

Overburden 8.60 m
Mineral 3.50 m
Bedrock 0.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Head over brickearth	Clayey silt, light brown to yellowish brown with bluish greenish grey mottling. Race abundant from 1.30 m to 1.80 m. Scattered carbonaceous patches	4.10	4.40
Buried Channel Deposits	Clayey silt with fine sand, dark olive grey, becoming light olive grey with depth. Scattered carbonaceous patches present	4.20	8.60
	Sandy gravel Medium sand with fine to coarse gravel. Gravel composed of angular to subrounded flint and well rounded flint and quartzite. Gravel content increasing with depth	3.50	12.10
London Clay	Silty clay, stiff, medium olive grey	0.20+	12.30

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
9.8	12.1	6	4	49	7	21	13

TQ 89 SE 38 8799 9177 Rochford, Essex. Block B

Surface level + 11.0 m (+36.0 ft)
Water struck at +8.8 m (+29.0 ft)
Shell, 203 mm diameter
November 1972

Overburden 1.20 m
Mineral 2.05 m
Bedrock 0.95 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay	0.15	0.15
Brickearth	Sandy clayey silt, moderate brown, with scattered flint pebbles	1.05	1.20
Terrace Deposits	Sandy gravel Medium to coarse sand with fine gravel. Gravel composed of subrounded and well rounded flint	2.05	3.25
London Clay	Silty clay, dark yellowish brown, firm becoming stiff and dark grey with depth	0.95+	4.20

GRADING

Mean for Deposit				Bulk Samples Percentages							
				Depth below surface (m)		Fines		Sand		Gravel	
	%	mm	%	From	To	-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	45	+16	2	1.3	2.9	7	1	32	14	45	1
		-16+4	43	2.9	3.25	7	1	35	18	34	5
Sand	48	-4+1	15								
		-1+¼	32								
		-¼+1/16	1								
Fines	7	-1/16	7								

TQ 89 SE 39 8975 9143 Stambridge, Essex. Block B

Surface level + 5.8 m (+19.0 ft)
Water struck at +4.0 m (+13.0 ft)
Shell, 203 mm diameter
November 1972

Overburden 1.00 m
Mineral 3.70 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey sandy silt	0.30	0.30
Brickearth	Clayey sandy silt, gravel at depth. Yellowish brown, some carbonaceous material. Abundant race between 0.70 m and 0.80 m	0.70	1.00
Terrace Deposits	Sandy gravel Mainly medium sand with fine and coarse gravel. Gravel composed of subangular to subrounded flint and well rounded flint and quartzite	3.70	4.70
London Clay	Silty clay, firm, brown becoming olive grey at 4.90 m	1.20+	5.90

GRADING

Mean for Deposit

	%	mm	%
Gravel	40	+16	19
		-16+4	21
Sand	56	-4+1	7
		-1+$\frac{1}{4}$	45
		-$\frac{1}{4}$+1/16	4
Fines	4	-1/16	4

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
1.0	2.1	7	5	34	9	25	20
2.1	3.0	9	4	45	8	22	12
3.0	4.7	0	4	52	5	17	22

TQ 89 SE 40 8967 9312 Canewdon, Essex. Block A

Surface level +9.7 m (+32.0 ft)
Water struck at C +5.7 m (+18.5 ft)
Shell, 203 mm diameter
November 1972

Overburden 4.00 m
Mineral 4.20 m
Bedrock 0.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Head over Brickearth	Mainly clayey silt, light brown and greyish orange with greenish and grey mottling. Scattered race and carbonaceous material present	3.20	3.50
Buried Channel Deposits	Sandy silty clay with race and some gravel	0.50	4.00
	Gravel. Fine to coarse gravel with medium sand. Gravel composed of subangular to subrounded flint; concentrated in top 1.00 m	4.20	8.20
London Clay	Silty clay, stiff, brown becoming grey with depth	0.40+	8.60

GRADING

Mean for Deposit

	%	mm	%
Gravel	59	+16	22
		-16+4	37
Sand	39	-4+1	9
		-1+¼	27
		-¼+1/16	3
Fines	2	-1/16	2

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	Sand +1-4	Gravel +4-16	Gravel +16
4.0	5.0	2	2	4	9	61	22
5.0	6.5	4	4	38	10	25	19
6.5	8.0	0	4	31	9	32	24

TQ 89 SE 41 8557 9337 Ashingdon, Essex. Block A

Surface level +55.1 m (+181.0 ft)
Water not struck
Shell, 203 mm diameter
December 1972

Waste 5.30 m
Bedrock 4.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sand	0.30	0.30
Sand and Gravel of Unknown Age	Clayey gravelly sand; gravel composed of angular flint	0.90	1.20
Claygate Beds	Intercalations of clay, silt and sand. Plant remains in upper 1.80 m. Selenite crystals in lower 2.20 m. Mainly pale to light brown with pale blue and green patches of reduced material in top 0.30 m	4.10	5.30
London Clay	Stiff silty clay, moderate yellowish brown becoming olive black with depth	4.20+	9.50

TQ 89 SE 49 8928 9239 Stambridge, Essex. Block B

Surface level +9.4 m (31.0 ft)
Water not struck
Shell, 203 mm diameter
December 1972

Waste 1.50 m
Bedrock 0.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silty sand	0.20	0.20
Head	Sandy silt with gravel becoming gravelly clayey sand at 0.8 m	0.90	1.10
Terrace Deposits	Medium to coarse sand with clay nodules. Some fine gravel	0.40	1.50
London Clay	Silty clay, firm, brown	0.60+	2.10

TQ 89 SE 50 8572 9013 Rochford, Essex. Block A

Surface level +14.7 m (+48.0 ft)
Water struck at C. +6.7 m (+22.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 7.20 m
Mineral 7.20 m
Bedrock 1.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.20	0.20
? Brickearth	Clayey silt and silty clay, firm to stiff with some flint gravel in top 1.00 m. Yellowish orange becoming light brown with greenish, yellowish, bluish mottling	3.20	3.40
Buried Channel Deposits	Clayey silty sand, soft, scattered pebbles; light brown to orange brown. Some carbonaceous patches; race nodules present in upper 0.60 m	3.80	7.20
	Sandy gravel Mainly medium sand with fine and some coarse gravel. Gravel composed of subangular flint and rounded flint and quartzite concentrated in upper 1.80 m	7.20	14.40
London Clay	Silty clay, firm, light brown, becoming stiff and greyish black with depth	1.30+	15.70

GRADING

Mean for Deposits

	%	mm	%
Gravel	36	+16	6
		-16+4	30
Sand	58	-4+1	12
		$-1+\frac{1}{4}$	42
		$-\frac{1}{4}+1/16$	4
Fines	6	-1/16	6

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	$+1/16-\frac{1}{4}$	Sand $+\frac{1}{4}-1$	+1-4	Gravel +4-16	+16
7.2	9.0	4	2	25	6	49	14
10.0	11.5	7	6	59	15	13	0
11.7	12.8	9	3	48	19	20	1

TQ 89 SE 51 8612 9104 Rochford, Essex. Block A

Surface level +12.6 m (+41.5 ft)
Water struck at +7.9 m (+26.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 9.40 m
Mineral 3.70 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Brickearth	Clayey silt, sandy in places with scattered flint pebbles. Mainly pale to light brown with greyish green mottling	2.70	3.00
Buried Channel Deposits	Mainly clayey silt but becoming more sandy with depth. Light brown with greyish green patches becoming yellowish brown towards base. Some rootlets and race nodules in upper 1.90 m	6.40	9.40
	Very 'clayey' gravel Medium sand with fine to coarse gravel. Gravel composed of angular to subangular flint and rounded flint and quartzite. Upper 0.60 m rather silty	3.70	13.10
London Clay	Silty clay, stiff, olive grey becoming greenish black with depth	1.20+	14.30

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-$\frac{1}{4}$	+$\frac{1}{4}$-1	+1-4	+4-16	+16
Gravel	41	+16	11	10.0	11.5	27	2	28	7	32	4
		-16+4	30	12.5	13.1	9	4	28	3	27	29
Sand	37	-4+1	6								
		-1+$\frac{1}{4}$	28								
		-$\frac{1}{4}$+1/16	3								
Fines	22	-1/16	22								

TQ 89 SE 52 8582 9211 Hawkwell, Essex. Block A

Surface level +16.5 m (+54.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 3.70 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.20	0.20
Head	Clayey silt, firm with angular to rounded flint gravel from 0.70 m to 1.00 m. Deposit mottled pale greyish orange, greenish grey and light brown	1.30	1.50
? Brickearth	Clayey silt, soft, light brown becoming moderate brown with depth. Some flint pebbles towards base. Scattered carbonaceous patches	2.20	3.70
London Clay	Stiff silty clay, moderate brown, some carbonaceous remains	1.00+	4.70

TQ 89 SE 53 8689 9457 Ashingdon, Essex. Block E

Surface level +1.2 m (4.0 ft)
Water struck at 0.7 m (2.5 ft)
Shell, 203 mm diameter
January 1973

Waste 2.30 m
Bedrock 0.95 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty clay, dark yellowish brown	0.20	0.20
Estuarine Alluvium	Soft to firm silty clay, yellowish brown mottled with greenish grey. Some organic material present. Becoming very soft, black organic clayey silt at 1.90 m with a basal shell horizon	2.10	2.30
? London Clay	Soft to firm silty clay, moderate yellowish brown becoming firm and dark yellowish brown with depth	0.95+	3.25

TQ 89 SE 55 8657 9046 Rochford, Essex. Block A

Surface level +11.3 m (+37.0 ft)
Water struck at +5.9 m (+19.5 ft)
Shell, 203 mm diameter
January 1973

Overburden 5.40 m
Mineral 4.10 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.20	0.20
Brickearth	Clayey silt, light to medium yellowish brown. Race nodules common. Scattered pebbles towards base	2.20	2.40
Buried Channel Deposits	Mainly fine sand with clay and silt. Some scattered pebbles of flint. Pale yellowish orange to yellowish brown	3.00	5.40
	'Clayey' sandy gravel Medium sand with fine and coarse gravel. Gravel, composed of angular and well rounded flint, predominantly in upper 1.60 m. Sand percentage increasing with depth	4.10	9.50
London Clay	Stiff silty clay, greenish to olive black	1.00+	10.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	43	+16	17
		-16+4	26
Sand	43	-4+1	8
		-1+$\frac{1}{4}$	30
		-$\frac{1}{4}$+1/16	5
Fines	14	-1/16	14

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
5.4	7.0	10	2	17	6	35	30
7.0	9.2	16	7	40	10	20	7

TQ 89 SE 56 8702 9175 Rochford, Essex. Block A

Surface level +11.2 m (+36.5 ft)
Ground water conditions not recorded
Shell, 152 mm diameter
June 1973

Waste 8.30 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.50	0.50
Brickearth	Sandy clayey silt becoming more clayey with depth and containing race pebbles below 1.60 m. Medium yellow brown	2.80	3.30
Buried Channel Deposits	Soft sandy clayey silt, sand content increasing with depth. Shell fragments in top 0.70 m	3.30	6.60
	Gravelly sand, rather silty. Gravel subangular to rounded with scattered cobbles. Sand mainly medium	1.70	8.30
London Clay	Stiff silty clay highly fissured, medium olive brown	1.00+	9.30

TQ 89 SE 63 8709 9038 Rochford, Essex. Block A

Surface level +9.0 (+29.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Waste 2.2 m
Bedrock 2.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.90	0.90
Brickearth	Sandy clayey silt, medium yellowish orange, with race and roots	0.50	1.40
Terrace Deposits	Gravelly sandy silt, moderate yellowish brown	0.80	2.20
London Clay	Stiff silty clay, dark yellowish brown with streaks. Highly fissured	2.80+	5.00

TQ 89 SE 64 8793 9044 Rochford, Essex. Block B

Surface level +10.3 m (+34.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
November 1973

Overburden 0.60 m
Mineral 2.80 m
Bedrock 2.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Gravelly sandy silt	0.60	0.60
Terrace Deposits	Sandy gravel Gravel coarsening and decreasing in amount with depth. Angular cobbles near base	2.80	3.40
London Clay	Stiff silty clay, dark yellowish brown becoming olive grey with depth. Weathered in to 4.00 m. Fissuring present below 4.00 m	2.10+	5.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	29	+16	11
		-16+4	18
Sand	67	-4+1	9
		-1+¼	50
		-¼+1/16	8
Fines	4	-1/16	4

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	Gravel +1-4	+4-16	+16
0.7	2.1	4	6	37	13	28	12
2.1	2.8	3	6	72	7	10	2
2.8	3.6	6	13	56	4	4	17

TQ 89 SE 69 8614 9188 Hawkwell, Essex. Block A

Surface level +15.8 m (+52.0 ft)
Ground water conditions not recorded
Shell, 203 mm and 152 mm diameter
April 1974

Waste 15.70 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Buried Channel Deposits	Fine to coarse gravel	0.30	0.60
	Silty clay, sandy and clayey, soft to stiff, moderate yellowish brown. Scattered pebbles occur between 2.50 m and 3.60 m. Firm brown clayey silt band occurs from 3.60 m to 4.00 m	4.00	4.60
	Sand, fine to coarse, more clayey to top and sandier towards base. Stiff to soft. Occasionally gravelly sand from 7.60 m to 10.00 m	8.00	12.60
	Gravel with some sand, subangular to rounded	3.10	15.70
London Clay	Weathered silty clay, laminated and micaceous, fine sand, dark yellowish brown	0.20	15.90
	Unweathered silty clay	0.60+	16.5

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
12.6	14.5	3	3	18	20	35	21

TQ 89 SE 70 8678 9487 South Fambridge, Essex. Block E

Surface level +1.8 m (+6.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Waste 7.50 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty clay	0.20	0.20
Estuarine Alluvium	Firm to soft silty clay, pale blue changing to light olive grey with depth	6.20	6.40
London Clay	Stiff silty clay, dark yellowish brown with pale blue streaks. Race in top 1.10 m only. Highly to moderately fissured	2.50+	8.90

TQ 89 SE 71 8650 9451 South Fambridge, Essex. Block E

Surface level +2.3 m (+7.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1974

Waste 2.00 m
Bedrock 2.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Very clayey silt	0.10	0.10
Estuarine Alluvium	Firm and soft silty clay, pale blue with dark yellowish orange patches. Some carbonaceous matter and angular flints	1.90	2.00
London Clay	Stiff silty clay, moderate yellowish brown with pale blue streaks. Highly fissured near top. Selenite crystals below 3.00 m	2.00+	4.00

TQ 89 SE 72 8925 9449 Beacon Hill, Canewdon, Essex. Block B

Surface level +26.0 m(+85.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 0.20 m
Bedrock 9.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Head	Firm brown silty clay with pebbles	0.20	0.20
London Clay	Weathered silty clay, stiff, pale brown. Highly fissured. Patches of fine sand, moderate brown. Selenite crystals present decreasing in number with depth	8.40	8.60
	Unweathered silty clay, stiff, medium light grey to olive grey, fissuring present	1.10+	9.70

TQ 89 SE 73 8723 9449 Canewdon, Essex. Block E

Surface level +2.1 m (+7.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 4.00 m
Bedrock 1.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.20	0.20
Estuarine Alluvium	Silty clay, soft, medium bluish grey with carbonised roots	1.30	1.50
	Soft clayey silt, light grey blue green becoming firm and dark yellowish orange with depth. Roots are present	1.70	3.20
Head	Firm silty clay, moderate yellowish brown with roots and mica	0.80	4.00
London Clay	Firm to stiff silty clay, moderate yellowish brown and highly fissured	1.60+	5.60

TQ 89 SE 74 8887 9311 Apton Hall, Essex. Block A

Surface level +10.9 m (+36.0 ft)
Water struck at +3.2 m (+10.5 ft)
Shell, 203 mm diameter
November 1973

Waste 10.30 m
Bedrock 1.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Brickearth	Silty clay, light brown, slightly carbonaceous	0.70	1.00
Buried Channel Deposits	Clayey silt, light brown becoming light olive grey, with roots and race. Race increases with depth	1.50	2.50
	Silty clay, firm, light brown, with some race	3.50	6.00
	Sandy clayey silt, becoming more clayey with depth. Dark yellowish orange calcareous nodules and micaceous silt below 7.00 m	2.50	8.50
	Sandy silty gravel	1.80	10.30
London Clay	Silty clay, stiff, highly fissured, olive grey	1.50+	11.80

TQ 89 SE 75 8802 9223 Rochford, Essex. Block A

Surface level +8.7 m (+28.5 ft)
Water struck at +6.5 m (+21.5 ft)
Shell, 203 mm diameter
November 1973

Overburden 3.50 m
Mineral 2.90 m
Bedrock 0.90 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Head	Stiff silty clay, moderate yellowish brown, with angular flints and race	0.50	0.80
Buried Channel Deposits	Stiff to firm silty clay, greenish grey, containing race. Shells present in top 0.40 m	1.00	1.80
	Sandy silt with sandy silty clay bands, which become thicker with depth, light brown. 10% to 20% gravel in lowest 0.20 m	1.70	3.50
	Gravel Silty clayey sandy gravel, becoming sandier with depth	2.90	6.40
London Clay	Stiff silty clay, olive grey, and highly fissured	0.90+	7.30

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	50	+16	19	3.5	4.0	5	8	24	5	31	27
		-16+4	31	4.0	4.5	4	10	18	7	35	26
				4.5	5.3	2	8	41	11	29	9
Sand	47	-4+1	8	5.3	6.0	4	7	33	8	28	20
		-1+¼	31	6.0	6.4	1	5	32	9	33	20
		-¼+1/16	8								
Fines	3	-1/16	3								

TQ 98 NW 25 9053 8930 Sutton, Essex. Block C

Surface level +9.4 m (+31.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Waste 1.80 m
Bedrock 0.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with pebbles	0.35	0.35
Brickearth	Sandy silty clay with scattered rounded pebbles. Yellowish brown to brown. Containing race pebbles below 1.00 m	1.45	1.80
London Clay	Firm highly fissured silty clay, medium brown	0.40+	2.20

TQ 98 NW 26 9069 8837 Sutton, Essex. Block C

Surface level +14.7 m (+48.0 ft)
Water struck at +12.8 m (+42.0 ft)
Shell, 203 mm and 152 mm diameter
October 1972

Waste 2.35 m
Bedrock 3.25 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		1.20	1.20
? Terrace Deposits	Sandy clayey silt with some race and scattered angular flint pebbles. Medium yellow brown	1.15	2.35
London Clay	Stiff sandy silty clay, sand content decreasing with depth. Highly fissured, medium brown	3.25+	5.60

TQ 98 NW 27 9167 8827 Barling Magna, Essex. Block C

Surface level +16.1 m (+53.0 ft)
Water not struck
Shell, 152 mm diameter
November 1972

Waste 1.20 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with scattered pebbles	0.50	0.50
?Brickearth	Sandy clayey silt with subangular to rounded pebbles. Firm, medium brown to medium yellow brown	0.70	1.20
London Clay	Firm silty clay, fissured, medium yellow brown with scattered race pebbles	0.80+	2.00

TQ 98 NW 28 9162 8765 Great Wakering, Essex. Block C

Surface level +16.6 m (+54.5 ft)
Water not struck
Shell, 152 mm diameter
November 1972

Waste 1.40 m
Bedrock 0.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with angular and rounded pebbles	0.30	0.30
Brickearth	Sandy clayey silt becoming more clayey with depth. Race pebbles in upper half; medium yellow brown	1.10	1.40
London Clay	Stiff silty clay, some race pebbles and carbonaceous material. Mottled medium yellow brown and pale blue green	0.40+	1.80

TQ 98 NW 29 9162 8660 Southend-on-Sea, Essex. Block D

Surface level +6.3 m (+20.5 ft)
Water not struck
Shell, 203 mm diameter
November 1972

Waste 1.50 m
Bedrock 0.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with some fine gravel and race pebbles	0.45	0.45
Brickearth	Sandy clayey silt, soft, with race pebbles in lower 0.45 m	1.05	1.50
London Clay	Silty sandy clay, stiff, medium yellow brown containing race and carbonaceous material. Moderately fissured	0.30+	1.80

TQ 98 NW 30 9274 8813 Barling Magna, Essex. Block D

Surface level +7.6 m (+25.0 ft)
Water not struck
Shell, 152 mm diameter
November 1972

Waste 1.45 m
Bedrock 4.75 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with race pebbles	0.45	0.45
Brickearth	Clayey sandy silt, firm, medium yellow brown, containing race pebbles in lower 0.60 m	0.80	1.25
Terrace Deposits	Clayey sandy silt with gravel	0.20	1.45
London Clay	Sandy silty clay, firm becoming silty clay, stiff with depth; containing scattered selenite crystals and some race in upper part. Medium yellow brown or medium brown to 4.90 m then dark olive brown to base	4.75+	6.20

TQ 98 NW 31 9258 8743 Great Wakering, Essex. Block D

Surface level +10.4 m (+34.0 ft)
Water struck at +7.2 m (+23.5 ft)
Shell, 152 mm diameter
November 1972

Overburden 3.80 m
Mineral 2.90 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with some gravel	0.30	0.30
Brickearth	Sandy clayey silt, medium yellow brown. Race pebbles present in lower 1.10 m and some subangular to rounded gravel in basal 0.40 m. Carbonaceous material present throughout	2.70	3.00
Terrace Deposits	Clayey silt with sand and flint gravel. Mottled medium yellow brown and pale olive brown	0.80	3.80
	'Clayey' sandy gravel Mainly medium sand with fine and coarse subangular and rounded flint gravel. Gravel content increasing with depth. Deposit rather silty including a 0.05 m clay band below 5.40 m	2.90	6.70
London Clay	Stiff sandy silty clay, medium brown becoming medium olive brown with depth. Moderately fissured; selenite crystals in lower 0.75 m	0.80+	7.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	30	+16	15
		-16+4	15
Sand	52	-4+1	7
		-1+$\frac{1}{4}$	41
		-$\frac{1}{4}$+1/16	4
Fines	18	-1/16	18

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
3.8	5.0	22	5	53	6	11	3
5.0	5.4	9	3	46	7	13	22
5.45	6.7	17	3	29	8	20	23

TQ 98 NW 32 9076 8776 Southend-on-Sea, Essex. Block C

Surface level +14.0 (+46.0 ft)
Water struck at +12.1 m (+39.5 ft)
Shell, 203 mm diameter
December 1972

Waste 2.50 m
Bedrock 1.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt	0.30	0.30
Head	Gravelly silt, clayey in lower part, overlying 1.00 m of fine and medium sand with silt, containing abundant race and some gravel. Gravel composed of angular, subangular and rounded flint	1.50	1.80
Terrace Deposits	Sandy clayey gravel; sand mainly medium and gravel fine to coarse composed of angular flint	0.70	2.50
London Clay	Silty clay, firm, dark olive brown	1.40+	3.90

TQ 98 NW 33 9266 8983 Barling Magna, Essex. Block C

Surface level +7.0 m (+23.0 ft)
Water struck at +2.4 m (+8.0 ft)
Shell, 203 mm diameter
January 1973

Waste 5.40 m
Bedrock 0.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.50	0.50
Brickearth	Sandy clayey silt, medium yellow brown, with scattered angular flint pebbles. Abundant race below 1.50 m. Carbonaceous material present throughout	1.50	2.50
Terrace Deposits	Sandy clayey silt, mottled medium yellow brown and pale blue passing at 3.90 m into sandy gravelly silt, the gravel content increasing with depth	2.90	5.40
London Clay	Stiff, highly fissured silty clay, medium brown	0.30+	5.70

TQ 98 NW 34 9452 8826 Great Wakering, Essex. Block D

Surface level +4.5 m (+15.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Overburden 1.20 m
Mineral 1.60 m
Bedrock 0.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.40	0.40
Brickearth	Silt, medium yellow brown with carbonaceous material and scattered race pebbles	0.40	0.80
Terrace Deposits	Silty sand with scattered pebbles of race. Medium yellow brown	0.40	1.20
	'Clayey' sand Mainly medium sand, silty with scattered pebbles. Some shell fragments (sand grade)	1.60	2.80
London Clay	Stiff sandy silty clay, medium yellow brown	0.60+	3.40

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
1.2	2.8	29	3	62	2	4	0

TQ 98 NW 35 9371 8690 Great Wakering, Essex. Block D

Surface level +5.5 m (+18.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 2.70 m
Bedrock 0.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.40	0.40
Brickearth	Sandy clayey silt, firm, medium yellow brown with scattered race pebbles. Becoming more sandy with depth; rounded pebbles in basal 0.20 m	2.30	2.70
London Clay	Stiff silty clay, medium brown	0.60+	3.30

TQ 98 NW 36 9464 8703 Great Wakering, Essex. Block D

Surface level +8.3 m (+27.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Overburden 2.35 m
Mineral 2.45 m
Bedrock 0.40 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil and subsoil		0.9	0.9
Brickearth	Silty clay, mottled dark yellow brown and medium yellow brown with shell fragments and peat passing at 1.75 m into clayey silt with calcareous veining	1.45	2.35
Terrace Deposits	'Clayey' pebbly sand Mainly medium sand with angular and rounded flint gravel; gravel content increasing and fines content decreasing with depth	2.45	4.80
London Clay	Stiff silty clay, medium brown with carbonaceous material	0.40+	5.20

GRADING

Mean for Deposit

	%	mm	%
Gravel	8	+16	1
		-16+4	7
Sand	81	-4+1	6
		$-1+\frac{1}{4}$	73
		$-\frac{1}{4}+1/16$	2
Fines	11	-1/16	11

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	$+1/16-\frac{1}{4}$	Sand $+\frac{1}{4}-1$	+1-4	Gravel +4-16	+16
2.45	3.60	15	2	78	4	1	0
3.60	4.80	8	2	68	8	12	2

TQ 98 NW 37 9175 8953 Barling Magna, Essex. Block C

Surface level +8.9 (+29.0 ft)
Water struck at +5.1 m (+17.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 1.20 m
Mineral 6.30 m
Bedrock 0.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt, dark yellow brown	0.45	0.45
Brickearth	Silt, medium yellow brown, containing abundant race in lower 0.20 m	0.75	1.20
Terrace Deposits	'Clayey gravel' Mainly fine and coarse gravel with medium sand. High fines content in top 1.00 m. Gravel content mainly subangular and rounded flint, increasing with depth	6.30	7.50
London Clay	Stiff silty clay, dark yellow brown	0.20+	7.70

GRADING

Mean for Deposit			Bulk Samples Percentages							
	%	mm	%	Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	51	+16	19	1.2	2.2	27	4	18	8	30	13
		-16+4	32	2.2	3.2	5	2	44	12	25	12
				3.2	4.2	18	3	32	7	24	16
Sand	37	-4+1	8	4.2	5.2	9	2	23	8	39	19
		-1+¼	26	5.2	6.2	6	1	27	10	35	21
		-¼+1/16	3	6.2	7.5	8	3	14	6	37	32
Fines	12	-1/16	12								

TQ 98 NW 38 9363 8839 Barling Magna, Essex. Block D

Surface level +7.1 m (+23.5 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Overburden 1.70 m
Mineral 0.90 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silt with scattered gravel	0.60	0.60
Brickearth	Silt with race pebbles; race content increasing with depth	1.10	0.70
Terrace Deposits	'Clayey' gravel Fine and coarse angular and rounded flint gravel with medium to coarse subangular to rounded flint and quartz sand	0.90	2.60
London Clay	Stiff, highly fissured silty clay, medium brown	0.80+	3.40

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
1.7	2.6	10	1	29	6	30	24

TQ 98 NW 39 9245 8651 Southend-on-Sea, Essex. Block D

Surface level +8.9 m (+29.0 ft)
Water struck at +4.5 m (+15.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 3.10 m
Mineral 1.40 m
Bedrock 0.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		1.20	1.20
Brickearth	Silt, firm, medium yellow brown, with race pebbles below 2.00 m. Lower part rather micaceous	1.90	3.10
Terrace Deposits	'Clayey' pebbly sand Mainly medium subangular to subrounded sand with some flint quartz gravel. Rather silty	1.40	4.50
London Clay	Soft medium yellow brown silty clay passing at 4.70 m into stiff highly fissured medium olive brown silty clay	0.50+	5.00

GRADING

Mean for Deposit

See opposite

Depth below surface (m) From	To	Bulk Samples Percentages Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
3.1	4.5	12	5	73	3	5	2

TQ 98 NW 41 9020 8909 Sutton, Essex. Block C

Surface level +10.3 m (+34.0 ft)
Ground water conditions not recorded
Shell, 152 mm diameter
June 1973

Overburden 0.70 m
Mineral 2.50 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy gravelly silt	0.70	0.70
Terrace Deposits	'Clayey' sandy gravel Fine and coarse gravel with medium sand. Gravel composed of angular to rounded flint, becoming coarser with depth. Fines content increasing with depth	2.50	3.20
London Clay	Stiff, highly fissured, dark yellow brown clay. Scattered selenite crystals present	0.80+	4.00

GRADING

Mean for Deposit

	%	mm	%
Gravel	46	+16	24
		-16+4	22
Sand	42	-4+1	9
		-1+$\frac{1}{4}$	28
		-$\frac{1}{4}$+1/16	5
Fines	12	-1/16	12

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
1.10	2.10	7	7	34	9	28	15
2.10	3.20	16	4	23	9	16	32

TQ 98 NW 42 9049 8971 Sutton, Essex. Block C

Surface level +5.6 m (+18.5 ft)
Water struck at +4.6 m (+15.0 ft)
Shell, 152 mm diameter
June 1973

Overburden 1.00 m
Mineral 1.50 m
Bedrock 0.85 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Very sandy gravelly silt	0.70	0.70
Terrace Deposits	Sandy clayey silt with gravel; carbonaceous material present	0.30	1.00
	Pebbly sand Mainly medium sand with some fine angular to subrounded flint gravel; rather silty	1.50	2.50
London Clay	Stiff, silty, highly fissured clay, dark yellow brown; scattered selenite crystals present	0.85+	3.35

GRADING

Mean for Deposit				Bulk Samples Percentages							
	%	mm	%	Depth below Surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Gravel	7	+16	0	1.0	2.0	7	7	72	6	8	0
		-16+4	7	2.0	2.5	6	8	76	5	5	0
Sand	86	-4+1	6								
		-1+$\frac{1}{4}$	73								
		-$\frac{1}{4}$+1/16	7								
Fines	7	-1/16	7								

TQ 98 NW 43 9235 8898 Barling Magna, Essex. Block C

Surface level +7.3 m (+24.0 ft)
Water not struck
Shell, 152 mm diameter
June 1973

Waste 1.40 m
Bedrock 0.90 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt	0.30	0.30
Terrace Deposits	Sandy silt, olive grey	0.40	0.70
	Medium sand with fine gravel, rather silty	0.70	1.40
London Clay	Stiff silty clay, dark yellow brown, highly fissured	0.90+	2.30

TQ 98 NW 51 9150 8794 Great Wakering, Essex. Block C

Surface level +14.4 m (+47.0 ft)
Water not struck
Shell 203 mm diameter
December 1973

Overburden 0.9 m
Mineral 1.2 m
Bedrock 2.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Head	Stiff clayey silt with gravel, moderate yellowish brown	0.9	0.9
Terrace Deposits	Sandy gravel Mainly medium sand with coarse and fine gravel. Gravel composed of angular to subangular flints and rounded to subrounded Tertiary pebbles	1.2	2.1
London Clay	Stiff silty sandy clay, moderate yellowish brown with streaks of pale blue clay, slightly carbonaceous along fissure planes. Passes at 2.40 m into stiff silty clay, dark yellowish brown and moderately fissured. Selenite crystals occur below 3.3 m	2.3+	4.4

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
1.0	2.0	3	5	33	16	30	13

TQ 98 NW 55 9485 8973 Great Wakering, Essex. Block E

Surface level +0.9 m (+3.0 ft)
Water struck at -3.2 m (-10.5 ft)
Shell, 203 mm diameter
March 1974

Overburden 4.25 m
Mineral 8.65 m
Bedrock 1.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Alluvium	Firm clayey silt, pale brown, becoming softer and less clayey with depth. Soft, sandy silt at the base, light olive grey with gravel and race	4.25	4.25
?Terrace Deposits	Sandy gravel Fine, medium and coarse sand and gravel. Gravel decreases in size and percentage with depth	8.65	12.90
London Clay	Firm clayey silt with mica, light olive grey and mottled; becomes more silty and less clayey at 14.00 m. Fissuring present	1.60+	14.50

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	34	+16	11	4.6	5.4	2	2	26	5	40	25
		+4-16	23	5.4	6.2	1	2	28	9	29	31
				6.5	7.2	1	4	43	14	27	11
Sand	65	+1-4	12	7.2	7.9	1	3	43	15	24	14
		+¼-1	47	7.9	8.7	1	6	52	17	23	1
		+1/16-¼	6	8.7	9.5	1	8	56	13	18	4
				9.5	10.0	1	11	65	13	9	1
Fines	1	-1/16	1	10.3	10.8	1	10	60	13	13	3
				10.8	11.5	1	9	66	14	9	1
				11.6	12.3	2	7	64	12	12	3
				12.3	12.9	1	6	27	6	39	21

TQ 98 NW 56 9428 8904 Little Wakering, Essex. Block E

Surface level +3.3 m (+11.0 ft)
Water struck at +1.5 m (+5.0 ft)
Shell, 203 mm diameter
March 1974

Waste 2.15 m
Bedrock 5.65 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.95	0.95
Estuarine Alluvium	Sandy silty clay becoming stiff, light brown, with light grey patches with increasing depth. Dark yellowish brown silty clay with fractures and some light grey fine to coarse flint gravel	1.20	2.15
London Clay	Weathered becoming less disturbed firm yellowish brown silty clay with pale blue mottling, micaceous. Selenite occurs below 5.80 m	5.65+	7.80

TQ 98 NE 8 9619 8817 Great Wakering, Essex. Block E

Surface level +2.1 m (+7.0 ft)
Water struck at +1.0 m (+3.5 ft)
Shell, 203 mm diameter
November 1973

Overburden 4.40 m
Mineral 1.70 m
Waste 3.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt	0.50	0.50
Estuarine Alluvium	Mainly silt, clayey and sandy in parts, soft, olive brown to yellow brown; some mica present. A 0.20 m layer of peaty silt present below 3.10 m	3.10	3.60
Buried Channel Deposits	Gravelly sandy silt becoming more gravelly and sandy with depth. Gravel composed of subangular and subrounded flint with some race	0.80	4.40
	Pebbly Sand Mainly medium sand with fine gravel. Gravel composed of subangular to rounded flint with quartzite, sandstone and rare igneous rock fragments. Some broken shells. Fines decreasing with depth	1.70	6.10
Estuarine Alluvium	Sandy silty clay, firm, some fissuring towards base; greyish green to greenish yellow with yellow brown mottling	3.10	9.20
?Terrace Deposits	Gravel, subrounded and rounded flint	0.10+	9.30

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	22	+16	4	4.60	4.90	14	4	49	15	16	2
		-16+4	18	4.90	6.00	4	2	54	17	19	4
Sand	72	-4+1	17								
		-1+¼	53								
		-¼+1/16	2								
Fines	6	-1/16	6								

TQ 98 NE 9 9532 8667 Great Wakering, Essex. Block E

Surface level +2.1 m (+7.0 ft)
Water struck at +0.95 m (+3.0 ft)
Shell, 203 mm diameter
December 1973

Waste 13.10 m
Bedrock 2.55 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt, dark yellow brown	0.50	0.50
Estuarine Alluvium	Sandy clayey silt, stiff becoming soft with depth. Medium yellow brown streaked with yellow green and dark grey	2.80	3.30
? Terrace Deposits	Silty sandy gravel becoming clayey silty sand with depth. Some fine and coarse angular, subangular and rounded flint gravel in upper 0.80 m	2.50	5.80
	Fine and medium sand with high fines content. Some flint and shell fragments in coarse sand	3.70	9.50
Buried Channel Deposits	Firm silty sandy clay, dark olive brown. Basal 0.30 m soft sandy silt	2.30	11.80
	'Clayey' gravel Fine and coarse angular to subangular flint gravel with pebbles of quartz, quartzite and igneous rocks. Some shell material present. A 0.80 m layer of gravel with cobbles (+64 mm material) at base	1.30	13.10
London Clay	Stiff, highly fissured, silty clay, olive grey, with selenite crystals	2.55+	15.65

GRADING

Mean for Deposit

	%	mm	%
Gravel	75	+16	53
		-16+4	22
Sand	13	-4+1	3
		-1+¼	9
		-¼+1/16	1
Fines	12	-1/16	12

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
11.8	12.3	22	3	9	5	36	25
12.3	13.1	5	0	9	2	14	70

TQ 98 NE 10 9961 8976 Foulness Island, Essex. Block E

Surface level +2.2 m (+7.0 ft)
Water struck at -3.1 m (-10.0 ft)
Shell, 203 mm diameter
December 1972

Waste 17.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt, medium yellow brown	0.60	0.60
Estuarine Alluvium	Mainly silt and clay, soft, sandy in parts with scattered pebbles of flint and quartz. Occasional layers of shell material	13.60	14.20
Buried Channel Deposits	Gravelly sand Mainly medium sand, silty, with some fine gravel in top 1.00 m overlying 1.00 m of fine and coarse gravel which in turn overlies medium sand with fine gravel. Gravel composed of subrounded and rounded flint and scattered cobbles	3.4+	17.60

GRADING

Mean for Deposit

	%	mm	%
Gravel	43	+16	19
		-16+4	24
Sand	49	-4+1	7
		$-1+\frac{1}{4}$	37
		$-\frac{1}{4}+1/16$	5
Fines	8	-1/16	8

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Gravel +1-4	+4-16	+16
14.6	15.6	12	8	53	11	14	2
15.6	16.6	1	2	9	3	38	47
16.6	17.6	11	4	50	6	20	9

Grading data given as termination of borehole leaves Terrace Deposit as unproven mineral

TQ 98 NE 11 9538 8727 Great Wakering, Suffolk. Block D

Surface level +6.7 m (+22.0 ft)
Water struck at +1.8 m (+6.0 ft)
Shell, 203 mm diameter
January 1973

Overburden 1.95 m
Mineral 5.15 m
Bedrock 1.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.50	0.50
Brickearth	Clayey silt, medium yellow brown, with abundant race pebbles in lower 0.85 m	1.45	1.95
Terrace Deposits	Sandy gravel Mainly medium sand with fine and coarse gravel concentrated in top 1.00 m and basal 2.00 m. Deposit rather silty. Gravel of subangular and rounded flint with scattered cobbles	5.15	7.10
London Clay	Stiff, highly fissured medium yellow brown silty clay passing at 7.20 m into medium olive brown clay	1.60+	8.70

GRADING

Mean for Deposit

	%	mm	%
Gravel	28	+16	11
		-16+4	17
Sand	63	-4+1	8
		-1+$\frac{1}{4}$	52
		-$\frac{1}{4}$+1/16	3
Fines	9	-1/16	9

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Gravel +1-4	+4-16	+16
2.0	3.0	3	1	22	7	33	34
3.0	4.0	12	4	64	8	8	4
4.0	5.0	9	3	74	8	6	0
5.0	6.0	10	3	60	8	16	3
6.0	7.0	10	4	43	10	20	13

TQ 98 NE 12 9537 8829 Great Wakering, Essex. Block D

Surface level +1.8 m (+6.0 ft)
Water not struck
Shell, 203 mm diameter
January 1973

Waste 1.80 m
Bedrock 1.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground	Silt and silty sand with gravel. Scattered shell fragments in lower 0.25 m	0.85	0.85
?London Clay Head	Slightly sandy silty clay with some rounded flint gravel	0.95	1.80
London Clay	Stiff silty clay, highly fissured dark yellowish brown	1.50+	3.30

TQ 98 NE 13 9805 8826 Havengore Island, Essex. Block E

Surface level +1.1 m (+3.5 ft)
Water struck at -0.4 (-1.5 ft)
Shell, 203 mm diameter
December 1972

Waste 10.60 m
Bedrock 3.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silty fine sand, medium yellow brown	0.60	0.60
Estuarine Alluvium	Silty clayey fine sand with shell material, laminated. Yellow green becoming dark olive brown with depth	2.40	3.00
	Soft clayey silt and silty clay with carbonaceous plant remains. Dark yellow brown and olive brown becoming medium blue at 7.50 m. A 0.10 m peat band encountered at 3.50 m	7.00	10.00
	Sandy clayey silt, medium olive brown, soft	0.60	10.60
London Clay	Stiff, fissured, dark yellow brown silty clay. Some sand lenses and scattered crystals of selenite	3.80+	14.40

TQ 98 NE 19 9562 8932 Potton Island, Essex. Block E

Surface level +1.0 m (+3.5 ft)
Water not struck
Shell, 203 mm diameter
April 1974

Overburden 10.65 m
Mineral 5.10 m
Bedrock 1.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.50	0.50
Estuarine Alluvium	Medium grey to dark grey, very soft clayey silt, mottled brown and greyish black with shell patches and plant debris. At 6.65 m dark yellowish brown soft silty sand with shell fragments and rare flint pebbles	10.15	10.65
Buried Channel Deposits	?Sandy gravel* Light olive brown soft sand with angular to subangular fine flints. At 12.50 m yellowish brown subangular to subrounded very sandy flint gravel with subrounded flint cobbles	5.10	15.75
London Clay	Dark olive grey hard silty clay	1.70+	17.45

* (No grading information available)

TQ 98 NE 33 9605 8836 Great Wakering, Essex. Block E

Surface level +0.8 m (+2.5 ft)
Water struck at -0.7 m (-2.5 ft)
Shell, 203 mm and 152 mm diameter
March 1974

Waste 10.0 m
Bedrock 5.25 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.60	0.60
Estuarine Alluvium	Silty clay medium dark grey, dark greenish grey and dark yellowish brown. Mottled. Lenses of peat	5.40	6.00
	Gravelly clayey silt. Fine to medium. Angular to well rounded flint and subangular to sub-rounded vein quartz. Becoming more sandy. Gravel content increasing	1.20	7.20
	Silty clay and clayey silt intercalated. Yellowish brown to light olive grey, laminated	2.80	10.00
London Clay	Silty clay, olive grey, stiff with scattered fine to coarse angular to subangular flint pebbles. Clay becoming slightly more silty with flecks of mica and selenite clusters	5.25+	15.25

TQ 98 NE 34 9683 8727 Foulness, Essex. Block E

Surface level +1.5 m (+5.0 ft)
Water struck at -4.8 m (- 15.5 ft)
Shell, 203 mm diameter
May 1974

Overburden 6.70 m
Mineral 9.05 m
Bedrock 3.35 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Topsoil with small roots	0.20	0.20
Estuarine Alluvium	Clay, laminated with silt and fine sand. Deposit brown and mottled, becoming grey to black with depth and increasingly sandy. Some fine gravel present below 5.2 m. Shell material present	6.50	6.70
Buried Channel Deposits	Sandy gravel Medium to coarse gravel, yellow brown, with mainly coarse sand	9.05	15.75
London Clay	Brown silty clay, becoming blue and fissured with depth	3.35+	19.10

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand $+\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Gravel	45	+16	9	6.7	7.7	4	3	25	16	37	15
		-16+4	36	8.7	10.7	3	6	53	12	18	8
				11.7	13.7	1	2	22	16	51	9
Sand	53	-4+1	15	14.7	15.7	2	3	31	17	39	6
		-1+$\frac{1}{4}$	34								
		-$\frac{1}{4}$+1/16	4								
Fines	2	-1/16	2								

TQ 98 NE 40 9778 8932 Foulness, Essex. Block E

Surface level +1.8 m (+6.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
April 1974

Waste 10.40 m
Bedrock 3.45 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Topsoil	0.15	0.15
Estuarine Alluvium	Sandy clay with some fine gravel and shell fragments. Deposit is dark yellowish brown, with laminations and some organic material present	5.25	5.40
	Greyish black clayey silt with peaty patches	0.20	5.60
	Clayey silt becoming sandy and gravelly with depth. Dark yellowish brown, soft, scattered carbonized wood fragments present	4.80	10.40
London Clay	Moderate yellowish brown clay with scattered gravel, becomes dark olive grey hard silty clay with depth	3.45+	13.85

TQ 99 NW 23 9112 9573 Canewdon, Essex. Block E

Surface level +0.8 m (+2.5 ft)
Water struck at -6.2 m (-20.5 ft)
Shell, 203 mm diameter
November 1972

Waste 7.80 m
Bedrock 3.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.15	0.15
Estuarine Alluvium	Silty clay, soft, mottled medium yellow brown and blue with abundant shell material	1.15	1.30
	Clayey silt with fine sand, soft, dark grey	0.60	1.90
	Silty clay, firm, medium olive brown	0.60	2.50
	Clay and silt, firm to stiff, medium yellow brown. Some shell debris in upper part and a 0.05 m layer of gravel below 3.75 m becoming sandy towards base	4.40	6.90
? Terrace Deposits	Fine subangular to subrounded flint gravel passing at 7.20 m into coarse clayey sand with fine flint gravel. Contains scattered clay intraclasts	0.90	7.80
London Clay	Silty clay, stiff dark brown, fissured in lower part, passing at 9.80 m into stiff silty clay, dark blue moderately fissured	3.0+	10.80

TQ 99 NW 24 9185 9557 Canewdon, Essex. Block E

Surface level +1.9 m (+6.0 ft)
Water struck at -0.2 m (-0.5 ft)
Shell, 203 mm diameter
November 1972

Waste 10.60 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty clay, firm	0.40	0.40
Estuarine Alluvium	Silty clay, soft, mottled brown and blue	1.15	1.55
	Silty clay, very soft, olive brown to dark grey containing scattered carbonaceous material	4.75	6.30
	Silty clay containing brown peat in layers	0.20	6.50
	Silty clay, medium brown with scattered subangular flint pebbles	0.70	7.20
? Terrace Deposits	Silty sand with coarse subangular to subrounded flint gravel	0.60	7.80
	Sandy silty clay. Firm to stiff with some gravel in upper 0.80 m and lower 0.30 m	1.50	9.30
	Coarse sand with fine gravel. Gravel of subrounded and rounded flint	1.30	10.60
London Clay	Silty clay, stiff, mottled medium yellow brown and blue	0.80+	11.40

TQ 99 NW 34 9076 9549 Canewdon, Essex Block B

Surface level +2.7 m (+9.0 ft)
Water not struck
Shell, 203 mm diameter
March 1974

Waste 1.2 m
Bedrock 2.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Head	Firm very silty clay. Abundant roots and carbonaceous remains. Subangular to subrounded flints	1.2	1.2
London Clay	Firm brown silty clay with blue vertical veins. Becoming highly fissured	2.3+	3.5

TQ 99 NW 35 9075 9563 Canewdon, Essex. Block B

Surface level +1.9 m (+6.0 ft)
Water not struck
Shell, 203 mm diameter
March 1974

Waste 2.8 m
Bedrock 1.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Alluvium	Firm to very soft silty clay yellowish brown and mottled with blue green patches	1.6	1.6
Head	Firm very silty clay with scattered flint pebbles, yellowish brown with blue grey veins. Becoming stiff brown and micaceous with reduction in veining	1.2	2.8
London Clay	Silty clay containing more silty patches of bright orange. Streaks of very fine sand	1.2+	4.0

TQ 99 NW 36 9216 9511 Canewdon, Essex. Block E

Surface level +2.6 m (+8.5 ft)
Water not struck
Shell, 203 mm diameter
March 1974

Waste 7.6 m
Bedrock 1.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Estuarine Alluvium	Firm alternating with soft grey and brown silty clay. Silt, becoming sandy and micaceous at 6.5 m	7.6	7.6
London Clay	Stiff brown very silty clay with patches of fine silty micaceous sand and fine glauconitic sand, greenish yellow orange. Carbonized roots and small race nodules occur	1.2+	8.8

TQ 99 NW 37 9255 9562 Canewdon, Essex. Block E

Surface level +1.1 m (+3.5 ft)
Water not struck
Shell, 203 mm diameter
March 1974

Waste 14.1 m
Bedrock 1.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Estuarine Alluvium	Firm to soft silty clay, grey and brown at top through to grey green and light olive becoming sandy and micaceous at 1.5 m	5.8	5.8
	Grey micaceous sand interspersed with dark grey and olive silts, soft to firm, containing carbonized roots. At 10.00 m, fine sandy silt with complete shells and olive grey laminae. Shell debris throughout	6.8	12.6
	Fine sandy clay, soft to firm with mica and carbonized roots, olive grey at 12.6 m. Becoming sand and gravel fine and medium with subangular and subrounded flints and worn shell debris	1.5	14.1
London Clay	Stiff brown very silty clay with pebbles in top 0.50 m. Finely laminated	1.2+	15.3

TQ 99 NW 38 9076 9621 Canewdon, Essex. Block E

Surface level +0.6 m(+2.0 ft)
Water not struck
Shell 203 mm diameter
March 1974

Waste 11.8 m
Bedrock 0.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Estuarine Alluvium	Firm to very soft, very silty clay, brown, becoming clayey silt, blue grey to greenish grey with carbonized roots. Slightly darker grey from 6.1 m. Coarser with abundant mica and brown streaks at 7.3 m	9.5	9.5
	Firm micaceous fine sandy clay, grey brown with carbonaceous streaks and patches of race nodules. Finely laminated	1.3	10.8
	Sand and gravel with some cominuted shells. Gravel fine medium and coarse, subangular: rounded 50:50. Septarian nodule fragments	1.0	11.8
London Clay	Stiff brown silty clay with excessive fissuring	0.2+	12.0

TQ 99 NW 39 9145 9606 Canewdon, Essex. Block E

Surface level +0.3 m (+1.0 ft)
Water struck at -8.5 m (-28.0 ft)
Shell, 203 mm diameter
March 1974

Waste 18.2 m
Bedrock 0.6 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Estuarine Alluvium	Soft alternating with very soft clayey silt, grey green to brown often mottled sometimes laminated. Shells at top. At 2.5 m increase in grain size and mica to micaceous very fine sand	3.8	3.8
	Micaceous clayey silt finely laminated. Yellowish laminae. Becoming very fine sandy silt, yellowish, with medium dark grey very fine sandy silt laminae	4.5	8.3
	Dark yellowish grey soft silty sand, mottled, passing into soft black silty micaceous dark grey very fine sand with broken shells	0.6	8.9
	Firm very fine sandy clay mottled brown grey and grey green with rare subangular flints and shells. Bed of silty fine sand lying above coarse sand and fine to medium gravel at 10.00 m	1.3	10.2
	Stiff to firm silty fine sandy clay becoming more silty varying from greenish yellow through pale olive green, dark green grey to brown. Bands containing broken shells coarse gravel and fine sand grade, subangular quartz fragments and carbonaceous roots. Beds up to 5 cms thick of sand and gravel (20:80) with fine, medium and coarse grade pebbles at 17 m	8.0	18.2
London Clay	Stiff very fine sandy silty clay moderate yellowish brown: micaceous and containing carbonaceous roots	0.6+	18.8

TQ 99 NW 41 9308 9510 Canewdon, Essex. Block E

Surface level +1.3 m (+4.5 ft)
Water struck at +0.3 m (+1.0 ft)
Shell, 203 mm and 152 mm diameter
January - February 1974

Waste 14.20 m
Bedrock 0.85 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty clay	0.25	0.25
Estuarine Alluvium	Firm light brown silty clay passing at 0.90 m into soft to very soft clay and silt with some sand, mainly greenish grey to dark olive grey. Sand increasing with depth	8.15	8.40
	Sandy clayey silt, olive grey, very soft, with scattered shell material. Shell content increasing with depth	1.90	10.30
	Soft sandy clayey silt, becoming firm with depth, light to medium olive brown. Some rootlets and carbonaceous patches	1.30	11.60
	Firm sandy clayey silt with rootlets and shell material. Medium olive brown and yellow green with streaks of light olive brown. Clay increasing with depth	0.80	12.40
?Terrace Deposits	Medium to coarse sand with fine and some coarse gravel. Gravel composed of rounded Tertiary and subangular to angular flint pebbles	1.80	14.20
London Clay	Stiff silty clay, dark yellowish brown streaked with medium to light bluish grey	0.85+	15.05

TQ 99 SE 3 9509 9248 Paglesham, Essex. Block E

Surface level +0.6 m (+2.0 ft)
Water struck at -5.1 m (-17.0 ft)
Shell, 203 mm diameter
October 1972

Waste 15.80 m
Bedrock 0.95 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt, greyish brown	0.25	0.25
Estuarine Alluvium	Silty clay, stiff, mottled medium brown to yellowish brown, fissured	0.55	0.80
	Clayey silt, soft, medium brown becoming dark bluish grey at 1.35 m. Some sand towards base, colour changing to light yellowish brown at 6.00 m	5.85	6.65
	Fine sandy silt and clay, greyish green with shell material and rare flint pebbles	1.85	8.50
	Silty clay, soft to firm, greyish green to olive brown becoming dark bluish grey towards base	3.25	11.75
	Clayey silt, soft dark greenish grey with streaks of organic material passing, at 13.40 m into dark grey sandy silt and clay with abundant organic material	2.95	14.70
	Fine to medium sand green, passing at 14.90 m into fine, medium and coarse sand with fine subrounded and rounded flint gravel	1.10	15.80
London Clay	Silty clay, stiff, dark grey becoming firm, sandy and olive grey at 16.20 m	0.95+	16.75

TQ 99 SE 4 9549 9463 Canewdon, Essex. Block E

Surface level +1.5 m (+5.0 ft)
Water struck at -0.5 m (-1.5 ft)
Shell, 203 mm diameter
November 1972

Waste 16.30 m
Bedrock 1.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt, stiff, light brown	0.70	0.70
Estuarine Alluvium	Fine sand with silt and clay, firm becoming soft to very soft with depth. Brown and yellow brown at top passing through bluish grey into dark grey at 2.80 m. Some mica present. Laminations of dark grey clay and olive grey silty sand in basal 1.60 m	7.10	7.80
	Silty sand, dark grey, with shell fragments	1.10	8.90
	Clayey sandy silt, dark olive brown to dark grey, laminated in parts, some mica present; becoming more sandy with depth	6.10	15.00
?Terrace Deposits	Sandy silty clay, olive grey with fine and coarse gravel. Gravel composed of subrounded and rounded flint. Some shell material present in upper part	1.30	16.30
London Clay	Silty clay, medium brown, firm to stiff with some sand and gravel in upper 0.60 m	1.60+	17.90

TQ 99 SE 5 9740 9467 Canewdon, Essex. Block E

Surface level +0.4 m (+1.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
November 1972

Waste 22.40 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.20	0.20
Estuarine Alluvium	Silty clay, stiff, mottled yellowish brown and light blue. Becoming soft and more clayey towards base. Some fine sand lenses	0.90	1.10
	Silty clay, soft, olive grey and dark grey with fine sand lenses and carbon rich bands. More sandy and medium olive grey in basal 0.80 m	5.50	6.60
	Fine silty sand, olive black, soft becoming olive brown to light olive grey and containing shell material below 10.50 m	5.20	11.80
	Fine and coarse subangular and rounded flint gravel with silty sandy clay. Some shell material present	1.20	13.00
	Clayey silty sand, soft to firm, greyish green and brown	5.20	17.20
	Fine and coarse subrounded to rounded flint gravel with fine to coarse light olive grey sand	5.20	22.40
London Clay	Silty clay, stiff, medium yellowish brown with pyrite, mica and selenite crystals passing at 22.50 m into stiff silty clay, fissured	1.00+	23.40

TQ 99 SE 7 9895 9396 Foulness, Essex. Block E

Surface level +2.8 m (+9.0 ft) Waste 9.50 m+
Ground water conditions not recorded
Shell, 203 mm diameter
December 1972

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Estuarine Alluvium	Fine sand and clayey silt, yellowish brown and greyish purple, with roots, stiff becoming more silty, soft, and pale yellowish brown with depth	1.40	1.70
	Fine sand with clay, soft dark grey to olive grey	1.70	3.40
	Fine sand with silt, rather clayey, soft, medium grey to dark olive grey. Some shell material at 4.00 m	6.10+	9.50

TQ 99 SE 8 9751 9130 Foulness, Essex. Block E

Surface level +1.5 m (+5.0 ft) Waste 14.00 m+
Water struck at -0.8 m (-2.5 ft)
Shell, 203 mm diameter
January 1973

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt, yellowish brown	0.50	0.50
Estuarine Alluvium	Silty clay, stiff, mottled yellowish brown and medium greenish grey. Highly fissured	1.30	1.80
	Sandy clayey silt, carbonaceous, olive grey to greenish black becoming more clayey, less sandy and uniformly olive grey with depth	9.40	11.20
	Sandy silt with some angular flint pebbles, yellowish brown becoming olive grey with depth	1.20	12.40
	Silty sandy gravel: gravel fine and coarse flint, coarse mainly angular to subangular and fine rounded	0.60	13.00
	Gravel, fine and coarse angular flint. Some medium sand of clear quartz with shell fragments	1.00+	14.00

TQ 99 SE 9 9500 9103 Barling Magna, Essex. Block E

Surface level +1.5 m (+5.0 ft)
Water struck at -2.5 m (-8.0 ft)
Shell, 203 mm diameter
December 1972

Waste 11.60 m
Bedrock 4.90 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silty clay	0.30	0.30
Estuarine Alluvium	Fine sand, silt and clay, soft, yellowish grey to light olive brown with root traces. Clay laminated. Thin lenses of sand present	1.50	1.80
	Fine silty sand, very soft, light to medium olive grey with dark grey layers	2.20	4.00
	Fine silty sand, olive to greyish black, very soft	5.50	9.50
	Sandy clayey silt, light olive grey, soft becoming firm and yellowish grey with depth. Some calcareous concretions in lower 1.30 m	1.50	11.00
	Sandy clayey silt with fine and coarse subangular flint gravel. Some root traces	0.60	11.60
London Clay	Silty clay, stiff, excessively fissured, dark yellowish brown passing at 12.30 m into dark brownish grey clay	2.60	14.20
	Silty clay, olive grey, stiff, highly fissured some scattered pyrite	2.30+	16.50

TQ 99 SE 24 9588 9228 Barling Magna, Essex. Block E

Surface level +1.6 m (+5.0 ft) Waste 9.80 m+
Water struck at -5.3 m (-17.5 ft)
Shell, 203 mm diameter
April 1974

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.10	0.10
Estuarine Alluvium	Mainly clayey silt, firm, brown, becoming blue grey and dark grey green with depth. Contains organic material	1.35	1.45
	Silty clay, very soft, brown with blue mottling, containing abundant shell material	1.00	2.45
	Clayey silt, soft to very soft, varying in colour from yellow brown to dark olive grey, laminated in parts. Patches of organic material present	3.95	6.30
	Mainly peat with silty clay and fine sand, medium yellow brown to light blue grey	0.40	6.70
	Clayey silt with fine sand, medium yellow brown, containing carbonaceous patches and scattered race nodules	1.10	7.80
	Sandy silty clay, yellow brown, stiff, laminated, some carbonaceous patches	2.00+	9.80

TQ 99 SE 25 9616 9023 Barling Magna, Essex. Block E

Surface level +1.6 m (+5.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
April 1974

Overburden 5.75 m
Mineral 1.95 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.05	0.05
Estuarine Alluvium	Mainly clayey silt, sandy in places, dark yellowish brown, firm becoming olive grey and soft with depth. Some organic matter and scattered calcareous nodules	1.15	1.20
	Peaty fine sandy clayey silt, olive grey, dark yellowish orange and black, firm to soft	0.90	2.10
	Fine sandy silt changing gradually to silty sand with depth. Predominantly medium yellowish brown with dark grey patches of organic matter. Some scattered race nodules	3.65	5.75
Buried Channel Deposits	Gravel Silty fine to medium sand with gravel passing, with depth into fine and coarse gravel with medium sand. Gravel fractions composed of subangular to subrounded flint with scattered comminuted shells	1.95	7.70
London Clay	Firm sandy clayey silt, dark yellow brown, excessively fissured, containing laminae of fine sand, passing, at 8.30 m into slightly sandy, very silty clay, firm, olive grey, highly fissured	1.20+	8.90

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	52	+16	24	6.2	6.5	2	5	19	4	33	37
		-16+4	28	6.5	7.0	2	4	37	7	27	23
				7.0	7.7	3	4	41	7	26	19
Sand	45	-4+1	6								
		-1+¼	35								
		-¼+1/16	4								
Fines	3	-1/16	3								

TQ 99 SE 26 9584 9119 Barling Magna, Essex. Block E

Surface level +0.8 m (+2.5 ft)
Water struck at -11.1 m(-36.5 ft)
Shell, 203 mm diameter
April 1974

Waste 15.50 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Dark brown with some shell material	0.30	0.30
Estuarine Alluvium	Firm to soft silty clay, brown and blue grey with carbonaceous material in top 0.40 m	1.10	1.40
	Mainly silt with sandy lenses, soft to very soft, dark grey to black becoming light grey brown and finally light olive with depth	3.60	5.00
	Silt, soft to very soft, dark grey, becoming sandy, dark olive grey to light olive grey with depth. Abundant shell material present	6.90	11.90
	Silty sand, soft with scattered pebbles of subangular to subrounded flint. Silt content decreasing with depth. Scattered shell material present	1.10	13.00
	Sandy clayey silt firm, mottled grey and brown passing, at 13.90 m into silty fine to medium sand with about 50% subangular to well rounded flint gravel	2.50	15.50
London Clay	Stiff, laminated silty clay, grey brown to light olive grey. Top 0.30 m contains scattered pyrite concretions	1.20+	16.70

TQ 99 SE 27 985 913 Foulness, Essex. Block E

Surface level +1.1 m (+3.5 ft)
Water struck at -1.4 m (-4.5 ft)
Shell, 203 mm and 152 mm diameter
April 1974

Waste 17.30 m
Bedrock 4.15 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.25	0.25
Estuarine Alluvium	Mainly silty clay, sandy towards base, firm, light brown to yellowish brown with reduced blue grey zones. Some organic material present	1.85	2.10
	Silt with fine sand, olive grey to grey green, soft to very soft. Organic material present, becoming more abundant with depth. Deposit shows laminations in parts	3.35	5.45
	Silt, very soft, yellowish green, olive grey and yellowish brown. Sandy in parts with scattered organic and shelly material	4.90	10.35
	Mainly clay with fine sand and some silt. Deposit shows wide colour variation but is mainly dusky yellow green, olive brown or dark yellowish orange. Scattered flint pebbles present, especially in top 0.15 m and basal 1.50 m	6.40	16.75
	Fine to medium sand with subrounded to well rounded flint and rounded vein quartz gravel	0.55	17.30
London Clay	Stiff silty clay, dark yellowish brown fissured changing, at 18.30 m to light olive grey, well fissured and, at 20.00 m to greenish black	4.15+	21.45

TQ 99 SE 28 9912 9056 Foulness, Essex. Block E

Surface level +1.3 m (+4.5 ft)
Water struck at -0.9 m (-3.0 ft)
Shell, 203 mm diameter
April 1974

Overburden 12.00 m
Mineral 5.10 m
Bedrock 3.55 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt, dark brown	0.20	0.20
Estuarine Alluvium	Mainly sandy clayey silt, firm, becoming soft at 0.60 m. Greenish grey passing into yellowish brown and olive to bluish grey and, at about 1.60 m into yellow brown. Basal 1.35 m blue to greenish grey. Shell material present in top 0.55 m and from 4.90 m to 5.50 m. Organic material present throughout	6.05	6.25
	Silt, black, firm, becoming dark grey towards base	0.20	6.45
	Mainly silt with varying amounts of clay and sand dull yellowish brown becoming olive brown with depth. Scattered shell fragments present below 9.50 m; subrounded flint pebbles present from 11.00 m to 11.40 m	5.55	12.00
Buried Channel Deposits	? 'Clayey' sandy gravel * Fine to medium sand with varying amounts of subrounded flint gravel; shell material present throughout. A band of sandy silty clay with scattered flint pebbles present at 13.70 m to 13.90 m	5.10	17.10
London Clay	Dark yellowish brown silty clay with wisps of fine sand passing at about 18.00 m into medium olive grey silty clay	3.55+	20.65

* (No grading information available)

TQ 99 SE 29 9895 9348 Foulness, Essex. Block E

Surface level +2.5 m (+8.0 ft)
Ground water conditions not recorded
Shell, 203 mm and 152 mm diameter
March 1974

Waste 20.50 m
Bedrock 5.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil and made ground	Sand, clay and hardcore	0.20	0.20
Estuarine Alluvium	Mainly silt with varying amounts of sand and clay, firm becoming soft with depth. Wide range of colouration but chiefly black, yellow brown, blue grey and olive grey. Bands of shells present and organic material common. Becoming more sandy with depth	5.75	5.95
	Fine sand, silty, dark olive grey becoming olive black with depth. Shells present throughout, but abundant in basal 0.25 m	11.90	17.85
	Clayey gravelly silt, dark yellow brown mottled with pale yellow brown. Gravel composed of subangular to rounded flint with some rounded vein quartz pebbles. Deposit becoming less silty with depth and changing to light olive grey	2.65	20.50
London Clay	Silty clay, firm to stiff, dark yellowish brown becoming dark olive grey at 20.70 m. A 60 mm - 80 mm thick layer of cementstone encountered at 24.30 m	5.10+	25.60

TQ 99 SE 30 9527 9337 Canewdon, Essex. Block E

Surface level -0.1 m (-0.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
May 1974

Waste 15.70 m
Bedrock 2.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Estuarine Alluvium	Silt and clay in varying proportions. Black grey to brown, some mottling. Deposit very soft to firm	7.10	7.40
	Sandy silty clay, stiff, brown and fissured, becoming more sandy with depth. Some fine gravel and siltstone nodules present low in this section	2.20	9.60
	Laminated silt and fine sand, moderate dark yellowish brown	3.60	13.20
	Coarse sand with gravel, brown, containing a band of grey brown mottled, laminated silty clay with gravel	2.50	15.70
London Clay	Blue clay	2.80+	18.50

TQ 99 SE 31 9954 9152 Foulness, Essex. Block E

Surface level +2.2 m (+7.0 ft)
Ground water conditions not recorded
Shell, 254 mm and 203 mm diameter
May 1974

Waste 15.60 m
Bedrock 2.95 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Topsoil	0.50	0.50
Estuarine Alluvium	Silty fine sand, fining to silty clay with depth, then becoming coarser again to fine sand. Deposit predominantly grey brown to grey with black clay present, soft to very soft	12.00	12.50
	Green and brown sand and gravel with shells and shell fragments	3.10	15.60
London Clay	Clay with some sand and gravel in upper part. Clay brown becoming blue with depth	2.95+	18.55

TQ 99 SE 32 9717 9370 Canewdon, Essex. Block E

Surface level +0.8 m (+2.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 23.75 m
Bedrock 3.25 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground		0.45	0.45
Estuarine Alluvium	Clayey silt, mottled light to moderate yellowish brown, speckled bluey green. Scattered shells present. Deposit soft with firm balls of brown silty clay. Peat bands and laminae present	6.15	6.60
	Silty fine sand becoming clayey with depth. Medium dark grey and olive grey. Scattered shells present and also shells in bands associated with fine gravel or sand. Deposit becomes firm clayey silt with loss of sand with depth. Fissured, some organic matter present	14.10	20.70
	Fine, medium and coarse sand, and gravel. At first silty and clayey becoming less so with depth. Scattered shells and cobbles. Reworked septarian nodules present	0.40	21.10
London Clay Head	Firm, very silty clay with some gravel and organic matter present. Deposit yellowish brown	2.65	23.75
London Clay	Stiff, very silty clay, fissured	3.25+	27.00

TQ 99 SE 33 9655 9262 Canewdon, Essex. Block E

Surface level +0.4 m (+1.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 16.40 m
Bedrock 2.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.20	0.20
Estuarine Alluvium	Slightly clayey silt with some fine sand, grey becoming olive grey to yellowish brown with depth. Shell fragments present. Soft to firm, deposit becomes mainly softer with depth. A gravel band is present and laminations of clayey and silty sand	15.80	16.00
	Fine, medium and coarse sand with fine and medium flint gravel. Septarian nodules present	0.40	16.40
London Clay	Firm, very silty clay, brown becoming dusky yellowish brown with depth. Some fissures present	2.60+	19.00

TQ 99 SW 47 9037 9373 Canewdon, Essex. Block A

Surface level +14.7 m (+48.0 ft)
Water struck at +5.9 m (+19.5 ft)
Shell, 203 mm diameter
September 1972

Waste 13.2 m
Bedrock 0.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silty clay, stiff, dark brown, with scattered flint pebbles	0.35	0.35
Brickearth	Sandy silty clay, stiff medium brown, containing rounded and angular flint pebbles	0.95	1.30
	Clayey silt, firm, medium brown, containing angular to subrounded flint pebbles and scattered race	0.40	1.70
Buried Channel Deposits	Clay and silt with fine angular to subrounded flint gravel; race common	0.30	2.00
	Intercalated layers of clay, silt and fine sand, brown to yellow brown in upper 3.30 m becoming olive brown with depth. Race and shell debris present at various depths. Carbonaceous material and scattered flint pebbles present in top 2.30 m	8.90	10.90
	Fine silty gravel with fine to coarse sand. Gravel composed of subangular to subrounded flint	2.30	13.20
London Clay	Sandy silty clay, soft, yellow brown, becoming stiff and dark olive brown with fissuring below 13.30 m	0.80+	14.00

TQ 99 SW 48 9062 9324 Canewdon, Essex. Block A

Surface level +10.0 m (+33.0 ft)
Water struck at +4.6 m (+15.0 ft)
Shell, 203 mm diameter
September 1972

Overburden 5.40 m
Mineral 4.90 m
Bedrock 1.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt, soft, yellow brown with some fine to coarse gravel	0.40	0.40
Brickearth	Mainly silty clay with variable amounts of fine sand. Medium yellow brown becoming olive brown from 2.50 to 4.90 m. Contains scattered race and carbonaceous material with some shell debris from 0.90 to 2.00 m (probable relict of agricultural drainage pattern)	5.00	5.40
Buried Channel Deposits	'Clayey' sandy gravel Medium sand with fine and coarse gravel. Gravel concentrated from 6.70 m to 8.70 m composed of subangular to subrounded flint. Scattered flint cobbles in basal 0.70 m	4.90	10.30
London Clay	Silty clay, stiff, olive black, fissured. Scattered selenite crystals	1.10+	11.40

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	36	+16	16	5.7	6.7	12	12	60	3	10	3
		-16+4	20	6.7	7.7	9	2	26	4	33	26
				7.7	8.0	10	3	32	6	24	25
Sand	53	-4+1	7	8.0	8.7	8	1	43	7	23	18
		-1+¼	42	8.7	9.6	9	3	55	8	12	13
		-¼+1/16	4	9.6	10.2	18	2	26	20	19	15
Fines	11	-1/16	11								

TQ 99 SW 49 9059 9258 Stambridge, Essex. Block B

Surface level +14.3 m (+47.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
September 1972

Overburden 0.30 m
Mineral 2.30 m
Bedrock 8.25 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey sandy silt with scattered angular and subangular flint gravel	0.30	0.30
Terrace Deposits	'Clayey' pebbly sand Mainly medium sand with some fine and coarse gravel in top 0.70 m. Gravel composed of well rounded flint. Deposit rather silty	2.30	2.60
London Clay	Sandy silty clay, soft, medium brown, becoming more clayey, firm and dark olive brown with depth	8.25+	10.85

GRADING

Mean for Deposit

	%	mm	%
Gravel	9	+16	5
		-16+4	4
Sand	74	-4+1	2
		$-1+\frac{1}{4}$	68
		$-\frac{1}{4}+1/16$	4
Fines	17	-1/16	17

Bulk Samples Percentages

Depth surface (m) From	To	Fines + 1/16	Sand +1/16-$\frac{1}{4}$	Sand $+\frac{1}{4}$-1	Gravel +1-4	Gravel +4-1/16	Gravel +16
0.6	1.0	16	8	46	4	10	16
1.0	1.6	19	3	76	0	1	2
1.6	2.3	20	1	77	1	0	1
2.3	2.6	11	5	64	7	10	3

TQ 99 SW 50 9141 9162 Stambridge, Essex. Block B

Surface level +14.7 m (+48.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
September 1973

Waste 1.20 m
Bedrock 7.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay with scattered pebbles	0.20	0.20
Head	Silty sandy clay with some gravel, brown to yellow brown, firm. Gravel, mainly rounded flint	1.00	1.20
London Clay	Silty clay, firm, moderate to light brown, fissured, becoming stiff and dark yellow brown with depth. Some race in upper part and scattered septarian nodules in top 4.90 m	5.90	7.10
	Silty clay, stiff, fissured, medium olive brown. Rare carbonaceous material and pyrite nodules	1.10+	8.20

TQ 99 SW 51 9189 9123 Stambridge, Essex. Block B

Surface level +6.7 m (+22.0 ft)
Water struck at +4.5 m (+15.0 ft)
Shell, 203 mm diameter
October 1973

Overburden 0.60 m
Mineral 3.60 m
Bedrock 3.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Gravelly sandy clay	0.30	0.30
Terrace Deposits	Gravelly silty sand, moderate yellow brown; some carbonaceous material present	0.30	0.60
	'Clayey' sandy gravel Mainly medium sand with fine and coarse gravel. Gravel composed of angular and subrounded flint concentrated in upper 1.90 m. Top 0.90 m light brown, becoming pale greenish yellow with depth. Deposit rather clayey	3.60	4.20
London Clay	Silty clay, firm, becoming stiff with depth, brown to dark yellow brown. Scattered selenite crystals and carbonaceous material towards base	2.90	7.10
	Silty clay, stiff, dark olive grey	0.20+	7.30

GRADING

Mean for Deposit			Bulk Samples Percentages								
	%	mm	%	Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	24	+16	10	0.8	1.3	16	3	29	8	28	16
		-16+4	14	1.3	1.8	22	1	31	16	18	12
				1.8	2.7	14	5	30	6	23	22
Sand	63	-4+1	9	2.7	3.8	1	1	86	9	3	0
		-1+¼	52	3.8	4.2	29	2	62	5	1	1
		-¼+1/16	2								
Fines	13	-1/16	13								

TQ 99 SW 52 9209 9103 Stambridge, Essex. Block B

Surface level +4.7 m (+15.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1973

Overburden 0.30 m
Mineral 2.90 m
Bedrock 1.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Gravelly sandy clay	0.30	0.30
Terrace Deposits	'Clayey' sandy gravel Medium sand with fine and coarse gravel. Gravel composed of subangular to rounded flint (approximately 30% of gravel is composed of rounded black flint). Deposit rather clayey	2.90	3.20
London Clay	Silty clay, stiff, medium yellow brown becoming medium olive grey with depth	1.30+	4.50

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	39	+16	15	0.3	0.9	22	2	23	7	30	16
		-16+4	24	0.9	1.5	25	6	23	8	29	9
				1.5	2.3	3	6	41	5	29	14
Sand	43	-4+1	6	2.3	2.6	19	10	43	3	14	11
		-1+¼	32	2.6	3.1	25	4	32	8	8	23
		-¼+1/16	5	3.1	3.2	29	3	41	5	13	9
Fines	18	-1/16	18								

TQ 99 SW 53 9033 9198 Stambridge, Essex. Block B

Surface level 11.0 m (+36.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1973

Waste 0.80 m
Bedrock 2.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silty clay	0.30	0.30
Head	Sandy silty clay, some recent roots	0.50	0.80
London Clay	Clay, firm, with scattered race	0.75	1.55
	Sandy silty clay, firm fissured, mottled blue and brown; some carbonaceous material	1.55+	3.10

TQ 99 SW 54 9021 9172 Stambridge, Essex. Block B

Surface level +6.0 m (+19.5 ft)
Water struck at +4.0 m (+13.0 ft)
Shell, 203 mm diameter
October 1972

Overburden 0.90 m
Mineral 4.80 m
Bedrock 1.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty sandy clay with some gravel	0.50	0.50
Brickearth	Sandy clayey silt, friable, medium yellow brown	0.40	0.90
Terrace Deposits	'Clayey' pebbly sand Mainly medium sand with some gravel concentrated in top 1.10 m. Gravel composed of angular, subrounded and rounded flint with scattered rounded vein quartz. High fines content from 2.00 m to 4.00 m	4.80	5.70
London Clay	Silty clay, firm, medium brown becoming, at 5.80 m brownish black and highly fissured	1.10+	6.80

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	14	+16	3	0.9	1.5	16	2	26	11	33	12
		-16+4	11	1.5	2.0	15	1	32	10	27	15
				2.0	3.0	35	24	35	4	2	0
Sand	67	-4+1	7	3.0	4.0	22	10	62	4	2	0
		-1+¼	52	4.0	5.3	10	2	73	9	6	0
		-¼+1/16	8	5.3	5.7	12	3	62	9	11	3
Fines	19	-1/16	19								

TQ 99 SW 55 9070 9073 Stambridge, Essex. Block B

Surface level +3.7 m (+12.0 ft)
Water struck at +1.7 m (+5.5 ft)
Shell, 203 mm diameter
October 1972

Overburden 1.00 m
Mineral 2.60 m
Bedrock 0.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Brickearth	Sandy silt, light to moderate brown. A 0.30 m layer of calcareous clayey silt at base	1.00	1.00
Terrace Deposits	'Clayey' gravel Mainly fine and coarse gravel with medium sand and silt. Gravel, composed of sub-angular and subrounded flint, concentrated in basal 0.90 m. Sand and fines content decreasing with depth	2.60	3.60
London Clay	Sandy silty clay, fissured, medium brown	0.50+	4.10

GRADING

Mean for Deposit

	%	mm	%
Gravel	42	+16	20
		-16+4	22
Sand	39	-4+1	5
		-1+¼	29
		-¼+1/16	5
Fines	19	-1/16	19

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
1.0	1.6	41	5	24	5	18	7
1.6	2.7	17	8	45	7	18	5
2.7	3.1	4	1	14	6	34	41
3.1	3.6	11	1	10	2	23	53

TQ 99 SW 56 9165 9334 Paglesham, Essex. Block A

Surface level +4.2 m (+14.0 ft)
Water struck at +3.0 m (+10.0 ft)
Shell, 203 mm diameter
October 1972

Overburden 0.80 m
Mineral 2.45 m
Bedrock 0.85 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Head	Sandy silty clay, grey, containing scattered subangular flint pebbles. A 0.35 m layer of calcareous silt at base	0.80	0.80
Buried Channel Deposits	'Clayey' pebbly sand Mainly medium sand with angular to subrounded fine flint gravel. Deposit contains silt and clay, especially in top 0.80 m	2.45	3.25
London Clay	Silty clay, firm to stiff, dark brown becoming blue-black with depth	0.85+	4.10

GRADING

Mean for Deposit

	%	mm	%
Gravel	8	+16	0
		-16+4	8
Sand	77	-4+1	13
		-1+$\frac{1}{4}$	59
		-$\frac{1}{4}$+1/16	5
Fines	15	-1/16	15

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Gravel +1-4	+4-16	+16
1.2	1.6	28	3	46	12	11	0
1.6	2.0	8	4	74	11	3	0
2.0	2.5	13	5	72	6	4	0
2.5	3.25	14	6	49	19	12	0

TQ 99 SW 57 9118 9203 Stambridge, Essex. Block B

Surface level +19.0 m (+62.5 ft)
Water struck at +17.0 m (+56.0 ft)
Shell, 203 mm diameter
October 1972

Overburden 2.40 m
Mineral 1.00 m
Bedrock 2.05 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Brickearth	Sandy and silty clay with scattered subrounded flint pebbles in upper 1.00 m becoming sandy clay with rare pebbles	2.40	2.40
Terrace Deposits	Very 'clayey' sand		
	Medium sand with silt	1.00	3.40
London Clay	Clay, stiff with silty layers, highly fissured		
	Grey-blue becoming brown with depth	2.05+	5.45

GRADING

Mean for Deposit — Bulk Samples Percentages

	Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Mean grading as opposite	2.4	3.4	24	5	68	3	0	0

TQ 99 SW 58 9248 9462 Canewdon, Essex. Block B

Surface level +4.3 m (+14.0 ft)
Water struck at +2.1 m (+7.0 ft)
Shell, 203 mm diameter
October 1972

Waste 0.50 m
Bedrock 7.15 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silty clay with some gravel	0.50	0.50
London Clay	Silty clay, medium yellow brown, firm, becoming stiff with depth. Colour change to dark green-grey at base. Some race and flint pebbles in top 1.75 m. A 0.05 m cementstone layer present below 2.25 m	7.15+	7.65

TQ 99 SW 59 9273 9324 Paglesham, Essex. Block B

Surface level +4.6 m (+15.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Waste 1.45 m
Bedrock 1.55 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Brickearth	Silty sandy clay, medium brown to yellow-brown with some flint pebbles	0.70	0.70
Terrace Deposits	Clayey silty sand with mainly fine but some coarse rounded flint gravel	0.75	1.45
London Clay	Silty clay, stiff, mottled medium yellow brown and greenish grey. Some race pebbles, especially in upper part	1.55+	3.00

TQ 99 SW 60 9257 9019 Barling Magna, Essex. Block C

Surface level +4.2 m (+14.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Waste 2.05 m
Bedrock 1.05 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt	0.30	0.30
Terrace Deposits	Sandy clay and silt medium yellow brown with subangular and subrounded flint pebbles. Carbonaceous plant remains and root traces present. A 0.05 m layer of silty clayey sand with subangular flints at base	1.75	2.05
London Clay	Silty clay, stiff, mottled dark yellow brown and blue-green. Some plant remains and calcareous material present	1.05+	3.10

TQ 99 SW 61 9334 9396 Paglesham, Essex. Block B

Surface level +2.0 m (+6.5 ft)
Water struck at Ordnance Datum
Shell, 203 mm diameter
October 1972

Waste 3.15 m
Bedrock 3.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Brickearth	Silty clay, yellow-orange to moderate yellow-brown, stiff becoming firm and then soft with depth. Some flint and chert pebbles towards base	1.90	1.90
Terrace Deposits	Silty sand with fine flint gravel. Gravel percentage increasing with depth	1.25	3.15
London Clay	Silty clay, stiff, fissured, dark yellowish brown, becoming olive grey with depth	3.60+	6.75

TQ 99 SW 62 9364 9274 Paglesham, Essex. Block B

Surface level +5.6 m (+18.5 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Overburden 1.05 m
Mineral 6.20 m
Bedrock 0.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey gravelly silt, dark brown	0.60	0.60
Terrace Deposits	Silty sandy clay with some gravel. Gravel, composed of subrounded and rounded flint pebbles, increasing with depth	0.45	1.05
	'Clayey' pebbly sand Mainly medium sand with fine and coarse gravel, rather silty in top 3.05 m. Gravel, composed of subrounded and rounded flint and concentrated in upper 2.55 m and lower 1.35 m	6.20	7.25
London Clay	Clay firm to stiff dark yellow-brown, becoming moderate olive-grey with depth	0.60+	7.85

GRADING

Mean for Deposit

	%	mm	%
Gravel	20	+16	8
		-16+4	12
Sand	67	-4+1	6
		-1+¼	57
		-¼+1/16	4
Fines	13	+1/16	13

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	Gravel +1-4	+4-16	+16
1.05	1.5	26	2	27	9	21	15
1.5	1.9	18	3	28	11	20	20
1.9	2.7	14	5	48	10	18	5
2.7	3.1	14	4	65	8	9	0
3.1	3.6	8	1	34	6	27	24
3.6	4.1	25	4	64	5	2	0
4.1	4.85	5	7	82	3	2	1
4.85	5.25	12	2	67	2	13	4
5.25	5.9	6	5	77	4	5	3
5.9	6.6	11	2	60	5	9	13
6.6	7.1	11	7	52	6	19	5

TQ 99 SW 63 9338 9017 Barling Magna, Essex. Block C

Surface level +2.8 m (+9.0 ft)
Water struck at +0.5 m (+1.5 ft)
Shell, 203 mm diameter
October 1972

Overburden 0.75 m
Mineral 1.55 m
Bedrock 4.65 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt	0.30	0.30
Brickearth	Sandy clayey silt, medium brown becoming calcareous and medium yellow brown at 0.45; scattered pebbles of flint towards base	0.45	0.75
Terrace Deposits	Very 'clayey' sandy gravel Medium sand silty, with fine and coarse gravel. Gravel composed of subangular and some rounded flint; no gravel in basal 0.30 m	1.55	2.30
London Clay	Silty clay with seams of sand, stiff, mottled brown to yellow brown and pale blue becoming dark olive grey at 5.00 m. Fissured in lower part	4.65+	6.95

GRADING

Mean for Deposit

	%	mm	%
Gravel	36	+16	23
		-16+4	13
Sand	42	-4+1	8
		-1+¼	28
		-¼+1/16	6
Fines	22	-1/16	22

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
1.3	1.7	26	1	13	15	18	27
1.7	2.0	2	2	31	5	20	40
2.0	2.3	37	16	46	1	0	0

TQ 99 SW 64 9377 9476 Canewdon, Essex. Block E

Surface level +2.3 m (+7.5 ft)
Water struck at -0.9 m (-3.0 ft)
Shell, 203 mm diameter
November 1972

Waste 7.70 m
Bedrock 1.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Alluvium	Silty clay, soft, dark grey with some yellow brown and dark blue patches. Abundant flakes of mica and some fine sand present in lower part	5.50	5.50
	Silty clay, dark grey, soft with shell and carbonaceous material and fine sand. Scattered rounded flint pebbles present below 7.00 m	2.20	7.70
London Clay	Silty clay, stiff, medium yellow brown. Scattered ?race pebbles	1.30+	9.00

TQ 99 SW 65 9382 9195 Paglesham, Essex. Block B

Surface level +2.2 m (+7.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
October 1972

Waste 1.00 m
Bedrock 1.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil overlying Brickearth	Clayey sandy silt soft, dark red brown with scattered angular flint pebbles. Calcareous material present below 0.50 m	0.80	0.80
Terrace Deposits	Clayey and silty gravelly sand. Sand and gravel coarse. Gravel composed of subrounded flint	0.20	1.00
London Clay	Sandy silty clay, firm with race, mottled medium yellow brown and pale blue green becoming dark yellow brown and pale blue with depth	1.50+	2.50

TQ 99 SW 66 9436 9240 Paglesham, Essex. Block B

Surface level +4.6 m (+15.0 ft)
Water struck at -0.4 m (-1.5 ft)
Shell, 203 mm diameter
November 1972

Overburden 1.40 m
Mineral 4.10 m
Bedrock 0.80 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt	0.30	0.30
Brickearth	Sandy silt, soft, medium brown, with present day roots passing at 0.75 m into soft silty clay, pale yellow brown with calcareous material and scattered flint pebbles	1.10	1.40
Terrace Deposits	'Clayey' gravel Fine and coarse gravel with medium to coarse sand rather silty. Gravel, evenly distributed throughout deposit, composed of subrounded to rounded (with some angular to subangular) flint. Fines content decreasing with depth	4.10	5.50
London Clay	Sandy silty clay, firm, medium brown becoming stiff and pale blue to dark grey	0.80+	6.30

GRADING

Mean for Deposit

	%	mm	%
Gravel	48	+16	19
		-16+4	29
Sand	42	-4+1	10
		-1+¼	30
		-¼+1/16	2
Fines	10	-1/16	10

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-¼	Sand +¼-1	Gravel +1-4	Gravel +4-16	Gravel +16
1.4	2.1	27	4	21	8	22	18
2.1	2.6	13	2	23	11	26	25
2.6	3.0	12	3	22	9	38	16
3.0	4.0	3	1	31	10	34	21
4.0	5.5	6	2	37	11	27	17

TQ 99 SW 68 9077 9492 Canewdon, Essex. Block B

Surface level +28.5 m (+93.5 ft)
Water conditions not recorded
Shell, 203 mm diameter
November 1972

Waste 1.00 m
Bedrock 3.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.35	0.35
Head Brickearth	Silty sandy clay, mottled yellow brown and grey green, firm to soft, some subangular flint pebbles. Calcareous material present in lower 0.30 m	0.65	1.00
London Clay	Silty clay, stiff, brown to yellow brown, fissured with scattered pockets of sand. Carbonaceous material and roots (present day) in top 0.70 m. Some mica present	3.20+	4.20

TQ 99 SW 70 9179 9034 Barling Magna, Essex. Block C

Surface level +4.3 m (+14.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
January 1973

Overburden 1.50 m
Mineral 1.50 m
Bedrock 0.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil and made ground		1.20	1.20
Terrace Deposits	Clayey sand with pebbles, greenish grey with some ferruginous staining	0.30	1.50
	Very 'clayey' pebbly sand Medium sand with silt and some gravel, yellow brown	1.50	3.00
London Clay	Clay, stiff, fissured	0.20+	3.20

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
1.5	3.0	25	6	49	7	7	6

TQ 99 SW 78 9289 9255 Paglesham, Essex. Block B

Surface level +3.5 m (+11.5 ft)
Water not struck
Shell, 152 mm diameter
October 1973

Waste 4.50 m
Bedrock 5.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Brickearth	Sandy silty clay, moderate yellowish brown, with scattered pebbles. Race pebbles present below 0.70 m	1.10	1.40
Terrace Deposits	Firm silty clay, medium greenish grey, with race pebbles passing, at C. 2.00 m into soft silty clay, medium olive grey, with rare race. Some sand present below 3.00 m	2.40	3.80
	Sandy silty clay, dark grey with some angular fine and rounded coarse gravel	0.70	4.50
London Clay	Silty clay, firm rapidly becoming stiff with depth	5.30+	9.80

TQ 99 SW 79 9323 9198 Paglesham, Essex. Block B

Surface level +1.2 m (+4.0 ft)
Water struck at -1.0 m (-3.5 ft)
Shell, 152 mm diameter
October 1973

Overburden 1.00 m
Mineral 4.00 m
Bedrock 0.50 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Brickearth	Clayey silt, firm, moderate yellowish brown, with roots (present day) and scattered flint gravel; becoming gravelly and sandy with depth	0.70	1.00
Terrace Deposits	Sandy gravel Mainly medium sand with fine and some coarse gravel. Gravel composed of angular to subangular and rounded flint. High concentrations of gravel in basal 1.00 m	4.00	5.00
London Clay	Silty, sandy clay, with carbonaceous material, firm, moderate yellowish brown passing at 5.20 m into stiff silty clay, dark olive grey	0.50+	5.50

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	34	+16	11	1.0	2.0	7	4	50	7	21	11
		-16+4	23	2.0	3.0	10	17	49	5	17	2
				3.0	4.0	8	21	43	3	17	8
Sand	59	-4+1	6	4.0	5.0	4	9	18	9	37	23
		-1+¼	40								
		-¼+1/16	13								
Fines	7	-1/16	7								

TQ 99 SW 80 9126 9368 Canewdon, Essex. Block B

Surface level +10.3 m (+34.0 ft)
Water struck at +6.8 m (+22.5 ft)
Shell 152 mm diameter
October 1973

Overburden 0.60 m
Mineral 4.00 m
Bedrock 4.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt, with some gravel	0.60	0.60
Terrace Deposits	Sandy gravel Fine and coarse gravel with medium sand. Gravel composed of angular to subangular and some rounded flint	4.00	4.60
London Clay	Silty clay, stiff, with some carbonaceous material and rare crushed shells, dark yellowish brown, becoming shell free and olive grey at 7.00 m	4.20+	8.80

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Gravel	43	+16	15	0.9	1.7	5	3	24	7	46	15
		-16+4	28	1.7	2.7	6	4	37	10	28	15
				2.7	3.5	4	11	61	8	12	4
Sand	52	-4+1	9	3.5	4.6	6	6	28	12	26	22
		-1+$\frac{1}{4}$	37								
		-$\frac{1}{4}$+1/16	6								
Fines	5	-1/16	5								

TQ 99 SW 85 9201 9287 Paglesham, Essex. Block B

Surface level +5.5 m (+18.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
December 1973

Overburden 1.20 m
Mineral 4.40 m
Bedrock 1.20 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.30	0.30
Brickearth	Silty clay, medium yellowish orange. Traces of gravel present	0.40	0.70
Terrace Deposits	Very sandy clayey silt	0.50	1.20
	Sandy gravel Mainly medium sand with fine and some coarse gravel. Gravel composed of subangular to angular flint with rounded Tertiary pebbles. Top 1.30 m rather silty. Some cobbles at base	4.40	5.60
London Clay	Stiff silty clay, highly fissured, dark yellowish brown becoming olive grey at 5.70 m	1.20+	6.80

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-¼	Sand +¼-1	+1-4	Gravel +4-16	+16
Gravel	37	+16	12	1.2	2.5	6	17	29	8	33	7
		-16+4	25	2.5	3.6	2	11	45	8	21	13
				3.6	4.6	1	8	50	13	20	8
Sand	60	-4+1	9	4.6	5.6	2	3	45	6	23	21
		-1+¼	41								
		-¼+1/16	10								
Fines	3	-1/16	3								

TQ 99 SW 87 9421 9491 Canewdon, Essex. Block B

Surface level +4.0 m (13.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Overburden 1.00 m
Mineral 2.50 m
Bedrock 1.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil and made ground		0.30	0.30
Brickearth	Soft to firm light brown clayey silt becoming soft and containing abundant race below 0.60 m	0.70	1.00
Terrace Deposits	Sandy gravel Mainly medium sand with fine and coarse gravel 70% of gravel composed of subangular pebbles. Top 1.20 m of deposit rather silty	2.50	3.50
London Clay	Stiff silty clay, highly fissured, light brown to medium greyish brown, becoming olive grey at 5.00 m	1.70+	5.20

GRADING

Mean for Deposit

	%	mm	%
Gravel	31	+16	10
		-16+4	21
Sand	61	-4+1	12
		-1+$\frac{1}{4}$	43
		-$\frac{1}{4}$+1/16	6
Fines	8	-1/16	8

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
1.0	2.2	13	5	29	17	27	9
2.2	3.3	3	7	57	7	15	11

TQ 99 SW 88 9285 9349 Paglesham, Essex. Block B

Surface level +1.2 m (+4.0 ft)
Water struck at -3.1 m (-10.0 ft)
Shell, 203 mm diameter
April 1974

Overburden 1.40 m
Mineral 3.00 m
Bedrock 0.70 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.30	0.30
Brickearth	Clayey silt, medium brown to yellowish orange with scattered subangular flint and rounded black Tertiary pebbles (becoming more common with depth) and passing at 1.10 m into sandy clay, mottled green, grey and brown, with abundant carbonaceous material	1.10	1.40
Terrace Deposits	Sandy gravel Medium to coarse sand with fine and coarse gravel. Sand becoming coarser and gravel content increasing with depth	3.00	4.40
London Clay	Stiff silty medium brown clay, highly fissured with streaks of yellowish orange sand; clay becoming dark yellowish brown at 4.80 m	0.70+	5.10

GRADING

Mean for Deposit

	%	mm	%
Gravel	42	+16	13
		-16+1	29
Sand	54	-4+1	12
		-1+$\frac{1}{4}$	36
		-$\frac{1}{4}$+1/16	6
Fines	4	-1/16	4

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
1.4	2.3	7	11	36	8	24	14
2.3	3.3	2	4	45	11	24	14
3.3	4.3	3	2	28	16	39	12

TQ 99 SW 89 9449 9341 Paglesham, Essex. Block E

Surface level +0.6 m (+2.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 12.50 m
Bedrock 1.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt, mottled dark yellowish and orange brown	0.30	0.30
Estuarine Alluvium	Mainly clayey silt with sandy layers. Dark yellowish brown to 1.80 m grading to blue-grey and then mottled green, brown and yellow from 2.80 m. Contains varying amounts of organic material throughout including a 0.15 m thick peat layer at 2.45 m. Deposit firm to 1.10 m then soft to base	6.80	7.10
	Fine silty sand with scattered angular to rounded flint pebbles overlying 0.90 m of firm sandy clayey silt; medium grey to olive grey. Some race nodules present in lower part	1.20	8.30
	Clayey, silty fine to medium sand, medium olive grey. Clay content decreasing with depth	2.20	10.50
	Fine to coarse sand with fine subrounded flint gravel	2.00	12.50
London Clay	Firm silty clay medium yellowish brown becoming darker with depth	1.00+	13.50

TQ 99 SW 90 9231 9374 Paglesham, Essex. Block B

Surface level +3.4 m (+11.0 ft)
Water struck at +0.4 m (+1.5 ft)
Shell, 203 mm diameter
March 1974

Waste 5.25 m
Bedrock 1.75 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.10	0.10
Estuarine Alluvium	Soft clay and silt, becoming sandy below 2.20 m. Red-brown to 1.10 m then mainly grey or blue-grey with some brown mottling. Organic remains present throughout deposit but particularly abundant from 1.75 to 2.20 m	5.00	5.10
	Soft clayey silt with fine sand and some fine, rounded flint gravel	0.15	5.25
London Clay	Firm brown silty clay with fine sandy partings passing at 6.10 m into stiff silty clay, dark yellowish brown	1.75+	7.00

TQ 99 SW 91 9450 9080 Barling Magna, Essex. Block E

Surface level +1.6 m (+5.0 ft)
Ground water conditions not recorded
Shell 203 mm diameter
April - May 1974

Waste 13.35 m
Bedrock 2.75 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Dry sandy stoney topsoil	0.30	0.30
Estuarine Alluvium	Grey clayey silt with varying amounts of sand and gravel. Shells present in some horizons	10.10	10.40
	Grey and black sandy gravel	2.95	13.35
London Clay	Sandy grey clay becoming blue grey clay with depth	2.75+	16.10

TQ 99 SW 94 9282 9188 Paglesham, Essex. Block B

Surface level +4.0 m (+13.0 ft)
Ground water conditions not recorded
Shell, 203 mm diameter
March 1974

Waste 1.50 m
Bedrock 3.30 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Brown silty sandy clay	0.20	0.20
Estuarine Alluvium	Silty clay, yellow brown and orange brown, firm, with some organic debris and scattered race nodules	1.30	1.50
London Clay	Firm silty clay, brown with vertical light blue streaks becoming, at 3.10 m dark yellowish brown, stiff, highly fissured. Scattered selenite crystals present towards base	3.30+	4.80

TR 09 SW 13 0032 9166 Foulness, Essex. Block E

Surface level +1.4 m (+4.5 ft)
Water struck at +0.1 m (+0.5 ft)
Shell, 203 mm and 152 mm diameter
November 1972

Waste 15.00 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt, dark yellowish brown	0.40	0.40
Estuarine Alluvium	Sandy clayey silt, firm in upper 0.10 m then soft. Mottled dark yellowish brown to dark yellowish orange	1.00	1.40
	Silt, soft, scattered race grains. Olive grey with some moderate yellowish brown mottling. Firm towards base. Shell material present in top 0.60 m	2.80	4.20
	Peaty clayey silt	0.20	4.40
	Silt, soft, micaceous, olive grey becoming firm towards base	7.20	11.60
	Clayey silt, medium olive grey, mainly soft but firm in parts. Shell material present, including complete oyster shells. Shell content decreasing with depth. Scattered race nodules	2.10	13.70
	Sandy silt, soft, light olive brown with medium bluish grey and medium brownish grey mottling. Some firm patches	0.30	14.00
	Silty sand, fine to medium with fine and coarse gravel. Gravel composed of angular to subrounded flint and rounded quartzite pebbles. Some shell material present	1.00+	15.00

TR 09 SW 14 0132 9322 Foulness, Essex. Block E

Surface level +2.0 m (+6.5 ft)
Water struck at O.D.
Shell, 203 mm and 152 mm diameter
December 1972

Overburden 14.00 m
Mineral 8.10 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt with scattered pebbles	0.45	0.45
Estuarine Alluvium	Sandy silt, light brown to greyish orange, soft, laminated, micaceous. Sand content increasing with depth	1.50	1.95
	Sandy silt, dark olive grey, soft. Scattered shell fragments present in upper 1.95 m	3.35	5.30
	Mainly sandy silt, olive black to dark olive grey, with layers of silty clay. Becoming less sandy with depth. Scattered shell fragments present in basal 3.20 m	7.90	13.20
	Sandy clay, medium olive grey, with abundant shell fragments; becoming more sandy towards base	0.80	14.00
Buried Channel Deposits	?'Very clayey' gravel* Mainly gravel, fine and coarse with fine to medium sand, C. 25% silt and clay. Gravel composed of angular to subangular flint	0.70	14.70
	?'Clayey' pebbly sand* Mainly sand with C. 20% silt and clay and local concentrations of gravel. Sand fine to coarse but mainly medium, olive and greenish grey to olive brown. Gravel composed of fine and coarse angular to subangular flint. Greenish grey to yellow brown clay bends present. Rare shell material throughout deposit	7.40+	22.10

* (No grading information available)

TR 09 SW 15 0402 9403 Foulness, Essex. Block E

Surface level +2.7 m (+9.0 ft)
Ground water conditions not recorded
Shell, 203 mm and 152 mm diameter
December 1972

Waste 24.40 m
Bedrock 0.90 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made ground	Bricks and fill	1.70	1.70
Estuarine Alluvium	Sandy silt, soft, olive black to dark olive grey, micaceous, with some shell fragments. Semiconsolidated layer of clayey silt 0.50 m thick struck at 6.20 m	13.30	15.00
	Sandy clayey silt, soft, micaceous, olive black, laminated becoming medium greenish-grey in basal 1.00 m	3.00	18.00
	Silt, soft, olive black, some fine sand	4.00	22.00
	Sandy clayey silt with abundant shell fragments. Soft, olive black	1.00	23.00
	Clayey silt, firm dark brownish grey, laminated, scattered shell fragments present. Becoming gravelly with depth	0.50	23.50
	Gravel, fine and coarse with some cobbles. Composed of angular and rounded flint. Scattered yellowish brown clay nodules present	0.90	24.40
? London Clay Head	Silty clay, firm to stiff mottled medium olive grey and medium yellowish brown. Scattered angular flint pebbles present	0.90+	25.30

TR 09 SW 39 0177 9226 Foulness, Essex. Block E

Surface level +2.2 m (+7.0 ft)
Water struck at +1.3 m (+4.5 ft)
Shell, 203 mm and 152 mm diameter
April 1974

Overburden 16.40 m
Mineral 6.00 m
Bedrock 3.60 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Moderate yellowish brown, sandy loam	0.60	0.60
Estuarine Alluvium	Fine silty sand, greyish orange with light brown patches. Deposit becoming more silty and darker, to almost black with depth. Shells and organic material present	6.90	7.50
	Olive black clayey sandy silt, becoming olive grey silty fine sand with clayey patches with increasing depth. Scattered shells	3.80	11.30
	Olive grey silty fine sand with shells abundant in bands. Scattered fine pebbles and organic matter present. Deposit becoming more sandy with depth	4.00	15.30
	Sandy gravel with whole and fragmented shells and brown sandstone fragments	0.60	15.90
	Very silty fine sand, becoming silt with depth, containing laminae of fine sand. Scattered shell debris and flint granules present	0.50	16.40
Buried Channel Deposits	'Clayey' sand Fine to medium light olive brown sand with laminated silt. Shell debris and occassional pebbles present. Deposit becoming coarser with gravel occuring at depth	6.00	22.40
London Clay	Stiff silty clay, dusky yellowish brown, fissured. Some pyrite, celenite and mica present. Deposit becoming darker with depth	3.60+	26.00

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
Gravel	2	+16	0	17.4	18.4	29	67	3	1	0	0
		-16+4	2	18.4	19.6	8	62	28	2	0	0
				20.0	21.0	3	22	65	3	6	1
Sand	85	-4+1	2								
		-1+$\frac{1}{4}$	32								
		-$\frac{1}{4}$+1/16	51								
Fines	13	-1/16	13								

TR 09 SW 40 0313 9325 Foulness, Essex. Block E

Surface level +2.1 m (+7.0 ft)
Water struck at +0.9 m (+3.0 ft)
Shell, 203 mm and 152 mm diameter
April 1974

Waste 23.95 m
Bedrock 4.55 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.20	0.20
Estuarine Alluvium	Sandy loam, moderate yellowish brown. Becoming sandier with depth. Clayey band present, also shells and root material	1.20	1.40
	Soft silty fine sand with scattered shells, becoming firmer and more shelly, then soft and less shelly, with depth. Olive black to black with a yellowish brown band	13.60	15.00
	Shell bank resting on greyish silty fine sand with gravel	1.40	16.40
	Fine sands, greyish to dusky olive, interbedded with dusky yellow silty clay. Deposit is very soft with scattered mica and shell debris. Some coarse sand present which becomes increasingly shelly with depth	5.20	21.60
	Silty fine sand, greenish to bluish grey, with greenish black laminae. Deposit becoming clayey and more silty with depth. Scattered mica and shell fragments are present	2.35	23.95
London Clay	Stiff silty clay, light olive grey. Bioturbated, with flecks of mica clusters of selenite present. Cementstone with pyrite occurs at depth	4.55+	28.50

GRADING

Mean for Deposit

See opposite

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	+1-4	Gravel +4-16	+16
20.6	21.6	1	6	73	10	9	1

TR 09 SW 41 0081 9376 Foulness, Essex. Block E

Surface level +1.9 m (+6.0 ft)
Water struck at +0.8 m (+2.5 ft)
Shell, 203 mm and 152 mm diameter
March - April 1974

Overburden 14.90 m
Mineral 10.15 m
Bedrock 2.45 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.10	0.10
Estuarine Alluvium	Silty loam, moderate brown to dark yellowish brown, becoming sandy and clayey with depth. Some root material present	1.10	1.20
	Silty fine sand, very soft, olive grey to black. Contains scattered shells and shell fragments which are also concentrated in bands	12.10	13.30
	Clayey pebbly silt, soft, greyish olive. Becoming less pebbly with depth. Shelly bands are present. Deposit is bioturbated	1.60	14.90
Buried Channel Deposits	Sandy gravel Gravel with sand overlying fine sandy gravel. Shells and shell fragments present, these become fewer with depth. Burrow infillings are present. Deposit contains bands of coarse gravel and cobbles	10.15	25.05
London Clay	Stiff silty clay, olive grey, with darker more silty patches. Clay fissured and scattered pyrite nodules and mica present	2.45+	27.50

GRADING

Mean for Deposit

	%	mm	%
Gravel	38	+16	6
		-16+4	32
Sand	61	-4+1	17
		-1+¼	40
		-¼+1/16	4
Fines	1	-1/16	1

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	+1/16-¼	Sand +¼-1	Gravel +1-4	+4-16	+16
15.5	16.5	2	4	48	16	28	2
16.5	17.5	1	6	64	11	16	2
17.5	18.5	1	6	51	7	20	15
18.5	24.0	1	3	35	20	36	5
24.0	25.0	1	2	26	18	46	7

APPENDIX G: LIST OF WORKINGS

In October 1975 there was one sand and gravel working known to be in operation in the area.

List of workings and their locations

Location of working	Grid reference	Deposit worked
Active		
Barling Magna	935 895	First Terrace sand and gravel
Abandoned		
Ballards Gore	904 929	Buried Channel sand and gravel
Canewdon	920 940	Second Terrace sand and gravel
Canewdon (Canewdon Wick)	910 947	Fourth Terrace sand and gravel
Rochford (Doggetts Lane)	878 914	Second Terrace sand and gravel

APPENDIX H: CONVERSION TABLE - METRES TO FEET

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

APPENDIX I: RESISTIVITY TRAVERSES

The results of the drilling programme revealed a number of problems regarding the extent and thickness of the deposits of sand and gravel beneath overburden. To assist in identifying the sub-crop of sand and gravel beneath waste or overburden, it was decided to apply resistivity techniques.

Resistivity work was carried out in 1972 by P. Grainger and later in the summers of 1973 and 1974 by M. Sarginson, both of the Engineering Geology Unit. Vacation students assisted with the main part of the field work.

The A.B.E.M. Terrameter (A.C. version) was used. It is of fairly rugged construction, is capable of being operated comfortably and rapidly by two people and it is able to provide reliable and detailed resistivity values where the anticipated lithological contrasts are not very great.

Of the two fundamentally different types of resistivity surveying, horizontal profiling and vertical profiling by expanding traverses, only the former system was employed using a standard Wenner configuration with a 5-meter electrode separation.

Although the positions of the traverses were chosen to supply information in areas where the sub-surface evidence for the spacial distribution of drift deposits (especially sand and gravel) was lacking, most traverses were positioned to include or pass near to boreholes so that they could be used as controls in the interpretation of the results. Of the many traverses carried out by the Engineering Geology Unit for the geological and geo-technical surveys in south-east Essex, only those run specifically to determine the extent of sand and gravel deposits have been shown on the resource map.

The author is indebted to M. Sarginson of the Engineering Geology Unit for the interpretation of the results.

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The sand and gravel resources of the country around Southend-on-Sea, Essex

Part 2

North and west of Southend-on-Sea

Description of 1:25 000 sheets TQ 78, 79 and parts of TQ 88 and 89

S. E. Hollyer and M. B. Simmons

CONTENTS

The sand and gravel resources of the country around Southend-on-Sea, Essex
Part 2 North and west of Southend-on-Sea

Description of 1:25 000 sheets TQ 78, 79 and parts of TQ 88, 89.

S. E. Hollyer and M. B. Simmons

SUMMARY

The assessment of the sand and gravel resources north and west of Southend-on-Sea is based on 44 boreholes drilled by the Institute and recent 1:10 560 geological mapping. This part of the report gives a brief account of the geology of the area, and the location, grading and volume of the resource. The arbitrary physical criteria used to identify potentially workable deposits of sand and gravel (mineral) are those set out in the Introduction to Part 1 of this report. Because of the scattered nature of the potentially workable deposits and the paucity of sample points, the estimates of volume are inferred.

Bibliographical reference:

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DESCRIPTION OF SHEETS TQ 78, 79 AND PARTS OF TQ 88 AND 89

GENERAL

The area contains the major urban areas of Basildon, Canvey, Corringham, Hadleigh, Hockley, Rayleigh, South Benfleet, Wickford and the western part of Southend-on-Sea, which together with the oil refineries at Canvey and Shellhaven cover about one fifth of the ground. The populated areas are mainly in the south and contrast with the largely rural areas north of Basildon and Rayleigh.

TOPOGRAPHY

The area is bounded to the south by the Thames Estuary, with the River Crouch flowing across the northern part. The topography is varied: the flat, low-lying spreads of Marine or Estuarine Alluvium of Canvey Island and the surrounding marshes give place to undulating higher ground to the north. The boundary between the two areas is the high ground of South Benfleet and Hadleigh, composed mainly of Claygate Beds and London Clay, where, on the steep southward-facing slopes, many landslips have occurred. In the north-west corner of the area is Hanningfield Water, occupying almost 3.5 km^2 of ground.

GEOLOGY AND RESOURCES

A summary of the formations present in the area is given in Table 1.

SOLID

Lower London Tertiaries

These deposits were found only in one borehole (78 SW 6) where 0.3 m of rounded flint gravel was proved beneath 16.8 m of London Clay; they are probably equivalent to the Woolwich Beds.

Because of their depth of burial, these deposits are not potentially workable and no assessment has been made.

London Clay

This is the oldest formation exposed in the area. It is a stiff olive-grey clay when unweathered, becoming highly fissured and dark yellowish brown, and often containing abundant selenite crystals, when weathered. The London Clay is exposed or underlies Drift or Claygate Beds over most of the area except in the extreme south beneath the

Table 1. Geological Succession

DRIFT	
*River Alluvium	
Marine or Estuarine Alluvium	
River Terrace Sand and Gravel	(undifferentiated - proved in boreholes beneath Marine or Estuarine Alluvium)
River Terrace Sand and Gravel	(associated with the River Crouch)
River Terrace Sand and Gravel	(associated with the River Thames)
*Head	
*Brickearth and Head Brickearth	
Sand and Gravel of unknown age	
Boulder Clay	
Glacial Sand and Gravel	
SOLID	
Bagshot Beds (including Bagshot Pebble Bed)	
*Claygate Beds	
*London Clay	
Lower London Tertiaries (proved in boreholes only)	

*Outcrop of these deposits not shown on the resource map.

Corringham Marshes. It forms the steep southerly facing slopes at Hadleigh and South Benfleet.

Claygate Beds

Cropping out in the north around Hanningfield and in the south-east around Hockley, Rayleigh and South Benfleet, these deposits are somewhat more silty and sandy than the London Clay. Claygate Beds were sampled in thirteen boreholes, the thickest sequence being proved in borehole 89 SW 26, where 22.7 m were proved beneath 3.8 m of Bagshot Beds. Because of their high clay and silt content these deposits are not regarded as potentially workable and no assessment has been made.

Bagshot Beds

These beds cap the high ground in the north-west around Hanningfield Water and in the south-east around Rayleigh and Hadleigh. They are composed of fine, fairly silty sand with some interlaminated silty, very carbonaceous clay. Thin beds of iron-cemented sandstone are present in some places. In colour the beds are orange to light brown, although dark olive and pale greenish grey mottling has been recorded where weathering has had less effect. The thickest sequence (14.8 m) was proved in borehole 79 NW 4. Overlying the sands of the Bagshot Beds north and west of Hanningfield Water is the Bagshot Pebble Bed, consisting of rounded brown flint pebbles in a fine sand matrix. Borehole 79 NW 4 proved 0.3 m of the Bagshot Pebble Bed. Of the seven boreholes drilled in Bagshot Beds only two, 79 NW 3 and 79 NW 4, proved mineral, the remaining five proving sandy clayey silt. In borehole 79 NW 3, 1.1 m of very 'clayey' pebbly sand overlay 3.2 m of very fine silty sand containing more than 50% fines. Borehole 79 NW 4 proved 9.8 m of mineral split equally into two by 1.2 m of waste, beneath 3.2 m of overburden. Only discrete patches of the Bagshot Beds, which were proved by drilling to be mineral, have been included in the grading and volume calculations. These areas are identified on the resource map and an assessment has been made.

DRIFT

Glacial Sand and Gravel

Four small patches of this deposit are present south of Ramsden Heath, West Hanningfield and Woodham Ferrers.

One borehole, 79 SW 1, was sited on these deposits and proved 3.9 m of 'clayey' gravel beneath 0.8 m of overburden. For assessment purposes the combined area of these deposits has been used.

Boulder Clay

Although it is more extensive than the Glacial Sand and Gravel, this deposit also occurs as isolated patches, individually rarely greater than 0.1 km^2 in area. The outcrops are restricted to the West Hanningfield, Ramsden Heath and Woodham Ferrers areas. Borehole 39 NW 4 proved 1.3 m of light yellowish brown clay with abundant chalk pebbles.

S

Sand and Gravel of unknown age

Four patches are present in the Hadleigh - Rayleigh area. These high-level deposits (all over +60 m Ordnance Datum) cannot be directly related to the terrace sequence and are thought to be of greater antiquity; they may be more closely related to the Glacial Sand and Gravel.

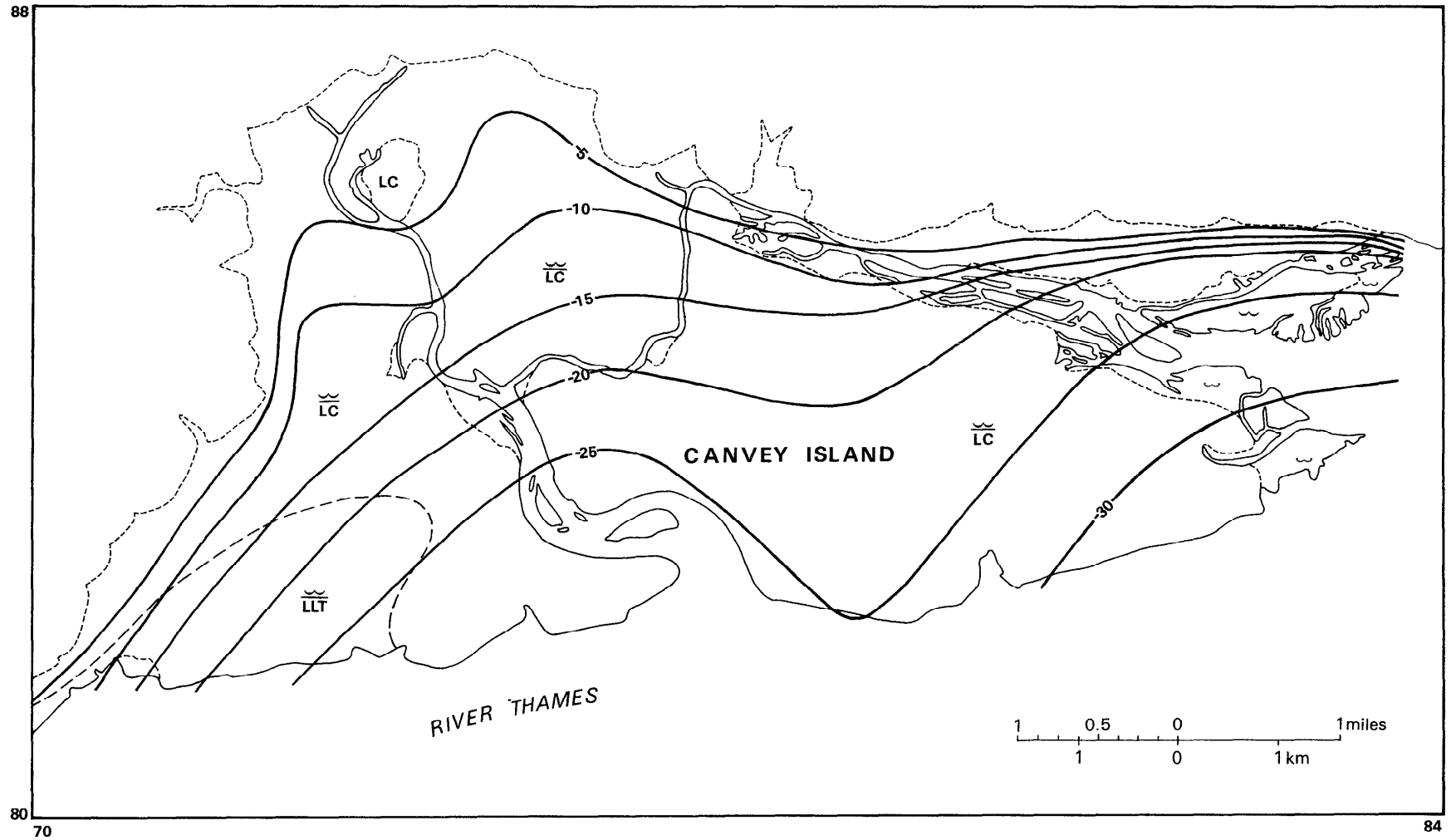
Four boreholes, 88 NW 57, 58, 59 and 60 penetrated these deposits. Borehole 88 NW 59 contained 0.7 m of clayey gravelly sand, the remaining three proving mineral varying from 1.9 to 4.9 m in thickness. An inferred assessment has been made of these deposits.

Brickearth and Head Brickearth

These deposits, consisting predominantly of silt with some clay and sand, are found immediately west and north-west of Eastwood. Some of the deposits show evidence of solifluxion and downhill movement.

Head

Head, mainly found mantling slopes of the minor valleys around Wickford, varies in composition reflecting the up-slope source material. Most of the material comprising the head is derived from the London Clay and is brown silty clay containing stringers of gravel and sand.



LC London Clay

LLT Lower London Tertiaries

Marine or Estuarine Alluvium

Marine Beach or Tidal-Flat Deposits

----- Extent of Marine or Estuarine Alluvium

— — Lower London Tertiary Beds/London Clay boundary

--5-- Contours in metres relative to Ordnance Datum

Fig. 1, Contours on the London Clay/Lower London Tertiaries surface beneath the Marine or Estuarine Alluvium in the vicinity of Canvey Island

River Terrace Deposits (sand and gravel) (associated with the River Thames)

These deposits are confined to the extreme south-west of the area around Corringham. Both Third and Fourth Terraces are represented, the former covering the larger area.

Three boreholes were drilled to determine the extent of these deposits. Borehole 78 SW 8 proved 2.4 m of mineral on London Clay with 0.8 m of overburden, and borehole 78 SW 5 proved 4.4 m of mineral beneath 11.5 m of overburden composed of gravelly silty sand and clay. Although mapped as Head, it is probable that this thick overburden may represent a fine-grained part of the terrace sequence. The remaining borehole, 78 SW 6, proved 3.8 m of similarly silty, sandy material overlying London Clay. An inferred assessment has been made of these deposits.

River Terrace Deposits (sand and gravel) (associated with the River Crouch)

These deposits occur as isolated patches, mainly east but also south and west of Wickford. They range from Second to Fourth Terrace in age.

Four boreholes were drilled through Crouch Terrace deposits. One, 79 SE 6, proved 3.3 m of clayey overburden over 1.1 m of sand and gravel and the remaining three boreholes 79 NE 2, 79 SE 5 and 89 NW 10 proved thin deposits of sand and gravel, often clayey and interbedded with clay and silt.

Thus, it is thought unlikely that the Crouch Terrace deposits (shown on the resource map) contain potentially workable sand and gravel and no assessment has been made of these deposits.

Marine or Estuarine Alluvium (including sub-alluvial terrace deposits)

These deposits flank the River Crouch downstream of Wickford, but the largest outcrop (about 40 km^2) is found south of South Benfleet including Bowers Vange, Fobbing, Corringham Marshes and Canvey Island.

(1) Canvey Island and adjacent marshes Beneath the unconsolidated alluvium the bedrock surface dips towards the south-east, reaching its lowest point in the south-east corner of Canvey Island. The slope is fairly gentle except beneath Hadleigh Marsh, south of Hadleigh. The London Clay forms the bedrock over most of the area except in the south-west beneath Corringham Marshes, where Marine or Estuarine Alluvium directly overlies the Lower London Tertiaries, and south of Hadleigh where it overlies Claygate Beds.

Except beneath the marginal areas of Alluvium, the bedrock is directly overlain by a fairly continuous spread of sand and gravel, composed of angular to subangular flint and rounded Tertiary pebbles in a silty or silty sandy matrix. Above these gravels are varying thicknesses of sand, silt and clay, often with peat or peaty silt and clay layers.

Seven of the eleven boreholes drilled through the Marine or Estuarine Alluvium reached bedrock. Two of the seven, 78 NW 2 and 78 SW 7, proved sand and gravel beneath the Marine or Estuarine Alluvium but the deposit was too thin to be classed as mineral.

Three of the boreholes, (78 SW 9, 78 SE 4 and 88 NW 3) which did not reach bedrock, proved sand and gravel, but in 78 SE 4 and 88 NW 3 the sand and gravel was too deeply buried to be regarded as mineral and because of difficult drilling conditions borehole 78 SW 9 had to be stopped when 1.2 m into the sand and gravel. The only borehole that did not prove bedrock or sand and gravel, 78 SE 6, was stopped at 16.5 m in silty clay. Only one borehole (78 SE 4) proved mineral within the clay and silt sequence of the Marine or Estuarine Alluvium.

Because of the depth of burial, thinness and impersistence of the sand and gravel in this area, it has not been regarded as mineral and no assessment has been made.

(2) East of Wickford Eight boreholes were drilled through the Marine or Estuarine Alluvium in this area. Two boreholes (79 SE 12 and 89 NW 15) proved mineral, and four (79 NE 4, 79 SE 11, 89 NW 12 and 89 NW 18) proved sand and gravel, but it was too thin or deeply buried or with too high a clay content to be classed as mineral. The two remaining boreholes (89 NW 5 and 89 NW 14) proved clay and silt directly overlying London Clay. No assessment has been made of these deposits, therefore.

River Alluvium

Deposits of river alluvium (including soil) are generally thin and limited in extent, occurring as narrow strips along the floors of the valleys of the small tributaries of the Crouch, and of the Crouch itself west of Wickford. Boreholes 79 SE 10 and 79 SE 13 penetrated 1.0 m and 0.8 m respectively of firm grey and brown mottled silty clay with carbonaceous remains and occasional pebbles overlying head and London Clay.

THE MAP

The sand and gravel resource map is folded into the pocket at the end of this report. It is based on the Ordnance Survey 1:50 000 scale First Series.

Geological data

The geological boundary lines shown on the resource map are taken from the 1:50 000 Geological Map (Sheet 258/259 Southend and Foulness and 241 Chelmsford) which is derived from a recent survey at the 1:10 560 scale by the field staff of the Institute's East Anglia and South-East England Unit. Geological information is displayed in the same way as on the adjacent Southend-on-Sea 1:25 000 resource sheet, described in Pt. 1 of this report, except for certain geological boundaries which have been omitted to maintain clarity (see Geological Succession, Table 1).

Mineral Resource Information

Occurrences of mineral are widely scattered and

Table 2 Sand and gravel resources of area: (inferred assessment)

Deposit	Number of boreholes	Area of mineral (km^2)	Mean thickness of mineral (m)	Mean thickness of overburden (m)	Inferred volume of mineral (million m^3)	Mean grading of deposits		
						Fines	Sand	Gravel
Bagshot Beds	2	0.7	5.5	2.3	3.9	30	69	1
Thames Terrace sand and gravel	2	1.4	3.4	6.2	4.8	5	59	36
Sand and Gravel of unknown age	4	2.1	2.4	0.8	5.0	21	58	21
Glacial Sand and Gravel	1	0.2	3.9	0.8	0.8	17	42	41

amount to only 4.4 km^2. It has not been necessary therefore to define resource blocks, and the assessment of resources has been made for each mineral-bearing formation (Table 2). Areas of exposed and concealed mineral are identified on the map by stipple of different densities instead of shades of red. Apart from these exceptions, the mineral resource information is shown according to the established format for sand and gravel resource maps.

RESULTS

All estimates of the sand and gravel resources are inferred as there is insufficient data available to make a statistical assessment. The results are shown on Table 2.

APPENDIX A: BOREHOLES USED IN ASSESSMENT OF RESOURCES

Borehole number by sheet quadrant	Grid reference	Page
TQ 78 NW 1	7256 8639	184
2	7472 8637	184
TQ 78 NE 1	7631 8551	185
TQ 78 SW 5	7171 8409	186
6	7107 8306	187
7	7276 8477	187
8	7016 8258	188
9	7376 8332	189
TQ 78 SE 4	7785 8457	190
5	7574 8404	190
79 NW 1	7192 9617	191
2	7030 9853	191
3	7413 9715	192
4	7020 9988	193
TQ 79 NE 1	7702 9606	194
2	7965 9602	194
3	7606 9886	195
4*	7952 9555	195
79 SW 1	7053 9400	196
2	7212 9298	196
79 SE 5	7646 9159	197
6	7747 9455	197
10*	7795 9322	198
TQ 79 SE 11*	7936 9466	198
12*	7856 9488	199
13*	7882 9250	200
TQ 88 NW 57	8145 8661	201
58	8219 8821	202
59	8159 8866	203
60	8076 8883	204
62	8399 8986	205
63	8138 8554	205
87*	8083 8627	206
88*	8140 8598	206
89*	8086 8646	207
TQ 89 NW 4	8076 9987	207
5	8337 9684	208
10	8076 9621	208
12*	8094 9576	209
13*	8185 9603	209
14*	8010 9580	210
15*	8259 9611	211
TQ 89 SW 26	8244 9158	212
36*	8163 9399	212

Asterisks denote Engineering Geology and East Anglia and South-East England Field Unit boreholes: all others are Industrial Minerals Assessment Unit boreholes

APPENDIX B: INDUSTRIAL MINERALS ASSESSMENT UNIT BOREHOLE RECORDS

TQ 78 NW 1 7256 8639 Vange, Essex

Surface level +2.3 m (+7.5 ft)
Groundwater conditions not recorded
Shell 152 mm diameter
January 1973

Waste 4.9 m
Bedrock 0.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.1	0.1
Estuarine Alluvium	Silty clay and clayey silt, firm near surface but becoming soft with depth. Uniform in texture with occasional shell and reed fragments	4.1	4.2
River Terrace Deposits	Silty sandy clay with occasional rounded flints. Slightly calcareous	0.7	4.9
London Clay	Silty clay, stiff, dark yellowish brown with blue veining	0.7+	5.6

TQ 78 NW 2 7472 8635 Pitsea, Essex

Surface level +3.5 m (+11.5 ft)
Water struck at -3.8 m (-12.5 ft)
Shell 152 mm diameter
January 1973

Waste 12.3 m
Bedrock 0.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.2	0.2
Marine or Estuarine Alluvium	Clayey silt and silty clay with abundant reed material and a peat band at 6.6 m. Stiff becoming soft and blue-grey in colour	11.5	11.7
River Terrace Deposits	Coarse and fine flint gravel in sandy clay matrix	0.6	12.3
London Clay	Silty clay, stiff, slightly fissured, dark yellowish brown	0.2+	12.5

TQ 78 NE 1 7631 8551 South Benfleet, Essex

Surface level +2.0 m (+6.5 ft)
Water struck at -11.7 m (-38.5 ft)
Shell 152 mm diameter
January 1973

Waste 16.2 m
Bedrock 0.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silty clay	0.2	0.2
Marine or Estuarine Alluvium	Silty fine sand and sandy silt becoming clayey near base. High organic content throughout, and abundant shells between 6 m and 9 m	16.0	16.2
London Clay	Silty clay, slightly fissured, dark yellowish brown	0.3+	16.5

TQ 78 SW 5 7171 8409 Fobbing, Essex

Surface level +23.7 m (+78.0 ft)
Groundwater conditions not recorded
Shell 152 mm diameter
December 1972

Overburden 11.5 m
Mineral 4.4 m
Bedrock 0.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Peaty sandy silt	0.2	0.2
River Terrace Deposits	Intercalating bands of silty clay, silt and silty sand, with roots in the clayey material, becoming gravelly near base and between 6.6 m and 6.8 m depth. Carbonaceous in places	11.3	11.5
	Pebbly sand Gravel: rounded to subangular flints mainly fine with a little coarse material. Becoming less gravelly with depth. Sand: coarse to fine but mainly of medium grade, patina and flint chips of coarse sand grade being concentrated near top of deposit	4.4	15.9
London Clay	Clay, stiff, brown, weathered	0.1+	16.0

GRADING

Mean for Deposit

	%	mm	%
Gravel	19	+ 16	5
		- 16 + 4	14
		- 4 + 1	7
Sand	74	- 1 + $\frac{1}{4}$	64
		- $\frac{1}{4}$ + 1/16	3
Fines	7	- 1/16	7

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
11.5	12.3	9	3	32	12	30	14
12.3	13.6	6	3	54	13	19	5
13.6	15.0	4	3	89	1	1	2
15.0	15.9	12	2	67	6	12	1

TQ 78 SW 6 7107 8306 Corringham, Essex

Surface level +6.5 m (+21.5 ft)
Water struck at -7.6 m (-25.0 ft)
Shell 152 mm diameter
January 1973

Waste 3.8 m
Bedrock 17.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy clayey silt with rare flint gravel	0.4	0.4
Head	Intercalating bands of fine sand, sandy and silty clay	3.4	3.8
London Clay	Silty clay with clayey silt beds from 6.0 m to 12.2 m, from 14.5 m to 16.0 m and from 18.0 m to 20.6 m. Unweathered	16.8	20.6
Lower London Tertiary Beds	Gravel with fine to coarse rounded flints	0.3+	20.9

TQ 78 SW7 7276 8477 Fobbing, Essex

Surface level +1.3 m (+4.5 ft)
Water struck at -5.6 m (-18.5 ft)
Shell 152 mm diameter
December 1972

Waste 13.5 m
Bedrock 1.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.2	0.2
Marine or Estuarine Alluvium	Sandy silty clay and clayey silt with peat bands at 6.9 m and 10.8 m. Firm near the surface, but becoming soft with depth. Abundant wood and reed fragments	12.4	12.6
River Terrace Deposits	Sandy silty clay with gravel	0.9	13.5
London Clay	Silty clay, firm to stiff, dark yellowish brown	1.2+	14.7

TQ 78 SW 8 7016 8258 Corringham, Essex

Surface level +15.6 m (+51.0 ft)
Water struck at +7.3 m (+24.0 ft)
Shell 203 mm diameter
January 1973

Overburden 0.8 m
Mineral 2.4 m
Bedrock 13.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.8	0.8
River Terrace Deposits	Gravel Gravel: consisting of roughly equal proportions of coarse and fine flints, rounded Tertiaries with a few subangular quartzites Sand: mainly medium grade with a little coarse	2.4	3.2
London Clay	Silty clay with rare silt bands. Firm, becoming stiff and occasionally hard, with moderate open fissuring. Weathered to 3.6 m depth	13.3+	16.5

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-$\frac{1}{4}$	+$\frac{1}{4}$-1	+1-4	+4-16	+16
Gravel	67	+ 16	33	0.8	3.0	4	2	17	6	36	35
		- 16 + 4	34	3.0	3.2	5	5	67	9	7	7
Sand	29	- 4 + 1	6								
		- 1 + $\frac{1}{4}$	21								
		- $\frac{1}{4}$ + 1/16	2								
Fines	4	- 1/16	4								

TQ 78 SW 9 7376 8332 Corringham, Essex

Surface level +2.1 m (+7.0 ft) Waste 17.2 m+
Water struck at -0.4 m (-1.5 ft)
Shell 203 mm diameter
March 1973

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Slightly sandy silt	0.1	0.1
Marine or Estuarine Alluvium	Clayey silt and silty clay with a semi-consolidated band at 11.0 m overlain by about 2 m of very silty sand	15.9	16.0
River Terrace Deposits	Gravel Gravel: mainly angular to subangular flints with a few rounded Tertiaries Sand: coarse to fine, mainly angular to subangular coarse flint chips	1.2+	17.2

TQ 78 SE 4 7785 8457 Canvey Island, Essex

Surface level +1.3 m (+4.5 ft)
Water struck at -1.2 m (-4.0 ft)
Shell 203 mm and 152 mm diameter
April 1973

Overburden 3.1 m
Mineral 5.9 m
Waste 10.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Marine or Estuarine Alluvium	Clayey micaceous silt soft beneath hard crust	2.8	3.1
	Sand Sand: almost entirely fine micaceous and olive grey in colour	5.9	9.0
	Very silty fine sand grading into sandy silt	8.0	17.0
River Terrace Deposits	'Clayey' gravel Gravel: coarse and fine Sand: coarse to fine	2.1+	19.1

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	0	+ 16	0	3.1	9.0	6	80	14	0	0	0
		- 16 + 4	0								
		- 4 + 1	0								
Sand	94	- 1 + ¼	14								
		- ¼ + 1/16	80								
Fines	6	- 1/16	6								

TQ 78 SE 5 7574 8404 Canvey Island, Essex

Surface level +1.9 m (6.0 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
April 1973

Waste 16.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey silt	0.1	0.1
Marine or Estuarine Alluvium	Silty clay, clayey silt and sand with a red band at 4.8 m. Firm, becoming soft with depth	16.4+	16.5

TQ 79 NW 1 7192 9617 Ramsden Heath, Essex

Surface level +56.9 m (+187.0 ft)
Water struck at +53.2 m (+174.5 ft)
Shell 203 mm diameter
January 1973

Waste 3.9 m
Bedrock 2.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Head	Gravelly clayey silt becoming less gravelly with depth. Soft, moderate yellowish brown	1.1	1.3
Claygate Beds	Clayey fine sand and silt with a septarian nodule at 3.7 m depth	2.6	3.9
London Clay	Silty clay with thin fine sand lenses and very common selenite. Dark yellowish brown, stiff and highly fissured	2.7+	6.6

TQ 79 NW 2 7030 9853 Stock, Essex

Surface level +90.6 m (+297.0 ft)
Water struck at +86.1 m (+283.0 ft)
Shell 203 mm diameter
February 1973

Waste 27.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.8	0.8
Bagshot Beds	Fine sand with thin silty clay beds and laminated clayey silt and sand	23.0	23.8
Claygate Beds	Sandy silt, silty sand and silty clay, soft becoming stiff	3.3+	27.1

TQ 79 NW 3 7413 9715 South Hanningfield, Essex

Surface level +72.1 m (+237.0 ft)
Water struck at +63.9 m (+210.0 ft)
Shell 203 mm diameter
February 1973

Overburden 0.2 m
Mineral 1.1 m
Waste 19.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Bagshot Beds	Very 'clayey' pebbly sand Sand loose, with occasional plant remains	1.1	1.3
	Silty sand with bands of silty clay and clayey silt	3.2	4.5
Claygate Beds	Intercalated beds of sandy silt and silty clay weathered to a depth of 7.4 m. Finely laminated, occasionally shelly, bioturbated	15.9+	20.4

GRADING

Mean for Deposit

	%	mm	%
Gravel	8	+ 16	0
		- 16 + 4	8
Sand	64	- 4 + 1	2
		- 1 + ¼	13
		- ¼ + 1/16	49
Fines	28	- 1/16	28

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-¼	+¼-1	+1-4	Gravel +4-16	+16
0.2	1.3	28	49	13	2	8	0

TQ 79 NW 4 7020 9988 Stock, Essex

Surface level +85.4 m (+280.0 ft)
Water not struck
Shell 203 mm diameter
March 1973

Overburden 3.2 m
Mineral 4.9 m
Waste 1.2 m
Mineral 4.9 m
Waste 1.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Sandy silt	0.2	0.2
Bagshot Pebble Bed	Silty gravelly fine sand, soft, greyish orange with up to 20% rounded brown flints	0.3	0.5
Bagshot Beds	Silty fine sand with silty clay bands and very thin bands of iron cemented sandstone	2.7	3.2
	Very 'clayey' sand Laminated fine sand and silty fine sand with occasional clay bands. Light brown. Abundant carbonaceous particles	4.9	8.1
	Clayey silt, light brownish grey	1.2	9.3
	Very 'clayey' sand Laminated fine sand and silty fine sand with occasional thin (less than 10 mm) clay bands	4.9	14.2
	Greenish black very silty fine sand	1.1+	15.3

GRADING

Mean for Deposit

	%	mm	%
(a)			
Gravel	0	+ 16	0
		- 16 + 4	0
		- 4 + 1	0
Sand	80	- 1 + $\frac{1}{4}$	1
		- $\frac{1}{4}$ + 1/16	79
Fines	20	- 1/16	20
(b)			
Gravel	0	+ 16	0
		- 16 + 4	0
		- 4 + 1	0
Sand	70	- 1 + $\frac{1}{4}$	1
		- $\frac{1}{4}$ + 1/16	69
Fines	30	- 1/16	30

Bulk Samples

Depth below surface (m) From	To	Fines -1/16	+1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
Percentages							
3.2	4.5	33	66	1	0	0	0
4.5	6.5	19	80	1	0	0	0
6.5	8.1	12	87	1	0	0	0
9.3	10.8	31	68	1	0	0	0
10.8	12.9	24	76	0	0	0	0
12.9	14.2	38	61	1	0	0	0

TQ 79 NE 1 7702 9606 Rettendon, Essex

Surface level +51.5 m (+169.0 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
February 1973

Waste 9.6 m
Bedrock 2.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.9	0.9
Claygate Beds	Interbedded silty clay and silty fine sand with hard sandstone laminae. Mainly yellowish brown	3.1	4.0
	Interbedded sand silt and clay with common borings. Clay predominant towards base	5.6	9.6
London Clay	Silty clay, stiff, some thin fine sandy beds with common borings	2.7+	12.3

TQ 79 NE 2 7965 9602 South Woodham Ferrers, Essex

Surface level +9.1 m (30.0 ft)
Water struck at +4.8 m (+15.5 ft)
Shell 203 mm diameter
February 1973

Waste 5.2 m
Bedrock 0.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.8	0.8
River Terrace Deposits	Clayey sandy gravel becoming less gravelly with depth	1.0	1.8
	Sandy clayey silt with some gravel. Race nodules and organic remains fairly common	3.4	5.2
London Clay	Silty clay, stiff and highly fissured. Dark yellowish brown	0.8+	6.0

TQ 79 NE 3 7606 9886 Rettendon, Essex

Surface level +56.1 m (+184.0 ft) Waste 18.8 m+
Groundwater conditions not recorded
Shell 203 mm diameter
March 1973

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.4	0.4
Claygate Beds	Slightly clayey, sandy silt changing at 2.8 m depth to very silty sand. Yellowish brown with orange patches	3.7	4.1
	Silty clay with calcite rhombs and calcareous concretions. Firm becoming stiff, moderately fissured, grading into sandy silt beds from 6.0 m to 8.0 m and from 11.0 m to 13.0 m	14.7+	18.8

TQ 79 NE 4 7952 9555 Hullbridge, Essex

Surface level +2.6 m (8.5 ft) Waste 5.1 m
Water struck at -2.2 m (-7.0 ft) Bedrock 1.3 m+
Shell 203 mm diameter
February 1974

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.1	0.1
Marine or Estuarine Alluvium	Silty clay with reed bed from 3.6 m to 4.0 m. Firm, becoming soft at 0.4 m. Dark grey, olive and blue grey in colour	4.7	4.8
River Terrace Deposits	Sandy gravel. Gravel consists of black rounded Tertiary pebbles and angular to subangular flints	0.3	5.1
London Clay	Very silty clay, with sandy patches and blue veining around roots	1.3+	6.4

TQ 79 SW 1 7053 9400 Crays Hill, Essex

Surface level +42.7 m (+140.0 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
February 1973

Overburden 0.8 m
Mineral 3.9 m
Waste 8.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Gravelly sandy silt	0.3	0.3
Glacial Sand and Gravel	Gravelly, clayey, sandy silt	0.5	0.8
	'Clayey' sandy gravel Gravel mainly fine near top of deposit, but becoming equally coarse and fine with depth. Fine gravel more angular than coarse. Sand mainly of medium grade	3.9	4.7
Claygate Beds	Interbedded clayey silt with fine sand laminae, and silty clay	8.0+	12.7

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
	%	mm	%	From	To	Fines		Sand		Gravel	
						-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	41	+ 16	17	0.8	2.5	20	13	24	4	27	12
		- 16 + 4	24	2.5	4.7	15	3	33	7	21	21
Sand	42	- 4 + 1	6								
		- 1 + ¼	29								
		- ¼ + 1/16	7								
Fines	17	- 1/16	17								

TQ 79 SW 2 7212 9298 Ramsden Bellhouse, Essex

Surface level +18.4 m (+60.5 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
February 1973

Waste 1.2 m
Bedrock 0.9 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Topsoil	Sandy silt	0.3	0.3
Head	Clayey silt with abundant gravel. Stiff and dark yellowish orange	0.9	1.2
London Clay	Silty clay, stiff and weathered	0.9+	2.1

TQ 79 SE 5 7646 9159 Wickford, Essex

Surface level +17.6 m (+57.5 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
January 1973

Waste 1.8 m
Bedrock 0.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Gravelly clayey silt	0.5	0.5
River Terrace Deposits	Sandy clay with fine and coarse gravel. Pale to moderate brown and firm	1.3	1.8
London Clay	Silty clay. Firm, moderate brown with reduced patches	0.4+	2.2

TQ 79 SE 6 7747 9455 Battlesbridge, Essex

Surface level +5.8 m (+19.0 ft)
Water struck at +2.9 m (9.5 ft)
Shell 203 mm diameter
February 1973

Waste 4.4 m
Bedrock 1.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.4	0.4
Head	Sandy silt. Stiff, with gravel	0.6	1.0
River Terrace Deposits	Clayey silt with abundant carbonaceous remains near top and race from 1.2 m to 2.0 m. Moderate yellowish brown	2.3	3.3
	Sandy gravel with fine and coarse gravel and mainly coarse sand	1.1	4.4
London Clay	Silty clay, stiff and very highly fissured	1.3+	5.7

TQ 79 SE 10 7795 9322 Rawreth, Essex

Surface level +14.5 m (+47.5 ft)
Water not struck
Shell 203 mm diameter
February 1974

Waste 2.0 m
Bedrock 1.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.1	0.1
Alluvium	Silty clay, firm and excessively fissured with scattered carbonaceous remains	0.9	1.0
Head	Fine sandy silty clay with scattered pebbles and common carbonaceous material. Mottled yellowish brown and blue. Soft	1.0	2.0
London Clay	Very silty clay with some mica, race and carbonaceous material. Firm finely laminated, very highly fissured	1.1+	3.1

TQ 79 SE 11 7936 9466 Battlesbridge, Essex

Surface level +2.2 m (+7.0 ft)
Water struck at +1.0 m (+3.5 ft)
Shell 203 mm diameter
February 1974

Waste 2.7 m
Bedrock 1.9 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Marine or Estuarine Alluvium	Silty clay and clayey silt with root traces. Brown becoming bluish grey	1.2	1.5
River Terrace Deposits	Gravelly, sandy, silty clay. Gravel coarse to fine	0.7	2.2
Head	Fine sandy silty clay with common race and occasional pebbles. Brown with blue patches	0.5	2.7
London Clay	Very silty clay with some fine sand. Very highly fissured, finely laminated and yellowish brown with blue patches	1.9+	1.6

TQ 79 SE 12 7856 9488 Battlesbridge, Essex

Surface level +2.7 m (+9.0 ft)
Water struck at +0.4 m (+1.5 ft)
Shell 203 mm diameter
February 1974

Overburden 3.0 m
Mineral 1.0 m
Waste 0.7 m
Bedrock 1.0 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Firm to very soft silty clay. Brown becoming blue grey with black patches of carbonaceous material from 0.9 m to 1.9 m	2.8	3.0
River Terrace Deposits	Gravel Gravel mainly fine with some coarse, consisting largely of subrounded black Tertiary pebbles	1.0	4.0
Head	Silty clay with common coarse and fine gravel. Firm	0.7	4.7
London Clay	Very silty clay with common mica flakes. Stiff excessively fissured olive grey (unweathered)	1.0+	5.7

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
							Sand			Gravel	
	%	mm	%	From	To	Fines -1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	53	+ 16	17	3.0	4.0	3	4	26	14	36	17
		- 16 + 4	36								
Sand	44	- 4 + 1	14								
		- 1 + ¼	26								
		- ¼ + 1/16	4								
Fines	3	- 1/16	3								

TQ 79 SE 13 7882 9250 Rawreth, Essex

Surface level +11.2 m (+36.5 ft)
Water not struck
Shell 203 mm diameter
February 1974

Waste 1.1 m
Bedrock 1.4 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Alluvium	Silty clay, firm with excessive fissuring. Abundant carbonaceous remains and rare pebbles	0.6	0.8
Head	Very fine sandy silty clay with a little mica and common fine and coarse gravel and carbonaceous remains. Firm to stiff, yellowish brown	0.3	1.1
London Clay	Very silty slightly micaceous clay with abundant race in top 0.4 m. Stiff and very highly fissured. Brown with blue veining	1.4+	2.5

TQ 88 NW 57 8145 8661 Hadleigh, Essex

Surface level +65.3 m (+214.0 ft)
Water struck at +63.1 m (+207.0 ft)
Shell 203 mm and 152 mm diameter
January 1973

Overburden 0.2 m
Mineral 4.9 m
Bedrock 1.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey gravelly sand	0.2	0.2
Sand and Gravel of Unknown Age	Very 'clayey' sandy gravel Gravel concentrated between 2.6 m and 4.6 m in depth, below which sand predominated. Sand mainly of medium grade	4.9	5.1
London Clay	Silty clay, stiff and moderately fissured	1.2+	6.3

GRADING

Mean for Deposit

	%	mm	%
Gravel	31	+ 16	12
		- 16 + 4	19
		- 4 + 1	6
Sand	45	- 1 + $\frac{1}{4}$	33
		- $\frac{1}{4}$ + 1/16	6
Fines	24	- 1/16	24

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
0.5	1.2	38	1	55	2	3	1
1.2	2.0	32	17	47	2	1	1
2.0	2.5	20	2	29	9	22	18
2.5	3.2	7	3	12	9	44	25
3.2	3.8	20	1	19	9	30	21
3.8	4.8	Results not available					
4.8	5.1	Results not available					

TQ 88 NW 58 8219 8821 Hadleigh, Essex

Surface level +63.6 m (+209.0 ft)
Water struck at +54.6 m (+179.0 ft)
Shell 203 mm diameter
January 1973

Overburden 0.3 m
Mineral 1.9 m
Waste 7.2 m
Bedrock 2.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Clayey sandy silt	0.3	0.3
Sand and Gravel of Unknown Age	'Clayey' pebbly sand Gravel concentrated near base of deposit, fine to coarse, angular to subangular flints and rounded reworked Tertiaries. Sand almost entirely of medium grade	1.9	2.2
Claygate Beds	Silty fine sand, silt and silty clay, occasionally laminated. Weathered to 4.5 m depth	7.2	9.4
London Clay	Silty clay, stiff, highly fissured	2.1+	11.5

GRADING

Mean for Deposit

	%	mm	%
Gravel	15	+ 16	6
		- 16 + 4	9
		- 4 + 1	5
Sand	70	- 1 + $\frac{1}{4}$	62
		- $\frac{1}{4}$ + 1/16	3
Fines	15	- 1/16	15

Bulk Samples Percentages

Depth below surface (m) From	To	Fines -1/16	Sand +1/16-$\frac{1}{4}$	Sand +$\frac{1}{4}$-1	Sand +1-4	Gravel +4-16	Gravel +16
0.3	1.2	17	3	77	2	1	0
1.2	1.6	Results not available					
1.6	2.2	13	3	40	10	19	15

TQ 88 NW 59 8159 8866 Hadleigh, Essex

Surface level +70.2 m (230.0 ft)
Water struck at +62.2 m (+204.0 ft)
Shell 203 mm diameter
January 1973

Overburden 0.2 m
Mineral 0.7 m
Waste 28.1 m
Bedrock 3.0 +m

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Silty gravelly sand	0.2	0.2
Sand and Gravel of Unknown Age	'Clayey' gravelly sand. Sand coarse; gravel coarse and fine angular flints and rounded Tertiaries	0.7	0.9
Bagshot Beds	Clayey silty fine sand. Soft, weathered, mottled dark blue and pale greenish grey	0.5	1.4
	Interbedded silty clay and clayey fine sand. Finely laminated, moderate brown to yellowish orange	10.3	11.7
Claygate Beds	Very silty clay with rare fine sand, laminated	17.3	29.0
London Clay	Stiff olive grey clay	3.0+	32.0

TQ 88 NW 60 8076 8883 Hadleigh, Essex

Surface level +74.5 m (+244.5 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
January 1973

Overburden 0.9 m
Mineral 2.6 m
Waste 8.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Made Ground		0.9	0.9
Sand and Gravel of Unknown Age	Very 'clayey' pebbly sand. Sand of mainly medium grade. Gravel angular to rounded flints and Tertiaries	2.6	3.5
	Sandy gravelly silt with clay lenses. Gravel coarse to fine, angular to rounded. Sand coarse to fine	2.0	6.5
Bagshot Beds	Clayey silt and clayey fine sand, finely laminated. Pale brown	1.2	6.7
Claygate Beds	Very silty clay with fine sand laminations. Olive grey	5.0+	11.7

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
						Fines		Sand			Gravel	
	%	mm	%	From	To	-1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	8	+ 16	2	0.9	3.0	21	11	56	4	6	2
		- 16 + 4	6								
		- 4 + 1	4								
Sand	71	- 1 + ¼	56								
		- ¼ + 1/16	11								
Fines	21	- 1/16	21								

TQ 88 NW 62 8399 8986 Rochford, Essex

Surface level +25.0 m (+82.0 ft)
Water not struck
Shell 203 mm diameter
February 1973

Waste 4.5 m
Bedrock 0.6 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil	Slightly clayey silt	0.2	0.2
Head Brickearth	Silty clay with occasional flint pebbles and orange silt and sand lenses. Yellowish brown. Bands of race and roots between 1.8 m and 2.1 m	4.3	4.5
London Clay	Silty clay with selenite crystals. Stiff and moderately fissured	0.6+	5.1

TQ 88 NW 63 8138 8554 Hadleigh, Essex

Surface level +2.8 m (+9.0 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
January 1973

Waste 23.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Clayey silt with some clay and silty fine sand. Occasional reed fragments and shell debris and bands of organic material. Firm in top metre, becoming soft with depth	20.8	21.0
River Terrace Deposits	Sand and gravel occasionally clayey. Gravel mainly angular to subangular flints with lesser amounts of rounded reworked Tertiary pebbles. Sand coarse to fine	2.8+	23.8

TQ 88 NW 87 8083 8627 Hadleigh, Essex

Surface level +50.2 m (+155.0 ft)
Water not struck
Shell 203 mm diameter
March 1974

Waste 5.1 m
Bedrock 14.9 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Claygate Beds	Silty sandy clay interbedded with silty fine sand. Clay contains selenite crystals; very highly fissured. Weathered	4.8	5.1
London Clay	Very silty clay with very fine sand streaks. Fissuring mainly high, weathered to a depth of 7.3 m	14.9+	20.0

TQ 88 NW 88 8140 8598 Hadleigh, Essex

Surface level +31.4 m (+103.0 ft)
Water not struck
Shell 203 mm diameter
March 1974

Waste 0.3 m
Bedrock 15.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
London Clay	Stiff silty clay and very silty sand, sandy in places. Finely laminated and highly fissured. Clayey silt from 4.4 m to 4.8 m and from 5.2 m to 6.5 m. Weathered to 9.7 m	15.1+	15.4

TQ 88 NW 89 8086 8646 Hadleigh, Essex

Surface level +57.2 m (+188.0 ft)
Water not struck
Shell 203 mm diameter
March 1973

Waste 9.9 m
Bedrock 9.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Head	Sandy silty clay with scattered pebbles. Brown.	0.5	0.8
Claygate Beds	Intercalated beds of sand, silty clay, sandy silt and clayey fine sand, soft becoming stiff. Weathered to 5.1 m depth	9.1	9.9
London Clay	Silty clay with occasional clayey silt bands. Stiff, olive grey	9.1+	19.0

TQ 89 NW 4 8076 9987 Woodham Ferrers, Essex

Surface level +57.3 m (+188.0 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
February 1973

Waste 2.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Chalky Boulder Clay	Clay with abundant chalk fragments. Light yellowish brown	1.3	1.6
Claygate Beds	Silty clay, stiff very highly fissured, mottled brown and pale blue	0.6+	2.2

TQ 89 NW 5 8337 9684 Stow Maries, Essex

Surface level +1.7 m (+5.5 ft)
Groundwater conditions not recorded
Shell 203 mm diameter
March 1973

Waste 3.8 m
Bedrock 1.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Marine or Estuarine Alluvium	Silty clay and clayey silt with some organic remains, olive grey and light brown	3.5	3.8
London Clay	Silty clay with calcareous nodules near the top. Firm, becoming stiff and moderately fissured	1.8+	5.6

TQ 89 NW 10 8076 9621 South Woodham Ferrers, Essex

Surface level +5.7 m (+18.5 ft)
Water not struck
Shell 203 mm diameter
April 1973

Waste 1.8 m
Bedrock 0.2 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.5	0.5
River Terrace Deposits	Very silty sand with rare gravel, grading into very "clayey" gravel	1.3	1.8
London Clay	Slightly silty clay with race. Stiff, highly fissured	0.2+	2.0

TQ 89 NW 12 8094 9576 South Woodham Ferrers, Essex

Surface level +1.3 m (+4.5 ft)
Water struck at -3.2 m (-10.5 ft)
Shell 203 mm diameter
February 1974

Waste 6.6 m
Bedrock 1.3 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Silty clay, soft, light grey grading at 0.7 m into soft light and dark grey silt with occasional subangular and subrounded flint pebbles	4.3	4.5
River Terrace Deposits	Sandy gravel in light olive silt matrix. Sand predominantly coarse. Gravel coarse and fine mainly subangular flints	1.0	5.5
Head	Very silty clay with mica common, sand and scattered pebbles. Brown	1.1	6.6
London Clay	Very silty clay with mica common. Firm, brown, very highly fissured	1.3+	7.9

TQ 89 NW 13 8185 9603 South Woodham Ferrers, Essex

Surface level +1.6 m (+5.0 ft)
Water struck at -4.1 m (-13.5 ft)
Shell 203 mm diameter
February 1974

Waste 6.3 m
Bedrock 1.8 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Firm to soft silty clay grading into clayey silt at 2.3 m and into silty and sandy clay at 4.3 m. Pale grey to black with carbonaceous remains; bivalves present at 3.9 m	4.4	4.6
River Terrace Deposits	Gravel and sand in a clay matrix. Becoming less clayey and gravel coarsening with depth	1.7	6.3
London Clay	Firm brown silty clay. Very highly fissured	1.8+	8.1

TQ 89 NW 14 8010 9580 South Woodham Ferrers, Essex

Surface level +2.2 m (+7.0 ft)
Water not struck
Shell 203 mm diameter
February 1974

Waste 1.5 m
Bedrock 1.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Silty clay, firm to soft	0.7	0.9
Head	Very silty clay, soft, yellowish brown with blue reduced zones	0.6	1.5
London Clay	Silty clay with mica and selenite present; sand streaks common in parts	1.5+	3.0

TQ 89 NW 15 8259 9611 South Woodham Ferrers, Essex

Surface level +1.3 m (+4.5 ft)
Water struck at -4.1 m (-13.5 ft)
Shell 203 mm diameter
February 1974

Overburden 5.5 m
Mineral 1.9 m
Bedrock 1.1 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Marine or Estuarine Alluvium	Very silty clay grading into clayey silt at 1.7 m and into shelly laminated silt at 3.8 m. Light grey, blue and black	5.3	5.5
River Terrace Deposits	Gravel Gravel mainly fine subangular and angular flints, with subordinate coarse gravel consisting mainly of subrounded reworked black flints. Shelly	1.9	7.4
London Clay	Silty clay. Firm, brown and excessively fissured	1.1+	8.5

GRADING

Mean for Deposit				Depth below surface (m)		Bulk Samples Percentages					
								Sand		Gravel	
	%	mm	%	From	To	Fines -1/16	+1/16-¼	+¼-1	+1-4	+4-16	+16
Gravel	70	+ 16	23	5.5	6.3	4	1	13	16	51	15
		- 16 + 4	47	6.3	7.4	6	1	12	8	44	29
Sand	25	- 4 + 1	12								
		- 1 + ¼	12								
		- ¼ + 1/16	1								
Fines	5	- 1/16	5								

TQ 89 SW 26 8244 9158 Hockley, Essex

Surface level +74.2 m (+243.5 ft)
Water struck at +69.0 m (+226.5 ft)
Shell 203 mm and 152 mm diameter
February 1973

Waste 26.5 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.3	0.3
Bagshot Beds	Sandy silt with scattered pebbles	3.5	3.8
Claygate Beds	Fine sand, silt and clay, generally laminated with occasional shell fragments and carbonaceous material	22.7+	26.5

TQ 89 SW 36 8163 9399 Hullbridge, Essex

Surface level +23.8 m (+78.0 ft)
Water struck at +19.8 m (+65.0 ft)
Shell 203 mm diameter
March 1974

Waste 1.0 m
Bedrock 8.7 m+

LOG

Geological Classification	Lithology	Thickness m	Depth m
Soil		0.2	0.2
Head	Silty clay with race pebbles and abundant carbonaceous root remains at 0.9 m. Brown	0.8	1.0
London Clay	Silty or sandy clay, finely laminated and highly fissured. Cryoturbated, race nodules to about 2 m. Scattered selenite crystals and weathered to 8.5 m	8.7+	9.7

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INSTITUTE OF GEOLOGICAL SCIENCES

INDUSTRIAL MINERALS ASSESSMENT UNIT

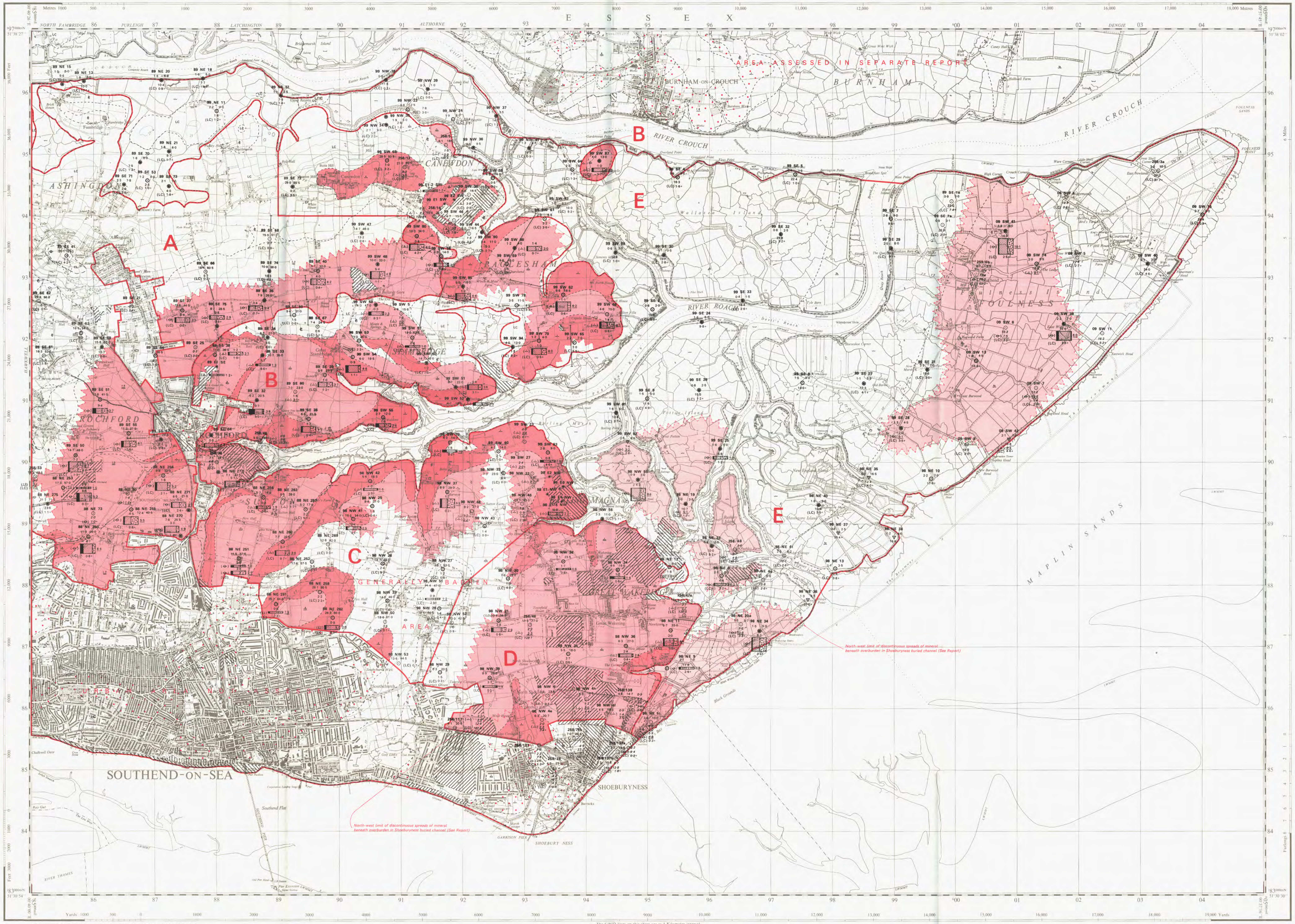
THE SAND & GRAVEL RESOURCES OF THE COUNTRY NORTH & EAST OF SOUTHEND-ON-SEA (ESSEX)

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

ORDNANCE SURVEY

PARTS OF SHEETS TQ 88,89,98,99 & TR 08,09

PROVISIONAL EDITION



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

Geological lines from a six-inch survey by C. R. Bristow in 1968 and G. W. Green, M. R. Henson in 1971-72.
S. C. A. Holmes, District Geologist.
Included in 1:50 000 Geological Sheets 258 and 259.

Sand and Gravel Survey by S. E. Hollyer, M. B. Simmons, R. A. Ellison and M. Sarginson in 1972-74.
R. G. Thurrell, Head, Industrial Minerals Assessment Unit.

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

1100/78

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

Compiled from 6″ sheets last fully revised 1906-12.
Other partial systematic revision 1938-59 has been incorporated.
Some major roads revised 1966.

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

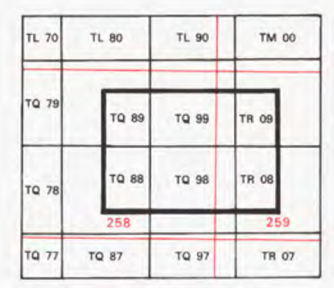


Diagram showing the relation of the National Grid 1:25 000 sheets with the 1:50 000 Geological Sheets 258 and 259

THE SAND & GRAVEL RESOURCES OF
THE COUNTRY NORTH & EAST OF SOUTHEND-ON-SEA (ESSEX)

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

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EXPLANATION OF SYMBOLS AND ABBREVIATIONS

DRIFT

RECENT AND PLEISTOCENE — Marine and Estuarine Deposits; River Deposits

- **Blown Sand (Present Day)** BS-6
- **Alluvium** -firm to soft silty clay A-24
- **Marine Beach or Tidal Flat Deposits** - clay and silt with some sand and pebbles MB-5
- **Marine or Estuarine Alluvium, Clay Deposits** -clayey silt with some fine sand ME-6
- **Marine or Estuarine Alluvium, Sand Deposits** -sand and silt ME-7
- **Marine or Estuarine Alluvium, Shell Deposits** -mainly shells with some sand ME-8
- **1st Terrace River Brickearth** -sandy clayey silt with scattered pebbles' often calcareous in lower part 1T-13
- **1st Terrace** -mainly sand and gravel 1T-14
- **2nd Terrace River Brickearth** -sandy clayey silt with scattered pebbles 2T-9
- **2nd Terrace** -mainly sand and gravel 2T-10
- **3rd Terrace River Brickearth** -sandy clayey silt with scattered pebbles 3T-8
- **3rd Terrace** -mainly sand and gravel 3T-9
- **4th Terrace** -mainly sand and gravel 4T-5
- **Buried Channel Deposits** -sand and gravel in the Rochford and Shoeburyness Channels, overlain by clay and silt. Proved in boreholes only BU-2
- **Head** -silty sandy clay with scattered pebbles H-16
- **Brickearth, including Head Brickearth** -variably yellow to light brown clayey silt, occassionally sandy, often with rounded pebbles towards the base B-8
- **Sand and Gravel, of unknown age** -clayey gravelly sand SG-2

SOLID

EOCENE

- CL **Claygate Beds** -intercalations of stiff light brown clay, silt and sand
- LC **London Clay** -stiff blue-grey to olive-black clay

BOUNDARY LINES

- Geological boundary, Drift
- Geological boundary, Solid
- Resource Block Boundary
- Inferred boundary between categories of deposits recognised

Broken lines denote uncertainty

- Landslip L-1
- Made ground MG-2
- Worked out area WO-11

BOREHOLE DATA

SITE LOCATIONS

- Industrial Minerals Assessment Unit (I.M.A.U.) Boreholes
- Other Institute of Geological Sciences Boreholes
- Dutch Cone Boreholes
- Other Boreholes and Pits

I.M.A.U. BOREHOLES

Borehole Registration Number → 88 NE 253
17·3 57·0 ← Surface level in metres and feet above O.D. (Newlyn)
Borehole Site → ⊙
2·9 ← Overburden
(1·2) 1·0 ← Mineral (sand and gravel)
8·6 ← Waste
Grading Diagram → (⊖) 5·3 ← Mineral (sand and gravel)
Geological Classification → (LC) 0·3+ ← Bedrock

Thicknesses in metres

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

Borehole Registration Number

Each I.M.A.U. borehole is identified by a Registration Number, e.g. **88 NE 253** The first number and letters refer to the quarter sheet, and the second number to the I.G.S. serial number for that quarter. The unique designation for borehole **88 NE 253** is **TQ 88 NE 253.**

Grading Diagrams

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

Sand (+1/16–4mm); Fines (−1/16mm); Gravel (+4mm)

The height of the diagram is proportional to the mineral thickness.
The widths of the divisions show the proportions of **Fines Sand** and **Gravel**

OTHER BOREHOLES

The layout of information is the same as for I.M.A.U boreholes, although data available may not be as comprehensive. They are registered in the same series, except for records in the Hydrogeological Department, for example, **258/138** signifies Hydrogeological Department borehole 138 on New Series One-Inch Geological Sheet 258.

EXPOSURE RECORDS

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

GEOPHYSICAL SURVEYS

Horizontal Resistivity Traverse

CATEGORIES OF DEPOSITS

- Exposed Mineral CAT-E6
- Continous or almost continous spreads of mineral beneath overburden CAT-C1
- Discontinous spreads of mineral beneath overburden CAT-D1
- Sand and Gravel (at surface) not assessed CAT-N4
- Sand and Gravel either not potentially workable (see Report) or absent CAT-A2

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 Director, at the appropriate offices of the Institute of Geological Sciences.

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